American Water Resources Association
2009 SPRING SPECIALTY CONFERENCE
Managing Water Resources Development in a Changing Climate
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Anchorage, AK

Tuesday, May 5
10:30 AM – 12:00 Noon
Session 14: Addressing Uncertainty with Models II

1. Linking RISA Scientists and Water Resource Managers: Climate Science & Water Management - Christine Kirchhoff, University of Michigan, Ann Arbor, MI

The Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) indicates that climate change has played a significant role in the increasing costs of natural disasters (IPCC 2007). In addition, Hurd et al. (1999) project significant economic consequences resulting from climate change impacts on water supply, water quality, and hydropower generation. The increasing costs of natural disasters and other climate change impacts will inevitably stress and stretch already burdened local and state governments as they struggle to respond to the varied impacts of climate change. In order to respond effectively and appropriately to the impacts of climate change local and state water managers must have scientific information upon which to base decisions. Climate change assessments, climate forecasts, and streamflow reconstructions produced by the National Oceanic and Atmospheric Administration (NOAA) Regional Integrated Sciences and Assessments (RISAs) provide one source of scientific information upon which to base effective and appropriate actions. This information offers the potential to increase the effectiveness of present management of water resources and to improve investment decisions that will enable more flexibility and reliability in the management of water resources in the future. But, the availability of climate change information does not automatically ensure its utility. The utility of climate change assessments for water resource management is impacted by many factors including: water managers' experience with innovation, perceived risk from climatic events, compatibility with existing decision making, norms, and technical and human capacity among others. This paper presents preliminary results from research that examines information use among water resource managers in the western US. This research builds on the efforts of scholars who have examined climate change information use by water resource management organizations at a local or state level. The work also builds on the scholarship of Cash and Clark (2001) who make clear that the effectiveness of assessments is dependent on the process not just the product itself. Ultimately, research results will help improve the effectiveness of regional climate assessments and increase our understanding of the link between knowledge generation and use by water resource management organizations.

2. Modeling Water Movement between Glacial, Agricultural Oasis and Desert for Water Resources Management in Northwest China - Chansheng He, Western Michigan University, Kalamazoo, MI (co-authors: Carlo Demachi, Thomas E. Croley II, Tim Hunter, and Qi Feng)

Water shortage is a chronic problem in arid Northwest China. In the context of climate change and urbanization, how much water will be available to support competing demands for water for domestic, irrigation, and industrial supplies and for maintenance of ecosystems in Northwest China? This paper describes the preliminary work of adapting the U.S. Department of Commerce's National Oceanic and Atmospheric Administration's Distributed Large Basin Runoff Model to the Heihe Watershed (the second largest inland river in arid Northwestern China, with a drainage area of 128,000 km2) for understanding water movement among glacial/snow melt, groundwater, surface runoff, and evapotranspiration, and for assessing hydrological impacts of climate change and glacial recession on water supply in the middle reach of agricultural oasis and lower reach of desert in the watershed. The results provide important information for sustainable use of the limited water resources in the region.

3. HydroGeoSphere Application to Evaluate Basin-Scale Integrated Surface-Subsurface Water Flow and Transport Systems in the Central Valley of California - George Matanga, U.S. Bureau of Reclamation, Sacramento, CA (co-authors: C. Mary Kang, Lorri Peltz-Lewis, Lisa Rainger, Rob McLaren, Don DeMarco)

Management of water resources in changing climatic conditions requires consideration of complex subsurface and surface-based hydrological/ecological systems at basin-wide scales. The surface-based systems are closely interconnected and include aquatic habitats (stream channels, wetlands, vernal pools, lakes, periodic floods and other surface-water bodies); riparian zones; lowlands (valley floor); and uplands (mountains). From a hydrological perspective, the surface-based systems (surface water regimes) are known to closely interact with the subsurface systems (subsurface water regimes). In the evaluation of the integrated surface-subsurface hydrological processes in the Sacramento Valley and the San Joaquin Valley of California, the surface water regimes are treated as two-dimensional systems, while the subsurface water regimes are handled as three-dimensional systems. The two- and three-dimensional water regimes are integrated into a single system through the use of HydroGeoSphere, a fully-integrated surface and subsurface water flow and transport model. Both models account for variably-saturated subsurface flow, precipitation, irrigation, river inflows, subsurface extractions, evapotranspiration, surface water, surface-subsurface water interactions, and exchange flux at the surface/subsurface interface. In order to accurately evaluate the hydrological processes at a basin scale, in terms of process simulation, it may be necessary to apply a small scale (refined model grid) for the stream channels and riparian zones and a large scale (coarse model grid) for the lowlands and uplands. Therefore, HydroGeoSphere's sub-gridding scheme has been applied to the San Joaquin Valley model to facilitate grid-refinement over a surface or volume of an element allowing for multi-scales in management of water resources in a basin. Success of predictive and conjunctive analyses of hydrological processes in integrated surface and subsurface water systems depends on availability of robust numerical models, with the capability to account for hydrological processes within and at the interfaces of the surface and subsurface water regimes at various scales. HydroGeoSphere-based models are well suited for physically-based predictions of the impacts of climate change due to its rigorous representation of surface-subsurface temperature, hydrology and water quality at various scales

4. Can We Use Hydrologic Models Calibrated With Past Data For Climate Change Impact Studies? - Annie Poulin, Ecole de technologie supérieure, Montreal, QC (co-authors: François P.Brissette Robert Leconte)

Hydrological impact assessment studies under climate change involve various sources of uncertainty. These are either related to the climate projections (global climate models, green house gas emissions scenarios) or to the modelling processes (downscaling methods, hydrological models). It is critical to assess the uncertainty at every stage of impact studies, to provide the right probabilistic information upon which water management decisions will be made. So far, the contribution of hydrological modelling to the overall uncertainty has received little attention in the scientific literature. The main objective of this study is to analyse the sensitivity of hydrological models to calibration/validation under contrasted climate conditions (e.g. cold and wet versus warm and dry), and to quantify the contribution of model calibration to the global uncertainty of climate change impacts. Because the historical record does not provide sufficient variability (especially for temperature data), daily runoff depths simulated by the Canadian Regional Climate Model (CRCM) are used as proxy data. Those are introduced into hydrological models (downstream of modelling processes) to generate hydrographs, which are used as a basis for model calibration, in conjunction with CRCM precipitation and temperature outputs. In a first step, the generated hydrographs (obtained from reanalysis-driven CRCM runoff data) are compared with observed daily flow data. The aim of this validation step is not to assess the CRCM's ability to reproduce observed daily runoff (since key CRCM outputs display seasonal biases), but rather to ensure that realistic hydrographs are obtained. After this assessment, outputs from the CRCM in climate- change mode (1961-2070) are used as input to simulate river flows and proceed to the calibration/validation of the hydrological models. The main advantage of this approach is that sufficiently large variations of temperature and precipitation are encompassed, allowing a clear assessment of hydrology model performance in a changed climate. The approach is applied to two Quebec watersheds using two different hydrology models (lumped conceptual and physically-based distributed). Results indicate that structural sensitivity of hydrological models can play a critical role in the uncertainty of climate change impact studies.