# Improved Telescopic Nesting for Hurricane Forecasting

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Telescoping Nesting: What and Why?

Sample 27:9:3 Gustav Run
θ_e (K) at 650 mbar

- Some areas are more important than others

- Some areas need higher resolution than others
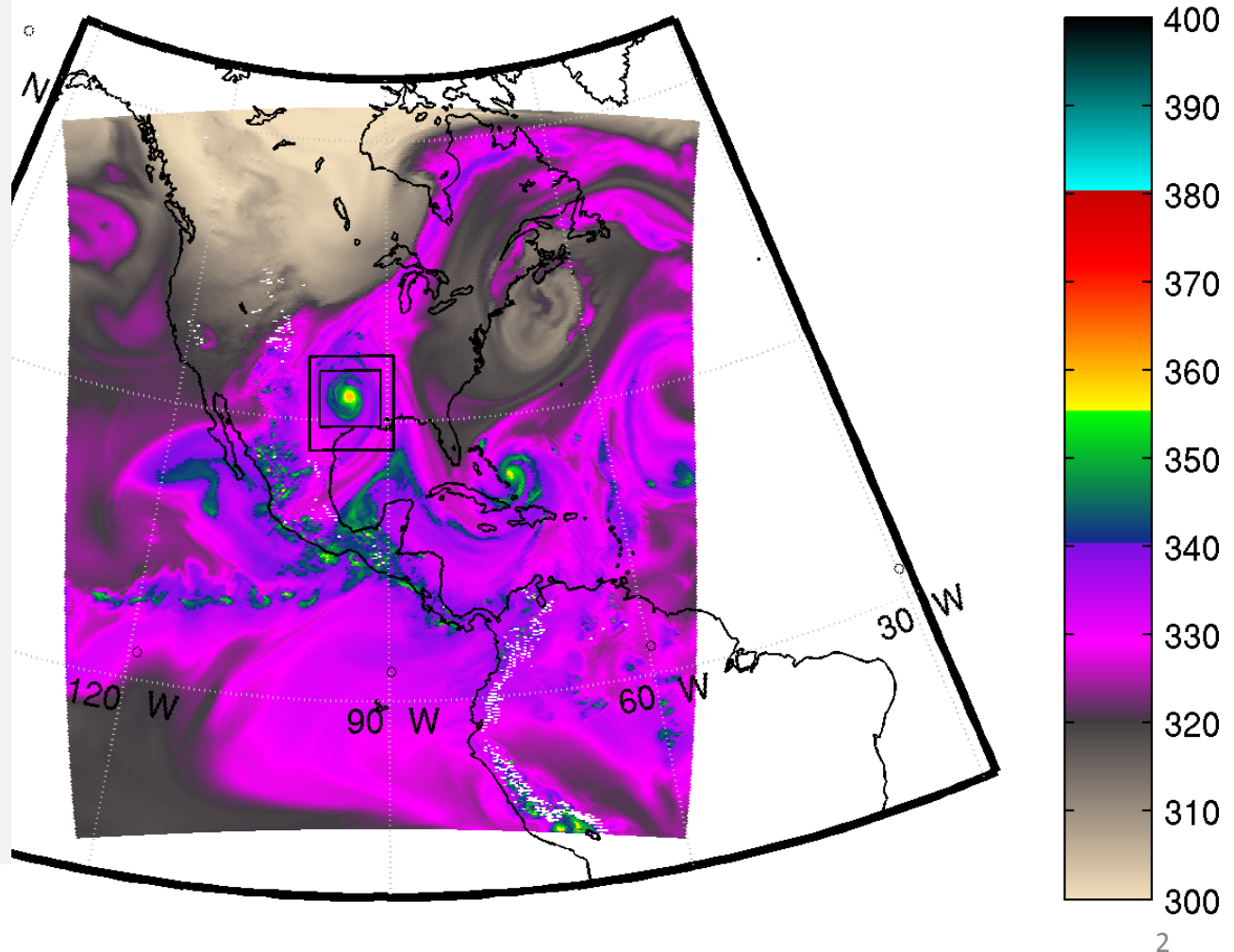
2012 Upgrade: 3km Resolution

- Hurricanes need higher resolution:
  - Need <4km for satellite products
  - <5km to represent wind maximum
  - <5km for mesovortices, vorticity waves
  - <3km for resolved convection
  - <1km for vorticity sheets
- Cannot do 3km everywhere. Too expensive!
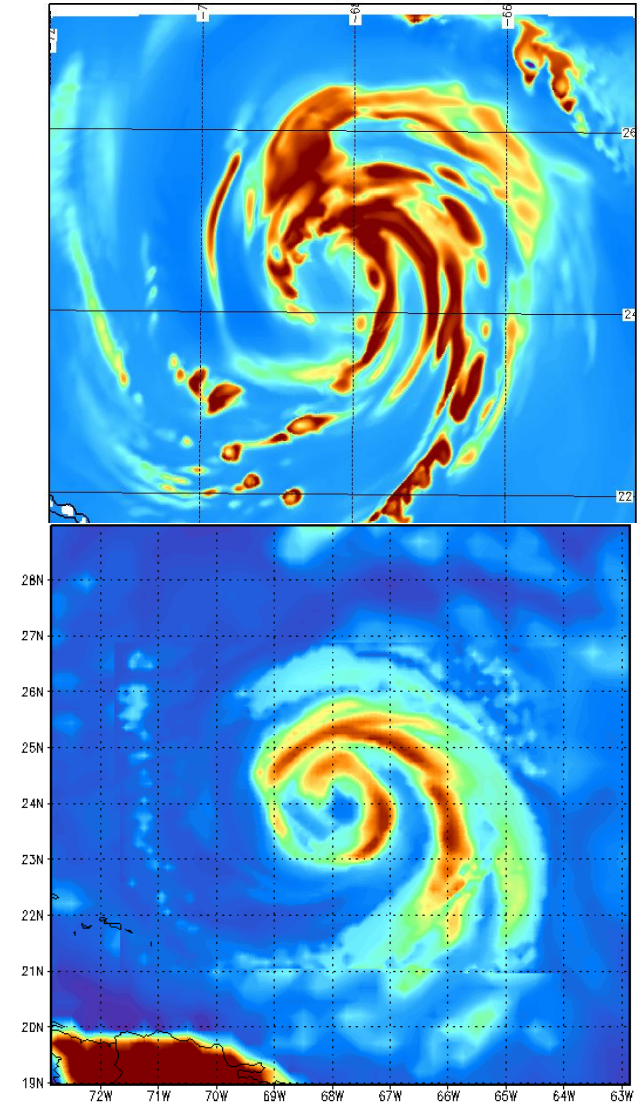
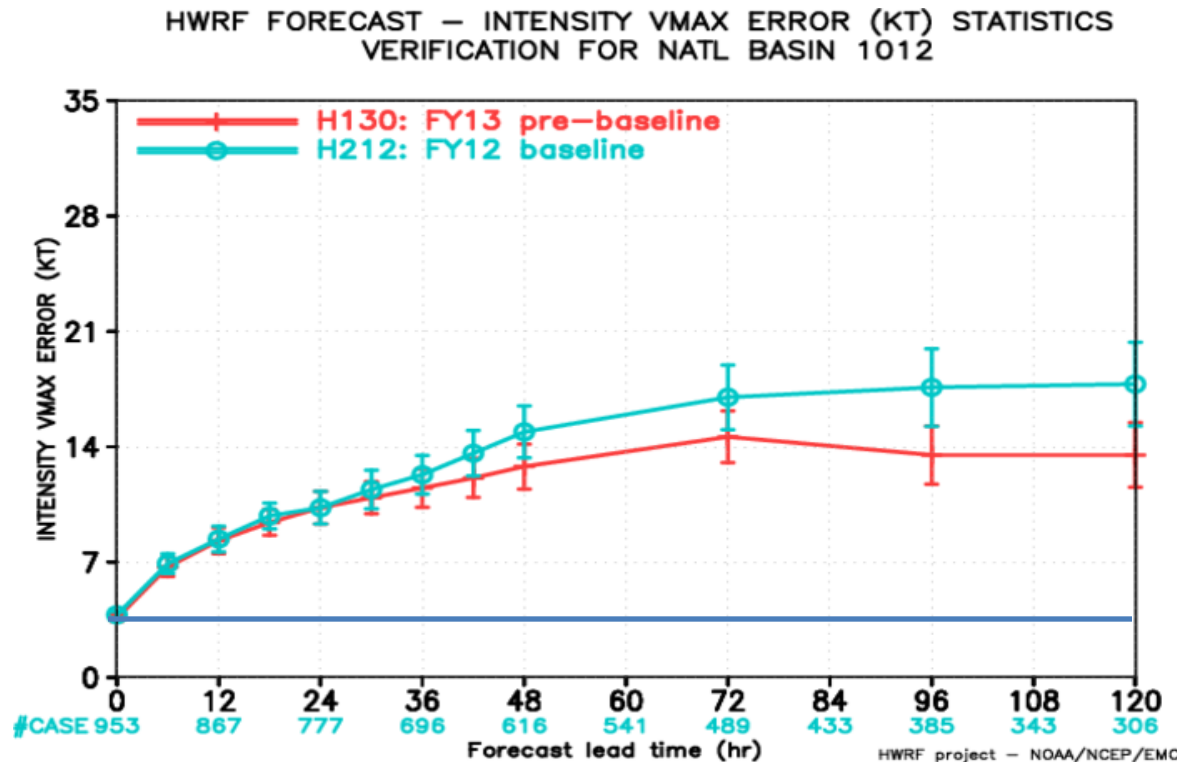# 27:9:3 2012 Implementation Problems Encountered

- Drastic improvement to track, improved structure, but *no improvement to intensity*
- Problems:
  - Domains did not properly follow storm
  - 3km domain too small
  - physics timestep too large
  - Convection scheme differences degrade synthetic satellite products.
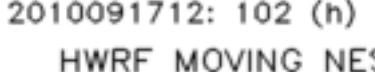
27:9:3 Planned 2013 Implementation Large Improvement

- Large 3km domain, smaller timesteps, better nest motion algorithm, improved nest-parent interpolation.

- and much more

HWRF FORECAST — INTENSITY VMAX ERROR (KT) STATISTICS VERIFICATION FOR NATL BASIN 1012

H130: FY13 pre—baseline
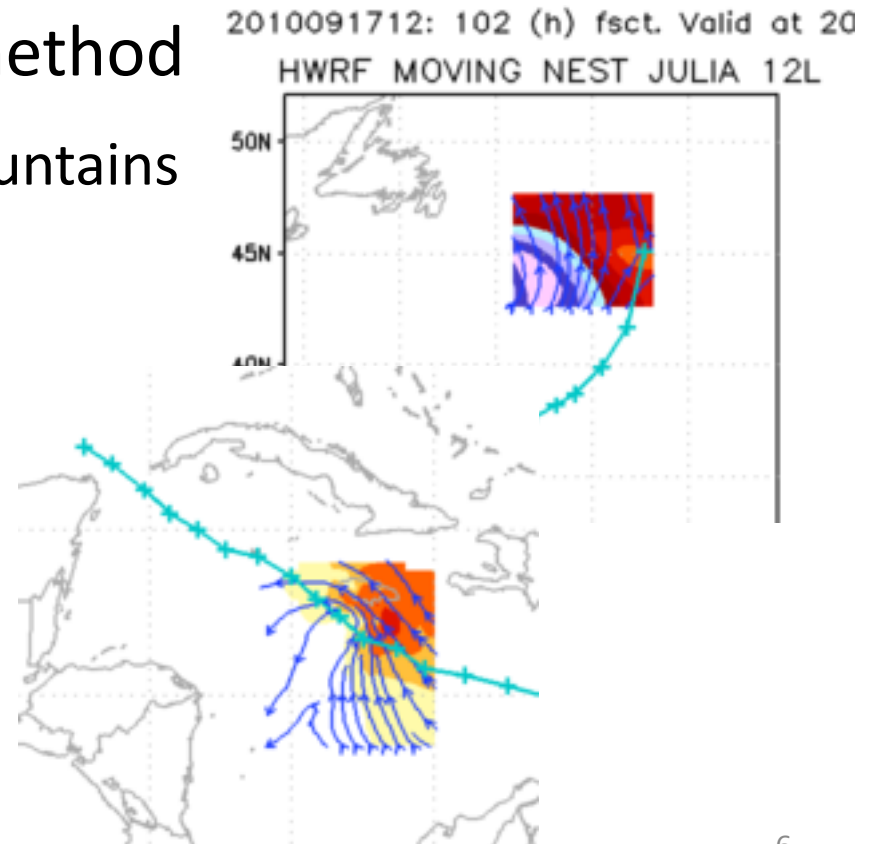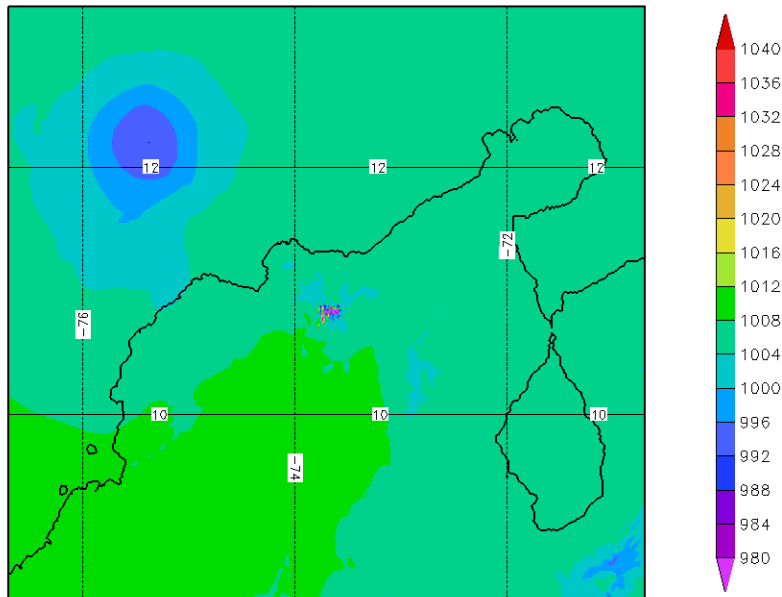H212: FY12 baseline

Nest Motion Trouble
MSLP Tracking No Longer Reliable

- 3km can resolve mesolows, vorticity sheets

  - Stronger localized MSLP values

- Bad MSLP calculation method

  - Spurious MSLP over mountains

2010091712: 102 (h) fsct. Valid at 20

HWRF MOVING NEST JULIA 12L

Experimental Product

Mean Sea Level Pressure [mb] for 53hr

Initial date: 2011102412

Nest Motion Solution
Membrane MSLP

$$dP = -\rho g dz$$

$$\nabla^2 T_v = 0$$
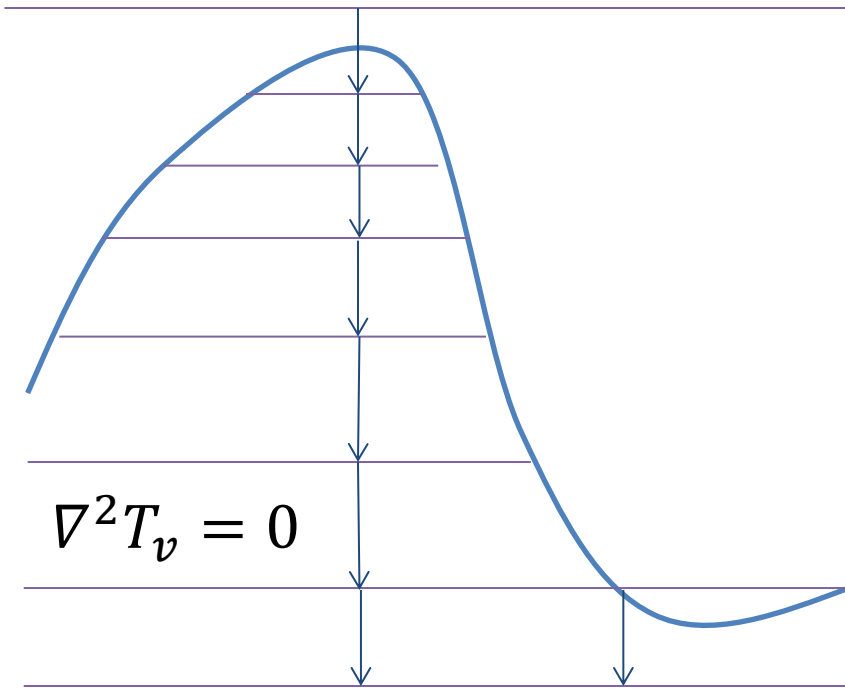
- Re-express atmosphere as ocean world on pressure levels

- Extrapolate virtual temperature on pressure surfaces

- Smooth atmosphere

- Integrate to get P(z=0)

Nest Motion Solution
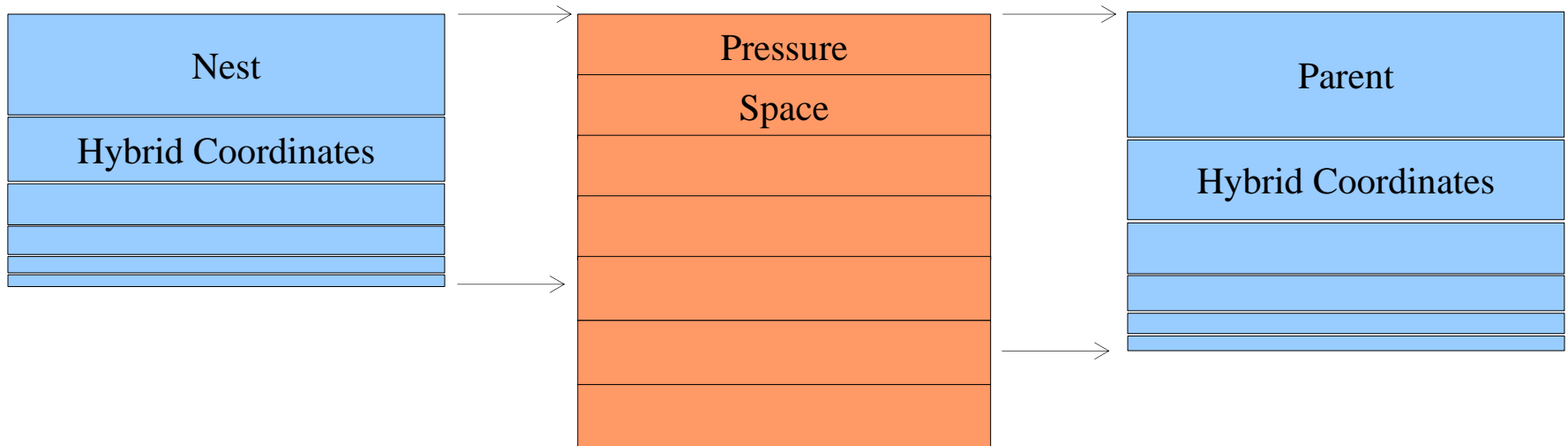## Nine Field Tracker

- MSLP alone is not enough

- Track nine thermodynamic and wind fields
  - Used in NCEP Tracker for storm track and intensity
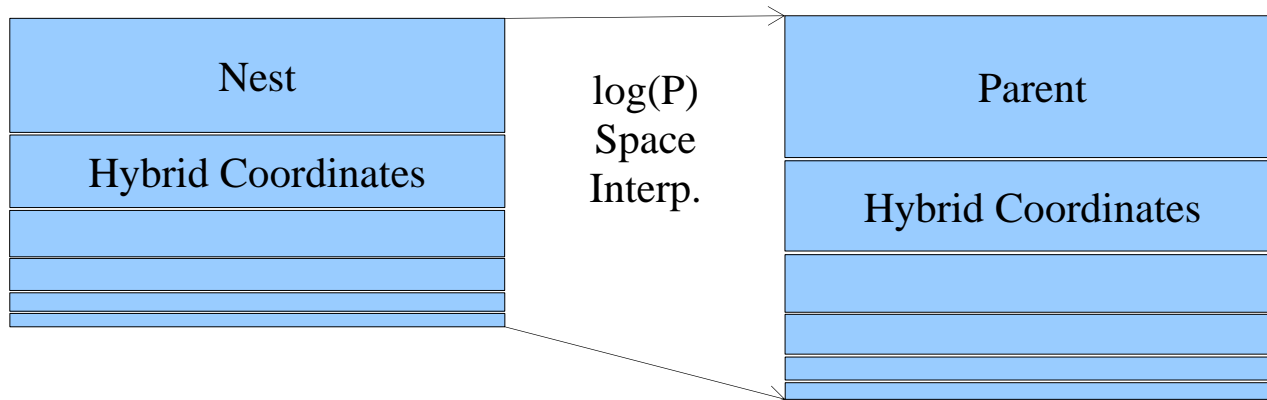 - Parallelized, modified for E grid rotated lat-lon
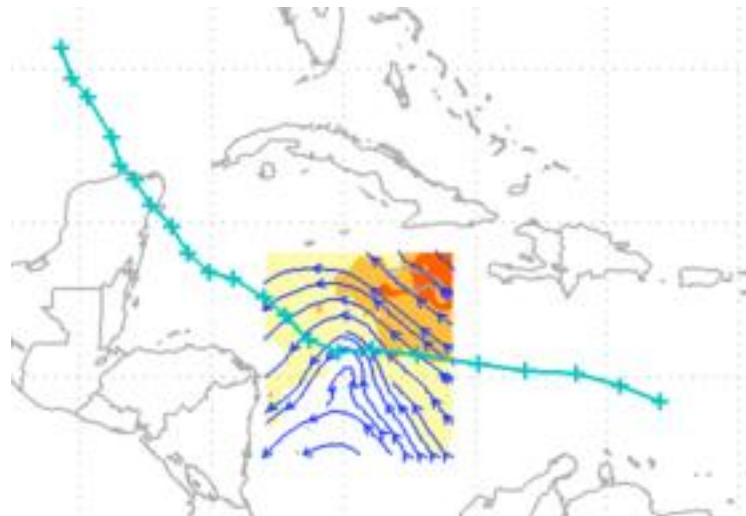
New Nest-Parent Interpolation
(also parent to nest)
Old Method: Two Step Interpolation

New Method: Single Step

New Nest-Parent Interpolation
## (also parent to nest)

- Allows non-bulk microphysics

  - Tested with Thompson and WSM6 schemes

- Faster

- Improved upscale interpolation

Larger Domain, Smaller Timesteps

- 5x5 degree grid too small – go to 6x6 degree
  - 50% more gridpoints (expensive!)
  - Affordable on new Intel/Linux WCOSS machines.
- Smaller physics timesteps:
  - 27km: 180 sec -> 90 sec
  - 9km: 180 sec -> 90 sec
  - 3km: 180 sec -> 30 sec

Improved Synthetic Satellite Products
Work in Progress
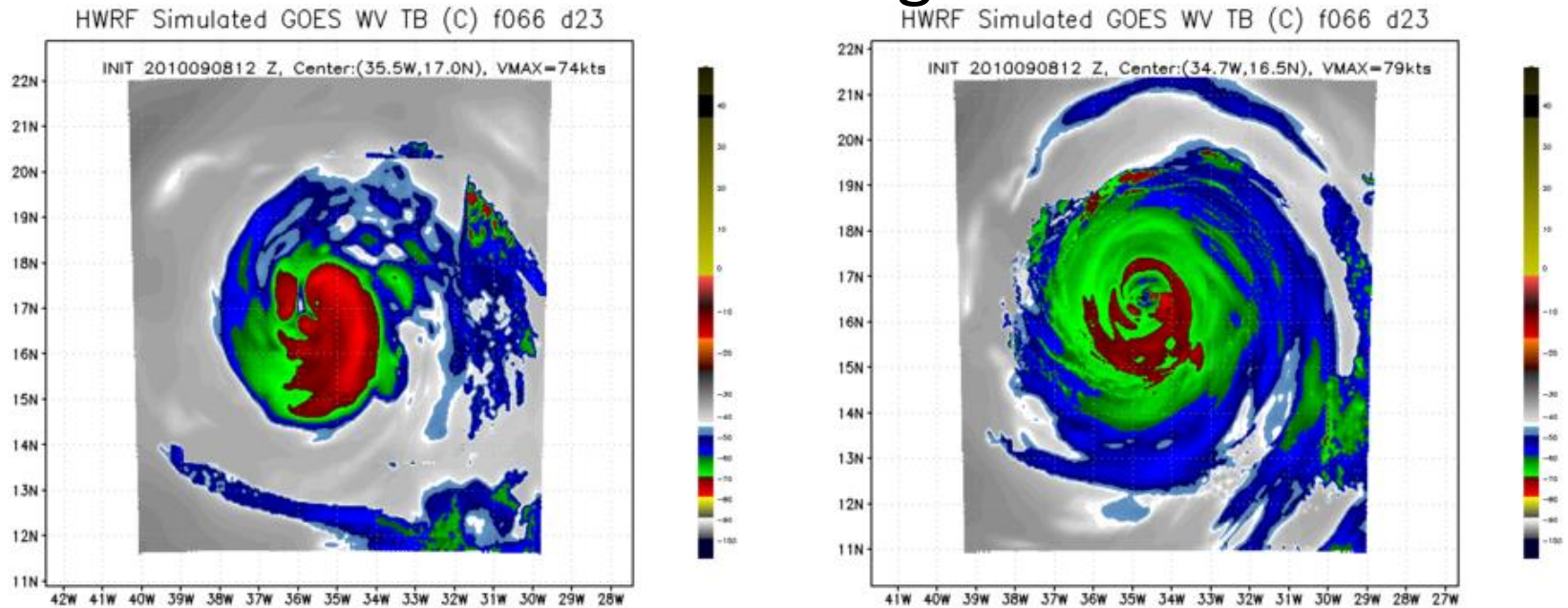
- Convection scheme in 27km, 9km domain, but not 3km.
- Post includes convective rain when calculating synth. sat.
- Result: discontinuities in satellite products.
- Meso-SAS convection scheme (work in progress)
  - Degradation of intensity skill
  - Working on fixing this

Conclusion

- Improved telescopic nesting in planned next HWRF model:

  - Larger domain, smaller timesteps, better nest motion algorithm, new interpolation schemes

  - Drastic improvements to intensity skill

- Developing better convection scheme to fix satellite product issues.