

HAFSV0.3S 2022

HFIP Real-Time Experiment

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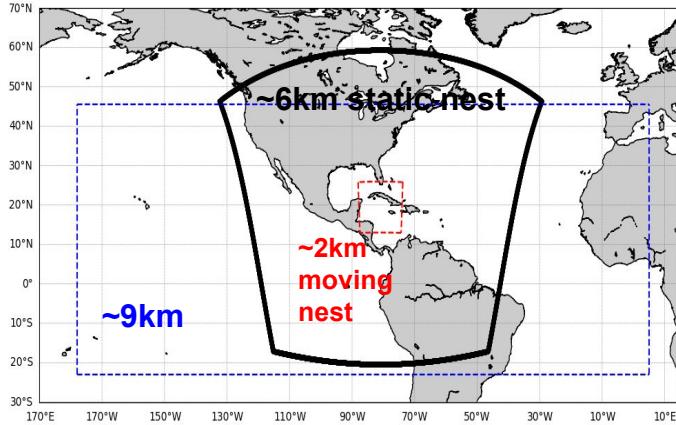
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GFDL Collaborators: Tim Marchok, Morris Bender

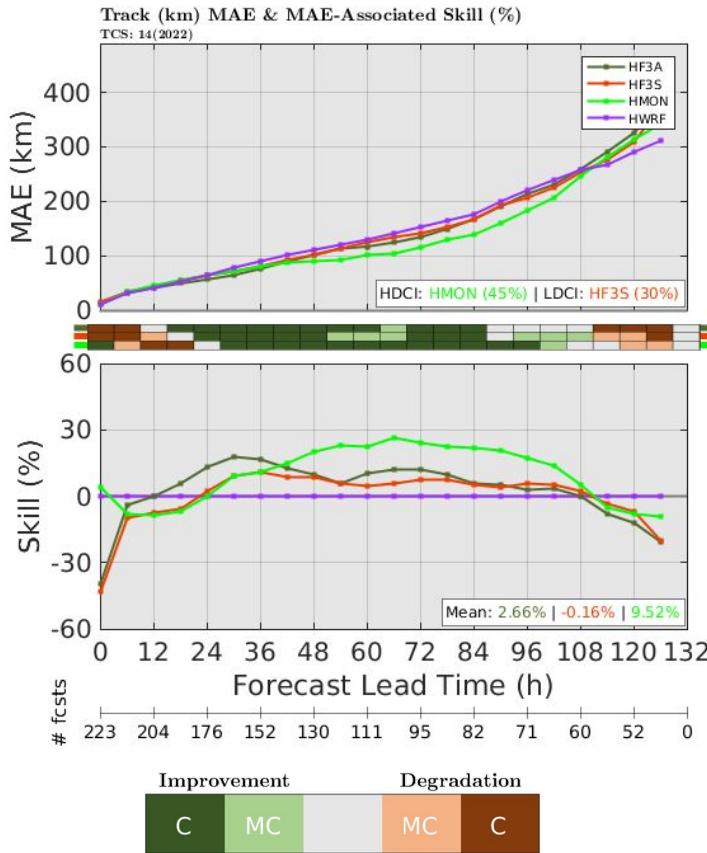
HAFSv0.3S Configuration



- Storm-centric version of HAFS
- Regional moving nest (W. Ramstrom)
- NHC HYCOM domain

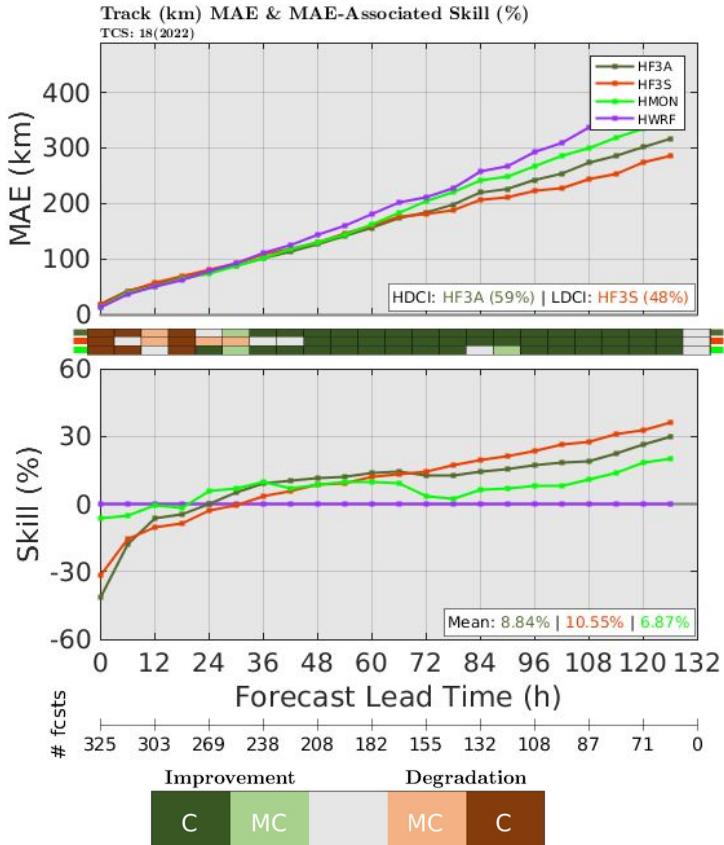
- 81 vertical levels
- Scale-Aware SAS
- RRTMG Radiation
- Modified EDMF-TKE based on LES results (Chen et al. 2022, WAF)
- Thompson microphysics
- Adaptive VI/DA (VR for all cases, VM for TCs > 30 m/s)

Overall Track: NATL



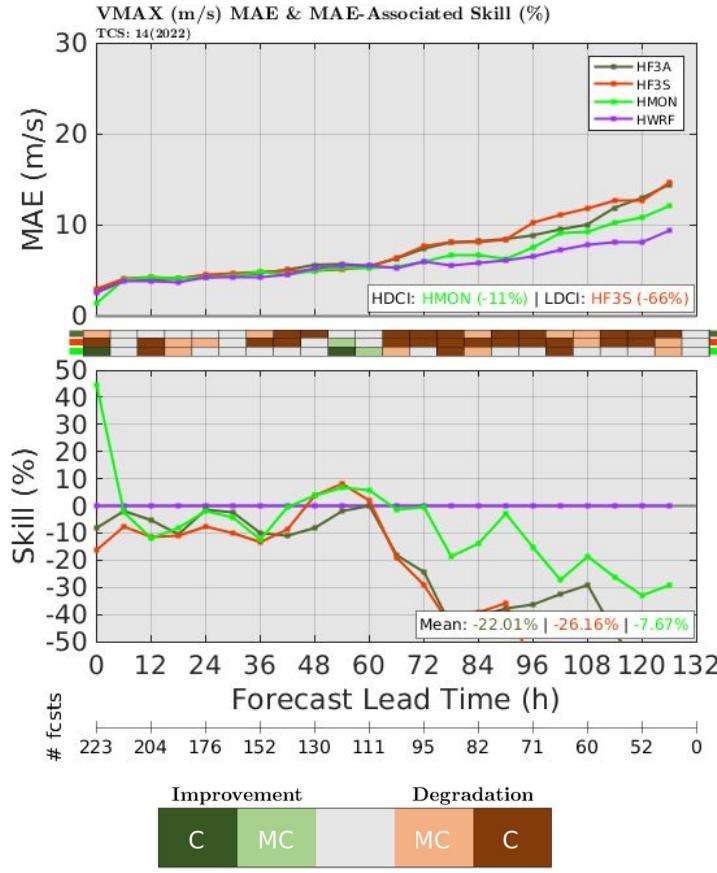
- Superior track to HWRF except at Day 5
- HAFS-A and HAFS-S performed similarly
- Early errors indicate need for improved initialization

Overall Track: EPAC

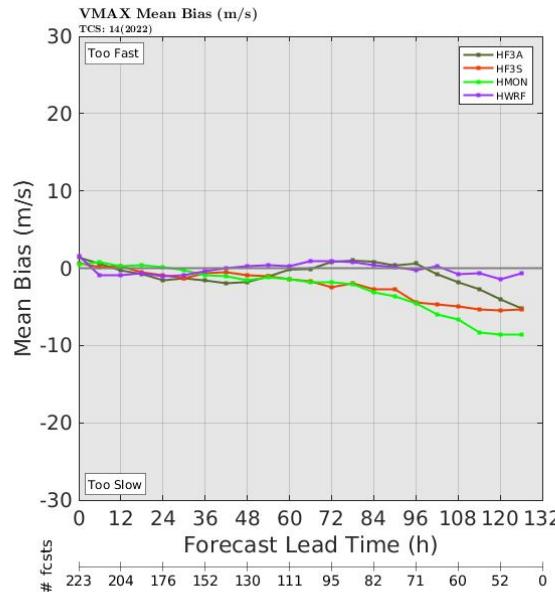


- HAFS-S track skill superior to HWRF from ~36h onward
- Superior to HMON after ~48h and HAFS-A after ~72h

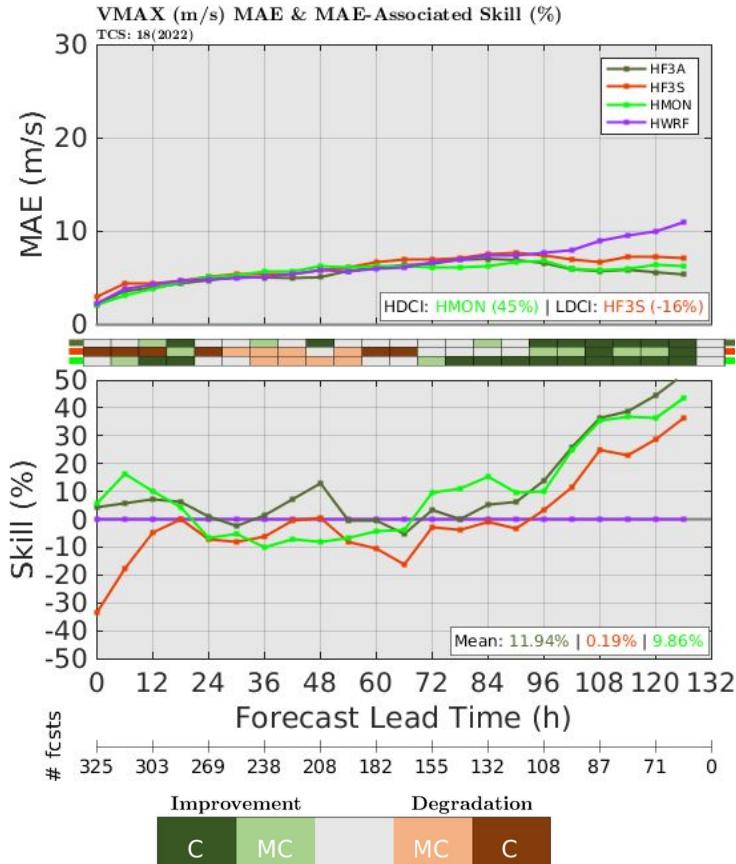
Overall Intensity: NATL



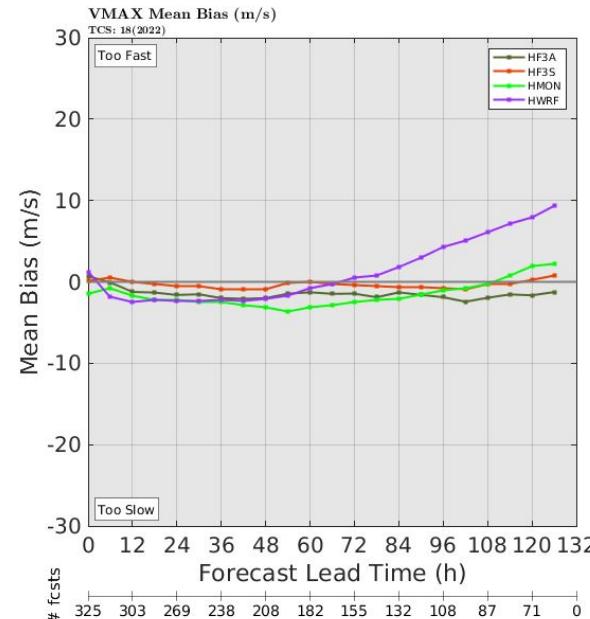
- Comparable performance to HWRF and HMON at Days 1-2
- Less skill at Days 4-5
- Mostly due to a negative bias (similar to HMON)



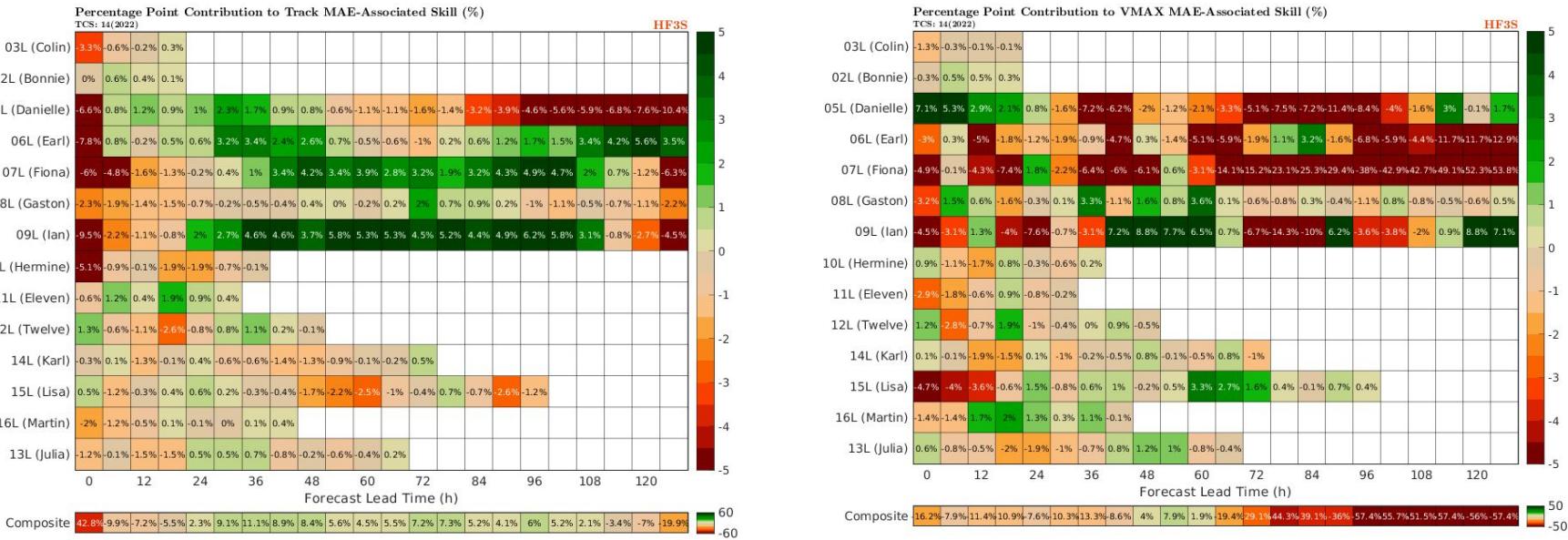
Overall Intensity: EPAC



- HAFS-S, HAFS-A, HMON all fairly similar
- Negative bias slightly reduced in HAFS-S

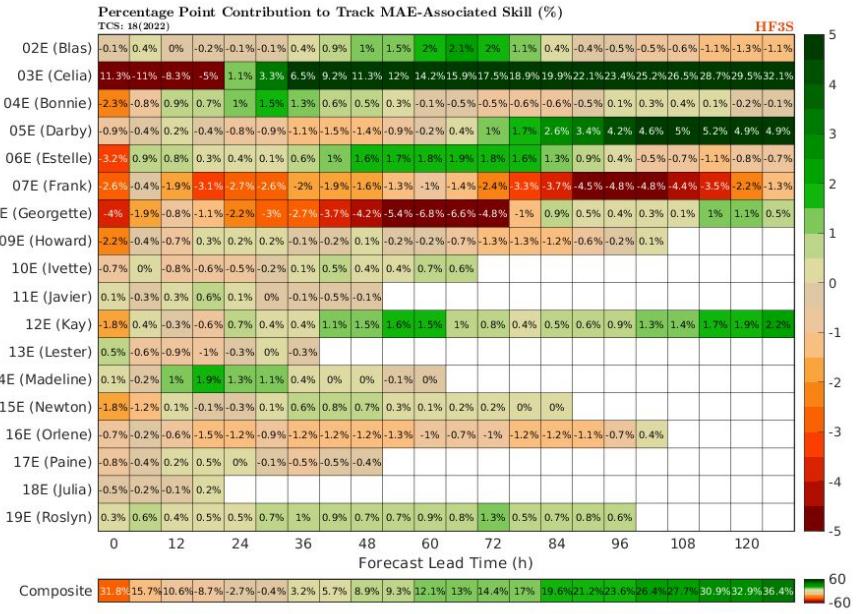
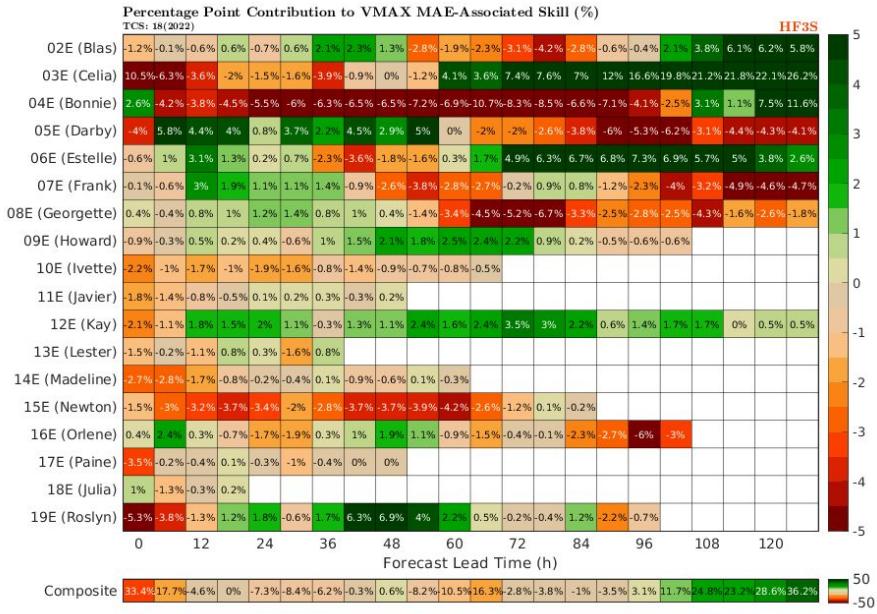


Contributions to Overall Skill: Atlantic



- PPC metric (Ditchek et al. 2022) shows the relative contribution of each case/lead time
- Danielle (and some Ian cycles) were the two main track concerns - track was good overall
- Earl and Fiona were the two main intensity concerns (opposite biases) - discussed in “challenging cases” talk

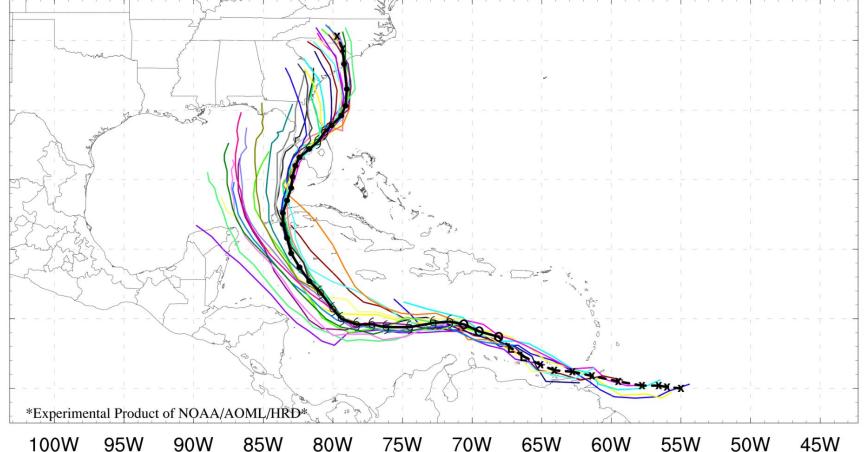
Contributions to Overall Skill: East Pacific



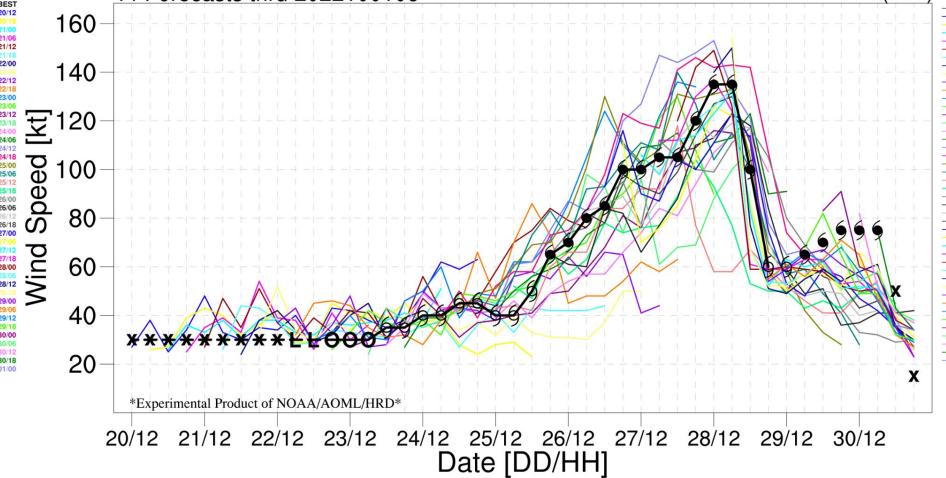
- Celia (03E) was a big positive for track and intensity in the East Pacific
- Kay (12E) was also a positive contributor
- Bonnie (04E) was a negative contributor for intensity skill

Hurricane Ian Case Study

HF3S Lifetime Track Forecasts
44 Forecasts thru 2022100106

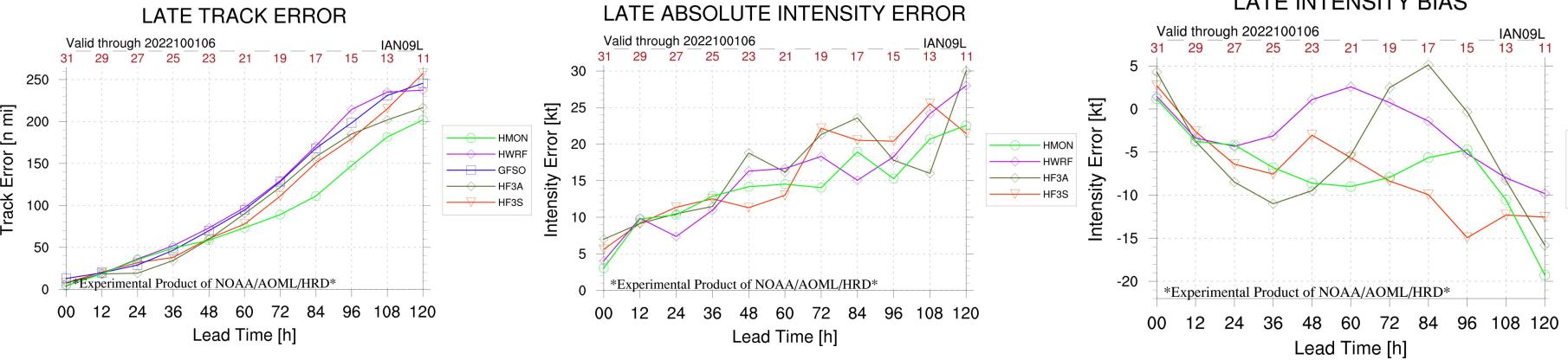


HF3S Lifetime Intensity Forecasts
44 Forecasts thru 2022100106



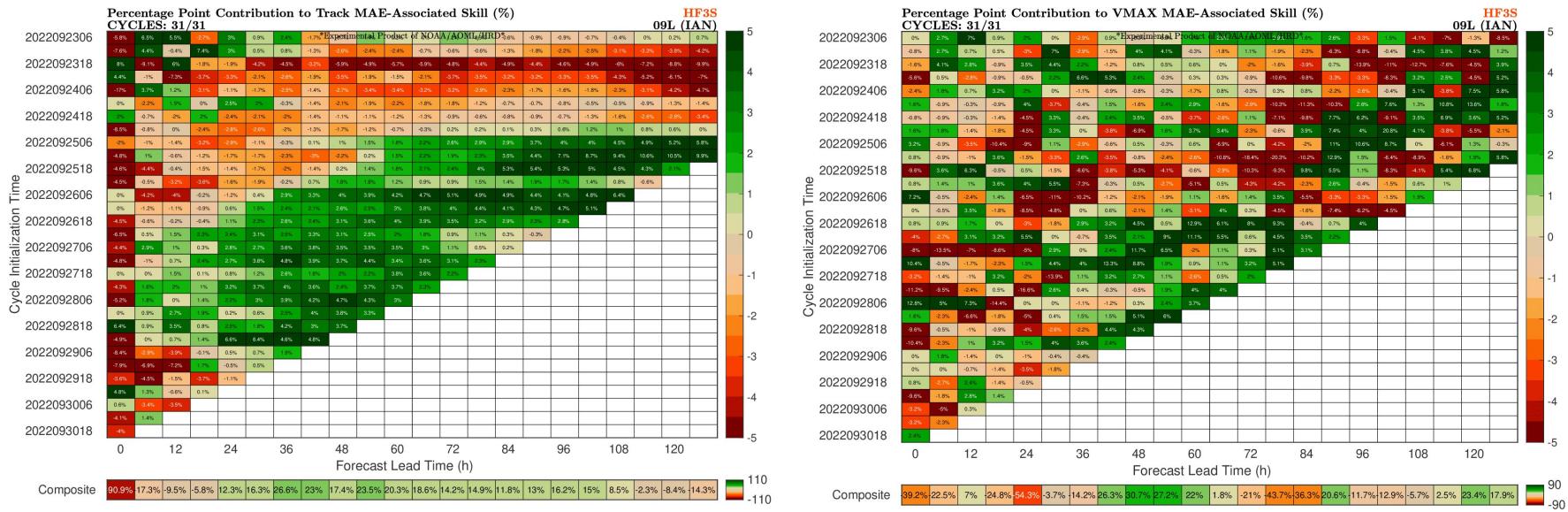
- Some early cycles had a track too far left
- Peak intensity generally well-predicted

Hurricane Ian Case Study



- Overall HAFS-S track was similar to HAFS-A, slightly better than HWRF
- Day 5 track error was larger
- Intensity performance generally comparable to HWRF/HAFS-A for Ian

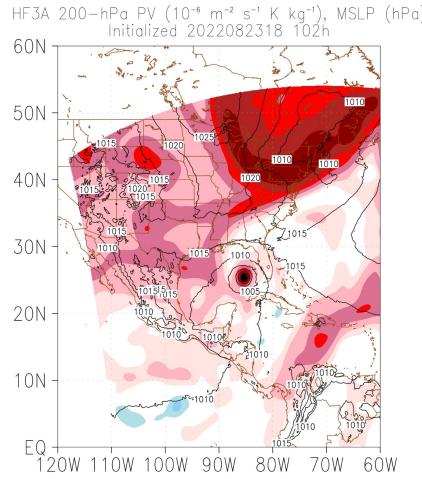
Hurricane Ian Case Study



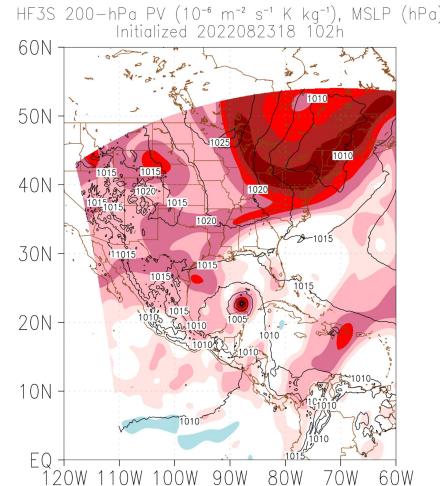
- First 4-5 cycles were where almost all of the long-range track degradation came from
- After 2022092500, almost all forecasts were more skillful at almost all leads
- Intensity skill was a mixed bag: some parts of some cycles better than HWRF, some worse

Hurricane Ian Case Study

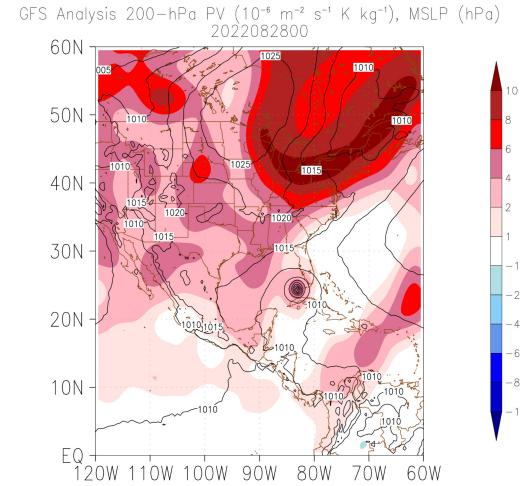
HAFS-A



HAFS-S

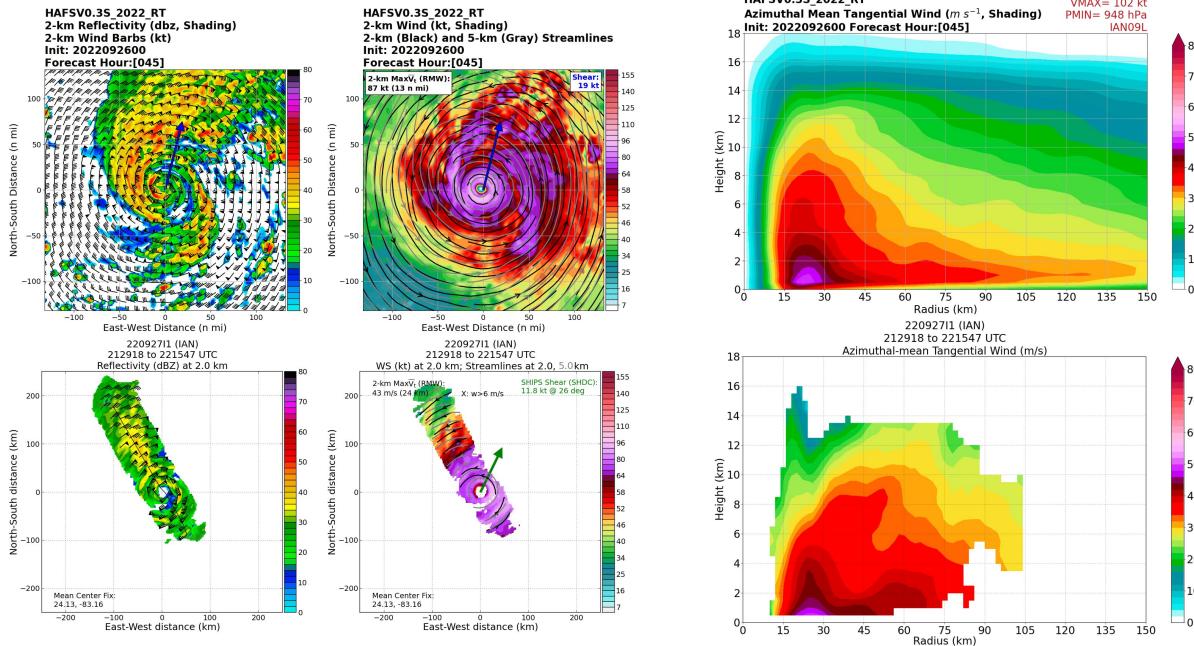


GFS Analysis



- Trough was not amplified enough in either HAFS-S or HAFS-A
- “Tail” of the trough was further east in HAFS-A than HAFS-S (for this run)
- Synoptic or storm-scale (diabatic PV erosion) difference?

Hurricane Ian: Model/Radar Comparisons for ERC



- Several cycles of HAFS-S correctly showed the ERC that occurred near the Keys
- Several P3 flights for comparison

2022 Summary

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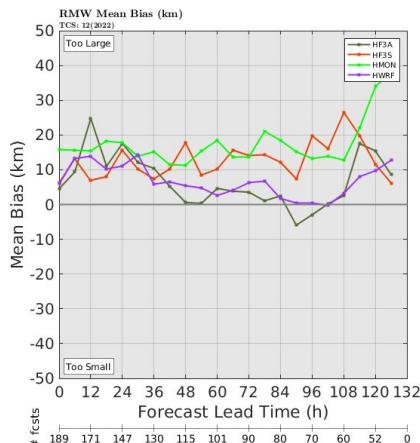
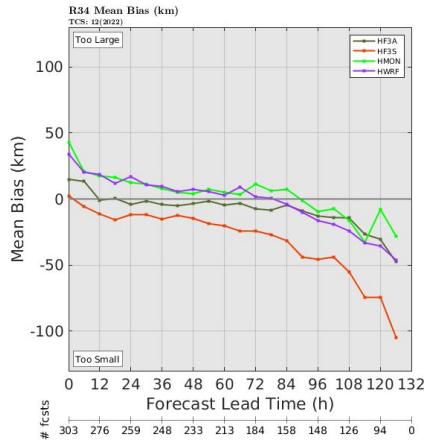
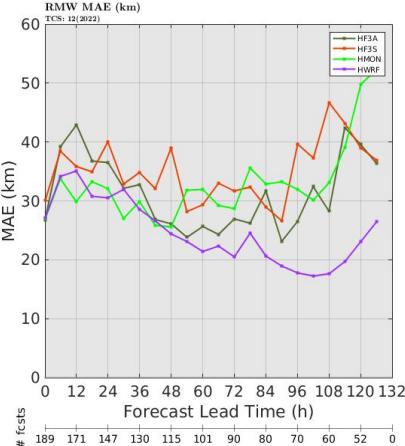
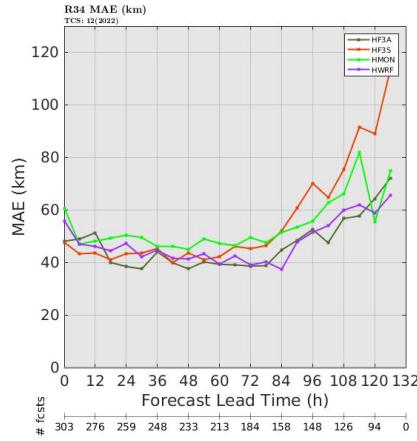
- HAFS-S performed better than HWRF in Atlantic and East Pacific track
- Intensity was a mixed bag: solid in the East Pacific with some long range struggles in the North Atlantic
- Hurricane Ian case showed some early track bias but also accurate forecasts within ~3 days of landfall, and fairly accurate RI prediction

Outstanding Issues and Ongoing Work

- Coupling: Working on testing the impact of a coupling flux fix
- Nesting: Diagnosing some moving nest issues near terrain (may have affected Fiona): gravity waves and tracker difficulties
- DA: Sensitivity tests with different initialization options (early lead times had less skill in some cases)
- Physics: PBL + MP sensitivity tests to determine the optimal configuration

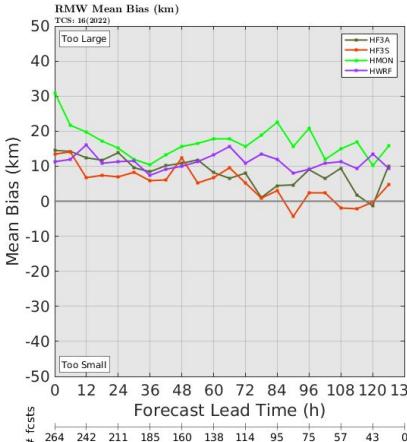
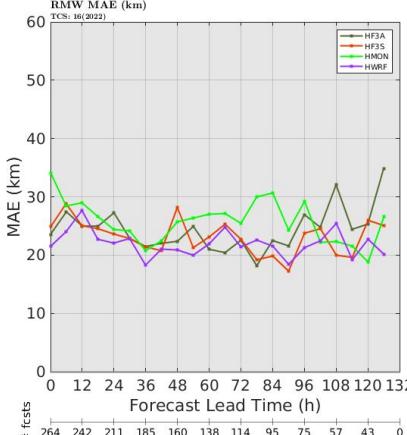
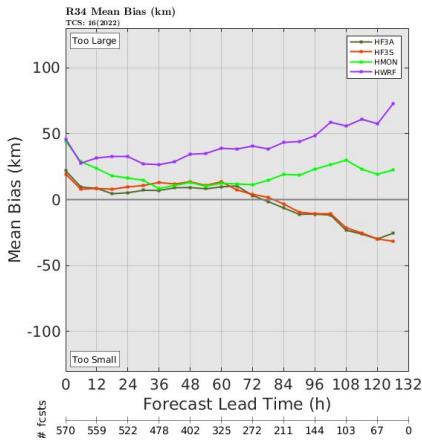
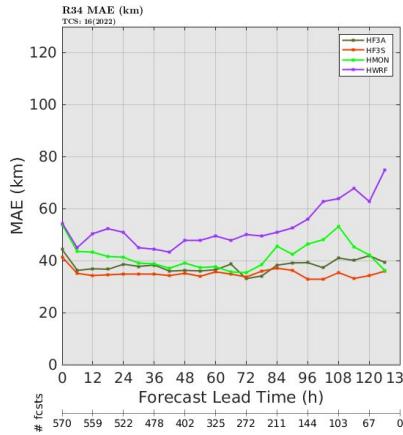
Extra Slides

Overall Structure: NATL



- Low bias in R34*
- Slight large bias in RMW
- Fairly comparable to HMON for RMW

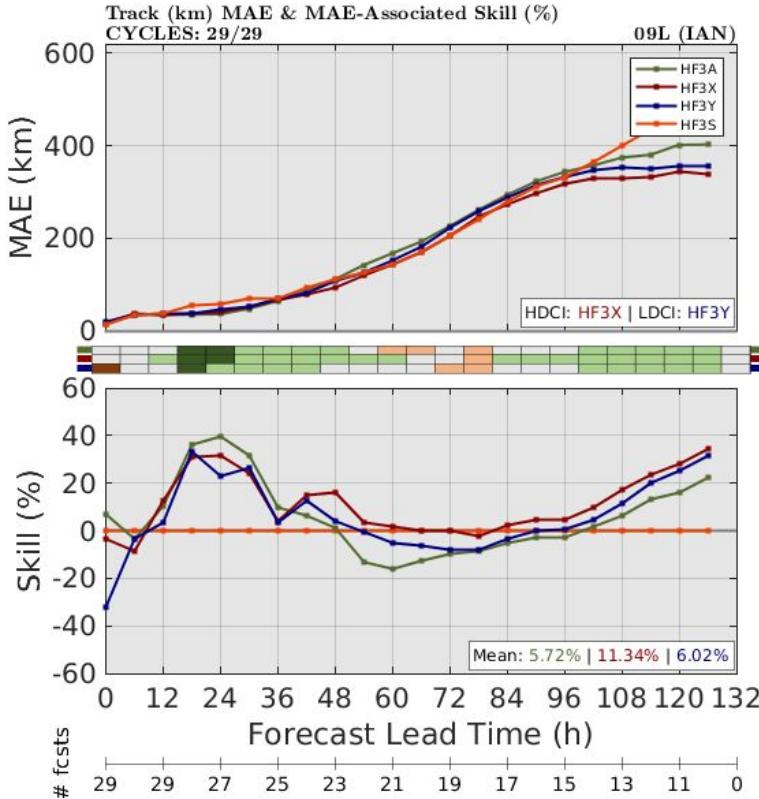
Overall Structure: EPAC



- HAFS has the least R34 error in the EPAC
- Both HAFS versions generally have a small bias for R34
- RMW is a bit smaller in HAFS-S than HAFS-A*

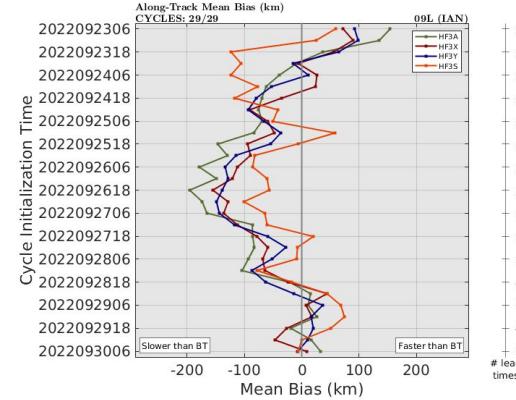
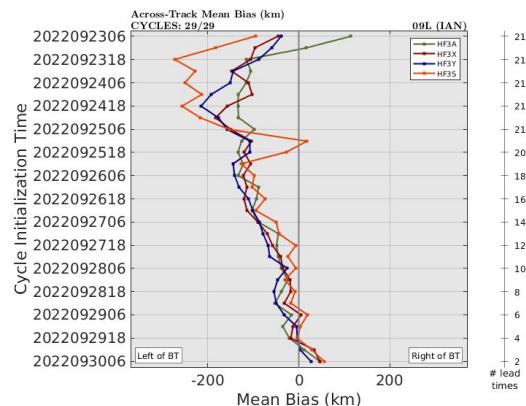
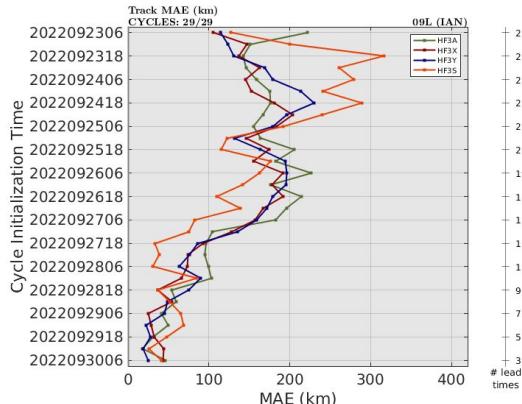
*Tracker version differs between operational HWRF/HMON and HAFS, which will affect this comparison

Ian Sensitivity Tests



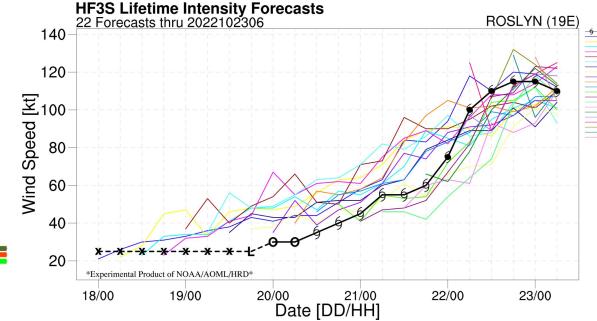
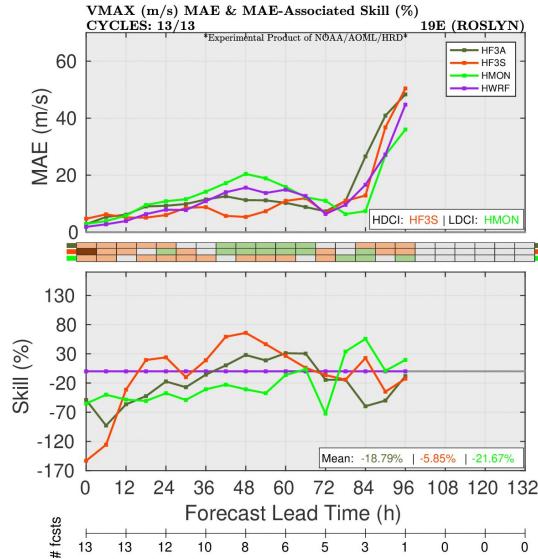
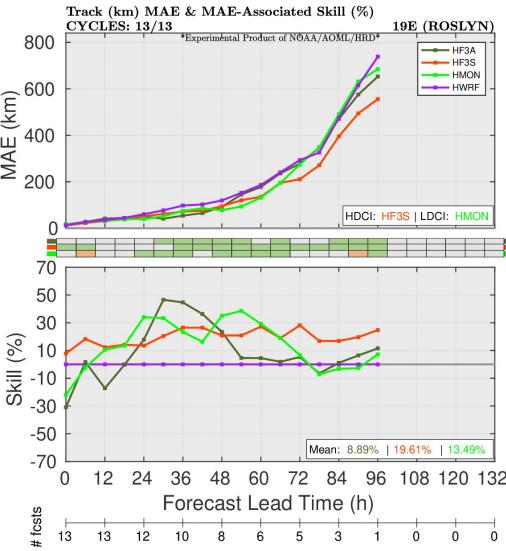
- HF3X: HAFS-S (PBL changes + adaptive VI/DA) with GFDL MP
- HF3Y: HAFS-A + PBL changes + cold start (no VI/DA)
- Both experimental configurations are superior to HAFS-S (and HAFS-A)

Ian Sensitivity Tests



- Huge decrease in track error for HF3S starting at 2022092512
- Mostly driven by a reduction in left bias

HAFS-S Results for Roslyn



- HF3S outperformed HF3A, HWRF/HMON for track for Roslyn
- Intensity was better at Days 2-3
- RI forecast generally consistent with what was observed

Roslyn First Cycle

