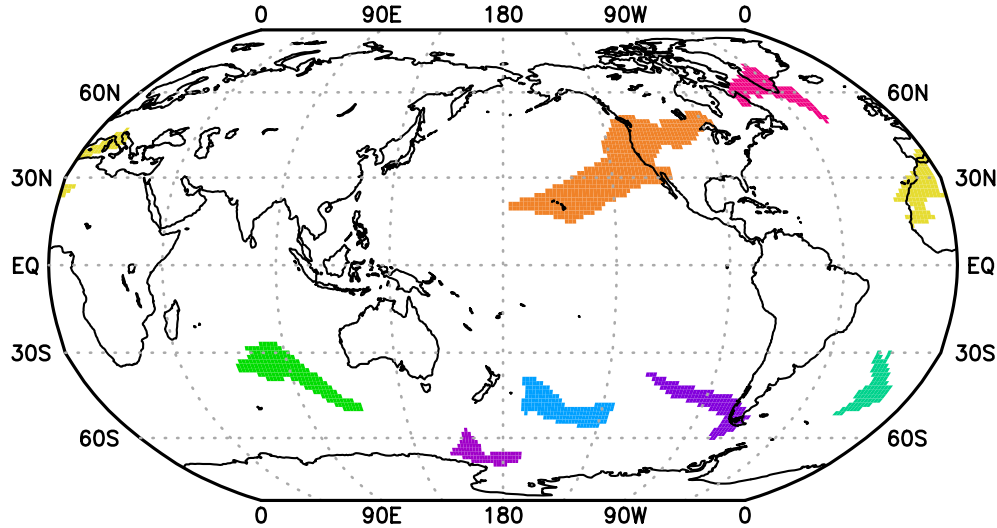


Global Perspective of Atmospheric Rivers

Climatology, and Climate Modulation



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Contributing to AR Book **Chapters 4.1 & 4.2**

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Outline

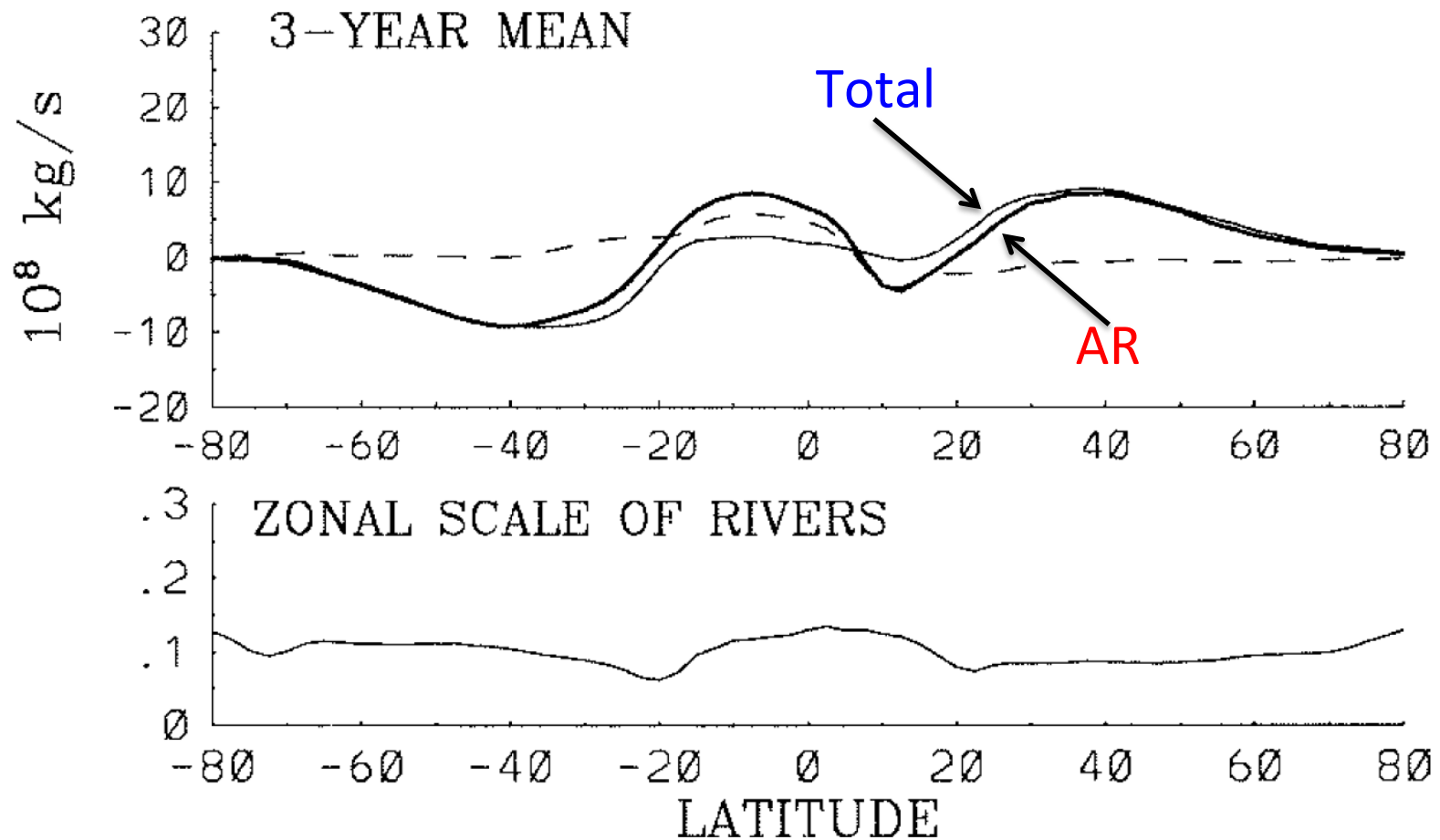
In this talk

1. Key motivations for a global perspective
2. Brief introduction to a global AR detection algorithm
3. Application of the algorithm: AR climatology and climate modulation during 1979-2015

In chapters 4.1 & 4.2:

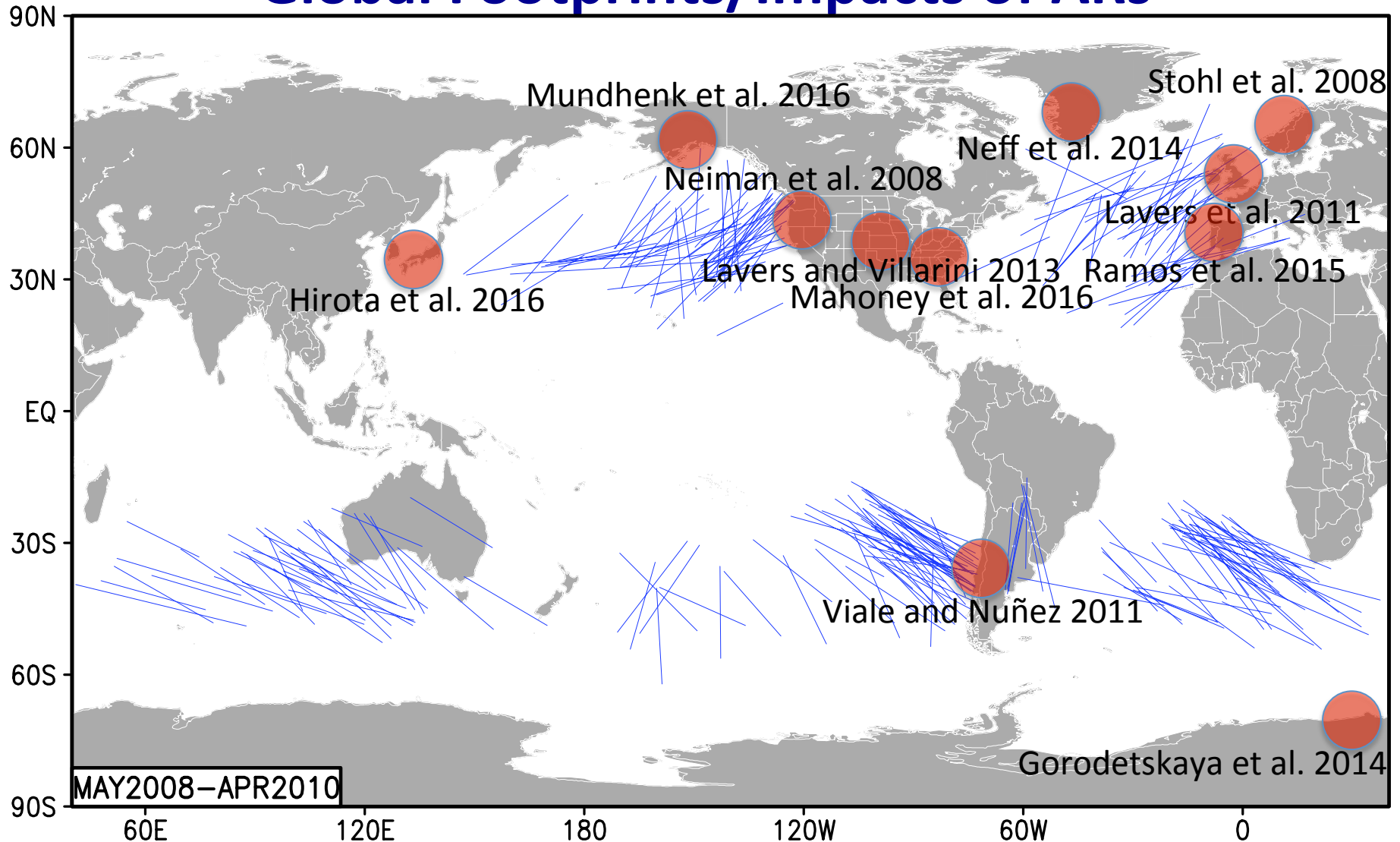
4. Discussion of related (regionally focused) studies facilitated by the above (global) framework

Key Motivations of a Global Perspective: Role of ARs in Global Water Cycle



Over 90% of poleward IVT at midlatitudes is realized by ARs that take up only $\sim 10\%$ of the zonal circumference; Zhu and Newell (1998)

Key Motivations of a Global Perspective: Global Footprints/Impacts of ARs

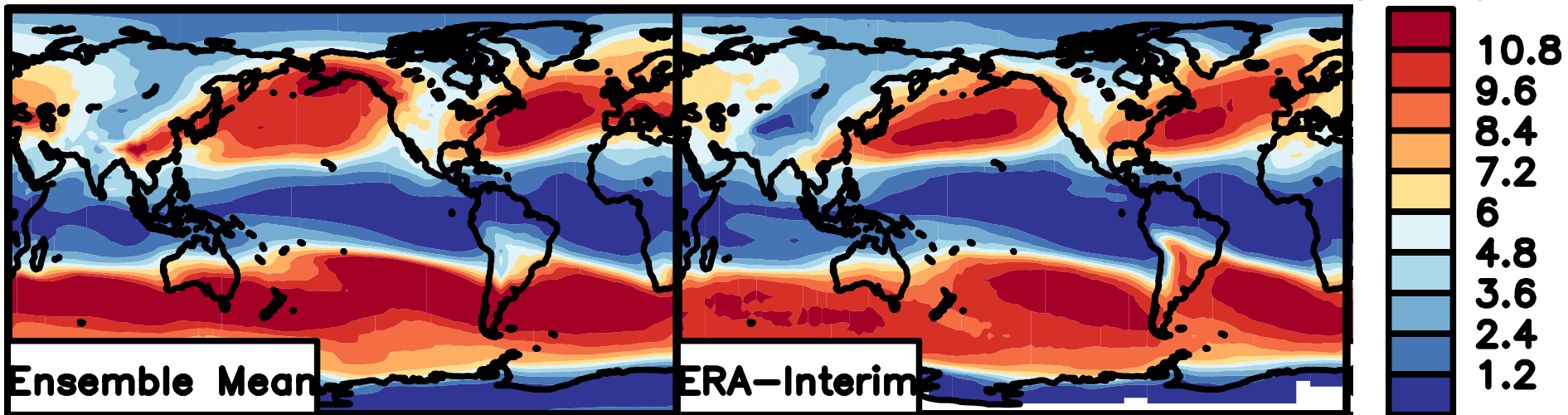


— Manually identified AR locations in 2 years; Waliser et al. (2012)

● Selected published studies with regional focus

Key Motivations of a Global Perspective: Global Model Evaluation

Frequency (%)

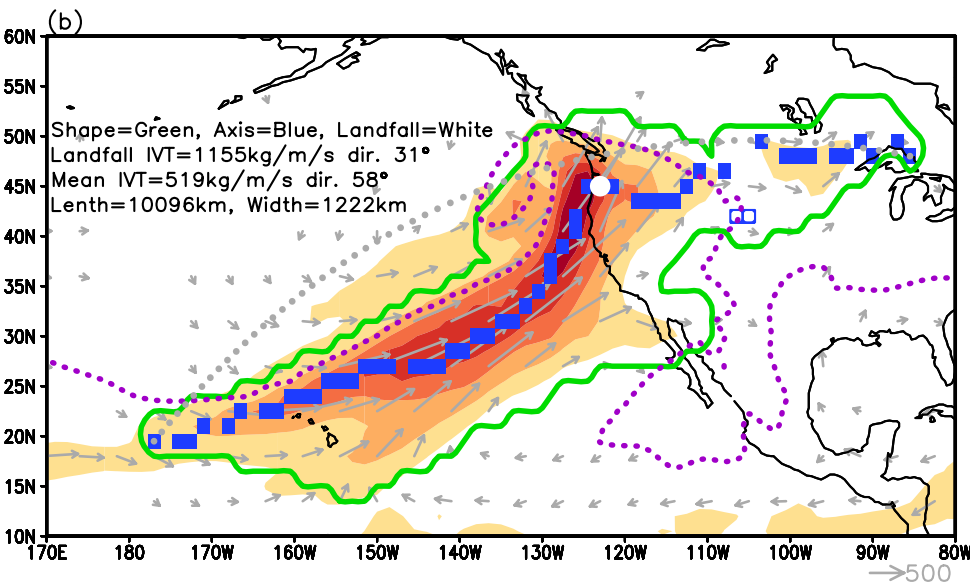
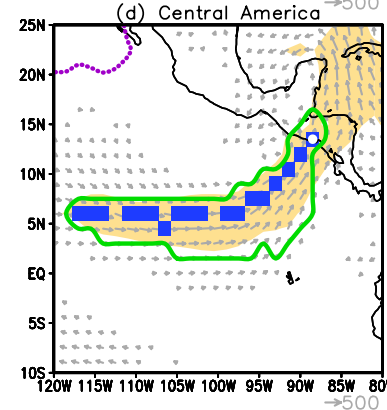
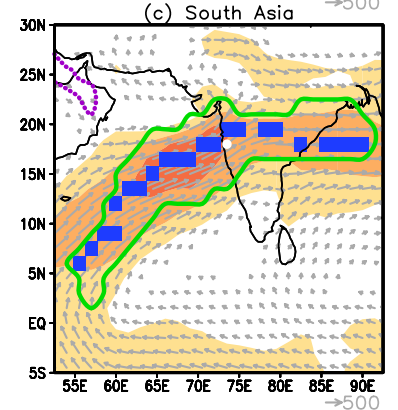
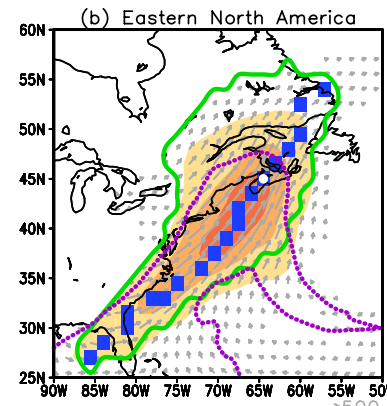
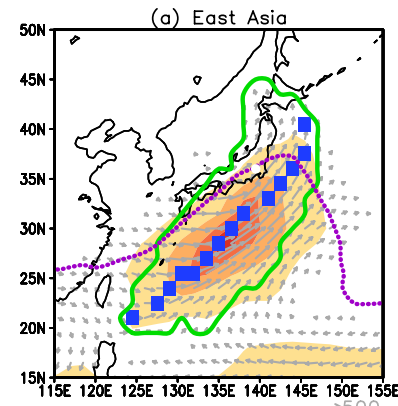
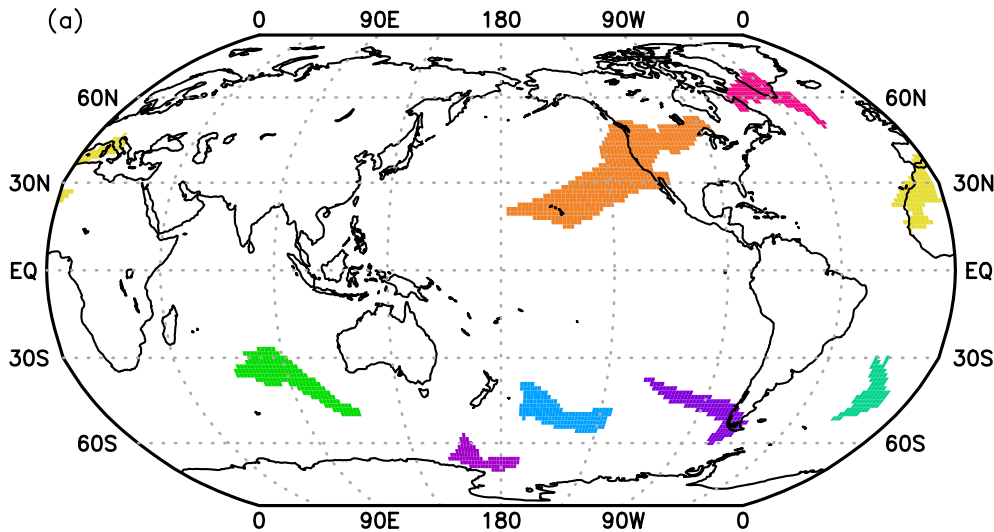


Reanalysis vs. 24 models from the GASS-YoTC Multi-model Experiment; Guan and Waliser (in prep.)

Previous model evaluation efforts have largely focused on landfalls, particularly in west coasts of North America and Europe.

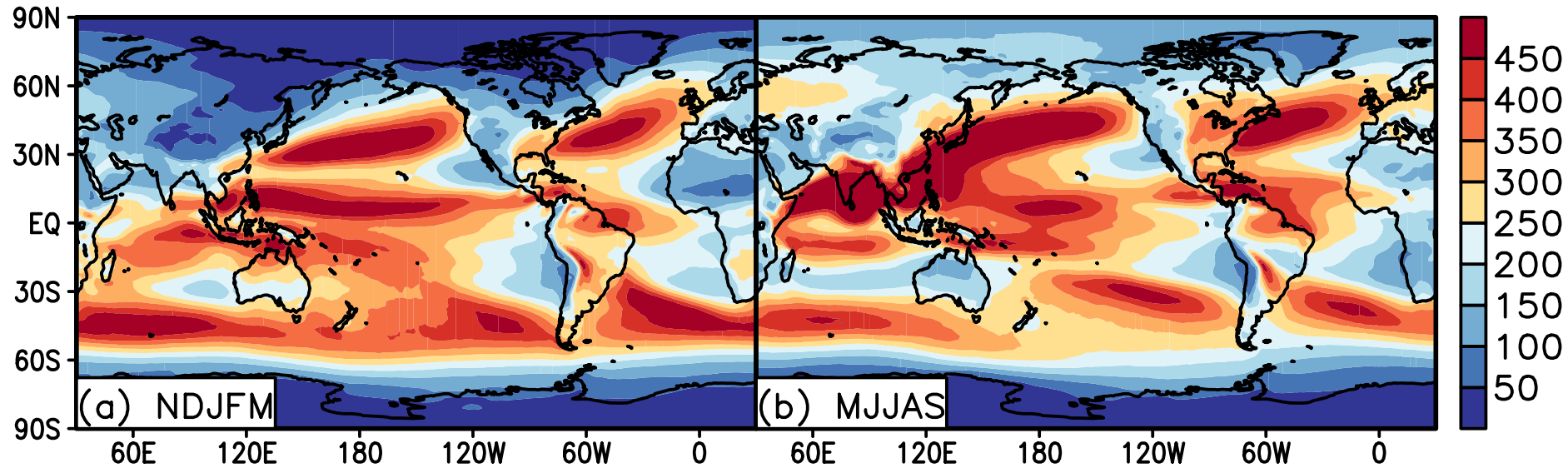
An AR Detection Algorithm for Global Studies

Guan and Waliser (2015)



Example output based on ERA-Interim 6-hourly IVT

Intensity and Geometry Thresholds



Intensity threshold:

$$\text{IVT} > \max(85^{\text{th}} \text{ percentile}, 100 \text{ kg m}^{-1} \text{ s}^{-1})$$

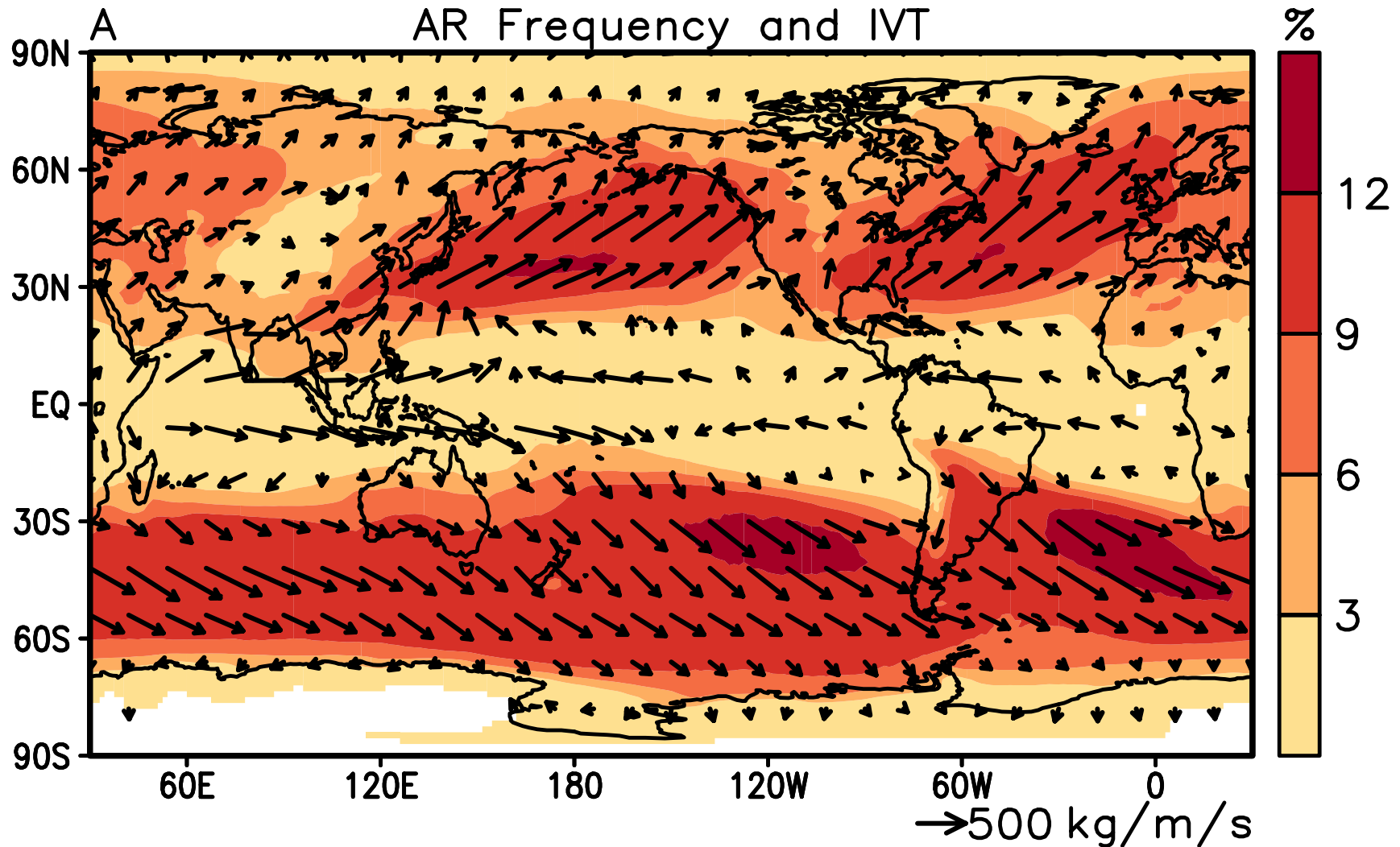
Geometry threshold:

$$\text{Length} > 2000 \text{ km}, \text{ Length/Width} > 2$$

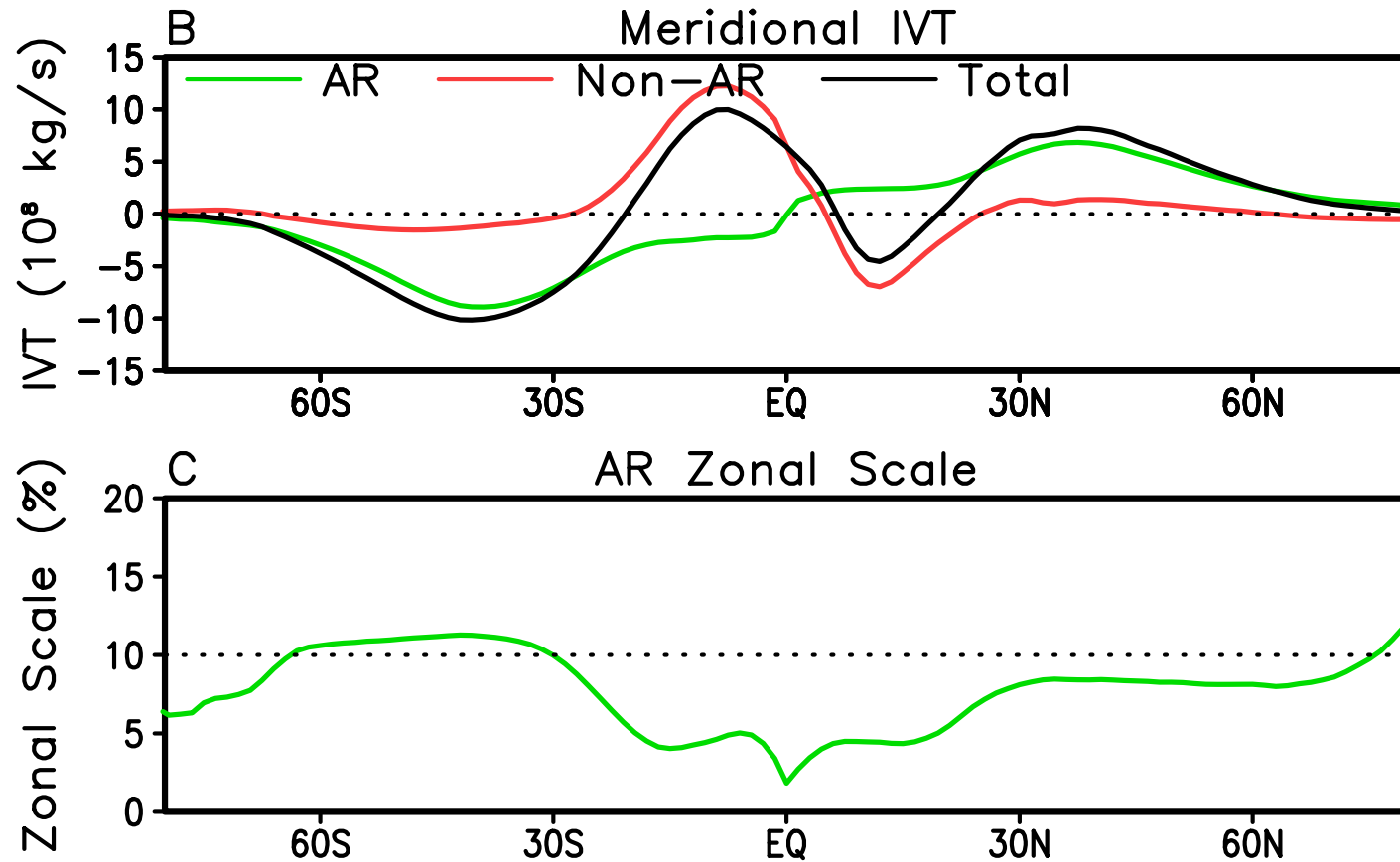
Over ~90% Agreement in Detected AR Landfall Dates Compared to 3 Independent Studies

Study Area	Western North America (Neiman et al. 2008)	Britain (Lavers et al. 2011)	East Antarctica (Gorodetskaya et al. 2014)
Period	1997–2014, November–March	1997–2010, October–March (High-impact events only)	2009–2012, All Months (High-impact events only)
Variable for AR Detection	IWV from SSM/I and SSMIS Retrievals	900-hPa Specific Humidity from Twentieth Century Reanalysis Project	IWV from ERA-Interim Reanalysis
Percent Agreement	94%	89%	100%

ARs occur globally; more in extratropical ocean basins

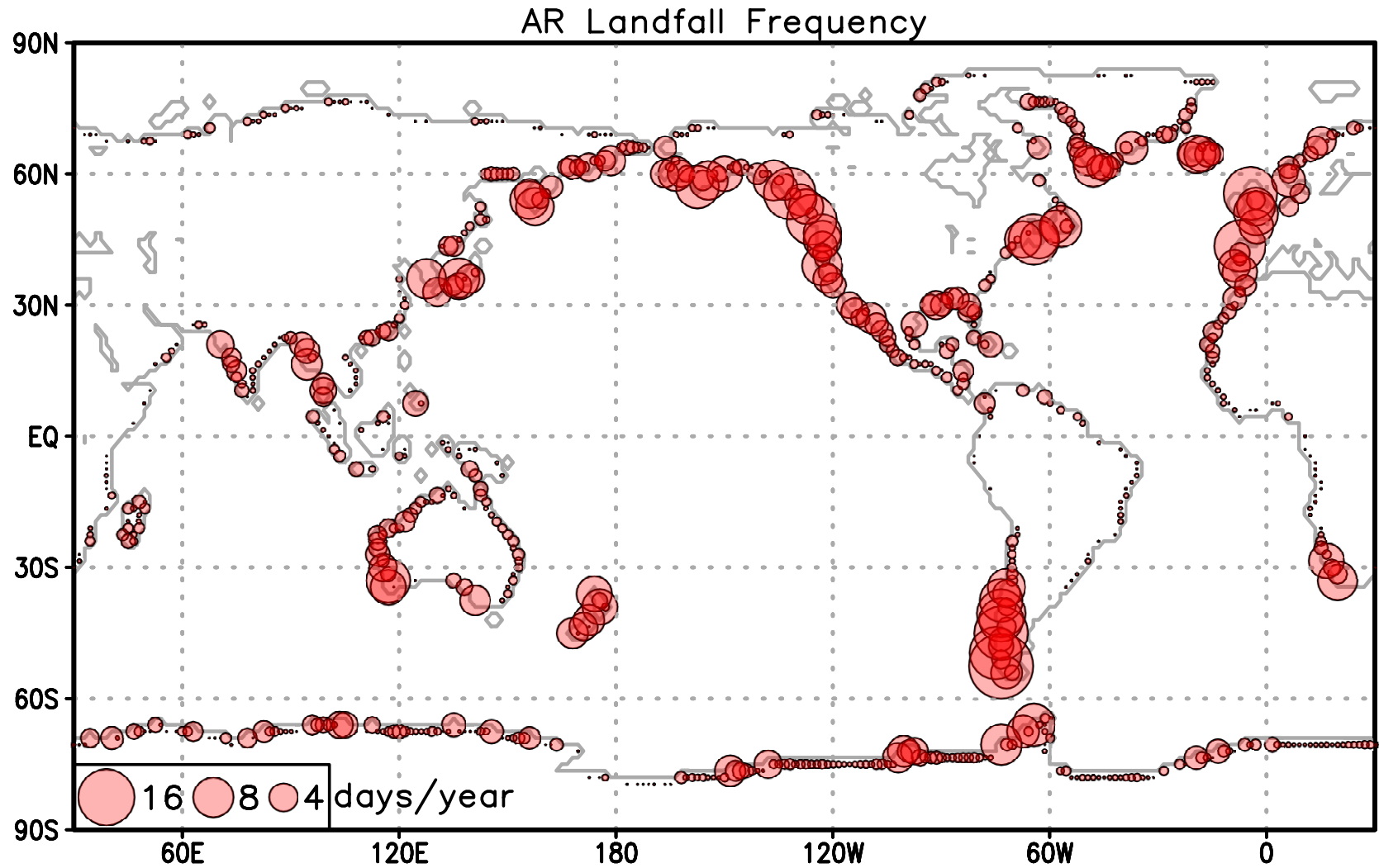


ARs account for majority of poleward moisture transport



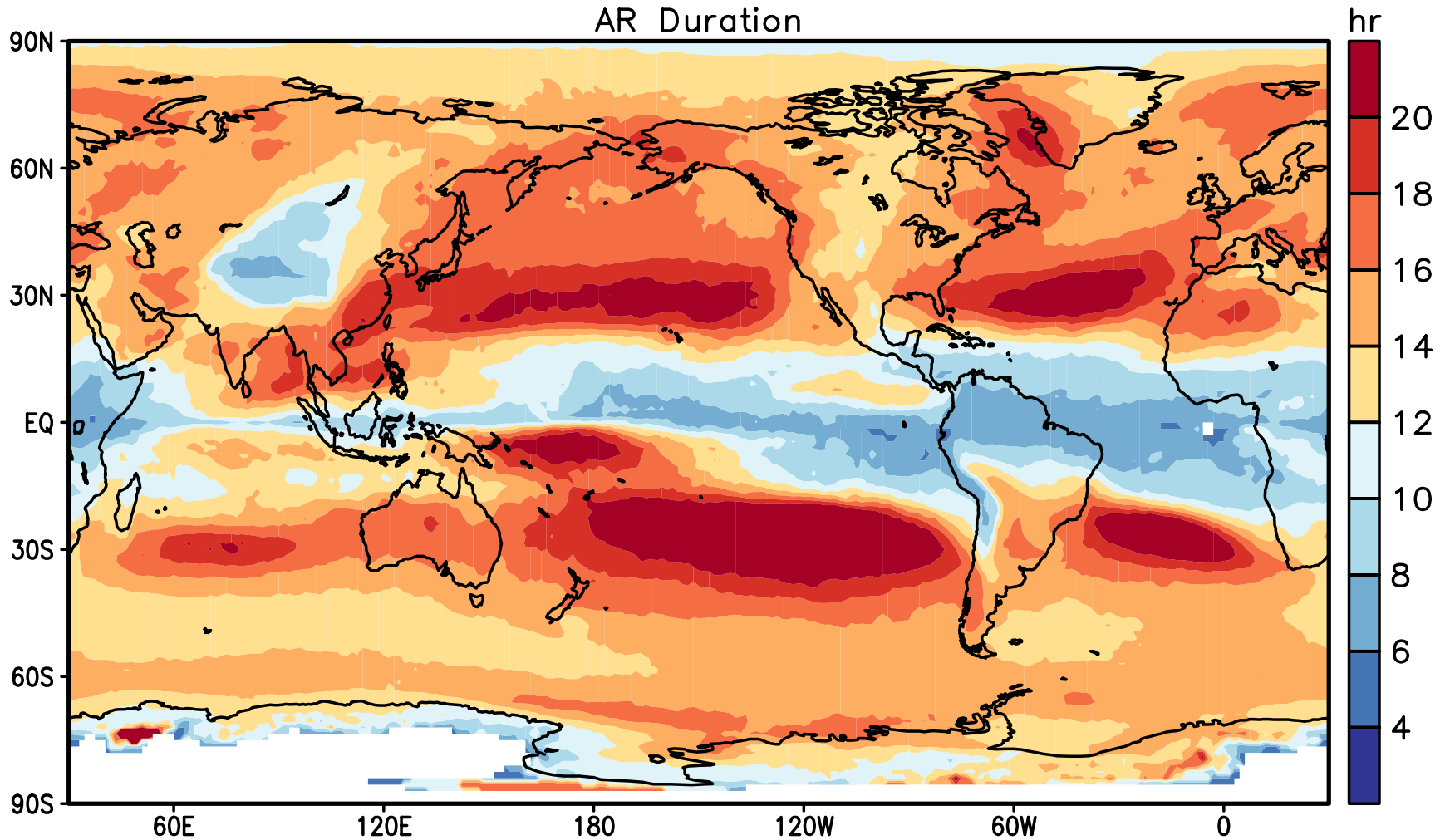
AR fractional poleward IVT and integrated zonal scale largely consistent with original estimate by Zhu and Newell (1998)

AR landfalls are most frequent in west coast areas; notable in many other areas

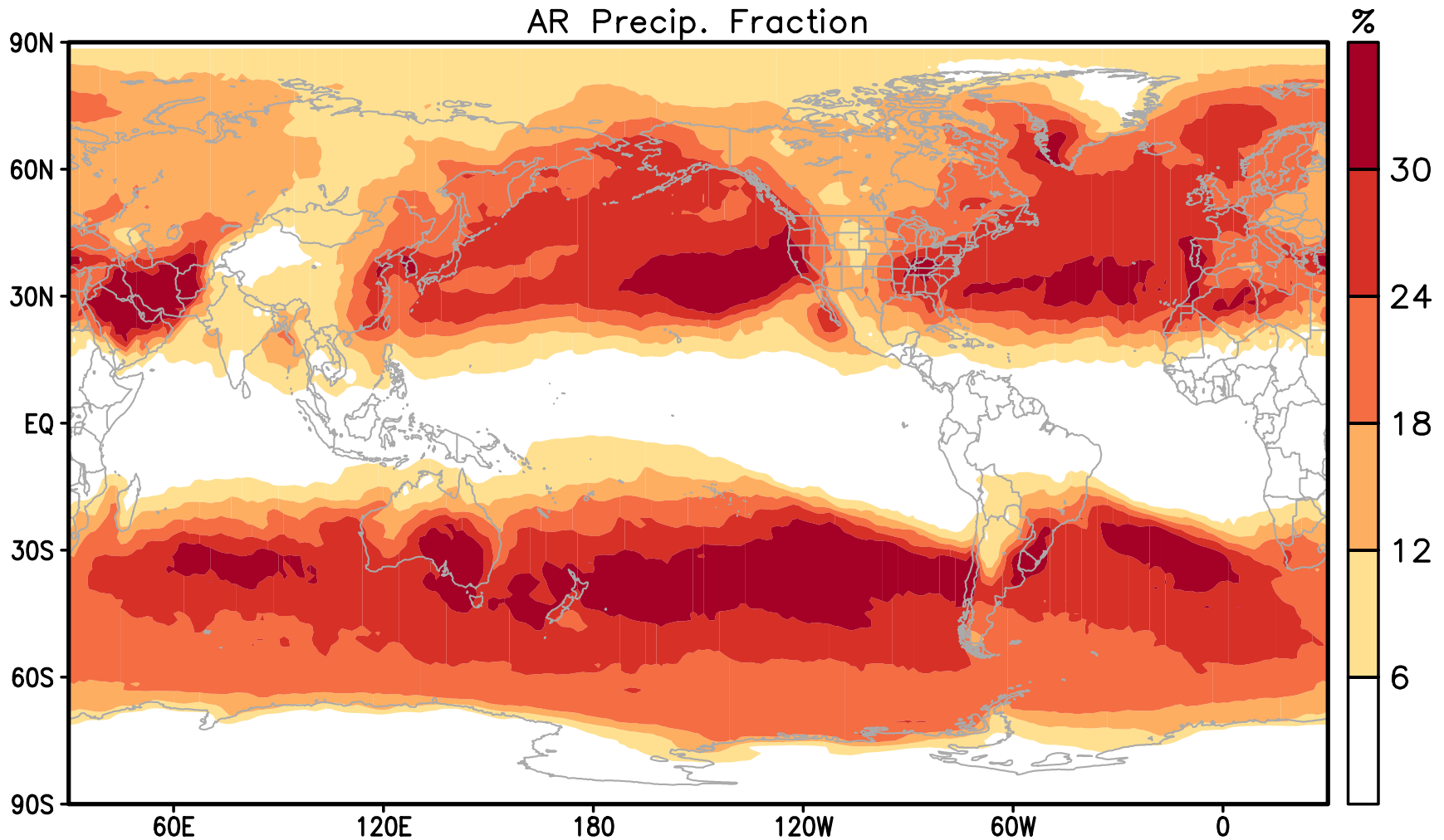


AR duration is longest in most subtropical ocean basins

AR Duration

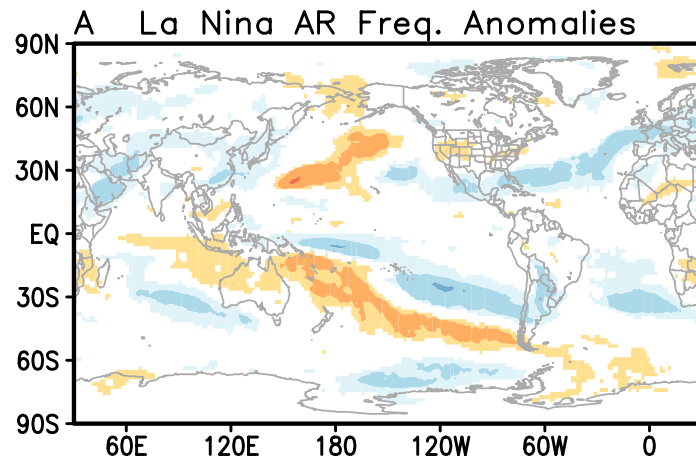


ARs provide notable fraction of total annual precipitation

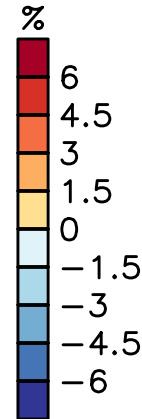
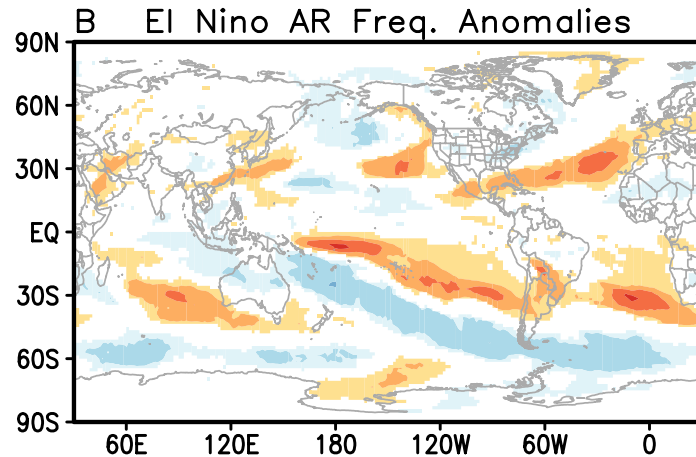


Climate Modulation: El Niño/La Niña

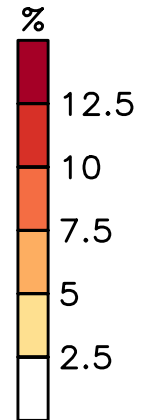
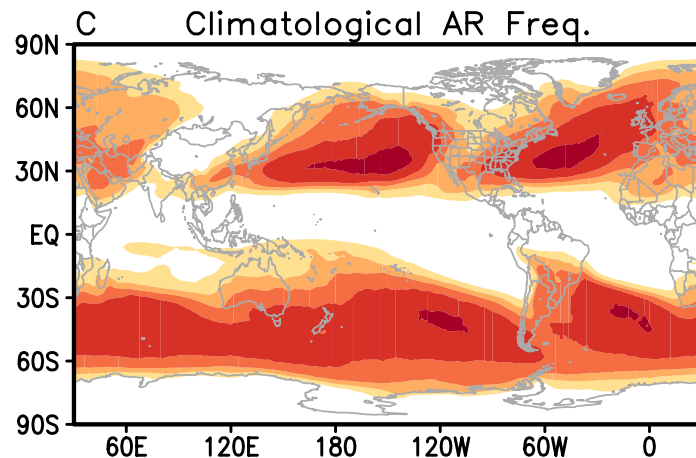
Notable influence in a number of areas compared to climatology



La Niña anomaly



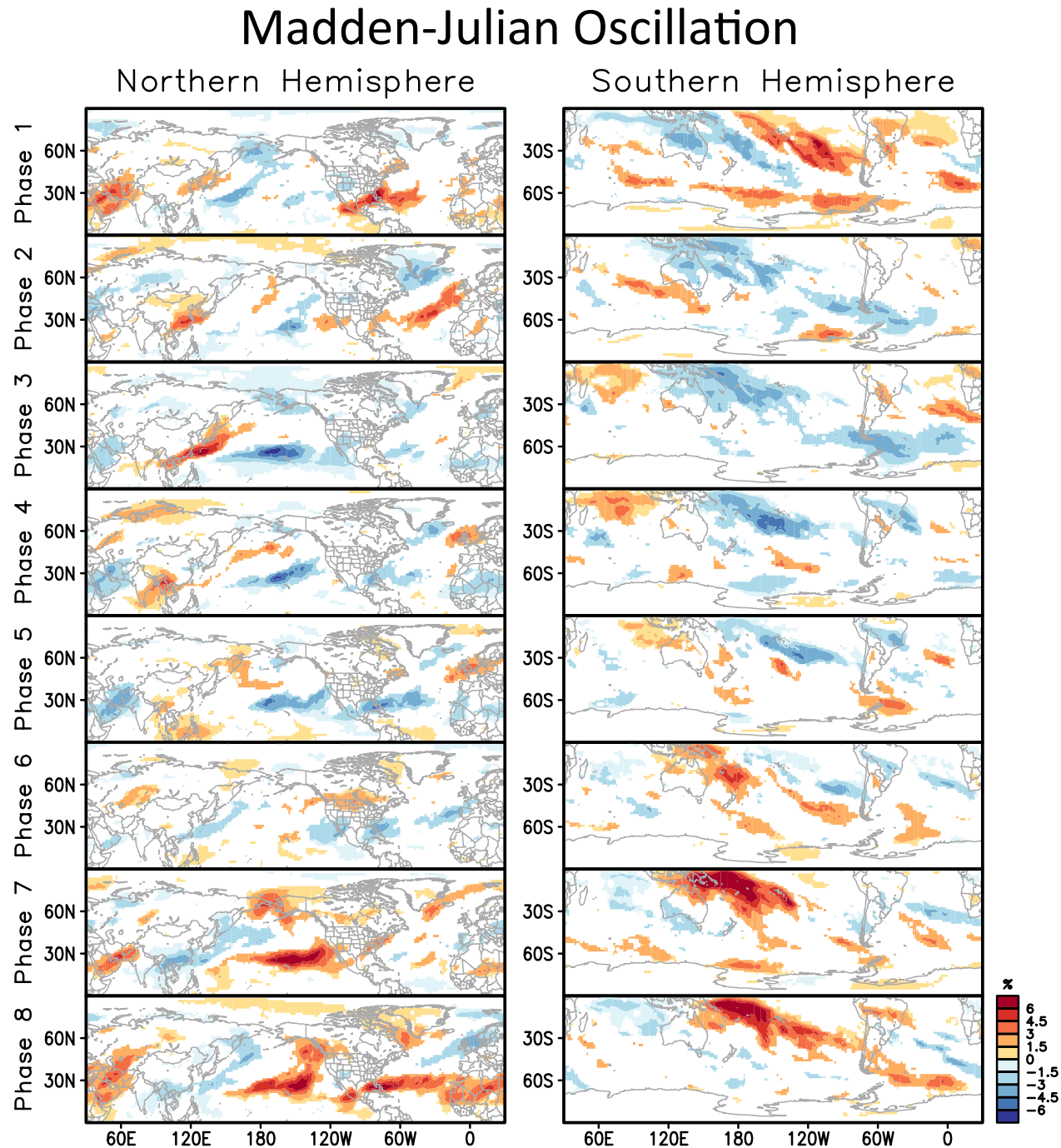
El Niño anomaly



Climatol.

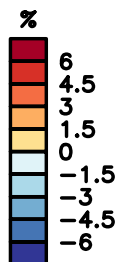
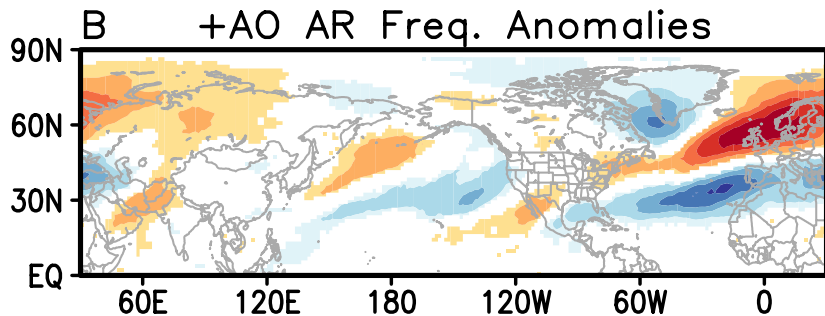
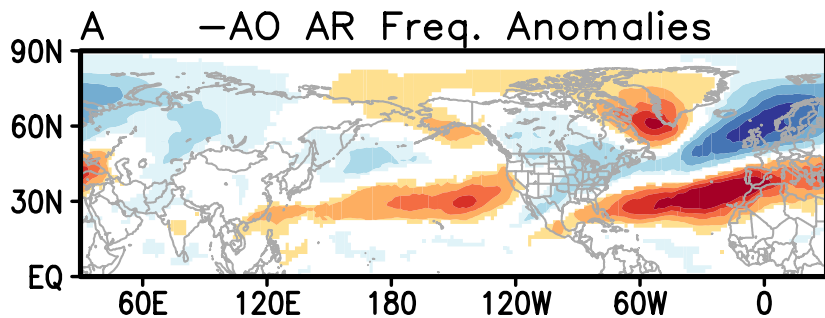
Climate Modulation: MJO

Coherent eastward-propagating anomalies reflecting MJO influence

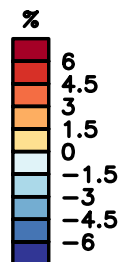
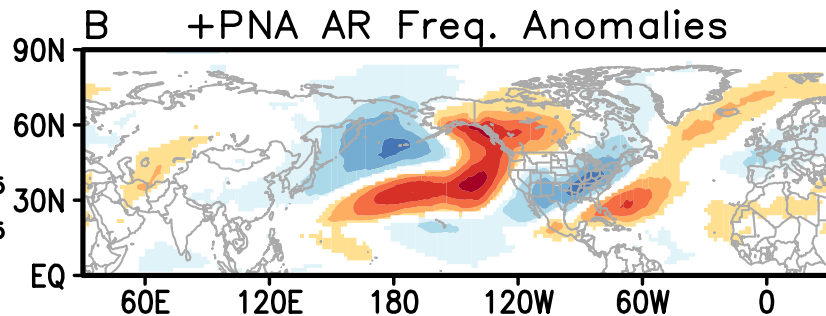
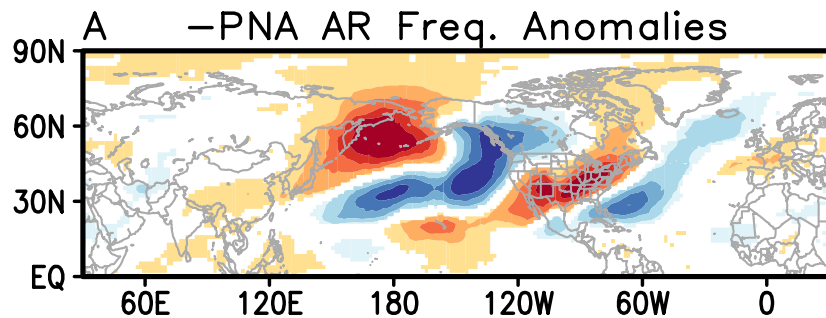


Climate Modulation: AO and PNA

Arctic Oscillation



Pacific-North American



Strong modulation of large-scale AR activities by AO and PNA

Summary

- Global climatology, and climate modulation of ARs during 1979-2015 were examined using a recently developed AR detection algorithm;
- Chapters 4.1 & 4.2 of the AR book will be based on materials presented herein and review/discussion of related studies;
- The results support the importance of ARs in global water cycle, weather, and climate.