

Uncertainty Associated with Atmospheric River-Derived Seasonal Snowfall Patterns

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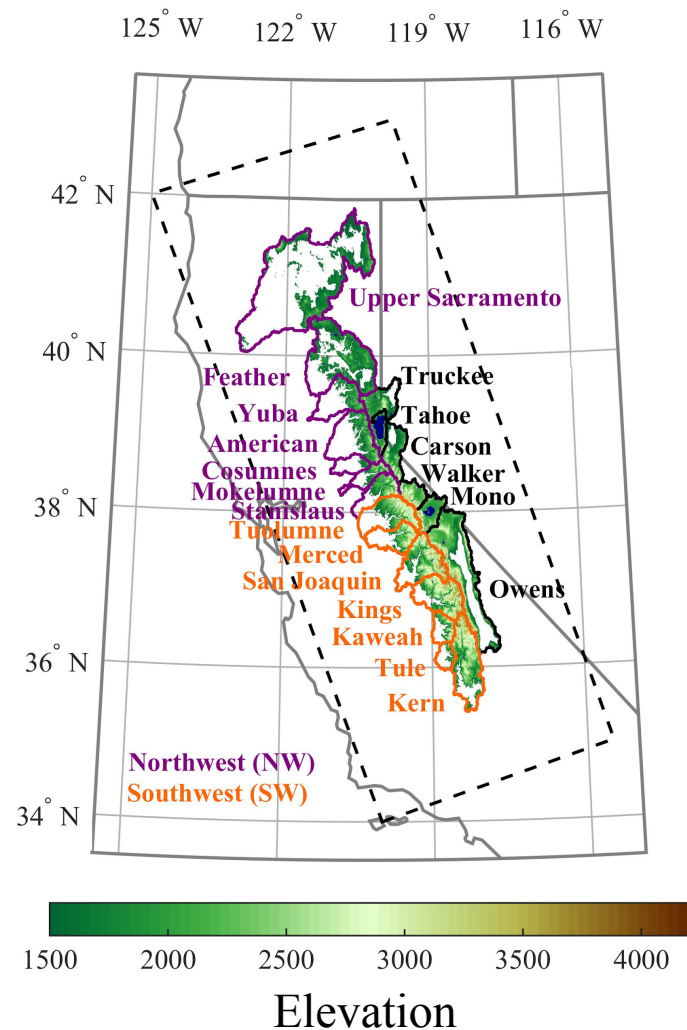
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Overarching Questions

How is the understanding of the atmospheric river (AR)-derived **seasonal snowfall distribution** across the Sierra Nevada impacted by:

1. the selection of the **AR detection method**?
2. the use of a single IVT-based detection algorithm applied to **multiple atmospheric reanalyses**?



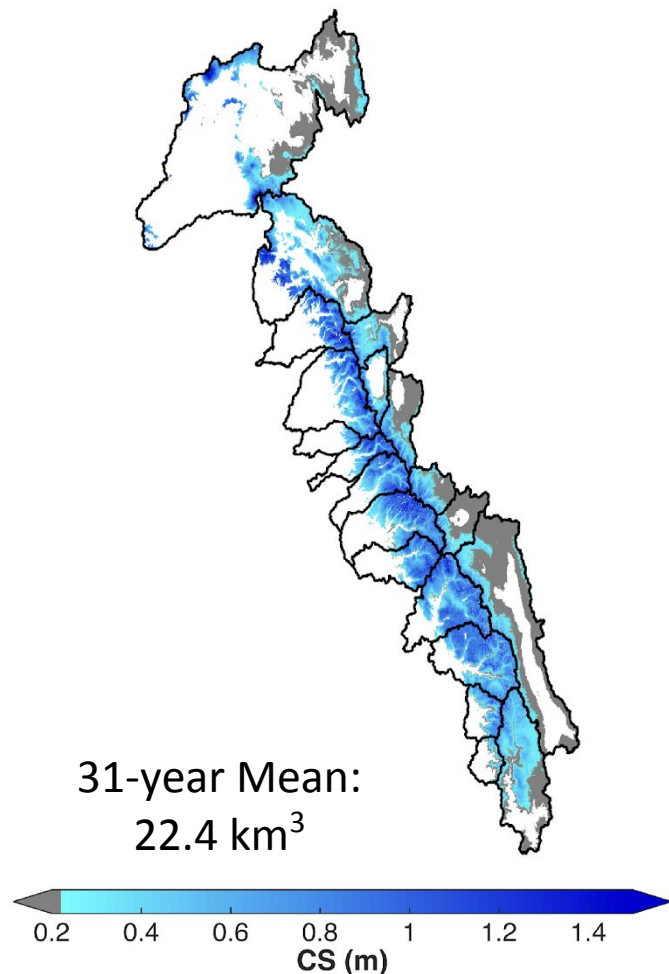
Cumulative Snowfall Dataset

Sierra Nevada Snow Reanalysis

(Margulis et al., 2016)

- **Availability:** Water Years (WYs) 1985-2015
- **Resolution:** Daily, 90-m
- Assimilated Landsat fractional snow-covered area images
- Spatially and temporally continuous snow water equivalent (SWE) maps

- **Cumulative Snowfall (CS):** Daily increases in SWE during accumulation season



Huning and Margulis, 2017 WRR

1) IWV- vs. IVT-based AR Detection (*Huning et al., 2017 GRL*)

Satellite-derived Integrated Water Vapor (IWV) Method

(*Neiman et al., 2008*):

IWV_{N08}

- SSM/I and SSMIS
- $IWV \geq 2$ cm and geometric constraints (length and width)

Atmospheric Reanalysis-based Integrated Vapor Transport (IVT) Method

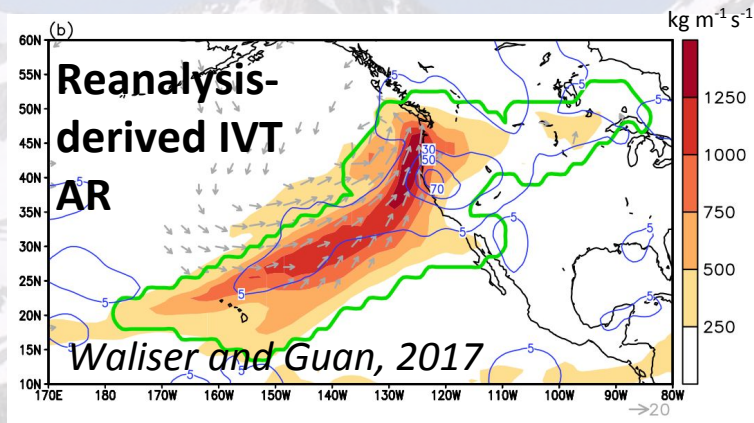
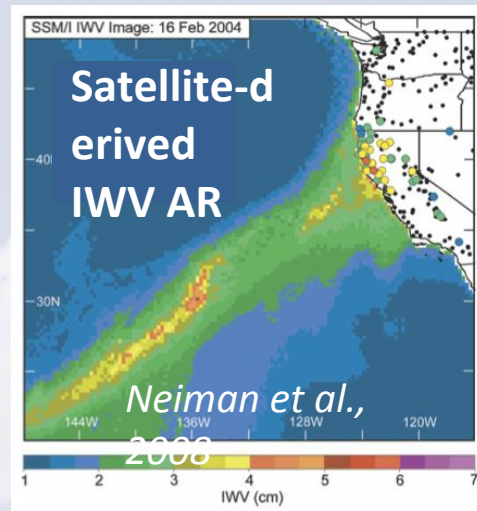
(*Guan and Waliser, 2015*):

IVT_{GW15}

- ERA-Interim
- 85th percentile IVT, coherence of IVT direction, geometric constraints, etc.

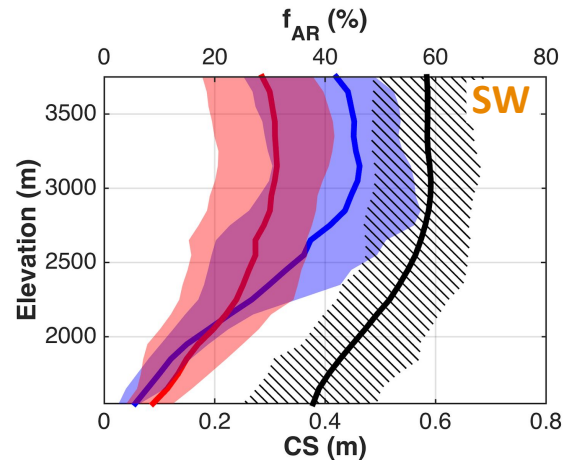
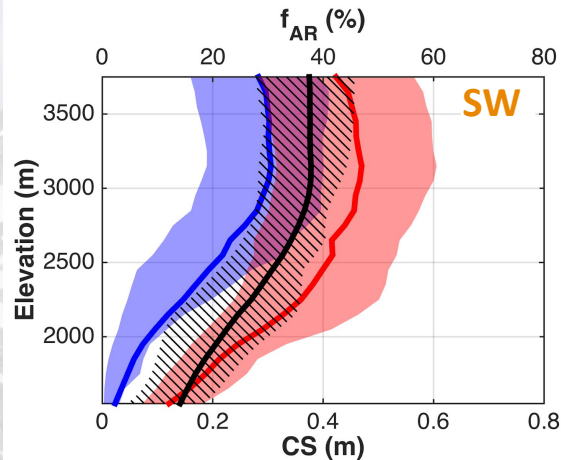
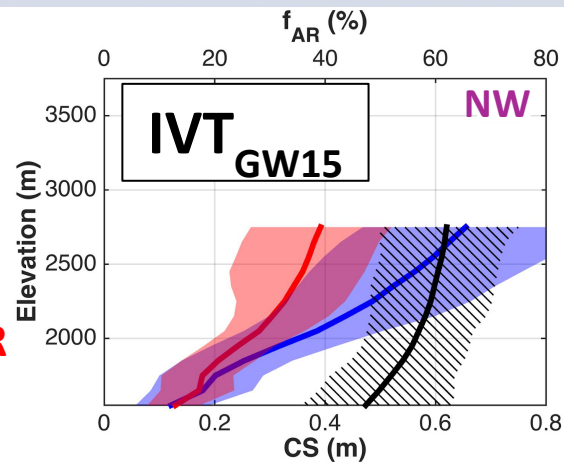
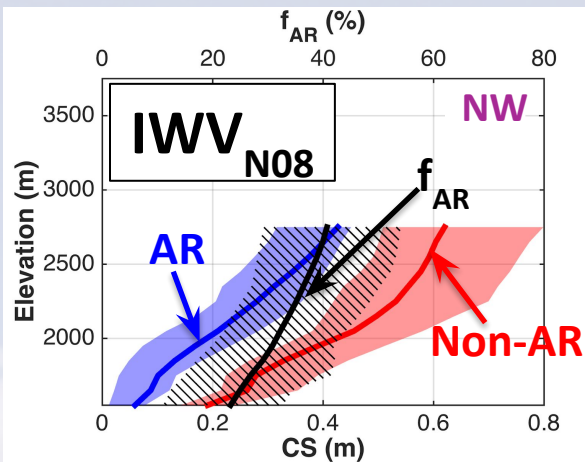
Study Years: WYs 1998-2015

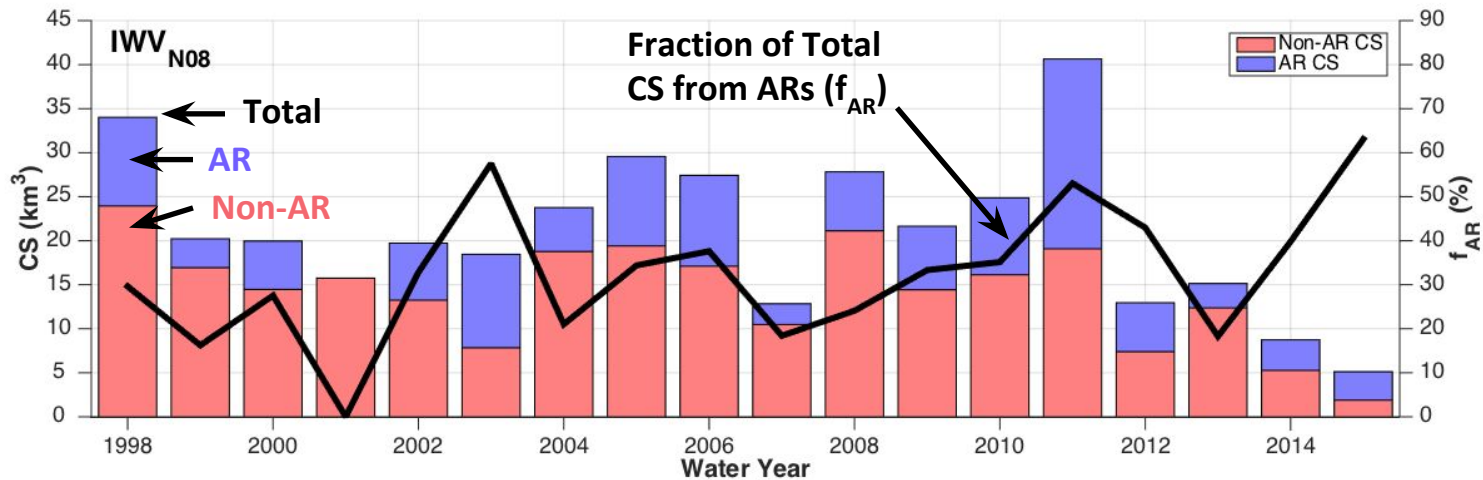
AR Catalogs → AR Days
Snow Reanalysis → Snowfall



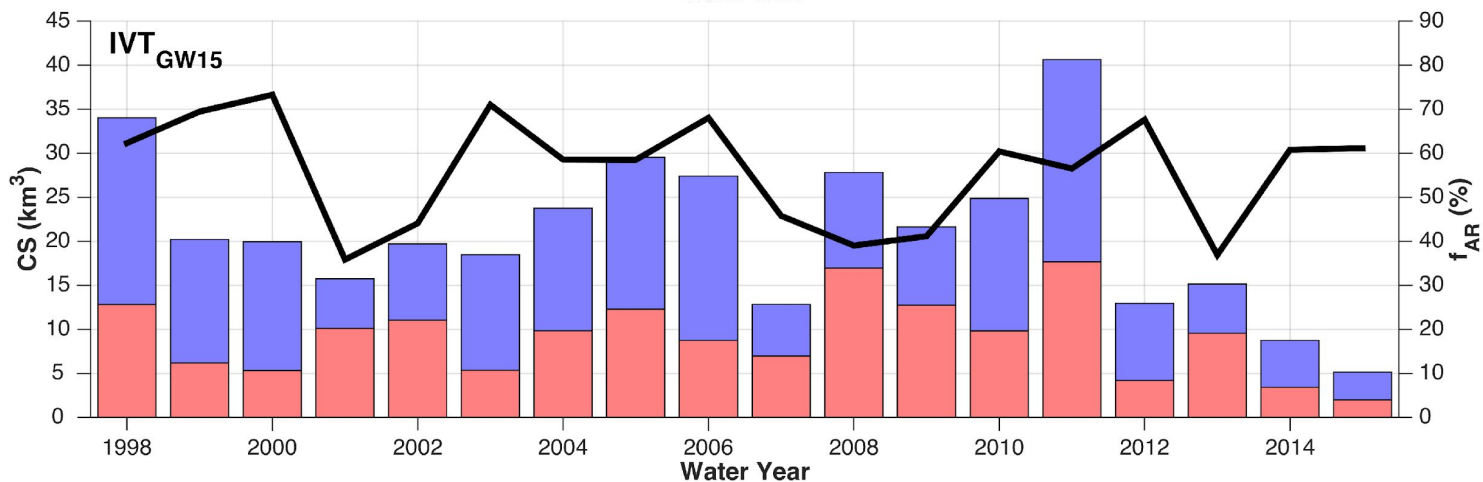
$$(Non-AR\ CS) = (Total\ CS) - (AR\ CS)$$

$$f_{AR} = (AR\ CS) / (Total\ CS) \times 100\%$$





	Mean
AR CS (km^3)	6.8
f_{AR} (%)	32.5



	Mean
AR CS (km^3)	11.9
f_{AR} (%)	56.1

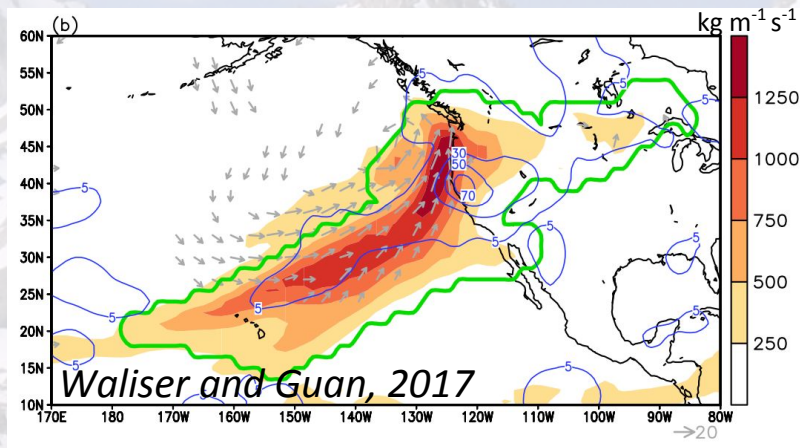
2) IVT-based AR Detection (*Huning et al., in prep*)

Atmospheric Reanalysis-based IVT Method (*Guan and Waliser, 2015*)

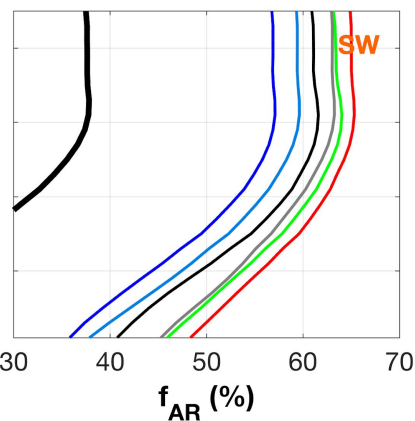
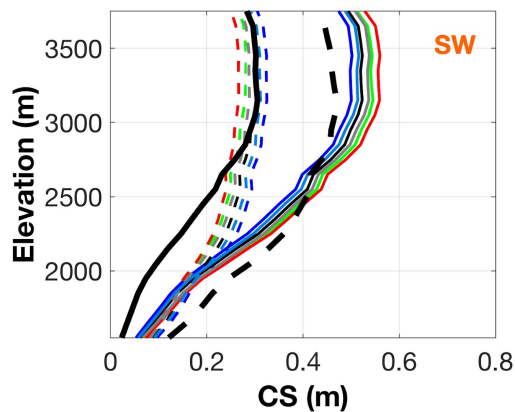
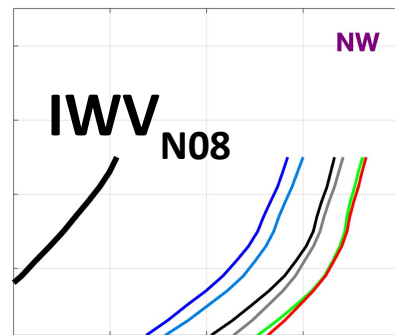
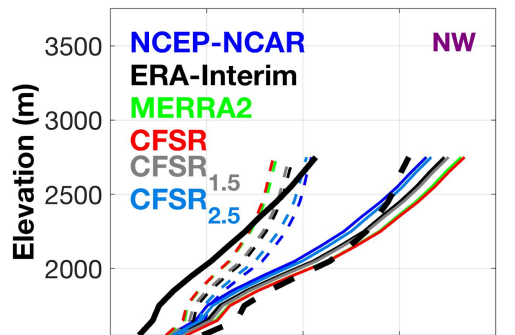
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|--------------------------------------|--------------------------------|
| – NCEP-NCAR | $2.5^\circ \times 2.5^\circ$ |
| – ERA-Interim (IVT _{GW15}) | $1.5^\circ \times 1.5^\circ$ |
| – MERRA2 | $0.5^\circ \times 0.625^\circ$ |
| – CFSR | $0.5^\circ \times 0.5^\circ$ |

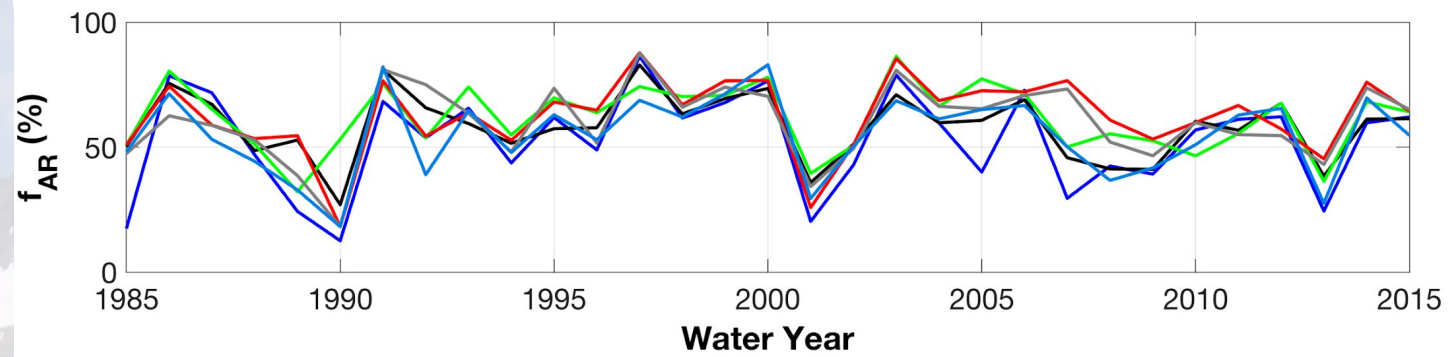
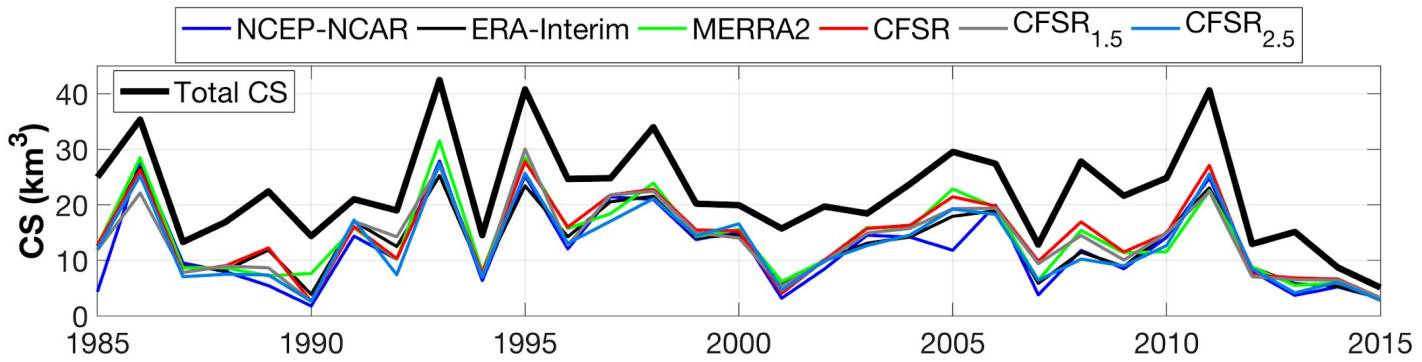
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Higher res.

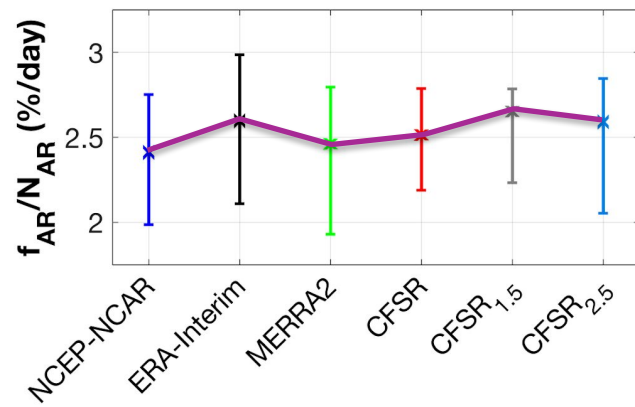
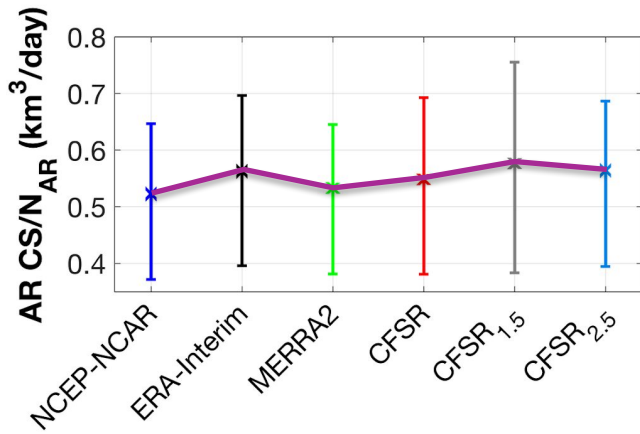
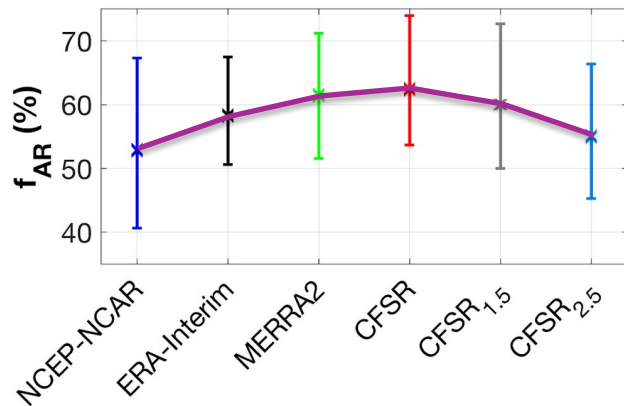
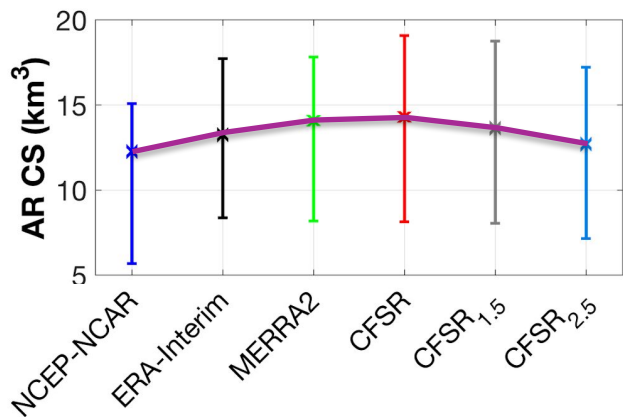
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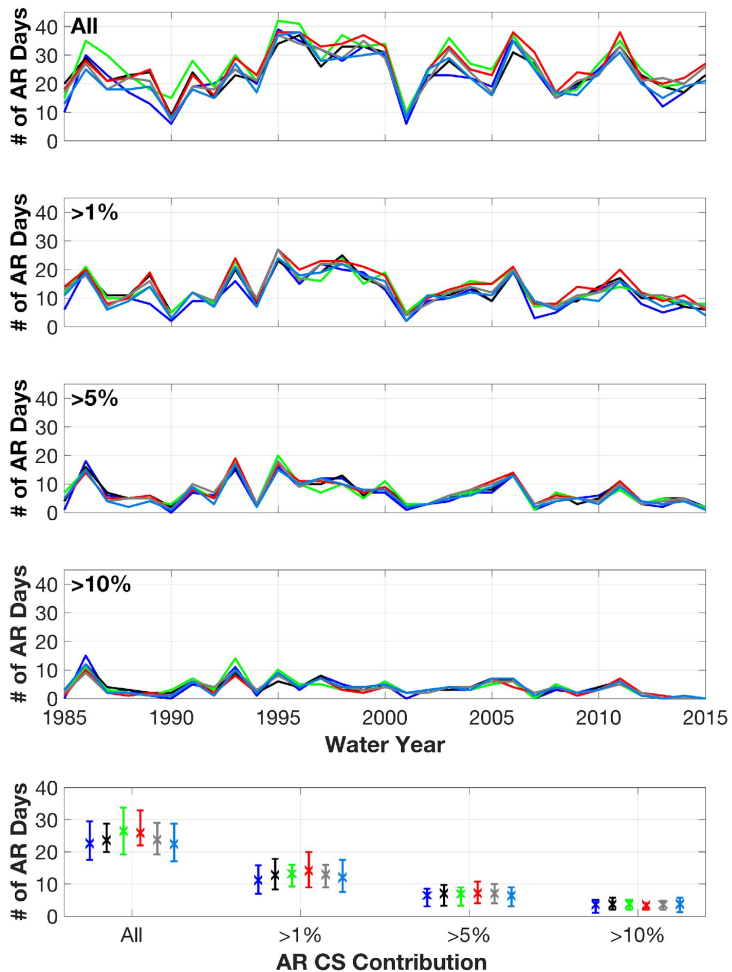
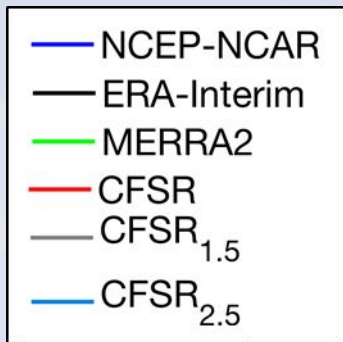


— AR CS
-- Non-AR CS









Conclusions

1) Satellite IWV- vs. Atmospheric Reanalysis IVT-based Detection (*Huning et al., 2017 GRL*)

- Understanding the importance of ARs is coupled to the detection method
 - e.g., ~33% vs. 56% of total CS is derived from ARs annually, on average

2) Single IVT-based Detection Applied to Multiple Atmospheric Reanalyses (*Huning et al., in prep.*)

- Sizeable attribution differences among AR catalogs, but are substantially reduced relative to Case 1
 - e.g., ~53-62% of total CS is derived from ARs annually, on average
- Differences in AR snowfall among the atmospheric reanalyses are reduced when a common resolution is used

Overall

- **It is important to understand how various detection methods and data sets impact hydrologic analysis**

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Questions?

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