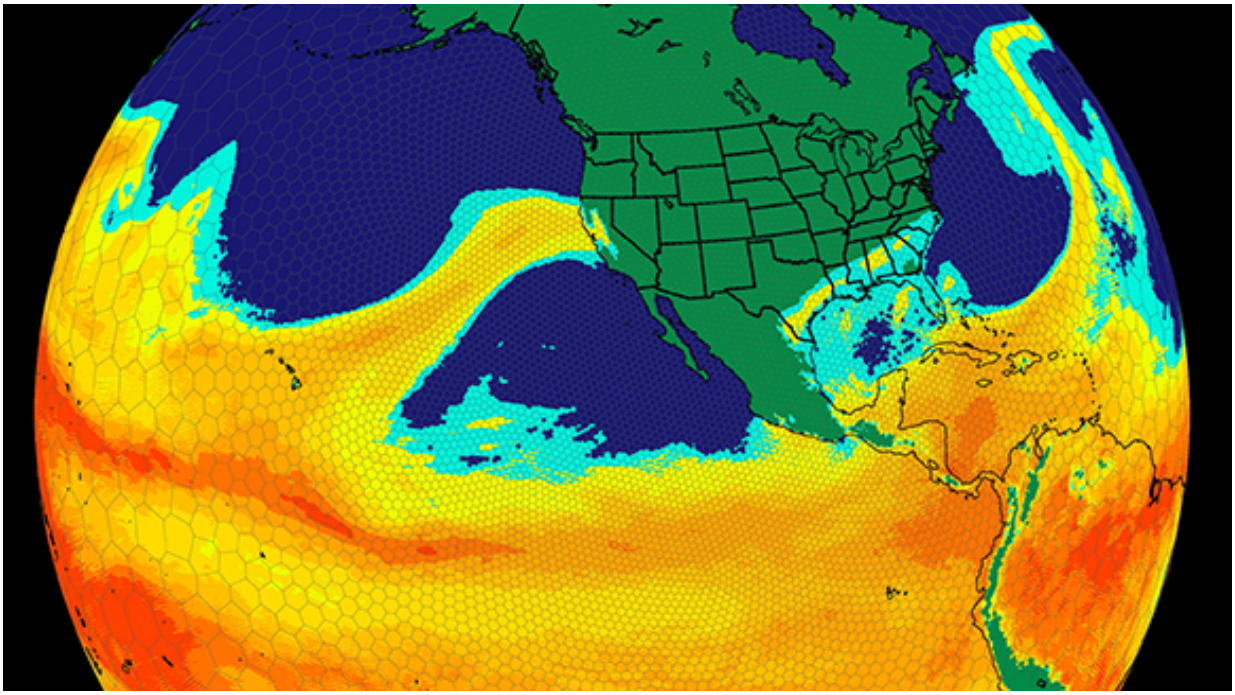
Researchers find more atmospheric rivers will hit western North America

October 16 2015



Atmospheric rivers can slam the western USA with heavy precipitation. In this model representation from the Community Atmosphere Model, vertically integrated water vapor is simulated at 30km high resolution. The simulated atmospheric river shows how moisture (dark yellow and orange) is carried from the tropics to the U.S. west coast.

A strikingly large increase in the number of atmospheric river days awaits the U.S. west coast if climate warming remains relatively

unchecked. Researchers at Pacific Northwest National Laboratory came to that conclusion after analyzing climate model projections through the end of the century under a comparatively high greenhouse gas emission scenario.

The fractional increase in atmospheric river days falls between 50% and 600%, depending on the seasons and landfall locations. These findings indicate that major challenges lie ahead for those managing water resources and flood risk. That is because atmospheric rivers (see sidebar) often produce heavy, cold season precipitation and flooding when they hit the west coast of North America.

"Atmospheric rivers can bring record-setting precipitation when making landfall in western North America. Our research indicates they will be more frequent under climate warming," said Dr. Yang Gao, a post-doctoral researcher and atmospheric scientist at PNNL, "causing increased flooding events."

On average, atmospheric rivers hit the western United States only a few times each winter, but they transport significant amounts of moisture that converges in the mountains producing heavy precipitation. In a warmer climate, the atmosphere can hold even more moisture, so it is not surprising that the number of atmospheric river days will increase in the future. However, it is unclear whether some areas will see larger increases in atmospheric river days than others.

This study found that associated with a poleward shift of the subtropical jet in the North Pacific basin, the number of atmospheric river days increases much more significantly in Alaska during spring because both increased moisture and increased wind speed gang up to increase the frequency of atmospheric rivers. These findings provide important insights for future water resource management throughout the North American west coast.

The PNNL research team analyzed model outputs from 24 global climate models used in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5). They compared two simulations, present and future, of atmospheric rivers determined from the vertically integrated water vapor flux to quantify the changes in atmospheric rivers that make landfall over western North America. To determine what processes contribute to the changes, they designed a rescaling method to isolate the contributions of changes caused by moisture and those caused by winds. The team found that the increased atmospheric moisture in a warmer climate plays the major role in driving the increases of atmospheric rivers. The changes in winds only slightly pull back the increased atmospheric river occurrences.

"Our study designed a method to quantify factors that contribute to the changes in AR days," said Gao. "It clearly points to the overwhelmingly dominant role of increased atmospheric moisture in a warmer climate that produces the increase of AR days. Even though changes in winds do counter such effect, the effect only moderately limits the large increase of AR events in the future."

Researchers next will analyze the same multi-model ensemble of global climate simulations used in this study to investigate the changes in atmospheric rivers in the North Atlantic that make landfall in Europe.

More information: Yang Gao et al. Dynamical and thermodynamical modulations on future changes of landfalling atmospheric rivers over western North America, *Geophysical Research Letters* (2015). DOI: 10.1002/2015GL065435

Provided by Pacific Northwest National Laboratory