UW Stream 1.5 Candidacy

2010 HFIP Annual Meeting

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9 November 2010

- UW-NMS and why it’s different
- Where we are currently
  - Current configuration / physics / datasets
  - Initialization
- Where we plan to be Spring 2011
- Demonstrated real-time operation

University of Wisconsin Nonhydrostatic Modeling System

- Enstrophy, entropy and kinetic energy conserving dynamics core – unique among regional models
- Would add diversity to roster dominated by WRF players (good thing for multi-model ensemble)

Enstrophy Conserving Dynamics

- Lamb Vector Form of Momentum Equations employed

$$\underbrace{\frac{\partial \mathbf{V}}{\partial t}}_{TOTAL} = \underbrace{\mathbf{l}}_{\text{LAMB VECTOR}} \underbrace{-\nabla k}_{\text{KEGRAD}} \underbrace{-\theta_v \nabla \pi + \mathbf{g}}_{\text{NPGRAD}} \underbrace{+\mathbf{F}^1 + \mathbf{F}^2 + \mathbf{F}^3}_{FRICT}$$

where the Lamb vector is defined as:

$$\mathbf{l} = \rho \mathbf{V} \times \eta$$

an where the 2D potential vorticity is

$$\eta = \frac{\varsigma + \mathbf{f}}{\rho}$$

and the absolute potential vorticity is:

$$\varsigma = \nabla \times \mathbf{V}$$

recall the density is defined as:

$$\rho = \rho_d + \rho_v + \rho_l + \rho_i$$
$$= \rho_m \left(1 + q_l + q_i\right)$$

Enstrophy Conservation (continued)

- 3D enstrophy and KE conserving operator employed
- 3D dynamic balance better represented
- Numerically consistent vorticity production by Lamb vector curl
- Perfect numerical 2D potential vorticity conservation
- Numerical coupling with entropy prediction to ensure near perfect Ertel potential vorticity conservation
- ***Numerical erosion of vortex reduced or eliminated***

Current Operational Configuration

- 3 grids
  - 60km (145 x 145 points)
  - 12km (92 x 92 points)
  - 4km (122 x 122 points)
- 33 vertical levels
  - 200m stretched to 1000m (model top ~ 24km)
- Coupled to 1.5 layer ocean
- Currently, 126-hr forecast requires ~5 hours

Current Physics

- RRTM shortwave / longwave
- NOAH LSM
- Tripoli / Flatau 2-moment bulk microphysics
- CMEE cumulus parameterization (grid 1 and 2)*
- Andreas Sea-Spray parameterization*
- New level 1.5 TKE scheme*

*under stream 2 development

Datasets

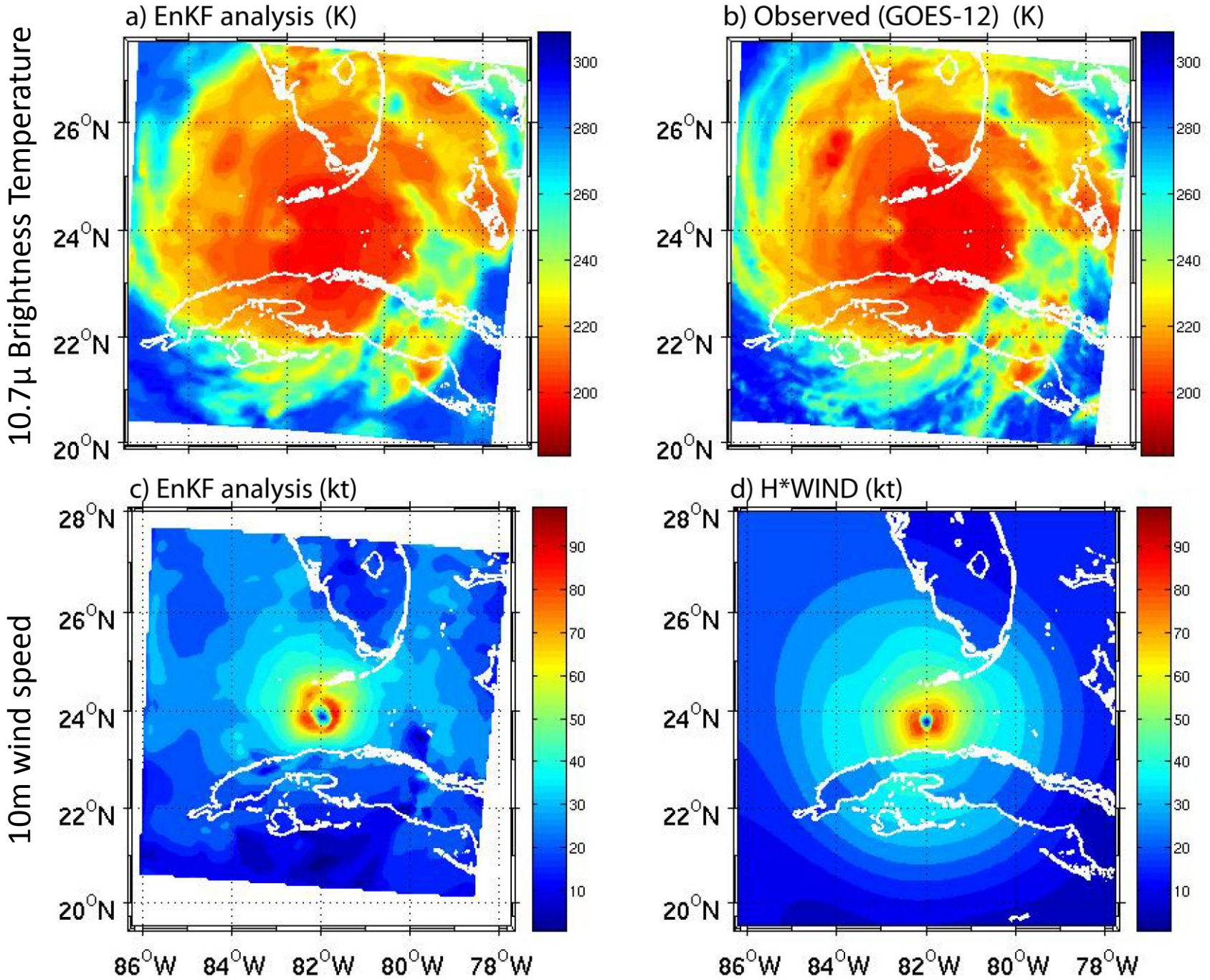
- GFS 1-degree analysis and forecasts
- FNMOC 9-km SST (updated 4X daily)
- Levitus 0.25 degree monthly ocean climatology (NODC)

Bogus Vortex Initialization

- Implemented Kwon and Cheong (2010) bogus vortex for use with UW-NMS
- Fewer spin-up problems than GFDL bogus, and no need to wait for GFDL files (saves ~2 hours)
- Potential for further refinement and ensemble generation (free ensemble forecast and DA)

EnKF

- Implementation of the UW-NMS EnKF will begin on Jet during the next few weeks
- Assimilation of raw geostationary satellite observations (IR, WV, SWIR) is our priority, but other satellite (passive microwave, satellite winds) as well as conventional and airborne data to be assimilated as well
- Testing thru spring 2011, plan to be ready for real-time summer 2011


10.7μ Brightness Temperature
a) EnKF analysis (K)
b) Observed (GOES-12) (K)
10m wind speed
c) EnKF analysis (kt)
d) H*WIND (kt)
26°N
24°N
22°N
20°N
28°N
86°W
84°W
82°W
80°W
78°W
300
280
260
240
220
200
90
80
70
60
50
40
30
20
10

Real-time Capability

- Stream 2 provided opportunity to demonstrate capability for executing and delivering forecasts 4X daily
- > 500 forecasts since June (AL, EP, CP)
- Completion of Retro Case runs anticipated spring 2011 (after completion of remaining stream 2 goals: physics and data assimilation)