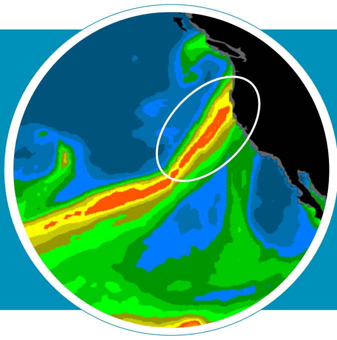


Atmospheric Rivers

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

Extreme precipitation from several ARs contributed to a flood risk management crisis at California's Oroville Dam in early 2017. (Credit: CA-DWR)

NOAA electronics engineer Tom Ayers installs equipment for an atmospheric river observatory in Bodega Bay, CA. (Credit: CA-DWR)

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.

How do atmospheric rivers contribute to flooding?

Research at NOAA's Physical Sciences Laboratory (PSL) used satellite data to show that during the winters (October through April) from 1997-2018, there were 340 days on which an AR impacted the California coast. When an AR stalls over a particular area or when ARs occur in rapid succession, flooding often follows. Collaborative research between PSL 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 1940 and 2020, weather-related disasters across the U.S. caused 19,206 fatalities and $677 billion in economic damages.[1] Between 1954 and 2021, California had received 100 presidential major disaster declarations, of which more than half (59) were related to flooding.[2]

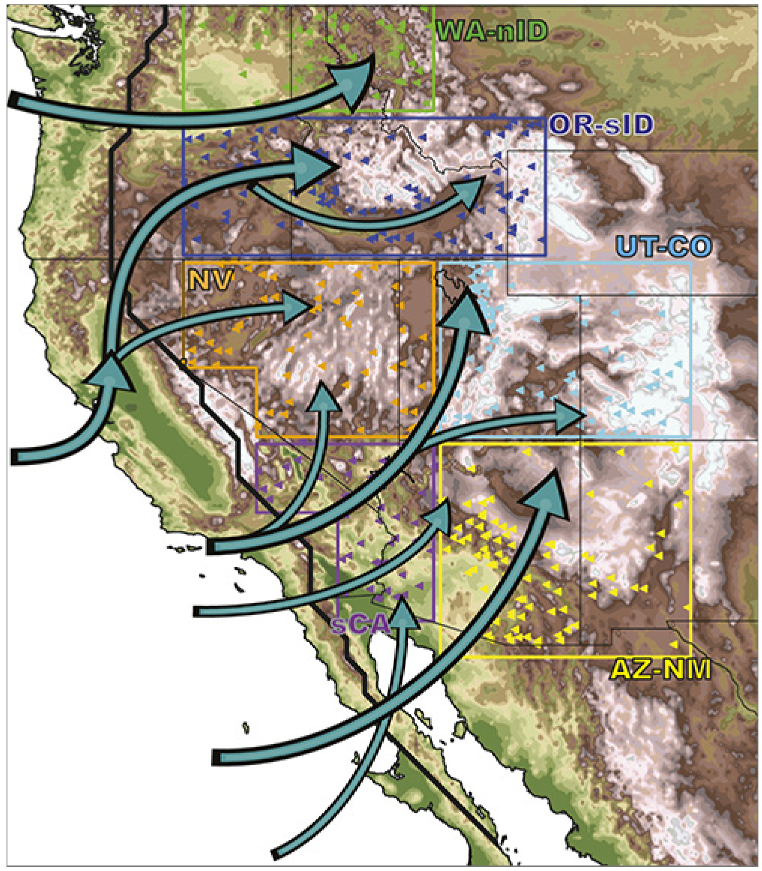
How is this being addressed?

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

1 NOAA National Weather Service, https://www.weather.gov/media/hazstat/80years_2020.pdf
2 FEMA, https://www.fema.gov/disaster/declarations

PSL scientists developed and prototyped an atmospheric river observatory (ARO) designed to further our understanding 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 implemented along the California, Oregon, and Washington coastlines with funding from the California Department of Water Resources (CA-DWR) and the U.S. Department of Energy. Two inland ARO's were added to monitor the inland transport of moisture through a prominent gap in the coastal terrain near the San Francisco Bay Area. Data and specialized display products obtained from the AROs provide forecasters with valuable information about the strength, location, and progression of ARs along the West Coast.

CA-DWR also funded a PSL-led project in the San Francisco Bay Area called Advanced Quantitative Precipitation Information (AQPI), which installed gap-filling, precipitation-scanning radars and other instruments to help improve the monitoring and forecasting of precipitation from ARs in a densely populated area that is not well observed by the National Weather Service operational radar network.



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

What are the benefits?

Improved monitoring, observation-based process understanding and predicting of ARs provide the critical knowledge needed by water supply authorities, reservoir operators, and emergency managers to mitigate the impacts of drought, or the risks of major flood events. PSL conducts targeted field campaigns using satellite measurements, offshore aircraft observations, and land-based AROs to guide forecast model development, which leads to improvements in the prediction of AR intensity and duration to support water resource management decisions.

For more information, visit:

https://psl.noaa.gov/arportal/
https://psl.noaa.gov/aqpi/
https://psl.noaa.gov/data/obs/
https://hmt.noaa.gov

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