

# Role of Atmospheric Rivers in New Zealand's Hydrology

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## Role of ARs in New Zealand's hydrology:

- Floods
- Droughts

# Role of ARs in hydrology - Floods

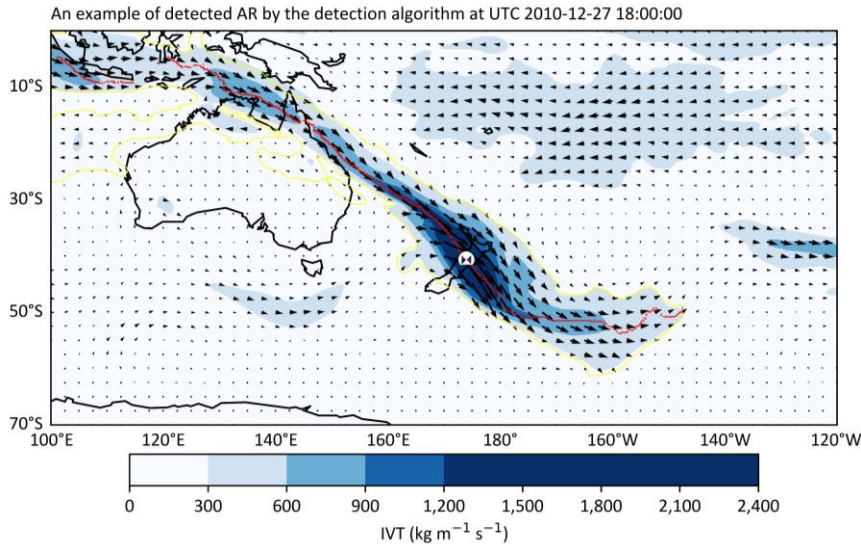
Hon Nikki Kaye  
Minister of Civil Defence

13 September 2013

## Report on West Coast Weather Event 27 & 28 December 2010



Flooding at Saltwater Creek, Paroa, 28 December 2010  
*photo courtesy of Jason Baddy*



Government gives \$536,000 for West Coast flood recovery

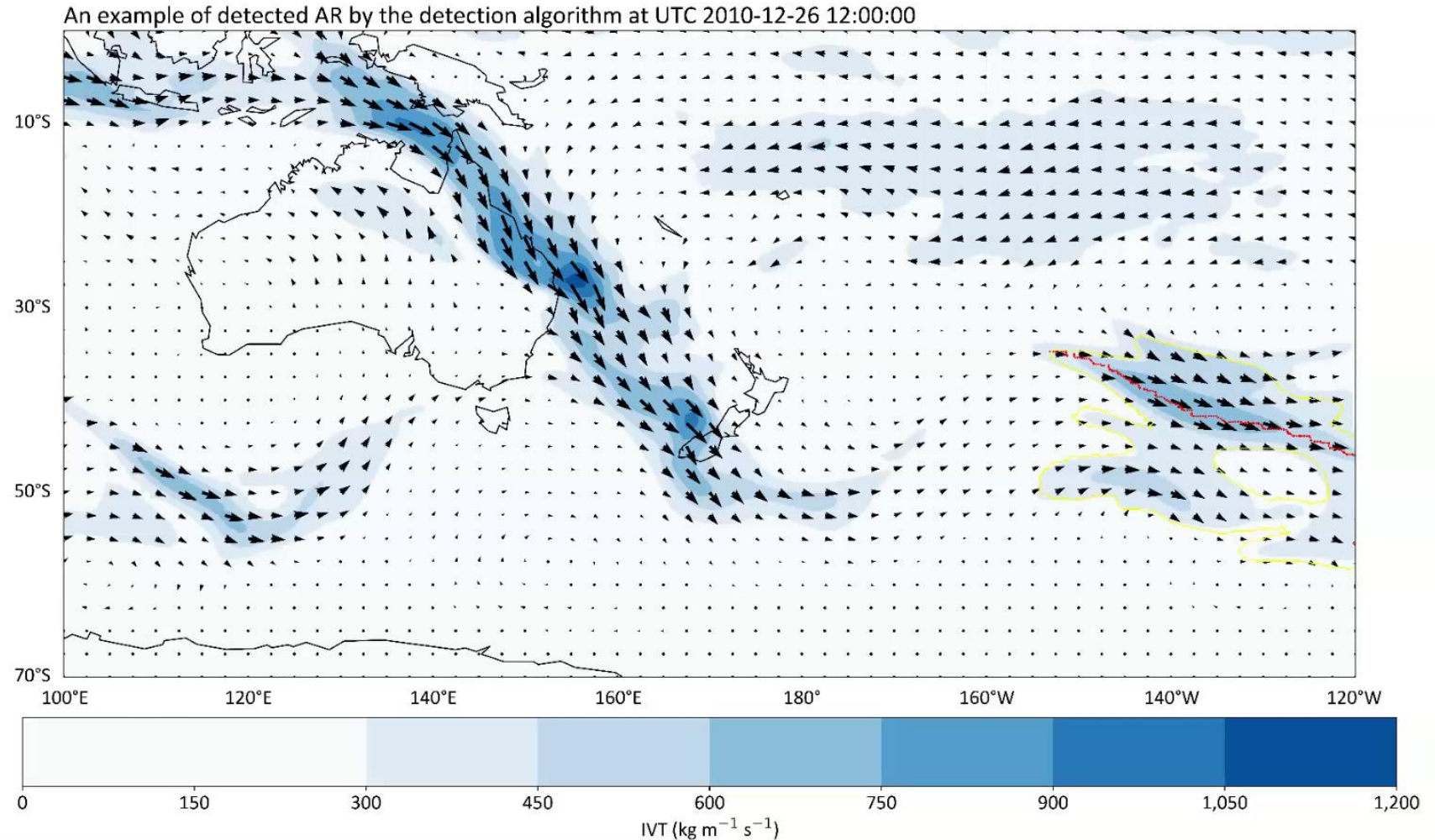
The Government is making a \$536,000 contribution to recovery costs from serious flooding on the West Coast in December 2010, Civil Defence Minister Nikki Kaye said today.

“Over a 48 hour period from 27 December 2010 heavy and persistent rain fell on the West Coast affecting areas from Haast to Karamea. This caused flooding, slips and debris fall, as well as considerable land and property damage and loss of livestock in the region,” Ms Kaye says.

News source: <https://www.scoop.co.nz/stories/PA1309/S00258/government-gives-536000-for-west-coast-flood-recovery.htm>

# Role of ARs in hydrology - Floods

- Developed at 26 Dec 2010 UTC
- Core part approached the west coast at 27 Dec 2010
- Left the country at 28 Dec 2010



Video: <https://www.youtube.com/watch?v=T-TEj3gG5qQ>

# Role of ARs in hydrology – Droughts

- Absence of ARs may increase the occurrence of hydrological droughts (Paltan *et al.*, 2017) in New Zealand

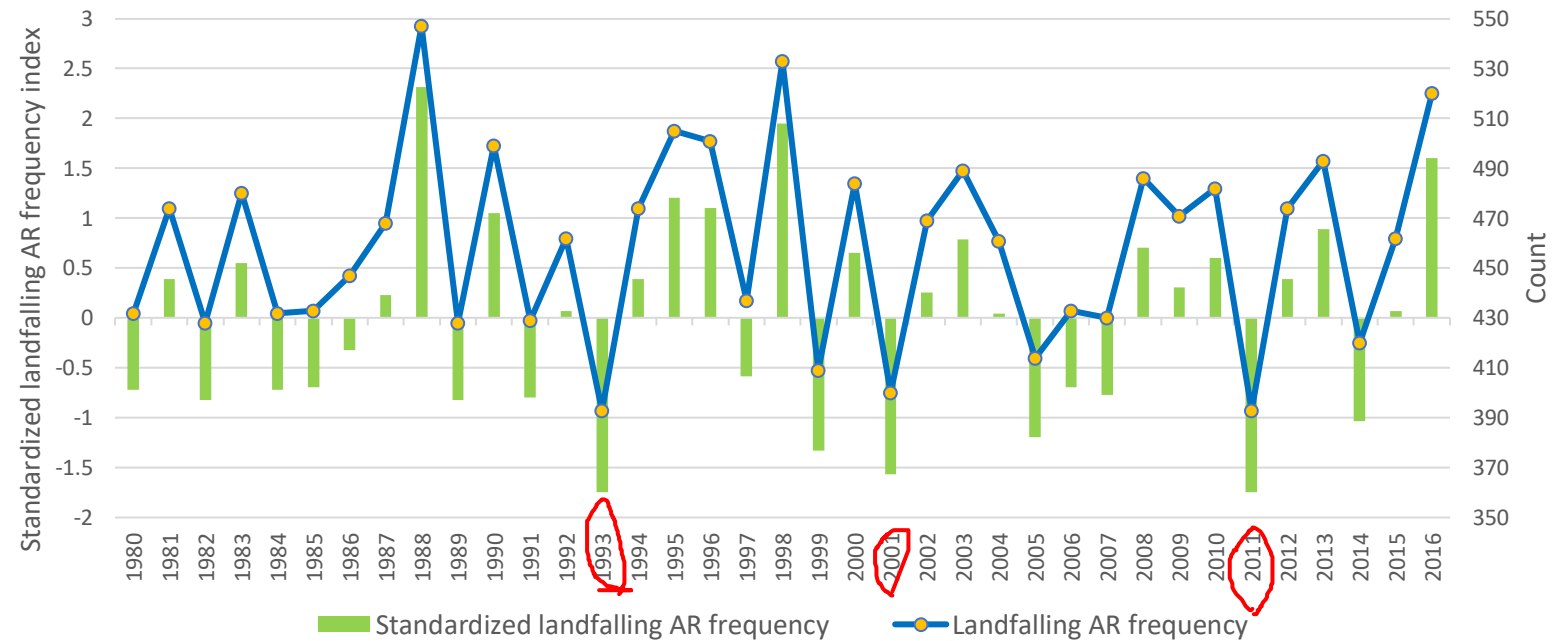
## The 2012-2013 drought affected the entire North Island plus the west coast of the South Island.

It was one of the most severe droughts to have impacted these areas in at least 40 years, and in some cases more like 70 years. The economic impact of the drought is estimated to be, at a minimum, \$1.3 billion (Ministry for Primary Industries, June 2013).

### Financial impact on the region's economy

The financial impact was brutal. Export kiwifruit crop, decimated in quantity and size, dropped from 3.5 million trays to overseas buyers in 2000 to only 1.5 million trays in 2001. Richard Brown, then president of Nelson-Marlborough Kiwifruit Growers, was desperate. "Most of the fruit has been completely written off," he said.

Landfalling AR occurrence between 1979-2017

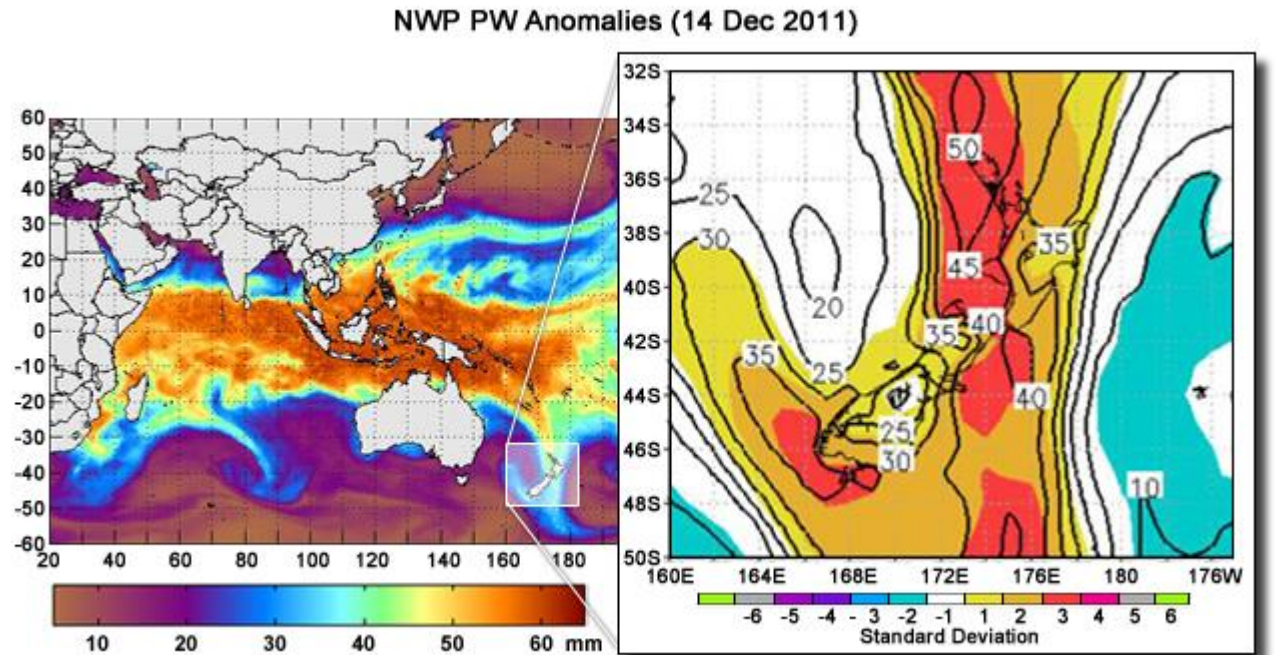
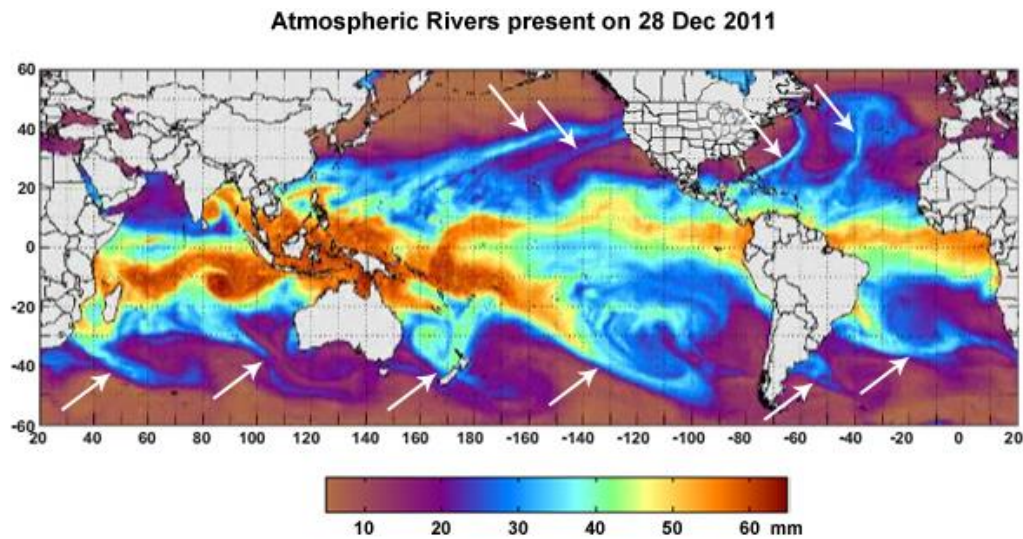


In May 1994 Auckland's water supply reservoirs dropped to 32 percent.

"The drought was broken by a relatively wet second half of 1994, which, combined with significant water savings, resulted in reservoir volumes reaching 95 percent by the end of 1994," a University of Auckland study from 2004 reads.

# What are Atmospheric Rivers (ARs)

- As defined by Ralph et al. (2004) and Ralph et al. (2005), ARs studied in the cool season along the United States' West Coast have values of IWV greater than 20 millimeters and are typically 400–600 kilometers wide, and more than 2000 km long.



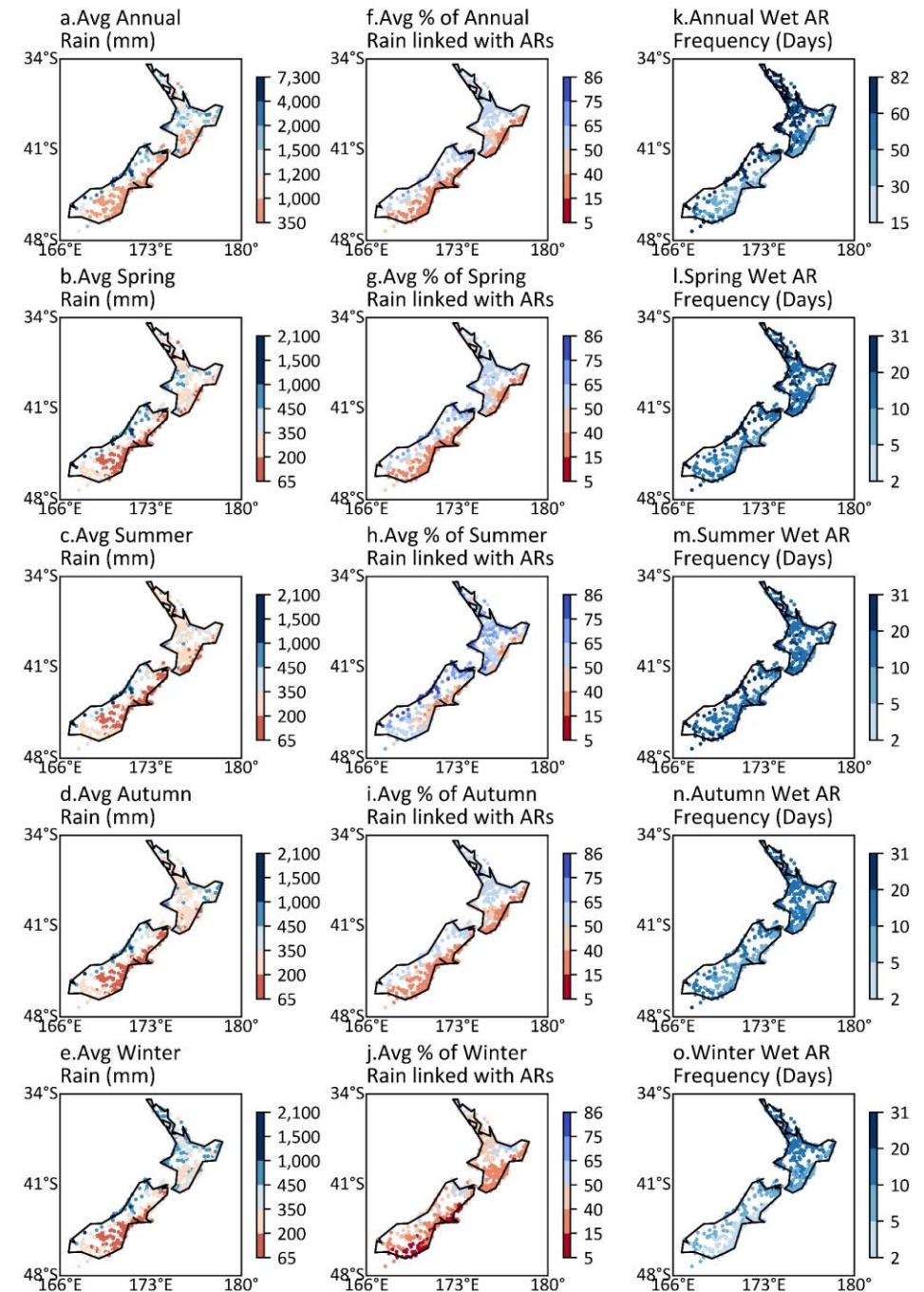
CIMSS/SSEC/NOAA/NWS/The COMET Program

Ralph, F. Martin, Paul J. Neiman, Gary A. Wick, 2004: Satellite and CALJET Aircraft Observations of Atmospheric Rivers over the Eastern North Pacific Ocean during the Winter of 1997/98. *Mon. Wea. Rev.*, **132**, 1721–1745.

Ralph, F. Martin, Paul J. Neiman, Richard Rotunno, 2005: Dropsonde Observations in Low-Level Jets over the Northeastern Pacific Ocean from CALJET-1998 and PACJET-2001: Mean Vertical-Profile and Atmospheric-River Characteristics. *Mon. Wea. Rev.*, **133**, 889–910.

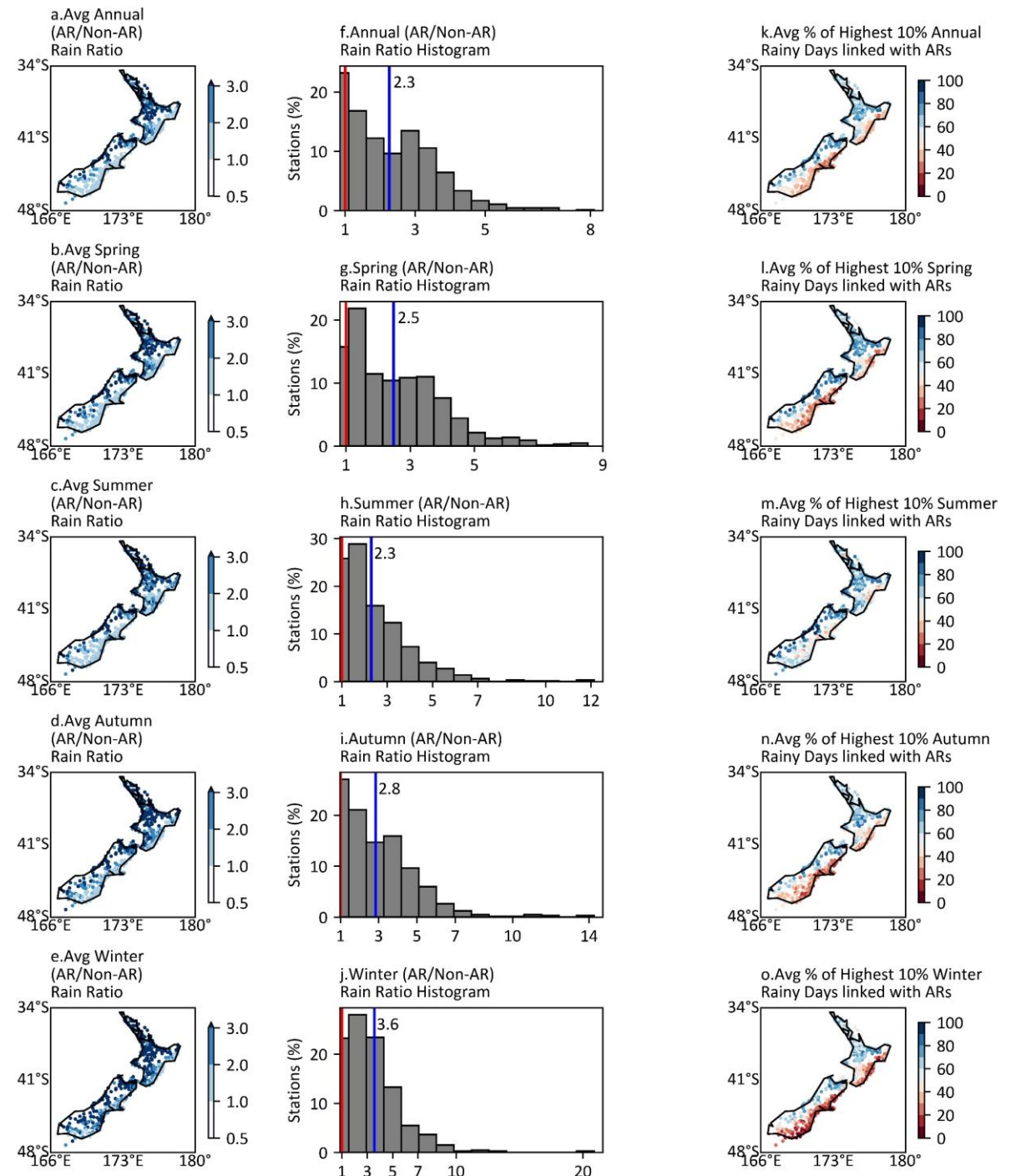
# Role of ARs in hydrology- Water resources

- Rainfall amounts are higher on the west side of mountain range
- For each rain site, the AR event day with rainfall defined as the “wet” AR day
- For the west side of mountain range areas, 5-82 wet AR days can contribute to more than 40% rain totals
- Generally, ARs can contribute to 40-86% rain totals on the western side of mountain ranges depending on the season
- Summer ARs have the greatest contribution



# Role of ARs in hydrology- extremes

- Daily rainfall amounts linked with ARs are generally higher than those linked to Non-AR storms
- The AR/Non-AR ration is higher in cool season
- On the west side of mountain ranges, the mean percent of 90<sup>th</sup> rainy days linked with ARs is notably high, especially summer



Shu, J., Shamseldin, A.Y. & Weller, E. The impact of atmospheric rivers on rainfall in New Zealand. *Sci Rep* 11, 5869 (2021). <https://doi.org/10.1038/s41598-021-85297-0>

## Conclusion and future study

- ARs play a significant role in the extreme rainfall events and water availability in New Zealand, especially where the orography dominates the weather system
- Understanding the physical process of ARs can improve predictivity of ARs to extreme rainfall events
- Understanding the climate variability of ARs might assist drought monitoring



Thank you