

Atmospheric Rivers & Extreme Precipitation Events in Ireland



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What Are Atmospheric Rivers?

- Term coined by Zhu & Newell (1998)
- "narrow corridors of water vapour transport in the lower atmosphere that traverse long swaths of the earth's surface"
- "narrow regions responsible for the majority of the poleward water vapor transport across the mid latitudes"
- 90% of poleward water vapor transport in 4-5 narrow bands at any given time
- IWV > 2cm
- No more than 500km wide, and at least 1000km long
- Occur in the warm conveyor belt of extra-tropical cyclones



What Are Atmospheric Rivers?

Rivers in the Sky

An atmospheric river is a narrow conveyor belt of vapor that extends thousands of miles from out at sea, carrying as much water as 15 Mississippi Rivers. It strikes as a series of storms that arrive for days or weeks on end. Each storm can dump inches of rain or feet of snow.

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Orientation

Origin

Atmospheric rivers usually approach California from the southwest bringing warm, moist air from the tropics.

Duration egastorm can last up 40 days and meander down the coastline Smaller rivers that arrive each year typically last two to three days: "pineapple expresses" come straight from the Hawaii region

Vapor Transport

Moisture is concentrated i a layer 0.5 to 1.0 mile he laver brir tropics, but the river car also pull in atmospheri moisture along its path

Buoyancy The warm, moist air mass easily rises up and over a If a river strikes perpenmountain range; as i dicular to a mountain does, the air cools and ange, much of the vapor moisture condenses into ondenses out. If it strikes at an angle (shown below), a "barrier jet" can random local storms be created that flows along the range, redistrib uting precipitation on the

abundant rain or snow. The river eventually decays into

> Precipitation Several inches of rain or feet of snow can fall unde neath an atmospheric river each day. Moderate storms can bring more than 15 inches of rair

The science behind atmospheric rivers

An atmospheric river (AR) is a flowing column of condensed water vapor in the atmosphere responsible for producing significant levels of rain and snow, especially in the Western United States. When ARs move inland and sweep over the mountains, the water vapor rises and cools to create heavy precipitation. Though many ARs are weak systems that simply provide beneficial rain or snow, some of the larger, more powerful ARs can create extreme rainfall and floods capable of disrupting travel, inducing mudslides and causing catastrophic damage to life and property. Visit www.research.noaa.gov to learn more.

A strong AR transports an amount of water vapor roughly equivalent to 7.5-15 times the average flow of water at the mouth of the Mississippi River.

ARs are a primary feature in the entire global water cycle and are tied closely to both water supply and flood risks, particularly in the Western U.S.

> On average, about 30-50% of annual precipitation on the West Coast occurs to the water supply — and

> > ARs move with the weather and are present somewhere on Earth at any given time.

ARs are approximately 250-375 miles wide on average.

> Scientists' improved understanding of ARs has come from roughly a decade of scientific studies that use observations from satellites, radar and aircraft as well as the latest numerical weather models. More studies are underway, including a 2015 scientific mission that added data from instruments aboard a NOAA ship.

WATER VAPOR COOLS





ERA5 Data – 13th Dec 1994



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The Plan - Part 1

- Identify a significant amount of AR's from ERA5
- MÉRA- investigate precipitation and ARs for dates identified
- Localized flooding in mountainous areas on West Coast
- Are ARs always linked with extra-tropical cyclones?

The Plan - Part 2

- Attempt to build a storm tracking algorithm
- Lagrangian approach to the problem
- Replicate results from an article from University of Reading (Dacre et al., 2015)
- Is there significant transport from the tropics?
- Is it a trail left behind by the cyclone?



Cyclone-centered water vapor transport at 0600 UTC 1 Feb 2002. Surface–500-hPa TCWV (kg m -2), is overlaid with (a) surface–500-hPa moisture flux vectors and (b) surface–500-hPa system-relative moisture flux vectors. Both panels are overlaid with frontal positions. The black arrow head shows the direction of cyclone propagation.

Any Questions?

Thanks for Listening!