



The Climatology and Impacts of Atmospheric Rivers near the Coast of Southern Alaska

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Avalanche!

- On January 24, 2014, a high-precipitation event affected the southern coast of Alaska. The storm broke precipitation and high-temperature records at Valdez, AK.
- On the same day, driven by significant rainfall and anomalously warm temperatures, avalanches blocked Alaska's Highway 4, leaving motorists stranded and cutting the city of Valdez off from the rest of the state.
- What caused these atmospheric conditions?

What is an atmospheric river?

- An atmospheric river (AR) is a narrow plume of anomalously high tropospheric water vapor transport.
- Atmospheric rivers frequently appear over the Pacific Ocean during all seasons.

Should you care?

- Upon interaction with synoptic-scale disturbances, atmospheric rivers can produce significant precipitation events.

Where do they occur?

- Prior research has focused on atmospheric rivers affecting (mostly during winter) the western coast of the contiguous United States, an area marked by coastal cities and complex topography.
- Papineau & Holloway (2011) identified several major precipitation events, potentially driven by atmospheric rivers, that hit the southern coast of Alaska.

Focus for Study

- Does southern Alaska get atmospheric rivers?
- Is there a seasonality associated with atmospheric rivers near southern Alaska?
- What is the synoptic setup necessary to produce these extreme events?

Methods

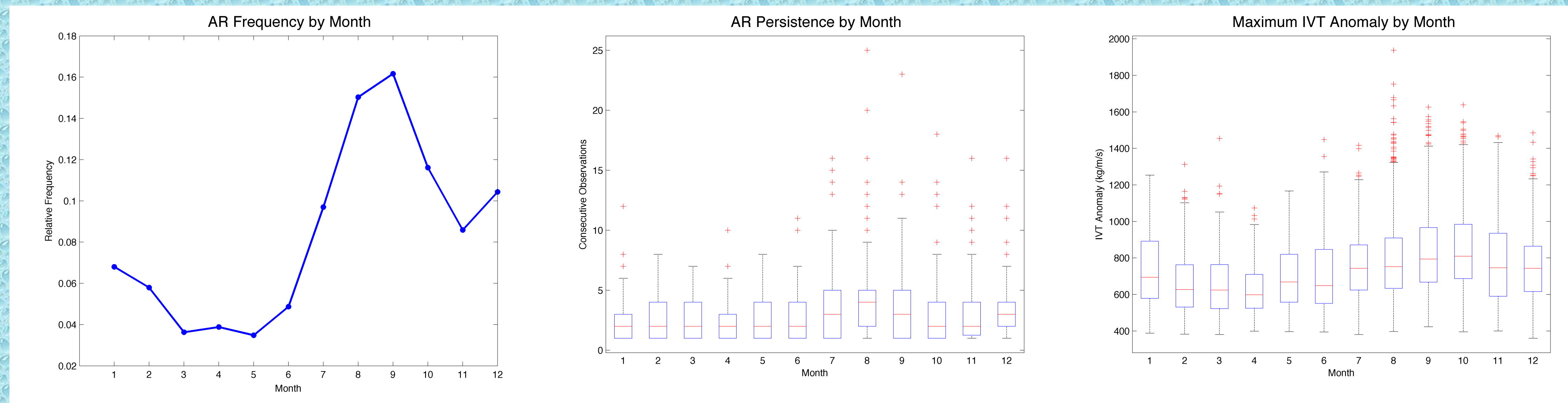
- A detection algorithm (Mundhenk et al., 2015) identifies atmospheric rivers (see Extreme Events, outlined in red) within a box (in green) encompassing southern Alaska.
- One method of detecting atmospheric rivers inspects the integrated water vapor transport (IVT) anomalies. IVT is calculated as follows:

$$IVT = \frac{1}{g} \int_{1000}^{300} q \bar{v} dp$$

where q is precipitable water, v is the wind vector, g is gravitational acceleration, and p is pressure (in hPa).

- Data source: MERRA reanalysis (6-hourly, period of record: 1979-2014)

Climatology

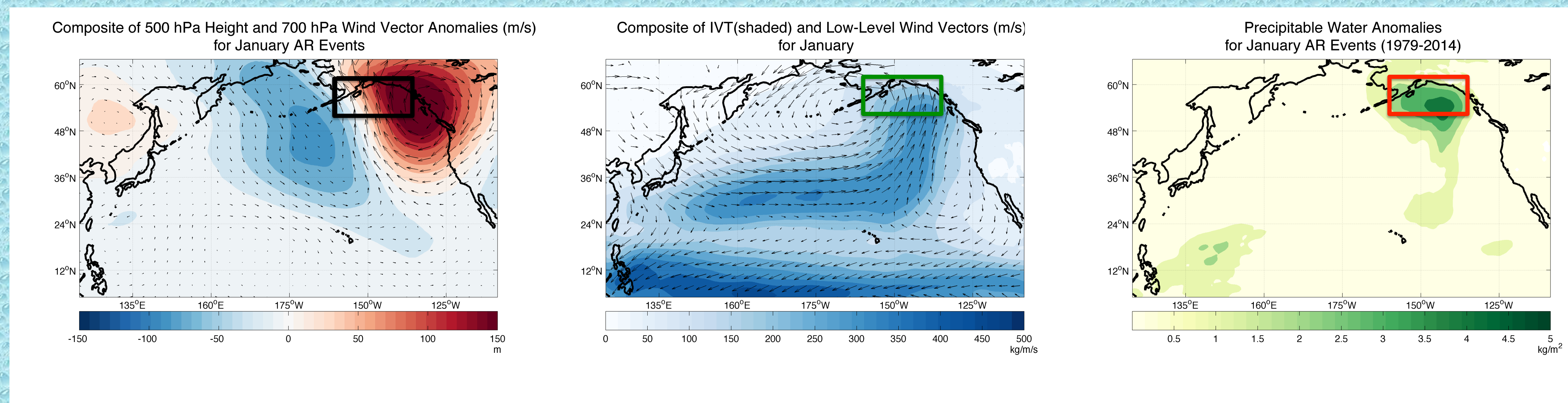


Atmospheric rivers most frequently occur over Alaska from late summer to early fall, but they also regularly appear in winter.

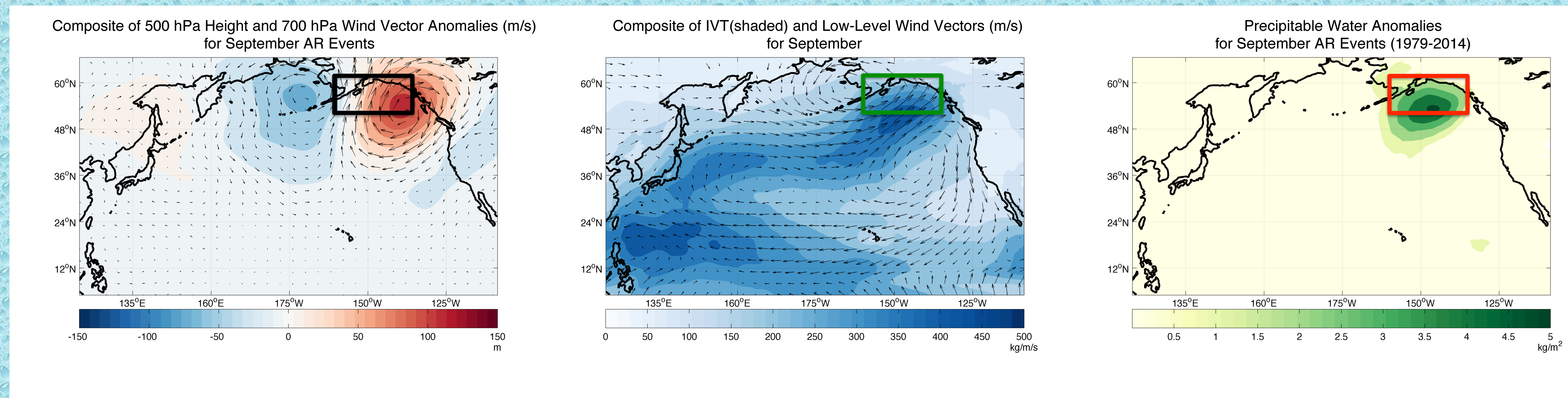
Atmospheric rivers have the greatest persistence over Alaska during the late summer and early fall.

Strongest atmospheric rivers occur over Alaska during late summer and early fall, though strong events can occur in winter.

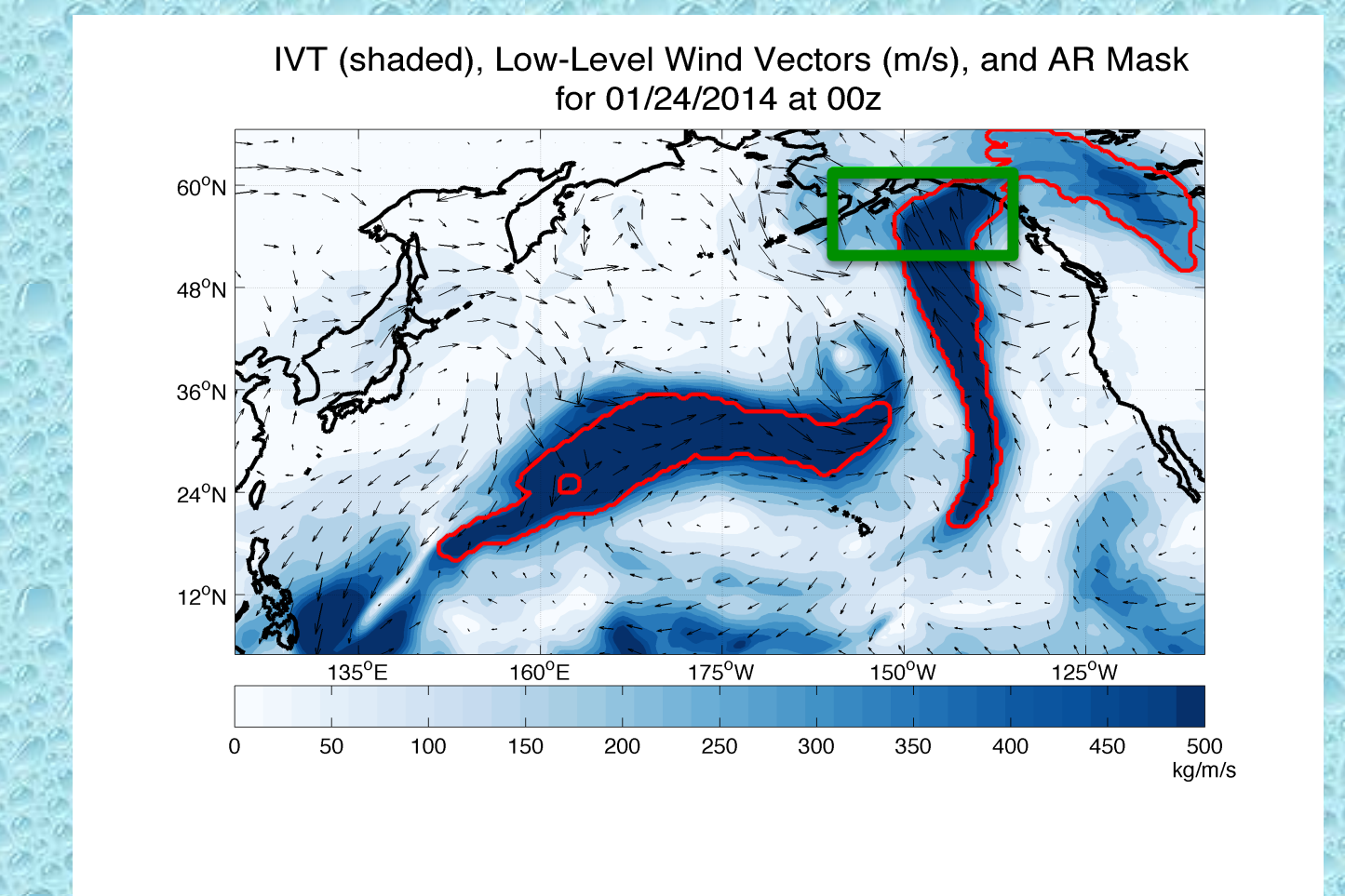
Synoptic Setup



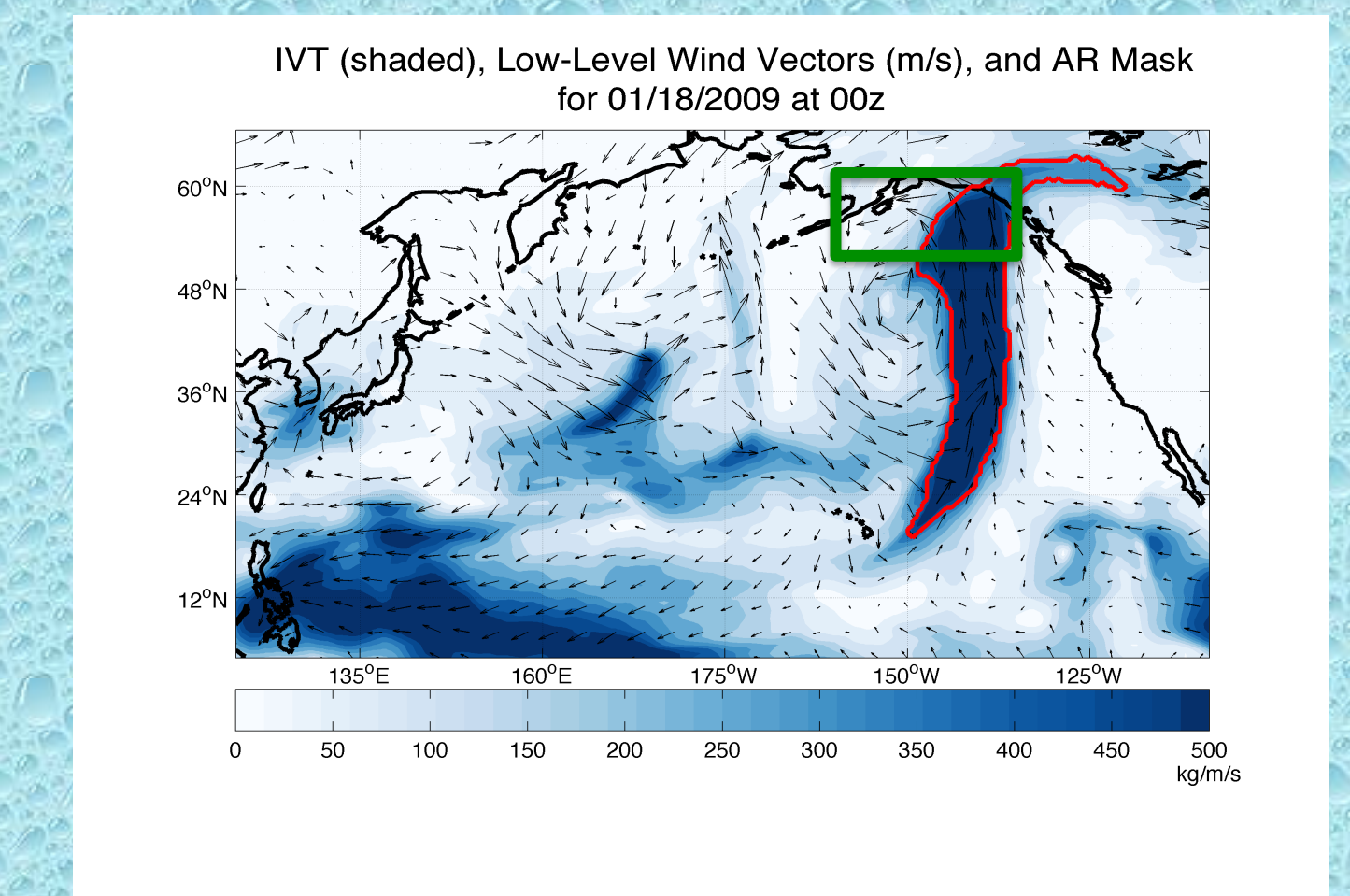
January atmospheric river events (above) coincide with an anomalously strong ridge over southeastern Alaska. September events (below) have modest ridging but feature greater moisture anomalies.



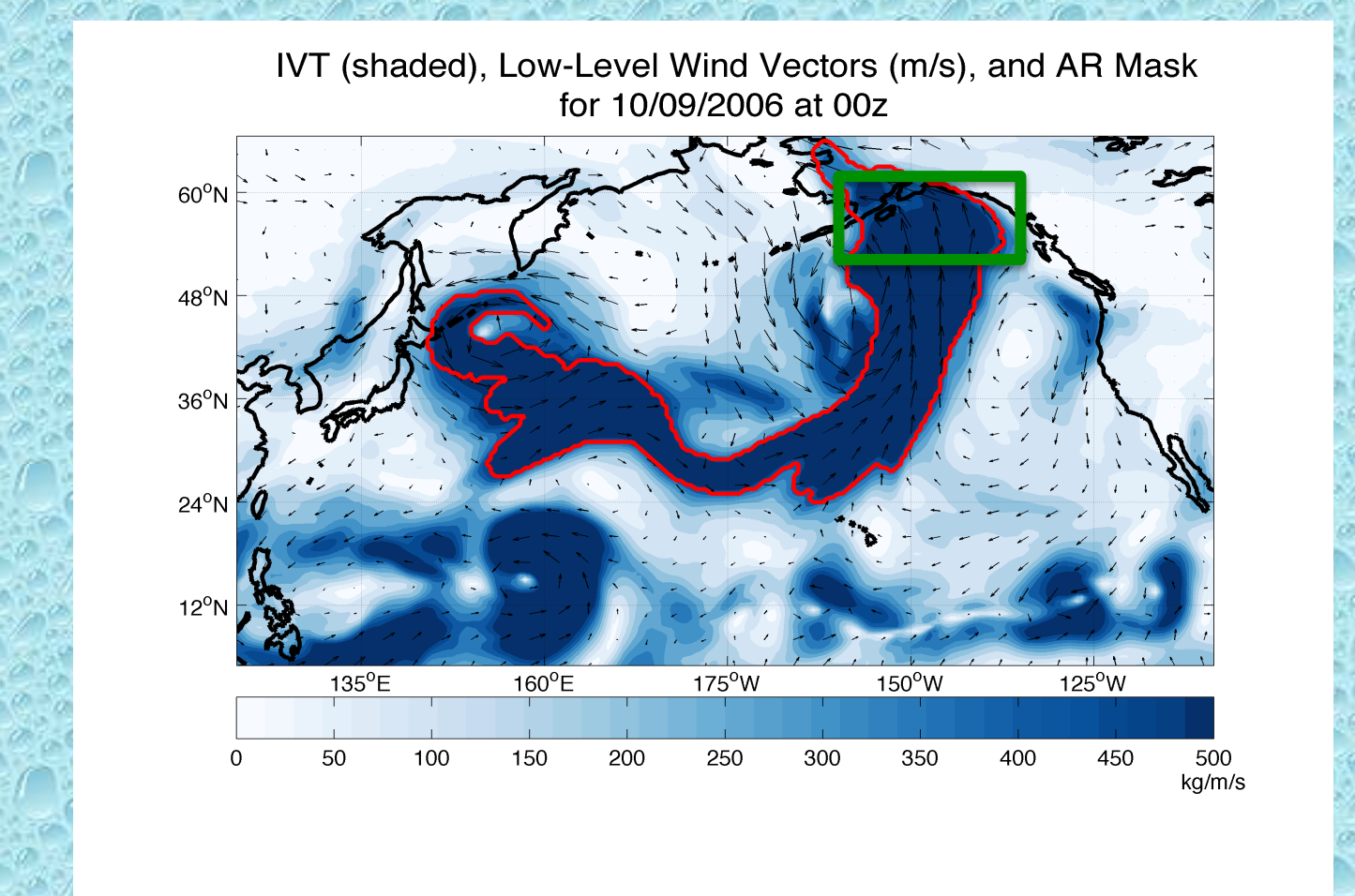
Extreme Events



Significant avalanches near Valdez, AK



13.2 inches of rain (3 days) at Yakutat, AK



Record river flooding near Cordova, AK

Further Research

- Can atmospheric rivers be divided into separate classes? Is there an associated seasonality?
- Will the strength and frequency of atmospheric rivers change in the future?

References

Mundhenk, B. D., E. A. Barnes, and E. D. Maloney, 2015: Climate variability in atmospheric river frequencies over the North Pacific (in draft).
 Papineau, J., E. Holloway, 2011: The Nature of Heavy Rain and Flood Events in Alaska. [this paper can be found at: www.pafc.arh.noaa.gov/research_papers].

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