Proceedings of Spatial Knowledge and Information - Canada (SKI-Canada) 2008, February 14-17 in Fernie BC, Canada.

VOLUME 2

Proceedings Editor
Renee Sieber

Executive Committee
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Renee Sieber, Mc Gill University
Nadine Schuurman, Simon Fraser University
This is the proceedings of the 2008 conference of Spatial Knowledge and Information Canada, held February 14-17 in Fernie BC, Canada. The intent of Spatial Knowledge and Information Canada is to bring together (digital) Geographic Information researchers and their students from across Canada. We define Geographic Information research broadly as any geographic research in which computation is its main focus. The prime computational platform is Geographic Information Systems although we include Geographic Information Science research, geomatics, remote sensing, geospatial web 2.0, and spatial statistics and modeling. We encourage theory and practice and we invite research on the widest range of applications from GIS-transportation and health to GIS in education and business. We also stress work-in-progress, our reasoning being that the conference would stimulate additional avenues of exploration.

The 2008 conference was held in partnership with the Canadian Association of Geographers and the GEOIDE Network Center of Excellence. Over 70 researchers, university faculty, students and interested parties from across Canada registered and attended. While the focus of the organization and conference is to bring together the Canadian Geographic Information community we also invited a small number of international attendees. The conference was composed of 50 scientific papers and 1 keynote address. We were delighted to have as our keynote speaker, Michael Goodchild, considered the father of GIScience. He gave a talk on the emergence of a new field in GIScience called volunteered geographic information. The conference concluded with a program committee meeting on the final day.

A substantial focus of the conference is to promote Canadian student research on Geographic Information. We were excited to have over 30 presentations by undergraduate, Master’s, and PhD students. We awarded seven outstanding students substantial awards for their research and presentation quality (monetary awards included one first prize award for $2000 and four second prize awards of $750 with honourable mentions receiving computer equipment). First prize went to Peter Johnson for his talk, Visioning Local Futures: The Development of a Computerized Tourism Planning Support System. Second prizes went to: Michael Martin for his talk on TITAN to Google Earth: Work Flow for Data Processing for Mobile Terrestrial LIDAR, Nathaniel Bell for GIScience Applications for Prevention Epidemiology: the Join-count Autocorrelation Test for Binary Health Data, Jennifer Evack for Improving Public Health Inspectors’ Efficiency Using Geographical Information Systems Optimal Routing Technology, and to Colin Robertson for A Comparison of Methods for Computing Cardinal Directional Relations of Polygons. Honourable Mentions went to: Alan Mc Conchie for his talk on Web Map Mashups: Cartography of Insurgence?, H.D. Eckstrand for Temporal and Spatial Analysis of Chlorophyll - A Measurement within the Strait of Georgia, British Columbia, and David Boschman for Projecting the Spread of an Invasive Species in an Urban Park Using Historical Spread Rates and a GIS. Congratulations, prize winners and to all our student presenters!

Please enjoy the extended abstracts of student and faculty talks in these 2 volumes, visit the SKI-Canada site and attend next year’s conference.

Proceedings Editor
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## Volume 1
### Plants and Animals
#### Making Sense of Animal Locomotion
Andrew Hunter and Gordon Stenhouse

#### The Impact of Landscape Change on Grizzly Bear Habitat Use in the Foothills Model Forest, Alberta Canada
Anne Berland, Trisalyn Nelson, Gord Stenhouse, Karen Graham, and Jermone Cranston

#### Quantifying the Impacts of Landscape Disturbance on the Spatial Patterns of Grizzly Bear Habitat Use
Mary Smulders and Trisalyn Nelson

#### Temporal and Spatial Analysis of Chlorophyll - A Measurement within the Strait of Georgia, British Columbia
H.D. Eckstrand, T.A. Nelson, M.P.F. Costa, and N.M. Komick

#### Mapping Local Knowledge on Recreational Boating in the Southern Strait of Georgia
Darcy Gray, Rosaline Canessa, and Peter Keller

### Involvement
#### First Nations and Spatial Ontologies: An Emerging Research Area
Christopher Wellen and Renee Sieber

#### Spatializing the Metis Historical Database using Google Maps API
Jon Corbett, James Love, Mike Evans and the BC Métis Mapping Initiative Project

#### Including Aboriginal Values in Resource Management Through Enhanced Geospatial Communication
Nancy Elliot, Alex Hawley, Roslyn Pokiak, Erin Sherry and Aaron Koning

#### Enhancing Stakeholder Bargaining Power: The Effectiveness of Collaborative GIS in Marine Zoning
Rosaline Canessa

### Interdependencies
#### Visioning Local Futures: The Development of a Computerized Tourism Planning Support System
Peter Johnson and Renee Sieber

#### The Role of GIS in Modeling Critical Infrastructure Interdependencies: A Case Study at UBC
Alejandro Cervantes-Larios and Brian Klinkenberg

#### Spatial Statistical Analysis of Detected Illegal Vessel-Source Oil Discharges in Canada's Pacific Region
Norma Serra, Rosaline Canessa, Stefania Bertazzon, Patrick O'Hara, Marina Gavrilova, and Peter Keller

#### Air Pollution and Exposure Modelling
Eleanor Setton, Perry Hystad, Karla Poplawski, Christy Lightowlers and Peter Keller

### Modeling Our Landscape
#### The Role of GIS in Agricultural Policy and Program Research
Christina M. Canart

#### Spectral Characteristics and Landscape-Level Mapping of Selected Shrub Types in the Canadian Mixed Prairie
Arun Govind and Scott Bell

#### Interactive Calibration of a Land-use Cellular Automata Model
Jean-Gabriel Hasbani and Danielle Marceau

#### The Use of Remote Sensing in Temporal Change Analysis for Grassland Monitoring
Jessica Henderson and Joseph Piwowar

#### Comparing Demographic and Lot Effects in an Agent-based Simulation of Land Use Change in the Brazilian Amazon
P.J. Deadman, A.R. Cabrera, and L. VanWey
## Moving Spaces

<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Comparison of Methods for Computing Cardinal Directional Relations of Polygons</td>
<td>Colin Robertson and Trisalyn A. Nelson</td>
</tr>
<tr>
<td>Cycling in Cities: Using GIS to Study how the Built Environment Influences Active Transportation</td>
<td>Meghan Winters, Kay Teschke and Eleanor Setton</td>
</tr>
<tr>
<td>An Exploration of Quantitative Methods for Comparing Urban Development Scenarios</td>
<td>Sean Howard</td>
</tr>
<tr>
<td>Improving Public Health Inspectors’ Efficiency Using Geographical Information Systems Optimal Routing Technology</td>
<td>Jennifer Evack, Rizwan Shahid, and David Strong</td>
</tr>
<tr>
<td>Projecting the Spread of an Invasive Species in an Urban Park Using Historical Spread Rates and a GIS</td>
<td>David Boschman, Joseph Piwowar, and Julia Siemer</td>
</tr>
</tbody>
</table>
Volume 2

Health of Things
Determining Appropriate Locations for Siting Palliative Care Hubs in British Columbia using Geographic Information Systems
Jonathan Cinnamon, Nadine Schuurman, and Valorie A. Crooks

Modelling Effects of Hospital Services Changes in Rural and Remote Areas using GIS
Nadine Schuurman and Myriam Berube

GIScience Applications for Prevention Epidemiology: the Join-count Autocorrelation Test for Binary Health Data
Nathaniel Bell and Nadine Schuurman

Emerging Infectious Diseases and Agent-based Models: Moving Epidemiology from Analyzing Pattern to Simulating Process
Raja Sengupta

Predictive Modeling and GIS for Conservation
David J. Lieske

Living on the Slopes
Living on the Edge: Spatial Pattern Implications of the Current Mountain Pine Beetle Epidemic
Jed Long, Trisalyn Nelson, and Michael A. Wulder

Determination of Canadian Snow Regimes Using Passive Microwave Radiometry
Carson Farmer, Trisalyn Nelson, Mike Wulder, and Chris Derksen

A Tale of Two Targets: Scanning Rockmasses and Building Facades with Static and Mobile LiDAR
Matt Lato, Robin Harrap, Mark Diederichs, and Jean Hutchinson

Using GIS to Manage and Analyse Spatial and Temporal Data in the Study of Massive Landslide Behaviour
Katherine Kalenchuk, Jean Hutchinson, and Mark Diederichs

TITAN to Google Earth: Work Flow for Data Processing for Mobile Terrestrial LiDAR
Michael Martin Evans, Robin Harrap, and Craig Sheriff

Online All the Time
Climate Change! Maps! Action! Public Response to Climate Change Projections using Digital Earth and Geoweb Applications
Britta Ricker

Internet Mapping in the Kootenays
Ian Parfitt

Classifying Spatial Data on the Internet
Scott Bell

Web Map Mashups: Cartography of Insurgence?
Alan Mc Conchie and Brian Klinkenberg

Unearthing Google: Corporate Networks: Public Participation Geographic Information Systems and (Infiltrating) Cyborgs
Gwilym Lucas Eades

Blue Sky
Structure Across Scales: Hierarchical Decomposition of Spatiotemporal Data Using A Scale-Space Approach
Arie Croitoru

The Rise of Multimodal Geospatial Interface Research
Nick Hedley

Spatial Statistics: Putting the Myths into Perspective
Marie-Josee Fortin and Mark R.T. Dale

Break and Enter Crime Opportunity Spaces in Regina
Joseph Piwowar, Julia Siemer and Jessica Henderson

Inter-generational
Participatory Geoweb: A Research Agenda
Renee Sieber
The Reflexivity of Geospatial Technology: Exploring the Geographies of Hope and Fear
Brian Klinkenberg

Geo Web Toolsets for Ecoforestry Education and Management
Charles Burnett, Patrick Hayes, and Jay Rastogi

Conducting Applied Geomatics Research under the NSERC College Community Innovation Pilot Program
David Colville

Applied Geomatics Research in Nova Scotia; Sharing our Eight Years of Experience
Robert Maher
Determining Appropriate Locations for siting Palliative Care Hubs in British Columbia using Geographic Information Systems

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Abstract

The purpose of this research is to determine appropriate location(s) for siting palliative care services (PCS) to better service rural and remote areas of British Columbia. Palliative or end-of-life care focuses on providing crucial services for the dying. Consequently, the aim is to reduce the severity of suffering, not to change the outcome. The interest in palliative care issues in Canada has grown in recent years as a result of the growing push to improve the quality of life for those affected by life limiting illness, death, and bereavement (BCHPCA, 2006). This has been compounded by the fact that the Canadian population is aging, resulting in service that is unable to keep up with demand, particularly in rural and remote areas which provide few, if any services for those in need of palliative care (CHPCA, 2005). Unlike many other health outcomes, the relocation of palliative care patients to urban centres that have PCS is controversial, as most people would prefer to spend their final days at home (Gilbar and Steiner, 1996; BC Ministry of Health, 2006). It is recognized that it is not feasible to implement full PCS in areas with sparse population and inadequate established health and support services (Pereira, 2005). However, suitable sites for implementation of regional palliative care hubs can be determined and rationalized using rigorous and robust GIS methods.

Background and Relevance

The purpose of this research is to determine appropriate location(s) for siting palliative care services (PCS) to better service rural and remote areas of British Columbia. Palliative or end-of-life care focuses on providing crucial services for the dying. Consequently, the aim is to reduce the severity of suffering, not to change the outcome. The interest in palliative care issues in Canada has grown in recent years as a result of the growing push to improve the quality of life for those affected by life limiting illness, death, and bereavement (BCHPCA, 2006). This has been compounded by the fact that the Canadian population is aging, resulting in service that is unable to keep up with demand, particularly in rural and remote areas which provide few, if any services for those in need of palliative care (CHPCA, 2005). Unlike many other health outcomes, the relocation of palliative care patients to urban centres that have PCS is controversial, as most people would prefer to spend their final days at home (Gilbar and Steiner, 1996; BC Ministry of Health, 2006). It is recognized that it is not feasible to implement full PCS in areas with sparse population and inadequate established health and support services (Pereira, 2005). However, suitable sites for implementation of regional
palliative care hubs can be determined and rationalized using rigorous and robust GIS methods.

Methods and Data

An extensive review of related literature was undertaken to elucidate current issues in palliative care, including its mounting importance in health services research, applications of GIS to health services and palliative care provision, and the relationship between access to palliative care for those in need, and their socio-demographic characteristics. Data of existing palliative care locations were gathered from the regional BC Health Authorities, combined into a single dataset, georeferenced and added to an existing map showing census-defined Urban Areas (UA) (communities with at least 1000 persons, and a population density of at least 400 people per km²). Using the dataset showing locations of current PCS, catchments were created surrounding these communities that boast PCS, based on a maximum travel time of one hour to the services.

Results

The catchments served to highlight the UAs considered to be out of the practical service range for palliative care in BC based on the determined maximum travel time of one hour. Several Urban Areas that are more than one hour drive from existing PCS were identified as potential candidate sites for the creation of regional palliative care hubs to provide service to the neglected areas of the province.

Conclusions

Results of this research suggest that serious inadequacies exist in the spatial distribution of palliative care services in British Columbia. Access to PCS in rural and remote regions of the province is particularly sparse or in many cases so distant as to be non-existent. The creation of strategically located regional palliative care hubs based on the findings of this study could help to ameliorate geographic inequities in service provision. The methodology employed in this study could be easily translated to other health research in which resolving inequities in geographic access and improving resource allocation are the objectives.

References


Modelling effects of hospital services changes on catchment populations in rural and remote areas using GIS

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Abstract

Hospital services are allocated by administrative fiat. GIS is seldom used to provide evidence for optimal location of services. This paper demonstrates an on-line application to enable policy makers to view the geographic areas and populations affected by hospital service closures and relocation using GIS. The graphical user interface (GUI) allows decision makers to select an area of British Columbia, choose a hospital service – or all services - and then model the population served within one, two and four hour travel time catchments around the service. The user can eliminate services to model effects of service closure on population served within a given travel time. This GUI is the first mapping application designed to enable policy makers and hospital administrators allocate services in a rational manner – based on physical accessibility to services.

Background and Relevance

Cost containment involves rationalizing healthcare service delivery through centralization of services to achieve economies of scale. Hospitals are frequently the site of cost containment and rationalization especially in rural areas. Socio-demographic and geographic characteristics make hospital service allocation more difficult in rural and remote regions. This paper presents a methodology to model rational catchments and percentage of the population served around rural hospitals – based on patient travel time – and displayed in real time on-line.

Data and Methods

A road travel time database was used to assign travel times to all road segments in the province of British Columbia. A vector-based algorithm was developed to determine catchments around 70+ rural and remote hospitals. The catchments were then linked with postal code population counts from the 2001 census to determine percentage of population served within one and two hours travel times for specific hospital services. A Java-based GUI was developed to display results in simple maps and tables on-line.

Results

This application provides a means to visualize effects of service closures and provides accurate counts for affected populations of the new catchments – based on travel time. Moreover, it allows modeling of variations in service allocation so that impact can be minimized.
Conclusions

Reduction of rural health services in the form of hospital downsizing or closure has consequently occurred in many Canadian jurisdictions. Smaller rural hospitals, in particular, have been targeted for closure as they are the least efficient to operate. This application provides hospital administrators and policy makers with precise information about the socio-demographic impact—and geographic distribution—of the effects of service relocation. Demonstration of the GUI indicates the profound effect of service closures on rural and remote populations.
GIScience applications for prevention epidemiology: the join-count autocorrelation test for binary health data

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Abstract

We explore how spatial autocorrelation statistics might be used alongside traditional statistical analysis to better understand the socio-spatial pattern of injuries. Out-of-the-box autocorrelation tools are widely available, but less capable of inferring spatial patterns of binary data. This paper presents current research in the analysis of intentional injury patterns in a large urban area in British Columbia and addresses many of the challenges associated with creating a binary autocorrelation method to explore rare health outcomes such as intentional injuries.

Background and Relevance

Injuries are the leading cause of death and hospitalization in British Columbia (BC) for all residents under the age of 44, with direct and indirect costs of all hospitalizations totaling over $2 billion annually. Studies have routinely shown that many injuries are more prevalent amongst the young and individuals from adverse socio-economic status (SES) backgrounds and that the causal mechanisms triangulate individual, social, and geographic variables. However, integrating sophisticated spatial analysis tools into prevention epidemiology is still in its infancy.

Methods and Data

We use a join-count spatial autocorrelation test and a generalized loglinear analysis to examine the socio-spatial pattern of intentional injuries in a large urban area in British Columbia. Data were obtained from the British Columbia Trauma Registry (BCTR) and stratified by age and gender. Socio-economic data was obtained from the 2001 Canadian Census. A VBA module was created in ESRI’s ArcGIS© software platform to calculate the join-count coefficient.

Results

There were significant spatial and social patterns of assault injuries amongst males under the age of 55. Spatial autocorrelation models were better suited than the loglinear model for identifying intentional injury patterns among females.

Conclusions

The join-count spatial autocorrelation test is a useful spatial analysis tool for exploring health outcomes that occur only in small pockets of the population.
Emerging Infectious Diseases and Agent-based Models: Moving Epidemiology from Analyzing Pattern to Simulating Process

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Abstract

This paper presents a conceptual framework describing the utility of spatially-explicit Agent-Based Models (ABMs) in simulating emerging infectious diseases and designing proactive policy measures to minimize contagion.

Background and Relevance

The sudden appearance of diseases like SARS (Enserink & Vogel, 2003), the devastating impacts that diseases like Ebola have had on both human and wildlife communities (Leroy et al., 2004), the fear that diseases like Avian Bird Flu have caused (Sengupta et al., 2007), and the immense social and economic costs created by viruses like HIV (Piot et al., 2004) underscore our need to understand and simulate the processes that underlie infectious diseases and predict their emergence. Epidemiological models to date have utilized a combination of mathematical and statistical modeling techniques, but have generally not incorporated explicitly spatial, temporal, and disaggregated dimensions in one system. For example, Susceptible-Infected-Recovering (SIR) models incorporate time but not space, whereas spatial statistics and cluster analysis incorporate space but not time. Further, spatial stastistics and cluster analysis are useful tools to explore spatial patterns once a disease emerges, but are not adequate to forewarn policy-makers about impending outbreaks so appropriate measures can be taken. This is a lost opportunity because infectious disease outbreaks are by their very nature both (1) spatially structured and (2) result from individual interactions in a spatially heterogeneous landscape.

Methods

A means around the lack of spatial structuring and simulation of individual interactions are ABMs incorporated within geospatial software. An ABM simulates the interactions between biological individuals and their landscape through the use of computer code to represent each individual as an agent in a ‘virtual’ environment stored within a GIS. Further, the computer code representing an individual must possess the following four properties: (a) autonomous behavior, (b) ability to sense its environment and other agents, (c) ability to act upon its environment alone or in collaboration with other agents, and (d) possession of rational behavior (Woolridge & Jennings, 1995). Additionally, researchers have pointed out that intelligent agents should not only be able to respond to, but also learn from, their environment. Humanistic characteristics such as beliefs, desires, intentions, and emotions and trust also could form a part of agent behavior (Shoham, 1993). Computational models of boundedly rational decision-
making behaviour are available to develop computer code that fulfills the criteria of autonomy, awareness, reactivity, and rationality.

ABMs (a growing area of interest in GIScience (Sengupta & Sieber, 2007)) are ideal environments within which the complexity of disease transmission resulting from interactions between individuals and of individuals with their landscape can be simulated over time and space. The emergence of a disease is simulated by focusing on the on individual and their interactions with one another over a simulated landscape which may give rise to epidemics. Because each individual is represented independently, agents can exhibit heterogeneities in traits that are of interest in the context of disease dynamics (disease type, probability of transmission, or mortality). Further, the agents move within a specified landscape whose characteristics can be modified (e.g., varying in the extent of ecotone which has transmission probability for a specific pathogen elevated to a specific level). This allows agent-based models to represent complex systems where the solutions are non-deterministic and often have a stochastic component represented by probabilities (e.g., a particular type of interaction in a specific landscape, such as disease transmission or mortality, has a certain probability of occurrence at each time step). General patterns resulting from the interactions thus begin to emerge when the simulation has been run iteratively multiple times. These “emergent properties” include features such as disease spread, all of which occur at the population level rather than the individual level. Thus, simulating individual interactions lead to emergent properties (i.e., the potential for an epidemic) that cannot be predicted in advance of running the simulations.

Conclusions

Understanding how spatial patterns of disease incidence or risk are generated (i.e, simulating the processes rather than analyzing the patterns) provides a useful epidemiological tool for monitoring emerging infectious diseases. Rather than reacting to changes in disease dynamics that result from anthropogenic modifications to landscapes leading to increased contact between infected individuals, researchers can predict what will happen if a particular change were to occur and potentially design means to mitigate the effects. As new diseases emerge, we can react to them and understand the reasons for their emergence after the fact, or we can take a proactive approach and try to understand the principles that govern the emergence of novel diseases in general. In concluding, this paper argues that the latter approach is preferable and has the greatest potential to benefit human health.

References


Predictive Modeling and GIS for Conservation

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Abstract

The combination of Geographic Information Systems (GIS) and statistical modelling is a powerful tool enabling an improved understanding of conservation issues. Two objectives that can be met include: (1) making inferences about the importance of factors of concern, and (2) predicting the response of organisms to changing conditions. GIS is intrinsically important for visualizing the impact of hypothesized factors or species responses, and for supporting spatial decision making (e.g., prioritizing areas for conservation). In collaboration with colleagues at Bird Studies Canada, Environment Canada and others, a modelling GIS study will be conducted to prioritize sections of Maritime coastline for the recovery of beached birds, oiled-at-sea. Chronic oil pollution is thought to be a potentially serious problem affecting sea birds of the East Coast of Canada, occasionally culminating in the recovery of dead and dying oiled birds. A key objective of this study is to determine the sections of coastline most likely to act as “catchments” for oiled birds, and will involve the modeling of sea bird occurrence, oil occurrence, and physical factors (e.g., favourable wind) most likely to result in a beached bird incident. It is expected that subsequent stages of this project will involve field validation of model predictions through the assistance of volunteer participants in beached bird surveys (BBS). It is anticipated that an enhanced understanding of factors determining the occurrence of sea birds, as well as their risk of oil exposure and likelihood of recovery on Maritime coastlines will result from this study.
Living on the Edge: Spatial Pattern Implications of the Current Mountain Pine Beetle Epidemic

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Abstract

The current mountain pine beetle epidemic in British Columbia is causing large scale disturbances to the spatial structure of the forest. The focus of this project is to quantify the nature of these changes from 2000 to 2006 using landscape metrics and local measures of spatial autocorrelation. The forest/non-forest structure, in 2000 and 2006, will be evaluated using local measures of spatial autocorrelation for categorical data. Landscape metrics, as traditionally used in landscape ecology, will be calculated and a comparison between years will be used to relate forest pattern changes to mountain pine beetle damage. The results will demonstrate the spatial relationships of the current mountain pine beetle epidemic. Increased fragmentation in the spatial pattern of the forest structure is expected. These results will provide valuable information for forest and wildlife managers to incorporate into mountain pine beetle planning and management efforts.

Background and Relevance

Currently, mountain pine beetle infestations are causing large scale disturbance of mature lodgepole pine forests in central British Columbia. This epidemic is the largest on record, and is expected to continue causing mortality in 80% of lodgepole pine before it subsides (Eng et al., 2005). These disturbances, via beetle kill or subsequent salvage logging, are causing widespread loss of forest and altering the forest structure of the region. The effects of forest loss cannot simply be measured in terms of quantity of forest lost, and indicators that incorporate the effects of spatial pattern are necessary (Franklin & Forman, 1987). Landscape metrics have been identified as a useful tool for quantifying the link between landscape patterns and ecological and environmental processes (Frohn, 1998). Quantification of landscape properties is required when attempting to identify significant changes through time and when relating spatial patterns to ecological functions (Turner, 1989). The goal of this research is to quantify the nature of the spatial pattern change to the forest, as a result of the current mountain pine beetle epidemic in British Columbia.
Methods and Data

Landsat 7 ETM+ imagery was acquired for the core infested region in central British Columbia. All imagery is from the summer of 2006, and minimal cloud cover occurs in most images. Data from 2000 has been provided by the Pacific Forestry Centre, for comparison analysis. A study site will be classified using similar methods to that of the Earth Observation and Sustainable Development of Forests (EOSD) program used for deriving Canadian land cover from Landsat imagery (Wood et al., 2002; Wulder et al., 2003; Wulder & Nelson, 2001). Duplication of methods will allow for an accurate comparison of this work to previous studies that were part of the EOSD program. From the EOSD classification hierarchy (Wulder & Nelson, 2001), a classification level will be chosen that fits the needs of this project. From this the Landsat image can be easily aggregated into a forest/non-forest classification for analysis. Mountain pine beetle has been a significant factor in altering the forest structure of this region, and this work focuses on the link between observed changes and mountain pine beetle processes.

The spatial pattern of the forest/non-forest landscape will be characterized using local measures of spatial autocorrelation and landscape metrics. Spatial autocorrelation refers to the non-random arrangement of values across the study region (Boots, 2002). Local measures of spatial autocorrelation can be used to determine areas of positive and negative local spatial autocorrelation (Boots, 2002; Getis & Ord, 1992). Novel methods for quantifying the nature of spatial autocorrelation in categorical data (Boots, 2003, 2006) will be employed. These methods enable a statistical comparison with random expectations to determine if spatial pattern could exist by chance. Landscape metrics are commonly used in the field of landscape ecology as a means for measuring landscape heterogeneity (Li et al., 2005). They will also be used to provide a quantitative value which measures a component of the spatial configuration of a landscape (Li et al., 2005).

Previously, a similar study by the Pacific Forestry Centre calculated landscape metrics for the entire region in 2000. These results will enable change comparison analysis to occur between 2000 and 2006, a time period which covers the current mountain pine beetle epidemic. Individual metrics will facilitate answers to questions such as: has the mountain pine beetle epidemic caused an increase in forest edge habitat from the year 2000 to the year 2006. The results of this comparative analysis will be useful to forest and wildlife managers, and will aid in determining the effect that the current mountain pine beetle epidemic is having on the spatial structure of the landscape and wildlife habitat. This will allow for a quantitative inventory of the spatial pattern of mountain pine beetle related landscape change.

Results and Conclusions

The results of this study will show how the forest/non-forest structure of British Columbia has changed during the current mountain pine beetle epidemic. Output will include a classified image of forest cover, an aggregated forest/non-
forest map, and several maps showing the spatial configuration of the forest. The fact that metrics are quantitative will allow the calculation of observable changes between 2000 and 2006. It is anticipated that local measures of spatial autocorrelation will reveal that spatial dependence is an important characteristic of the current mountain pine beetle epidemic. It is expected that the extensive loss of forest from mountain pine beetle kill will have significant effects on both the quantity and spatial pattern of the forest structure. This study will form the foundation for future work aimed at exploring the impacts, that mountain pine beetle related change to the forest configuration, will have on differing wildlife species’ habitat.

References


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Determination of Canadian Snow Regimes Using Passive Microwave Radiometry

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Abstract

Snow water equivalence (SWE) is an important factor in the control of regional and global climate systems, hydrologic cycles, and atmospheric processes. Daily monitoring of SWE using passive microwave radiometry provides datasets capable of defining long-term spatial-temporal patterns in SWE. Using spatial-temporal patterns of SWE, it is possible to distinguish unique regimes of snow cover in Canada. Knowledge of the distribution of these SWE regimes will help analysts answer key questions regarding their impact on human and ecological processes. The current research uses novel temporal metrics derived from long-term SWE estimates, and spatially constrained cluster analysis, to objectively define the major SWE regimes across Canada.

Background and Relevance

The spatial distribution of terrestrial snow cover impacts local snowmelt release (Luce et al., 1998), global and regional atmospheric circulation (Derksen et al., 1998a; Barnett et al., 1989), and global and local climate and hydrological cycles (Wulder et al., 2007; Derksen and McKay, 2006; Derksen et al., 2000; Serreze et al., 2000). The sensitivity of terrestrial snow cover to atmospheric conditions and overlying air temperatures also makes snow cover a useful indicator of climate change (Derksen et al., 2000; Goodison and Walker, 1993).

Snow cover is often measured as snow water equivalent (SWE), which refers to the amount of water (expressed as a depth in millimeters) stored in a snow-pack that would be available upon melting (NSIDC, 2007). SWE regimes describe the regular spatial and temporal patterns of SWE accumulation in individual regions, and are a major control of spatial and temporal patterns and processes in many ecosystems (Walker et al., 1999). Characterization of SWE regimes is of primary concern for analysts concerned with biodiversity monitoring (e.g. Duro et al., 2007), meso-scale controls of biological systems (e.g. Walker et al., 1993), species and community distribution (e.g. Walker et al., 1999), and many anthropogenic processes such as tourism, recreation, and urban and agricultural water supply (Walker et al., 1993).

Traditionally, data on snow cover and depth measurement have been spatially and temporally sparse (Walker and Goodison, 2000; Wulder et al., 2007; Tait, 2005). However, over the past two decades, high quality SWE datasets over large areas throughout Canada (Derksen et al., 2000; Derksen and McKay, 2006; Walker and Goodison, 2000) and the world (Tait, 1996; Pulliainen and Halliskainen, 2001) have
been developed using passive microwave radiometry. The Scanning Multichannel Microwave Radiometer, and the Special Sensor Microwave/Imager provide over two decades of continuous satellite data for North America from which SWE can be derived. The large spatial and temporal extents of this dataset provide a unique opportunity to study the spatial and temporal patterns in SWE, and to delineate Canadian SWE regimes. The goal of this paper is to examine the temporal patterns of SWE through time, and quantify if and how they vary across the study region in order to delineate relatively homogenous SWE regimes. Consideration of large spatial and temporal extents, with relatively fine spatial and temporal resolutions, is a development over previous space-time SWE research which has generally focused on examining the spatial distribution of SWE over time, emphasizing the spatial patterns of snow cover and SWE over short time periods (e.g., Derksen et al., 1998b, 1998c), or the coarse-scale spatial patterns of snow cover and SWE for longer time-series (e.g., Brown, 2000; Laternser and Schneebeli, 2003).

Methods and Data

SWE estimates used in the present analysis are based on brightness temperatures (in Kelvin) acquired by the SSM/I passive microwave radiometer onboard the Defense Meteorological Satellite Program (DMSP) F13 satellite. The data are provided in the Equal Area Scalable Earth Grid (EASE-Grid) format (see Armstrong and Brodzik, 1995) from the National Snow and Ice Data Center (Knowles et al., 1999; Armstrong et al., 1994), and are represented by 25 km grid cells. The analysis is applied over the entire Canadian landmass, and uses SWE estimates for the period from 1987 to the present.

A daily SWE estimate is computed for each pixel in the dataset, generating approximately 365 SWE estimates per pixel, per year. This analysis is carried out over the entire study period (19 years), generating approximately 6,935 SWE estimates per pixel. Because SWE is a seasonal variable, the time-series’ form relatively simple sinusoidal SWE accumulation curves. The various temporal components of the waves can be separated into representative temporal metrics by treating each grid cell within the study region as a separate sinusoidal time-series. The temporal components that can be derived from the time series’ include the period, amplitude, and frequency of the temporal wave, as well as temporal metrics such as mean yearly accumulation, maximum SWE, minimum SWE, mean time to maximum SWE, yearly mean SWE, and total mean SWE.

Once the number of temporal metrics has been reduced to a few representative measures, a classification based on a spatially constrained multivariate cluster analysis (e.g. Oliver and Webster, 1989) will be employed to ensure that the SWE regimes include spatially contiguous pixels. The result will be a map which delineates the major SWE regimes across Canada. This map can then be used to define ecologically relevant study regions for SWE related research, including climate modeling, snow-atmosphere interaction studies, biodiversity monitoring, and ecosystem characterization.
Conclusions

The methodology presented in the current analysis provides a means for determining the natural SWE regimes across Canada. By implementing a method for analyzing long-term, spatially-referenced SWE datasets, the regular spatial and temporal patterns of SWE accumulation can be used to define representative SWE management units for both ecological and anthropogenic processes. This analysis also has implications for other types of spatial-temporal analysis in the natural and human environments, and may be particularly useful for analysts interested in obtaining objective estimates of animal home-ranges, soil and atmospheric regimes, as well to derive estimates of representative scales for spatial analysis. In addition, this type of analysis will be useful for analyzing the growing number of spatial datasets collected over long time periods, at fine spatial and temporal resolutions.

References


A Tale of Two Targets: Scanning rockmasses with and building facades with static and mobile LiDAR

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Abstract

Light detection and ranging (LiDAR) uses the reflection of light from objects to produce referenced locations. LiDAR sensors can be employed in static or mobile environments, depending on the instrument configuration and project needs. Static systems are comprised of a sensor, tripod, and (often) a GPS. Mobile systems are comprised of a vehicle (truck, helicopter, or airplane), a sensor, a differential GPS, and an inertial measurement unit (IMU or INS). LiDAR sensors themselves are of two types; time-of-flight (ToF) and phase-based. The characteristics of the different acquisition systems and an example of the resulting data from each system will be discussed and demonstrated. Our research objective is to conduct experiments that will test the validity of the capacity of lidar to be used to assess both geotechnical and urban infrastructure targets using both static and mobile LiDAR. The critical concerns being orientation based sampling bias and occlusion.

Background and Reference

The predominant issues between the two classes are dynamic range and acquisition speed, the two classes being time-of-flight (ToF) and phase-based sensors. ToF sensors can collect data out to as much as 1,200m from the sensor location. However, the sensor is limited to a collection rate of typically between 2,000 - 10,000 3d points per second. The limited acquisition rate results from the time required for each pulse to travel the full range (1,200m) and return to the sensor. Upon completion of the ‘trip’, the sensor must re-power for the next pulse and the returned information must be written to memory. For static and low range (truck or helicopter mounted) systems, increasing the strength of the pulse to limit the recharge time, would change the safety classification of the laser; thus precluding use in public areas. Phase-based sensors on the other hand can collect data within a range of 0.5m to 70m. In contrast to the ToF sensors, the collection rate for a phase-based scanner is upward of 500,000 points per second. The accuracy of a phase-based sensor is typically in the range of 0.1-3mm while a ToF sensor is in the range of 1-10cm per data-point. The prices for systems using the two approaches are comparable.

Methods and Data

The decision to use a ToF sensor versus a phase-based system is typically based on the location of the object or scene being scanned in relation to the sensor, although availability of an instrument is often a consideration as well. If the scene is in the range window of a phase-based scanner there are no disadvantages in comparison to a ToF sensor. The data generated by both systems are comparable and generally given as a 3d location plus a returned signal intensity value. For projects that involve precision
工程学，如结构设计，一个基于阶段的系统具有显著的优势：
收购时间和准确性对于这些系统都更优。

**Results**

当前研究重点在皇后大学的数据收集指南和处理工作流程，特别是在基础设施目标和地质应用的LiDAR数据上。探索不同的数据收集方法，处理选项，和可交付成果，最终导致了有效扫描实践的指导方针（Lato et al., 2007）。例如，对于岩层的力学评估，需要高分辨率和高精度的岩层。然而，对于电话杆等静态城市物体的模型，所需的空间分辨率降低了，但目标区域面积变大。我们的工作的一个结果是静态扫描器放置和特征提取分辨率的影响（Lato et al, 2007）。

已完成了对移动LiDAR收集的显著研究，其中飞行LiDAR单元安装在卡车并以标准交通速度通过一个区域。初步结果表明，从移动收集，点云的可接受密度可以进行城市分析和地质评估。移动系统的主要优点是可以收集大量的数据，覆盖大面积区域，在极小的时间内。这使得可以在交通走廊如铁路和高速公路上收集LiDAR数据，而不会给交通或操作带来重大干扰。

**Conclusion**

我们的工作侧重于复杂岩溶和建筑物的有效扫描；两者的表面形态都很复杂。我们也在研究输出工作流程，包括与3D建模和Google Earth的集成。

到目前为止，我们的工作已经展示了地质技术的和城市基础设施目标，可以有效地使用静态和移动LiDAR扫描。与静态LiDAR相比，移动系统的数据集是一个巨大的挑战。我们正在研究使用计算机视觉研究的物体识别方法来增强LiDAR工作流程。
References


Using GIS to Manage and Analyse Spatial and Temporal Data in the Study of Massive Landslide Behaviour

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Abstract

Research is underway to develop a rigorous and geomechanically sound approach to analyzing risk potential associated with slow-moving, massive landslides. Multi-dimensional instability analyses of complex landslides integrate data from instrumented sensor networks with three-dimensional numerical modeling. Field monitoring data and numerical model output provide impressive volumes of information describing slope behaviour. Major challenges lie in managing the large quantities of data returned from simulated case histories, in visualizing both field and simulated data and in comparing simulated data with field data. The use of geographic information systems (GIS) tools is vital to overcoming this challenge.

Background and Relevance

History has demonstrated catastrophic impact of massive landslide failure, for example the Frank Slide of 1903 [McConnell and Brock, 2003] and the 1963 Vaiont failure [Müller, 1987]. Infrastructure and community development in landslide prone regions demands knowledge of complex landslide behaviour. Extensive monitoring systems are used to track landslide deformations, although monitoring data is often cumbersome and complicated, especially when complex deformations are occurring. Massive landslides are generally impossible to prevent, and very difficult to mitigate: experts must therefore be trained to deal with, and interpret, monitoring data in such a fashion that advance warning can be used to avoid catastrophe. Numerical modeling, a fundamental component of ongoing research, is being used to probe the sensitivity of landslide behaviour to key geomechanical factors [Kalenchuk, 2007] and also to create cause-effect models of large landslides which will be used to train decision systems [Hutchinson et al, 2006]. Integrating numerical model outputs with instrumentation data and spatial data management tools (GIS) will aid in the development of geotechnical rule sets for landslide hazard identification and risk management.

Methods and Data

Field data is collected through monitoring networks of borehole inclinometers, extensometers, survey monuments, and piezometers. The interpretation of cumbersome spatial and temporal data is difficult. GIS tools aid the visual representation and manipulation of the data significantly. Spatial regression techniques compare the sensitivity of displacement rates to local factors such as local shear zone thickness, slip surface orientation or groundwater response time. These functions
contribute to four-dimensional data analysis, providing insight into the key parameters that may influence landslide behaviour.

Numerical modeling plays a major role in the study of complex landslide behaviour. Slope stability is generally assessed using plane strain models of slope cross-sections, or three-dimensional models with basic geometries [Agliardi et al, 2001, Eberhardt et al, 2004, Hutchinson et al, 2006], neither of which adequately simulate massive landslide behavior. With ongoing research, sophisticated three-dimensional models have been developed to replicate massive landslides based on geological information and instrumentation data. Field data provides information for specific discrete locations within a landslide system, and therefore many factors, such as shear surface geometry, strength parameters and piezometric conditions, must be inferred for most of the landslide extents. Careful calibration of the models is thus required to assure that simulated deformation processes accurately reflect recorded slope behaviour.

**Results**

A comparison of preliminary modeling results to field data using visual analysis and spatial regression will be presented. Areas of the landslide model that do not accurately reflect the true landslide behaviour are isolated. Sensitivity analysis is then applied to determine which input factors: first, the inferred shear surface geometry and later, the distribution of mechanical strength parameters, contribute to discrepancies between real and simulated landslide deformations. Once numerical models achieve adequate representation of observed behaviour from case studies, the simulation of potential trigger scenarios will be used to generate synthetic response data for individual and groups of sensors. Synthetic records will be fed into decision support systems, to model the various potential combinations of sensor output. This has valuable application in hazard management of massive landslides, enhancing the ability of technical experts to interpret large amounts of field data and respond to rapid changes in sensor output, allowing for advanced warning of possible failure scenarios.

**Conclusions**

Vast quantities of data returned from real time monitoring and numerical simulations can be overwhelming and difficult to interpret. This approach to managing and analysing spatial and temporal data using GIS tools is key to the effective analysis of landslide behaviour. GIS tools are being used to assess real and simulated data in order to better understand the mechanical process taking place in massive landslides. Comparing these two data sources improves calibration of numerical models which replicate ongoing deformation processes and test geometric and parametric assumptions. Calibrated simulations of landslide case histories allow for the simulation of possible trigger scenarios and the establishment of failure thresholds. GIS tools are used to amalgamate modeling output with real field data, improving the decision-making capabilities of technical experts and the management of landslide-associated hazards.
References


TITAN to Google Earth: Work flow for Data Processing for Mobile Terrestrial LIDAR

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Abstract

Terrestrial LIDAR scanners are pushing the boundaries of accurate urban modelling. Automation and the usability of tools used in feature abstraction and, to a lesser degree, presentation have become the chief concerns with this new technology. In order to broaden the use and impact of LIDAR in the geomatics, LiDAR datasets must be converted to feature-based representations without loss of precision. One approach, taken here, is to simultaneously examine the overall path that data takes through an organization and the operator-driven tasks carried out on the data as it is transformed from a raw point cloud to final product. Presented here is a review of the current practices in LiDAR data processing and a foundation for future efforts to optimize.

Background and Relevance

Terrestrial mobile LIDAR scanners integrate precise positioning technology with laser ranging to allow the acquisition of precise 3D locations from objects along transportation corridors at flow-of-traffic speeds. The TerraPoint TITAN system was used to acquire urban infrastructure for Kingston, Ontario; in less than six hours this system generated over 15GB of 3D point locations in geographic coordinate space. This presents a pair of problems: how do experts and non-experts cope with such data volumes effectively, and how can they then communicate their results or share their information products?

The normal acquisition and processing pipeline of TITAN LIDAR data includes survey planning, location control setup, mobile data acquisition, pre-processing and position correction of the acquired data. Concerns arise over what options exist from this point forward, especially at the client side where specialized tools are often too expensive or complex for adoption.

The options for processing LiDAR include: Handling and display of points in specialized LIDAR software tools, directly integrating points with off the shelf consumer software and communication tools, or taking intermediate results from LIDAR tools into consumer software.

Methods

We examine alternative LIDAR processing workflows with two key questions in mind: computational efficiency - whether the process can be done using the tools at all - and tool complexity - what operator skill level is needed at each step. Using these workflows the usability of the specific software tools and the required knowledge to effectively carry out the procedures using the tools are examined.
Workflows based on dedicated LIDAR tools such as InnovMETRIC Polyworks, commercial modeling tools such as Autodesk 3D Studio Max and Google SketchUp, and using output platforms such as Google Earth and other GIS visualization tools provide case studies of the spectrum of options. We specifically target desired end products such as geographic flythrough and widespread data proliferation via Google Earth where the users may have little knowledge or even interest in the technical details of LIDAR acquisition and processing, but simply wish to visualize a local environment with the accuracy that LIDAR can provide.

**Results**

Preliminary results of this work has yielded workflows that successfully translate LIDAR to 3D object models, highly decimated point representations of street data represented in Google Earth, and large volume point data flythroughs in ESRI ArcScene. We are documenting the pragmatic limits on each of these workflows and tools, both in terms of computation time and realistic performance in the hands of end-users.

**Conclusions**

Terrestrial LIDAR brings with it new innovations for spatial visualizations, but also questions of viability. The technology as proved valuable for specialized applications for experts, but it is important to examine whether this technology can be useful as a tool for proliferating 3d spatial information by and to non-experts. This study illustrates the issues associated with preparing 3d LIDAR data for presentation in mainstream visualization environments.
Climate Change! Maps! Action!
Public response to climate change projections presented via Google Earth

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Abstract

This presentation explores the effectiveness of the Geoweb as a successful means of communicating climate change to the general public. This will involve visual depictions of select aspects of climate change on Google Earth (GE), which will be presented to focus groups. Questionnaires will be given to participants to complete before, during and after the interactions with the Geoweb. It is expected that this research will yield mixed results on effectiveness of the Geoweb to communicate climate change.

Background and Relevance

Despite the overwhelming scientific evidence supporting the claim that humans are currently the main contributors to climate change, communicating this data in a compelling manner is no easy task. Climate change is not perceived as an urgent risk by the general North American public (Dilling and Moser 2007). Risk is defined as the likelihood that an individual will experience the effects of danger (Short Jr. 1984), whereas perceived risk is the subjective consideration of the probability of an accident happening and how concerned we are with the price of the negative outcome (Sjoberg et al. 2004). One of the struggles of communicating climate change is recognition and acceptance of the difference between actual and perceived risk involving climate change.

Other major barriers to communicating the negative effects of climate change include remoteness of impacts, lack of peer support and solution skepticism. Barriers to action combating anthropogenic forcing of climate change include lack of political will and leadership and cognitive barriers (Dilling and Moser 2007). Creative means for overcoming these barriers to climate change communication are in order.

This communication is viewed as extremely important for effective resolution of climate change issues. The United Nations Framework Convention on Climate Change calls for (1) the development and implementation of educational and public awareness programs on climate change and its effects; (2), the public access to information on climate change and its effects; (3) the public participation in addressing climate change and its effects and; (4) developing adequate responses (UN Framework Convention Climate Change 1994, article 6 paragraph i-iii). Support for mitigation measures may increase as the public becomes more aware of the causes of atmospheric greenhouse gasses (Seacrest et al. 2000). The United Nations and other international organizations recognize
that communication is the first step to help reduce greenhouse gasses.

This research aims to discover if the Geoweb is an effective means of achieving these goals. The Geoweb “is an integrated, discoverable collection of geographically related web services and data that spans multiple jurisdictions and geographic regions” (Lake et al. 2007). The presumption is that individuals and stakeholders now have the means to utilize free, user-friendly technology that is obtainable to anyone with access to an Internet-enabled computer or mobile device. It provides the ability to display and analyze geospatial data and add to that information without professional training (Rouse et al., 2007). It is hoped that since Geoweb platforms such as GE are free and user friendly, money and professional training will no longer be a barrier to allow individuals to easily interact with publicly accessible maps.

In terms of climate and environmental change, GE provides a means to visually “visit” remote and relatively inaccessible landscapes most vulnerable to environmental degradation and climate change. For example, the Sierra Club’s display of the Arctic National Refuge is featured in GE Outreach’s showcase. This enables users to “fly over” Northern Alaska to view environmental impacts of oil drilling, which has destroyed the once flawless landscape. Projections and flyovers may have the potential to dismantle current cognitive barriers hindering communication of the realities of climate change. This study seeks to present geospatial information displaying the effects of climate change in the most efficient way possible.

**Methods**

For the purposes of this study I will concentrate on one aspect of the Geoweb, the digital earth, GE. I chose GE because of its relative ease of use. Users can interact with GE using KML, which is a widely-used markup language. (KML is a dialect of XML.) Furthermore, GE is currently extremely popular with the general public, likely due to its versatility. GE appears to be exciting to navigate for an expert computer programmer or an average Internet surfer.

I will determine the effectiveness of communicating climate change by assessing the degree of learning that takes place during this study. Was the true immediacy of risk communicated effectively? Did the participants learn more than they knew before about climate change? Did GE aid in this process? One way to determine the answers to these questions would be to present spatial data depicting the risks of climate change to focus groups via GE. Possible examples of risks induced by climate change would be sea level rise and/or coastal flood surges. Focus groups may be a good option for this study because focus groups encourage people to discuss their views and opinions with peers and the researcher simultaneously. Focus groups are also a good way to assess the ease of use and interface design as the participants may discuss struggles and achievements with each other throughout the exercise. Other options for gathering data are being considered to reveal the effectiveness of the Geoweb as a means of communicating climate change.
Furthermore, this study will investigate the likelihood that these new ways of displaying spatial data illustrating the effects of human-induced climate change will spark community action. Information alone will not necessarily change behavior (Schmel 2004, Dilling and Moser 2007), but perhaps a convincing interactive map made available on the web may aid in this process. For the purposes of this study, “effectiveness” will be measured via a questionnaire. The participants will fill out the questionnaire before the exercise and as they navigate the information presented in GE. The questionnaire will aim to reveal participants perceptions of climate change during each process of the exercise.

This research will be conducted in Barbados, a small island developing state (SIDS). SIDSs contributes the least to global climate change, they are among those that will suffer the most from it (UN General Assembly 1994). They are vulnerable due to their small size, insularity and remoteness, environmental factors that limit disaster mitigation capability and demographic and economic structure (Pelling, 2001, UNFCCC 1994, Belle et al. 2005). This research will attempt to understand how do people living in SIDSs think about climate change and how do they view risk imposed by climate change?

Conclusion

The impending results will reveal public response to climate change projections using digital earth and Geoweb applications. It is expected that the Geoweb will be an effective means of communication for some and not others. The digital divide still exists and will act as a barrier to hinder the effectiveness of GE as a means of communication climate change. Another barrier to communication via the Geoweb might be the participants’ educational background and geospatial understanding. Recognizing and acknowledging participants’ risk perception versus their actual risk is another communication hurdle that will need to be taken into consideration. However, it is also likely that some participants will embrace the technology and develop a meaningful understanding of the data presented and an ability to navigate through the data quickly and effectively. It is hoped that those who are able to navigate the digital earth smoothly will communicate with others about what they have seen and encourage others to view the data online. The first step to lessen the anthropogenic impacts of climate change is to communicate the impending risks and impacts. With creative new ways of communicating the effects of climate change it is hoped that new and creative ways of lessening the impacts of climate change will immerge. This research strives to discern the effectiveness of the Geoweb as a means of communicating climate change.

Bibliography


Internet Mapping in the Kootenays

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Abstract

Within the contemporary context of Internet mass geomedia, this paper considers the use and delivery of interactive Internet map services in the Kootenay region of southeast BC. An inventory and typology of web sites created and maintained within the region is presented and compared with other sites delivered by developers outside the region in BC and Canada. Little is known about the perception of these sites and whether or not they provide useful and used spatial information. A questionnaire to participants in a recent workshop for the Columbia Basin Biodiversity Atlas provides some data on how a geospatially-literate user group perceives and uses Web-mapping services.

Background and Relevance

Web-mapping has gained ubiquitous public adoption through a wave of new applications providing services ranging from visualization (Google Earth) to location or direction finding (Map Quest). This new virtual enlightenment ripples through the geospatial community as established software vendors continue the move forward into Internet mapping, GIS departments provide access to a wider range of information over the net, and the Open Source community takes notice. The newness of both the technology and public interest in it however means that not much research has been done using Internet mapping or investigating the relationship between the media and its audience.

Methods and Data

The inventory of web-sites was developed through web-searches and through networks. Geomatics agencies within government were queried. The inventory is largely complete for Kootenay-based interactive Internet map services (as opposed to static maps available by download from sites or included in pages as images).

The Biodiversity Atlas workshop, held in Nelson on October 22, 2007, brought together twenty-six representatives from academia, federal, provincial and regional government agencies, and NGOs to provide direction for this online resource. At the end of the day long workshop a questionnaire was circulated and 16 completed forms were collected. Questions about frequency of use of Internet Mapping sites, degree of GIS experience, and the sites used by participants were included as well as questions about the participants experience at the workshop and questions in regards to Atlas development.
Results

At present interactive Internet map services within the region are primarily within the domain of governments at the local (Revelstoke and Castlegar) and Regional District (Regional District of Central Kootenay (RDCK) and Regional District of Kootenay Boundary (RDBK)) level, and academia (Selkirk College). In all cases organizations have selected software developed by leading GIS software vendors over Open Source solutions.

All sixteen workshop questionnaire respondents had at least a good understanding of the capabilities of a GIS, while 62.5% worked with GIS regularly. This geospatially literate group all used Internet mapping sites at least once a month, with 50% accessing such sites on a daily basis. The most common sites accessed were BC government Internet mapping sites (75% of respondents) followed by MapQuest (68.8%) and Google Earth and Google Maps (both at 62.5%). Yahoo maps was the least used of sites available for selection at only 6.3% of respondents. In general, the more frequently a respondent used such sites, the more different sites they accessed, as the daily users (n=8) averaged 4.5 sites, the weekly users (n=6) averaged 2.8 sites and the monthly users (n=2) averaged 3.5. Only 37.5% of respondents used sites developed within the Kootenays (Selkirk College, 25%, RDCK, 12.5%).

Reasons for using Internet mapping sites varied from identifying data available within a given study area, to reconnaissance, to getting directions to somewhere, to accessing some GIS services without requiring GIS experience, to creating maps.

Conclusions

Internet mapping sites developed in the Kootenays are currently completely within the domain of government and academia and use software from traditional GIS vendors. The geospatially literate group surveyed used Internet mapping sites developed outside the region, including BC government sites and sites developed by Google and MapQuest, more frequently than sites developed in the Kootenays. The BC government sites were used by the most respondents, suggesting that it is possible to build applications that can successfully compete with or complement the sites developed by the global Geoweb industry. It is evident that GIS literate people are using these sites regularly and find them useful for a range of purposes.
Classifying Volunteered Geographic Information: A Model for Retrieving Spatial Data from the Internet

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Abstract

While Internet Mapping services abound on the web there is another potentially more important movement taking place. Community mappers, including individuals, groups, governments, and other organizations are collecting and delivering the raw materials for mapping at an alarming rate. Web 2.0 is central to this and other emerging social, political, economic, and geographic phenomena. While there is still an important place for traditional web mapping services the participatory nature of blogs, wikis, and bottom-up web development is providing a new way of thinking about spatial data.

Background and Relevance

The availability of spatial data at publicly accessible locations via the Internet is having an important impact on research, social exchange, and social justice (Goodchild, 2007). While mapping services are well known, what is potentially more important are mappable bodies of spatial data that are currently unmapped. Mapping Volunteered Geographic Information (VGI) requires two parties of users, the internal users who provide the data and external users who map the data and make it accessible in mapped form on the Internet. Bell and Logan (2008, forthcoming) have introduced the concept of internal and external users in the context of research-focused Internet mapping systems. With respect to Internet mapping sites Inside and Outside user categories are suggested; Inside users having conceived of and created the research focused internet mapping systems and Outside user being those people who access the map services and spatial data to answer new research questions. In the broader context of VGI, data providers operate with fewer constraints in terms of what they must offer to the eventual mapper of their data. The data provider might offer a dataset that brings together data from disparate sources in a form that can be downloaded and immediately mapped or geocoded. At the other extreme they might offer a single piece of qualitative spatial information (a place name for instance) that the user must validate, integrate, and hopefully geocode in order to map and use. The following classification scheme is one attempt to help clarify the variety of spatial information that might be classified as VGI and discusses some of the implications of each category.

Methods and Data

Experience gained from the development and construction of the US School Matters mapping system led to the following classification scheme. The following simple classification scheme includes three categories based on the type of geographic information being provided its level of integration with similar information. While the
data sources for our project were of a specific type (presented both Type 1 and Type 2 information) we were challenged to consider the continuum on which such CGI exists. Our project goal was to map all US public schools (all schools governed under No Child Left Behind policies) and present that information with information regarding populated places, demographics, and some physical and infrastructure. While the latter data were all available from reliable sources (Census, American Factfinder, USGS, Geography Network, etc.) the school data is just now becoming available and is characteristic of much of the VGI available on the Internet. Our experience has been that a great deal of VGI providers aren’t yet familiar with how the spatial component of their data will be used or the needs of the end-users (researchers, cartographers, etc.) of this data. Furthermore, when VGI is provided in a global coordinate system (latitude/longitude, UTM, state plane, etc.) the necessary metadata does not always accompany the coordinates. This was our experience when using SchoolMatters to access both geographic (school addresses and later, latitude and longitude coordinates) and non-geographic (enrolment, test scores, school demographics, etc.) information. SchoolMatters integrates data from each state to provide a single location for school performance (and location) for the whole country. This service comes at some cost, as the origins of the data are the individual states who are responsible for testing, setting standards, collecting data, and making it publicly available.

Results

A VGI Classification

Specific or Narrow Data/Low Value-added: Internal User Provides VGI; External User Validates, Integrates, and Maps
FORMAT: Information comes in a form that requires intervention to map, this might include street addresses, city names, place names, etc.
COLLECTION: The collection is in no way comprehensive and the developer (internal user) has made no effort to integrate their data with similar data. While such information might be in an Internet location associated with a community such integration does not facilitate the retrieval of the geographic information along with large amounts of similar data. Examples might include wikipedia entries, photo archives (flickr, facebook, etc.), blogs, etc. and have the potential to provide rich and novel information. The spatial component (place name, coordinate, address, etc.) can be in almost any form and will likely require intervention to map. Interventions include geocoding, metadata search, coordinate system calculation/conversion and are the sole responsibility of the external user of the data.

Topical Data/Low Value-added: Internal User Provides and Integrates VGI; External User Geocodes and Maps (and may Integrate with other data)
FORMAT: Information comes in a form that requires intervention to map, this might include street addresses, city names, place names, etc.
COLLECTION: The data source has been integrated in some fashion with similar data. The integration might be the work on a third party or by the developer/owner. Such integration includes search companies such as City Search that collects useful information about businesses and services in urban areas. The primary value added for
the potential end-user of such data sources is that data can be retrieved efficiently based on the logical and consistent structure of the data (using a computer/database program, either commercial or proprietary). We have had success using “webscraping” programs that are commercially available as well as producing our own programs and scripts for pulling together data with some common and formal structure. Both commercial and self-produced approaches have the capacity to pull spatial and non-spatial information from websites and can perform searches through hierarchically structured websites, as long as such sites’ structure is formalized.

Both Type 1 and Type 2 data sources involve more work by the external end-user of the data but should increase data reliability and reduce data uncertainty as the application of discrete geographic coordinates is the job of the external user.

**Topical or General/High Value-added:** Internal User Provides Georeferenced VGI; External User Validates (and Integrates)
FORMAT: Information comes in a form that requires no intervention to map, data is tagged with a latitude and longitude with a reasonably easy to assess coordinate system making reliable mapping straightforward
COLLECTION: Data provider is likely actively interested in having the spatial component of their data used by external users. Data sources of this type have the greatest potential for providing extensive datasets that have internally consistent characteristics. Internal data providers are likely high up on a hierarchy of similar organizations (state and federal government, national non-profit or international NGOs, foundations, etc.); this is a direct result of their own access to such data. Our experience is that without comprehensive metadata geographically referenced data has a greater potential for spatial uncertainty than data that requires the external user to assign such coordinates. Take for example a website such as SchoolMatters that provides the geographic coordinates and test scores for individual schools in the USA. Since this site provides data that is generally the responsibility of individual states it is difficult to assume that all the data was collected or the geographic coordinates recorded in a common frame of reference (datum, reference system, etc.). Without explicit metadata concerning the origins of the spatial data the user is presented with questions that are among the first things students of geography, cartography, and GIS are warned about with respect to the importance of map projections, geodesy, and frames of reference.

**Conclusions**

This classification scheme is useful for determining the state of a potential VGI source and both the work that will be involved in mapping and analyzing data from such sources. Furthermore, it the external user can more quickly evaluate the type of work and how much work will be involved in using data from a particular source.
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Web Map Mashups: Cartography of Insurgence?

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Abstract

This presentation explores and critiques the world of online “mashups,” hybrid web applications that combine data from multiple internet sources and often include a mapping component. We investigate how geospatial mashups deal with problems of data and representation, how they are positioned with respect to conventional Geography and GIS, and how they negotiate a sometimes antagonistic relationship with the providers of data upon which these mashups are based.

Background and Relevance

Mashups are often made by non-expert individuals, and mashup culture presents itself as a populist alternative to traditional top-down forms of knowledge transfer. Geospatial mashups are often associated with the term “neogeography”, implying a self-conscious break from the established discipline of Geography and the realm of GIS professionals. Similarly, the term “mashup” is borrowed from the practice of creating new works of music by sampling parts from other songs, often resulting in violation of copyright and producing a culture necessarily antagonistic to established structures of power and even forms of economic exchange. In a similar vein, many web mashups obtain their data through the process of screen scraping, often in violation of the scraped web site’s Terms of Service agreement. However, to others mashups are well within the mainstream, emblematic of the new paradigm of distributed authoring and sharing of content known as Web 2.0. Numerous geospatial internet startups, along with established search companies such as Google and Yahoo! have created a variety of tools to facilitate the creation of mashups and the sharing of geospatial data, hosting an increasing amount of user-created data on their own servers. It is on this landscape that the conflicted culture and technology of mashups continues to develop, a medium both for amateurs and experts, positioned both in- and outside the structures of power.

Methods and Data

In this presentation we present a historical analysis of the development of web map mashups since their inception, using selected case studies to focus attention on the shifting relationships between outsider mashups (for example, mashups created by community and activist groups) and their constituent third-party data sources (such as Google’s base maps or information screen scraped from government or corporate websites). Contrasting these mashup case studies with traditional paper cartography and GIS, we explore a number of questions: Are web map mashups a new kind of cartography that is more usable or more accessible to more kinds of people? Is the public using mashups to present fundamentally different representations of the world?
Do map mashups comprise a democratic mapping practice that opens up representations of space to concerns beyond those of business and the state? Finally, we track the changing stance of Google and Yahoo! with respect to mashups, and analyze the consequences of the differing approaches they have taken to attract map mashups onto their servers.

Conclusions

It is our belief that web map mashups do in fact provide new tools and new ways of representing space and, as such, define a new cartography, whose implications are still to be determined. Nonetheless, enthusiastic claims about the ability of mashups to wrest mapmaking from state and corporate hands are currently overstated. We show here how web map mashups are neither inherently liberating nor repressive, but rather are instruments used toward different ends, embedded in a network of interdependencies and interests.
Unearthing Google: Corporate Networks, Public Participation Geographic Information Systems, and (Infiltrating) Cyborgs

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Abstract

The aim of this paper is to examine how large mapping software companies produce corporate network structures that may or may not hinder the work of progressive and/or grassroots organizations. Furthermore, it will examine how to counter corporate network structures with techno-social approaches to mapping. Techno-social approaches to Geographic Information Systems (GIS) involve moving beyond strictly technological approaches. While technological approaches to GIS adhere to strict rationality, rigid structures, and individualistic, bureaucratic, or corporatist guarding of knowledge, techno-social approaches bridge three types of knowledge: scientific, technical, and cultural (Puri and Sahay, 2003). Techno-social approaches are in compatible with critiques of GIS that focus on alienating aspects of GIS. A solution to this ‘alienation problem’ is the creation of GIS/2, which might include tagged information in conjunction with user-generated content, open source code, ‘infiltration of the cyborg,’ and the introduction of public participation into GIS (or PPGIS). ‘Infiltration of the cyborg’ means that an individual with techno-social and innovative GIS capabilities, enters technocratic offices. Once ‘inside’, the ‘cyborg’ can introduce changes. Google Earth and Google Maps are two tools appropriate for this project. Ion conclusion I examine the consequences of investing time and energy in Google, from a critical standpoint. Care must be taken to avoid recapitulating the ‘alienation problem’ of older GIS approaches within the newer approaches.

Background and Relevance

Producers of well known software packages and mapping systems include large corporations, such as the Environmental Systems Research Institution (ESRI), comparable in scale (in the GIS world) to Microsoft. These companies produce hegemonic corporate network structures that define and constrain the ways we choose to live on a daily basis. This occurs through top-down approaches to building software, interfaces, and databases. These top-down approaches tend to create bureaucratic and rationalized forms of knowledge that become more static the more entrenched they become (Pickles, 1995). It is posited here, that not only ESRI and Microsoft are implicated in the process just described, but also companies such as Google. In order to counter the rigid rationalization of knowledge, a techno-social approach to GIS is proposed in this paper.

Techno-social approaches to GIS combine and bridge scientific, technical, and cultural knowledge (Puri and Sahay, 2003). Those involving free and open-source software might, furthermore, become instances of Public Participation
GIS (PPGIS). Additionally, PPGIS as ‘crowdsourcing’ holds exciting new possibilities for participatory mapping. ‘Crowdsourcing’ is form of peer review through usage, with validation by the ‘masses,’ in the style of Wikipedia. One real-world example of a ‘crowdsourced’ PPGIS application is the Google Maps ‘mash-up’ produced in the aftermath of Hurricane Katrina, which allowed anyone to enter geographically specific information, with attached text, about locations of people in distress or needing attention. Errors and vandalism were detected by legitimate users, and were quickly corrected (Miller, 2006). In this way, a social approach to technology (or techno-social) was put into action.

Free, online, or open-source programs (or combinations thereof), such as Google Maps and Google Earth, allow for an ‘infiltration of the cyborg’ into guarded spatial domains. ‘Infiltration of the cyborg’ means that an individual with techno-social and innovative GIS capabilities, might openly enter traditional technocratic offices. Once ‘inside’, the ‘cyborg’ can introduce changes. In this way, GIS/2 and PPGIS might enter the mainstream and change it for the better (Sieber, 2004). Furthermore, the ‘infiltrating cyborg’ has at their disposal mapping systems that allow (or do not disallow) hacking in, such that the hacker can program their own code into the application, modifying it for their own (and their employer’s) purposes, free of charge.

The point here is not that a ‘cyborg’ should be militant, but that the presence and capabilities of the programs, applications or methods should be asserted and considered against attempts to continue the hegemony of, for instance, ESRI programs. Thus, at budget meetings, ‘cyborgs’ should feel it their duty to add open source and free options, singly or in combination, especially if there are budget constraints. This would involve a shift from within from GIS to more of a PPGIS environment, without the overt use of such a name. PPGIS is an approach, and it is important to remember that even dominant software programs, used in a participatory way, may, to varying degrees, have the potential to be (or they may actually be) PPGIS or GIS/2. It is incumbent, then, upon the ‘cyborg’ to educate his/her coworkers about GIS, so they can also use it, not just the experts, managers, or ‘insiders’ with some special knowledge.

Next, I examine the consequences of placing so much time and energy in Google, from a stance that is critical of corporatist and top-down management styles. It might be said that Google is a company fully composed of ‘cyborgs.’ In other words, the corporate style is such that each employee of Google is allowed to think creatively and outside ‘the box.’ It would seem that (creative) subversion is actually promoted within the ‘Googleplex’. Recently The Economist (2007) suggested that while Google enjoyed the status as the ‘good guy’ early in its formation (and it is still very young), following its own maxim of ‘don’t be evil,’ it is increasingly concerned with control of the markets. Furthermore, Google has proven that it will use tactics that, while not evil, are certainly corporatist. Monopolization of markets, for instance or just ‘being the best,’ will be seen by competitors and consumers alike, as cutthroat tactics. Google is sophisticated enough to realize these objections in advance and adapt. Or it might lose its
ability to be reflexive beyond a certain size. Perhaps a ‘critical mass’ has been reached: it is possible that Google is already no longer in touch with ‘the masses.’

Conclusions

The (PP)GIS community needs to be very careful in moving beyond static GIS models with corporate data structures, in order to avoid installing new structures of the very same, oppressive type. We must look beyond Google, and keep in mind our primary goals: promoting the interests of Indigenous peoples, protecting the environment, fighting corporate hegemony, helping those who cannot help themselves, promoting health, and many others.

References

Structure Across Scales: Hierarchical Decomposition of Spatiotemporal Data Using A Scale-Space Approach

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Abstract

The ability to derive relationships between parts (granules) of a phenomenon that extends over space and time at different scales is essential in numerous application areas. Currently, the task of deriving a hierarchical decomposition of a spatiotemporal phenomenon relies on expert domain knowledge and is driven by a human operator. With the increased availability of spatiotemporal data this approach is quickly becoming impractical, thus requiring the development of automated tools for spatiotemporal data mining over multiple granularities. This presentation will review the problem of partitioning a spatiotemporal phenomenon into salient granular parts over multiple scales, and will introduce a novel analytical approach for reconstructing a multi-scale hierarchical decomposition of a given spatiotemporal data set.

Introduction

Many phenomena in virtually all areas of natural sciences involve the study of change, and in particular, change in space and time. A primary reason for this interest in change is simple: change has a fundamental role in our perception and understanding of the world as it provides a systematic approach to the evolution of things in space and time. The identification and formalization of change patterns allows us to achieve what is often taken for granted: formalize rules, apply reasoning, and predict future behaviors of a given phenomenon. Consequently, the study of change in spatial data over time is essential in various areas, such as meteorology, geophysics, forestry, biology, and epidemiology. The study of change in all these disciplines is closely related to the study of events and processes. The description of change in terms of events (and processes) is natural to us – as humans we intuitively tend to perceive an activity as consisting of discrete events (Zacks and Taversky, 2001). Yet the way spatiotemporal data should be decomposed into salient events and processes is often unclear and difficult without expert a-priori knowledge. Furthermore, our perception of events and processes is directly influenced by the scale by which we perceive and analyze the data (Galton, 2000), making the distinction between salient events and processes and the discovery of relations between them even more challenging. In light of this, the primary motivation of this work is to develop an analytical approach that would provide a hierarchical decomposition of spatiotemporal data into salient features (events and processes) while retrieving the hierarchical relations between the features using little or no a-priori knowledge.

The proposed approach

The proposed approach is based on a decomposition of spatiotemporal data using a scale-space representation of the data. The construction of a scale-space representation is carried out by imbedding the signal $f$ into a one parameter family of derived signals, in
which the scale is controlled by a scale parameter $t$. More formally, given a signal $f(x):\mathbb{R} \rightarrow \mathbb{R}$ for all $x \in \mathbb{R}$, and a scale parameter $t \in \mathbb{R}_+$, the scale space representation $L: \mathbb{R} \times \mathbb{R}_+ \rightarrow \mathbb{R}$ is defined as $L(x,t)=g(x,t) * f(x)$, such that $L(x,0)=f(x)$, and $*$ is the convolution operator (Lindeberg 1994). Typically, $g(x,t)$ is taken as a Gaussian kernel (Witkin, 1983), (Lindeberg 1990) but in the general case $g(x,t)$ can be any well-defined waveform (e.g. a wavelet). A primary advantage of the scale-space representation is its ability to provide an insight into the inherent inner structure of the data across different scales. By following inflection (extremum) points in the scale-space representation, and by using these inflection points as event/process indicators it is possible to generate a scale-space “sketch” in which the evolution trajectory of events and processes across scales becomes evident (Fig. 1(b)). A formal representation of the scale-space inner structure can then be constructed by generating an interval tree from the scale-space sketch (Witkin, 1983). A detailed outline of the proposed scale-space approach can be found in Croitoru et al. (2006). Once created, the interval tree can be analyzed using the granularity tree formalization (Reitsma and Bittner, 2003). Here, several forms of analysis can take place in addition to the reconstruction of the event/process hierarchy (Fig. 1(c)), for instance: (a) pattern detection, in which a search for a particular subset of the granularity tree is carried out; (b) change detection, in which two granularity trees are compared and differences are indicated.

![Figure 1: Hierarchical decomposition using scale space. (a) a tidal time series; (b) the corresponding scale-space sketch; (c) reconstruction of the granularity tree (each node represents an event or process).](image)

**Results**

In order to evaluate the proposed approach two types of data were analyzed: meteorological (storms) and ocean data. In the case of meteorological data the evaluation of the proposed approach was carried out using satellite data from NASA-GFSC’s GOES project (http://goes.gsfc.nasa.gov) that provides GOES-12 imagery. A total of five storms were collected, and for each storm four additional permutations were generated with a varying level of noise resulting in a set of 25 time series. Then, using the proposed approach, the data set was clustered in an attempt to recover the five storm clusters. In this case the proposed approach was able to correctly cluster the data and showed resistance to noise. In the case of ocean data wave height time series were analyzed in an attempt to detect and characterize a change in the measure phenomenon. The data was derived from GoMOOS - a buoy sensor network operating in the Gulf of Maine (http://www.gomoos.org). Using the proposed approach a granularity tree was derived and analyzed for change detection, resulting in the successful detection of
change. It should be noted that in the proposed approach change is detected across scales and not a single scale.

Conclusions

Recent years have been characterized by unprecedented amounts of spatiotemporal data. As we become more reliant on spatiotemporal data, the need to develop a sound analytical foundation for processing and inferring knowledge from such data becomes evident. In this work the problem of processing spatiotemporal data over multiple granularities was addressed. The proposed approach builds on scale-space theory in which multiple scales (instead of a single scale) are utilized, thus reducing the need for a-priori domain-specific knowledge in order to process the data. Furthermore, the proposed approach is specifically geared towards dealing with events and processes at multiple granularities, and allows reconstructing the inherent structural hierarchy of spatiotemporal phenomena. This work outlined and demonstrated how scale-space theory together with granularity trees can be used to mine spatiotemporal data, and eventually lead to the discovery of knowledge from such data.

The work presented here could be expanded in several directions. First, the scale-space approach presented could be expanded to simultaneously consider multiple object attributes. This would result in a multi-dimensional granularity tree structure, and would enable the discovery of multi-dimensional event patterns across scale. Work in a two-dimensional space has recently been presented in the context of object analysis and detection (Siddiqi et al., 1999), but further expansion into multiple dimensions is needed. A second area in which this work could be expanded is the development of modeling and analysis tools for intra and inter-object events and processes. The work presented here focuses on a single salient objects (i.e. a hurricane cloud mass) and assumes that the topology of the object remains unchanged (i.e. the cloud mass does not split, or merge with another storm’s cloud mass). However, various application areas, such as transportation, meteorology and homeland security, require the capacity to detect events and processes that include changes in the composition of an object or in the relation between objects over time, space, and scale (McIntosh and Yuan, 2005). In order to accommodate such a capacity change in topological relations over time should be incorporated, and temporal ordering rules should be applied (Peuquet, 1994). Potentially, this could be done through a conceptual neighborhood graph based approach (Cohn et al., 1997). In addition, a framework for describing topological relations over multiple granularity levels should be developed.

References


The Rise of Multimodal Geospatial Interface Research

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Abstract

I will discuss how emerging geospatial interface technologies support new informational, educational and communication experiences in real, virtual and hybrid spaces, and why this requires new research methodologies and commensurate conceptual frameworks to accomplish. Addressing these challenges may allow geographers to better position themselves in the new geographic information society that seems to be emerging.

Relevance

Developments in enabling technologies both within and outside of conventional geographic territory have significant implications for Geography and Geographic Information Science. Increasingly, industrial and societal trends in geographic technology use are escaping the inertia of conventional geospatial information communities, and suggest a disciplinary shift from static, sedentary geographic tools, to ones that are mobile, multimodal, and more transparently interwoven into everyday practice.

Emerging interface technologies are one of the core drivers of this trend. They provide powerful new capabilities for people to interact with spatial information and each other in real, virtual and hybrid spaces. These capabilities are more than novel technological components - they deliver powerful new ways to explore, perceive and understand complex geographic phenomena. They also support new ways for individuals, groups and networks of people to collaborate and share geographic information explorations.

In geography to date, interactions with geographic information and enabling tools have been engaged most frequently by research communities of GIScience, geographic visualization, geovisualization, and ‘cyber-cartography’, to name a few. While there have been many useful contributions made, it is becoming increasingly apparent that an updated or new conceptual framework is needed to accommodate fundamentally new ways of interacting with geospatial information.

Most geographic conceptual frameworks conflate significant and subtle properties of interfaces into homogenized tools, when in fact they are composed of complex combinations of geographic data representations, visual and other forms of display, mediated by various interface technologies, accessed via a range of interaction designs, and engaged through multiple modalities.

Now that geographic information is increasingly being delivered in interactive 3D tools and adopted by large groups of non-experts, geographers must evaluate and
consider how well positioned we are to inform and contribute to these new directions in geospatial information delivery and use. The fields of human-computer interaction, interface research, and computer science have been aware of these human-computer interface factors for several decades, and it therefore comes as no surprise that the majority of contributors to spatial tools such as Google Earth are computer scientists, and not geographers. This should be of great concern to us. This paper presents examples from my past and ongoing research in geospatial interfaces in industry and academia (including applications of virtual environments, augmented reality and multimodal interfaces). The presentation will identify key interface technologies that have emerged in the past 5 years. We will explore their properties, consider their significance, and discuss concepts and principles that geographers must integrate into contemporary GIScience - if they are to be a major player in the emerging geospatial interface technology economy.

Methods

I will use several examples of current applied geospatial interface research projects at the Spatial Interface Research Lab (at Simon Fraser University). Using these examples I will illustrate and explore how emerging interface technologies deliver powerful new opportunities for understanding complex geographic phenomena (such as volumetric natural hazards, public education and emergency planning). This will include addressing how we represent, explore and interact with geographic information, and the methods we are using to pursue this path of research.

I will discuss how emerging geospatial interface technologies support new informational, educational and communication experiences in real, virtual and hybrid spaces, and why this requires new research methodologies and commensurate conceptual frameworks to accomplish. Addressing these challenges may allow geographers to better position themselves in the new geographic information society that seems to be emerging.

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Spatial Statistics: 
Putting the Myths into Perspective

Marie-Josée Fortin and Mark R.T. Dale

A major aim of including the spatial component in ecological studies is to characterize the nature and intensity of spatial relationships between organisms and their environment. The growing awareness by ecologists of the importance of including spatial structure in ecological studies (for hypothesis development, experimental design, statistical analyses and spatial modeling) is beneficial because it promotes more effective research. There is a drawback however: as more researchers use and include spatial notions and spatial statistics in their analysis some misconceptions about the virtues of spatial statistics that have been carried through the process and years. Here, we review the most common misconceptions about spatial autocorrelation as a list of myths and challenges. We synthesise the problems related to incorporating spatial considerations correctly in the analysis of spatially heterogeneous ecological systems. We conclude in proposing approaches to solutions to those problems.

Background and Relevance

Nowadays, it is increasingly common for ecological studies to acknowledge the importance of the spatial aspects of the systems under study (Dungan et al. 2002, Fortin and Dale 2005, Wagner and Fortin 2005), and to include them as well as possible in the study’s design (Legendre et al. 2002) analysis (Legendre et al. 2004) and modeling (Keitt et al. 2002, Lichstein et al. 2002) among others. Spatial effects, however, are many and take various possible interdependent forms including scale effects, spatial autocorrelation, locational and neighbour effects, and the general interaction between spatial pattern and temporal process. The topic is both complex and potentially confusing, and while the increasing awareness of the importance of spatial issues is beneficial, its complex nature has given rise to a certain amount of misunderstanding of the underlying concepts, as well as a number of misconceptions, what could be called “myths”, about related issues and their potential solutions. Indeed, spatial statistics are often thought to be the panacea that will solve all the problems of having or not spatially structured data. Although there is help available in the literature and in a number of textbooks (Cressie 1993, Haining 2003, Fortin and Dale 2005), it may require some restating or interpretation, and even with such assistance, challenges will undoubtedly remain. It is our intention to review some of what we see as prevalent myths about spatial effects, with an attempt to correct the related misunderstandings.
Myths, Challenges and Solutions

The most common myth is that there is a *Distance to Independence*, that is if your samples are far enough apart, there is no problem; they are good as independent. This comes from the assumption that autocorrelation declines with distance (rapidly) to zero and remains approximately zero thereafter, so that distant samples are effectively independent. The problems are, however: (1) the spatial structure is still present in the system investigated regardless of the spaced between the samples; and (2) it is also the *Myth of Insignificance*, that is if autocorrelation at distance x is not significantly different from zero, it can be ignored. Indeed the detection of “significance” is dependent on the numbers of observations at the lag distances investigated; larger distances tend to have fewer observations and therefore are less likely to be detected as significant. Therefore, there may be bias against detecting significant autocorrelation at larger scales, which will depend on the characteristics of the sampling design and the study area. The challenge is the *Lack of independence*, is that autocorrelation is not the only source of lack of independence encountered in spatial studies in ecology: dependence also arises when spatial coefficients are computed at more then one distance lag and because the same data are used again and again in calculations; for example, the data used to calculate autocorrelation at lag 2 are used again in different combinations to calculate autocorrelation at lag 6.

No single solution solves all problems. Solutions are context-, scale-, and system-dependent. As with the choice of spatial methods, some care and judgment will be needed in finding a set of solutions to a multifaceted or complex problem with several possible confounded effects. One note of hope is that while the effects of autocorrelation on univariate tests have currently no obvious solution, there seems to be a general pattern for solutions for bivariate tests. In fact, the more variables that are considered, the less important this problem may become.

Conclusions

In spite of the difficulties of this topic, and despite the myths and misunderstandings, this is an area in which real progress has been made in the last decade, both in a greater general awareness and understanding on the part of ecologists and scientists in related disciplines, and in the technical sophistication of finding solutions to the inherent problems. The continued emphasis in ecology on the importance of the relationship between pattern and process and of the spatial context of ecological systems (configuration, not just composition) ensures that this topic will continue to be a focus in the years to come.

References

Break and Enter Crime Opportunity Spaces in Regina

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Abstract

Criminal activity is inherently spatial: crime happens somewhere. Crime analysts study the spatial distribution of criminal activity to try and apprehend the offender(s) and/or to predict where crime may happen again. However, any analysis of crime patterns will reveal that offenses are not distributed randomly in time and space. GIS can help us understand why some crimes occur more frequently at some places than in others.

In this paper we assess the potential of a GIS model to predict the frequency of break and enter crimes in Regina. This work was developed as part of the National Summer Institute for the Statistical and GIS Analysis of Crime and Justice Data held annually at the University of Regina.

We found that the model’s predictions generally compare favourably with the locations of actual break and enter events obtained from the Regina Police Service.

Background and Relevance

Crime pattern theory proposes that offenders are more likely to commit a crime in areas that are familiar to them (Brantingham and Brantingham, 1981). Like us, criminals have cognitive "awareness maps" that arise from their daily activities of journeying between their places of residence and jobs, schools, shops, restaurants, bars, movie theatres, etc. Like us, criminals are more at ease and feel less conspicuous in their spaces of routine activity. Many offenders are also aware of places where the opportunities for successfully committing crimes without getting caught are better. It is at the intersection of their awareness and opportunity spaces, then, that a criminal will most likely commit an offence (Felson and Clarke, 1998). GIS can play a vital role not only in mapping crime, but also analyzing where it frequently occurs (Boba, 2005; Chainey and Ratcliffe, 2005).

Moffatt (2005) generalized these concepts to produce maps of opportunity spaces for residential break and enters in Ottawa, Ontario. He identified 6 characteristics of the built environment that had a spatial relationship with burglaries. In particular, he created a spatially predictive model for break and enter crimes in Ottawa that demonstrated that there was a high probability of occurrences in areas within 289m of commercial land uses, 360m of parks and vacant land, 308m of major transportation routes, 98m of 4-node intersections, 684m of urban trails, and 280m of recreation land uses.

The purpose of this research is to assess the validity of this model to break and enter crimes in Regina, SK.
Methods and Data

Land use and transportation data were obtained from the GIS Unit at the City of Regina. Decaying raster buffers were created around each of Moffatt’s 6 environmental characteristics and numerically overlaid to derive spatially distributed break and enter crime prediction indices. Higher index values indicated areas of greater crime potential.

Break and enter data from 2005 were obtained from the Regina Police Service. The burglary data were geocoded to the city’s street network by address matching.

The efficacy of Moffatt's model was evaluated by tabulating the crime prediction indices for each break and enter incident reported in the 2005 data.

Results

The results of our analyses show that while Moffatt's model is generally applicable in Regina there is some room for improvement, particularly in the peripheral areas.

Kernel-density (“hot spot”) maps were created to help us visualize the strengths and weaknesses of the derived mode. In addition we computed some basic spatial statistics (mean centre, standard distance, standard deviational ellipses) as well as assessed the spatial autocorrelation (nearest neighbour statistic, Moran's I) present in the Regina break and enter data.

Conclusions

Felson and Clarke (1998) note that opportunity spaces are concentrated both spatially and temporally; they have different spatial foci at different times and in different locations. Although we did not detect any significant temporal differences in the locations of break and enters in Regina when examined as monthly aggregates, we did find important differences in the predictive capacity of Moffatt's model in Ottawa and Regina. We suggest that these differences are due not only to the dissimilarities in the sizes of the two cities, but also due to differences in their socio-economic makeups (Wallace et al., 2006).

References


Participatory Geoweb: A Research Agenda

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Abstract

This presentation frames a research agenda for the Participatory Geoweb, that is, the involvement of advocacy nonprofits and marginalized communities—civil society—in the geospatial technologies of Web 2.0.

Background and Relevance

The Geoweb—the intersection of geospatial awareness and Web 2.0—has created a paradigm shift in GIScience and Geomatics. Its platform independence, friendly user interface, user-generated content, and (in the case of digital earths such as Google Earth/Maps and MS Virtual Earth) bundled geospatial information create an appealing foundation upon which to launch geographic applications. A significant contribution of the Geoweb is its seeming facility to engage the public, whether this is accomplished through screen scrapings and mashups, or the geolocation of stories and points of interests on digital earths (D. Butler 2006). There is a small but important literature emerging on the participation of the public in this emerging medium (Gibson and Erle 2006; Scharl and Tochtermann 2007; R. Butler 2006; Turner 2006; Tulloch 2007) but it tends towards the mechanical and the evangelical.

This short presentation will frame a critical research agenda for the Participatory Geoweb, that is, the involvement of advocacy nonprofits and marginalized communities—the civil society—in the geospatial technologies of Web 2.0. It builds on prior research in participatory GIS (Craig et al. 2002; Sieber 2006), which has demonstrated the importance of understanding the nature of public, the extent to which participation is actually taking place and the association between participation and empowerment. Because this is a new medium, and (potentially) a new way of thinking about distributed online geospatial information, existing lessons do not necessarily transfer. For example, the Geoweb may represent the “tyranny of the individual”, that is, a far more atomistic level of personal engagement than in traditional PGIS activities. In addition to a critical research agenda examining the nature of participation, a research agenda could frame requirements for spatial literacy, challenges in geospatial data handling and access, the place for user generated content, the utility for spatial analysis (and other traditional GIS activities), and the role of culture in mediating application development. At minimum, it would be helpful to simply “map out” the emergent applications of geographically represented information on Web 2.0. Finally, a research agenda must be driven by actual needs of people and remain relevant to the civil society that has become transfixed (at least momentarily) by the Geoweb.

Methods and Data

The methodology consists of a content analysis of existing applications and data (e.g., kml’s, scraped sources), review of existing geoweb literature and interviews with key actors (primarily neogeographers). Moreover, certain promoters of the Geoweb—self-termed neogeographers (Turner 2006)—tend to hold GIS (and PGIS) researchers in some disdain, so a research agenda has added need to connect its findings to long-term practice. I am in the process of developing
applications on three digital earths that integrate analysis and representation. The key point will be the extent to which PGIS is relevant to understanding how and why and to what effect civil society becomes engaged in the Geoweb.

Results

As this research is in the formulation stages, I will report on the initial framing of the research agenda.

Conclusions

It is expected that, after an initial hype about the power of online mapping and mashups, the Geoweb will become yet another prosaic tool in the arsenal of Web 2.0 applications that appear online and on mobile devices. Nonetheless it will provide another avenue to jump scale so that individuals and groups can obtain far larger outreach in their advocacy. It is hoped this research can provide a guide and a cautionary note for empowerment on the Geoweb.

References

The Reflexivity of Geospatial Technology: Exploring the Geographies of Hope and Fear

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Abstract

Only by fully considering the reflexive nature of the relationship between geography and technology, and exploring how GSTs and their products are employed today and could be employed in the future, will we be able to ensure that future landscapes are ones that we, as Geographers, can be proud of.

Background and Relevance

Geospatial technology is both a product of geography and a means of redefining geography, a relationship of reflexivity that underscores the circular nature of geographical evolution. As digital geographic data is still reflective of the past “unevenness” in the experienced economic and social (and gender, ethnic, race, age) geographies of the world (Zook et al. 2004), so too are geostpatial technologies (GSTs) reflective of their origins (e.g., Goodchild 1988; Rhind 1988). We must consider how that past influences the landscapes of hope and fear generated by GSTs (Klinkenberg, 2007). We can work to reconfigure how those landscapes are formed, and many people are actively doing so. The geospatial technologies of the future should be very different from those in the fore today—the ‘social’ will be embedded in the technology, and spatial technologies will be one of many complementary methods used in an analysis (Wyly 2004). How technological and social concerns inform geospatial technologies will be the subject of my talk.

Discussion

Blind use of technology is driving us to a society where there is no anonymity, where fear drives the watchers, and everyone becomes a subject. Is a geography of hope possible in an ever-vigilant society? In light of these issues, concerns related to the ‘grain’ at which our life’s history is being recorded (our digital spatial shadows) have been raised and, as Geographers, we need to explicitly address such concerns. As finer grained geospatial data are collected, stored, and analyzed, personal privacy issues come to the fore, and the increasing lack of spatial anonymity becomes an issue that must be addressed. Should the right to locational privacy become a basic human right (Monmonier 2002; Taipale 2004; CSIS 2005), and how would one ensure that such a right is even possible? How can we ensure that the landscapes formed through the use of geospatial technologies are those reflective of geographies of hope, and do not become the domains of those who fear.

Conclusions

As with any journey over an unknown landscape, we must carefully prepare for that journey by planning for the worst while hoping for the best. Only by fully considering the reflexive nature of the relationship between geography and technology, and exploring how GSTs and their
products are employed today and could be employed in the future, will we be able to ensure that future landscapes are ones that we, as Geographers, can be proud of.

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GeoWeb Toolsets for Ecoforestry Education and Management

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Abstract

We explore an open-source linked web-map/desktop GIS toolset for forest management in the case of an ecoforestry woodlot. Ecoforestry operations require tools both for management and planning, and for visitor services and education. We report on a combination of engagement processes and tools that input and extract data stored in spatialized databases and render that information to web browsers, desktop GIS, and three dimensional virtual world explorers. We examine the tools in terms of effectiveness, practicality, and scalability.

Background and Relevance

The roles, relationships, and strategies of private, public and NGO institutions in British Columbia forest planning are in flux. Spatial knowledge is a critically important component of this move to creating better practices, policies and power relations within a political system (Elwood 2006) and this is certainly true of forest management. Land trusts, advocacy groups, First Nations governments, and the BC government all use spatial narratives to push their agendas. These efforts, often using static or dynamic web-maps, have been mostly one-way presentations of information. The future of these advocacy tools will incorporate participatory elements like commenting, image/video blogging and even full interactive access to forestry databases. In so doing, the information will become contextualized and valued, will become knowledge.

Ecoforestry is a type of forest management that, in contrast to industrial stand replacing and old-growth removing forestry, emphasizes maintenance of ecosystem function, visitor education and production of value-added products (Rastogi 2007). Ecoforestry management focuses on collecting and processing information describing the forest as a provider of ecosystem services, non-timber forest products, and timber, in that order of priority. Ecoforestry sites are working forests of a new (or the oldest) kind, and ecoforestry practitioners emphasize open access to management decisions, holistic views on forest services, and public participation.

Geographic information system (GIS) tools are tools common to forest management and planning, but issues of functionality, interoperability and cost have to date largely prohibited adoption by smaller forestry operations. Ecoforestry sites are often owned and operated by small land owners or non-profit groups and these landowners do not have the resources to purchase or train in commercial off-the-shelf GIS. Map exploration has also been under-utilized as part of forest ecological educational outreach.
New dynamical map generation systems are becoming available to ecoforestry managers/educators. Using maps, trained foresters and ecologists or tourists can explore the forest virtually, before a physical visit, and may participate in knowledge building post-visit by uploading spatial information such as comments and images (place marking, geo-blogging). These systems also enable the contrasting (layering) of many themes of data (Kalliola et al. 2002) and are useful for reinforcing ecological lessons demonstrated at the site. Our ability to represent the dimensions, patterns and dynamics of nature is slowly rising to the task of capturing ecosystem complexity in accessible and compelling ways (Burnett 2002).

In this paper we ask the following questions: How readily can the current generation of web mapping tools be implemented by small non-profit groups for ecoforestry management and visitor services? How mature are open source solutions? How useful are free but commercial tools? Do open and closed systems play well together? What are the barriers to implementation? To answer these questions we built and bridged a web-mapping system for visitors and an open-source desktop GIS system for on-site managers. We break the following report into sections roughly mirroring Sieber (2006).

**Place and People**

We conducted our study at Merv Wilkinson’s woodlot, now owned by The Land Conservancy of BC (TLC). Wildwood, located on Vancouver Island, is a 28 hectare mix of old growth and second growth Douglas-fir, western redcedar, grand fir, Arbutus, bigleaf maple, red alder, western hemlock. The property is diverse, with areas of steep and undulating slopes, marshy areas as well as dry ridges. Several paths run through the property, and ecoforestry tours are conducted every weekend by TLC staff [www.conservancy.bc.ca/content.asp?sectionack=Wildwood](http://www.conservancy.bc.ca/content.asp?sectionack=Wildwood).

TLC views Wildwood as (1) a model for alternative forestry, (2) a focal node in a local ecological network. It places a high priority on visitor education and knowledge sharing. We were asked to develop a Web-mapping/GIS system that was open and interactive, and able to provide three levels of access. Firstly, the system must serve two types of visitors. General visitors include neighbouring land owners, other woodlot owners from other parts of BC and the world, and many students. The second type of visitor to are those trained in ecology and forestry.

Needs assessments suggested that the general visitor wanted a system allowing pre-visit planning opportunities and post-visit posting of comments, pictures and video (place marking, multimedia blogging). Trained visitors wanted to view, down-load data on, and comment on permanent sample plots, timber cruises, species maps, blow-down maps, location of good seed trees, skidding trails, non-timber forest resources, disease outbreaks, and cutting plans. The site manager requested additional GIS functionality for management, but wanted the web-mapping system and any desk-top GIS to be linked
Technology and Data

How did we provide interactive access to spatialized forestry data to three types of users? We linked two systems (Figure 1). The first system, serving the visitor types is based on a modified Drupal Content Management System (CMS, www.drupal.org). Drupal is the world’s most popular open-source CMS and is generally noted for it’s portability to almost any hosting environment and a modularity and extensibility that allows it to be customized for almost any purpose. The system we built for wildwood extends Drupal by adding a spatial data type. Our Drupal GeoBrowser module (GPL’d and available for free), we give users the power to intuitively browse an online map of hyper-linked data points. The visitor can open pop-up windows associated with each point (for example, an old-growth stand or a permanent sample plot) and peruse text, images, video and other multimedia. Visitors may also post comments, images and video. The site is easily managed; administrators may add or edit content and spatial metadata in a wiki-like manner (with the possibility for rollback if any mistakes are made) – allowing non-technical administrators the flexible management without the fear of permanently breaking or disfiguring the site. The Wildwood manager has access to Drupal’s powerful web-based information management tools including ability to manage visitors, add custom icons to the map, and change the back-ground ‘base map’ data.

The second toolset we developed for Wildwood focused on providing the site manager with more powerful GIS tools. This desktop GIS system needed to be linked to the web-mapping system so that changes made to the ‘visitor’ layer in the web-map would appear in the GIS as an up-dated layer. We loaded all the Shapefiles and associated table data that the Wildwood manager provided to us into a PostGIS database. We then set-up an open-source desktop GIS, Quantum GIS (www.qgis.com), to display and edit these features.

Future Steps

The next steps (Figure 2) will be to modify the Geobrowser code so that is works with the Drupal Geo module instead of the Locations module. Location is fine for lat/long and basic place name capture, but Geo will store feature data in a full OGC-compliant simple features format, like PostGIS. Since Drupal can use PostgreSQL as a back-end database, PostGIS is what we are aiming for.
Outcomes and Evaluation

You can explore the demo community portal at [http://wildwood.geomemes.com](http://wildwood.geomemes.com). We asked volunteer foresters and ecologists from the Ecoforestry Institute to explore some of the Wildwood data online using web browsers. We will be presenting some of their comments on the participatory nature of the system at the SKI Conference.

Feedback from the Wildwood manager is that the GeoBrowser-based tool is excellent for the kind of visitor education that The Land Conservancy aims for. We will work with TLC to get more multimedia information onto the system. For example, the original owner of the site, Merv Wilkinson, is still alive and active on the site and it would be excellent to get video segments uploaded and linked to points of interest in the web-map site.

References


Conducting applied Geomatics research under the NSERC College Community Innovation Pilot program

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Abstract

In 2004, the Natural Sciences and Engineering Research Council (NSERC) announced a new pilot program designed specifically for community colleges. The focus was on applied research and collaboration between colleges and the private sector, leading to community economic development. The Applied Geomatics Research Group (AGRG) at the Nova Scotia Community College (NSCC) submitted a proposal on the integration of geomatics and environmental technologies for landscape assessment, monitoring and restoration. A key criterion was the matching by NSERC of the private sector funding. To meet this objective, AGRG developed an internship program for Centre of Geographic Sciences (COGS) graduates to work at the AGRG for six months on an applied research problem defined by industry.

To illustrate the type of applied research that is being conducted, this presentation will highlight our work on satellite-based solar energy mapping. In collaboration with Green Power Labs Inc. the AGRG has developed a GIS-based solution for calculating solar irradiation by processing 1 km visible spectrum imagery obtained by NASA GOES satellites. Using these software tools we conducted a regional level (Maritime Canada) assessment and mapping of solar energy based on the analysis of satellite data. Solar irradiation was calculated from pixel values adjusted by a dynamic pixel range obtained from the long-term climatology. This methodology results in a spatially explicit map of solar energy resources for a time span from hours to decades. The modeling results have been compared to existing ground-based pyranometer data. The satellite-based approach to solar energy resource mapping used here allows us to predict solar radiation at any geographical location in the region to a spatial resolution of 1 km.

The NSERC internship program at the NSCC has had an impact on our applied research agenda. There was a significant drop in the enrollment for the Advanced Diploma in Applied Geomatics Research; market demand for project experience appears to outweigh the value of a second advanced diploma. More recently, the NSCC has partnered with Acadia University on a joint M.Sc in Applied Geomatics. Changes in the rules from the Canada Revenue Agency (CRA) will move us towards a fellowship model in 2008, where the student must be enrolled in a program at NSCC. With the completion of the NSERC pilot, AGRG has met the challenge of different time lines for fiscal management and the
project deadlines set by the industry client. Despite the complexity of the relationships, NSERC (based on the results of the six pilot projects across Canada) has made the commitment to a permanent College Community Innovation (CCI) program. Another outcome of the NSERC program at NSCC is the development of a successful proposal for the creation of a Business Incubation Centre at our campus in Middleton, funded by the Atlantic Canada Opportunities Agency.
Applied Geomatics research in Nova Scotia; sharing our eight years of experience

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Abstract

In January 2000, the Applied Geomatics Research Group (AGRG) was established to conduct research into the application of Geomatics technologies. Over eight years, we have competed successfully in the following competitions: CFI (3), AIF, CIHR, NSERC, the Rural Secretariat and HP Innovation awards. In that time frame, AGRG has grown from three Research Scientists to a group of seventeen staff and ten graduate internships. This presentation will highlight the major accomplishments and identify some of the ongoing challenges.

The foundation of our applied research has been the advanced diploma programs at the Centre of Geographic Sciences (COGS). Each of the original group members had been instrumental in the design, development and delivery of these programs in GIS and Remote Sensing in the 1980’s. With the creation of AGRG, we were in a position to apply these technologies to a wide range of environmental and social issues.

CFI provided capital equipment to universities and colleges. AGRG has received three awards. Most noteworthy has been the acquisition of ground based and airborne LiDAR and the building of a network of meteorological stations throughout the Annapolis valley. Under AIF, AGRG partnered with the private sector, GeoNet and CARIS, to develop a decision support system for disaster management in the coastal zone. This research was based on earlier contracts with NRCan and Environment Canada to model the impact of sea level rise and storm surges on the Atlantic Canada coast, especially PEI and New Brunswick. Further success was forthcoming with CIHR collaboration between AGRG and Dalhousie University and other Atlantic universities leading to the establishment of the RURAL Centre. AGRG role was to provide Geomatics services to the Health community. In 2004, NSERC announced a specific program for community colleges; AGRG at the NSCC was successful and embarked on a two year pilot project. One of the key criteria was collaboration with local industry for community economic development. Through an internship arrangement, AGRG completed ten projects. These projects and their context will be described in a separate presentation.

Our most recent funding has come from the Rural Secretariat. We have established a rural knowledge cluster around Applied Geomatics. This has led to the creation of a Business Incubation Centre. Under these auspices, we have
conducted a series of community mapping workshops for rural Nova Scotians. This research has recently benefited from HP award to develop a mobile Geomatics lab, centred on twenty tablets and using new social networking software.

Along the journey, there have been many lessons and challenges. They can be grouped under the following headings:

a) institutional challenges – the role of applied research in a community college;
b) educational challenge – the appropriate mix between hands on community problem solving and conceptual understanding

c) community challenges – the difference approaches to Community Economic Development through Geography and GIScience;
d) personal challenges – the expansion of application domains and the balance between teaching and research.

To assist other institutions, we have developed a conceptual model of our Applied Geomatics research, an educational model for graduate students, a funding model for long term sustainability and a shamrock model of our business partners.