HAFSV0.2B 2021
Real-time Results

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2021 Grid Configuration and Model Setup

- Keep the 2020 “global tropical channel” FV3 layout, with 13-km global resolution (C768)
- Static 3-km nest covering most of the tropical Atlantic
- Requested resources to extend Atlantic nest from 2020 by ~6 degrees
- Nest was coupled to HYCOM for 2021
- 168h forecasts 4x daily
- 4560 cores in ~5 hours
Atlantic Track Performance

➢ GFS track outperformed all high-resolution models
➢ HAFS-B had a right bias overall again (though lower than 2020)
➢ HAFS-B had a slow bias as well (slightly smaller than GFS)
Atlantic Intensity Skill

- Intensity guidance had generally similar performance for the first ~72h
- HAFB was slightly worse than HAFA/HMON at Days 4-5
- Bias was well-calibrated on Days 1-3, slight high bias at Days 4-5
- 48 hours was where HAFS-B showed the best performance relative to HWRF (after spinup due to lack of DA)
Atlantic Radii Skill

➢ HAFB had a positive R34 bias early
➢ RMW bias also slightly positive early, but better at longer range
➢ R64 was slightly too large on average in all models
Global Skill

➢ Assessment of global skill is an important part of the HAFS-globalnest (HAFS-B) configuration

➢ Track results for the East Pacific and West Pacific are mostly neutral, maybe slightly better than the operational GFS at longer lead times
Global Skill

➢ HAFB had lower intensity errors than GFS in the EPAC
➢ Downstream advection of high-res disturbances?
➢ Highlights the importance of a multiple-nested global configuration eventually
➢ WPAC intensity results were mostly similar to GFS (further from the high-resolution nest)
➢ After genesis, track forecasts were accurate (some were slightly slow)
➢ Most forecasts correctly showed RI and peak as a strong Category 4
Slight left/slow bias (typical of most HAFS runs)

Initial slow ramp up followed by sudden RI, consistent with obs
Wind structure was very consistent with obs near peak intensity
RMW slightly smaller in observations
Moat region more pronounced in observations
Design of Sensitivity Experiments

➢ Wanted to test some of the differences between HAFS-A and HAFS-B
➢ Two testable differences were tracer advection (\texttt{hord\_tr} = 8 vs. -5) and PBL scheme mixing length (\texttt{elmx/rLmx} = 300 vs. 100)
➢ We also included a test with L91 (not feasible in real-time)
➢ Larger nest and ESG grid were two options that we could not test
➢ A few different test configurations were designed to be progressively closer to HAFS-A in the physics/dynamics options:
  ○ HBTA (\texttt{hord\_tr} = 8 instead of the \texttt{hord\_tr} = -5 used in HAFSV0.2B)
  ○ HBML (\texttt{hord\_tr} = 8 + \texttt{elmx/rLmx} = 300 instead of the 100 used in HAFSV0.2B)
  ○ HBVL (\texttt{hord\_tr} = 8 + \texttt{elmx/rLmx} = 300 + L91 instead of the 75 used in HAFSV0.2B)
➢ Tested on several high-profile 2021 cases
Larry was a main high bias case
Tracer advection didn’t alter the results much
Mixing length was more important, and L91 to some extent
Opposite results for RI cases: smaller mixing length cap did better
Needs to be configured to capture *both* RI and weakening events correctly
Conclusions

➢ HAFS-B (HAFS-globalnest) had comparable track skill to other HAFS and GFS-based guidance
 ➢ Good intensity skill in the first 2-3 days of the forecast, slight high bias at longer leads (mostly from Hurricane Larry)
 ➢ Impressive results (from the global domain) in the East Pacific: shows the value of the evental multiple-moving-nest configuration
 ➢ Rapid intensification of Hurricane Ida and structure evolution was well forecast
 ➢ Sensitivity tests show that vertical resolution and PBL structure are critical
 ➢ Physics, dynamics, and resolution need to work together to cover the full range of intensity change (RI and weakening)
Extra Slides
August 27, 15Z (1st flight)

Initial wind+precip field was very asymmetric

HAFS-B represented this well
Ida 2021082706 Structure Analysis

➢ August 27, 21Z (2nd flight)
➢ Vortex was interacting with Cuba
➢ Broad wind field and large band to the NE was well-represented by HAFS-B
Ida 2021082706 Structure Analysis

- August 28, 12Z (3rd flight)
- Precipitation was more symmetric
August 28, 21Z (4th flight)
Core was becoming more compact
HAFS-B reproduced this structure
Wind field was much more symmetric, with hurricane force winds around the eyewall at 2 km
TC was primed for RI
Ida 2021082706 Structure Analysis

- August 29, 15Z (5th flight)
- Extreme wind field post-RI
- Strongest winds in the NE quadrant
- Eye was slightly too large in HAFB (common model issue)