EVALUATING THE EFFICACY OF AIRBORNE RADIO OCCULTATION OBSERVATIONS ON IMPROVING WEST COAST PRECIPITATION FORECASTS

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BACKGROUND / OBJECTIVE

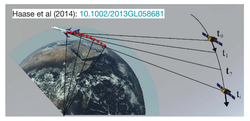
Improving atmospheric river (AR) forecasts to better predict where they may land and their precipitation intensity is essential in order to mitigate flood risk and damages. AR's precipitation forecasts have been improved by using observations from dropsondes, buoys, and more recently, refractivity profiles from GNSS airborne radio occultations (ARO), during AR Recon campaigns. This study explores whether these forecasts can be enhanced even more by utilizing a more raw product from ARO, the bending angles.

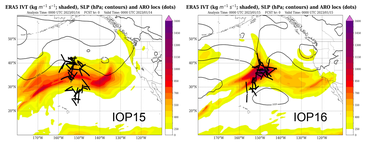
Question: What is the impact of assimilating ARO bending angle observations on forecasting precipitation of landfalling ARs over the western coast of the US?

DATA

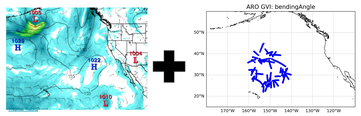
Period of study: 1800 UTC 06 - 0000 UTC 17 January 2023

ARO bending angles from 1st time **11-flight sequence** sampling California ARs





2 data assimilation experiments:



- MPAS-JEDI 2.0 (MPAS-A v.7.0) with globally uniform 30km mesh
  - CTRL: conventional, radiances and GNSS RO
  - ARO: CTRL + GNSS ARO bending angles



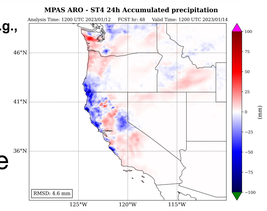
METHODS

IVT/MSLP vs ERA5 Reanalysis | Precipitation vs STAGE-IV data

ECMWF ERA5 Reanalysis
- 0.25 deg

STAGE-IV Precipitation Data
- 4km gridded data

- Plots of differences between experiments and reference data:



- Verification for dichotomous (yes/no) forecasts
  - Contingency tables to evaluate ARO improvements

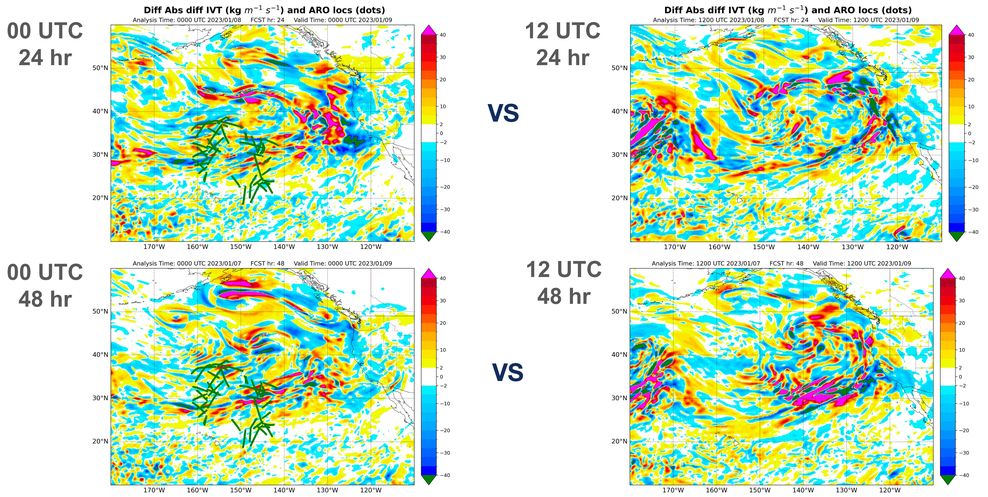
Forecast \ Observed	yes	no	Total
yes	*hits*	*false alarms*	*forecast yes*
no	*misses*	*correct negatives*	*forecast no*
Total	*observed yes*	*observed no*	*total*

WWRP/WGNE Joint Working Group on Forecast Verification Research (2009)

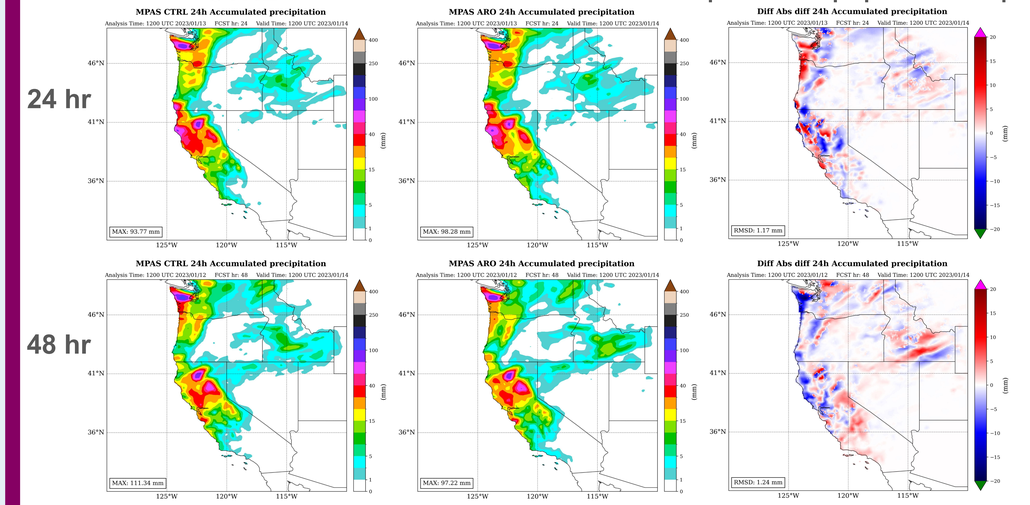
Metrics: FBIAS, POD, FAR, CSI, ACC, HRATE

RESULTS

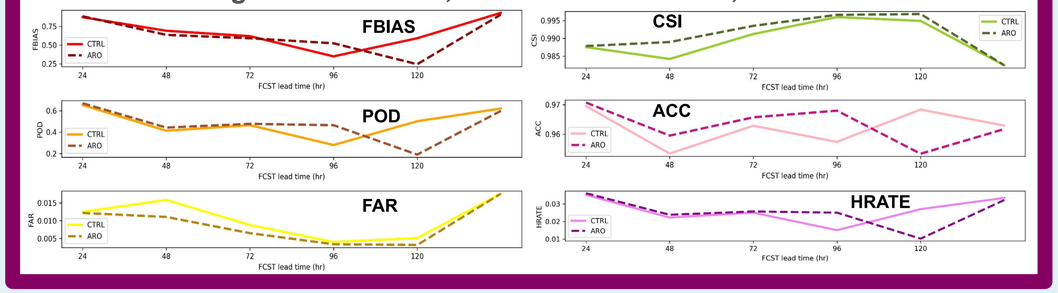
00 UTC vs 12 UTC Analysis Time Comparison for IVT (|ARO-ERA5| - |CTRL-ERA5|)



24hr Accumulated Precipitation Differences



Categorical Statistics, 25mm/24hr threshold, 14 Jan 2023



CONCLUSIONS

- **IVT:** Larger direct impact from ARO at 00 UTC when the ARO observations are assimilated; indirect positive impact at 12 UTC (no ARO observations assimilated) over targeted regions
- **PREC:** ARO and CTRL capture precipitation features very well, but ARO can improve the intensity and coverage at 48 hr and 24 hr forecasts
- **CATEGORICAL STATS:** ARO and CTRL capture precipitation features very well, but ARO can improve the intensity and coverage at 48 hr and 24 hr forecasts
- **FUTURE:** Look at neighborhood verification methods and over watershed areas as in DeHaan et al. (2023)

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