Abstracts

Tuesday, April 29

Session E4: Assessing Effects of Climate Change

3:30 – 5:00 pm | Room 237

Regional Vulnerability Assessments to Detect Climate Change Effects in Streams

Britta Bierwagen[1], Anna Hamilton[2], Jen Stamp[3], Jonathan Witt[4], Angelica Murdukhayeva[4] and Margaret Passmore[5]
[1]US Environmental Protection Agency, Washington, D.C., [2]Tetra Tech, Inc., Santa Fe, N.M., [3]Tetra Tech, Inc., Montpelier, Vt., [4]ORISE, Washington, D.C., [5]US Environmental Protection Agency, Wheeling, W.Va.

Abstract
Climate change effects on stream ecosystems will vary throughout the United States, influenced by many factors across spatial and temporal scales. The degree to which climate change impacts a specific aquatic community depends on its exposure and its sensitivity to these changes. The capacity for a community to adapt further modifies this impact, leading to an overall vulnerability. While assessments of vulnerability are conceptually straightforward, quantifying vulnerability is challenging due to data gaps for both current conditions and future trajectories, as well as the ecological interactions and processes that characterize sensitivity and adaptation. Despite these obstacles, the United States Environmental Protection Agency (US EPA) has been collaborating with states and US EPA regional offices in the northeast, mid-Atlantic and southeast to collect available data in order to assess which ecoregions, watersheds, or other stream classes may be more vulnerable to effects of climate change. We selected three exposure scenarios relevant to stream communities: increasing water temperature, increases in heavy precipitation events, and extended periods of low flow. This presentation discusses current data needs, the methodology used to conduct the assessments, how climate scenarios and environmental variables were selected, expected ecological impacts related to each scenario, and how results are being applied could be expanded to other parts of the US.

Stream Classification in Support of Regional Monitoring to Detect Climate Change Effects

Jonathan Witt[1], Jennifer Stamp[3], Maggie Passmore[2], Anna Hamilton[4] and Britta Bierwagen[1]
[1]US Environmental Protection Agency, Arlington, Va., [2]US Environmental Protection Agency, Wheeling, W.Va., [3]Tetra Tech, Montpelier, Vt., [4]Tetra Tech, Santa Fe, N.M.

Abstract
Climate-related impacts on streams are occurring now and are predicted to increase. Expected impacts include rising temperatures, changes in the timing, intensity, and frequency of precipitation, and extended summer low flows. A number of state biomonitoring programs have expressed an interest in incorporating annual monitoring at minimally disturbed sites to detect temporal, climate driven stream changes and to better distinguish these effects from other stressors. The United States Environmental Protection Agency (US EPA) has been collaborating with states and US EPA regional offices to develop connected regional monitoring networks in the northeast, mid-Atlantic and southeast. To inform the design of these networks, survey data from the National Aquatic Resource Surveys have been used to identify aquatic communities along environmental gradients to create a stream classification that can be applied across the three regions. Here, we describe the classification groups that have been developed for the monitoring networks, methods that were used to identify them, and their expected vulnerability to potential climate scenarios.

Coastal Monitoring Network to Study Effects of Climate Change on Ecosystem Processes

Patricia Cunningham[1], Kimberly Matthews[1], Susan Cohen[2], Michael Piehler[3], Craig Tobias[4] and Norm Christensen[5]
[1]*RTI International, Research Triangle Institute, N.C.,* [2]*Marine Corps Base Camp Lejeune, Jacksonville, N.C.,* [3]*University of North Carolina at Chapel Hill, Morehead City, N.C.,* [4]*University of Connecticut, Groton, Conn.,* [5]*Duke University, Durham, N.C.*

Abstract
Military installations and other facilities in estuarine/coastal areas are at particular risk from climate change associated with changes in extreme weather (*i.e.*, severe droughts, heavy rainfall events, warming temperatures, and increased storms) and rising sea level compounded by storm surge. Installation managers need to understand the trade-offs between military training sustainability, ecosystem resilience, and other ecosystem service dependencies in a changed climate. The Defense Coastal/Estuarine Research Program (DCERP) was created to conduct basic and applied research on the coastal ecosystems. This 10-year program was initiated in 2007 with the development of a network of monitoring stations across the aquatic/estuarine, coastal marshes, coastal barrier, and terrestrial ecosystems. The first five years of DCERP focused on understanding chemical, biological, and physical processes and stressors regulating these ecosystems of the New River Estuary in North Carolina. The second five years of the program are focusing on how these ecosystem processes including nutrient and carbon cycling may respond to climate change through the use of predictive models and to assess opportunities for management of carbon in these coastal ecosystems.

The DCERP monitoring network includes systematic, time-series observations of drivers to determine the status, trends, and natural variations of measured parameters in these ecosystems. Data and outcomes from research and monitoring efforts feed into modeling and assessment tools which provide the ability to identify synergies and conflicts among carbon management strategies amidst other priorities such as military mission sustainability, natural resource conservation, and water quality management. Collectively, research and monitoring efforts encompass an integrated continuum of ecosystem response to changing climate with respect to carbon storage, ecosystem services, and managed habitat sustainability. Research results and transfer of management-focused, decision-support and predictive modeling tools will form the basis for adaptive management recommendations to managers to sustain these coastal habitats. This presentation will focus on how the monitoring network supports scaling of field measurements for relatively small dimensions to the watershed and climate change scales of the predictive modeling tools.

Rising Air and Stream-Water Temperatures in Chesapeake Bay Region, USA

Karen Rice[1,2] and John Jastram[1]
[1]*US Geological Survey, Richmond, Va.,* [2]*University of Virginia, Charlottesville, Va.*

Abstract
Trends in monthly mean air temperature (AT) at 85 sites and instantaneous stream-water temperature (WT) at 129 sites for the period 1960-2010 were determined for the mid-Atlantic region of the eastern USA. The study area includes 85% of the Chesapeake Bay watershed; previous work indicates the bay is warming. Statistically significant regional trends with means of 0.019 °C yr-1 for AT and of 0.011 °C yr-1 for WT were detected. Temperature anomalies for two periods, 1961-1985 and 1985-2010, relative to the climate normal period of 1971-2000, indicated that the latter period was statistically significantly warmer than the former period for both mean AT and mean WT. Relations between 190 landscape factors and significant WT trends were examined. Measures of watershed elevation, relief, and slope were inversely correlated with WT trends, suggesting that warming trends are damped in higher-elevation settings. The mean WT trend for watersheds with southeastern aspects was three times greater than the trend for those without such aspects; the increasing WT trends for both groups were statistically significant, suggesting that both solar radiation and AT contribute to warming streams in the region. Inverse correlations were found for measures of developed land cover, including population density, suggesting that urbanization is not a strong driver of stream warming. Continued warming of Chesapeake Bay and its contributing streams will likely lead to changes in water quality and will result in shifts in the distributions of aquatic biota.