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# Radiance Assimilation In a Mesoscale Model for Improving Hurricane Track Forecast

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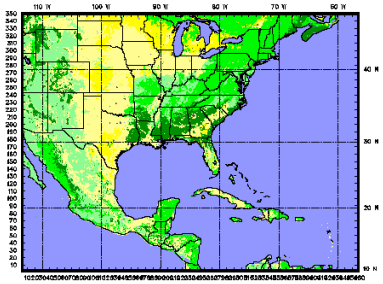
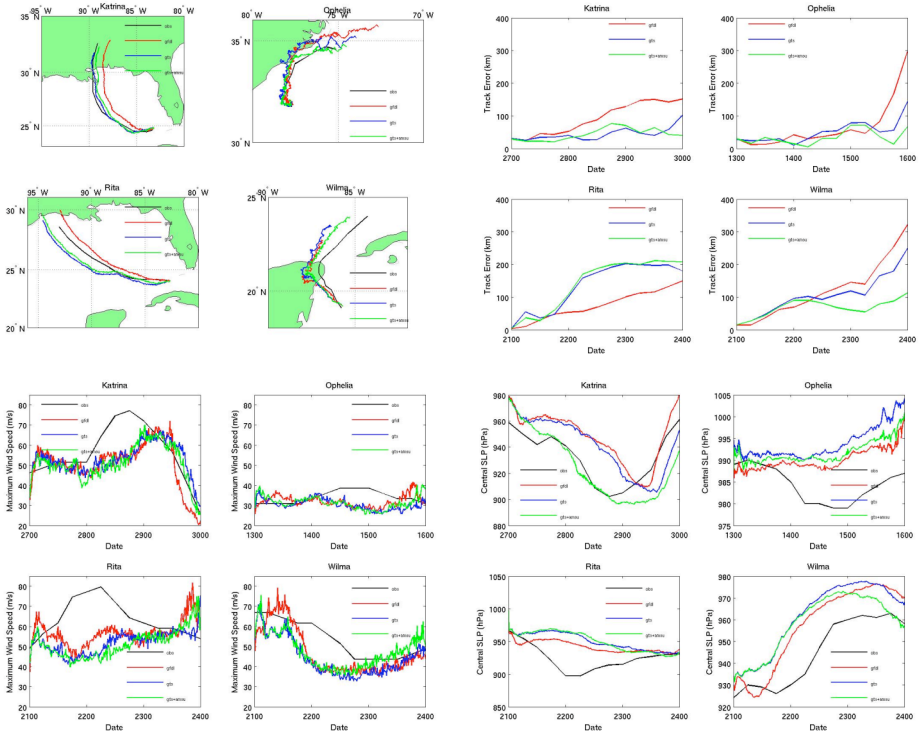
## Introduction

Direct satellite radiance assimilation in Weather and Research Forecast Variational Assimilation (WRF-Var) system was implemented in the past two years for improving analysis and forecast at mesoscale (Liu and Barker, 2006). The system incorporates two widely used radiative transfer model, CRTM and RTTOV, into WRF-Var system. This study investigates the potential of assimilating microwave radiance from NOAA AMSU instruments for improving hurricane track forecast using NCAR WRF-ARW model. 4 cases from 2005 Atlantic Hurricane season are investigated.

## 2005 Hurricane Experiments with Advanced Hurricane WRF

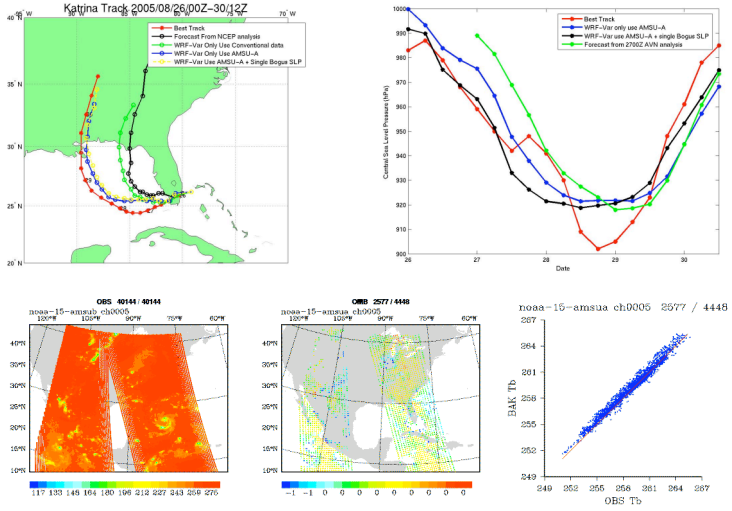
- 4 cases (Initial time is at 00Z):
  Katrina (0827), Ophelia (0913), Rita (0921), Wilma (1021)
- 72h forecasts with the Advanced Hurricane WRF (AHW)
  - -Two nested domains of 4km and 1.33km grid spacing track the vortex within a fixed parent domain of 12km grid spacing. The smallest grid spacing is necessary to resolve inner core dynamics.
  - - AHW is coupled to a simple columnar ocean-mixed layer model to capture the first order negative impact of the ocean on cyclone development.
  - -Physics: YSU boundary layer; explicit convection in the nests; WSM3 microphysics surface drag increases linearly with wind speed up to a maximum at about 35m/s.
- 3 experiments:
  - –GFDL initialization (no WRF-Var data assimilation)
  - –GTS (WRF-Var with only conventional data assimilation)
  - –GTS+AMSU (conventional + AMSU-A/B assimilation)
    - –AMSU-A channels 5~9, AMSU-B channels 3~5

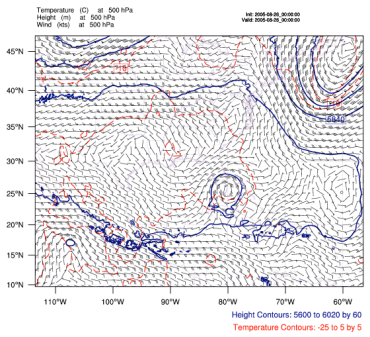




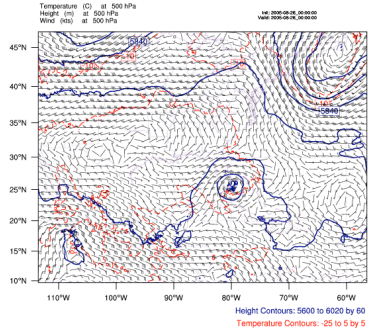

## Katrina Case at 00Z 26th Aug. 2005

Model: WRF-ARW with 12km*51L, (not nested), model top at 10hPa, WSM3
Assimilation Experiments: use WRF-ARW 6h forecast initialized from NCEP GFS analysis at 18Z 25th as the background for WRF-Var assimilation




**GFS Initial Condition**




**Initial Condition of Assimilating AMSUA+1 SLP**

## Summary

- Radiance assimilation is useful to improve Hurricane track forecast by a better representation of environment field over sea where other data is limited.
- Radiance data seems to be not helpful for intensity forecast, given that radiance observations over votex are mostly discarded due to inability of current assimilation scheme over cloudy/precipitating conditions.
- Assimilate an additional Sea Level Pressure observation at votex center can help to some extent intensity analysis and forecast

## Reference

Liu, Z.-Q. and Barker, D. M., 2006. Radiance Assimilation in WRF-Var: Implementation and Initial Results. 7th WRF users??? workshop, Boulder, Colorado, 19-22 June 2006. http://www.mmm.ucar.edu/wrf/users/workshops/WS2006/abstracts/Session04/4_2_Liu.pdf