Abstract number 465

Abstract title Lake Ice Monitoring using Multi-Polarized SAR Imagery

Author list Torsten Geldsetzer, Joost van der Sanden and Brian Brisco
Canada Centre for Remote Sensing, Ottawa, Ontario

Abstract

C-band SAR imagery is used to monitor lake ice phenology in the Old Crow Flats region of the Yukon. Single-polarization RADARSAT-1 (HH), dual-polarization ENVISAT-ASAR (VV, HH), and dual-polarization RADARSAT-2 (HH, HV) imagery are evaluated. Backscatter statistics are compiled for various lake ice states (initial freeze-up, floating ice, bottom-freezing, melt-onset, and ice breakup). Mean and standard deviation backscatter values are used, in conjunction with ancillary meteorological data, to estimate optimal backscatter threshold values for discriminating lake ice states. Thresholds are evaluated for co-polarized and cross-polarized backscatter, as well as VV/HH and HV/HH ratios over various incidence angles. Optimal threshold values are used to classify lake ice states within SAR images. Preliminary results indicate that optimal image modes vary throughout the ice season. For ice breakup, HV images provide robust discrimination of ice and open water; HH images perform well at large incidence angles; and the VV/HH ratio also provides ice/open water discrimination. Similar evaluations are provided for other dates. Results show strong spatial variability in backscatter signatures related to lake depth. This work is done within the “Understanding Canada from Space” Program of the Earth Sciences Sector of Natural Resources Canada. The work is financially supported, in part, through the Government Related Initiatives Program of the Canadian Space Agency. The targeted end user within the Government of Canada as well as partner in the research is Parks Canada.

Abstract number 466

Abstract title Floating Models for 3D Building Modeling from Topographic Maps and LiDAR Data

Author list Sendo Wang (1), Yi-Hsing Tseng (2), and Ayman F. Habib (1)
1 - University of Calgary
2 - National Cheng Kung University

Abstract Building models are essential to versatile applications such as true ortho-photos, virtual city, urban planning, telecommunication, transportation, and real estate management. Traditionally, models are reconstructed by measuring point-by-point with a digital photogrammetric workstation, which is a both time and labor consuming process. To solve the bottle-neck, earlier work proposed the Floating Model concept and a semi-automated building reconstruction strategy from aerial photos. The floating model is a pre-defined primitive model floating in the space. Its size is adjustable by shape parameters, while its location and rotation is controlled by pose parameters. A building is reconstructed by adjusting these model parameters so the wire-frame model adequately fits into the buildingi¦s boundary on all overlapping photos. This model-based reconstruction provides good constraints to the shape of the model in contrary to the data-based approach. Although aerial photos imply 3D information of building models, existing topographic maps give more direct and discrete 2D outlines of buildings. On the other hand, LiDAR data generally provides better height information than photogrammetry due to its geometric characteristics. Therefore, the floating model is modified and applied to topographic maps and LiDAR data in this paper. The model parameters are re-arranged into two groups: plane and height parameters. The plane parameters are determined by fitting the top or bottom boundary of the model to the topographic maps. The height parameters are decided by fitting the modeli¦s top surface to the LiDAR data, and resampling the modeli¦s bottom height from the DEM. The proposed reconstructing procedure is semi-automated. First, the operator chooses an appropriate model and approximately fit to the buildingi¦s outlines on the topographic map. Second, the computer computes the optimal fit between the model and the topographic map based on an ad hoc least-squares model fitting algorithm. Third, the computer computes the roof or ridge height form the LiDAR point cloud within the roofi¦s boundary. Finally, the model parameters and standard deviations are provided, and the wire-frame model is superimposed on all overlapped aerial photos for the operator to check the result. The operator can make any necessary modification by adjusting the corresponding model parameters. To test the proposed algorithm and approach, we selected a 500hectare area of downtown Taipei City for the experiments. The existing 1:1000 digital topographic maps have been pre-processed to generate clean and complete building polygons. The point density of LiDAR point cloud is about 10 points/m2, which is good enough to reconstruct normal building roofs. We developed a PC program for implementing the floating model concept and the semi-automated building reconstruction procedures. Two operators worked for one week and reconstructed 4130 building models. These models are manually evaluated against aerial and terrestrial photos. Then, the fit model parameters are transformed into 3D coordinates of vertices and compared to photogrammetric and ground measurements. Most of the modern buildings can be modeled smoothly, and the fitting result achieves the photogrammetric accuracy. However, some of the buildings are illegally built into an arbitrarily shape, which makes it difficult to be modeled by our pre-defined models. In that case, the building should be decomposed into several parts for fitting and then aggregate into one composite model. In spite of these exceptions, the proposed approach is able to reconstruct the building models in an efficient way. In addition, the implicit constraint of the model keeps the building shape without distortion.

Abstract number 467

Abstract title

A Geographic Object-Based Image Analysis (GEOBIA) Approach to Estimate Forest Vertical Structure Using Optimal Lidar Transects and Quickbird Data

Author list

Gang Chen & Geoffrey J. Hay, Department of Geography, University of Calgary

Abstract

Lidar (light detection and ranging) data have demonstrated the ability to provide detailed information on forest vertical structure (e.g., canopy surface height); however, current lidar data collection and processing are resource intensive and expensive. In this research, our two objectives are (i) to automatically select the location of ¡®optimal¡¯ lidar transects derived from high-resolution Quickbird imagery, and (ii) to use these small area transects to accurately estimate the forest vertical structure of a larger 2601 ha forested study site, located 10 km S.W. of Campbell River, BC.

To achieve these objectives (i) A GEOBIA method (Size Constrained Region Merging) is applied to segment a Quickbird image into meaningful forest-objects based on a user defined minimum, mean and maximum object-size. We will also define new forest texture characteristics, based on the multiscale spatial patterns of neighboring forest-objects. (ii) A height-relationship between optical forest objects and corresponding lidar objects will then be defined. (iii) The ¡®optimal¡¯ lidar transect flight-paths (comprising the least number of transects) will then automatically be selected so as to sample the greatest height variability in the study area. (iv) Generalization and replacement methods are then applied from known forest-objects (located within corresponding lidar and optical transects), to forest objects defined by optical data only. (v) The quality of lidar transects is then evaluated by comparing the generalized lidar data with the original lidar data covering the corresponding study area. (vi) Error maps will also be generated to provide an accuracy assessment on a species height class basis.

Abstract number 468

Abstract title Remote Sensing at the Flight Research Laboratory: Applying the Tools and Techniques to Diverse Disciplines

Author list George Leblanc (1), Ramesh Srinivasan (1), Mengistu Wolde (1), Dave Marcotte (1), Sion Jennings (1), Greg Craig (1), Brad Nelson (2), Elizabeth Pattey (3)
1 - Flight Research Laboratory
2 - Defence Research and Development Canada
3 - Agriculture and Agri-Food Canada

Abstract Increasingly, remote sensing technologies are being directed to diverse research disciplines that are not directly related to traditional remote sensing applications. The Flight Research Laboratory (FRL) of the National Research Council Canada owns and operates a fleet of 9 research aircraft and has been at the forefront of developing partnerships and applying new airborne remote sensing techniques to a wide variety of disciplines for over 60 years.

The recent scope of remote sensing programs at FRL encompasses a multitude of diverse disciplines including:
- Earth observation (minerological and vegetation studies) with hyperspectral imaging systems and gradient aeromagetics,
- Atmospheric characterization and cloud detection using W and X band cloud radar
- Aircraft icing characterization and detection using airborne cloud radar and ground-based SWIR hyperspectral imagers
- Military applications such as: anti-submarine warfare with aeromagnetics, enhanced flight safety and security with night vision technologies, EO and target acquisition and interrogation with visible and IR broadband cameras and visible to long wavelength IR Fourier Transform hyperspectral systems and camouflage detection with SWIR hyperspectral imaging system,

The presentation will include an overview of the most recent programs and results of applications of remote sensing at FRL with special emphasis on the current multi-temporal hyperspectral vegetation biomass study, atmospheric radar studies, anti-submarine warfare and night vision technologies.

Abstract number 469

Abstract title A Framework for Better Surface Description through the Integration of Photogrammetric and LiDAR Data

Author list Changjae Kim (1), Ayman Habib (1), Chang-Rak Yoon (2), Sung-Woong Shin (2), and Kyung-Ok Kim (2),
1 - University of Calgary
2 - Department Electronics and Telecommunications Research Institute

Abstract

The United Nations predicted that roughly 62% of the global population will dwell in urban areas by 2030 in the report entitled 'State of the World Cities 2006/7'. To successfully control social and environmental situations that might arise from this rapid urbanization, decision makers in various fields must have access to accurate and up-to-date geo-spatial information in a timely manner and at a reasonable cost. It has been, hence, recognized that the research and academic communities should develop practical and accurate tools for assisting these decision makers in exploiting the influx of geo-spatial datasets from multi-sensory systems. Human understanding of urban environments can be fully assisted through the use of both spectral and positional information. Hence, the tools must be designed based on a system that uses both types of information. It is well known fact that the complementary characteristics of photogrammetric and Light Detection And Ranging (LiDAR) data can lead to better surface description through their integration, when compared to that derived from either system alone, by supplying both accurate 3D positional information and spectral/descriptive information.

This paper is concerned with the integration of photogrammetric and LiDAR data to achieve a better surface description through true orthophoto generation, building hypothesis and primitive generation, and Digital Building Model (DBM) generation procedures. This research starts with two alternative true orthophoto generation methodologies to produce 2D and 3D visualizations while overcoming the limitations of the existing methodologies. Even though the improved true orthophoto generation methodologies are utilized, it is hard to avoid the decrease in the quality of the 2D and 3D visualization products around breaklines, due to the irregular and sparse nature of LiDAR data. To improve the accuracy of the positional and descriptive information around breaklines, an accurate DBM generation procedure is needed. The building detection process is carried out first in order to generate building hypotheses and primitives from the LiDAR data alone. Then, the building reconstruction process is carried out using the derived building primitives. In order to produce precise boundary segments, the matching ambiguity problem - this mostly occurs when dealing with large scale imagery over urban areas, is resolved by incorporating LiDAR data into the matching process as a constraint. Then, colour information near the line segments derived through the matching process is utilized to find precise boundary segments. In addition, boundary segments in the occluded areas are reconstructed by hierarchically projecting the constructed segments of higher building primitives onto lower, neighbouring ones when these primitives share common vertical walls. All the derived boundary segments contribute to DBM generation. At last, the accurately generated DBMs are used to produce improved 2D and 3D visualizations.

Based on the proposed methodologies, experimental analysis is implemented using real datasets over urban areas. The evaluation of the experimental results is performed by qualitative and quantitative analysis. The qualitative verification is conducted by comparing the produced 2D and 3D visualizations before and after incorporating DBM into the visualization process. Also, the quality of the produced DBMs is checked by projecting the products on top of the relevant images. Moreover, the quantitative analysis is done by comparing the reconstructed DBM with that derived by human operators.

In summary, this paper provides a new framework for better surface reconstruction and description of urban environments. The accuracy of the products is ensured by taking advantages of the synergic properties arising from the integration of photogrammetric and LiDAR data.

Abstract number 470

Abstract title Land Use Monitoring In the Mixed Wood Plains Ecozone: Current State

Author list Guy Letourneau, Environment Canada

Abstract

The purpose of this project is to do a periodic review of land use along the Great Lakes and the St. Lawrence River and to identify the changes that have taken place along their shores. The main project objective is to implement a follow-up remote sensing activity for this component to contribute to the State of the St. Lawrence Monitoring Program. To do so, one or more shore condition indicators will have to be developed on the basis of the existing maps as well as a method for identifying significant changes in land use since the 1970s by means of the Canadian archives of Landsat images (MSS, TM and ETM) and existing land use maps. Mapping is currently under way using 1970s Landsat-MSS images and should produce ten general land use classes. That mapping will be used as the baseline year for this project. Among the existing datasets are 1999-2003 mappings of the valley of the St. Lawrence, and circa mid-1990 mappings by the Ontario Ministry of Natural Resources. A post-classification change analysis was made between the 1970s map and the more recent ones. Different trends appeared locally on losses and gains between broad classes on the study territory.

Abstract number 471

Abstract title Monitoring Wetland Area along the St. Lawrence River: A Multi-Sensor Approach

Author list Guy Letourneau, Martin Jean and Caroline Savage, Environment Canada

Abstract

Part of the State of the St. Lawrence Monitoring Program, there is a project monitoring the condition of the St. Lawrence wetlands periodically and supporting the concerted effort to protect and restore these habitats. Regular production of remote-sensing-based wetlands maps an estimate of the areas of the various classes of wetlands or phytocenoses. Changes in these environments relative to the area of natural habitats and the distribution of the main species, including invasive species, may be observed by comparative study of these maps and detailed analysis of field inventories. Various sensors were used in this project. Thus, the airborne MEIS-II sensor was used for mapping in 1990-1991 and 2000, while multispectral aerial videographic images and IKONOS multispectral images were used for 1996-1997 and 2002, respectively. A field campaign during the summers of 2000, 2001 and 2003 was part of the supervised maximum-likelihood image classification. In general, what was observed was a slight increase in the area of marsh and swamp between 1990-1991 and 2000-2002. In sectoral terms, wetland losses were observed in the Montreal-Longueuil sector and in Lake St. Pierre. In contrast, marsh and swamp area in Lake St. Francis remains constant whereas wetland advanced in the riverine estuary, the middle estuary and part of the maritime estuary.

Abstract number 473

Abstract title

Analysis of the Department of National Defence/Canadian Forces Space-Based Surveillance Objectives for the RADARSAT Constellation Mission

Author list

Mark Ball and Ian Chapman, Defence Research and Development Canada Centre for Operational Research and Analysis (DRDC CORA)

Abstract

The Canadian Space Agency is currently designing the RADARSAT Constellation Mission (RCM), a follow-on project to the highly successful RADARSAT-2 project. RCM will serve departments within the Government of Canada having security and/or earth observation mandates, each with wide-ranging mission goals. The current concept for RCM calls for a constellation of 3 satellites, albeit with SAR capabilities reduced on a per-satellite basis as compared to RADARSAT-2, in a near-terminator orbital plane.

The Department of National Defence/Canadian Forces (DND/CF) is in the process of initiating a project to utilize RCM. The proposed primary military applications for RCM are the surveillance of Canada's maritime approaches and Arctic landmass for the purpose of sovereignty protection. Military planners have indicated an interest in including the surveillance of the maritime zones of several allied nations in the capability objectives of RCM for the purpose of options analysis.

This paper presents the results of the initial analyses of the DND/CF objectives for RCM, conducted using STK and ArcGIS. The discussion includes an assessment of the satellite duty cycle required to image the Canadian Areas of Interest, as well as the implications of the addition the maritime zones of the indicated allied nations. We will show how the improved coverage provided by RCM would be reflected in the probability of detection of vessels off the East and West coasts of Canada. Also discussed is the capability of a 3-satellite constellation to image numerous small objects of interest and the capacity of the constellation to perform tandem or multi-satellite Coherent Change Detection on several small areas of interest around the world.

Abstract number 474

Abstract title Intensity Image Integration from RADARSAT-2 Full Polarimetric Data

Author list Igor Zakharov, Canadian Government Laboratory Visiting Fellow at Canada Centre of Remote Sensing;
Thierry Toutin, Canada Centre of Remote Sensing, Natural Resources

Abstract

Full polarimetric capabilities of RADARSAT-2 open new possibilities for stereo–radargrammetric applications. The generation of Digital Terrain Model (DTM) requires a stereo pair of intensity images. Thus we are interested in an image which contains useful information from all polarimetric bands. The preliminary results of full polarimetric SAR data processing for the purpose of the intensity image integration are discussed in this work. Received results of image integration were compared with some other ways of intensity polarimetric images integration. The comparison shows that a received restored image has better performances (equivalent number of looks, textural measures) than intensities summation (span) or the diagonal sum of the filtered full polarimetric coherency matrix. The difference in range and azimuth directions for several textural measures values is about 25 %. The image processing result was also analysed at the signal level. An estimation of influence on the point spread function and edge features makes it possible to conclude that there is a good preservation of small details and edge with the use of the image restoration technique.
The image integration from polarimetric images will be introduced into the stereo-radargrammetric process to generate DTM. The comparison of this DTM with generated from single polarimetric stereo images and other ways of validations the restoration procedure will be shown at the Symposium. Others image restoration methods and information-theoretical quality assessments, while also taking into account probability functions of SAR data and coherence transfer function, will also be discussed.

Abstract number 475

Abstract title Soil Moisture Inversion from RADARSAT-2 Images Acquired Over an Agricultural Area

Author list Imen Gherboudj (1), Ramata Magagi (1), Aaron Berg (2), and Brenda Toth (3)
1 - Université de Sherbrooke, Centre d'applications et de recherches en télédétection (CARTEL)
2 - University of Guelph
3 - Environment Canada, MSC Hydrometeorology and Arctic Lab, Saskatoon

Abstract Soil moisture is a key element for the understanding of the hydrological cycle and the energy budget. It can be a preventive factor in agricultural production. Due to its high temporal and spatial variability, traditional ground measurements are unable to provide sufficient information on the availability of soil moisture in an operational context. However, using microwave remote sensing data (passive and active), areal soil moisture data can be obtained at different temporal and spatial scales. In this study, the emphasis is on the estimation of soil moisture from Radarsat-2 synthetic aperture radar (SAR) images acquired over agricultural fields located in Saskatoon (Saskatchewan, Canada). The adopted approach relies on the combined use of modeling, four RADARSAT-2 images acquired at different modes during the summer of 2008, and ground measurements of soil moisture, surface roughness and vegetation characteristics coincident with the satellite overpasses. First, a sensitivity study of Radarsat-2 signals to surface (crop types, soil moisture and roughness) and sensor parameters (particularly incidence angle and polarimetric information) will be conducted. Then, an inversion method of soil moisture will be developed using soil and vegetation empirical models. The results will be compared to ground soil moisture measurements and discussed in terms of the spatial resolutions of Radarsat-2 sensor.

Abstract number 476

Abstract title RADARSAT-2: Serving Canadians

Author list Daniel De Lisle, Denis Auger, Luc Brûlé

Abstract

RADARSAT-2 was successfully launched in December 2007. RADARSAT-2 will be the most versatile commercial SAR Earth observation system with a high spatial resolution mode of 3 meters and a fully polarimetric mode that will be available on an operational basis. The advancement in satellite technology do not only profit the imaging modes, other innovations on RADARSAT-2, such as high downlink capacity, onboard digital recorders, and high performance processing will increase the quality of the service and products.
RADARSAT-2 is unique example of public-private partnership. The private sector owns and operates the spacecraft, and in return for their investment, the Government of Canada has obtained a credit for data to be drawn against over the lifetime of the spacecraft. RADARSAT-2 data will be used by the Government of Canada to meet the current and evolving priorities of the Government and the needs of Canadians.

Therefore, beyond the commercial benefits, the Government has a vital interest in the public good aspects of RADARSAT-2. The CSA has committed to objectives that pertain to natural resource management, environmental monitoring, ice mapping and marine monitoring. RADARSAT-2, together with RADARSAT-1 help assure Canada's safe navigation in icy waters, patrol of coastal waters, support for pollution and fisheries interdiction, and, sustainable development of the far north. RADARSAT-2 will be an important space asset, providing Government departments with the continuity of critical and timely data for the active management of natural resources and monitoring of the environment.

CSA is also committed to provide RADARSAT-2 imagery not only to the Government of Canada but also to Canadian stakeholders such as the Provinces and Territories, Academia and Industry. A wide range of programs have been put in place to promote Research & Development of the new capabilities of Radarsat-2 such the Dual polarization modes, the polarimetric mode and the ultra-fine mode. The Science Operational Applications Research (SOAR) program provides an opportunity to explore the enhanced capabilities of RADARSAT-2 and their potential contributions to applications through a loan of limited amounts of RADARSAT-2 data to research projects. The main outcome pursued by the SOAR is to ensure that Canadian stakeholder's benefits, through research and development activities, of the $450M investment made for the development of RADARSAT-2. Now that the satellite is fully operational, Government of Canada would like to develop specific initiatives under the SOAR umbrella.
This paper will briefly present RADARSAT-2 and its imaging capabilities, and will focus on the activities that the Canadian Government is undertaking to optimize the use of RADARSAT-2 in support of its mandate and priorities.

http://www.asc-csa.gc.ca/eng/satellites/radarsat2/default.asp

Abstract number 477

Abstract title Observing ground deformation in the city of Auckland, New Zealand by C- and L-band Synthetic Aperture Radar

Author list Sergey Samsonov. University of Western Ontario and GNS Science

Abstract

In this study ground deformation is observed by C-band ENVISAT ASAR and L-band ALOS PALSAR Differential Synthetic Aperture Radar for the city of Auckland, the largest city in New Zealand with a current population of over one million. Auckland is situated on a basaltic volcanic field which consists of ca. 50 individual largely monogenetic volcanoes with a total area of 360 sq. km. The most recent and largest eruption occurred 600 years ago. While it is anticipated that the chance of the volcano reawakening is very low, a new volcano could be created at any time in a new location within the field. For this study we acquired and processed 23 SLC images from ENVISAT satellite (Track 151, Frame 6442, IS2, VV) spanning from July 2003 until November 2007 and 7 RAW images from ALOS (Track 27, Frame 6430, FBS&FBD, HH) spanning from January 2007 until April 2008. The data was processed with GAMMA software and all possible combinations of differential interferograms were created. Stacking, Small Baseline Subset (SBAS) and Permanent Scatterers (PS) processing algorithms where used to determine spatial and temporal patterns of surface deformation as well as average rates. A number of localized deformation regions were consistently observed by all three techniques. Three regions of subsidence are believed to be caused by groundwater extraction but the cause of uplifts is presently unknown. The observed signal was modeled with Genetic and Monte Carlo Simulated Annealing algorithms for the exact location, depth and source strength.

Abstract number 478

Abstract title ALOS PALSAR interferometry of Taupo Volcanic Zone, New Zealand

Author list Sergey Samsonov (1, 2), Kristy Tiampo (1), John Beavan (2), Chris Bromley (2), Bradley Scott (2), and Gill Jolly (2)
1 - University of Western Ontario
2 - GNS Science

Abstract Taupo Volcanic Zone, an area with dimensions of 50 (NW-SE) by 350 (SW-NE) km located in central North Island of New Zealand, currently experiences active continental spreading related to the subduction of the Pacific plate beneath the Australian plate. The area is characterized by intense tectonic activity and volcanic eruptions of different scales, for example, frequent small (<0.1 km3) eruptions at Mt Ruapehu, the largest active stratotovolcano in New Zealand, and much larger (>10 km3), but infrequent (1000-10,000 year recurrence interval), caldera eruptions. The potential for intense seismic and volcanic activity creates a significant hazard for the inhabitants of this region. At the same time pressure draw-down associated with withdrawal of geothermal fluids for power generation in TVZ causes notable ground subsidence at sites where subsurface formations are highly compressible (for example, parts of Tauhara, Wairakei, and Ohaaki geothermal fields). This can result in significant risk to infrastructure. In the past, multiple attempts were undertaken to use C-band differential interferometry for measuring ground deformation in this region but results were only partially successful because of a significant decorrelation effect caused by the dense vegetation. For this study we acquired over 50 ALOS PALSAR images in raw format across the TVZ region spanning December 2006 to February 2009 and interferometric processing was performed using GAMMA software. For this region PALSAR interferograms were coherent for time periods longer than one year and perpendicular baselines smaller than 2000 meters. Atmospheric and orbital errors were widely observed and corrected where possible. Stacking of interferograms was performed and results were analyzed. Signals of different magnitude and areal extents are observed around the region. For example, large regional uplift around Taupo township and large regional subsidence in the center of the Bay of Plenty are noted. Conversely, localized subsidence with rates close to 100 mm/year is observed at several geothermal sites; this is in reasonable agreement with ground based levelling measurements. First attempts were undertaken to model these signals with Genetic and Monte Carlo Simulated Annealing algorithms.

Abstract number 479

Abstract title Development of an Annual Forest Change Product for Canada from 250m MODIS Data

Author list Darren Pouliot, Rasim Latifovic, Richard Fernandes, and Ian Olthof, Canada Centre for Remote Sensing

Abstract A methodology for change detection based on a multi-feature decision tree approach previously developed (Pouliot et al., submitted) was applied for disturbance detection in Canada at annual intervals from 2001-2005 from MODIS 250m data. Initial product evaluation and validation efforts are presented. Current limitations identified and intended future developments discussed

Abstract number 480

Abstract title Creation and Evaluation of DEMs from TerraSAR-X Stereo Images

Author list Chen Xu[1], Stephen Griffiths[1], Parivash Lumsdon[2], Bryan Mercer[1], and Qiaoping Zhang[1]
Intermap Technologies Corp.

Abstract

Stereo radargrammetry has been applied to airborne and subsequently satellite image pairs (particularly RadarSat-1) for DEM extraction purposes since the 1980's. Its utility lay in mapping large areas, particularly in cloud-covered parts of the world. However the satellite DEM accuracies achievable, in the absense of ground control points (GCPs), were limited, in part by the resolution of RadarSat-1 and partly by its coarse orbital accuracy. Subsequently the interferometrically-derived, near-global, SRTM DEM largely removed the rationale for stereo DEM extraction. However the more recent availability of higher resolution imagery (TerraSAR-X, RadarSAT-2) with much better satellite positioning information motivates interest again in performing stereo radargrammetry in order to potentially improve upon the level of detail and accuracy available from SRTM. In this work we present stereo-derived DEM example results using TerraSAR-X strip-map mode images. TerraSAR-X strip map mode is characterized by 3m resolution, 30 km swath width and a series of narrow angle beams with mean incidence angles ranging from 20-60 degrees. The stereo intersection geometry is another major determinant of achievable DEM accuracy, and in this work we typically are using intersection angles in the range of 15-20 degrees. The satellite orbit determination accuracy is sub-meter, thus removing the need for GCPs to be incorporated into the process.

An end-to-end digital process has been developed by Intermap that is intended to be operated with large volumes of data, eventually for commercial purposes. The process, with area-based correlation at its heart, results in a 10 meter gridded output product interpolated from a cloud of acceptably matched stereo image points. In this paper we describe elements of the process and performance. The stereo-derived DEM is compared with STAR-3i DEMs (vertical accuracy specification is 1 meter RMSE for a 5 meter grid) covering the same test area. While the process is not yet fully mature, we are achieving results that in moderately-sloped, unobstructed terrain is approaching 3 meters RMSE. In this paper, we will show comparative visualizations and statistics of the TerraSAR-X stereo-derived DEMs with respect to DEMs from STAR-3i and SRTM.

Abstract number 481

Abstract title

North American Land Change Monitoring System
Present and future

Author list

Rasim Latifovic (1), , Darren Pouliot (1), Collin Homer, , Chandra Giri (2), Francisco Takaki (3), Rainer Ressl (4),
1 - Canada Centre for Remote Sensing
2 - U.S. Geological Survey
3 - National Institute of Geographic Statistics and Information of Mexico
4 - Mexico National Commission for the Knowledge and Use of Biodiversity

Abstract

At the Land Cover Summit meeting held in Washington, DC in September of 2006 the North American Land Change Monitoring System (NLCMS) collaborative project was initiated between representatives from the US Geological Survey (USGS), the National Institute of Geographic Statistics and Information of Mexico (INEGI) and the Canada Centre for Remote Sensing (CCRS). The objective of the NALCMS is a joint effort to create a harmonized system for multi-scale and multi-temporal monitoring and reporting of North American land cover change. The proposed system couple 250m and 30m resolutions, offering products relevant at both spatial scales of land cover change. The two scales will provide users with investigation, confirmation, calibration, and assessment of 250m cell change products with 30m product support. The result will be products that enable users to identify a greater variety of land cover change, find change across much smaller land cover patches, and eventually identify more types of change (e.g. gradual change over time). In due course these land change products can provide continental, national, and regional consistency to land cover change analysis.

Abstract number 482

Abstract title Post-Launch Monitoring of Satellite Sensor Calibration Using Rangeland Terrain as a Reference Site

Author list Philippe M. Teillet (1), Xiaomeng (1), and Anne M. Smith (2),
1 - Department of Physics and Astronomy, University of Lethbridge
2 - Agriculture and Agri-Food Canada

Abstract

The ongoing characterization and calibration of space-based terrestrial imaging sensors are vital to achieve the developing Global Earth Observation System of Systems (GEOSS) for coordinated and sustained observations of the Earth. This can only be achieved reliably in the post-launch environment through the careful use of observations by multiple sensor systems over common, well-characterized terrestrial targets. Earth surfaces with suitable characteristics have long served as benchmark or reference standard test sites to verify the post-launch radiometric calibration performance of satellite instruments. The associated methodologies are often referred to as vicarious or ground-look calibration. Many of these approaches use surface and atmospheric measurements to estimate top-of-atmosphere radiance at the entrance aperture of a given satellite instrument. This provides a verification of, or an update of, the nominal instrument calibration and helps to monitor instrument performance over time.

Historically, field measurement campaigns at calibration test sites typically targeted only one instrument per field sortie, but many of the more recent campaigns have focused on multiple instruments that passed over a given test site within a short time or on the same day. Nevertheless, efforts such as these remain resource intensive. Therefore, it has also been of considerable interest to develop less expensive complementary approaches that can provide more frequent calibration updates, even if they are less accurate. In particular, the use of terrestrial targets to provide updates of the radiometric calibration of a given satellite instrument without coincident surface measurements or to transfer radiometric calibration between satellite instruments (so-called cross-calibration) without coincident surface measurements has increased.

The possibility of using an extended region of prairie rangeland in Western Canada for cross-calibration purposes was initially considered by Teillet et al. (1998), with encouraging results for a test site in Newell County rangeland, Alberta (NCRA). Subsequently, the NCRA test site was successfully included in trials of a novel methodology to use spatially extensive hyperspectral imagery acquired over test sites to generate reference data that enables radiometric cross-calibration of multiple satellite sensors (Teillet et al., 2001). The work described in this paper concerns a retrospective study of the NCRA site undertaken using 20 calibrated SPOT satellite images from 2001 to 2007. Statistical measures were used to assess the suitability of the NCRA site in terms of the most radiometrically uniform areas and stable times of year for cross-calibration purposes. The results indicate that the NCRA site's spatial uniformity is affected increasingly by incursions of petroleum exploration infrastructure that disturb and fragment the rangeland terrain.

Teillet, P.M., G. Fedosejevs, R.P. Gauthier, and R.A. Schowengerdt, 1998, "Uniformity Characterization of Land Test Sites Used for Radiometric Calibration of Earth Observation Sensors", Proceedings of the Twentieth Canadian Symposium on Remote Sensing, Calgary, Alberta, pp. 1-4.
Teillet, P.M., G. Fedosejevs, R.P. Gauthier, N.T. O'Neill, K.J. Thome, S.F. Biggar, H. Ripley, and A. Meygret, 2000, "A Generalized Approach to the Vicarious Calibration of Multiple Earth Observation Sensors Using Hyperspectral Data", Remote Sensing of Environment, 77(3): 304-327.

Abstract number 483

Abstract title Image-Based Measurements of Vegetation BRDF Characteristics

Author list Philippe M. Teillet (1), Xiaomeng (1), Refah Seyed-Mahmoud (1), Craig Coburn (2), Anne M. Smith (3), and Scott Noble (4)
1 - Department of Physics and Astronomy, University of Lethbridge
2 - Department of Geography, University of Lethbridge
3 - Agriculture and Agri-Food Canada
4 - Department of Agricultural and Bioresource Engineering, University of Saskatchewan

Abstract

Once satellite image data are placed on an absolute radiometric scale and corrected for atmospheric effects, they can be used to estimate the spectral reflectances of terrestrial surfaces, useful in a wide variety of Earth and environmental applications. A number of factors involved in remote sensing measurements affect the information content of these spectral reflectances and the resultant derived image products (e.g., vegetation indices). In particular, surface reflectance anisotropies as a function of solar illumination and off-nadir observation geometries, defined in terms of the bidirectional reflectance distribution function (BRDF), are important to address from both experimental and modeling perspectives, but such studies remain challenging to undertake. Nonetheless, understanding vegetation BRDF is of increasing interest due to the arrival of multi-angle satellite sensor systems with high information yield potential.

Ground-based measurements for the validation of vegetation property retrievals from satellite imagery and vegetation canopy reflectance models have concentrated primarily on the optical properties of individual foliage elements, usually taken out of their canopy context, or the canopy as a whole. Canopy measurements at spatial scales in between (from millimetres to a meter) have been made much less frequently, even though it is likely that these scales contribute significantly to the radiative process. Our research is guided by the principle that vegetation canopy architecture is a feature of the target BRDF. The issue of scale is a frequent confounding variable in BRDF studies as the scale of the angular signature of the ground observation must match the imaging sensor for the BRDF information to be useful information addition. This has implications for BRDF studies since there may be distinctly different combinations of structural attributes yielding the same BRDF (i.e., equifinality).

As an initial step in this direction, a project was undertaken to acquire and analyse digital image sequences obtained over a vegetation canopy using a Nikon D-80 digital single-lens-reflex (DSLR) camera as a function of illumination and viewing angle using a goniometer. Having image-based BRDF observations enabled us to examine BRDF samples of sub-scene elements separately. A key objective was to document lessons learned in preparation for more involved research to follow using an imaging spectrometer and a more advanced goniometer apparatus. The field measurements were carried out in 2007 over a plot of blue grama (Bouteloua gracilis (Willd. ex Kunth)) grass at the Lethbridge Research Centre of Agriculture and Agri-Food Canada. The BRDF was sampled at three solar zenith angles (60, 45 and 30 degrees), at nine view zenith angles (0, +/-15, +/- 30, +/- 45, +/- 60 degrees (backscatter negative)), and in six evenly-spaced view azimuth planes. The camera settings and the view solid angle were kept constant for all images. A region of interest (ROI) was extracted and analysed for each of the three colour bands (blue, green, and red). An involved image classification procedure was created to overcome the complication of the absence of geometric registration between the different geometric views of the ROI. Four classes were considered (grass, litter, shadow, and unclassified) and the BRDF results for the sub-scene elements compared. In the blue band, grass and litter contribute equally to the overall angular signature, whereas litter's angular signature is significantly closer than that of grass to the overall angular signature in the green and red bands. In all three spectral bands, in the solar principle plane, the shadow class contributes significantly for view zenith angles between -30 and +40 degrees, with the greatest influence between 0 and +20 degrees.

Abstract number 485

Abstract title

HEAT - Home Energy Assessment Technologies: High Resolution Airborne Thermal Imagery Based Residential Energy Efficiency Monitoring.

Author list

Geoffrey J. Hay and Christopher D. Kyle, University of Calgary

Abstract

A key component of being environmentally responsible is the efficient use of energy. What is an individual to do if they wish to evaluate the energy efficiency of the building materials used in one's home? The lack of easy, efficient and low-cost ways for home owners to access home efficiency information is a limiting factor in the adoption of high efficiency building materials such as doors, windows and insulation.

A pilot project in Calgary has been undertaken which overcomes shortcomings of earlier thermal heat efficiency studies. The HEAT project has developed tools for evaluating and monitoring the energy efficiency of structures, focusing primarily on homes.

Geo-referenced thermal imagery is matched to building outlines from cadastral datasets. A home's square footage is used to calculate its heating or cooling energy requirements. By analyzing the thermal envelope of a home and current energy prices, potential cost savings as well as a carbon footprint can be calculated and presented to the end-user. For homes not in existing cadastral datasets a GEOBIA segmentation approach is applied to identify them and update the cadastral datasets.

HEAT allows free and timely dissemination of information to home owners through web services like Google Maps. Home owners can visually see the thermal envelope of their properties thus evaluating and monitoring it themselves. This helps owners more confidently decide if upgrades are required for their home. HEAT's tools are also useful to decision makers at all levels of government for evaluating areas, monitoring change and collecting carbon footprint statistics.

Abstract number 486

Abstract title The use of Stereo Satellite Imagery: Applicability and Accuracy Assessment

Author list Ahmed SHAKER and Wai Yeung YAN, Ryerson University

Abstract

Applications of stereo satellite imagery enter into a new era by the launch of Geoeye-1 and its competitors with less than 0.5 m spatial resolution. The high spatial resolution of the new satellites will pave the way for further exploitation of the stereo imaging capabilities of these satellites for many applications. Up-to-date, there are number of satellites that have stereo imaging capabilities including but not limited to: SPOT, IRS, and IKONOS satellites. This paper discusses the applicability and the accuracy of stereo satellite images for a variety of applications. In particular, the paper discusses the use of stereo satellite imagery in landslide, transportation, and mapping applications. The paper focuses on different mathematical models that can be used for satellite sensor modelling and it further evaluates the accuracy that could be achieved. Three stereo image data sets have been tested for different applications: a) IKONOS stereo image for landslide hazard assessment; b) IRS-1D stereo images for topographic mapping and DEM generation; and c) IKONOS stereo images for highway parameters extraction. A number of Ground Control Points (GCPs) and Checkpoints have been observed by static and kinematic Global Positioning System (GPS) techniques. The GCPs are used for sensor modelling and image orientation and the checkpoints are used for accuracy assessments. Comparative studies are presented to evaluate the accuracy of the data extracted by the stereo satellite images and the data extracted by the conventional techniques. The results show that the data extracted from stereo satellite images are comparable to the results achieved by the conventional techniques.

Abstract number 487

Abstract title Investigation of Landslides and Subsidence in Alberta Using Persistent Scatterer Interferometry

Author list John Dehls (1), Corey Froese (1) Valentin Poncos (2), Shilong Mei (1), and Vern Singhroy (3),
1 - Alberta Geological Survey
2 - University of Calgary
3 - Canada Centre for Remote Sensing

Abstract

Interferometric synthetic aperture radar (InSAR) is a proven technology for measurement of both large and small ground displacements. Two-pass differential interferometry (DInSAR) is capable of measuring displacements on the order of centimetres to metres, although it is unable to distinguish between actual displacement and atmospheric disturbances. Within the last decade, a number of new algorithms have been developed that use long time-series of SAR images to accurately measure displacements on the order of millimetres. While they differ in detail, all of these Persistent Scatterer Interferometry (PSI) algorithms rely on the identification of stable point scatterers that are identifiable over most or all of the time period being studied.

In Alberta, the Alberta Geological Survey, with support from the Canadian Space Agency and the Canadian Centre for Remote Sensing, are currently using PSI to measure and monitor surface displacements due to landslides and residual coal mine subsidence. In addition, we are beginning new projects to measure surface displacements related to in-situ extraction of bitumen, and underground storage of CO2.

The Town of Peace River is situated along the banks of the Peace River in northern Alberta. Large portions of the river band are affected by retrogressive landsides, including the town itself. Since 2006, a study has been underway to characterize these landslides. In addition to ground-based measurements, we are performing PSI using both the historic ERS image archive and new Radarsat-1 images acquired since 2006. Movements have been measured in both the flood plain and the valley walls.

Located about 140 km west of Lethbridge, in the Crowsnest Pass, Turtle Mountain was the site of a catastrophic rock avalanche in 1903, which killed more that 70 people. In subsequent years, it has become apparent that significant portions of the mountain remain unstable, putting at risk both lives and major transportation infrastructure. In addition, much of the area is underlain by abandoned coal mines. PSI using Radarsat-1 images from 2001-2006 reveals residual subsidence over the mines, as well as down slope creep of recent talus deposits. No movement within the bedrock has been measured.

The city of Edmonton is cut by the deeply incised valley of the North Saskatchewan River, and its tributary ravines. The soft rock and glacial soils that make up its riverbanks result in many geotechnical challenges. In addition, numerous seems of coal exposed along the river valley were mined up until the 1940's. These now abandoned mines extend under both downtown and residential areas. A new project has begun, with the objective of using both TerraSAR-X and Radarsat-2 data to detect and quantify residual subsidence related to the coal mines as well as instabilities along the riverbanks. PSI processing of historic ERS images (1992-2000) has revealed mm-scale movements. High resolution (3.3 metre) TerraSAR-X Stripmap mode images are currently being acquired in both ascending and descending orbits, using relatively shallow incidence angles. It is hoped that by combining the results of these two datasets we will be able to distinguish between vertical and horizontal movements. In addition, very high resolution (1.7 metre) Spotlite mode images are being acquired over the downtown area. All of these images are being supplied by the German Space Agency (DLR). Radarsat-2 data are also being acquired in order to compare the use of X and C-band images for urban subsidence monitoring.

Abstract number 488

Abstract title Combining Interannual Airborne Lidar and Diurnal Oblique Thermal Imagery to Investigate Glacial Moraine Dynamics

Author list Chris Hopkinson (1), John Barlow (2), Mike Demuth (3) and John Pomeroy (2)
1 – Applied Geomatics Research Group, NSCC Annapolis Valley Campus, Nova Scotia
2 – Department of Geography, University of Saskatchewan, Saskatoon
3 – National Glaciology Program, Geological Survey of Canada, Ottawa

Abstract As glacier extents in the Canadian Rockies diminish, the influence of groundwater and other baseflow inputs to headwater river systems will gradually take on a more important role in terms of their contribution to the available water resource. It is believed that commensurate with decreasing exposed ice extents there is a volumetric increase in the reservoir of debris covered and therefore insulated ice cored moraines adjacent to and surrounding glacier margins. There is plenty of geomorphic evidence that clearly illustrates these storages of buried ice are increasing during the current period of glacier recession but to date little effort has focussed on investigating the relative proportions of buried ice melt vs. exposed ice melt in the Rockies, and the impact this might have on future water resources. In this paper, we present the results of multi-temporal lidar collections over the Peyto Glacier (2000, 2002, 2006, 2007) that accurately quantify rates of volumetric moraine downwasting. The spatial variability of lateral moraine downwasting is high but the average across the 7 year period was approximately 1.5 m p.a. While some of the downwasting can be attributed to slope creep, slumping and general mass wasting processes, the lack of debris volumes at the foot of slope clearly indicate that some other process is in operation and in fact dominates. By comparing the ratios of moraine to exposed ice downwasting, we find that up to 5% of the mass loss from the Peyto basin is from these marginal moraine areas, and we further hypothesize that most of this volume is lost in the form of melt water from ice cored moraines. This hypothesis was evaluated by collecting oblique diurnal thermal imagery to map the rise and decay in temperature signal over a large area of moraine adjacent to the Peyto Glacier. While no exposed ice was visible anywhere on the moraine slope, the presence of shallow ice core beneath the debris covered surface could be inferred in areas of slow temperature rise during daylight solar heating and rapid thermal decay after sunset. It is presumed that this apparent increased loss of heat in certain areas of the moraine is being used to drive internal melt processes. With some calibration and energy balance modeling, this technique will be further developed to map debris cover depth and assist in the parameterisation of glacial hydrological melt models.

Abstract number 489

Abstract title Investigating terrain controls on vegetation height and fractional cover using airborne lidar

Author list Chris Hopkinson, Applied Geomatics Research Group, NSCC Annapolis Valley Campus, Nova Scotia

Abstract

Twelve lidar datasets collected across five ecozones and eight forest species within Canada have been used to explore both localized and universal relationships between terrain and vegetation attributes. The datasets all have similar lidar data properties of point density, sampling geometry, multiple return and pulse intensity; cover a range of terrain types from prairie to montane; and geographic locations from Nova Scotia to British Columbia. Raster models of canopy height (CHM) and fractional cover (FC) have been generated for all datasets at 1m grid resolution. Summaries of the localized vegetation canopy attributes have been generated for each of the following terrain attributes: slope, aspect, elevation, depression, upland, and riparian buffers. Given the high variability in terrain type across all datasets and minimal variability in certain terrain attributes in certain locations, no universally applicable relationships between terrain and vegetation attribute were identified. However, as would be expected, the well known influence of riparian corridors on increased biomass was evident at many of the study sites. However, in some cases, this can be attributed more to land management practice than natural growth conditions. Further, in many of the landscapes studied strong correlations between terrain morphology (e.g. upland and lowland) and both vegetation height or canopy cover were clearly present. However, the nature of the relationship varied depending on species type and local soil and hydrometeorological conditions. While some of the local correlations identified in this study have not previously been catalogued, the general observations recorded were as would be expected; for example: reduced canopy height and cover with increasing terrain elevation is not a new result but locally an understanding of terrain controls on vegetation canopy attributes can be very useful. The value in this analysis is in demonstrating the efficacy of lidar to simultaneously map both terrain and overlying canopy variations at high resolutions; and further in developing localised semi-predictive models of canopy attributes based on terrain properties. This has implications in the field of hydrological modeling where the interdependence of terrain and vegetation at the local scale plays a significant role in controlling: a) the storage and transport of water within the canopy and soil fabric of the watershed; and b) fluxes of water vapour to the atmosphere.

Abstract number 490

Abstract title New Approach for LiDAR System Calibration Based on the Discrepancies Between Overlapping stripsNew Approach for LiDAR System Calibration Based on the Discrepancies Between Overlapping Strips

Author list Ayman F. Habib, Ki In Bang, and Ana Kersting, University of Calgary

Abstract

LiDAR systems have been widely adopted for the direct acquisition of dense and accurate object-space surface models. The accuracy of the derived point coordinates from LiDAR systems depends on the magnitude of random and systematic errors in the system measurement and parameters as well as the nature of scanned surfaces. The quality of the LiDAR data can be improved through either strip adjustment or system calibration procedure. The strip adjustment reduces or eliminates discrepancies between overlapping strips using the available coordinates of the LiDAR points. Calibration procedures, on the other hand, improve the quality of the LiDAR data by the recovery of systematic errors in the system parameters and/or measurements through the use of the LiDAR equation and the system raw measurements (i.e., position and orientation information of each laser pulse, measured ranges, and laser scan angles). The main advantage of strip adjustment procedures is that the end-users can eliminate or reduce discrepancies between overlapping strips without requiring the availability of the system raw measurements. This approach, however, is limited to the overlapping strips that are considered and might not improve the absolute positional accuracy of the LiDAR points. The capability of estimating a set of parameters that can be used for improving the quality of the derived coordinates of the point cloud from other data acquisition missions is furnished by the LiDAR system calibration. Current LiDAR calibration techniques require full access to the system parameters and raw measurements. Unfortunately, the raw measurements are not usually available to the end-users. This research proposes a new method for LiDAR system calibration, without the need for the full access to the system raw measurements. The proposed method uses the available coordinates of the LiDAR points in overlapping strips to estimate biases in the system parameters and measurements (more specifically, biases in the planimetric lever-arm offset components, boresighting angles, ranges, and mirror-angles). In this approach, a simplified LiDAR system equation is derived based on a few reasonable assumptions. The simplified LiDAR equation is, then, used to model the mathematical relationship between conjugate surface elements in overlapping strips in the presence of the above mentioned systematic biases. Since there is no point-to-point correspondence between overlapping LiDAR strips, the proposed method establishes the correspondence between points in one strip and conjugate patches, which are defined by the vertices of triangular patches from a generated TIN – Triangular Irregular Network, in the other strip. The point-to-patch correspondence can be assumed as long as some of the generated patches represent the physical surface (i.e., the patches coincide with the physical surface). The point-to-patch correspondence is established through an iterated closest patch procedure. The identified point-patch pairs are then used to estimate the discrepancies between overlapping strips. These discrepancies are then used to estimate the biases in the system parameters and measurements. Finally, the estimated biases are utilized to correct the coordinates of the derived point cloud for any later LiDAR mission. After the proposed calibration procedure, the coordinates of LiDAR points are adjusted using the simplified LiDAR equation and the estimated biases in the system parameters and measurements. The compatibility of the adjusted coordinates in overlapping strips is, then, compared with the compatibility of the original data before being adjusted through the proposed procedure. For compatibility evaluation, systematic discrepancies and the quality of fit between overlapping strips are evaluated by determining the 3D transform parameters between considered overlapping strips. To illustrate the feasibility and the performance of the introduced procedure, experimental results from simulated and real data will be introduced.

Abstract number 491

Abstract title Estimating Snow Volume in the Elbow River Watershed Using Airborne LiDAR

Author list
Tim Collins (1,2), Chris Hopkinson(1), Axel Anderson(3), Ian Spooner(2)
1 - Applied Geomatics Research Group, NSCC Annapolis Valley Campus, Nova Scotia
2 - Department of Geology, Acadia University, Wolfville, Nova Scotia
3 - Sustainable Resources Development, Government of Alberta, Calgary, Alberta

Abstract
In this research snow pack modeling was attempted in the Elbow River watershed, west of Calgary, Alberta using lidar derived elevation data. The City of Calgary and the Department of Sustainable Resources Development (SRD) were interested in determining whether a winter and a summer lidar dataset can be used to estimate the mean snow depth. Lidar is an airborne laser system that calculates the distance to the ground by determining the return time of emitted laser pulses spatially located by a survey grade global positioning system (GPS) and an inertial motion unit (IMU). Subtraction (Digital Elevation Model (DEM) change detection) of the summer dataset from the winter dataset provides a snow depth dataset that is used to determine mean snow depth. Mean snow depth and an average field-measured snow densities were used to calculate snow water equivalent (SWE). An estimate of snow volume was determined using three methods, 1) one mean snow depth, 2) four terrain attributes (slope, aspect, elevation, and canopy fractional cover) individually and 3) a multiple terrain attribute GIS approach. Application of an average snow depth (3.4 x 107m3) rendered a similar approximate value for snow water equivalent for the study site as the results from slope (3.6 x 107m3), aspect (3.5 x 107m3) and canopy fractional cover (3.5 x 107m3) terrain attributes. Elevation (4.2 x 107m3) and the GIS model (4.3 x 107m3) gave higher estimates of snow water equivalent in the Elbow River watershed since elevation plays a strong role in snow accumulation. Future research should include validation of lidar runoff values with stream gauge data; as well re-evaluating the methods proposed in an area of greater snow depth (the average snow depth in the Elbow River watershed was 18cm, which is the accuracy limit of current lidar systems). Preliminary results indicate that the use of lidar to estimate snow depth is viable option for the determination of snow depth in a mountainous region. Application of this research can be used in conjunction with current water resource management strategies to assist in prediction of seasonal runoff volumes. The advancement of water volume prediction for watersheds can aid city planners with regulating water supply as well as prepare for flooding events.

Abstract number 493

Abstract title Mapping the Health of Forests

Author list David G. Goodenough, Natural Resources Canada, K. Olaf Niemann, University of Victoria, Geoff Quinn, Natural Resources Canada, Jessie Liu, Natural Resources Canada

Abstract

Relationships in foliar biochemistry are capable of determining forest health: reflectance from airborne hyperspectral sensors can yield information regarding stress and productivity [1]; chlorophyll-a/b has been shown to increase in conditions of low nutrient availability [2]. In this study, chlorophyll–a/b in Douglas-fir trees was determined and the relationship with tree stress investigated. Changes in pigment ratios were expected to reflect the influence of elevation and topography on nutrient availability [3].

Long standing PFC study sites within the Greater Victoria Watershed District (GVWD) are dominated by Douglas-fir and span wide ranges of ages and disturbance regimes. Elevation ranges from ~50-800 m with a mean ~200 m. The forested landscape is affected by logging activities, root disease and insect damage [4], yet the moist temperate climate sustains exceptional forest growth. Due to climate, ecological history, and topography of the GVWD, we anticipated variations in forest health.

An AISA hyperspectral dataset was acquired in 2006 and calibrated to AVIRIS data. The AISA data were acquired at the nominal resolution of two meters. Organic chemistry assays were conducted on ten samples per plot, including moisture and chlorophyll. AISA data were supplemented with LIDAR and a GVWD GIS database.

Partial least squares regression (PLS) was employed to model biochemistry data from hyperspectral imagery [5]. Hyperspectral data cubes were stratified by species, understory and age, then transformed into chlorophyll maps. Chlorophyll-a/b maps were generated. The correspondence of elevated ratios with regions of known disturbance factors was assessed. In addition, the relationship between stand age and chlorophyll ratio was investigated.

References

[1] Y. Zhang, J.M. Chen, J.R. Miller, and T.L. Noland, “Leaf chlorophyll content retrieval from airborne hyperspectral remote sensing imagery”, Remote Sensing of Environment, vol. 112, pp. 3234-3247, 2008.

[2] K. Kitajima, K.P. Hogan, “Increases of chlorophyll a/b ratios during acclimation of tropical woody seedlings to nitrogen limitation and high light,” Plant, Cell and Environment, vol. 26, pp. 857-865, 2003.

[3] R.P. Griffiths, M.D. Madritch, S.K. Swanson, “The effects of topography on forest soil characteristics in the Oregon Cascade Mountains (USA): Implications for the effect of climate change on soil properties,” Forest Ecology and Management, vol. 257, pp. 1-7, 2009.

[4] E.M. Hansen, E.M. Goheen, “Phellinus Weirii and Other Native Root Pathogens as Determinants of Forest Structure and Process in Western North America,” Annual Review Phytopathology, vol. 38, pp. 515-539, 2000

[5] M.L. Smith, M.E. Martin, L. Plourde, S.V. Ollinger, “Analysis of Hyperspectral Data for Estimation of Temperate Forest Canopy Nitrogen Concentration: Comparison Between an Airborne (AVIRIS) and a Spaceborne (Hyperion) Sensor,” IEEE Transactions on Geoscience and Remote Sensing, vol. 41, pp. 1332-1337, 2003

Abstract number 494

Abstract title Spectrophotometric Detection Of Phellinus sulphurascens Colonization In Douglas-Fir (Pseudotsuga menziesii) Foliage

Author list Geoff Quinn, University of Victoria, K. Olaf Niemann, University of Victoria, David G. Goodenough, Natural Resources Canada

Abstract

Forest management practices have impacted forest composition and health [1]. To ensure our forests are managed sustainably, it is important that forest health be monitored. New technologies and refinement of analytical procedures have enabled the capacity for estimating foliar biochemistry [2]. A project was undertaken, which applied the use of reflectance in determining pigment concentrations. Ultimately, samples exhibiting stress responses affected by a fungal root pathogen were discriminated.

Study sites were established within The Greater Victoria Watershed District, Vancouver Island. Site species compositions were largely Douglas-fir but included Western Red Cedar and Western Hemlock. The forested landscape is marked by the typical agents of natural disturbance including wind throw, disease and a 100 year logging history [3].

Samples collected from upper canopies of infected and healthy trees were processed for pigment content and lab reflectance. Pigments were extracted promptly with a DMF solvent and sampled spectrophotometrically. Reflectance measurements were made of aligned homogenous needles by an ASD in a darkroom setting.

Reflectance spectra were transformed to first and second derivatives [4] and a continuum removal band depth analysis [5] was performed. Linear and partial least squares regression analyses were conducted to relate chlorophyll levels (a, b, and total) to features. The predictive powers of reflectance attributes, such as the red edge and 5 parameters from continuum removal, were assessed. For example, PLS regression achieved coefficients of determination (r2) in excess of 0.85 for chlorophyll a. Linear regressions from feature attributes also had r2 greater than 0.8. A significant age effect, such as a blue shift of the red edge, was also observed in the reflectance of chlorophyll samples from damaged young trees.

References

[1] K.E. Baleshta, S.W. Simard, R.D. Guy, C.P. Chanway, “Reducing paper birch density increases Douglas-fir growth rate and Armillaria root disease incidence in southern interior British Columbia,” Forest Ecology and Management, vol. 208, pp. 1-13, 2005.

[2] I. Moorthy, J.R. Miller, T.L. Noland, “Estimating chlorophyll concentration in conifer needles with hyperspectral data: An assessment at the needle and canopy level,” Remote Sensing of Environment, vol. 112, pp. 2824-2838.

[3] D.G. Goodenough, A.S. Bhogal, A. Dyk, K.O. Niemann, T. Han, H. Chen, C. West, C. Schmidt, “Calibration of Forest Chemistry for hyperspectral Analysis, IEEE International IGARSS Geoscience and Remote Sensing Symposium,” vol. 1, pp. 52-56, 2001.

[4] G.V.G. Baranoski, and J.G. Rokne, “A practical approach for estimating the red edge position of plant leaf reflectance,” International Journal of Remote Sensing, vol. 26, pp. 503-521, 2005.

[5] R.F. Kokaly, and R.N. Clark, “Spectroscopic Determination of Leaf Biochemistry Using Band-Depth Analysis of Absorption Features and Stepwise Multiple Linear Regression,” Remote Sensing of Environment, vol. 67, pp. 267-287, 1999

Abstract number 495

Abstract title Using A Markov Network For Individual Tree Detection From Airborne Laser Scanning Data

Author list Junjie Zhang and Gunho Sohn, GeoICT Lab, Department of Earth and Space Science and Engineering, York University

Abstract

LiDAR (Light Ranging and Detection) technology holds unparallel advantage of rapid acquisition of 3D information of Earth surface and features. The unique capability of ALS (Airborne Laser Scanning) to penetrate canopy and measure the ground in forested area in large scale results in new demands and new methods in forest inventory, which is believed to hold great potential in deriving more accurate tree-based forest parameters, such as tree height, crown size, and tree species. However, single tree detection is the basis for stand-wise analysis and to obtain more accurate individual-tree-based parameters.

The presented research addresses difficulties of individual tree detection problems in terms of object representation and objective function. The study highlights a novel Markov Network to model ALS point clouds as for clustering individual tree points in which a global optimum can be achieved by balancing error rates in detection of local single trees and separation of neighboring trees. The method firstly over-extracts local maxima using relatively small filter size as candidate tree top points. Then a Markov Network is modeled as a unidirected graph using candidate points by which two potential energies for each node (¡°attachment energy¡±) and arc (¡°contextual energy¡±) are computed. A graph cutting algorithm is applied to achieve an optimized graph by iteratively pruning unnecessary graph nodes (i.e., erroneous local maxima). The process continues until no significant energy change is computed by modifying the graph. The developed method is tested in areas with close-growing trees and preliminary result shows an improvement in detection rate of single trees, thus the feasibility of the method.

Abstract number 496

Abstract title

Comparing C- And L-Band Radar for Mapping Riparian Wetlands in the Brazilian Savannah Context: An Approach Using Unsupervised Image Segmentation

Author list

Thiago de Alencar-Silva and Philippe Maillard, Universidade Federal de Minas Gerais

Abstract

Knowledge of wetlands distribution is very important for land use managements, flood control, monitoring wildlife, modeling hydrologic network, carbon cycle, and all water related studies. Wetlands provide a wide range of ecologic services from which many aspects human activities depend. Since Brazil does not have an official wetland definition, there is a general lack of knowledge about wetland distribution and health, especially small riparian wetlands. Given the size of Brazil, remote sensing is the only viable tool to fill these gaps, and radar images have a well recognized potential for permitting the quick identification of saturated or flooded wetlands. The objective of this article is to evaluate C- and L-band SAR image data in an unsupervised segmentation context for mapping riparian wetlands. First we assessed the capacity of both SAR data types to identify different types of riparian wetlands based on statistical distance between sigma naught values. Than a segmentation program especially build for SAR imagery, SMAGIC was used on both image types to asses both their wetland delineation potential and the capacity of SMAGIC to identify these wetlands in an unsupervised manner. Validation data was acquired from a single Ikonos scene and some field data. Results show that L-band is more effective in distinguishing the various elements, especially wet and dry grassland, riparian forest, flooded areas and open water. C-band shows a better capacity for separating wetland areas from non-wetland area. SMAGIC proved very efficient in segmenting significant classes providing their number is correctly supplied.

Abstract number 497

Abstract title Characterizing the Spectral Trajectory of Cerrado Regeneration to Estimate Its Age

Author list Priscilla de Souza da Costa-Pereira, Universidade Federal de Minas Gerais
Philippe Maillard, Universidade Federal de Minas Gerais

Abstract Cerrado is a woody savanna formation found in Brazil with a very complex structure and rich biodiversity suffering increased human pressure. Medium to fine resolution remote sensing data are the only means to monitor the evolution of its conversion and regeneration. With this study our objectives were to understand how and at what speed cerrado regenerates after a clear cut; determine what structural variables best represent its age and establish clearly what contribution multitemporal optical remote sensing can bring to estimate the age of cerrado regeneration. Our reference data is composed of 47 plots that were surveyed in a state park in Minas Gerais that used to be a eucalyptus plantation until 1994 and for which the exact age of regeneration is known with precision. Nineteen Landsat TM images were digitally processed to model the reflectance trajectory of the regenerating cerrado. Results show that whereas structural measurements can be used to estimate the age of regeneration for the first few years, the spectral counterpart shows potential to estimate an age for a more advanced stage of regeneration. In particular, the spectral trajectory of band 5 shows a quase-linear trend that directly relates to the time elapsed after the clear cut.

Abstract number 498

Abstract title CCRS-China RADARSAT-2 Applications Research Program Overview

Author list Brian Brisco (1), Ridha Touzi (1), Joost van der Sanden (1), Bert Guindon (1), Ying Zhang (1), Guo Huadong (2), Li Zhen (2), Liao Jinjuan (2) and Liu Guang (2)
1 - Canada Centre for Remote Sensing
2 - Centre for Earth Observation and Digital Earth Chinese Academy of Sciences, Beijing, China

Abstract RADARSAT-2 data from several test sites for applications development research and from areas affected by natural disasters (floods and earthquakes) were evaluated by a joint research team from China and Canada. The Centre for Earth Observation and Digital Earth (CEODE) and the Canada Centre for Remote Sensing (CCRS) conducted these investigations as part of the Capacity Building Centre for Earth Observation (CBCEO) under the China/Canada S&T MoU for science and technology collaboration. The preliminary analyses includes an evaluation of the new Touzi polarimetric decomposition for both urban and wetland targets as well as the standard evaluation of images and false colour polarization composite products from the SAR data. This presentation will provide the background to the CBCEO agreement and present preliminary results from the analyses of the RADARSAT-2 data.

Abstract number 499

Abstract title Compact Polarimetry Assessment: Wetlands and Soil Moisture

Author list Brisco, Brian, François Charbonneau and Mélanie Trudel
Canada Centre for Remote Sensing

Abstract A SAR with hybrid-polarity architecture (CL-pol) transmits circular polarization and receives two orthogonal mutually-coherent linear polarizations, which is one manifestation of compact polarimetry. The resulting radar is relatively simple to implement, and has unique self-calibration features and low susceptibility to noise and cross-channel errors. It also enables maintaining larger swath coverage than fully polarimetric SAR systems. This compact polarimetry mode configuration for a SAR satellite is evaluated for wetland mapping and soil moisture estimation. A methodology was developed at CCRS for a comparison of fully polarimetric data with compact polarimetry data for applications important to the GoC, under the Understanding Canada from Space and the Groundwater Mapping programs. This paper will present the approach developed and provide some example analyses techniques, such as results for wetland classification and soil moisture estimation. The implication of the results will be discussed with respect to future SAR missions such as the RADARSAT Constellation or India's RISAT.

Abstract number 500

Abstract title Compact Polarimetry Assessment: Sea Ice

Author list Roger DeAbreu (1), Matt Arkett (1), Brian Brisco (2), and François Charbonneau (2)
1 - Canadian Ice Service/Environnent Canada
2 - Canada Centre for Remote Sensing

Abstract A SAR with hybrid-polarity architecture (CL-pol) transmits circular polarization and receives two orthogonal mutually-coherent linear polarizations, which is one manifestation of compact polarimetry. The resulting radar is relatively simple to implement, and has unique self-calibration features and low susceptibility to noise and cross-channel errors. It also enables maintaining larger swath coverage than fully polarimetric SAR systems. This compact polarimetry mode configuration for a SAR satellite is evaluated for applications important to the GoC. Of interest to operational ice services is the relative benefits of compact polarimetry to the ice information provided in single (e.g. HH) and dual polarization (e.g. HH+HV, HH+VV) channels. A methodology was developed at CCRS for a comparison of fully polarimetric data with compact polarimetry data for applications important to the GoC, under the Understanding Canada from Space and the Groundwater Mapping programs. This paper will present the analyses techniques and results for both visual and automated sea ice classification. The implication of the results will be discussed with respect to future SAR missions such as the RADARSAT Constellation or India's RISAT.

Abstract number 501

Abstract title An Assessment of Compact Polarimetry for Crop Classification

Author list Heather McNairn, Jiali Shang, Catherine Champagne, Francois Charbonneau and Amine Merzouki
Agriculture and Agri-Food Canada

Abstract

Agriculture and Agri-Food Canada (AAFC) has developed and comprehensively validated a method to classify crops across Canada's diverse cropping systems, using data from optical and Synthetic Aperture Radar (SAR) sensors. Results convincingly demonstrated that single frequency SAR (C- or L-Band) assisted with crop identification when integrated with one or two multi-spectral images. A multi-temporal multi-frequency (C- and L-Band) data set produced classification accuracies equal to those achieved with a multi-temporal optical data set. However in both scenarios, crop classification was successful only with the availability of multi-polarization or polarimetric data. Analysis of quad-pol data demonstrated that polarimetric decomposition parameters provide overall crop classification accuracies equal to or better than accuracies achieved with linear multi-polarization (HH, HV, VV, VH) data.

This research has advanced understanding of the value of SAR for crop classification. However, the small swaths currently associated with fully polarimetric SARs, such as RADARSAT-2, present a challenge for implementation of operational crop monitoring. A compact polarimetric mode has the potential to provide much of the information needed for crop identification, but with a swath coverage more suited for wide-area mapping. This paper evaluates the capability of parameters derived from simulated compact polarimetric data for crop classification.

In 2008, four quad-polarization RADARSAT-2 images were acquired over an agricultural test site in eastern Ontario (Canada), along with crop information for about 275 fields. A compact polarimetric data set was simulated from each RADARSAT-2 acquisition. Several parameters were generated from the simulated compact polarimetric data including, the four stoke vector components, the degree of polarization, circular polarization ratio, relative phase, ellipticity, hybrid entropy and the m-delta decomposition parameters. These compact pol parameters were used in AAFC's decision-tree classifier to identify corn, soybean, cereal and hay-pasture crops. Freeman-Durden (double bounce, single bounce, volume scattering) and Cloude Pottier (H,a, A) decomposition parameters were derived from the RADARSAT-2 quad-pol data and were also evaluated. Classifications were assessed using both crop specific and overall accuracy statistics. Results demonstrated that when compared to parameters from the fully polarimetric data, classification accuracies were slightly lower when using parameters derived from the simulated compact polarimetric data. However, the capability of a compact polarimetric mode to acquire data over much larger swaths is a fair trade-off for a small reduction in classification accuracy.

Abstract number 502

Abstract title Ship Detection using RADARSAT-2 Polarimetric and Simulated Compact Polarimetric Data

Author list Chen Liu, Paris W. Vachon
Defence R&D Canada – Ottawa

Abstract

One form of Compact Polarimetry (CP) is hybrid-polarity in which circular polarization is transmitted and two orthogonal, mutually-coherent linear polarizations are received. Hybrid-polarity can be viewed as an extension of conventional dual-polarization radar in which swath width is conserved, but additional target information is available through access to Stokes parameters. The potential performance of CP for ship detection has been investigated by simulating hybrid-polarity data from RADARSAT-2 Fine Quad (FQ) Mode data and applying polarimetric SAR (PolSAR) ship detection algorithms to both the FQ and simulated CP data. From statistical decision theory, the likelihood ratio test with Neyman-Pearson criterion was used to define a decision variable. Detection performance was characterized by calculating receiver operating characteristics from RADARSAT-2 data and simulated CP data to quantify the trade-off between the probability of missed detection and the probability of false alarm. Full polarization (i.e., quad-polarization), dual polarization (including simulated CP and HH + HV with both amplitude and phase), and single polarization (HH) images of known ships were considered. The results demonstrate that a full polarimetric system provides the best ship detection results as compared to other SAR systems, but at the expense of a narrow swath. The results also demonstrate the improved detection performance of CP as compared to single polarization and conventional dual polarization systems.

Abstract number 503

Abstract title An Overview of Compact Polarimetry

Author list
R. Keith Raney
Johns Hopkins University Applied Physics Laboratory
Defence R&D Canada – Ottawa

Abstract

A compact polarimetric synthetic aperture radar (SAR) is a dual-polarized system in which the relative phase is retained between the two receive channels. All transmissions are at only one polarization. In response, the received and focused (complex) data at each pixel are comprised of four numbers–the magnitudes of the two channel outputs, and the real and imaginary parts of their cross product. These data are sufficient to calculate the 2x2 covariance matrix, which is a complete representation of the information contained in the observed backscattered field. Compact polarimetry is of interest because the interpretation and classification of SAR data in many applications is far better than for a mono-polarized or a conventional dual-polarized radar, while avoiding the key disadvantages of a fully- (or quadrature-) polarized configuration. On the other hand, compact polarimetry cannot replicate the 4x4 scattering matrix which is the canonical data product of a fullypolarimetric SAR, although in certain applications compact polarimetry fares quite well in comparison.

The information content conveyed by compact polarimetry is independent of the polarization basis of the receiver. The only requirement is that the two receive channels be at orthogonal polarizations. Thus a conventional linearly-polarized (H and V) approach is perfectly acceptable, as long as their relative phase (embedded in HV*) is included in the data product. The effectiveness of a given compact polarimetric SAR, however, depends strongly on the polarization of the transmitted field. There are two leading alternatives for the transmitted polarization–pi/4, which is a linearly polarized wave at an orientation 45o away from horizontal, and hybrid, in which the transmitted polarization is circular. Both techniques have seen application since the 1980s in radar meteorology, but have been given serious consideration for imaging radars only in the past five years or so. There
is now in lunar orbit the hybrid-polarimetric SAR (on Chandraayan-1), and several other SARs now in advanced planning or implementation will also have hybrid-polarimetric modes.

This paper describes compact polarimetry in the context of all possible polarimetric combinations applicable to synthetic aperture radar systems. The advantages of hybrid-polarity are reviewed, especially with reference to certain well-known disadvantages of quad-pol SARs. The conclusion is that a hybrid-polarity mode offers considerable practical advantages to the user
community, and at small marginal implementation cost, especially if one starts with a system that already has two receive channels at orthogonal polarizations.

Abstract number 505

Abstract title A Structural Analysis for Single Tree Classification Using Airborne Lidar Data

Author list Jili Li, Baoxin Hu, Gunho Sohn,Department of Earth and Space Science and Engineering, York University.

Abstract

Structural characteristics of individual trees are very important for tree species classification, forest inventory and management. Light Detection and Ranging (LiDAR) technique exhibited a great potential in detecting significant structural information of trees. This study is to investigate the similarities and differences of various structural characteristics among coniferous and deciduous species at individual tree level.To do this, high density (10 pts/m^2) airborne LiDAR data are utilized, which provides sufficient structural information for an individual tree. Since different tree species tend to have different shape and foliage distribution, in this study, metrics are derived from LiDAR data to describe them. To describe tree crown shape characteristics, a convex hull algorithm is applied to segment 3D tree points into interior and boundary points. Parabolic and cone shape models are then fitted to the boundary points by a least square adjustment procedure. Parameters of the models calculated are assembled to represent shape characteristics, for example top sharpness, shape symmetry and tree volume etc. To describe foliage distribution characteristics, 3D tree points are subdivided into multi height layers from which characteristics such as proportion of first or second return, vertical density and intensity distributions, as well as horizontal crown area variance are extracted. These developed crown shape and foliage distribution descriptors are tested with 40 trees with different species. The results demonstrate that tree top sharpness and horizontal crown area variance are two best structural characteristics to classify tree species among coniferous and deciduous trees using high density LiDAR data.

Abstract number 508

Abstract title Image Registration of Optical and SAR Images Using Control Point and Area-Based Matching

Author list Siyue Chen (1), Chen Xu (2), Henry Leung (1), Anne Smith (3)
1 - University of Calgary
2 - Intermap Technologies Corp.
3 - Agriculture and Agri-Food Canada

Abstract Combining data from different sensors of the same scene acquired at different times to create a hybrid is a common task in remote sensing. The first step of this task is to register these same-scene images because of their different scales and geometric transformations. The accuracy of this step is important to create a valuable final hybrid image. Control point (CP) is one of the most popular registration methods. Firstly, the pairs of feature-based CPs are selected manually. And by assuming a proper transformation models, e.g., affine, projective or polynomial, the transformation parameters are usually estimated by using least-squares adjustment to solve a set of linear equations. Although the CP-based registration method is easy to implement, its accuracy primarily relies on the quality of CP selection, which is significantly dependent on the operator's experience and the distinctions between images. In this paper, CP is employed to obtain an initial guess of the transformation parameters. In the next step, a point-to-point area-based matching is then performed to improve registration accuracy. More specifically, a 2D normalized linear correlation method is used to create a matching correlation surface for each pixel. A sub-pixel accuracy thus can be achieved by a parabola fitting. The proposed method is applied to register the optical image (SPOT 4, 20 m pixels) and the ASAR ortho-rectified radar image (Envisat, 30 m pixels). The registration results demonstrate the effectiveness of the proposed method.

Abstract number 509

Abstract title Performance Evaluation of Multi-Spectral and Panchromatic Image Fusion Techniques

Author list Qing Guo (1, 2), Siyue Chen (1), Henry Leung (1), Shutian Liu (2),
1 - University of Calgary
2 - Harbin Institute of Technology

Abstract In the past few years, many fusion algorithms have been proposed to combine a high-resolution panchromatic image with a low-resolution multi-spectral image to produce a high-resolution multi-spectral image. Among them, the wavelet based method has gained its popularity due to its ability of multi-resolution decomposition. More specifically, a wavelet transform is first applied to images. The wavelet coefficients are then combined based on a certain rule
to produce the fused image. In this paper, we will evaluate the performances of both the wavelet transformation algorithms and the methods of coefficient combination when they are applied to fusion of multi-spectral and panchromatic images. For the wavelet transformation methods, the Mallet and ``\`{a} trous'' algorithm are chosen. For coefficient combination, the additive wavelet method, the additive wavelet intensity method, the additive luminance proportional method, and the additive wavelet principal component method are selected. To evaluate the spectral quality of the fused images, correlation coefficient and ERGAS are used as a local and global measure, respectively. Meanwhile, average gradient and standard deviation are used to evaluate the spatial quality. Our experiments show that when keeping the combination method the same, the ``\`{a} trous'' algorithm works better than Mallet for the fusion purpose. In addition, if keeping the wavelet transform algorithm the same, the combination methods mentioned above are found to have different tradeoffs between the spatial resolution improvement and the spectral quality preservation.

Abstract number 511

Abstract title Mapping Wetlands Variantion Using High Resolution Image in the Pandeiros Wildilife Sanctuary, Brazil

Author list Ivan Seixas Barbosa, Philippe Maillard, Thiago Alencar Silva. Universidade Federal de Minas Gerais

Abstract

The Pandeiros is a unique wetland in the sub-arid to semiarid Northern Minas Gerais, Brazil. Although its ecological importance is well recognized by land management authorities who have transformed it into a wildlife sanctuary, the absence of specific law defining and protecting wetlands in Brazil yields place to degradation from grazing and other human activities. Having no official definition, most environments of the Pandeiros have not yet been identified or characterized as wetlands. In this article we present a pioneering effort for identifying and characterizing numerous wetland environments found in the Pandeiros using high resolution Ikonos images as the prime data source. Since we had very little a priori knowledge of the area, unsupervised image processing methods were preferred. Areas appearing to be preserved were selected based on visual interpretation to serve as primary targets. Both pixel-based and region-based methods of classification were tested and their results compared with the characteristics of the environments we have observed on the field. The results show that both unsupervised methods have good potential for identifying the main vegetal physiognomies but that an over-segmentation is usually needed in order to preserve all significant environments. The region-based approach had the advantage of a much superior spatial consistency and allowing easier visual interpretation. The Pandeiros revealed itself complex beyond the single spectral criterion used in our study which had the benefit to supply a primary classification key.

Abstract number 512

Abstract title Land Use Mapping at Micro-level: Application of IKONOS Images in South-west Bangladesh

Author list Quazi K. Hassan, University of Calgary; Mir A. Matin, International Water Management Institute

Abstract

Land use mapping at very high spatial resolution (~4m) is a critical issue for developing strategic plans for current and future socio-economic activities in the coastal regions of south-west Bangladesh, where there is a remarkable changes in land use practices in the recent time. In this paper, we employed two IKONOS XMS images over two different areas within the coastal regions to delineate land use maps, where there were distinct differences in land use practices between the areas. One of the areas was dominantly utilized by shrimp cultivation (with the land use classes of tidal rivers and water drainage networks; only shrimp; shrimp and then rice during late September-December; rural settlements; and embankments, roads, and static ponds), while the other one was a low-lying area being flooded during monsoon season (with the land use classes of tidal rivers and water drainage rivers; only fresh water fish ponds; fresh water fish pond and then rice during Jan-April; rural settlements; and embankments, and roads). In the event of identifying the tidal rivers and water drainage networks, and rural settlements, we used texture analysis techniques. The ISO-data clustering technique was utilized for delineating the classes of only shrimp cultivation area, shrimp and then rice areas, only fresh water fish ponds, and fresh water fish pond then rice cultivation areas. On-screen digitization was then performed to extract the embankments and rural road networks due to their fusion resulted from the trees along the both sides. A comparison between the classified images and the ground validation dataset reveal strong overall accuracies (~>92%) among the classes.

Keywords: IKONOS XMS, land use mapping, coastal area

Abstract number 513

Abstract title Spatiotemporal Dynamics of MODIS-based Leaf Area Index in the Boreal Forest in Northern Alberta

Author list Quazi K. Hassan, University of Calgary; Charles P.-A. Bourque, University of New Brunswick

Abstract

Leaf area index (LAI: the integration of leaf area along the canopy) is an important factor in terrestrial ecosystems and represents the amount of surface area involved in (i) the plant-to-air and air-to-plant transfer of gases and particulate matter, (ii) energy exchange, (iii) eco-physiological processes of evapotranspiration, photosynthesis, and net primary production, and (iv) forest-landscape growth and development. Leaf area integrated along the canopy gives us the leaf area index (LAI). In order to understand the spatiotemporal dynamics of LAI over the boreal forest in northern Alberta, we employed MODIS-based 8-day LAI products at 1-km spatial resolution available from NASA (i.e., MOD15A2: a solution from an inverse application of a 3-dimensional radiative-transfer model and atmospherically-corrected MODIS spectral surface reflectance and biome identification as input) during the period April-October in 2005. We observed increases in regional mean LAI values from April to July (~0.70 to 2.93), and decreases from August to November (~2.93 to 0.70). These changes correspond with the seasonal changes in temperature and phenology of the overstory and understory vegetation. We also have investigated LAI as a function of six major forest cover types (i.e., hardwood, black spruce fens/bogs, black spruce, pine, white spruce, and mixed forest). It revealed that greatest mid-summer LAI occurred in the hardwood cover (~3.5) and the smallest in the pine stands (~2.0). In theory, LAI-values over conifer forests (e.g., pine stands) should not change with time of year. However, we observed MODIS-based LAI to decline in the coniferous stands during the late summer-to-winter period, primarily as a result of (i) phenological changes in the understory layer (i.e., herbaceous and/or shrub layers) in the fall, and (ii) subsequent build-up of snow on the ground and vegetation in the late fall-to-winter period. Snow on the ground is expected to interfere with the estimation of LAI with remote sensing techniques. In a second phase, we plan to verify MODIS-based LAI by comparing with ground-based estimates we will collect in the summer 2009.

Keywords: MODIS, leaf area index, spatiotemporal dynamics, boreal forest

Abstract number 514

Abstract title Evaluation of Radar Backscatter Models over Agricultural Fields: Validation Using Polarimetric C-band RADARSAT-2 SAR Image Data

Author list Amine Merzouki, Heather McNairn, Eric Gauthier. Research Branch, Agriculture and Agri-Food Canada

Abstract

It is well known that backscatter from Synthetic Aperture Radar (SAR) is correlated with surface characteristics such as the soil dielectric proprieties, the surface roughness, and the vegetation cover. The purpose of this study is to evaluate the capability of surface radar backscatter models to estimate soil moisture over agricultural fields from fully polarimetric RADARSAT-2 C-band SAR responses. For validation purposes, ground measurements over 255 sampling sites in Eastern Ontario and Southern Manitoba were carried out in the spring of 2008 simultaneous with satellite data acquisitions. A comparison was made between the backscatter coefficient results derived from three scattering models (the semi-empirical models of Dubois et al. (1992) and Oh et al. (1994), and the theoretical integral equation model (IEM) of Fung et al. (2004)) and the SAR image backscatter. Discrepancies between measured radar backscatter coefficients and those predicted by the models have been investigated. Overall, results show that semi-empirical approaches tend to overestimate the radar response, but correction factors of about 3.5 dB and 2.0 dB were found sufficient to correct, respectively, the Dubois HH and VV backscatter coefficients. The Oh model backscattering estimations were less variable than the ones derived from the previous model; however, a correction factor of about 5.0 dB was necessary in this case. Simulated data by the IEM showed significant fluctuations. This result was somewhat expected, since previous studies have shown that correlation length measurements are very sensitive to profile length and in this study, a relatively short profile length was used (~ 1 m). These results indicate that further work is needed to assess the reasons behind the requirement for correction factors, such that these models can be implemented to estimate soil moisture to support agricultural monitoring.

Abstract number 515

Abstract title

Comparing Change Detection Methods based on a Vegetation Index and Canopy Reflectance Model for the Detection of Aspen Dieback from Multi-temporal Landsat Thematic Mapper Data

Author list

Eric J. Arsenault, Ron J. Hall, E.H. (Ted) Hogg, and Michael Michaelian,
Natural Resources Canada, Canadian Forest Service

Abstract

Trembling aspen (Populus tremuloides Michx.) is the predominant tree species in the aspen parkland and boreal transition ecoregions located within the Canadian Prairie provinces. Recent, severe drought in this region has led to extensive dieback, mortality and reduced growth of aspen forests. Tree level estimates of percent dieback were used to create an index of foliar biomass loss at the plot level that could be related to the change values derived from satellite imagery. Multitemporal Landsat Thematic Mapper data representing pre-dieback (1999) and progressive stages of dieback conditions observed in 2001, 2003 and 2006 were analysed. Results suggest that image estimates of differences in crown closure derived from the inversion of the Li-Strahler canopy geometric-optical model were more sensitive to canopy structure and the loss of foliage caused by dieback than the use of relative differences of the infrared simple ratio. These results were likely due to an improved characterization of understory vegetation when sunlit background reflectance was incorporated into the modeling process. Future work will focus on translating the loss in foliage biomass to stand-level impact assessments on aspen forest productivity and biomass.

Abstract number 516

Abstract title Determination of telluric water vapour using absorption measurements of lunar irradiance

Author list Richard R. Querel and David A. Naylor, Department of Physics and Astronomy, University of Lethbridge

Abstract

Determination of atmospheric water vapour is important to ground-based astronomy on account of its strong absorption and emission characteristics in the infrared spectral region. Also, the distribution of water vapour can be highly dynamic, varying dramatically, both spatially and temporally. Thus, any practical method for accurately estimating and monitoring the real-time water vapour abundance has direct applications in surface-based infrared astronomy and in space-based terrestrial remote sensing.

A novel instrument has been designed to measure atmospheric water vapour by using transmission differences around the 0.94 micrometers water absorption feature. Line-of-sight lunar irradiance was employed as the exoatmospheric illumination source. The ratio of on-band to off-band radiance measurements were compared to the expected absorption losses due to water vapour as output from a radiative transfer simulation of the atmosphere above Lethbridge. The derived precipitable water vapour values were compared with the emission-based measurements of a 20-micrometer radiometer and available satellite and model data sets for the same time periods and location. Strong correlation was found between the differing methods and data sets over several observation periods.

Abstract number 517

Abstract title Remote Sensing of Water Vapour above the Las Campanas Observatory

Author list Richard R. Querel (1), David A. Naylor (1), Joanna Thomas-Osip (2), Gabriel Prieto (2)
1 - Department of Physics and Astronomy, University of Lethbridge
2 - Las Campanas Observatory, Chile

Abstract We present simultaneous precipitable water vapour (PWV) measurements made at the Las Campanas Observatory, Chile, in late 2007 using an Infrared Radiometer for Millimetre Astronomy (IRMA) and the Magellan Inamori Kyocera Echelle (MIKE) optical spectrograph. Opacity due to water vapour is the primary concern for ground based infrared astronomy. IRMA has been developed to measure the emission of rotational transitions of water vapour across a narrow spectral region centred around 20 microns, using a 0.1 m off-axis parabolic mirror and a sophisticated atmospheric model to retrieve PWV. In contrast, the MIKE instrument is used in conjunction with the 6.5 m Magellan Clay telescope, and determines PWV through absorption measurements of water vapour lines in the spectra of telluric standard stars. With its high spectral resolution, MIKE is able to measure absorption from optically thin water vapour lines and can derive PWV values using a simple, single layer atmospheric model. In an attempt to improve the MIKE derived PWV measurements, we explore the potential of fitting a series of MIKE water vapour line measurements to the simulated manifold output from our multi-layer, line-by-line, site-specific radiative transfer model, BTRAM. These fits were performed in the near-infrared absorption bands located around 700, 800 and 900 nm.

Abstract number 518

Abstract title Estimating Forest Structural Attributes From Airborne Remote Sensing Datasets for Use in Mountain Pine Beetle Susceptibility Mapping

Author list A.M. Faraguna and G.J. McDermid
Foothills Facility for Remote Sensing and GIScience, Department of Geography, University of Calgary, Calgary

Abstract The current mountain pine beetle (MPB) epidemic in western-Canada is having major impacts on the economy and ecology of affected areas. Advance knowledge of suitable MPB habitat is key in designing control programs in order to mitigate some of these impacts. Currently, a MPB susceptibility model (Shore and Safranyik 1992) is being employed by provincial and federal governments to serve this need. However, due to jurisdictional constraints on forest inventory data needed for the susceptibility calculations large areas of western-Canada are noticeably lacking in susceptibility information. In order to bridge the existing knowledge gap in forest stand susceptibility to MPB, relationships between field data and airborne remote sensing data are necessary. LiDAR (Light Detection and Ranging) and CASI (Compact Airborne Spectral Imager) data will be used to establish relationships between the remote sensing data and collected field data on forest attributes used in susceptibility calculations; these include stand density, susceptible pine basal area and forest stand age. A number of techniques will be explored in order to find the best fit between the two datasets for each forest structural variable. This work is expected to establish an effective method for estimating variables needed to map landscape level MPB susceptibility, thus overcoming gaps in existing forest inventory data.

Abstract number 520

Abstract title

The application of ALS LIDAR data to differentiate among three classes of increasing structural complexity in boreal spruce and mixedwood forest types

Author list

Ben Kuttner and Jay Malcolm, University of Toronto

Abstract

Abstract:

Small footprint discrete return airborne laser scanner (ALS) LiDAR systems are becoming increasingly popular in forestry applications because of their ability to simultaneously characterize above ground forest components in three dimensions while accurately mapping terrain surfaces below forest canopies. However, despite LiDAR's proven ability to characterize both the horizontal and vertical distribution of forest components, relatively few studies to date have examined ALS data in relation to the spatial arrangement of forest structures or within-stand forest structural heterogeneity itself. We investigated the utility of ALS data to discriminate among three classes of increasing structural complexity in boreal mixedwood and spruce forest types of northeastern Ontario, Canada. Specific objectives were to: 1) examine the utility of LiDAR in characterizing forest structure; 2) understand the effects of sampling intensity on LiDAR metrics; and 3) derive effective variables for structural classification. Several LiDAR metrics were significantly correlated with sampling intensity, which varied widely among field plots as is common with ALS data. We present methods to detect, and statistically correct for, systematic biases in LiDAR summary metrics introduced by variable point densities at the plot scale. Several predictive models of structure class were developed and compared. LiDAR metrics which describe the distribution of LiDAR derived vegetation heights often outperformed more commonly used metrics such as mean and maximum heights for stand structural classification. Classification success for 400 m2 field plots using the best models was 95% in boreal spruce (n=14), and 82% for boreal mixedwood stands (n=43). Results demonstrate that remotely sensed LiDAR data may be used to enrich the information content of traditional forest resource inventories.

Abstract number 521

Abstract title Object-Oriented Classification of Multi-Resolution Images For the Extraction of Narrow Linear Forest Disturbance

Author list Yuhong He (1), Steven E. Franklin (1), Xulin Guo (1), Greg J. McDermid (2), Gordon Stenhouse (3)
1 - Department of Geography and Planning, University of Saskatchewan,
2 - Department of Geography, University of Calgary,
3 - Foothills Model Forest.

Abstract

Narrow linear forest disturbances (e.g. seismic cutlines) have been found to have significant effects on wildlife habitat and biodiversity (e.g. species richness and abundance). Accurate mapping of cut lines can therefore contribute to a better understanding of wildlife habitat and biodiversity. However, previous studies have indicated that seismic cutlines are fairly difficult to detect and map even with available high spatial resolution imagery (e.g. SPOT 5).

This study investigated the potential combination of high spatial resolution imagery with very high spatial resolution imagery for extracting seismic cutlines using multi-resolution object-oriented classification approach. Data used include SPOT 5 and Quickbird multispectral and panchromatic images, existing GIS databases, and surface observations within one Bear Management Area (BMA) in the eastern slopes of the Rocky Mountains in Alberta. A pansharpening algorithm was first applied to fuse multispectral and panchromatic images for spatial resolution improvement and colour information enhancement. Multi-resolution image segmentation was then applied on the pansharpened images, resulting in different levels of polygon primitives at different space scale. The fuzzy rule decision tree classifier was eventually used to classify the polygon primitives based on shape, texture, context and spectral information.

Results indicated that the pansharpening approach was capable of improving of seismic line identification. The multi-resolution image segmentation with a scale parameter of 30 resulted in objects small enough to differentiate seismic cutlines. The object-oriented multi-resolution classification approach classified seismic cultines with greater than 80% accuracy. This study confirmed that it is feasible to rapidly update seismic cutline maps based on multi-resolution images.

Abstract number 522

Abstract title model-based approach to examining the reduction of noise in NDVI time series.

Author list Jennifer Hird , Foothills Facility for Remote Sensing and GIScience, Department of Geography, University of Calgary

Greg McDermid, Foothills Facility for Remote Sensing and GIScience, Department of Geography, University of Calgary

Abstract The limiting nature of persistent and prevalent noise in multi-temporal Normalized Difference Vegetation Index (NDVI) data sets is a well-recognized concern in the remote sensing of vegetation phenology. A wide variety of noise-reduction algorithms, many principally focused at the level of per-pixel time series, have been proposed, but few quantitative comparisons of these have been undertaken. A model-based quantitative evaluation that compares several of these NDVI time series noise reduction approaches is presented. By using actual NDVI data to simulate ideal time series with known levels of introduced noise and analyzing the ability of these methods to return time series to their original condition, this work offers a new and more detailed look into the performance these methods, and the various factors that can influence that performance. The analysis revealed the generally superiority of two function-fitting techniques when evaluated against several filtering methods, and the strong influence of noise level, strength and bias, and NDVI time series-based phenological variables such as start of spring green-up, on technique performance. This work underlines the advantages of employing a model-based approach to evaluating and understanding noise reduction for multi-temporal NDVI data sets in the remote sensing of vegetation phenology.

Abstract number 523

Abstract title The remote sensing of vegetation phenology: questioning the benefits of noise reduction.

Author list Jennifer Hird , Foothills Facility for Remote Sensing and GIScience, Department of Geography, University of Calgary

Greg McDermid, Foothills Facility for Remote Sensing and GIScience, Department of Geography, University of Calgary

Abstract The prevalent and limiting effects of noise on the application of NDVI time series in the remote sensing of vegetation phenology, is well-recognized. A variety of approaches to minimizing such noise are employed by researchers, but rarely are the benefits of such techniques for the study of vegetation growth and development ever questioned. Here a two-part analysis examining when and where the application of per-pixel NDVI time series noise-reduction algorithms is advantageous or disadvantageous is presented. This evaluation involved both a Root Mean Square Error analysis, and a study of the effects of noise reduction on the extraction of phenologically-based NDVI time series metrics (e.g. start of growing season) over a variety of conditions. Results showed that while unwanted high-frequency variations in time series were minimized by the application of the algorithms tested, their application also tended to distort the original signal in such a way that phenological variables subsequently derived from these time series, were notably less accurate. Particular conditions, such as the level of noise or the phenological metric one chooses to extract, were shown to influence these trends. In questioning the application of noise-reduction algorithms to NDVI time series, this analysis offers new insights into the complexities involved in employing these data for the remote sensing of vegetation phenology.

Abstract number 524

Abstract title Evaluating Land Cover Classification Accuracy for the Rare Hairy Prairie Clover

Author list Sarah Lowe, University of Saskatchewan

Abstract

Hairy prairie clover (Dalea villosa) has been listed as threatened under Canada's Species at Risk Act, leading to the need for the development of a comprehensive conservation strategy. Employing new techniques of critical habitat conservation to Dalea villosa requires the development of a habitat suitability model which can correctly delineate areas of critical habitat necessary for the plants survival. A metapopulation of Dalea villosa is known to occur within the Dundurn, PFRA community pasture south of Saskatoon, Saskatchewan, Canada. Being a habitat specialist species, confined to areas of active parabolic sand dunes, the plant's spatial occurrence on the landscape is limited to the spatial occurrence of sand dunes on the landscape. Thus, an accurate land cover classification for the study area, specifically sand dune delineation, is necessary as the first step in identifying areas of critical habitat. Land cover for a Panchromatic SPOT5 image with a spatial resolution of 2.5m and a Multispectral SPOT5 image with a spatial resolution of 10m was classified using object-oriented and per-pixel classification methods. The classifications were implemented using eCognition and PCI software. The main objective of this study is to determine which method (object-oriented or per-pixel) coupled with which image (Panchromatic or Multispectral) produces 1)the greatest accuracy in image classification and 2) the greatest accuracy in sand dune identification and delineation. Preliminary results reveal an average accuracy of 88% for per-pixel classification methods and an average accuracy of 99% for per-pixel delineation of sand dunes.

Abstract number 525

Abstract title Katrina's Oil Spill Hazard Evaluation and Analysis Using SAR Image Processing

Author list Hamid Assilzadeh (1), Jason K. Levy (2), Yang Gao (1)
1 - University of Calgary
2 - Virginia Commonwealth University

Abstract Oil spills in the ocean are one of the major environmental concerns, especially in coastal area. Hurricanes are one of the most important sources of oil spills in the north of the Gulf of Mexico. Major oil spill causes due to damage in onshore oil refineries and storage facilities, oil rigs and transportation platforms, as well as pipeline structures at this region. It is very difficult to evaluate oil spill area after hurricanes accidents. These difficulties are due washing the majority of oil spillage by seawater and immediate dispersion and emulsification of oil in water. These effects make application of SAR image for evaluating oil spill area at hurricanes time more important than other sensors like optical and infrared. This research evaluates the oil spill associated with Hurricane Katrina covering a large area of the northern Gulf of Mexico in the wake of Hurricane Katrina back in 2005 using SAR data. Variety of SAR image modeling and processing technique including texture analysis, mathematical operations, and unsupervised classification, have been used to extract the oil spill extents and evaluate their various thicknesses. Major damaged on platforms and oil structures through the hurricanes are rectified and delineated.

Abstract number 526

Abstract title Effects of classification approaches on CRHM model performance

Author list Xulin Guo (1), Xing Fang (1), Lyle Boychuk (2), Adam Minke (1), Cherie Westbrook (1), and John Pomeroy (1)
1 - University of Saskatchewan
2 - Ducks Unlimited Canada

Abstract Cold Regions Hydrological Model Platform (CRHM), a physically based hydrological model using a modular and object-oriented structure, has been applied to simulating redistribution of snow by wind, snowmelt, infiltration, evapotranspiration, soil moisture balance, surface depression storage, and runoff routing. Land use land cover classification is a pre-processing procedure to provide required parameters for CRHM. Per-pixel based and object-oriented classifications are two major classification approaches currently in practice. The objective of this study is to evaluate if the more complex objective oriented classification method can significant improve the performance of CRHM model in a prairie landscape. The study was conducted in Smith Creek watershed in the eastern Saskatchewan. SPOT multispectral imagery was used to classify the area into seven classes: cropland, fallow, grassland, wetland, water, woodland, and town/road. Both pixel based maximum likelihood supervise classification method and nearest neighbour object-oriented classification approaches were applied to the satellite image for the study area. Parameters derived from both classification methods were inputted into CRHM. Results indicated that object-oriented method can significantly improve the performance of CRHM on simulating water balance in the prairie environment.

Abstract number 527

Abstract title Enhanced Methodology for Oil Spill Contingency Systems

Author list Hamid Assilzadeh, University of Calgary; Yang Gao, University of Calgary; Jason K. Levy, Virginia Commonwealth University;

Abstract

A new structure for oil spill emergency response is designed to cover deficiencies in current oil spill management systems. The system can act in response to any feature of oil spill accidents including pipeline, ships or other transportation based accidents in sea and land locations as well as other failures in production or transportation process. The core development is based on application of Remote Sensing, Event Driven based GIS and communication technologies. Remote sensing from various sources of electromagnetic bands can be used as oil spill early warning and monitoring system. The first product from the emergency response system comes through image processing or oil spill reports from other early warning systems. Oil spill disaster location map generates from integrating oil spill locations data and other information in GIS environment. Various models were developed to produce additional products including oil spill trajectory, oil spill risk, oil spill affected area and oil spill emergency response maps from the oil spill locations. The event driven GIS facilitates mutual communications between various clients including disaster managers and administrators as well as disaster players and emergency responders on the ground. Communications include real time distribution of disaster maps, GIS data as well as associated commands from oil spill accident management board to disaster players. Communication is also including relevant data required for disaster modeling and detection such as remotely sensed data, ocean and atmospheric data or reports from disaster players. The system acts as a single umbrella of control and administration for oil spill accidents and enhances oil spill accident management, early warning and alert mechanisms.

Abstract number 528

Abstract title Quantify the effects of litter on the performance of spectral indices in mixed grassland

Author list Xiaohui Yang and Xulin Guo, Universtiy of Saskatchewan

Abstract

Litter (falling and standing materials) is a major component in grassland, which contributes to the overall spectral responses of a canopy. Thus litter influences the performance of spectral indices to detect the soil and green vegetation and other features. The objectives of this study are 1) to acquire canopy reflectance in different mixed scenes of green vegetation and litter, 2) to derive relationship that shows the spectral indices as a function of the amount of litter, 3) to test whether the variability of litter cover influences the performance of the spectral indices. Ground based canopy reflectance with differing litter and green vegetation mixtures and litter cover were measured in the mixed grassland in Grassland National Parks. Normalized vegetation index (NDVI), the atmospheric adjusted soil adjusted vegetation index (ATSAVI), little adjusted ATSAVI (L-ATSAVI) and cellulose absorption index (CAI) were selected to evaluate spectral indices performances with respected to litter. Through comparing the performances of the four vegetation indices to variation of litter cover, the results indicate that curvilinear relationships were found between vegetation indices and litter level, which implied that the performances of vegetation indices were inhibited by litter both at low and high level. L-ATSAVI showed higher resistance to litter impacts among four vegetation indices. The CAI was most sensitive to litter, shown a promising relationship with litter, and 61% variation was explained by litter, which could be used to quantify litter qualitatively.

Abstract number 529

Abstract title Suitable Vegetation Indices on Monitoring Temporal Variation of Leaf Area Index in Mixed Grassland

Author list Zhaoqin Li and Xulin Guo, University of Saskatchewan

Abstract

Relationship between Leaf Area Index (LAI) and Vegetation Indices (VIs) is the most commonly-used and efficient way to estimate LAI which is an important input in models describing energy, momentum exchange between ground and surface. Most of these models are sensitive to the temporal variation of LAI. However, it is difficult to monitor the temporal variation accurately because of the variable performance of VIs during the entire growing season. The objective of this study is to identify suitable VIs which can better describe the temporal variation of LAI in mixed grassland. Hyperspectral and LAI data used in this study were biweekly collected by ASD spectroradiometer and LAI-2000 from June to September, 2008 in St. Denis National Wildlife Reserve, Saskatchewan. The VIs selected for research can be grouped into five categories: 1) ratio-based VIs (NDVI, RDVI,MSR,PM, and SAVI), 2) soil-line-related VIs (MSAVI, TSAVI, ATSAVI, and SARVI), 3) chlorophyll-corrected VIs (TVI, MCARI, MCARI1, MTVI1, MCARI2, and MTVI2), 4) soil-line-litter-corrected VI (L-ATSAVI), and 5) chlorophyll-independent VIs (SLAIDI and SLAIDI_A). The linear regression was performed to test performance of different categories of VIs. The results showed ratio-based VIs, L-ATSAVI, and chlorophyll-independent VIs were more suitable to monitor temporal variation of LAI than soil-line-related and chlorophyll-corrected VIs. NDVI always showed moderate or good performance, and both SLAIDI and SLAIDI_A had a better performance in the entire growing season. In addition, L-ATSAVI had a better performance in starting and ending growing season than in peak growing season.

Abstract number 532

Abstract title Using new earth observation products for a nationwide assessment of ecosystem status and trends

Author list Frank Ahern, TerreVista Earth Imaging; Risa Smith, Environment Canada

Abstract

Canada is currently undertaking the development of an Ecosystem Status and Trends Report (ESTR), as a contribution to assessing progress towards the United Nations 2010 Biodiversity Target and the Canadian Biodiversity Strategy. ESTR represents a major effort by federal, provincial, and territorial scientists and resource managers, under the auspices of the Canadian Councils of Resource Ministers. Environment Canada and the Nova Scotia Department of Natural Resources are the co-lead agencies for this work.

In 2008 Environment Canada contracted TerreVista Earth Imaging to select, assemble, and document earth observation products to provide ESTR participants with the broad spatial and temporal perspective made possible through earth observations from space.

In response, TerreVista Earth Imaging has provided Environment Canada with a large number of national and regional products, together with documentation and a preliminary assessment of the implications for the status and trends of Canada's ecosystems. At the national level, these products include land cover maps and land cover change analysis, maps of burn scars, an analysis of NDVI trends, maps of snowmelt dates, forest fragmentation, and a new Dynamic Habitat Index. The national products have been developed by research teams at the Canada Centre for Remote Sensing and the Canadian Forest Service. Regional products include maps of urbanization for the Golden Horseshoe of Ontario and the Lower Fraser Valley of British Columbia, land cover change in southeastern Alberta and southwestern Saskatchewan, and changes in land and water cover in the Peace Athabasca Delta. These were produced by TerreVista Earth Imaging using Canadian Landsat data acquired from a number of sources.

These products are now being used by ESTR researchers in conjunction with their own datasets.

We will briefly present the most significant of the products produced for ESTR and some preliminary conclusions they are helping to support an assessment of the Canada's ecosystems. We will conclude with a look to the future: what activities by remote sensing resarchers can have the greatest impact in monitoring the status of Canada's ecosystems.

Abstract number 533

Abstract title Spectral interpretation of plankton blooms and floating vegetation in global waters

Author list Stephanie King, Institute of Ocean Sciences
Jim Gower, Institute of Ocean Sciences

Abstract The MERIS imager on the European satellite Envisat has a unique spectral configuration enabling a new perspective of the marine environment. We have used the band at 709 nm in a wide range of applications including the detection of intense surface plankton blooms, pelagic Sargassum and super-blooms in Antarctic ice. This paper explores the spectral characteristics, spatial patterns and temporal distribution of plankton blooms and floating vegetation.

Abstract number 534

Abstract title Spectroscopic Study Of Deuterated Fluoroform In The Context Of Atmospheric Greenhouse Gas Monitoring

Author list

Petr Pracna (1), Adina Ceausu-Velcescu (2), Adriana Predoi-Cross (3), and Brant Billinghurst (4),
1 - J. Heyrovsky Institute of Physical Chemistry, v.v.i., Academy of Sciences of the Czech Republic
2 - Université de Perpignan, Laboratoire de Mathématiques, Physique et Systèmes,3 - Canadian Light Source.
3 - University of Lethbridge, Department of Physics and Astronomy,
4 - Canadian Light Source Inc.,

Abstract

HCF3 (fluoroform, HFC-23) has found recent industrial use as a replacement for chlorofluorocarbons, as it does not have any ozone-depletion potential. This gas may nevertheless play an important role in the greenhouse effect, with its global warming potential having been estimated to be twelve times greater than that of CO2. For the monitoring of HCF3 in the atmosphere, a full rovibrational analysis of its infrared spectrum is of crucial importance, because it makes the analysis of atmospheric spectra easier and more accurate.

The deuterated fluoroform (DCF3) is an interesting isotopologue of fluoroform, because it has many submillimeter-wave emissions when pumped by a CO2 laser. The CO2 laser multiple-photon dissociation of fluoroform has also been studied, and it has been shown that this dissociation is isotopically selective, being an almost ideal tool for deuterium separation. This systematic study of the DCF3 molecule by high-resolution infrared and submillimeter wave spectroscopy provides the necessary information, supplementary to that from HCF3, for accurate determination of the anharmonic potential function and the equilibrium structure of fluoroform.

The high-resolution infrared spectrum of deuterated fluoroform (DCF3) was studied in the n3 region near 700 cm-1 and in the v4 region near 1200 cm-1, in order to perform the rovibrational analysis of the v4=1 CF3 asymmetric stretching vibration. The very high-resolution spectra were recorded at the far-infrared beamline at the Canadian Light Source.

Abstract number 535

Abstract title Spectroscopic Study of the 11102-10002 Band of Pure Carbon Dioxide for Atmospheric Remote Sensing

Author list A. Predoi-Cross (1), Amr Ibrahim (1), V. Malathy Devi (2), D. Chris Benner (2), Brant Billinghurst (3), Phil Teillet (1)
1 - Department of Physics and Astronomy, University of Lethbridge,
2 - Department of Physics, The College of William and Mary,
3 - Canadian Light Source.

Abstract

Instruments on board of the AURA, AQUA and IASI satellites are using the observed radiances in infrared spectral regions where emission from atmospheric carbon dioxide predominates to retrieve the atmospheric temperature profiles. Carbon dioxide has a strong absorption in the atmospheric microwindow located at about 15 microns and hence this range is a good candidate for retrievals of atmospheric temperature profiles.

In this study we undertake a systematic and careful laboratory analysis of the 11102-10002 band of carbon dioxide to successfully apply the retrieved spectroscopic line parameters to atmospheric remote sensing measurements. The ultimate questions for which we wish to seek answers through this study are: “What is it that we are missing in the spectral characterization of carbon dioxide to be able to fully and accurately characterize the atmospheric spectrum and what is the right physics for CO2?” The problems may be caused by inadequate molecular line shapes and therefore we carefully examine the appropriate line shape profiles and line mixing effects.

Thirty two room temperature carbon dioxide spectra recorded at the Canadian Light Source using the Bruker IFS 125 spectrometer and a path length of 72 m were analyzed using a constrained multispectrum nonlinear least square curve fitting program. The line shape parameters for transitions of this weak band will be reported. We constrained the multispectrum nonlinear least squares retrieval technique to use quantum mechanical expressions for the rovibrational energies and intensities rather than retrieving the individual positions and intensities line by line.

Abstract number 536

Abstract title Lineshape Study of Carbon Dioxide Transitions for Tropospheric Remote Sensing Applications

Author list

A. Predoi-Cross (1), A.R.W. McKellar (2), A. Liu (1), C. Povey (1), D. Hurtmans (3),
1 - Department of Physics and Astronomy, University of Lethbridge,
2 - Steacie Institute for Molecular Sciences, National Research Council of Canada
3 - Service de Chimie Quantique et Photophysique, Université Libre de Bruxelles,

Abstract

Spectroscopic techniques have the potential to increase our understanding of Earth and planetary atmospheres through spectroscopic studies that will enable more accurate modeling of infrared radiative transfer in the Earth atmosphere and other planetary bodies. There is a need in atmospheric research to accurately model absorption profiles over a wide range of pressures and temperatures. Using a correct understanding of the physics of spectral formation, data may be reliably extrapolated from the laboratory case to the atmosphere. In practice, a full understanding of the physics is hard to obtain, particularly when the numbers of parameters are considered.

The spectral parameters reported here (pertaining to pure CO2) are relevant for the future remote sensing studies of Mars and Venus whose atmospheres are almost entirely CO2 gas. This application will require accurate knowledge of spectral lineshape parameters in a wide range of pressures and temperatures.

In this study, transitions of carbon dioxide in two near-infrared vibrational bands were recorded at temperatures between 215 K and 296 K using a Fourier transform spectrometer located National Research Council of Canada. These data were analyzed using a multispectrum fit technique applying a speed dependent line shape model with line mixing. Pressure broadening coefficients, pressure shifts, their temperature dependences, line mixing and speed dependence are all retrieved simultaneously in the same solution. The results obtained are compared with other studies available in the literature.

Abstract number 537

Abstract title Spectroscopy of Methane at 7.6 ìm in Support of NASA's Upper Atmosphere Research Program

Author list M. A. H. Smith (1), V. Malathy Devi (2), D. Chris Benner (2), and A. Predoi-Cross (3),
1 - Science Directorate, NASA Langley Research Center,
2 - Department of Physics, The College of William and Mary
3 - Department of Physics and Astronomy, University of Lethbridge

Abstract Self- and air-broadening, pressure-induced shifts, and line mixing have been studied in infrared spectra of methane in the 6-9 ìm region. The laboratory absorption spectra used in this study were recorded at high resolution at the National Solar Observatory. Sample temperatures ranged from 210 to 314 K, and broadening gas pressures were between 0.06 and 0.72 atm. The line broadening, shift and mixing parameters (off-diagonal relaxation matrix elements) were obtained by using the multispectrum technique [1] to fit selected regions of 20 or more spectra simultaneously. In addition, accurate line center positions and absolute intensities were determined. The temperature dependences of the broadening and shift coefficients were determined for numerous transitions in the í4 and í2 bands of 12CH4. Line mixing was observed in the Q branches and in the J-manifolds of the P and R branches of the í4 bands of 12CH4 [2, 3] and 13CH4 [4]. Line mixing parameters were also determined for 11 pairs of transitions in the weak í2 band of 12CH4 [5]. The parameters from the present work are compared with the results of other recent studies, as well as with the HITRAN database.

[1] D. Chris Benner et al., JQSRT 53, 705-721 (1995).
[2] M. A. H. Smith et al., JQSRT, in press (2009).
[3] M. A. H. Smith et al., Manuscript submitted to JQSRT (2009).
[4] M. A. H. Smith et al., Manuscript to be submitted to JQSRT (2009).
[5] M. A. H. Smith et al., Manuscript to be submitted to JQSRT (2009).

Abstract number 538

Abstract title Estimating Prairie Wetland Water Storage Using a LiDAR DEM

Author list Adam Minke (1), Cherie Westbrook (1), Xulin Guo (2),
1 - Centre for Hydrology, University of Saskatchewan
2 - Department of Geography and Planning, University of Saskatchewan

Abstract The Prairie Pothole Region (PPR) of North America contains millions of shallow depressions which store surface water. Hydrologic models for this region inaccurately predict runoff due to an inability to properly characterize wetland storage. Regression equations that relate wetland surface area to volume are commonly used to estimate storage at the watershed scale, but accuracy is often poor because depression morphology is not considered. Hayashi and van der Kamp developed a powerful, simple equation that we found accurately estimates wetland storage. However, their method can not be applied to the watershed scale due to the need for very detailed ground elevation and water level data. Our objective was to determine if the Hayashi and van der Kamp equation can accurately estimate wetland storage at the watershed scale using LiDAR Digital Elevation Model (DEM) derived wetland characteristics. Preliminarily tests have been conducted on 6 wetlands in the St. Denis National Wildlife Area, Saskatchewan. GIS tools were used to fill wetland depressions in the LiDAR DEM to the spill elevation. This provided multiple surface area measurements at 0.25-1 m depth intervals and allowed for the necessary Hayashi and van der Kamp coefficients to be derived. Volume estimation errors were mostly <10%. Results from several other wetlands in the PPR will be discussed, and a potential automated method to estimate wetland storage will be presented. This works is expected to improve current hydrology models that predict runoff in watersheds dominated by wetland storage.

Abstract number 540

Abstract title Impact of sampling intensity and failed acquisition of GPS locations on home range estimations

Author list A. Sobol (1), J. Linke (1), G.J. McDermid (1), J. Boulanger (2), G. Stenhouse (3),
1 - Foothills Facility for Remote Sensing and GIScience, Department of Geography, University of Calgary 2 - Integrated Ecological Research
3 - Foothills Research Institute and Alberta Fish and Wildlife Division

Abstract Home range delineation is an essential tool in wildlife research and conservation, serving to infer the spatial extent and the associated habitat characteristics of an animal's movement over a given course of time. However, the minimum number of global positioning system (GPS) locations required to obtain adequate delineation is unknown, and remains an active research issue. We presently lack guidelines surrounding the selection of home range estimators, the influence of sampling intensity, animal behaviour, missing locations, and other related factors. In this study, we investigate the effects of sample size on home range delineations using three different estimators: (i) 99.999% fixed kernel, (ii) k-local convex hull (k-LoCoH) and (iii) minimum convex polygon (MCP). The variability in sample size was achieved by subsetting a complete (nearly perfect acquisitions every 20 minutes) data set from two grizzly bears (Ursus arctos) in two manners: (i) systematically, to obtain different sampling intensities (i.e. timing between two observations), and (ii) randomly within sampling intensity categories, to mimic dropped satellite signals due to terrain and habitat cover interactions. Our preliminary findings show that sample size effects are not constant between home range estimators: the estimated extent of fixed kernel and MCP home ranges tend to be more sensitive to sampling intensity and failed GPS acquisition than k-LoCoH. The search for the minimum required number of locations may be better guided by a combination of both the sampling intensity and the range of failed GPS acquisition rates when estimating home ranges.

Keywords: grizzly bear, home range, missing locations, sample size, sampling intensity

Abstract number 541

Abstract title Teaching RADARSAT across disciplines

Author list Elizabeth L. Simms, Memorial University

Abstract

Contribution of remote sensing to multidisciplinary work relies on the understanding participants have of the information the data convey. Therefore, to communicate the potential remote sensing images have as a cognate discipline is useful to its integration as a source of data to operational applications. A website based instructional package was developed for use by students and by instructors for whom remote sensing is a cognate discipline.

Images sets of five Central and Eastern Canada locations illustrate interpretation examples of land cover types. The website has the ability to show information from different spectral bands and spatial resolutions of a geographical area. The images interpreted were recorded quasi-simultaneously by the RADARSAT-1 and Landsat-7 satellite systems and near anniversary date by the RADARSAT-2; therefore providing useful comparative documentation for the understanding of the information recorded from different spectral bands. Access to interpretation rubrics are set at regional and local spatial scales through image links. Thematic content is accessible from all image locations and conversely, all locations can be accessed back-and-forth to see examples of a feature in a different geographical context. Further development of the website focuses on the incorporation of single and multi-polarimetric RADARSAT-2 images and the presentation of image analysis alternatives.

The Canadian Space Agency Data for Research Use and RADARSAT-2 Science and Operational Applications Research programs, and the Geogratis portal provided images for this project. The Memorial University Instructional Development Grant program funded the website development.

Abstract number 542

Abstract title An Interactive Atmospheric Radiative Transfer Model Application

Author list Ian Chapman (1), Peter Davis-Imhof (2), David Naylor (3), Brad Gom (3)
1 - Defence Research and Development Canada Centre for Operational Research and Analysis (DRDC CORA)
2 - Blue Sky Spectroscopy Inc
3 - Department of Physics and Astronomy, University of Lethbridge

Abstract The Blue Sky Transmission and Radiance Atmospheric Model (BTRAM) was developed in an effort to create a radiative transfer model that takes advantage of modern array processing methods and is fully customizable by the user. A number of earlier radiative transfer models, such as FASCODE and MODTRAN, offer powerful simulation capabilities but have interfaces that make it difficult to tailor the model to the specific needs of a user. BTRAM, developed in the Interactive Data Language (IDL®), provides users with a straightforward interface that allows the efficient calculation of radiative transfer through custom atmospheric profiles or gas cells, from submillimetre to visible wavelengths, all at variable resolution. BTRAM also allows the user to convolve simulated spectra with custom instrumental line shapes, providing users with a better simulation of instrumental performance.

This paper discusses the radiative transfer calculations used in the BTRAM code and presents a comparison of the model results with FASCODE. Applications of BTRAM simulated spectra in high-resolution, near-infrared, astronomical echelle spectroscopy and mid-infrared atmospheric radiometry are also discussed.

Abstract number 543

Abstract title Advanced research initiatives using the Mackenzie Delta Air Photo Project spatial data

Author list
Marcella Snijders
Indian & Northern Affairs Canada.

Abstract
The Mackenzie Delta Air Photo Project is a multi-year mapping project (2003-2008) involving four federal departments (INAC, NRCAN, DFO,EC) and Centre for Geomatics and Municipal and Community Affairs of the Government of NWT as partners. This INAC–NT led project has a goal to provide sufficiently detailed mapping products to adequately meet the mapping needs of regulators for issuing permits and licences, to enable assessment of environmental impacts of industry development in the Delta and Mackenzie pipeline corridor area. The Mackenzie Delta Air Photo Project data acts as baseline mapping tool to monitor change due to climate fluctuations. The data is available free of charge in a compressed format from the Centre for Geomatics webpage download site.
The presented Poster will outline some science research topics employing this data.
The Mackenzie Delta Air Photo Project data has a general research purpose as framework data, useful for planning field work and logistics – e.g. Bird Surveys.
Four studies or initiatives are highlighted in the poster. These studies employ the high resolution geo-rectified orthophotos for terrain, vegetation or permafrost analysis. In addition, there is an example of Digital Elevation Model tiles (DEM) used to examine in geomorphological studies to remote survey for presence of methane Gas.
The number of research initiatives using the Mackenzie Delta Air Photo Project spatial data can only increase and its use become more integrated as the Mackenzie River watershed region is increasingly affected by physical and climate change.

Abstract number 544

Abstract title An Architecture of Integrating GIS/RS/GPS in Urban Fire Response System

Author list Zhinong Zhong and Yang Gao, University of Calgary

Abstract

Urban fire response system plays an important role in urban fire fighting. With the development of GIS/RS/GPS, the technologies of integrating GIS/RS/GPS, which extend the capabilities of traditional fire management activities, are used widely in modern urban fire response system. By the technologies, the accurate real-time positioning information of fire fighting units provided by the GPS, the high-precision images of fire areas provided by the RS, and the powerful functions of spatial display, spatial operation and spatial analysis provided by GIS, are integrated to provide a reliable technological support for fire response. Based on an analysis of current urban fire response systems, we propose an architecture of integrating GIS/RS/GPS in urban fire response system. The architecture presents how GIS, RS and GPS are cooperative to support fire alarming receiving and dispatching, fire fighting planning, fire fighting real-time monitor and decision support. The paper also discusses the spatial data organization, system functions and user interface of an actual fire response system, which adopt the architecture.

Abstract number 545

Abstract title

Architecture
of an Intelligent System for Remote Sensing Image Processing and Classification

Author list

Mohammad Mostafa Kamal, Department of Geography, University of Saskatchewan,

Abstract

The recent development in the remote sensing industry has opened up a huge potential for diverse applications, which contributed to the rapidly increasing user community in developed and developing countries; the frequency and the volume of Image Processing and Classification work increased simultaneously.
However, the number of expert in the area did not increase in the same pace. Therefore, not only the advanced methods are required for diverse and complex image processing and classification works, an intelligent system is required, which incorporates advanced methods and reduces the expert dependency. In this context, this paper presents an architecture for an intelligent image processing and classification system that has been designed and implemented a small-scale prototype to evaluate its viability using a set of real data. The prototype is a federation of experimented advance methods, experts' knowledge, metadata, expert system shell, and GIS and Remote Sensing software, to classify multitemporal RADARSAT data for wet season land use and land cover mapping. The system is designed to run automatically, where the user merely provides the initial information regarding the intended task and the source of available data. The system itself acquires necessary information about the data from metadata files in order to make decisions and perform tasks. The test and evaluation of the prototype demonstrates the viability of the proposed architecture and the possibility of extending the system to perform other image processing tasks and to use different sources of data.

Abstract number 546

Abstract title Far-Infrared Imaging Fourier Transform Spectroscopy

Author list Locke D. Spencer and David A. Naylor, University of Lethbridge, Department of Physics and Astronomy.

Abstract

The Fourier transform spectrometer (FTS), with its high throughput, broad spectral coverage, variable resolution, intrinsic calibration, and simplistic design has proven to be the spectrometer of choice in many demanding spectroscopic applications. The rapid development of imaging detector arrays has also continued at longer wavelengths, beyond the limit of human vision. By combining an infrared imaging detector array with a Fourier transform spectrometer it is now possible to obtain, simultaneously, a spectrum from each point in a scene corresponding to an individual pixel in the array. An imaging spectrometer therefore provides both morphological and spectral information about a scene. This work discusses the performance characterization and spectroscopic capabilities of the spectral and photometric imaging receiver (SPIRE) imaging Fourier transform spectrometer on board the European Space Agency's Herschel space observatory. There are many parallels between the application of hyper-spectral imaging from a space based observatory in the far-infrared region of the electromagnetic spectrum and far-infrared hyper-spectral imaging in atmospheric monitoring and remote sensing. This work discusses the advantages and challenges of performing hyper-spectral imaging using FTS instrumentation.

Abstract number 547

Abstract title Architecture of an Intelligent System for Remote Sensing Image Processing and Classification

Author list Mohammad Mostafa Kamal
Department of Geography, University of Saskatchewan,

Abstract The recent development in the remote sensing industry has opened up a huge potential for diverse applications, which contributed to the rapidly increasing user community in developed and developing countries; the frequency and the volume of Image Processing and Classification work increased simultaneously. However, the number of expert in the area did not increase in the same pace. Therefore□□C not only the advanced methods are required for diverse and complex image processing and classification works, an intelligent system is required, which incorporates advanced methods and reduces the expert dependency.

Abstract number 549

Abstract title Improving the canopy model inversion using a weighting function

Author list K. Frank Zhang, Baoxin Hu, Jian-guo Wang, York University
Anne Smith: Agriculture and Agri-Food Canada

Abstract

Abstract: Biophysical parameters, such as leaf area index (LAI) and leaf chlorophyll content play a very important role in precision agriculture management, forest ecology monitoring and global climate change. Accurate and robust retrieval of these parameters from remote sensing data remains a challenge. How to weight all of the available information is the common issue of the existing inversion methods. This issue is especially significant with the development of multi-angular and Hyper-spectral sensors, such as Compact High Resolution Image Spectrometer (CHRIS). Without proper approaches to deal with the high redundancy of multi-angular Hyper-spectral data, important characteristics of a vegetation cover may be lost or submerged by other insignificant information or noise, which co-exist in the data, and thus inversion accuracy may be even deteriorated. In this study, a weighting function was developed to improve the iterative optimization inversion method. For any given vegetation biophysical parameter to be retrieved, the data more sensitive to this parameter are given higher weights. To construct such a weighting function, the variance based sensitivity analysis, which is widely used in geodetic surveying, was used. The contribution of each observation to the parameter was calculated using multi-variable Mahalanobis distances. The modified iterative optimization inversion method using proposed weighting function was validated by inverting a coupled PROSPECT and SAILH model for retrieval of LAI and leaf chlorophyll content of vegetation canopies from CHRIS data over Southern Alberta area obtained in summer 2004. The preliminary results were compared with non-weighted inversion and popular Marquardt-Levernberg method and validated against the ground truth data, which had shown a clear improvement in both RMSE and R^2.

Abstract number 550

Abstract title Object-Oriented Urban Tree Cover Extraction from High-Resolution Colour-Infrared Aerial Imagery

Author list Brad Lehrbass (1), Jinfei Wang (1), Ian Smyth (2), John Bontje (3),
1 - Department of Geography, University of Western Ontario
2 - Ontario Ministry of Natural Resources
3 - GIS and Information Systems, City of London, London, Ontario, Canada

Abstract

A healthy urban forest will keep the air and buildings cool in the summer, absorb CO2 and other pollutants, reduce rainfall runoff and prevent erosion. To manage its forest effectively, a city should maintain accurate forestry spatial data; this is often gathered using expensive, lengthy on-ground tree surveys.

The City of London, Ontario has partnered with the University of Western Ontario and the Ontario Ministry of Natural Resources to determine if a remote-sensing approach is viable for creating an accurate urban tree canopy map. The MNR has had success in classifying rural forests by processing high-resolution aerial colour-infrared imagery using an object-oriented classification method which can be more effective than the traditional pixel-based approach for high-resolution imagery. However, to map urban tree canopy presents a difficult challenge because of the complex urban landscape. Previous attempts using per-pixel classification methods were not successful.

This paper presents an effective object-oriented segmentation and classification method for urban tree cover extraction from high-resolution colour-infrared aerial imagery. First, the image is segmented into image-objects based on similarity in NDVI. Vegetation is identified by an NDVI threshold and merged together. These super-objects are then segmented again based on similarity in NIR, red and green spectral bands. Training samples are selected manually and a nearest-neighbour classification is performed based on spectral, spatial and textural properties of the objects. Finally, object-based rules are applied to improve classification accuracy. Initial results on a 2km by 2km downtown image are promising; the tree cover was determined to be 15.8% with 91.8% overall accuracy.

Abstract number 552

Abstract title Hyperspectral Remote Sensing Algorithms for Retrieving Forest Chlorophyll Content

Author list Yongqin Lisa Zhang, University of Toronto

Abstract

Quantitative estimates of forest chlorophyll content from hyperspectral remote sensing are of great use for terrestrial carbon cycle modeling and sustainable forest management. Open forest canopies present a big challenge for the separation of the effects from canopy structure and leaf optical properties, and thus the retrieval of biochemical parameters. Process-based algorithms were developed to estimate the chlorophyll content of broadleaves and needleleaves from hyperspectral measurements.

Field experiments were conducted from 2003 to 2004 near Sudbury and Haliburton, Ontario, to collect canopy structural, leaf biophysical and biochemical data. Experiments show that optical properties and biochemical contents of broadleaves change with the growing season and canopy height. Needleleaves from different sites, age classes, and branch orientations demonstrate different visible optical properties in relation to their chlorophyll contents. A process-based radiative transfer model PROSPECT was modified to retrieve leaf chlorophyll content from measured leaf spectra. For broadleaves, leaf thickness was introduced to consider the seasonal and canopy-gradient variation in light absorption. The accuracy of chlorophyll retrieval is increased from 67% to 91%. For needleleaves, the effects of needleleaf width and thickness, and geometrical effects of leaf-holding devices on spectra measurements were taken into account. These modifications improve the accuracy of chlorophyll retrieval from 31% to 59%.

Correct exposure for digital hemispherical photographs is crucial for estimating canopy structural parameters. A photographic exposure theory was tested for different forest types with various canopy closures and under different sky conditions. The new exposure method improves the estimates of leaf area index by 40% in comparison with commonly used automatic exposure.

The effects of canopy structure on optical remote sensing signals were investigated using the geometrical-optical model 4-Scale. A look-up-table approach was developed to provide the probabilities of viewing sunlit foliage and background components, and a spectral multiple scattering factor as functions of LAI, and solar and view zenith angle. Leaf reflectance spectra and chlorophyll content were quantitatively retrieved from the hyperspectral Compact Airborne Spectrographic Imager (CASI) images with a root mean square error of 4.34 ìg/cm2 for needleleaf species. LAI was retrieved and chlorophyll content was mapped using CASI imagery.

Key Words: Hyperspectral Remote Sensing, Algorithm, Forest Chlorophyll Content

Abstract number 553

Abstract title Measurement of snow water equivalent and depth using differential interferometric synthetic aperture radar

Author list Ali Esmaeily G.(1) Hardy B. Granberg (1), Q. Hugh J. Gwyn (2),
1 - Université de Sherbrooke
2 - Infotierra CO.

Abstract At temperatures below freezing ice and snow are transparent to electromagnetic radiation at C-band radar wavelengths. Wet snow is not. Snow therefore distorts digital elevation models (DEM) generated using cross-track interferometric synthetic aperture radar (InSAR). Ice has a dielectric constant of 3.2 which places a dry-snow covered DEM below that of a snow free DEM surface. Theoretically the displacement is linearly proportional to the snowpack water equivalent. In contrast, wet snow places the DEM surface at the level of the snow surface. The elevation distortions have a measurable impact on the precision when using differential InSAR. Accordingly, with appropriate atmospheric corrections, repeat-pass cross-track InSAR offers a means for measuring, sometimes the depth, sometimes the water equivalent and, under some circumstances, the bulk density of the snow cover, all at very high spatial resolutions. In an attempt to obtain proof-of-concept, we employed airborne cross-track InSAR DEM's that were generated as part of the CLPX experiment. Using roads and wind-swept ridge crests as common references, we found signals related to snow water content and snow depth in dry and wet conditions respectively. However, more precise ground truth data are necessary to assess the precision of the results.

Abstract number 554

Abstract title Land use land cover change detection through fragmentation analysis

Author list Kristi Fedec and Xulin Guo, University of Saskatchewan.

Abstract

Efforts have been made to protect native grassland areas throughout the world, as these areas have become endangered habitats due to climate change and human disturbance, especially overgrazing. Grasslands National Park plays a major role in promoting habitat restoration and species preservation and reintroduction in Canada. While the area within the park boundaries has maintained some consistency in grassland habitat, the surrounding use of land does not allow for the same protection. In order to determine the amount of fragmentation that has occurred in and around the park, a study was conducted to detect the change of landscape over the park and surrounding area. A segmentation approach was utilized to capture the fragmented and scattered pattern of change, comparing imagery between 1984 and 2008. Preliminary results indicate that Grasslands National Park is functioning in both positive and negative ways regarding grassland conservation and heterogeneity. The conservation prevented fragmentation dramatically, but at the same time, the grassland community is tending to be more homogeneous due to the lack of grazing. The recent bison grazing and cattle grazing experiments propose to enhance the grassland integrity. Remote sensing has become a promising tool for monitoring the grassland dynamics successfully.

Abstract number 555

Abstract title Blanding's Turtle (Emydoidea blandingii) Potential Habitat Mapping in Gatineau Park, Quebec, Using Aerial Orthophotographic Imagery

Author list ebecca Barker and Doug King, Carleton University

Abstract Blanding's Turtle (Emydoidea blandingii) is a threatened species in southern Quebec that is currently being inventoried for abundance and potential habitat by the Quebec Ministry of Natural Resources. In collaboration with that program, spring leaf-off aerial orthographic images of the north-western section of Gatineau Park in Quebec were analyzed to evaluate geospatial and biological attributes associated with known habitat criteria: wetlands with standing water in spring, vegetation mounds for sun basking and protection, and logs on the water surface for spring basking. Image processing involved pixel-based and object-oriented classification of wetlands using texture measures and rule-based methods to isolate them from surrounding terrestrial terrain and create a bit mask of water. Object-based rules were then used to segment within–wetland vegetation mounds and logs by integrating contextual information and spatial relations. Objects were classified using fuzzy membership functions. Field data collected in the summer of 2008 were used to validate the classification accuracy. The classification results are integrated with geospatial data to develop a habitat suitability map for Blanding's Turtles that can be employed in conservation planning and management.

Abstract number 556

Abstract title Spectral Line Fitting of an Astronomical Source

Author list Scott Jones, David Naylor, University of Lethbridge
Rene Plume, University of Calgary

Abstract Astronomy is perhaps the most fundamental application of remote sensing, utilizing many of the same data analysis techniques as its terrestrial based counterparts. In particular, hyperspectral line fitting has become commonplace in many fields as a means of gleaning additional information. I will explore this synergy in the context of the fitting that I have done of G34 data from the Spectral Legacy Survey (SLS) project. This work, while mostly exploratory in nature, is toward the eventual goal of simulating observations that will be done by a Fourier Transform Spectrometer (FTS) on board the second incarnation of the Submillimeter Common User Bolometer Array (SCUBA-2) situated atop Mauna Kea in Hawaii. To this end, I have convolved the relevant SLS band with the instrumental line shape of the FTS, namely a sinc function of three representative resolutions. While this will provide a meaningful preview of the expected performance of the FTS for this specific source, it will also afford the opportunity to refine both our line-finding and fitting methods, such as which lineshape to use (and how to handle the wings of the function), the fitting performance given random instrumental noise and the number of iterations required.

Abstract number 557

Abstract title Emergency Management Systems with Event-Driven GIS

Author list Shui Liu and Yang Gao, University of Calgary, Songnian Li, Ryerson University

Abstract

Abstract

The art and science of multi-sensor data fusion has emerged as an underlying foundation for real-time business and predictive business, including applications such as intelligent transportation systems, emergency management systems. Emergency management systems and other complex inference processing solutions require the management of real-time events from distributed sensors, agents, and other processing components, including historical data-at-rest repositories. Distributed event-driven architectures provide the underlying communications infrastructure that enables high performance rule-based event processing services.

With the emergence of event driven architectures, and the event processing within the recent years, the combination of service oriented thinking and event driven thinking has become a natural match. Service oriented architecture deals with the modularization of business process and software, and packaging functionality as services, while the event driven architecture deals with communication of various components / sub-systems in a decoupled, asynchronous manner, and the ability to identify situations that combines multiple events. In this paper we propose an architecture of “sense and respond systems” based on event-driven service-oriented architecture and complex event processing (CEP). The major technologies such as remote sensing and the key components will be described and analyzed. Complex event processing engines, which allow processing and analysis of high volume event streams, uncovering opportunities and threats as they happen, not after the fact, will be introduced. And finally, a system for real-time detection of natural gas and oil spills, as an example of emergency management systems, will be presented to demonstrate how to apply the proposed architecture to support real applications.

Keywords: Service-Oriented Computing (SOC), Event-Driven Architecture (EDA), Enterprise Service Bus (ESB), Complex Event Processing (ECP), Web Services, Sense and Respond Systems, GIS.

Abstract number 558

Abstract title Hydrologic modeling of protected area boundary in Sundance Provincial Park using SAR data

Author list David Aldred (1), Jinfei Wang (1), Harold Zwick (2),
1 - University of Western Ontario
2 - Macdonald Dettwiler & Associates

Abstract Roofs are the prominent features of buildings as seen from above by remote sensors and can be considered surrogates for building footprints that are integral to urban mapping projects. Object-based methods for extracting urban rooftops from high spatial resolution remotely sensed data typically rely on semantic inference of spatial and contextual classification parameters in scenes of regular spatial or material composition. In this study, a supervised statistics-based method of determining discretive parameters for rooftops in urban scenes of irregular composition and applying them in a rule-based procedure is presented. After pre-processing to pan-sharpen Ikonos image test data, the method includes the following steps: (1) image segmentation; (2) supervised object-based classification into broad spectral classes; and (3) spectral, spatial, textural and contextual parameters developed from sample rooftop objects are implemented in a fuzzy logic rule base to separate rooftops from other impervious surfaces. Classification of a test scene results in 93% accuracy of rooftop identification, demonstrating the applicability of the method to the discrimination of spectrally similar but semantically variable classes.

Abstract number 559

Abstract title A Multi-Scale Approach To Extract Savanna Tree Structure Parameters

Author list
Martin Béland and Richard Fournier
Centre for Research and Applications in Remote Sensing (CARTEL)
University of Sherbrooke.

Abstract

Savanna ecosystems account for 20% of the terrestrial surface. They are characterized by the coexistence of trees and grass in highly heterogeneous spatial patterns. They face important anthropogenic pressure, their dynamics are not well understood, and many ecological questions remain, particularly pertaining to the equilibrium between growth forms and the effect of a changing climate and higher atmospheric CO2 on this sensitive environment. Despite its significance, monitoring of savanna trees structure is lacking, partly because of difficulties in using remote sensing techniques in this environment.

Limitations using available remote sensing techniques mainly have to do with the difficulty in discerning between the spectral response of tree leaves and the prominent grass. The objective of the present study is to develop a bottom-up approach to tree structure mapping in savannas using a ground-based lidar, very high resolution imagery, and multiangular imagery.

Two study areas are used, located in Mali and Argentina. Analysis of remotely sensed data will rely on radiative transfer modeling which is supported by field measurements. In this study, the simplified spatial configuration of savanna trees, the use of multiangular imagery and reliable data on field conditions are expected to favor an improved understanding and interpretation of tree structure effects on the BRDF as sampled from satellite imagery. Results of this study are expected to contribute to means of accurately estimating structural parameters at multiple scales, for use as input in ecosystem function models, and as information base for global carbon cycle monitoring and resource management.

Abstract number 564

Abstract title Mapping native grassland change using single-date multispectral satellite imagery

Author list Anne M. Smith 1, G.L. Larson 1, C. Kloppenburg 1,
B. D. Hill 1, R. Carreau 1 and P.M. Teillet 2
1 - Agriculture and Agri-Food Canada 2 - University of Lethbridge

Abstract Quantifiable estimates of the rate and location of native grassland change in western Canada are not readily available due to the expense of collecting the data. Yet such information is critical to understanding the impacts of change on the cattle industry, recreation, tourism and wildlife, greenhouse gas emissions and water resources. This study examines the potential to isolate grassland from annually cultivated agriculture using a single-date multi-spectral satellite image using two test sites in southern Alberta that exhibit variation in land conversion. Landsat and SPOT imagery from July 1999 and 2005 were acquired and ortho-rectified. Extensive training and validation sets of land cover type were created using an independent data source. Four classification algorithms, maximum likelihood, support vector machine, decision tree and neural networks, were tested. The classification of native grassland versus cultivated agriculture was superior with Landsat (Kappa values 0.84-0.92) compared to the SPOT (Kappa vales 0.71-0.78). Qualitatively, areas of misclassification in the coulees, river valleys and saline lowlands were observed in the classified images. The use of segmentation analyses together with a rule-based system involving soil data from AGRASID (Agricultural Region of Alberta Soil Inventory Database) improved the classified product. The results suggest that satellite multi-spectral remote sensing could be used as an alternative source of data for tracking changes in the spatial extent and fragmentation of the native grasslands.

Abstract number 565

Abstract title Spectral Separability of Selected Rangeland Plant Species Common to Southern Alberta

Author list David Rolfson (1,2), Karl Staenz (1,2), Craig Coburn (2), Philippe Teillet (1,2), Anne Smith (3)
1 - Alberta Terrestrial Imaging Center
2 - University of Lethbridge

Abstract

Advances in hyperspectral remote sensing technologies show promise for improving accuracy in plant species classification. However, rangeland areas have proven difficult to classify and monitor using remotely sensed data due to their highly variable vegetation cover. One of the challenges encountered is being able to identify endmembers necessary for spectral unmixing in the extraction of fractional cover.

In 2008, spectral data were collected at one site where three shrub species (silver sage, snowberry, and wild rose) were present, and at two pre-established study areas in which homogeneous plots of specific native rangeland grasses have existed (june grass, needle and thread, blue gramma, western wheatgrass, Idaho fescue, and crested wheatgrass). Spectra of plant samples were extracted from measurements taken from June through November 2008. They were compared statistically in order to establish the degree to which the species studied are separable using spectral characteristics. Some species appear spectrally indistinguishable using current statistical methods. Therefore, a comparison of phenology was also done using the data collected through the summer and fall.

Presentation of results will include graphs illustrating spectra measured and an index table describing degrees of similarity between species including results of a performance comparison of similarity measures, and illustrations describing the result of including a phenology analysis.

Abstract number 568

Abstract title Monitoring Rangeland Community/Health Using Multispectral and Hyperspectral Data.

Author list Nadia Rochdi (1), Peter Eddy (1), Jinkai Zhang (1), Karl Staenz (1), Livio Fent (2), Barry Adams (2), Anne Smith (3).
1 - Alberta Terrestrial Imaging Center
2 - Alberta Sustainable Resources Development
3 - Agriculture and Agri-Food Canada

Abstract This work aims to map rangeland community and health in the province of Alberta, Canada using multi/hyper-spectral remote sensing data. Rangeland mapping is based on percent cover of the following components: trees, shrubs, grasses/herbaceous plants, plant litter, soil and water.
Two field campaigns have been carried out during the summer of 2007 and 2008 to characterize the rangeland components and validate the approach adopted. Simultaneously, multispectral SPOT and hyperspectral casi and CHRIS data were acquired. Field measurements included spectroradiometer measurements for site characterization and percent cover estimates were also conducted using the Daubenmire method. In addition, leaves were sampled and optical properties were measured in laboratory using an integrating sphere.
Remote sensing data were first radiometrically and atmospherically corrected. Rangeland areas were then delineated using SPOT data and the support vector machine classifier. The spectral mixture analysis (SMA) technique was then applied to hyperspectral data to derive fractional cover of the different rangeland components. As no endmembers (pure pixels) were found in the remote sensing imagery, two sets of endmembers were considered. The first one was based on spectral ground measurements acquired over a number of micro-plots with pure landcover and almost no background. The second set was based on canopy reflectance simulations using the Scattered Arbitrarily Inclined Leaves (SAIL) model together with leaf optical properties measured in the laboratory. The SMA results will be discussed with regard to the set of endmembers used and reference data.

Abstract number 569

Abstract title Automatic Surface Reflectance Retrieval from SPOT Data using MODTRAN-based Look-up-table

Author list Jinkai Zhang (1), Karl Staenz (1), Nadia Rochdi (1), Philippe M. Teillet (2)
1 - Alberta Terrestrial Imaging Center
2 - University of Lethbridge

Abstract The retrieval of surface reflectance plays an important role in quantitative information extraction and multi-temporal data analysis. This paper describes an automatic atmospheric correction approach for SPOT data. The approach is fundamentally based on the 6-D look up table (LUT) generated from MODTRAN4, incorporating the information from MODIS aerosol product and SRTM DEM data. The LUT is prebuilt and used to provide atmospheric parameters (e.g. transmittance, direct and diffuse fluxes at the surface, path radiance and the atmospheric spherical albedo) that are required for reflectance retrieval through multidimensional linear interpolation. This approach first chooses an atmospheric model and associated LUT, according to the imaging date and geographical latitude in the metadata. Since SPOT data lacks the blue and short-wave infrared bands typically used in the estimation of aerosol optical depth (AOD), the proposed approach uses the median of the MODIS AOD product over the past 5 years for the imaging date and location. The selection of the aerosol type is based on the global land use/cover MODIS product. The default water vapor value for the specific atmospheric model is used, since the four SPOT bands are outside of major water absorption features. The average elevation is obtained from the global SRTM DEM map and the remaining parameters are extracted from the SPOT metadata. Results obtained from the proposed approach will be presented and compared with the established ATCOR2 technique for both SPOT4 and SPOT5 multispectral data.

Abstract number 571

Abstract title Spectral and Spatial Variability within the Northern Mixed-Grass Prairie

Author list Joseph M. Piwowar. University of Regina

Abstract

The northern Great Plains of North America are second, only to the Arctic, for their sensitivity to climate change in Canada. This study is part of a larger research project that is using remote sensing data to understand the climate impacts on native mixed-grass prairie environments. The primary objective of this study is to develop an understanding of spatial variations in ground cover are manifested in the spectral reflectances retrieved by spaceborne sensors. Our attention is focused on two research questions. First: How well do spatial aggregates of in situ spectral reflectances correlate with spectral data acquired from orbiting platforms? Secondly: Is the strength of this correlation affected by the type and heterogeneity of the ground cover?

During the summer months of 2006, 2007, and 2008 field data were collected from over 50 sites in Grasslands National Park of Canada. Measurements were made of the vegetation type, percent ground cover, soil colour, soil moisture, and spectral reflectance at 1m, 10m, 20m, 250m, 500m, and 1000m ground spacing distances. These measurements were spatially averaged and then correlated with multispectral data from the SPOT HRG and HRV, Landsat TM and ETM, Terra and Aqua MODIS, and NOAA AVHRR sensors.

Abstract number 573

Abstract title Classification of Polarimetric SAR Images Using Support Vector Machines

Author list Reza Shah Hosseini (1), Iman Entezari (1), Saeid Homayouni (1), Babak Mansouri (2)
1 - University of Tehran
2 - International Institute of Earthquake Engineering and Seismology

Abstract

Abstract:

Fully polarimetric SAR data analysis results show improvements in revealing the scattering behaviour for different land covers as compared with the information extracted from single-channel SAR data. Classification of polarimetric SAR images may be divided in two stages, 1) extraction of appropriate polarimetric parameters or features, and 2) classification of these features based on a decision rule. The study of polarimetric parameters plays essential roles in information extraction, because such measures carry additional specific information related to the object-target scattering mechanisms. Several parameters have been proposed to assist in the interpretation and the classification of the polarimetric SAR data. These include Individual Channel Backscatter Value, Coherency Matrix Elements, Eigenvector Decomposition parameters, Radar Vegetation Index (RVI) and Pedestal Height.

Concerning the development of classification schemes, the multivariate remotely sensed data can be treated within the pattern recognition frameworks. Recently, Support Vector Machines (SVMs) have been introduced and gained attentions as a promising tool in performing supervised classification. This technique has been applied in different contexts and applications such as in remote sensing with polarimetric SAR images. The main idea of this technique is to estimate a separator boundary or surface between information classes. The advantage of using SVMs is primarily its ability to handle a nonlinear classifier problem that may be the case of extracted feature vectors form polarimetric SAR image data.

In this research, a classification algorithm that is based on SVMs technique was applied to the fully polarimetric AIRSAR L-band data of the San Francisco Bay area with a spatial resolution of 10m. In order to evaluate the accuracy of the approach, different combinations of the polarimetric parameters were considered and the classification results were assessed. The evaluation demonstrates that the SVMs classifier is efficient in analysing polarimetric SAR Images and has acceptable levels of accuracy.

Key words: Synthetic Aperture Radar, Polarimetric Imagery, Support Vector Machines, Land Cover, Classification.

Abstract number 574

Abstract title Mapping Leaf Area Index (LAI)through SPOT images in a managed forest in Central Mexico

Author list J. René Valdez-Lazalde (1), Carlos Arturo Aguirre-Salado (2), Gregorio Ángeles-Pérez (1), Hector M. De los Santos-Posadas (1).
1 - Colegio de Postgraduados
2 - Universidad Autonoma de San Luis Potosi

Abstract Leaf area index (LAI) is a useful parameter for describing forest ecosystem productivity and dynamics. This work links upward and downward remote sensing for mapping LAI. As upward remote sensor, a hemispherical photography digital camera was used, while a SPOT 5 HRG image was used as the downward sensor. The study was carried out in Central Mexico in a managed Pinus patula forest composed of different-age stands. LAI was obtained by calibrating optical measurements (hemispherical photography) through non linear regression using allometric LAI data (Pseudo r2=0.7912). Geospatial estimations (mapping) was done using linear regression analysis and the non parametric k-nearest neighbor method (k-nn). Average estimations for forested stands and obtained errors were: LAI = 6.5m2/m2, Root mean square error (RMSE) = 0.50m2/m2. A high correlation was found between LAI and built spectral indexes. At the stand level, both multiple linear regression and k-nn estimations were comparable, but considerable more computational effort is required for the k-nn method.

Abstract number 575

Abstract title

Spectral Reflectance Retrieval for Mineralogical and Remote Sensing Analysis of Historical Gold Mine Tailings Sites in Nova Scotia, Comparisons And Comments

Author list

H.P.White, Canada Centre for Remote Sensing, Natural Resources Canada
J.B. Percival, Geological Survey of Canada, Natural Resources Canada

Abstract

Deleterious elements in mine tailings derived from historic goldmines can be naturally distributed into, and adversely impact, local environments. Historic gold mining in Nova Scotia have generated more than 3 million tonnes of tailings pre-1940s, much originally slurried into local rivers, wetlands, lakes, and the Atlantic Ocean. These tailings contain elevated concentrations of mercury (derived from the ore extraction process) and arsenic (from natural waste rock leaching). This study focuses on detecting and monitoring contaminated tailings transport into receiving environments.

In this study, in situ spectral reflectance measurements are obtained using two different approaches. One approach is designed to relate target spectral reflectance to optical remote sensing, relying on sun and sky illumination and retrieving reflected spectral radiance along the line-of-sight to an orbiting sensor. The other approach follows methodology used by geologists in determining target mineralogy. Here, a reference light source illuminates along the reflected radiance pathway. The two results are evaluated to spectral reflectance acquired with EO-1 Hyperion. Spectral unmixing is then used to delineate landcover and sites of potential contamination. A correlation between landcover and tailings concentration resulting from natural transport supports assessing future delivery, assessing risk factors to human and ecosystem health, and remediation planning.

Comparison of the two field approaches, and their application to remote sensing, highlight the impacts of perspective on interpretation and application of in situ spectral reflectance. This presentation focuses on tailings transport from historic goldmines with special emphasis on the impacts on the local environments surrounding the Upper and Lower Seal Harbour areas of Nova Scotia.

Abstract number 576

Abstract title Towards developing an appropriate means of characterizing arctic vegetation in the Canadian North using hyperspectral image data

Author list R.P. Gauthier, H.P. White, R.J. Soffer, B. Brisco, Canada Centre for Remote Sensing, Natural Resources Canada

Abstract

Several studies have noted that traditional broad band vegetation indices (such as NDVI) are, due to the nature of arctic tundra vegetation (e.g., clumped sparse cover, mixture of leafy plants, lichen, and moss) and the local environment (e.g., low sun angle, frequent exposed rock, snow, and surface water), normally inappropriate for a basic characterization of arctic vegetation. New methods for characterizing the arctic ground cover are necessary to improve an understanding of this environment with respect to its sensitivity to climate change, contributions to mineral exploration, and for habitat mapping. With a forecasted increased availability of spaceborne hyperspectral sensors (with the upcoming EnMap, PRISM, and HyspIRI) and increased airborne hyperspectral acquisitions in the north, spectral unmixing provides a promising method of characterising the arctic landcover.

To evaluate the potential of using spectral unmixing to help characterise the general vegetation (defined here as leafy plants, lichen, and moss) in an arctic environment, EO-1 Hyperion imagery was acquired of Wager Bay (located in Ukkusiksalik National Park) during the 2007 and 2008 growing seasons. The scenes were pre-processed to minimize the influence of noise, spectral curvature, and atmospheric contributions, resulting in two at-surface spectral reflectance data cubes. A weakly constrained unmixing process, using endmember spectra obtained from field surface reflectance measurements, was applied to the resulting data cubes to produce fraction maps associated with land cover. A spatio-temporal variance analysis of the two images was used to further refine the fraction maps in order to gain a better understanding of the general vegetation distribution around Wager Bay.

Abstract number 577

Abstract title The Topographic and Tectonic Features of the Arabian Rift zone and its Water resources

Author list Dr.Eng. Mohamad Rukieh
Counselor Minister of Communications and Technology in Syria

Abstract

Abstract:
Keywords: space images, water studies, spatial survey systems, surface and groundwater.
This research reviews the important tectonic features of the Arabian rift zone depending on the research which I have carried out by using remote sensing techniques. Then it reviews the topography of the rift line and its surrounding areas. The third part of this research reviews the water influences in this rift. The Arabian rift line extends from al-Akaba gulf from the south to the north along more than 1100km, Several tectonic schemes of different scales and topographic one for the rift line have been prepared
The schemes have provided new data about the rift structure and its development through identifying faults, lineaments, annular structures (in different scales), and distinguishing the volcanic eruptions associated with the rift. Also these schemes have shown the positive importance of the rift in the water resources of the area through the great relief change of the rift line which ranges between(412m under the sea level and 1200m above the sea level). and the formation of high mountains in Syria and Lebanon. this lead to form important springs and big rivers of different length and abundance in Lebanon, Syria and Jordan such as Orontes, Litany, Jordan, al-Caber al-Janobee, al-Hasbani, al-Wazani, Banyas, Barada, and al-Awaj rivers. Also, there are many other short rivers, the length of which range between 5-40km.
This research refers to some fresh water(such as Tiberias lake) and salty, (Dead sea ,which is used for Potassium sold exploitation) and also to several pools and swamps which have been formed along the rift extension through faults and fractures of different directions and extensions,. These areas form recharge zones for the ground water basins.. Fresh springs were formed in the seas along Lebanese and Syrian coast.

Abstract number 578

Abstract title Thermal Remote Sensing of the Greater Toronto Area Urban Heat Island

Author list Matt Maloley, CCRS, Natural Resources Canada

Abstract

Urban centres can be susceptible to extreme heat events due to the Urban Heat Island (UHI) effect. Extreme heat is a health risk to vulnerable populations and with 80% of Canadians living in cities and a projected increase in extreme heat events, there is a clear requirement for UHI monitoring. The UHI of the Greater Toronto Area (GTA) was mapped using Landsat TM and ETM+ thermal imagery and a set of in-situ air and surface temperature measurements collected over the summer of 2008. The in-situ surface temperature measurements served to both validate the satellite surface temperature estimates, but also to explore the diurnal variations in surface temperature that are represented by single daytime measurements in satellite based acquisitions. Results indicated significant diurnal temperature variations, however these thermal patterns correlated strongly with land cover. UHI intensity for various climatic conditions was quantified solely from air temperature differences between urban and rural surrounds. Attempts were made to predict air temperature over the study area based on the satellite derived surface temperature estimates and land cover type. The study also involved an analysis of the inter-annual variations in surface temperature over the GTA. Landsat TM and ETM+ thermal images, from 1990 to 2008, were compared to explore the relationship between changes in surface temperature and changes in urban growth and land cover. The thermal images were normalized to “typical” radiative conditions, in order to quantify relative temperature differences over the 18 year study period.

Abstract number 579

Abstract title Research on Relationships between Landscape Spatial Pattern and Grizzly Bear Appearance in Agricultural Areas in Alberta

Author list Kai Wang, Adam Collingwood; Steven Franklin and Xulin Guo. University of Saskatchewan.

Abstract

Management plans to reduce problem bear conflicts in agricultural areas are seen as one of the strategies with the greatest potential to mitigate human-induced harmful effects on grizzly bear (Ursus arctos) populations in Alberta. Agricultural practices change the physical structure and composition of the landscape. The purpose of this research was to determine which, if any, landscape configurational and compositional metrics were related to grizzly bear presence or abundance in an agriculture-dominated landscape. Locational data for 8 bears was examined in an area southwest of Calgary, Alberta. The 4494 km2 study area was divided into 107 sub-landscapes of 42 km2. Thirty-meter spatial resolution Landsat imagery was used to classify the area and derive compositional and configurational metrics for each sub-landscape. It was found that both land cover and the secondary effects of landscape configuration could explain grizzly bear use under the specific classification scheme. The multiple-regression model suggests that bear use of an area increases with decreasing patch density, stream density and road density. Higher percentage of wetland herbs, lower percentage of fallow and lower contagion index were the most consistently significant predictors in bear presence / absence models. Spatial and thematic resolutions were also found to be dominant factors explaining bear use via landscape metrics.

Abstract number 580

Abstract title Quantifying Biomass Production on Rangeland in Southern Alberta Using SPOT Satellite Imagery

Author list Kristin Grant (1), Dan Johnson (2), David V. Hildebrand (3), and Derek Peddle (2)
1 - Iunctus Geomatics Corp.
2 - University of Lethbridge
3 - Agriculture Financial Services Corporation

Abstract In Southern Alberta rangeland biomass is important for agricultural producers, primarily because it provides forage for livestock. It also reduces erosion, provides habitat for threatened species, supports important biodiversity, and provides other ecosystem services. Drought is a frequent feature of this region, and results in economic loss. Species composition and rangeland biomass vary as a function of climatic conditions associated with sub-regions within the six natural regions of the province. This research examined methods of estimating biomass for ungrazed pastures in two of those sub-regions using SPOT 20 meter multispectral satellite imagery and several vegetation indices intended to predict rangeland biomass. The Renormalized Difference Vegetation Index (RDVI) provided the best prediction (r2 = 0.68) of the amount of green biomass production. However, the increase was only marginally better than the Normalized Difference Vegetation Index (NDVI) and other indices tested. In almost all cases a power function best described the form of the relationship between biomass and imagery variables. The predictive power was poorer (r2 = 0.15 to 0.20) when vegetation carryover was included in the model, indicating the importance of dry matter to the vegetative reflectance signal, especially on ungrazed pastures.

Abstract number 581

Abstract title

High-Performance Field and Laboratory Goniometer for Measuring Hyperspectral Bi-directional Reflectance Characteristics of Various Agricultural Canopies.

Author list

Craig A. Coburn (1), Scott D. Noble (2)
1 - University of Lethbridge
2 - University of Saskatchewan

Abstract

The derivation of the Bidirectional Reflectance Distribution Function (BRDF) from earth surface features is vital data for improved remote estimation of Earth surface features and properties. The angular component of a reflectance signature represents a valuable source of information that has largely been ignored due to the lack of empirical data. BRDF data products are now readily available from a variety of remote sensing platforms, and require extensive field validation to ensure data quality. This paper presents a high-performance, low-cost computer controlled goniometer system capable of sampling surface BRDF, and demonstrates several example applications. The system introduces a number of technological advances including real-time reflectance calibration, programmable sampling schemes, zero target interference structure and ease of portability. Using this instrument, BRDF estimates were gathered from a variety of agricultural crops in field and laboratory settings with performance gains of 4 times the speed of current designs. This system can provide very fast acquisition of a BRDF estimate depending on the desired angular resolution. Initial experiments demonstrate that this new style of hyperspectral goniometer is a significant advance over previous designs with respect to scan capabilities, angular resolution, calibration, and portability.

Abstract number 582

Abstract title Hyperspectral land covers classification using an SVM-based algorithm

Author list Reza Shah Hosseini and Saeid Homayouni. University of Tehran

Abstract

Abstract:

Hyperspectral Imagery (HIS) provides a profuse source of information for various earth observation themes and applications. Despite of this potential for information extraction, the classic image analysis and classification techniques encounter some challenges including high volume data processing; high dimensional space modeling and Hughes phenomenon. Particularly, the training step of supervised algorithms for hyperspectral images is time consuming and costly. So, the objective is to find a method that needs less training data and has less computational cost. As a solution, the new concept and method based on statistical learning theory and data mining have been developed and used researcher of different area.

Support Vector Machines (SVMs) technique is a supervised classification method based on above idea. This technique has been applied in different context and for classification of different data, such as remote sensing applications and hyperspectral images. The key idea of this technique is to estimate a separator boundary or surface between the spectral classes. This surface that maximise the margin between classes, uses limited numbers of boundary pixels (support vectors) to create the decision surface.

In this paper, an algorithm based on SVMs has been applied in a chain of processing steps. In the first step, the hyperspectral data are projected to a new similarity space using a priori knowledge of class-of-interest. This projection could be from an n-D space to any m-D space, where m << n. In a particular case, the hyper dimensional data are transformed to a spectral angle-distance similarity space. The second step uses the SVMs to separate the class-of-interest pixels from background pixels. The final step is to combine the one-class maps to obtain a full land-cover map.

This algorithm was applied to two sets of remotely sensed data; first was the Hyperion imagery that contains 242 bands with 30m of spatial resolution and the second is a CASI (Compact Airborne Spectrographic Imager) imagery having 9 spectral bands with 4m of spatial resolution. There are reliable ground truth data for both of data sets. So, the evaluation study is done to assess the accuracy of classification. The results demonstrate that this developed algorithm is relatively efficient, rapid and reliable.

Key words: Support Vector Machines, Spectral Similarity, Hyperspectral Images, Supervised Classification.

Abstract number 583

Abstract title Developing Future Carbon Algorithms for SMAP

Author list Lucas Jones (1), John Kimball (1), Ke Zhang (1), and Kyle McDonald (2),
1 - University of Montana
2 - Jet Propulsion Laboratory/California Institute of Technology

Abstract Uncertainty in the magnitude and direction of surface process feedbacks limits our knowledge of whether high latitude ecosystem processes can continue to buffer rising atmospheric CO2 and air temperatures in the near future. Errors from driving data, model parameters, and model structure constrain our ability to characterize the terrestrial carbon cycle using satellite remote sensing and ecosystem process models. The Soil Moisture Active Passive (SMAP) mission with scheduled 2012 launch date will provide moderate resolution soil moisture (10 km) and freeze-thaw state (1-3 km) information. We anticipate that SMAP data assimilation will improve current data coverage and provide new, accurate estimates of land surface processes, including daily net ecosystem exchange of CO2 (NEE). We developed a prototype carbon model to derive daily NEE using MODIS GPP and surface soil moisture and temperature retrievals from AMSR-E as driving data. Model parameters and variability are uncertain on continental spatial scales. Disturbance and stand succession can also push ecosystems far from steady state with associated shifts in carbon source-sink dynamics. In this study, we apply an ensemble-based model-data assimilation of FLUXNET tower CO2 observations for calibration, initialization, and uncertainty assessment across a range of representative global biomes, while accounting for error in flux observations, driving data, and model structure. We compare assimilation diagnostics to determine the relative value of remotely sensed information for accurate prediction of carbon fluxes. The results of this study offer a benchmark for assessing the incremental value of SMAP observations over information available from existing sensors, assessment of ecosystem NEE parameters, and associated uncertainties.

Abstract number 584

Abstract title Automation of Geospatial Image Processing for Creating Northern Resource SPOT Mosiacs

Author list J. R. Gibson & M. Buchheit
Canada Centre for Remote Sensing

Abstract

The subject of this paper is the creation of a SPOT mosaic of a portion of the Cumberland Peninsula on Baffin Island. Twenty-two separate panchromatic and multi-spectral SPOT scenes were reformatted into five data sets for the purpose of building a mosaic covering an area of 48,000 km2. The work was done at the Canada Centre for Remote Sensing (CCRS) as part of the Remote Predictive Mapping Project in the GeoMapping for Energy and Minerals Program at the Geological Survey of Canada (GSC). The Cumberland Peninsula Mosaic has presented several difficult challenges; there is very little reliable ground control information and the time-window for acquiring snow-free data with adequate sun angles is very short.

Photogrammetric principles were applied in constructing condition equations based on satellite ephemeris and attitude data and the specific sensor model (e.g. focal length, field of view, etc), for the adjustment of the 5 data sets. By correcting the satellite ephemeris and attitude data in advance of any image processing, it is possible to compute ground coordinates for any location in a raw image; this enables more accurate atmospheric corrections and the application of terrain slope and Bi-directional Reflectance Distribution Function (BRDF) corrections.

The overall purpose in developing an automated system for processing satellite imagery is to enable the rapid generation of large-area image products with a minimum of operator intervention. An important consideration in the CCRS approach to this is that of maintaining a national focus both in area and multi-temporal coverage and accumulating relevant data that may be employed to improve both the image calibration and information extraction processes.

Abstract number 585

Abstract title Measurement of Tree-Level Attributes in Heterogeneous Stands Using Terrestrial Laser Scanners

Author list Caroline Rivest (1), Richard A. Fournier (1), Chhun-Huor Ung (2), Enda Keane (3), Garret Mullooly (3), Hans Pretzsch (4), Hans-Joachim Klemmt (4).
1 - Université de Sherbrooke
2 - Sciences Canadian Service Forest
3 - TreeMetrics Ltd.
4 - Technische Universität München

Abstract

The use of terrestrial lidar in forestry is tied to the need to improve ground inventories. Parameters such as diameter at breast height (DBH), tree height, stem profile and branch diameter can be decisive factors in forest resource management, as well as the stem number and stem diameter per hectare. Various research projects have enabled the development of processing tools for forest lidar data, including the Autostem software (©TreeMetrics) and another piece of software designed by the Chair of Forest Yield Science at the Technische Universität München in Germany.

The main objective of this project is to explore the suitability of these two software programs for processing terrestrial lidar data from various stands located in Canada, Ireland and Germany. Processing data from natural heterogeneous stands located in Gaspésie (Québec, Canada) has proven to be particularly difficult. The complexity of these sites imposed important constraints, particularly with regard to the understory, general canopy density and high branch density in the lower part of the tree. DBH, stem profile and tree height measurements obtained with each piece of software were compared with manual measurements taken on the ground. The strengths and limitations of using terrestrial lidar for forest inventory measurements at the tree level will be presented.

Abstract number 586

Abstract title

Analysis of northern ET trends and associated regional water balance changes using satellite inputs and meteorology reanalysis from 1983 to 2005

Author list

Ke Zhang, John Kimball, Lucas Jones, Qiaozhen Mu, Steven Running. University of Montna.

Abstract

We developed a satellite remote sensing based ET algorithm to assess spatial patterns and temporal trends in ET over the pan-Arctic region from 1983 to 2005. The algorithm quantifies canopy transpiration and soil evaporation using a modified Penman-Monteith approach with biome-specific canopy conductance determined from NDVI, and quantifies water body evaporation with a Priestley-Taylor approach. These algorithms were applied over the pan-Arctic region using AVHRR GIMMS NDVI with regionally corrected NCEP/NCAR reanalysis daily surface meteorology and NASA/GEWEX solar radiation inputs. We analyzed changes in the regional water balance defined as precipitation (P) minus ET, where P was derived from Global Precipitation Climatology Project (GPCP) and Global Precipitation Climatology Center (GPCC) monthly data. Estimated ET fluxes agree well with measurements from six flux towers within regionally dominant land cover types (RMSE=8.3 mm month-1, R2=0.89). ET showed generally positive trends over most of the region, and corresponded with regional warming and vegetation greening, while negative ET trends were observed over 32% of the region, primarily in boreal forests of western and central Canada. Positive ET, P and river discharge trends imply intensification of the pan-Arctic terrestrial water cycle, although regional P and associated water balance estimates have uncertainty. Increasing water deficits in eastern Alaska, Canadian Yukon and western Prairie Provinces, and Northern Mongolia agree with regional drought records and recent satellite observations of vegetation browning and productivity decreases. Our results indicate that the pan-Arctic water balance responds to changing climate in complex ways with direct links to terrestrial carbon and energy cycles.

Abstract number 587

Abstract title Assessment of Temporal Dynamics and Stress of the Vegetation Using Series of Seven-day NOAA AVHRR NDVI Thematic Images

Author list Eugenia Roumenina, Lachezar Filchev, Vanya Naydenova, Georgi Jelev, Petar Dimitrov, and Vassil Vassilev. Space Research Institute.

Abstract

Current work represents a methodology of applying satellite remote sensing for monitoring of the vegetation condition. The work is part of PHARE project EOS+ETS for sustainable management of crises. For that purpose, the study was carried out using open and available dataset of seven-day NOAA AVHRR NDVI Level 3 satellite imagery with spatial resolution of 1113m for the period 1997-2008 downloaded from DLR-EOWEB Internet interface. The image archive was stored in its source .hdf and in .img file formats. The geodatabase in ArcGis/ArcCatalog 9.2 was used for storing, visualization and managing the dataset. Within the geodatabase was stored phenological data for agricultures such as wheat and sunflower for the observational period 2000-2008. It contains statistical information for mean dates of sowing to harvesting related to the imagery with relationship classes. The data was collected in field observational stations from the observational network of National Institute of Meteorology and Hydrology (NIMH), Bulgarian Academy of Sciences (BAS). Aforementioned methodology for monitoring of the vegetation cover and stress situations was based upon reference images derived from the image archive within WinDisp 5.1 application environment. Series of analytical maps for Max, Min, Avg, Median, Range, Sum, Count, Stddev, Decloud, Slope, MaxDate, MinDate were made and analyzed. Each of these analyses images was compared to the reference ones using difference functions to study the status of the vegetation for 2007/2008 agricultural year. In summary, the research represents objective analysis of stress situations, trends and dynamics in vegetation vigor from low-resolution NDVI thematic images.

Abstract number 588

Abstract title

Evaluation of alternative remote sensing land cover products for modeling and monitoring forest bird habitat in the Western Boreal Plains

Author list

Evan Seed, Environment Canada, National Wildlife Research Centre, Carleton University, Ottawa, K1A 0H3, Canada. Steven Cumming, Sciences du Bois et de la Forêt, Université Laval, Québec, G1V Evan Seed (1), Steven Cumming (2), Erin Bayne (3), Jason Duffe (1), Ken Baldwin (4)
1 - Environment Canada, National Wildlife Research Centre, Carleton University
2 - Sciences du Bois et de la Forêt, Université Laval, Québec
3 - Department of Biological Sciences, University of Alberta, Edmonton
4 - Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre

Abstract

Land cover products derived from remotely sensed data are now widely used in forest ecology and management as environmental layers for predictive modeling of wildlife distribution and abundance and as inputs to the design of biomonitoring programmes. In the boreal forest, there is an urgent need to quantify the effects of industrial activity on wildlife habitat (e.g., songbirds and woodland caribou), in part to meet Environment Canada's mandates under the Species at Risk Act. Remote sensing data is the most likely spatially extensive data on habitat that can potentially meet such mandates. The purpose of this study was to evaluate the relative efficacy of three recently developed land cover products to describe spatial variation in forest habitat, by systematic comparison against a common vegetation data layer. Specifically, we evaluated the: 1km North American Land Cover (NALC), 250m MODIS Land Cover Classification (LCC05) and 25m Earth Observation for Sustainable Development of Forests (EOSD) products. As ground truth data, we used an extensive suite of georeferenced vegetation relevé data, pre-classified according to a standardized taxonomy of plant communities (Canadian National Vegetation Classification). The study provisionally corrected ground truth data for temporal changes in land cover due to fire and forest harvesting over the sampling period. Relations between the classified relevé data and the land cover products are reported by means of straightforward cross tabulations and confusion matrices. We then consider how these products could be directly linked to the observational wildlife data and discuss some implications for the appropriate use and possible improvement of land cover products for species habitat modeling.

Abstract number 589

Abstract title

Prairie Shelterbelt Inventory:
Using High Resolution Imagery and Object-based Classification

Author list

Joey Pankiw Dept. of Geography, University of Regina
John Kort PFRA Shelterbelt Centre, Agriculture and Agri-Food Canada
Joseph M. Piwowar Dept. of Geography, University of Regina

Abstract

The Shelterbelt Program established by the Prairie Farm Rehabilitation Administration (PFRA) has had several benefits to farmers and the prairie landscape. The effective planting of shelterbelts can mitigate the effects of soil erosion, provide a means to control snow drifting over highways or roads and provide wildlife habitat. Due to growing concerns of about rising levels of carbon dioxide in the atmosphere shelterbelts have also been seen an effective way to sequester carbon dioxide from the atmosphere. Despite its success PFRA has limited channels to judge the success of the program. The current number of trees that exists and their exact location on the landscape are not known.

In Saskatchewan and Manitoba, records for the Prairie Shelterbelt Program exist in the form of the number of trees or shrubs shipped and the purpose for which they were intended. Estimates for the number of functioning shelterbelts can be made from these numbers with certain assumptions being made for tree lifespan. However, the accuracy of these estimates depends on independent corroboration of the shelterbelts on the ground. The use of high resolution satellite imagery along with object-based image classification software has been shown to be an effective way to create such a large inventory.

The objective of this study is to use Definiens eCognition software along with SPOT-5 panchromatic imagery at a spatial resolution of 2.5 meters, to produce an accurate inventory of Prairie shelterbelts which will be used in future research to create an inventory of carbon sequestration in Prairie Shelterbelts.

Abstract number 590

Abstract title Monitoring grassland biophysical parameters and carbon fluxes of mountane grasslands using remote sensing measurements

Author list Loris Vescovo, Damiano Gianelle (CRI, Fondazione Mach, Trento, Italy) Georg Wohlfahrt (University of Innsbruck, Austria) , Manuela Balzarolo (Università della Tuscia, Viterbo, Italy)

Abstract

Grasslands cover 62.7 Mha of the European surface and therefore play an important role in the global carbon balance. Carbon fluxes of meadows and pastures are strictly controlled by vegetation dynamics and phenology, which can be effectively monitored with remote sensing both in the seasonal and inter-annual variability

The linkage of ecosystem fluxes measured with the eddy covariance technique and remotely sensed information is foreseen as the most promising method for scaling up surface fluxes and to overcome the modest spatial coverage of the eddy covariance sites.

In this study, proximal sensing measurements were used to calculate different vegetation indexes which were applied as predictors of grassland carbon fluxes and Leaf Area Index. Reflectance and carbon fluxes data were collected on at six grassland sites in Italy and Austria. Clear relationships between GPP, NEP, TER, phytomass and the most commonly-used spectral vegetation indices could be assessed. On the other hand, saturation problems were evident both in biophysical and ecophysiological parameter estimation.

On a temporal basis, the NIR wavelengths showed an evident potential for estimating grassland biophysical parameters. The relationship between spectral vegetation indices calculated from NIR reflectance and biophysical parameters showed to be linear. On the other hand, this relationship showed to be site-specific and thus not suitable for spatial mapping. Further studies are needed to determine the usefulness of using these spectral features and the potential for upscaling the observations at the airborne and satellite levels, as well as for other ecosystem types.

Abstract number 591

Abstract title

Agricultural Land Use Classification Accuracy: Comparing Maximum Likelihood Classification to Neural Net Tree Models using Single and Multi Date SPOT Imagery

Author list

Gary L. Larson, Anne M. Smith, Bernard D. Hill and Travis Hulstein
Lethbridge Research Station, Agriculture and Agri-Food Canada

Abstract

Satellite imagery has many uses in agriculture from qualitative assessment of crop damage to quantitative land use change monitoring systems. Earth observation has been used to classify land use for many years but as technology and methodology advance so does the potential to improve land use classification accuracies. Traditional methods of supervised classification like maximum likelihood (MLC) serve as a good reference point to evaluate new methodology.

The purpose of this study was to determine the potential to enhance land cover identification using single or multi-date optical earth observation data and neural network (NN) classifiers. Typically, one NN is used to classify all land cover classes, however, the development of a series of NN linked into a tree structure, with each individual NN involving a yes or no decision, may provide superior results. The study site, located around Lethbridge, Alberta, Canada (Lat. 49.7oN, Long. 112.833oE), is semi-arid and of low topographical relief, with the exception of the coulee formations along the Oldman River basin. The agricultural landscape includes a mix of dryland and irrigated crops.

Three SPOT 4 images acquired on 23rd June, 24th July and 19th August 2004 were obtained. The images were orthorectified, and atmospherically corrected using ATCOR 2. Cloud cover was manually removed. In addition to the four bands of data in the SPOT 4 imagery, the Optimised Soil Adjusted Vegetation Index was used in the classifications. Training and validation data were created from independent data sources. The fields were selected to account for variation across the image scene. With respect to single date images, land cover classification proved more effective with July and August than June imagery using both ML and NN classifiers. The NN classifiers (Kappa values 0.77 to 0.80) proved more effective than ML (Kappa values 0.59-0.72) classifiers with single date imagery. Classification accuracies with multi-temporal data indicated that there was little difference between classification methods (Kappa values of 0.83 for ML and 0.82 for NN). The results suggest that NN classifiers may be more suitable if only a single date of SPOT imagery is available within a season for agricultural land cover mapping.

Abstract number 592

Abstract title SPECTRAL LINE PARAMETERS FOR ETHANE FUNDAMENTAL BAND AT 12 MICRON

Author list V. Malathy Devi (1), D. Chris Benner (1), C.P. Rinsland (2), R.L. Sams (3), T.A. Blake (3).
1 - Department of Physics, The College of William and Mary
2 - Science Directorate, NASA Langley Research Center
3 - William R. Wiley Environmental Molecular Sciences Laboratory, Pacific Northwest National Laboratory

Abstract The fundamental band of ethane located near 12 micron is the strongest band in the terrestrial window and has been used for its identification and abundance determination in several remote monitoring applications of planetary atmospheres data such as the Earth, Titan, the giant planets and even comets. Infrared laboratory absorption spectra of the 12 micron band of ethane have been recorded in the 750 to 900 reciprocal cm spectral region. The data were obtained at room- and low-temperatures (297 K to 219 K) using the high resolution Bruker 120 HR Fourier transform spectrometer located at the Pacific Northwest National laboratory (PNNL), in Richland, Washington. Spectra of pure (99.5%) and lean mixtures of ethane in nitrogen were acquired at ~0.002 reciprocal cm using absorption path lengths of 3.2 m and 20 cm. Spectroscopic parameters such as line positions, intensities, self- and nitrogen-broadened Lorentz half width coefficients determined from room temperature data for select PQ and RQ sub bands employing a multispectrum nonlinear least squares fitting algorithm [1] will be presented.

[1] D. Chris Benner, C.P. Rinsland, V. Malathy Devi, M.A.H. Smith, and D. Atkins: “A multispectrum nonlinear least squares fitting technique,” J. Quant. Spectrosc. Radiat. Transfer 53 (1995) 705-721.

Abstract number 593

Abstract title Twenty-five year monitoring of the Mealy Mountains, Labrador, tree line

Author list Élizabeth L. Simms, Alvin Simms and Heather Morrison, Memorial University

Abstract

The Normalized Difference Vegetation Index (NDVI) calculated from five image sets recorded between 1983 and 2008 and a digital elevation model produced information on the spatiotemporal variation of the tree line in a region of the Mealy Mountains, Labrador, Canada.

The vegetation cover variation is investigated through changes of the absolute and classified NDVI values as well as the size and shape of contiguous areas delineated by different NDVI classes. Multi-date comparison of size and shape provide additional information on the vegetation cover changes. Analyses also include an investigation of the landscape topographical characteristics for the areas exhibiting NDVI variations.

Over the 25-year observation period, as well as the shorter time laps, changes are explained by an increased NDVI within a majority of the study area. A twofold increase is observed at higher terrain elevations. Changes from the intermediate to the highest NDVI classes occur over relatively small areas distributed throughout the lower elevations. Transition from low to intermediate and highest vegetation index classes take place at higher elevations and over large continuous patches.

Multi-sensor based monitoring augments long–term knowledge on possible effects of climate change on vegetation cover. Not only the spectral information is useful but also the structural characteristics are highly relevant to explaining the green biomass spatiotemporal dynamics.

The NSERC IPY Present processes, Past changes, Spatiotemporal dynamics Arctic Canada project is the main source of funding for this research.

Abstract number 594

Abstract title Wetland Classification in the Boreal Plains of Alberta: A Multiscale Geographic Object-Based Image Analysis (GEOBIA)

Author list Ryan Powers, Geoffrey J. Hay University of Calgary

Abstract

It is estimated that Canada comprises approximately 18% of the world's wetlands (1.6 million sq. km), which provide essential ecological services such as purifying water, nutrient cycling, reducing flooding, recharging ground water supplies, and protecting shorelines. Yet despite their importance, Canada does not have a national wetland inventory.

To address this problem, the Canadian Wetland Inventory (CWI) was initiated in 2004, and includes evaluating new Geographic Object Based Image Analysis (GEOBIA) methods to inventory and monitor Canada's wetlands. GEOBIA is used for segmenting remote sensing images into meaningful image-objects, and assessing their characteristics through spatial, spectral and temporal scales. While the GEOBIA methods used by CWI are promising, they are limited in two ways: (i) their application to medium resolution imagery (Thematic Mapper, 30m+) and (ii) the underutilization of texture information. Consequently, physically smaller wetlands (<0.9ha, which are abundant in Alberta) are not detected. In addition, wetlands that are spectrally similar but texturally different to other landcover types may be classified into wrong thematic classes.

This paper introduces a multi-scale GEOBIA approach to estimate how many wetlands are missing between high-resolution (2.5m) and medium-resolution (<30m) classifications using resampled SPOT 5 imagery. Specifically, we will (i) determine whether it is possible to accurately classify the same wetland types at a range of different spatial resolutions (i.e., 2.5m, 5m, 10m, 15m, 20m, 25m, 30m) from the same SPOT 5 sensor, (ii) Investigate the 'optimal' spatial resolution(s) required for best classification accuracy of different wetlands types (within our study area), (iii) propose new geo-object based texture methods (geotex) for improving wetland classifications, and (iv) based on a comparison between our high-resolution and medium resolution classification results, we will estimate the change in classification accuracy, the numbers of different wetland types identified and their associated areas through scale.

Abstract number 595

Abstract title Estimation of gross ecosystem production by hyperspectral measurements in a rice field

Author list Micol Rossini (1), Michele Meroni (1), Giovanni Manca (2), Lorenzo Busetto (2), Guenther Seufert (2)
1 - Remote Sensing of Environmental Dynamics Lab. University of Milano-Bicocca (UNIMIB) Italy
2 - Institute for Environment and Sustainability JRC Ispra Italy, Sergio Cogliati, UNIMIB,

Abstract The objective of this study was to monitor the carbon uptake of a terrestrial ecosystem (Gross Ecosystem Exchange, GEP) from remote and high spectral resolution radiometric measurements. Estimation of GEP from remotely sensed data is based on the light use efficiency model (LUE) which states that GEP is a function of the photosynthetically active radiation absorbed by vegetation (APAR) and the radiation use efficiency (å). Hyperspectral data were exploited in this study in order to derived both the APAR and the å term. The study was conducted in a rice field equipped with an Eddy Covariance (EC) flux tower during two growing seasons (2007 and 2008). Half-hourly measurements of Net Ecosystem Exchange were partitioned to derive GEP. Canopy reflectance spectra were collected under clear sky conditions using high resolution spectrometers (full width at half maximum of 0.13 nm), allowing the estimation of steady-state fluorescence at 760 nm (F) and vegetation indices. Different formulations of LUE model were tested. Formulations differ with respect to the methods selected for å and APAR estimation based on remote sensing techniques. The best performing model was the one with photosynthetic APAR estimated as a function of F and å as a function of the Photochemical Reflectance Index (PRI) which provided a root mean square error in cross validation of 3.7 ìmol CO2 m-2 s-1 in GEP estimation.
Finally, to provide long term, continuous and unattended acquisitions of hyperspectral data, the prototype robotic HyperSpectral Irradiometer was developed and tested at the EC site in summer 2008.

Abstract number 596

Abstract title Individual Tree Crown Delineation using Combined LiDAR Data and Optical Imagery

Author list Baoxin Hu (1),Wen Zhang (1),Kun Qian (1), and Murray E. Woods (2),
1 - York University, Department of Earth and Space Science and Engineering
2 - Ontario Ministry of Natural Resources

Abstract Abstract: Individual tree crowns delineation has been investigated using either optical imagery or LiDAR data. With optical imagery, tree crown delineation is negatively affected by the anisotropic reflectance properties of tree canopies, which is especially significant for open canopies. On the other hand, a tree crown tends to have a distinct edge in the 3D data clouds collected by a LiDAR instrument, especially for open canopies. For close canopies, trees grow together, which makes the distinction between crowns in the LiDAR data less evident.

In this study, a multi-scale progressive tree delineation method was developed using the integrated optical and lidar data. With this approach, the objects that can be segmented with the highest confidence were delineated first. Specifically, the multi-scale progressive tree delineation method was carried out as follows: coarse resolution objects, such as trees, non-tree vegetation and non-vegetation were grouped together first, based on the vegetation indices and digital surface model (DSM) calculated from optical imagery and lidar data, respectively. The tree groups were then progressively segmented into continuous tree stands based on structural information derived from lidar data. More detailed spectral information was used last to separate tree stands into tree crowns based on spectral correlation and morphological approaches. The uniqueness of this approach is that information from different data sources is intelligently employed, which prevents useful information from being masked by non-useful information and noises. The proposed method was validated using the optical and LIDAR data collected over the Petawawa and Swan Lake Research Forests, Ontario.

Abstract number 597

Abstract title

Spatial modeling of foliar nutrients using hyperspectral and LIDAR remote sensing at a boreal mixedwood forest in northern Ontario, Canada

Author list

Kemal Gökkaya, Virginia Tech Valerie Thomas, Virginia Tech Tom Noland, Ontario Ministry of Natural Resources Harry McCaughey, Queen's University Ian Morrison, Canadian Forest Service Paul Treitz, Queen's University

Abstract

N, P and Mg are important nutrients responsible for plant structure and
function. N and Mg are constituents of the chlorophyll molecule and are thus
directly related to photosynthesis. P, like N is present in nucleic acids, nucleotides, coenzymes and plays a key role in reactions where ATP is involved. Hyperspectral (HS) remote sensing data have been used to estimate foliar N, lignin and pigments and LIDAR has successfully been utilized to estimate mainly forest height and biomass in a variety of forest ecosystems. The objectives of this study are to 1) develop predictive calibration equations for the above mentioned nutrients using HS indices in the visible, red-edge and near infrared wavelengths, 2) test whether the integration of LIDAR metrics improves the models, and 3) produce foliar concentration maps based on these equations for the boreal mixedwood site. Two-variable calibration models were developed for N, P and Mg with r2 values of 0.78, 0.79 and 0.55. The LIDAR metric integrated models had r2 values of 0.76, 0.70 and 0.65 and they had consistently higher validation r2 values than the HS indice models. The results showed that HS remote sensing can provide reasonable estimates of N, P and Mg for boreal mixedwood forests and LIDAR data improve the predictive power of the model for Mg. Foliar nutrient concentration maps could provide valuable insight into the spatial patterns of canopy health, condition and productivity. The potential use of integration of LIDAR metrics with HS indices to predict nutrients needs to be tested in different ecosystems with additional nutrients.

Abstract number 598

Abstract title Quantifying Crop Biomass Accumulation Using Multi-temporal Optical Remote Sensing Observations

Author list Jiangui Liu (1), Elizabeth Pattey (1), Jiali Shang (1), Stuart Admiral (1), Guillaume Jégo (1), Heather McNairn (1), Anne Smith (1), Baoxin Hu (2), Frank Zhang(2) and Jim Freementle (2),
1 - Agriculture and Agri-Food Canada
2 - York University, Department of Earth and Space Science and Engineering

Abstract Monitoring crop production systems is critical in assessing food security and in mitigating against environmental and climatic variability. Optical remote sensing data have proven to be capable of quantitatively estimating crop development status. In this study, multi-temporal optical remote sensing data acquired by the Compact Airborne Spectrographic Imager (CASI) and by the SPOT-4 satellite were used to monitor crop seasonal development status of corn, soybean and wheat. The modified triangular vegetation index (MTVI2) was used to derive maps showing the seasonal variation of leaf area index (LAI), with a determination of coefficient (R2) of 0.85 and a root mean square error (RMSE) of 0.76 over the sampled sites for all three crops throughout the growing season. Although MTVI2 was not directly related with the above-ground dry biomass its integration over time, a surrogate of cumulative absorbed photosynthetic active radiation, was found to be strongly related to the above-ground dry biomass accumulation. The R2 and RMSE were 0.98 and 0.030 kg m-2 for corn, 0.88 and 0.037 kg m-2 for soybean, and 0.56 and 0.096 kg m-2 for wheat, respectively. The weaker correlation for soybean was due to the loss of dry leaves in the later season. For wheat, increased variability was generated by an infestation of weeds in the field which were not harvested for biomass sampling. The derived maps of LAI could be assimilated in a crop growth model, such as STICS, for improving crop yield estimation.

Key words:
Biomass, LAI, remote sensing, multi-temporal, hyperspectral, multi-spectral

Abstract number 599

Abstract title Classification of Polarimetric SAR Data in Toronto Suburban Areas Using Model-Based Decomposition and Morphology Analysis

Author list

Niu, Xin and Yifang Ban
Division of Geoinformatics
Department of Urban Planning and Environment
Royal Institute of Technology - KTH
Stockholm, Sweden

Abstract

The objective of this research is to evaluate multitemporal RADARSAT-2 polarimetric SAR data for urban land-cover classification using a novel classification scheme. Six-dates of RADASAT-2 Quad-Polarimetric SAR data were acquired during the summer of 2008 in the rural-urban fringe of the Greater Toronto Area.. The major land-cover types are high-density builtup areas, low-density builtup areas, roads, parks, golf courses, forest, water and several types of agricultural crops.

In this research, different urban land-cover types and their corresponding polarimetric behaviors will be studied. The polarimetric signatures, polarimetric textures and the phase information of the various urban land-cover types will be extracted from the multitemporal RADATSAT-2 SAR images and analyzed using a new hierarchical classification method. The classification logic is to classify the images into several most distinct classes first, then some of the classes will be subdivided into more detailed classes. Various polarimetric features will be used at different classification levels based on their characteristics. The preliminary result reveals that entropy of the HV SAR image is a good descriptor for forest and roads. More polarimetric features will be investigated. The capacity of different polarimetric features for differentiating various land-cover types will be analyzed and compared. The pros and cons of the new hierarchical classification method will be discussed.

Abstract number 600

Abstract title Determining the Temporal Detection Period of Fire Scars in a Mixed Grassland Ecosystem

Author list Geoffrey Gunn and Joseph Piwowar, University of Regina.

Abstract

This analysis attempted to determine the effective temporal window in which a fire scar in a mixed grassland ecosystem would remain with enough of a spectral differentiation to classify. To accomplish this, original Landsat TM and ETM+ data were used with common transformations and vegetation indices. These images were examined using a histogram-based separation analysis to form groups of highly separated images for classification. A single-image classification was performed on each collected group for each image, followed by manual reclassification into burnt and unburnt information classes. This analysis determined that a principle component transformation of all TM/ETM+ reflectance bands plus the thermal infrared emission band provided the most consistent low-error image of the fire scar. Nearly as effective—particularly in summer months—was a classification that incorporated all available images: seven TM/ETM+ images, five principle components, three tasselled cap images, and three vegetation indices. Also effective, particularly at points in time further removed from the original fire event, was the group that incorporated all images with a separation index value greater than 0.5, as opposed to groups made with only the top 4 or top 2 separated images.It can be concluded from this that a principle components transformation is the best candidate for reliable classification when the thermal infrared emission band is included with standard reflectance bands. This is likely caused by the mixture of mostly-correlated reflectance bands with an uncorrelated and highly spectrally separated thermal emission band that aids in unsupervised classification.

Abstract number 601

Abstract title NEURAL NETWORK CLASSIFICATION OF HYPERSPECTRAL IMAGE DATA FOR IMPROVED SITE-SPECIFIC HERBICIDE MANAGEMENT.

Author list P.R. Eddy (1,2), A.M. Smith (3,2), B.D. Hill (3), D.R. Peddle (2), C.A. Coburn (2), R.E. Blackshaw (3).
1 - Alberta Terrestrial Imaging Center
2 - Department of Geography, University of Lethbridge
3 - Agriculture and Agri-Food Canada,

Abstract Site-Specific Herbicide Management (SSHM) in Precision Agriculture (PA) requires weed detection in crop fields for directed herbicide application instead of spraying entire fields. This technique has significant economic and environmental advantages for improved agricultural practices. In this study, Artificial Neural Networks (ANNs) were evaluated for crop and weed discrimination accuracy using very high resolution (1.25mm spatial) hyperspectral image data acquired on two dates (July 19 and 26, 2005). Two network model development methods, one using the full hyperspectral cube (single and multi-temporal training) and second using a reduced subset of narrow bands, quantified the effect of spectral and temporal dimensionality on classification accuracy. The results obtained were evaluated against the commonly used Maximum Likelihood Classification (MLC).

The ANN models consistently outperformed MLC in both single date and multi-temporal classifications as well as in reduced subset of narrow input bands. Higher class accuracies were obtained with multi-temporally trained ANNs (84-92% overall), with improvements up to 31% over MLC. Classification accuracy from a narrow waveband subset (7 of the original 61 bands) resulted in overall accuracy reductions of only 1-2%. Generally, the reduction of the original 61 wavebands to 7 bands provided similar classification results (spatially and contingency tables) in all weed/crop combinations. Multi-temporal training provides adaptability of the network models in the temporal domain, while the reduction of spectral information to a subset of narrow bands will improve processing efficiency. With advancements in imaging technology and computer processing speed, this ANN method may constitute a viable farm option for real-time detection and mapping of weed species for SSHM of cropping systems.

Abstract number 602

Abstract title Remote Sensing of Ecosystem Light Use Efficiency

Author list

Karl F. Huemmrich (1), Elizabeth Middleton (2), David Landis (3),
Andy Black (4), Alan Barr (5), J. Harry McCaughey (6), Forrest G. Hall (1).
1 - University of Maryland
2 - NASA Goddard Space Flight Center
3 - SSAI,
4 - University of British Columbia
5 - Climate Research Branch, Meteorological Service of Canada,
6 - Queens University.

Abstract

Understanding the dynamics of the global carbon cycle requires an accurate determination of the spatial and temporal distribution of photosynthetic CO2 uptake by terrestrial vegetation. Optimal photosynthetic function is negatively affected by stress factors that cause down-regulation (i.e., reduced rate of photosynthesis). Present modeling approaches to determine ecosystem carbon exchange rely on meteorological data as inputs to models that predict the relative photosynthetic function in response to environmental conditions inducing stress (e.g., drought, high/low temperatures). This study examines the determination of ecosystem photosynthetic light use efficiency (LUE) from remote sensing, through measurement of vegetation spectral reflectance changes associated with physiologic stress responses exhibited by photosynthetic pigments. This approach uses the Moderate-Resolution Spectroradiometer (MODIS) on Aqua and Terra to provide frequent, narrow-band measurements of high radiometric accuracy. The reflective ocean MODIS bands were used to calculate the Photochemical Reflectance Index (PRI), an index that is sensitive to reflectance changes near 531nm associated with vegetation stress responses exhibited by photosynthetic pigments in the xanthophyll cycle. MODIS PRI values were compared with LUE calculated from CO2 flux measured at four Canadian forest sites: A mature Douglas fir site in British Columbia, mature aspen and black spruce sites in Saskatchewan, and a mixed forest site in Ontario, all part of the Canadian Carbon Program network.

Abstract number 603

Abstract title Hyperspectral Discrimination of Cottonwood Clones in Southern Alberta

Author list Aaron Mullin, Craig Coburn. University of Lethbridge

Abstract

Riparian forests play a central role in maintaining healthy riverine ecosystems. Floodplains in temperate climates are natural colonization areas for cottonwoods (Populus spp.) where they act as an umbrella species which ensures ecosystem diversity and health. Cottonwoods have a rich diversity of species at the stand level in Southern Alberta. Until now, however, a census of the species richness at the stand level was time consuming, labour intensive, and relatively costly. Ground-based hyperspectral measurement from a number of different cottonwood species including many cottonwood clones were measured across the 2008 growing season. These measurements were made at both the leaf and canopy level and were evaluated for their ability to differentiate cottonwood species. A principle components analysis was conducted on the temporal database and differences with senescence patterns were extracted at 1450, 1120, 420, 590, and 520nm. Using ANOVA, these results indicate that spectral differences in senescence patterns exist for three cottonwood species (Populus deltoides, Populus balsamifera, and Populus angustifolia) at a 90% confidence level.

Abstract number 604

Abstract title Monitoring Glacial Change with ALOS PALSAR

Author list Don Atwood, Franz Meyer
Geophysical Institute, University of Alaska Fairbanks

Abstract

Significant retreat has been seen in many glaciers worldwide. With increasing concern about the impact of global warming, there has been a concerted effort to monitor on-going change. Projects such as GLIMS (Global Land Ice Measurements from Space) rely upon the contributions of institutions worldwide to update a global database of digital glacier outlines. To a great extent, this effort relies upon the manual extraction of glacier area from satellite optical instruments, such as ASTER. Unfortunately, dependence on optical imagery poses two significant challenges. First, clouds preclude viewing of many glaciers, making periodic measurements impossible. Second, many alpine glaciers are characterized by debris-cover. Thus, clear delineation of glacial extent becomes difficult via low resolution optical means.

The sensitivity of SAR coherence to motion offers a method for detecting glacial extent that is independent of weather and debris-cover. In this paper, we describe an automated methodology for delineating area for two glaciers in Alaska; one with and one without debris-cover. We rely upon the periodic global observations of the Advanced Land Observing Satellite (ALOS) L-band PALSAR instrument to generate coherence images. These serve as the primary indicator of glacial extent. However, coherence can be degraded by the topography of mountainous areas. Hence we have developed a decision tree that also considers phase gradients and mountain slope to identify glacier boundaries. The result is a robust technique for generating digital glacier outlines. Coupled with the comprehensive global acquisitions of ALOS, it suggests a new methodology for monitoring glacier change around the world.

Abstract number 605

Abstract title Inferring spatial distribution of vegetation nitrogen content from airborne hyperspectral remote sensing imagery

Author list Yongqin Zhang (1), John R Miller(1), Jing M Chen (2).
1 - York University
2 - University of Toronto

Abstract Leaf chlorophyll and nitrogen content are important bio-indicators of vegetation growth and health. Detailed examinations of chlorophyll-nitrogen relationships among tree species have been scarce. Spectrally continuous airborne hyperspectral remote sensing imagery has proven successful at retrieving vegetation total chlorophyll content, an important parameter related to leaf nitrogen content, at both leaf and canopy scales.

In this research, extensive field and laboratory experiments were carried out for seven main tree species in a boreal forest in southeastern Ontario, Canada. Leaves were sampled from sites of different conditions through the growing season. Year-around comparative experiments were also conducted at one black spruce (Picea mariana (Mill.)) stand, in which two groups of trees were subjected to control and girdle treatments, respectively. The variation of leaf chlorophyll and nitrogen content, and their relationship through the season and under various growth conditions were investigated. Consistent correlation was found between leaf chlorophyll and nitrogen content. Leaf nitrogen and chlorophyll content in new needles are more closely correlated than in old needles. Leaf nitrogen content of old needles showed stronger correlation to chlorophyll content on a mass basis, while new needles showed tighter correlation on an area basis.

During the active growing season, a general correlation (r^2=0.78) between these two variables on a mass basis were found among 282 leaf samples of different leaf age, growth conditions, leaf habit (deciduous and evergreen) and growth stages. Leaf nitrogen content was estimated from leaf chlorophyll content with an accuracy of RMSE=2.2 mg/g, equivalent to 20.5% of the average measured nitrogen content. Combing this chlorophyll-nitrogen link and a hyperspectral remote sensing algorithm for leaf chlorophyll content retrieval, leaf nitrogen content of major land cover types in boreal forests was inferred and mapped using the airborne hyperspectral remote sensing imagery acquired by Compact Airborne Spectrographic Imager (CASI).

Keywords: leaf nitrogen content, leaf chlorophyll content, relationship, hyperspectral remote sensing

Abstract number 606

Abstract title

Using Bi-Directional Reflectance to Identify and differentiate crop types using the University of Lethbridge Lightweight Field Goniometer 2 (ULGS2).

Author list

Steve Myshak (1), Craig Coburn(1), Philippe Teillet(1), Anne M. Smith,
1 - University of Lethbridge
2 - Agriculture and Agri-Food Canada

Abstract

The use of bidirectional reflectance characteristics for the identification of Earth surface features represents a more complete use of their reflectance characteristics. Given that the majority of natural targets are not perfectly diffuse reflectors, additional information can be gained by observing the bidirectional reflectance characteristics of a target. Crop canopies are often difficult to characterize using a single angle reflectance measurement due to their complex and varied canopy structure. Several hyperspectral bidirectional reflectance data sets of canola, triticale, and field pea canopies were acquired with the use of a new and novel goniometer system at the Agriculture and Agri-Food Canada Research Centre in Lethbridge, Alberta Canada. Hyperspectral bidirectional scans were completed using a 360⁰ azimuthal hemispherical pattern acquiring 221 points from +60⁰ to -60⁰ zenith at 10⁰ resolution in both dimensions. Scan comparisons revealed that angle and orientation with respect to the solar principal plane are important factors in identifying crop type. For these crops of varied architecture, some angles reflected only 3% difference in the NIR, and even less in the visible, while for other scan angles, differences as great as 25% in the NIR and 6% in the visible spectrum were recorded. With this information, optimal scan angles for crop canopy differentiation were determined. These findings could be used to help identify and differentiate different crop types from remote sensing platforms such as SPOT, CHRIS and other hyper- or multi-spectral systems with off-nadir capabilities.

Abstract number 607

Abstract title First Field Tests of realSens; for Detection of Leaks of Natural Gas

Author list Boyd T. Tolton, Doug Miller, and Adrian Banica

Abstract realSens is an imaging infrared remote sensing technology developed by Synodon Inc. for the detection of leaks of natural gas. It employs a new form of gas-filter correlation radiometer (GFCR) known as a simultaneous view correlation radiometer (SVCR), specifically designed for airborne surface-viewing atmospheric remote sensing. Detection of leaked natural gas is achieved by detecting the presence of ethane (C2H6), a minor component of natural gas with an atmospheric background concentration of ¡Ö1 ppbv. By detecting C2H6 in natural gas instead of methane (CH4), fewer ¡°false¡± leak are detected. The instrument is a 32 pixel wide push-broom imager providing a spatial resolution of 2 m on ground for a 64 m wide swath from a nominal altitude of 300 m. The first flight of realSens was in December 2007, with first field tests performed in Tucson AZ in January 2009. The commercial realSens service is scheduled to commence in May 2009. This paper describes the SVCR technique, the realSens instrument and the results of the first field test of the realSens technology.

Abstract number 608

Abstract title BIOPHYS: A Physically-Based Continuous Fields Algorithm for Ecosystem, Climate and Carbon Models

Author list
Forrest G. Hall - NASA GSFC
Derek R. Peddle - Department of Geography, University of Lethbridge
Fred Huemmrich - NASA GSFC

Abstract
Remote sensing imagery contains essential biophysical and structural information (BSI) for input to ecosystem, climate and carbon models. However, conventional methods to extract this information have been problematic. This paper presents the BIOPHYS algorithm as an improved, physically based approach for deriving required vegetation continuous fields for independent use and validation, and/or follow-on process model input. BIOPHYS is based on innovative and flexible methods implemented for the inversion of canopy reflectance models, such as the multiple-forward mode (MFM) approach. Based on spectral, angular, temporal and scene geometry inputs that can either be provided or derived, the approach generates look-up tables (LUTs) that comprise reflectance data, structural inputs over specified or computed ranges, and associated CRM output from forward mode runs. Image spectral values (per-pixel) are located in the LUTs together with corresponding BSI output as the continuous fields results. BIOPHYS results using models such as GeoSail and GOMS are summarised from a variety of study areas, sensors and models, such as multi-angular airborne image data from Minnesota, multi-temporal Landsat imagery from Virginia, and MODIS imagery from boreal and montane sites in Canada. Overall results indicated that integrated analyses of imagery acquired at multiple solar view angles improved retrieval precision, with solution set processing validated against BSI site means; retrieval results were sensitive to sun-surface-sensor geometry that is captured in the BIOPHYS algorithm; and that, for a temporal chronosequence, results over a decade period in Virginia provided outcomes such as the area and percent of forest disturbance (burned,logged: 1.03 Mha, 5.8% of area) and with early regrowth and succession (0.89 Mha, 4.9%) that represented useful inputs to process-driven models.

Abstract number 609

Abstract title MFM Canopy Reflectance Modeling of Forest Stand Height in Mountainous Terrain, Kananaskis Alberta

Author list Neal Pilger (1, 2), Derek R. Peddle (1) and Ronald J. Hall (1, 3)
1 - Department of Geography, University of Lethbridge
2 - Queen's Univ-Geography
3 - CFS-NFC Edmonton

Abstract The estimation of tree or stand height is a fundamental forest attribute collected during a forest inventory. As a result, remote sensing, particularly from passive optical satellite imagery, has been widely explored but has had variable success. In this paper, a physically-ba sed modeling approach based on multiple-forward mode (MFM) canopy reflectance model inversion was used to derive tree heights for different species within the Montane Ecoregion at Kananaskis Alberta in the Canadian Rocky Mountains. Overall MFM height accuracies against field measurements were ±0.9m for lodgepole pine and ±1.4m for trembling aspen from IKONOS 4m imagery. Based on results from this and other MFM studies covering larger regions and involving diverse applications, MFM provides a capability for height estimation from passive optical satellite imagery over areas that are neither feasible nor cost-effective with current LiDAR, aerial photography, radar or field-based surveys. MFM output is suitable for independent use, or for integration with existing forest inventories or other applications.

Abstract number 610

Abstract title

Adaptive Full-Blind Multiple Forward-Mode Canopy Reflectance Model Inversion of Forest Structure in Mountain Pine Beetle Damaged Stands, Central British Columbia

Author list

Derek R. Peddle (1), Sarah Boon (1), Aaron P. Glover (1), and Forrest G. Hall (2)
1 - Department of Geography, University of Lethbridge
2 - NASA GSFC

Abstract

A new approach for using canopy reflectance models is presented that requires no field data or knowledge about the image(s) used or the study area. The fully unconstrained Multiple Forward-Mode Adaptive Full-Blind (MFM-AFB) method provides forest biophysical structural information (BSI) and can be used for classification, biomass estimation and spectral mixture analysis at sub-pixel scales – without needing training data, endmember spectra, or user-specified model inputs. In an example application using 2007 Landsat imagery of forest damaged by a mountain pine beetle (MPB) epidemic in British Columbia Canada, overall accuracy was ±0.10 trees/m2 for stand density, ±0.5m for crown radius, and ±1m tree height for healthy and MPB stands. MFM-AFB software is suitable for regional, multi-temporal and unknown imagery and areas. By eliminating the need to know a priori model inputs to infer BSI, MFM-AFB may help enable more mainstream use of diverse and advanced CRMs for image analysis.

Abstract number 611

Abstract title Recent Results on Forest Height and DTM Extraction using a Single-Pass Fully Polarimetric L-Band InSAR System

Author list Bryan Mercer, Qiaoping Zhang, Marcus Schwaebisch, Michael Denbina

Abstract

Polarimetric SAR interferometry (Pol-InSAR) has shown considerable promise in recent years in a variety of applications. Extraction of forest height and DTM beneath the forest are applications of particular interest. The use of L-Band SAR data is of specific relevance since it has reasonable forest penetration capability while being less restricted by bandwidth licensing restrictions than longer wavelengths. Thus it is being considered for satellite platforms of the future. However the interferometric phase response recorded from typical forest environments is a mixture of ground and forest contributions. The potential of Pol-InSAR, together with an appropriate model such as the Random Volume Over Ground (RVOG) model, has demonstrated significant success for the recovery of canopy height and, to a lesser extent, ground elevation beneath canopy, as has been documented in the literature.

However, the L-Band experience to date has been obtained with repeat-pass Pol-InSAR, so that temporal de-correlation as well as residual motion remains an issue. For this reason, an experimental L-Band, fully polarimetric, single-pass, airborne InSAR system has been developed at Intermap, to assess performance in forest conditions in the absence of temporal de-correlation and residual motion issues.

In this paper, we show results from recent tests using this newly-developed, unique, single-pass L-Band Pol-InSAR system. A series of tests were carried out over the period December 2007 – June 2008 in western Canada. In this paper we present test results from a pine-forested area near Edson, Alberta with stand heights ranging to 30 meters, interspersed with clear-cut areas of new growth. Ancillary data, used for analysis and comparative purposes, included high resolution color air-photos, X-Band image and DEM data, and lidar ground and feature data. Results presented in this paper demonstrate forest height accuracies at the 5-10% level for canopy heights in the 15-30 meter range. Corresponding DTM accuracies achieved were at the 3 meter RMSE level. Follow-on plans will be presented.

Abstract number 612

Abstract title ATIC (Alberta Terrestrial Imaging Center) - an Introduction

Author list Erik Kokko - ATIC, Lethbridge Canada.

Abstract The presentation will introduce ATIC, the Alberta Terrestrial Imaging Center. ATIC is a not-for-profit Start-Up Company that is a joint venture between the University of Lethbridge and Iunctus Geomatics Corporation. Its mandate is to undertake research and development of remote sensing software tools and to develop applications and products for remote sensing end users for managing natural resources and protecting the environment. ATIC also is developing the Canadian academic market for SPOT satellite data. The presentation will outline who we are and what we do, with many examples.

Abstract number 613

Abstract title

Anisotropic Reflectance Effects on the Sensitivity of Spectral Indicies for Estimating Ecophysiological Parameters

Author list

Craig Coburn, Eric Van Gaalen, Derek Peddle, Lawrence Flanagan. University of Lethbridge.

Abstract

Remote sensing studies are affected by the influence of the anisotropic reflectance of natural surfaces. This study investigated the bidirectional reflectance factor (BRF) properties of Pleurozium schreberi moss from the Fluxnet-Canada Western Peatland site in northern Alberta. Using a sequence of hyperspectral reflectance measurements from the University of Lethbridge Goniometer System, plant BRF values were evaluated with respect to their effect on a variety of spectral indices. These indices, such as the water band index (WBI), are often used to estimate ecophysiological parameters such as plant water content and subsequently have the potential to contribute to estimates of ecosystem CO2 flux across large regions. Laboratory BRDF measurements of Pleurozium schreberi moss were made and WBI computed under controlled illumination conditions to evaluate the degree of potential variation in WBI by view direction. As viewing angle increased from nadir, WBI declined dramatically from 1.40 to 1.24. This finding increases our understanding of the effect of anisotropic reflectance on vegetation indices and enhances our ability to derive improved information from remote sensing data when these angular effects are prevalent for different surface targets.

Abstract number 614

Abstract title

Image and Terrain-based Estimation of Snow Distribution in the Canadian Rocky Mountains: A Comparison of Spatial Interpolation Methods

Author list

Shiyong Y. Xu and Derek R. Peddle - Department of Geography, University of Lethbridge

Abstract

Snow is the primary form of precipitation in the Canadian Rockies and provides essential water for downstream urban, agricultural, industrial and other needs. However, it is challenging to accurately describe the spatial variation of snow accumulation, especially in this mountainous environment, for input to water quantity analyses and monitoring studies. This paper tested several local and global interpolation methods for mapping snow spatial variation based on image delineated snowpacks and terrain based indices for a high relief, 2300 km2 area in the Front Ranges of the Rocky Mountains in Alberta and British Columbia Canada. Research results showed that two topoclimatic indices, the Orographic Precipitation Index (OPI) and the Slope-Aspect Index (SAI), were significantly related to snow accumulation. OPI is a function of elevation and proximity to the continental divide and is an indicator of precipitation, and SAI is derived from terrain geomorphometry and is driven by wind processes with respect to snow redistribution. Elevation was a key explanatory variable for snow accumulation and snow depth variation amongst all predictor variables. The error indicators showed that the global interpolation methods, regression tree model, linear regression model, and generalized additive model (GAM) had more robust capability for snow depth estimates than local methods. GAM provided the most accurate estimates, as it explained 92% of the variance in the observed snow accumulation data with an average error of 71 cm snow depth at the study site. Using GAM, a snow accumulation distribution map was produced. Given appropriate elevation model and image inputs, the GAM method presented here could be used in the parameterization of a distributed hydrological model.

Abstract number 615

Abstract title An Inventory of Canadian Universities Active in (Radar-) Remote Sensing

Author list Dirk Werle, Aerde Environmental Research, Halifax, NS
Guy Aube, Canadian Space Agency, St. Hubert, QC

Abstract Over the past decades, university-based remote sensing education and research in Canada has gained domestic and international attention and experienced significant growth. However, there is little up-to-date information relating to location, size, strength and thematic interest of this community of professors, lecturers and researchers engaged in this field. Recently, the Canadian Space Agency's Earth Observation Applications & Utilization Division has commissioned a study with the objecti
ve to collate and summarize information on university-based remote sensing activities in general and radar-related activities in particular. This paper provides an overview of the study and its main results.

Abstract number 616

Abstract title

Demonstration of RADARSAT-2 and
Space-based Automatic Identification System (AIS) for Ship Detection

Author list

Paris W. Vachon (1), Nicholas Sandirasegaram(1), Ryan English(1), Jeff Secker(1), and Ian D'Souza (2)
1 - Defence R&D Canada – Ottawa
2 - COM DEV Canada

COM DEV Canada

Abstract

The integration of Automatic Identification System (AIS) ship information with ship signatures in synthetic aperture radar (SAR) imagery improves the identification of ship targets. AIS, a ship-based VHF transponder system intended for collision avoidance and vessel traffic management, is typically received line of sight from coastal, airborne, or ship-based stations. Space-based AIS reception was recently introduced on several fronts, but here we focus on the Nano-satellite Tracking of Ships (NTS) mission that COM DEV launched in 2008 as a risk-reduction activity. We were able to arrange for concurrent acquisition of NTS AIS data and RADARSAT-2 ScanSAR narrow imagery (HH + HV) off the coast of Iceland on 24 October 2008. Ships were detected in the RADARSAT-2 imagery using several different ship detection engines and were correlated with both space-based and shore-based AIS data. Twenty one different fishing vessels in the 29 m to 70 m length range were identified in the RADARSAT-2 imagery. Of these, 76% were detected by NTS AIS while only 52% were detected by coastal AIS. Of the ship detection engines considered, the best performance was observed for very simple detection algorithms operating on the HV channel alone. The results demonstrate the value added that is realized by integrating data from these two sources, as well as the impact that space-based AIS reception will have on ship surveillance.

Abstract number 617

Abstract title Decision Support for Real-time Oil Spill Emergency Management

Author list Jason Levy (1), Hamid Assilzadeh (2), and Yang Gao (2).
1 - Virginia Commonwealth University
2 - University of Calgary

Abstract

Abstract:
Advances in decision support can make a valuable contribution to enhancing real time Oil Spill Emergency Management. The current generations of oil spill emergency management systems provide reliable, detailed, cost-effective, and continuous coverage of land and sea-based oil spills. We seek to important questions about the role of decision support for Real-time Oil Spill Emergency Management such as: What is the most effective way to marshal resources to respond to an oil spill? How to reconstruct the historical record of a previous oil spill? We focus on advances in operations research and real-time data acquisition and hardware/software integration to improve the monitoring and control of emergency vehicles with fixed or moving sensors.

Abstract number 618

Abstract title Remote Sensing of Vegetation Phenology and Relations to Grizzly Bear Health

Author list David Laskin1, Scott Nielsen2, Jennifer Hird1, Greg McDermid1, Gord Stenhouse3
1. Foothills Facility for Remote Sensing and GIScience, Department of Geography, University of Calgary,
2. Department of Renewable Resources, University of Alberta, 3. Foothills Research Institute and Alberta Fish and Wildlife Division.

Abstract The grizzly bear (Ursus Arctos L.) is an umbrella species whose populations in Alberta are threatened by habitat loss and high rates of human]caused mortality. Understanding the impact of landscape disturbance on grizzly habitat is a serious management concern, especially considering the temporal brevity and spatial limitations of optimal forage sites for these animals. The potential of recently available satellite imagery to map the quality and spatio]temporal distribution of essential herbaceous foods remains largely untapped. The primary objectives of this study are to understand i) how natural phenological changes in vegetation, both intra] and inter]annually, affect grizzly bear habitat conditions in Alberta, and ii) how these natural variations affect individual animal health, which is presumed to be an effective indicator of overall population condition. More specifically, in this paper we assessed the relationships between satellite]based phenological variables, derived from multi]temporal MODIS Normalized Difference Vegetation Index (NDVI) data sets, and field]based measures of individual grizzly bear body condition.

Abstract number 621

Abstract title

Tracking Annual Landscape Change in the Rocky Mountain Foothills of Alberta: An Application of the Disturbance-Inventory Monitoring Framework

Author list

J. Linke, G. McDermid Department of Geography, University of Calgary, Calgary, Alberta

Abstract

Change detection is concerned with the accurate identification and portrayal of dynamic features on the landscape. In geographic data models, these features are represented by spatial entities and their associated attributes. When pursued within a conventional remote sensing framework, change detection projects tend to place less emphasis on the precise delineation of entities (spatial accuracy) than on the accurate identification of attributes (thematic accuracy). However, when the purpose of the analysis involves quantifying landscape pattern (aka landscape metrics), spatial accuracy and consistency across the monitoring timeframe becomes critical.

In this research, we describe the application of our disturbance-inventory monitoring framework to track landscape change from 1999 to 2005 across a 60,000 km2 study area in the foothills of west-central Alberta, Canada. The approach uses annual Landsat imagery to delineate disturbance objects, which are stored in a vector database and boundary-conditioned to allow for seamless and sliver-free integration. The annual rates of change in forest composition and configuration in this area are reported at two scales of observation.

Abstract number 622

Abstract title Effect of Photo Plot Displacement on Landscape Pattern Analysis: Implications for Biodiversity Monitoring in Alberta

Author list J. Linke, G. Castilla, A. McLane, G. McDermid Department of Geography, University of Calgary, Calgary, Alberta

Abstract

The Alberta Biodiversity Monitoring Institute's (ABMI's) core goal is to provide long-term monitoring of species and habitats in order to inform resource management and decision-making responsibilities in the province of Alberta, Canada. To achieve this goal, the ABMI maintains 1656 permanent sample sites evenly spaced across a systematic 20-kilometer grid, and conducts surveys at each site approximately once every five years. In addition to recording the occurrence and abundance of individual species, ABMI requirements also call for information on habitats, in order to enable inferences about the monitored species in non-sampled locations. To fulfill this need, the ABMI proposes establishing 3x6 km2 air photo plots surrounding each ground sample site, under the assumption that these photo plots will be representative of the mosaic in which the field plot is embedded. In this research, we investigated the effect of photo plot displacement on various landscape metrics used quantify the composition and configuration of landscape mosaics. We performed systematic displacements of 30 ABMI photo plots in the ALPAC FMA near Lac La Biche in northeastern Alberta. Within-site deviations of landscape metrics (i.e., metric deviations observed for individual plots) were found to increase significantly with displacement distance and unpredictably with direction, though some metrics were affected more strongly than others. The rate of increase was found to depend largely on the heterogeneity of the underlying landscape mosaic. Global deviations of landscape metrics (i.e., metrics deviations summarized across all 30 plots) were found to be unbiased overall by photo-plot displacement, though the loss of local precision raises questions surrounding sensitivity and detectability.

Abstract number 624

Abstract title Remote Sensing and Forest Inventory for Wildlife Habitat Assessment

Author list G.J. McDermid (1), R.J. Hall (2), G.A. Sanchez-Azofeifa (3), S.E. Franklin (4), G.B. Stenhouse (5), T. Kobliuk (6), and E.F. LeDrew (7)
1 - Foothills Facility for Remote Sensing and GIScience, Department of Geography, University of Calgary,
2 - Canadian Forest Service, Northern Forestry Centre,
3 - Department of Earth and Atmospheric Science, University of Alberta,
4 - Department of Geography, University of Saskatchewan,
5 - Foothills Research Institute and Alberta Fish and Wildlife Division,
6 - Resource Analysis Section, Forest Management Branch, Public Lands and Forest Division, Sustainable Resource Development, Edmonton, AB

Abstract Researchers and managers undertaking wildlife habitat assessments commonly require spatially-explicit environmental map layers such as those derived from forest inventory and remote sensing. However, end users must often make choices regarding the source and level of detail required for characterizing habitat elements, with few published resources available for guidance. We appraised three environmental data sources that represent options often available to researchers and managers in wildlife ecological studies: (i) a pre-existing forest inventory; (ii) a general-purpose, single-attribute remote sensing land cover map; and (iii) a specific-purpose, multi-attribute remote sensing database. The three information sources were evaluated on the basis of map quality attributes (accuracy, vagueness, completion, consistency, precision, and depth) and their ability to explain patterns of grizzly bear (Ursus arctos) telemetry locations across a 100,000-km2 study area in west-central Alberta, Canada. We found the forest inventory database to be reasonably functional in its ability to support resource selection analysis in regions where coverage was available, but overall, the data suffered from quality issues related to availability, accuracy, and consistency. The general-purpose remote sensing land cover product ranked higher in terms of overall map quality, but demonstrated a lower capacity for explaining observed patterns of grizzly bear habitat use. We found the best results using the specific-purpose, multi-attribute remote sensing database, and recommend that similar information sources be used as the foundation for wildlife habitat studies whenever possible, particularly those involving large areas that span jurisdictional boundaries.

Abstract number 625

Abstract title

Mapping the cumulative footprint of anthropogenic and natural disturbances in the boreal forests of Canada with the Landcover Change Mapper (LCM)

Author list

A.Fraser, G. Castilla, J.Linke, and G. McDermid

Abstract

Monitoring landscape change is a requisite for sustainable development that should be achievable through the analysis of multitemporal satellite imagery. However, the development of effective methods to analyze these data in a consistent and reliable manner is a challenging issue that demands new approaches. This presentation demonstrates the use of a recently developed change detection tool (the Landcover Change Mapper, LCM) for creating a spatially consistent, multi-date disturbance inventory. LCM is a software tool requiring little or no user interaction that rapidly generates a polygon vector layer (.shp) of regions of change from two images acquired over the same scene at different dates. The 34,000 km2 area that we used for this study is located in west-central Alberta, Canada (WRS-2 Path 44 / Row 23), and is chiefly covered with boreal forest. Main disturbances in the area include timber harvesting (clearcut), oil and gas exploration (seismic cutlines) and extraction (wellsites), surface mining, and forest fires. The ultimate goal of this study is to evaluate whether the LCM tool can successfully replace Definiens object-oriented image analysis software in the detection and delineation of new disturbance features. We compared the performance of the LCM and Definiens for detecting areal disturbance features (cut blocks, mines, and forest fires) that occurred in the study area between 2001 and 2005 using Landsat TM imagery.

Abstract number 626

Abstract title Influence of the extent of sample landscapes on the accuracy of human footprint statistics in the context of biodiversity monitoring

Author list Adam McLane, Jennifer Hird, Julia Linke, Guillermo Castilla, and Greg McDermid

Abstract

The accurate quantification of the human footprint of a region, i.e., the accumulated impact of human activities on the landscapes of that region, is an indispensable requirement for sustainable development and species management. The human footprint concept is particularly relevant for biodiversity issues, as demonstrated by the approach followed by the Alberta Biodiversity Monitoring Institute (ABMI). To estimate reference conditions (under a pristine situation), upon which the intactness of a species or group of species can be monitored, the ABMI seek to establish empirical relationships between species occurrence/abundance and human footprint. We present a remote sensing-based approach to quantify the amount of human footprint at 1656 3x6 km ABMI sample plots across the province of Alberta, which represent a sampling intensity of 4.5% and evaluate the deviation of human footprint statistics with varying sampling intensity and sample plot extent. By analyzing these deviations in human footprint statistics, this work illustrates the balance between increasing costs and the loss of information incurred by sampling at smaller extents, as well as the benefit of multi-scale analysis in biodiversity monitoring. Analysis reveals human footprint statistics deviate far greater from 100% sampling intensity at the local level than they do at the regional level. These results indicate that regional assessment of human footprint is far less sensitive to changes in sampling intensity and extent than is a local assessment.

Abstract number 627

Abstract title Comparing Remote-Sensing and Climate-Based Methods for Modeling Pine Species

Author list Adam McLane, Greg McDermid, Nicholas Coops

Abstract

It is recognized that the combination of spectral and topographic information for predicting the stand-level occurrence of pine species has proven useful; however the empirical nature of the approach combined with a reliance on indirect variables may hinder its portability. In addition, recent research has shown that mechanistic variables such as coldness, warmness and wetness derived from large-area climate products can be used to estimate the probability of occurrence (POC) of pine species at the regional level. A model-based, quantitative evaluation that compares remote-sensing, topographic and climate oriented approaches to mapping pine species distribution at the stand-level is presented using See5 software and cross-validation model evaluation. By comparing these approaches for stand-level pine species distribution prediction, this work offers a new and more detailed look into the performance of these methods and the various factors that can influence them. The analysis revealed the superiority of spectral information from the remote sensing approach when it comes to the prediction of pine species at the stand level. The results indicate the suggested portability of remote sensing-derived variables and the lesser influence of mechanistic variables when it comes to stand level characterization of pine species distribution.

Abstract number 628

Abstract title Mapping and Update of Vegetation and Land Cover for Grizzly Bear Research and Conservation in Alberta

Author list G.J. McDermid (1), S.E. Nielsen (2), J.N. Hird (1), D.N. Laskin (1), S.E. Franklin (3), and G.B. Stenhouse (4)
1 - Foothills Facility for Remote Sensing and GIScience, Department of Geography, University of Calgary,
2 - Department of Renewable Resources, University of Alberta,
3 - Department of Geography and Planning, University of Saskatchewan,
4 - Foothills Research Institute and Alberta Fish and Wildlife Division,

Abstract The purpose of the Foothills Research Institute Grizzly Bear Research Program (FRIGBRP) is provide knowledge and management tools designed to ensure the long-term conservation of grizzly bears (Ursus arctos) in the province of Alberta, where the species is under pressure from habitat loss and human-induced mortality. In recent years, the FRIGBRP's science program has been working diligently to map grizzly bear range across the entire province of Alberta: roughly 228,000 km2 of complex multi-jurisdictional terrain. In addition to generating initial maps products, the program has also grown to incorporate an updating/monitoring component required to maintain the temporal relevancy of our geospatial map products. In this paper, we present an overview of recent mapping and remote sensing activities in the FRIGBRP, as they pertain to mapping and monitoring Alberta's grizzly bear range. We start first with a brief review of previous mapping efforts and lessons learned, followed by a description of our present mapping and update strategy. Finally, we give a current account of the provincial grizzly bear habitat-mapping work, including a look at the latest remote sensing products and their transformation to RSF-based habitat maps. The recent completion of habitat-mapping in the province has led directly to specific management changes in Alberta, including the delineation of grizzly bear conservation areas in the province's new land use framework.

Abstract number 629

Abstract title Assessing the Effect Of Point Density And Terrain Complexity On The Quality Of Lidar-Derived Dems In Multiple Resolutions

Author list S. Sanii and G.J. McDermid
Foothills Facility for Remote Sensing and GIScience, Department of Geography, University of Calgary, Calgary, Canada.

Abstract Light Detection And Ranging (LiDAR) systems are rapidly becoming the prime source for high-resolution, high-quality digital elevation models (DEM). Data density and DEM resolution are two of the main factors that affect the quality of DEMs. In addition, point density plays an important role in LiDAR mission planning and cost of a LiDAR project. The goal of this project was to assess the effect of point density and terrain complexity on the quality of LiDAR-derived DEMs in multiple resolutions. The result indicated that the quality of DEM is more affected by point density and terrain complexity than by DEM resolution. DEMs created from low-density datasets were found to be more sensitive to terrain complexity. However visual analysis of 3D DEM surfaces revealed that high-resolution DEMs created from low density data contain artefacts which degrade the quality of DEM. This observation stresses the importance of an appropriate evaluation strategy when assessing the quality of DEM and other 3D surface models.

Abstract number 630

Abstract title

Characterization of Olive (Olea europaea L.) Tree Crowns Using Terrestrial Laser Scanning and 3D Radiative Transfer Modeling

Author list

Inian Moorthy (1), John R., Miller (1), Jose A. Jimenez-Berni (2), Pablo J. Zarco-Tejada (2_, Baoxin Hu (1)
1 - Center for Research in Earth and Space Science, York University,
2 - Instituto de Agricultura Sostenible (IAS), Consejo Superior de Investigaciones Cientificas (CSIC), Córdoba, Spain

Abstract

Physically-based radiative transfer models are capable of accurately estimating biophysical variables of plant communities from remote sensing observations, provided that canopy architecture and scene components are accurately considered. With the recent introduction of Terrestrial Laser Scanning (TLS) units, there now exists a means of rapidly measuring structural details of vegetation canopies for input into 3D radiative transfer models. In this investigation, the Intelligent Laser Ranging and Imaging System (ILRIS-3D) was deployed to Córdoba, Spain, where field experiments were conducted in olive (Olea europaea L.) orchards. ILRIS-3D data was acquired for 24 structurally variable trees in two modes: a) conventional tripod-mounted horizontal perspective and b) nadir perspective (i.e from a platform 12 meters above ground). The laser pulse returns were analyzed to retrieve crown dimensional parameters, namely tree height, crown width, crown height, and foliage assemblage properties, like gap fraction, leaf area index (LAI) and clumping index. These retrievals were used as direct inputs into the Forest LIGHT (FLIGHT) 3D ray tracing model for characterization of the spectral behavior of the olive crowns. Comparisons between FLIGHT simulated spectra and measured 6-band multispectral data showed minimal differences in the visible (< 3%) and near infrared (< 10%) range. These differences were subsequently correlated to the effects of background scene elements ($r^2 = 0.80$) and crown complexity ($r^2 = 0.71$). Such findings emphasize how TLS measured crown parameters can be used as accurate inputs into 3D radiative transfer models for precise spectral modeling.

Abstract number 631

Abstract title Spatial Heterodyne Observations of Water in Middle Atmosphere

Author list
Dr.Yunlong Lin
York University

Abstract
Water is a critically important constituent throughout the stratosphere and mesosphere. The Spatial Heterodyne Observations of Water (SHOW) project developed a new instrument to measure water vapour from 15km to 85km in height, on a global scale, using the unique capabilities provided by Spatial Heterodyne Spectroscopy (SHS). This work builds on Canadian expertise in fabricating solid Michelson interferometers to fill a significant niche in our current capability.
The SHS has similar setup as the FTS, but the mirror is replaced by diffraction gratings at Littrow configuration. Wavelength depended Fizeau fringes are recorded by a 320*256 InGaAs camera without any scanning elements, the high resolution spectral information along one detector dimension can be obtain from Fourier analysis, and the other dimension will provide the spatial information. At a limb view point, a field-widened SHS with half-angle of 6 degrees for water observations at 1364nm is desired, the resolution is 0.02nm within full bandwidth of 2nm, and the resolving power is about 68,000.

Abstract number 632

Abstract title

Global Monitoring of Green House Gases using
A Constellation of three Micro-Satellites

Author list

Dr.Yunlong Lin
York University

Abstract

Coupling our investigations in the current 'hot' issues of climate changes with our understanding of the better use of small satellite remote sensing, we came to concentrate on the monitoring of greenhouse gases (GHG) in the atmosphere across the world. It is our hope, through these studies that we may build a constellation of three Micro-satellites to assist WMO and world nations for the monitoring and control of GHG emissions, in accordance with domestic and international environment policies and agreements.

The three greenhouse gases monitoring Micro-satellites will be on Sun-Synchronous orbit and form a constellation to provide best land coverage and at least 250 cloud-free measurements in an area of 500km x 500 km each month. The Spatial Heterodyne Spectrometer with Infrared sensor array on-board each satellite could provide detailed spectral images of CO, CO2, CH4 and H2O in a spatial resolution of 1 km x 1 km.

In this paper, the scientific needs and orbital considerations for this constellation are introduced in the beginning. The prime sensor used in the mission is described in details. Following the discussions of the Microtechnology application in both payload design and small spacecraft design, the initial consideration of the mission operation is briefly described in the end.

Abstract number 633

Abstract title

A 2006 Land Cover Classification for Agricultural Land in Saskatchewan, Alberta and the British Columbia Peace River Region

Author list

David V. Hildebrand (1), Carmen Finnigan (2), Weidong Zhou (2), and Chun Chen (2)
1 - Agriculture Financial Services Corporation
2 - Digital Environmental

Abstract

An agricultural land cover classification was produced using multi-temporal AWiFS imagery from the RESOURCESAT-1 satellite. Composites were produced for May, July, and September of 2006. The land cover classes were Annual Cropland, Native Pasture, Improved Pasture, Hay, Forest, Wetlands, Water, Barren and Urban Areas. The study area was stratified by ecoregion prior to classification. Imagery was segmented into image objects with Definiens Professional and Classification and Regression Tree (CART) was used for regression tree analysis to predict class membership from the individual image bands. Ground truth sites were distributed amongst the various land cover classes as well as ecoregions to be as representative as possible. An overall classification accuracy of 80% was achieved with annual cropland and pasture accuracy of about 85%. Most classification errors were caused by the presence of cloud or haze in one or more image date. These mismatched areas were resolved by isolating the problem cloud and haze by means of a cloud mask. An unsupervised ISODATA classification was used to fill the cloud areas.

Abstract number 634

Abstract title Effets des changements climatiques en zone tropicale : cas de la disparition des cours d'eau de la région de Katiola en Côte d'Ivoire

Author list
Talnan Jean Honoré COULIBALY, Université Paris Est, France
Jean Paul DEROIN, Université Paris Est, France
Issiaka SAVANE, Université d'Abobo-Adjamé, Côte d'Ivoire

Abstract
Depuis 1980, la disparition des cours d'eau de surface précédé par un phénomène d'eutrophisation se fait sentir dans toute l'Afrique de l'Ouest. L'objectif de cette étude est l'analyse et le suivi sur le terrain et par télédétection de l'organisation et de l'évolution des eaux de surfaces des savanes de Côte d'Ivoire précisément celle du département de Katiola de 1986 à 2009. Le travail a consisté à étudier une série d'images satellitaire de type LANDSAT. Contrairement aux régions glaciales ou le changement climatique se manifeste par une fonte des calottes de glace; dans les régions de savanes il se manifeste par l'assèchement, voire la disparition des eaux de surface. Le suivi de l'évolution des eaux de surface permet de mieux appréhender l'impact du changement climatique sur les savanes tropicales.

Abstract number 635

Abstract title On Incidence Angle Dependence in Polarimetric SAR Imagery

Author list Joseph R. Buckley, Department of Physics, Royal Military College of Canada

Abstract

The incidence angle dependence of the intensity of radar backscatter in SAR imaging is a well known phenomenon. Less well known is the effect of incidence angle on polarimetry. While it is clear that the distinction between the horizontal and vertical polarized response of a surface becomes blurred with decreasing incidence angle, it is less clear the effect this blurring has on derived polarimetric quantities.

In association with the Pacific Forestry Centre of Natural Resources Canada, a set of Radarsat 2 quad-pol imagery of the Petawawa Research Forest and the adjacent Canadian Forces Base Petawawa has been acquired and analysed. Every time the area could be imaged during the summer of 2008, an image was acquired. The resulting data set of 13 images spanned four different incidence angles, on both ascending and descending passes, and included several 24 day repeat pairs.

Analysis of this set shows a significant relationship between basic scattering mechanism as determined from the polarimetry and incidence angle. As incidence angle increases, so does the proportion of volume scatterers, while the proportion of surface scatterers decreases.

This result implies that, for the collection of long term time series of imagery over a specific site with the intention of monitoring land cover and changes in it, the incidence angle needs to be kept constant, or nearly constant, throughout the acquisition sequence.

Abstract number 636

Abstract title The Annual Cycle of Vegetation at CFB Shilo as Monitored with Radarsat 2 Polarimetry

Author list Joseph R. Buckley, Department of Physics, Royal Military College of Canada

Abstract

Many previous studies have related vegetation type and land cover classification to polarimetric SAR imagery, but, until now, these studies have only been able to collect one or two snapshots of the areas of interest. Using the operational capability of Radarsat 2, it is now possible to collect meaningful time series of imagery to investigate the temporal variability of vegetation, and the polarimetric SAR's ability to track it.

Through the Canadian Space Agency's SOAR programme, a time series of Radarsat 2 fine quad-pol imagery is being collected over the grasslands, forests and wetlands that comprise Canadian Forces Base Shilo in south-western Manitoba. This time series, on a 24 day repeat cycle, started in June, 2008, soon after the commissioning of the satellite and is continuing.

Results to date show a clear separation of grassland, deciduous forest, coniferous forest and wetland, and show changes consistent with the leaf cycle of the deciduous woodlands, with the summer growth of grasses, with changes in water level in the wetlands and with the onset of snow.

Comparison with related dual-pol ALOS/Palsar imagery acquired in 2007 show a consistency of major polarimetric features between years, imaging wavelengths, and polarization.

An implication of these results is that vegetation analysis through polarimetric SAR imagery certainly supplements analysis carried out with satellite imaging at visible and near-infrared wavelengths, and could become the primary tool for these studies.

Abstract number 637

Abstract title An Investigation into the Impact of Surface Saturation on Laser Pulse Intensity Data.

Author list Kevin Garroway (1), Chris Hopkinson (2), and Rob Jamieson (1).
1 - Dalhousie University.
2 - AGRG.

Abstract Airborne Laser Scanning (ALS) using a high-repetition, near infra-red, light pulse (LiDAR) provides more information about scanned surfaces than just high resolution elevation data. We explored the effect surface soil moisture had on Optech's ALTM 3100 laser pulse intensity. The purpose of this study was to assess the usage potential of ALS for mapping surface soil moisture. The study area, an agricultural watershed in the Annapolis Valley of Nova Scotia, was scanned seventeen times over an eighteen month period using controlled apparatus settings on two ALTM 3100 systems. The intensity data was normalized to account for range bias effects. The intensity values were scaled to an 8-bit output, 1 – 255, for comparability. Tests included comparing raw intensity data to range-normalized intensity data, comparing daily and seasonally collected data for change detection in intensity observations, and comparing intensity data to ground sampled volumetric moisture content data. The range-normalized intensity data comparison revealed that there are still unresolved issues with the technique, which was highlighted when adjacent flightlines were mosiacked. Temporal intensity fluctuations were identified throughout the study area; however a combination of vegetation conditions and moisture variability proved to be difficult to separate. Ground sampled volumetric moisture content data and the intensity data was not strongly correlated, however it was shown that the two methods were measuring similar trends at the surface level. Ground surface vegetation influences LiDAR return intensity to a greater degree than subtle changes in moisture.

Abstract number 638

Abstract title Monitoring Freeze/Thaw Conditions over Agricultural Fields from Radarrsat-2 Polarimetric Data

Author list Louis-Philippe Rousseau (1), Ramata Magagi (1), Robert Leconte (1), Aaron Berg (3), Brenda Toth (4),
1 - Université de Sherbrooke.
2 - École de technologie supérieure.
3 - University of Guelph.
4 - Environment Canada

Abstract Soil freezing/thawing is known to affect the emission of CO2 and NO2 gas from agricultural soils and hence contribute to the enhanced atmospheric greenhouse effect. Soil freezing/thawing also affects soil erodibility as erosion is related to rain on frozen or thawing soils. A good understanding of its spatial and temporal distributions is therefore important, as it can be used for a better planning of sowing and harvesting, and for the operational monitoring of damages caused by runoff during the spring. Frozen soil is characterised by a low dielectric constant that allows the microwave signal to interact with soil over a depth which depends on the signal frequency. In remote sensing, many studies showed the ability of active and passive microwaves for freeze/thaw detection and mapping. They relied on a thresholding approach applied to a) the spectral gradients of brightness temperatures computed from SSM/I (Special Sensor Microwave/Imager) or SSMR (Scanning Multichannel Microwave Radiometer) data and to b) the ratio of backscattering coefficients measured at the beginning and at the end of the fall season. In this study, we focus on the ability of RADARSAT-2 fully polarimetric data to monitor soils freeze/thaw conditions over agricultural areas located in Saskatoon (Saskatchewan) and in Lennoxville (Quebec). As a first step, a qualitative analysis will be undertaken to assess the sensitivity of RADARSAT-2 for frozen soils in comparison with AMSR-E (Advanced Microwave Scanning Radiometer - EOS) and SSM/I. Then, new algorithms for the mapping of frozen soils will be presented, based on target decomposition techniques developed by Freeman-Durden and Cloude-Pottier. The surface (Ps) and volume (Pv) contributions obtained from the Freeman-Durden decomposition will be analysed together with soil temperature variations. As for the results obtained from the Cloude-Pottier decomposition, the scattering of data in the H/α plan will be discussed according to soil temperature values. In addition, the effect of soil characteristics (type and roughness) on the results will be discussed. Conclusions can be drawn about the potential of these algorithms for monitoring frozen soils.

Abstract number 639

Abstract title

AMSR-E Passive Microwave Brightness Temperatures for Snow Properties Retrieval Compared With In-Situ Measurements across a Boreal Forest to Taiga Transect In Quebec

Author list

Alain Royer, Alexandre Langlois and Kalifa Universite de Sherbrooke

Abstract

To retrieve snow water equivalent (SWE) from satellites and other physical snow parameters needed for surface energy estimates (snow depth, density, grain size, temperature) or climate change studies is still a challenge. While passive microwave brightness temperatures (Tb) are among the most effective way to achieve this goal, the retrieval algorithms still show large uncertainties, in particular over Eastern Canada where high snow depths (over 1 m) and dense boreal forest are found.
The objective of this presentation is to analyze the AMSR-E 19 and 37 GHz brightness temperatures with intensive and detailed in-situ snow and vegetation measurements acquired during the QuÃ©becâ€™s IPY field campaign in February 2008 across various ecological regions from southern dense boreal forest to northern open tundra. The measured spaceborne data are compared to simulated brightness temperatures derived from the Swiss snow microwave emission model (MEMLS) using snow ground-based measurements. The in-situ grain size information needed for the radiative transfert calculation is derived from an innovative approach based on calibrated NIR-photographs of snowpit wall.
Strategies to improve SWE estimates are analyzed through the comparison between simulated and AMSR-E Tb and through a sensitivity analysis of model predictions for the wide range of observed snow types. We discuss the potential for retrieving SWE by coupling a snow model (SNOWPACK) driven by reanalysis NARR data with a snow emission model (MEMLS).

Abstract number 640

Abstract title Towards Validation of RADARSAT-2 Data and Snow on First-Year Sea Ice Parameterization.

Author list M. Christopher Fuller and Melissa Peters, University of Calgary

Abstract

This study presents polarimetric C-band backscatter observations of snow on first-year sea ice during the spring melt period in the Beaufort Sea and Hudson Bay.

The recent decrease in Arctic sea ice extent has the potential to open the region to transportation, resource, and economic development. These changes will impact human, wildlife, and environmental concerns. Snow cover plays an important role in both the formation and ablation of sea ice through insulating and albedo effects. The role of snow on sea ice is understood, however current parameterization of snowcover lacks validation; therefore, snowcover is rarely accurately represented in general circulation models. It is important to parameterize, quantify, and forecast snowcover properties for modeling Arctic sea ice trends with respect to global warming. The data set consists of surface-based C-band polarimetric backscatter with concomitant RADARSAT-2 backscatter and in situ snow data (ie. depth, density, salinity, dielectric properties) collected in April and May of 2008 and 2009. Snow transect and variogram data (depths, surface roughness) over rough and smooth first-year sea ice from both study periods will also be presented. The goal of this work is to derive relationships between polarimetric response and change in snow properties. This work is expected to provide surface-based validation of RADARSAT-2 backscatter. Modeled relationships will be inverted in order to estimate snowcover properties from RADARSAT-2 polarimetric SAR data.

Abstract number 641

Abstract title Implementation of a New Adaptive Image Representation Approach (AIPR-BPNN) For Compression of IKONOS Images

Author list
V. Sherkashyn (1), D.-C. He (1), R. Kountchev (2)
1 CARTEL- Centre d'Application et de Recherche en Télédétection, Département de Géomatique Appliquée, Sherbrooke, Canada.
2 Department of Radio Comunication and Video Technology, Technical University-Sofia, Sofia, Bulagaria

Abstract
IKONOS can receive high definition images (<1 m). But the gain in high resolution images essentially increases the volume of image files. It is a complicated process of analysis, processing and transportation of data images. As well, long term storage of the image files demands more requirements for storage banks (memory volume, time of database query, order of search, etc.). Modern methods of loss compression allow reducing the volume of image data. Such reduction conducts of data volume leads to significant distortions of the restored images. In fact, the distortions are appreciable as the levels of a compression ratio rises (CR> 250).
We offer new techniques of image representation. The method is based on an inverse pyramidal decomposition with neural networks. The transformed image is presented in the field of the hidden layer of a neural network. The coefficients of transformation are adapted to the content of the image. They are calculated using three layer back propagation neural networks (BPNN) during the learning period. The new original algorithm to panchromatic band of a satellite image of the high definition (Sherbrooke, Quebec, Canada, May 20th, 2001 at 10h50) has been applied.
The results of simulation of a new method showed the best visual quality of the restored images in comparison with JPEG2000 and LuraSmartCompress technique. We are confirming the limitation of use of the current algorithm (JPEG Std.) for level of compression ratio more then CR>60.

Keywords: satellite image representation and compression; adaptive image pyramidal representation (AIPR); neural networks (BPNN)

Abstract number 643

Abstract title The National Land Cover Project for Geobase

Author list Alexandre Beaulieu, Natural Resources Canada, Centre for Topographic Information, Ottawa, Canada.

Abstract

Land Cover information is required by numerous public and private sector organizations. In recognition of this, the GeoBase Steering Committee recently decided that Land Cover would be a priority map layer to add to the GeoBase portal. The National Land Cover Project Team was formed from members of the Land Cover Community of Practice (LCCoP) and the GeoBase Program, with partial funding from the Government Related Initiatives Program (GRIP) of the Canadian Space Agency (CSA) with the objective to integrate Land Cover mapping from provincial and federal organizations and produce a harmonized data base that is consistent with international standards, to meet the broadest range of user needs.

Two major Land Cover products have already been created to meet the needs of specific sectors. The Canadian Forest Service (CFS) created EOSD (Earth Observation for Sustainable Development) to satisfy the forest sector requirements, in cooperation with provincial governments. Agriculture and Agri-Food Canada (AAFC) is currently producing a Land Cover product as part of the National Land and Water Information Service (NLWIS) to meet the agriculture sector needs, again in collaboration with provincial governments. Northern Territories Land Cover was realized by the Canada Centre of Remote Sensing (CCRS). A User Needs Assessment was conducted last year and the response was very clear; the level of interest in the currently planned GeoBase Land Cover product is high, and the product can benefit a large number of users. The final vector product will be made available this spring 2009 on the GeoBase portal (www.GeoBase.ca).

Abstract number 644

Abstract title Traitements de données Radarsat-2 pour la cartographie topographique Radarsat-2 data processing for topographic mapping

Author list Saïd Kharbouche, Frédéric Happi Mangoua, Daniel Clavet

Abstract

Le Centre d'information topographique de Sherbrooke (CITS), évalue présentement la faisabilité de mettre à jour ses données topographiques et d'extraction des entités planimétriques à l'aide des données Radarsat-2. Les caractéristiques spécifiques des images sont liées à différents modes de polarisation, de formats, ainsi qu'à différentes résolutions (ultra-fine, fine, fine-quad et standard-quad). Les tests ont consisté à sélectionner le meilleur mode de polarisation, le meilleur format et la meilleure résolution qui donneraient une qualité visuelle améliorée de l'image radar pour des fins de captage, et d'extraction d'entités planimétriques. L'application et le développement de nouvelles techniques de traitement d'image radar font aussi l'objet des travaux en cours. Les tests portent sur deux sites représentatifs de régions habitées et nordiques au Canada soit : la région du Lac Beauport, Québec et de Clyde River, Nunavut.

La capacité d'extraction et le niveau de conformité des données sont évaluées en comparant les vecteurs CanVec (réalité terrain) aux vecteurs captés sur les images Radarsat-2. Les résultats préliminaires démontrent qu'il est possible de procéder à la mise à jour de certaines entités topographiques et à l'extraction d'entités planimétriques : Les images en mode ultra-fin sont tout particulièrement indiquées comme source de données pour l'acquisition de la majorité des entités topographiques, selon les normes et spécifications (contenu et précision) de produit.

Abstract number 645

Abstract title The Impact of Sampling Intensity and Failed GPS Acquisition on Animal Home Range Estimation

Author list Aleksandra Sobol (1), Julia Linke(1), Gregory J. McDermid (1), John Boulanger (2), and Gordon Stenhouse (3),
1 - Foothills Facility for Remote Sensing and GIScience, Department of Geography, University of Calgary, Calgary, Canada.
2 - Integrated Ecological Research, Nelson, Canada.
3 - Foothills Research Institute and Alberta Fish and Wildlife Division, Hinton, Canada.

Abstract Home range delineation is an essential tool in wildlife research and conservation, serving to infer the spatial extent and the associated habitat characteristics of an animal's movement across a given span of time. However, the suitable number of global positioning system (GPS) locations required to obtain an adequate home-range delineation is currently unknown, and remains an active research issue. In particular, we lack guidelines surrounding the influence of sampling intensity, animal behaviour, missing locations, home range estimation algorithms, and other related factors. We investigated the effects of variability in GPS sample size on three home range estimators – minimum convex polygon, k-local convex hull, and fixed kernel density estimation – by subsetting datasets (nearly perfect acquisition every 20 minutes) attained from grizzly bears (Ursus arctos) in west-central Alberta, Canada: (i) systematically, to obtain different sampling intensities simulating variation in timing between subsequent observations, and (ii) randomly, to mimic dropped satellite signals caused by terrain and habitat cover interactions. Our results showed that the lowest sampling intensity required to accurately delineate home-range characteristics (systematic sampling) and how their characteristics are influenced by dropped locations (stratified random sampling) vary depending on the home range estimator utilized and the behaviour exhibited by the animal.

Keywords: fixed kernel, home range, k-LoCoH, MCP, missing locations, sample size, sampling intensity

Abstract number 646

Abstract title Spatial Modeling Of Carbon Stocks Using Discrete Multi-Return Lidar Data In A Sub Boreal Forest: A Comparison To Optical Remote Sensing

Author list Darren Janzen, Claudette Bois, Roger Wheate, and Arthur Fredeen, University of Northern British Columbia

Abstract

Previously, forest carbon ecosystem carbon stocks were estimated with a time series of Landsat TM/ETM+ images. Reliable estimates of biomass C were produced using this imagery, but the data were not able to support the estimation of individual components of biomass, including large trees, secondary structure, shrubs, herbs, and woody debris.

In this research, we set out to determine whether the use of LiDAR data with the same modelling approaches would improve estimates of total biomass, and permit estimation of individual components of biomass. Plot measurements of forest ecosystem carbon (C) were spatially interpolated using forest structural attributes derived from discrete multi-return LiDAR data. Monte Carlo uncertainty analysis described uncertainty in singular model predictions and spatial autocorrelation approximation formulae allowed landscape level predictions.

Models were created to estimate total biomass C, large tree C, secondary structure C, and herb C with r2 values of 0.792, 0.782, 0.571, and 0.749 respectively. However, the LiDAR data were not able to develop quality models for woody debris C. The secondary structure and herb C models were also tested for their efficacy at describing the relevant stocks whether underneath overstory vegetation or not and the difference in r2 values was negligible, indicating no effect of overstory vegetation on model accuracy. This is significant as no other remote sensing system has shown the capability to reliably estimate secondary structure underneath mature canopies. These estimations may prove critical in maintaining a mid-term timber supply in the wake of the Mountain Pine Beetle epidemic in Western Canada.

Abstract number 647

Abstract title Integration of Earth Observation and Ancillary Data in the Production of an Historical National Land Use Map of Canada

Author list Ted Huffman1, Mark McGovern2, Don Leckie3, David Hill3, Robby Bemrose1, Flavius Rogrovan2, Dominique Blain2, Nancy Hoffmann4 and Morgan Cranny3

1Agriculture and Agri-Food Canada, Research Branch, Ottawa ON
2Environment Canada, Greenhouse Gas Division Gatineau, QC
3Natural Resources Canada, Canadian Forest Service, Victoria, BC
4Statistics Canada, Ottawa, ON

Abstract

A circa 1990 land use map of seven broad internationally defined land use classes was produced at 28 m resolution for all of Canada south of 60o latitude. Input data sources were several nation-wide Landsat-derived land cover classifications (1990 Geocover, 2000 Earth Observation for Sustainable Development), regional classifications (Prairie Farm Rehabilitation Administration circa 1995 of the prairies, Ontario Ministry of Natural Resources 1990 of southern Ontario), plus National Topographic System (NTDB) data. These data were combined in an hierarchical rules-based system to convert land cover inputs to a land use map for circa 1990.

Sources of error were found to be: the rules, misclassification within the source data sets and timing issues related to using input data that is not circa 1990. Preliminary accuracy assessment indicated an average class accuracy in the order of 75% over all classes, both users and producers. Map accuracy was 80% (i.e., 80% of all pixels in the map were the correct class).

The product provides land use information for long-term spatial analysis, policy issues and scientific research, but a main impetus was as base data to help with international reporting of land use distributions and greenhouse gas emissions under the United Nations Framework Convention on Climate Change and the Kyoto Protocol. The basic approach is viable and can be applied in other cases where data and needs are similar. The project was a collaborative effort supported by the Canadian Space Agency.

Abstract number 648

Abstract title Lower Souris River Watershed Biophysical Inventory (Poster)

Author list Lyle Boychuk, Bill Tedford, and Eric Mayer, Ducks Unlimited Canada

Abstract

The Prairie Pothole Region is uniquely heterogeneous, comprised of a matrix of small wetlands or potholes interspersed with native upland elements occurring with variable frequency and abundance across the landscape. The Saskatchewan Prairie Conservation Action Plan (PCAP) estimates that provincially only 17% of the original native prairie remains intact, confirming the notion that the Prairies are one of the most altered ecosystems on earth. The large footprint of annual cultivation has reduced the extent of native habitat available to wildlife while increasing the fragmentation of remnant habitat. Agricultural use, such as grazing, further alters the species composition and condition of remnant habitats which drastically alters the spectral characteristics of target features. The complexity of the modern Prairie landscape presents a significant challenge to the remote sensing community to find creative solutions to accurately characterize the distribution of remaining habitat.

In 2007, Ducks Unlimited Canada, in partnership with the Lower Souris River Watershed Committee, developed a comprehensive biophysical inventory to establish a baseline of terrestrial and aquatic habitats in the Lower Souris Watershed. The project incorporated wetland geometry captured using soft copy photogrammetric methods from conventional 1:40,000 B/W aerial photography while the upland characterization was completed utilizing 3 seasons of SPOT 5 multi-spectral imagery and an object-oriented image analysis technique. Upland class membership functions were derived with a Classification and Regression Tree (CART) approach. Road and cultural thematic layers were included as well to compile a comprehensive land cover for the 980,000 Ha watershed. The poster presentation will illustrate project classification methodologies and workflow, the realized classification accuracy of 80%, and the importance of the project deliverables for prioritizing conservation efforts in the Lower Souris Watershed.

Abstract number 649

Abstract title Topographic LiDAR – providing a new perspective in the Mackenzie Delta

Author list Dustin Whalen (1), Don Forbes(1), Chris Hopkinson (2), JC Lavergne (3),. Gavin Manson (1), Phillip Marsh (4), and Steve Solomon (1).
1 – Natural Resources Canada, Geological Survey of Canada, Ottawa, Canada.
2 - Appied Geomatics Research Group, Centre of Geographic Sciences, Lawrencetown, Canada.
3 - Natural Resources Canada, Geodetic Survey Division, Ottawa, Canada.
4 - National Water Research Institute, Saskatoon, Canada.

Abstract Topographic LiDAR is being used to map flooding hazards along the Beaufort Sea coast, in particular on the outer Mackenzie Delta. Flooding can be caused by storm surges anywhere along the coast and by high river discharge or backwater at spring breakup. LiDAR data are ideal for feature recognition and quantification, providing small-scale geomorphological and depositional details within a larger-scale context. The identification and formation of coastal and river levees, crevasses, secondary channels, and floodplain topography can be useful in determining flooding thresholds, inundation pathways, and drainage patterns. Indicators of past flooding events such as lines of driftwood debris, dead vegetation patterns and the accumulation of alluvial material inland can also be detected through the topographic LiDAR data. Due to the relatively flat nature of much of the low-lying modern Mackenzie Delta, slight increases in water levels can produce extensive additional flooding inland. Flood-simulation models based on LiDAR digital elevation models can show the potential for inland flooding for a given storm-surge water level at the coast. The intensity and severity of coastal flood hazards in this region are expected to increase over the next century due to climate warming, land subsidence, accelerated sea-level rise, and a possible reduction in sea ice. In this context, it is important to develop a better understanding of flood hazards under present conditions. Information derived from LiDAR datasets provide a new perspective for this poorly mapped region, which will ultimately help to better understand the effects of global climate change and constraints on industrial development in a high-latitude deltaic and coastal setting.

Abstract number 650

Abstract title Design And Qualification Of The Sac-D NIRST Flight Model Radiometer

Author list François Châteauneuf (1), Linh Ngo Phong (2), Mélanie Leclerc, (1), Linda Marchese(1), Patrice Côté (1), Claude Chevalier (1), and Hugo Marraco (3),
1 - INO, Quebec City, Quebec, Canada
2 - Canadian Space Agency
3 - Comisión Nacional de Actividades Espaciales

Abstract Aquarius/SAC-D is a cooperative international mission conducted jointly by the National Aeronautics and Space Administration (NASA) of the United States of America (USA) and the Comisión Nacional de Actividades Espaciales (CONAE) of Argentina. The overall mission targets the understanding of the total Earth system and the consequences of the natural and man-made changes in the environment of the planet. Jointly developed by CONAE and the Canadian Space Agency (CSA), the New IR Sensor Technology (NIRST) instrument will monitor high temperature events on the ground related to fires and volcanic events, and will measure their physical parameters. Furthermore, NIRST will take measurements of sea surface temperatures mainly off the coast of South America as well as other targeted opportunities.

NIRST has one band in the mid-wave infrared (MWIR) centered at 3.8 um with a bandwidth of 0.8 um, and two bands in the thermal infrared (TIR), centered respectively at 10.85 (TIR1 band) and 11.85 um (TIR2 band) with a bandwidth of 0.9 um. The temperature range is from 300 to 600 K for the mid-infrared band and from 200 to 400 K for the thermal bands with challenging temperature resolution requirements. The baseline design of the NIRST is based on microbolometer technology developed jointly by the CSA and INO. Two arrays of 512x3 uncooled bolometric sensors will be used to measure brightness temperatures. The instantaneous field-of-view is 534 microradians corresponding to a ground sampling distance of 350 m at the sub-satellite point. A pointing mirror allows a total swath of +/- 500 km.

This paper will first give an overview of the design of the NIRST camera module. The qualification activities for the Flight Model (FM) will be presented. Key performance parameters, as measured during the verification campaign at INO, will be reported.

Abstract number 651

Abstract title Remote Sensing of glacial ice in the Canadian Arctic.

Author list Laurence Gray (1) and Dave Burgess (2), 1 - Natural Resources Canada, Canada Centre for Remote Sensing, Ottawa, Canada. 2 - Natural Resources Canada, Geological Survey of Canada, Ottawa, Canada.

Abstract

The study of change in Arctic Ice Caps has been on going for many years, particularly since the 'mass balance' work begun by Dr. Roy (Fritz) Koerner in the sixties. In this presentation we concentrate on the role that remote sensing is playing in the continuing monitoring of glacial ice in the Arctic.

The Devon Ice Cap has been selected as a site for CRYOSAT calibration and validation, and will be used in this talk to illustrate the potential of remote sensing to the monitoring of change in Arctic Ice Caps. GSC/CCRS field parties collected surface data in the spring of 2006 and 2008, and on both occasions an airborne CRYOSAT simulator (ASIRAS) overflew the test sites. In this paper we summarize the surface, airborne and satellite data that was collected and try to relate these results to our knowledge of the ice conditions. In particular the following topics will be addressed:

- The airborne 2006 ASIRAS altimeter results showed that often the dominant scattering surface was not the surface but corresponded to the denser melt layers from the previous summer and fall. Further, closer to the ice cap summit multiple layers could be distinguished. These results immediately pose the question; does this type of high bandwidth altimeter data have the potential to map spatial accumulation variation? And could this be done with CRYOSAT?
- Very high bandwidth (10-13 GHz) surface radars were used in both years. In 2008 the radar was borrowed from the UK (thanks to the British Antarctic Survey, University College London, and the University of Edinburgh) under the CRYOSAT programme and used for specific sites. The very high resolution capability (~ 2 cm) allows one to relate temporal peaks in the radars returns to layering in the winter accumulation.
- Finally we have a good history of satellite SAR data over the Devon Ice Cap. Recently, there has been excellent coverage with RADARSAT-2 and some preliminary polarimetric and interferometric results will be shown, including recent estimates of the speed of some of the outlet glaciers.

Abstract number 652

Abstract title Terrestrial Imaging Spectroscopy – Some Future Perspectives

Author list K. Staenz, Alberta Terrestrial Imaging Centre and Dept. Of Geography, University of Lethbridge, Canada.

Abstract

This paper covers 60 years of terrestrial imaging spectroscopy or hyperspectral remote sensing – 30 years each devoted to past and future developments. For this purpose, a brief history of imaging spectroscopy is given, covering civilian airborne sensor and spaceborne mission developments and associated data processing capabilities. Moreover, the paper reviews the existing and planned space systems, examines the current status in hyperspectral remote sensing in terms of data quality and availability, algorithm development, data processing, and applications development. Although many problems have been overcome since the advent of hyperspectral remote sensing, there are still major bottlenecks, as pointed out in this paper, which need to be addressed to further advance this area. Future needs in hyperspectral remote sensing are summarized in terms of space missions and the data products they provide, algorithm development, data processing, and applications development. The paper will conclude by speculating on civilian hyperspectral systems that might be in operation for terrestrial imaging 30 years down the road. In addition, an outlook of the data processing capabilities needed to analyse the increasing volume of data is given for the same time frame.

Abstract number 653

Abstract title

The Synthetic Crown Recognition Model
for Automatic Image Interpretation on UltraCamD Imagery

Author list

Chengqian Zhang (1), Michael Collins (1) , Don Lackie (2), and François Gougeon (2), 1 - Department of Geomatics Engineering, University of Calgary
2 - Natural Resources Canada, Canadian Forest Service, Pacific Forest Centre

Abstract

Detailed stand information has become more and more important for sustainable forest management as well as forest industry. High-spatial resolution aerial photography currently is the most reliable data source providing the information; however, applications of aerial photography are still limited on visual interpretation which is experience depended. Focusing on this problem, this research developed an automatic interpretation approach based on mathematical morphology, and tested the method with Vexcel UltraCamD images with spatial resolution at 28 cm.

Besides several aerial photograph interpretation principles, practically, crown shape and branching habitat are two important characteristics on the role of variations as the aids to visual interpretation. In visual interpretation, crown shape and branching habitat can be easily identified by experienced personal. In computerized interpretation approach, however, the feature of crown shape is difficult to define. Unlike crown shape, branching habitat is presented by linear bright pixels (i.e. local maximums) on high-spatial resolution aerial photographs, and has an inherent relation with crown shape and species. In this research, mathematical morphology was employed to define branching habitat based on the medial-axis transformation (MAT) of major branches.

To develop a generalized automatic interpretation approach, this research designed a synthetic crown recognition model which is insensitive to crown type and outline (i.e. crown boundary). The model includes three major tasks: crown/background separation, crown medial-axis transformation, and crown type definition. To separate an individual crown from its backgrounds, histogram equalization filter and modified histogram thresholds were used, and a binarized region of interest (ROI) for each spectral bands (RGB and NIR) was generated; crown skeletons (i.e. the outputs of MAT) were extracted with thinning operation and smoothed by closing process; crown types were defined by three types of skeleton pixels including end-pixels, line-pixels and junction-pixels. The synthetic model was tested with five species (white pine, red pine, white birch, sugar maple and trebling aspen) selected from Vexcel UltraCamD images acquired over Petawawa Research Forest, Ontario.

Abstract number 654

Abstract title

Utilisation conjointe de données de micro-ondes passives et actives pour le suivi du gel saisonnier du sol de la toundra dans le Nord du Québec.

Author list

Parvin Kalantari, Maxime Rousseau et Monique Bernier
INRS, Centre Eau Terre Environnement, Québec, Canada.

Abstract

Cette étude, réalisée dans le cadre de l'Année Polaire Internationale et du projet Variability and Change in the Canadian Cryosphere sous le leadership d'Environnement Canada suit le gel saisonnier du sol dans la région sub-arctique au nord du Québec en utilisant conjointement des données micro-ondes passives et actives.
Le cycle saisonnier gel-dégel du sol est un phénomène majeur dans le système climatique jouant un rôle important dans le fonctionnement de l'écosystème, en influençant le taux de photosynthèse et la respiration de la végétation, en limitant l'évaporation, en diminuant la pénétration de l'eau dans le sol et en modifiant le ruissellement de surface.
Les objectifs de cette étude sont d'abord, d'effectuer une analyse spatio-temporelle sur les données AMSR-E afin de mieux comprendre les variations saisonnières du gel du sol, ensuite, d'évaluer les impacts de la couverture de neige ainsi que les effets de l'occupation du sol et, enfin, de développer un algorithme pour cartographier le gel saisonnier du sol en utilisant conjointement des données micro-ondes passives et actives.
Les cartes sont générées pour deux saisons (2007-2008) et (2008-2009). Une méthode est développée pour intégrer l'imagerie RADARSAT dans le processus. Les données in situ serviront à étalonner et valider les données. Les données et les cartes fournies par cette recherche seront utilisées pour évaluer la représentation du gel du sol dans les modèles climatiques régionaux. Elles permettront aussi aux communautés nordiques de connaître les variations de la période du gel d'une année à l'autre.

Abstract number 655

Abstract title Adaptation of Toutin's 3D physical math model for wide FOV MERIS full resolution data

Author list C.V. Schmitt, Th. Toutin
Natural Resources Canada, Canada Centre for Remote Sensing, Ottawa, Canada.

Abstract

The European Space Agency, in co-operation with the Canadian Space Agency, will be freely distributing the North American coverage of the full resolution (FR) Medium Resolution Imaging Spectrometer (MERIS) data in support of Canadian Earth Observation (EO) research. The MERIS sensor will provide geophysical characteristics of the earth at 260 X 290-m ground resolution with a 1150-km swath coverage.

Toutin's 3D physical model for rigorous photogrammetric image correction, well known in the Canadian EO community, was originally developed for medium to high resolution sensors with a small field of view (FOV). This research focuses on adapting Toutin's 3D physical model to support geometric image correction for the large FOV MERIS sensor. Currently, with Toutin's existing 3D physical sensor model and the FR MERIS data, large root mean square (RMS) residual errors were mainly found in the across-track direction. This is hypothesized to be due to the panoramic effect inherent to the wide FOV (68.5º) MERIS sensor.

Preliminary math model tests indicated a majority of the ground control points (GCP) residual error in X-direction increased as their distance increased from nadir. It was also demonstrated that the current model can correct for panoramic distortion up to a 400-km swath width.

In the following months, further research and testing will be completed to verify the hypothesis by a) introducing the pixel spacing variation parameter into Toutin's 3D physical model to correct for panoramic distortion, and b) calibrating and validating the model and measuring the improved modeling capacity of the system. The second part of this study includes analysing the RMS residuals of the GCPs and the RMS errors the independent check points.

Abstract number 656

Abstract title Erosion Estimation Using Remote Sensing Data - An Approach for Northern Pakistan and Adjoining Regions

Author list Syed Amer Mahmood, Arief Wijaya, Mathias Leidig, Faisal Shahzad, and Richard Gloaguen
Remote Sensing Group, Institute of geology, TU-Bergakademie Freiberg, Germany.

Abstract An integrated approach of several remote sensing techniques backed by field studies provides a solid base to understand the earth systems that operate over diversified spatio-temporal scales. It requires specialized techniques to compute and model their correlation. This project estimates and calculates the erosion based on interactions of the morphology with other factors like precipitation as a climate factor in a tectonically active region. There is a need of erosion estimation on large scales and compare it to results obtained through other methods. This study contributes to recognize the correlation between climatic factors and soil erosion. In contrary to previous attempts with different GIS and other ground based data sets, we calculated the average quantity of soil erosion rates using the Revised Universal Soil Loss Equation (RUSLE) based on remote sensing data. We used SRTM-90 meter data to calculate slope length parameter, and Tropical Rainfall Measuring Mission (TRMM) data as a base for estimating the rainfall erosivity. Modified soil map from the FAO is also used to estimate the soil erodibility. Using ASTER and Landsat 7 data the land use over the study area is classified, and used to predict management and support factors. Results show that RUSLE method in the Hindukush-Pamir-Himalaya (HPH) is a good method to produce a precise erosion risk map for the study area. Our results contribute to the understanding of the relationship between climatic and erosion factors. This study also points out the difficulties of modeling erosion processes in a highly complex region like HPH.

Abstract number 657

Abstract title Lower Souris River Watershed Biophysical Inventory

Author list Lyle Boychuk (1), Bill Tedford (2), and Eric Mayer (1)
1 - Ducks Unlimited Canada. Western Region. South Saskatchewan Operations. Regina, Saskatchewan, Canada.
2 - Ducks Unlimited Canada. National Headquarters. Oak Hammock Interpretive Centre. Stonewall, Manitoba, Canada.

Abstract

The Prairie Pothole Region is uniquely heterogeneous, comprised of a matrix of small wetlands or potholes interspersed with native upland elements occurring with variable frequency and abundance across the landscape. The Saskatchewan Prairie Conservation Action Plan (PCAP) estimates that provincially only 17% of the original native prairie remains intact, confirming the notion that the Prairies are one of the most altered ecosystems on earth. The large footprint of annual cultivation has reduced the extent of native habitat available to wildlife while increasing the fragmentation of remnant habitat. Agricultural use, such as grazing, further alters the species composition and condition of remnant habitats which drastically alters the spectral characteristics of target features. The complexity of the modern Prairie landscape presents a significant challenge to the remote sensing community to find creative solutions to accurately characterize the distribution of remaining habitat.

In 2007, Ducks Unlimited Canada, in partnership with the Lower Souris River Watershed Committee, developed a comprehensive biophysical inventory to establish a baseline of terrestrial and aquatic habitats in the Lower Souris Watershed. The project incorporated wetland geometry captured using soft copy photogrammetric methods from conventional 1:40,000 B/W aerial photography while the upland characterization was completed utilizing 3 seasons of SPOT 5 multi-spectral imagery and an object-oriented image analysis technique. Upland class membership functions were derived with a Classification and Regression Tree (CART) approach. Road and cultural thematic layers were included as well to compile a comprehensive land cover for the 980,000 Ha watershed. The poster presentation will illustrate project classification methodologies and workflow, the realized classification accuracy of 80%, and the importance of the project deliverables for prioritizing conservation efforts in the Lower Souris Watershed.

Abstract number 658

Abstract title

Mapping Eastern Spruce Budworm Cumulative Defoliation Severity from Landsat and Spot

Author list

R.J. Hall (1), M. Filiatrault (1), A. Deschamps (2), E. Arsenault (1)
Natural Resources Canada
1 - Canadian Forest Service, 2 - Canada Centre for Remote Sensing.

Abstract

The eastern spruce budworm (Choristoneura fumiferana Clem.) is among the most damaging of forest insects in Canada's boreal forest. In Eastern Canada, aerial observations have recently reported increasing outbreaks that are raising concerns to assess and monitor the location, area and potential impacts from this pest. In this study, field and remote sensing estimates of cumulative defoliation over a 2006-08 time frame were compared for an outbreak in Baie-Comeau, Quebec, to determine the extent that observed spectral response differences on remote sensing images were related to actual observations derived from the field. A method based on the relative difference in infrared simple ratio as a proxy for detecting differences in leaf area that was previously applied to aspen defoliation was adapted for this study. A post-defoliation Spot 4 image was registered and normalized to a pre-defoliation Landsat 5 image from which the relative difference in infrared simple ratio was empirically related to field-derived defoliation estimates. While both ocular and branch sample defoliation ratings were statistically correlated, branch sample estimates were more highly correlated to observed image values than ocular ratings. First iteration spruce budworm defoliation severity models were developed and applied to susceptible areas comprising dominant conifer and mixedwood land cover. Future work is focusing on potential refinements from improvements to a phenology normalization process, additional field sampling over a broader ecological range of susceptible forest types, map validation, and determining its linkage to growth impacts.

Abstract number 659

Abstract title Modelling and mapping forest structural complexity using high resolution airborne imagery and topographic information.

Author list Jon Pasher and Doug King
Department of Geography and Environmental Studies
Carleton University, Ottawa, Canada

Abstract Forest structural complexity has been identified as a potential indicator of biodiversity. While remote sensing has been widely used for modelling and mapping individual forest structural attributes, such as LAI, stem density, and tree heights, the development of methods for modelling and mapping multivariate aspects of structural complexity has not been fully explored. This research used high resolution airborne imagery for modelling structural complexity in a temperate hardwood forest in southern Quebec. A Redundancy Analysis (RDA) approach was used to develop a statistical model representing a general gradient of structural complexity. This model was constructed using variables representing image spectral and spatial properties and object based information of crowns and shadows within the forest as well as additional topographic information. Bootstrapping was used within the RDA for variable selection as well as model validation. The final RDA model was applied spatially across the entire study area to produce a map of predicted structural complexity, which was further validated using independent field sites and found to be approximately 80 % accurate. This map could serve as an indicator of biodiversity or habitat, but as well contribute to forest inventories and carbon budget modelling. Additional multiscale testing using re-sampled imagery suggested that the methods could be scaled up and potentially used with current pansharpened or future sub metre resolution multispectral satellite imagery, which would be able to provide much greater spatial coverage compared to airborne imagery.

Abstract number 660

Abstract title

La classification de l'occupation du sol à partir des images SPOT et RADARSAT-2 au Vietnam du Nord

Author list

Kim-Huong Hoang(1), Monique Bernier(1), Sophie Duchesne(1), Minh-Y Tran(2)
(1) Institut National de la Recherche Scientifique (INRS),
Centre Eau, Terre et Environnement (ETE)
(2) Académie des sciences et des technologies du Vietnam
Institut des sciences spatiales

Abstract

Le bassin versant de la rivière Câu (Vietnam) connait un développement économique important accompagné d'urbanisation et d'industrialisation. Les terres agricoles, incluant les rizières, ont subi des transformations importantes. Pour suivre les impacts de ces changements de l'occupation du sol sur la qualité de l'eau, un outil de gestion intégrée est adapté.

Une analyse des changements de l'occupation du sol entre 1993 et 2003 a été faite à partir d'images Landsat-5 TM et Landsat-7 ETM+. Cette étude a montré que ces images ne nous permettaient pas de bien extraire les rizières à cause de leur résolution (30 m) et de la ressemblance des différents types de cultures en saison sèche. Les rizières ayant un impact significatif sur l'hydrologie d'un bassin versant, il est important de connaître leur localisation et le cycle annuel de culture. Ces informations servent directement pour la modélisation hydrologique.

Afin de suivre l'évolution récente de l'occupation du sol, des images HRVIR 2 de SPOT-4 ont été acquises fin novembre 2007 et janvier 2008. L'approche de classification contextuelle à partir de pseudo-bandes spectrales (ACP, NDVI) est appliquée sur ces images afin d'extraire les classes d'occupation du sol pertinentes à la modélisation hydrologique sauf les rizières. Une série d'images RADARSAT-2 multi-polarisations seront aussi acquises en 2009. Une méthode de traitement adaptée sera utilisée afin d'identifier les rizières et le cycle annuel des cultures. Ces dernières informations seront ensuite intégrées à la carte thématique de l'hiver 2008. Nous présenterons donc les résultats des premières classifications dérivées des deux types de capteurs.

Abstract number 662

Abstract title Predicting tree species distribution in the southern Gulf Islands, Canada, using ASD FieldSpec3, AISA and Mark II data fusion

Author list Trevor Jones (1), Nicholas Coops (1), and Tara Sharma (2),
1 - University of British Columbia
2 - Parks Canada

Abstract The spectral reflectance of dominant overstory tree species was retrieved from leaf samples using an ASD FieldSpec3 spectroradiometer and curves were entered into a spectral library. The library was resampled to match the wavelength range of hyperspectral AISA sensor. Resampled AISA data were used in discriminant analysis to select key wavelengths that minimize within species variance while maximizing between species variance. Based on a Wilks Lambda test, this resulted in a reduction of data dimensionality from 1075 to 40 bands at an ¦Á level of 0.005. Selected wavelengths were used in normal discriminant analysis to test between species seperability. Results show differentiation between all species is possible at accuracies ¡Ý 98.15 %. The shortwave infrared II region (1401-2400nm) proved to contain the most significant wavelengths, confirming the significance of various biogeochemical foliar constituents.

Once leaf-level significance was identified in resampled AISA data, significant wavelengths were targeted in actual AISA imagery, thus decreasing hyperspectral dimensionality and reducing data volume. Prior to image classification, targeted AISA bands were fused with LiDAR derived canopy height models to isolate pixels containing tree crown. Image classification was undertaken to predict the distribution of species of interest. Results indicate that classification can be extended to all areas within the Gulf Islands National Park (GINPR) covered by hyperspectral transects. The information supplied by this study can greatly improve upon the manner in which essential distributive information is conventionally acquired. Furthermore, its application proves useful throughout the region.

Abstract number 663

Abstract title

The use of LiDAR and high-resolution aerial photography to assess the influence of forest structure on snow accumulation and ablation in extensively disturbed forests

Author list

Andres Varhola (1), Nicholas Coops (1), Pat Teti (2), Sarah Boon (3), Markus Weiler (4), Christopher Bater (1)
1 - University of British Columbia
2 - BC Ministry of Forests and Range
3 - University of Lethbridge
4 - Universität Freiburg

Abstract

The extensive mountain pine beetle (MPB) outbreak in lodgepole pine forests of British Columbia has raised concerns about the impacts on water resources. Changes in forest structure resulting from defoliation, limb loss, windthrow and salvage harvesting in infested stands has increased snow accumulation and melting rates below canopies as a result of reduced interception and higher amounts of radiation reaching the ground surface. This can alter water discharge regimes by increasing the risk and magnitude of flooding during spring and decreasing streamflow during summer. In order to quantify these effects, there is a need to improve our understanding of the link between forest structure and snow processes. We used LiDAR-derived canopy metrics and high resolution aerial photography obtained along a 200 km transect between Quesnel and Fraser Lake (British Columbia) to statistically correlate forest structure with ground-based MPB infestation indices and snow accumulation and ablation. Results showed that simple ground-based MPB infestation indices obtained by classifying the trees into different levels of defoliation were strong predictors of forest cover at the plot level, explaining up to 80% of the variability. LiDAR-derived forest cover was the strongest predictor of peak snow accumulation ($r^2 = 0.70$, $p = 0.003$) and snow ablation ($r^2 = 0.58$, $p = 0.009$). These results will improve our ability to quantify the effects of changes in forest structure at large scales and model related watershed processes.

Abstract number 664

Abstract title Remote Sensing of glacial ice in the Canadian Arctic.

Author list Laurence Gray, CCRS and Dave Burgess, GSC

Abstract

The study of change in Arctic Ice Caps has been on going for many years, particularly since the 'mass balance' work begun by Dr. Roy (Fritz) Koerner in the sixties. In this presentation we concentrate on the role that remote sensing is playing in the continuing monitoring of glacial ice in the Arctic.

The Devon Ice Cap has been selected as a site for CRYOSAT calibration and validation, and will be used in this talk to illustrate the potential of remote sensing to the monitoring of change in Arctic Ice Caps. GSC/CCRS field parties collected surface data in the spring of 2006 and 2008, and on both occasions an airborne CRYOSAT simulator (ASIRAS) overflew the test sites. In this paper we summarize the surface, airborne and satellite data that was collected and try to relate these results to our knowledge of the ice conditions. In particular the following topics will be addressed:

- The airborne 2006 ASIRAS altimeter results showed that often the dominant scattering surface was not the surface but corresponded to the denser melt layers from the previous summer and fall. Further, closer to the ice cap summit multiple layers could be distinguished. These results immediately pose the question; does this type of high bandwidth altimeter data have the potential to map spatial accumulation variation? And could this be done with CRYOSAT?
- Very high bandwidth (10-13 GHz) surface radars were used in both years. In 2008 the radar was borrowed from the UK (thanks to the British Antarctic Survey, University College London, and the University of Edinburgh) under the CRYOSAT programme and used for specific sites. The very high resolution capability (~ 2 cm) allows one to relate temporal peaks in the radars returns to layering in the winter accumulation.
- Finally we have a good history of satellite SAR data over the Devon Ice Cap. Recently, there has been excellent coverage with RADARSAT-2 and some preliminary polarimetric and interferometric results will be shown, including recent estimates of the speed of some of the outlet glaciers.

Abstract number 666

Abstract title Spatial partitioning of CO2 fluxes based on canopy structure within a heterogeneous managed boreal wetland ecosystem

Author list Laura Chasmer Cold Regions Research Centre, Dept. Of Geography, Wilfrid Laurier University, Waterloo ON N2L 3C5, Richard Petrone Cold Regions Research Centre, Dept. Of Geography, Wilfrid Laurier University, Waterloo ON N2L 3C5, Scott Brown Cold Regions Research Centre, Dept. Of Geography, Wilfrid Laurier University, Waterloo ON N2L 3C5, Chris Hopkinson Applied Geomatics Research Group, Centre of Geographic Sciences, Nova Scotia Community College, Lawrencetown NS B0S 1P0, Natascha Kljun Department of Geography, Swansea University, Swansea, UK, and Kevin Devito Department of Biological Sciences, University of Alberta, Edmonton AB T6G 2E9

Abstract Vegetation canopy structural characteristics play an important role in the transfer of mass and energy exchanges through time. The spatial variability of biomass surrounding the eddy covariance flux measurement system (EC) will result in differences in a) the amount of surface area available for flux exchanges, b) aerodynamic roughness of the ecosystem, and c) the source area (biophysical influences) on fluxes, depending on wind direction.

The following study classifies CO2 fluxes based on wind direction and land cover/vegetation type using a combination of EC flux measurements, footprint model parameterization, and airborne lidar within a heterogeneous boreal wetland ecosystem. CO2 and H2O fluxes have been examined within the Utikuma Regional Study Area, Alberta, using EC methods since 2005. This site is unique because, in most cases, EC are deployed in flat and homogeneous land cover types with large fetch. The wetland/upland complex examined here is heterogeneous and is characterised by low-lying wetlands to the south and south-west of the EC and upland aspen forests to the north and north-east. Further, airborne lidar provides spatially explicit, high resolution three-dimensional measurements of the vegetation canopy, understory, and ground surface that are both time consuming and expensive to measure using typical forest mensuration/survey methods. The influences of vegetation structure, specifically surface area of leaves (leaf area index), aerodynamic properties of vegetation surrounding the EC, and land cover types on fluxes are examined. Spatial partitioning of fluxes based on land cover type and wind direction is used to examine both wetland and upland exchange processes.

Abstract number 667

Abstract title

Quantifying change in peat plateau and wetland areas within the discontinuous permafrost zone: 1947 to present

Author list

Laura Chasmer Cold Regions Research Centre, Dept. Of Geography, Wilfrid Laurier University, Waterloo ON N2L 3C5, Chris Hopkinson Applied Geomatics Research Group, Centre of Geographic Sciences, Nova Scotia Community College, Lawrencetown NS B0S 1P0, William Quinton Cold Regions Research Centre, Dept. Of Geography, Wilfrid Laurier University, Waterloo ON N2L 3C5 , and Masaki Hayashi Department of Geoscience, University of Calgary, Calgary, AB T2N 1N4

Abstract

The area, distribution and dynamics of permafrost plateaus and wetlands within the discontinuous permafrost zones of the Canadian sub-arctic have significant influences on rates of greenhouse gas emissions. Soil thaw is driven primarily by surface energy balance and the degradation of forests located at the edge of peat plateaus. Therefore, increased ground surface heating over the last ten years is hypothesized to result in an exponential increase in wetland area at the expense of permafrost plateau area. The following study examines permafrost plateau and wetland area changes from 1947 to the present within the Scotty Creek Watershed, Northwest Territories using a series of aerial photographs and high resolution satellite imagery.

Abstract number 668

Abstract title CCUVS

Author list Sterling Cripps

Abstract

Canadian Centre for Unmanned Vehicle Systems
Centre Canadien des Systèmes de Véhicules Télépilotés
Facilitating sustained, profitable growth in the Canadian unmanned systems sector

4, 49 Viscount Avenue, Medicine Hat, Alberta, T1A 5G4, Canada
t: +1 403 488 7208; e: ccuvsoffice@ccuvs.com: w: www.ccuvs.com

The Canadian Centre for Unmanned Vehicle Systems (CCUVS) is a federally registered not for profit company, based in Medicine Hat, Alberta, with representatives in many of Canada's Provinces from the Pacific to the Atlantic.
The purpose of CCUVS is to facilitate sustained, profitable growth in the Canadian unmanned vehicles systems sectors.
CCUVS is governed by a Board of Directors, drawn from across Canada, representing academia, industry and government and working in air, ground and maritime unmanned systems environments. Head Office staff members are based at Medicine Hat Airport, Alberta, with other staff positions in Ottawa and elsewhere.
CCUVS activities and services include: unmanned systems standards work, influencing research, applications and technology solutions development, training, provision of facilities (such as access to test ranges and UAS launcher services), publishing studies, consultancy, promoting civil and commercial use of unmanned systems and stimulating Canadian economic growth.
Current objectives include:

- Developing standards, initially for unmanned aircraft systems, which can be recommended to Transport Canada for use in the development of regulations to allow unmanned aircraft to fly alongside manned aviation in National and international airspace.
- Expanding Knowledge, Awareness, Learning and Skills (KALS) across Canada in the unmanned systems sector.
- Promoting Canadian exploitation of unmanned systems in both existing and new innovative applications.
- Promoting the formation of unmanned systems clusters across Canada to increase synergy, cooperation and the economic growth of the sector.
- Encouraging both national and international investment in the Canadian unmanned systems sector.
- Identifying Canada's strengths in the unmanned systems sector and focusing research and development to produce integrated solutions.
- Developing Test and Evaluation capabilities, in line with growing market demand, which are optimized for unmanned systems.
- Marketing Canadian unmanned systems, facilities and services internationally.

Abstract number 669

Abstract title Use of the fluorescence line height (FLH) signal from MERIS for mapping chlorophyll in coastal waters

Author list Jim Gower, Institute of Ocean Sciences, Sidney, BC. Stephanie King, Institute of Ocean Sciences, Sidney, BC.

Abstract Numerous authors have noted problems when estimating chlorophyll concentrations in coastal waters using the standard green to blue ratio method in coastal waters. Difficulties seem especially serious in areas where fresh-water runoff from land is significant. We show examples of estimating the timing and spatial properties of the spring bloom in the Strait of Georgia, BC, where patterns detected using FLH differ from those shown by the standard MERIS Algal 1 chlorophyll product. This appears to be a case where the fluorescence technique provides a significant advantage over traditional algorithms based on pigment absorption.

Abstract number 670

Abstract title

A method for determining classification parameters and fuzzy logic rules in object-based urban rooftop extraction from VHR multispectral images

Author list

David Aldred, University of Western Ontario; Jinfei Wang, University of Western Ontario; Harold Zwick, Macdonald Dettwiler & Associates

Abstract

Roofs are the prominent features of buildings as seen from above by remote sensors and can be considered surrogates for building footprints that are integral to urban mapping projects. Object-based methods for extracting urban rooftops from high spatial resolution remotely sensed data typically rely on semantic inference of spatial and contextual classification parameters in scenes of regular spatial or material composition. In this study, a supervised statistics-based method of determining discretive parameters for rooftops in urban scenes of irregular composition and applying them in a rule-based procedure is presented. After pre-processing to pan-sharpen Ikonos image test data, the method includes the following steps: (1) image segmentation; (2) supervised object-based classification into broad spectral classes; and (3) spectral, spatial, textural and contextual parameters developed from sample rooftop objects are implemented in a fuzzy logic rule base to separate rooftops from other impervious surfaces. Classification of a test scene results in 93% accuracy of rooftop identification, demonstrating the applicability of the method to the discrimination of spectrally similar but semantically variable classes.