NARCCAP

FOURTH USERS' MEETING

APRIL 10-11, 2012

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

BOULDER COLORADO

NARCCAP

2012 FOURTH USERS' MEETING

APRIL 10-11, 2012

NCAR, Boulder, Colorado

Center Green Laboratory 1, North Auditorium

AGENDA

TUESDAY April 10

08:00	Bus departs Golden Buff for Center Green 1
08:20 – 09:00	Pick up registration materials, badges, cups
09:00 - 09:15	Welcome & Overview of NARCCAP – Linda Mearns, NCAR
09:15 - 10:00	Introduction of Attendees – Toni Rosati, NCAR
10:00 - 10:30	*Break*
10:30 - 12:30	About the RCMs – Representatives from each RCM group will talk for 20 minutes, on features of their RCM and what the group is working on.
	HRM3 – Richard Jones, UK Hadley Centre (presented by TBD) – Effect of NCEP vs. ERA Interim Boundary Conditions on HadRM3
	CRCM – Sébastien Biner, Ouranos – Interannual Variability
	MM5I – Ray Arritt, Iowa State
	WRFG – Ruby Leung, PNNL – The Pineapple Express
	RSM – Ana Nunes, University of Rio de Janeiro (presented by TBD)
	RCM3 – Mark Snyder (remote) – Changes in Model Configuration to better Represent Lakes
12:30 - 13:30	*Lunch (provided)*
13:30 - 14:30	Panel Discussion with Regional Climate Modelers
14:30 - 15:00	*Data Issues, Archiving and Related Topics* – Seth McGinnis, NCAR
15:00 - 15:30	*Overview of Phase I Results* – Bill Gutowski, Iowa State
15:30 - 16:00	*Break*
16:00 - 16:30	*Overview of Climate Change Results* – Linda Mearns, NCAR
16:30 - 17:00	*Towards Establishing the Credibility of the NARCCAP RCMs for the North American Monsoon* - Melissa Bukovsky, NCAR
17:00 - 17:30	Meeting adjourns – Transportation to Mesa Lab
17:30 - 19:30	Poster Session (drinks, hors d'oeuvres), Mesa Laboratory Cafeteria
19:30 - 21:00	Dinner + poster session (cont'd)
21:00 - 21:30	Bus back to Golden Buff and Marriott Residence Inn

WEDNESDAY April 11

08:15 Bus departs Best Western Golden Buff for Center Green 1

09:00 – 09:30 *Quantifying Uncertainty – New Results* – Steve Sain, NCAR

09:30 - 10:30 Invited talks (20 minutes each)

- 09:30 - 09:50 *Changes in Winter Precipitation Extremes for the Western United States* - Francina Dominguez, University of Arizona
- 09:50 - 10:10 *Downscaling of Precipitation Extremes* - Kelly Mahoney, NOAA
- 10:10 - 10:30 *Surface Wind Speed Simulations in the NARCCAP Models* - Gene Takle, Iowa State

10:30 - 11:00 *Break*

11:00 - 11:30 Topic Pods

- Introduction – Toni Rosati and Seth McGinnis
- Wind – Gene Takle
- Extremes – Bill Gutowski
- Further Downscaling – Melissa Bukovsky
- Discussion of forming Impacts Pod

11:30 - 14:45 Participants Presentations (15 minutes each) - Lunch from 12:30 to 13:30

- 11:30 - 11:45 *Analyzing Global Warming on Linear Infrastructure using NARCCAP Data Sets: A Case Study in the Northeastern U.S.* - Jennifer Jacobs, University of New Hampshire
- 11:45 - 12:00 *Analysis of NARCCAP Results for Extremes in the Canadian Columbia Basin* - Stephen Sobie, PCIC
- 12:00 - 12:15 *Projecting Future Changes in U.S. Forest Fuel and Fire Conditions using NARCCAP Regional Climate Change Scenarios* - Yongqiang Liu, Forest Service
- 12:15 - 12:30 *Interannual Variability of Surface Temperature and Precipitation using Regional Modeling Over Western North America* - John Mejia, Desert Research Institute
- 13:30 - 13:45 *Environment, and Sustainable Communities, Development of Climate Change Projections for Prairie Hydrological and Water Quality Modeling* - Hua Zhang, Inst. for Energy
- 13:45 - 14:00 *An Investigation of the Pineapple Express Phenomenon via Bivariate Extreme Value Theory* - Grant Weller, Colorado State University
- 14:00 - 14:15 *Evaluation of Monthly Temperature and Precipitation using the JPL Regional Climate Model Evaluation System* - Jinwon Kim, UCLA
- 14:15 - 14:30 *High Resolution Extreme Temperature Scenarios over North America* - Guilong Li, Environment Canada

14:30 - 15:00 Final Wrap Up/Discussion – Future of NARCCAP - Linda Mearns

15:00 Meeting Adjourns

15:15 Bus back to Best Western Golden Buff

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PI AND TEAM MEMBERS

Linda Mearns	●
Sébastien Biner	●
Melissa Bukovksy	●
Daniel Caya	○
Philip Duffy	○
William Gutowski	●
Isaac Held	○
Richard Jones	○
Ruby Leung	●
Larry McDaniel	●
Seth McGinnis	●
Don Middleton	○
Ana Nunes	●
John Roads	○
Stephan Sain	●
Lisa Sloan	○
Mark Snyder	○
Eugene Takle	●
Toni Rosati, Student Assistant	●
Joshua Thompson, Student Assistant	●

● Attending

PI AND TEAM MEMBER BIOGRAPHICAL SKETCHES

LINDA O MEARNS, NCAR

Linda O. Mearns is Director of the Weather and Climate Impacts Assessment Science Program (WCIASP) and Section Head of RISC within the Institute for Mathematics Applied to Geosciences and Senior Scientist at the National Center for Atmospheric Research, Boulder, Colorado. She served as Director of the Institute for the Study of Society and Environment (ISSE) for three years ending in April 2008. She holds a Ph.D. in Geography/Climatology from UCLA. She has performed research and published mainly in the areas of climate change scenario formation, quantifying uncertainties, and climate change impacts on agro-ecosystems. She has particularly worked extensively with regional climate models. She has published papers on the effect of uncertainty in climate change scenarios on agricultural and economic impacts of climate change, and quantifying uncertainty of regional climate change. She has been an author in the IPCC Climate Change 1995, 2001, and 2007 Assessments regarding climate variability, impacts of climate change on agriculture, regional projections of climate change, climate scenarios, and uncertainty in future projections of climate change. For the 2013 IPCC Reports she is a lead author of the Working Group 2 Chapter on Regional Context. She leads the multi-agency supported North American Regional Climate Change Assessment Program (NARCCAP), which is providing multiple high-resolution climate change scenarios for the North American impacts community. She was a member of the National Research Council Climate Research Committee (CRC) and Human Dimensions of Global Change (HDGC) Committee, and the NAS Panel on Adaptation as part of the America's Climate Choices Program. She is currently on the NAS Panel on Advancing Climate Modelling. She was made a Fellow of the American Meteorological Society in January 2006.

SÉBASTIEN BINER, OURANOS

Sebastien Biner is a climate simulation specialist for the Ouranos Consortium in Montreal, Canada. As such, he contributes to the production, analysis and improvement of the regional climate simulations used by Ouranos users and partners. Scientifically, he is particularly interested in studies related to the internal variability, added value and uncertainties of Regional Climate Models. He is also strongly involved in maintaining and improving the operational infrastructure at Ouranos and in the distribution of climate simulation data. Sebastien is co-supervising graduate students and supervising interns. He has a M.Sc in atmospheric sciences and a B.Sc in physics from the University du Quebec, Montreal. Sebastien is a father of three and a ski and cycling enthusiast.

MELISSA S. BUKOVSKY, NCAR

Melissa Bukovsky is a project scientist in IMAGe at NCAR working directly with the North American Regional Climate Change Assessment Program (NARCCAP). Her research revolves around regional climate model credibility and diagnostics. Melissa is interested in determining how credible regional climate model simulations and projections are via process-based weather and climate analysis. She is also interested in the impact of model bias/error and its propagation from present-day to future climate simulations. Current focus areas include central U.S. warm-season precipitation and the North American Monsoon.

She is also working to further downscale select NARCCAP simulations to 10-km over western North America.

DANIEL CAYA

Daniel Caya holds a degree in Atmospheric Science from UQAM, and began his career as a consultant in meteorology and atmospheric science with a private firm. After earning his PhD in Environmental Science from UQAM, he headed the Canadian Regional Climate Modelling Network from 1997 to 2001. In 2001, Ouranos appointed him to plan, develop and manage the Canadian climate modeling program. Since then he has been directing the Climate Simulation group, in charge of developing and producing regional climate projections for Canadian scientists. Mr. Caya is also an associate professor at the regional climate study and modeling centre (ESCER) at UQÀM, at INRS-ETE and at ISMER (UQAR). He remains very involved in training highly skilled staff to maintain Canadian expertise in regional climate simulation.

PHILIP DUFFY, OSTP

Dr. Duffy is a senior policy analyst with the Office of Science and Technology Policy . Previously he had joined Climate Central as the Scientific Director of the Palo Alto Office and Senior Research Scientist. He worked at the Lawrence Livermore National Laboratory, where he was a physicist for 22 years. He is the founder and director of the University of California Institute for Research on Climate Change and its Societal Impacts, and an Adjunct Associate Professor at UC Merced. Dr. Duffy has a A.B. degree from Harvard in Astrophysics, and a Ph.D. from Stanford in Applied Physics. Dr. Duffy is a member of the Nobel-honored Intergovernmental Panel on Climate Change (IPCC). He has published over 50 peer-reviewed papers on many aspects of climate science. His recent work has focused on increasing the spatial resolution of climate projections, to make them more suitable for assessing potential societal impacts of climate change.

WILLIAM GUTOWSKI, IOWA STATE UNIVERSITY

William J. Gutowski, Jr. is Professor of Atmospheric Science in the Department of Geological and Atmospheric Sciences at Iowa State University. His research concentrates on the role of atmospheric dynamics in climate with a focus on the dynamics of the hydrologic cycle and regional climate. Dr. Gutowski's research program entails a variety of modeling and data analysis approaches to capture the necessary spatial and temporal scales of these dynamics and involves working through the Regional Climate Modeling Laboratory at Iowa State University. His work also includes regional modeling of Arctic, African, and East Asian climates, in which he collaborates with scientists from these regions.

Dr. Gutowski currently serves as an Editor for the Journal of Hydrometeorology. He was a Lead Author for two U.S. Climate Change Science Program reports (CCSP 3-1, Climate Models: An Assessment of Strengths and Limitations; CCSP 3-3, Weather and Climate Extremes in a Changing Climate) and a contributing author to the IPCC Third and Fourth Assessment Reports. In addition, he was a member of the U.S. National Academy/Transportation Research Board panel to study the impacts of climate change on transportation. Dr. Gutowski received a Ph.D. degree in meteorology from the Massachusetts Institute of Technology and a Bachelor of Science degree in astronomy and physics from Yale University.

ISAAC HELD, NOAA

Dr. Isaac Held is a Senior Research Scientist at NOAA's Geophysical Fluid Dynamics Laboratory, where he conducts research on climate dynamics and climate modeling, and is head of the Weather and Atmospheric Dynamics Group. He is also a lecturer with rank of Professor at Princeton University, in its Atmospheric and Oceanic Sciences Program, and is an Associate Faculty member in Princeton's Applied and Computational Mathematics Program and in the Princeton Environmental Institute. Dr. Held is a Fellow of the American Meteorological Society (1991) and the American Geophysical Union (1995), and a member of the National Academy of Sciences (2003). He recently received the AMS Carl Gustav Rossby Gold Medal (2008). He was a lead author of Ch.11 of the WG1 AR4 report on regional projections. He is particularly interested in the connections between planetary scale aspects of climatic responses and regional issues. He has coordinated the contribution of GFDL to NARCCAP, working with Bruce Wyman both to provide time-resolution output from GFDL's AR4 model (CM2.1) for downscaling and to provide data over North America from a time slice simulation with a ~50km version of AM2.1, the atmospheric component of the GFDL model.

RICHARD JONES, HADLEY CENTRE FOR CLIMATE CHANGE RESEARCH, UK

Richard Jones is manager of regional predictions at the Meteorological Office Hadley Centre. His main responsibilities are to provide state of the art regional climate modeling systems and to provide and analyze regional climate change scenarios and advice on these as required under contracts for various UK government departments and international bodies. He developed regional climate modeling in the Hadley Centre involving development of a consistent GCM/RCM modeling system; domain-size experiments; climate simulations driven by numerical weather prediction analyses; multi-decade regional climate change experiments; development of GCMs to provide high quality boundary conditions for RCMs; ensemble regional climate change experiments. He is a lead or major contributing author to many publications in regional climate modeling and was a lead author of the IPCC Assessment Reports Three and Four. He led the development of the regional climate modeling system PRECIS, has worked with many European institutes and is currently working with institutes across all continents in the fields of climate prediction and climate scenario development and application. In the NARCCAP project he is responsible for providing boundary conditions from Hadley Centre global climate model projections for downscaling by NARCCAP RCMs, for downscaling the GCMs used in NARCCAP with PRECIS and assisting with interpretation of the model projections.

RUBY LEUNG, PNNL

Ruby Leung is a Laboratory Fellow at the Pacific Northwest National Laboratory (PNNL) and an Affiliate Scientist at the National Center for Atmospheric Research. She received her MS and Ph.D. in Atmospheric Science from the Texas A&M University in 1988 and 1991. She has performed much of her research using regional climate models since the early 1990s when she developed a regional climate model with special features that account for the subgrid scale effects of topography, lake and vegetation. Her model enables the coupling of climate and hydrologic processes in regions with complex orography. Since then Dr. Leung has led several projects to examine the impacts of climate variability and change and the effects of aerosols on the regional hydrological cycle. In 2001, Dr. Leung organized the Workshop on “Regional Climate Research: Needs and Opportunities” co-sponsored by the National Science Foundation and Department of Energy to examine various approaches to modeling regional climate. In 2005, she organized the Workshop on “Research Needs and Directions of Regional Climate Modeling Using WRF and CCSM”. The workshop identified the needs to develop capability for high resolution modeling, regional earth system modeling and up scaling. More recently, she is leading an effort to use a hierarchical evaluation approach to assess global high resolution, global variable resolution, and regional climate models for modeling climate at the regional scale. She is a member of the NRC study committee on “A National Strategy for Advancing Climate Modeling”. Dr. Leung is a fellow of the American Association for the Advancement of Science and American Meteorological Society.

LARRY MCDANIEL, NCAR

Larry McDaniel is a Software Engineer in IMAGE. His interests center around climate variability and climate impacts. He prepares data sets (observed and model output) for use in agricultural models, heat wave studies as well as other projects. He writes code to analyze and validate model output with observed data sets.

SETH MCGINNIS, NCAR

Seth McGinnis has worked as an Associate Scientist at NCAR since 2003, shortly after he received his Ph.D. in geophysics from CU-Boulder. He has a strong background in computer programming and works on a variety of projects related to making atmospheric science data accessible and usable to end-users of all types. He is the Data Manager for NARCCAP: assisted by Josh Thompson, he quality checks the model data, checking for errors and ensuring that it meets formatting and metadata standards, and then publishes the data via ESG. He also works with Larry McDaniel to develop and automate the creation of derived data products and visualizations, and with Toni Rosati to support the NARCCAP user community. His research has lately focused on spatial interpolation of climate data.

DON MIDDLETON, NCAR

Don E. Middleton leads the Visualization and Enabling Technologies Section in NCAR's Computational and Information Systems Laboratory. He is responsible for developing and managing an emerging technologies program that encompasses data and knowledge management, analysis and visualization, collaborative visual computing environments, Grid computing, digital preservation, and education and outreach activities. Don's professional interests center on the frontiers of managing, preserving, and analyzing large, complex earth system datasets and communication using advanced visual technologies. Don is currently serving in a PI or co-PI capacity on a number of projects, including: the Earth System Grid, the Earth System Curator, the Virtual Solar Terrestrial Observatory, the North American Regional Climate Change Assessment Program, the Cooperative Arctic Data and Information Service, and NCAR's Cyberinfrastructure Strategic Initiative. Don recently completed a term on a National Research Council committee for NEES/NEESGrid and Earthquake Engineering and was a contributing author for the new publication, The Visualization Handbook.

ANA NUNES, FEDERAL UNIVERSITY OF RIO DE JANEIRO

Ana Nunes is a professor in the Department of Meteorology within the Institute of Geosciences at the Federal University of Rio de Janeiro, Rio de Janeiro, Brazil. Currently, she is one of the leading members of a research team working on the development of a System for Environmental Risk and Disaster Assessment. As part of this research topic a Reconstruction of South American Hydroclimate is planned. Dr. Ana Nunes was a weather/climate modeler at the Experimental Climate Prediction Center (ECPC) at the Scripps Institution of Oceanography. Formerly, she worked with the Modeling Development Division of the Center of Weather Prediction and Climate Studies at the National Institute for Space Research in Brazil, which is considered one of the most prestigious scientific institutions in South America. One of the subjects of her research is improving our understanding of atmospheric dynamics, and dynamical downscaling in particular, via the assimilation of precipitation, as well as the applications of precipitation assimilation to water cycle modeling.

Dr. Nunes is a member of the NARCCAP team, and in charge of the ECPC-Regional Spectral Model (RSM) participation in this program.

JOHN ROADS, SCRIPPS INSTITUTION OF OCEANOGRAPHY

Dr. John Roads was a Senior Scripps Research Meteorologist, Sr. Lecturer and Director of the Experimental Climate Prediction Center (ECPC) at the Scripps Institution of Oceanography, University of California, San Diego. He was also the co-chair of the Global Energy and Water-cycle Experiment (GEWEX) Coordinated Energy and water-cycle Project (CEOP). Dr. Roads was a previous chair of the National Centers for Environmental Research (NCEP) Regional Reanalysis Scientific Advisory Committee, several international Regional Spectral Model workshops, and the National Research Council GEWEX committee. He had also been a Principal Investigator on many NOAA, NASA, USFS; and other US agency grants. He was a Fellow of the AMS and has published more than 140 refereed articles.

Dr. Roads was the ECPC principal investigator in charge of contributing the Regional Spectral Model (RSM) simulations to NARCCAP. Dr. Ana Nunes now serves in this capacity.

Dr. John Roads died in June, 2008.

STEPHAN R. SAIN

Stephan R. Sain is the head of the Geophysical Statistics Project in the Institute for Mathematics Applied to Geosciences at the National Center for Atmospheric Research. He received undergraduate degrees in mathematical sciences and statistics as well as a masters and PhD in statistics from Rice University in Houston, TX. His research focuses on developing statistical methodology for analyzing the complex, multivariate data that are typical in the geosciences. His current work centers around the analysis of regional climate model output, the assessment of the impact of climate change, and the design and analysis of computer experiments. These projects bring together a broad range of statistical areas: spatial and spatial-temporal methods, hierarchical models, statistical computing, and methods for analyzing extremes. As a NARCCAP co-Pi, he is responsible for the development of statistical methodology to assess and quantify uncertainties in the NARCCAP regional climate model ensemble.

LISA SLOAN, UNIVERSITY OF CALIFORNIA AT SANTA CRUZ

Lisa Sloan is a Professor of Earth and Planetary Sciences and the Director of the Climate Change and Impacts Laboratory the University of California Santa Cruz (UCSC). She is also the Vice Provost and Dean of Graduate Studies at UCSC. Sloan received her B.S. from Allegheny College and her Ph.D. from Pennsylvania State University, and did postdoctoral work at the University of Michigan. Sloan joined the faculty at UCSC in 1995. Sloan has been the National Secretary of the American Geophysical Union's Ocean Sciences Section, a scientific Fellow of the David and Lucile Packard Foundation, Editor-in-Chief of the international journal Global and Planetary Change, editor of the international journal Paleoceanography, and has co-chaired the National Center for Atmospheric Research's Paleoclimate Working Group. She has served and continues to serve on and many national scientific advisory boards that deal with past and future climate change as well as scientific computing challenges. Sloan's research is concentrated in two broad areas: (1) understanding the mechanisms of climate changes in the geologic past and (2) studying and modeling future climate change at regional scales and investigating the possible impacts of future climate change on human and natural systems. She has authored or coauthored more than 60 peer-reviewed articles and book chapters, and is a frequent public speaker in California on issues of climate change.

EUGENE S. TAKLE

Eugene S. Takle is professor of Atmospheric Sciences and Agricultural Meteorology at Iowa State University. Eugene's current climate-related research includes both basic research on climate change and impacts of climate change. Basic research centers on how the features of the earth surface influence turbulent flow and exchange processes that influence surface momentum, energy, and moisture fluxes. Research on climate-change impacts includes assessing the interactive roles of climate and land-manager choices on land-use/land-cover change in agricultural area, development and evaluation of downscaling tools for near-surface flow and impacts of climate change on wind power, evaluating effects of climate changes on Midwest agroecosystems using a climate-crop coupled model, and assessment of variability and trends in Iowa climate data on pavement performance by use of a mechanistic-empirical pavement design model. The land-use/land-cover project uses SWAT (Soil and Water Assessment Tool) to simulate stream flow in large complex watersheds in agricultural areas under current and future scenario climates. Changes in surface wind speed and wind power over the 20th and 21st Centuries are explored through use of statistical downscaling and regional climate models. By coupling crop models with regional climate models we explore the impact of crop selection on carbon uptake and evapotranspiration over the Midwest during the growing season. Roadways in Iowa have been designed under assumptions of average climate conditions that do not reflect actual climate variability or future climate change. Working with civil engineers we are using a standard pavement design model to explore expected changes in various roadway failure modes under actual variability and projected trends in climate over the next 60 years.

Eugene's role in NARCCAP is as part of the ISU team organizing and analyzing the reanalysis-driven runs and contributing to the scenario-driven runs. A central focus is promoting appropriate and effective use of regional climate model information in impacts studies.

TONI ROSATI, NCAR

Toni Rosati is an Environment and Society graduate student at the University of Colorado, Denver studying hazard education mitigation efforts.

JOSH THOMPSON, NCAR

Josh Thompson is a student assistant in NARCCAP, assisting with quality checking and data preparation. His research interests include climate change impacts on tropical storms and snow/ice cover.

USERS BIOGRAPHICAL SKETCH

MIGUEL ARANGO, Kansas State University

Miguel Arango is a PhD student in the department of Agronomy at Kansas State University. He has been very interested in climate change topics throughout his PhD studies. One of his objectives is to understand the interactions among soils and plants and their relationship with environmental issues. Miguel Arango is studying greenhouse gases emissions especially Nitrous Oxide which is one of the most important greenhouse gas produced by agricultural systems. He is looking at different tillage systems and nitrogen management that reduced the emissions. His final objective is focused in the developing strategies to decrease the emissions of Nitrous Oxide by experimental and theoretical methods.

MARC BALDO , Riverside Technology, Inc.

Marc Baldo is a Water Resources Engineer specializing in modeling climate change, reservoir modeling and water supply modeling for Riverside Technology, inc. (Riverside). He has experience in computer based water accounting, water rights modeling, and application of hydrology models supporting climate change analysis.

Riverside's primary interest in NARCCAP data is to provide short-term storm data to drive NOAA models of snow accumulation and rainfall runoff. Current research includes the web-based Climate Change Decision Support System which enables water managers to assess the impact of projected climate change scenarios.

Marc is interested application of climate data to rainfall/runoff models for water supply planning.

CARLOS CARRILLO, The University of Arizona

Carlos Carrillo is a PhD graduate student interested in the climate variability of the North American Monsoon rainfall regimen.

SOYEE CHIU, Columbia University

Soyee Chiu is a programmer/analyst at the Center for Climate Systems Research, part of Columbia University's Earth Institute. She is responsible for processing and analyzing climate model data to make long-term climate projections that are specifically designed to be utilized within climate change adaptation strategies. Soyee has worked on the Agricultural Model Intercomparison and Improvement Project (AgMIP). Prior to joining the Center for Climate Systems Research, Soyee received her M.A. in Climate and Society from Columbia University, and also holds a B.S.E. in Atmospheric, Oceanic, and Space Sciences with a concentration in Meteorology and a minor in Mathematics from the University of Michigan.

Soyee Chiu's interests include analyzing climate model data to make long-term climate projections that are specifically designed to be utilized within climate change adaptation strategies in the urban and agricultural sectors.

LESLIE LYONS DUNCAN, Vanderbilt Institute for Energy and Environment

Leslie Lyons Duncan received her undergraduate degrees in Mathematics and Geosciences from Murray State University in 2006. Avid for undergraduate experience in academic inquiry, she explored the effects of large-scale climate variations on streamflow response and analyzed technology availability and adoption in the state of Kentucky. After graduation she worked as a research and GIS analyst for Connected Nation to develop research that promoted technology expansion and adoption across the nation. Then, in 2009, she began the Ph.D. program in Environmental Engineering at Vanderbilt University as a fellow of the Vanderbilt Institute for Energy and Environment, receiving her M.S. in Environmental Engineering in 2011. Her current research focuses on the interactions between subsurface, surface, and meteoric water at multiple spatial and temporal scales.

JORGE GONZALEZ, City College of New York

Dr. Gonzalez earned his Doctorate (1994) and Bachelor (1988) degrees in Mechanical Engineering from the Georgia Institute of Technology and from the University of Puerto Rico-Mayaguez, respectively. Currently, he is the NOAA CREST professor of Mechanical Engineering and Director of the Graduate Initiative on Earth Systems and Environmental Sustainability at The City College of New York (CCNY). He joined CCNY faculty in 2008 after tenures at Santa Clara University, California, as Professor and David Packard Scholar, and as Chairman and Professor of Mechanical Engineering at the University of Puerto Rico-Mayaguez. He teaches and conducts research in renewable energy, climate change, climate modeling, urban remote sensing and low energy buildings. Professor Gonzalez research has produced more than 50 peer-reviewed articles, four patents in building integrated and solar energy technologies, and in aerosol detection, and more than $20M in external research funding. He was recognized as a prominent young researcher by the National Science Foundation in 1997 with a prestigious CAREER Award, and received the 1999 Outstanding Mechanical Engineering Faculty Award at the University of Puerto Rico-Mayaguez (UPRM). He is a Fellow Member of the American Society of Mechanical Engineering, and Member of the American Meteorological Society and of the International Association of Urban Climate.

He is interested in climate and energy nexus, analysis and modeling of urban climate and weather, environmental sustainability.

JENNIFER JACOBS, University of New Hampshire

Jennifer Jacobs is a Professor in the Department of Civil Engineering at the University of New Hampshire. She has worked as a water resources faculty member since 1997. After her first faculty position at the University of Florida, she returned to her native New Hampshire to teach the next generation of NH's engineers about water and climate. Her recent research projects include interdisciplinary infrastructure engineering and climate change, the characterization of New England coldwater streams and the application of satellite remote sensing to global analysis of long-term trends in snowmelt flooding.

Jennifer received a Ph.D. in Civil and Environmental Engineering from Cornell University, a Masters in Civil Engineering from Tufts University, and a Bachelors degree in Electrical Engineering from Brown University. Jennifer is a prolific cyclist and she and Tide, her award winning German wirehaired pointer, are a feature attraction on Portsmouth NH's horse-drawn carriage tour.

She is interested in infrastructure and riverine systems performance under a nonstationarity climate.

JINWON KIM, UCLA

Researcher at the UCLA Joint Institute for Regional Earth System Science and Engineering. Jinwon Kim's major interests are in regional climate modeling, model evaluation, link of regional climate model data to impact assessment models, with particular emphasis on streamflow, water resources, and agriculture and ecosystems.

GUILONG LI, Environment Canada

Guilong Li is a climatologist in Environment Canada. His research interests are climate change impact and adaptation at regional scale. His focus is on extreme temperature and precipitation changes, and their impacts in Canada, such as heat wave, heavy rainfall etc.

NARCCAP data provide high resolution outputs for his study. Guilong Li's current project is trying to analyze high resolution extreme temperature changes and their uncertainties in North America. Extreme value model has been used to construct probabilistic projections of high resolution extreme temperature over North America.

YONGQIANG LIU, USDA Forest Service

Yongqiang Liu is a Research Meteorologist and Team Leader of the Atmospheric Science Team, Center for Forest Disturbance Science, USDA Forest Service. His research is focused on climate-forest ecosystem interactions, which is aimed at understanding forest disturbances (wildfire, land cover change, forest water stress, etc.), their interactions with climate variability and climate change, and the environmental consequences. The research is expected to help strategy development and implementation to reduce forest vulnerability to forest disturbances and their adverse environmental impacts.

PATRICK LYNCH , NOAA NMFS Northeast Fisheries Science Center

Patrick Lynch is currently working as a postdoctoral researcher, studying river herring population dynamics as related to climate variability.

He is interested in sustainable fishing practices and holistic ecosystem approaches to marine resource management. To support these objectives, my research focuses on the general topics of fish population dynamics, stock assessment, fish distributions, ecological relationships, and environmental influences on these processes.

KELLY MAHONEY, CIRES/University of Colorado/NOAA-ESRL

Kelly Mahoney is CIRES Research Scientist working at NOAA ESRL on dynamical downscaling of warm season extreme precipitation events in the Front Range of the Rocky Mountains. She is using NARCCAP data as initial conditions to high-resolution (1-km) model runs of extreme precipitation events. Results are intended to benefit water managers and related stakeholders by clarifying how maximum precipitation thresholds and other extreme event criteria may evolve in the face of a changing climate in the western U.S.

Kelly graduated in 2009 from North Carolina State University where she earned a B.S., M.S. and PhD in Atmospheric Science. While at N.C. State, she worked on a number of collaborative research projects with the National Weather Service, focusing on topics such as quantitative precipitation forecasting and numerical forecast model representation of severe thunderstorms. Her dissertation work focused on model representation of convective momentum transport, with a larger goal of improving forecasts of organized, warm-season convective systems and the prediction of damaging surface winds. Kelly was a UCAR-PACE postdoctoral fellow, and through her new appointment with CIRES is also currently working on extreme precipitation forecasting on shorter time scales across other regions of the US.

JOHN MEJIA, Desert Research Institute

John Mejia's research interest is focused on the implementation and development of statistical and dynamical based downscaling techniques using Global Clime Modeling products into space scales relevant for regional and local impact studies. His special emphasis has been to create the framework and to explore and explain future climate change signals in Nevada and SW U.S intermountain region. Other research interest include: efforts to quantify and reduce uncertainty within and across models in order to increase the accuracy of regional and local climate projections; provide fine-resolution climate predictions on regional and subregional scales, including assessment of confidence and variables of most relevance for the other disciplines; provide and disseminate climate information that is more relevant to adaptation and policymakers; promote guidance and information in plain English associated with climate models, downscaling methods and resulting data; and continue integration of research with education component via students and teaching and training.

DEBRA PERRONE, Vanderbilt Institute for Energy and Environment

Debra Perrone received her undergraduate degree in Civil & Environmental Engineering from Lafayette College in 2008. An active member of Lafayette's Engineers Without Borders chapter, she worked on water projects in rural Honduras. After graduation she began the Ph.D. program in Environmental Engineering at Vanderbilt University and has been a fellow of Vanderbilt Institute for Energy and Environment for the past 3 years. In 2011, she was awarded an Environmental Protection Agency STAR fellowship for her research on the water-energy-food nexus.

Debra Perrone is currently working on exploring the spatio-temporal dimensions of U.S. water, energy, and food resources.

RUBEN PICON-FELICIANO, City College of New York

Ruben Picon-Feliciano is native from Arecibo, Puerto Rico. Since a child he worked in professional photography with his father. He then became a professional photographer. Another of his dreams was to pursue a Mechanical Engineering degree. Currently, he holds a BS and an ME in mechanical engineering from the University of Puerto Rico at Mayaguez (UPRM). During his undergraduate and graduate years, he worked on mathematical modeling to predict the heat transfer thru aluminum 6101-T6 open-cell metal foam samples under the supervision of Dr. Nihad Dukhan. Later on in his master years, he worked on the development of a Direct Numerical Simulation (DNS) FORTRAN code for homogeneous isotropic turbulence applied to two-phase turbulent flows in real and spectral space under the supervision of Dr. Vikram Pandya. He also worked as a Heat Transfer and Secondary Flow Engineer at Infotech Aerospace Services Pratt & Whitney Joint Venture. Having the experience of working in the industry and holding a master degree inspires him to move forward in the PhD path. He learned about the ESES Graduate Initiative at The City College of New York (CCNY) and he decided to apply. Actually, he is a PhD student from the Department of Mechanical Engineering at CCNY under the supervision of Dr. Jorge E. Gonzalez. His research interests are climate modeling, numerical methods and environmental sustainability.

MOHAMMAD REZA NAJAFI, Portland State University

Reza is a PhD candidate in hydrology and currently working in the Water Resources and Remote Sensing Lab. His research interests include downscaling of the GCMs, uncertainty analysis and spatial analysis of hydroclimate extremes.

SHIMELIS G. SETEGN, Florida International University

Dr. Shimelis Gebriye Setegn is a Research Scientist at Florida International University, Miami, Florida. Dr. Setegn earned his Ph.D. in Land and Water Recourses Engineering. At FIU he have been responsible in leading the hydrological modeling component of the Caribbean Coastal Scenarios project where he use hydrological models to simulate seasonal and inter-annual fluxes of fresh water, sediments, and dissolved loads to coastal zones of Puerto Rico, Jamaica and Dominican Republic as a function of climate and catchment characteristics. He adapted GCM downscaling method using historical modification approach to generate station level daily climate data for the different emission scenarios. He is also involved in remote sensing application on analyzing the vegetation dynamics due to climate and hydrological regime changes in the Florida Everglades National Park. Currently he is leading the GIS and monitoring and evaluation component of the Global Water for Sustainability Programe ? GLOWS at FIU. The Global Water for Sustainability (GLOWS) program is a consortium financed by the United States Agency for International Development (USAID) working to increase social, economic, and environmental benefits to people of the developing world. GLOWS works on-the-ground to implement water supply, sanitation, and hygiene (WASH) services, improve water management practices, and build local capacity.

Dr. Setegn has an interdisciplinary background and experience emphasizing hydrology, hydrological and hydrodynamic modeling, watershed modeling and management, predicting impact of climate and land use changes, Geographical information system (GIS) and remote sensing applications in land and water resources. He has more than 10 years of teaching, research, and development experiences in the United States, Caribbean, Africa, Europe and Mexico. His effort in different international projects has led to invited and scientific presentations at AGU, AWRA and several peer-reviewed publications in leading journals.

DARRIN SHARP, Oregon Climate Change Research Institute

Darrin Sharp has a BS and MS in Computer Science from the University of Illinois, and an MS in Ecology from Colorado State University. He has experience working in both the high-tech and environmental consulting industries. His interests include the development of information technologies used for ecological and environmental research, and the downscaling of global climate model results to the regional level.

STEPHEN SOBIE, Pacific Climate Impacts Consortium

Stephen is a Regional Climate Impacts Analyst with the Pacific Climate Impacts Consortium (PCIC) at the University of Victoria. PCIC provides regional stakeholders with information on climate change and impacts projections in order to assist with decision-making. Stephen?s research focuses on analyzing recent, local climatological trends and projected changes in a range of climatological extremes using global and regional climate model simulations. He is also involved in statistical downscaling as part of the Downscaling Intercomparison Project examining the capabilities of a variety of statistical techniques in replicating climate extremes.

Stephen received a BSc in Physics and an MSc in Atmospheric Sciences at the University of Victoria with a dissertation on using synoptic typing techniques to downscale precipitation on Vancouver Island.

Research Interests: Climate extremes, regional climate change projections, statistical downscaling and adaptation planning.

VENKAT SRIDHAR, Boise State University

Dr. Venkat Sridhar earned his Ph.D. in Biosystems and Agricultural Engineering from Oklahoma State University, his M.Eng. in Irrigation Engineering and Management from the Asian Institute of Technology in Thailand, and his B.S. in Agricultural Engineering from Tamil Nadu Agricultural University in India. He is a Registered Civil Engineer in Nebraska and Idaho and is a Civil Engineering faculty at Boise State University since 2007.

Dr. Sridhar's primary research interest is in understanding the effects of land surface heterogeneity at the sub-GCM grid level and their effect on the land-atmosphere exchange phenomena. His group studies eco-hydrological modeling of complex mountainous terrain, sustainability, irrigated agriculture, and natural grasslands/sagebrush ecosystems, and the impacts of climate change on the regional hydrology and water resources in Idaho and the Pacific Northwest region.

GRANT WELLER , Colorado State University

Grant Weller is a PhD candidate in the Department of Statistics at Colorado State University in Fort Collins, CO, and a visitor to the Institute for Mathematics Applied to Geosciences (IMAGe) at NCAR. He is currently studying extreme value theory under the direction of Dr. Dan Cooley (CSU), and has a particular interest in modeling climate extremes. Grant is also a current participant in the 2011-2012 Uncertainty Quantification program at the Statistical and Applied Mathematical Sciences Institute (SAMSI) in Research Triangle Park, NC.

Grant's research involves modeling extreme precipitation from NARCCAP output and connecting extremes to large-scale dynamics.

PING YANG, City College of New York

Dr. Ping Yang is a post-doctoral fellow at the CUNY Environmental CrossRoads Initiative, The City College of New York, City University of New York. Dr. Yang got his MS.c. and Ph.D. in Geosciences from Wuhan University, China in 2006 and 2009. His research interests including Environmental Modeling, Spatiotemporal Modeling and Open source GIS software development. Currently Dr. Yang is working on Northeast Regional Earth System Model project which aims to establish a coupled earth model system for providing a century forecasting of U.S. Northeast region on the carbon emission, energy consumption and water safety, etc.

Dr. Ping Yang is interested in using NARCCAP data as well as other modeling and observational data on Meso-scale Regional Earth System Model project for a coupled earth model system to forecast U.S. Northeast region on the carbon emission, energy use and water management, etc in 21 century.

HUA ZHANG, Institute for Energy

Hua Zhang is postdoctoral research fellow at the Institute for Energy, Environment and Sustainable Communities, Regina, Canada. He obtained his PhD in environmental engineering from the University of Regina. His research experiences include hydrological and water quality modeling, climate change impact assessment and adaptation, water sources planning and management, geospatial analysis, and environmental risk assessment. He has been involved in a number of research projects related to climate change and water security. Hua Zhang's current research interests focus on the impacts of climate change on surface hydrology, water quality and water sources management.

ORAL AND POSTER PRESENTATIONS

MIGUEL ARANGO, Kansas State University

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Evaluation of climate change on N2O emissions in corn agroecosystems in Kansas, USA (Poster)

Understanding the effects of climate change on nitrous oxide (N2O) emissions in agroecosystems is important because agricultural soil management activities, such as fertilizer application and other cropping practices is a major contributor of N2O emissions in the United States. This involves developing plausible future climate scenarios which can then be used in a process based N2O model at the regional level.

The objective of this study is to analyze the future scenarios of daily precipitation, maximum and minimum temperatures, and N2O to evaluate the potential effects of climate change on N2O emissions from corn fields across Kansas. Change Factor Methodology (CFM) was used to derive plausible future scenarios of precipitation and temperatures from Regional Climate Models (RCM). The daily simulations from multiple RCMs were obtained from North American Regional Climate Change Assessment Program (NARCCAP) for grid box closest to the centroid of 23 weather stations in Kansas for baseline (20C3M, 1968-2000) and future (A2, 2038-2070) time periods. The Denitrification and Decomposition (DNDC) model was used to simulate N2O emissions.

Preliminary results indicated an increase in temperatures across the state and the rate of increase varied among the stations. In the case of precipitation, there was variability in the rate and direction of change across the state. There was variability in N2O emissions predicted from DNDC model due to changes in climate and agricultural management practices in corn.

In collaboration with Aavudai Anandhi, Charles Rice, Stacy Hutchinson

SEBASTIEN BINER, Ouranos

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Interannual Variability

Analysis of the interannual variability and the climate change signal for the 2m Temperature fields of the NARCCAP regional climate projection ensemble.

The North American Regional Climate Change Assessment Program (NARCCAP) is a project that aims at studying the uncertainty related to regional climate projections run at a nominal resolution of 50 km. It also supplies the scientific community with a considerable ensemble of climate simulations over a region covering most of North America at the regional scale. These simulations are produced from six Regional Climate Models (RCMs) using different sources of large-scale information in recent and future climate.

Results of the analysis of the 2m Temperature interannual variability from the NARCCAP ensemble are presented. The analysis covers RCM simulations using reanalysis and General Circulation Models (GCMs). These results are the used to look at the climate change projections and evaluate their strength in a signal to noise paradigm.

MELISSA BUKOVSKY, NCAR

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Towards Establishing the Credibility of the NARCCAP RCMs for the North American Monsoon

This talk will provide an overview of the simulations produced by the North American Regional Climate Change Assessment Program (NARCCAP) in terms of their ability to simulate the North American Monsoon (NAM) system. The end goal of this work is to determine the credibility of the precipitation projections made by the regional climate models (RCMs), without focusing purely on the precipitation itself. I will inspect various processes behind the NAM system precipitation, identify their bias, and examine the impact of the biases on the ability of the RCMs to produce a realistic monsoon signal. In this way, I hope to establish which projections of precipitation are likely to be more credible; that is, I hope to identify which changes in precipitation are supported by the most physically realistic causal mechanisms.

FRANCINA DOMINGUEZ, University of Arizona

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Changes in Winter Precipitation Extremes for the Western United States *(Invited)*

It is increasingly evident that under a changing climate the probability distributions of precipitation that are used for water infrastructure design are likely to be different from those estimated from the historical record due to the non-stationarity of the climate system. In this work we analyze the future changes in the intensity of extreme winter precipitation in the Western US as projected by an ensemble of eight regional climate models (RCMs) driven by IPCC AR4 global climate models (GCMs). We find a consistent and statistically significant increase in the intensity of future extreme winter precipitation events over the region. All eight simulations analyzed in this work consistently show an increase in the intensity of extreme winter precipitation with the multi-model mean projecting an area-averaged 12.6% increase in 20-year return period and 14.4% increase in 50-year return period daily precipitation. In contrast with extreme precipitation, the multi-model ensemble shows a decrease in mean winter precipitation of approximately 7.5% in the southwestern US, while the interior west shows less statistically robust increases. The intensification of extreme events will affect many other aspects of society and the natural environment in addition to water management systems, including agriculture, plant and animal species, ecosystems structure and habitat.

JENNIFER JACOBS, University of New Hampshire

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Analyzing Global Warming on Linear Infrastructure using NARCCAP data sets: A Case Study in the Northeastern U.S.

The Intergovernmental Panel on Climate Change attributes the observed pattern of change to the influence of anthropogenic forcing, stating that it is extremely unlikely that the global pattern of warming can be explained without external forcing, and that it is very likely the greenhouse gases caused the warming globally over the last 50 years. Consequently, much effort has been focused on understanding the contribution of road transportation to the emissions of greenhouse gases. Striking little research has been conducted to understand the implications of climate change on the performance and design of road networks.

When using water and energy balance approaches, climate is an integral part of modeling pavement deterioration processes including rutting, thermal cracking, frost heave, and thaw weakening. The potential of climate change raises the possibility that the frequency, duration, and severity of these deterioration processes may increase. This research explores
the value of NARCCAP climate data sets in transportation infrastructure models. Here, we present a general methodology to demonstrate how built infrastructure might from an effort to use various RCM climate scenarios and pavement designs to quantify the climate change impact on pavement performance using a case study approach. We present challenges and results in using the Regional Climate Model datasets as inputs, through intermediary hydrologic functions, into the Federal Department of Transportation?s Mechanistic-Empirical Pavement Design Guide Model.

JINWON KIM, UCLA

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Evaluation of Monthly Temperature and Precipitation using the JPL Regional Climate Model Evaluation System

Evaluation of the monthly fields of precipitation and surface air temperatures from the 5 RCMs participated in the multi-decadal NARCCAP hindcast experiment using the JPL Regional Climate Model Evaluation System (RCMES) will be presented. The findings illustrate a number of systematic biases in simulating these key climatological fields. All RCMs show warm biases in the Great Plains and the California Central Valley and cold biases in the Atlantic and Gulf of Mexico coastal regions. The errors common to all RCMs in simulating the annual precipitation include wet biases in the northwestern part of the western U.S. and dry biases in the Gulf of Mexico and southern Great Plains regions. Evaluated in terms of the RMSE normalized by the annual-mean values, all RCMs show better performance over the eastern half of the conterminous U.S. than in the western half. All RCMs show notably low skill in simulating precipitation over the inland Pacific Northwest region, east of the Cascades, for all seasons and in the Arizona-western New Mexico in summer. The latter suggests that all RCMs suffer difficulties in simulating precipitation related with the North American monsoon circulation. The model ensemble is among the best performers for all metrics, regions, and seasons for both fields. The systematic variations in model errors suggest that bias correction, a key step in applying model data to assess the impact of climate change on various sectors, may need to be performed differently for regions, seasons, variables, and assessment models.

GUILONG LI, Environment Canada

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High Resolution Extreme Temperature Scenarios over North America

We propose a framework for the construction of probabilistic projections of extreme temperatures at high resolution over North America using available simulations conducted by CMIP3 GCMs and by multiple regional climate models (RCMs). In this approach, we first establish statistical relationships between RCM simulated extreme temperatures and seasonal mean temperatures from the corresponding driving GCM, using a non-stationary generalized extreme value (GEV) distribution. We then apply such relationships to seasonal mean temperatures simulated by CMIP3 models to obtain downscaled high resolution extreme temperatures. Those statistically downscaled projections are used to estimate empirical quantiles of extreme temperature at various return levels. Uncertainties in the projected extreme temperatures are partitioned corresponding to four sources. We found large spatial variability in projected future extreme temperature changes, with increasingly larger changes towards cold air outbreaks path in winter and larger changes in southwest of the great lakes in summer. Large changes in extreme temperature have been projected, for example, the probability of the current 20-yr return extreme hot temperatures could be doubled for about every 30-yrs. The difference in the structure of RCMs is the most important source of uncertainty. Difference in the projected extreme temperatures due to emission scenarios increases with time, but it is comparable with that in the projected mean temperatures. Using regional frequency analysis that combines multiple grids and multiple model simulations yields more robust estimation of the statistical relationship, resulting in smaller uncertainty in the projection of extreme temperatures.

YONGQIANG LIU, Center for Forest Disturbance Sciecne, USDA FS

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Projecting Future Changes in U.S. Forest Fuel and Fire Conditions using NARCCAP Regional Climate Change Scenarios

Climate is an important factor for forest conditions and disturbances such as fuel moisture, fuel loading, and wildland fires. Significant climate change has been projected for many U.S. regions due to the greenhouse effect by various general circulation models (GCMs). As a result, large changes in future forest fuel conditions and fires are expected. We have been conducting research to understand and project the impacts of future climate change on forest conditions and disturbances in the United States using the dynamical downscaling of climate change from the North American Regional Climate Change Assessment Program (NARCCAP). An example of projecting fuel moisture and fire potential using the HadCM3-HRM3 scenario will be presented to indicate the value of the NARCCAP regional climate change scenarios to understanding the impacts of climate change on forest disturbances and developing mitigation strategies. It is shown that fire potential, measured by the Keetch-Byram Drought Index (KBDI), is expected to increase in the Southwest, Rocky Mountains, northern Great Plains, Southeast, and Pacific coast, but decrease in the inter-Mountains. Most significant increases occur during summer and autumn. Fire seasons become longer. The projected increases in wildfire potential suggest that increased resources and management efforts for disaster prevention and recovery will be needed in the future for many regions of the U.S.

KELLY MAHONEY, CIRES/Univ of CO/NOAA-ESRL

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Downscaling of Precipitation Extremes *(Invited)*

Dynamical downscaling of climate model data continues to gain popularity as a method to link potential changes in the large-scale climate pattern to discernible ?weather? at regional and local scales. However, many possible methodologies and datasets exist with which to dynamically downscale climate projections, and large gaps persist in our understanding of the advantages or limitations of various approaches.

The challenge of characterizing the uncertainty associated with a dynamically-downscaled dataset becomes even more acute when dealing with extreme weather phenomena such as flood events. Adequate resolution of fine-scale atmospheric processes necessitates that models be run at resolutions high enough to resolve convective-scale processes, as well as the details of precipitation-modulating complex terrain.

This study uses the Weather Research and Forecasting (WRF) model to further dynamically downscale three of the NARCCAP experiments: (i) GFDL-Timeslices, (ii) WRFG+CCSM, and (iii) RCM3+CGCM3. The downscaled simulations are generated for individual 24-hour events, and use the most ?extreme? (i.e., top 1%) precipitation events as initial conditions. The simulations are performed at ?convective-scale? (1.3-km gridspacing) and thus omit cumulus parameterization.

Using the WRF model to simulate the events at storm-scale resolution allows for examination of convective-scale parameters most relevant to precipitation processes. Analysis focuses on changes in overall precipitation amount, intensity, spatial distribution, and maximum terrain elevation at which extreme precipitation occurs. The ability to resolve fine-scale precipitation processes and features further provides enhanced detail with respect to precipitation type (i.e., hail/graupel vs. rain), as well as precipitation accumulation and runoff, potentially forming a more realistic picture of future flood risk.

These three experiments are compared (along with a short discussion of other downscaling methodologies tested) for simulations across central and eastern Colorado, with the ultimate objective of better informing the needs of water resources managers in the western US.

JOHN MEJIA, Desert Research Institute

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Interannual Variability of Surface Temperature and Precipitation using Regional Modeling Over Western North America

Interannual climate patterns related to El Niño-Southern Oscillation (ENSO) are investigated for present climate simulations using the North American Regional Climate Change Assessment Program (NARCCAP) dynamically downscaled projections at 50 km resolution (for 6 different Regional Climate Models), and the dynamically downscaled simulations at 36 and 12 km resolution using the Desert Research Institute's Regional Climate Model (DRI-RCM) based on the Weather and Research Forecasting Model (WRFV3.2.1). Teleconnection patterns were calculated using both central Pacific ENSO (CPAC) events and eastern Pacific ENSO (EPAC) indices. Correlation and composite maps were created to analyze added value spatial climate patterns over Western United States. We evaluate regional simulations' performance based on observational gridded products of similar resolution. Results highlight the usefulness, strengths, and limitations of these regional downscaling methods for climate change assessment and impact studies.

In collaboration with Kristien C. King, John F. Mejia, and Darko Koracin, Desert Research Institute, Reno, NV

RUBEN PICON-FELICIANO, NOAA-CREST at The City College of New York

rubenpicon@gmail.com

Untitled (Poster)

There is a need for high resolution weather and climate forecasting tools for heavy populated regions, particularly coastal. Scientific evidence accumulating over the past decade shows that climate change impacts are already being experienced in the U.S. Northeast (Hayhoe et al. 2007).The aim of this research is to assess the ability to predict weather and climate for the heavy populated region of the US Northeast Region. Further improvements will result from the assessment.The Weather Research and Forecasting (WRF) model is used coupled to the NOAH Land-Surface Model (NLSM) (Tewari et al., 2004), to evaluate impacts of the urban areas on the temperature and precipitation in the entire U.S. North East Region.The NLSM model adjusts values of surface albedo, heat capacity, and roughness to account for the presence of urban areas.One domain with a resolution of 16 km was used in WRF to represent the entire region. The National Centers for Environmental Prediction (NCEP) North American Regional Reanalysis (NARR) data were employed to initialize the simulation and as boundary condition. Simulations were performed from year 2000 thru 2010.

STEPHEN SOBIE, Pacific Climate Impacts Consortium

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Analysis of NARCCAP Results for Extremes in the Canadian Columbia Basin

Demand for projections of extremes has arisen out of local infrastructure vulnerability assessments and adaptation planning. Collaboration with regional stakeholders such as the Columbia Basin Trust (encompassing communities within the Columbia River Basin) has lead to in depth analyses current and future climates in south-eastern British Columbia. A critical component of this future planning requires detailed knowledge of how extreme events are likely to change into the future.

This need for projections of extremes has been met using an ensemble of Regional Climate Model (RCM) results from NARCCAP, in some cases supplemented by and compared to statistical downscaling. Evaluation of the RCM's ability to simulate climatology in the Columbia Basin has been completed through comparisons to both station observations and a variety of gridded observational datasets. A range of extreme values, from simple daily maxima and minima to complex multi-day and threshold-based climate indices have been computed and analyzed for the Columbia Basin. Selected results will be shown for several indices of extremes, including the Climdex set of indices that has been widely used elsewhere (e.g., Stardex) and specific parameters of interest defined by users. Finally, the need for threshold scaling of some indices and use of as large an ensemble as possible will be illustrated.

EUGENE S. TAKLE, Iowa State University

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Surface Wind Speed Simulations in NARCCAP Models *(Invited)*

We have examined surface wind speed simulations by NARCCAP models as produced in the reanalysis-driven runs and the scenario climates. To evaluate model simulation (at the 52-km grid spacing of NARCCAP) of extreme high winds we identified observed periods of derecho events in the upper Midwest for the period 1980-2004 and queried models in the archive reanalysis-driven runs for their representation of extreme high winds during these specific times. We found that, indeed, models do show evidence of high winds (on a very relative scale, of course, due to model resolution) associate with observed events. Interannual variability of winds is of high interest for air pollution, wind energy, and agriculture, so we are examining model capability of representing known periods of extreme low windspeeds as well. Results show differences among models in their ability to reproduce observed characteristics of low summer-time

winds. Only one model reproduces observed high frequency of calm night-time surface winds in summer. We also studied the frequency distribution of modeled surface winds in contemporary and future scenario runs to assess changes associated with climate change and found a general reduction in extreme high winds in future climates but model-dependent changes in the overall frequency distribution.
In collaboration with and Rachel Hatteberg

GRANT WELLER, Colorado State University
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An Investigation of the Pineapple Express Phenomenon via Bivariate Extreme Value Theory

The pineapple express (PE) phenomenon is responsible for producing extreme winter precipitation events on the west coast of the US and Canada. We study regional climate models' ability to reproduce these events by defining a quantity which captures the spatial extent and intensity of PE events. We use bivariate extreme value theory to model the tail dependence of this quantity as seen in observational data and the Weather Research and Forecasting (WRF) regional climate model driven by reanalysis, and we find tail dependence between the two. To link to synoptic-scale processes, we use daily mean sea-level pressure (MSLP) fields from NCEP to develop a daily "PE index" for extreme precipitation which exhibits tail dependence with our observational quantity. Other models from the NARCCAP ensemble are used to estimate the future marginal distributions of NCEP-driven WRF output and observational precipitation. Finally, we employ the fitted tail dependence model to simulate observational precipitation measurements in the future, given output from a future run of WRF. We find evidence of a change in the tail behavior of precipitation from current to future climates, and examination of PE index values of simulated events suggests increases in frequency and intensity of PE precipitation in the future scenario.

HUA ZHANG, Institute for Energy, Environment and Sustainable Communities, Canada
hua.zhang211@gmail.com

Development of Climate Change Projections for Prairie Hydrological and Water Quality Modeling

Regional climate models (RCMs) have been increasingly used for climate change studies at the watershed level. However, the performances of RCMs are strongly dependent upon the driving conditions, internal parameterizations and domain configuration. Also, the spatial resolution of RCMs often exceeds the scales of small watersheds in the Canadian prairie region. This study developed a two-step method to generate climate change projections for small watersheds through combining weighted multi-RCM ensemble and stochastic weather generator. The ensemble was built based on a set of five model performance metrics to describe the RCM's skill in reproducing present climate state. The regional pattern of climate change was generated by the ensemble as monthly shift terms of climate variables. The stochastic weather generator was then used to incorporate these shift terms into observed climate normals, in order to produce synthetic future weather series at the watershed level. The proposed methods were applied to the Assiniboia Watershed in southern Canada. The weighed multi-RCM ensemble led to reduced biases in temperature and precipitation estimates by properly emphasizing models with good performance. The ensemble-derived climate change information was well reproduced as daily weather series by the stochastic weather generator. The proposed combination of dynamic downscaling and stochastic downscaling can improve the reliability and resolution of future climate projection for small prairie watersheds. It is also an efficient solution to daily weather series of future climate state, which are important inputs for watershed hydrological and biogeochemical simulations.

NARCCAP: Overview and Regional Climate Change Results

Linda O. Mearns and the NARCCAP Team

National Center for Atmospheric Research, Boulder, CO

website: http://www.narccap.ucar.edu

NARCCAP Team: Melissa Bukovsky, Seth McGinnis, Larry McDaniel, Don Middleton, Doug Nychka, Steve Sain, Toni Rosati, Josh Thompson, NCAR; Phil Duffy, Climate Central; Isaac Held, GFDL; Richard Jones, Wilfran Moufouma-Okia, Simon Tucker, Hadley Centre; William Gutowski, Ray Arritt, Dave Flory, Gene Takle, Iowa State; Daniel Caya, Sébastien Biner, OURANOS; Ruby Leung, James Correia, Yun Qian, PNNL; Ana Nunes, John Roads, Scripps; Lisa Sloan, Mark Snyder, UC Santa Cruz; René Laprise, UQAM;

NCAR

OURANOS

INTRODUCTION

The North American Regional Climate Change Assessment Program (NARCCAP) is an international program to produce high resolution climate change scenarios and investigate uncertainties in regional scale projections of future climate by nesting multiple regional climate models (RCMs) within multiple atmosphere-ocean general circulation models (AOGCMs) forced with the A2 SRES scenario and with historical data over a domain covering the conterminous United States and most of Canada and Northern Mexico.

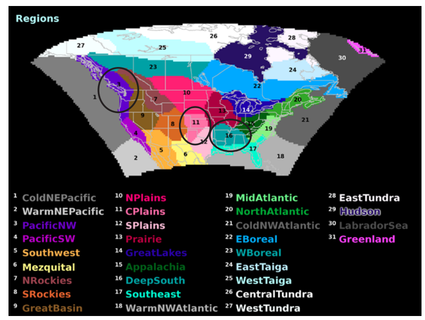
The resulting 60+ TB of data are being archived for distributed storage and made available to global change impacts researchers worldwide via the Earth System Grid (ESG). To ensure that the final product is usable by the impacts community, GIS practitioners, climate analysts, modelers, policy-makers, and other end users, data is stored in CF-compliant NetCDF format, making it fully compatible with many popular analysis programs, including ArcGIS, Matlab, IDL, and R. Tools are also available for converting data to plain text.

GOALS

- Exploration of multiple uncertainties in regional model and global climate model regional projections.
- Development of multiple high resolution regional climate scenarios for use in impacts assessments.
- Further evaluation of regional model performance over North America.
- Exploration of some remaining uncertainties in regional climate modeling (e.g., importance of compatibility of physics in nesting and nested models).
- Creation of greater collaboration between US and Canadian climate modeling groups, as well as with the European modeling community.
- Quantification of uncertainty across all models.

REGIONALIZATION

Developed by M. Bukovsky, NCAR



This subregionalization was created to aid in the analysis of NARCCAP simulations in subregions of the North American domain. It is, in essence, a simplification of the terrestrial ecoregions provided in Ricketts et al. (1999), and over the U.S. it closely follows the regions used by NEON (National Ecological Observatory Network, Kampe et al. (2010)). Several standard climate classifications also informed the final regionalization. Each subregion tries to capture a homogeneous climate and important features of the climate system (e.g., the Deep South captures the eastern US winter time maximum).

NARCCAP AT A GLANCE

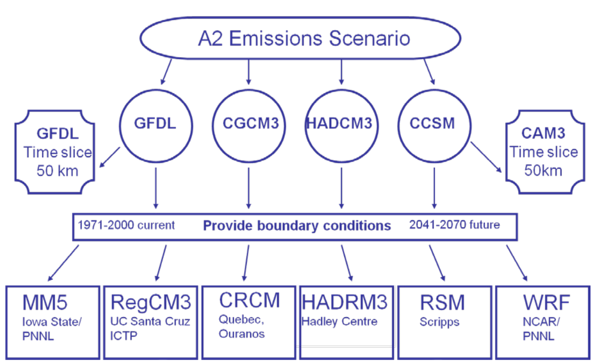
- 4 different AOGCMs driving 6 different RCMs
- 50 km spatial resolution
- 3 hourly temporal resolution
- 52 output variables
- 2 high-resolution AGCM timeslice experiments
- Future scenario: SRES A2

Phase I: RCMs are driven by historical (1979-2004) observed (NCEP2 Reanalysis) data

Phase II: Each RCM is driven by 2 GCMs for current (1971-2000) and future (2041-2070) scenarios. GCM/RCM pairings are chosen for maximum value in statistical analysis.

Timeslices: Atmospheric components of the GFDL & CCSM global models are run at 50 km resolution using observed SST data (offset in the future scenario) instead of a coupled ocean.

NARCCAP PLAN – Phase II



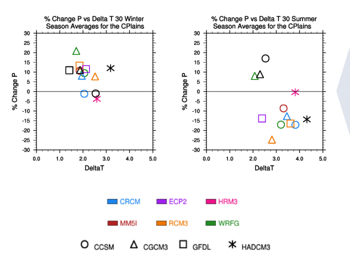
EXPERIMENTAL DESIGN

NARCCAP uses a fractional factorial design to manage funding limitations. Each RCM is paired with two GCMs. Timeslice experiments are also performed for two of the GCMs (CCSM & GFDL). Each RCM is paired with one of the two timeslice GCMs.

RCM \ GCM	Phase I	Phase II			
	NCEP	GFDL	CGCM3	HADCM3	CCSM
CRCM	X		X		X
ECPC	X	X		X	
HRM3	X	X		X	
MM5I	X			X	X
RCM3	X	X	X		
WRFP	X		X		X

SAMPLE SUBREGIONAL ANALYSIS

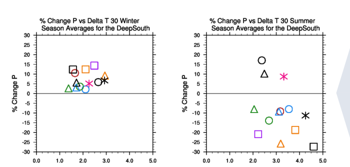
We analyze three different subregions to represent the variability of climate change responses in different parts of the domain and across different model combinations. The plots present seasonal (winter/summer) changes in precipitation and temperature from the four different GCMs and from nine of the GCM-RCM combinations. We examine the overall spread of the results and the relationships between the changes in the RCMs and those in the parent GCMs.



KEY: Color indicates RCM.
Shape indicates nesting GCM.
Black symbols are GCM alone

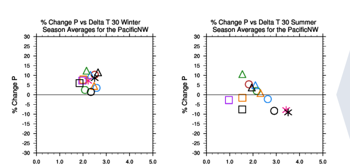
Central Plains

This sub-region displays considerable scatter in seasonal change in temperature and precipitation in all seasons. In winter two of the GCMs represent the outside range for temperature change. Considerable distance is found between the responses of the GCMs and the RCMs driven by them, such as the HadCM3 vs. HRM3, which show different directions of precipitation change in winter. The RCMs show a greater range of precipitation change than do the GCMs. In summer there is much wider scatter of change in precipitation than in winter. Some RCMs follow the parent GCM pattern of change closely (e.g. CGCM3 and WRFG) while others depart (e.g., CGCM3 and RCM3).



Deep South

This sub-region displays low variability of climate change in winter across the different models with change in precipitation ranging from 2 to 15%, and change in temperature from 1.3 to 3°C, whereas in summer, there is a wide spread both in temperature and precipitation. The GCMs exhibit a larger range in precipitation change than do the RCMs in summer.



Pacific Northwest

In winter, there is extremely low variability in climate change across the different model combinations, with temperature change ranging from 2 to 3°C and precipitation change from 0 to 12% increase. Summer exhibits a much wider range of change across the RCMs and GCMs (1 to 4°C in temperature and -10% to +10% change in precipitation).