

Regional Data Assimilation of AIRS Profiles and Radiances at the SPoRT Center

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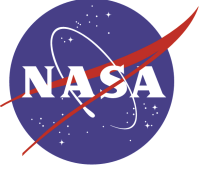
NASA/MSFC

NASA Sounder Science Team Meeting

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- ◆ SPoRT Overview
- ◆ Overview of WRF-Var AIRS Profile Assimilation Set-Up
- ◆ Results
- ◆ Explanation of Results/Lessons Learned
- ◆ Conclusions



NASA's Short Term Prediction Research and Transition (SPoRT) Center

Mission: Apply NASA measurement systems and unique Earth science research to improve the accuracy of short-term (0-24 hr) weather prediction at the regional and local scale

(<http://weather.msfc.nasa.gov/sport/>)

- ◆ Test-bed for rapid prototyping of new products
- ◆ Development of new products is end-user driven
- ◆ Transition research capabilities/products to operations
 - real-time MODIS and GOES data and products to NWS weather forecast offices and private companies (e.g. Worldwinds, Inc., The Weather Channel)
- ◆ Development of new products and capabilities for transition
 - MODIS SST composites, AMSR-E rain rates, ocean color products
- ◆ AIRS Data Uses/Plans
 - Regional assimilation of L2 temperature and moisture profiles into regional model (Chou, Zavodsky)
 - Regional assimilation of L1B radiances into regional model (McCarty; paper published in JGR)
 - L2 temperature and moisture profile product
- ◆ All work with AIRS has application to other current (IASI) and future (CrIS) instruments



transitioning unique NASA data and research technologies to the NWS



Past Work with WRF-Var

- ◆ Developed and tuned WRF-Var system to assimilate AIRS L2 temperature and moisture profiles for more realistic-looking analyses and forecasts
 - generated background error covariance matrix using control WRF forecasts and internal “gen_be” software (NMC method)
 - altered source code to add AIRS profile data sets as separate land and water sounding data types with separate error characteristics
- ◆ Knowledge gained through these experiments can be applied to other hyperspectral sounder data (e.g. IASI, CrIS, etc.)
- ◆ Have examined over a month of analyses and forecasts
- ◆ We initially found mixed results with forecasts containing AIRS profiles with better results at later forecast hours
- ◆ What follows is an overview of the some lessons learned in data assimilation of AIRS thermodynamic profiles in our



WRF-Var Setup Overview

AIRS QI's for 17 Jan 2007

- ◆ L2 Version 5 temperature and moisture profiles
- ◆ 28-level standard product
- ◆ Land and water soundings w/ separate errors
- ◆ Quality control using P_{best} value in each profile

Current Analysis Error Characteristics

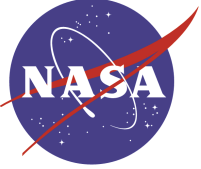
BKGD

AIRS water

AIRS land

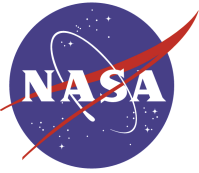
- ◆ WRF initialized with 40-km NAM at 0000 UTC
- ◆ 12-km analysis and model grid
- ◆ Short WRF forecast used as background for analysis





Overview of Results

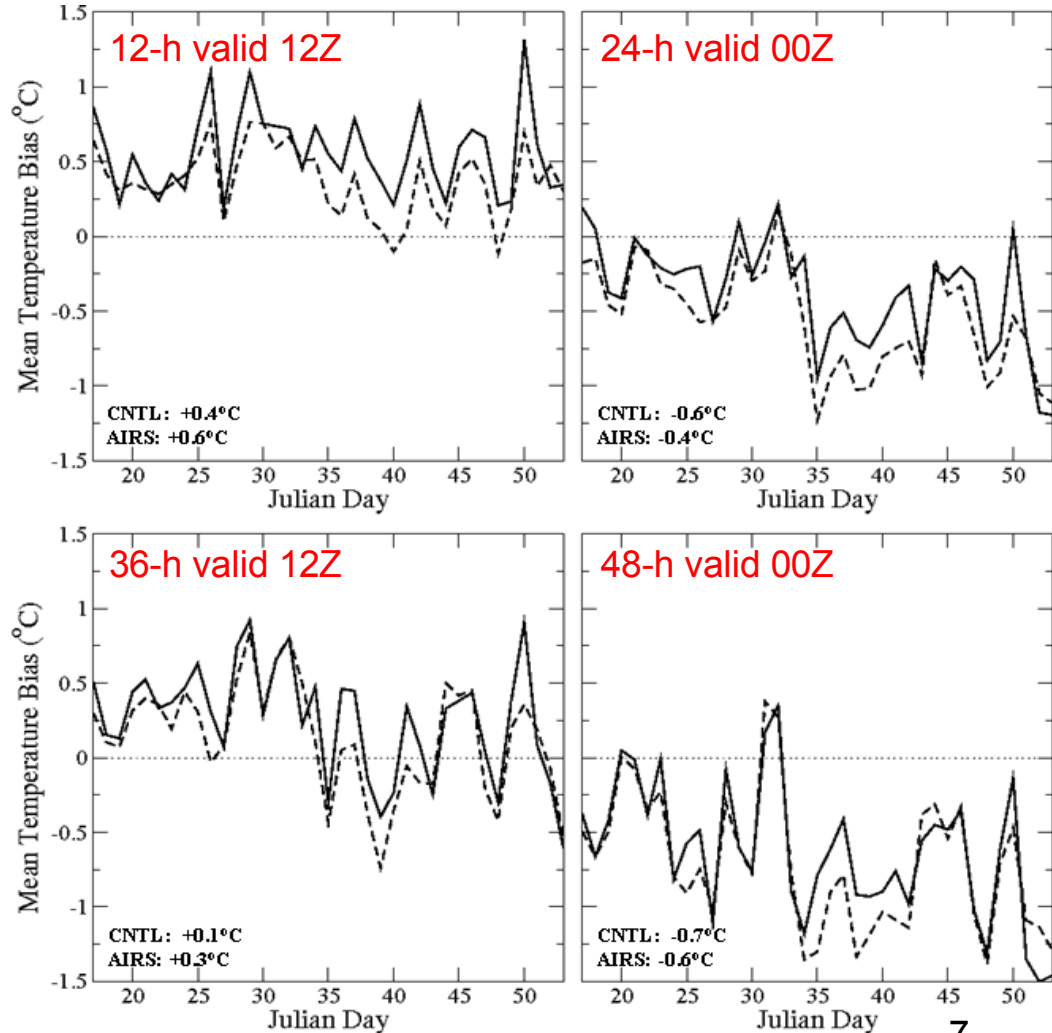
- ◆ Mixed results
- ◆ show high MSLP fields
- ◆ show mixed temperature results



Cold Bias in WRF Forecasts with Dudhia Scheme

- ◆ AIRS-NAM (solid) seems warm biased at most days in lowest levels compared to CNTL-NAM (dashed) throughout forecast cycle
- ◆ Dudhia SW Radiation Scheme in WRF model used for this experiment
 - Case et al. (2007) showed Dudhia scheme exhibits a slight daytime cold bias
 - Negative forecast in day
 - Positive forecast at night
- ◆ Changes in lower-level temperature result in changes to geopotential height field in model, which impacts the forecast

1000 hPa Temperature Difference Time Series





Evolution of Analysis Grid

Model/Ob Soundings near Key West 1/17/07

37 Sigma Levels

50 Sigma Levels

NAM ICs

WRF BKGD

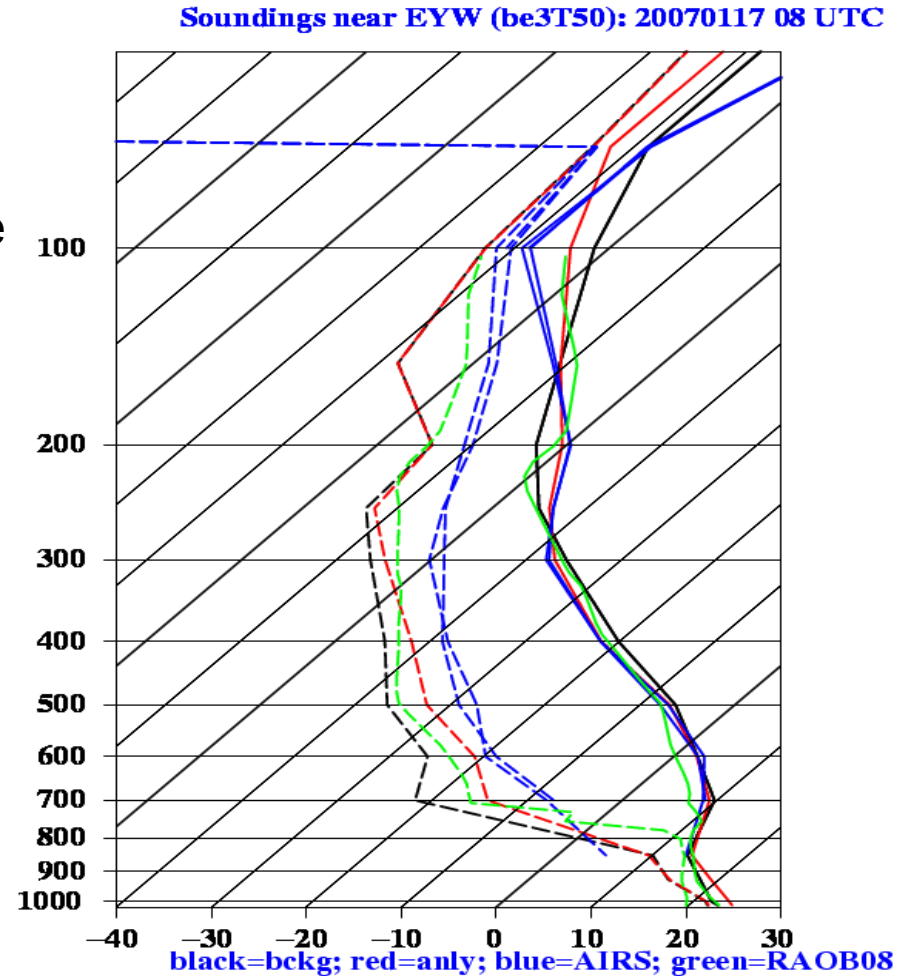
RAOB

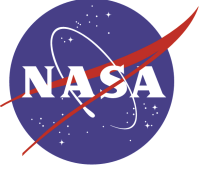
- ◆ Originally grid had 37 levels with high resolution near surface and lower resolution aloft
- ◆ Interpolation of NAM initial conditions to WRF led to the background field being 2-3°C too warm
- ◆ Interpolation error leads to exaggerated innovations at 100 mb that cause either:
 - Large changes to the surface pressure field due to correlations in the B matrix or
 - Large changes to the surface pressure field due to analysis balance that leads to warming in the other levels to compensate for the large cold change aloft



AIRS Profiles Too Cold Near Tropopause

- ◆ Observation errors may have been too aggressive
- ◆ We were trying to see what role a large impact from AIRS profiles would have that we underestimated the lower and upper level errors
 - ◆ Thus, best part of profile (mid-troposphere) is corrupted by problems in upper and lower levels of profiles

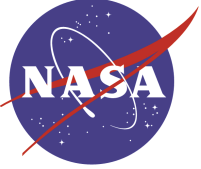




Conclusion



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Questions?
Suggestions?
Comments?

