

# Nested-EAGLE: A Data Driven, Global Weather Model with High Resolution over the Contiguous US

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## Goal

- Develop a global medium range weather prediction model that:
- captures synoptic scale forcings
  - represents precipitation at scale useful for decision makers
  - produces forecasts at a low computational expense

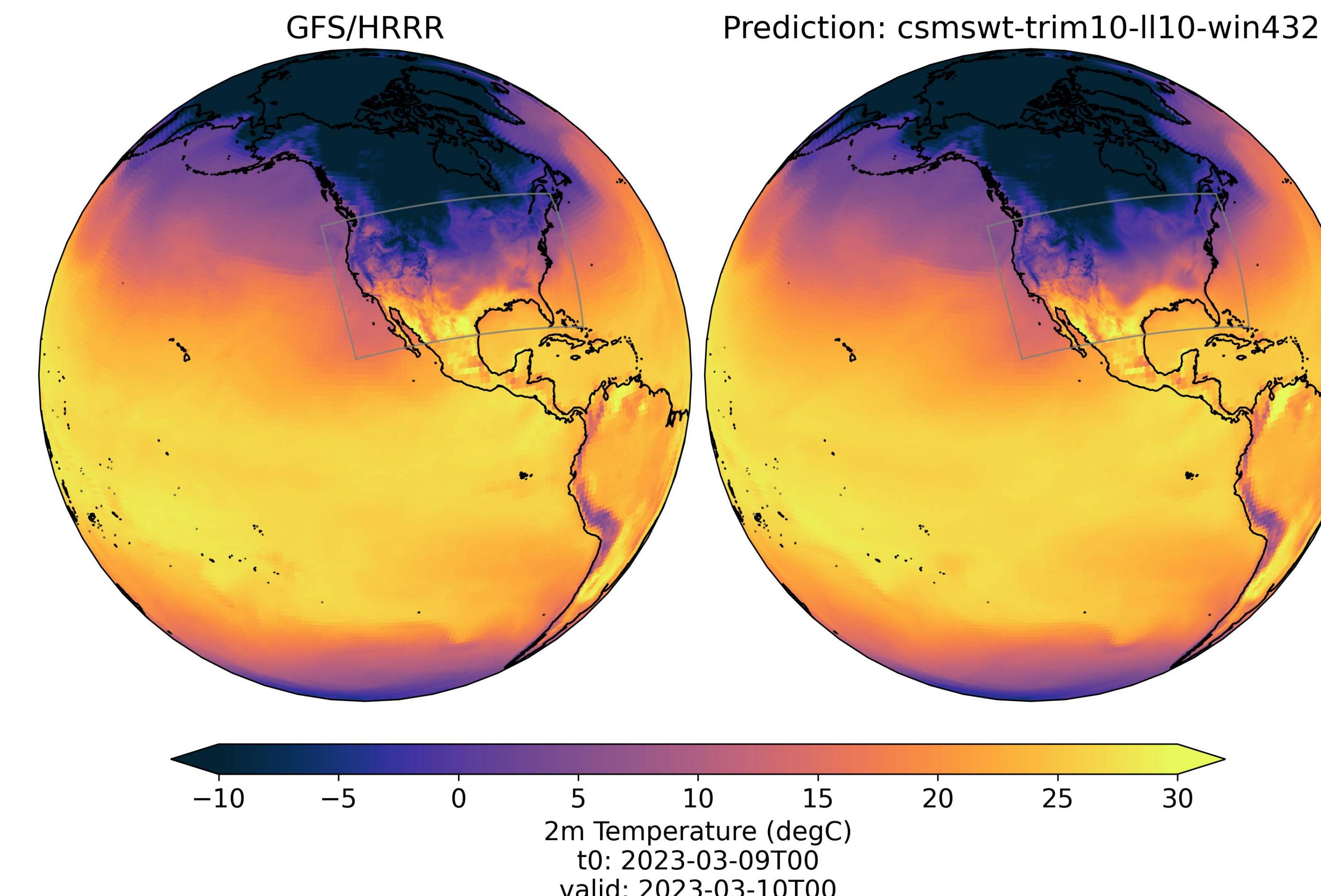
## Data

- Train on GFS + HRRR “Analysis” ( $fh=0$ ) for all variables, except precipitation, which uses 0-6h forecast accumulations
- Implement nested or “stretched” grid approach, following Met Norway, where HRRR grid is cut out of GFS grid (no overlap)
- Use full archives available on NCAR RDA and AWS:
  - Training: Feb 2015-Jan 2023
  - Validation: Feb 2023-Jan 2024
  - Testing Feb 2024-Jan 2025
- Conservatively regrid archived  $0.25^\circ$  GFS to  $1.00^\circ$  and 3km HRRR to 15km

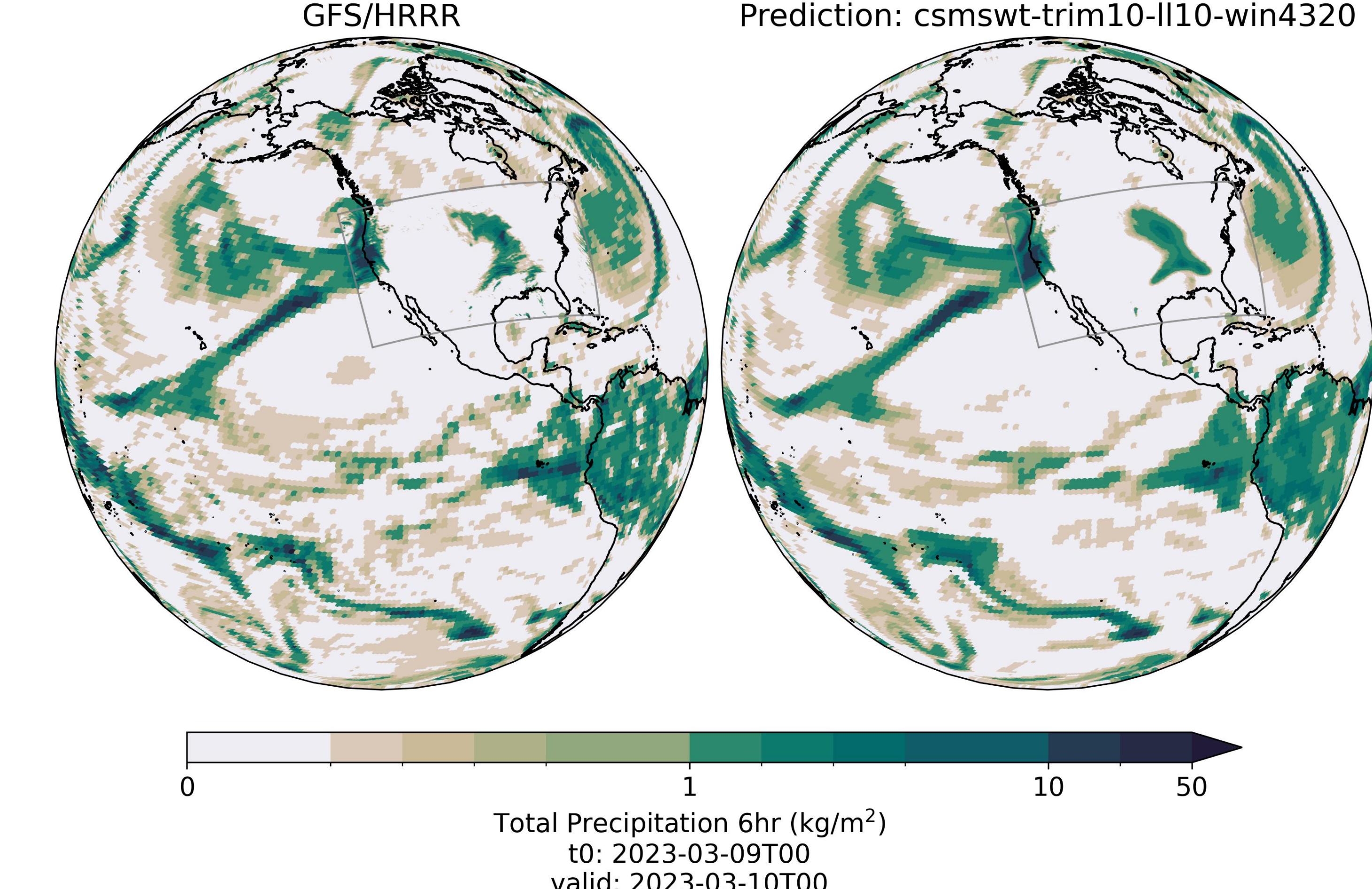
## Design Choices that Mattered

- Using shifted window processor removed GFS/HRRR boundary artifacts
- Reduce CONUS loss weight 50%→10% improved skill significantly

## Prognostic Skill Over CONUS

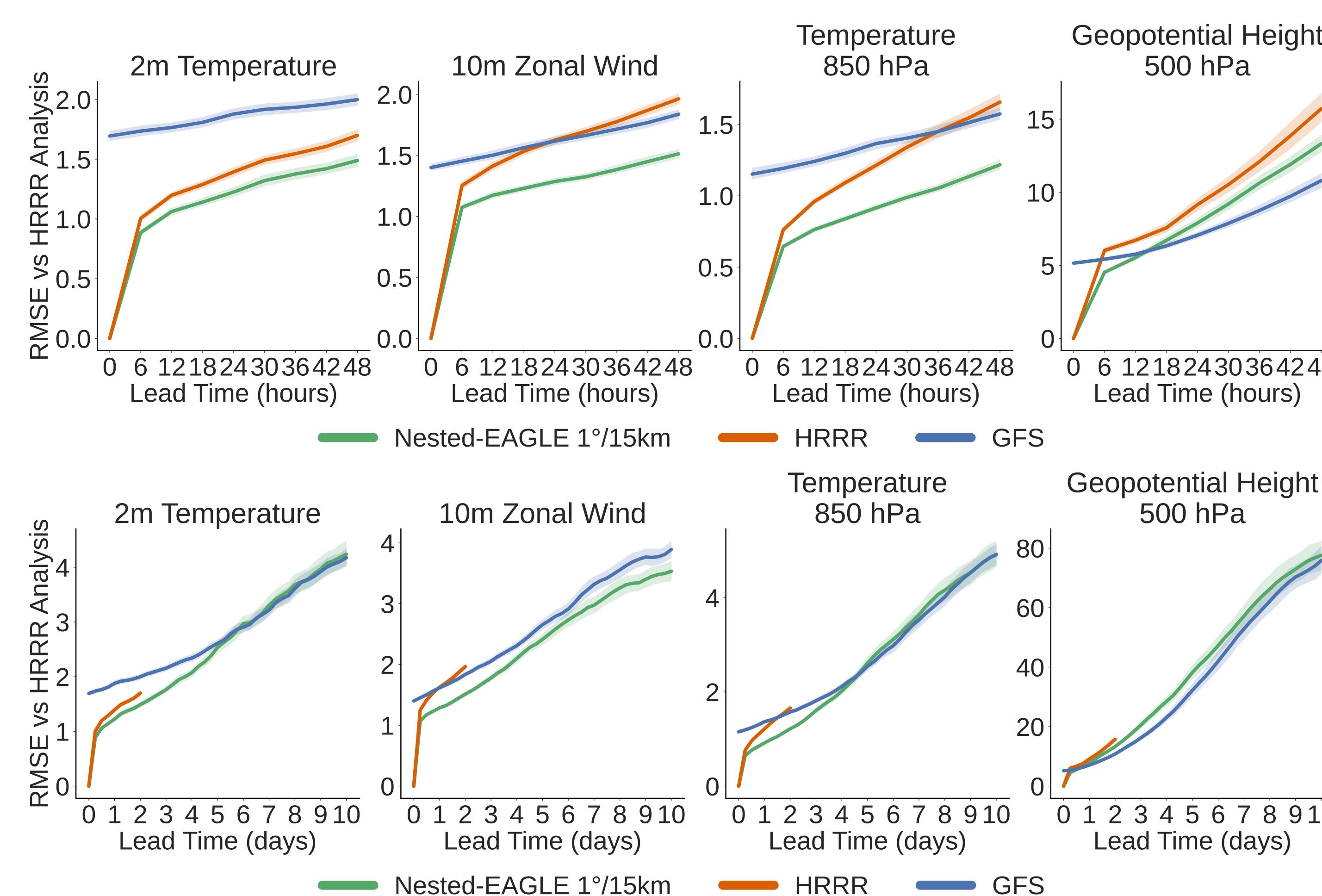


## Precipitation Skill Over CONUS



### Evaluation against HRRR Analysis:

- 158 forecasts initialized throughout validation period
- all datasets conservatively regridded to 15km using `ufs2arco`
- plots show median Root Mean Squared Error (RMSE), shading indicates 95% confidence interval



## Main Results

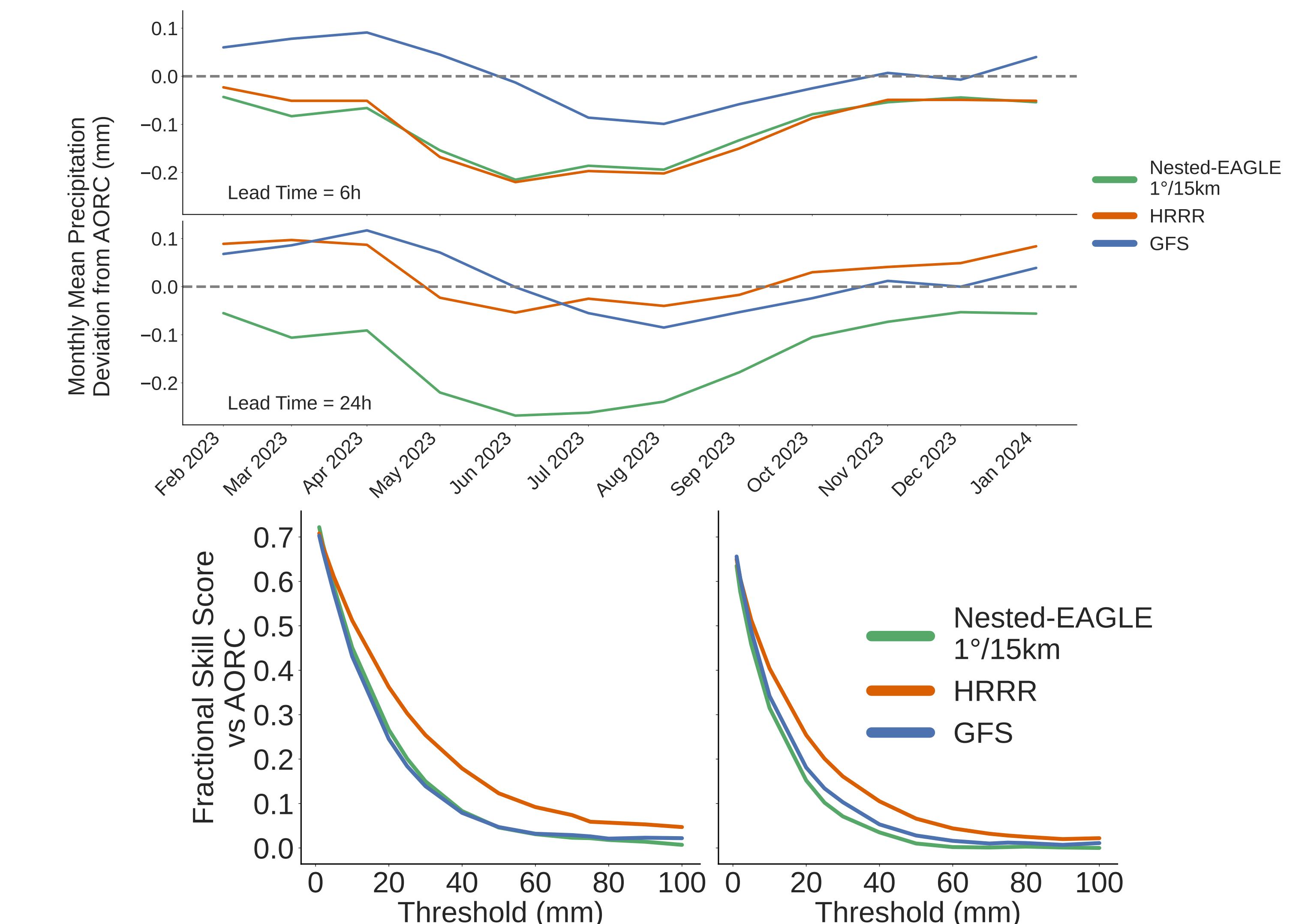
- Lower RMSE than HRRR vs HRRR Analysis on all prognostic variables analyzed
- At 10 days, RMSE is competitive with GFS
- At 6h lead, monthly mean precipitation matches HRRR, but longer lead times have larger bias
- Fractional Skill Score highlights blurring in the model, owing to MSE loss in deterministic model training

### Evaluation against NOAA's Analysis of Record for Calibration (AORC) Dataset:

- 1450 forecasts initialized during validation period
- compare 6h accumulations from each model at lead times: 6h, 12h, 24h, and 48h
- all datasets conservatively regridded to 15km using `ufs2arco`

Here we show:

- monthly mean precipitation, relative to AORC
- Fractional Skill Score (FSS), using a  $\sim 33\text{km}$  radius



## Next Steps

- Scale to  $0.25^\circ$  global + 6km CONUS resolution
- Train with CRPS loss for ensemble uncertainty estimation and better feature representation
- Incorporate observations into evaluation and training