Technology Innovation Project

Project Brief

TIP 304: Predicting the Hydrologic Response of the Columbia River System to Climate Change

Context

Global climate change, largely caused by burning of fossil fuel and changes in land use, is expected to lead to a significant warming of the planet over the coming decades, particularly in the polar and alpine regions of the planet.

This increase in temperature will be accompanied by changes in other aspects of the climate system, such as atmospheric circulation and precipitation. Resulting changes in hydrological fluxes (streamflow, evapotranspiration) and states (snow water equivalent, soil moisture) are likely to change the flow regime of many rivers around the world.

The Columbia River's flow regime is heavily dependent on seasonal snow melt, and will likely experience significant changes in the timing and total volume of the streamflow.

Description

This project updates and enhances the existing climate change streamflow hydrologic dataset that was developed for use by the Columbia River Basin Management Joint Operating Committee (RMJOC) in 2009-2011 to incorporate recent global and regional model output.

The project leverages and expands on existing projects within the University of Washington's Land Surface Hydrology Group and its partner Oregon State University that are using multi-model approaches to hydrological prediction, downscaling and bias correction approaches, and regional scale climate and hydrological modeling.

We also incorporate ongoing work in the explicit representation of glacier processes in hydrological models as well as efficient methods for estimating seasonal changes in runoff associated with different climate change projections.

Improvements and changes relative to the existing streamflow dataset consist of the following:

- latest CMIP5 climate change scenarios, which also form the basis for the upcoming IPCC AR5 climate change assessments, as well as recent regional climate modeling

- rapid evaluation of a large number of climate change projections to estimate changes in seasonal streamflow. This methodology can also be used by BPA after the end of the project to update seasonal streamflow projections as more climate change simulations become available

- multiple downscaling methods, including the hybrid delta method that formed the basis for the existing streamflow dataset. New methods will fully exploit daily archives of CMIP5 global model output (CMIP3 archives, which were the basis for the previous study, are mostly limited to monthly climate model output)

- multiple hydrological models, including the explicit representation of glacier processes in at least one of them and recalibration of the model parameters of the VIC hydrological model.

We will use the same model domain and streamflow locations as have been used for the existing streamflow dataset. This includes the Columbia River Basin, the coastal parts of Washington and Oregon State, the Olympic Peninsula and the Puget Sound drainage basin.

Why It Matters

Long-term planning efforts need access to the best possible estimates of future climate change. Climate change scenarios based on the latest climate science are not only relevant to water resources management decisions made by the RMJOC, but are also required for National Environmental Policy Act (NEPA) analyses of large capital projects by BPA business lines such as Transmission and Environment, Fish, and Wildlife.

Large organizations such as BPA will make use of the latest emission pathways, climate model simulations, and related scientific advances that form the basis of Intergovernmental Panel on Climate Change (IPCC) reports. This means the existing datasets need to be updated to reflect the CMIP5 model simulations.

In completing this research, BPA is also striving to implement President Obama's Executive Order on November 1, 2013 requiring all federal agencies to develop science-based actions to increase our resiliency from the impacts of global climate change (see links).

Goals and Objectives

The goal of this project is the development of a climate change streamflow dataset for the Columbia River Basin using CMIP5 and NARCCAP and CORDEX climate model simulations.

Deliverables

The deliverables for this project will be the streamflow time series and hydrological data sets for the period 1950-2100. These data sets will be delivered in a format that can be used by BPA and its partners as input to their hydroregulation models.

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Project Start Date: October 1, 2013

Project End Date: September 30, 2016

Reports & References

Links

[Executive Order 13653 -- *Preparing the United States for the Impacts of Climate Change*](#)

Participating Organizations

University of Washington

Oregon State University

Funding

Total Project Cost:	$1,434,606
BPA Share:	$712,160
External Share:	$722,437
BPA FY2015 Budget:	$203,598

For More Information Contact:

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