

The Newsletter of the Statistical and Applied Mathematical Sciences Institute

## Uncertainty Quantification will Certainly Be a Lively Year at SAMSI

During this coming academic year, SAMSI will devote most of its resources to a sole main program on Uncertainty Quantification (UQ). This field is sometimes described as the science of quantitative characterization and reduction of uncertainties in applications. Having its focus on the interface between mathematics, statistics and the disciplinary sciences, UQ is at the heart of SAMSI's mission.

Virtually every field of science, engineering, medicine, and business has come to rely on computational simulation of complex processes. These simulations are made possible by a remarkable growth in computer power along with impressive progress in algorithms. This allows not only a solution to solve larger and larger problems but also to open to simulation previously intractable problems. The reliable utilization of such computer models of processes requires addressing Uncertainty Quantification.

As pointed out by a former US Secretary of Defense, uncertainties come in different flavors: known unknowns versus unknown unknowns, statistical uncertainties versus epistemic uncertainties, inherent stochastic nature of a phenomenon versus our lack of information on it. The SAMSI UQ program will have a main

methodological thread to address this type of issue in the context of computer modeling. More specifically, this side of the program will investigate foundational issues, representation and propagation of uncertainties, data assimilation, inverse



The uncertainty quantification program will focus on four major areas including methodology, climate, engineering/energy and the geosciences. (photo courtesy of NCAR)

problem and calibration and rare events.

Along with the methodological thread, three important and distinct application fields will be considered, namely, (i) climate, (ii) engineering/energy and (iii) geoscience applications. This will render possible the seamless integration into the program of these fields and their corresponding research communities. The area of climate modeling is a quintessential field of application for UQ. In fact, a sizable part of the research done in the quantification of uncertainty in computer models has been driven by the pressing

needs of climate modelers. Analyzing and predicting the behavior of complex systems with multiple length and time scales in behavior, processes and components has become a central activity in engineering fields such as materials, circuits, aeronautics, fusion and fission reactors, nano/MEMS-scale devices. Many problems in geoscience and environmental engineering are described by computationally expensive models. Computational time is arguably the main obstacle to doing rigorous statistical analysis of uncertainty; this calls for new algorithms.

Each of the above threads will have its own opening workshop for a grand total of four, including one on the West Coast! This coming June, we have also teamed up with researchers at Sandia to jointly offer a UQ Summer School in Albuquerque, New Mexico. Finally, SAMSI played a seminal role in the creation of a new Society for Industrial and Applied Mathematics (SIAM) activity group on UQ along with a partner UQ Interest Group within the American Statistical Association (ASA). The first of this group's biennial conference will take place in Raleigh, April 2-4, 2012.

We are excited about this promising multifaceted program and hope you will join us for it.

## From the director...

As we wind down another year of program activities and prepare for next year, it is a pleasure to say a big “thank you” to our staff for all the hard work they do for SAMSI. The winter months saw a lot of frenzied activity as we worked to complete our request to the National Science Foundation for the renewal of our 5-year grant; fortunately that went in on schedule in February and we are eagerly awaiting the reviews. If all goes well, we expect to have a site visit during the Fall and to know the outcome of the process by the end of 2011.

There are also some pending changes in the Directorate. We are delighted to welcome Ilse Ipsen, newly elected as Associate Director representing NC State. Ilse’s term officially begins July 1, but she is already hard at work and making great contributions to our planning process. Deputy Director Pierre Gremaud will continue in that role for another year and then we will seek a new person to fill that role. Unfortunately, we have lost the services of Rick Durrett, who has resigned

as Associate Director representing Duke; we are currently seeking a replacement for that position.

Meanwhile, the two main research programs this year have been continuing at a fast pace. The Analysis of Object Data and the Complex Networks programs have their Transition workshops in June, and we are gearing up for what promises to be a strong year of activities in Uncertainty Quantification. One of the features of this program is the extent of collaboration with national laboratories – it has been one of SAMSI’s objectives for the last few years to pursue such collaborations to expand the scope of our activities. In this program we have program activities at Sandia National Labs and the Lawrence Livermore National Lab, while scientists from the Los Alamos National Lab have been heavily involved in organizing the program.

The subject of climate change has been the focus of some public outreach activities lately. Elsewhere in this newsletter, you will find some information about my own visit to Capitol Hill as part of a

climate change group coordinated by the American Association for the Advancement of Science. Closer to home, I was personally delighted that we were able to host a public lecture by Doug Nychka, head of the Institute for Mathematics Applied to Geosciences at the National Center for Atmospheric Research (NCAR). Apart from having his undergraduate degree from Duke, Doug was formerly a professor at NC State before moving to NCAR, and has been involved in several of SAMSI programs over the years. His talk on “Climate Change: the Past, the Present and Our Future” attracted a sizeable audience to Duke’s Bryan Center, and generated discussion that lasted for more than half an hour at the end of the talk.



## SAMSI Postdoc Profile: Sylvie Tchumtchoua

One of SAMSI’s postdoctoral fellows, Sylvie Tchumtchoua, grew up in Cameroon. She did her undergraduate studies at the National School of Applied Economics in Senegal. She graduated top of her class, majoring in statistics and economics. Her statistics and econometrics professor, Xavier Bry, always encouraged her to pursue a PhD in quantitative methods in the social sciences.

Upon graduation, she went back home and started working as statistician at the National Institute of Statistics. After working for only 2 months, she felt the need to obtain a graduate degree so she applied to universities in Canada. At that time a professor from the University of Connecticut went to Senegal and visited her department and was very impressed by the School. Her department head called her and said there was an opportunity at U. Conn. that she needed to pursue. She was offered an assistantship to get her graduate degree from the University of Connecticut in agricultural economics. She completed a Master’s degree in the program in 2004 and was admitted into the PhD program.

She liked the quantitative aspect of the program but the required statistics classes were not advanced enough so halfway into her PhD program, she decided to take some statistics courses. She took a Bayesian inference class with Dipak Dey, which she enjoyed very much. Dipak encouraged her to get a second PhD in Statistics, which she did, because of the wide applicability of statistics in economics and the social sciences in general.

During her time there, the Statistics Department hosted the New England Statistics Symposium and she remembered seeing Jim Berger speak about SAMSI and the opportunities available for postdocs. She also got to meet some of the postdocs and talked to them about their experience and they told her it was a great place to be. She attended the opening workshop for the Space Time Analysis program and liked the atmosphere of SAMSI so she applied and was accepted.

Sylvie is involved with the brain imaging and hierarchical methods for object data working groups and she is working on flexible models for high dimensional

data with biomedical and social and behavioral science applications. “It’s really been great to see people from different backgrounds get together to work on a particular problem. I’m Bayesian, so I have a certain view of the problem, while others have different views of things. I also really enjoyed meeting some of the top people whose papers I have read. That is really something. You get to sit across the table with them and interact with them. I get to see how they think,” remarked Sylvie.

Next year, Sylvie will be teaching at Duke, but will also be involved with the Uncertainty Quantification program. “I am really enjoying my stay here and I really love Durham,” said Sylvie.



Follow us!

@NISSSAMS



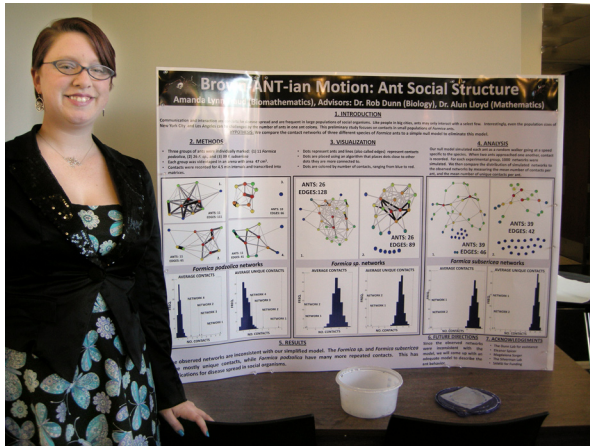
twitter

facebook

LinkedIn

## Graduate Student Poster Session

The SAMSI graduate students shared their work at the SAMSI graduate student poster session and reception held April 13. The research conducted by the students ranged from topics such as “dynamic social networks in a baboon troop,” to “analysis of principal nested spheres,” to “canine activity park networks for studying the spread of infectious disease in domestic dogs.”



Pictured here is Amanda Traud, SAMSI graduate student who is studying at NC State University and her work on “Brown-ANT-ian Motion: Ant Social Structure.”

## Richard Smith Represented Statisticians at Climate Science Day

Richard Smith, director of SAMSI, joined 35 other scientists from various disciplines to participate in the American Association for the Advancement of Science (AAAS) Climate Science Day in Washington DC. The event took place on February 17 and included five statisticians that were nominated by the American Statistical Association (ASA).

The objective behind the event was to have scientists from many disciplines meet with Congressional leaders to emphasize the importance of climate change in the world we all inhabit. For example, sea level rise is a threat to many coastal states including North Carolina; another example is the effect of drought on both human welfare and agriculture. The purpose of the meetings was not to promote a particular view of the causes of climate change, still less to advocate a particular form of policy, but just to remind legislators that the issue is not going away and that it does have real impacts for their constituents.

Statisticians have been involved in climate change research for many years and their inclusion in this event is some recognition of this fact. At SAMSI, climate change research has been a sub-theme of several programs, such as the

2006-07 program on Complex Computer Models, or the 2009-10 program on Space-Time Analysis. During 2011-12, we will again return to this theme as part of the year-long program on Uncertainty Quantification.

The five statisticians chosen by ASA included Richard Smith, Leonard Smith of Oxford University, who was a visitor at SAMSI in 2004-05 for the Data Assimilation for Geothermal Systems; Peter Craigmile of Ohio State University who was a visitor for the Space-Time Analysis for Climate Change program last year; Murali Haran from Penn State, who was a visitor at SAMSI last year also for the Space-Time Analysis for Climate Change program and a former SAMSI postdoc; and Mark Berliner from Ohio State University who has been involved in many past SAMSI programs including Large-Scale Computer Modeling of Environmental Systems in 2003-04, 2004-05 program on Data Assimilation for Geothermal Systems and last year’s Space-Time Analysis for Climate Change program.

# samsi.info

### Directorate:

Richard Smith | Director  
The University of North Carolina at Chapel Hill

Pierre Greaud | Deputy Director  
North Carolina State University

Ilse Ipsen | Associate Director  
North Carolina State University

Alan Karr | Associate Director  
National Institute of Statistical Sciences

### SAMSI Staff:

Gordon Campbell | Operations Director  
campbell at samsi.info

Rita Fortune | Financial Analyst  
rita at samsi.info

Karem Jackson | Workshop Specialist  
kjackson at samsi.info

Katherine Kantner | Webmaster  
kak at niss.org

Deborah Leistikow | Program Assistant  
dcleisti at samsi.info

Cammey Cole Manning | Interdisciplinary Undergraduate Coordinator  
manningc at Meredith.edu

Sue McDonald | Senior Program Coordinator  
sue at samsi.info

Jamie Nunnally | Communications Director  
nunnally at niss.org

Debbie Smith | Program Assistant  
dsmith at samsi.info

James Thomas | Computational Systems  
help at samsi.info

# Calendar of Events for SAMSI

*For more information about SAMSI programs and workshops, visit SAMSI's Web site at <http://www.samsi.info>*

2010-2011 Program on Complex Networks  
**Complex Networks Transition Workshop**  
June 6-7, 2011 at SAMSI

2010-2011 Program on Analysis of Object-Oriented Data  
**Analysis of Object-Oriented Data Transition Workshop**  
June 9-11, 2011 at SAMSI

2011-2012 Program on Uncertainty Quantification  
**SAMSI/SANDIA Summer School on Uncertainty Quantification**  
June 20-24, 2011 at Sandia National Laboratories, Albuquerque, NM

2011-2012 Program on Uncertainty Quantification  
**Opening Workshop & Tutorials - Climate Change**  
August 29 - 31, 2011 in Pleasanton, CA

2011-2012 Program on Uncertainty Quantification  
**Opening Workshop & Tutorials - Methodology**  
September 7-10, 2011 at SAMSI

2011-2012 Program on Uncertainty Quantification  
**Opening Workshop & Tutorials - Engineering & Renewable Energy**  
September 19-21, 2011 at SAMSI

2011-2012 Program on Uncertainty Quantification  
**Opening Workshop & Tutorials - Geosciences**  
September 21-23, 2011 at SAMSI



19 T. W. Alexander Drive  
P.O. Box 14006  
Research Triangle Park, NC 27709-4006