1. MOTIVATION

To improve weather forecasts using AIRS temperature and moisture profiles

2. USE OF AIRS PROFILES

- Version 5 L2 temperature and moisture profiles over land and water
- Level-dependent quality indicators (QIs) determine maximum pressure level above which quality data should be assimilated (colored points in Fig. 1)
- Separate observation errors are used for the land and water soundings
- Land: from Tobin et al. (2006)
- Water: from AIRS instrument specs

3. ANALYSIS/FORECAST MODEL

- 12-km resolution, 450 x 360 horizontal grid; 37 vertical levels topped at 50 hPa
- ARW initialized at 0000 UTC each day using 40-km NAM
- 6-h ARW forecast used as first-guess for WRF-Var; AIRS profiles assimilated at observation time
- Matrix generated using NMC Method using control WRF forecasts

4. ANALYSIS IMPACT

- AIRS profiles cooler than background over FL and Great Lakes; Warmer over SE US (Fig. 3a); they are generally moister except in the region from the Florida panhandle to coastal South Carolina (Fig. 3b)
- Analysis increments show similar T and Q patterns compared to innovations
- Temperature and moisture soundings of AIRS-enhanced analysis lie between those of background and AIRS profiles below 300 hPa (Fig. 4)
- AIRS profile closer to RAOB than background
- Addition of AIRS produces analysis increments closer to radiosondes than background at mid- and lower troposphere

5. FORECAST IMPACT: 37-DAY CASE STUDY 17 JANUARY TO 22 FEBRUARY 2007

- Temperature Results:
  - CNTL too cool in lower troposphere and too warm in upper troposphere
  - AIRS warms lower levels and cools upper levels reducing bias (Fig. 7a)
  - RMSE is slightly degraded over entire profile (Fig. 7b)
- Temperature forecasts are degraded over large part of domain at early forecast hours
- Later forecast hours, though, show broad area of improved forecasts across the Great Lakes (Fig. 5)

- Mixing Ratio Results:
  - CNTL too dry below 700 hPa but within 0.1 g/kg of the NAM analyses in the mid- and upper troposphere (Fig. 7c)
  - AIRS tends to moisten the whole atmosphere and improves the 900 and 700 hPa levels
  - RMSE is slightly degraded with AIRS (Fig. 7d)

- Geopotential Height Results:
  - CNTL heights too low in the mid- and upper-troposphere but close to zero bias near surface
  - AIRS raises heights at all levels degrading bias near surface but improving aloft (Fig. 7e)
  - RMSE improved aloft but degraded near surface (Fig. 7f)

- Overall, height forecasts show broad area of improved forecasts across the Great Lakes at all forecast times with larger area coverage and magnitude of improvement at later forecast times (Fig. 6)

- 6-h Cumulative Precipitation Bias Score Results (Fig. 8):
  - Bias score > 1 means over forecasting; bias score < 1 means under forecasting
  - ETS takes into account forecast hits and misses and give some degree of certainty above random results
  - Inclusion of AIRS improves ETS and bias scores at all precipitation thresholds

6. CONCLUSIONS/FUTURE WORK

- Prudent assimilation of AIRS thermodynamic profiles and quality indicators can improve initial conditions for regional weather models
- In general, AIRS-enhanced analysis more closely resembles radiosondes; forecasts with AIRS profiles are generally closer to NAM analyses than CNTL for sensible weather parameters
- Assimilation of AIRS cloud-cleared radiances in WRF-Var
- Comparison of AIRS profiles and AIRS radiances using GSI