

American Water Resources Association
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Tuesday, Nov. 10

1:30 PM – 3:00 PM

SESSION 26: Water Resources and Water Supply

Regional Climate Impact Studies for Water Resources in West Texas - Spandana Tummuri, CDM Inc, Fort Worth, TX

Understanding the long-term effects of climate change on local water resources is critical for sound regional water planning. Appreciating the effects of climate change helps policy makers prioritize the mitigation/adaptation techniques to assure adequate water supplies in a time of uncertainty. Regional climate models that are focused on specific regions of interest are efficient tools that help policy makers incorporate climate change in their decision-making process. This presentation presents the findings of a regional climate impact study that was carried out for the Upper Brazos River basin in West Texas. A General Circulation Model (GCM) that represents the climate forcings of the northwest Texas region efficiently was selected based on a careful comparison of the output from 15 GCMs for IPCC scenarios A2 and B1 (mid-high & mid-low climate change scenario). After performing a 20-yr validation run (1970 - 1990), regional climate modeling was carried out for a 20-yr future period (2030 - 2050) using GCM output. The hydrologic variables were analyzed by comparing the model output from the historical runs with the climatic and meteorologic observations obtained from the NCDC and the TWDB. The results were analyzed to determine the key components impacting the hydrologic budget of the study area for historical and future time periods. Statistical analysis of long-term trends in precipitation and temperature from model output were compared with observations for a historic period and projected for a future period. Trends in evaporation and in components affecting evaporation (wind and relative humidity) were studied. While the comparison of historical analysis verified the adaptability of the model, the future trends projected a decrease in the frequency and the magnitude of precipitation, increase in the temperature, and evaporation values in the Upper Brazos River basin. Therefore, it was concluded that a scientifically sound methodology to conduct regional climate modeling for the West Texas region was developed. The methodology used, the principles applied, and the results obtained were specific to the regional nature of study area.

Climate Variability and Water Infrastructure: Historical Experience in the Western United States - Scott Lowe, Boise State University, Boise, ID (co-authors: Zeynep K. Hansen, Gary D. Libecap)

Greater historical perspective is needed to enlighten current debate about future human responses to higher temperatures and increased precipitation variation. We analyze the impact of climatic conditions and variability on agricultural production and flood control in the western states, which are characterized by the continent's driest and most variable climate. We have assembled county-level data on dams and other major water infrastructure; agricultural crop mixes and yields; precipitation and temperature; soil quality, and topography. Using this extensive data set, we analyze the impact of water infrastructure investments on crop mix and yields and the incidence of floods in affected counties relative to similarly-endowed counties that lack such infrastructure. We anticipate that water infrastructure will smooth agricultural crop mixes and output, and reduce flooding. In addition, we explore the political economy of the Reclamation Act of 1902 to cast light on how politics and climatic factors may influence contemporary investment decisions.

Impact Assessment of Hydrothermal Dynamics in Urban Area by Using Multi-Scaled Integrated Approach - Tadanobu Nakayama, National Institute for Environmental Studies, Tsukuba, Iba, Japan (co-authors: T. Fujita, S. Hashimoto, H. Hamano)

We coupled the process-based NIES Integrated Catchment-based Eco-hydrology (NICE) model to an urban canopy model and the Regional Atmospheric Modeling System (RAMS) in order to simulate the effect of urban geometry and anthropogenic exhaustion on the hydrothermal changes in the atmospheric/land and the interfacial areas of the Japanese megalopolis. The simulation was conducted with multi-scale in horizontally regional–urban–point levels, and in vertically atmosphere–surface–unsaturated–saturated layers. The model reproduced excellently the observed values by using ground-truth data, stable isotope analysis, budget-derived method, and spatial satellite data in various types of natural/artificial landcovers. The simulated results also suggested that the latent heat flux in new water-holding pavement (consisting of porous asphalt and water-holding filler made of steel by-products based on silica compound) has a strong impact on hydrologic cycle and cooling temperature in comparison with the observed heat budget by including the effect of the amount of water on the heat conductivity in the pavement and by comparing results of simplified empirical model. Because water temperature in an aquifer is almost constant throughout the year, it is estimated that the use of groundwater as a heat sink would be very effective for tackling the urban heat island, particularly during the summer. We evaluated the relationship between the effect of groundwater use to ameliorate the heat island and the effect of infiltration on the water cycle in the catchment by further expanding to a physically-based mosaic or tile approaches. These procedures to integrate the multi-scaled model simulation with political scenario for the effective selection and use of ecosystem service sites would be very powerful approaches to create thermally-pleasing environments in the megalopolis.

Simulation Modeling of Large Watersheds on the US Southeast Coast - Daniel Tufford, University of South Carolina, Columbia, SC (co-authors: Greg Carbone, Lauren Felker, Peng Gao)

This presentation will discuss development of Hydrologic Simulation Program Fortran (HSPF) models of the Winyah Bay drainage in North and South Carolina. The models are part of a larger project to examine the individual and combined effects on freshwater resources of increased demand from expanded development in the context of climate variability and change, drought, and sea level rise. Three significant rivers flow into the bay. Two are located entirely in the Coastal Plain physiographic province; the third and largest watershed extends into the Piedmont and Blue Ridge provinces. Streamflow generation is very different in the Coastal Plain than the other provinces. Surface runoff is the dominate process in the Piedmont and Blue Ridge. Significant interaction with shallow subsurface flow and surficial aquifers dominates on the Coastal Plain. This presented special challenges for calibration and testing the Coastal Plain watersheds. We will provide specific examples of process-based issues we addressed and compare them among provinces. We will conclude with some comments about how these results are being integrated into scenario analyses based on overall project objectives.