The lifecycle of an Atmospheric River – from Moisture Sources to Socioeconomic Impacts

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In December of 2007, an Atmospheric River (AR) impacted the U.S. west coast causing intense flooding in the Chehalis River basin in western Washington state. The AR drew significant amounts of moisture from the tropical Pacific Ocean, which generated extreme precipitation and the maximum flooding recorded in several stream gauges. The flooding resulted in approximately $ 680 million in damages in three counties in the region (Grays Harbor, Lewis and Thurston). We present an integrated modeling system that is able to realistically simulate the atmospheric-hydrologic-hydraulic and socioeconomic processes of this extreme AR.

The question we pose in our study is: what would happen if the December 2007 AR occurred in a warmer climate? With increasing surface temperatures, saturation vapor pressure increases nonlinearly and ARs are able to transport more water vapor – creating a greater potential for extreme precipitation and flooding. We use a pseudo-global warming approach in which the lateral boundary conditions of the atmospheric model (the Weather Research and Forecasting model) are perturbed to simulated an atmosphere with increased greenhouse gas forcing. The changes in atmospheric conditions lead to changes in precipitation, streamflow, flooding extent and inundation depth – which then translate into changes in socioeconomic impacts. Uncertainties in atmospheric forcing are included in our analysis.

This type of integrated modeling approach can provide communities with information about possible future changes related to ARs and vulnerabilities in the system that could lead to severe economic and social impacts. The method can help with adaptation efforts in AR-affected regions.