HFIP Coupling Working Group

Progress report with contributions of

Tolman (NCEP), Chen (NRL), Ginis (URI)

Hendrik L. Tolman
Chief, Marine Modeling and Analysis Branch
NOAA / NWS / NCEP / EMC

Hendrik.Tolman@NOAA.gov

Contributors

- NOAA/NCEP
  - HWRF-HYCOM coupled system.
  - Upgrades of RTOFS-Atlantic (HYCOM) system in which HWRF-HYCOM is nested.
  - HWRF-HYCOM-WW coupled system technical development.
- NRL Monterey
  - Development of coupled COAMPS-NCOM-WW system.
- URI (and partners)
  - Science development of HWRF-HYCOM-WW coupled system.

WW = WAVEWATCH III wave model

Status

- HWRF-HYCOM coupled system.
  - Parallel real-time testing at NCEP (slides follow)
- Upgrades of RTOFS-Atlantic (HYCOM) system in which HWRF-HYCOM is nested.
  - Massive operational upgrades 11/02/09 to get operational RTOFS-Atlantic upgraded to system used for parallel HWRF-HYCOM.
- HWRF-HYCOM-WW coupled system.
  - First technical development finished at NCEP and handed over to URI (continuous NCEP support).
- Development of coupled COAMPS-NCOM-WW system.
  - Slides follow.

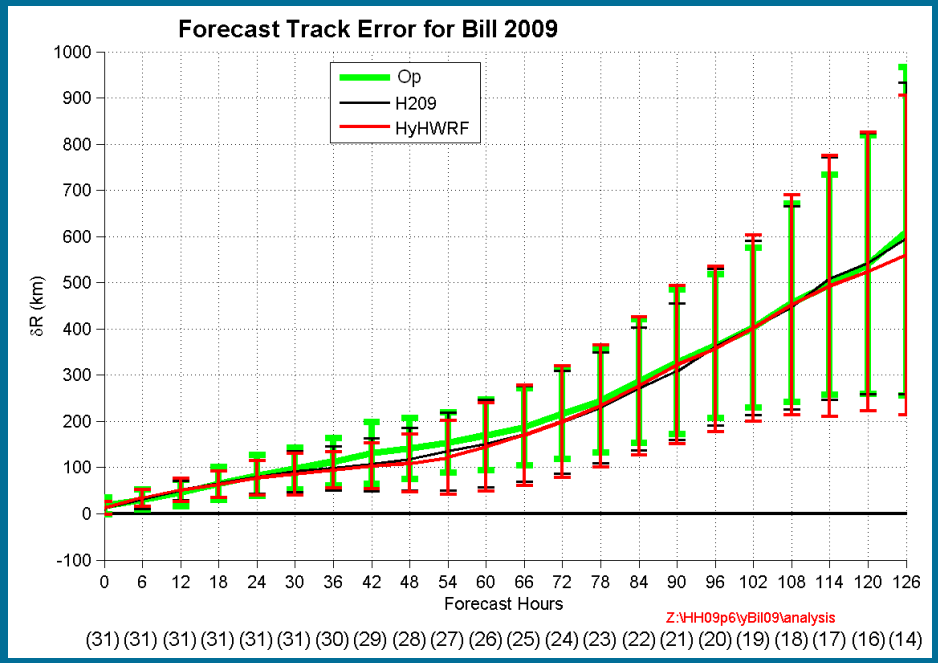
WW = WAVEWATCH III wave model

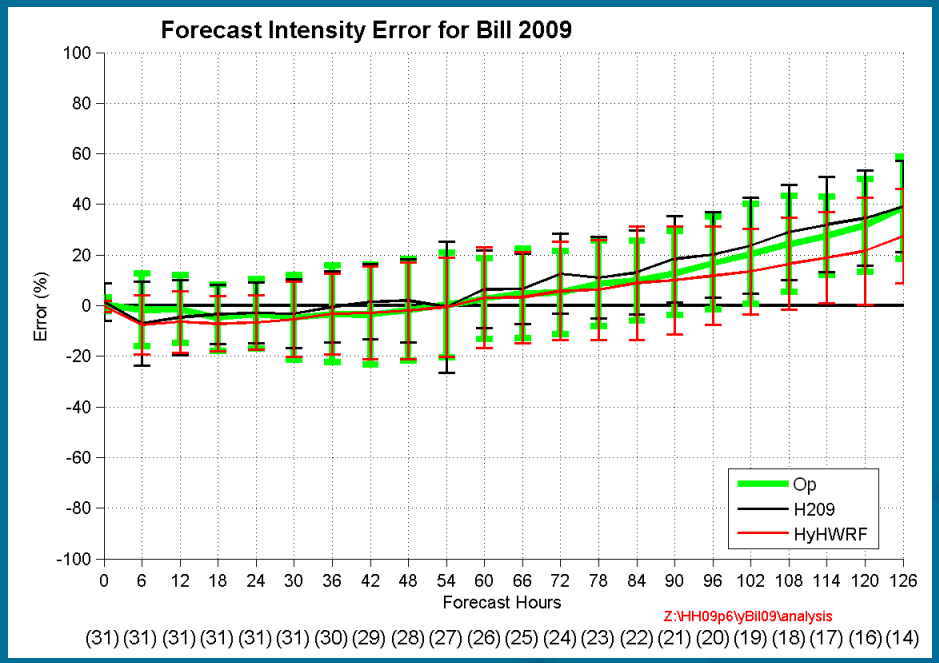
Summary of Real-Time Hurricane Simulations for 2009 Season in Atlantic

- Models: Coupled HWRF-HYCOM (HyHWRF), where HWRF is the 2009 version (will do with 2008 = ops version).
- Approach: Real-time in parallel to Operational HWRF
- Cases:
  - 1. Hurricane Bill (Category 4)
  - 2. Tropical Storm Danny
  - 3. Tropical Storm Erika
  - 4. Hurricane Fred (Category 3)
  - 5. Tropical Storm Grace
  - 6. Tropical Storm Henri

Typical example Hurricane Bill

Small but systematic improvements for HyHWRF



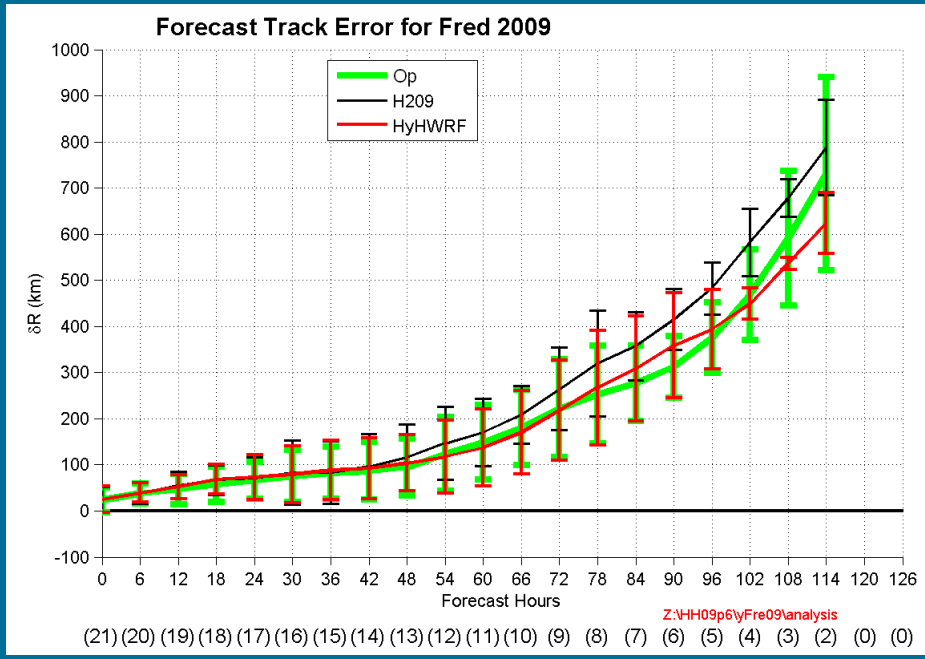


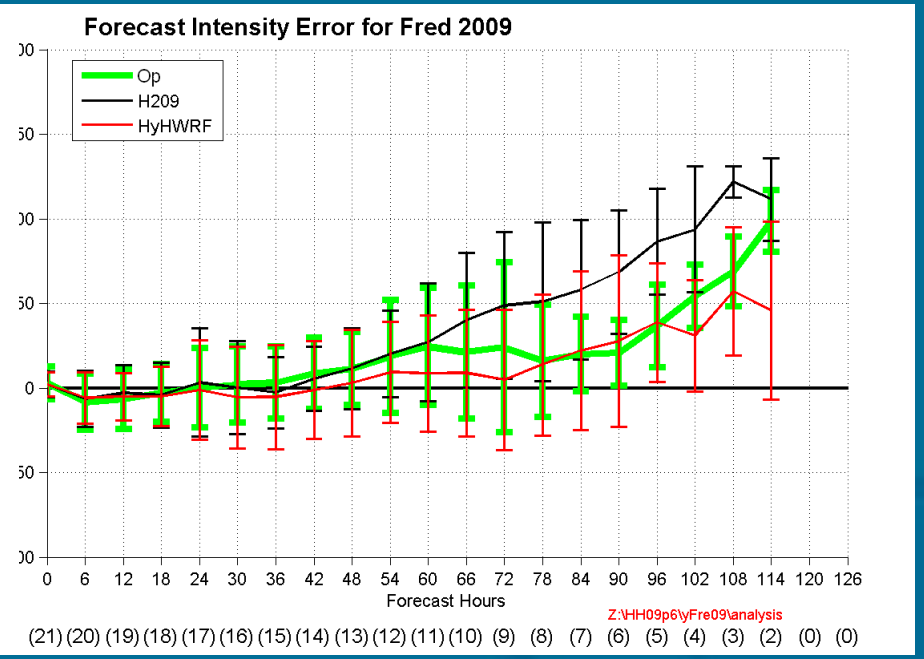
Green: NCO operational HWRF (coupled to POM)

Black: parallel HWRF (version 2009) coupled to POM

Red: parallel HWRF (version 2009) coupled to HYCOM

Atypical example Hurricane Fred
H209 poor, HyHWRF (with H209!) good.





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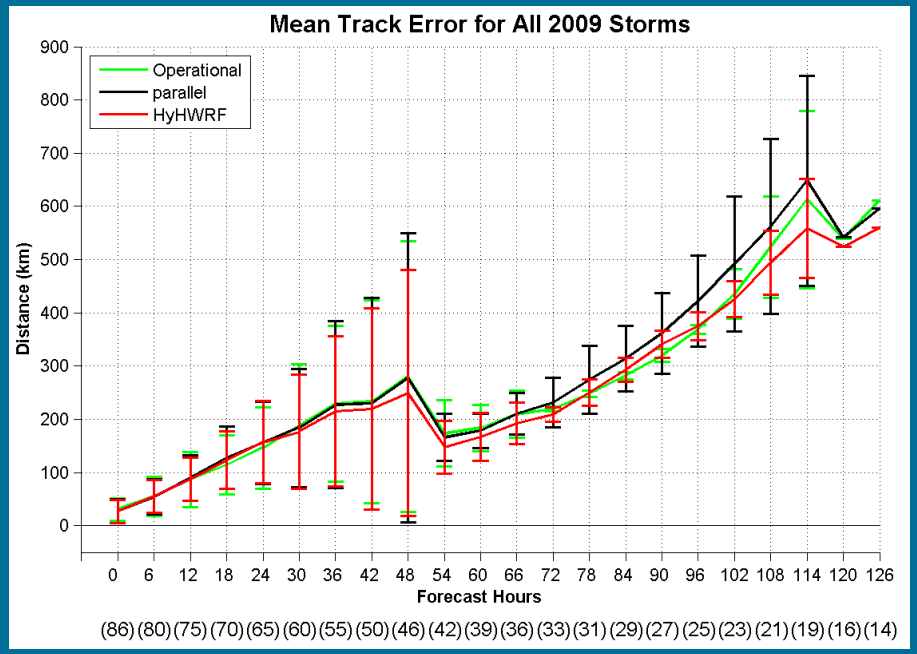
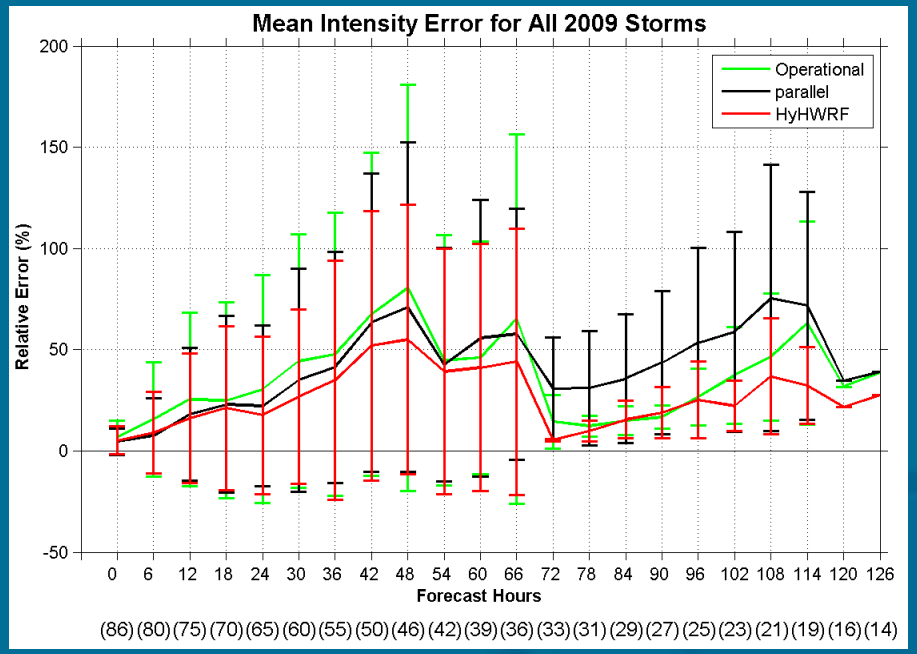
Overall 2009 parallel results

Two populations due to several short weak systems





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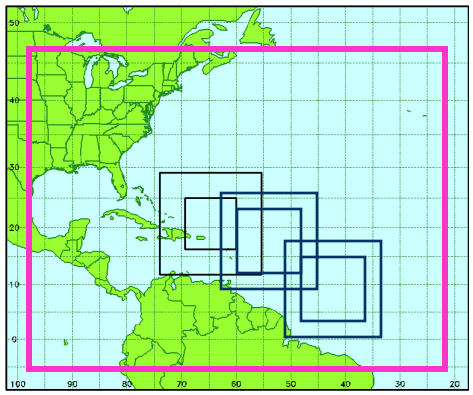
Coupled COAMPS-TC



Couple Model configuration

Atmosphere:

3 nests (45, 15, 5 km), 40 vertical levels. 15 and 5 km domains automatically follow TC

Ocean:

1 nest (10 km), 46 vertical levels and 30 sigma layers

FY 2009 Milestones:

•Integrate NCOM into COAMPS-TC to enable the two-way coupling capability
•Test and evaluate the two-way coupled impact on TC intensity and track forecast using cases from the 2009 season and other historical Atlantic and Gulf Hurricanes

Accomplishments:

•Completed the integration of two-way air-ocean coupled COAMPS-TC
•Tested the system on one Atlantic Hurricane – Bill (2009)

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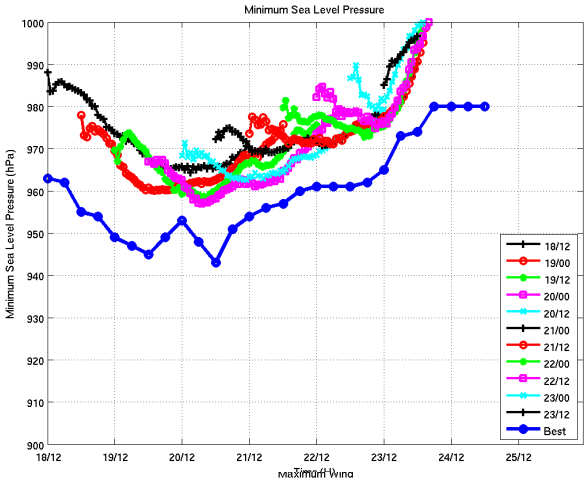
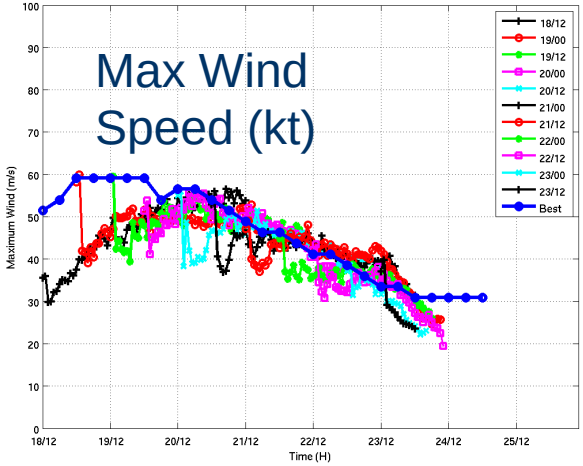
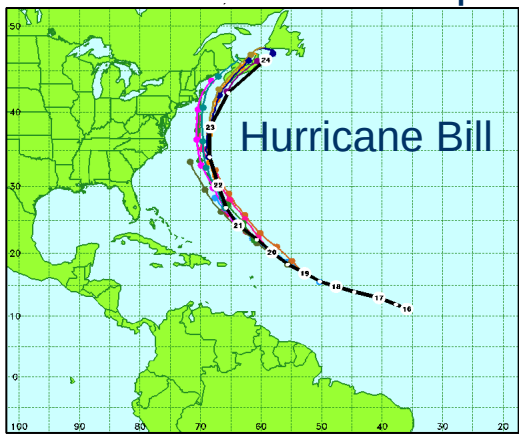
Results





Best tract data from National Hurricane Center

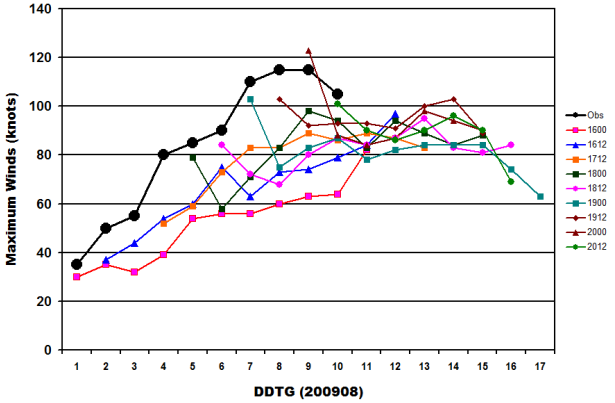


Coupled COAMPS-TC, 72 H forecast

2009081800-2009082312

Uncoupled real-time COAMPS-TC

120 H forecast, 2009081600-2009082012



Both coupled and uncoupled simulations show initialization issues early in the forecast for Bill.

Summary & Future Work

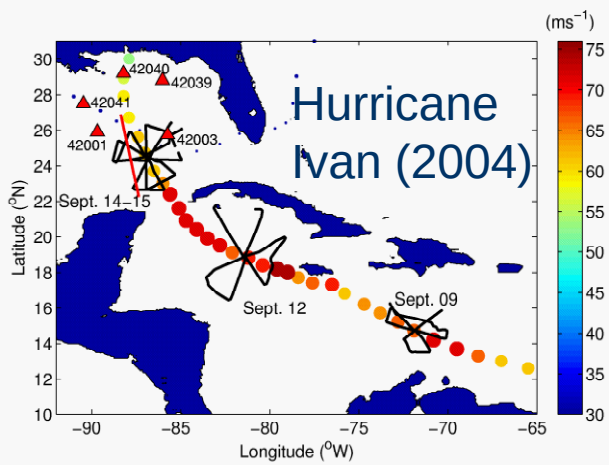
FY 2010 milestones:

- Continue testing and evaluation of coupled COAMPS-TC and fine tune the ocean data assimilation system
- Incorporate recent COAMPS-TC improvements to the coupled version (improved tracker, precipitation output on the moving nests, and total liquid water output)
- Perform coupled model evaluation using the 2009 season hurricane cases
- Test the coupled model configuration for the 2010 real-time HFIP Demo

Science development

- URI building coupler with consistent fluxes between atmosphere, ocean and waves.
- Consistent fluxes shown to improve wave model results (following URI slides, using WSRA and buoy H_s data).
- Starting project on the validation of the ocean model component of coupled hurricane-ocean models
  - NCEP/EMC: Carlos Lozano, Hyun-Sook Kim
  - URI/GSO: Isaac Ginis, Richard Yablonsky, Biju Thomas
  - AOML/HRD: Joseph Cione, Eric Uhlhorn, George Halliwell
  - FSU: Eric Chassignet, Henry Winterbottom
  - U. Washington: Eric D'Asaro, Dorota Kolber
  - UCSD: Peter Niiler, Jan Morzel

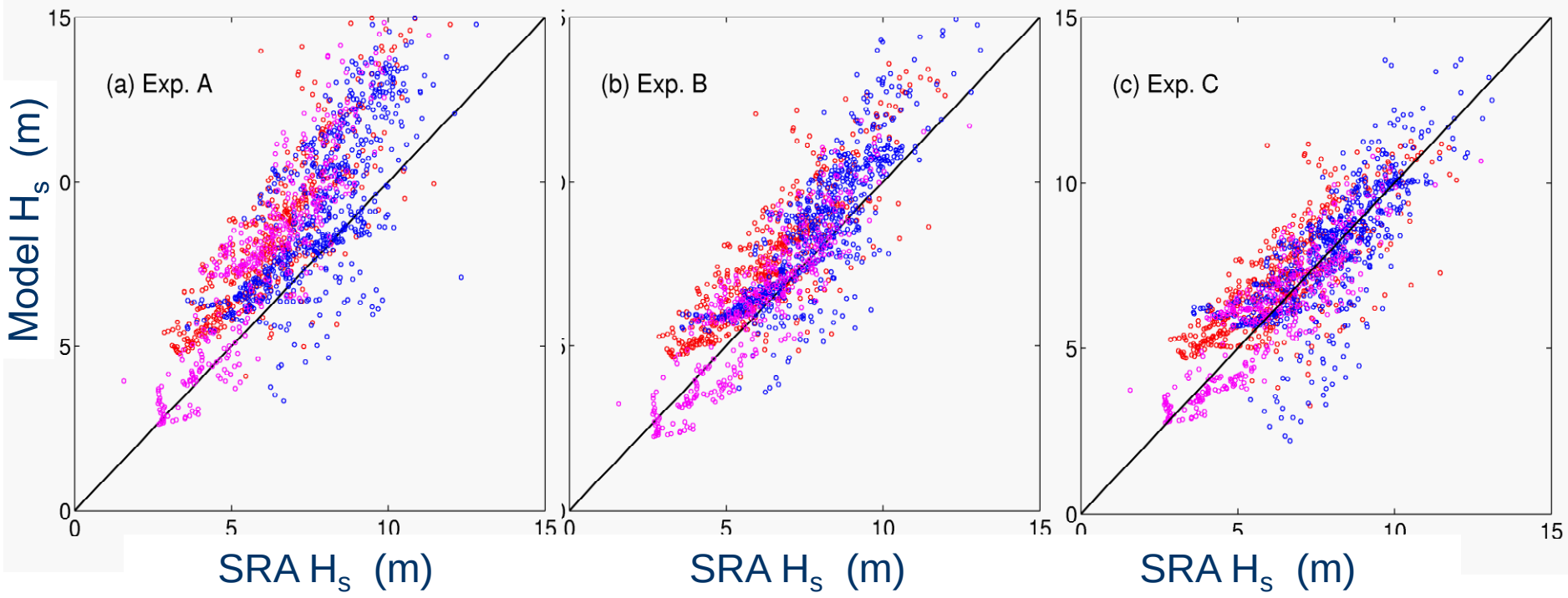
Implementing New Flux Parameterization and Wave-Current Interaction in the WAVEWATCH for Improving Hurricane Forecasts



Original WW3

New momentum flux

Wave-current interaction



o – Sept. 9 **o – Sept. 12** **o – Sept. 14-15**

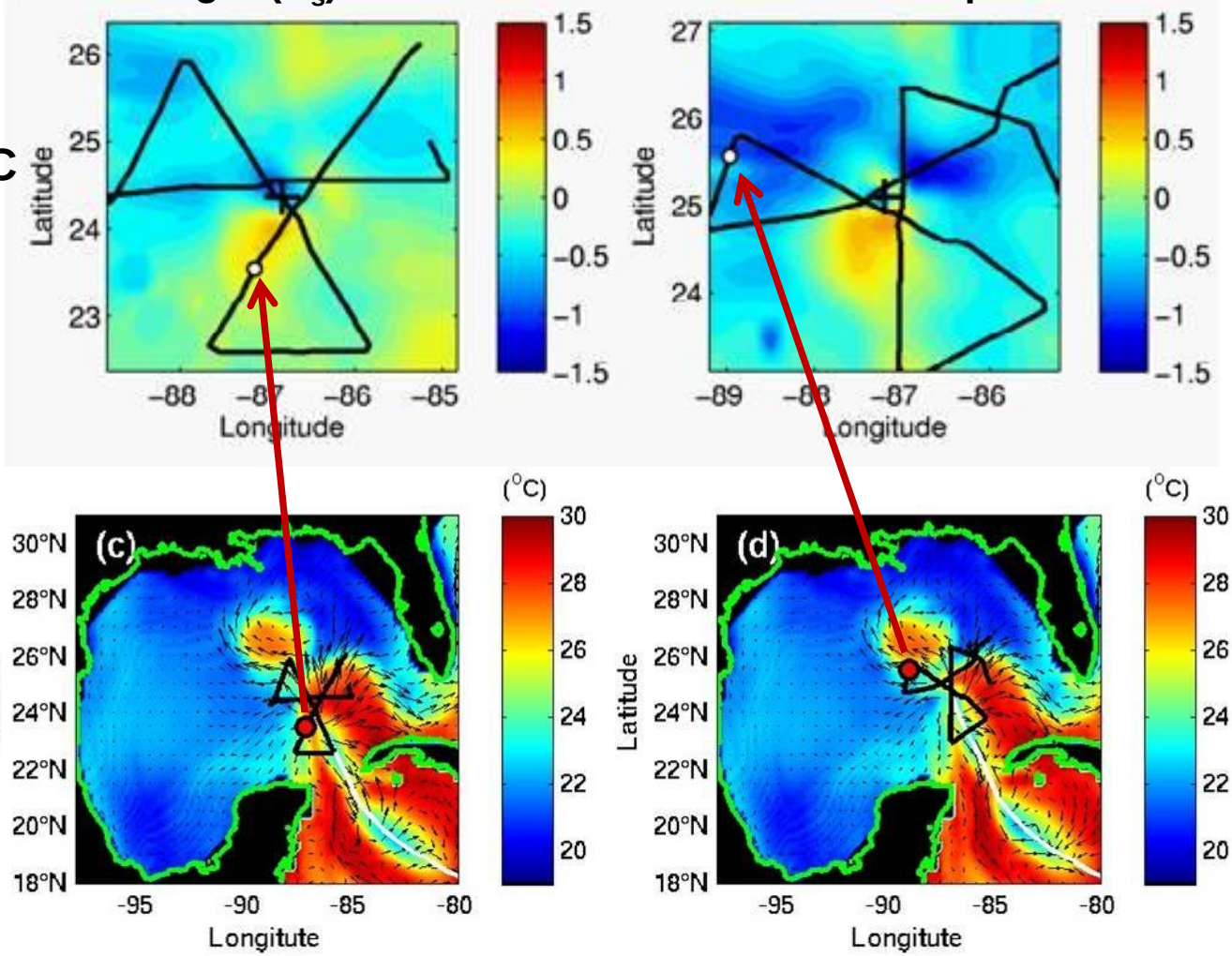
Effect of Loop Current and Warm Core Eddy on Wave Prediction with WW3

Hurricane Ivan (2004)

Significant wave height (H_s) difference with and without Loop current and WCE

21:00 UTC Sept.14

2:40 UTC Sept. 15

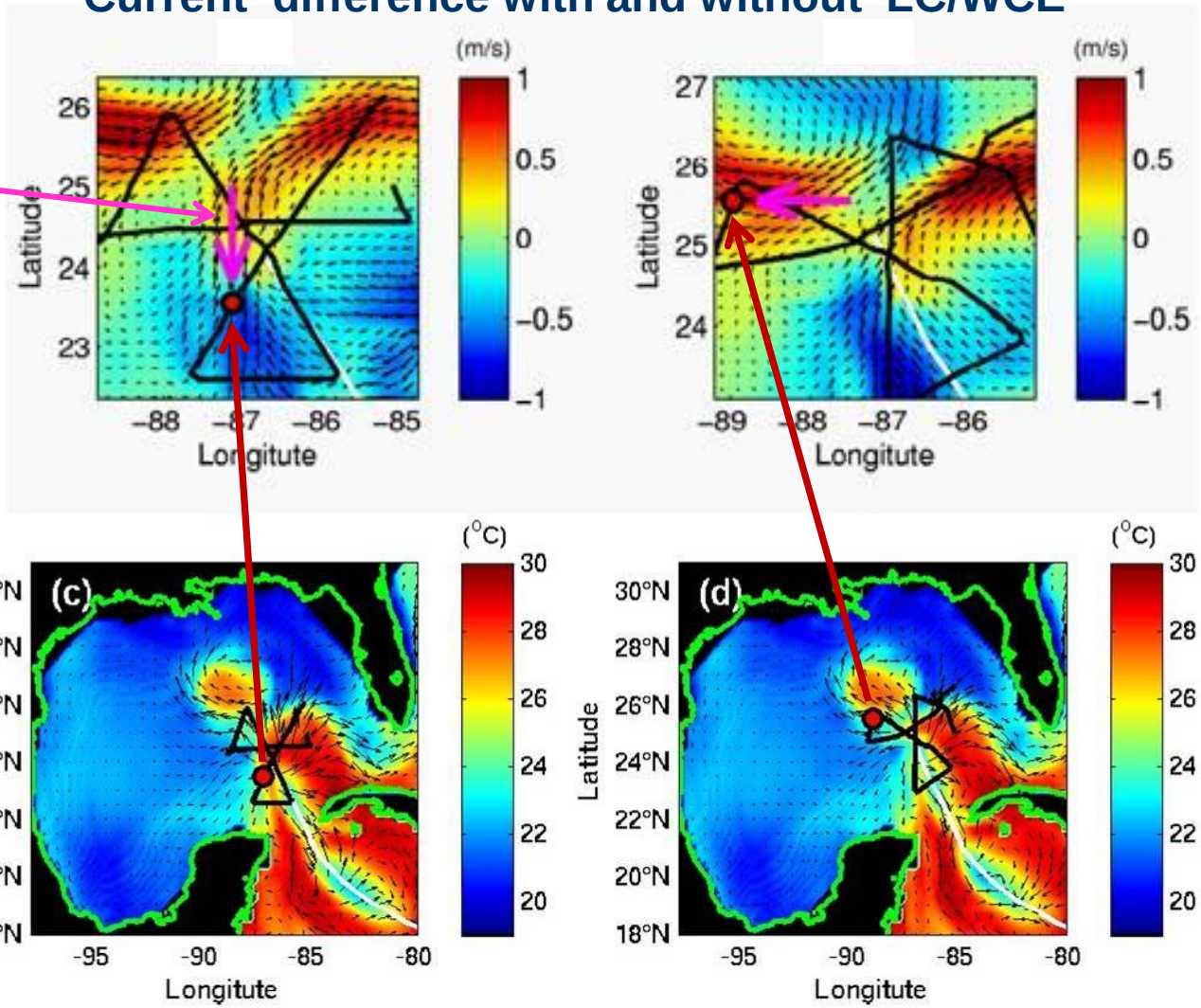


Effect of Loop Current and Warm Core Eddy on Wave Prediction with WW3

Hurricane Ivan (2004)

Current difference with and without LC/WCE

Direction of dominant wave propagation



I. Ginis