

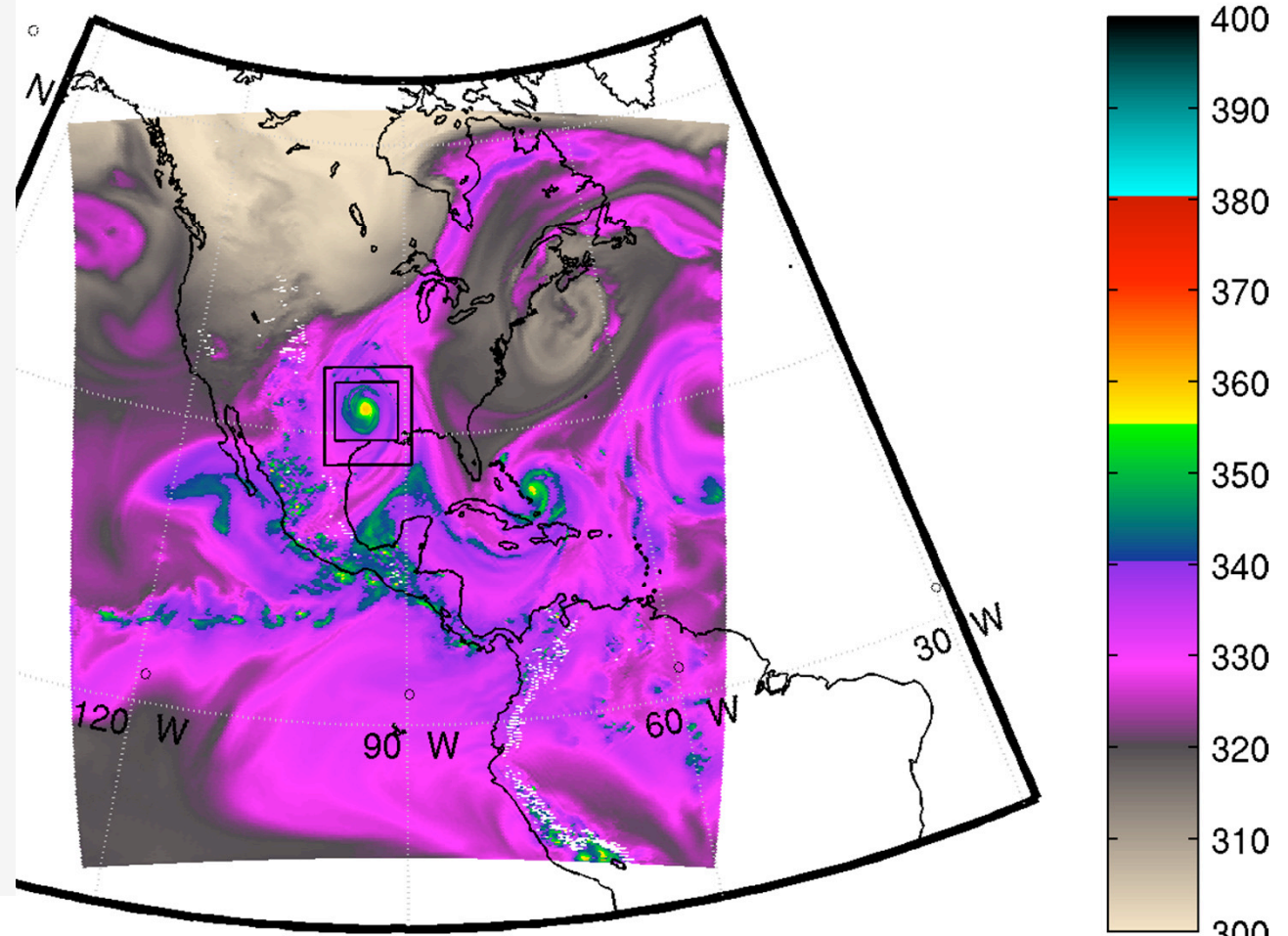
Improved Telescopic Nesting for Hurricane Forecasting

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Telescoping Nesting: What and Why?

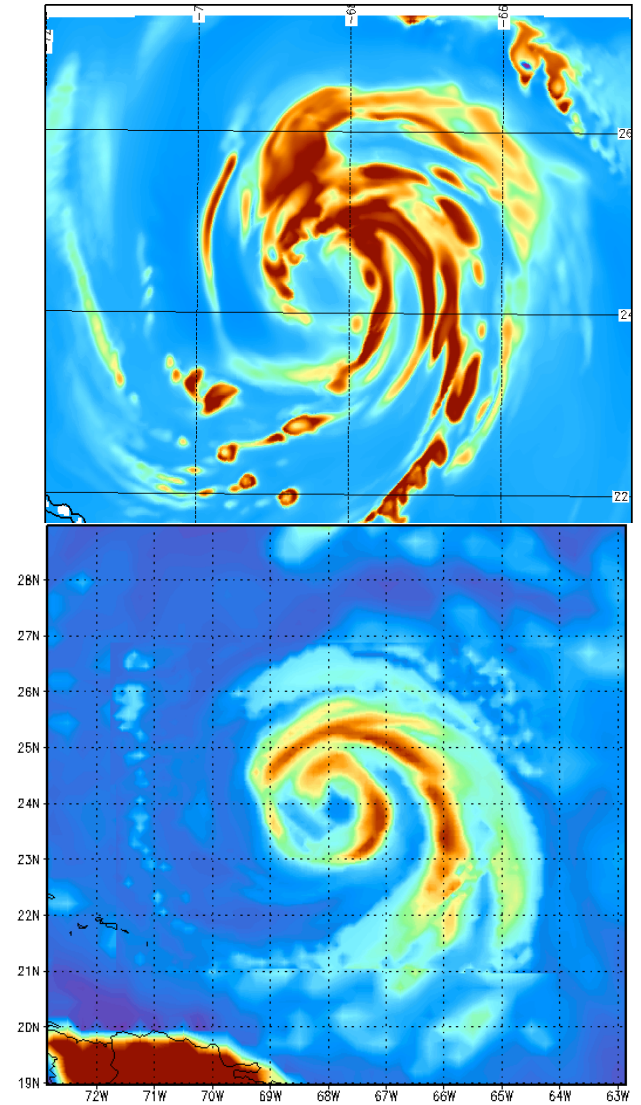
Sample 27:9:3 Gustav Run
 θ (K) at 650 mbar
e

- 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

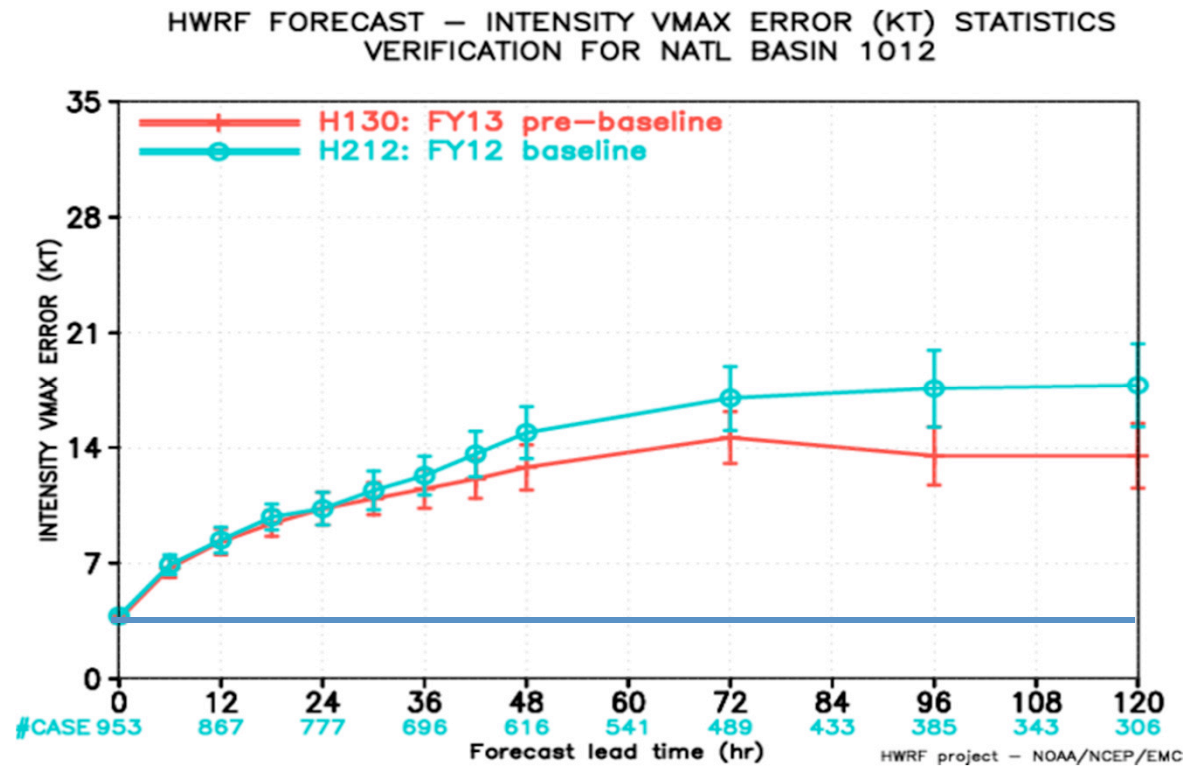
Problems Encountered

- 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



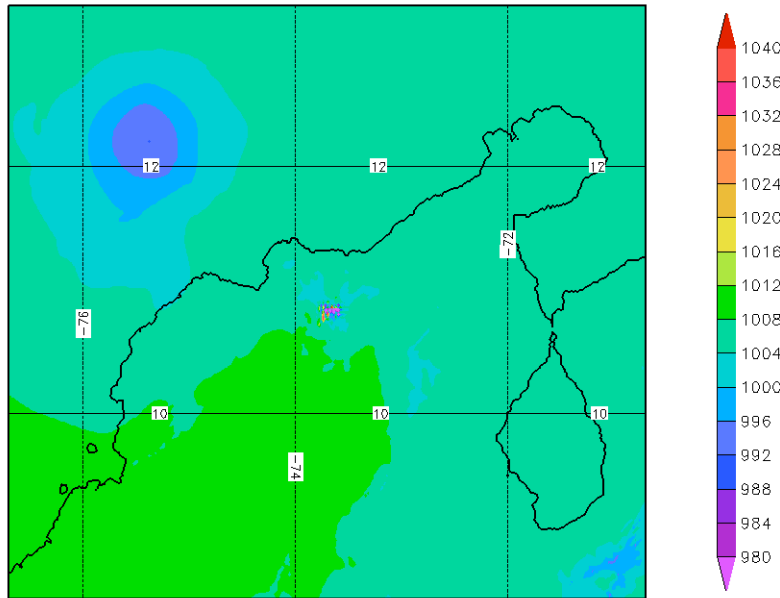
Nest Motion Trouble

MSLP Tracking No Longer Reliable

- 3km can resolve mesolows, vorticity sheets
 - Stronger localized MSLP values
- Bad MSLP calculation method
 - Spurious MSLP over mountains

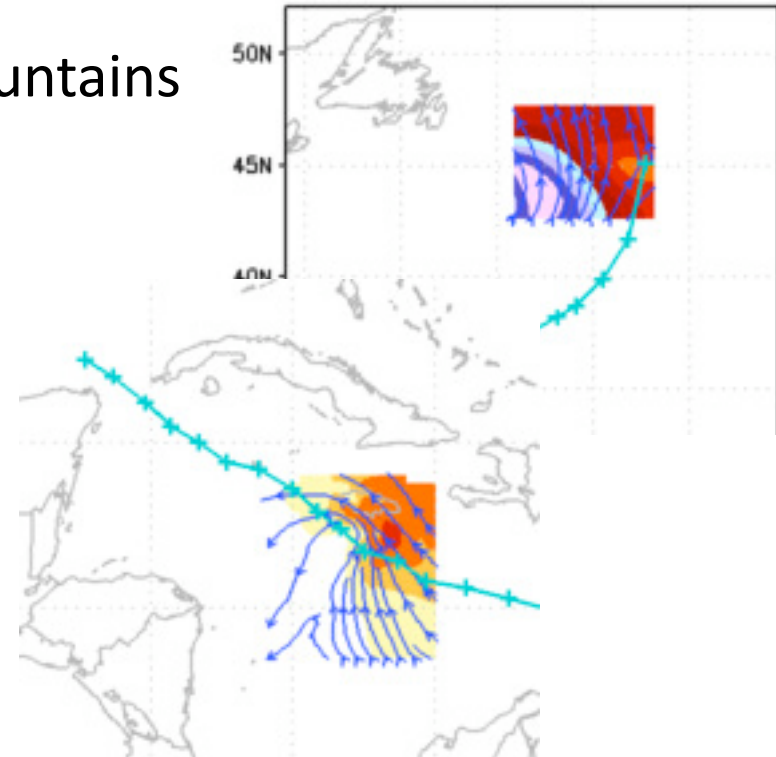
Experimental Product

Mean Sea Level Pressure [mb] for 53hr



Initial date: 2011102412

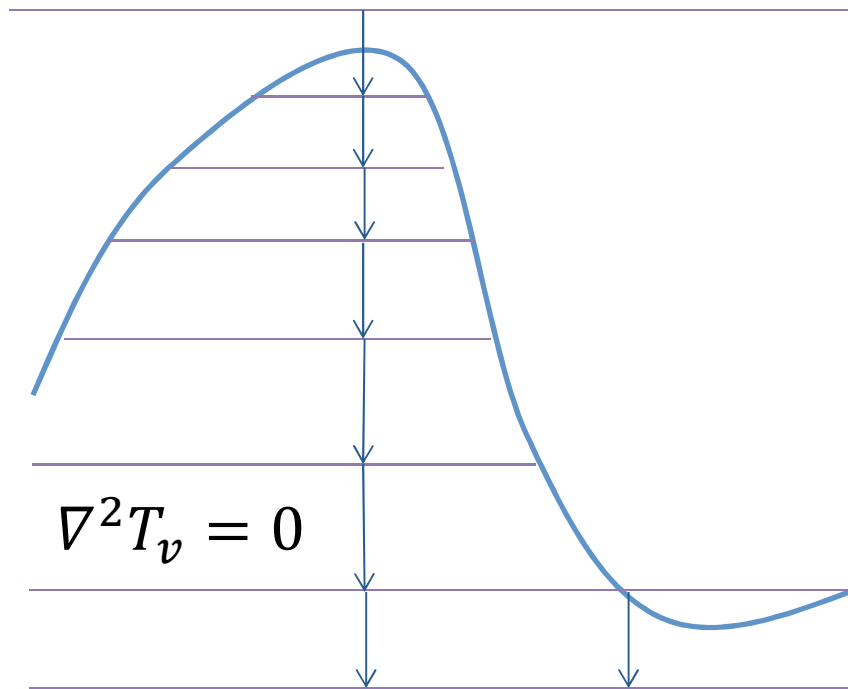
2010091712: 102 (h) fscf. Valid at 20
HWRP MOVING NEST JULIA 12L



Nest Motion Solution

Membrane MSLP

$$dP = -\rho g dz$$

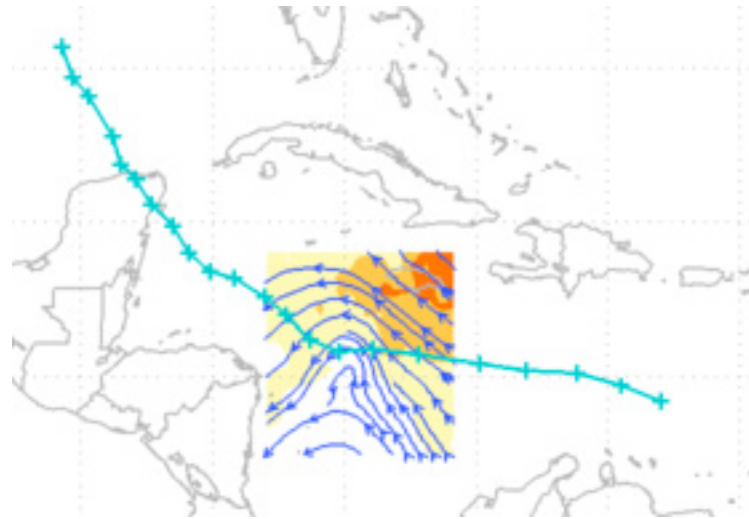


- Re-express atmosphere as ocean world on pressure levels
- Extrapolate virtual temperature on pressure surfaces
- Smooth atmosphere
- Integrate to get $P(z=0)$

Nest Motion Solution

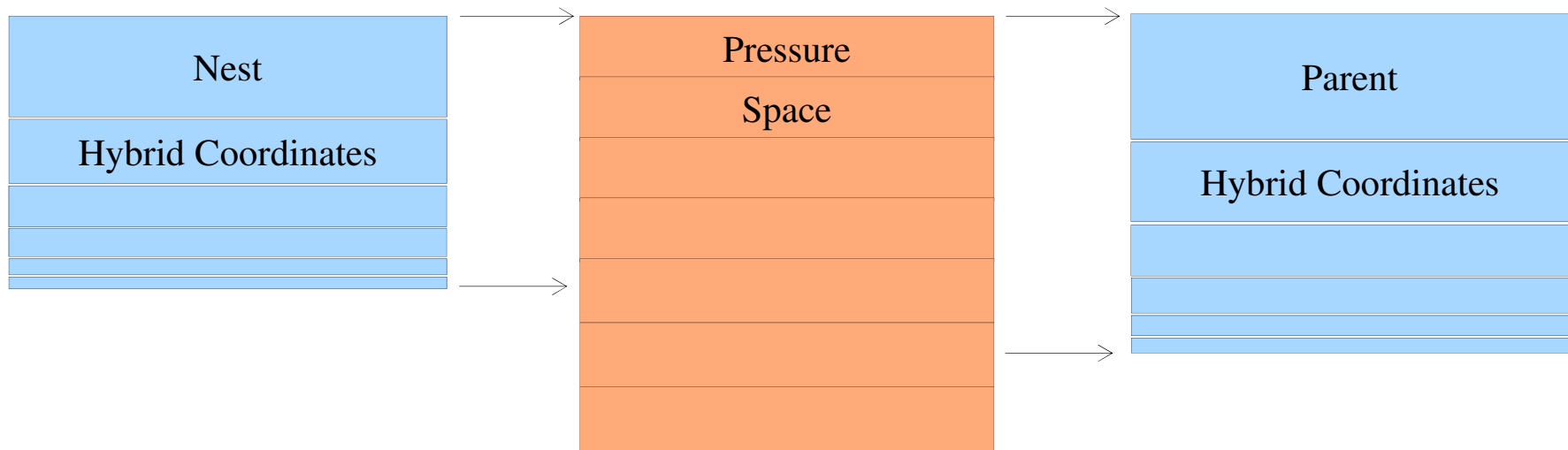
Nine Field Tracker

- 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

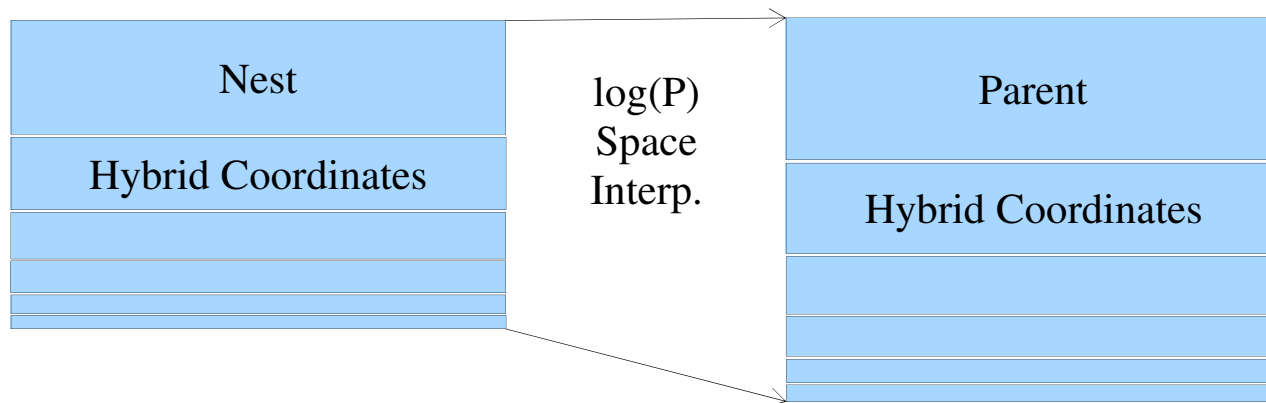


New Nest-Parent Interpolation (also parent to nest)

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

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