2013 STATMOS Annual Report  
Report Period: 10/01/2012 – 09/30/2013

PARTICIPANTS

Faculty and Senior Personnel

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Other Organizations involved as partners:

SARMA Nordic Top-Research Initiative Network on Statistical Approaches to Regional Climate Models for Adaptation
North Slope Borough, Department of Wildlife Management
Center for Robust Decision Making on Climate and Energy Policy (RDCEP), NSF-supported center at University of Chicago
Norwegian University of Science and Technology
Aquarius: NASA's Jet Propulsion Laboratory is coming onboard.
Other Collaborators/Contacts:

Climathnet (UK network)
Dominici, Francesca, Professor of Biostatistics and Associate Dean for Information Technology, Harvard University
F Finazzi and A Fasso, University of Bergamo, Italy
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Uncertainty Quantification for Climate Observations:
Dr. Jessica Matthews, Research Associate, NOAA-CICS;
Professor Pierre Gremaud, NCSU Mathematics and SAMSI.

These individuals from the Pacific Institute for Mathematical Science (PIMS) node in Canada, have requested regular contact on information related to STATMOS:

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ACCOMPLISHMENTS

What are the major goals of the project?

Network building: The main purpose of the network is to build local and national links between statisticians and atmospheric and ocean scientists. We do this by having faculty, students and postdocs visit other nodes, for short or long periods of time, by organizing workshops and summer courses, and by local activities (at each node) of various kinds, from occasional seminars to regular course offerings.

Research: The emphasis of the network is on work in atmospheric and ocean sciences, and the main scientific contributions of the network are in this context. Among the important areas of study are uncertainty propagation, downscaling, data assimilation and other approaches to combining data and deterministic models, stochastic modeling, spatial and spatiotemporal extremes and computational issues associated with large environmental datasets.

Teaching: The network nodes aim at developing new multidisciplinary courses and methods for delivery beyond the individual classroom.

Outreach: The main outreach goals for the network consist of web based presentations and activities for the general public (at the “Stories” part of the network web pages), curriculum development for K-12 education, the creation of an electronic journal, and participation in policy-directed activities, such as Climate Science Day on the Hill.

What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

For this reporting period describe: 1) major activities; 2) specific objectives; 3) significant results, including major findings, developments, or conclusions (both positive and negative); and 4) key outcomes or other achievements. Include a discussion of stated goals not met

Major Activities:

Network growth

During the reporting period the network has added four nodes, at Argonne National Laboratory and the University of Michigan (under the UC hub), at Charles III University of Madrid (under the NCSU hub) and at University of Glasgow (under the UW hub). The two non-US nodes both have long-standing relationships with network members. The management team has worked on developing guidelines for the evaluation of current and potential nodes, and will discuss these with node leaders at the annual meeting in Montréal in August.

Research areas

The NCSU team has worked in collaboration with atmospheric scientists from UNC-W, NCAR and NCDC on extreme weather modeling and forecast, introducing statistical models that would improve the accuracy of storm surge forecast and seasonal hurricane prediction by fusing together deterministic models and observations.

The NCSU team has been also working with the National Birth Defects Prevention Study North Carolina study team in investigating complex environmental exposures, primarily to extreme weather and air pollutants, and birth defects under potentially changing climatic conditions. We have conducted an ancillary study using data from the North Carolina Department of Health to investigate feasibility of using crop maps from the National Agricultural Statistics Service (NASS) along with data on timing of pesticide application to investigate patterns of pesticide use and the
probability of birth defects. We continue to move forward with current emphasis on Bayesian methods for case-control data and Bayesian methods for complex mixtures. We meet regularly with the entire NBDPS study team to discuss work in progress and brainstorm promising future directions.

Several foci have emerged in the NCSU team’s research agenda. One is the ongoing investigation of data assimilation challenges for understanding weather and environmental exposure, particularly with regard to climate change and compliance issues, necessitating hierarchical modeling with careful attention to sources of noise, and the development of posterior predictive distributions. A second is the continued advancement of strategies for accommodating increasingly larger space and space-time climate and health datasets. A third involves species demography with interest in response to change in environment, particularly climate change. A fourth involves investigation of directional data in space and time. Such methodology enables investigation of angular data processes such as waves, wind, animal movement, and even crime patterns.

From the UW node there have been contributions to climate science in methodology to estimate the uncertainty of temperature rankings, to evaluate regional climate models with respect to their representation of temperatures, and sea ice SAR image analysis. In addition, we have evaluated policy options and reevaluated semi-empirical approaches to statistical downscaling of sea level rise.

At Chicago, a major focus has been on computational methods. Specific methods include unbiased estimating equations, incomplete Cholesky decompositions, covariance tapering and low rank approximations to covariance matrices and preconditioning as a tool for speeding iterative solutions to large systems of linear equations. Wavelet methods have been explored for modeling and analysis of both time series and spatio-temporal data. Specific applications considered by group members include GCM output, OMI measurements of total column ozone, high frequency (every minute) surface meteorology from the ARM Southern Great Plains site, arsenic levels in wells, meteorological reanalysis data and Arctic sea ice. Simulation of future climates at a range of spatial and temporal scales is of particular interest to both this project and RDCEP (Center for Robust Decision Making for Climate and Energy Policy), also funded by NSF.

Much of Kate Calder’s (OSU) work and projects currently underway are motivated by problems in other disciplines including climatology, oceanography, and geology.

Weller (CSU PhD student) and Cooley (CSU faculty) used extreme value methods to study the correspondence between extreme precipitation events as produced by the NARCCAP regional climate models (RCMs) and events in the observation record. The methodology was developed in a paper which has appeared in Environmetrics, and a comprehensive RCM investigation has been submitted. This is joint work with Melissa Bukovsky, Stephan Sain, and Linda Mearns at NCAR.

**Significant Results:**

Significant advances at Chicago include the development of unbiased estimating equations for Gaussian process models that have nearly the statistical efficiency of maximum likelihood methods but require substantially less computation, new models and algorithms for fitting statistical models to Global Climate Model output at the global scale using axially symmetric models and parallel computation, and theoretical and numerical results showing the strengths and especially the weaknesses of covariance tapering and low rank approximations for reducing computations with large spatial and spatio-temporal datasets. An important ongoing project concerns the simulation
of future climates by modifying observed climatological data in the spectral domain by using climate model output to estimate only changes in the mean climate and in the spectral behavior of variability about the mean rather than the absolute state of the climate. Mondal has made significant advances in a number of areas including an edge correction method for a general intrinsic autoregression on a two-dimensional finite rectangular lattice. The proposed method retains the simple neighborhood structure, and enables swift and matrix free computations. Mondal and his collaborators have also developed wavelet methods for estimating the long range dependence parameter of Gaussian time series, including the setting of missing observations in the time series, worked out a hierarchical likelihood, or h-likelihood, approach for sparse mixed linear models and devised new algorithms for carrying out computations for Gaussian process models based on a sparse conjugate gradient approach. The NCSU interdisciplinary team working on weather forecast has introduced an improved version of hurricane forecasting models.

The UW node has been focusing on uncertainty estimation and propagation and climate model assessment. Novel results include tools for assessing the uncertainty in rankings, where the ranked items come with errors. We have used spatio-temporal extreme value models to compare station data to a regional climate model, and used distributional tools, such as Doksum's shift function, to assess CMIP5 models.

Weller and Cooley (CSU) found that in general, the RCMs were able to reproduce extreme precipitation events for the summer and winter on the Pacific coast, and also did so for winter precipitation in the midwest. Results for summer extreme precipitation in the Midwest showed no tail dependence between the RCM output and observations. Weller and Cooley also created an index based on synoptic scale meteorological data which showed tail dependence to winter extreme precipitation events on the Pacific coast known as the Pineapple Express.

**Key Outcomes or Other achievements:**
The network is committed to the reproducibility of our research and to provide software for its dissemination and implementation. NCSU graduate student Luke Smith working under the supervision of Fuentes and Reach is developing an R package for Bayesian simultaneous quantile regression entitled *Bsquare*. This package will accommodate continuous, discrete, and censored data, and allow the user to center the Bayesian model on many parametric quantile functions, or use semi-parametric spline fitting. The package is nearing completion, and should be available by the summer of 2013. This is the software used in our work to study the impact of climate change on ozone and human health, by using spatial quantile regression.

**What opportunities for training and professional development has the project provided?**
Describe opportunities for training and professional development provided to anyone who worked on the project or anyone who was involved in the activities supported by the project. "Training" activities are those in which individuals with advanced professional skills and experience assist others in attaining greater proficiency.

STATMOS participants have been provided numerous opportunities to attain greater proficiency and experience by attending and leading seminars, talks, and presentations within nodes, between nodes, and at other institutions.

Elizabeth Mannshardt (NCSU) was teaching a Graduate Special Topics Course: Advanced Spatial
Statistics (ST810) at NCSU in the Fall of 2012. She has served as a mentor in PhD research with Katarina Sucic, NCSU Statistics, from 2012 ongoing under Montserrat Fuentes. She has also mentored Katarina Sucic and Ryland Pigg (NCSU Statistics) in the Statistics graduate student consulting team (ST641) EPA Project in 2013. Elizabeth Mannshardt (NCSU) has mentored several graduate students in Marine, Earth, and Atmospheric Science at NC State University. She has mentored Michelle Cipullo in her thesis project under the advisor Walter Robinson. She mentored Tao Gao in his PhD dissertation under the guidance of professor Lian Xie.

A case-based course in statistical climatology was developed and given by Peter Guttorp spring quarter 2013 at the University of Washington. The course had eight students, and was also followed by Bo Li, Purdue, and by Ying Sun and Andrew Poppick, Chicago. We covered cases on daily mean temperature estimation and propagation of uncertainty in local sea level projections, with guest presentations by Alson Cullen and Ashley Steel. The main product was a set of web pages on policy options and uncertainty assessment of sea level rise projections at Olympia, Washington. These are aimed at citizens and policy makers in the city, and are available (together with the programs and data used to produce the projections) at http://courses.washington.edu/statclim. It is likely to result in a research paper by the participants.

A Spatial Statistics Workshop at CSU, April 10-11, 2013 was co-organized by Dan Cooley and Jennifer Hoeting (Colorado State University) and partly sponsored by STATMOS and PIMS. The two-day conference included a short course on Integrated Laplace Bayesian methods by Drs. Håvard Rue and Daniel Simpson from Norwegian University of Science and Technology, a poster session, and invited talks by senior researchers. Almost 50 people attended the conference, including 35 individuals from STATMOS institutions. Over two-thirds of the attendees were graduate students and post-docs showing that this conference strongly supported young, upcoming researchers with interests in spatial statistics and the research areas of STATMOS. The students and post-docs put on a terrific poster session that was highly interactive. There were also a good number of senior people at the conference who interacted with the junior researchers. Several of the junior researchers gave feedback after the conference that they learned a lot from the conference. They also said they got some great suggestions about directions to take their own research during the poster session. During the conference we also held a session on strategies to get an academic position. This is an important component of mentoring for the graduate students and post-docs at this juncture of their career.

Dianne Cook, Iowa State University, gave a STATMOS/IMA Ge workshop on Visualization of Climate Data on May 13-17, 2013 at NCAR in Boulder, Colorado. This was a five-day event modeled on a previous workshop in Iceland with the Nordic network SARMA. The course had 40 participants, half of whom where NCAR scientists. 10 participants came from STATMOS nodes, supported either by STATMOS or by PIMS. The workshop was very successful and lead to many new collaborations. This served as the STATMOS summer school for 2013.

There is close interaction between the STATMOS group at Chicago and the NSF-funded RDCEP Center, also based in Chicago. In particular, several STATMOS group members (including STATMOS Director M. Stein) regularly attend the weekly meetings of the climate group within RDCEP to learn about the challenges in using climate model output and other information as inputs into integrated assessment models to study impacts of climate change and their attendant uncertainties. Postdoc William Leeds is funded by both RDCEP and STATMOS and helps to foster interaction between the two centers.

How have the results been disseminated to communities of interest?
Describe how the results have been disseminated to communities of interest. Include any outreach activities that have been undertaken to reach members of communities who are not usually aware of these research activities, for the purpose of enhancing public understanding and increasing interest in learning and careers in science, technology, and the humanities.
Peter Guttorp (UW) travelled to Cuba in May, 2013, with a delegation from the American Statistical Association to develop ties between Cuban and US statisticians and climatologists. This is part of an endeavor to form a Pan-American network on statistics and climate to tie in with existing networks in the Nordic countries (SARMA), the UK (MathCliNet) and North America (STATMOS). A Pan-American Advanced Study Institute co-organized by Guttorp and Charmaine Dean (PIMS) and planned for Brazil in July, 2014, also is a part of this endeavor. A similar network effort is at the proposal stage in Australia.

Richard Katz (NCAR) replaced Peter Guttorp (UW) at the beginning of 2013 as the Chair of the American Statistical Association Advisory Committee on Climate Change Policy, for which Michael Stein (UC) and Peter Craigmile (OSU/UG) also are members. Katz, together with Stein, Guttorp and Richard Smith (SAMSI), participated in Climate Science Days in Washington D.C. on February 26-27, 2013 to discuss climate science with congress staffers. Michael Stein is a guest editor for a special issue of Statistical Science on Mathematics of Planet Earth.

Peter Guttorp wrote a blog entry on Uncertainty, knowledge, statistics and climate change for the statistics blog at Huffington Post. It was posted April 1, 2013, at http://www.huffingtonpost.com/peter-guttorp/

SAMSI conducts a one-week undergraduate modeling workshop each year. Dorit Hammerling and colleagues used the hurricane data as the modeling data set this year. The students were provided a scientific introduction to hurricane research as well as statistical modeling for hurricane counts. Blog and a description of the workshop can be found at: http://mpe2013.org/2013/05/22/predicting-the-2013-hurricane-season-using-real-data-focus-of-samsi-undergraduate-modeling-workshop/ and http://www.samsi.info/workshop/undergraduate-modeling-workshop-may-13-17-2013

NC State Researchers have been making predictions on the active hurricane season for 2013. Researchers at North Carolina State University forecast an above-average hurricane season for 2013. According to Dr. Lian Xie, professor of marine, earth and atmospheric sciences (MEAS), and collaborators Dr. Montserrat Fuentes, professor of statistics, Dr. Dorit Hammerling, postdoctoral research associate in statistics and Bin Liu, research assistant professor in MEAS, we should expect to see 13 to 17 named storms forming in the Atlantic basin, which includes the entire Atlantic Ocean, the Gulf of Mexico and the Caribbean Sea. This number is higher than the (1950-2012) 62-year average of 10.8 named storms. Of those named storms, 7 to 10 may grow strong enough to become hurricanes, and three to six may become major hurricanes. Press release: http://news.ncsu.edu/releases/tp-xie2013/ Detailed technical report accessible at: http://cfdl.meas.ncsu.edu/research/TCom2013/TCom2013_data.html

What do you plan to do during the next reporting period to accomplish the goals?

There are several network activities that we are planning within the next reporting period.

An IMAGe Theme-of-the-Year workshop on Next Generation Climate Data will take place at NCAR, Boulder, Colorado in July 2013. Among the organizers are Veronica Berrocal (UM), Bo Li (Purdue), Richard Smith (SAMSI), Doug Nychka (NCAR and Peter Guttorp (UW).

Marian Scott (University of Glasgow) has a training course planned for August involving statistical methods for environmental scientists Banff workshop on contribution of oceans to climate variability October 2013

The Third International Workshop on Climate Informatics will take place September 26-27, 2013 at NCAR, Boulder, Colorado. STATMOS members of the organizing committee include Bo Li (Purdue), Doug Nychka (NCAR), Tao Shi OSU) and Susan Tolwin-Ward (NCAR).
A Banff workshop on the role of oceans in climate model uncertainty is scheduled for the BIRS center in October, 2013. The organizing committee includes Peter Guttorp (UW), Michael Stein (UC), Montserrat Fuentes (NCSU) and Frederick Bingham (UNC-W).

Another Banff workshop, a few weeks later, is on forest fire modeling, also in October, 2013. Charmaine Dean (PIMS) and Peter Guttorp (UW) are among the members of the organizing committee. The Canadian participants are keenly interested in maintaining connections to support the training of students and networking related to this important topic for Canada especially because of recent changes in insect infestations and forest fire activity in British Columbia. Development of tools for management of these growing concerns is critical, and is one of the aims of the workshop.

Rosa Lillo from the Universidad Carlos III de Madrid and colleagues are organizing an activity called “STAT WAR” with objective of spreading the usefulness of Statistics in real life. This activity will be held in November 2013 and is mainly directed to high school students.

A Pan-American Advanced Study Institute is planned for Brazil July, 2014. The institute will consist of a summer school in space-time modeling (which will serve as the STATMOS summer school for 2014), as well as two advanced workshops on nonstationary covariance models and on multivariate spatial statistics. The organizing committee contains Peter Guttorp (UW) and Charmaine Dean (PIMS), together with Alexandra Schmidt (Brazil), Lelys Bravo de Guenni (Venezuela) and Eliane Rodrigues (Mexico). Funding has been obtained from NSF and PIMS, and is being sought from other Pan-American sources.

Marian Scott has a grant application with the University of Edinburgh for constraining climate models (results pending).

The University of Michigan has new participants including Ewa Kominiak that have joined STATMOS in 2013 and since then have been working on topics related with the ocean's salinity and analyzing the ARGO and Aquarius data sets. The UM node joined STATMOS in October 2012 and reports that there definitely has been more interest among students to be involved in research related to atmospheric sciences problems. In particular, Robert Yuen, graduate student from the Department of Statistics, has applied for funding to participate in the “Next generation climate data products” that will be held at NCAR in July.

In the future, Biostatistics Ph.D. student Douglas Hom will be participating more actively in STATMOS activity particularly on non-stationary covariance functions with Kate Calder (OSU). Frederick Bingham (UNC-W) is planning to submit a proposal to the NASA Ocean Salinity Science Team announcement in July 2013.

The research assistant for outreach, based at UW, has so far been used for web page development. With a new research assistant (to be hired) we now shift focus to development of activity-based curriculum for high school AP Statistics classes.

**PRODUCTS**

**Papers & Publications**


Lillo R., Rodríguez J. and Ramírez Cobo, P. Nonidentifiability of the two-state BMAP.

Lillo R. Sguera, C. and Galenao, E., Spatial Depth-Based Classification for Functional Data.


Website:
The UW node is in charge of the project web pages, located at http://www.statmos.washington.edu. During the period September 1, 2012 – May 1, 2013 there were 5107 visits and 12,109 page views. These visits were by 3,252 different visitors, the majority of which came from the United States. There were 685 visitors from Australia, 275 from the UK and 116 from Canada. The most popular page was Past events, followed by Career opportunities, Movies about climate and Upcoming events. During the year we have updated the web page layout, adding current events and stories on the front page, added a Featured papers page, and an Annual reports link on the About menu. We have also updated the travel request system, and streamlined the reporting format. A manual for updating the web pages and accessing the STATMOS data base has been developed.

SEMINARS, TALKS & PRESENTATIONS

WITHIN NODES:
P. Guttorp, In the Heat of the Sun–How we know that our climate is changing. Lecture in Research Exposed! seminar series, UW.

Space-time working group, organized by Sampson and Guttorp:
Oct 3 Aila Särkkä, Chalmers University, Sweden
Oct 17 Raja Hafiz Affandi, CS & Stat
Oct 31 Peter Guttorp, Stat
Nov 28 Mari Myllimäki, Aalto University, Finland
Jan 16 Aditya Kharma, Quantitative Ecology and Resource Management
Jan 30 Adel Lee, Environmental Health
Feb 13 Roman Jandarov, Biostatistics
Feb 27 Miranda Fix, Quantitative Ecology and Resource Management
April 18 Grant Weller, CSU
May 2 Anna-Kaisa Ylitalo, Jyväskylä University, Finland
May 16 Casey Olives, Health Metrics and Evaluation

Amy Kim gave a presentation Uncertainty in Rankings on Research Night of the UW Statistics & Probability Association, November 2012
Amy Kim presented a poster, Uncertainty in Ranking the Hottest Years of U.S. Surface Temperatures, at the UW Undergraduate Research Symposium, May 17, 2013.
R. Yuen, “Statistical inference for spatial extremes”, presentation at University of Michigan, Department of Statistics. (November 2012)
T. Brown, “Analyzing spatial fields using deformations”, presentation at University of Michigan, Department of Statistics. (November 2012)
H. Kashavarz, “Anomaly detection for spatiotemporal data”, presentation at University of Michigan, Department of Statistics. (November 2012)

In addition to the presentations given to faculty from other nodes listed below, students and postdocs at Chicago (S. Castruccio, S. Dutta, M. Horrell, W. Leeds, A. Poppick and Y. Sun) participate in regular group meetings attended by faculty M. Stein and D. Mondal and all of them presented their work at least twice in the last year. Further presentations at Chicago by UC participants:
S. Castruccio. Poster presentation on a meeting at the University of Chicago in September 2012.
M. Horrell. Poster Presentation for New Student Visitation at UChicago: Covariance Estimation for Large Spatio-Temporal Data.
S. Dutta. Thesis proposal in front of committee and visiting Professor Peter J. Green on 04/17/2013.

J. Guinness, Poster Presentation at SAMS/SAVI Workshop on Environmental Statistics, March 4-6, 2013.
J. Guinness, Poster Presentation at Scope Academy, NC State, April 13,


BETWEEN NODES:


P. Guttorp (UW): Visits to Simon Fraser University and University of Chicago to give seminar (How a paper can come about at SPU, The Heat Is On! A Statistical Look at the State of the Climate at Chicago), interact with graduate students and faculty, and develop research ties.

Guttorp: Received data from NCDC and SDSU.

Guttorp: Joint work with Richard Smith (SAMS), Peter Craigmile (Glasgow) and Peter Thorne (Duke/NCDC) on temperature tercile streak probability calculations.

Guttorp: Joint work with Peter Craigmile (Glasgow) on temperature extremes and regional models.

Paul Sampson and Colin Sowder (UW): Participated in INLA workshop at CSU.

L. Richardson (UW): Participated in SAMS undergraduate workshop on statistics and climate.

Cervantes and Rinnan (UW): Participated in STATMOS workshop on visualization at NCAR
Michael Stein (UC) visited University of Michigan and met with faculty from both Statistics and Biostatistics on November 2, 2012. He gave an overview of some recent research and heard four presentations, three from graduate students, on work related to STATMOS activities. Presenters included:

Stilian Stoev, Associate Professor, Department of Statistics "Max-stable processes and spatial extremes"

RA Yuen, Ph.D. student, Department of Statistics "Inference for max-stable random fields"

Thomas Brown, Ph.D. student, Department of Statistics "Analyzing Spatial Nonstationarity Through Deformations"

V. Berrocal (UM), visit to Ohio State University in November 2012. Gave a Department seminar entitled "A generalized class of conditionally autoregressive models".

Alan Gelfand, STATMOS node director at Duke University, visited the University of Chicago for interactions with Michael Stein regarding handling large space and space-time datasets. Gelfand also gave a joint lecture to the Department of Statistics and the Department of Ecology and Evolution entitled Wildfires in South Africa, Cherry trees in Japan. An important component of his talk involved the possibility of assessing the effects of climate change on the return time for forest fires and on the first flowering dates for cherry trees. In addition, on Tuesday, Gelfand joined Stein to offer feedback on a collection of six presentations driven by environmental process problems, given by graduate students and post doc within the Department of Statistics.

Speakers and titles include: Ying Sun, New estimating equations for efficient inference in large spatial datasets; William Leeds, A spectral-based approach to conditional simulation of climate; Stefano Castruccio, Global space-time models for climate ensembles; Andrew Poppick, A Joint Model for Temperature and Dew Point; Michael Horrell, MLE Approximation for Large Spatio-Temporal Datasets; Somak Dutta, REML computations for spatial linear model based on intrinsic, Matérn dependence with nugget effects.

M. Fuentes (NCSU), visit to University of Michigan, Department of Statistics, February 2013. Gave a Department seminar entitled “Nonparametric spatial models for extremes: application to extreme temperature data”

Graduate students Robert Yuen and Naveen Naidu Narisetty attended the workshop in Spatial Statistics held at Colorado State University, April 2013 and presented two posters: Robert Yuen presented the poster entitled “CRPS M-estimation for max-stable models”, while Naveen Naidu Narisetty presented the poster entitled “Functional depth based simultaneous inference”. S. Castruccio (UC), Seminar at NCSU in October 2012.

S. Castruccio (UC), Poster presentation on a meeting at NCAR in February 2013
M. Horrell (UC), Poster Presentation at CSU's Workshop on Spatial Statistics: Covariance Estimation for Large Spatio-Temporal Data.
W. Huang (Purdue), Gave two presentations to the STATMOS group meetings at UC during his visit to Chicago May-June 2013.

S. Dutta (UC), Spatial Statistics Workshop 2013 held in Colorado State University, April 10 - 11, 2013.
Poster presentation: "REML for approximate intrinsic Matérn models with nugget effects."

University.


M. Fuentes (NCSU), Seminar Presentation, Impact of Climate Change on Mortality in the Southeastern United States (Abstract), Universidad Carlos III de Madrid, February 15, 2013.

PIMS participants (funded by PIMS):
Camila Casquilho, Li Xing and Ehsan Karim (UBC) at INLA workshop at CSU
Jonathan Baik and Vincenzo Coia (UBC) at STATMOS visualization workshop at NCAR

AT OTHER INSTITUTIONS:

J. A. Hoeting, “Penalized Importance Sampling for Parameter Estimation in Stochastic Differential Equations,” University of Missouri, Department of Statistics, April 2013

Douglas Nychka (NCAR) and T. Greasby, “Mining spatial structure in regional climate,” 12th International Meeting on Statistical Climatology, Jeju, South Korea, 24-28 June 2013.


M. Risser (OSU), S. Vaidyanathan (OSU), Desheng Liu (OSUI), Attended: 10 Lectures on Statistical Climatology, University of Washington, August 2012.
C. Calder (OSU), Conference Presentation. Spatial Statistics Conference, Colorado State University, April 2013.


Veronica Berrocal, presentation at SAMSI Environmental workshop, March 2013. Presented the joint paper with Peter Guttorp (Washington) and Peter Craigmile (Glasgow) entitled “Regional climate model assessment using statistical upscaling and downscaling techniques”.
Veronica Berrocal, presentation at the High Dimensional Data international workshop, May 2013 at UBS. Will present the joint paper with Alan Gelfand (Duke) entitled “Space-time downscaling of numerical model outputs from prediction of spatial extremes: an application to ozone extremes”.
Veronica Berrocal, Department of Statistics Seminar, Brigham Young, March 2013. Presented the joint paper with Alan Gelfand (Duke) entitled “A generalized class of conditionally autoregressive models”.
Veronica Berrocal, Workshop on “Next generation climate data products” at NCAR, July 2013. Will present the joint paper with Peter Guttorp (Washington) and Peter Craigmile (Glasgow) entitled “Space-time downscaling of numerical model outputs from prediction of spatial extremes: an application to ozone extremes”.

Xuanlong Nguyen, 9th conference on Bayesian nonparametrics, Amsterdam, June 2013. Will present “Borrowing strength in hierarchical Bayes: convergence of the Dirichlet base measure”.

S. Castruccio, Seminar at University of Heidelberg (Germany) in December 2012.

S. Castruccio, Seminar at ETH (Switzerland) in December 2012.


J. Guinness. Upcoming invited presentation, ”Covariances for data on the sphere ” at TIES 2013 Conference in Anchorage, Alaska.

CliMathNet seminar, April 2013, M Scott, upcoming conference talks at IWSM, Palermo, (Miller et al), EMS, Budapest (Scott et al), JSM, Montreal (Lee), TIES, Anchorage (Scott)


Talk title: ”Testing independence of consecutive truncated and censored data”

E. S. Kominiak, 27th International Workshop on Statistical Modelling (Prague, Czech Republic), July 17, 2012.  
Poster title: ”Estimation of the conditional distribution of two censored gap times based on a nonparametric approach”

Talk title: ”Single-index model with censored data: A comparative study”


Laniado,H., Lillo, R.E., Pellerey, F. and Romo, J., 8th World Congress in Probability and Statistics, Portfolio Selection, Portfolio Selection for Elliptically Distributed Assets, Istanbul (Turkey), July
Laniado, H., Lillo, R.E. and Romo, J., International Conference on Computational Statistics (COMPSTAT), Portfolio Selection through an Extremality Order, Limassol, (Cyprus), August 2012.


D. Mondal, Bayesian Computations and Spatial Analysis of Areal-unit Data, ISBA Regional Meeting and International Conference on Bayesian Theory and Applications, Varanasi, January 2013, India.


OTHER INTERACTIONS BETWEEN NODES AND NETWORKS

D. Kim (NCDC) provided 60 years of U.S. climate data (daily precip, temperature) to Prof. Fuentes's
team (NCSU), and engaged in e-mail discussions on algorithmic aspects of extreme value modeling (Dr. Mannshardt, NCSU). He is also engaged in exploratory discussions of Hurricane ensemble forecasting with the Univ. Chicago Node. Dr. Kim is available to facilitate researchers receiving data sets available from the National Climatic Data Center.

**IMPACT**

**What is the impact on the development of the principal discipline(s) of the project?**

*Describe how findings, results, techniques that were developed or extended, or other products from the project made an impact or are likely to make an impact on the base of knowledge, theory, and research and/or pedagogical methods in the principal disciplinary field(s) of the project.*

Dr. Fuentes (NCSU) is working with EPA on determining promising methods for examining exposures to mixtures of compounds in the air pollution setting. Methods for studying spatial-temporal effects of mixed exposures are sorely lacking. This important work will affect risk assessment in the years to come by facilitating comprehensive analyses that investigate combined pollutant exposures rather than looking one-by-one at mixture elements in purported isolation. One of our network research focuses is the development of fusion approaches to combine climate models and observations, as well as chemistry air pollution models and monitoring data, introducing spatial and spatio-temporal up- and downscalers, as well as methods for calibration of deterministic models. Another concern of our work has been on the integral projection models for demography. This work has revealed an inherent problem in current demographic projection, particularly with plant populations. Analyzing individual level data to infer about population level demography need not work well (an example of the ecological fallacy); population level modeling using population level data is required. Moreover, with interest in scaling to larger regions, only population-level data will be available, so models at that scale must be employed. This work is generating discussion in the ecology community. The computational tools being developed at Chicago for applying Gaussian process models to large spatial and spatio-temporal datasets will expand the class of datasets to which statistically efficient estimates can be computed, particularly for ungridded data and for global data.

**What is the impact on other disciplines?**

*Describe how the findings, results, or techniques that were developed or improved, or other products from the project made an impact or are likely to make an impact on other disciplines.*

Geof Givens (CSU) has conducted research with colleagues that may affect several other disciplines. Although the applied problem is rather specialized, the methods they develop are potentially applicable to other wildlife surveys. This is particularly true for their research with estimation of visual detection probabilities from two-perch visual survey of migrating animals with uncertain “capture”, uncertain “recapture”, and uncertain group size. This addresses a common problem that is usually just “assumed away” in standard capture-recapture analyses for fishery and terrestrial applications.

Geof Givens and colleagues conducted research that relates to the “Oceanic Sciences” component of STATMOS in the sense that we study statistical methods for assessment and management of marine resources (whales). In the past year, they have focused on two topics: (1) Estimation of visual detection probabilities from two-perch visual survey of migrating animals with uncertain “capture”, uncertain “recapture”, and uncertain group size, and (2) estimation of whale population abundance combining acoustic data on animal availability, visual count data, and detection probability estimates as above, using a modified Horvitz-Thompson type approach.
The NCSU results on climate change and the impact on human health, in particular the expected increase in mortality due to heat waves, has generated a lot of discussion across disciplines. Dr. Fuentes in 2012 was a member of the ASA Advisory Committee on Climate Change Policy, and she met with members of Senate to present this work.

Peter Guttorp (UW) and colleagues' current work includes propagation of uncertainty for local sea level rise projections based on CMIP5 projections, assessment of streak probabilities for continental US mean monthly temperatures, comparison of CMIP5 historical forcing runs to data, statistical estimation of annual seasons and methods for homogenization of weather data. Among their interesting findings are that the CMIP5 historical ensemble is well calibrated in a distributional sense to data. The Swedish regional climate model RCA3, forced by reanalysis, is well calibrated to observed minimum annual temperatures, but has a puzzling difficulty in producing minimum temperatures near freezing.

Elizabeth Mannshardt (NCSU), Katarina Sucic (NCSU), Frederick Bingham (UNC-W) andMontserrat Fuentes (NCSU) have collaborated efforts on the “Aquarius Project”. Aquarius satellite measurements and ARGO in situ observations are in general spatial and seasonal agreement. Aquarius allows for finer scale investigation of the characteristics of salinity. Quantile-regression shows that weather covariates have different relationships with salinity across the quantiles of salinity, particularly the lower quantile. The methodology explored is certainly applicable to many different scientific questions involving satellite remotely sensed data.

Elizabeth Mannshardt (NCSU), Katarina Sucic (NCSU), Wan Jiao (NCSU), Francesca Dominici (Harvard), H Christopher Frey (NCSU), Brian Reich (NCSU) and Montserrat Fuentes (NCSU) have collaborated on the SHEDS project. Their results indicate that SHEDS-PM provides approximately the same information about the effect of particulate matter on human health effects as CMAQ modeling output or AQS monitoring data. However, SHEDS-PM and CMAQ bring additional information which helps reduce the uncertainty in our estimated risk by approximately half. In addition, SHEDS-PM provides additional power of AQS in detecting a positive effect on relative risk associated with fine particulate matter exposure. SHEDS-PM also provides a metric capable of capturing population variability introduced by possible movement across grid cells, while the CMAQ metric is static.

Elizabeth Mannshardt (NCSU), Katarina Sucic (NCSU), Soumendra Lahiri (NCSU), Ryland Pigg (NCSU), Kristen Foley (EPA), and Montserrat Fuentes (NCSU) worked on a CMAQ-AQS project to help monitor and understand relationships between meteorology and particulate behavior. CMAQ provides a valuable metric for characterizing primary and secondary standards for ozone under different emissions scenarios. SIP states show stronger evidence of ozone reduction due to reductions in NOx emissions. In metropolitan areas, CMAQ is better at capturing the decrease in tail behavior of ozone while in non-metro areas CMAQ is better at capturing median behavior. The meteorological data provides useful information for understanding and describing ozone’s behavior under different meteorological conditions.

In collaboration with University of Miami, University of Florida and NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML), Lian Xie and colleagues are developing a dynamic-statistical down-scaling system for improved prediction of seasonal hurricane activity and more reliable assessment of the impact of climate change on Atlantic hurricane activity. During the summer of 2013, a graduate student, Sofia Montalvo will spend full time collaborating with our collaborating partners at University of Miami and NOAA/AOML to complete her thesis research. The results from this research have been applied to the prediction of Atlantic seasonal hurricane activity, and the prediction has been shared with local and national news outlets. Montserrat Fuentes and Joe Guinness have an ongoing collaboration with researchers in the Department of Soil Science at NC State on a project involving spatial variation of elemental concentration in sand grains. They have been collaborating with two researchers in NC State's Soil
Science department, Dean Hesterberg and Matthew Polizzotto, on a project involving understanding the spatial variation of toxic trace elements on sand grains at very fine scales. Using X-Ray fluorescence and secondary ion mass spectrometry techniques, the researchers have collected spatial fields of elemental concentrations on a sand grain at spatial resolutions as high as 5 micrometers. The primary goal of the project is to develop methods for predicting the amount of Arsenic that will deposit on the sand grain based on the spatial distributions of the other elements present on the grain when it comes into contact with Arsenic. Montserrat Fuentes and Joe Guinness are contributing to the project by developing multivariate spatial random field models that may be used to help understand any spatial correlation present in the data and the complex interactions among the various elements.

Montserrat Fuentes’s statistics group at NCSU is spear-heading as well as consulting on many projects within the STATMOS projects involving a wide-range of environmental topics. Collaboration and discussion is encouraged, and provides a valuable asset and learning environment for researchers of all career stages and scientific disciplines.

At Chicago, the methods we have been developing for analyzing global data provide a way of comparing climate models to each other and to data, in particular, for assessing the realism of climate models for capturing spatial and spatio-temporal dependencies in the actual climate. Since climate models are not in any way tuned to capture these dependencies, these diagnostics provide an important tool for establishing the credibility of climate models. The methods for simulating future climates are critical for integrated assessment models that appropriately account for variability in climate on impacts. Mondal’s research has focused on studies of agronomic trials, climate downscaling, and environmental risk mapping. In addition, the development of the R and Matlab codes under this project has and will help researchers in other disciplines make use of methodologies he has developed. He has already received a few queries via e-mail for codes. The NCDC node is developing a gridded trends and N-year return levels of extreme precipitation, which is based on GEV model.

What is the impact on the development of human resources?

Describe how the project made an impact or is likely to make an impact on human resource development in science, engineering, and technology.

One of the key goals of the network is to develop a core of cross-disciplinary researchers with deep knowledge and understanding both of the statistical and the scientific aspect of research questions. Towards that goal we are organizing workshops, summer schools, and actively encouraging our students and postdocs to visit other nodes to collaborate with statisticians and subject matter scientists on problems of mutual interest.

Colorado State benefited from STATMOS in many ways in 2012-2013. Our graduate students benefited by being granted travel to multiple opportunities throughout the United States that they would have been unable to attend had there been no STATMOS support. This support comes at an important time when grant support is not easily available but it is of vital importance for our students to gain experience at new venues. This resulted in a strong hiring year at CSU with our PhD students gaining employment at top universities across the nation.

Secondly, STATMOS provided the majority of the funding for our Spatial Workshop in April 2012. This workshop was attended by an international group of mostly post-docs and graduate students. It was a terrific way for our young researchers to learn new techniques in statistics and to make connections with other researchers with similar interests. The workshop was located at CSU because of a STATMOS-sponsored trip by one of our graduate students (Erin Schliep) to Norway in 2012. Without that link, CSU would probably not have been included in the Norwegian researchers’ US itinerary. Drs. Rue and Simpson from Norwegian University of Science and Technology taught the short course that the workshop was built around. This is one example of the importance of building the STATMOS network. One graduate student’s STATMOS-supported trip to Norway in
2012 was the key spark that resulted in a conference that was attended by more than 50 people at CSU in 2013.

**What is the impact on information resources that form infrastructure?**

*Describe ways, if any, in which the project made an impact, or is likely to make an impact, on information resources that form infrastructure.*

The project is developing a new electronic journal in which statisticians and biogeoscientists can share ideas and improve communication between these inextricably linked disciplines. Professor Jennifer Hoeting (Colorado State University) and Dr. Michael Werner (Lawrence Berkeley Laboratory) will be the likely initial editors, and professors Michael Stein (U of Chicago), Montse Fuentes (U of North Carolina) and Peter Guttorp (U of Washington) will serve as members of the Advisory Board. Associate editors will be recruited from across a wide range of disciplines, including statistics, mathematics, atmospheric science, oceanic science, and ecology.

We want to create a journal that will be highly visible (like the PLoS journals have become in the US) and widely read across disciplines. The journal publishing environment is currently undergoing dramatic changes (see, for example, the special issue on the future of publishing in *Nature*, March 2013). We are proceeding carefully with the journal establishment in part to see how things are going to develop for the new academic publishing environments. We hope to create a new journal that is freely available online and can exist long after the NSF funding for STATMOS has concluded.

Hoeting is working with three potential publishers for the journal. Wiley is a long-time publisher with a traditional journal set-up. Copernicus publishes the journals of the European Geosciences Union, which are free to the public but requires authors to pay for articles published in their journals. We are also talking to Episciences, an effort towards open-access publications led by mathematician Jean-Pierre Demailly. The idea of Episciences is to build journals by using archives such as ArXiv.

The operation of the journal will be relatively standard, with peer-reviewed articles. Hoeting and Werner have created a list of potential associate editors. They will rely on their extensive network of collaborators and contacts when establishing the initial editorial board. Associate editors will contact reviewers and the review process will be carried out in the manner that is standard for many scientific journals with an emphasis on timely and useful reviews.

The first issue will contain invited submissions from well-known statisticians and scientists from around the world. We will use the new research being done by members of the STATMOS network as key contributors for the first and subsequent issues.

**What is the impact on society beyond science and technology?**

*Describe how results from the project made an impact, or are likely to make an impact, beyond the bounds of science, engineering, and the academic world.*

Our research has continued to grow the possibilities for successful data fusion between environmental exposure data collected at monitoring stations and computer model output for such exposures. Evidence of the impact of this work is the adoption by the Environmental Protection Agency of this methodology, with associated software development, for both historical data assimilation and for real time forecasting of exposure.

The work on future climate simulation could have important impact on our ability to explore the effects of various energy policies, including more realistic estimates of impacts at local scales and more realistic quantification of the uncertainties in impact assessment due to uncertainties in the future climate.

Geof Givens (CSU) participates in the International Whaling Commission Scientific Committee meetings, yielding important statistical input to the policy decisions made by the Commission. The web pages produced by the Statistical Climatology class at the University of Washington illustrate to decision-makers the importance of including variability in their decision-making process. It is the first publically available full assessment of uncertainty in adaptation directed
statistical downscaling of climate variables.

The continuing participation of STATMOS members in Climate Science Day on the Hill helps keeping a statistical perspective in the forefront when considering legislative action on climate issues. The ongoing personal connection with Congress staffers will be beneficial both for society and for the research community.

**CHANGES & PROBLEMS**

The structure of the network grant, in particular the funding intended to have postdocs spend substantial time at more than one node, has been found rather difficult to implement. There are two issues: one is that potential candidates are reluctant to relocate after only a year, and the other that it is difficult to convince the Human Resources divisions at the hubs that it is appropriate to advertise for a position that is neither fully funded nor entirely located at the institution advertising it. The co-PIs are looking forward to discussing potential solutions or alternative mechanisms with NSF.

**ADDITIONAL INFORMATION**

Stefano Castrucio (University of Chicago) has received the 2013 Student Paper Award, First place, ASA section on Statistics and Environment for a paper coauthored with Michael Stein. Ying Sun, currently a STATMOS postdoc at Chicago, will be joining the faculty at OSU in August and will become a STATMOS participant as part of the OSU node.

**Node Visits**

Visit to PIMS node Simon Fraser University 2012-11-02 – 2012-11-03
Guttorp visited Simon Fraser University to talk to students about STATMOS. He gave a departmental seminar entitled *How a Research Paper Can Come About*. In addition he participated in the PIMS Scientific Review Panel proposal review meeting.

Visit to University of Michigan
Michael Stein visited University of Michigan and met with faculty from both Statistics and Biostatistics. He gave an overview of some recent research and heard four presentations, three from graduate students, on work related to STATMOS activities. Presenters included:

Stilian Stoev, Associate Professor, Department of Statistics "Max-stable processes and spatial extremes"
RA Yuen, Ph.D. student, Department of Statistics "Inference for max-stable random fields"
Thomas Brown, Ph.D. student, Department of Statistics "Analyzing Spatial Nonstationarity Through Deformations"

Visit to University of Chicago, 2012-12-03 – 2012-12-04
Alan Gelfand, STATMOS node director at Duke University, visited the University of Chicago for interactions with Michael Stein regarding handling large space and space-time datasets. Gelfand also gave a joint lecture to the Department of Statistics and the Department of Ecology and Evolution entitled *Wildfires in South Africa, Cherry trees in Japan*. An important component of his talk involved the possibility of assessing the effects of climate change on the return time for forest fires and on the first flowering dates for cherry trees. In addition, on Tuesday, Gelfand joined Stein to offer feedback on a collection of six presentations driven by environmental process problems, given by graduate students and postdocs within the Department of Statistics. Speakers and titles include: Ying Sun, New estimating equations for efficient inference in large spatial datasets.
William Leeds, A spectral-based approach to conditional simulation of climate,
Stefano Castruccio, Global space-time models for climate ensembles,
Andrew Poppick, A Joint Model for Temperature and Dew Point,
Michael Horrell, MLE Approximation for Large Spatio-Temporal Datasets,
Somak Dutta, REML computations for spatial linear model based on intrinsic, Matérn dependence with nugget effects.

The visit was highly interactive and quite productive.

Visit to University of Chicago, May 6 2013
Peter Guttorp visited the University of Chicago for interactions with the UC node. He gave a
departmental colloquium entitled The Heat Is On! A Statistical Look at the State of the Climate. He
discussed administrative matters with Michael Stein, interacted with the same graduate students
and postdocs as professor Gelfand, and met with other UC faculty.

Reflections of Network Interactions

Long Trips:

1. **Grant Weller**
   weller@stat.colostate.edu
   Colorado State University
   Travel to: University of Washington
   From: 2013-04-16
   To: 2013-04-25
   Tutor: Peter Guttorp
   peter@stat.washington.edu

1. Briefly summarize the goals of your visit as described in your research plan for the visit.
   My hope was that my visit to UW would introduce my work to researchers there, as well as generate
   possible ideas for future projects. In particular, I hoped to develop potential collaborations with
   Professor Peter Guttorp.

2. To what extent were these goals met? Not met?
   Well met

3. Did your visit lead to your undertaking any new research directions not anticipated in your
   research plan? If so, describe briefly.
   Yes. While I didn’t have any specific research ideas in mind leading up to my visit, Peter Guttorp and
   I discussed a project which incorporates aspects of mutual research interests, and has readily
   available data. Peter presented an idea for a new spatial modeling approach for extreme
   temperatures, and we reached a point where we felt that significant progress can be made on the
   project after my departure.

4. List all people (students/postdocs/faculty) with whom you had significant, substantive
   interactions and the topics you discussed with each.
   Peter Guttorp (faculty) - We discussed the research project described above.
   Paul Sampson (faculty) - He coordinated the space-time modeling working group at which I
   presented a talk in Peter’s absence, and we discussed the research I presented.
   Bailey Fosdick (student) - We had discussions about transitioning from a student into an academic
   position (we are both finishing this spring/summer).
In addition, I presented a talk to Peter Guttorp's informal space-time modeling working group, and several other faculty members and students attended.

5. What were the most positive aspects of your visit?  
The most positive aspect was the generation of a collaboration with Peter Guttorp. Also, I found that visiting an institution other than my own allowed me to be very focused and productive during my visit.

6. In what ways might your visit have been more productive?  
If I were to visit again, I probably make an effort to reach out to more members of the department at UW. The visit was very useful and productive, but I would have liked to meet with more people.

7. Do you plan to undertake further visits to the same or other institutions in the network?  
Yes

8. Any additional comments on your visit?  
Overall, the visit was very useful for me, and will hopefully lead to a research paper and new future collaborations. I am transitioning to an academic position at Carnegie Mellon University, but I am hoping that I will be able to use STATMOS funds for future visits to institutions in the network.

2. Darwin Scott Rinnan  
rinnan@u.washington.edu  
University of Washington  
Travel to: National Center for Atmospheric Research  
From: 2013-05-11  
To: 2013-05-19  
Tutor: Peter Guttorp  
peter@stat.washington.edu

1. Briefly summarize the goals of your visit as described in your research plan for the visit.
I hoped to gain familiarity with plotting and analyzing spatial datasets in R, and learn about packages and functions that are useful in dealing with this type of data.

2. To what extent were these goals met? Not met?  
Well met

3. Did your visit lead to your undertaking any new research directions not anticipated in your research plan? If so, describe briefly.  
My research direction hasn’t changed itself, per se, but the tools I use have. In particular, I plan on incorporating ggplot2 graphics into my work, where previously I was using a combination of the basic plot functions and ArcMap.

4. List all people (students/postdocs/faculty) with whom you had significant, substantive interactions and the topics you discussed with each.  
Homero Flores, Mattia Molinaro, Kira (don’t know her last name) all worked to varying degrees on the data challenge together, and talked about R code a lot. Antonio and I went for a long hike together and talked about all things school, career, and research related.

5. What were the most positive aspects of your visit?  
Getting to see the NCAR Mesa Lab, spending the week with classmates from so many different disciplines and backgrounds, and the breadth of material covered were all positive aspects for me.

6. In what ways might your visit have been more productive?  
I think getting a more comprehensive introduction to ggplot2’s syntax and structure at the very beginning of the week would have been very helpful. I would also like to have seen some material
on how to read shape files in R.

7. Do you plan to undertake further visits to the same or other institutions in the network?
Yes

8. Any additional comments on your visit?
Overall, a very well designed and executed course. I will be recommending it to other students in my program in the future.

Short trips

1. Whitney Huang  
   huang251@purdue.edu  
Purdue University  
Travel to: National Climatic Data Center  
From: 2012-11-13  
To: 2012-11-16  
Mentor: Dongsoo Kim  
dongsoo.kim@noaa.gov  
To communicate with domain experts on spatial extremes in climatology, and to find an interesting data set to work on.

Plan:

Reflection: Visit to National Climatic Data Center, Asheville, NC 11-14-12 to 11-16-12.
Mentor Dr. Dongsoo Kim
Goals: To discuss with NCDC Scientists on the various applications in spatial statistics, and to explore NCDC’s environmental dataset for my Ph.D. work. The goals were well met.

New directions: The Research Scientists I talked with helped me in several ways. First I realized the importance of data quality, especially the “data” we referred to may not correspond to real measurement. It could be a derived data product. In this situation how to combine different sources of information and to quantify the associated uncertainty is crucial. Also there are some practical issues we need to pay attention to, for example the missing data problem. How to carry out the imputation is really depends on the underlying missing mechanism which requires a detailed study. Because climate/weather applications are spatial/temporal in nature. It provides us a great opportunities to explore the spatial/temporal structure in the real world data.

Interactions:
Dr. Dongsoo Kim (discuss several working projects and the statistical issues)  
Dr. Jessica Matthew (discuss uncertainty quantification in terms of climate modeling)  
Dr. Peter Thorne (describe the international surface temperature initiative project)  
Dr. Huai-main Zhang (describe NCDC global surface temperature portfolio management plan and surface flux analysis)  
Dr. Mike Squires (discuss regional snowfall indices)  
Greg Hammer (a wonderful Building Tour of NCDC)

Positive aspects: The NCDC were welcoming and generous with their time, especially the individuals listed above. I really appreciated the opportunity to talk with experts in
climatology.

This could be more productive: Next time I would like to have an long term visit with a specific topic.

Interested in more visits: Yes. It was a great visit. I really appreciated the opportunity to communicate with the people at NCDC and I am looking forward to further collaboration.

2. **Michael Horrell**

   horrell@galton.uchicago.edu

   University of Chicago

   **Travel to:** Duke University

   **From:** 2013-03-17

   **To:** 2013-03-24

   **Mentor:** Alan Gelfand

   alan@stat.duke.edu

   I plan to work with Professor Gelfand on my research on estimation of large spatial models, and I plan to consider different applications for this research.

   **Plan:**

   **Reflection:** I met with Professor Alan Gelfand and two of his students, Thomas Leininger and Dr. Joao Monteiro, at Duke to discuss my current research project on fitting models to large datasets produced by polar-orbiting satellites. Much of what we discussed was about applications of this research and on focusing parts of my current project. I also met with Professor Montserrat Fuentes and Dr. Joe Guinness at NC State. Discussing my research at both locations I felt was very valuable in that I gained experience presenting my research, and I was exposed to outside opinions of what I was producing. I believe my time during this trip will result in possible future collaborations and certainly will help me produce stronger research.

3. **Ying Sun**

   sunwards@galton.uchicago.edu

   University of Chicago

   **Travel to:** Colorado State University

   **From:** 2013-04-09

   **To:** 2013-04-12

   **Mentor:** Jennifer Hoeting

   jah@rams.colostate.edu

   **Plan:** Statistically and Computationally Efficient Estimating Equations for Large Spatial Datasets
Reflection: Good workshop and talks in CSU.

4. **Robert Yuen**

*bobyuen@umich.edu*

University of Michigan

**Travel to:** Colorado State University

**From:** 2013-04-09

**To:** 2013-04-12

**Mentor:** Jennifer Hoeting

*jah@rams.colostate.edu*

Workshop on Spatial Statistics.

**Poster Title:** Statistical inference for max-stable models.

**Plan:**

Reflection: The CSU spatial statistics workshop was exceptional. Three experiences standout. First, the INLA course introduced me to a powerful method for Bayesian computing which I was previously unaware of and there is great potential for the use of INLA in our current work on prediction for spatial extremes. The INLA course also opened my eyes to several possibilities for further research. In particular, max-stable models which are driven by latent Gaussian processes, many of which have been proposed in the literature, have not seen wide-spread use in applications due to computational intractability. It would be of great value if INLA provides some solution to these computational challenges, in which case max-stable models can be better applied to modeling of spatial extremes which is an important area given the tremendous impact of extremes for atmospheric processes. Second, there were excellent topics discussed by the invited speakers which gave me insight into the practical challenges we face when modeling spatial processes. Topics included modeling of land use change, ecological applications, extreme temperature modeling, and high dimensional spatial modeling of variety trials. Nearly all talks introduced me to novel and current state of the art methodology. Lastly, the poster session was an event of tremendous value. In particular, I received many constructive comments about our proposed method for fitting max-stable models, a consistent M-estimator that is applicable in a very general max-stable setting. This was important for us because prior to this event we have had little discourse with the spatial extremes community and without an event like the CSU workshop we would not be able to receive the kind of in-depth, in-person feedback that I got from some of the attendees who are experts in the field. Many of the suggestions I received will greatly improve our work. For instance, while our simulation studies support our theoretical results, we have had trouble interpreting results in real world applications. Suggestions I received from the workshop attendees were very helpful in this regard, such as how one might compare inference across various methods for the same application as well as which applications may be best suited to our method.

5. **Colin Sowder**

*csowder@uw.edu*

University of Washington

**Travel to:** Colorado State University
Reflection: I attended the Short Course on INLA and Workshop on Spatial Statistics at Colorado State on April 10-11. I’d like to thank STATMOS for the opportunity to attend this workshop and briefly touch on the lectures, the focus on graduate students, and the logistics of the workshop.

The lectures themselves were tremendously helpful, and I hope that some of what I learned can give me new ways of thinking about my own research. For background, my previous experience with INLA was limited to knowing it was a fast alternative to MCMC, but I had never attempted to fit any models with the package. The early lectures from Havard Rue provided a nice background on the package, and got me up to speed so I could appreciate the more complicated SPDE material from Daniel Simpson in the second half of the day. The Thursday morning sessions provided nice breadth after an intensive first day.

I think the poster session on Wednesday night along with the general focus on graduate students deserves special mention. This poster session was the most vibrant that I have participated in, and I received interesting feedback both from fellow graduate students and other attendees. Along with the informal graduate student lunch on Thursday, this session helped connect me to the workshop as a participant, not just as a student.

Lastly, all of the logistics associated with the conference were fantastic. From recommending the Green Ride shuttle instead of a rental car from Denver to keeping the sessions on time, everything flowed smoothly. Two days was the perfect amount of time for this workshop; it would have been too much travel for just one day, but I was able to be back in class on Friday morning.

Again, I thank STATMOS for the opportunity to attend this workshop. As I’m at the point in my graduate studies that I transition from classwork to research, this session provided me with a lot to think about as I start exploring spatial statistics.
Simulation of Climate Variables Under Changing Dependence Structures.

Plan:

Reflection:

7. **Brian Reich**  
brian_reich@ncsu.edu  
North Carolina State University  
Travel to: Colorado State University  
From: 2013-04-09  
To: 2013-04-11  
Mentor: Jennifer Hoeting  
jah@rams.colostate.edu  
Plan: I will attend the CSU workshop and present a paper.  
Reflection: I attended the spatial statistics conference at CSU.

8. **Mevin Hooten**  
mevin.hooten@colostate.edu  
Colorado State University  
Travel to: Colorado State University  
From: 2013-04-10  
To: 2013-04-11  
Mentor: Jennifer Hoeting  
jah@rams.colostate.edu  
Plan: presenting invited talk  
Reflection: This was an excellent meeting! It consisted of 2 days with the first being a workshop on INLA and the second being a conference on spatial statistics. The workshop on INLA provided by Rue and Simpson was very informative and gave us all a good feel for where the developers of that software are going with it in the future. The spatial statistics conference on the second day was excellent with several great speakers and a very good audience. There was also a fantastic poster session on the evening of the first day that provided a great opportunity for students and postdocs to interact with faculty and other researchers in a social setting. This is exactly the sort of thing that should be done more often. The local organizers, Jennifer Hoeting and Dan Cooley, did an excellent job putting together this workshop/conference and it was a joy to attend. Looking forward to the
Data depth for multivariate data and their application for robust inference have been studied extensively. However, depth notions for infinite dimensional objects such as functional data have received relatively less attention. They are of practical importance in applications such as temporal climate and atmospheric studies. We develop new notions of functional depth with the objective of using them for simultaneous inference with functional data. Specifically, we use the depth metrics to identify $100(1 - \alpha)%$ percent of the sample functions, which are then used to construct simultaneous confidence bands for the underlying function of interest. These metrics are shown to satisfy desired properties of functional depth and the associated confidence bands have asymptotically correct coverage. An application of the techniques to obtain simultaneous confidence bands in polynomial regression is described.

Position: Student
Department: Statistics
Advisors: Vijay Nair and Xuming He

Reflection: I visited CSU for spatial statistics workshop. I started working on spatial data and was interested in learning about the modern computational issues related to spatial modeling. I learned a great material about INLA and many state of the art spatial modeling methods from talks and poster session. I also presented my previous work on functional data analysis through which I received valuable feedback. My sincere thanks to STATMOS for sponsoring my travel which provided me great exposure and also helped me interact with researches from all over the country.
jah@ramse.colstate.edu

Plan:
Global space-time models for a multi-model ensembles and land/ocean nonstationarities

Reflection:

11. Javier Flores Cervantes
homefc@uw.edu
University of Washington

Travel to: National Center for Atmospheric Research
From: 2013-05-12
To: 2013-05-17
Mentor: Peter Guttorp
peter@stat.washington.edu

Attend the IMAGE STATMOS workshop on Visualization of Climate Data at NCAR to learn methods of data visualization and analysis.
This will contribute to my work on producing hydrologic scenarios for the next 100 years in the pacific northwest using a hydrologic model (VIC) and the latest output of from GCMs.

Plan:

Reflection:

12. Michael Horrell
horrell@galton.uchicago.edu
University of Chicago

Travel to: Colorado State University
From: 2013-04-09
To: 2013-04-11
Mentor: Jennifer Hoeting
jennifer.Hoeting@colostate.edu

I plan to attend the Workshop on Spatial Statistics to learn about INLA, and I plan to present a poster on fast estimation for Gaussian random fields.

Plan:

Reflection:

On the first day, we were introduced to INLA and applications of INLA in latent Gaussian models and GMRF representations of GRFs. A poster session was that evening, and I presented my poster. On the second day there were presentations on several spatial models and applications including extreme value models and animal population tracking. The workshop/conference was small, but its size may have facilitated communication between all who attended. Feedback on my poster and research project was invaluable.
13. **Somak Dutta**  
somakd@uchicago.edu  
University of Chicago

Travel to: Colorado State University  
From: 2013-04-09  
To: 2013-04-12  
Mentor: Jennifer Hoeting  
jah@rams.colostate.edu

Residual likelihood analysis for Gaussian intrinsic approximate Matérn models with nugget effects.

Plan:  
Reflection: I visited the workshop on spatial statistics in Colorado State University to attend the workshop on INLA, present my research work in a poster and listen to talks delivered on various topics related to spatial statistics. Overall it was a very nice experience. I enjoyed the workshop on INLA although I think it could have been a little more technical because the audience was already familiar with spatial statistics. I enjoyed the poster session very much. People were enthusiastic about the research works and it was a nice experience to explain my own research to them. The talks on the second day were very interesting and engrossed the audience. The best part of the conference was its size. I got opportunities to engage in conversation with everyone. Jennifer, Dan and other students of the Stat. dept there were extremely nice and welcoming. I think I learnt a lot about different aspects of Spatial statistics and about the scholars who are working on those topics.

14. **Naveen Naidu Narisetty**  
naveennn@umich.edu  
University of Michigan

Travel to: Colorado State University  
From: 2013-04-09  
To: 2013-04-12  
Mentor: Jennifer Hoeting  
jah@rams.colostate.edu

Data depth for multivariate data and their application for robust inference have been studied extensively. However, depth notions for infinite dimensional objects such as functional data have received relatively less attention. They are of practical importance in applications such as temporal climate and atmospheric studies. We develop new notions
of functional depth with the objective of using them for simultaneous inference with functional data. Specifically, we use the depth metrics to identify $100(1 - \hat{I}_c)$ percent of the sample functions, which are then used to construct simultaneous confidence bands for the underlying function of interest. These metrics are shown to satisfy desired properties of functional depth and the associated confidence bands have asymptotically correct coverage. An application of the techniques to obtain simultaneous confidence bands in polynomial regression is described.

Position: PhD Candidate, Department of Statistics. Advisors: Vijay Nair and Xuming He

Reflection:
I visited the Spatial Statistics workshop at CSU. It was a great experience for me as I learned modern computational techniques for spatial modeling and also got an opportunity to share my work with other researchers during the poster session. I would like to thank STATMOS a lot for providing funding for my visit which opened up new directions for my future work.

15. Debashis Mondal
mondal@galton.uchicago.edu
University of Chicago

Travel to: Colorado State University
From: 2013-04-09
To: 2013-04-14

Mentor: Jennifer Hoeting
jah@rams.colostate.edu
presenting invited talk

Plan:

Reflection: This was an excellent visit. I thought there was a very good poster session where students from different universities interact with themselves. The short course on INLA was interesting, and I also benefited from all the talks in the workshop. Personally, I was great to meet and interact with Jennifer Hoeting, Havard Rue, and Daniel Simpson and learning about their current research on spatial statistics. As far as my research is concerned, I got very positive feedback from Havard Rue. Furthermore, Brian J. Reich from NCSU expressed interest in my work.

16. Joseph Guinness
jsguinne@ncsu.edu
North Carolina State University

Travel to: National Center for Atmospheric Research
From: 2013-07-14
To: 2013-07-19

Mentor: Doug Nychka
Montse Fuentes
I plan to attend and give a talk at the Next Generation Climate Data Products Workshop hosted by NCAR July 15-19. I was contacted by Andrew Finley about the workshop.

Plan:

Reflection:

17. Catherine Calder
calder@stat.osu.edu
Ohio State University
Travel to: Colorado State University
From: 2013-04-09
To: 2013-04-11
Mentor: Hoeting
jah@rams.colostate.edu
presenting invited talk

Plan:

Reflection: I attended the Short Course on INLA and the Workshop on Spatial Statistics at Colorado State University on April 10-11. I enjoyed both the short course and workshop. The short course gave me the opportunity to learn a great deal about INLA and better understand its applicability to fitting spatial statistical models. The settings and allocated time for invited talks on the second day encouraged discussion from the audience. I received very helpful feedback from others on the work I presented on Bayesian regression models for multicategory spatial data both during my talk as well as afterward. In my opinion, the best part of the workshop was the lively poster session held on Wednesday evening. I had a great time talking with the students and junior researchers who presented posters. The quality of the posters and explanations was uniformly high, and I was impressed by the sophistication of the research from a scientific perspective. It was exciting to see how these young researchers value the applicability of their statistical research. I greatly appreciate the support provided by STATMOS for this short course and workshop.

18. Whitney Huang
huang251@purdue.edu
Purdue University
Travel to: Colorado State University
From: 2013-04-09
To: 2013-04-11
Mentor: Dan Cooley
During this STATMOS visit I would like to discuss with Prof. Cooley about modeling spatial extremes via a spatial temporal (marked) point process.

Plan:

Reflection: During this STATMOS visit I have discussed with Prof. Cooley about modeling spatial extremes via a spatial temporal (marked) point process. Prof. Cooley pointed out some critical issues regarding the spatial aspects. We could not really treat those points exceed some threshold in space as a realization of a spatial point process because we could not have a point without observations (i.e. we could not have a point where there is no station). I also met with two of Prof. Cooley’s student, Grant Weller, and Brook Russell and had a brief conversation about the research in extreme. Overall, it is a great experience to visit CSU and I would like to have another not so short visit when I get a more specific idea of modeling spatial extremes.

19. Xieting Zhang
zhangx88@uw.edu
University of Washington
Travel to: National Center for Atmospheric Research
From: 2013-05-12
To: 2013-05-17
Mentor: Peter Guttorp
peter@stat.washington.edu
Application to the IMAGe STATMOS workshop on Visualization of Climate Data in Boulder, Colorado May 13-17 is successful and will be attending it. I plan to learn and master advanced R programming skills in analyzing and presenting climate related data.

Reflection:

20. Colette Smirniotis
csmirniotis@mail.sdsu.edu
San Diego State University
Travel to: National Center for Atmospheric Research
From: 2013-05-12
To: 2013-05-17
Mentor: Peter Guttorp
peter@stat.washington.edu
Plan: I am currently in my first year of the Computational Statistics joint doctoral program at San Diego State University and Claremont Graduate University and have been accepted to attend the IMAGe STATMOS Workshop on Visualization of Climate Data. I am very interested in environmental research, including climatology. I have both experience and familiarity using R software and working with large data sets but would benefit from further formal instruction.

Reflection: The IMAGe STATMOS Course on Visualization of Climate Data at NCAR was very productive and engaging. I now am able to use some impressive R packages of which I was unaware before, including plyr, lubridate, and ggplot2. I have some great tips on handling and manipulating large datasets to make them into easier formats. The maps, times series, and glyph maps are powerful tools I will be able to use in the future. I also especially enjoyed learning to use ggobi as an interactive tool for exploring datasets. Most importantly, this workshop confirmed my aspirations of working in the field of environmental and climatological research.