



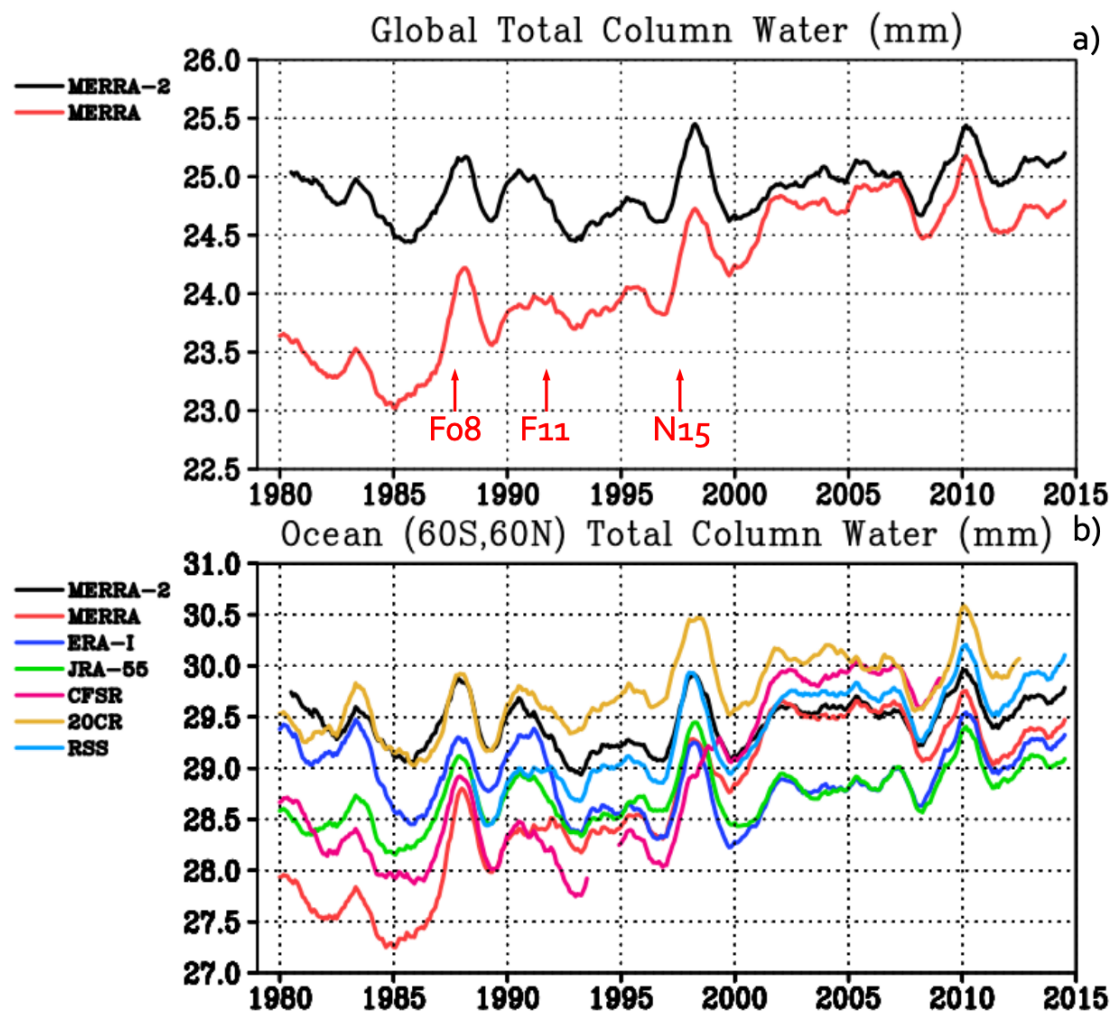
ARTMIP Tier 2 Reanalysis Effort

March 27, 2020 Telecon

Allie Collow

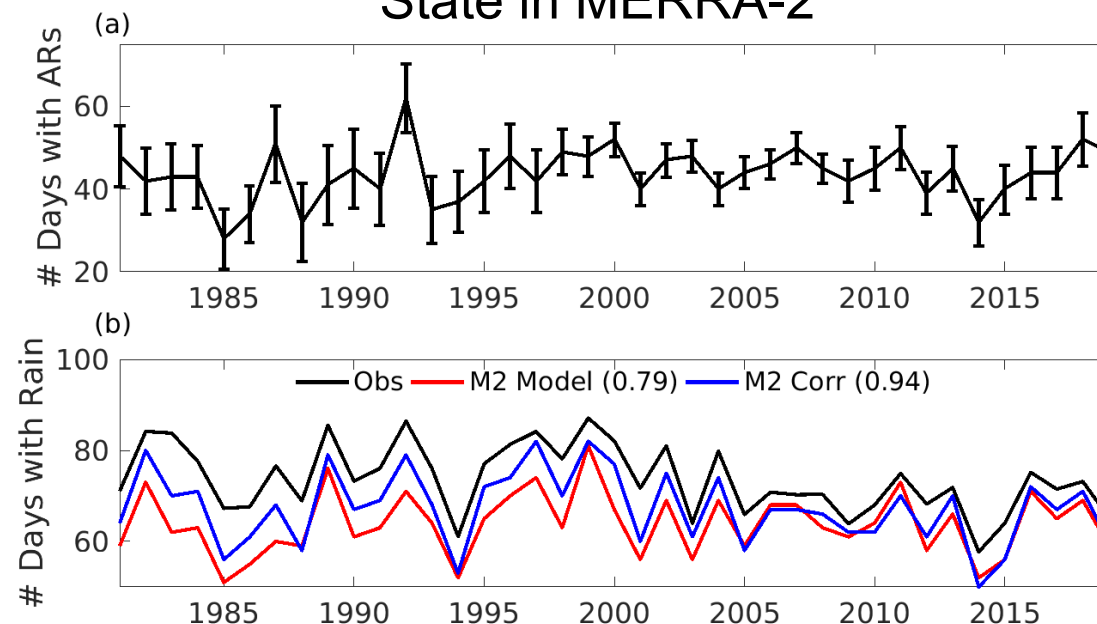
Universities Space Research Association
NASA GSFC, Code 610.1 (GMAO)

Motivation for a Reanalysis Comparison



(Bosilovich et al., 2015; MERRA-2 tech memo)

Along the Coast of Washington State in MERRA-2

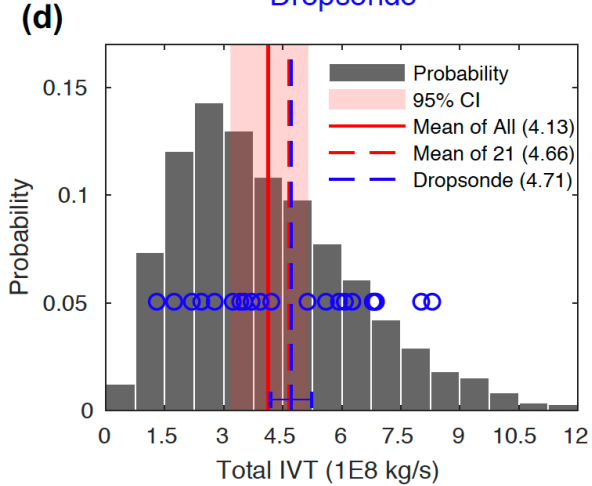
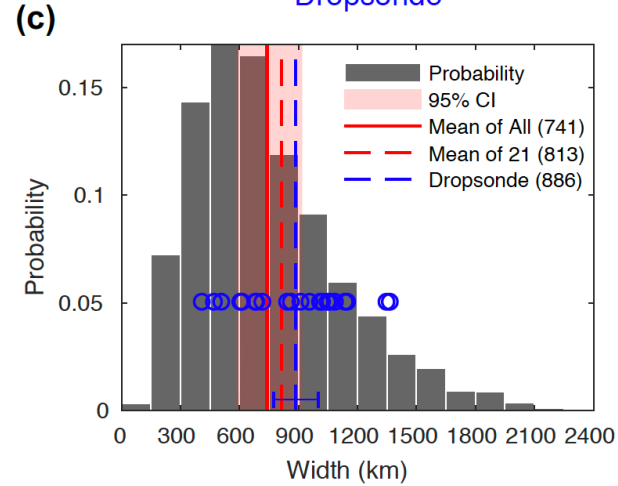
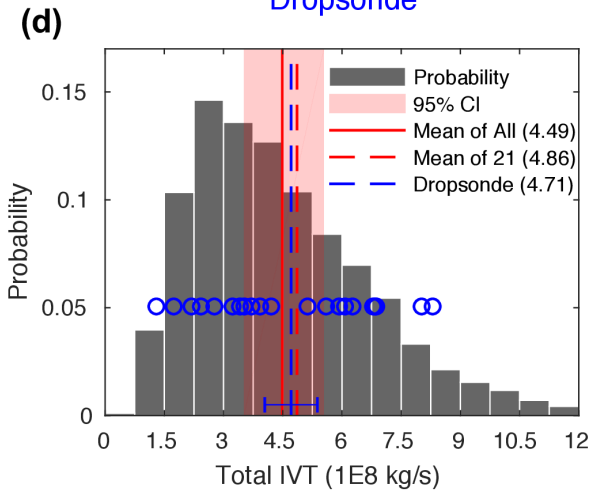
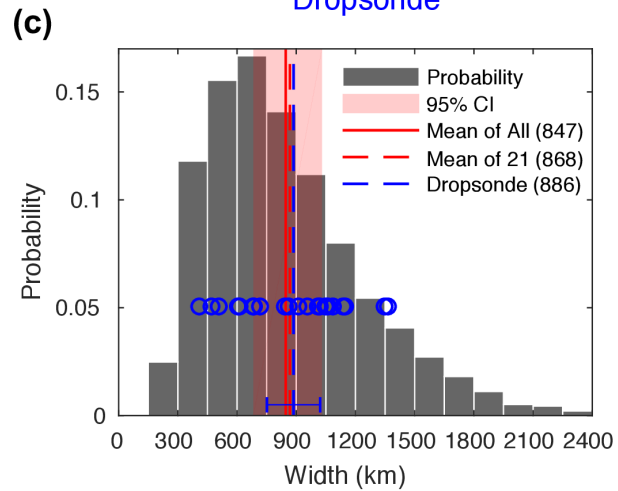
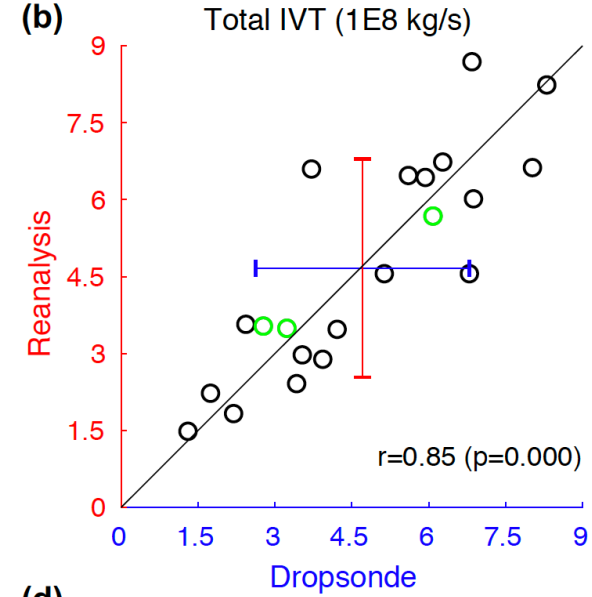
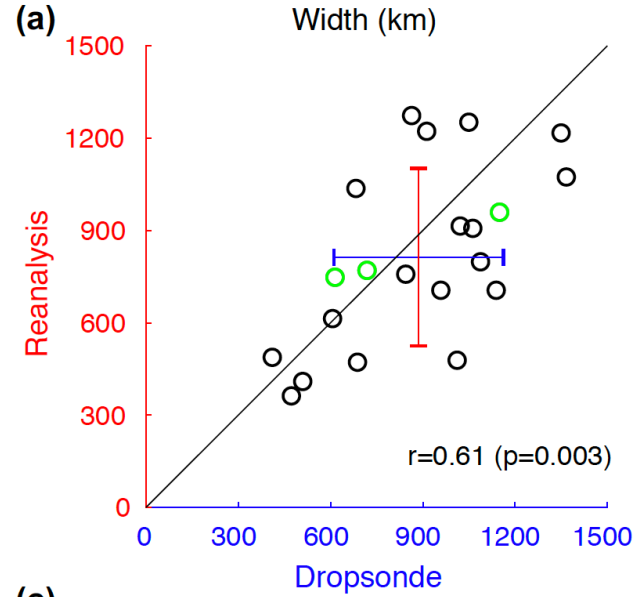
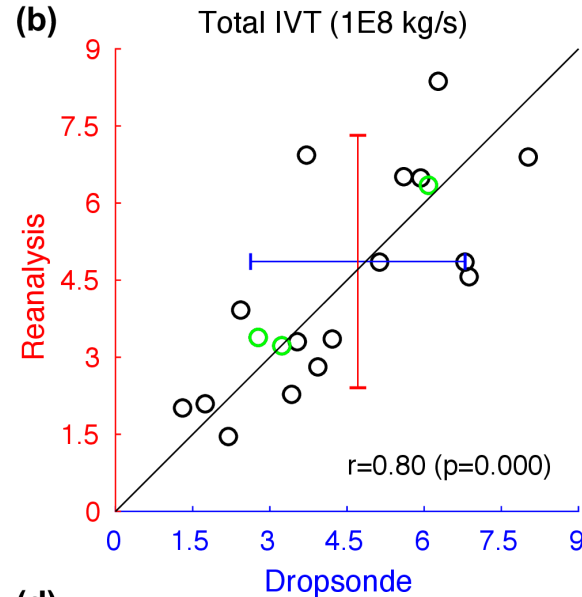
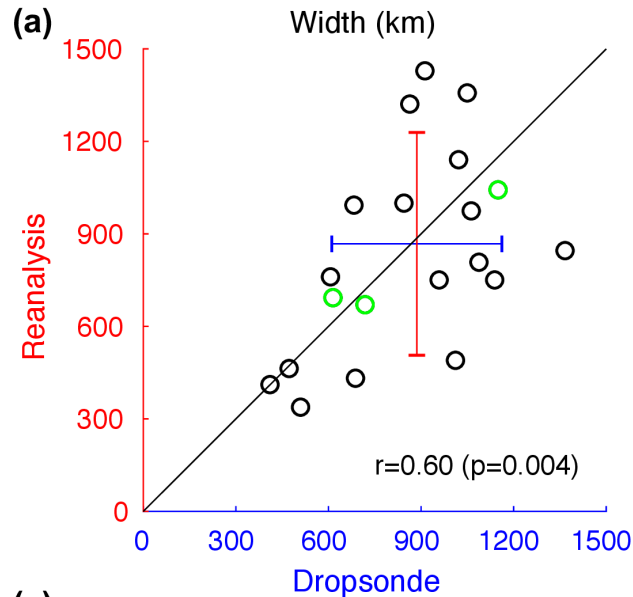


- Variability in atmospheric moisture exists among reanalyses, especially prior to the EOS era
- Reanalyses are reliant on data assimilation and an underlying MODEL
- This can be translated into AR detection and the associated precipitation

Background/Preliminary Work

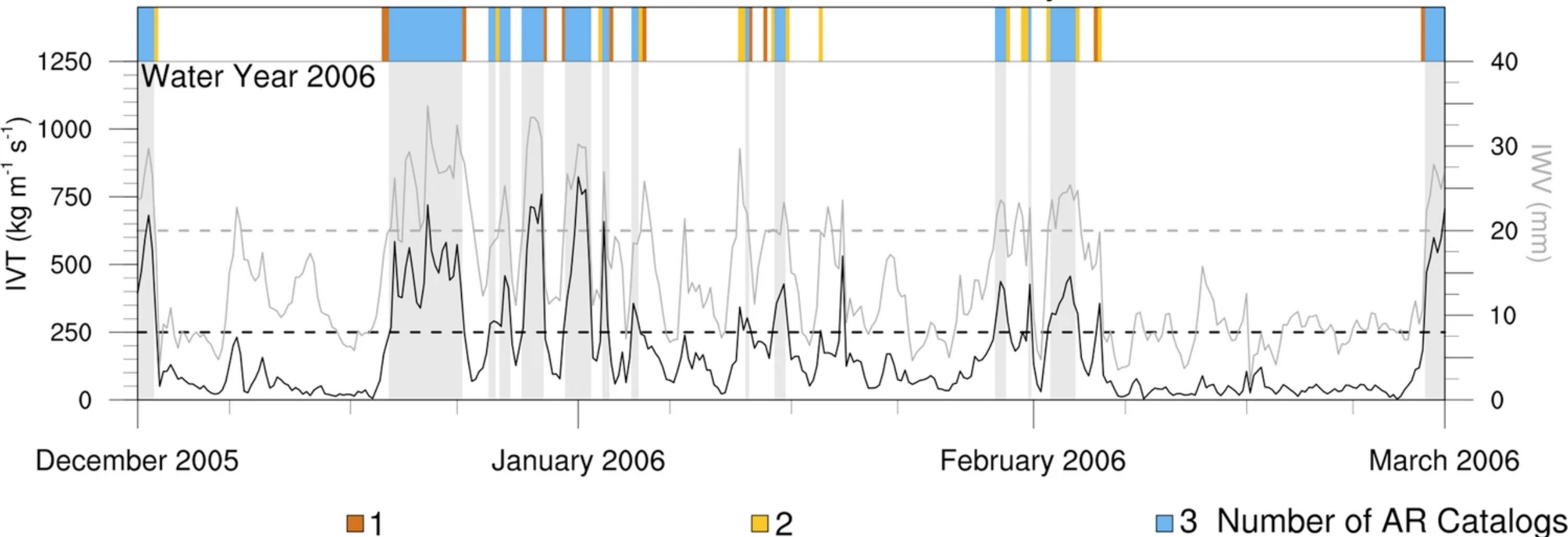
ERA-Interim

MERRA-2



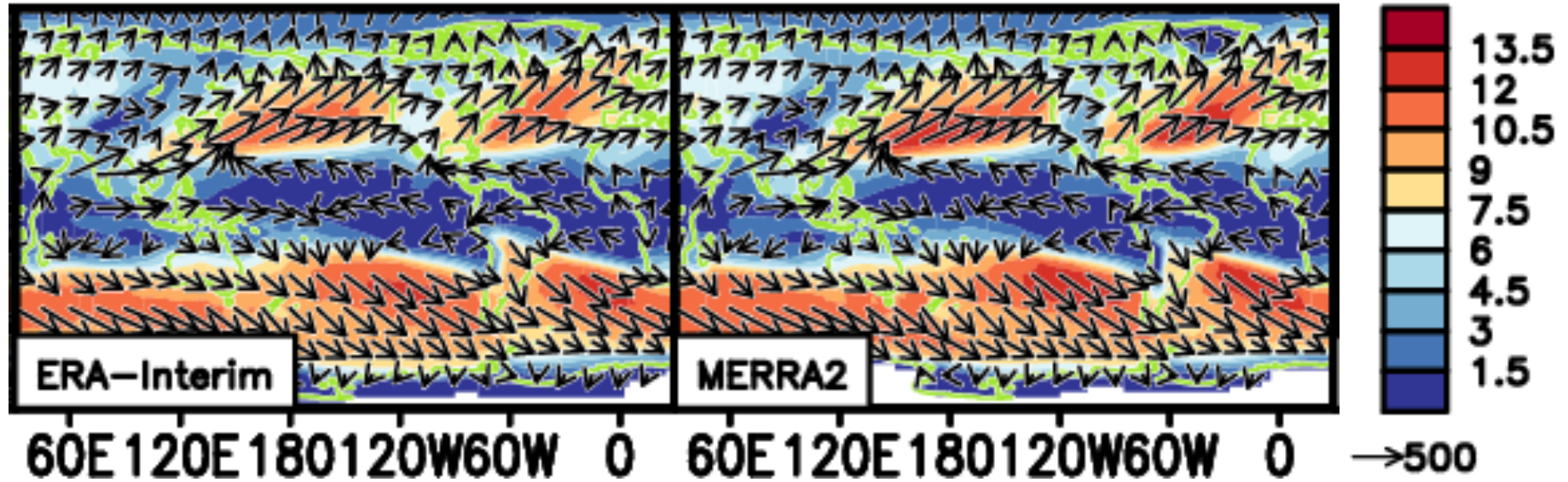
Background/Preliminary Work

RSR2014 ARDT on Different Reanalyses



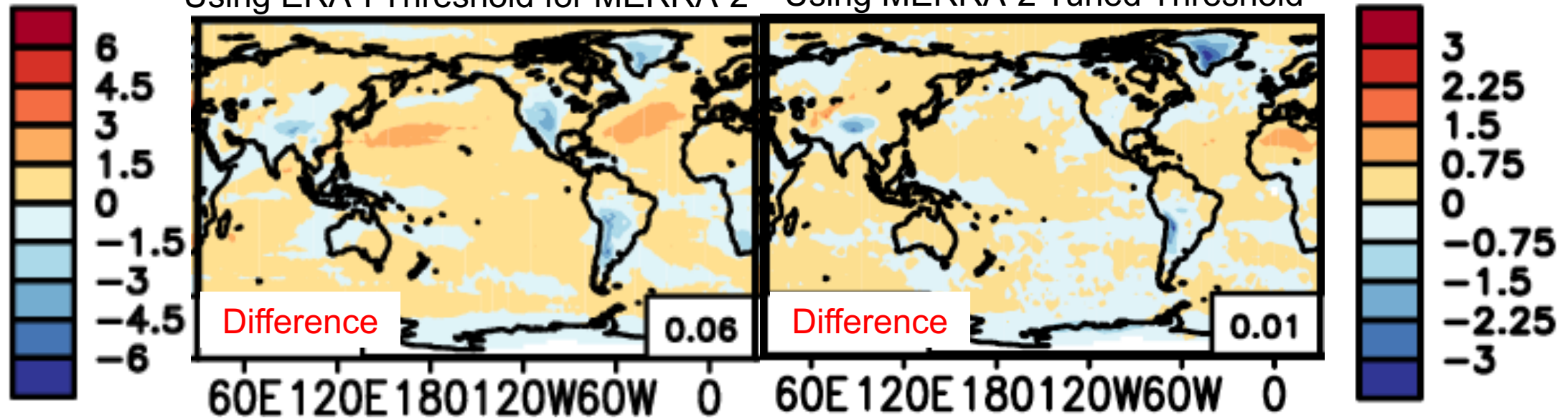
- <https://link.springer.com/article/10.1007%2Fs00382-018-4427-5> (Ralph et al., 2019)
- Limited to Russian River Watershed, only includes MERRA-2, ERA-I, and NCEP

ERA-Interim vs. MERRA-2: AR Frequency



Using ERA-I Threshold for MERRA-2

Using MERRA-2 Tuned Threshold



Science Questions

1. What are the appropriate metrics for investigating ARs and how they have/will change in time?
 - 1.a. What is the best way to handle regional differences in ARs in a global algorithm?
 - 1.b. How are diagnostic reanalysis variables, such as precipitation, impacted by AR detection?
2. How does the uncertainty in AR frequency among reanalyses compare to the uncertainty among tracking algorithms?
3. How suitable are century scale reanalyses for studying ARs?
 - 3.a. Does a coupled system improve reliability (CERA-20C vs ERA-20C)

Possible extensions of the generated dataset:

- stitching of detected ARs using hourly data, is there any indication that ARs have changed over time (must be evaluated with caution using traditional reanalyses)?, relation to teleconnections
- influence of offline/online IVT calculation and hourly vs 3 hourly data for AR detection

Reanalysis Datasets

Reanalysis	Resolution	Temporal Resolution	Time Period Available	Already Computed IVT
ERA5	~30km/0.28°, 137 vertical layers	Hourly	1979-NRT	✓
CFSR	0.5°		1979-2010	
MERRA-2	~50km/0.625° x 0.5°, 72 vertical layers	Hourly	1980-NRT	✓
JRA-55	1.25°	3 hourly		✓
JRA-55c	1.25°	3 hourly	1928-2012	✓
20CRv3	1°, 64 vertical levels	3 hourly	1900-2015	
CERA-20C	~125 km, 91 vertical layers	3 hourly	1901-2010	
ERA-20C	~125 km, 91 vertical layers	3 hourly	1900-2010	

Reanalyses Omitted: NCEP/NCAR, ERA-Interim, MERRA

Answering Science Questions 1 and 2

Reanalysis	Resolution	Temporal Resolution	Time Period Available	Already Computed IVT
ERA5	~30km/0.28°, 137 vertical layers	Hourly	1979-NRT	✓
CFSR	0.5°		1979-2010	
MERRA-2	~50km/0.625° x 0.5°, 72 vertical layers	Hourly	1980-NRT	✓
JRA-55	1.25°, 60 vertical levels	3 hourly	1958-NRT	✓

- Focus on overlapping period of 1980 – 2019, for 40 years of data
- Attention given to changes in the observing system and how this impacts AR detection
- Use model derived IVT
- Use native hourly IVT (3 hourly for JRA-55)
- Needed input data to be put in centralized location

- Catalogues due Summer 2020?

Answering Science Question 3

Reanalysis	Resolution	Temporal Resolution	Time Period Available	Already Computed IVT
JRA-55c	1.25°	3 hourly	1928-2012	✓
20CRv3	1°, 64 vertical levels	3 hourly	1900-2015	
CERA-20C	~125 km, 91 vertical layers	3 hourly	1901-2010	
ERA-20C	~125 km, 91 vertical layers	3 hourly	1900-2010	

- Will need to calculate IVT from available 3-D data
- Compare with results from MERRA-2 Tier 1 catalogues (already 3 hourly with ARTMIP calculated IVT), and JRA-55 Tier 2 catalogues
- Focus on overlapping period of 1980 – 2010
- Each has multiple ensemble members; Is it feasible to run algorithms on an individual member plus the ensemble mean?
- Delay catalogue due date to fall 2020/early winter?

What data do you need for your algorithm?

- IVT
 - TPW
 - U850
 - V850
 - U and V components of IVT
-
- Please let me know if you need anything not listed here

Analysis of Catalogues

- To participate, required catalogues include MERRA-2 and ERA5 hourly AR tags
- Input data can be found at <https://gmao.gsfc.nasa.gov/gmaoftp/acollow/ARTMIP/> and will be made available at NCAR (cascade)
- Metrics to investigate: AR frequency, AR duration, mean and variance of IVT, AR category?, ...
- Model derived variables to investigate: precipitation associated with ARs, ...

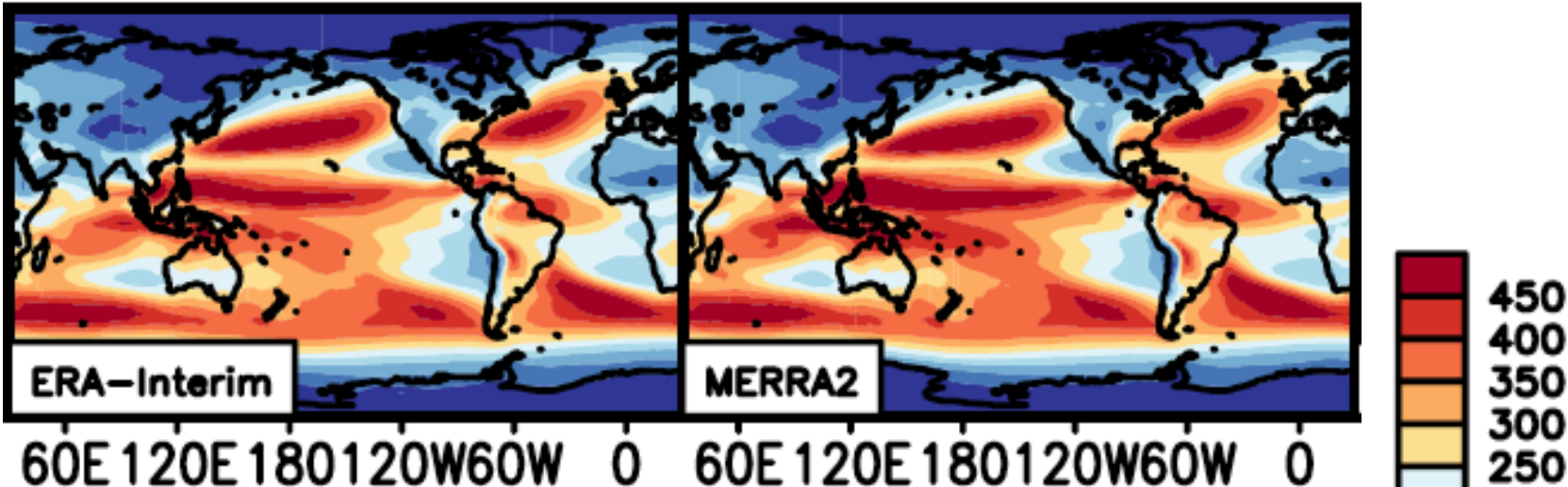


Extra Slides from ARTMIP Workshop

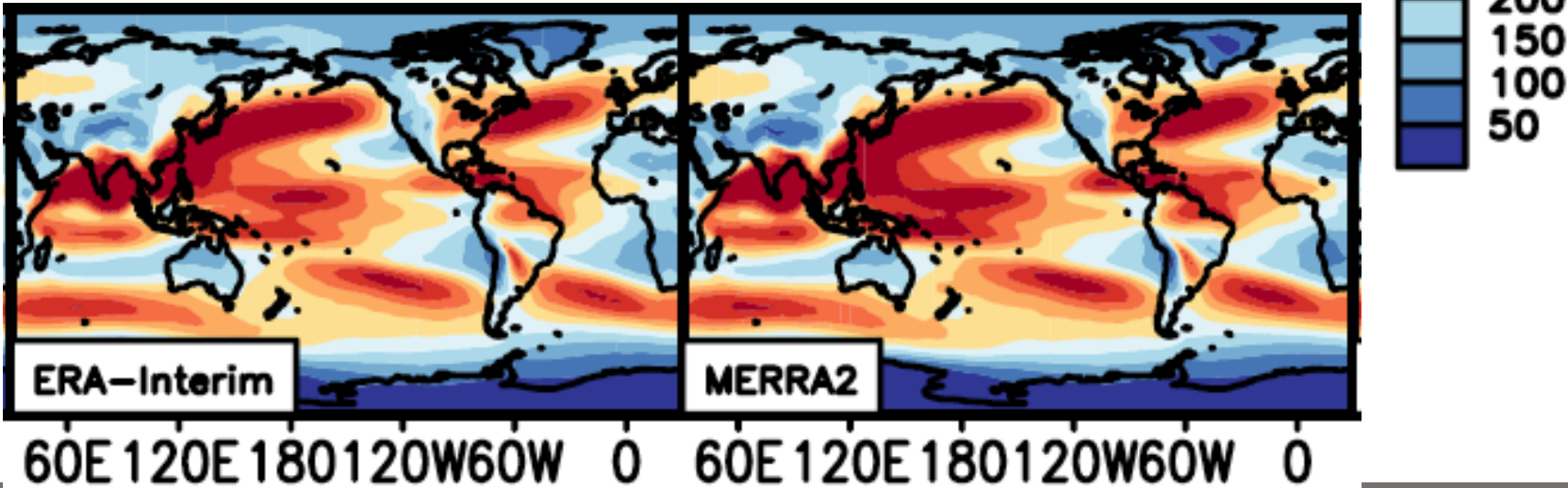


IVT 85th Percentile Based on all 6-hourly data

Winter (NDJFM)



Summer (MJJAS)



ERA-Interim representation of 21 dropsonde-observed ARs

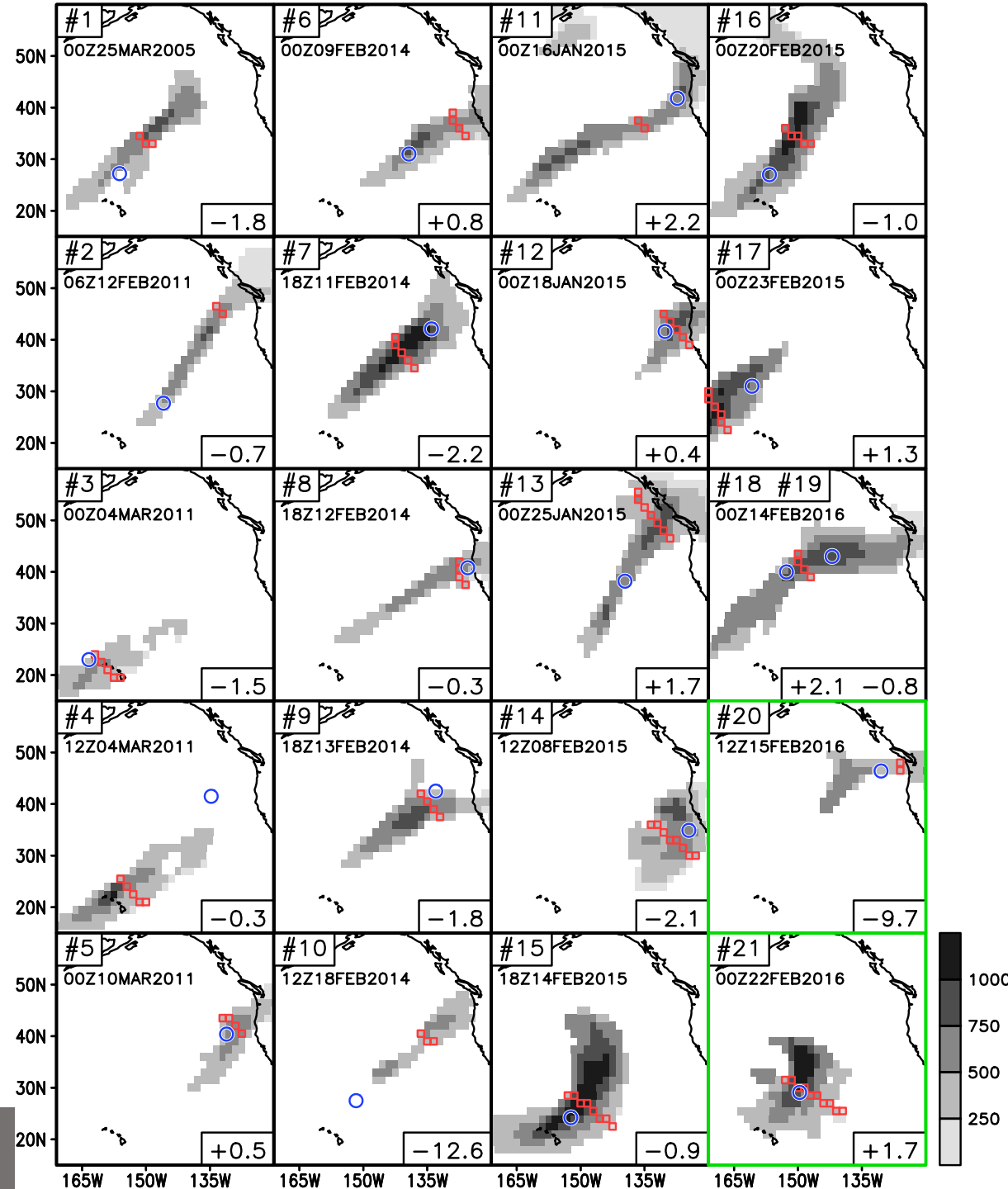
Algorithm + Reanalysis

- Shading: AR shapes.
- Red: transect going through AR centroid.

Dropsonde

Blue: midpoint of AR transect.

All 21 dropsonde ARs have a matching reanalysis AR; 19 of them matched within ± 3 hours.



MERRA-2 representation of 21 dropsonde-observed ARs

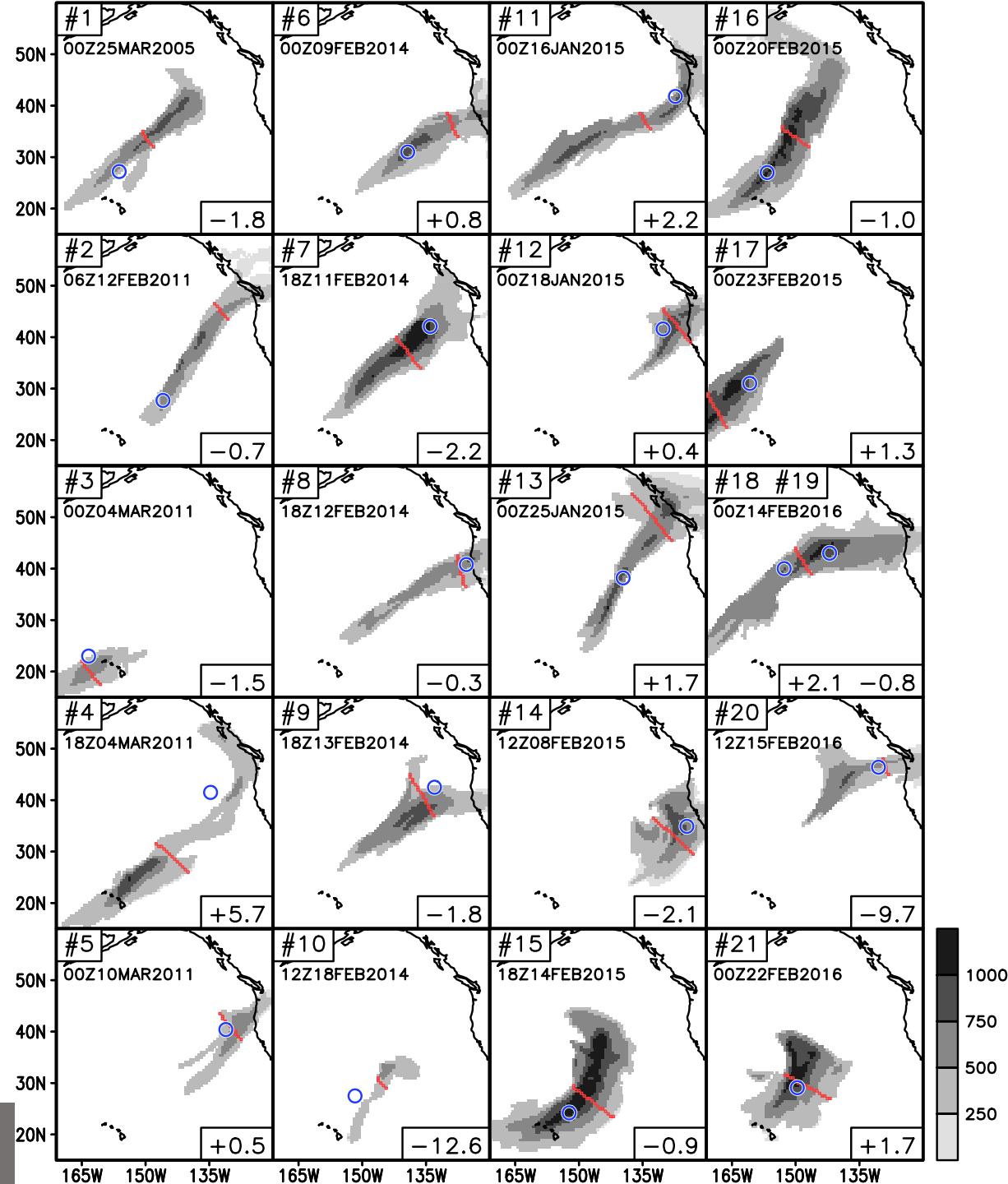
Algorithm + Reanalysis

- Shading: AR shapes.
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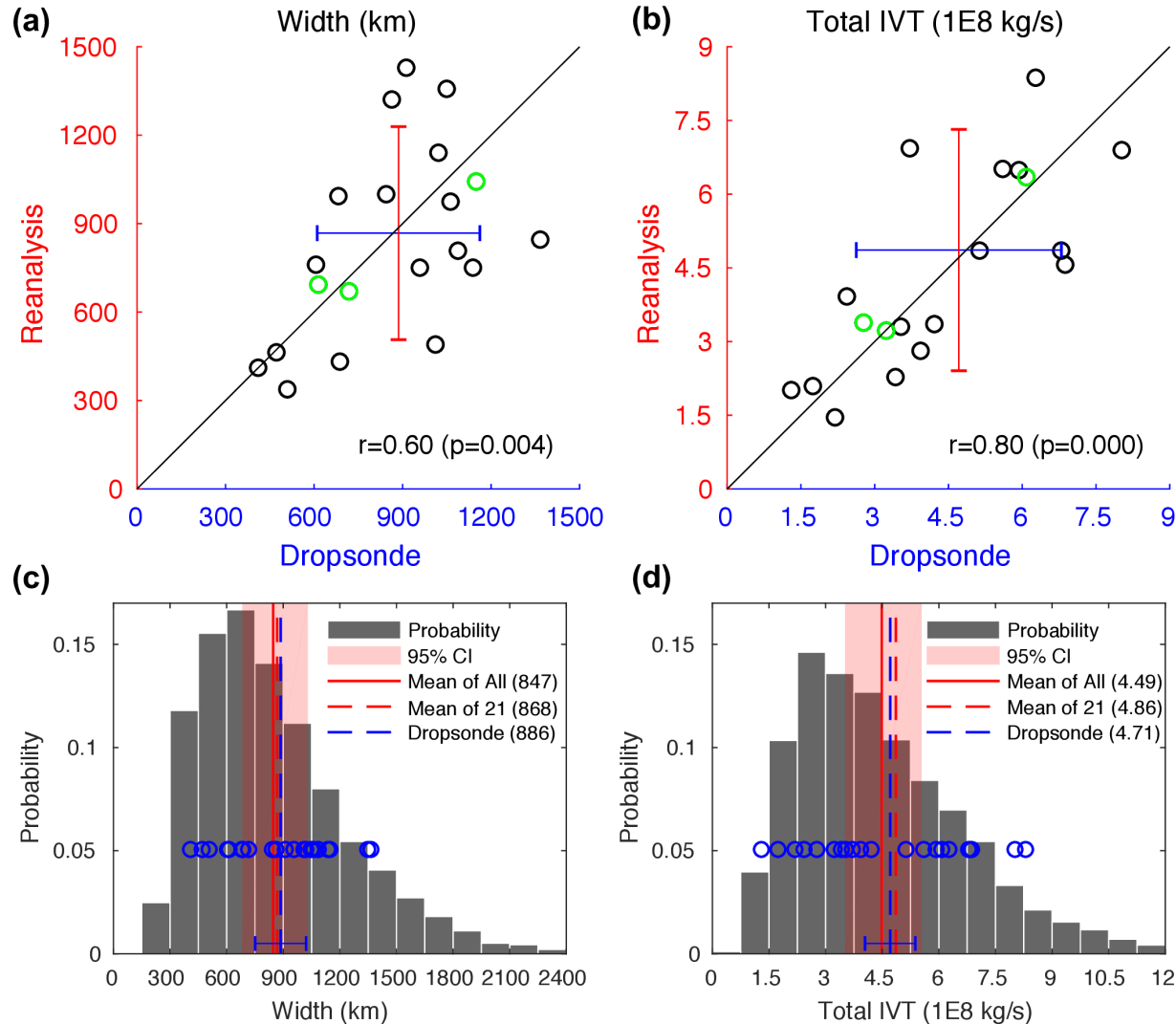
Dropsonde

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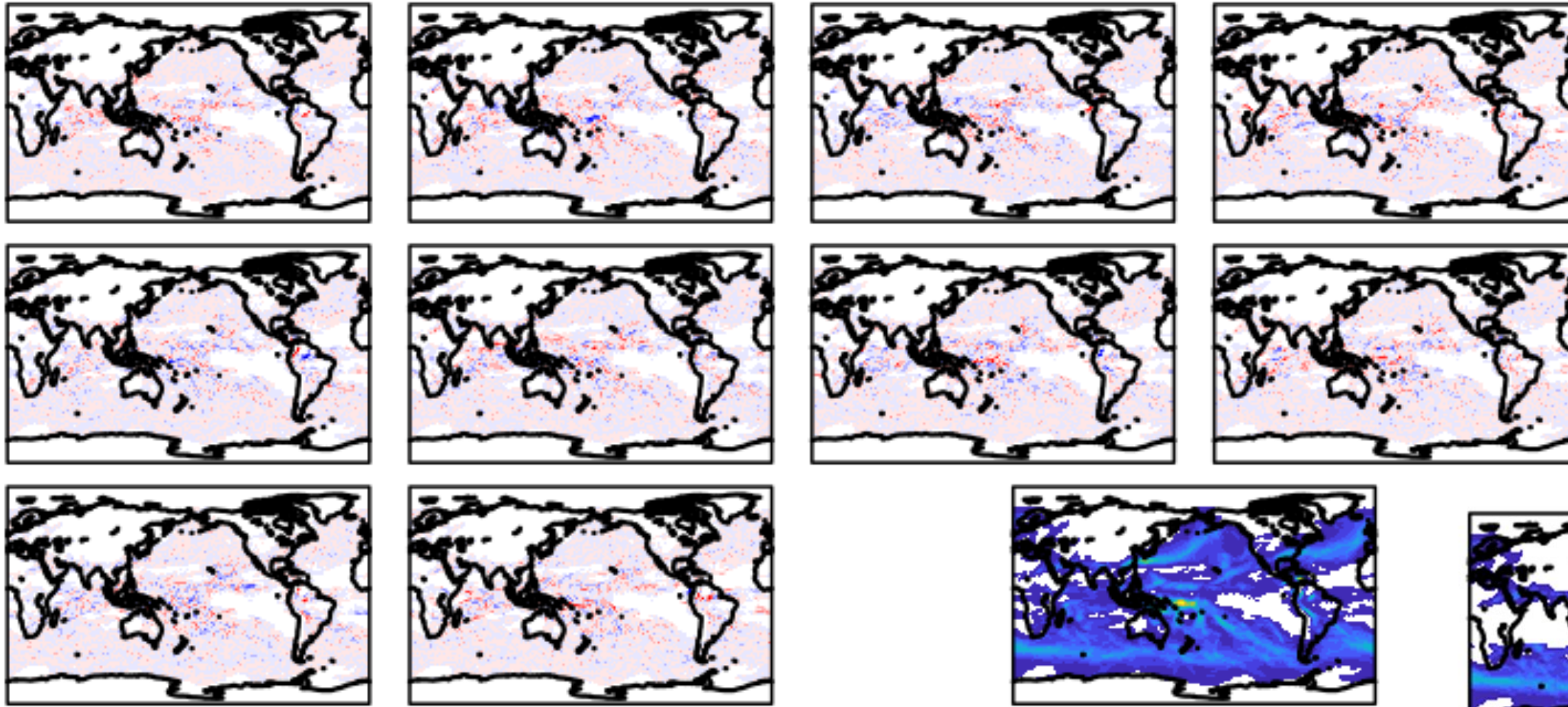
Remarkable Agreement Between Two Totally Independent AR Catalogs (ERA-Interim vs. Dropsonde)



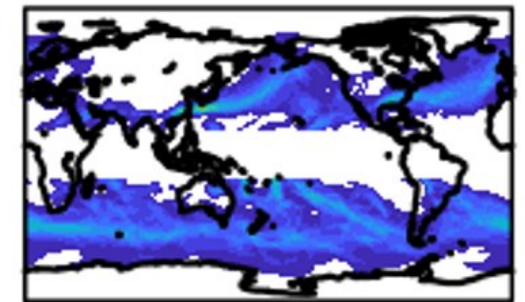
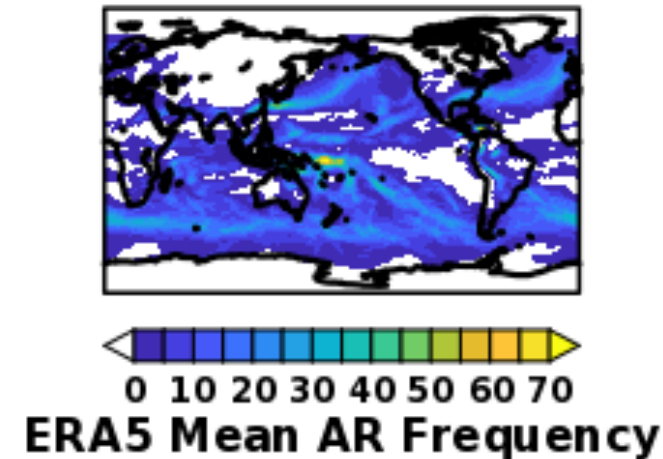
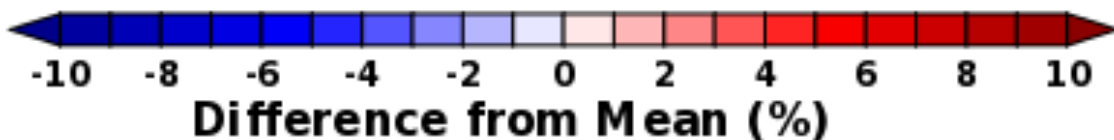
- Top: ERA-Interim-based AR width (-2% error) and total IVT (+3% error) validate well against dropsonde observations.
- Bottom: Dropsonde-observed AR width (5% difference) and total IVT (5% difference) well represent the entire population (21 vs. ~6000 ARs).

Uncertainty within a Reanalysis

February 2019



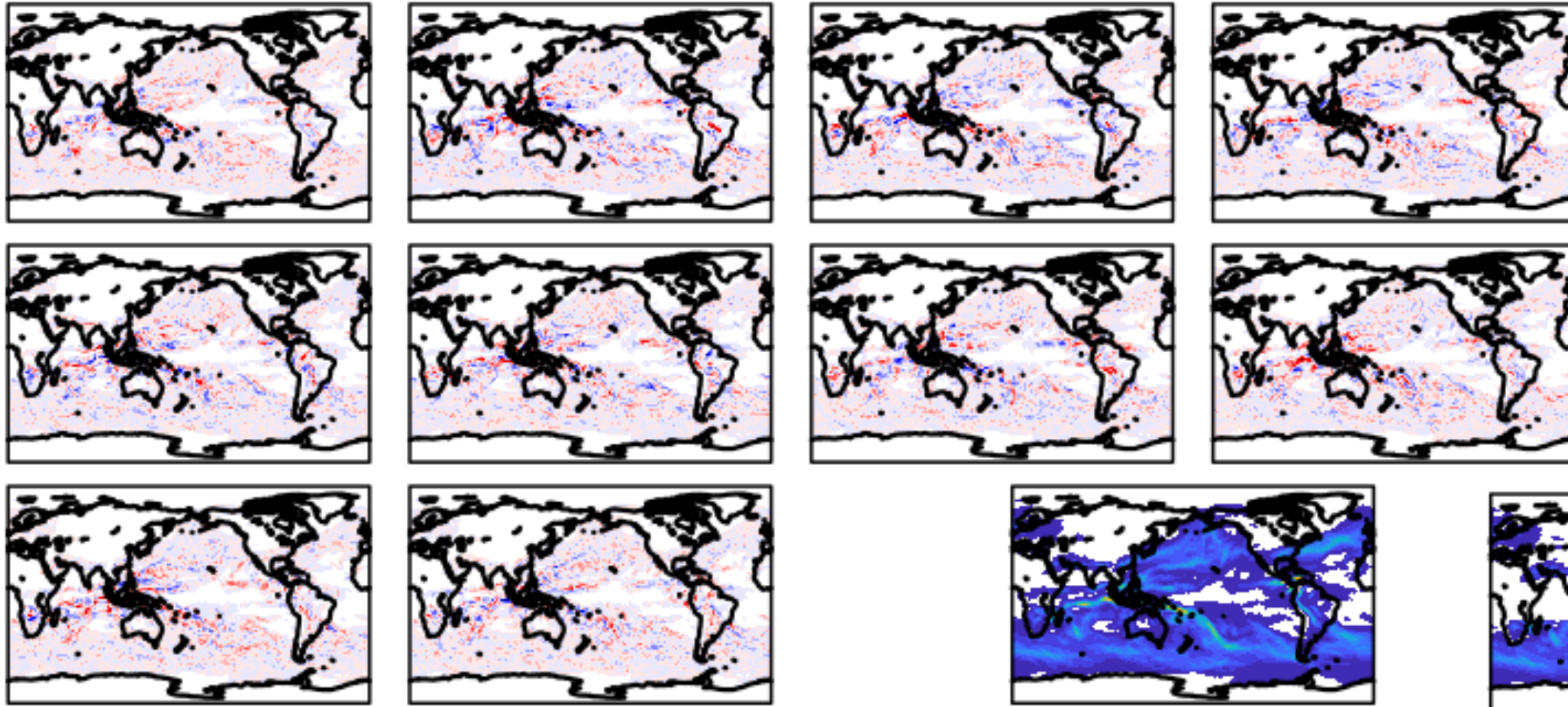
- Individual ensemble members in ERA5
- Differences are minimal, except though nearing 10% in the tropics



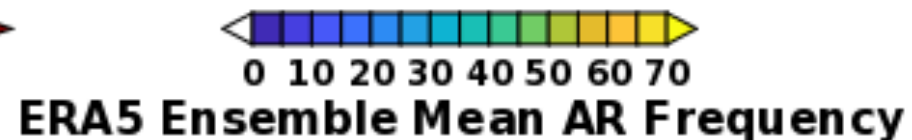
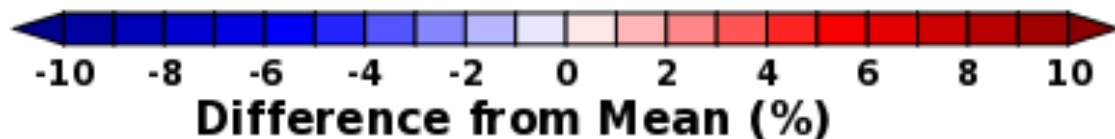
MERRA-2
(only for mid latitudes)

Uncertainty within a Reanalysis

February 1989



- Individual ensemble members in ERA5
- Differences expand to midlatitudes



MERRA-2
(only for mid
latitudes)