American Water Resources Association
2009 ANNUAL WATER RESOURCES CONFERENCE
November 9-12, 2009
Seattle, WA

Tuesday, Nov. 10
8:30 AM – 10:00 AM
SESSION 17: Climate Change

Land Use and Infrastructure: Revisiting the Role of Federal Authority in Light of Climate Change and Long Term Infrastructural Investment - Eric Fitch, Marietta College Environmental Science Program, Marietta, OH

In response to the economic downturn of 2008, the Obama administration in concert with Congress embarked on an ambitious stimulus package parts of which addressed infrastructure needs across the United States. In an attempt to maximize economic impact, the primary criteria for state and local governments to have projects approved were that there was a demonstrated public need and that they were "shovel ready". Though most projects went through standard environmental impact assessments, few of these took into account the impact of the projects on long term climate adaptation strategies. Roads, bridges, waterworks and other types of public infrastructure not only provide for existing needs, but often help to shape and reinforce patterns of land and water use for decades or even centuries. It is here where the time frames of climate change and public investment come together. Infrastructural choices can and often do accelerate the concentration of population in coastal storm hazard zones, areas vulnerable to sea level rise and areas where long term drying reduces critical water supply. Over the long run, the infrastructure investment of today can create situations where ever greater infrastructure expenditures and technological innovation will be required to support water resource needs and protect coastal populations. It is time to revisit the role of the federal government in terms of infrastructural development and land use decision-making. There is precedent for requiring specific land use criteria being met for the receipt of federal funding in laws and programs such as the Coastal Zone Management Act, the Coastal Barriers Resources Act, the National Flood Insurance Program and many others. Now, when there is a surge in federal infrastructure investment comparable to that of the Eisenhower Interstate Highway System or even the Works Progress Administration and the programs of the New Deal, it is necessary to establish criteria to dissuade development of infrastructure leading to development which will overstress water resources and place people and property in harm's way in the Coastal Zone.

Climate Change Impacts on Water Resources in Northwestern Ontario, Canada: Uncertainty from Downscaling Methods - Woonsup Choi, University of Wisconsin-Milwaukee, Milwaukee, WI (co-authors: Sung Joon Kim, Mark Lee, Kristina Koenig, Peter Rasmussen, Adam Moore)

Climate change is expected to cause significant impacts on various sectors in Canada, including the hydropower industry which is highly vulnerable to trends in water availability. This study has investigated the impact of potential climate change on water availability by applying three different statistical downscaling methods, namely SDSM, LARS-WG, and Nearest Neighbor Resampling, respectively. The statistical downscaling methods were used to generate climate scenarios of temperature and precipitation from the third generation Canadian Global Climate Model (CGCM3/T47) simulated with three greenhouse gas emission scenarios (A1B, A2 and B1) for weather stations in the Winnipeg River basin. The hydrological model SLURP was set up and calibrated to simulate runoff from a catchment in the Winnipeg River basin for two different time slices, 1971-2000 (1980s) and 2046-2065 (2050s) under the emission scenarios. All downscaling methods agree that temperature will increase with time and indicate that precipitation will also increase with more varying degrees. However, resulting runoff changes from the temperature and precipitation changes are quite different by combinations of emission scenarios and downscaling methods. When it comes to runoff changes in the future, the most dramatic difference is observed between SDSM and LARS-WG for A1B (–28% to 25%) and B1 (–15% to 13%) scenarios while LARS-WG and NNR show the biggest difference in A2 (–9% to 22%) at the annual scale. Overall, statistical downscaling methods have far greater uncertainty than emission scenarios in projecting future water availability.

Reconciling Projections of Colorado River Stream Flow Over the Next Century - Julie Vano, University of Washington, Seattle, WA (co-authors: Tapash Das, Dennis Lettenmaier)

The Colorado River is a critical source of water for the rapidly growing southwestern United States. Over the last decade, the Colorado River basin has experienced a persistent drought that has called into question the sustainability of the basin's water resources. In particular, the possibility that these conditions may signal a transition to a permanently drier state is of great concern to the region's water managers. Several recent studies have projected reductions in Colorado River flows by mid- century ranging from ~6% to ~45%, a range so large as to greatly complicate management responses. These differences in part are attributable to wide variations in climate model projections (especially of precipitation and temperature), but they also reflect variations in hydrologic model sensitivities to changes in precipitation and temperature. We evaluate the second contribution to the overall uncertainty, specifically, inter-model-dependence of projections of runoff change to changes in precipitation and temperature. To do so, we compare multi-decadal simulations with three semi-distributed hydrological models (Variable Infiltration Capacity model, NOAH land surface scheme, and Sacramento Soil Moisture Accounting Model), all applied over the entire Colorado River basin at 1/8 degree latitude by longitude spatial resolution. For each model, in addition to a baseline historical simulation, we perform simulations in which daily air temperatures are increased by one degree C each day, and in which precipitation is increased by 10 percent (also for each day of the simulation period). We then compute, for each model grid cell, and for aggregates over major Colorado River tributaries, the elasticity of model runoff to precipitation (percent change in annual average runoff divided by 10 percent, the imposed fractional change in precipitation) and the temperature sensitivity (percent change in annual average runoff for the imposed one degree C temperature change. In addition to aggregates for the major sub-basins, we evaluate the spatial distribution of precipitation and temperature elasticities and sensitivities, respectively, as well as composite elasticities and sensitivities for percentile bands of the (spatial) probability distribution of long-term average annual runoff.

Spatial and Temporal Changes in Runoff Resulting from Climate Change in the Willamette River Basin of Oregon - Heejun Chang, Portland State University, Portland, OR (co-author: Ilwon Jung)

We estimated potential changes in runoff in the 218 sub-basins of the Willamette River basin of Oregon for the 21st century. The U.S. Geological Survey's Precipitation and Runoff Modeling System (PRMS) was calibrated and validated for representative river basins between 1973 and 2006. A regionalization method and GIS analysis determined the PRMS model parameters for ungauged basins. Twenty-one climate change simulation results downscaled at the 1/16 degree resolution was used to estimate spatial and temporal changes in runoff at a sub-basin scale in the future. While runoff changes exhibit a wide range of responses to changes in precipitation and temperature inputs, seasonal variability of flow is projected to increase consistently with increases in winter flow and decreases in summer flow. These trends are amplified by the end of the 21st century with a wide range of flow. Snowmelt-dominated basins exhibit greater reduction in summer flow, while rainfall-dominated basins show greater increases in winter flow. Snowmelt and April 1st snow water equivalent are consistently projected to decline with higher rate of decline in high altitude basins. Spatial autocorrelation, measured by Moran's I, show slight increases in spatial dependence. The results of this study show that temporal variability of runoff increases, while spatial variability of runoff may reduce in the future.