Hurricane Model Transitions to Operations at NCEP/EMC

2005 Joint WRF/MM5 User's Workshop

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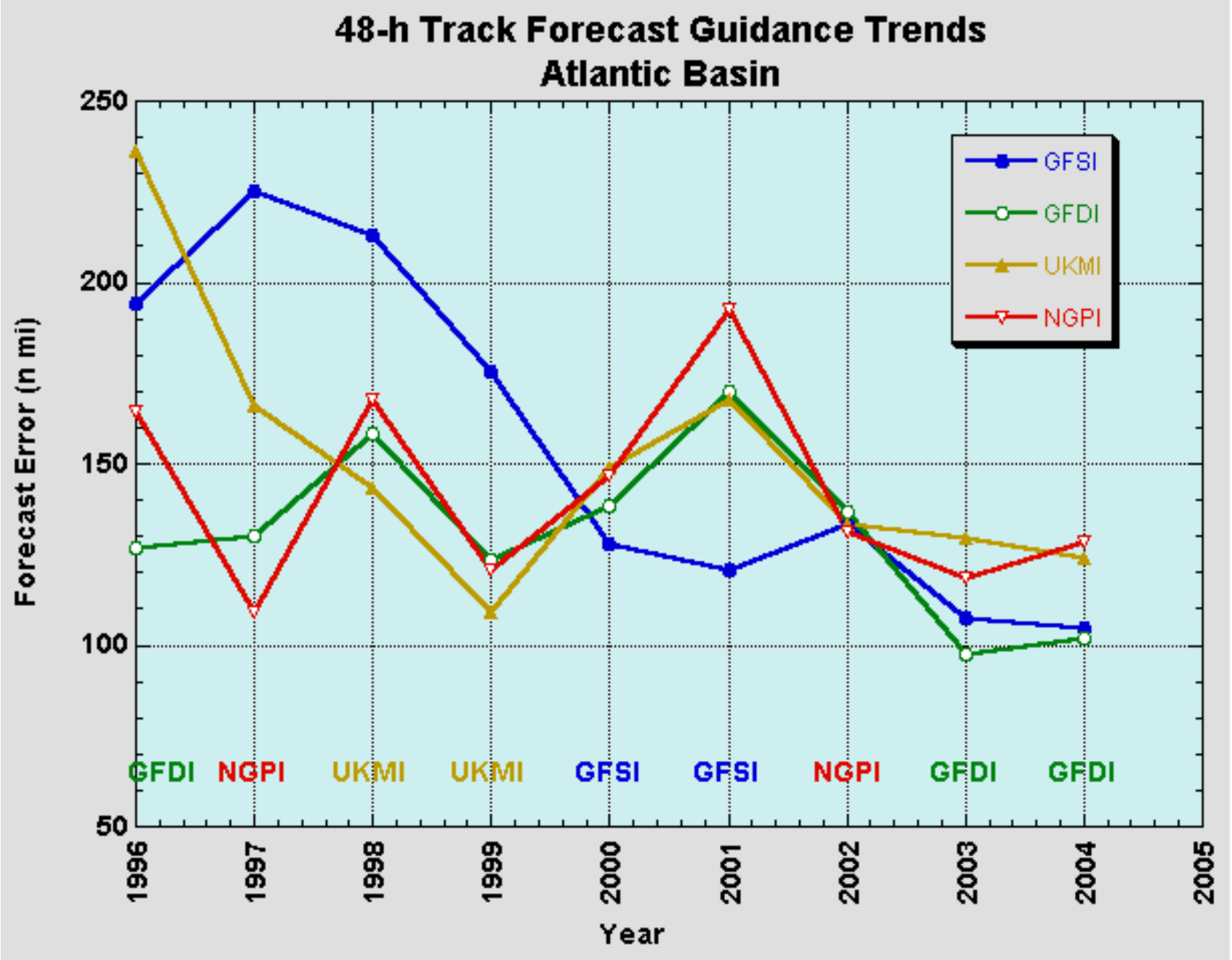
JHT sponsored

Development of the Hurricane WRF prototype System at EMC

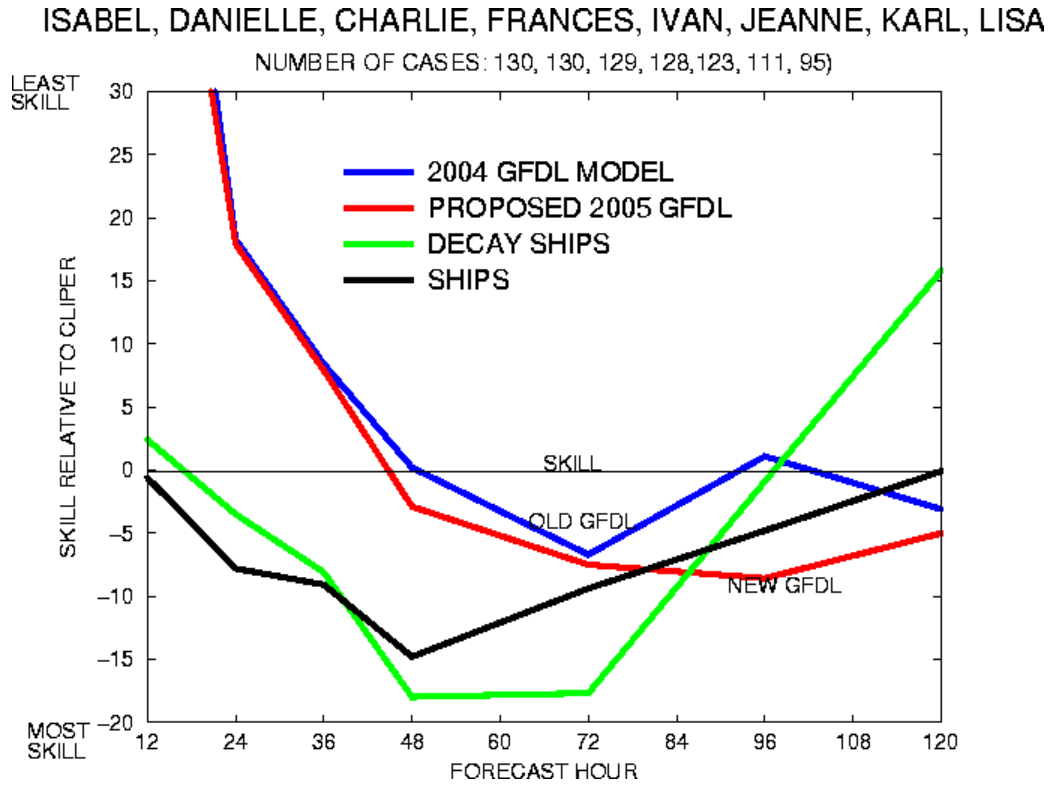
- Establish baseline of skill for WRF development
- Begin transition of Hurricane model from GFDL to WRF
- Design of the prototype system for HWRF
- 2004 preliminary HWRF forecasts
- Future plans

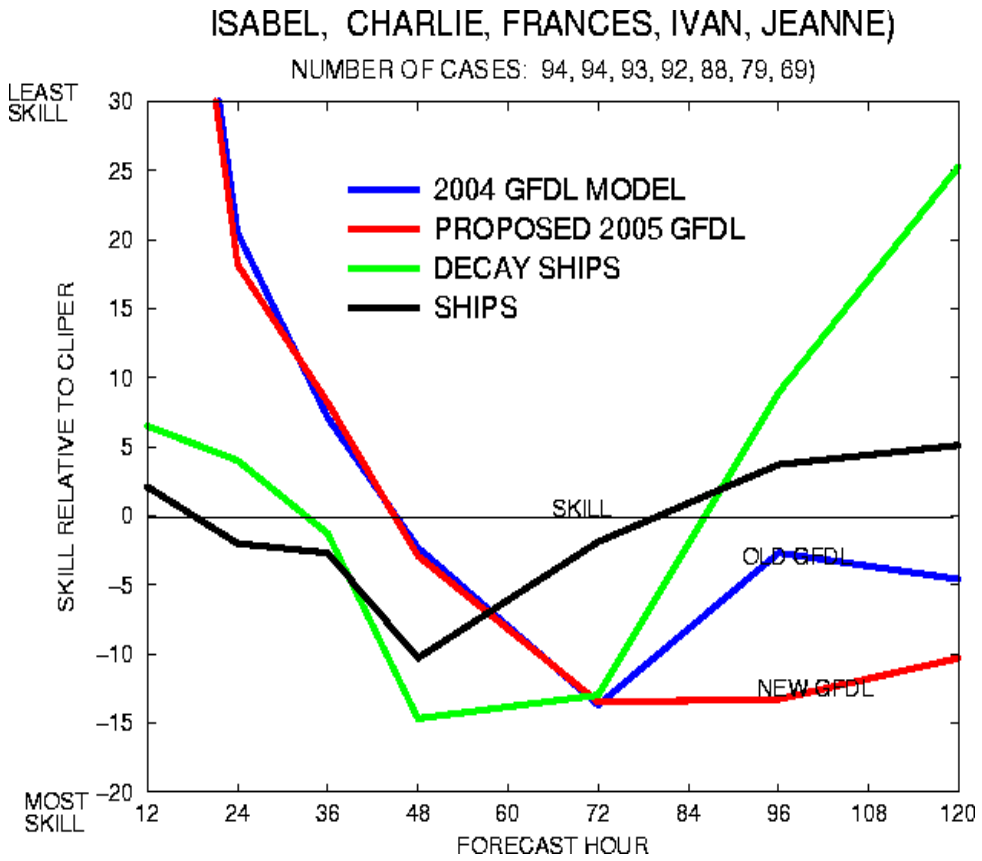
track


48-h Track Forecast Guidance Trends
Atlantic Basin
Forecast Error (n mi)
250
200
150
100
50
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year
GFSI
GFDI
UKMI
NGPI
GFDI NGPI UKMI UKMI GFSI GFSI NGPI GFDI GFDI

INTENSITY VERIFICATIONS: 2004 VS. 2005 MODELS

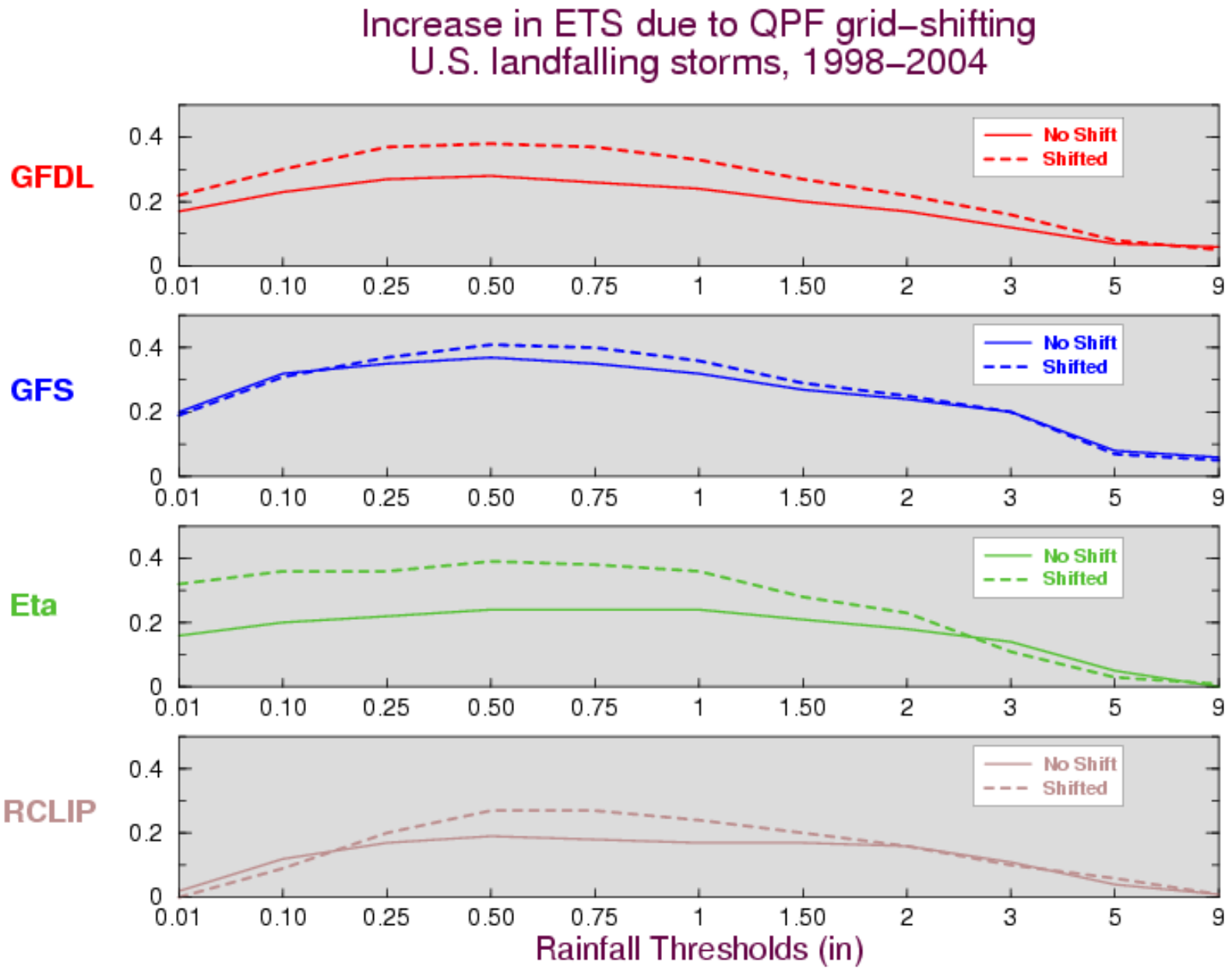
IMPROVED SKILL AT 3-5 DAYS



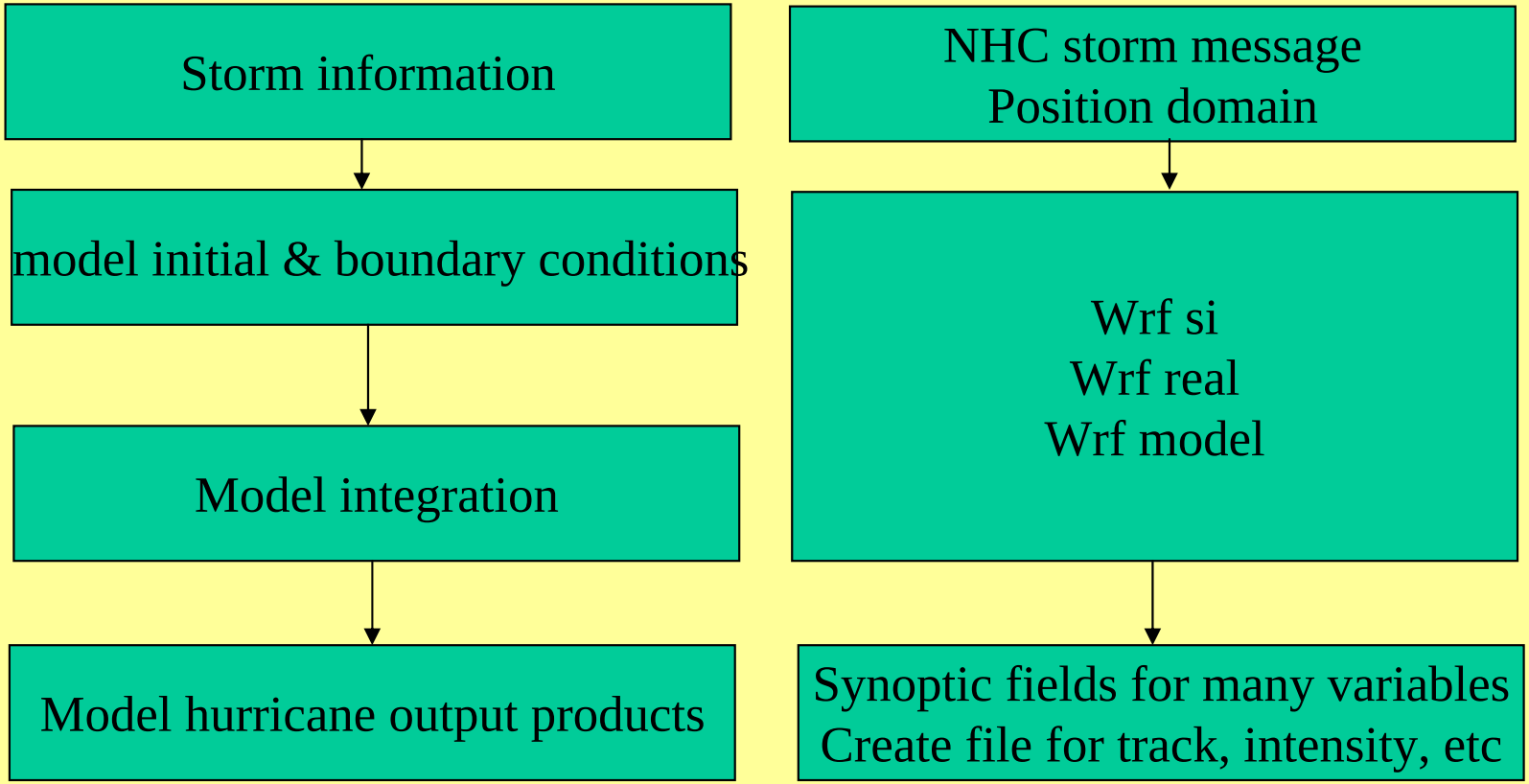


Rainfall

ETS improvements due to grid shifting



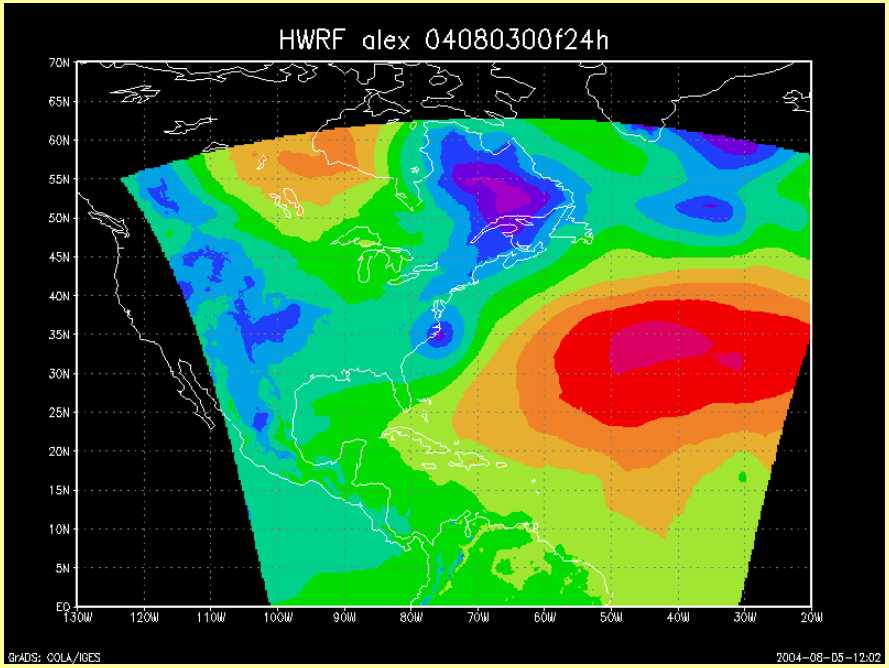
Hurricane Forecast System

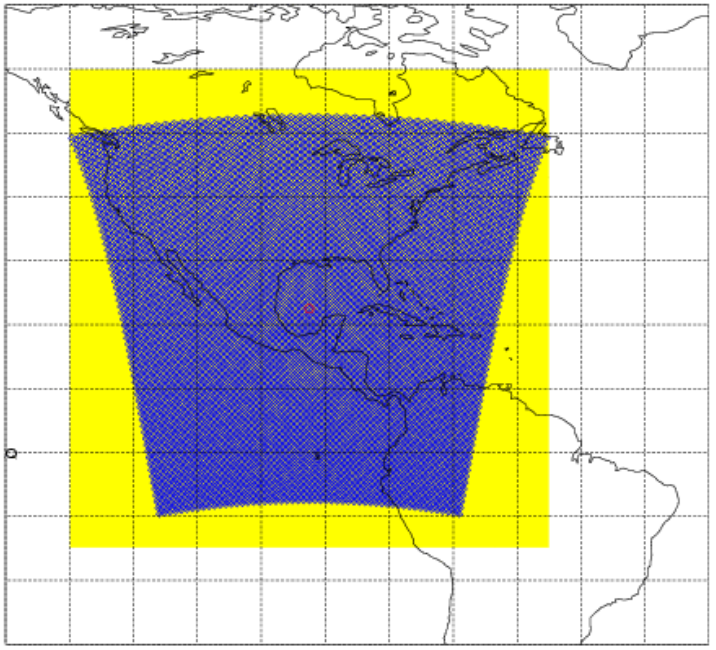


HWRF features

- Uses WRF NMM dynamic core
- Initial condition options
  - ✓ Current or historical cases
  - ✓ GFS or GFDL initial conditions
  - ✓ HWRF forecast/analysis cycle
- Physics options
  - ✓ Eta/NMM model physics
  - ✓ Transitioning to GFDL(GFS) physics

GFS……..GFDL


HWRF alex 04080300f24h
70N
65N
60N
55N
50N
45N
40N
35N
30N
25N
20N
15N
10N
5N
EQ
130W
120W
110W
100W
90W
80W
70W
60W
50W
40W
30W
20W
GrADS: COLA/IGES
2004-08-05-12:02



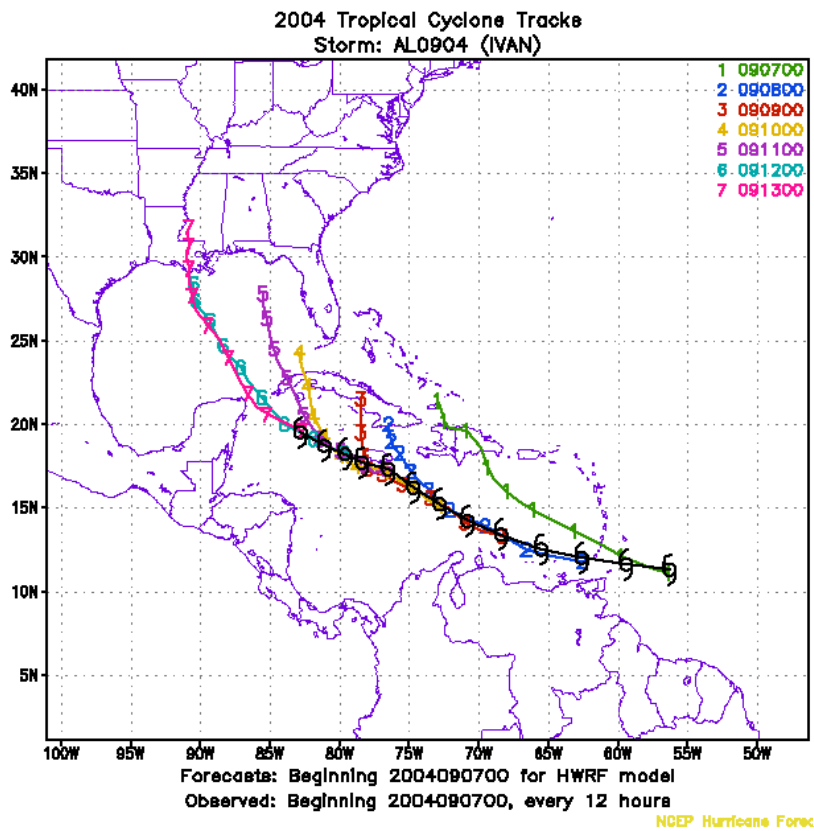
Additional HWRF features

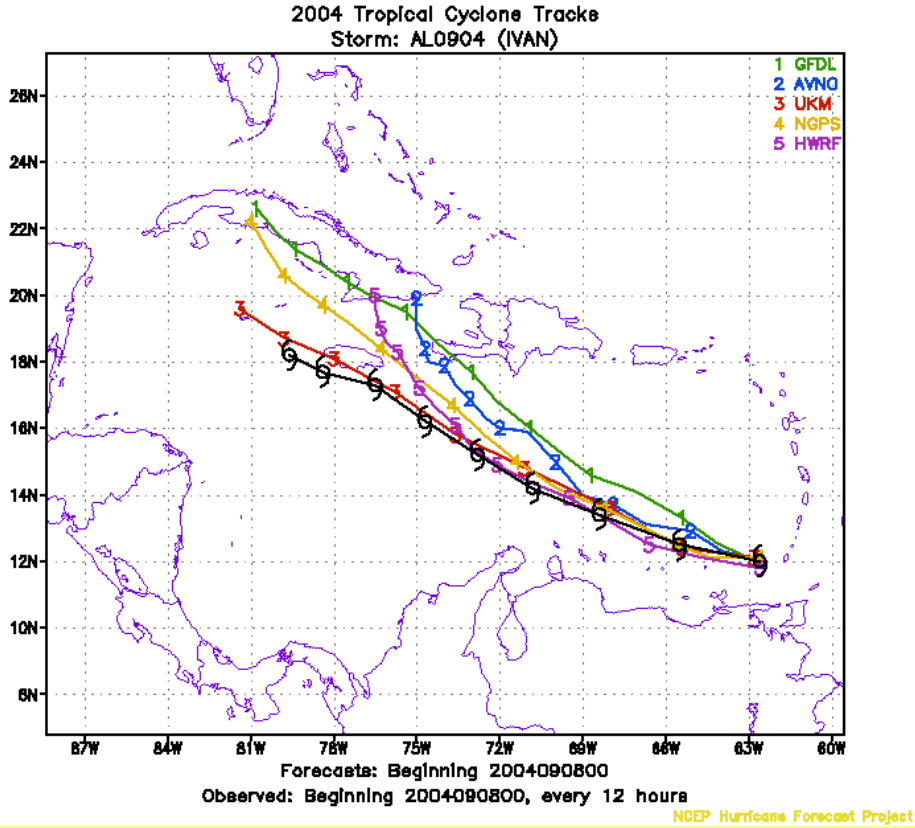
- Requires grib input of initial conditions
  - ✓ replaced by analysis cycle
- Uses wrf binary and netcdf files
  - ✓ Rotated-E NMM grid … a bit awkward
  - ✓ WRF SI…a slow, big, generalized interpolator
  - ✓ Netcdf WRF output on native model grid
- HWRF post
  - ✓ Uses EMC post utilities to interpolate to ‘A’ grid on pressure levels
  - ✓ Creates synoptic fields at ~ model resolution
  - ✓ EMC post output grids in grib format
  - ✓ Creates ‘atcf_unix’ file to track storm location, intensity, and extent
  - ✓ More output products to be developed
- Tracker software to create storm temporal forecast information
  - ✓ May be part of model run or done in post in/out of house
  - ✓ ‘tracker’ becoming a misnomer since intensity and storm structure also analyzed
  - ✓ Usually requires temporal data near surface, 850mb and 500mb
  - ✓ Usually multi-variable analysis…vorticity, U, V, T, etc.
  - ✓ EMC uses scheme by Tim Marchok (GFDL)

2004 preliminary HWRF forecasts

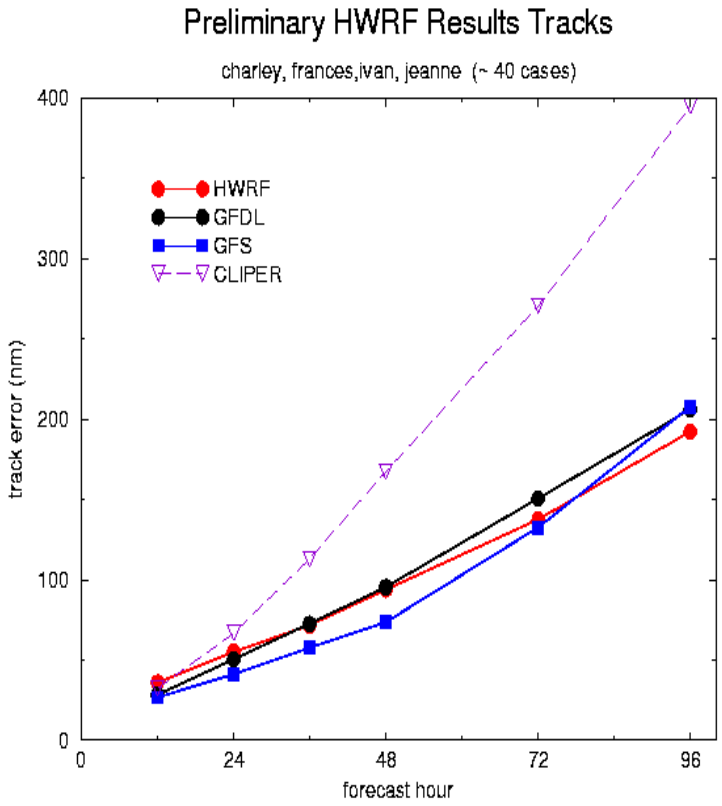
- Run at least one storm per day (00utc)
- >120 uniform resolution cases
- ~20km resolution with 42 GFDL levels
- System found to be quite robust with few if any non-user failures
- Started with ETA/NMM-physics, GFS initial condition
- A work in progress !!

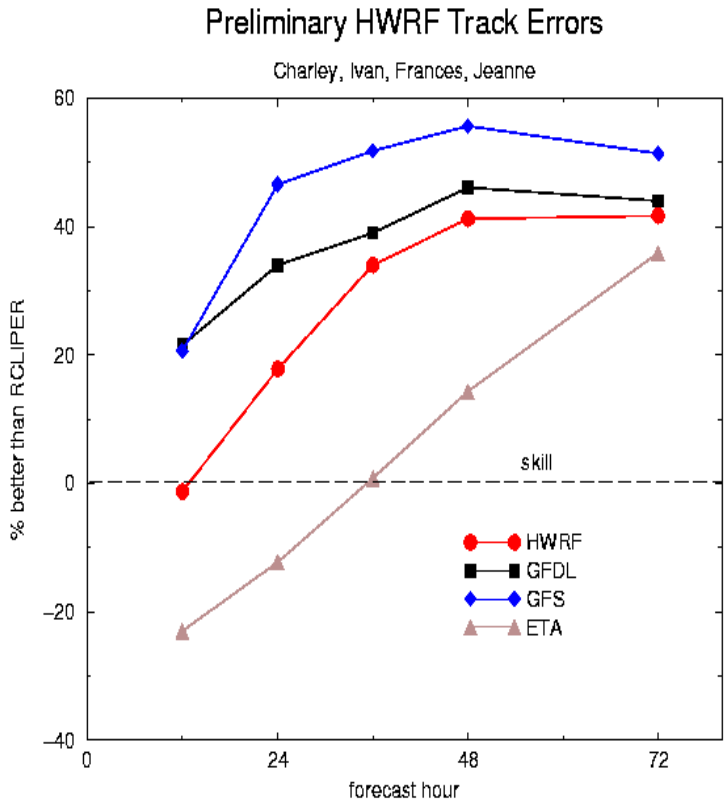
Preliminary HWRF results





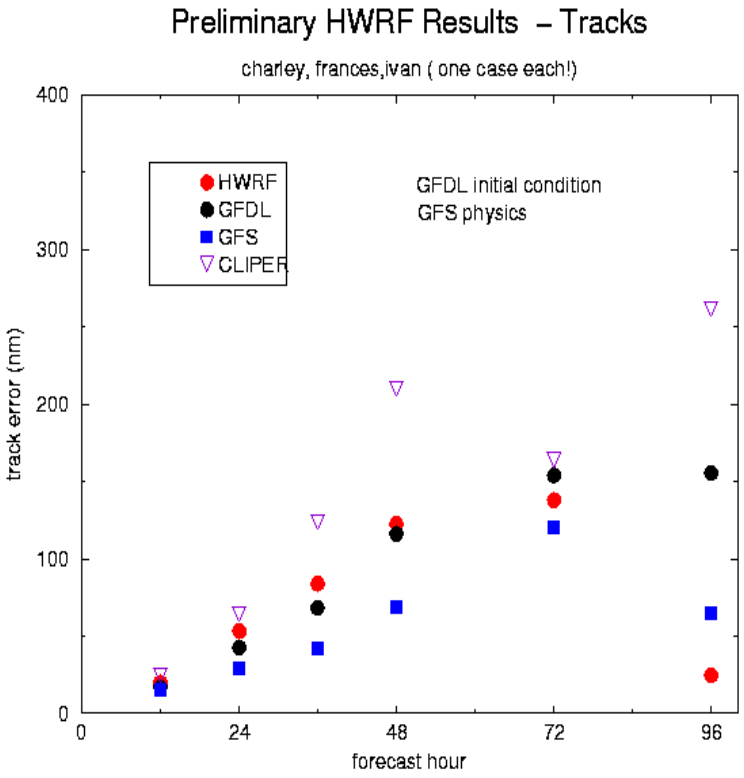
HWRF Track Verification



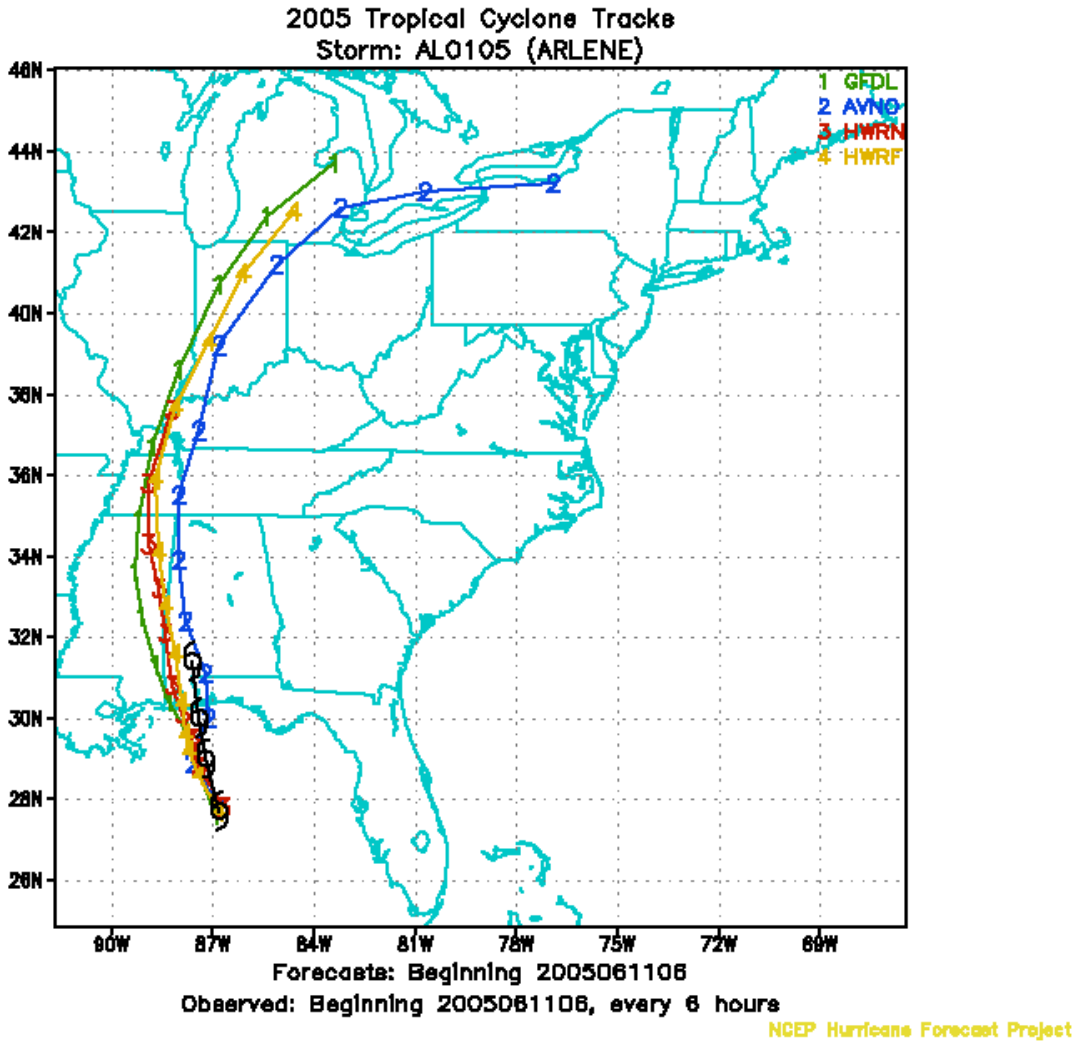


HWRF Agenda

- An active start for HWRF !
- Migrate to improved initial condition
- Migrate to GFDL-type physics + microphysics
- Begin forecast verification & analysis
- Initiate moveable, nested HWRF
- 2005 season ..nested runs
- 2005 season …uniform grid Forecast/analysis cycle



HWRF run of Arlene

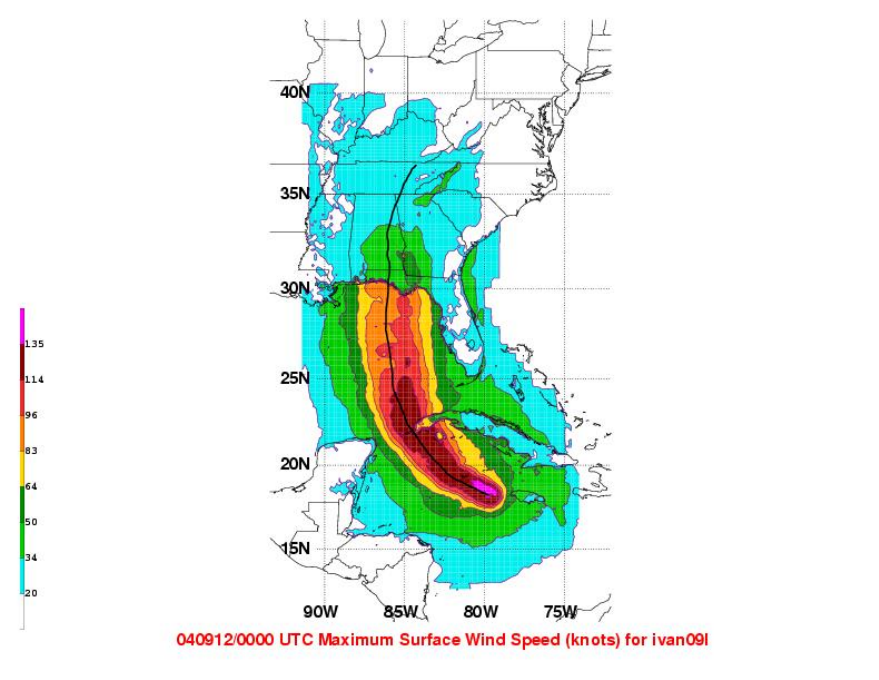


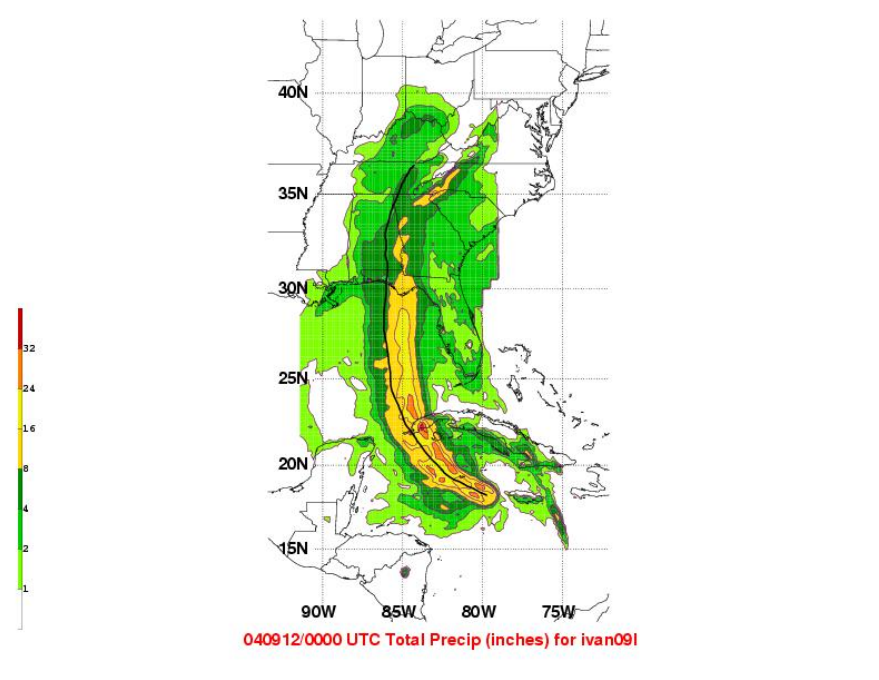
Additional HWRF products
Sfc Wind & Rainfall

Requires wrf output at shorter time interval

Puts strains on distributed software design

New products needed??



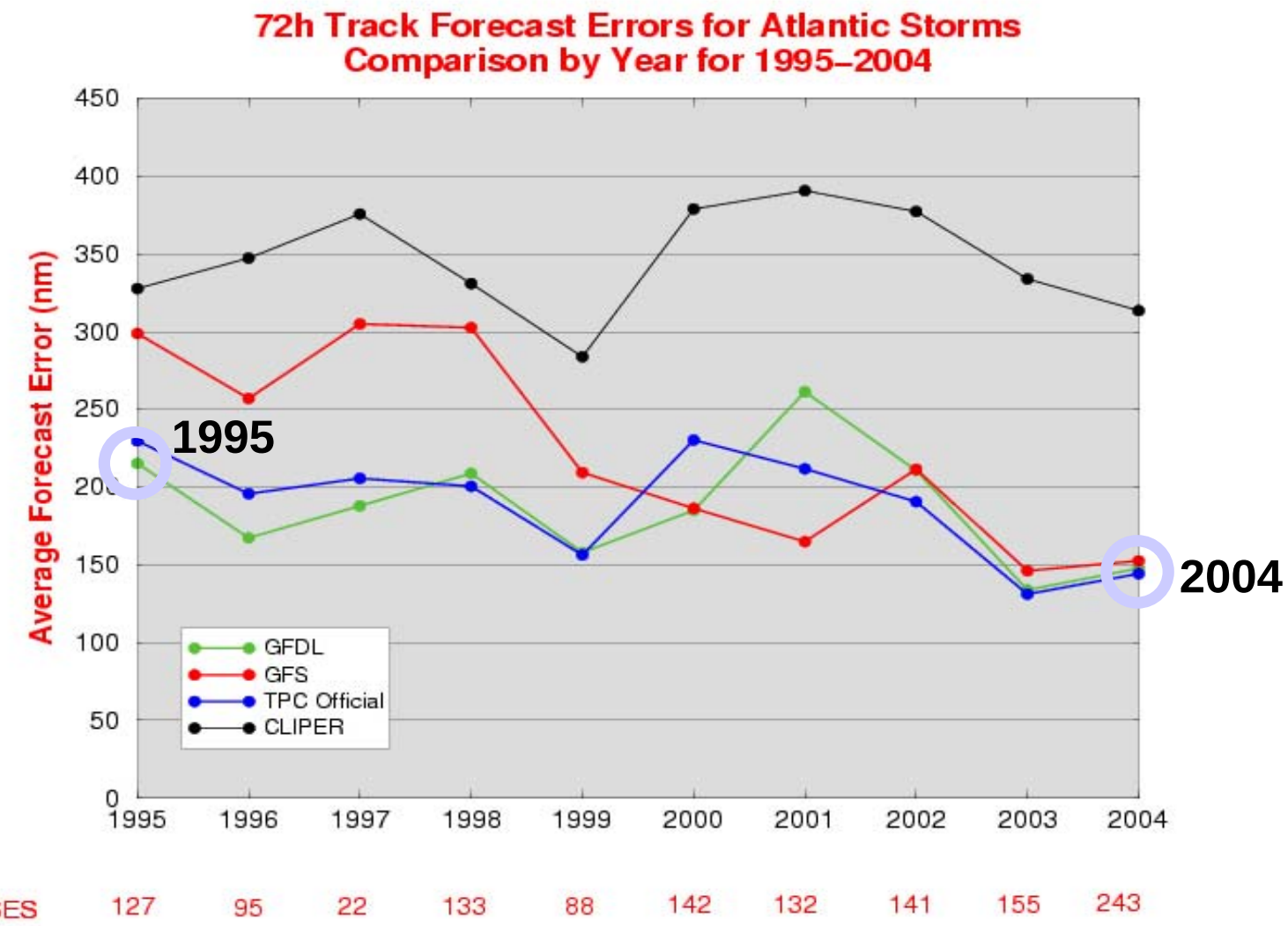


Summary & Plans
HWRF

- Can physics upgrades be made without degrading track while improving intensity and structure ???
- GFDL model initial conditions now available at 1/6º for WRF SI grib… ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/hur/prod/hur.yyyymmddhh

- Upgrade and evaluate physics….surface layer, lsm, microphysics, radiation
- Continue parallel HWRF runs…. forecast/analysis cycle ….initiate moveable, nested HWRF
- Compare with GFDL and other models

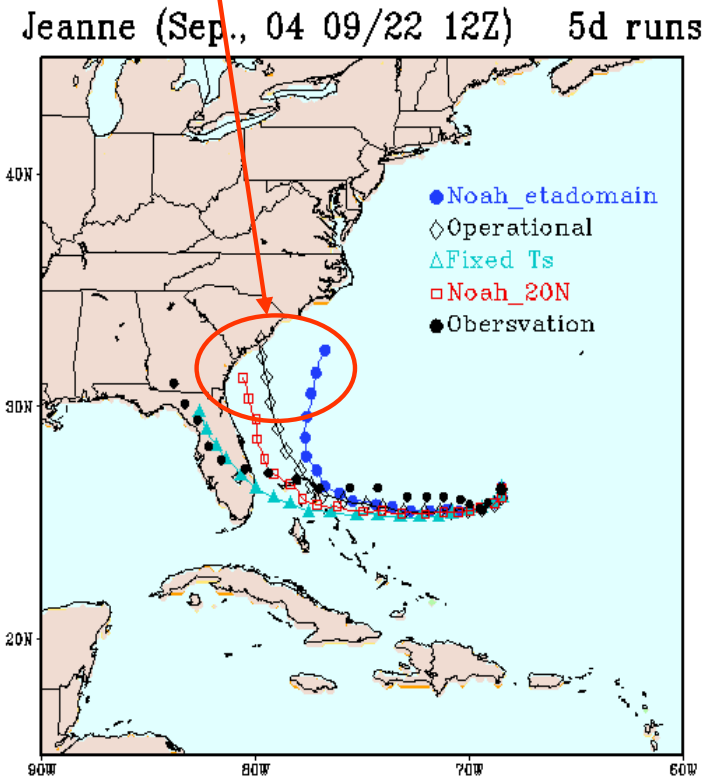
72h Forecast Errors for the GFS, GFDL and the Official Forecast Since 1995 in the Atlantic



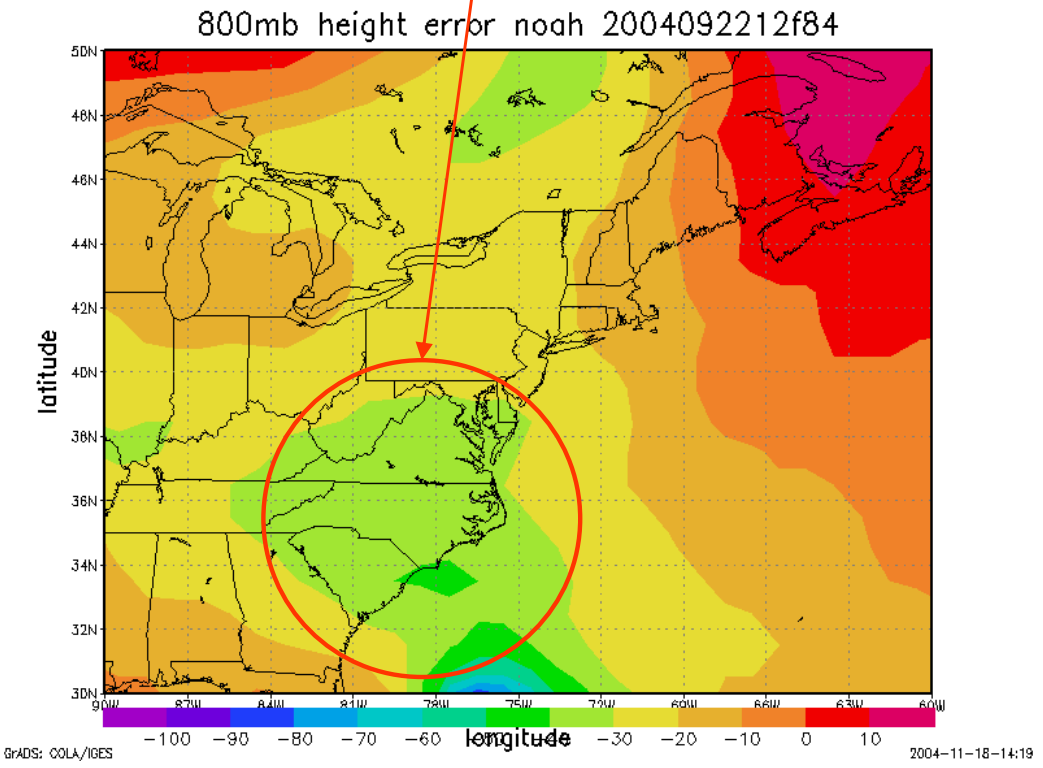
Breakdown in ridge leads to increased anomalous northward movement of Jeanne in coupled GFDL-LSM

Noah_etadomain: Noah lsm on the Edas land + slab over the rest
Operational: Slab lsm over land
Fixed Ts: Fixed land surface temperature everywhere
Noah_20N: Noah lsm above 20N + fixed over the rest

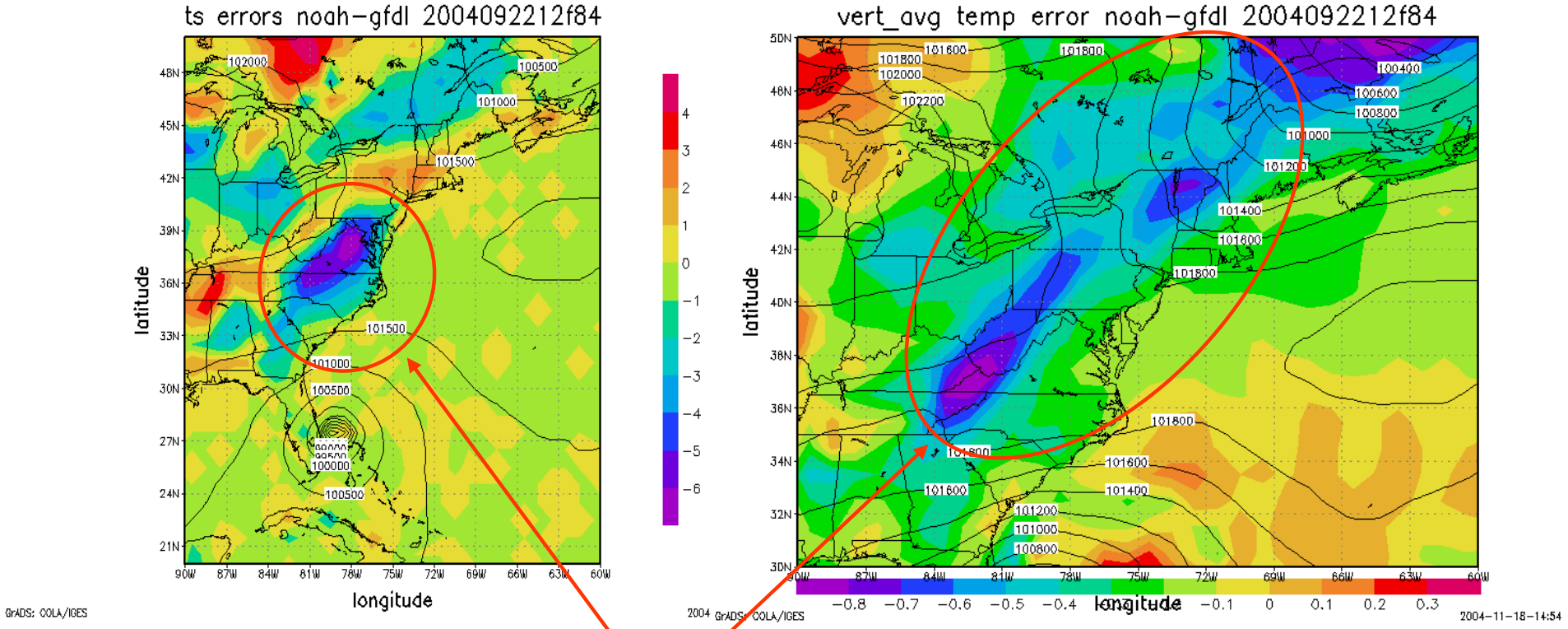
GFDL moves Jeanne north!!



heights too low



Coupled GFDL-LSM appears to have more accurate thermal field ….but ???



Improvements with LSM