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Testing and Evaluation of the GSI-Hybrid Data Assimilation for Hurricane Forecasts – A Case Study

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Acknowledgements:
Jeff Whitaker and Henry Winterbottom at NOAA/GSD for providing global ensemble data

DTC Developmental Testbed Center

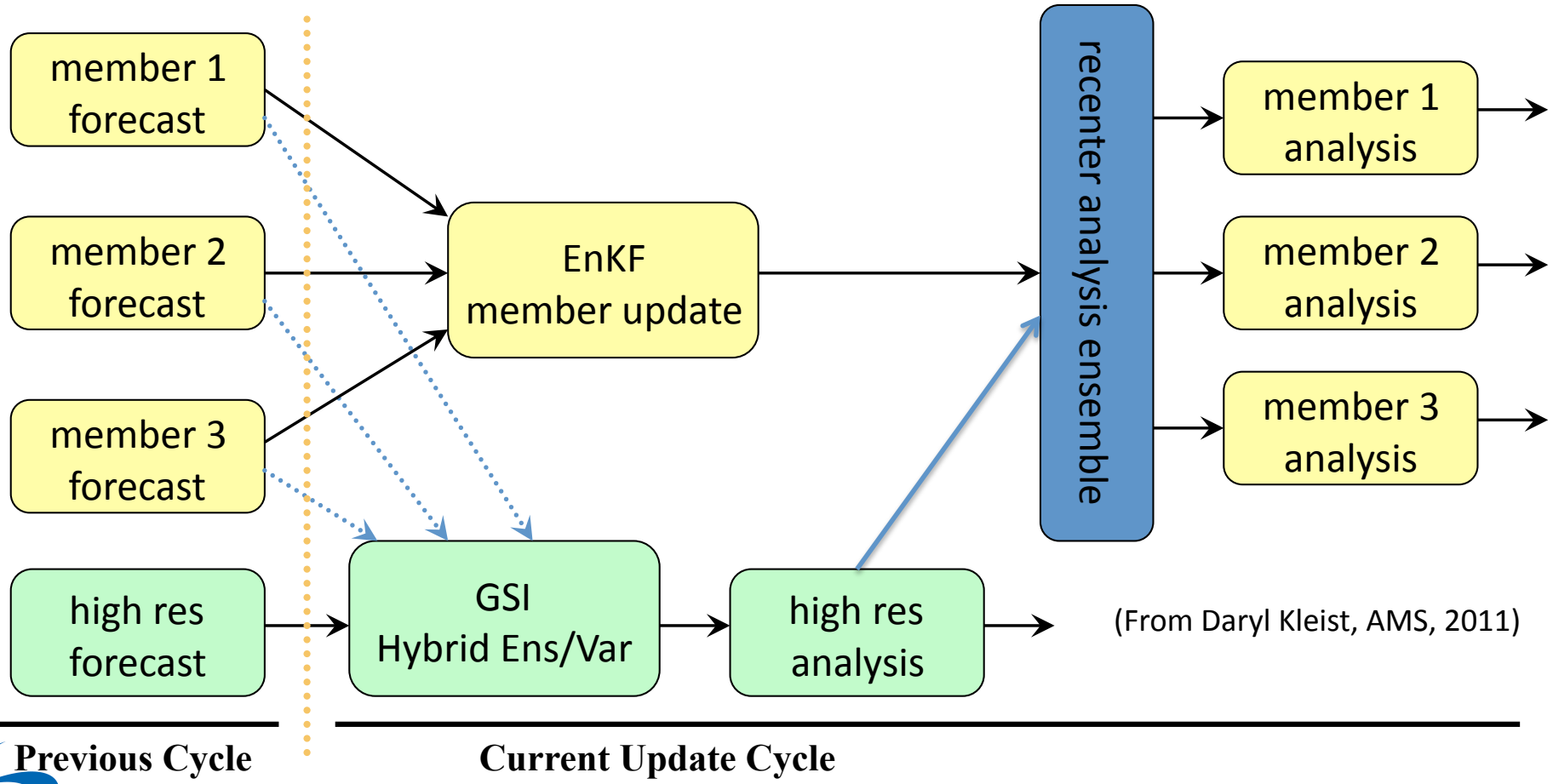
Goals and Efforts of Data Assimilation at DTC

- Provide current operational capabilities in data assimilation to the research community (O2R)
- Provide a framework for distributed development of new capabilities & advances in data assimilation
- Provide a pathway for data assimilation research to operations process (R2O)
- Provide rational basis to operational centers and research community for enhancement of data assimilation systems

GSI | GSI-Hybrid | EnKF | BUFR/PrepBUFR

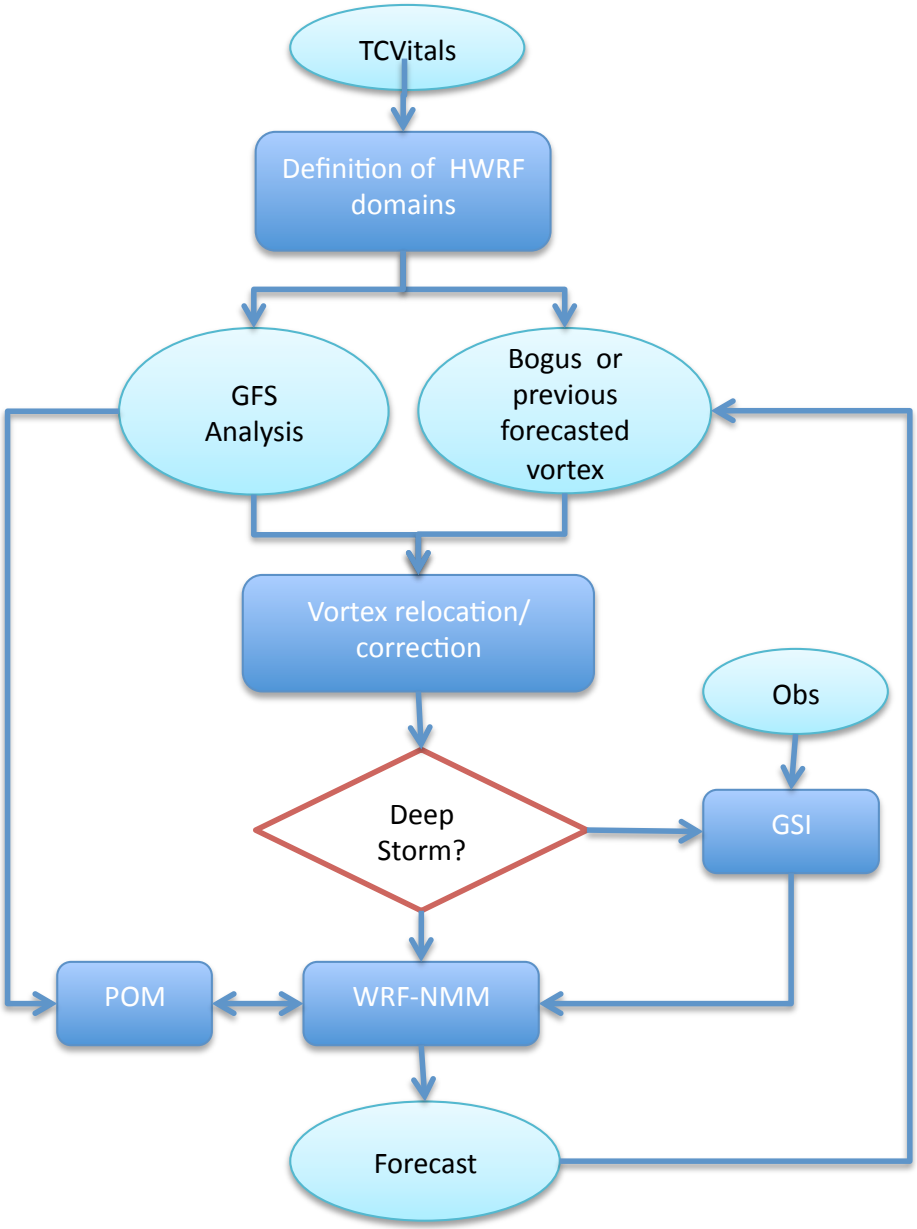
HFIP EnKF-GSI Hybrid DA Testing and Evaluation

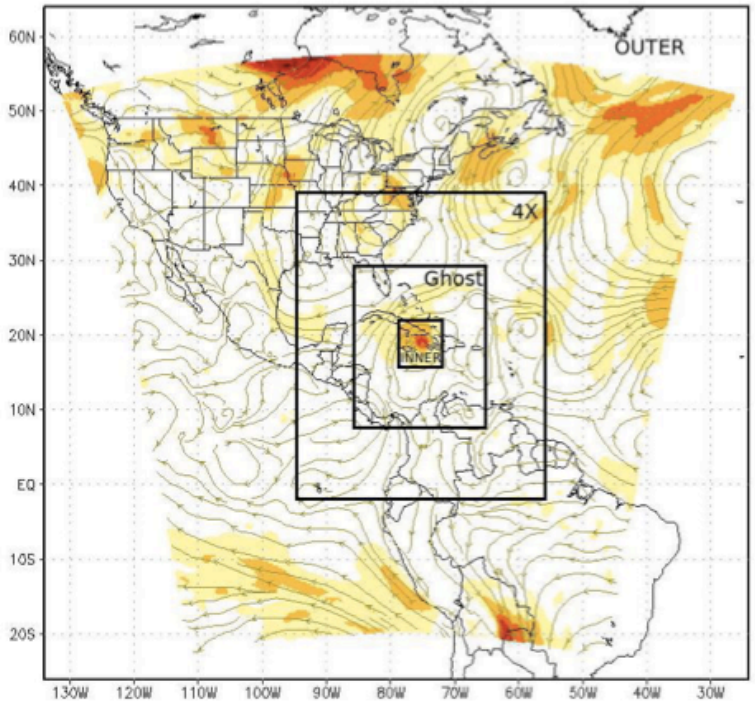
- Regional code (including interface and scripts) is under development primarily by NCEP/EMC and NOAA/PSD based on the global GSI based hybrid system at NCEP.
- Testing and evaluation are collaborated among NCEP/EMC, NOAA/PSD, AOML, DTC and other HFIP community.



(From Daryl Kleist, AMS, 2011)

2011 HWRF Operational Configuration

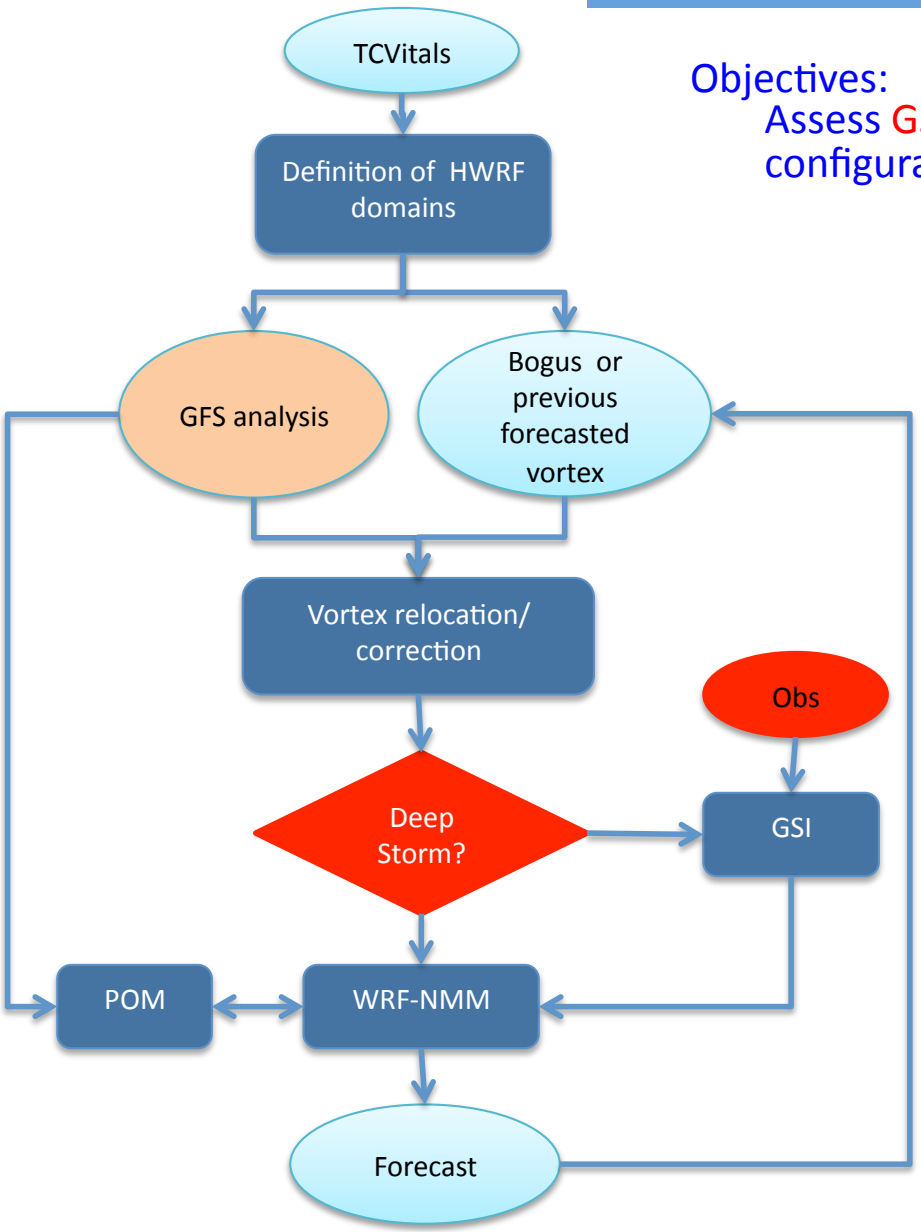




- Model forecast domains: outer and inner
- HWRF vortex initialization domain: 4x
- GSI analysis domain: outer (0.18deg) and ghost (0.06deg)

- ✓ TCVital: Tropical Cyclone Vital Statistics Records
- ✓ Deep storm: estimated top of circulation is 200 mb

Experimental Design

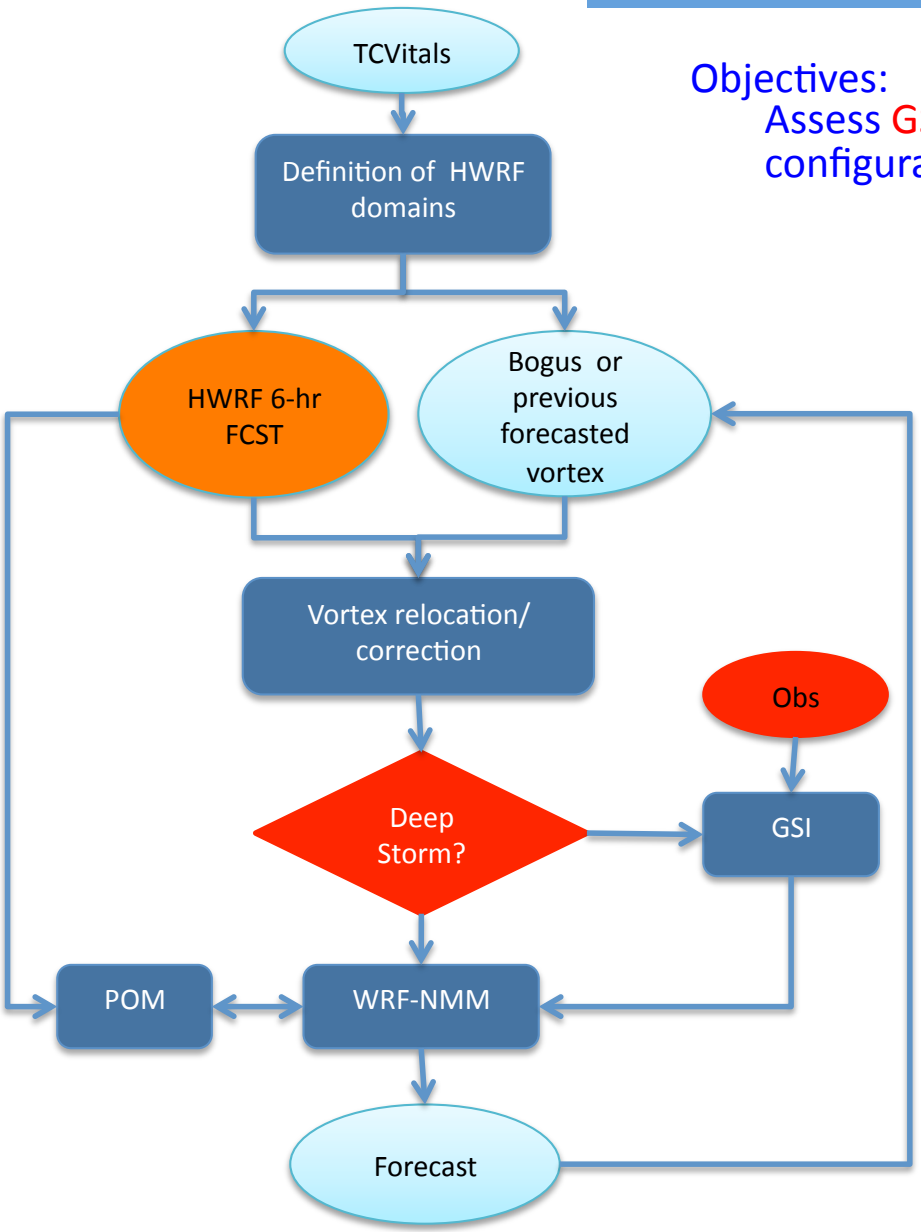


Objectives:

Assess GSI-Hybrid impact with operational framework/ configuration.

- HWRF: v3.3a
- GSI: April 2012 trunk version, Global BE + ensembles
- Testing period:2011071800-2011072000
- Background: GFS
- Experiments:
  - NoDA: No GSI
  - GSI: GSI-3DVAR, PrepBUFR + radiance
  - HYBRID: GSI-Hybrid, PrepBUFR + radiance

Experimental Design



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Case Study: Bret 2011

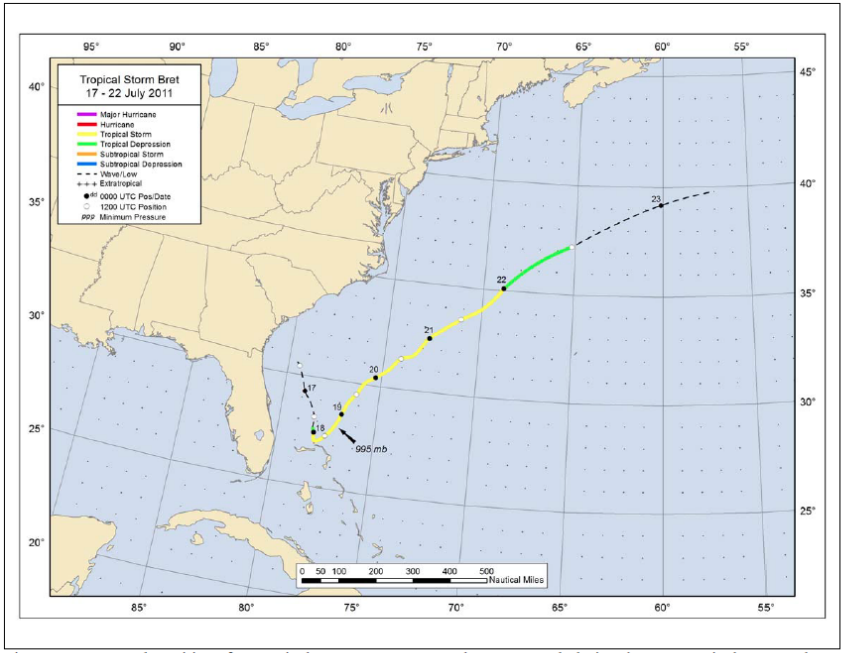
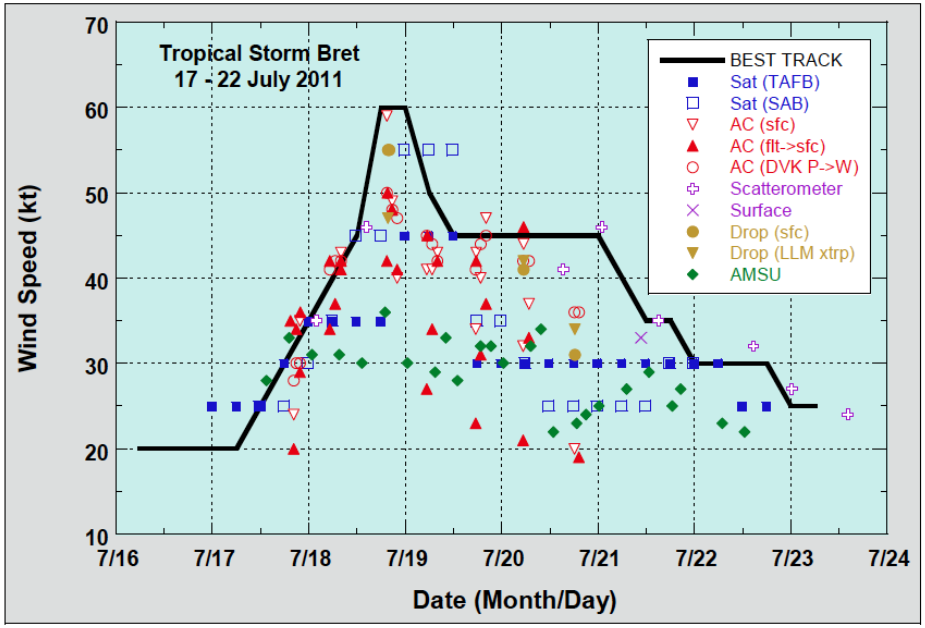
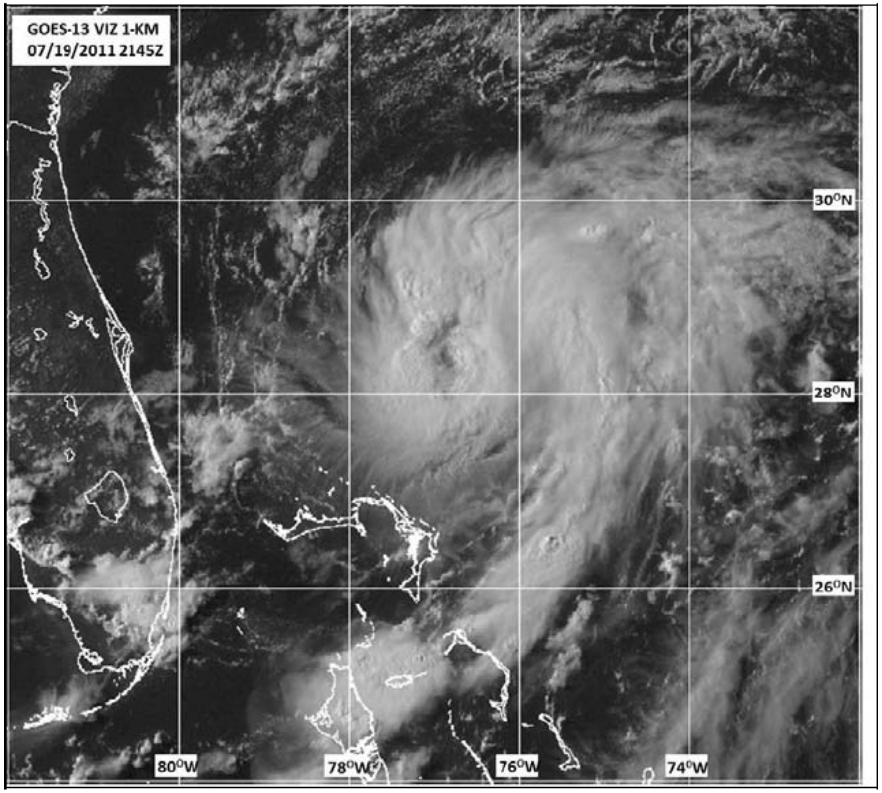


Figure 1. Best track positions for Tropical Storm Bret, 17-22 July 2011. Track during the post-tropical remnant low stage is based partly on analyses from the NOAA Ocean Prediction Center.





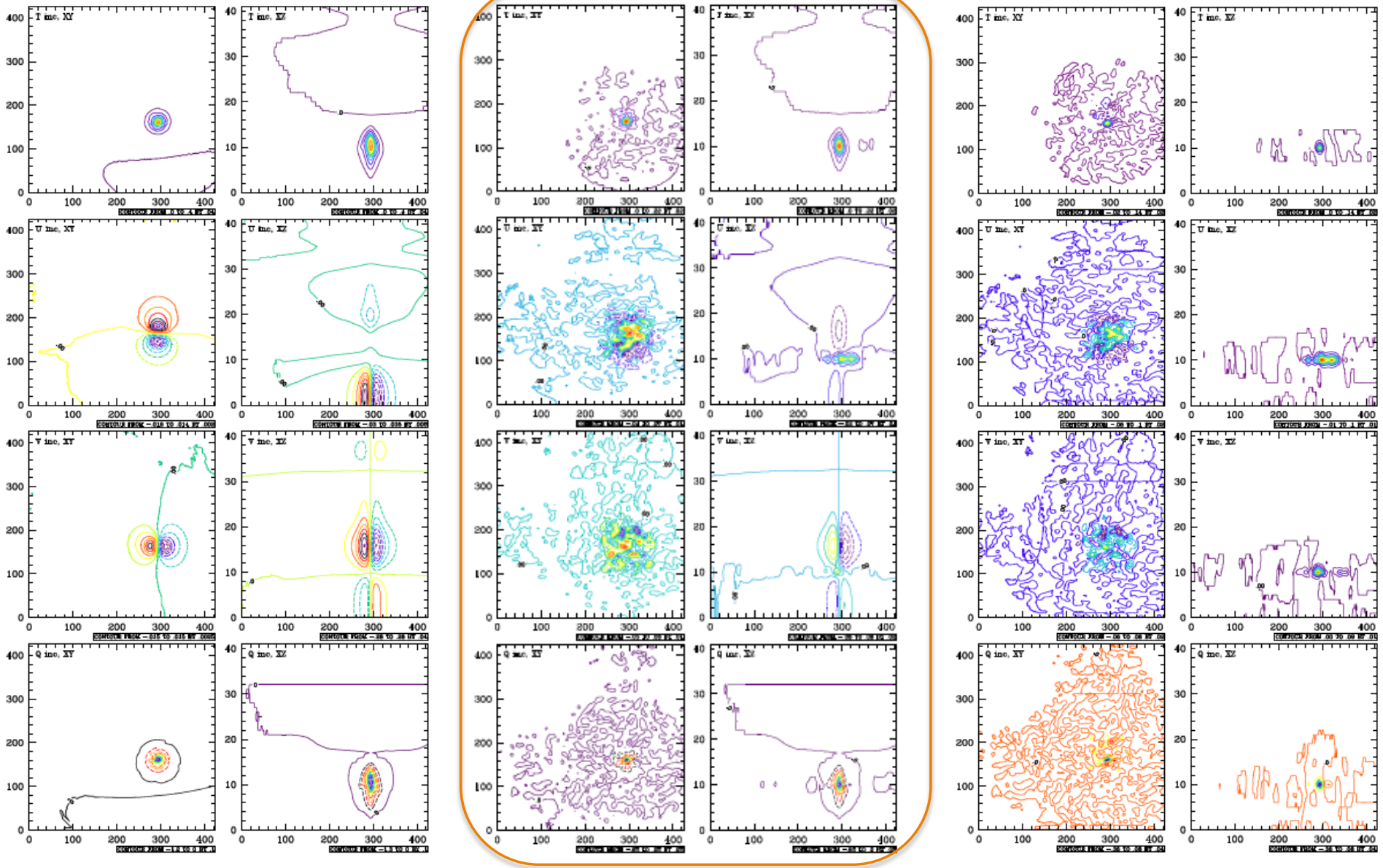
Courtesy of NHC

PSOT – T= 1K at 850hPa

Pure 3DVAR

Hybrid 3DVAR

Pure Ensemble



Beta=1.0

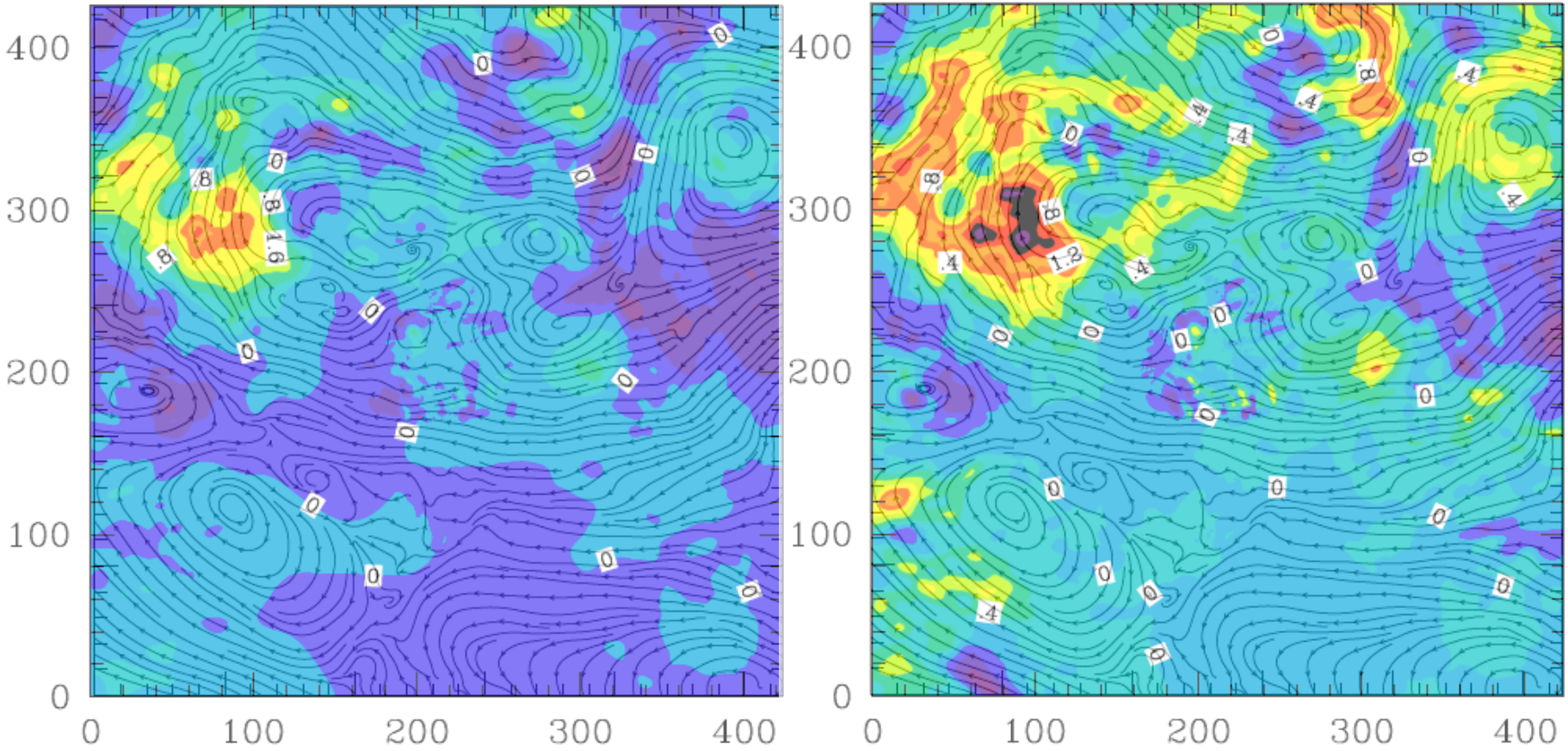
Beta=0.25

Beta=0.0

Analysis increment of T (color) and Streamline - 2011071800

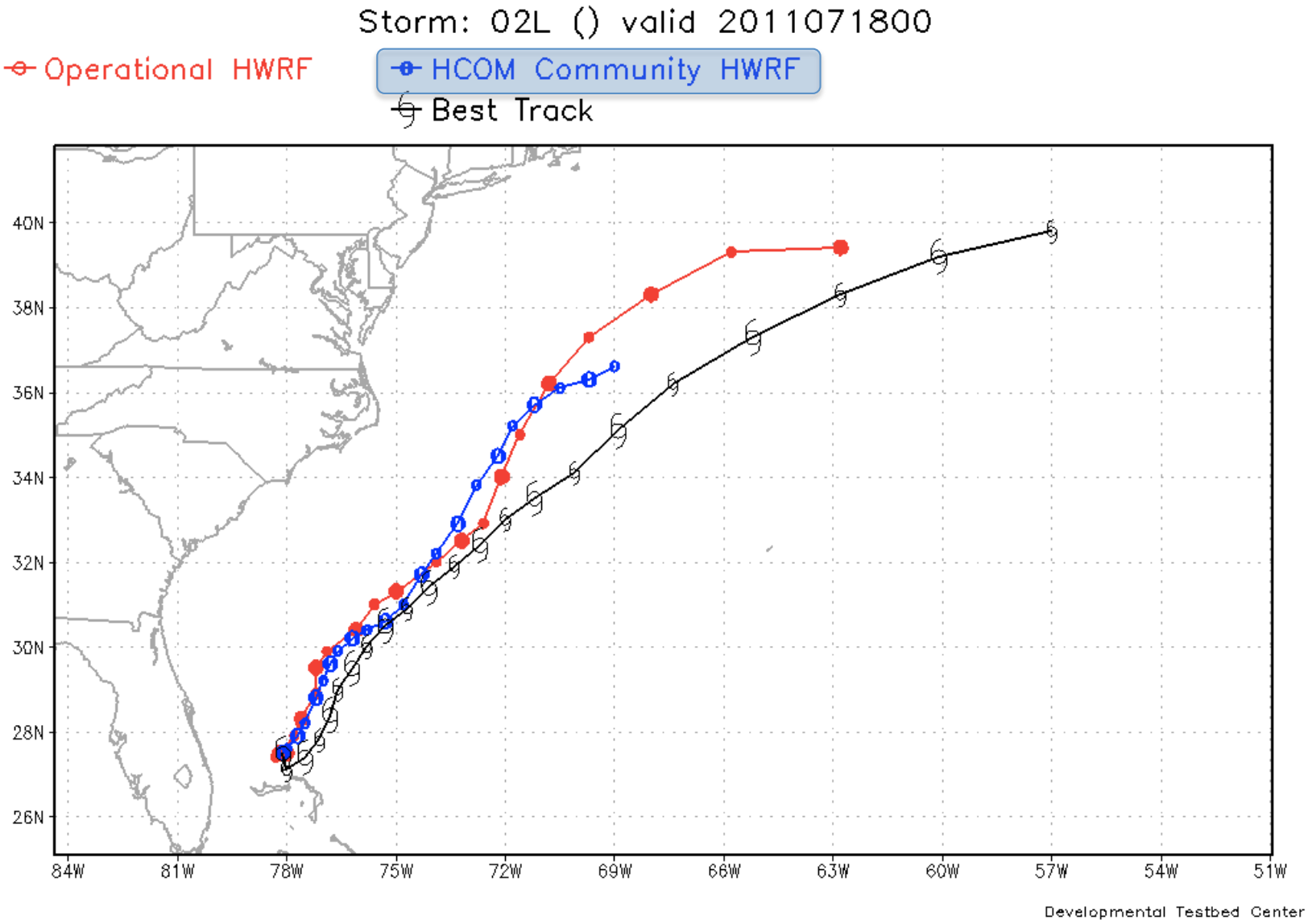
GSI 3DVAR

GSI Hybrid

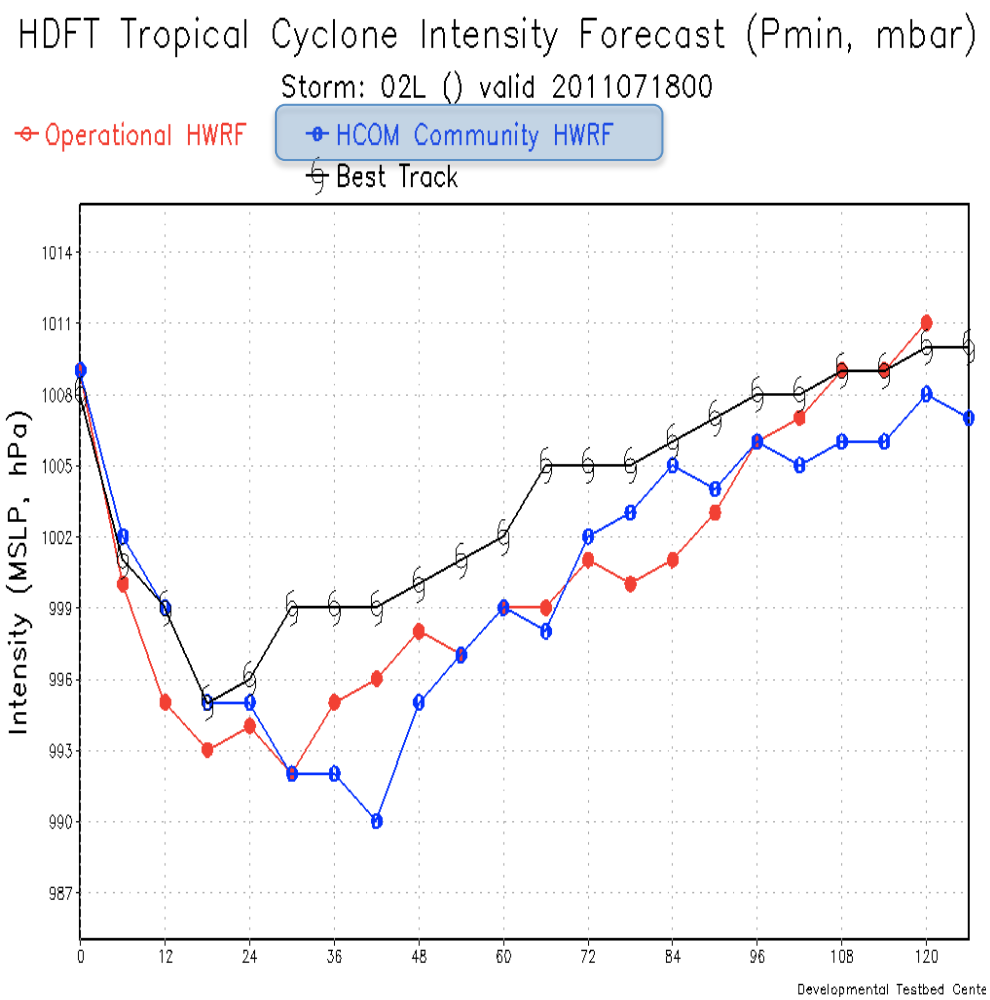


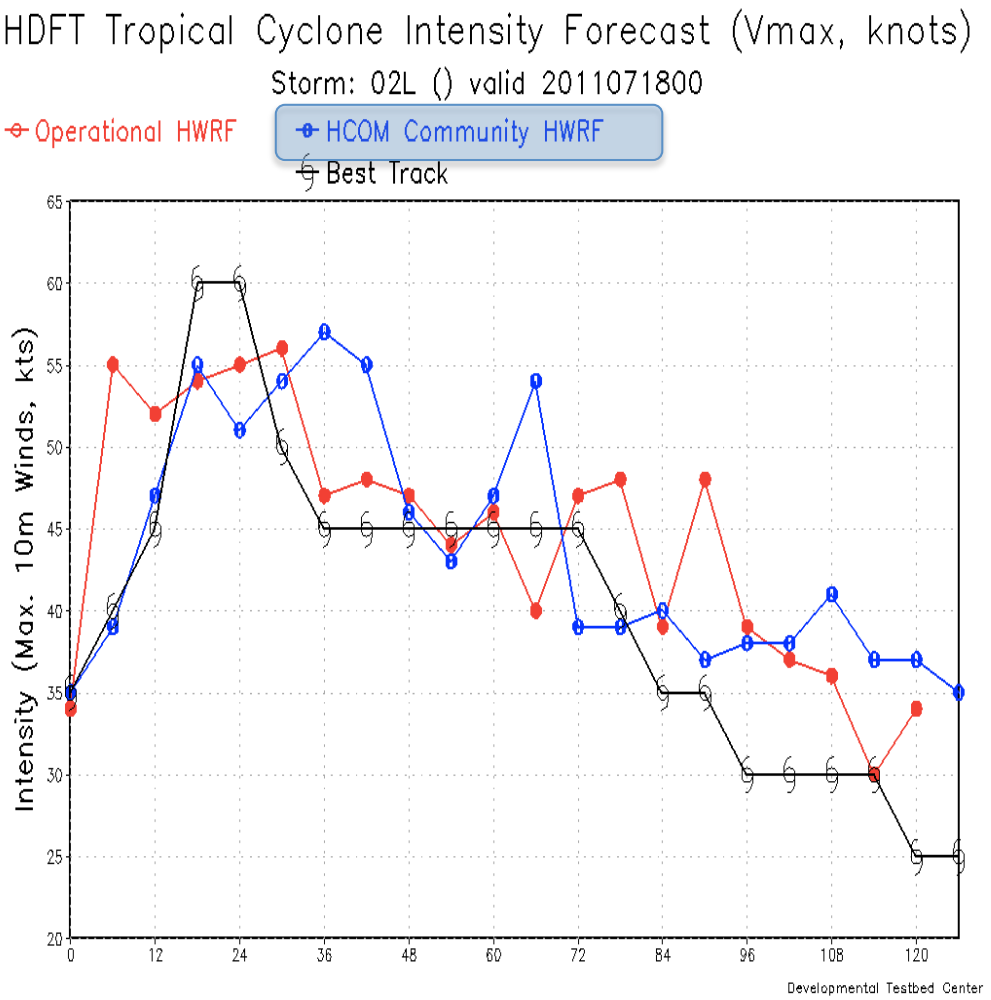
Track and Intensity Forecast for Bret 20110718 00 - 20110720 00

Bret Track Forecast: No GSI

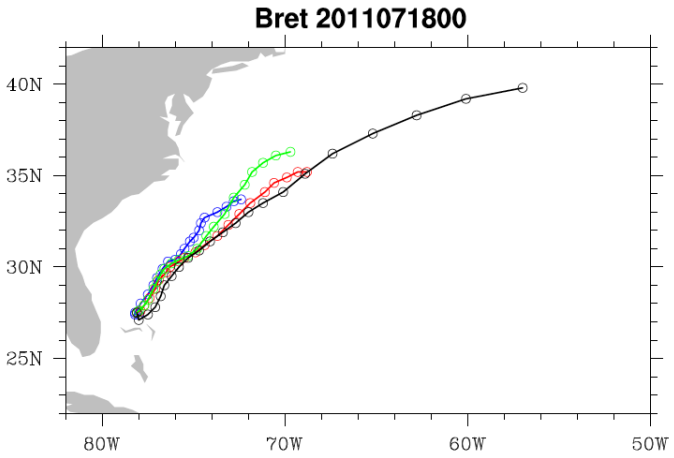


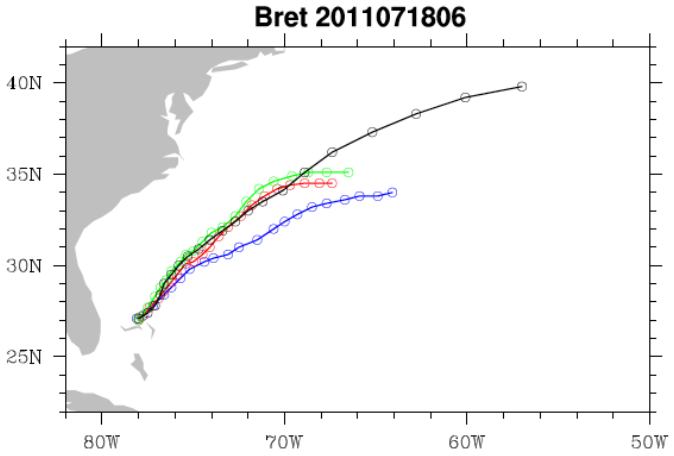
Bret Intensity Forecast: No GSI

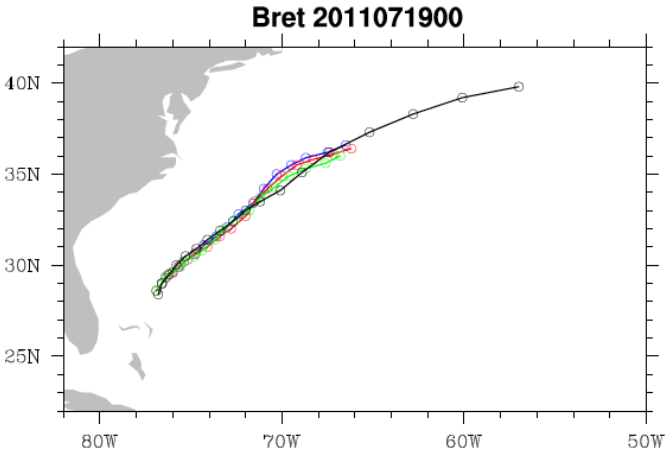


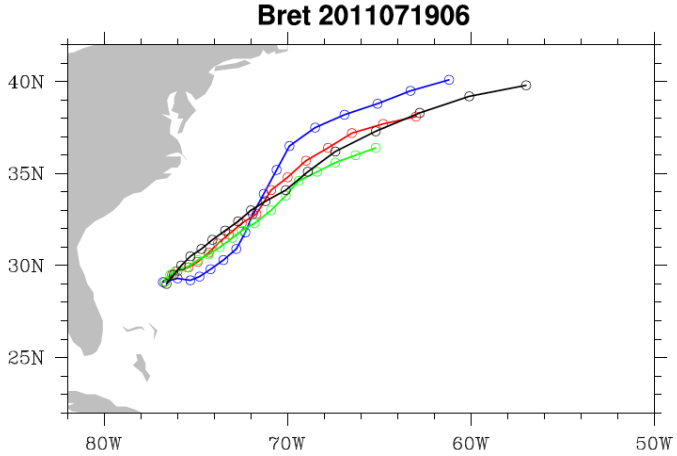


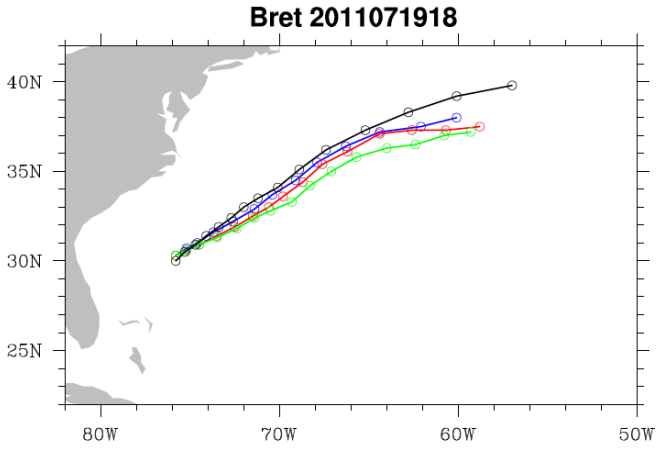
Track Forecasts of Bret

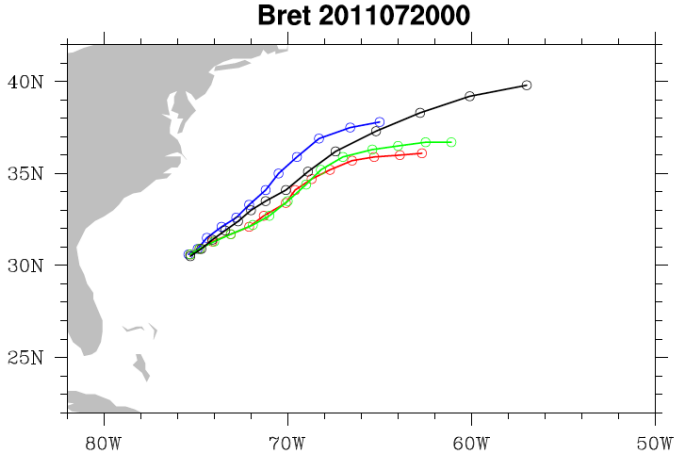












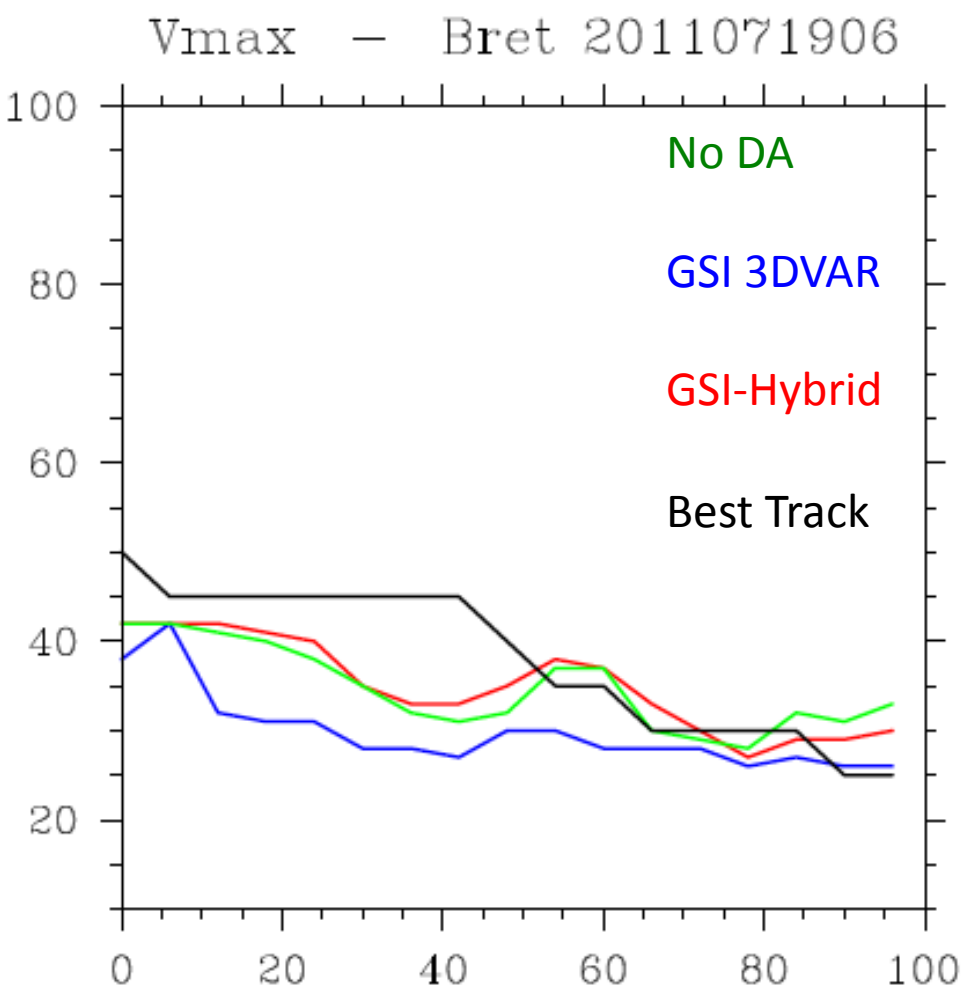
No DA

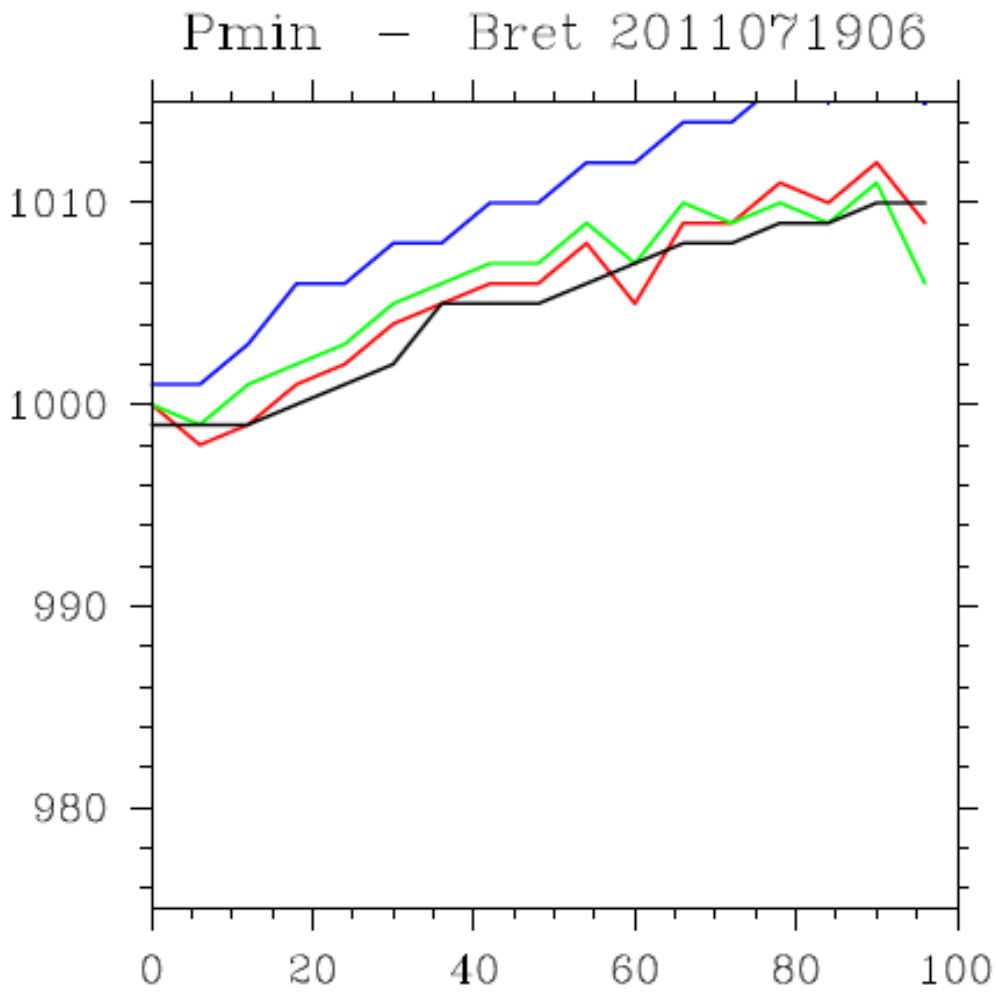
GSI 3DVAR

GSI-Hybrid

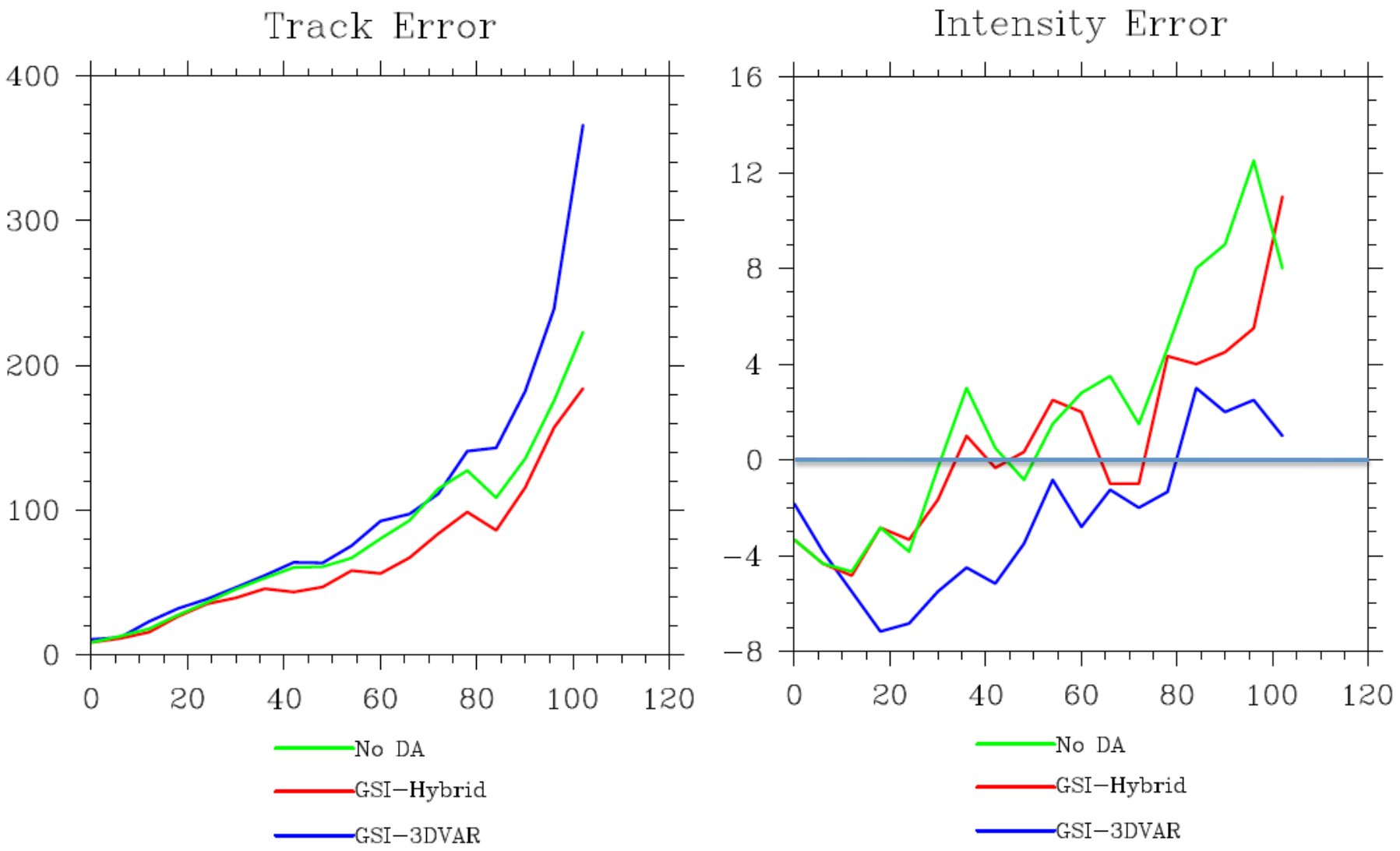
Best Track

Intensity Forecasts of Bret





Mean Track and Intensity Errors for Bret 2011071800-2011072000



Summary and Future Work

- GSI-Hybrid greatly improves the track forecast for Bret 2011;
- Some positive impact on the intensity forecast;
- Extend the tests to more storms;
- Test 2-way GSI-Hybrid capabilities;
- A unified GSI-Hybrid framework to serve the community in the future.

Questions ?