GEORISK AND CLIMATE CHANGE

A proposal to establish a Collaborative Research Group and a permanent distributed educational and research center on environmetrics.

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Submitted to the Pacific Institute for the Mathematical Sciences by

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PIMS Environmetrics CRG

The eventual goal of this project, whose specific theme is georisk and climate change, is to develop a multi-site, distributed environmetrics research center. Activities of such a center would include conferences, workshops, summer schools, joint courses, a diploma/certificate program, and collaborative research. In order to develop this idea, we propose to hold an initial meeting in January of 2007 with participants from a number of institutions, principally Simon Fraser University (SFU), University of British Columbia at Okanagan (UBC-O) and Vancouver (UBC-V), University of Victoria (UV) and University of Washington (UW).

In addition to the Center’s Pacific Northwest aspect, we are working on extending links with international collaborators.

- We will be taking advantage of collaboration between the Universities of Lund and Washington, partly funded by a Swedish STINT grant (see the workshop on trends in extreme climate events below).
- In addition, the Principal Investigators (PIs) are building contacts with Pacific Rim universities, in particular the Institute of Mathematical Sciences (IMS) and the Tropical Marine Science Institute at the National University of Singapore. Meetings in June 2006 with the Director of the IMS, Louis Chen, have led to an agreement in principle to explore joint ventures, funded in part by a newly announced Singaporean research grants program on environment and water resources. Specifically Louis proposes that mathematicians and statisticians with the relevant expertise meet with engineers to identify common areas of interest for joint research at a workshop described below.
- During meetings at the University of Sheffield in July, Jim Zidek and Tony O’Hagan explored possible links between O’Hagan’s newly established research program, about “managing uncertainty in complex models (MUCM)” and the distributed center to be established with the requested PIMS support. Over the next 4 years, the MUCM project is to establish a technology for quantifying and reducing uncertainty in the predictions of complex models across a wide range of application areas, including basic science, environmental science, engineering, technology, biosciences, and economics. The PIMS project would test and thereby possibly assist in the development of the new technology. As well, there might well be opportunities to exchange personnel, information and ideas. Moreover, some of the MUCM group might well benefit from or even make contributions to the courses, workshops and conferences being organized as part of the PIMS project.
- Additional linkages will also be explored between this group and a German research group with a focus on sustainable forest management (http://www.sustman.de/seite1_e.htm). With partners at the University of Ulm, Volker Schmidt and Marian Kazda, a workshop will be held at Reisensburg Castle, a facility of the University of Ulm, for the week April 21-25, 2008. The research topics will lie at the interface of mathematics, statistics and forest ecology. Other international linkages with a focus on forestry are expected with
the project leader, Paulo Justiniano Ribeiro Jr, and his team at the Laboratório de Estatística e Geoinformação at the Universidade Federal do Paraná in Brazil where geostatistical methods are developed for mapping and studying ecological aspects of forest and agricultural regions in Brazil.

We are collaborating with two main US institutes:

- the Institute for Mathematics Applied to Geophysics (IMAGe) at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado (where we have plans for a summer school in 2008).
- the Statistical and Applied Mathematical Sciences Institute (SAMSI) at Research Triangle Park, North Carolina. Derek Bingham (SFU) will be participating in this year’s program on “Program on Development, Assessment and Utilization of Complex Computer Models” and related workshops at NCAR beginning with the organizational meeting in Sep 2006. Jim Zidek (UBC) has also been invited to participate in that program as well as one on random matrices. The former is closer to the research in this proposal and that invitation has provisionally been accepted. The proposal budget includes funds for a visit to the Research Triangle Park in North Carolina early in 2007.

2. Opening meeting:

Organizers: Peter Guttorp, U Washington, Jim Zidek, U British Columbia


The introductory meeting will open with a presentation of the old NRCSE (by Guttorp) and a presentation of the current PIMS plan (by Zidek). The remainder of the afternoon will be spent with presentations of a variety of current projects (individuals currently involved are mentioned below).

- Policy and decisions regarding climate change (Alison Cullen, Martina Morris, Mark Handcock, Peter Guttorp)
- Agroclimate risk management (Jim Ramsey, Sam Shen, Jim Zidek)
- Impacts of climate change: moth prevalence (with impact on the BC apple industry); fisheries (especially salmon production); animal populations; forest fires, fire regimes and fire management; forest ecology; human health. (Charmaine Dean, Sylvia Esterby, Rick Routledge, Carl Schwarz, Mike Brauer, John Petkau, Sverre Vedal, Thomas Lumley, Lianne Shepard, Tim Larsen)
- Numerical vs. statistical modeling methods: quantifying uncertainty; combining; multi-resolution issues (William Hseih, Peter Guttorp, Paul Sampson, Tillman Gneiting, Nhu Le, Zhong, Adrian Raftery, Douw Steyn, Jim Zidek, Francis Zwiers)
- Design (Will Welch, Steve Thompson, Derek Bingham, Jason Leoppky, Nhu Le, Paul Sampson, Jim Zidek)

During dinner we may discuss a statistical report card for the International Panel for Climate Change. The second day will be spent discussing individual activities in small groups, followed by a summary meeting and overall discussion of the plans for the CRG.

2. Summer Schools:

2007: Summer school: Space-time modeling of environmental processes

Location: University of Washington

Target audience: Senior graduate students and young researchers

Instructors: Peter Guttorp and Paul Sampson (University of Washington), Jim Zidek and Nhu Le (University of British Columbia Vancouver)

Dates: TBA.

Content: Transform tools, such as power spectra, wavelets, and empirical orthogonal functions, are useful tools for analyzing temporal, spatial and space-time processes. We will develop some theory and illustrate its use in a variety of applications in ecology and air quality.

Harmonic (or frequency) analysis has long been the one of the main tools in time series analysis. Application of Fourier techniques work best when the underlying process is stationary, and we develop and illustrate it here for stationary spatial and space-time processes. However, spatial stationarity is rather a severe assumption for environmental models, and we show how the theory can be generalized beyond that assumption. In some circumstances, we can develop formal tests for stationarity.

In geophysics and meteorology, variants of principal components called empirical orthogonal functions (EOFs) are used to describe leading modes of variability in space-time processes. Smoothed EOFs can be used to model the spatio-temporal mean field of a random field, while another type of spatially nonstationary model will be introduced to describe the random part of the field.

Finally, we describe an approach to a fully Bayesian modeling of space-time processes, using several of the tools discussed earlier in the course. This will enable analysis of space-time processes for which the covariance structure is non-separable, an assumption, which has frequently (but incorrectly) been made in the literature.

Funding synergies: Some funding for this summer school will come from a UW VIGRE NSF grant.
2008: Summer school: Computation in environmental statistics.

Location: The National Center for Atmospheric Research, Bolder, Colorado

Target audience: Senior graduate students and young researchers in atmospheric and statistical science.

Instructors: TBA

Dates: TBA

Content: This course is given as a “field trip” to the National Center for Atmospheric Research. The course will cover topics for which NCAR is uniquely equipped: managing and handling large datasets; fast computing algorithms such as the ensemble Kalman filter; current research topics; distributed computing.

3. Workshops:

2007: Maintaining and assessing water quality

Organizer: TBA (joint with National University of Singapore)


Content: Mathematicians and statisticians with the relevant expertise will meet with engineers to identify common areas of interest for joint research to enable interaction and exchange ideas on environmental research. That workshop would involve PIMS and CRG participants. Topics would include climatic changes, air pollution and water resources, with the aim of encouraging research collaboration.

Funding: The IMS would fund the program/workshop up to S$75,000 (= US$46,000) for the expenses [accommodation, per diem for all and airfare (with cap) for some] of the invited speakers.

Possible participants: Abdel El-Shaarawi, Sylvia Esterby, Hans Künsch, Noel Cressie, Mark Kaiser, Yingcun Xia.

2008: Extreme climate event

Organizers: Peter Guttorp (Statistics), University of Washington, Gabi Hegerl (Earth and Ocean Sciences), Duke University, Georg Lindgren (Mathematical Statistics), Lund University
Content: There is a lot of current interest in judging whether we are observing changes in the Earth’s climate due to global warming. A special issue of the Bulletin of the American Meteorological Society (no. 3, 2000) contains five articles about trends in extreme weather and climate events, covering observations (Easterling et al., 2000), socioeconomic impacts, terrestrial ecological impacts, and model predictions (Meehl et al., 2000). The tools used in these articles are those developed for single variable extremes in independent and identically distributed data, and lack firm estimates of variability. There is a rapidly growing amount of data on extremes, both from observations and particularly from climate models that are now being used in ensemble predictions of future climate (e.g. Stainforth et al. 2005). However, the statistical methods used to interpret this information, especially the assessment of trends in extreme events, requires some attention. Several gaps in the knowledge were identified and future research needs pointed to in IPCC (2002). The use of spatial data can help to improve estimation of extreme value models that are regionally similar (Casson and Coles, 1999).

In this workshop we will be discussing tools for the identification of significant parametric and nonparametric trends in spatiotemporal extremes.

Preliminary list of speakers: Georg Lindgren (U of Lund, Sweden), Francis Zwiers (Canadian Climate Centre and U of Victoria), Gabi Hegerl (Earth and Ocean Sciences), Duke University, Rick Katz (NCAR), Jan Heffernan (Lancaster U), Richard Smith (U of NC).

Funding synergies: Some funding for this workshop will come from a Swedish STINT grant, and from an EU project called SEAMOCS.

4. Conferences


Organizer: Peter Guttorp (U of Washington)

Location: Seattle

Dates: June 19–21, 2007

Content: This meeting, the first of its kind in North America, has as its theme “Climate change and its environmental effects: monitoring, measuring, and predicting”. Keynote speakers include David Brillinger, UC Berkeley, and Paul Switzer, Stanford University. There will be invited sessions on

- Agroclimate risk assessment
- Forests, fires and stochastic modelling
• The role of statistics in environmental policy
• Using large spatial datasets in ecology
• The hockey stick controversy
• Monitoring the environment and biota on landscape to continental scales
• Assessing trends in extreme climate events
• Inference for mechanistic models


Organizer: Charmaine Dean, Simon Fraser University

Location: BIRS

Dates: June 2008

Content: A proposal for hosting a workshop on "Climate Change Impacts on Ecology and the Environment" at the Banff International Research Station, June 2 - 6, 2008 will be submitted jointly with this application. This meeting will consider agroclimate risk management; impacts on the structure and biodiversity of forests including those resulting from the greater frequency, severity and scope of fire events in combination with landscape change; the implications of emissions for global and regional climate change; and space-time modeling of environmental processes. The primary aim of the workshop will be to compile and assess models and methods for modeling climate events and assessing sensitivity of environmental outcomes to changes, and to assess the evidence for existing impacts. Gaps in methodological developments will be identified, for example, methods for isolating the species and ecosystems most vulnerable to climate change, and detection of changes when observations are available at several spatial and temporal scales. This workshop will also play the important role of providing opportunity for discussion of timelines and progress toward the goals identified in the collaborative research group application and interim reporting on research objectives.

2008: TIES 2008: Quantitative Methods for Environmental Sustainability

Organizers: Sylvia Esterby, UBC-Okanagan and David Brillinger, UC Berkeley

Location: Kelowna, BC

Dates: June 8–13, 2008

Content: TIES 2008, the 19th annual conference of The International Environmetrics Society (TIES) will be held at The University of British Columbia Okanagan. Conference technical topics are expected to include: monitoring, modeling and managing environmental systems, network design and efficient data collection, design and analysis of computer experiments, analysis of extremes, space-time modeling, environmental risk assessment, assessing status and trends, environmental reporting and indicators, and
environmental standards. Areas of application will be biodiversity, climate change, sustainable agriculture, air quality, water quality, soil contamination, energy, environmental economics, ecosystem and human health. TIES conferences draw an international and interdisciplinary group of participants, feature special lectures relevant to the theme and are organized to provide ample opportunity for informal discussions and the facilitation of collaborations. As such, linking the conference with the BIRS workshop and the CRG should further facilitate the promotion of Environmetrics in the region and beyond.

2008: Pacific Northwest Environmetrics Meeting

Location: TBA

Dates: Autumn 2008

Content: This will be the closing session for the CRG, aimed at making permanent the multi-site environmetric research center.

5. Certificate/diploma program

We will develop a joint program wherein graduate students at any of the participating universities may get a certificate or diploma, signifying that, in addition to their graduate degree, they have successfully completed an approved program in the quantitative analysis of environmental problems. While the details of this program remain to be worked out, we anticipate that students will be able to take courses that count towards this program at any of the campuses. We also hope that we will be able to offer some of these courses over the web or using other remote technologies. The development of these courses will enhance the quality of the graduate education at all the campuses. In order to work out the details of these courses we will have interested faculty from all the sites meet during two half-day meetings, one each year.
6. Research narratives:

Statistical & deterministic models in georisk analysis
(UBC-V: Phil Austin, Nancy Heckman, Nhu Le, Douw Steyn, Will Welch, Jim Zidek; 
UBC-O: Jason Loeppky; SFU; Derek Bingham; San Diego: Sam Shen; McGill: Jim Ramsey)

Neither statistical nor physical models like those in climate modeling suffice for modeling large-scale processes like those involved in climate change. That is spawning a new modeling paradigm that seeks to combine the best elements of both. One promising approach due to Adrian Raftery and his co-authors uses Bayesian melding to integrate them. Central to this approach is the “truth” represented by a latent random Gaussian process. Deterministic models are assumed to be affine transformations of integrals of the truth over the grid cells that derived from the difference equation methods used to solve these deterministic models; monitoring site measurements, such as those involved in climate modeling, are similarly biased point measurements of the truth. A Bayesian hierarchical framework enables the integration of these two very different outputs. This framework enables uncertainty estimates to be added to deterministic outputs and those outputs to be dynamically tuned over time as data flows in. At the same time, the deterministic models may well provide statistical models with the “backbones” they lack when confronting large-scale climatic processes.

However, a number of research questions arise in connection with the use of deterministic models in a statistical domain. These would be addressed in the PIMS study.

1. How should environmental processes best be monitored taking account of the need to protect human populations from the deleterious societal impacts of such change? (Obviously more emphasis would need to be placed on impacts on populated areas whereas most classical design approaches focus only on physical aspects of the environmental.)

2. How can deterministic models constructed at different scales of resolution be statistically integrated by the use of wavelets, for example. (Those at the coarsest resolution run quickly on a computer so the goal would be to use statistical methods for predicting the hypothetical outputs of the deterministic models at finer scales to gain speed and practicality.)

3. How can deterministic models be turned into practical forecasting tools, say to predict drought or exceptionally hot weather?

4. Most environmental fields are not Gaussian processes but rather (after suitable transformation) multivariate-t processes. How can melding be adapted for use with such processes?

5. How can the spatial melding approach best be turned into a space-time melding approach? (The plan: use dynamic linear modeling on the coefficients generated by an orthogonal decomposition. Purpose built software has been developed at UBC that might be used for that purpose.)
Funding: For #1-5 above, funding is requested below for a full time UBC-V Statistics PhD student, Zhong Liu (Jan 1 – Aug 30, 2008) who is co-supervised by Le and Zidek.

Modeling space-time fields.
(UBC-V: Nancy Heckman, Nhu Le, Jim Zidek; UW: Peter Guttorp, Paul Sampson)

Modeling environmental space-time processes has become an area of intense research activity (see Le and Zidek 2006. Statistical analysis of environmental space – time processes. New York: Springer) in recent years. Yiping Dou, a Statistics PHD GRA at UBC – V, has made substantial progress in the development of dynamic linear models (DLMs) for such fields using the approach of West and Harrison, in particular. However a number of topics remain to be addressed:

1. The use of physical models and the DLM in conjunction with the Le – Zidek prefiltering approach to modeling multivariate processes with non-stationary spatial covariances modeled by the Sampson – Guttorp approach. As well, covariates will need to be included.

2. Models and their MCMC implementation for multivariate response vectors (where multiple responses are obtain at each site)

3. Log matroid-normal random response fields (eg species x time x space) and their implementation in a hierarchical Bayesian framework for environmental processes.

Funding: One year of partial postdoctoral funding is requested below for Yiping Dou, a current UBC-V doctoral student who is expected to complete her PhD in the summer of 2007. The remainder will be provided by grants held by her current thesis co-supervisors, Nhu Le and Jim Zidek.

Agroclimate risk analysis
(UBC-V: Nhu Le, Jim Zidek; McGill: Jim Ramsay; U San Diego: Sam Shen)

Climate change has led to the need for agricultural risk management where amongst other things drought has assumed increasing importance. That has prompted Agriculture Canada to allocate funding for managing risk. Such management entails the development of appropriate models for precipitation and methods for finding optimal management strategies. The National Program for Complex Data Structures (NPCDS) has approved and committed funding for a startup workshop to develop a detailed research proposal and subject to the approval of funding and the requisite matching funding, work should begin on this project early in 2007. However, such a workshop may not now be needed since Jim Ramsey attended one in June 2006 that reviewed, compared and discussed techniques for gridding precipitation on 10 km and daily scales. Discussion of those
techniques with Agriculture Canada and other subject area scientists, notably Aston Chipanshi, Denise Neilson, Harvey Hill and Allan Howard, suggested some important statistical research directions for risk management.

In particular, new methods are needed for spatial precipitation analysis that admit covariates such as elevation, wind direction and velocity, along with other climate covariates to improve the accuracy of precipitation. Moreover recent advances in statistical theory make it possible to estimate aspects of the entire distribution of rainfall at any given location and time point.

Such advances include work on quantile regression pioneered by Roger Koenker and his colleagues, and described in Koenker, R. (2005) *Quantile Regression*, Cambridge University Press. This work estimates any quantile or percentage point in the distribution of the outcome variable defined by a linear model, in addition to the mean of that distribution. The methodology has been already been applied to very large scale problems, including spatially distributed data, with the collaboration of Ivan Mizera (Dept. of Mathematics, U. of Alberta). Moreover, Jim Ramsay and a Postdoctoral Fellow, Giles Hooker, are developing a method for estimating the distribution of a response variable at any point over the continua over which the data are distributed. In this context, we would have the capacity to provide an estimate of the probability density function at any location and any time.

Alternatively, advances in hierarchical Bayesian modeling enable continuous covariate fields (like temperature) to be input as latent variables into discrete (or mixed) process models such as the binary process of precipitation occurrence using the clipped Gaussian (or multivariate t) approach. This leads to a Bayesian version of disjunctive kriging appropriate for use in climate change impact modeling of precipitation fields. A large number of unanswered questions arise in this connection. The process of answered these question began at UBC-V this summer with the work of Reza Hosseini, a Statistics PhD student. He downloaded Alberta precipitation data and wrote the software needed to manage it. Finally, he began to look into the feasibility of building a hierarchical Bayesian model using ideas of De Oliveira (2000 Computational and Statistical & Data Analysis, 299-314.)

**Funding:** Funding has been tentatively approved by the National Program for Complex Data Systems (NPCDS) with Agriculture Canada as a funding partner. That will support another full time Statistics PhD GRA, Reza Hosseini (Jan 1 2007 –Dec 30 2008). No PIMS funding will be needed to cover this part of the proposed research program.

**Environmental quality assessment, with emphasis on water and linkages to agriculture and species at risk.**
(UBC-O: Sylvia Esterby, Paramjit Gill, Jason Loeppky; National Water Research Institute and McMaster: Abdel El-Shaarawi)

Assessment of status and trends and the prediction of future status provide important information for the processes of environmental planning and management. Attribution of
changes in environmental status to natural or anthropogenic origin is also critical. The Okanagan region faces pressures on water resources, forests, rare species and air quality from rapid population growth and changing climate. Agricultural practices are adapting to climate change and to the need for sustainable modes of operation. As such, the region provides an ideal setting for studying environmental change as a prototype for expected changes due to a warming climate and in relation to agriculture and impacted species.

The PIMS study will concentrate on improved methods for the analysis of environmental, ecological and agricultural data and on data collection designs, clear needs if predictive models and climate-change/resource-sector-impact scenarios are to provide reliable information for planning and management. The study will also address an imbalance between the expenditure of effort and resources, high for data collection and low for the extraction of information from data. Some research topics which have been identified are briefly described:

1) Regardless of the environmental question being considered, invariably the question asked is whether or not environmental quality is changing. Methods that incorporate the complexities of the system, including covariates if appropriate, will be developed and applied to existing climatological and water-resource data sets to permit quantitative statements about status and change in status, be it linear change or change of a more complex nature. Currently nonparametric methods that are amenable to testing for monotonic change are often all that is used. Modern smoothing and regression methods will be adapted and/or extended to the particular designs of the data collections.

2) Climate scenarios and hydrological scenarios are being developed from models, where the models are calibrated with observational data. An open question is how to determine if the model is adequate for the region of interest. One method is the calculation of a coefficient that measures how well the model-generated hydrograph compares with the observed hydrograph. Methods for testing the fit will be developed where several features of the record are important. Model calibration is important in a number of other areas where models are being used to develop scenarios after a qualitative judgment of the adequacy of the calibration. Quantitative methods for evaluating the calibration would increase our confidence in the credibility of the scenarios being generated.

3) Locations where fruit crops can be grown depend on microclimates in mountainous areas. Analyses of fruit-crop pests will be extended to include new data on microclimates in situations where pest counts are low. This is a case of spatial-temporal modeling of counts with covariates and in the presence of many zeros. The data sets are part of a project to control pests with reduced usage of pesticides. Statistical methods used for this data set will be relevant to another area of interest, methods for species at risk where counts are low. Sample collection designs are also being considered. These topics coincide with the research interests of Zuzana Hrdličková who is expected to spend a post doctoral year at UBC O, with some time at collaborating universities. Collaborations with Howard Thistlewood, entomologist, at Pacific Agri-Food Research Centre in Summerland will continue.
4) Environmental quality is always measured in terms of an indicator. The indicator may be simple such as the concentration of a specific form of phosphorous in a stream collected under standard conditions, complex where a suite of measurements are used, or derived as an index from a suite of measurements. Remote sensing provides the opportunity for the development of indicators that may cost less than ground measurements or provide more spatially extensive data. Statistical methods play a role since a relationship between the remote measurement and the environmental property must be established in the use of such quality indicators. A project has been proposed for the application of GIS and remote sensing on watershed hydrology and other watershed processes.

Aquatic Habitat Indicators and Forest Harvesting in BC Interior: Using suitable indicators as an important approach to support sustainable forest management has been widely recognized in scientific and resource management communities. This approach is particularly relevant in BC because of the recent introduction of the results-based Forest and Range Practices Act (FRPA). In spite of significant efforts devoted to selection of forest sustainability indicators, many identified watershed indicators have not been well tested and applied in supporting design of forest management strategies for protection of both terrestrial and aquatic values in BC. Lack of well-tested, sensitive, measurable indicators as well as a system for their broad application will greatly constrain our ability to evaluate the environmental implications of the results-based FRPA. Therefore, we propose to use GIS and remote sensing, together with multivariate statistical analysis based on field measurements to assess aquatic habitat indicators at both the stream reach and watershed scale. The aquatic habitat indicators to be tested would mainly be focused on channel morphological features (e.g. residual pool depth, channel unit sequences, substrate, sinuosity etc.), riparian conditions and characteristics of in-stream large woody debris (LWD).

The rationale for this proposed research includes the following. First, there are many watershed indicators including hydrology, water quality, biology and channel morphology. It has been suggested that those stream morphology-related aquatic habitat indicators are likely more sensitive to forest management and land use changes, and they can also be easily measured and monitored. Second, large spatial variability generally exists in many aquatic habitat indicators and their interactions with watershed properties, forest disturbance and land use changes. The spatial variability could best be assessed through GIS and remote sensing technologies.

5) Mapping water quality in southern British Columbia streams/creeks: There are about 300 watersheds in the southern British Columbia. A short term goal of the project is to map the (seasonal) water quality indicators for these watersheds and relate the quality to bio-geoclimatic zones and to the level of land use for upstream reaches.

The long term goals are: (i) To create a province-wide coordination with other agencies and groups, (ii) To create a standardized database for the region and (iii) Long term predictions taking climate change and human intervention into account.
6) Linkages with the “Statistical vs Deterministic Models” project of UBC V are expected in terms of hydrological modeling. An additional aspect, regional downscaling of climate predictions is particularly relevant in developing climate-driven hydrological scenarios in mountainous regions.

**Funding:** One year of partial postdoctoral funding is requested for Zuzana Hrdličková, PhD student at Masaryk University Brno Czech Republic, who is about to complete her degree and is expected to come to UBC O early January 2007. Partial funding is requested to support a PhD level GRA in year two of the CRG. The remainder will be provided by research grants, funding of partners at Environment Canada and teaching one course (post doc).

**Impact of climate change:** Modeling changes in the diversity and structure of forests and in animal and insect populations, and assessing impact on human health (SFU: Charmaine Dean, Rick Routledge, Carl Schwarz; UBC-V: Mike Brauer, John Petkau, Kirstin Campbell; UBC-O: Sylvia Esterby; U Victoria: Bill Reed, Farouk Nathoo; UNBC: Chris Hawkins; U Alberta: Fangliang He; U Toronto: Dave Martell; U Western Ontario: John Braun; U Calgary: Ed Johnson)

Forest fires are a natural component of many of Canada’s forested ecosystems, yet they pose a threat to public safety, property and forest resources. Forest fires cause millions of dollars worth of damage and sometimes force the evacuation of affected communities. Affiliated industries can also be heavily affected; for example, construction labour costs have risen dramatically in Kelowna, BC, because of the need to replace the many houses that were destroyed by fire in August of 2003. Such problems will be exacerbated as more homes and cottages are established in and near forested areas and as climate change alters forest vegetation. Currently, there is a very limited understanding of the changes in diversity and structure of forests as a consequence of fire regime and landscape change. Studies that address these issues are critical, however, in view of future changes in fire regimes because of climate shifts. Forest ecology studies are also important with increasing outbreaks of mountain pine beetle and other insects and also more broadly in evolutionary studies which aim to understand how the conversion of old-growth forests to managed forests affects the structure, function, and species diversity of ecosystems and whether converted forests will eventually recover to a state that mimics many of the traits of old-growth stands. Research topics include:

1) The forest fire research community has made steady progress over the past four decades in increasing our understanding of the nature of forest fires. Deterministic spread models are used for planning purposes and have been incorporated in computer simulations to aid in the prediction of the future behaviour of existing and potential fires. Such models are used in conjunction with queueing, simulation and mathematical programming models for the strategic and tactical management of fire-fighting resources such as aircraft and fire-fighters. Although much has been learned about the interactions of weather and fuel-types and their effects on fire spread and intensity, a large number of questions remain. For example, how can the fire hazard in particular areas be estimated reliably, given sparse networks of weather stations, precipitation radar and lightning
stroke detectors? Importantly, what are the potential impacts of climate change on fire regimes and fire management systems? How should uncertain weather forecasts influence the management of large project fires? What is the impact of pine beetle on fire regime?

We will develop stochastic models of these processes, including adaptations of point process intensity models have been used successfully to model earthquakes and volcanoes. For example, the times and locations of lightning strikes and fire ignitions can be viewed as a bivariate point process. A mutually exciting process is a possible model, where the lightning process drives the ignition process, but where the ignition process itself may also have a self-exciting component, such as jump-fires. Interacting particle system models offer a way to model, stochastically, the spatio-temporal dynamics of a forest fire. Stochastic cellular automata may provide a way to simulate fire spread more effectively than current deterministic models. In particular, jump-fires might be modelled more effectively.

2) Scientists have recently begun using charcoal abundances in lake sediments to generate insight on the local fire history. A layer of sediment in which charcoal is unusually abundant suggests a local fire around the time that the layer was deposited. Statistical techniques will be developed for distinguishing such layers from an often noisy background and estimating the deposition dates for the sediment. There are frequently several sources of incomplete information from sources such as 14C estimates from older, deeper deposits, 210Pb estimates from younger deposits closer to the sediment surface and fire scars on trees. There is typically a gap of around 200 years between the two types of isotope dates where, in the absence of fire-scarred trees, there is no direct information on deposition dates. In addition, a researcher may have observations from sediments in several lakes which need to be analyzed spatially in tandem. Recent developments in computational Bayesian statistics will be of particular value, along with ideas from state-space modeling, statistical process control, and metaanalysis. In addition, evidence is emerging of substantial changes in fire history associated with European suppression of aboriginal broadcast burning in the 19th century and subsequent suppression of wildfires in the latter half of the 20th century. Other specific needs for improved statistical methodology include incorporating information from multiple sources for dating a lake sediment core, and a variety of unsolved statistical challenges associated with combining charcoal records in lake sediments, fire scars on nearby trees, and written and oral history for inferring fire history.

3) In the forest ecology arena, an important focus will be to develop and test new methods for predicting pine beetle outbreaks and the outbreak severity based on forest data and climate data. The lack of stability caused by pine beetle and fire is a threat to economic sustainability, but that variability supports the biodiversity that is so essential for the maintenance of natural ecosystem processes. We will therefore also develop new statistical models that can be incorporated in stochastic timber supply models that will be used to explore the extent to which tradeoffs between these apparently conflicting management and environmental objectives affect economic returns, harvest levels, and
harvest flow stability, reconciling those with the integrity of the natural ecosystem processes.

For modeling annual beetle infestations in British Columbia forests state space models will be employed including “mixture models” where the population consists of two or more subsets behaving differently and where spatial clustering is evident both in the placement of the population mixtures and their evolution over time. With pine beetle attacks on trees, it is hypothesized that there are present trees that never succumb to attack, while other trees experience transitions from the attacked to non-attacked states, for example, depending on spatially-correlated, random effects. The primary goal of this aspect of the work is the development of methodology for analysis of such spatially-correlated mixture Markov models. This is important for identifying trees from the two sub-populations and their characteristics, and how susceptibility to attack depends on the spatial environment and temporal effects. Advancements in the development of methodology in this field have been recently made by Nathoo (U Vic) and Dean (SFU). Extensions to include effects of a weevil parasite which is predominant in the Pacific region are underway. Complex models for multiple insect attacks are important in a variety of areas and methodology developed will be framed in a broad context.

4) The development of methods for mapping species abundance and diversity is required for forest management and conservation. It is important to understand how the conversion of old-growth forests to managed forests affects the structure, function, and species diversity of ecosystems and whether converted forests will eventually recover to a state that mimics many of the traits of old-growth stands. Methods for the development and dynamics of the ecosystems from a newly disturbed to an old-growth stand and the development of tools for predicting vegetation succession are fundamental. Of importance in the short term is the reliable projection of some specific, important stand features. However, evolution to a substantial spatio-temporal scale which will investigate stand dynamics for exploring environmental, and particularly climatic, changes for forest management is of essence. This research is part of a multidisciplinary coastal forest chronosequences study, starting from 1991, led by the Canadian Forest Service. For modeling succession dynamics, stem mapping techniques, statistical point process modeling and computer simulation will be jointly utilized. A specific goal is to understand how the three dominant species, Douglas-fir, western hemlock, and western redcedar, coexist and partition space along a chronosequence comprised of immature, mature, and old-growth stands.

5) The development of methods for assessing the impacts of climate change on animal populations and on human health is another important facet of this component. In order to assess the impacts of change, it is necessary to know basic biological parameters about animal populations such as survival rates, population numbers, population movement rates etc. These are often obtained using methods such a capture-capture, point-count, or distance-sampling. The design of long-term studies using these methods needs to be planned carefully in order to detect change with some reliability. To give an idea of the order of magnitude of some of these studies, the Northern Spotted Owl is an endangered species in the Pacific North West. There has been a 20+ year monitoring study where
approximately 32,000 captures have been made on 11,000 banded birds costing about (cumulative) $25,000,000 in field and analysis costs! The analysis of such studies requires sophisticated analysis tools not usually available, nor accessible to most biological researchers. The development of suitable methodologies in capture-recapture, distance-sampling, and point-count methodologies for these large scale problems will be another focus of this CRG. In addition, tools for both modeling and analysis of current ecosystems and inferring past conditions from natural recorders will be investigated. Current applications include (i) ecological interactions between salmon farms, sea lice, and wild Pacific salmon, and (ii) the role of spring river discharge on the marine survival of outmigrating juvenile sockeye salmon in Rivers Inlet, British Columbia. Identified needs for improved statistical methodology include relating deterministic, fluid-dynamic modelling to observations containing considerable stochastic components. In the area of human health, methods for quantifying risk for certain diseases (asthma, cardiovascular disease) associated with climate change and specific strategies to assess health impacts will be considered. A specific and important application is the development of methods for forest fire smoke modeling and linkages with adverse events related to asthma.

**Funding:** Partial funding to support graduate students working in the areas of topics 2, 3 and 5 is requested. Support for research in the other topics will be provided by NPCDS funding with partners from the Canadian Forest Service, the GEOIDE NCE, the BC Ministry of Forests and the German Center for Environmental Research.
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**Opening meeting**
- **TIES NA 2007**: 19500 in Seattle
- **PNWEM Workshop 1**: 5000 in Seattle, 3000
- **Summer school 1**: 15000 in Singapore-Vancouver
- **Workshop 2**: 10000 in Seattle
- **Summer school 2**: 20000 in Lund
- **BIRS**: 10000 in Banff
- **TIES 2008**: 10000 in NCAR, 7000 in Kelowna
- **Total**: 49500 in Kelowna
FORM 100
Personal Data Form
PART I

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<th>Initial(s) of all given names</th>
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<td>Charmaine</td>
<td>CB</td>
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I hold a faculty position at an eligible Canadian college
(5) (complete Appendices B1 and C)

I do not or will not hold an academic appointment at a
Canadian postsecondary institution

APPOINTMENT AT A POSTSECONDARY INSTITUTION

Title of position
Burnaby Mountain Research Professorship

Department
Statistics & Actuarial Science

Campus
Burnaby, B.C. V5A 1S6

Canadian postsecondary institution
Simon Fraser

ACADEMIC BACKGROUND

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TRAINING OF HIGHLY QUALIFIED PERSONNEL

Indicate the number of students, fellows and other research personnel that you:

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<tr>
<td>Affiliate Scientist</td>
<td>BC Cancer Agency</td>
</tr>
<tr>
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<tr>
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### RESEARCH SUPPORT

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<td>New methodology for handling overdispersion as arises in recurrent event data and disease mapping NSERC Research Grant</td>
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List all sources of support (including NSERC grants and university start-up funds) held as an applicant or a co-applicant: a) support held in the past four (4) years but now completed; b) support currently held, and c) support applied for. For group grants, indicate the percentage of the funding directly applicable to your research. Use additional pages as required.

<table>
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<th>Amount per year</th>
<th>Years of tenure (yyyy)</th>
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### Highly Qualified Personnel (HQP)

Provide personal data about the HQP that you currently, or over the past six years, have supervised or co-supervised.

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<td>E. Juarez</td>
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<td>Spatial patterns and competition of tree species</td>
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<td>Spatial Markov Mixture Models and Analysis</td>
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<td>M. Chui</td>
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<td>Supervised 2000 - 2002</td>
<td>Multistate Survival Analysis Model for Two Endpoints</td>
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<td>J. Nielsen</td>
<td>Master's (Completed)</td>
<td>Supervised 1999 - 2001</td>
<td>Semi-Parametric Analysis of Recurrent Event Data</td>
<td>PhD student under my supervision</td>
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<td>M. Ugarte</td>
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<td>Mapping Disease Rates</td>
<td>Assistant Professor, Univ Publica de Navarra, Spain</td>
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<td>Y. MacNab</td>
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<td>Spatio-Temporal Modeling of Rates</td>
<td>Assistant Professor, UBC Health Care &amp; Epidemiology</td>
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Personal information collected on this form and appendices will be stored in the Personal Information Bank for the appropriate program.

PROTECTED WHEN COMPLETED
1. Most Significant Contributions to Research and/or to Practical Applications

*See end of Section for listing of these publications.*

**Derivation of Methods for Mapping Disease/Mortality Rates**

*This is work done with my PhD students Y. MacNab, F. Nathoo and my PDFs M. Ugarte and G. Silva.* MacNab and Dean (2001) develop methods for describing the geographic and temporal distribution of mortality/incidence rates using generalized additive mixed models. The models use autoregressive local smoothing across the spatial dimension and spline smoothing over the temporal dimension. MacNab and Dean (2002) discuss spatio-temporal modeling of rates and disease mapping broadly. This paper has had high impact in the biostatistical user-community. Dean, Ugarte and Militino (2001) develop tests for interaction between random spatially correlated region and fixed age-group effects in disease mapping. It is not uncommon for mapping studies to proceed on the assumption that this interaction is absent. This paper discusses that the effect of a failure of the assumption can be substantial and derives a simple test for interaction, and the computation of its power function. Note that new work with Nathoo makes substantial strides in the advancement of methods for spatio-temporal analyses by developing methods for the analysis of both discrete time and continuous time longitudinal spatial data permitting spatial variability in the rates of transition. Recent new work with Silva focuses on specialized techniques in spatial analyses for non-rare events.

**Count Processes and Longitudinal Data Analysis**

This is work done with my PhD student R. Balshaw. Dean and Balshaw (1997; JASA) consider the loss in efficiency in the analysis of counts generated from a non-homogeneous Poisson process versus the analysis of the full counting process which records the actual times of occurrence of events. Data for an individual are stochastically ordered, correlated, subject to censoring, and the times of followup need not be coincident. The paper derives conditions under which the analysis of the counts is fully efficient both for models with and without random effects. The paper also considers the loss in efficiency when the conditions are not satisfied, explores how different experimental designs affect efficiency, and how far away from the ideal design one must be before severe losses are incurred. The practical relevance is cost-effective design of clinical studies. Balshaw and Dean (2002) develop methods for the semiparametric analysis of recurrent event data arising in a panel structure.

*Student co-authors are indicated in bold.*


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2. Other Research Contributions

Refereed Publications


**Articles Submitted to Refereed Journals**


3. Other Evidence of Impact and Contributions

Relevance of Work

Overdispersion: Dean, C.B. (1992), Testing for overdispersion in Poisson and binomial regression models, *J. Amer. Statist. Assoc.* 87, 451-457. My previous work on overdispersion generated substantial interest in the community with many application papers and several methodological papers considering related problems. This paper has been used as a building block for much other work and hence I mention it – based on citations of publications in 1992 of this high impact journal, this article ranks in the top 5%. I continue to review several papers a year which are quite closely related to this work (special cases; truncated count data models; zero-heavy count data models popular in econometric studies, for example) and primarily because of this work I was invited to serve as a statistical appraiser for the American Public Health Association.

Spatio-temporal methods for disease mapping: My interest in mapping rates was initiated by the Division of Vital Statistics at the BC Ministry of Health and this work is directly related to their mandate. It has also led to my participation in a GEOIDE NCE grant for the study of heart disease in Quebec with the emphasis being the estimation of the effect of an intervention in the recent change in management of the disease in Quebec and in the spatial analysis of survival data related to the disease. With Michael Hayes and others I am involved in a study to understand spatial distribution of health inequities and localized policy impact within Vancouver’s census metropolitan area. This will also analyze the distribution of health status indicators, and make linkages with disease incidence and mortality at the intra-regional level; the project will use health status indicators from *BC’s Health Goals: the Roadmap Initiative*, including quality of life indicators, social capital and other variables.

Awards: 2003 CRM-SSC Award. The SSC website explains this award as follows: “The award, jointly sponsored by the Statistical Society of Canada and the Centre de recherches mathématiques de Montréal, is given each year to a Canadian statistician in recognition of outstanding contributions to the discipline during the recipient’s first 15 years after earning a doctorate.”

Prestigious Invited Lectures in the last 6 Years


Presidential Terms: Committee of Presidents of Statistical Societies, 2001-03 & 05-08; President, Statistical Society of Canada, 06-07, President-Elect 05-06, Past-President, 07-08; President, International Biometric Society, Western North-American Region, 2002; President-Elect,
01; Past-President, 03; President, Biostatistics Section, Statistical Society of Canada, 1999-00; President-Elect, 1998-99; Past-President, 2000-01.

**Journals/Bulletins:** Senior Editor, *Advances in Disease Surveillance*, 2005 - Present; Statistical Appraiser for the American Public Health Association, 1995-Present; Associate Editor, *Liaison*, 1996-00, Associate Editor, *Canadian Journal of Statistics*, 03-2008; Associate Editor, *Biometrics*, 05-08.

**Granting Agencies:** College of Reviewers, UK Engineering and Physical Sciences Research Council, 2006-09; Review Panel, NIH Biostatistical Methods and Research Design, 2006-07; Health Effects Institute, U.S. Environmental Protection Agency, 2005-06; College of Reviewers of the Canada Research Chairs Program, 04-Present; Michael Smith Foundation for Health Research Council Member, 2004-07; Chair of the NSERC Statistical Sciences Grant Selection Committee, 2001-03; NSERC Statistical Sciences Grant Selection Committee, 2000-03; Michael Smith Foundation for Health Research Population Health Grant Selection Committee, 2001-02; Chair, Search Committee for SFU Site Director for the Pacific Institute for the Mathematical Sciences, Fall 2000; SFU PIMS Steering Committee, 99-01; PIMS Postdoctoral Fellow Selection Committee, 1998-00; PIMS Research Panel, 1996-98.

**NISS:** Board Member, National Institute of Statistical Sciences (NISS) Corporation, 2002; AAAS: American Association for the Advancement of Science Section on Geology and Geography Cmtee, 2003-05; ASA: Snedcor Award Cmtee, 2001-2003; SSC: SSC Research Cmtee (97-03); Publications Cmtee (00-01); Elections Cmtee (00-01); Search Cmtee for Editor of CJS (99-00); Chair, Cmtee on Women in Statistics (97-98); Chair, Education Cmtee (96-97); WNAR Program Chair, 1999 Seattle Meeting; CRM: Chair, CRM-SSC Award Committee, 2004-05.

4. Delays in Research Activity

**Department Chair at SFU:** In 1998, I became Director of Statistics and developed a proposal for the establishment of a Department of Statistics and Actuarial Science at SFU. My main administrative priority at SFU between 1998 and 2001 was the establishment of this department. In 2004, I became the Associate Dean in SFU’s new Faculty of Health Sciences in charge of the hiring of twelve faculty and the development of programs. A major implication for my research was a reduction of time for work with collaborators. However, a strong focus on high quality training of students was maintained. I intend to increase research activity with students and with collaborators as detailed in the proposal.

5. Contributions to the Training of Highly Qualified Personnel

**Thesis Supervision detailed on Part I of Form.**

**Thesis Co-Supervision and External Examination:**

Over the last 6 years I served as External Examiner for 4 PhD students (2000 Curtin U Australia; 2001 U of Windsor; 2002 U of Alberta; 2004 Memorial U of Newfoundland), 6 MSc students at SFU; as a committee member for 6 MSc and 2 PhD students at SFU.
Complete this appendix (i) if you are an applicant or co-applicant applying for the first time; (ii) if you need to update information submitted with a previous application; or (iii) if you do not hold an appointment at a Canadian postsecondary institution. For updates, include only the revised information in addition to the date, your name and your PIN.

This information will be used by NSERC primarily to contact applicants and award holders. It may also be used to identify prospective reviewers and committee members, and to generate statistics. It will not be seen or used in the adjudication process.

<table>
<thead>
<tr>
<th>Family name</th>
<th>Given name</th>
<th>Initial(s) of all given names</th>
<th>Personal identification no. (PIN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean</td>
<td>Charmaine</td>
<td>CB</td>
<td>48748</td>
</tr>
</tbody>
</table>

Position and complete mailing address if your primary place of employment is not a Canadian postsecondary institution or if your current mailing address is temporary

If address is temporary, indicate:

<table>
<thead>
<tr>
<th>Date</th>
<th>2006/09/24</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Language</th>
<th>Read</th>
<th>Write</th>
<th>Speak</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
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<td>X</td>
<td>X</td>
</tr>
<tr>
<td>French</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

I wish to receive my correspondence: in English X in French

<table>
<thead>
<tr>
<th>AREA(S) OF EXPERTISE</th>
<th>Research subject code(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>overdispersion, quasi-likelihood, spatial statistics, point process, random effect models, spline smoothing, disease mapping, longitudinal data analysis, markov models, mixture models</td>
<td>Primary 3005 Secondary 3007</td>
</tr>
</tbody>
</table>
NSERC applicants are required to describe their contributions to the training or supervision of highly qualified personnel (HQP) by providing certain details about the individuals they have trained or supervised during the six years prior to their current application. HQP information must be entered on the Personal Data Form (Form 100). This information includes the trainee’s name, type of HQP training (e.g., undergraduate, master’s, technical etc.) and status (completed, in-progress, incomplete), years supervised or co-supervised, title of the project or thesis, and the individual’s present position.

Based on the federal Privacy Act rules governing the collection of personal information, applicants are asked to obtain consent from the individuals they have supervised before providing personal data about them to NSERC. In seeking this consent, the NSERC applicant must inform these individuals what data will be supplied, and assure them that it will only be used by NSERC for the purpose of assessing the applicant’s contribution to HQP training. To reduce seeking consent for multiple applications, applicants will only need to seek consent one time for a six-year period. If the trainee provides consent by e-mail, the response must include confirmation that they have read and agree to the text of the consent form.

When consent cannot be obtained, applicants are asked to not provide names, or other combinations of data, that would identify those supervised. However, they may still provide the type of HQP training and status, years supervised or co-supervised, a general description of the project or thesis, and a general indication of the individual’s present position if known.

An example of entering HQP information on Form 100 (with and without consent):

<table>
<thead>
<tr>
<th>Name</th>
<th>Type of HQP Training and Status</th>
<th>Years Supervised or Co-supervised</th>
<th>Title of Project or Thesis</th>
<th>Present Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consent Received from Marie Roy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roy, Marie</td>
<td>Undergraduate (Completed)</td>
<td>Supervised 1994 - 1997</td>
<td>Isotope geochemistry in petroleum engineering</td>
<td>V-P (Research), Earth Analytics Inc., Calgary, Alberta</td>
</tr>
<tr>
<td>Consent Not Obtained from Marie Roy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(name withheld)</td>
<td>Undergraduate (Completed)</td>
<td>Supervised 1994 - 1997</td>
<td>Isotope geochemistry</td>
<td>research executive in petroleum industry - western Canada</td>
</tr>
</tbody>
</table>

Consent Form

Name of Trainee

Applicant Information

Name: Dean, Charmaine CB

Department: Statistics & Actuarial Science

Postsecondary Institution: Simon Fraser

I hereby allow the above-named applicant to include limited personal data about me in grant applications submitted for consideration to NSERC for the next six years. This limited data will only include my name, type of HQP training and status, years supervised or co-supervised, title of the project or thesis and, to the best of the applicant's knowledge, my position title and company or organization at the time the application is submitted. I understand that NSERC will protect this data in accordance with the Privacy Act, and that it will only be used in processes that assess the applicant's contributions to the training of highly qualified personnel (HQP), including confidential peer review.

Trainee's signature

Note: This form must be retained by the applicant and made available to NSERC upon request.
CURRICULUM VITAE

Sylvia R. Esterby
Mathematics, Statistics and Physics
The University of British Columbia Okanagan
Email: sylvia.esterby@ubc.ca

Education

Ph.D., Statistics, 1976 University of Waterloo
B.A., Chemistry, 1968 Queen's University, Kingston

Selected Professional Experience

2005- Associate Professor, Statistics and Head, Mathematics, Statistics and Physics, UBC Okanagan
2000-2005 Associate Professor, Mathematics and Statistics, Okanagan University College
1998- Adjunct Associate Professor (part-time teaching to 2000), Mathematics and Statistics, McMaster University
1985 - 87 Section Head, Ecological Impact Section, Aquatic Ecology Division, National Water Research Institute.


1990 Workshop on Statistical Methods, eight-country International Development Research Centre (IDRC) Project Viña Del Mar, Chile
1992 Five day course, "The Interpretation of Analytical Data", La Secretaria de Desarrollo Social of Mexico, organized by the Instituto Nacional de Ecología, Mexico and sponsored by the World Bank.
1995 Consultant for River Nile Protection and Development Project, Phase II, Central Laboratory for Environmental Quality Monitoring component, Canadian International Development Agency(CIDA), Cairo, Egypt
1995 Workshop on Water Quality Trend Assessment, Centre for Applications of Statistics and Mathematics, University of Otaga, Dunedin, New Zealand.


National/bi-national Workshops:


NSERC: Member of NSERC, GSC Statistical Sciences, 1997-2000; Chair 1999-2000.


Reviewer for Natural Sciences and Engineering Research Council strategic and operating grants, Hong Kong University Research Grants Council, and for Great Lakes University Research Fund.

The International Environmetrics Society (TIES): member of Founding Board of Directors; Secretary-Treasurer, 1989-1994; Treasurer, 1994-1998; President-Elect, 1998-2000; President, 2000-2002; Co-Editor TIES Newsletter 2002-.

Statistical Society of Canada: includes Ontario Regional Representative, Board of Directors, 1991-1995; President-Elect, President, Past-President Biostatistics Section, 1994-1997; Accreditation Appeals Committee (IAAC), 2004 -.

Honours, Accreditation:
Fellow of the Modelling and Simulation Society of Australia and New Zealand (MSSANZ), awarded August 1, 2000.
Elected member of the International Statistical Institute, February 2004.
Accreditation as Professional Statistician, P.Stat.,2004 (Statistical Society of Canada)

Research Funding
NATO Linkage Grant and Networking Supplement ($21,900), with, Institute of Limnology, Russian Academy of Sciences, Statistical methods and software for lake water quality series, 1998and 1999


NSERC Research Grant, Individual: Statistical methods in the assessment of environmental status and change, 4 yrs, $12,000 per year, GSC 014, first year of grant is 2002-2003

GEOIDE Strategic Investment Initiative, Forests, Fires and Stochastic Modeling. Funding as Co-applicant: $12,000 01/01/06-31/12/07. Principal Investigators: C.B. Dean, D. Martell, J. Braun.

NPCDS, Forests, Fires and Stochastic Modeling. Funding as Co-applicant: $12,000 01/01/06-31/12/07. Principal Investigators: C.B. Dean, D. Martell, J. Braun.

Publications: papers published as 34 journal or refereed proceedings, 19 proceedings and 17 reports, and one edited proceeding. Some selected articles are as follows:


issue.
CURRICULUM VITAE FOR PETER GUTTORP

Personal
Born March 10, 1949 in Lund, Sweden.
Citizen of Sweden.
Permanent resident of the United States of America.

Education
Fil. kand., University of Lund, Sweden, 1974 (with distinction in Mathematical Statistics and Musicology).
M.A. (Statistics), University of California at Berkeley, 1976.
Ph.D. (Statistics), University of California at Berkeley, 1980.

Professional And Cross-Disciplinary Activities
Dr. Guttorp has published two monographs, 78 papers, 25 book chapters, and numerous non-refereed works. He has supervised 21 PhD students. Dr. Guttorp has initiated and directed a multidisciplinary research center for statistics and the environment, with participation from 32 University of Washington scientists from 14 departments. As part of the outreach aspect of this center, he assisted in the development of a middle school curriculum aimed at teaching the scientific method through a hands-on approach. He also initiated the University of Washington VIGRE program, enabling vertical and horizontal integration of teaching and research between the mathematical sciences departments at the University and affecting education at all levels, from students in kindergarten to postdoctoral researchers. He is the 2004-2005 Environmental Research Professor of the Swedish Organization of Graduate Engineers.

Selected Professional Experience
1980- Assistant, Associate and Full Professor, Statistics, University of Washington.
1996- Director, National Research Center for Statistics and the Environment.
2002- Chair, Statistics, University of Washington

Selected Honors And Grants
1996-99 Principal investigator on National Science Foundation grant: Statistics in Atmospheric Science.
1996-02 Principal investigator on Environmental Protection Agency cooperative agreement: A National Center for Environmental Statistics.
1999-09 Co-Principal investigator on National Science Foundation grant: Integration of Research and Education in the Applied and Computational Mathematical Sciences.
2001 Fellow of the American Statistical Association
2002-05 Co-Principal Investigator on National Science Foundation grant: Wavelet-based statistical analysis of multiscale geophysical data.

Selected Professional Services
1989-91 Member, panel on Spatial Statistics, National Research Council.
1995-97 Associate Editor, Annals of Statistics.
1995-98 Program chair, 7th International Meeting on Statistical Climatology, British Columbia.
1996-03 Associate Editor, Bernoulli.
1997- Associate editor, Environmetrics.
1999- Member, Advisory Panel for the Geophysical Statistics Project, National Center for Atmospheric Research (Chair 2003-).
2000- Associate Editor, International Statistical Review.
2000-04 President-elect and President, the International Environmetric Society.
2001- Member, Scientific Advisory Panel, Banff International Research Station.

Selected Conference Lectures
Statistics from Mars: some analysis of Viking pressure data, Pacific Northwest Statistics Meeting, Vancouver, Canada.
Space-time modelling of tropospheric ozone. Royal Statistical Society International Meeting, UK.
1997 Hidden Markov models in atmospheric ozone. AMS Short Course on Time Series, Long Beach, California.
1999 Picture the Future—graphical innovation in environmental statistics. Hunter lecture, TIES/SSES meeting (ISI satellite), Athens, Greece.
2001 Six lectures on Inference for stochastic processes in environmental science. Vth Brazilian School of Probability, Ubatuba, SP, Brazil.
2002 Bayesian estimation of nonstationary spatial covariance. Statistical Society of Canada annual meeting, Hamilton, ON, Canada.
Estimating health effects of particulate matter air pollution (two lectures). III Curso/taller de Contaminacion Atmosferica y matematicas. UNAM, Mexico City, Mexico.

Recent Doctoral Students
Wendy Meiring (Statistics): Estimation of heterogeneous space-time covariance
1996 Ian Painter (Statistics): Inference in a discrete parameter space
1997 Sandra Catlin (Statistics): Statistical inference for partially observed Markov population models
1998 Brandon Whitcher (Statistics): Assessing nonstationary time series using wavelets
1999 Ashley Steel (Quantitative Ecology and Resource Management): In-stream factors affecting juvenile salmon out-migration
2000 Enrica Bellone (Statistics): Nonhomogeneous hidden Markov models for downscaling synoptic atmospheric patterns to precipitation amounts
Barnali Das (Statistics): Global covariance modeling: a deformation approach to anisotropy
Daniela Golinelli (Statistics): Bayesian inference in hidden stochastic population processes
Peter Craigmile (Statistics): Parameter estimation of trend contaminated long memory processes
2002 Doris Damian (Biostatistics): A Bayesian approach to estimating heterogeneous spatial covariances
**FORM 100**  
**Personal Data Form**  
**PART I**

<table>
<thead>
<tr>
<th>Family name</th>
<th>Given name</th>
<th>Initial(s) of all given names</th>
<th>Personal identification no. (PIN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zidek</td>
<td>James</td>
<td>V</td>
<td>4599</td>
</tr>
</tbody>
</table>

- [x] I hold a full, an associate or an assistant professor position at a Canadian university
- [ ] I do not or will not hold an academic appointment at a Canadian postsecondary institution
- [x] I hold an academic appointment at a Canadian university but am not a full, an associate or an assistant professor (complete Appendices B and C)
- [ ] I hold a faculty position at an eligible Canadian college (complete Appendices B1 and C)

**Place of employment other than a Canadian postsecondary institution (give address in Appendix A)**

**APPOINTMENT AT A POSTSECONDARY INSTITUTION**

<table>
<thead>
<tr>
<th>Title of position</th>
<th>Canadian postsecondary institution</th>
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<tbody>
<tr>
<td>Professor Emeritus</td>
<td>British Columbia</td>
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</tbody>
</table>

**Department**

Statistics

**Campus**

**ACADEMIC BACKGROUND**

<table>
<thead>
<tr>
<th>Degree</th>
<th>Name of discipline</th>
<th>Institution</th>
<th>Country</th>
<th>Date yyyy/mm</th>
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<tbody>
<tr>
<td>Bachelor's</td>
<td>Mathematics</td>
<td>Alberta</td>
<td>CANADA</td>
<td>1961/05</td>
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<tr>
<td>Master's</td>
<td>Statistics</td>
<td>Alberta</td>
<td>CANADA</td>
<td>1963/05</td>
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<tr>
<td>Doctorate</td>
<td>Statistics</td>
<td>Stanford University</td>
<td>UNITED STATES</td>
<td>1967/09</td>
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**TRAINING OF HIGHLY QUALIFIED PERSONNEL**

Indicate the number of students, fellows and other research personnel that you:

<table>
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<th>Currently</th>
<th>Over the past six years (excluding the current year)</th>
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</thead>
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<tr>
<td></td>
<td>Supervised</td>
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<tr>
<td>Undergraduate</td>
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<tr>
<td>Master's</td>
<td>2</td>
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<tr>
<td>Doctoral</td>
<td>1</td>
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<tr>
<td>Postdoctoral</td>
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<tr>
<td>Others</td>
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</tr>
<tr>
<td>Total</td>
<td>2</td>
</tr>
<tr>
<td>Position held (begin with current)</td>
<td>Organization</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Professor Emeritus</td>
<td>British Columbia</td>
</tr>
<tr>
<td>Visiting Research Scientist</td>
<td>Statistical &amp; Applied Math Sciences Institute, NC</td>
</tr>
<tr>
<td>EPSRC Fellow</td>
<td>University of Bath, UK</td>
</tr>
<tr>
<td>Head</td>
<td>U British Columbia</td>
</tr>
<tr>
<td>EPSRC Fellow</td>
<td>University of Kent, UK</td>
</tr>
<tr>
<td>Visiting Professor</td>
<td>National University of Singapore</td>
</tr>
<tr>
<td>Visiting Research Scientist</td>
<td>University of Bath, UK</td>
</tr>
<tr>
<td>Head</td>
<td>U British Columbia</td>
</tr>
<tr>
<td>Visiting Professor</td>
<td>University of Washington</td>
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## ACADEMIC, RESEARCH AND INDUSTRIAL EXPERIENCE

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<th>Position held (begin with current)</th>
<th>Organization</th>
<th>Department</th>
<th>Period (yyyy/mm to yyyy/mm)</th>
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<tr>
<td>Visiting Research Scientist</td>
<td>Imperial College London</td>
<td>Mathematics</td>
<td>1982/11 to 1983/06</td>
</tr>
<tr>
<td>Visiting Research Scientist</td>
<td>CSIR, South Africa</td>
<td>Statistics &amp; Operations Research</td>
<td>1982/07 to 1982/10</td>
</tr>
<tr>
<td>Visiting Research Scientist</td>
<td>Imperial College London</td>
<td>Mathematics</td>
<td>1977/01 to 1977/06</td>
</tr>
<tr>
<td>Professor</td>
<td>U British Columbia</td>
<td>Statistics</td>
<td>1976/07 to 2004/12</td>
</tr>
<tr>
<td>Visiting Research Scientist</td>
<td>CSIRO, Australia</td>
<td>Statistics &amp; Applied Math</td>
<td>1975/07 to 1976/12</td>
</tr>
<tr>
<td>Visiting Research Scientist</td>
<td>University College London</td>
<td>Statistics</td>
<td>1971/07 to 1972/06</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>U British Columbia</td>
<td>Statistics</td>
<td>1971/07 to 1976/06</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>U British Columbia</td>
<td>Statistics</td>
<td>1967/07 to 1971/06</td>
</tr>
</tbody>
</table>
### RESEARCH SUPPORT

<table>
<thead>
<tr>
<th>Family name and initial(s) of applicant</th>
<th>Title of proposal, funding source and program, and time commitment (hours/month)</th>
<th>Amount per year</th>
<th>Years of tenure (yyyy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>James V Zidek</td>
<td>Likelihood methods and spatial mapping</td>
<td>40,000</td>
<td>2002</td>
</tr>
<tr>
<td></td>
<td>NSERC</td>
<td>40,000</td>
<td>2003</td>
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<td></td>
<td>Discovery Grants</td>
<td>40,000</td>
<td>2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>106 hours/month</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmetrics, likelihood &amp; decision theory</td>
<td>86,300</td>
<td>2006</td>
</tr>
<tr>
<td></td>
<td>NSERC</td>
<td>66,299</td>
<td>2007</td>
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<tr>
<td></td>
<td>Discovery Grants</td>
<td>38,300</td>
<td>2008</td>
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<td></td>
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<td>153 hours/month</td>
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<td></td>
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<td>36,300</td>
<td>2009</td>
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<td></td>
<td></td>
<td>36,300</td>
<td>2010</td>
</tr>
</tbody>
</table>

List all sources of support (including NSERC grants and university start-up funds) held as an applicant or a co-applicant: a) support held in the past four (4) years but now completed; b) support currently held, and c) support applied for. For group grants, indicate the percentage of the funding directly applicable to your research. Use additional pages as required.

**a) Support held in the past 4 years**

**c) Support applied for**
## Highly Qualified Personnel (HQP)

Provide personal data about the HQP that you currently, or over the past six years, have supervised or co-supervised.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type of HQP Training and Status</th>
<th>Years Supervised or Co-supervised</th>
<th>Title of Project or Thesis</th>
<th>Present Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jean-Francois Plante</td>
<td>Doctoral (In Progress)</td>
<td>Supervised 2004 -</td>
<td>Extensions of the Weighted likelihood</td>
<td>PhD Student, Statistics, UBC</td>
</tr>
<tr>
<td>Howard Chang</td>
<td>Undergraduate</td>
<td>Co-supervised 2002 - 2004</td>
<td>Environmental risk and Aircare data analysis</td>
<td>PhD Student, Biostats, Johns Hopkins U</td>
</tr>
<tr>
<td>Audrey Fu</td>
<td>Master's (Completed)</td>
<td>Co-supervised 2001 - 2002</td>
<td>Inference for rainfall extremes</td>
<td>PhD student, Statistics, U Washington</td>
</tr>
<tr>
<td>Eugenia Yu</td>
<td>Master's</td>
<td>Co-supervised 2001 - 2002</td>
<td>Analysis of Vancouver airpollution fields</td>
<td>Statistical analyst, St Pauls Hospital</td>
</tr>
<tr>
<td>Eugenia Yu</td>
<td>Master's (Completed)</td>
<td>Co-supervised 2001 - 2002</td>
<td>Analysis of a randomized clinical trial in the presence ...</td>
<td>Statistical analyst, St Paul’s Hospital</td>
</tr>
<tr>
<td>Eugenia Yu</td>
<td>Undergraduate</td>
<td>Supervised 2000 - 2001</td>
<td>Fairness and effectiveness of emission repair $ limits</td>
<td>Statistical analyst, St Paul’s Hospital</td>
</tr>
<tr>
<td>Liang Chou</td>
<td>Undergraduate</td>
<td>Co-supervised 2000 - 2001</td>
<td>Survival distribution of vehicle repairs for emission fails</td>
<td>Unclassified UBC student</td>
</tr>
<tr>
<td>Xaiogang Wang</td>
<td>Doctoral (Completed)</td>
<td>Co-supervised 1996 - 2001</td>
<td>Weighted likelihood</td>
<td>Assistant Professor, York University</td>
</tr>
<tr>
<td>Vivien Wong</td>
<td>Undergraduate</td>
<td>Supervised 2000 - 2000</td>
<td>Analysis of vehicle emission and repair data</td>
<td>Undergrad SFU Actuarial Program</td>
</tr>
</tbody>
</table>
1. Most Significant Research Contributions:

The emerging theory for the relevance weighted likelihood (created with my then PhD student, Feifang Hu) holds promise. It: (1) provides a framework for development of that theory to enable data from disparate sources to be combined, allowing prior knowledge to be incorporated in complex problems where applying Bayesian methods may be difficult. (2) generalizes nonparametric regression, providing new solutions to old problems there; (3) provides smoothing approaches in statistical quality control and other areas where smoothing had not been introduced; **Significant recent publication:**


A new approach to bootstrapping, based on estimating equations seems promising because it circumvents the issue of how re-sampling should be done. Moreover, Kalbfleisch and Hu extended it in a deep and elegant paper that broadens its domain of application, in particular to include dependent data. **Significant recent publication:**


A Health Canada pNEM software development project led to a simulation model for setting air quality criteria in Canada. It has been redeveloped as a WWW based platform (pCNEM) that can be accessed and run online for any pollutant for which the internet client has the needed data. PCNEM can be run to predict sub-population air pollution exposures under hypothetical regulatory scenarios. Recently McBride, Zidek and Williams show the predictive exposure distribution to be well calibrated for a group of seniors whose personal exposures were monitored. Most importantly, Shaddick and Zidek show in a London study (unpublished as yet) that pCNEM /PM10 forecasted exposures of senior males turns associations between mortality (cardiovascular and also respiratory) from insignificant to (marginally) significant. **Significant recent publication:**


Another important development: a Bayesian theory of optimal design and spatial prediction for environmental processes. This work led directly to two Health Canada research contracts since it yields a predictive distribution for a random fields (like air pollution). The contracts supported a number of research students. As well, it led to a joint EPA cooperative agreement with a Harvard group on personal exposure models. That agreement also provided substantial graduate student and Post- doctoral support, as well as an opportunity for interdisciplinary research. Finally the work led to: (1) a number of speaking invitations (see proceedings articles below); (2) membership on a tribunal to resolve a dispute on the amount of cleanup needed at the Rocky Mountain Arsenal, Colorado; (3) membership on a multi-year high-level EPA panel concerned with ozone air quality standards in the USA; (4) a research monograph (with associated software) that will appear in late 2005. **Significant recent publication:**
James V Zidek

When spatial fields such as those for particulate air pollution are measured as short-term time aggregates (e.g. hourly), time and space become "inseparable", a problem that did not seem to have been previously addressed. A method of dealing with it appears in the publication below.

**Significant recent publication:**

2. **Other Research Contributions over the last six years:**

**Refereed Publications:**


van Eeden, C and Zidek, JV (2004). Combining the data from two normal populations to estimate the mean of one when their mean difference is bounded. J Mult Anal, 88, 19-46. Funding: NSERC. Alphabetical author order.


Non refereed publications:


Submitted or under revision:


James V Zidek


3. Other Evidence of Impact and Contributions

Awards
1976 Elected Fellow, Institute of Mathematics Statistics
1979 Elected Member, International Statistical Institute
1988 Elected Fellow, American Statistical Association
1987/88 President, Statistical Society of Canada, 1987- 88
1989/90 Izaak Walton Killam Senior Fellowship for
1999 9th Eugene Lukacs Symposium Distinguished Service Award,
2000 Invited Presidential Address, Statistical Society of Canada
2000 Gold Medal, Statistical Society of Canada
2000 Distinguished Achievement Medal, Environmental
Statistics Section of the American Statistical Association
2001 Izaak Walton Killam Research Prize
2003 Hunter Lecture, International Environmetrics Society
2003 Elected Fellow, Royal Society of Canada
2004 Plenary Lecture, South African Statistical Association
2005 Honorary Membership Statistical Society of Canada

Notable Panels and Review Committees
2005 Review Committee, Department of Statistics, Oxford University
2005 - Scientific Advisory Committee, National Center for Atmospheric Research, Boulder Colorado
2005 - Clean Air Scientific Advisory Committee for Ozone, Environmental Protection Agency, USA

Editorships:
2005-: Associate Editor, JASA
1998-2001: Associate Editor, Canadian Journal of Statistics
1999- Wiley: Editor for Encyclopedia of Environmental Statistics

Invited presentations since 1999:
1999 6 invited talks omitted to save space
2000 5 invited talks omitted to save space
2001 3 invited talks omitted to save space
“Approaches the Monitoring Network Design.” SPRUCE Workshop on Environmental
Design, Estoril, Portugal, Mar.
“Space-time interaction issues in the spatial prediction of pollution fields”, European Meeting
of Statisticians, Funchal, Madiera, Aug.
James V Zidek


2003

“Uncertainty.” Institute Statistics & Decision Sciences, Duke U, Jan
“A computer model for predicting human exposure to air pollutants in environmental risk assessment.” Statistical & Applied Mathematical Sciences Instit, Jan
“Uncertainty” Dept Statistics, U of Florida, Apr
“Designs for Predicting the Extremes of Spatial Processes.” 2003 ENAR Spring Meeting.
Tampa, FL, Apr


2004

“Uncertainty and Information.” Institute of Mathematics, Federal University of Rio de Janiero, Feb
“Current directions in modelling environmental space time processes.” 7th Encontro Brasileiro de Estatistica Bayesiana, Sao Carlos, Brazil, Feb
“Physical vs Statistical Modelling: Towards a Reconciliation.” Joint SFU – UBC colloquium, Oct
“A Statistical Characterization of a Simulated Canadian Annual Maximum Rainfall Field.”
Institute of Martime Technology, Simon’s Town & University of Orange Free State, South Africa, Nov
“Uncertainty”, University of Cape Town, Nov
“Accounting for Time-Activity Patterns in Estimating Human Exposures to Air Pollution for Health Risk Analysis”, Medical Research Council, Cape Town, Nov

"Physical vs Statistical Modelling: Towards a Reconciliation." Plenary Address, Statistical Association of South Africa, Nov

2005


4. Delays in Research Activity
My second five year term as Head of Statistics cut into my research time during the 1997- 2002 as did the research monograph begun in 2002 and now to appear.

5. Contributions to the Training of Highly Qualified Personnel.
Following my Headship, I was granted a year’s administrative leave so I delayed taking on any on new graduate students until I returned. Our graduate student population has grown dramatically recently, so have opportunities for training especially PhDs.

Undergraduates (Chou, Yu and one unnamed) were involved with massive (BC AirCare) SQL databases and learned how to handle. Valuable training for modern apps.
Complete this appendix (i) if you hold an academic appointment at a Canadian university but are not a full, associate or assistant professor, or (ii) if you hold a part-time academic appointment at a Canadian postsecondary institution. This would include applicants or co-applicants holding an adjunct professor or a professor emeritus position and all co-applicants from an eligible Canadian college. This information is collected to provide peer reviewers with additional information on your activities at the postsecondary institution and at your main place of employment (if applicable).

<table>
<thead>
<tr>
<th>Family name</th>
<th>Given name</th>
<th>Initial(s) of all given names</th>
<th>Personal identification no. (PIN)</th>
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<tbody>
<tr>
<td>Zidek</td>
<td>James</td>
<td>V</td>
<td>4599</td>
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**DESCRIPTION OF ACTIVITIES AT CANADIAN POSTSECONDARY INSTITUTION**

Outline the nature of your 1) research, 2) teaching, 3) training, 4) administrative and 5) other activities. Each of these aspects must be addressed. Indicate the time typically spent on location at the postsecondary institution on each of these activities (e.g., 1 day every week, 2 weeks every 4 months).

1) My research program has two components: (a) concerns the weighted likelihood estimator and the properties of the estimators it produces; (b) concerns the environmental space-time processes, their measurement, modelling and mapping.

2) I have no teaching duties.

3) I have three PhD students that are not expected to complete their theses for at least 3 years.

4) I am an Editor of the ChapmanHall/CRC textbook series and serve on the Advisory committee for UWashington's PM Center. I spend 100% of my time at UBC, save for National and International meetings.

**DESCRIPTION OF ACTIVITIES AT PLACE OF EMPLOYMENT OTHER THAN CANADIAN POSTSECONDARY INSTITUTION (if applicable)**

Place of employment other than Canadian postsecondary institution, including self-employment

I do not hold a position outside a Canadian postsecondary institution

Outline the nature of your research program and other activities at your other place of employment. Also describe the relationship between your research program at this organization and the proposed research. Refer to the institution's involvement in research and development, if possible.

I am a Special Government Employee, serving on a panel for the US Environmental Protection Agency for 2-5 years, the goal being to recommend new US air quality criteria for ozone. The work requires about 2 weeks per year of my time.