Study: Columbia River glaciers, streamflow changes

January 16 2014, by Michelle Ma

An aerial view of Bonneville Lock and Dam on the Columbia River. The dam is about 40 miles east of Portland, Ore. Credit: Kevin Wingert, Bonneville Power Administration

(Phys.org) —The Columbia River is perhaps the most intricate, complex river system in North America. Its diverse landscape crosses international borders and runs through subarctic, desert and sea-level ecosystems. Surrounding communities rely on the river for fishing, agriculture, transportation and electrical power.

As the Earth warms, experts know the Columbia will change – they just don't know how much or when.

University of Washington environmental engineers are launching a new study to try to understand how climate change will affect streamflow patterns in the Columbia River Basin. The team will look at the impact of glaciers on the river system, the range of possible streamflow changes and how much water will flow in the river at hundreds of locations in future years.

"Getting a new set of streamflow predictions factoring in climate change will help guide long-term decision-making for the Columbia River Basin," said Dennis Lettenmaier, a UW professor of civil and environmental engineering. He is leading the project with Bart Nijssen, UW researcher in civil and environmental engineering, and Philip Mote of Oregon State University.

The Columbia River's headwaters are in the Rocky Mountains of British Columbia, and the waterway winds about 1,200 miles through Washington and along the border of Oregon before emptying into the Pacific Ocean. Hydroelectric dams provide cheap electricity to roughly three quarters of the Pacific Northwest's population and help with flood control throughout the basin, particularly in the Portland metro area. It's also an important waterway for migrating salmon, steelhead and sturgeon, and for navigation, irrigation and agriculture.

Changes in streamflow due to climate change could affect hydropower and flood control operations on the Columbia as well as fisheries management and future policy decisions, including a possible treaty renegotiation between the U.S. and Canada.

The Columbia River. Credit: Kevin Wingert, Bonneville Power Administration

The UW researchers will use the most recent projections from the Intergovernmental Panel on Climate Change along with climate and hydrology models to come up with a dataset of streamflow predictions for Bonneville Power Administration, the U.S. Army Corps of Engineers and the Bureau of Reclamation, which jointly commissioned this study. The Bonneville Power Administration's Technology Innovation Office, Oregon State University and the UW are funding the study, which leverages glacier model developments from a NASA-funded interdisciplinary science project.

"Hopefully, this study will be able to better bracket the uncertainty that exists methodologically between all these climate and hydrology models. If we want to be able to plan ahead on a 20- to 50-year timescale, we need to know what range of uncertainty to expect," Nijssen said.

The impact that declining glaciers could have on the basin hasn't fully been studied by U.S. scientists until now, though Canadian researchers recently started to look at their role. Glaciers are receding across the region and, as temperatures warm, they will continue to melt and erode. In 2005, glaciers covered about 420 square miles in the upper reaches of the Canadian Columbia Basin, or roughly 5 percent of that area. Twenty years before glaciers covered 490 square miles.

Melting glaciers put more water into the river system and boost its flow, but only for a period. This short-term boost could actually benefit the river – especially during low-flow periods in the drier summer months – but only in the short term. As the glaciers eventually disappear, perhaps as early as 2100, this added water will also disappear and further reduce already low summer flows, researchers say.

But the river's yearly flows depend mostly on melting snowpack. Cooler spring and early summer temperatures can preserve mountain snowpack until the drier months, when water from melting snow is important to keep river flows high enough for migrating fish. As the climate warms, though, the timing of when that crucial snow melts and discharges into the river also is likely to change.

"The hydrology of the Columbia River basin is really driven by winter snow accumulation and melting in the spring and summer months. When it warms up, you change that balance," Lettenmaier said.

The UW's data could have policy implications for the Columbia River. Since 1964, a treaty between the U.S. and Canada has governed the river for hydropower production and flood control. But starting in 2014, each country can notify the other of an intent to terminate or modify this treaty. Changes to the treaty could be implemented as early as 2024.

"We want to have the best scientific information possible to help federal agencies and other regional stakeholders in long-range decision-making," said Erik Pytlak, manager of the weather and streamflow forecasting for the Bonneville Power Administration. "With or without a treaty, climate change is coming. It will be beneficial for all of our partners and customers in the region to have an updated understanding of what climate change is doing to the region."

The UW's streamflow predictions will be publically available after the study is finished in three years. Similar studies are underway at Portland State University, also funded by Bonneville, and by climate scientists in Canada.

Provided by University of Washington