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Flooding in the Russian River Basin, CA. Photo by Dave Gatley, FEMA

# Atmospheric Rivers

Atmospheric Rivers (ARs) are narrow belts of concentrated moisture transported in the atmosphere, and are a key process linking weather and climate. ARs provide beneficial water supply and snowpack. When fewer than the normal number of ARs occur, drought often results. But ARs can also produce flooding rains that disrupt travel, induce mud slides, and cause catastrophic damage to life and property. Satellites help us detect ARs around the globe. However, once an AR hits land, other instruments and methods are needed for continued monitoring.

## What is the role of atmospheric rivers in creating floods?

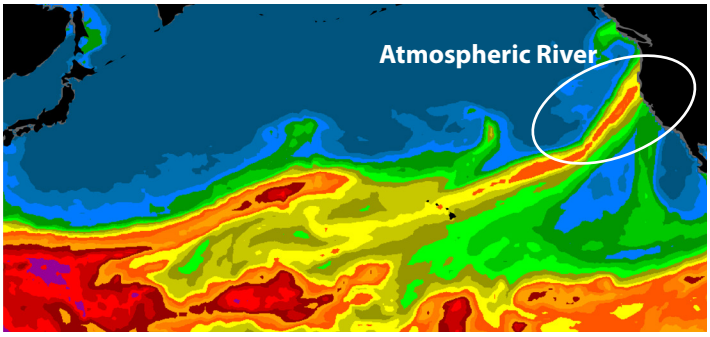
Research at NOAA's Earth System Research Laboratory (ESRL) used satellite data to show that during the winters (November through April) from 1997-2016, there were 217 days on which an AR impacted the California coast. The precipitation caused by these ARs can be beneficial to water supply, but can also lead to devastating floods. Collaborative research between ESRL and Scripps Institution of Oceanography indicates that ARs are responsible for 30-50% of all the precipitation that occurs in California, Oregon, and Washington.

Flooding caused by ARs will become increasingly important as costs associated with extreme weather events continue to increase. Between 2011 and March 2017, weather-related disasters across the U.S. caused 1,643 fatalities and $313 billion in economic damages. Between 1954 and 2017, California had received 83 presidential disaster declarations, of which more than half (48) were related to flooding. The two 2017 declarations were both related to flooding.[1]

## How is this being addressed?

NOAA ESRL conducts research on precipitation and weather conditions that can lead to flooding, and promotes transition of scientific advances and new tools into forecasting operations.

ESRL scientists developed and prototyped an atmospheric river observatory (ARO) designed to further our understanding



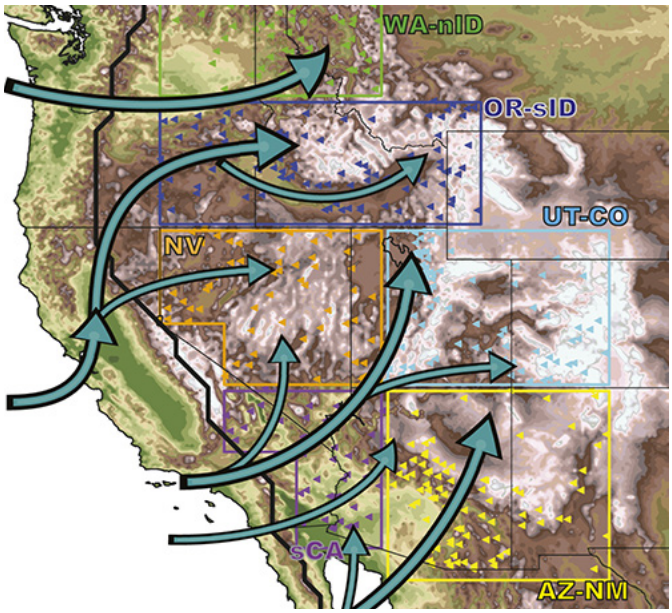
Satellite image of an atmospheric river in February 2017.

1 Statistics in this paragraph from NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2017). https://www.ncdc.noaa.gov/billions/

of the impact of ARs on enhancing precipitation in the coastal mountains and the high Sierra of California. A West Coast network of AROs was recently implemented along the California, Oregon, and Washington coastlines with funding from the California Department of Water Resources and the U.S. Department of Energy.

## What are the benefits?

Improved monitoring, observation-based process understanding and predicting of ARs provide the critical knowledge needed by flood control managers, water supply authorities, and reservoir operators to mitigate the risks of major flood events while being able to take advantage of these heavy rainfall events as drought busters. NOAA ESRL conducts targeted field campaigns using satellite measurements, offshore aircraft reconnaissance, and land-based AROs to guide model forecast system development, leading to improvements in the prediction of AR intensity and duration to support water resource management decisions.




Map showing the major pathways of moisture transport in ARs from the Pacific Ocean into the Intermountain West.

## For more information, visit:

https://www.esrl.noaa.gov/psd/arportal/
https://www.esrl.noaa.gov/psd/data/obs/
https://hmt.noaa.gov

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NOAA electronics engineer Tom Ayers installs equipment for an atmospheric river observatory in Bodega Bay, CA. (Credit: California Department of Water Resources)

Torrential rain from a severe winter storm causes the Russian River to spill over into this vineyard in Sonoma County, CA. (Credit: Adam DuBrowa, FEMA)

Extreme precipitation from several ARs contributed to a flood risk management crisis at California's Oroville Dam in early 2017. (Credit: California Department of Water Resources)