



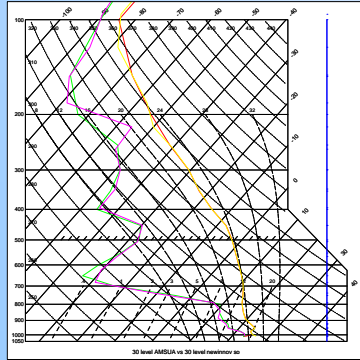
Implementing Radiance Assimilation in NAVDAS-AR: Lessons Learned



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NAVDAS-AR Design Considerations

- Observation pre-processing routines for NAVDAS-AR
 - NAVDAS-AR initially used NAVDAS observation pre-processing routines
- For NAVDAS, the innovations are computed from the gridded fields
 - 720x361 fields, 30 pressure levels
 - 3-, 6-, and 9-hr forecasts
 - Interpolated to observation location and time
- Innovations used by NAVDAS-AR are recomputed from the model trajectories (spectral → gaussian grid, sigma coordinates) interpolated to the ob location
- Vertical profiles of temperature and humidity are not the same
 - Esp. in regions with strong vertical gradients (e.g. tropopause, stratopause)
 - Computed Tbs are not the same - and show systematic differences (bias)
 - Bias corrections can vary between the two (gridded fields vs. AR trajectory)
- Where should data selection, QC and statistical monitoring performed?



Differences between temperature and humidity background profiles for 30 pressure-level (prep; green and red) and 30 sigma level (AR; magenta and yellow) backgrounds for the RT model. AMSU-A locations are in the tropical western Pacific.

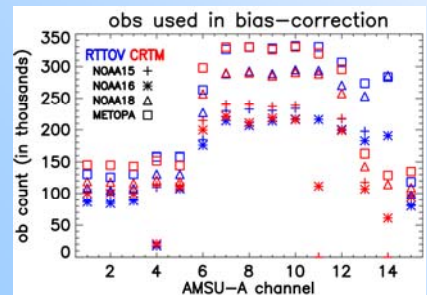
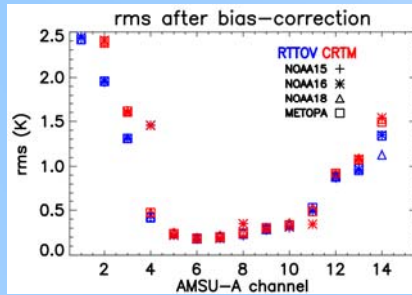
NOAA-15, AMSU-A Bias Corrected Innovations Assimilated channels, 2008032612

| Channel | Number | NAVDAS Prep Bias | NAVDAS Prep S.D. | AR Trajectory Bias | AR Trajectory S.D. |
|---------|--------|------------------|------------------|--------------------|--------------------|
| 4 | 3541 | 0.024 | 0.482 | -0.012 | 0.49 |
| 5 | 3577 | 0.023 | 0.235 | -0.015 | 0.235 |
| 6 | 8590 | 0.024 | 0.199 | 0.011 | 0.198 |
| 7 | 9486 | 0.004 | 0.197 | 0.007 | 0.190 |
| 8 | 9504 | -0.005 | 0.220 | 0.027 | 0.202 |
| 9 | 9389 | -0.061 | 0.283 | 0.029 | 0.256 |
| 10 | 9191 | 0.011 | 0.385 | 0.027 | 0.317 |

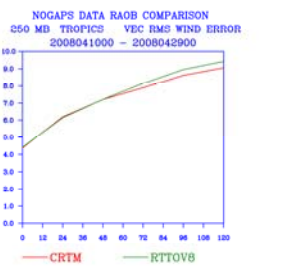
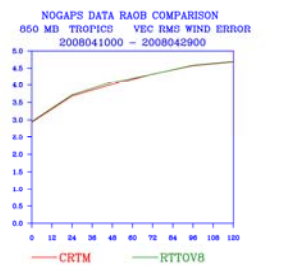
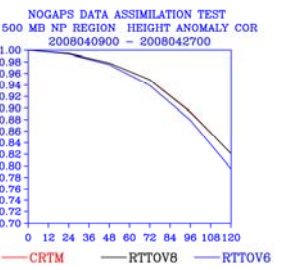
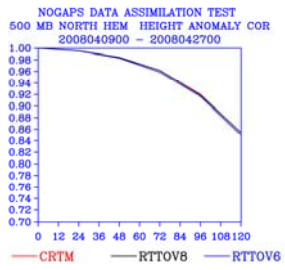
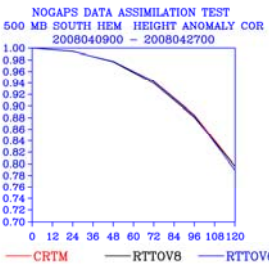
- The mean bias-corrected innovations are small for each case. However, the mean innovations tend to be of opposite sign, and the difference between the means can be large.
- Bias corrections based on the prep routine innovation statistics, and applied to AR-generated innovations can lead to biases in the analyses.
- For the above example, the 30-level NOGAPS fields are output onto 53 pressure levels for input to CRTM. The bias-correction statistics are generated from the AR-computed innovations.

Comparisons between RT Models RTTOV-6 vs. RTTOV-8.7 vs. CRTM v1812

- Issue**
- Operational RT model RTTOV-6 is no longer supported
 - Cannot add assimilation of new sensors (AIRS, IASI, METOP-A AMSU) without upgrading RT models
 - Previous tests with JCSDA CRTM gave worse NWP forecast skill, even with an additional AMSU-A sensor
 - Ongoing testing with RTTOV-8.7 and CRTM v1812
 - Added stricter QC, new RT models have smaller forward model errors

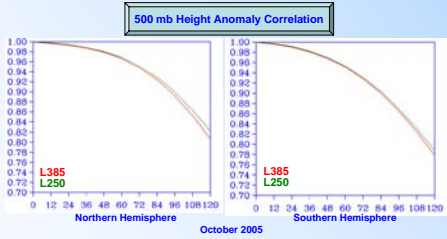


- RMS statistics for assimilated channels very similar for the two RT models.
- Ob counts are similar, except for the higher-peaking channels.
- The RTTOV-8.7 setup uses NESDIS ATOVS retrievals to provide the background above the model top (4 hPa).
- For CRTM, the input profile is limited to 4 hPa and below.

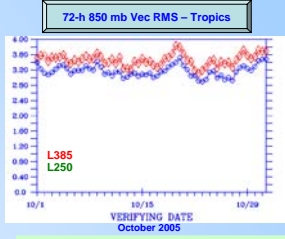


- The latest release of CRTM is much improved.
- NAVDAS with CRTM is still being "spun-up"; however the verification statistics are quite similar to those from RTTOV-8.7
- Operational NAVDAS uses RTTOV-6

NAVDAS/NOGAPS Background Error Correlation Length Scale Tests



Background error correlation length scale; L = 385 km → L = 250 km



→Still room for improvements to existing system →Results were very similar for NAVDAS-AR

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Cooperative Institute for Meteorological Satellite Studies, 2008.