Assimilation of Atmospheric Infrared Sounder (AIRS) Data Into the Prototype High Resolution Rapid Refresh for Alaska (HRRRAK)

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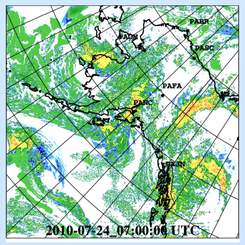
Introduction

The Arctic Region Supercomputing Center has been running a quasi-operational prototype of a High Resolution Rapid Refresh for Alaska (HRRRAK) at 3km resolution, initialized by the 13km Rapid Refresh (RR). Although the RR assimilates a broad range of observations into its analyses, preliminary experiments with the HRRRAK suggest that there may be added value in assimilating observations into the 3km initial conditions, downscaled from the 13km RR analyses. In this work we asses the use of assimilated satellite soundings and the effect on a control (non-assimilated) HRRRAK case study as a preliminary step towards deploying the assimilation in the quasi-operational environment.

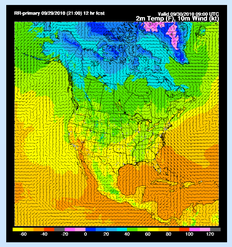
Alaska High Resolution Rapid Refresh

The HRRR-AK is an evolving Alaska-centered adaptation of the FULL CONUS High Resolution Rapid Refresh (HRRR) run at NOAA/ESRL/GSD. At 3km resolution, this 56 million grid point model is run four times per day for 24-hour forecasts, consuming 2.2 million cpu-hours per year at the University of Alaska's Arctic Region Supercomputing Center.

The HRRR-AK is initialized by the highly-assimilated Rapid Refresh (RR), also run at ESRL/GSD, and utilizes the 11km Alaska NAM to extend lateral boundary conditions beyond the RR forecast period.



1050x1050x51 grid point HRRR-AK domain

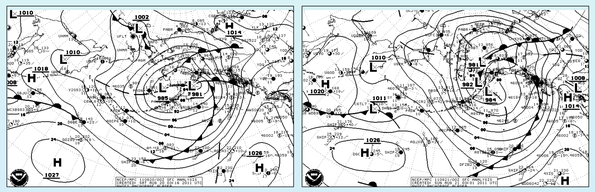


13km Rapid Refresh (RR), used for initialization

Atmospheric Infrared Sounder

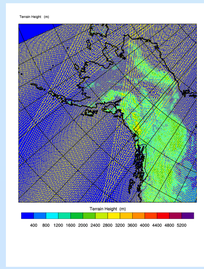
The Atmospheric Infrared Sounder (AIRS) data comes from an instrument aboard NASA's polar-orbiting EOS Aqua satellite. Among its many products are two key ones – temperature and moisture vertical profiles. The NASA Short-term Prediction Research and Transition (SPoRT) group has been experimenting with the use of AIRS for data assimilation since 2004, using WRF and WRF-Var over the contiguous United States with promising results. Through the use of the Gridpoint Statistical Interpolation (GSI) system for assimilating AIRS data into the HRRRAK, we have performed a preliminary case study to assess performance in the model to guide future activities.

Case Study

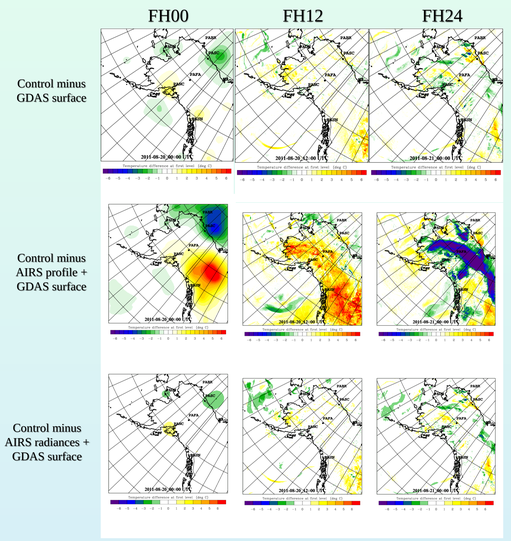


A strong Gulf of Alaska late-summer cyclonic event was selected, a 24-hour forecast beginning at 2011-08-20_00Z. Four tests:

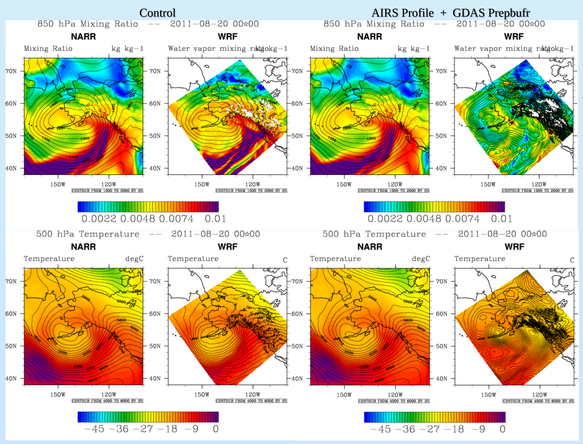
- Control run with no assimilation
- GDASPrepbufr: assimilation of surface and raobs
- AIRS Profiles + GDASPrepbufr: AIRS temperature and moisture profiles in addition to GDAS
- AIRS Radiances + GDASPrepbufr: Radiances in addition to GDAS.



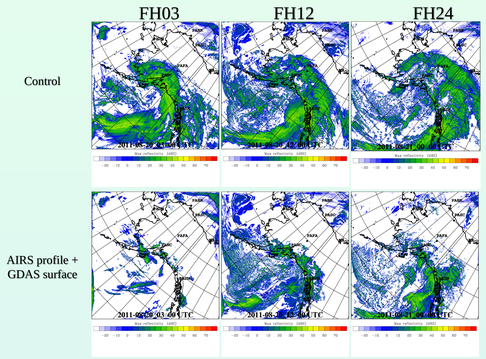
Diff of T at lowest model level (approx 7m)



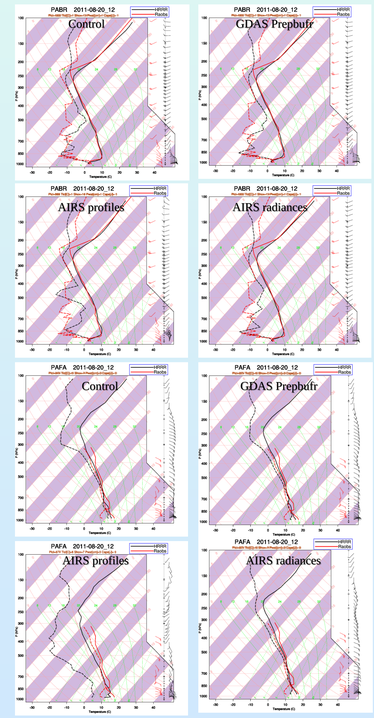
Side by side comparison with NARR (FH00)



maxDBZ Comparisons



Raobs versus model soundings



Issues

- This was an initial black-box approach
- Data is good and plentiful, so how to successfully assimilate?
- Possible GSI issues in assimilating GDAS surface obs

Arctic Region Supercomputing Center

SPoRT

NASA

DTC Developmental Testbed Center

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