HFIP Team Meeting

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HFIP Lead

Assessment after 1 year

Overall opinion – suffering growing pains, too much going on, little standardization of assessment. Need to step back and reexamine performance

Observations:

1.Science:

- ✓ HPC infrastructure, advances in HPC support (TACC and DOE proposals)
- – Business as usual - lots more model runs and data sets collected, little progress digesting & evaluating beyond 3 numbers (lat, long, peak wind)
- – Generated multi-model regional ensembles, high-resolution global ensembles from both FIM and GFS – lack of evaluation/understanding
- – Models suffer from physics issues in high-wind regimes, e.g., scaling operational physics to 1-3 km overdeveloping weak cases, high-bias
- – May also be due to ICs – regional model DA improvements critical
- – Little progress evaluating with observations - Need to use inner core observations to initialize and evaluate high-resolution physical processes

Research Priorities (1)

Assessment related to HIRWG criticism that models at resolutions of ≤1 km needed to improve forecasts:

- Increased model resolution is necessary, but not sufficient condition (HRH test, etc.)
- Results to date suggest more issues than resolution must be addressed before progress is made
- Made good start, but only highlights how far we need to go
- Challenges ability to understand what technology improvements bring to problem
- Need to change our approach to focus on understanding why

Research Priorities (2)

- Underutilization of data (flight-level, Doppler, dropsondes and satellite microwave, IR, vis) in analyses of model runs. Must improve diagnosis of impacts of model differences/changes on performance. Need to combine model development, DA, and analysis of observations to digest mountains of model output generated.
- Develop improved DA system to take advantage of inner core observations to improve our initial analyses.
- Develop observing system analysis capability to better evaluate impacts of observations on models, and better evaluate models through new diagnostic approaches linking observations with model in model space
- Improve understanding of physical processes and their representation within models. Many physics packages running operationally and in research models received little testing in simulations at very high resolution - can not expect physics that work at 9-10 km to work same at higher resolution

Research Priorities (3)

- Develop methods to test and evaluate physics development beyond traditional model development approaches and evaluation. Exploit traditional tools such as idealized studies and new tools such as OSSE approach comparing impact to truth ("Nature run") to improve understanding of impacts of any physics changes. Useful in making trade-offs to realize improvements within operational constraints, or in global models as they approach cloud-resolving resolutions
- Develop means to utilize ensembles (single and multi-model, global and regional) to improve forecast guidance
  - Address observations uncertainty (Best track included)
  - Assess predictability or uncertainty of forecasts for different storms – e.g., ensembles in Bill and Erica track forecasts. Deterministic run is just one potential realization, dependent on how well model represents environment evolution and storm's impact on that evolution. Multi- or single-model ensembles can assess probability (spread) of different tracks (GPCE) or wind probability

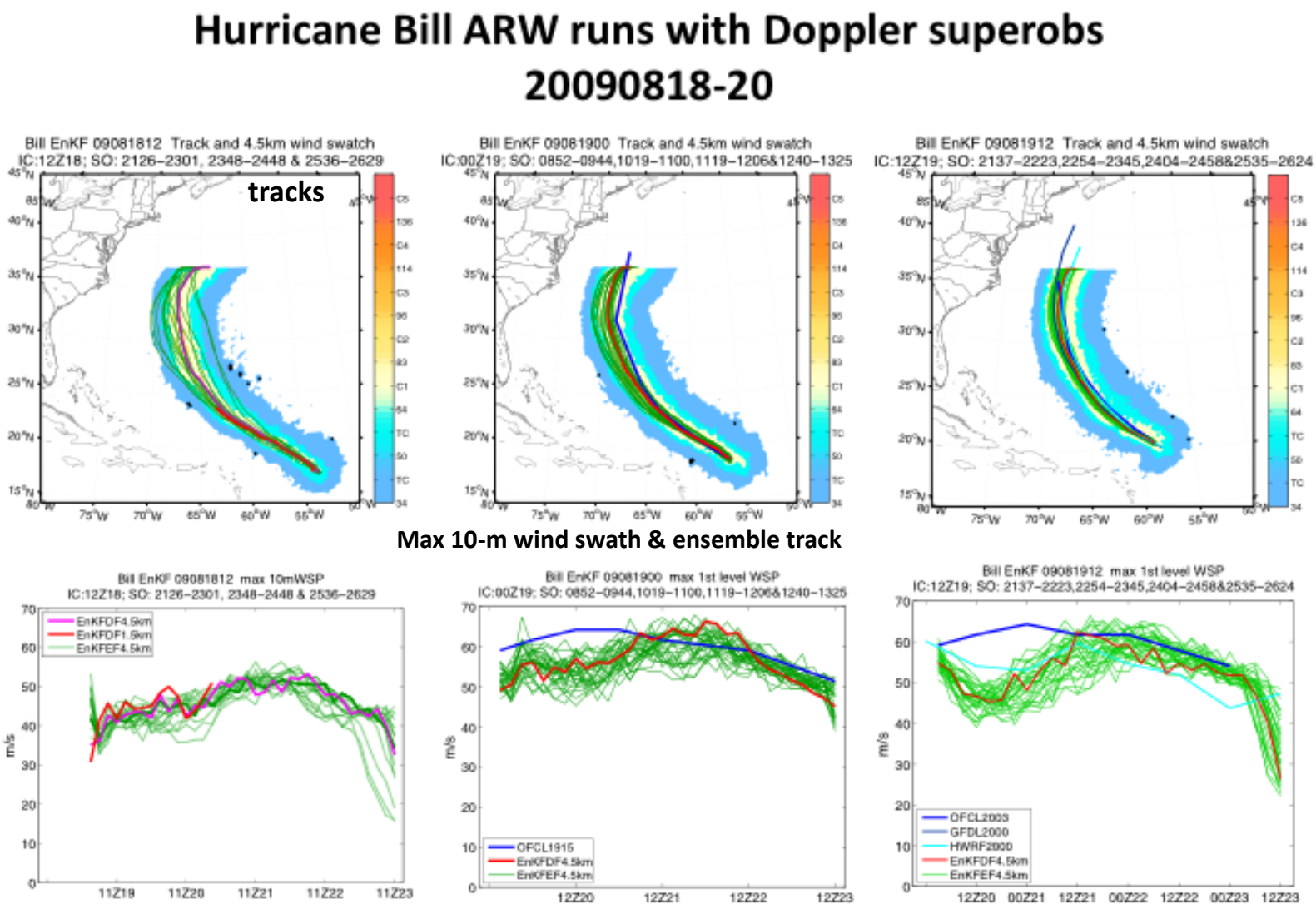
Research Priorities (4)

- Develop means to utilize ensembles (continued)
  - Assess impacts of changing physics - how do changes to physics packages impact spread of ensembles and identify sensitivities (in similar manner to current practice of running model over a large number of cases to assess impact). Ascertain if changes over many cases are within ensemble spread, insuring impacts not due to model variability
  - Address predictability/variability within and between different models given different resolution, physics, and different numerics. Model behavior of idealized case ensemble provides basic understanding of the model physics and resolution variability, or baseline for expected variability. Test model model error covariance sensitivity to changes in physics, resolution, numerics, etc. Assess impact of environment in real case by evaluation of spread by added large-scale variability

Assessment after 1 year (2)

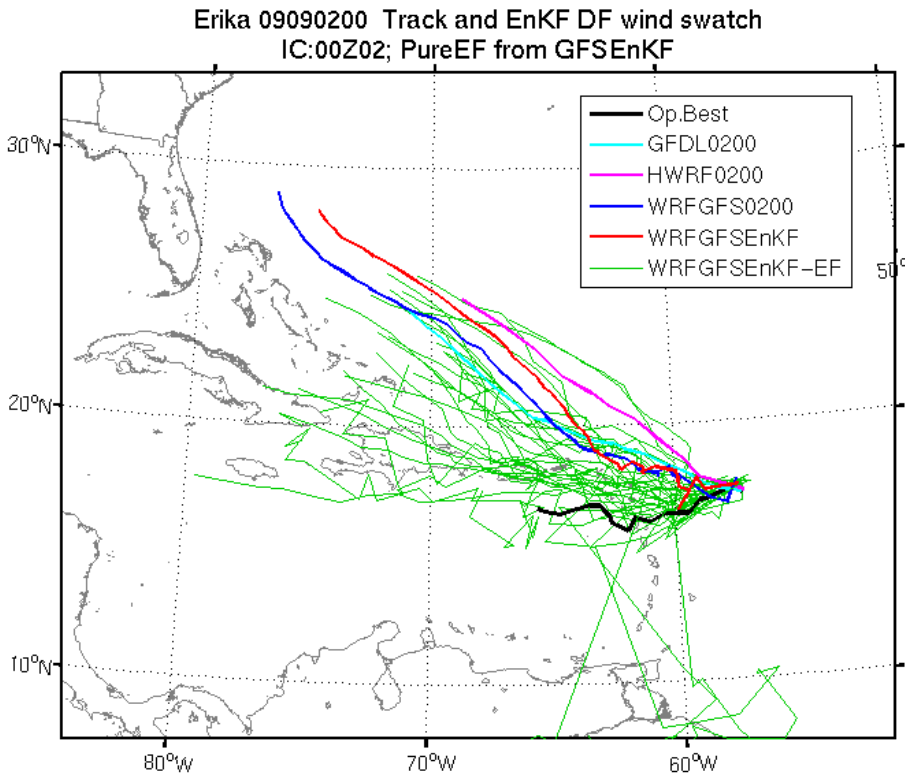
2. **Teams**: need to provide clearer expectations
   - Number – Too many with overlapping objectives, need coordinated efforts from multiple teams, consolidation needed, e.g., both regional model and physics development, global model and physics development should be combined
   - Charges: revision needed for clarity and consistency
   - Leadership: need best folks - inclusive and can lead diverse efforts – need to revisit, possibly rotate or bring in new
   - Interactions: not enough interactions between team leads and their members - some groups worked well together, whereas others not.
   - Coordination: Not enough beyond weekly HFIP calls – only one team workshop combining Diagnostics and Verification
   - Reports: varying quality and effort. Need standards for reporting and what is HFIP expectation

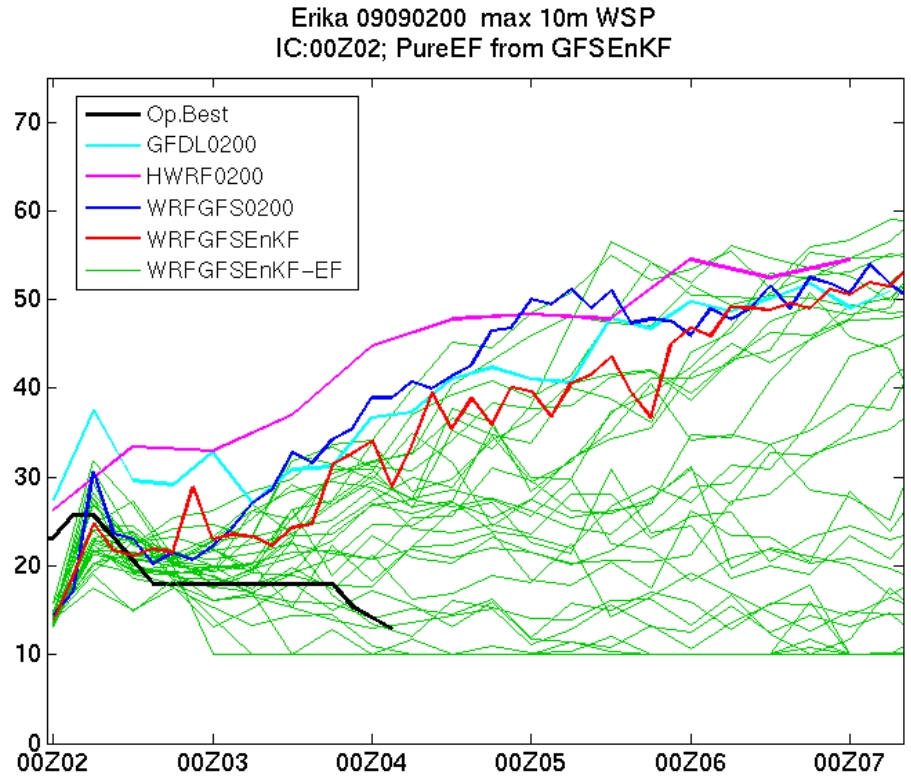
Single Model Ensembles: Bill



Courtesy of Fuqing Zhang (PSU)

Single Model Ensembles: Erika

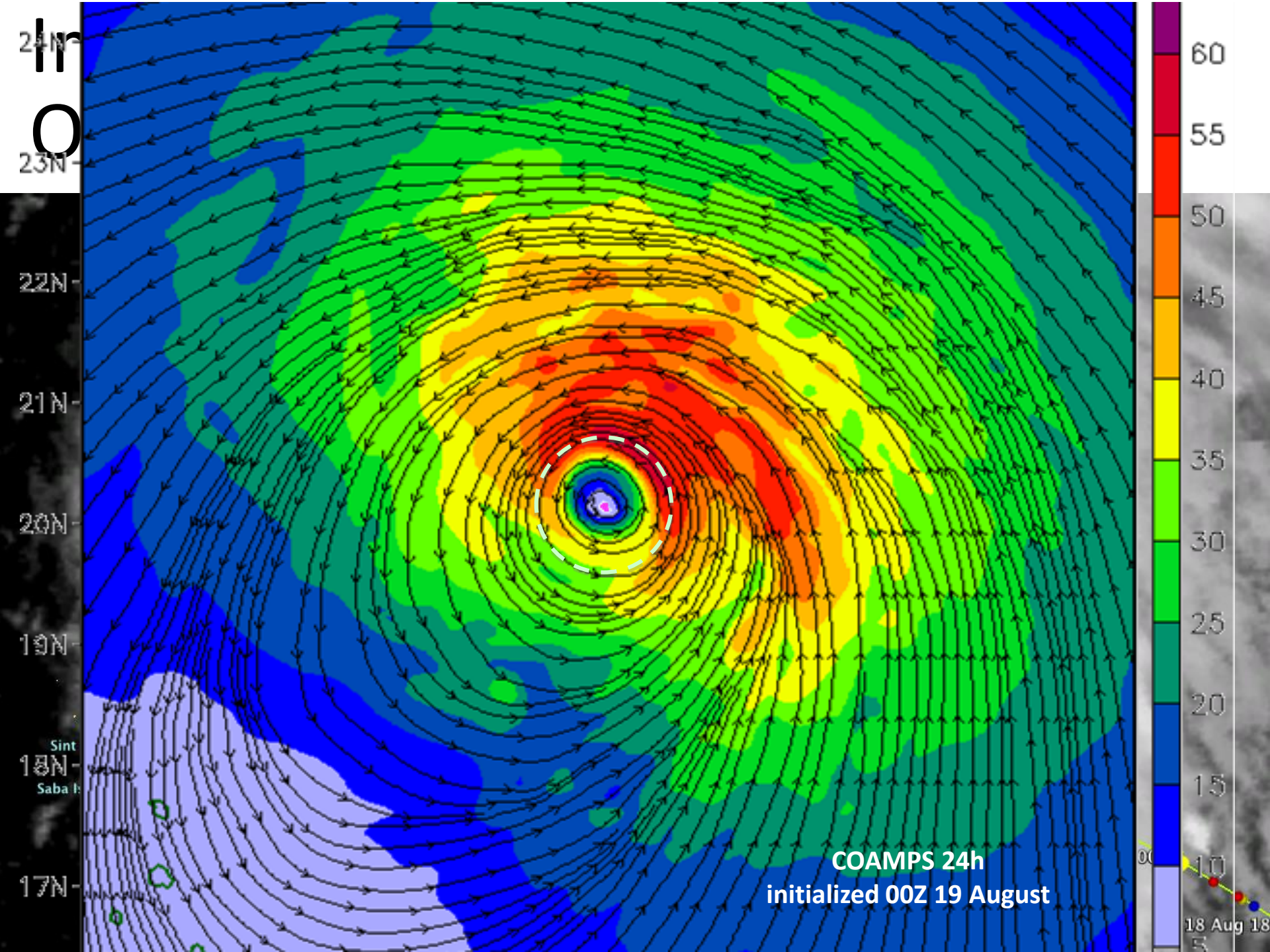




Courtesy Fuqing Zhang (PSU)

ICs: GFS-EnKF analysis

BCs: GFS forecast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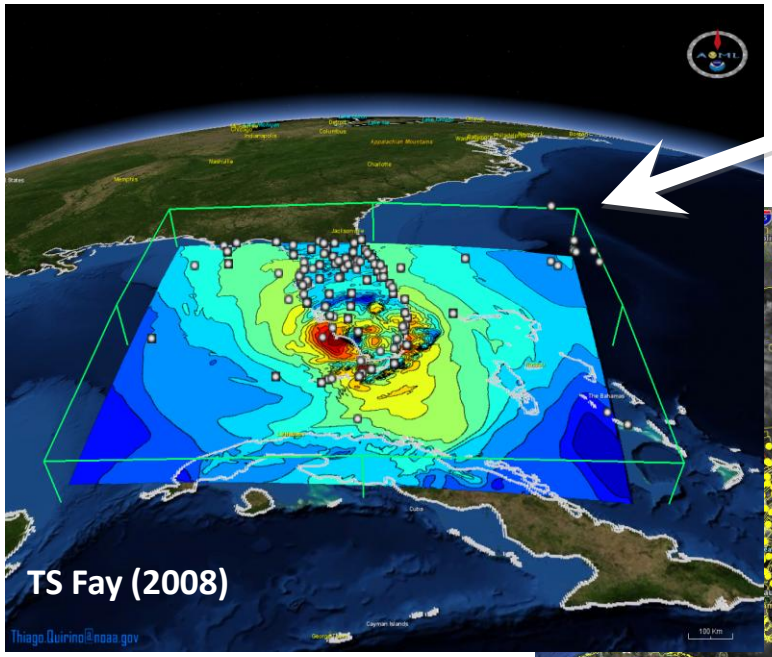
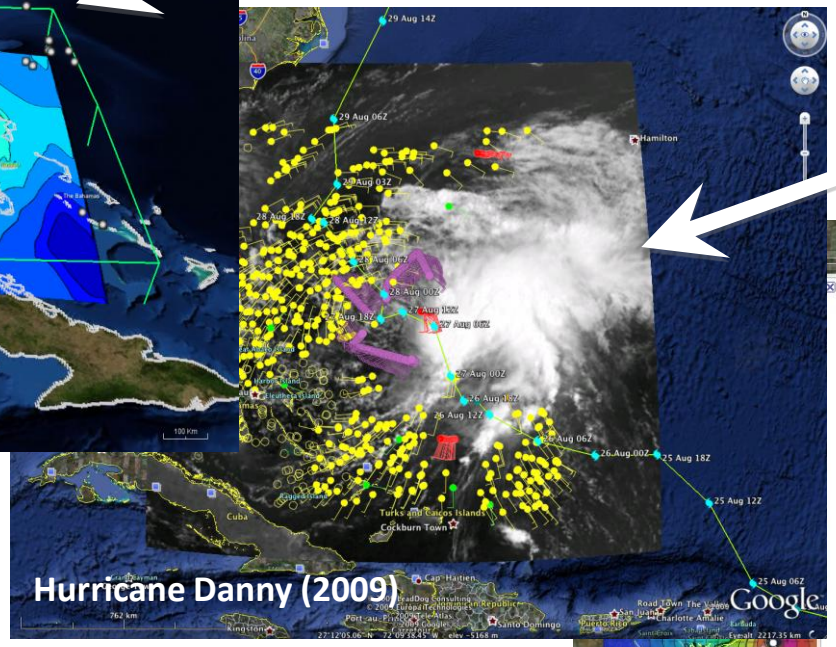
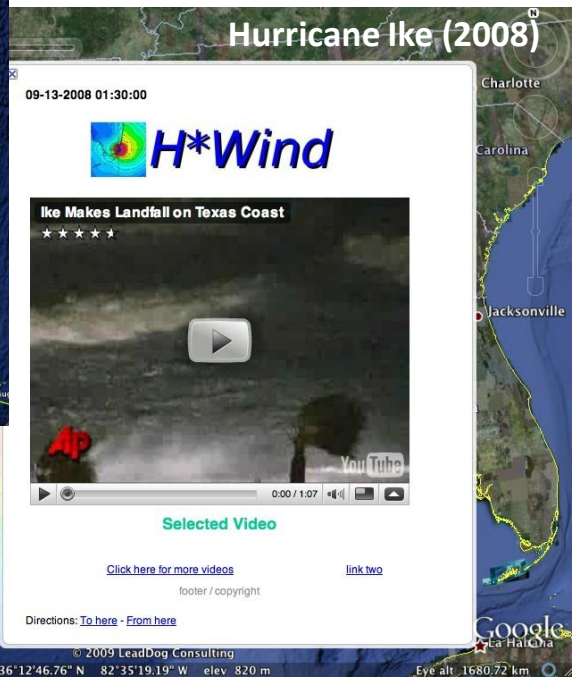
Improved Models & Data: Visualization



- Integration of HWind database & Model

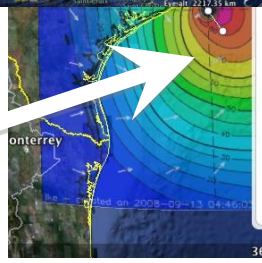
- Integration of HWind database & NRL satellite imagery





- Exploring AWIPS-II integration through use of common standards

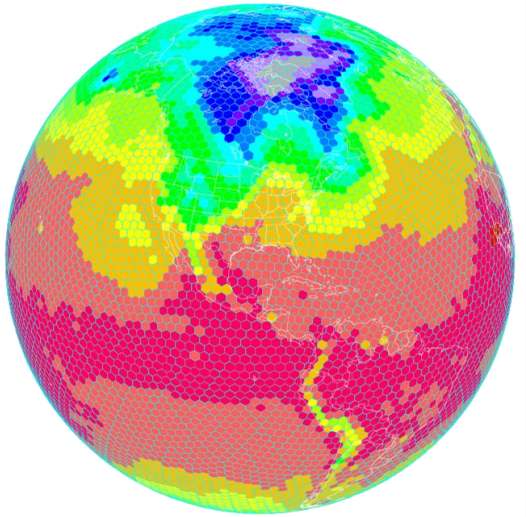
- Integration of HWind database & YouTube



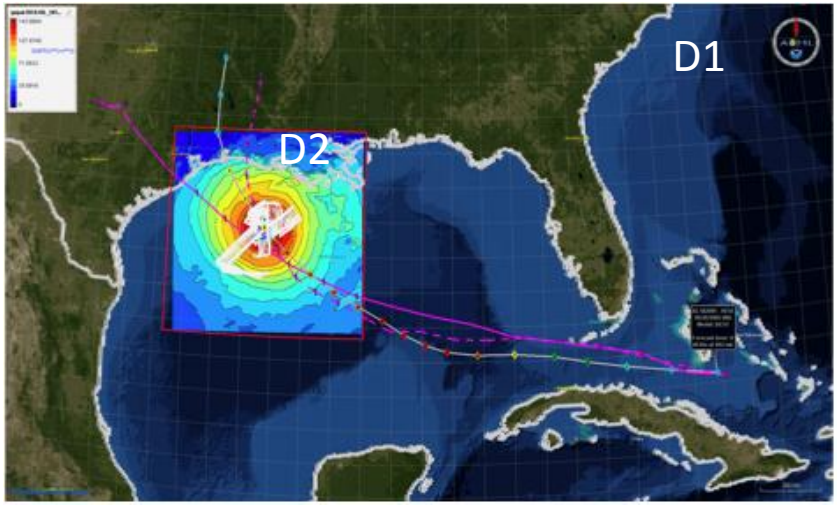
Improved Models: Dynamical Models

National Hurricane Forecast System

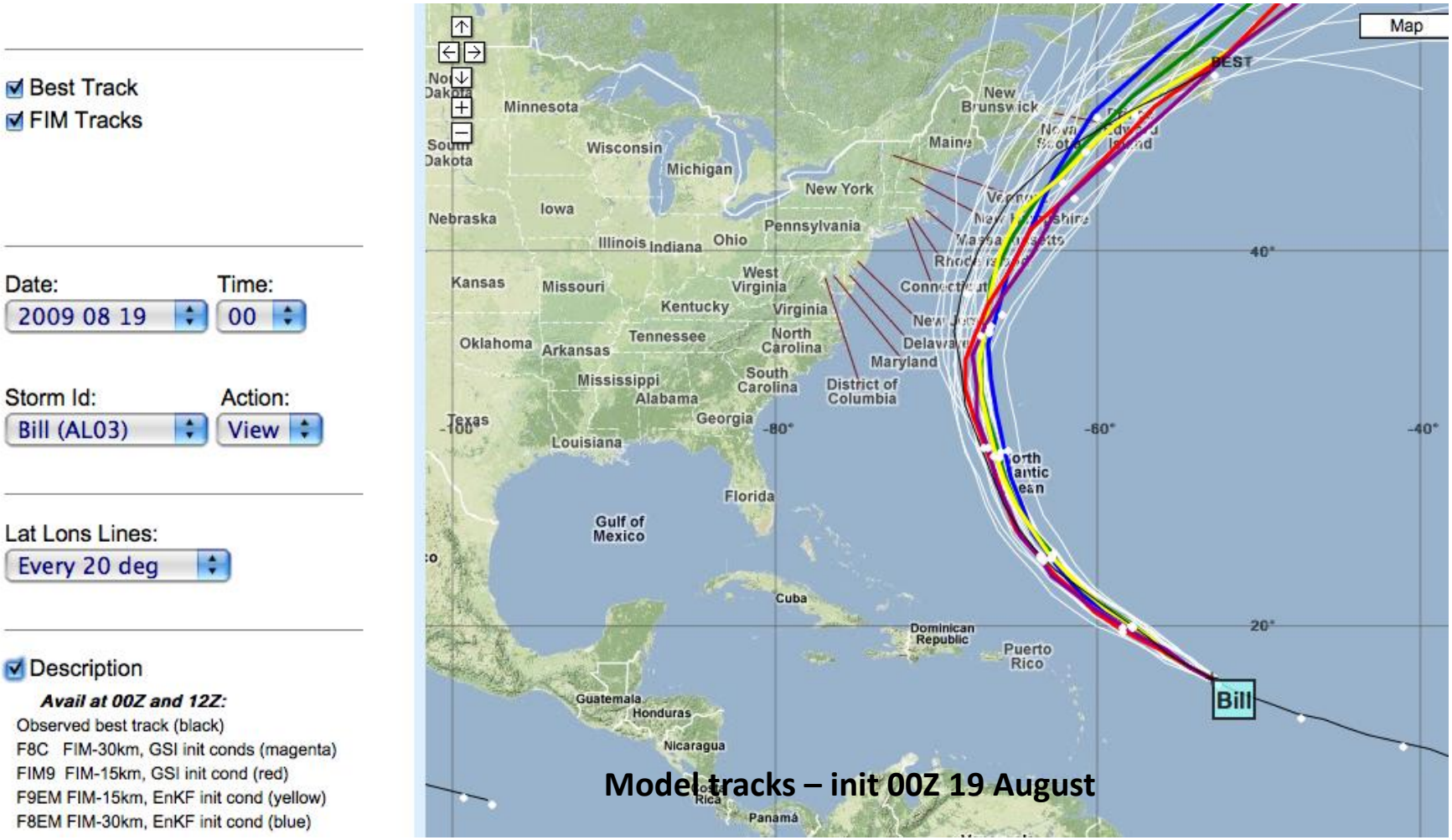
- **Global:**
- FIM global model developed at ESRL with help from NCEP
- Uses unique global grid (soccer-ball-like horizontal, adaptive vertical coordinate)



- **Regional:**
- Experimental HWRF developed at AOML & ESRL based on NCEP HWRF
- Triply-nested regional model down to 1-km horizontal resolution



Global Model Development - FIM



Model tracks – init 00Z 19 August

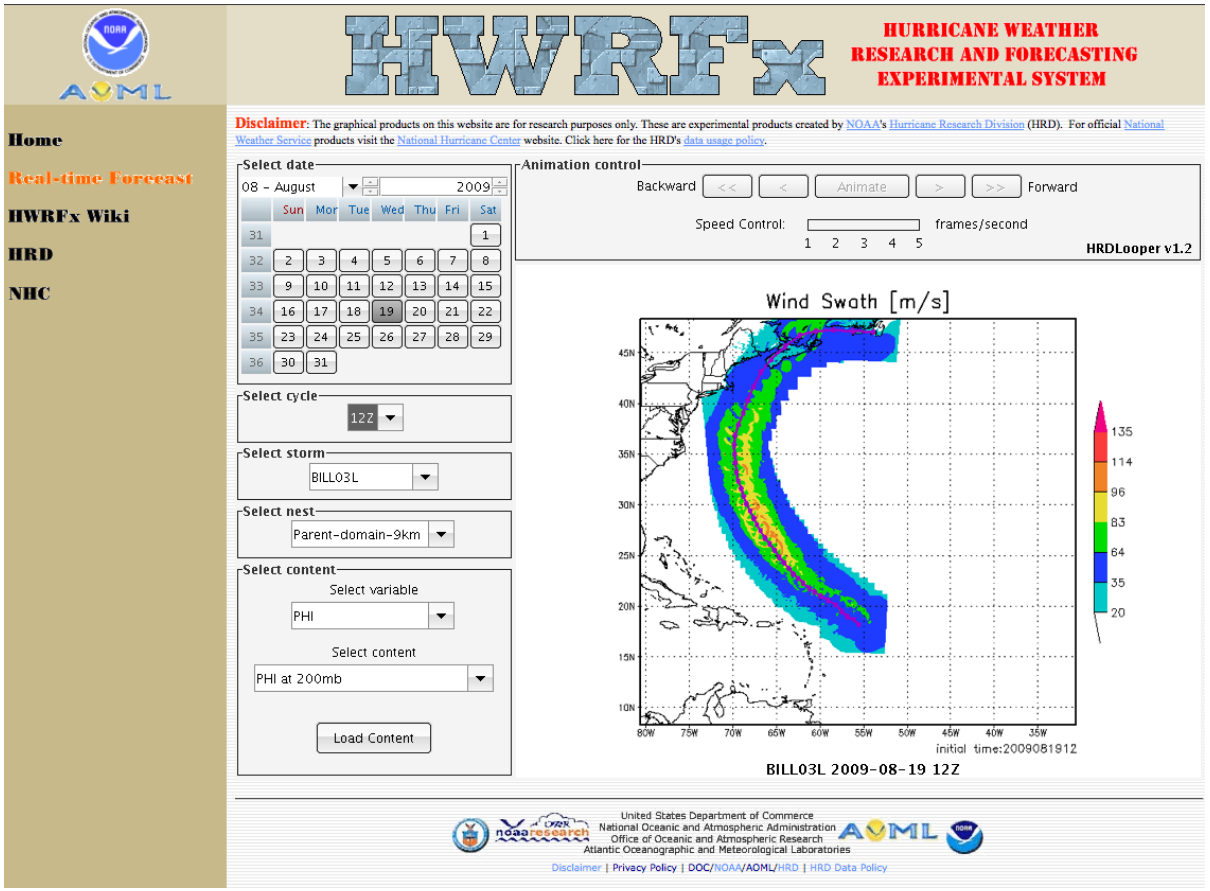
Courtesy of Stan Benjamin

FIM

Regional Model Development - HWRFx

- 2009 hurricane season:
  - Ran HWRFx at resolution (9/3km), no ocean, no vortex initialization (HWRF IC/BC)
  - HWRFx run real-time twice a day (00Z, 12Z) for >100 cases 126 h forecasts
  - Provided in ATCF format to DTC & multi-model regional ensemble
  - NJET statistics (average):
    - Simulation time: 2.5 h
    - Post-processing: 50 min

HWRFx real-time demo simulations (https://storm.aoml.noaa.gov/hwrfx/)



Multi-model Ensembles

- 2009 hurricane season:
  - Multi-model regional ensemble
  - HWRFx does better on intensity for strong hurricanes (Bill & Fred), but worse for weak systems (Ana, Danny, Erika, AL08, & Henri)
  - HWRFx sensitivity tests with GFS IC vs HWRF IC has inverse behavior when using GFS IC (e.g., weak bias with strong storms), & track error worse