

Flooding in the Columbia River basin expected to increase under climate change

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Credit: Oregon State University

The Columbia River basin will see an increase in flooding over the next 50 years as a result of climate change, new modeling from Oregon State University indicates.

The magnitude of flooding—the term used to describe flooding severity—is expected to increase throughout the basin, which includes the Columbia, Willamette and Snake rivers and hundreds of tributaries. In some areas, the flooding season will expand, as well.

"The flood you're used to seeing out your window once every 10 years will likely be larger than it has been in the past," said the study's lead author, Laura Queen, a research assistant at OSU's Oregon Climate Change Research Institute.

The findings are based on natural river conditions and do not take into account potential flood control measures, including dams, but the increases are significant nonetheless, said study co-author Philip Mote, a professor in the College of Earth, Ocean, and Atmospheric Sciences and dean of the Graduate School at OSU.

"We don't know how much of this increased flood risk can be managed through mitigation measures until we study the issue further," Mote said. "But managing a 30% to 40% increase, as is predicted for many areas, is clearly beyond our management capabilities."

The findings were published recently in the journal *Hydrology and Earth System Science*. Co-authors are David Rupp of the Oregon Climate Change Research Institute and Oriana Chegvidden and Bart Nijssen of the University of Washington.

The study emerged out of Queen's work on her honors thesis as an undergraduate in the University of Oregon's Robert D. Clark Honors College. Queen, a Corvallis native, continued the work at OCCRI and is now enrolled in a doctoral program at Victoria University of Wellington in New Zealand.

The goal of Queen's research was to better understand how flooding in the Columbia River basin might change as the planet warms. The Columbia River drains much of the Pacific Northwest, including portions of seven states and British Columbia. It has the fourth-largest streamflow volume in the United States.

The Pacific Northwest has a history of costly and disruptive flooding. The largest flood in modern history occurred in late spring 1948 when flooding from the Columbia River destroyed the city of Vanport, Oregon, displacing more than 18,500 people. Floods on the Chehalis River in 2007 and 2009 closed Interstate 5 in Washington and floods along the Willamette River in 1996 and 2019 caused hundreds of millions of dollars in damage.

Queen ran simulations using hydrology models and a previously collected set of streamflow data for 396 sites throughout the Columbia River basin and other watersheds in western Washington. The data included a 50-year window from the past, 1950-1999, as well as a 50-year window of expected streamflows in the future, 2050 to 2099, that was developed using several different climate models.

Previous studies predicting future streamflows showed mixed results, but the results of this new analysis were clear and surprising, Mote said.

"This was the best and most complete set of data," he said. "It shows that the magnitude of one-, 10- and 100-year floods is likely go up nearly everywhere in the region. These are profound shifts."

The Willamette River and its tributaries are expected to see the biggest increase in flooding magnitude, with 50% to 60% increases in 100-year floods. The streamflows are expected to be smaller downstream and grow larger upstream.

On the Snake River, streamflows will grow larger as they move downstream until they reach the confluence of the Salmon River tributary and then will drop abruptly. Parts of the Snake River will see a 40% increase in 10-year floods and a 60% increase in 100-year floods. But below the confluence with the Salmon River on the Oregon-Idaho border, the increase drops to 20% for 10-year floods and 30% for

100-year floods.

The model also suggests a significant increase in the flood season on the Snake River, which is largely concentrated in late spring now but could start as early as December or January in the future, Mote said.

One of the drivers of the change is warmer winters that will see precipitation fall more as rain instead of snow. Lower spring snowpack will lead to earlier spring streamflows in many rivers. The cold upper Columbia River basin in Canada is projected to experience little change in snowpack volume, but the snow will melt faster.

The study's findings could have implications for flood management policy in the coming decades, Mote said. A logical next step in the research is to run the models again and include existing dams to see the role they may play in mitigating flooding.

"This work provides information and impetus for the people who manage [flood risk](#)," he said. "We'll need to know how much of this can be mitigated by existing [flood](#) control."

More information: Laura E. Queen et al, Ubiquitous increases in flood magnitude in the Columbia River basin under climate change, *Hydrology and Earth System Sciences* (2021). [DOI: 10.5194/hess-25-257-2021](#)

Provided by Oregon State University

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