HAFS Moving Nest Development and Global Nest Real-time Demo

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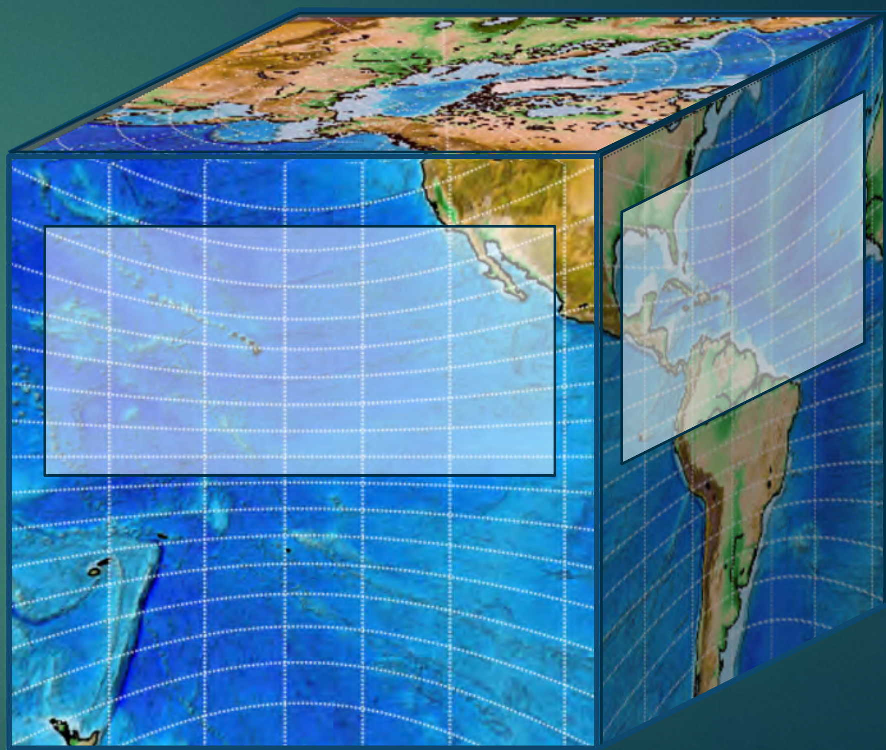
HAFS Ongoing Activities at AOML

Completed
Ongoing

- Multiple static nests
  - Configuration
  - Preprocessing
  - Multiple nest testing
  - Code transition review by EMC and GFDL
- Moving Nest
  - Draft code under development
  - FMS code under update and revision
  - Internal track under development
- HAFS real-time global-nest demo (Joint effort with EMC)
  - Domain configuration, timing and workflow
  - Physics evaluation
  - Reservation footprint test and application
  - Real-time research and forecast products
  - Dissemination website—Centralized operational and demo model product view
- Code porting
  - Prepare code transition and testing on Hera/Juno and Orion
  - Prepare HAFS configuration for scientific experiments

Multiple Static Nests

- Capabilities of Multiple Nests
  - Pre-processing
  - Initialization
  - Multiple nest setup
- Scalability and Reproducibility
  - Scalability
  - Reproducibility (ongoing)

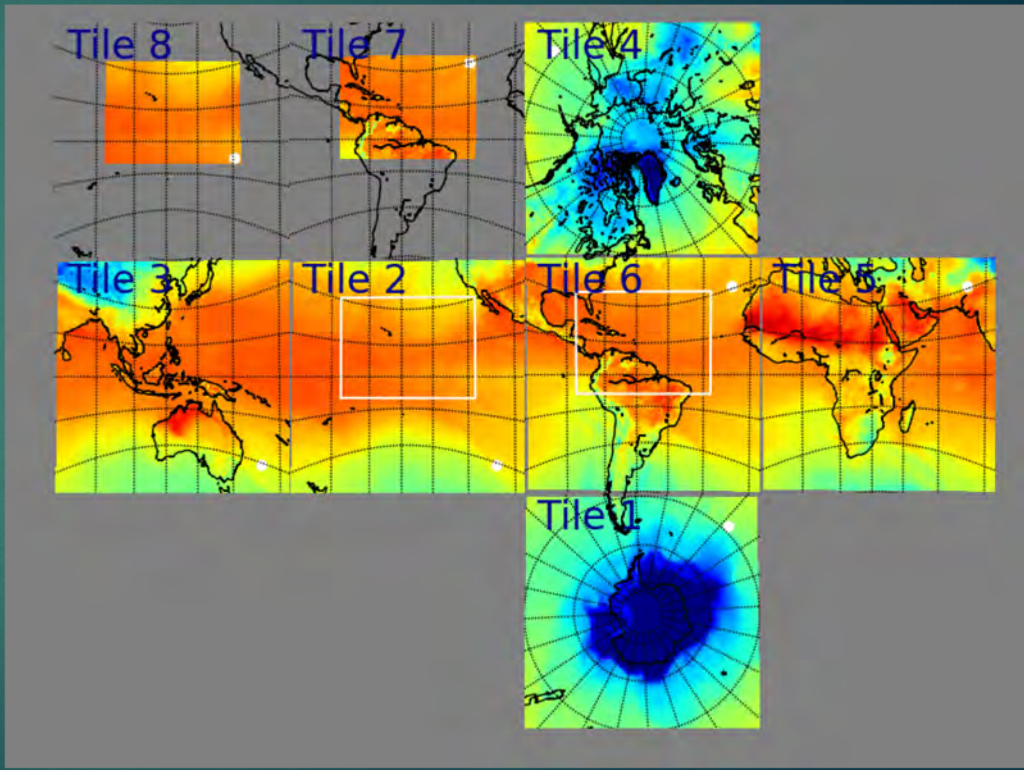


Goal: Extended from one to many nests

Scalability—Two-nest case

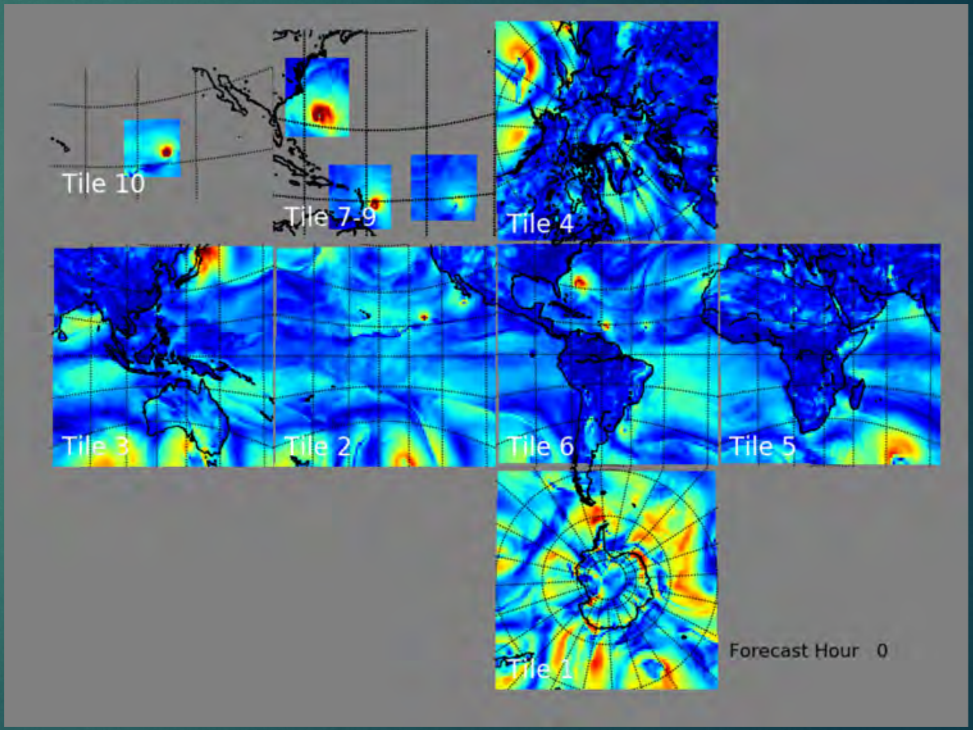
- Stable runs to 168 hours
- Similar forecasts
- Scalable performance
  - 96 hour forecast at C96
  - 24 cores global tiles
  - 12 cores each nest
  - 1 nest case/36 cores: 1:29
  - 2 nest case/48 cores: 1:32

Only 3-minute difference adding one additional nest in 90 minutes (3.3%)

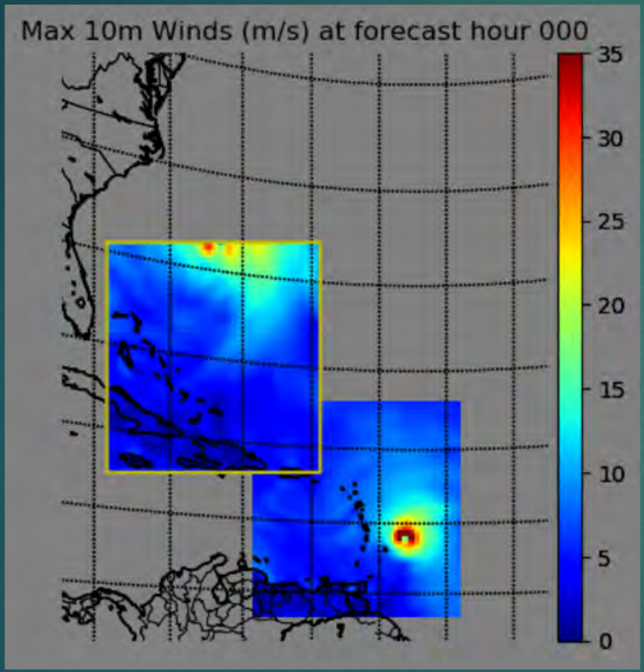


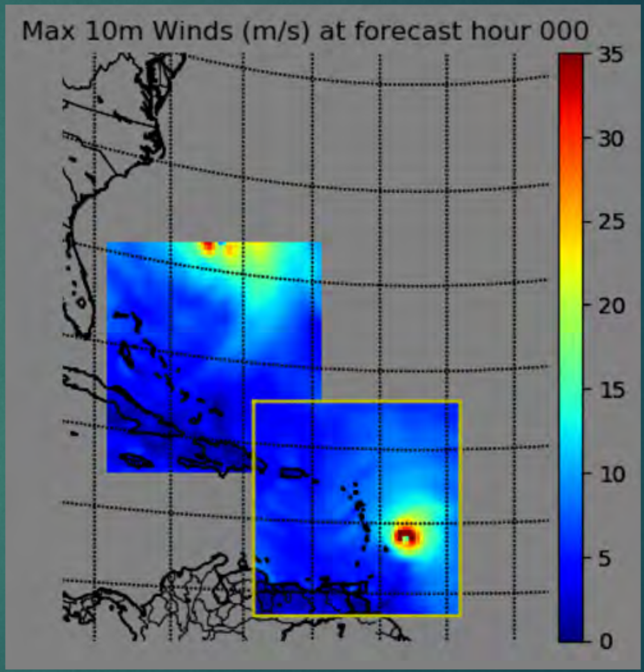
Four-storm case

- 24 hour loop for 20170918 00Z
  - Atlantic nests for Jose, Maria, and Lee
  - Eastern Pacific nest for Otis
- Additional code changes required to allow 2 digits for tile number: 6 global tiles + 4 nest tiles



Nest overlapping case



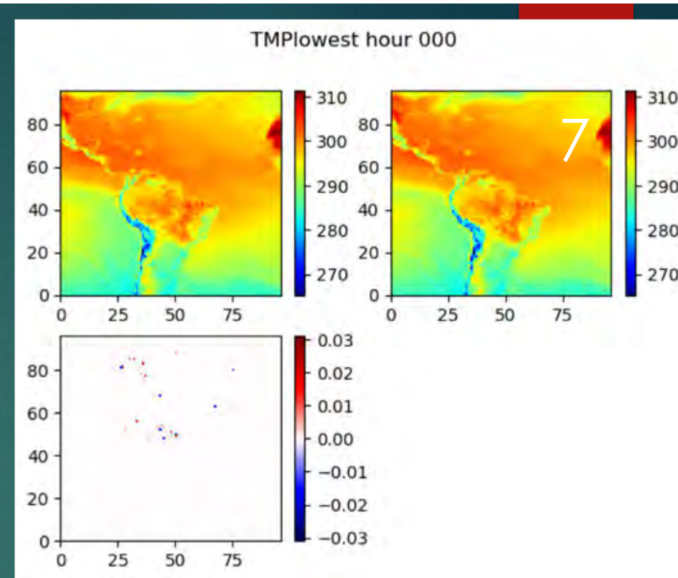


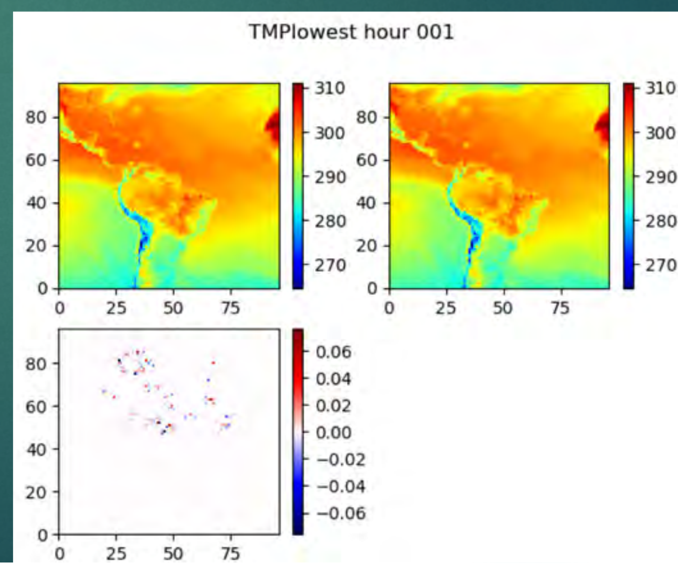
Jose and Maria

Coarse update first from nest03 (west), then from nest02 (east) overwrites (feedback scheme will be changed

Reproducibility

- Stable runs to 168 hours
- Similar forecasts – not yet identical
  - Terrain and initial conditions are identical
- Validation Goals Underway
  - Original single nest results identical
  - Multiple nests alter forecast in expected ways
- Terrain smoothing
  - Disable full_zs_filter
  - Different results for terrain height depending on number of cores
- Namelist options





Moving Nest Development Approach

- Basic moving nest
- Full-featured storm following nest on one cube face
- Edge crossing
- Corner crossing

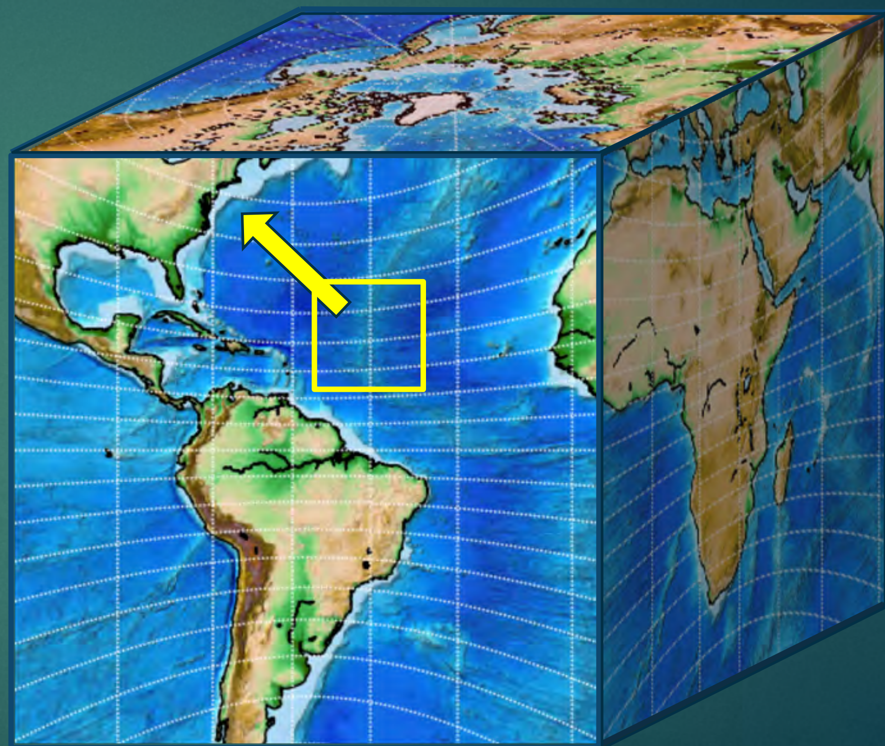
Single moving nest

Initial Focus

- Transferring data between PEs
- Downscaling atmospheric data at leading edge from global tile

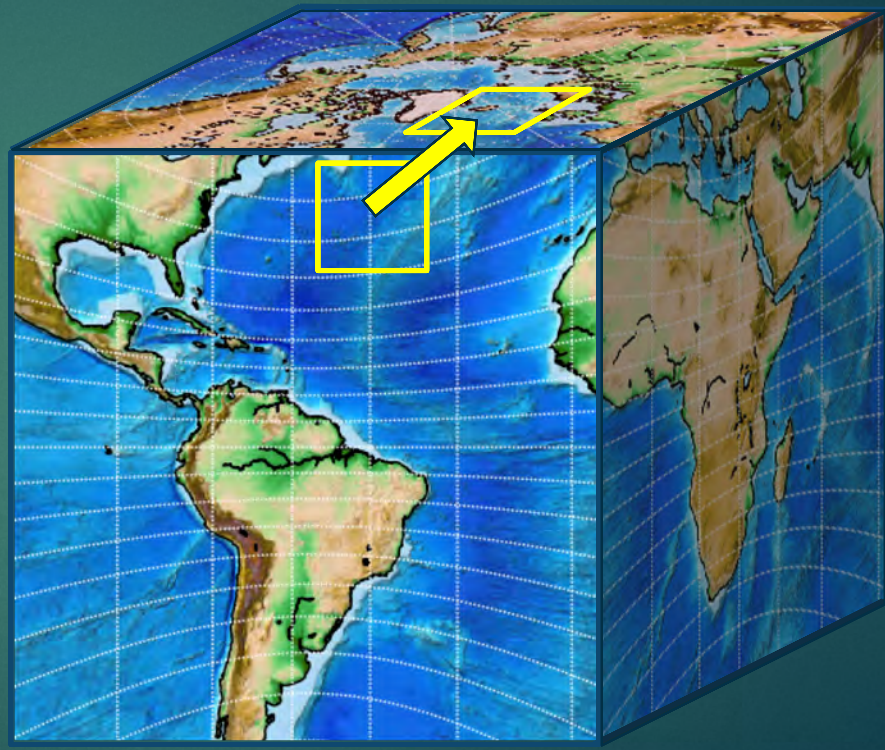
Simplifications

- Movement in single cube face
  - Upgrade to edge/corner crossing
- Prescribed nest motion
  - Upgrade to storm tracking
- Nearest neighbor land/sea, surface fields
  - Upgrade to high res surface
- Single x or y grid point per timestep move
  - Upgrade to multiple grid point moves



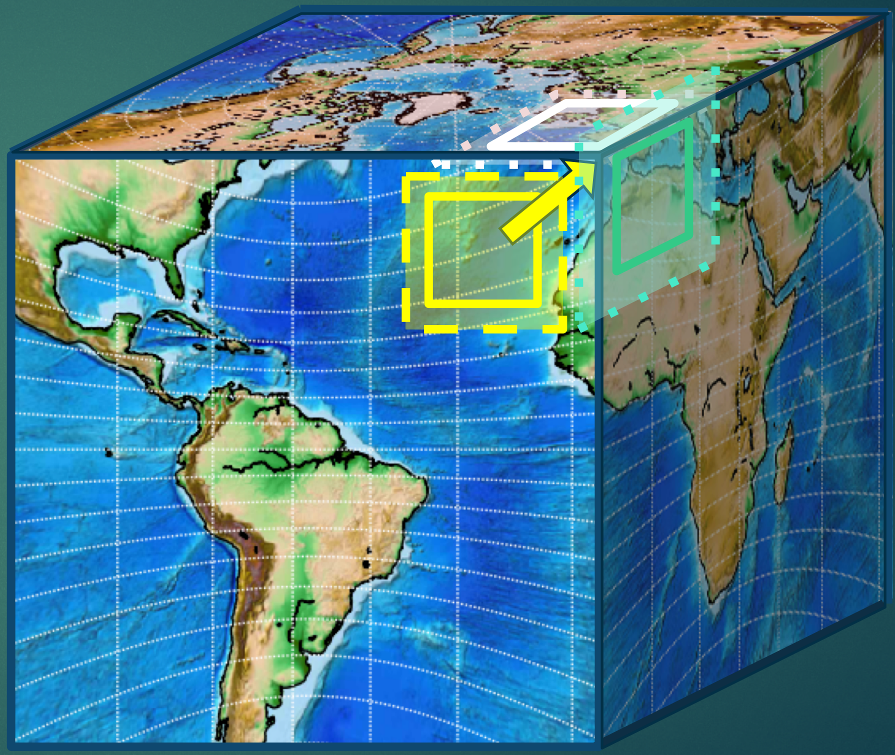
NEST CROSSING CUBE EDGE

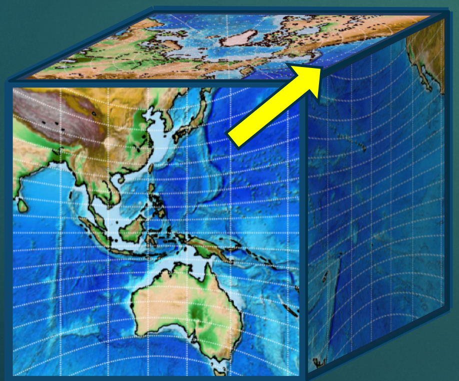
- Cube faces aligned to minimize TCs crossing edges
- Cannot entirely be avoided
- Reprojection necessary
- Handling of nest that straddles edge



NEST CROSSING CUBE CORNER

- Corners in North Atlantic, North Pacific
- Leslie-type tracks might cross corner
- Halo crossing edges/corner

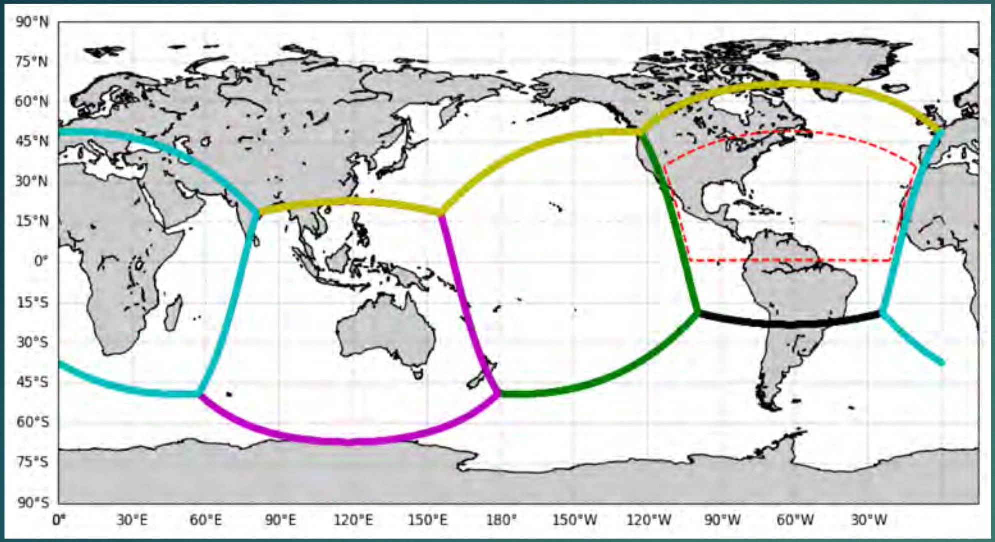


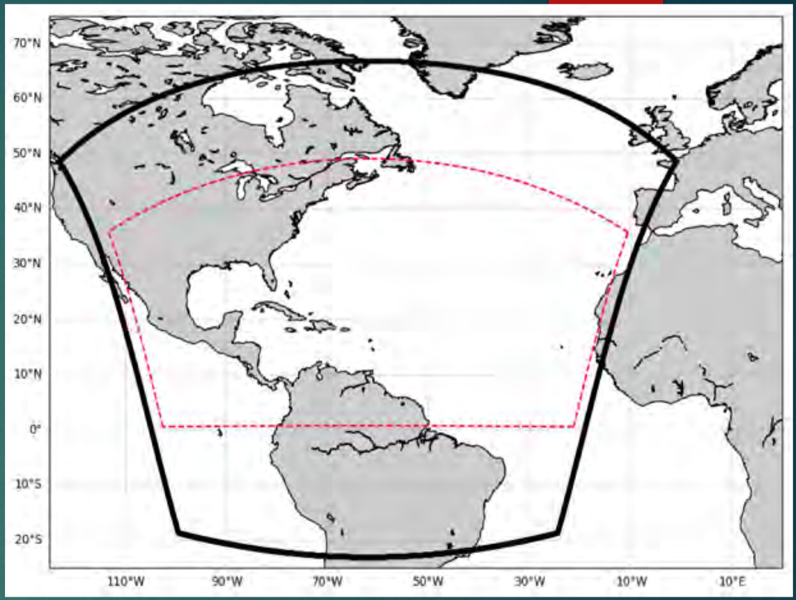


HAFSV0.B Real-time Demo Setup

- Global-nested FV3GFS
- 3-km static nest inside a 13-km global run (see next slide)
- Grid size similar to that described in Hazelton et al. (2018b) using GFDL FV3
- Will be compared with HAFSV0.A using the FV3 SAR
- Forecasts will be run 4x daily (00, 06, 12, 18 UTC)
- Forecasts will be run out to 168h

Grid Layout





- Global tiles laid out to center one on the Atlantic
- Domain stretches from the coast of Africa to west of Mexico

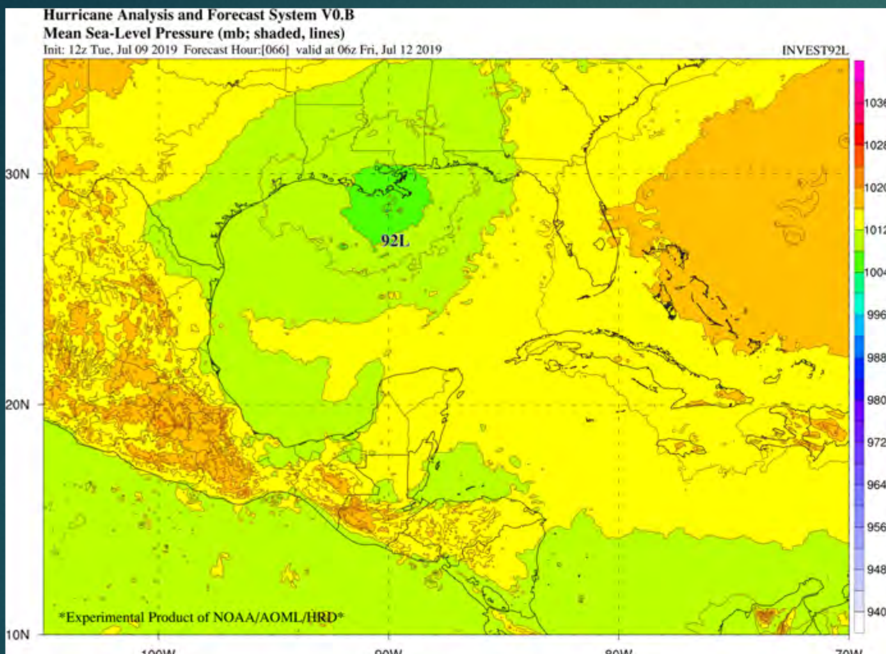
HAFS & GFS Configurations

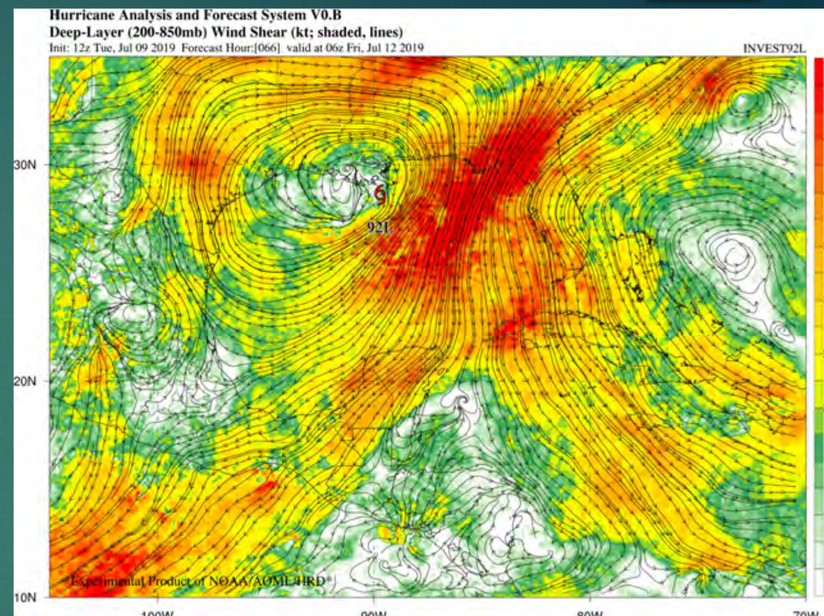
	Operational GFS	HAFSV0.B (Global-Nest)	HAFS V0.A (SAR)
Resolution	**~13 km**	**Global: ~13 km Nest: ~3km**	**~3km**
Convective Scheme	**Scale-AWARE SAS**	**Scale-Aware SAS (Off for Nest)**	**Off**
PBL	EDMF	K-modified EDMF	K-modified EDMF
Surface	GFS	Modified GFS	Modified GFS
Microphysics	GFDL	GFDL	GFDL
hord (advection)	**5**	**5 global, 6 nest**	**6**
Forecast Length (hr)	**384**	**168**	**126**

HAFS0.B Reservation Footprints

Task	Start Time	End Time	Duration
Chgres	0430	0445	15 min
Forecast	0450	0950	5 hr
Post	0450	0950	5 hr (with forecast)
Product	0450	0950	5 hr (with forecast)

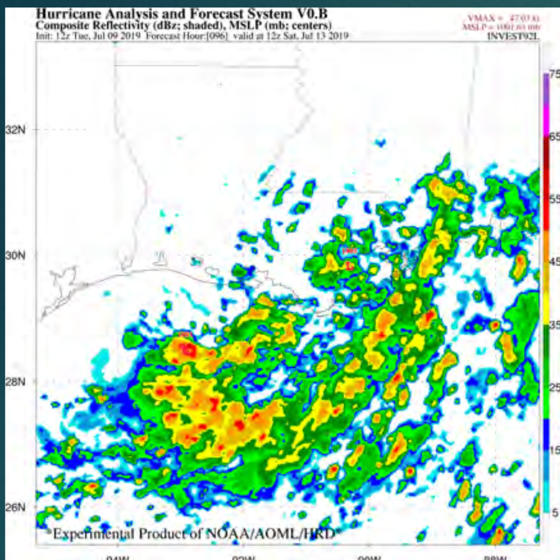
HAFSV0.B Products (Large-Scale)

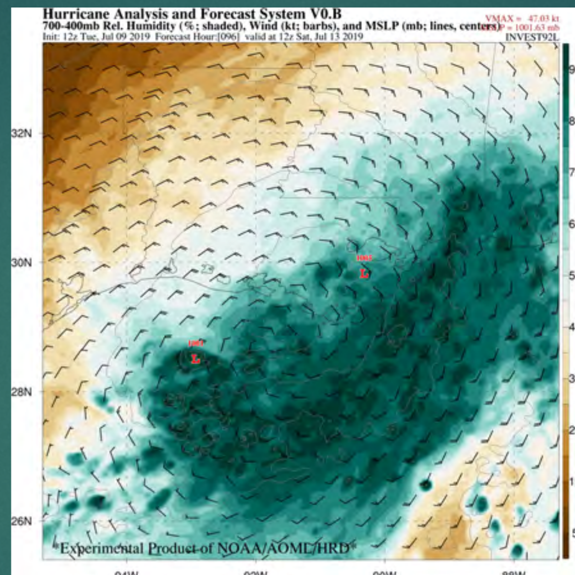


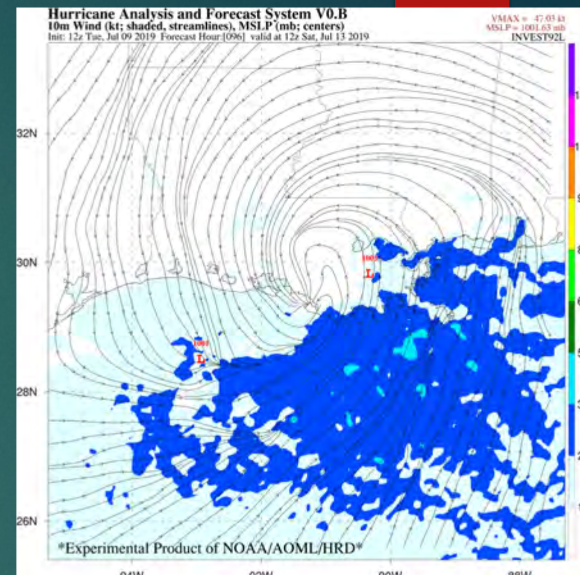


- Large-scale graphics allow for assessment of general synoptic setup
- Example shows the shear interacting with 92L

HAFSV0.B Products (Storm-Scale)

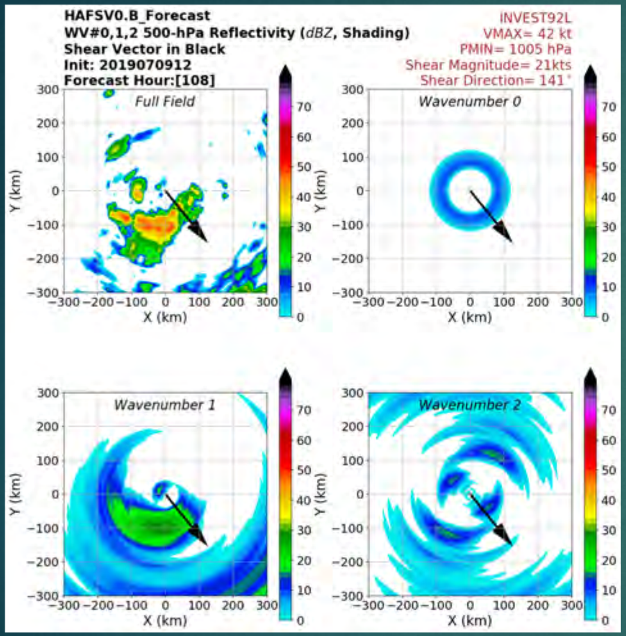


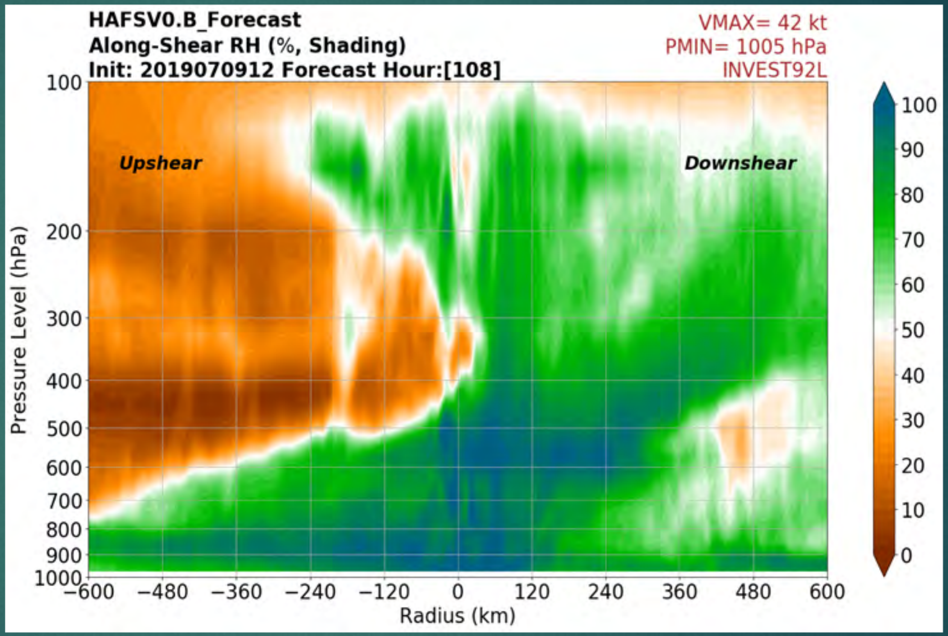




- Storm-scale graphics allow for detailed examination of storm structure
- Moisture, precipitation, and wind fields all included

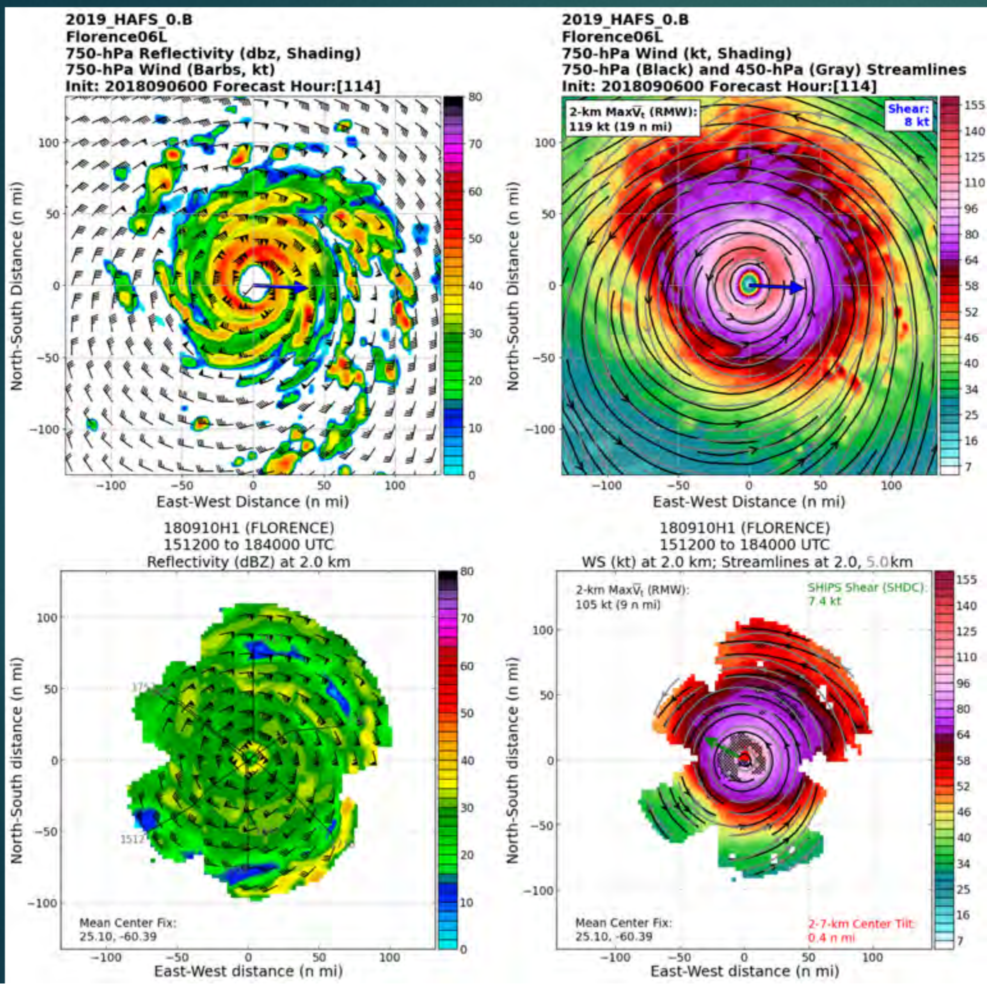
HAFSV0.B Products (Cylindrical Analysis)





- Analysis created to analyze shear-relative structure
- Examples include wavenumber analyses of precipitation structure and along-shear cross-section of humidity

Model-Radar Comparisons

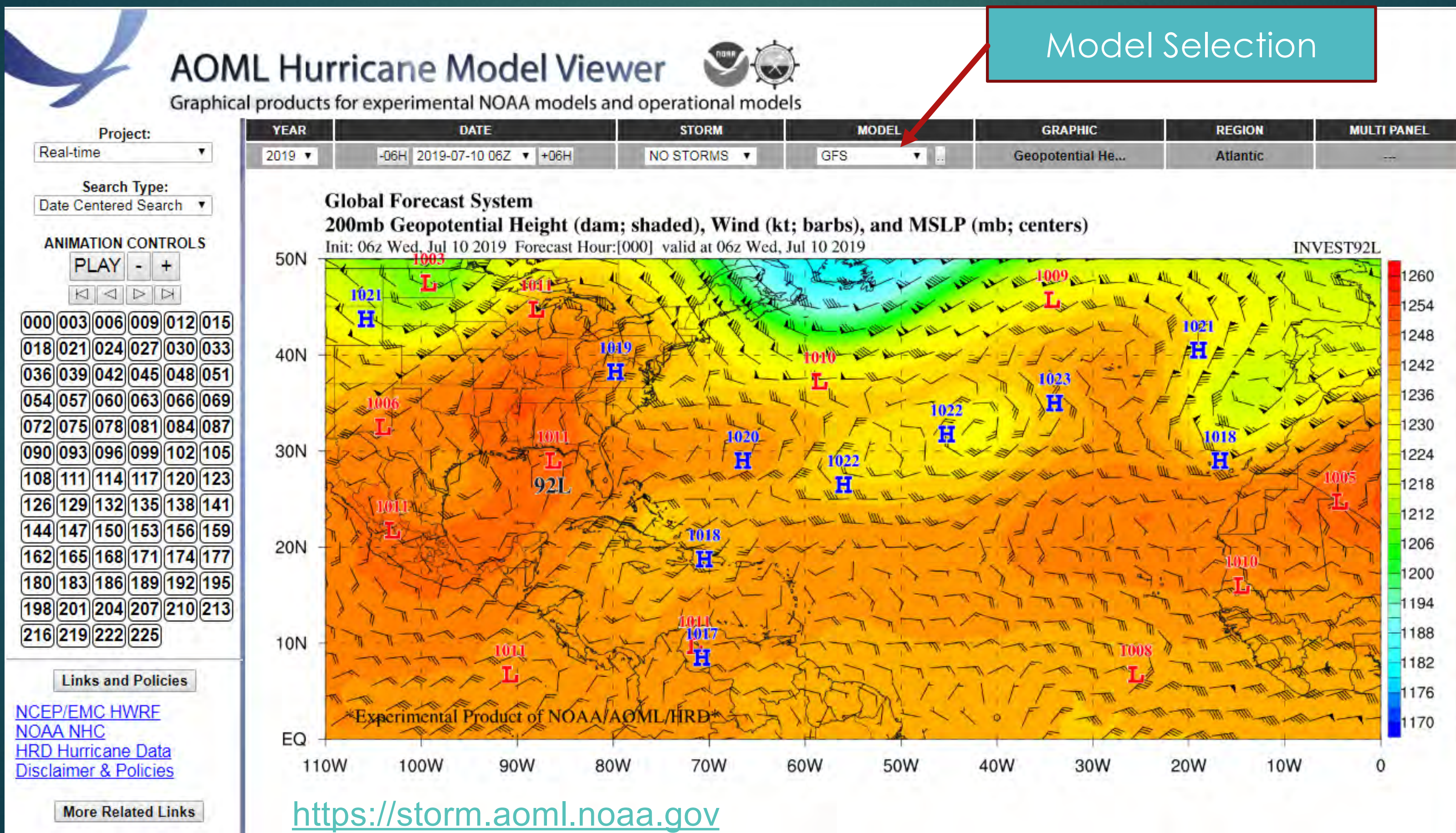


Florence (2018)

- Radar images come from "merged analysis" from each flight
- Reflectivity and wind fields examined
- In this case, storm was too strong although the eye was slightly too big
- Precipitation symmetry was consistent with observations

Products Dissemination Website

Model Selection



https://storm.aoml.noaa.gov