HAFS Data Assimilation: Progress and Future Strategy

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Outline

HAFS IOC timeline

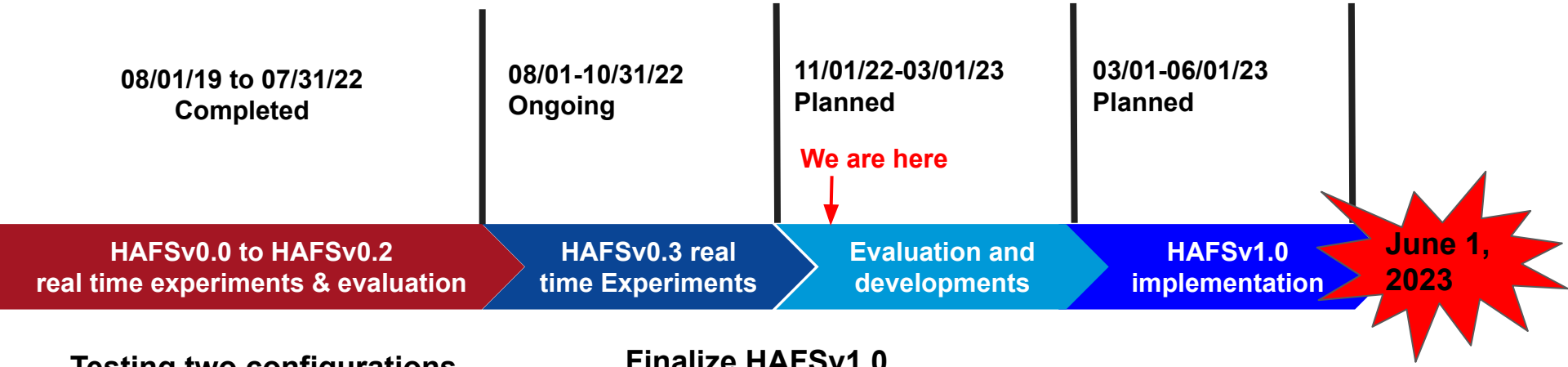
HAFS DA -- current status

HAFS Atmospheric DA requirements

HAFS Ocean DA requirements

HAFS evolution and next steps

Timelines for HAFS v1 Transition to Operations



Testing two configurations (HAFSv0.3):

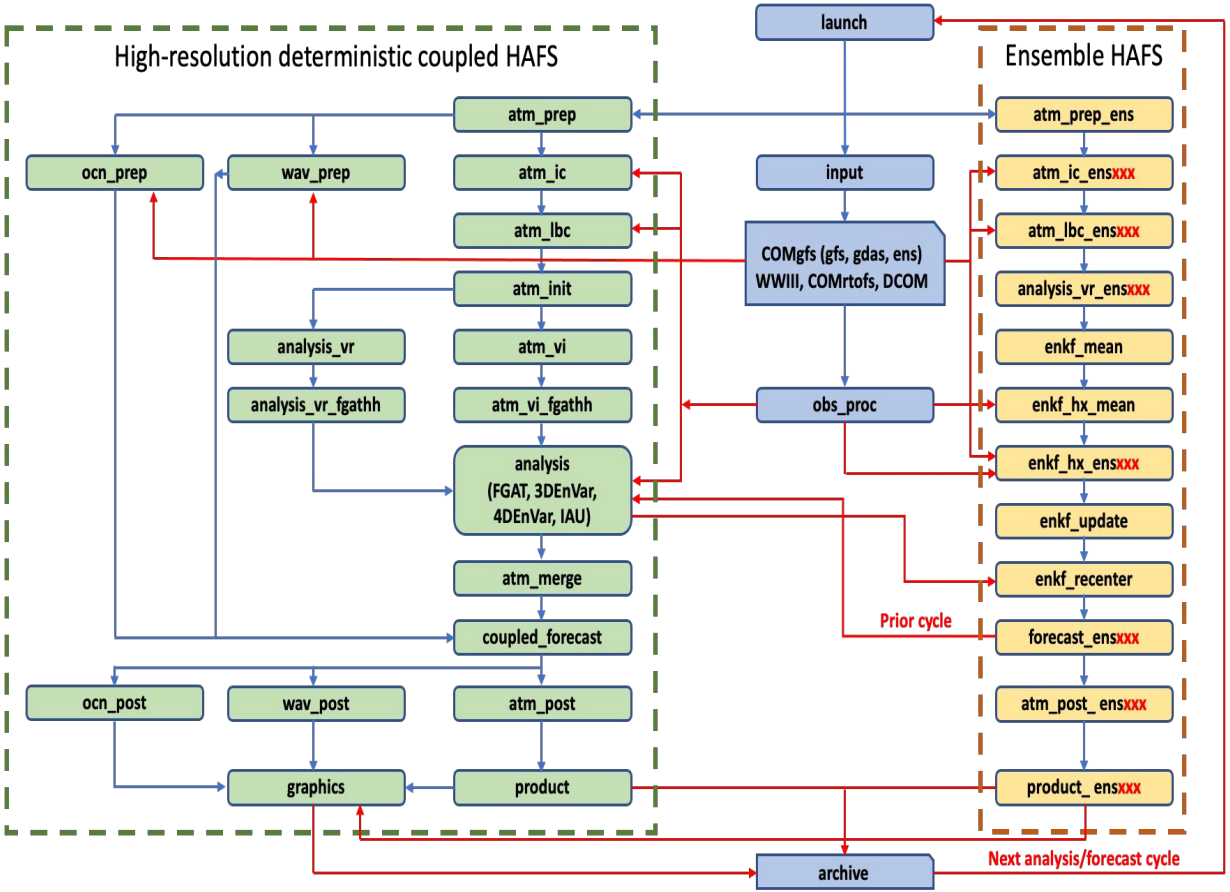
- High resolution moving nest
- Improving model physics
- Vortex initialization and Inner-core data assimilation
- T&E to select optimal configurations

Finalize HAFSv1.0

- ESG grid with Dynamic core diffusion tuning
- Vortex initialization threshold
- 4DEnVar using GDAS ensemble
- Enhanced GOES-R AMVs and GOES-18
- NOHA MP LSM with VIIRS Veg Type
- Ocean coupling bug fix
- Unified Gravity Wave Drag, uGWP
- Ocean coupling bug fix
- Code optimization
- Model instability
- JTWC basins T&E
- New GFSv16.3 input

NCO implementation

HAFS IOC Data Assimilation Configuration



Available DA options:

Both parent and nested domains
OR
Nested domain only.

Storm-centric
OR
Basin-centric domains.

Self-cycled DA using HAFS based ensembles
OR
self-cycled DA using GDAS based ensembles
OR
self-cycled DA using both.

HAFS Atmospheric Data Assimilation (requirements)

1. Cycle mesoscale error covariance over basin-scale regions from which any storm in the basin can draw.
2. Develop and explore cycled basin-scale analysis with mixed HAFS/GDAS covariance (CONOPS challenges).
3. Develop higher frequency DA: Enhance to hourly or three-hourly DA for operational forecasts. Need to consider enhanced availability of recon data (multiple missions targeting multiple storms) in the future (see item 4) (CONOPS challenges).
4. Mitigate initial model spin-up and -down issues due to inconsistency between VI and DA, potential methods.
5. Transition 3DEnVAR to 4DEnVAR with IAU and alternate methods to improve analysis and mitigate spindown.
6. Develop across scale-spectrum DA for HAFS, e.g. Multi-scale DA (DA for both large- and vortex- scales vs. scale-aware DA.
7. Assimilate new obs. (derived satellite products vs. direct radiance), prioritize obs data.
8. Develop all-sky DA for HAFS to ultimately replace need for VI.
9. Develop possible AI applications with EnKF hybrid DA.
10. Transition to JEDI-based DA.
11. Extend DA to all basins.

HAFS Ocean Data Assimilation (requirements)

1. Explore and refine ocean initialization and data assimilation algorithms for HAFS-Oceans (CONOPS challenges).
2. Explore an ensemble DA approach.
3. Explore frequent analysis cycle, preferably 6 hourly.
4. Explore additional derived and directly observed datasets for ocean data assimilation.
   Examples include: SWOT altimetry; SLSTR (for SST's); Ocean Color from Satellites; Velocities from Gliders and Saildrones, HF-Radar and Satellites.
5. Explore coupled DA (Atmosphere and Ocean).
6. Transition to JEDI-based DA (in the works).
7. Extend DA to all basins.

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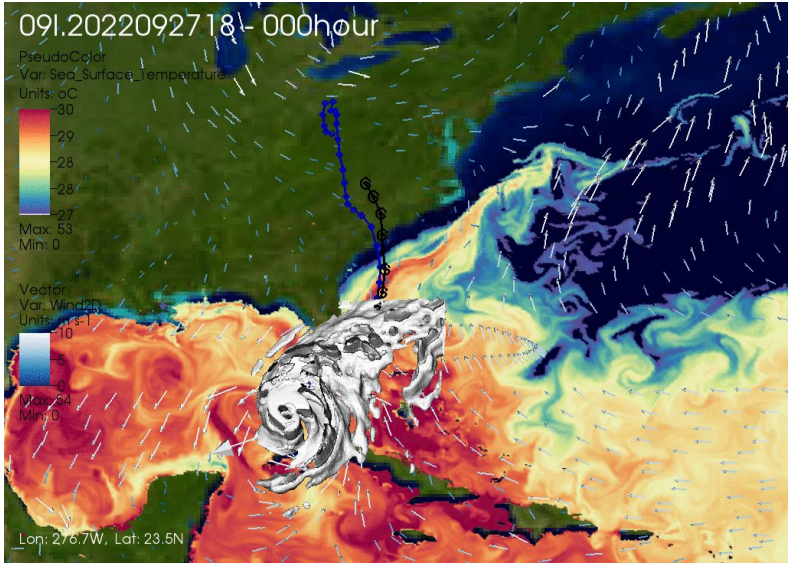
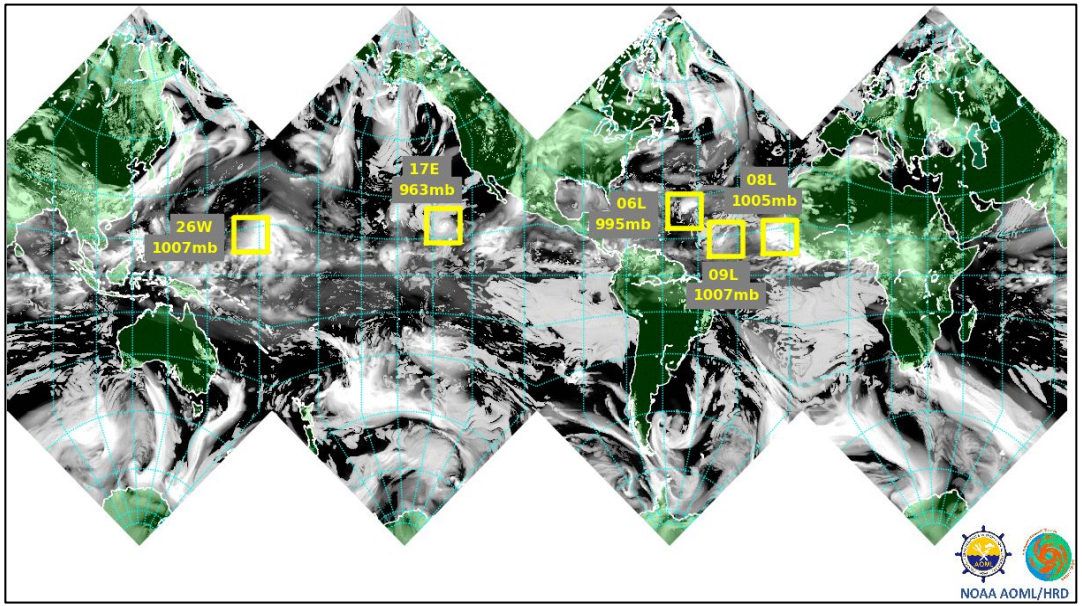
Evolution of Future Operational Hurricane Analysis and Forecast System (HAFS)



Current: HAFS single storm-centric configuration targeted for operational implementation in FY23

Future: Merged GFS-HAFS with multiple moving high resolution nests following multiple storms embedded in a global domain



Next Steps

- Please outline a strategy to address the listed requirements.
- The strategy should align with other HAFS developments for configurations, resolutions, physics and coupling.
- What can be included in HFIP real-time experiments during the FY23 Hurricane season? Can these developments be targeted for HAFS v2 T2O?
- What can be planned for the FY24 Hurricane season?
- Requested inputs due **03/01/23.**