CLIMATE CHANGE AND WATERSHED MERCURY EXPORT IN A COASTAL PLAIN WATERSHED

Heather Golden, Christopher D. Knightes, Paul A. Conrads, Toby D. Feaster, Gary M. Davis, Stephen T. Benedict, Paul M. Bradley[1]

Future changes in climatic conditions may affect variations in watershed processes (e.g., hydrological, biogeochemical) and surface water quality across a wide range of physiographic provinces, ecosystems, and spatial scales. How such climatic shifts will impact watershed mercury (Hg) dynamics and hydrologically-driven Hg transport is a significant concern. We apply an ensemble of watershed models to simulate watershed hydrological and total Hg (HgT) fluxes from the landscape to the watershed outlet (i.e., HgT export) and water column HgT concentrations in response to a set of statistically-downscaled climate change projections in a Coastal Plain watershed. Three watershed models are used to quantify and bracket potential changes in hydrologic and HgT export, including the Visualizing Ecosystems for Land Management Assessment Model for Hg (VELMA-Hg), the Grid Based Mercury Model (GBMM), and TOPLOAD, a water quality constituent model linked to TOPMODEL hydrological simulations. Based on downscaled estimates from two global circulation models (i.e., ECHO, which represents dry future conditions for the region, and CCSM3, which reflects wet future conditions) we estimate a 19 percent decrease in average annual watershed HgT export in response to climate change using the ECHO projections and a 5 percent increase with the CCSM3 projections in the study watershed. Average monthly watershed HgT export increases using both climate change projections in the late spring (March through May), when HgT concentrations and streamflow are high. Results suggest that hydrological transport associated with changes in precipitation and temperature is the primary mechanism driving HgT export response to climate change. Our ensemble watershed model approach highlights the uncertainty associated with projecting climate change responses – both hydrologically and biogeochemically – and the use of such projections in future watershed management and planning efforts.

[1]Heather Golden, Research Physical Scientist, US Enviornmental Protection Agency, Office of Research & Development, National Exposure Research Laboratory, Cincinnati, OH 45268
Christopher D. Knightes, Environmental Engineer, US.Enviornmental Protection Agency, Office of Research & Development, National Exposure Research Laboratory, Athens, GA 30605
Paul A. Conrads, Surface Water Specialist, US Geological Survey, South Carolina Water Science Center, Columbia, SC 29210
Toby D. Feaster, Hydrologist, US Geological Survey, South Carolina Water Science Center, Clemson, SC 29631
Gary M. Davis, Enviornmental Engineer, US Enviornmental Protection Agency, Office of Research & Development, National Exposure Research Laboratory, Athens, GA 30303
Stephen T. Benedict, Hydrologist, US Geological Survey, South Carolina Water Science Center, Clemson, SC 29631
Paul M. Bradley, Hydrologist, US Geological Survey, South Carolina Water Science Center, Columbia, SC 29210

Citation for proceedings: Stringer, Christina E.; Krauss, Ken W.; Latimer, James S., eds. 2016. Headwaters to estuaries: advances in watershed science and management—Proceedings of the Fifth Interagency Conference on Research in the Watersheds. March 2-5, 2015, North Charleston, South Carolina. e-Gen. Tech. Rep. SRS-211. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 302 p.