

Upgrading STOFS-3D-Atlantic: A Bias Correction Method for Improved Total Water Level Predictions

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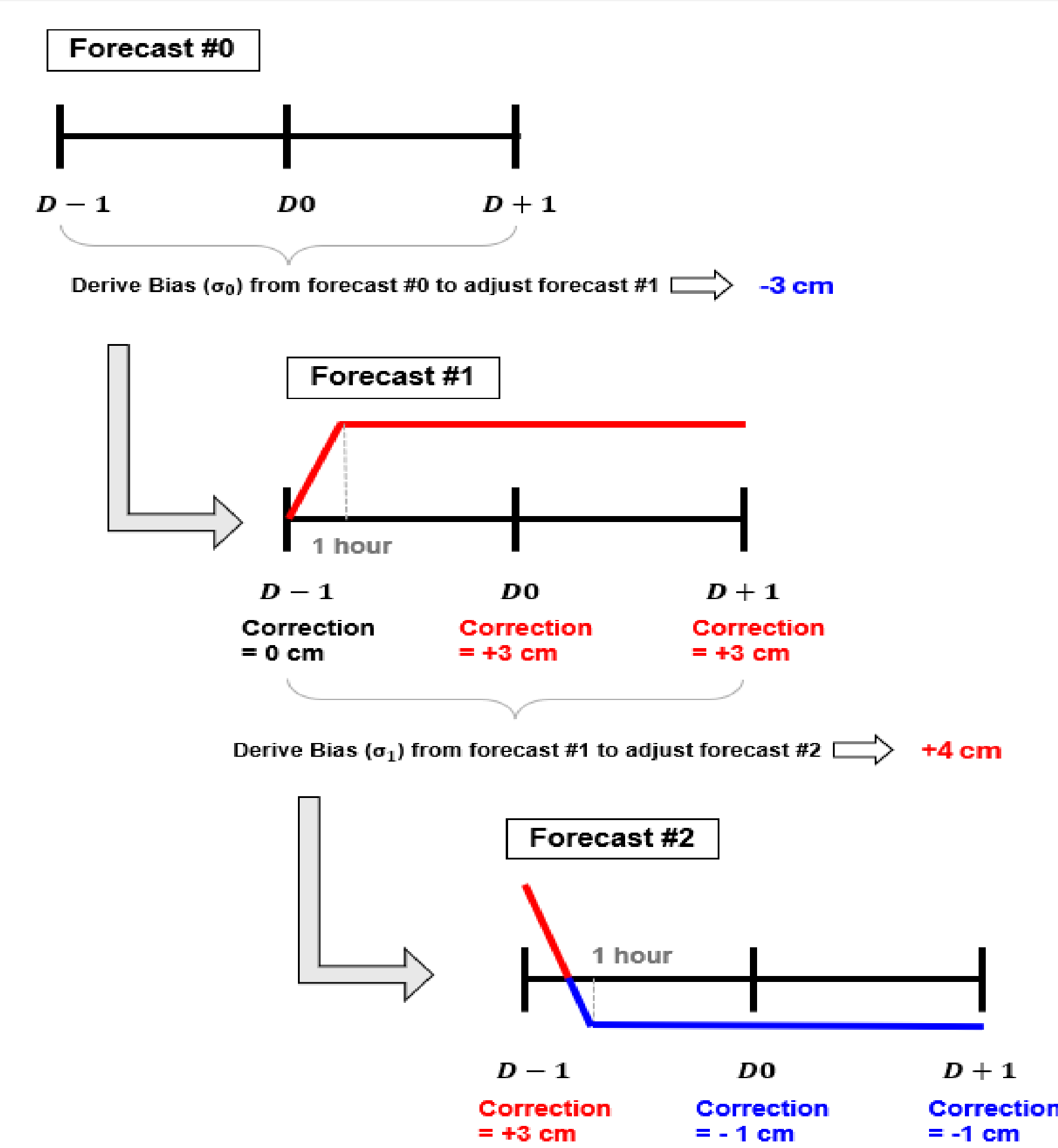
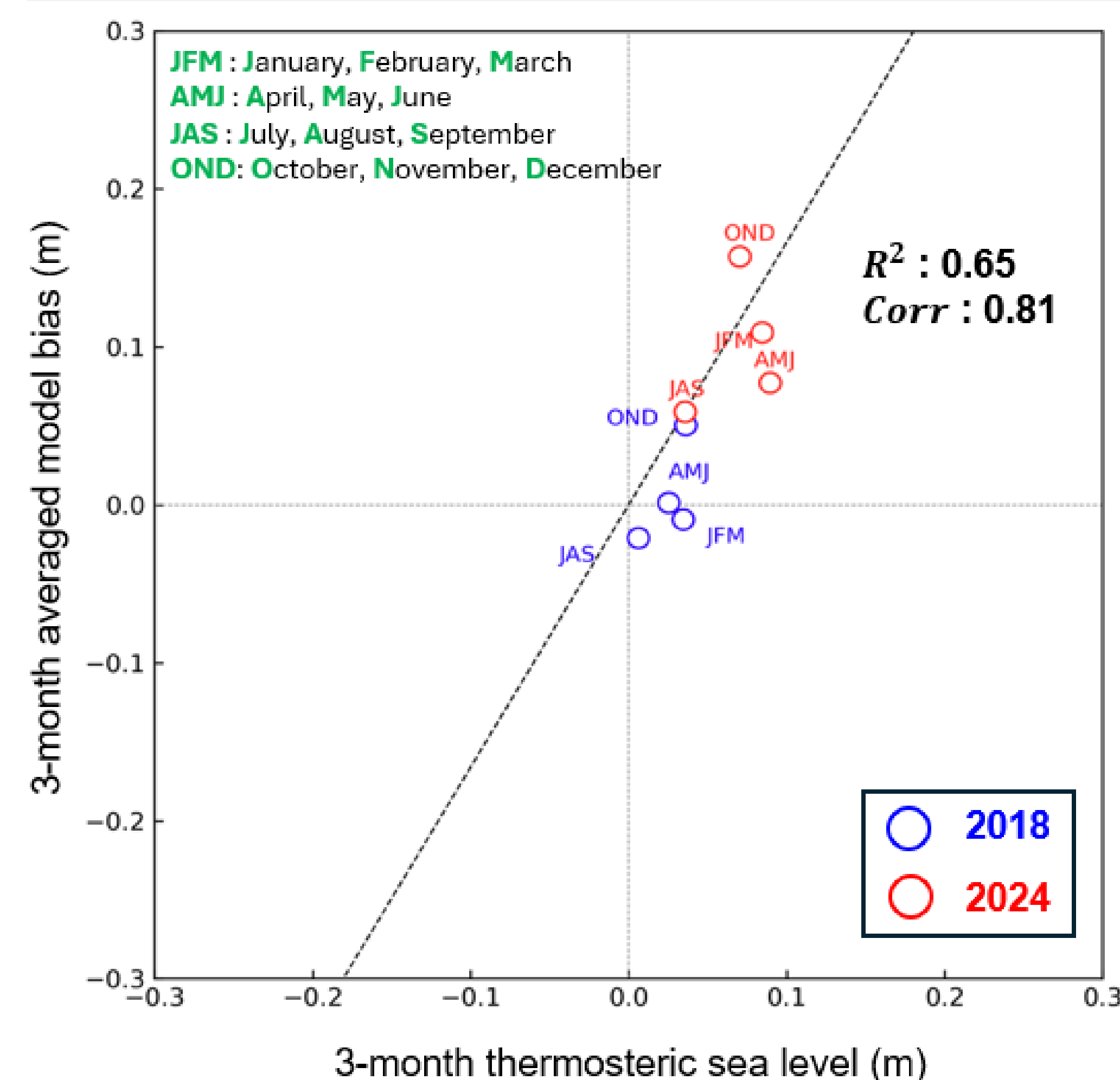
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Introduction

- **Challenge** : Accurate Total Water Level forecasts at continental scale are more challenging than small-domain simulations – but essential for coastal flood management.
- **Gap** : NOAA's STOFS-3D-Atlantic is skillful, but residual biases remain due to DEM uncertainties and missing process (e.g., **thermal expansion**)
- **Our approach** : A bias-correction method for STOFS-3D-Atlantic, built on the SCHISM framework, to improve forecast skill.

Method

- **Bias analysis** : HCA & PCA revealed consistent spatiotemporal bias patterns across ~ 140 NOAA tide gauges.
- **Validation** : Bias strongly correlated (**~65%**) with NOAA NCEI thermosteric sea level.
- **Correction** : Applied a dynamic **uniform offset** to the **non-tidal boundary condition**, computed from the prior 2 days.

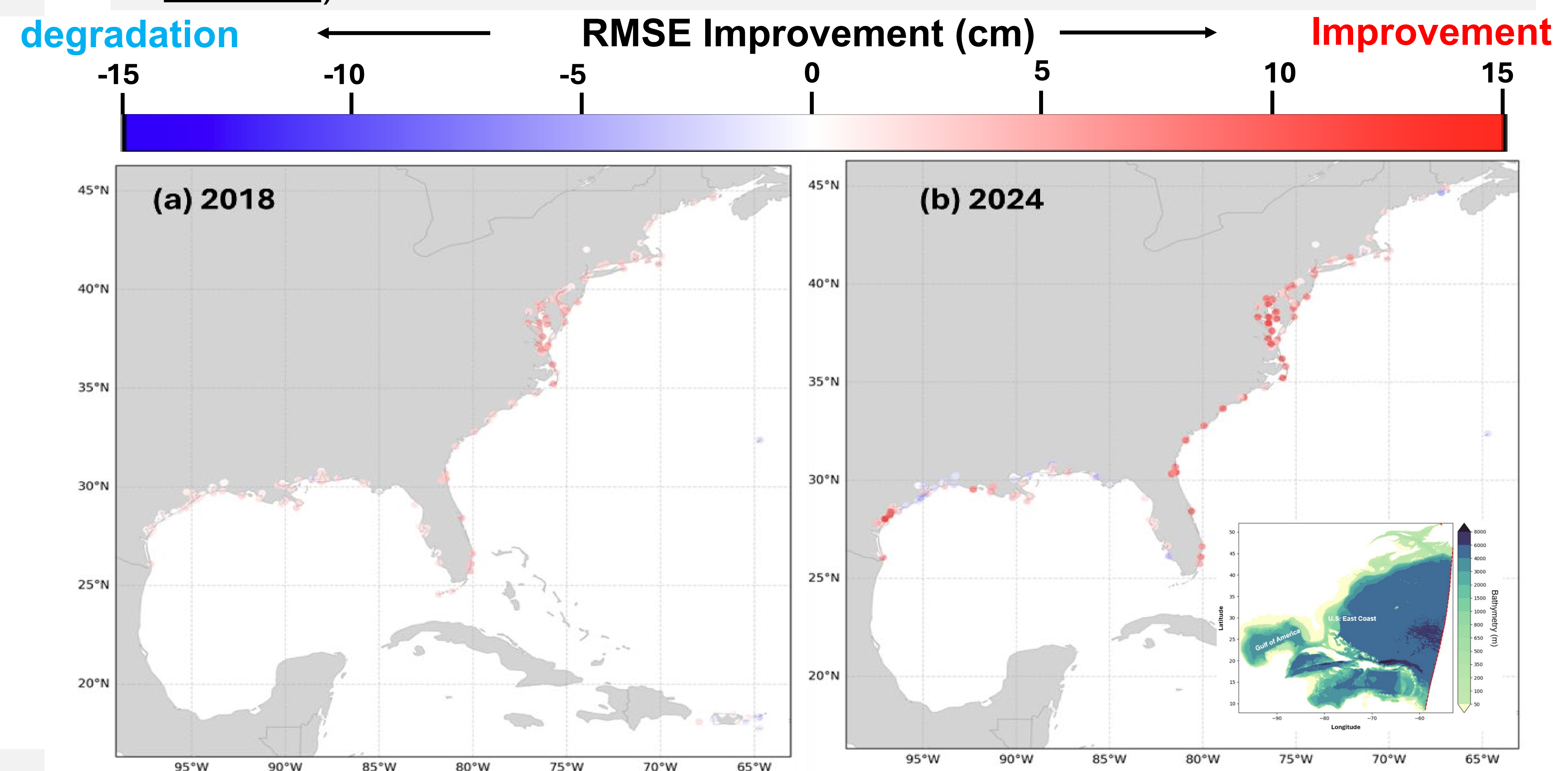


Model configuration

- **Model & Domain** : SCHISM based STOFS3D-v7 with unstructured grid (~ 5.7 M element) covering the U.S. East & Gulf coasts; refined rivers, estuaries and floodplains
- **Simulation** : Two years (2018 & 2024), including hindcast and re-forecast runs; atmospheric (ERA5/HRRR), ocean (HYCOM/AVISO), and river (NWM) forcings applied

Results

- **Targeted impact** : Correction mainly improves non-tidal elevation while preserving tidal signals.
- **Consistent improvement** : RMSE reduced at most stations, with average gains of ~2-3 cm and local improvements up to ~ 10 cm
- **Broad coverage** : about 80% of stations showed RMSE less than 15 cm after bias correction. (**Average improvement of RMSE ~140 stations: ~2-3 cm**)



Conclusion

- **Efficient solution** : Bias correction provides a simple computationally efficient way to account for missing steric effects
- **Impact** : Enhances physical realism and improves the accuracy of operational TWL forecasts **guidance** in STOFS-3D-Atlantic.