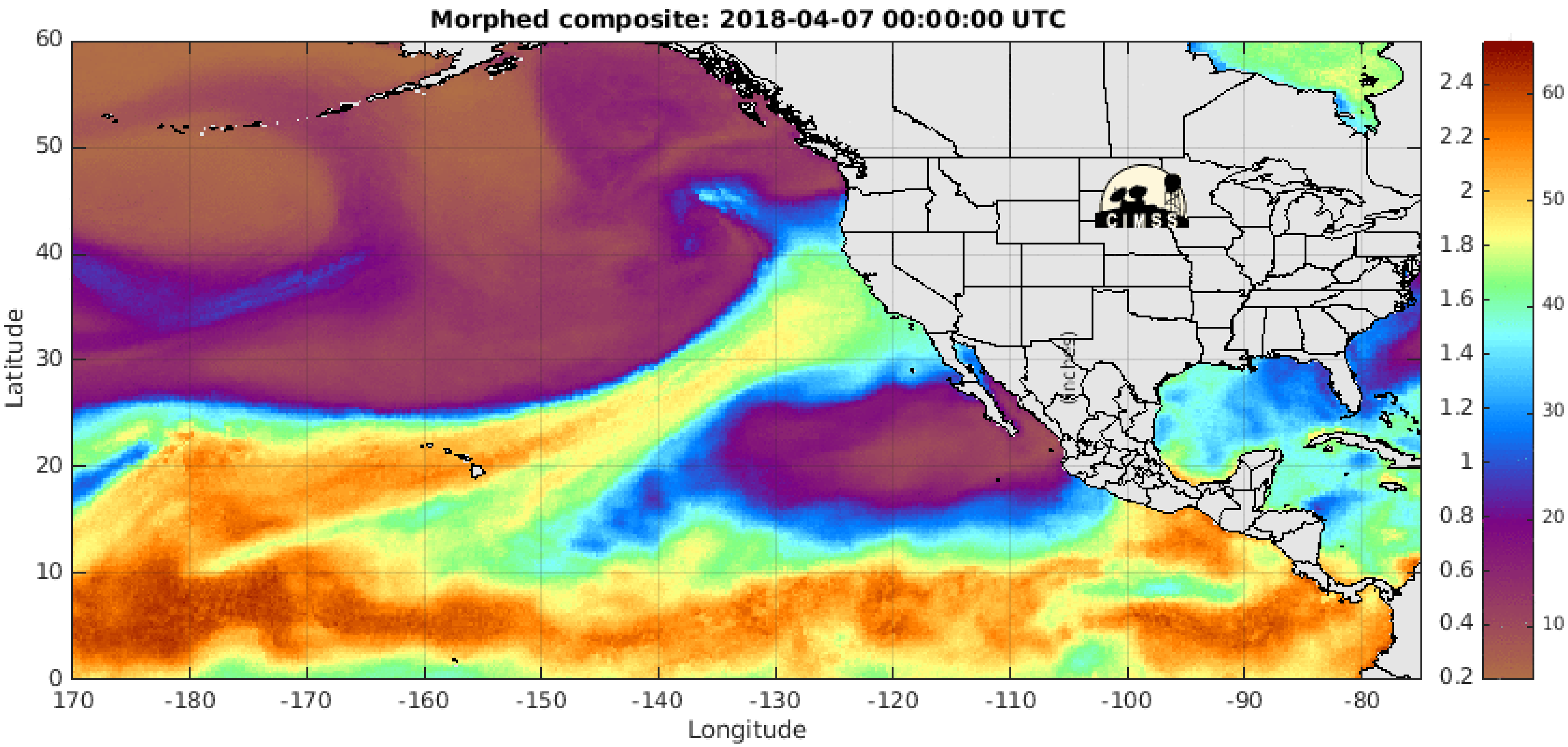
The Atmospheric River Tracking Method Intercomparison Project (ARTMIP): Quantifying the Uncertainties in Atmospheric River Climatology and Impacts

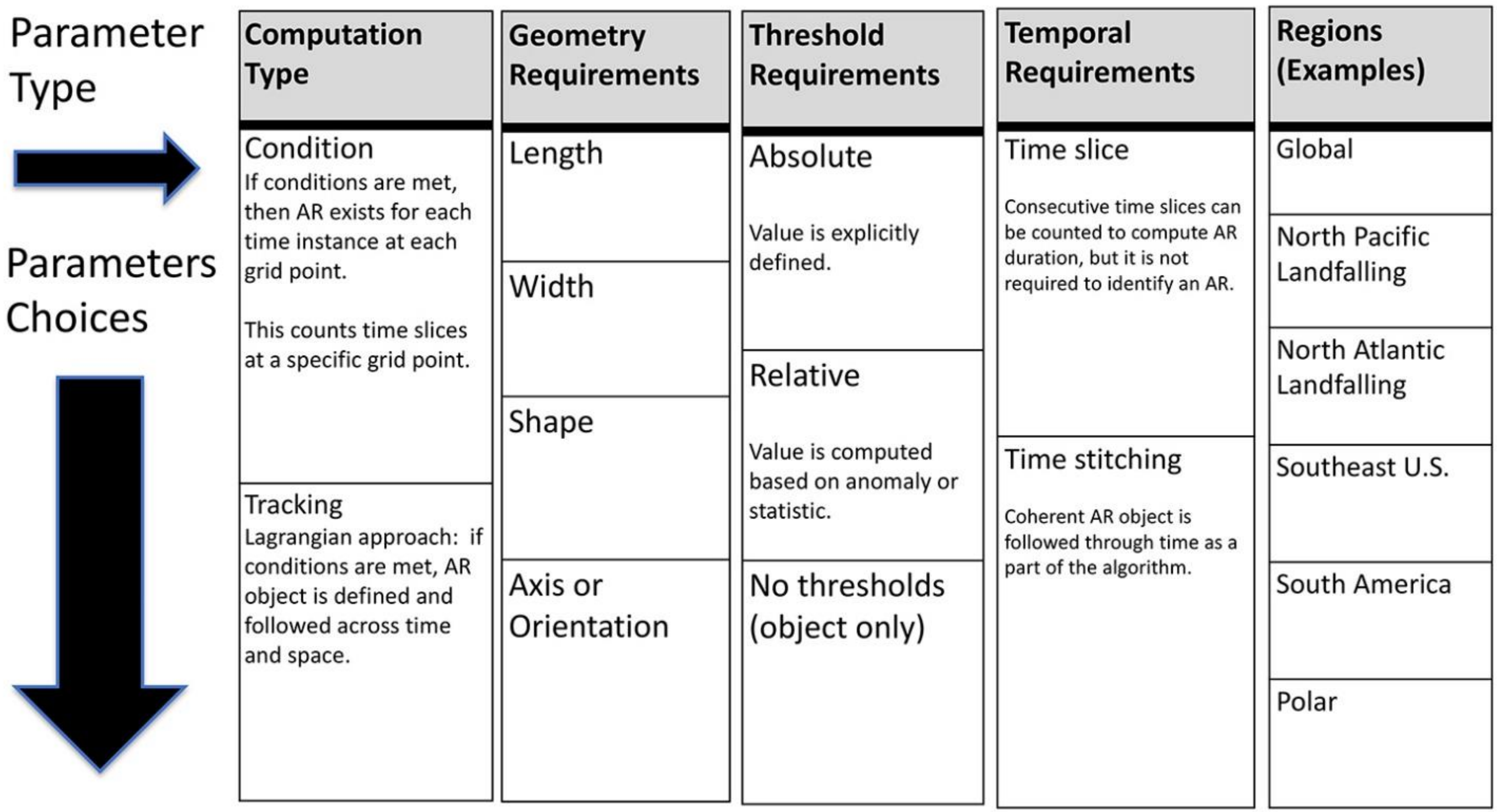


Jon Rutz – June 26th, 2018

Acknowledgements: Christine Shields, Juan Lora, Ashley Payne
ARTMIP Committee, ARTMIP Participants

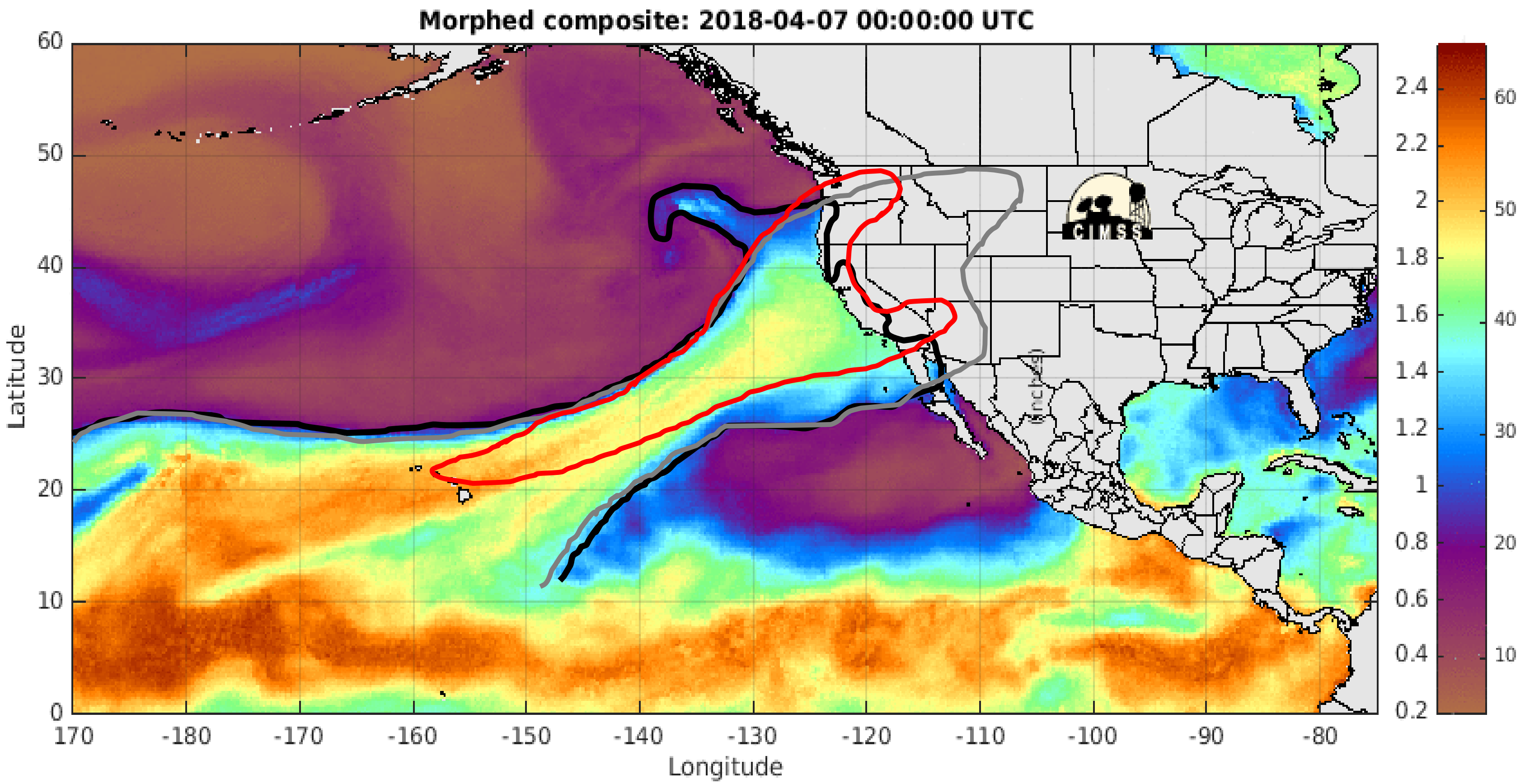
Why ARTMIP?

Atmospheric river (AR) science has taken off in recent years. Dozens of AR identification and tracking methods are in use by researchers and documented in peer-reviewed journals.



Why ARTMIP?

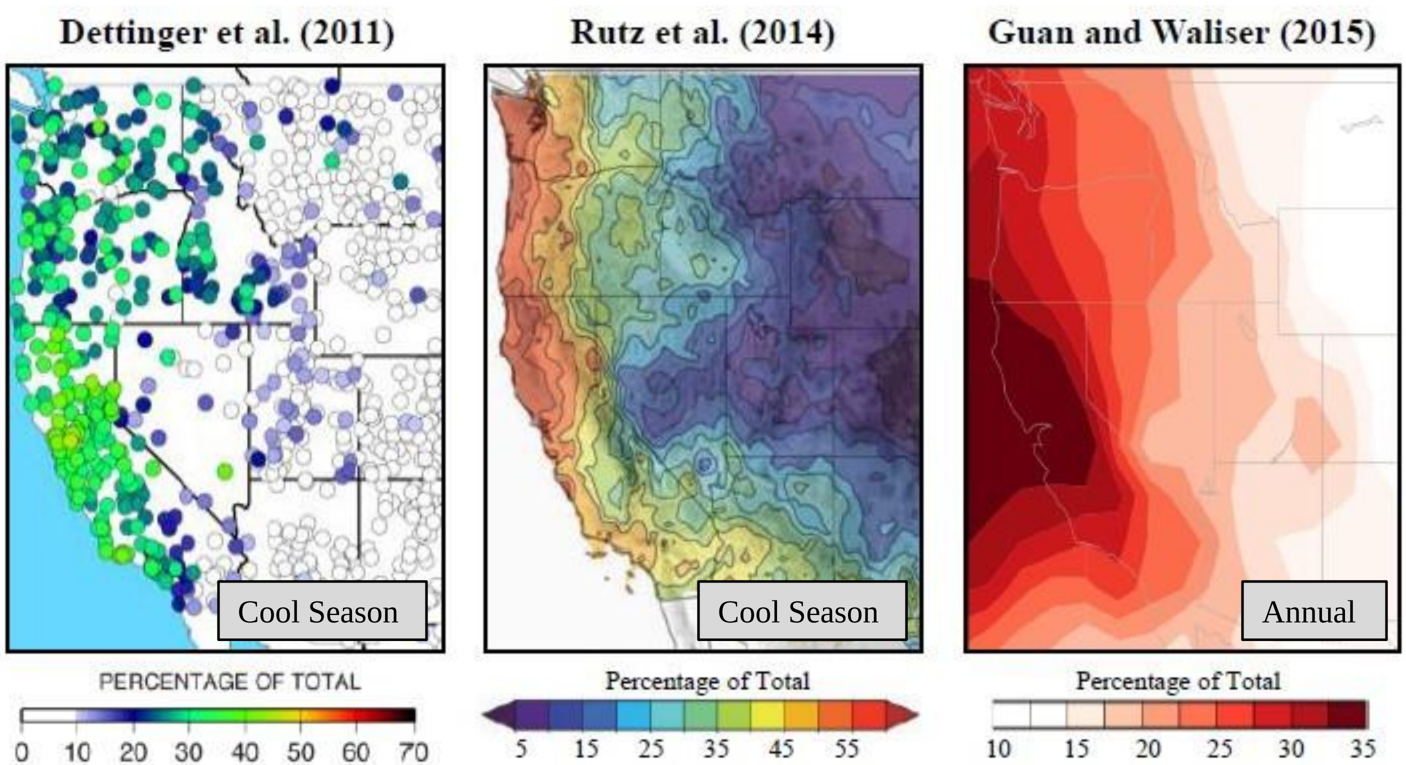
Different methods result in some methods identifying ARs at specific geographic locations and observation times, whereas other methods do not. This results in uncertainty regarding the AR climatology (e.g., frequency, duration, intensity, seasonality), and how it relates to precipitation and water supply.



Integrated Water Vapor (IWV) IWV Anomaly IWV Transport (IVT)

Why ARTMIP?

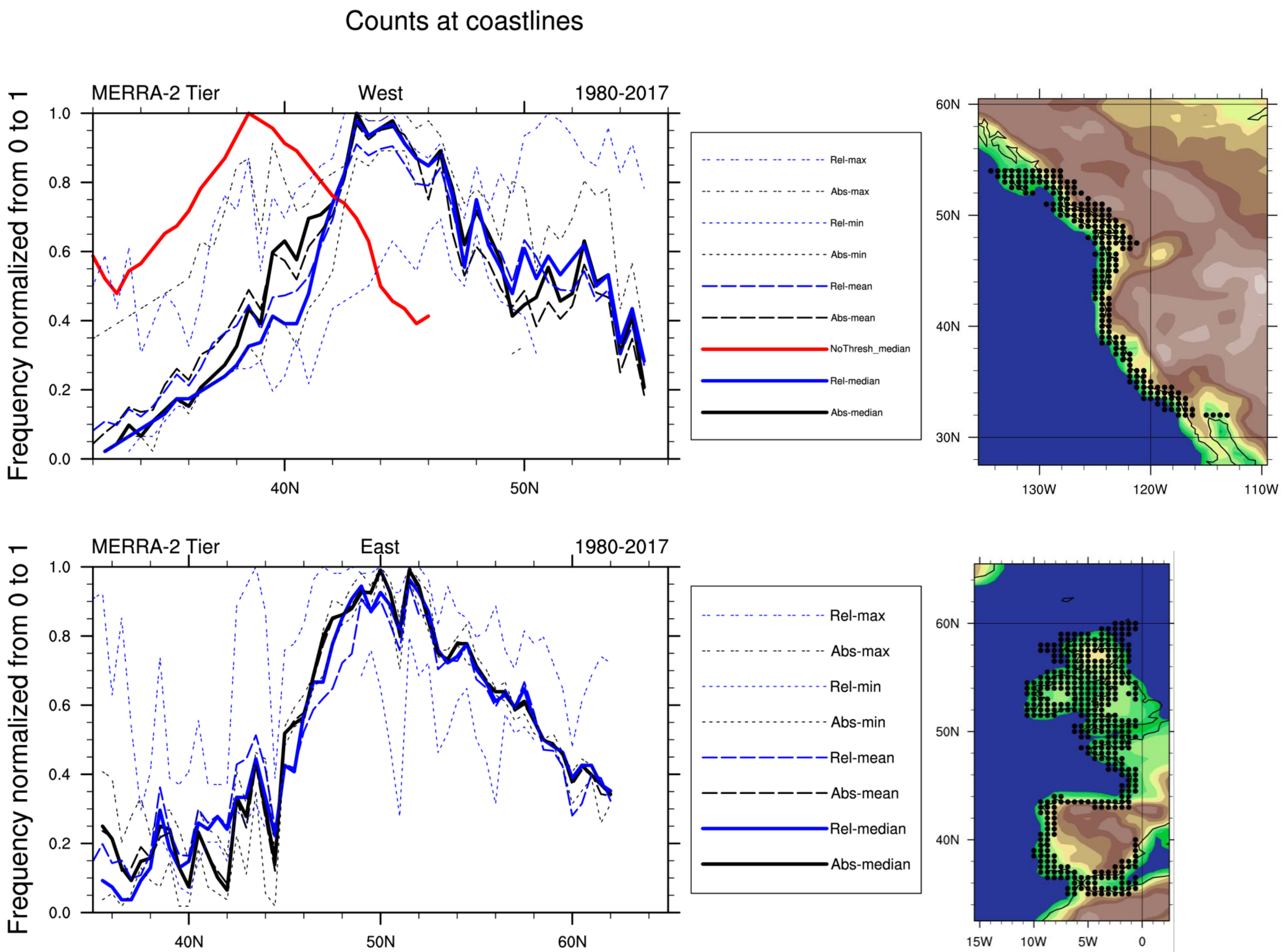
The methods used to identify and track ARs greatly affect how precipitation is attributed to ARs. Given their role in high-impact weather and hydroclimate, it is critical to understand how AR-related contributions to precipitation will change in the future.

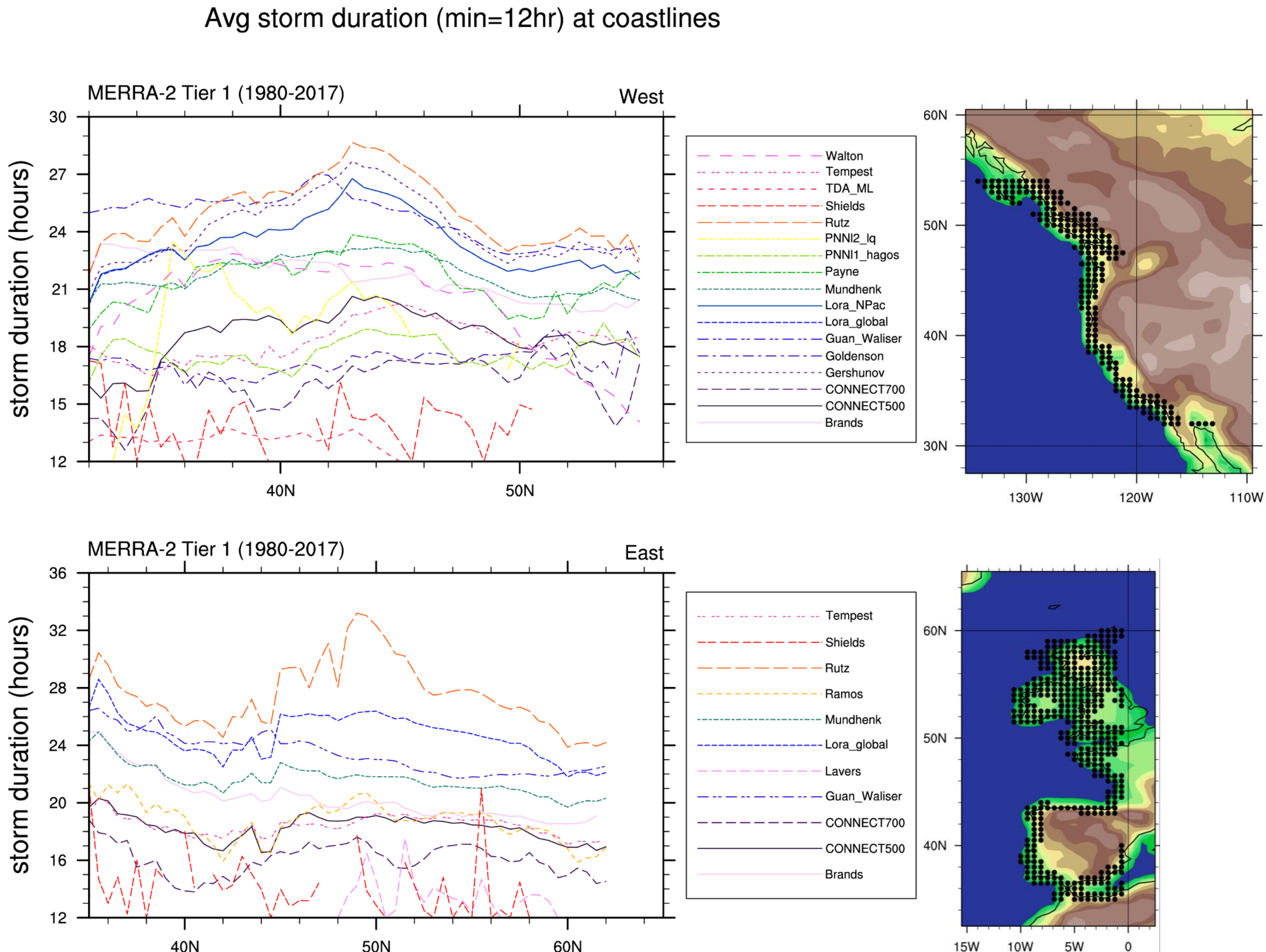


ARTMIP exists to quantify the uncertainty in AR climatology, the relationship between ARs and precipitation, and how these may change in the future. ARTMIP also aims to offer recommendations regarding which methods are best suited to answer which questions.

Key AR Metrics

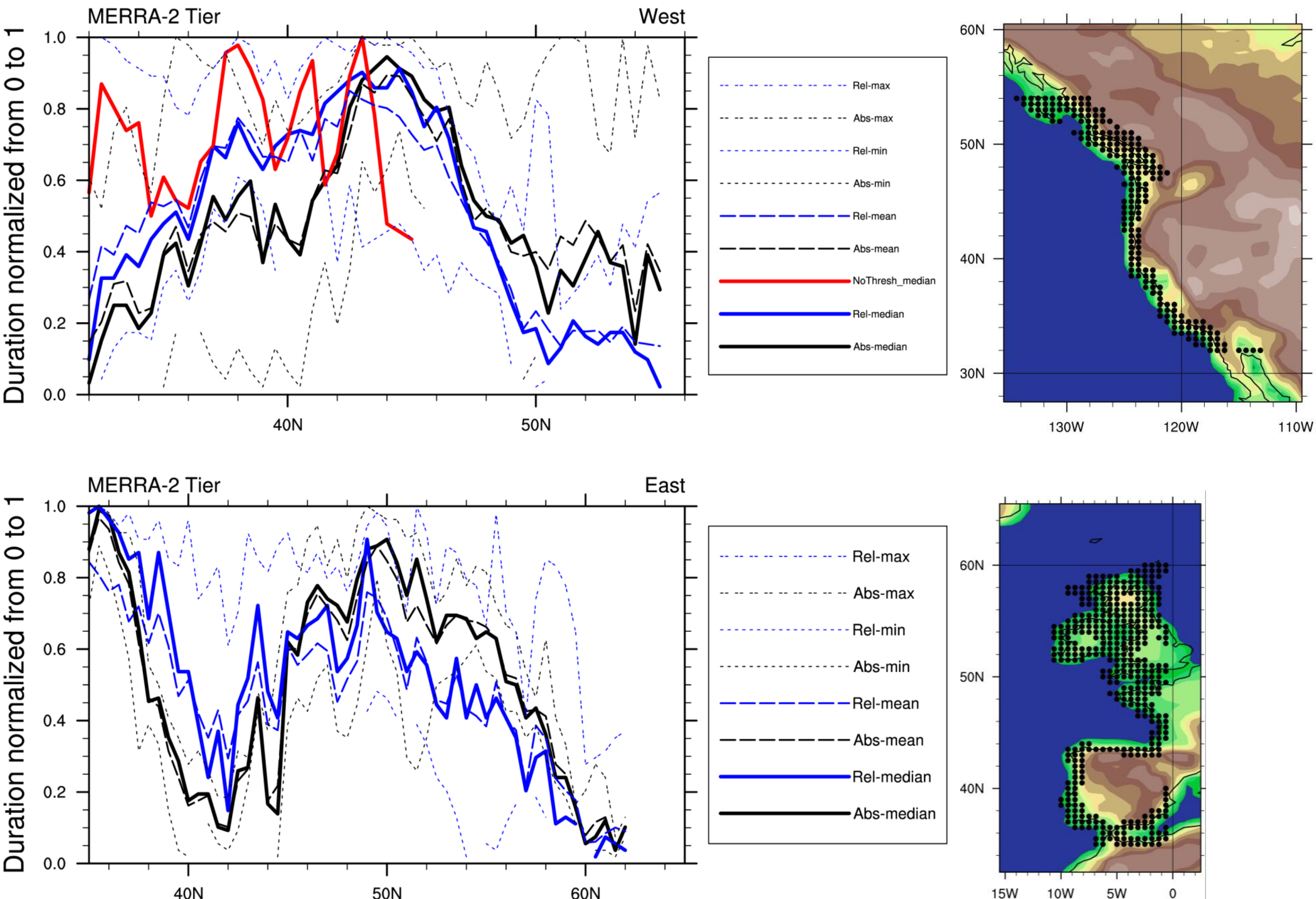
- The ARTMIP “Tier 1” Analysis is focused on quantifying the uncertainties in a few key metrics that arise as a result of different AR identification and tracking methods…
  - AR Frequency
  - AR Duration / Method Overlap
  - AR Seasonality
  - AR Intensity / Efficiency
  - AR-Related Precipitation (*not yet done*)


Counts at coastlines
MERRA-2 Tier
West
1980-2017
Frequency normalized from 0 to 1
1.0
0.8
0.6
0.4
0.2
0.0
40N
50N
Rel-max
Abs-max
Rel-min
Abs-min
Rel-mean
Abs-mean
NoThresh_median
Rel-median
Abs-median
60N
50N
40N
30N
130W
120W
110W
MERRA-2 Tier
East
1980-2017
Frequency normalized from 0 to 1
40N
50N
60N
Rel-max
Abs-max
Rel-min
Abs-min
Rel-mean
Abs-mean
Rel-median
Abs-median
15W
10W
5W
0

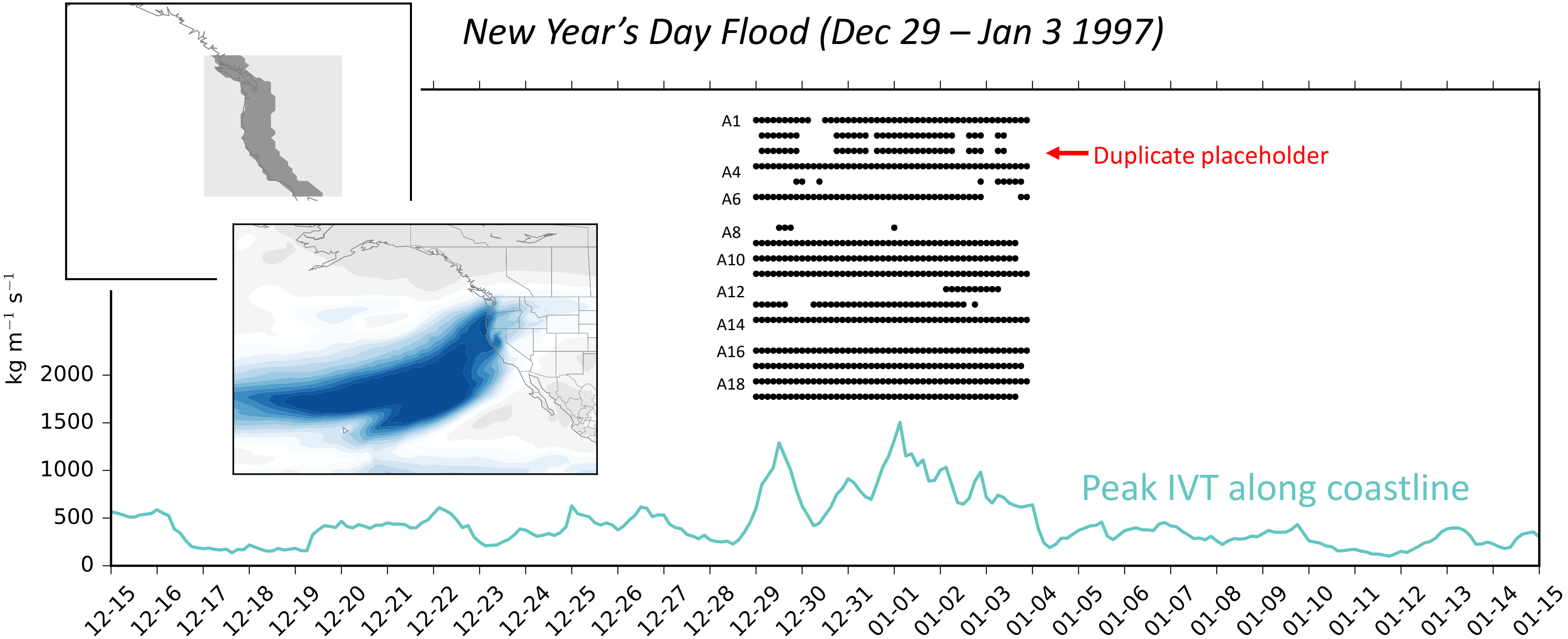


Avg storm duration (min=12hr) at coastlines
MERRA-2 Tier 1 (1980-2017)
West
storm duration (hours)
30
27
24
21
18
15
12
40N
50N
Walton
Tempest
TDA_ML
Shields
Rutz
PNNl2_lq
PNNl1_hagos
Payne
Mundhenk
Lora_NPac
Lora_global
Guan_Waliser
Goldenson
Gershunov
CONNECT700
CONNECT500
Brands
60N
50N
40N
30N
130W
120W
110W
MERRA-2 Tier 1 (1980-2017)
East
storm duration (hours)
36
32
28
24
20
16
12
40N
50N
60N
Tempest
Shields
Rutz
Ramos
Mundhenk
Lora_global
Lavers
Guan_Waliser
CONNECT700
CONNECT500
Brands
60N
50N
40N
15W
10W
5W
0

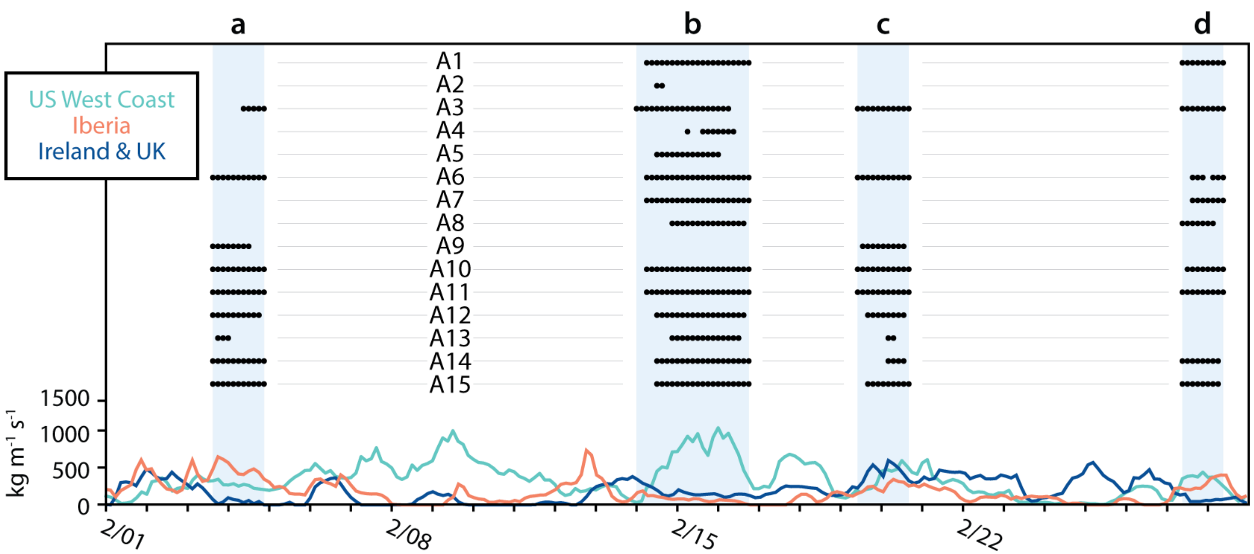
Avg storm duration (min=12hr) at coastlines



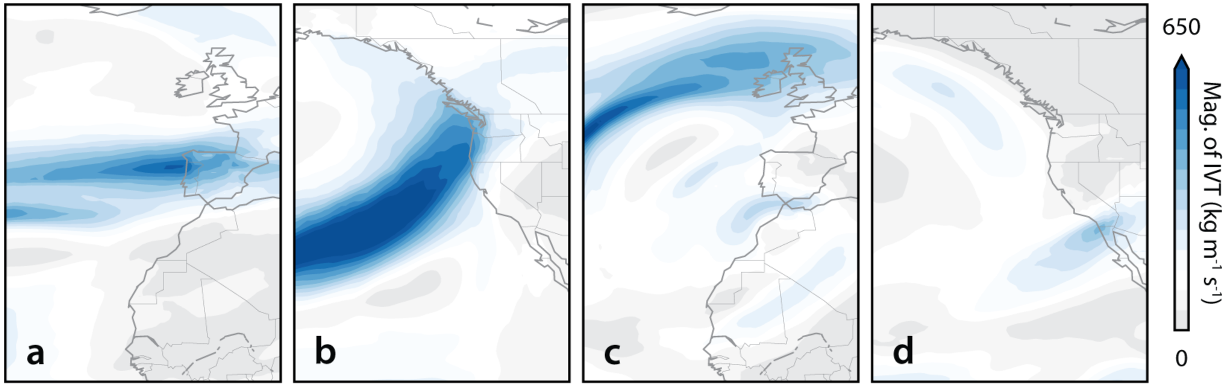
AR Method "Overlap"



AR Method "Overlap"

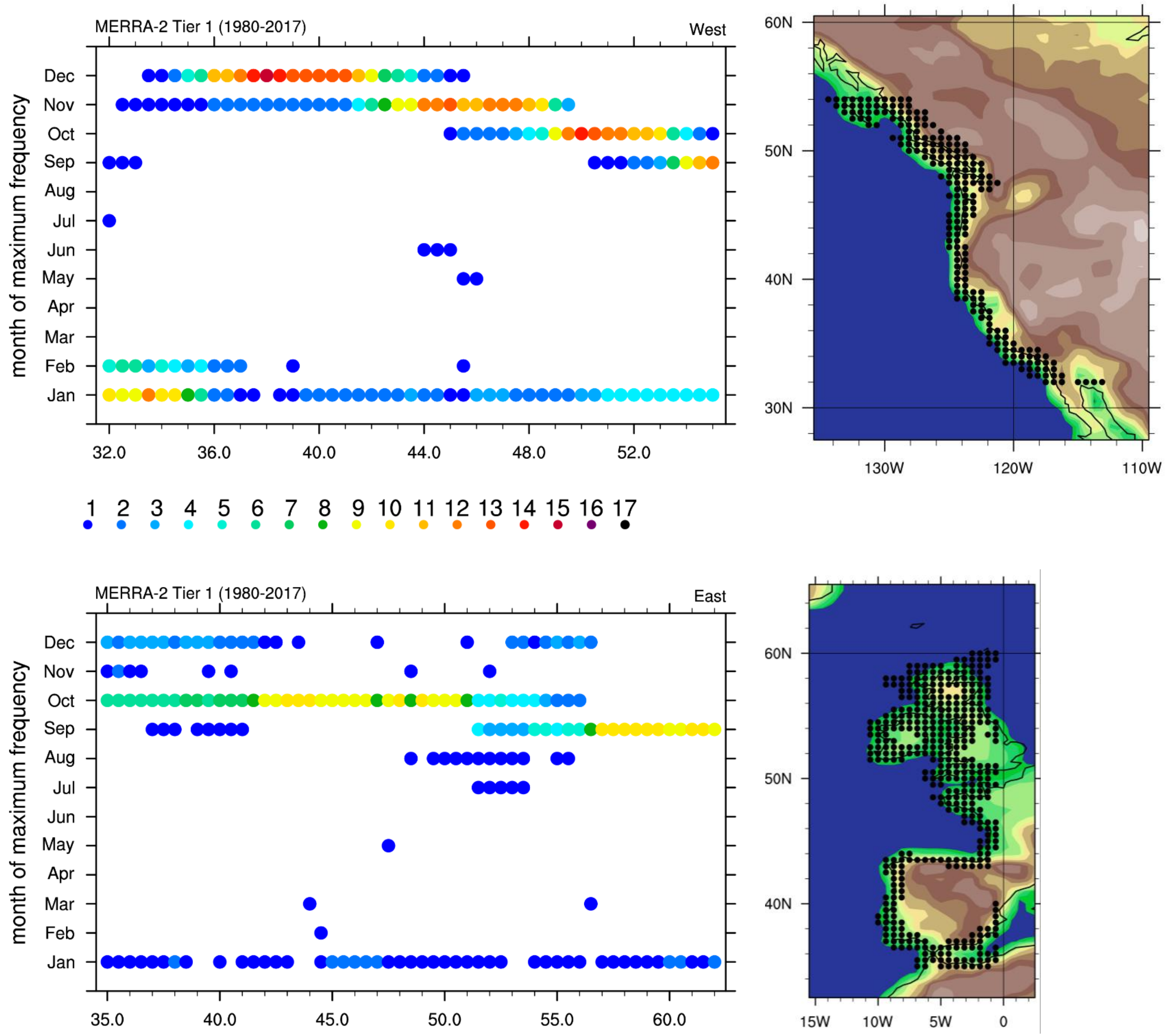


Time series of IVT along coastline and hits by each algorithm

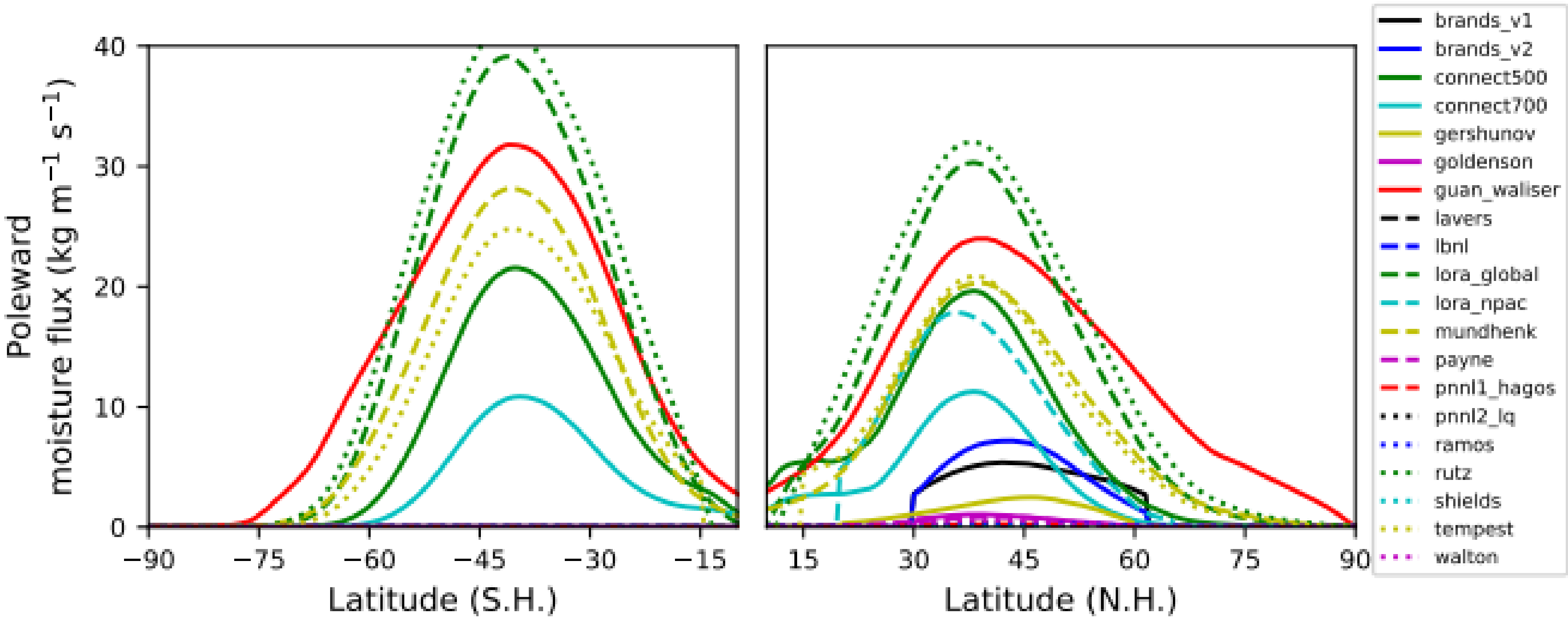


Composites of each event

of Methods that Agree on Max Month



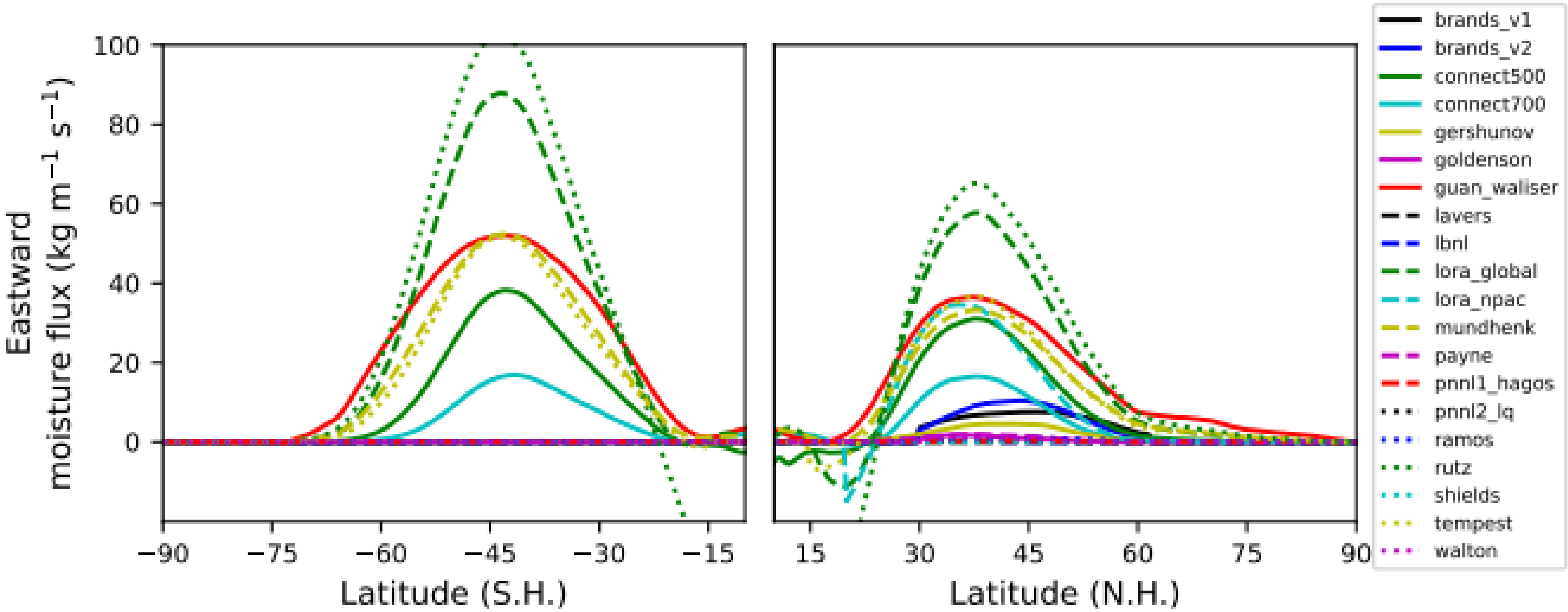
Meridional (Poleward) IVT



<u>Zonally-averaged meridional IVT within ARs</u>

- Maximized at mid-latitudes (~30-50° N/S)
- Larger (smaller) for absolute (relative) methods
- Larger (smaller) for less (more) restrictive methods

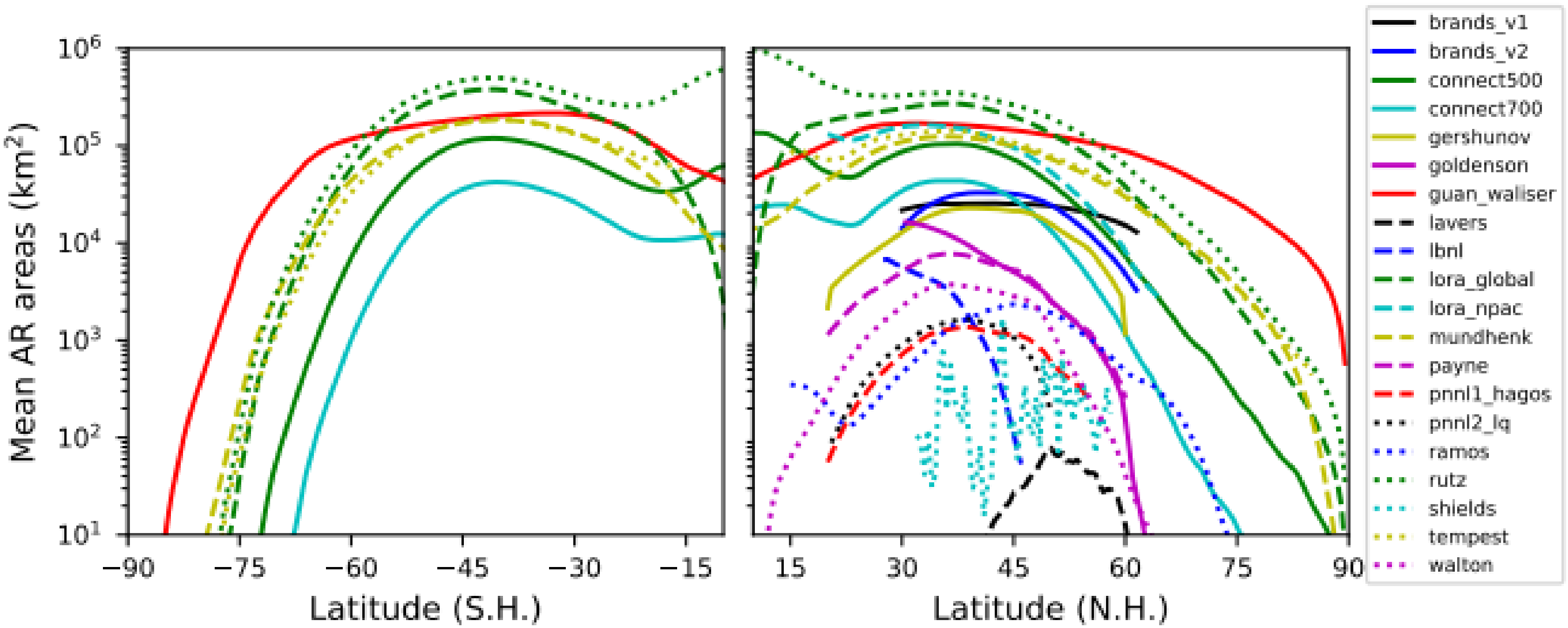
Zonal (Eastward) IVT



Zonally-averaged zonal IVT within ARs

- Maximized at mid-latitudes (~30-50° N/S)
- Larger (smaller) for absolute (relative) methods
- Larger (smaller) for less (more) restrictive methods

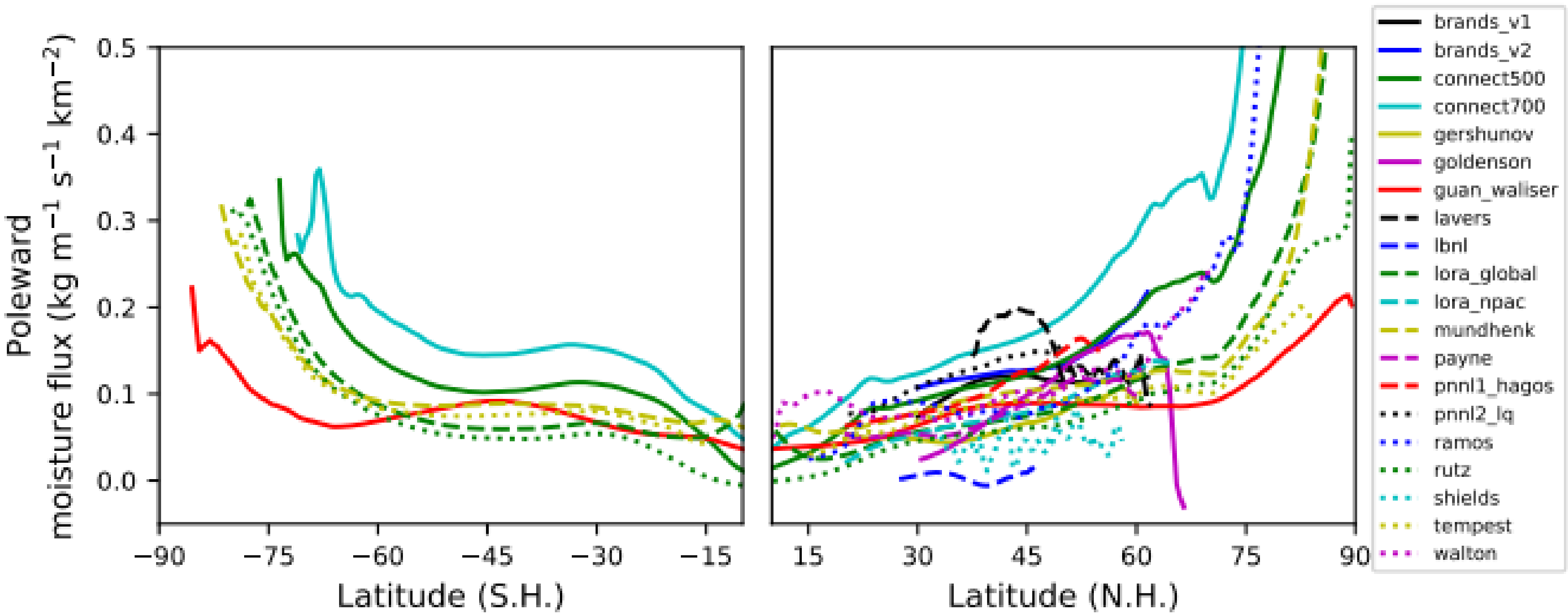
AR Spatial Area



Zonally-averaged spatial area of ARs

- Maximized at mid-latitudes (~30-50° N/S), but variable with method
- Larger (smaller) dependence on latitude for absolute (relative) methods

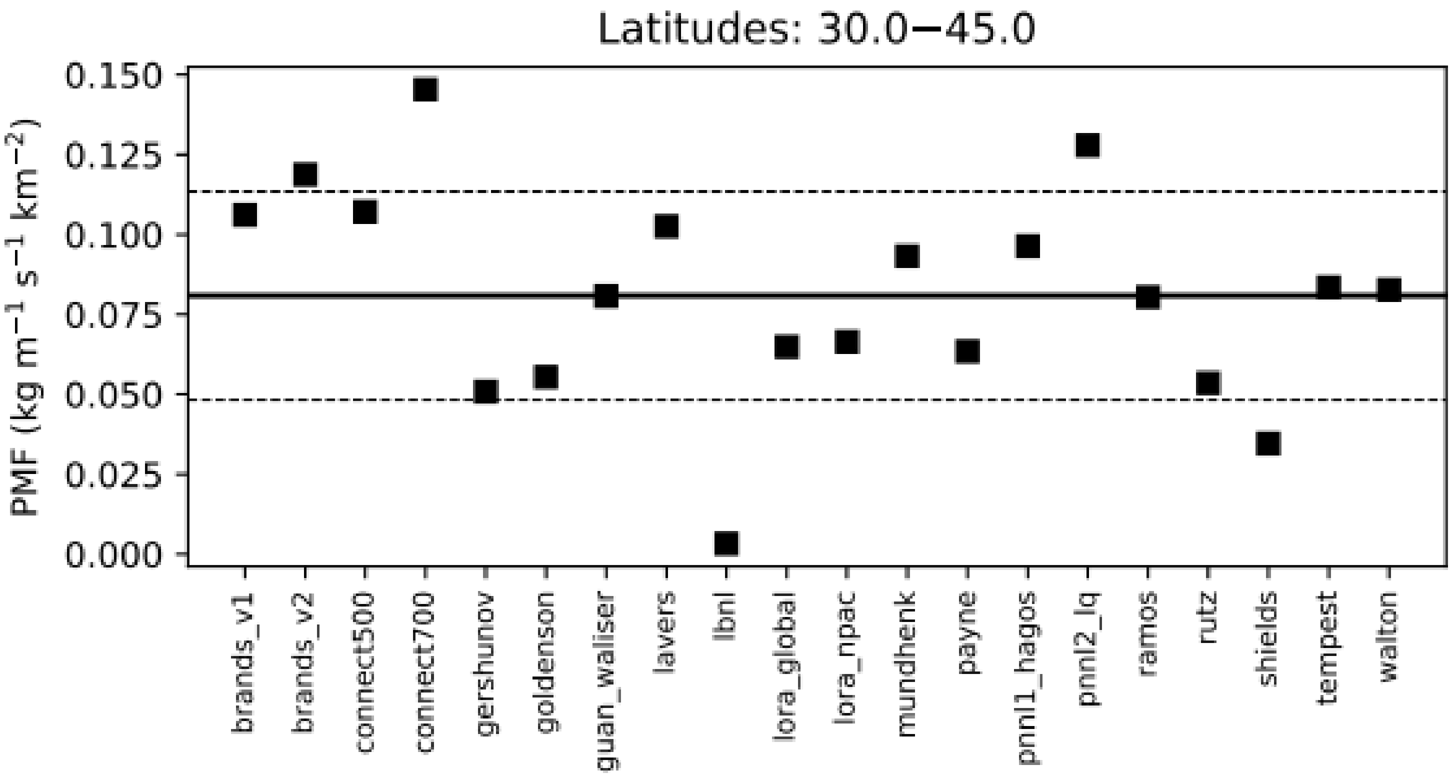
Meridional IVT "Efficiency" (vIVT / Area)



Zonally-averaged meridional IVT "efficiency" (vIVT / area) of ARs

- Maximized at high latitudes (~ >60° N/S), but variable with method
- Larger at high (low) latitudes for absolute (relative) methods
- Larger (smaller) dependence on latitude for absolute (relative) methods

Meridional IVT “Efficiency” Spread



<u>Zonally-averaged meridional IVT “efficiency” (vIVT / area) of ARs</u>

- Generally, more (less) restrictive methods are more (less) “efficient”… in other words, they don’t include lower-intensity portions of storms that contribute less to transport

Summary

Results

- When normalized from 0 to 1, most methods show good agreement on AR frequency and duration along the West Coasts of North America and Europe
- Duration or seasonality
- Methods vary widely in AR spatial footprint, zonal and meridional water vapor transport, and "efficiency" of water vapor transport
- Key metrics for absolute (relative) methods generally exhibit larger (smaller) variation as a function of latitude

To-Do List

- Analyze, compare, and contrast precipitation fractions attributable to ARs as a function of different AR identification and tracking methods
- Begin writing "Tier 1" Summary Paper

ARTMIP Information

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