

National Scale Modeling to Evaluate Impacts of Climate Change on Hydrology and Water Quality

Project Summary: EPA ORD's 20 Watershed Modeling Project

The U.S. EPA's Global Change Research Program (GCRP) is conducting watershed modeling in 20 large, U.S. watersheds to:

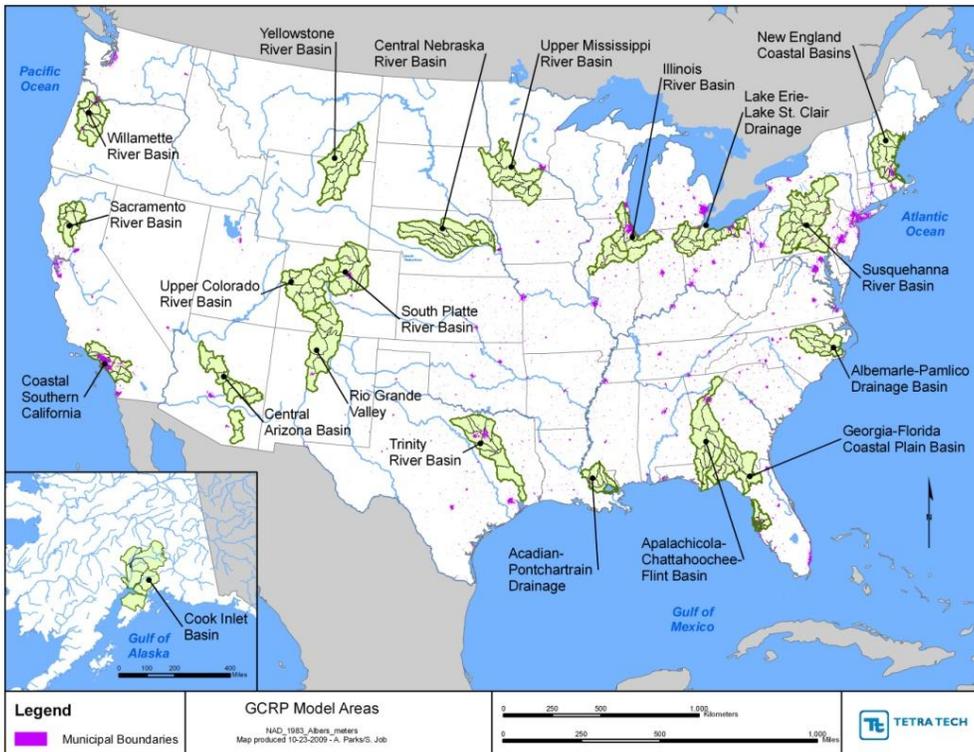
- characterize the sensitivity of U.S. streamflow, nutrient (total N and P), and sediment loading to climate change across a broad range of plausible mid-21st Century climate futures
- better understand the potential interactions of these climate changes with increasing urbanization in these watersheds (changes in agriculture and other land-use types are not considered in this study)
- evaluate the sensitivity of modeling results to different methodological choices such as the integration of existing tools (e.g., climate models, land-use models, watershed models) and datasets to address these scientific questions

The scientific uncertainties related to our understanding of the physical climate system are large, and they will continue to be large for the foreseeable future. Faced with this uncertainty, our general strategy is to take a scenario-based approach to the problem. Scenarios are used in assessments to provide alternative views of future conditions considered likely to influence a given system or activity. By systematically exploring the implications of a wide range of plausible alternative futures, or scenarios, we can reveal where the greatest vulnerabilities lie.

Watershed Modeling

Study watersheds were selected based on a range of criteria including distribution across geographic, hydrologic, and climatic characteristics; representation of a wide range of relevant issues; and the availability of hydrologic and water quality data for model calibration and validation.

Modeling experiments will consider the effects of future climate change alone, land-use change alone (urban development only, other types of land-use change are not considered), and the effects of coupled climate and land-use change on streamflow, total N, total P, and sediment loads. All future climate and land-use change scenarios will be based on the IPCC A2 greenhouse gas emissions scenario for mid-century, circa 2050. Climate change scenarios for this study have been acquired from the North American Regional Climate Change Assessment Program (NARCCAP), run out of the National Center for Atmospheric Research (NCAR), supplemented by bias corrected and statistically downscaled data from the archive of developed by Bureau of Reclamation/Santa Clara University/Lawrence Livermore. Land-use change scenarios have been acquired from the EPA GCRP's Integrated Climate and Land Use Scenarios (ICLUS) project. The ICLUS dataset provides national-scale scenarios of changes in urban and residential land developed using a demographic model (a cohort-component



Watershed modeling locations – EPA ORD 20 Watershed study

model and gravity model), coupled with the Spatially Explicit Regional Growth Model (SERGOM) spatial allocation model.

All 20 watersheds will be modeled using the SWAT (Soil water Assessment Tool) model using a consistent set of climate and land-use change scenarios. In a subset of 5 study watersheds, referred to as pilot sites, additional simulations will also be conducted to address methodological questions related to the conduct of climate change impacts assessments. The pilot watersheds are the Willamette, Salt/Verde/San Pedro, Minnesota, Appalachian/Chattahoochee/Flint, and Susquehanna basins. In these watersheds, a second watershed model, the Hydrologic Simulation Program-Fortran (HSPF), will be run using the same climate and land-use scenarios used with SWAT to assess the influence of different watershed models on simulated hydroclimatic sensitivity. Pilot watersheds will also be evaluated for additional climate change scenarios to assess hydroclimatic sensitivity to different methods of downscaling climate data. All watershed models are constructed at a scale approximating HUC10s, but the finest spatial resolution of model calibration and output will be on the order of HUC8 watersheds.

It should be noted that several study watersheds are complex, highly managed systems including water management operations that are not represented in detail by these models. Information from this study is intended to assess the general sensitivity of streamflow and water quality to underlying watershed processes. It is not the intent and is beyond the scope of this study to develop detailed, place-based models and scenarios of future change, including specific management activities, in individual study watersheds.