Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

Understanding Flood- And Landslide- Producing Atmospheric Rivers In Southeast Alaska

CHALLENGE

Residents of SE AK are accustomed to heavy or extreme rainfall and the hazards that can accompany it – floods, landslides, and avalanches. 75–93% of the time there is an extreme rainfall event in Southeast Alaska, it is associated with an **atmospheric river** (AR). Here, we define an AR, identify what they look like, and distinguish important characteristics of ARs that are likely to result in extreme rainfall in Southeast Alaska.

WHAT IS AN ATMOSPHERIC RIVER?

Atmospheric rivers are defined as **long and narrow regions of intense water vapor transport in our atmosphere** - like rivers in the sky. On average, ARs reach Southeast Alaska 8–15 days per month (blue bars below), **yet only six atmospheric river days per year (light blue bars below) are the source of up to 91% of Southeast Alaska's extreme rain and snow days.**

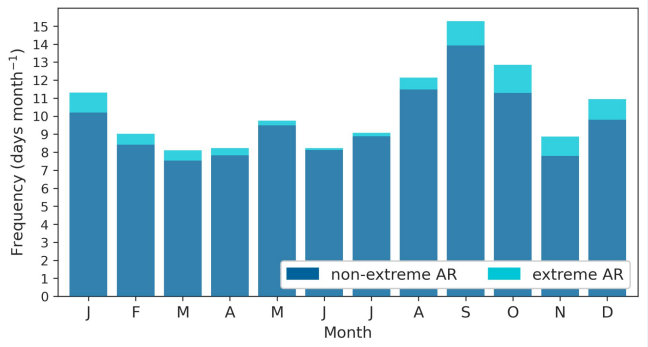

Figure 2. Average monthly frequency (bars, days month^{-1}) of non-extreme AR (blue; precipitation <95th percentile) and extreme AR (light blue; precipitation >95th percentile) days averaged over the six communities (Hoonah, Klukwan, Skagway, Craig, Kasaan, Yakutat) in Southeast Alaska between January 1980 and December 2019.

Figure 1. (left) The Hippoback Slide near Hoonah, AK that occurred sometime during the December 1-3, 2020 AR. (right) The Crawfish Inlet Slide near Sitka, AK that occurred sometime during the August 12, 2023 landslide. *(credit: D. Nash)*

WHAT INCREASES THE LIKELIHOOD OF EXTREME PRECIPITATION?

- **Intensity:** Atmospheric rivers with higher intensity water vapor transport are likely to result in higher intensity precipitation.
- **Direction:** Atmospheric rivers directly perpendicular to the topography are likely to increase precipitation efficiency. In Southeast Alaska, this is typically on southwest facing slopes.

*Similar to how there are different types of salmon, there are different types of atmospheric rivers! You may have heard of the term, "**pineapple express**" – this is a type or flavor of AR that specifically originates over Hawaii.*

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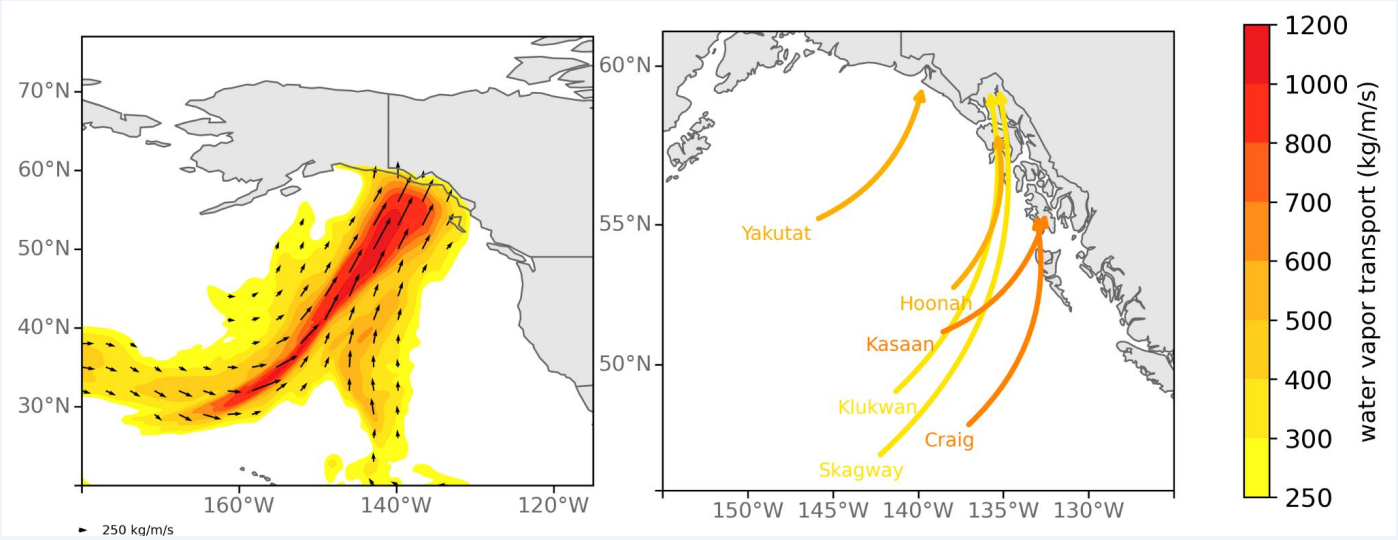

Figure 3. *(left)* This is what the AR looked like on December 1, 2020 06 UTC. The intensity (shading) and direction (arrows) of the AR is represented by the water vapor transport. 250 kg/m/s is the minimum value used to identify ARs. *(right)* Arrows represent the average location, orientation, and intensity (color) for atmospheric rivers that result in extreme precipitation for each community. Note that the intensity (color) is when the AR is directly overhead that community; therefore, communities further inland (e.g., Skagway and Klukwan) have lower intensity due to the AR losing moisture through precipitation as it moves inland, but still produce extreme precipitation for those locations.

COMMUNITY SPECIFICS

Subtle shifts in AR placement and orientation relative to community location and topography lead to differences in extreme precipitation and overhead water vapor transport in different locations.

- **Hoonah:** 86% of extreme ARs (precipitation between 1.25–3.75 inches per day) have southerly or southwesterly water vapor transport of about 340–1000 kg/m/s.
- **Skagway and Klukwan:** 80%–90% of extreme ARs (precipitation between 1.25–4 inches per day) have southerly water vapor transport of about 200–650 kg/m/s.
- **Yakutat:** 84% of extreme ARs (precipitation between 2.5–7 inches per day have southerly or southwesterly water vapor transport of about 300–1000 kg/m/s.
- **Craig and Kasaan:** 75%–80% of extreme ARs (precipitation between 1.5–3.5 inches per day) have southerly or southwesterly water vapor transport of about 400–1200 kg/m/s.

FLOOD WATCH VS. FLOOD WARNING

A **flood watch** is issued when **flooding is possible**. Stay tuned to trusted news sources and be ready to seek higher ground. **Be prepared**.

A **flood warning** is issued when **flooding is happening or about to happen**. Move to higher ground immediately. Never drive or walk through floodwaters. **Take action!**

STAY CONNECTED & REPORT IMPACTS

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Gunalchéesh to the Tlingit people for their stewardship of Lingít Aaní since time immemorial and today.

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REFERENCES

[1] Nash et al., (2024) *JGR: Atmospheres*, http://dx.doi.org/10.1029/2023JD039294