Study finds climate change impact on stream flow differs according to location

February 19 2013

A new analysis of river basins in the western United States suggests that climate change will have the greatest impact on summer stream flows in those waterways that might seem less vulnerable – the large, snow-fed rivers that originate in the high Cascades and other mountain ranges.

Though these iconic rivers – including the Willamette, McKenzie, Deschutes, Klamath and Rogue – appear to have plenty of water, they also may be among the most sensitive to climate change, the study concludes.

Results were published in the journal, *Hydrological Processes*.

"These are big rivers fed by snow that enters deep groundwater systems with highly permeable geology," said Mohammad Safeeq, a post-doctoral researcher at Oregon State University and lead author on the study. "Their response to climate change involves more than just a change in snowfall patterns – the steepness of the terrain and the 'drainage efficiency' of the system are just as important to flow rates.

"We looked at 61years of records and it looks like Cascade streams today have an average summer flow that is about two centimeters lower – or about a 36 percent decline – over historical averages," he added.

Gordon Grant, a research hydrologist with the Pacific Northwest Research Station of the U.S.D.A. Forest Service and co-author on the study, says resource managers shouldn't panic over such analyses, which he hopes won't lead to "fear-mongering."

"Oregon will continue to have plenty of water in the future," Grant emphasized. "The storage offered in our high Cascades groundwater system is a unique gift on this planet and one that won't go away. But it is important to acknowledge that even these big, bountiful rivers will be affected by climate change and that may have an impact on everything from power generation, to irrigation and fish survival."

In their study, the researchers explored daily stream flow data from 81 watersheds across the western United States during the years 1950 to 2010, to explore the drainage efficiency and snowpack dynamics of the systems. They also looked at rain-driven systems and discovered these, too, have experienced declining stream flow in late fall and winter.

While both rain- and snow-driven river systems respond to changing climate differently, the study showed that the intrinsic speed at which water moves through the ground once it falls out of the sky or melts is a key factor in determining how much water will be available in rivers in the future. This speed depends on the steepness of the terrain and the porosity and permeability of the underlying geology.

For instance, the researchers note that in areas with steep slopes and relatively impermeable rocks – such as the Coast Range or older Cascades – rain and snowmelt rapidly run off the land, resulting in high flows in winter and very little water in summer.

In contrast, in young volcanic areas such as the high Cascades the heavy snowfall melts and instead of flowing directly into rivers, much of it seeps into the porous underlying rock and begins a slow journey toward the Deschutes, McKenzie, Rogue and other big river systems.

This slow journey through the rocks means that in a warming climate, when there will be less snow and earlier melt in the spring, rivers draining regions like the Cascades will continue to drop for longer periods, resulting in lower late-summer flows.

"Summer stream flow in rain-driven streams and those in rapidly draining landscapes such as the Coast Range won't be affected as much by climate change because they're already more or less dry in the summer," said Grant, who is a courtesy professor in OSU's College of Earth, Ocean, and Atmospheric Sciences. "Systems like the Calapooia River, for example, just don't have as much water to lose.

"There may be some seasonal differences," he added, "but the impact by the end of summer isn't as great as in the slow-draining systems."

Safeeq, a post-doctoral researcher in OSU's College of Earth, Ocean, and Atmospheric Sciences, noted that no one previously had looked at the magnitude of retrospective stream flow change in different river basins "through the lens of their hydro-geologic differences."

"They act differently and in ways many scientists may not have predicted," Safeeq pointed out. "The bottom line is that slow-draining, snow-driven river systems may appear to be less affected by climate change, but they are in fact most sensitive to change."

Grant noted that the study shows that "we have to look beyond just knowing where snow will turn to rain in the future to predict stream flows. The geology of the landscape and its effect on how fast water moves is equally important."

Provided by Oregon State University

Citation: Study finds climate change impact on stream flow differs according to location (2013,

February 19) retrieved 26 April 2024 from https://phys.org/news/2013-02-climate-impact-stream-differs.html