MODIS/AIRS & HIRS/AIRS Radiometric Comparisons (Brightness Temperatures at 11 microns)

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Introduction

• Motivation
  – Ongoing AIRS instrument validation, with an interest in examining differences for cold scenes.
  – Climate studies require analysis across/between multiple instruments/platforms, needing to contend with instrument spectral bandpass differences, spatial footprint variations, and orbital variations.

• Data set
  – MODIS band 31, HIRS channel 8 (both 11 um window channels) and selected 11 um region AIRS channels provide a reasonable data set for developing comparison methods.
Introduction (cont.)

- The calibration of AIRS and MODIS has been established at better than the 0.1 K level for MODIS band 31, for one day means for two test days on 20020906 and 20040218 (Tobin)

- We used tropical ocean daytime granule 20020906.176 and night time antarctic granule 20020906.72 to verify this.

- Can this result be repeated with more recent data?

- What happens when we look at the radiometric validation over Antarctica?
Method

- **MODIS - AIRS comparisons**
  - Average MODIS band 31 (11 um) data to 5 km x 5 km
  - Approximate broadband 11 um band brightness temperatures with a linear combination of AIRS channels with frequencies 900, 912.7, 881, and 891.
  - Matchup MODIS 5 km x 5 km pixels with AIRS, using 0.075 surface degrees (~8 km) distance criterion. Results in ~9 matches per AIRS footprint.

- **HIRS - AIRS comparisons**
  - Use same prescription for 11 um broadband radiance (assumed to be the same as MODIS band 31).
  - Matchup AIRS footprints with HIRS footprints (20 km on 40x26 km centers), using 0.07 surface degree criterion. Results in 1 AIRS/HIRS match.
Differences in areas of high gradient are due to matchup uncertainties.
The comparison for 20020906 tropical ocean granule 176 looks very good down to the 200 K level.

There is a very small bias and there is a small slope.

MODIS b31 is 0.3 K warmer than AIRS at 200 K, 0.1K colder at 300 K.

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The 20020906 granule 72 Dome C overpass comparison of MODIS and AIRS shows excellent agreement.

Offset at 200 K is 0.2 K.
20050829, granule 192 is the New Orleans overpass with Katrina at 1:30 pm

The 20050829 data look much more complicated.

There is little offset between 250 and 300K.

At 200 K, MODIS band 31 is about 1.1 K warmer than AIRS.
Recent (20050711) Dome C data also show a cold shift

Offset at 200 K is also 1.1 K.

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Trend of 200 K offset over Antarctica

9/18/04
1/16/05, T > 230 K
4/22/05
10/31/05, T > 212 K
9/18/04

200 K intercept

Date

9/1/02 3/20/03 10/6/03 4/23/04 11/9/04 5/28/05 12/14/05
HIRS channel 8 - AIRS equivalent, 20020906

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HIRS channel 8 - AIRS equivalent, 20050711

20050711.146.a62g.DomeC.mat

(hirs ch 8)-airs equiv

airs equiv: x=+0.23+/-1.29 n=1891

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Conclusion

• This is a work in progress, however, first indications are
  – MODIS - AIRS brightness temperature differences indicate a change has occurred.
  – HIRS - AIRS has remained steady
• Will expand data set to include deep convective cloud tops for warmer antarctic months, as well as warmer land scenes to better define trends.
• A more complete analysis will be presented in the August 2006 SPIE meeting in San Diego.
20020906 Egypt granule 110 comparison shows a warm bias

In granule 176 MODIS is 0.1 K colder than AIRS at 300 K
In granule 110 MODIS is 0.8 K colder than AIRS at 325 K