The Progress of Operational Regional Hurricane Model Track Forecast Performance Compared with Global Forecast Models

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Outline

- Overview of the track prediction progress and comparison
- Track prediction performance of Hurricane Franklin and Hurricane Tammy 2023
- Deep layer mean flow comparison
- Other factors
- Summary

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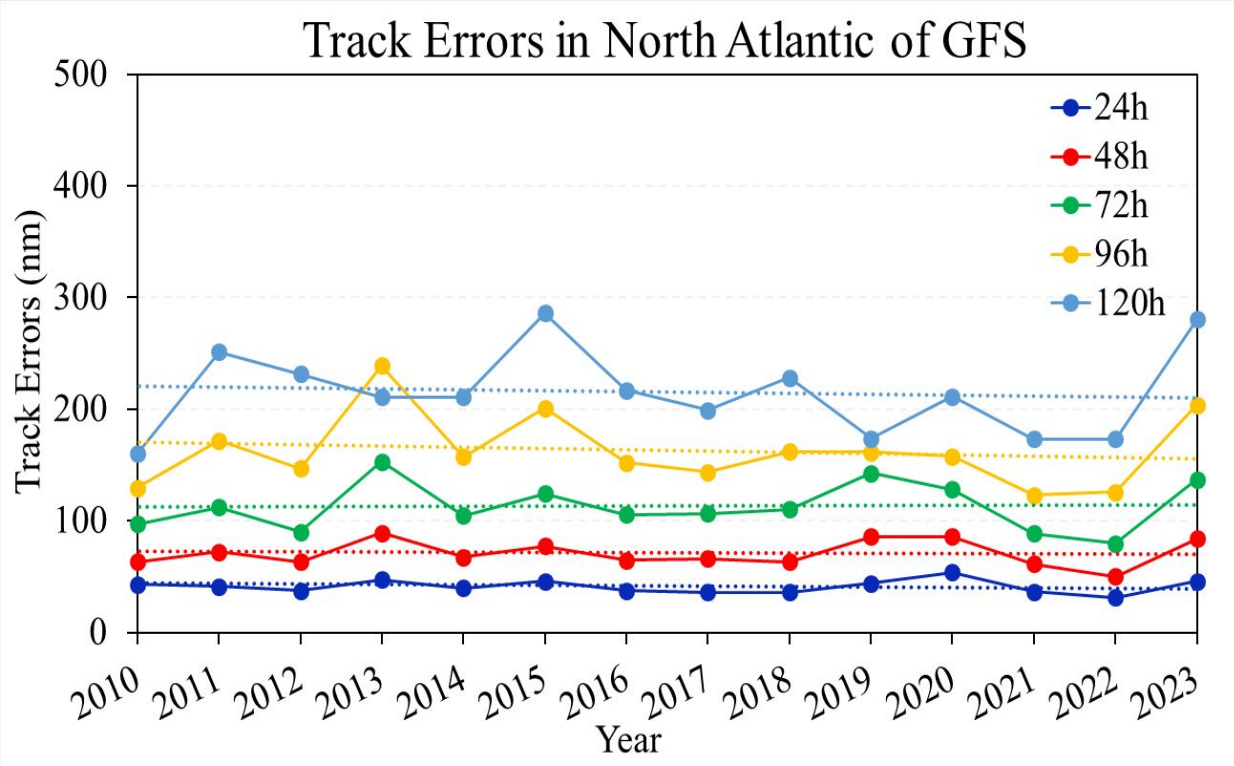
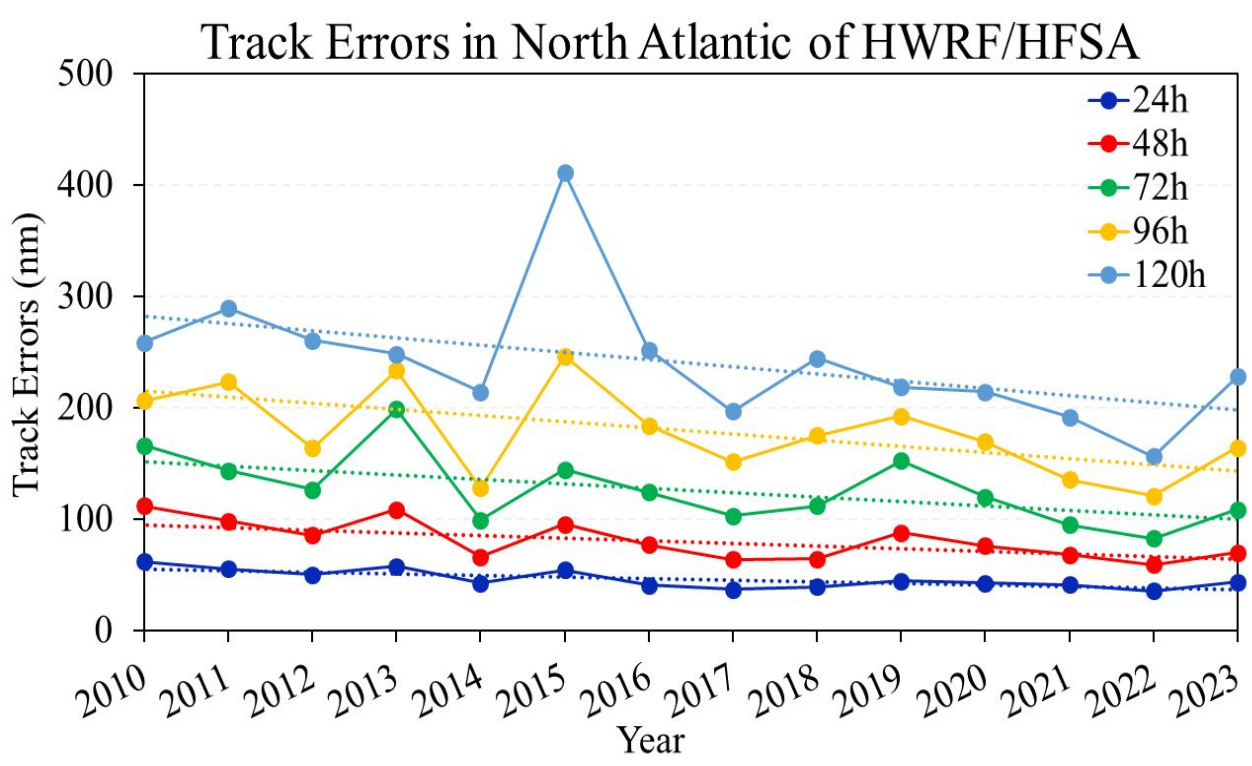
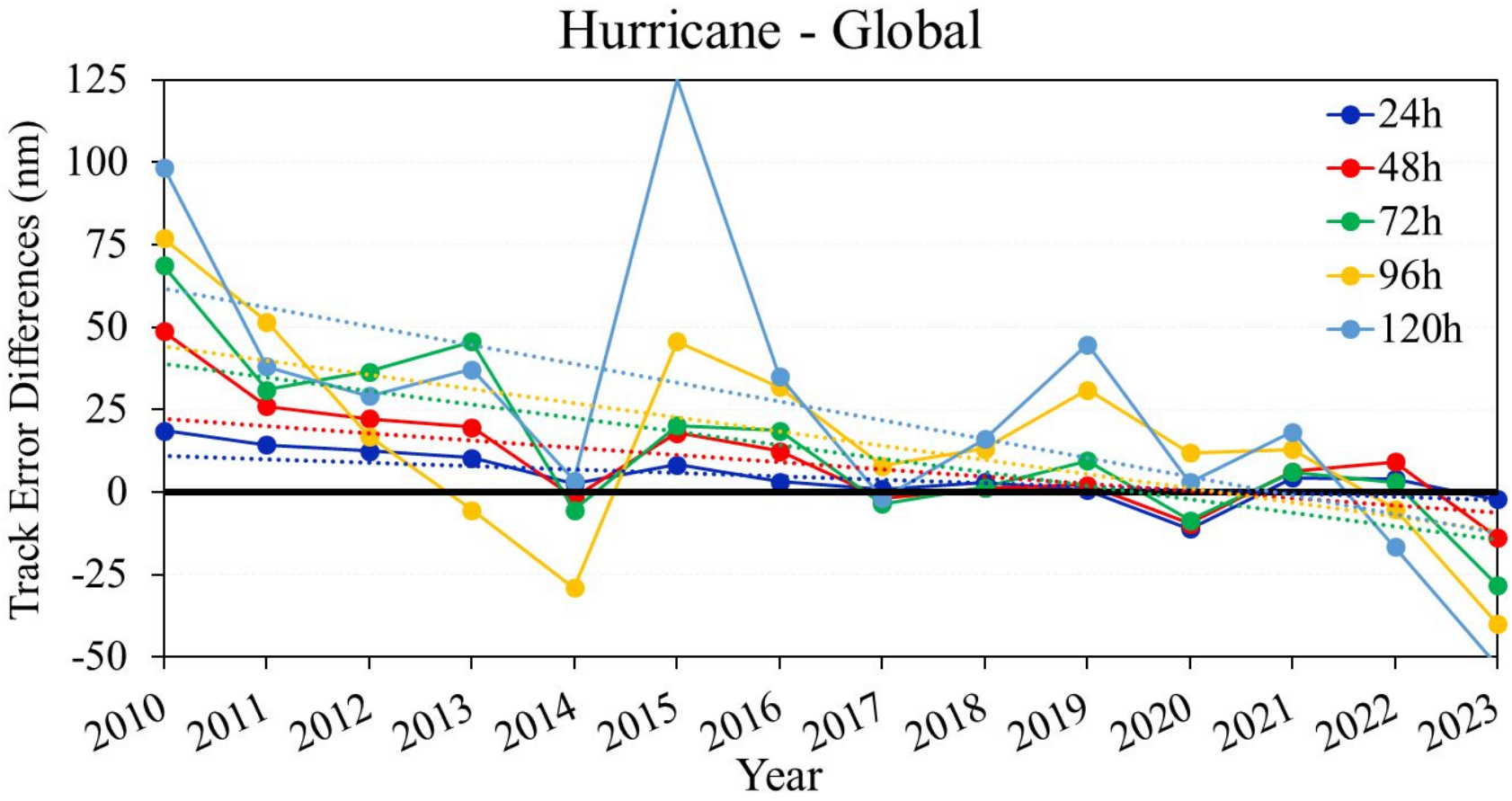
Track Forecast Progress of Global and Hurricane Models





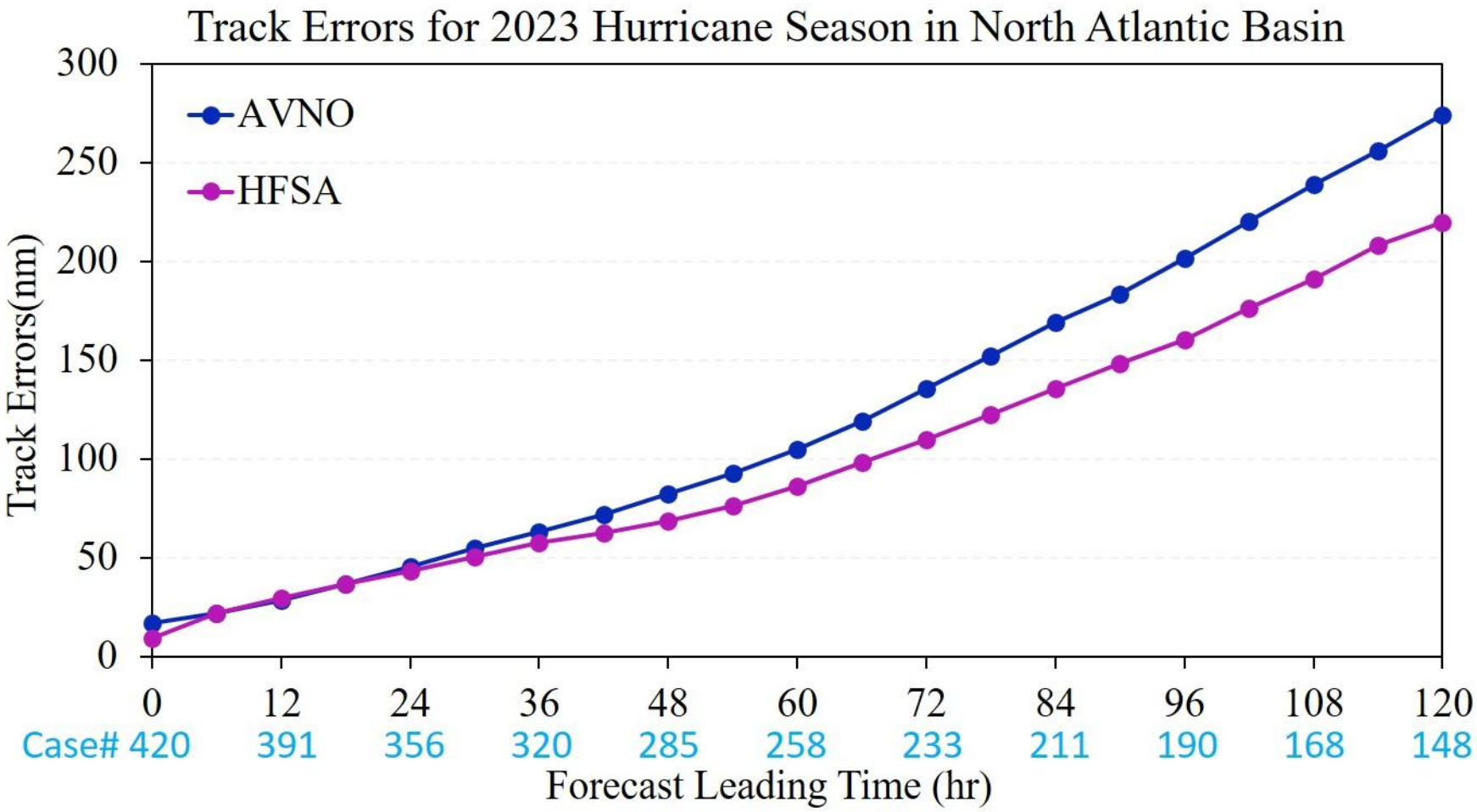
Over the past 10 years, both global models and regional hurricane models have improved hurricane track forecast for all forecast lead times. Also, the hurricane models have greater improvement than global models.

The Difference of Track Errors by Hurricane vs Global



The disparity of track errors between global models and hurricane models is decreasing, with hurricane models better than global models.

The Track Forecast Performance of HFSA and GFS



The track performance of HFSA is better than GFS for almost all forecast leading times during 2023 hurricane season in NATL.

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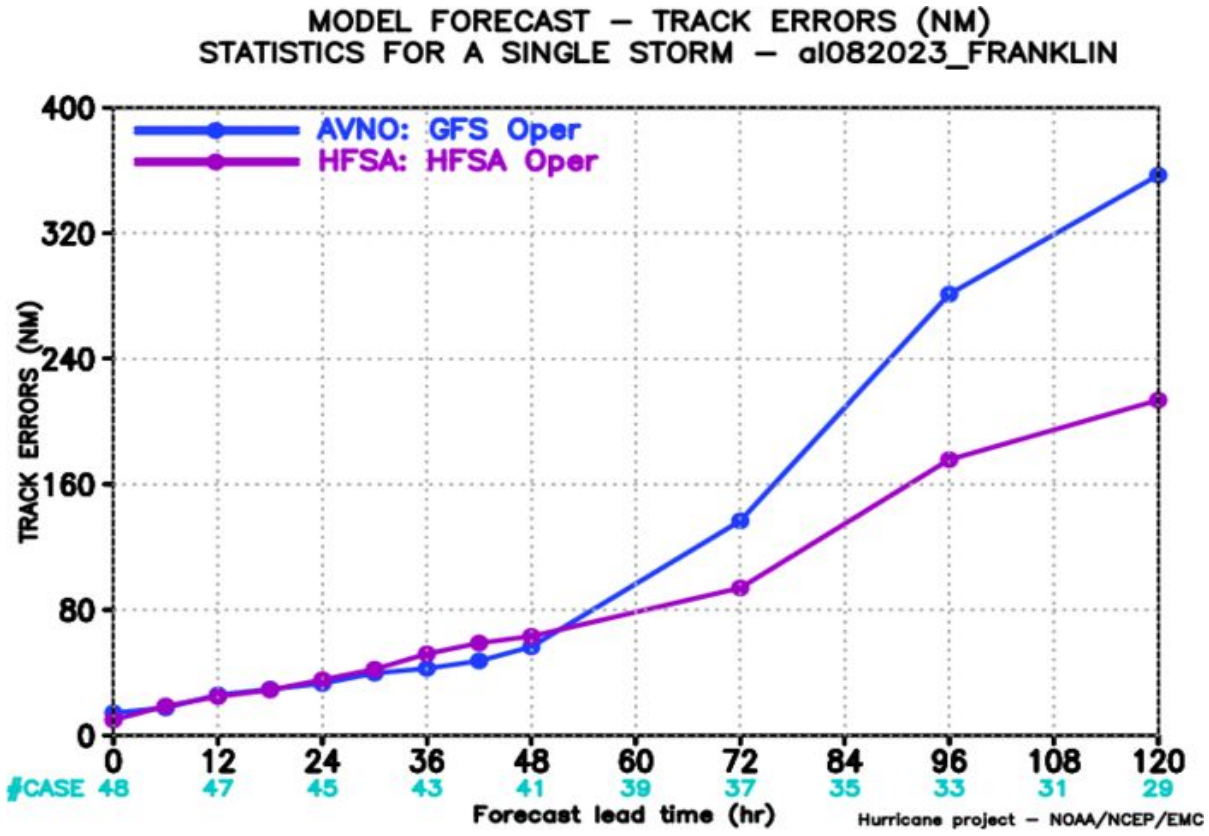
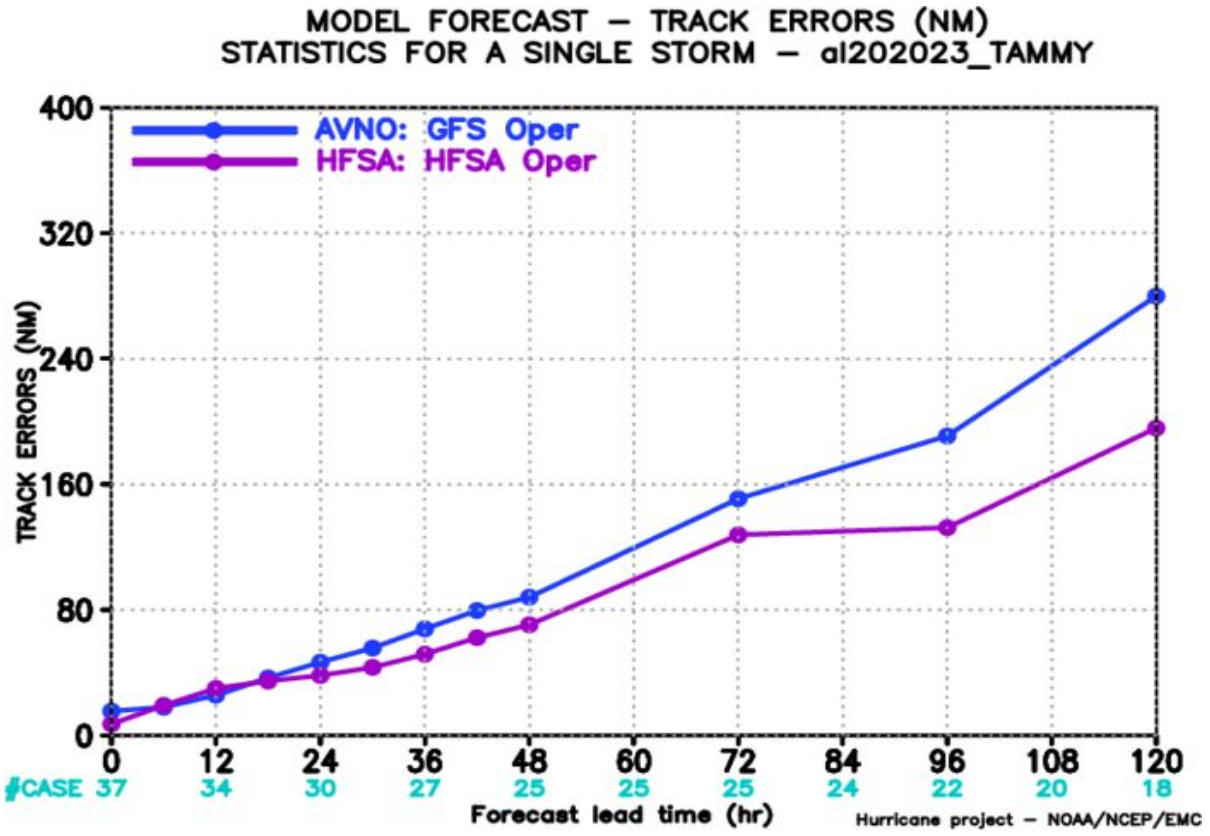
The Track Errors of Hurricane Franklin and Hurricane Tammy

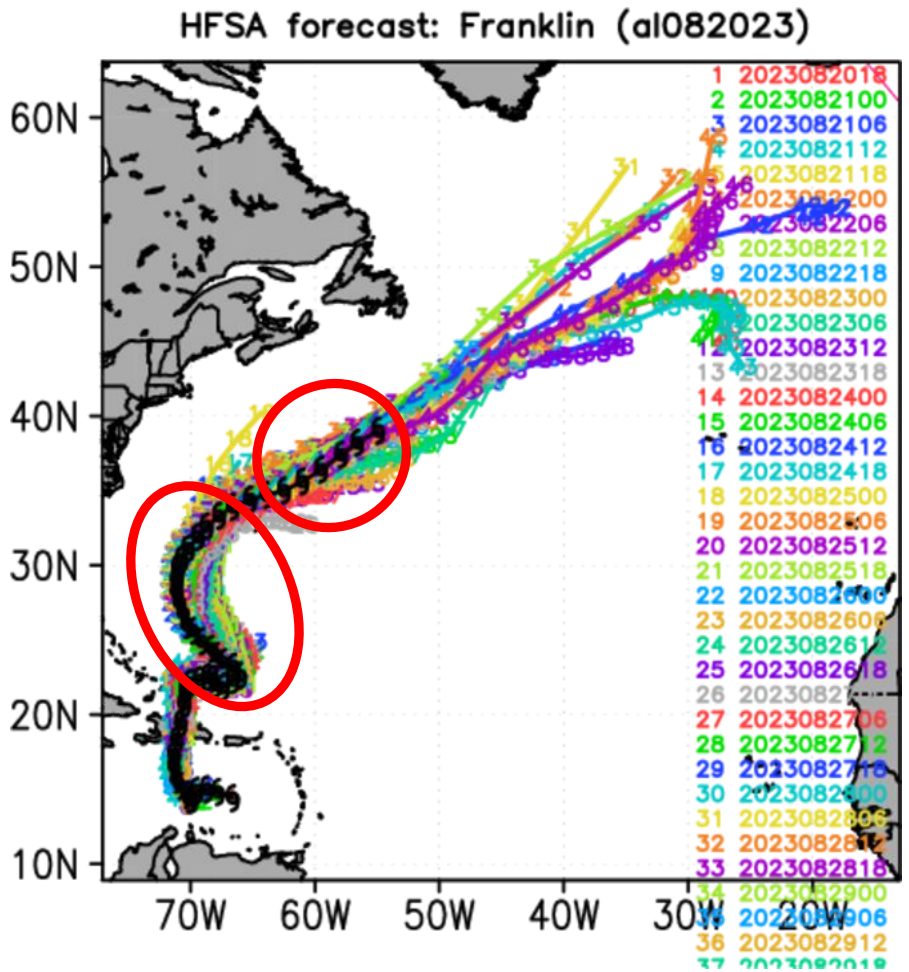


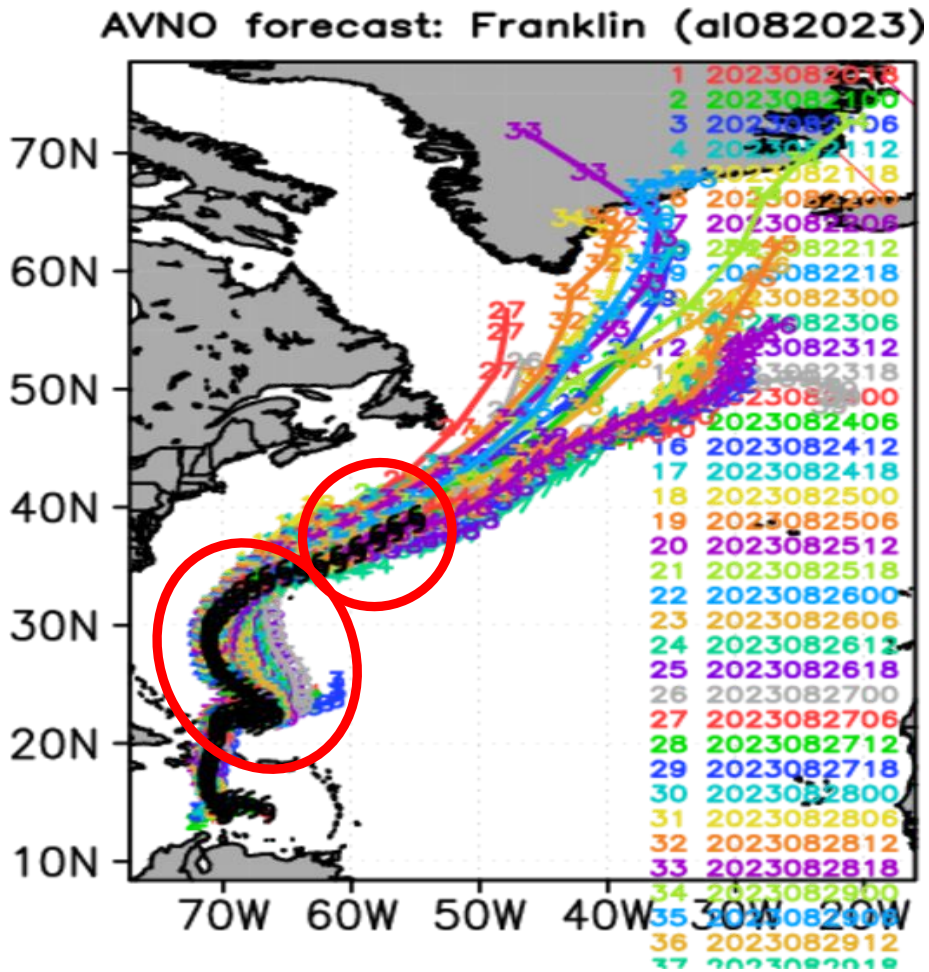
For Hurricane Franklin 08L 2023, the track performance of HFSA is better than GFS after day 2.



For Hurricane Tammy 20L 2023, the track performance of HFSA is better than GFS after 18 hours.

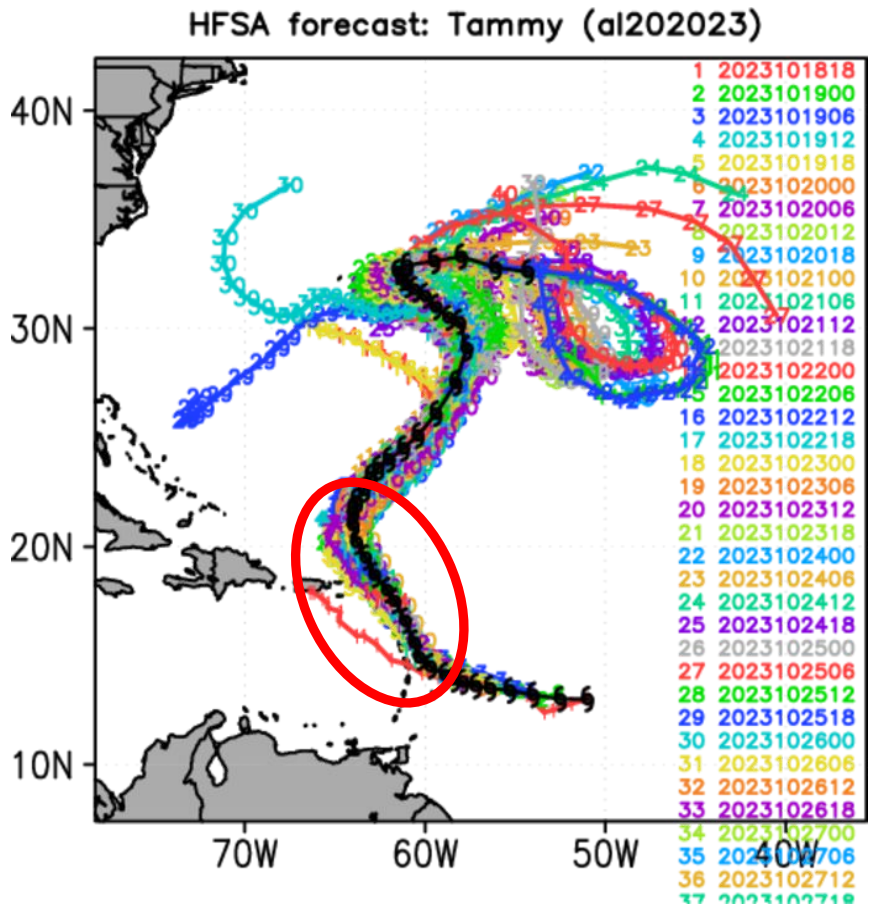
The Track Composite of Hurricane Franklin 08L 2023

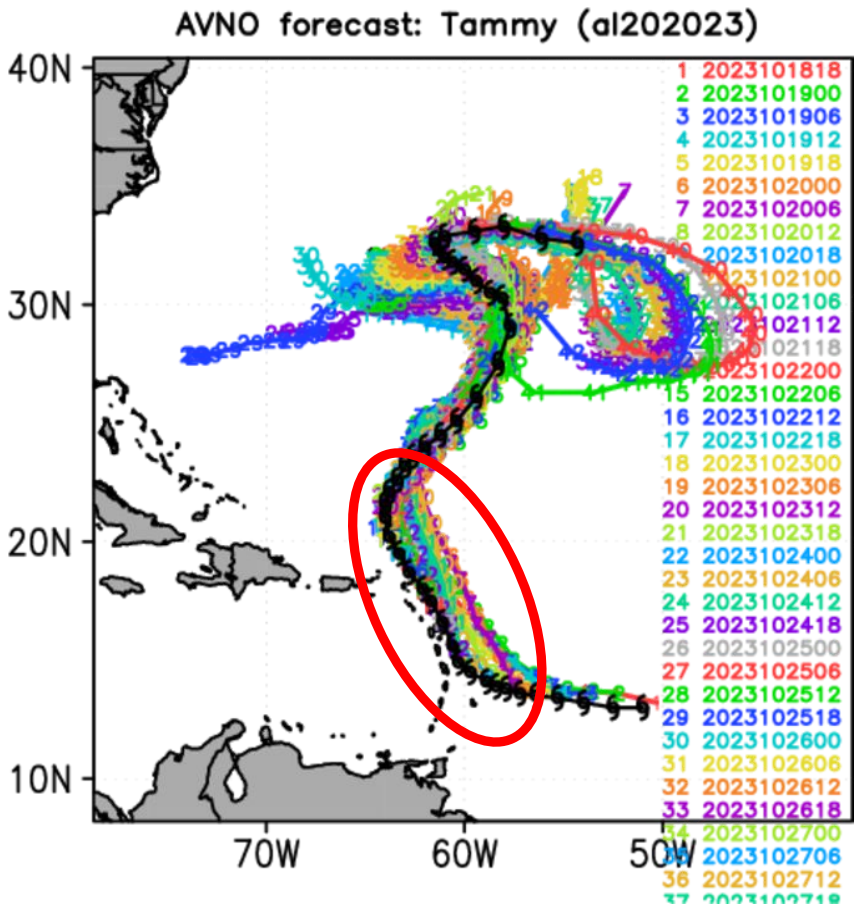




Although both HFSA and GFS exhibit large track errors when Hurricane Franklin made sharp turns and in the late stage of the storm, compared with GFS, HFSA demonstrates relatively smaller errors.

The Track Composite of Hurricane Tammy 20L 2023





Both HFSA and GFS exhibit large errors in the late stage of Hurricane Tammy, however HFSA demonstrates better track performance when the storm moves northwest along the islands towards Puerto Rico.

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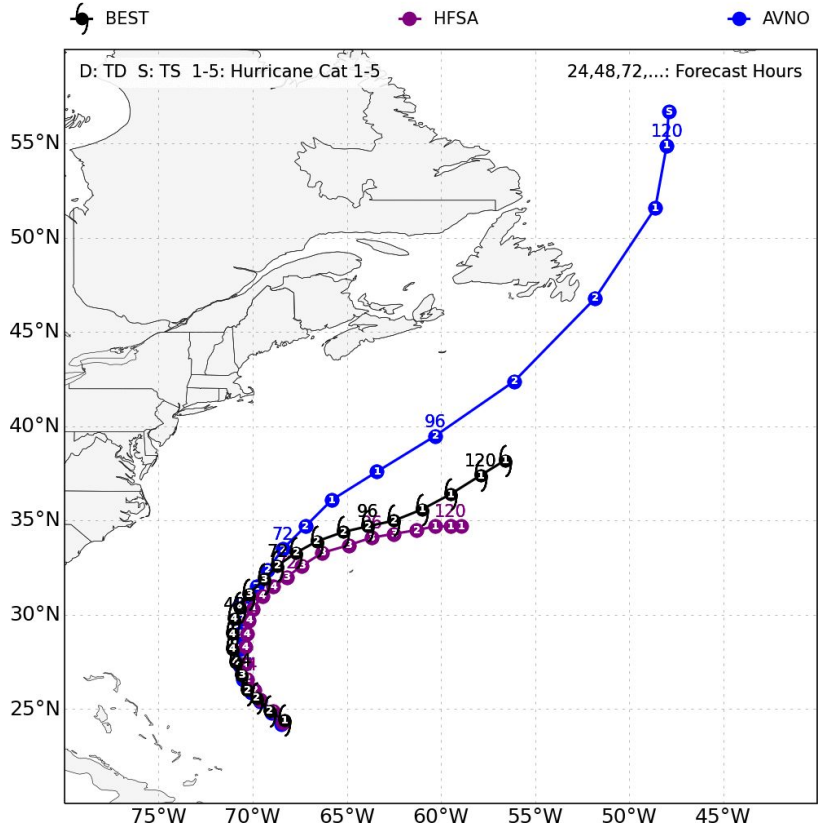
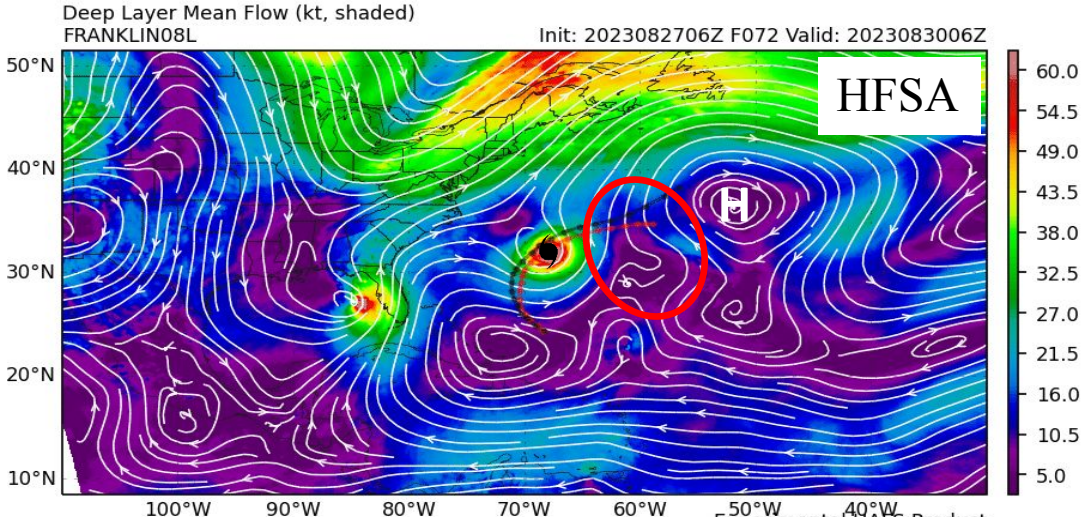
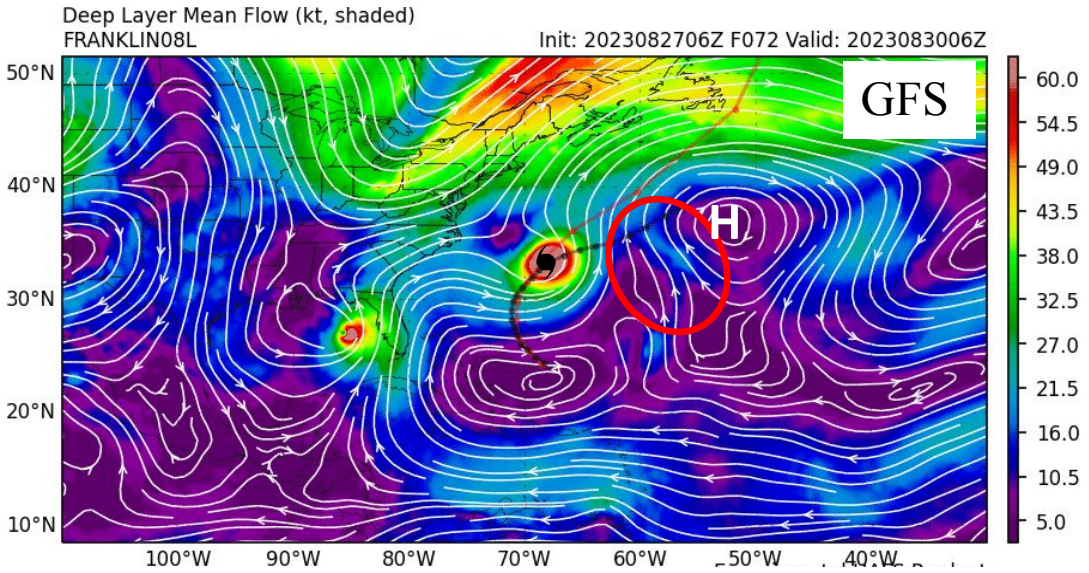
The Track Prediction and Deep Layer Mean Flow of Hurricane Franklin at 20230827 06z cycle



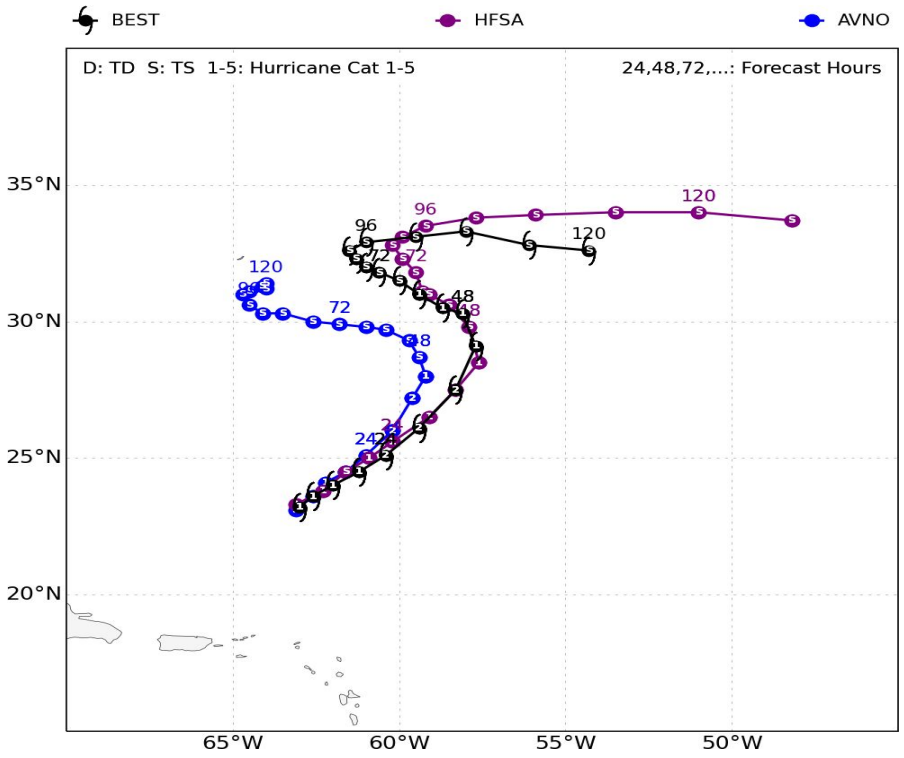




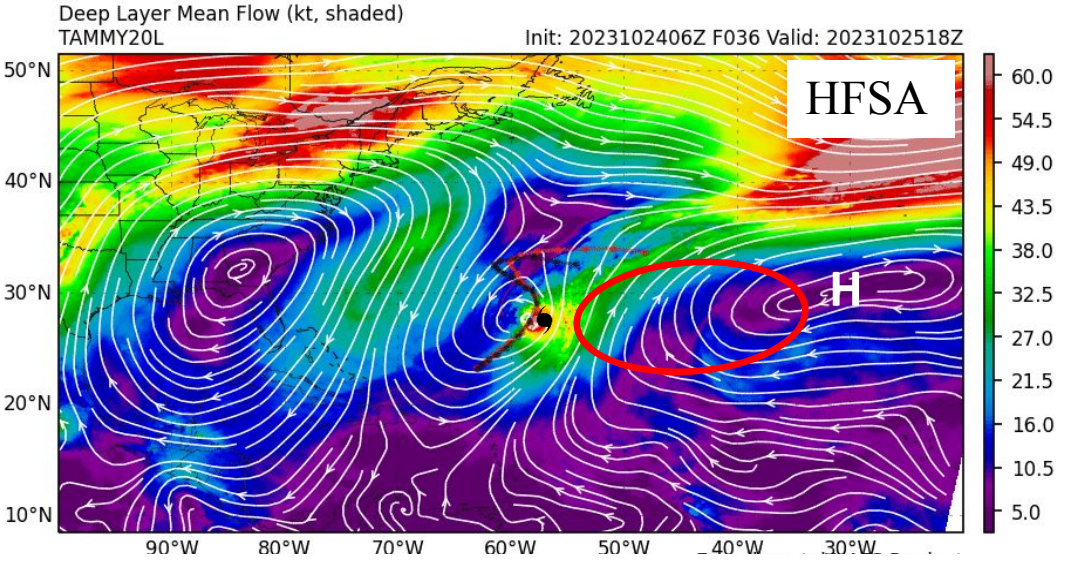
- Deep layer mean flow (850-200 hPa, magnitude in shading and streamline)
- best track (black)
- model predicted track (red)

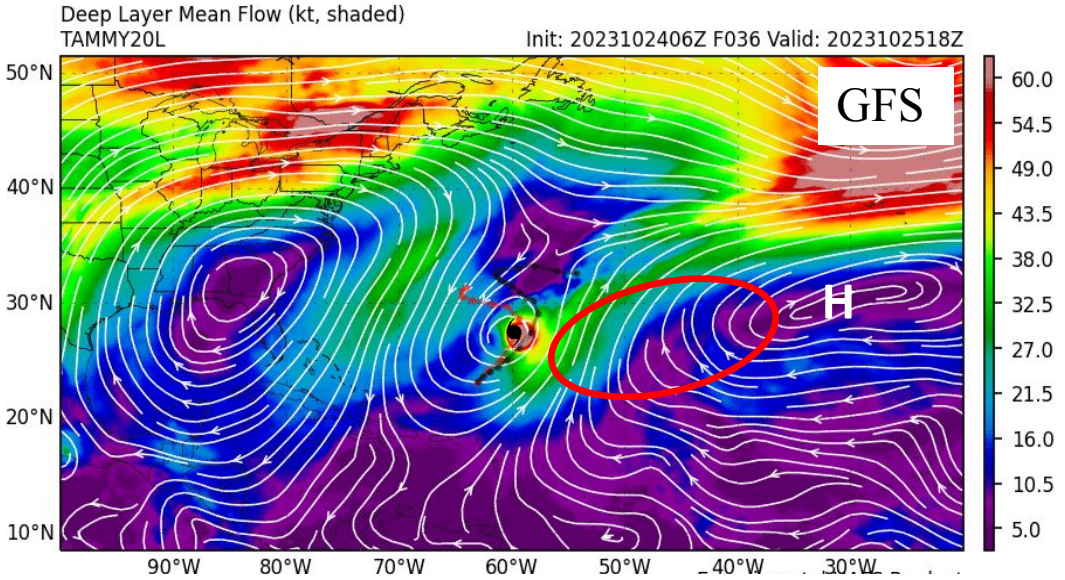
The track predicted by GFS diverged from HFSA after 72-h forecast. In deep layer mean flow, GFS predicted relative stronger subtropical high comparing with HFSA, causing the storm move slightly north.

The Track Prediction and Deep Layer Mean Flow of Hurricane Tammy at 20231024 06z cycle



The predicted tracks by HFSA and GFS diverged after 24-h forecast, also GFS predicted a little bit stronger high than HFSA in deep layer mean flow at 36-hr forecast leading time, causing the storm to turn west further and earlier.





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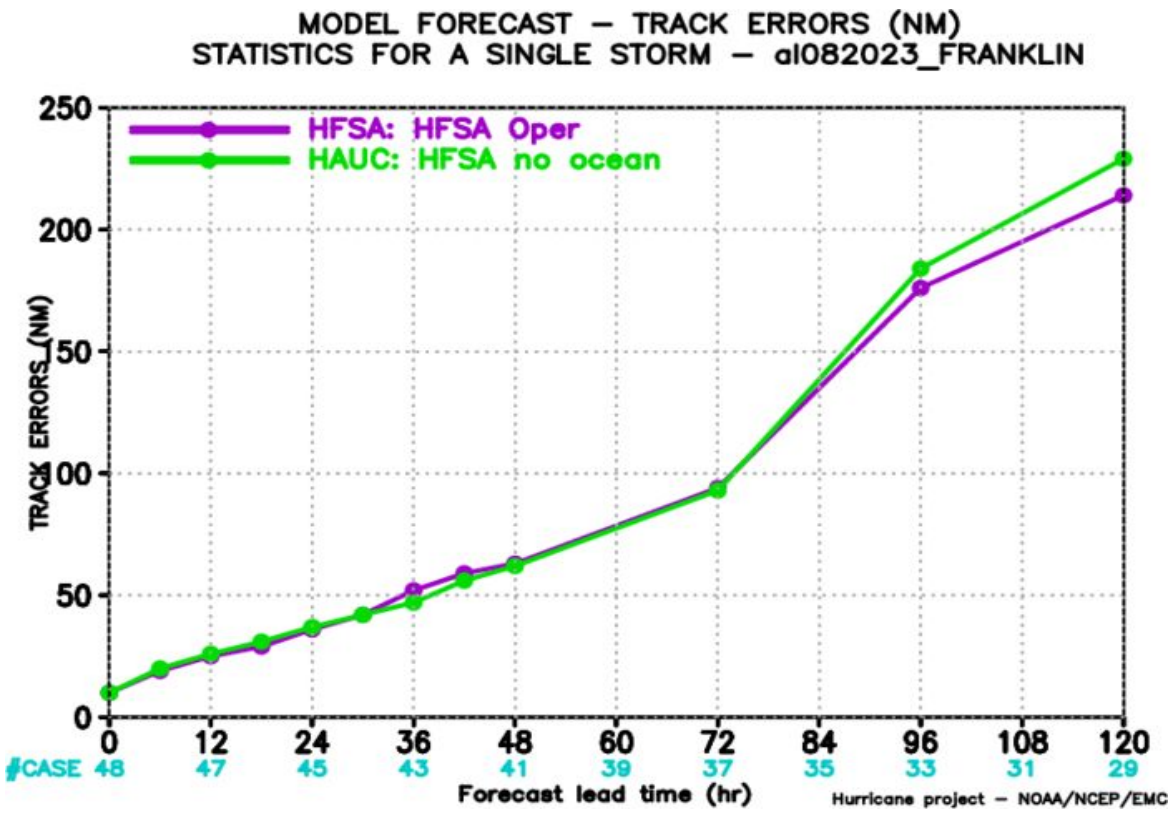
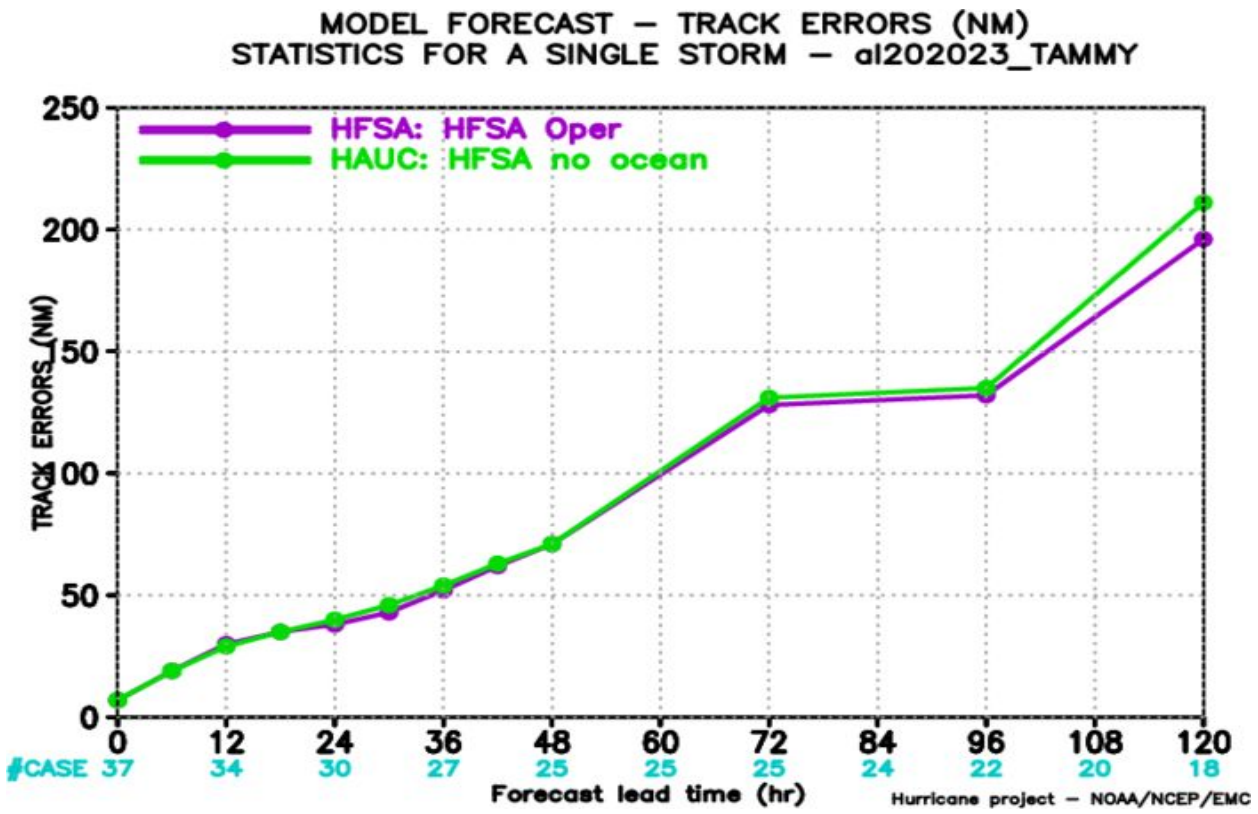
Impact of Ocean Coupling

The Track Errors of Hurricane Franklin and Hurricane Tammy 2023



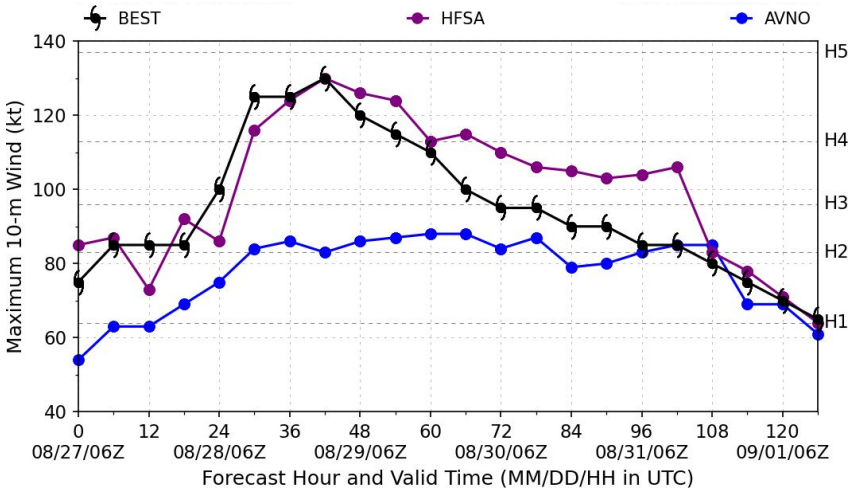


For Hurricane Franklin 08L 2023, the track performance of HFSA is better than GFS after day 3.

For Hurricane Tammy 20L 2023, the track performance of HFSA is better than GFS after day 3.

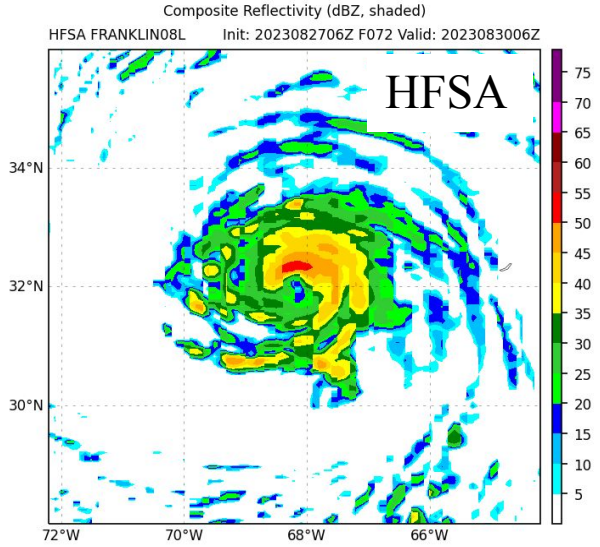
Storm Structure (*Hurricane Franklin at 20230827 06z cycle*)

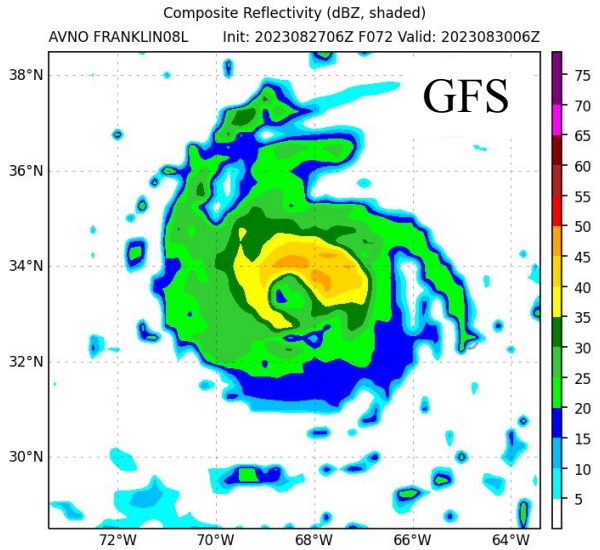
Intensity Forecast at 20230827 06Z cycle



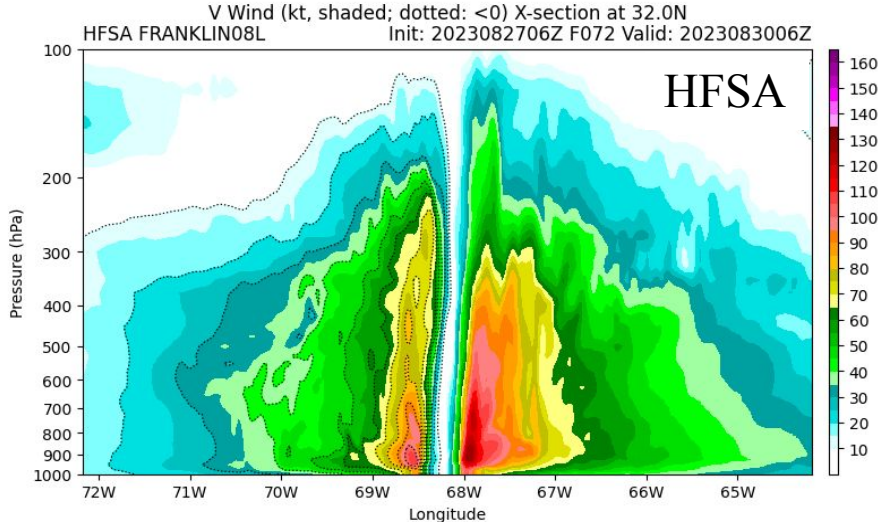
The intensity forecasted by HFSA almost reached Category 5, closer to best track, and significant stronger than GFS. Also, HFSA captures the detailed storm structure in both horizontal and vertical.

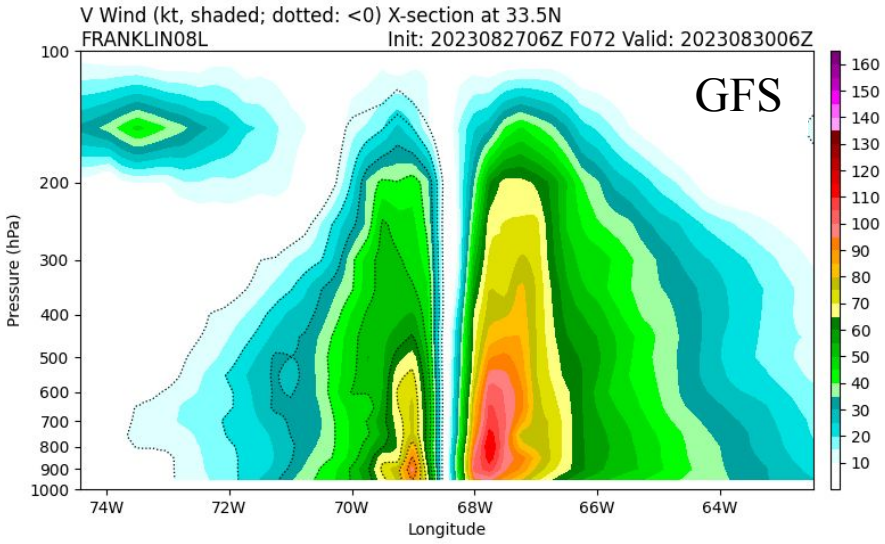
Radar Reflectivity





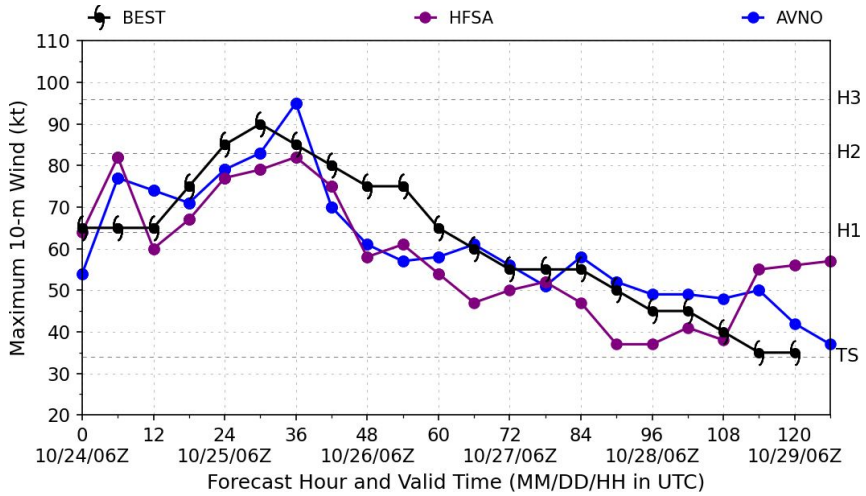
West-east Cross Section of wind





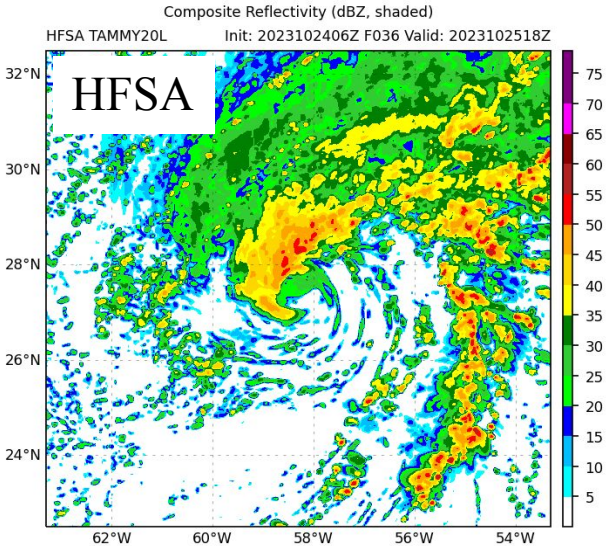
Storm Structure (*Hurricane Tammy at 20231024 06Z cycle*)

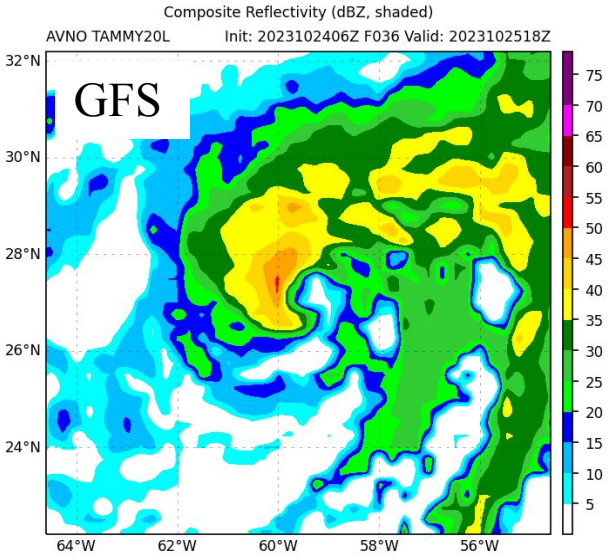
Intensity Forecast at 20231024 06Z cycle



Both forecasted intensity by HFSA and GFS are similar and close to best track. HFSA shows more detailed rainbands, the storm is shallower than GFS.

Radar Reflectivity





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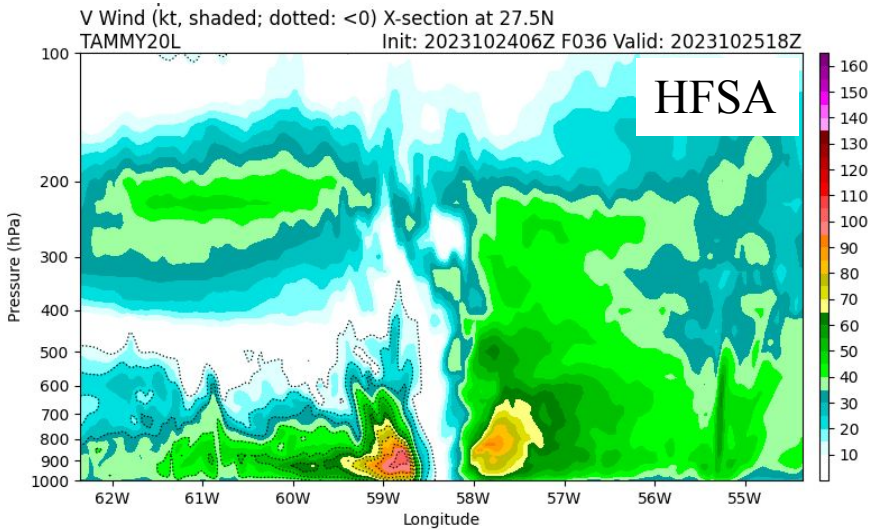

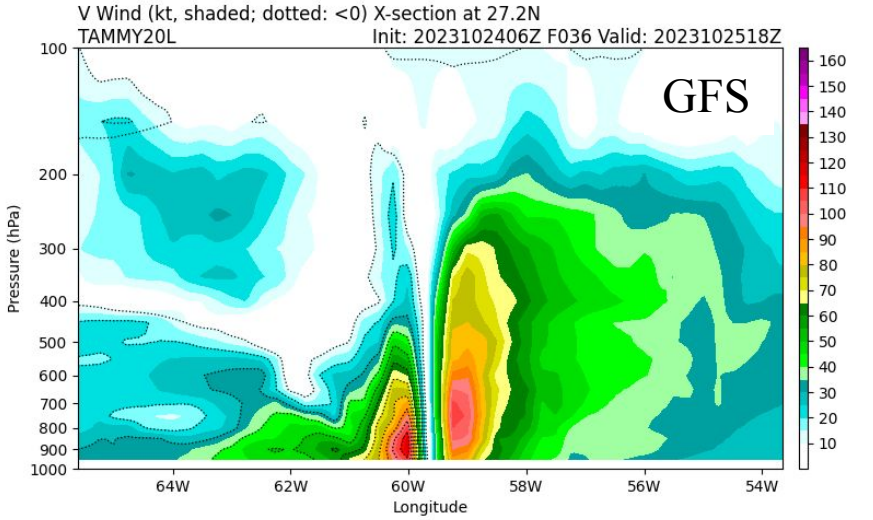

Summary

- The track performance has been improved over the past 10 years for both hurricane models and global models, with hurricane models showing greater improvement.

- Compared with GFS, HFSA demonstrates similar or improved deep layer mean flow for steering the storm motion.

- The higher resolution assists HFSA in capturing the detailed storm structure, and other factors, such as ocean coupling may also improve storm track prediction.

Thank you!