Session D4: Assessing Climate Change Impacts on Water

Room A107-109
8:00 – 9:30 am

0403
D4-1

Vulnerability Assessment of New England Streams to Contribute to a Monitoring Network to Detect Climate Change Effects

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Changes in stream temperatures and hydrologic regimes due to climate change will affect aquatic biota throughout the ecosystem, though not all places and organisms will be impacted equally. Currently, there is no monitoring program specifically designed to detect these types of changes and spatial differences. As part of a collaborative effort with states in the Northeast, EPA Region 1, EPA OWOW and USGS to develop a framework for monitoring climate change effects in streams, we conducted a vulnerability assessment based on potential climate change exposure and sensitivity. The vulnerability assessment allowed stratification of streams according to exposure and sensitivity combinations, such that locations highest in both categories could be selected as sites likely to exhibit impacts the soonest, in contrast to sites that scored low in both, which may serve as refugia for climate-sensitive organisms. Supporting analyses of biomonitoring data from the Northeast show that streams and macroinvertebrate communities within a stream class are sufficiently similar, such that streams within a class can be pooled when selecting sites for the monitoring network. This also facilitates coordination and collaboration among state and federal agencies and other organizations and reduces the monitoring burden to any individual organization.

0122
D4-2

Development of a Decision Support System for Estimating Salinity Intrusion Effects Due to Climate Change on the South Carolina and Georgia Coast

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The ability of water-resource managers to adapt to future climatic change is especially challenging in coastal regions of the world. There are many municipal water intakes along the Georgia and South Carolina coast that are proximal to the saltwater-freshwater interface of tidal rivers. An increase in the extent of saltwater intrusion along the coast due to climate changes could threaten freshwater intakes for several major cities along the coast. Water-resource managers need estimates of the change in the frequency, duration, and magnitude of salinity intrusion near their water intakes that may occur as a result of climate change.

Salinity intrusion results from the interaction of three principal forces - streamflow, mean tidal water-levels, and tidal range. To analyze, model, and simulate hydrodynamic behaviors at critical coastal gage locations along the Atlantic Intracoastal Waterway and Waccamaw River near Myrtle Beach, S.C., and Savannah River near Savannah, GA, data-mining techniques were applied to over twenty years of hourly streamflow, coastal water-quality, and water-level data. Artificial neural network (ANN) models were trained to learn the specific variable interactions that cause salinity intrusions. Streamflows into the estuarine systems are input to the models as time-delayed variables and accumulated tributary inflows. Tidal inputs to the models were obtained by decomposing tidal water-level data into a "periodic" signal of tidal range and a "chaotic" signal of mean water levels. The ANN models were able to accurately reproduce historical salinity dynamic behaviors in both systems.

User-defined hydrologic and coastal water-level inputs from down-scaling of regional climate models can be simulated in the salinity intrusion models to evaluate various climate-change scenarios. The models for the two systems are deployed in a decision support system and disseminated as a spreadsheet application to facilitate the use of the models for management decisions by a variety of coastal water-resource managers. Preliminary model results near a municipal freshwater intake indicate that a sea-level rise of 1 foot (30 centimeter) would double the daily frequency of brackish water over a seven-year model simulation. Water-resource managers can use this information to plan mitigation efforts to adapt to potential effects from climate change.

0090
D4-3

Modeling Hydrologic Alteration and Ecosystem Response to Climate Change in the Southeastern US

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Resource managers are at the forefront of a new era of management. They must consider the potential impacts of climate change on the Nation's resources and proactively develop strategies for dealing with those impacts on terrestrial and aquatic ecosystems. This requires rigorous, scientific understanding of the interactions among the varying components of the atmospheric, hydrologic, terrestrial, and biological systems and the ability to predict future changes to these systems. The Southeast Regional Assessment Project (SERAP) is the first regional assessment by the USGS National Climate Change and Wildlife Science Center to analyze climate-change data and develop tools for assessing how changing conditions are likely to impact resources.

SERAP is using an interdisciplinary approach to examine climate change and ecosystem responses. Statistically downscaled climate models provide information on long-term average changes and high-impact climate extremes. Probabilistic forecasts of sea-level rise along the Gulf Coast incorporate parameters that affect land-surface elevation such as inundation, erosion, subsidence, and accretion. These and other new tools will assist resource managers to predict areas most impacted by sea-level rise. Regional climate models are integrated with urbanization and vegetation dynamics models to assess landscape change and its affect on bird species. A watershed model of the Apalachicola-Chattahoochee-Flint River Basin simulates streamflow and water temperature conditions in response to future climate scenarios. Ecological models that incorporate these simulated streamflow and water-temperature changes will predict the distribution of fish and mussel species under altered conditions.

0375
D4-4

The Indigenous Observation Network (ION): Preliminary Results of Long-Term Water Quality Monitoring in the Yukon River Basin to Address Climate Change

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The Yukon River Inter-Tribal Watershed Council (YRITWC) Science Department was developed to address increasing concerns about observed changes and the health of the Yukon River voiced by Indigenous Peoples living in the Yukon River Basin (YRB). As a result, the YRITWC Science Department has partnered with the US Geological Survey (USGS) and over 20 Alaska Native Tribes and Canadian First Nations to create the largest international Indigenous Observation Network (ION) in the world. Long-term datasets have proven to be indispensable in documenting trends in systems and identifying drivers that cause noticeable shifts from baseline conditions. These datasets are becoming increasingly important, as changing climate begins to alter the livelihoods of people around the world. The livelihoods of Indigenous populations, who rely on subsistence resources, will likely be the first to feel the more substantial effects of a changing climate. The foundation of ION is the participation and support of Tribes and First Nations within the YRB in Alaska and Canada. Interested participants from the Tribes and First Nations were trained to collect water samples and follow protocols in accordance with USGS standard methods. Water quality parameters, including pH, alkalinity, major ions, dissolved organic carbon, greenhouse gases, and water isotopes, have been collected from 45 sites during 2001–2010. Of these sites, five have been continuously sampled since 2001. The ION sampling efforts include simultaneous biweekly collections from widely distributed sites on the Yukon River and tributaries by the indigenous technicians. From these data we are assessing possible trends in the river system, observing major tributary influence and seasonal variation on the Yukon River, and calculating loads of chemical constituents. Data collection continues in an effort to extend the long-term database to better understand the effects of climate change on this major river system.