Intercalibration of AIRS and CrIS via SNOs, PDFs, and Large Random Samplings

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Understanding L1b Differences between AIRS and CrIS

Outline

• SNOs
  • Large statistical intercomparisons

Prerequisites

• L1c
• AIRS2CrIS (Howard Motteler’s previous talk)
• Sampling strategies
• L1b/L1c Q/C (for extremes)

Approach

• SNOs
  • 20 km, 20 min (somewhat relaxed)
  • Convert AIRS L1c to CrIS (AIRS2CrIS) for comparison
• Statistical Comparisons
  • Nadir subset (1% of data)
  • Full sampling (all scenes) for 900 and 2550 cm\(^{-1}\) data
  • Separate land and ocean
CrIS vs AIRS L1c Spectra

20 Deg. Zonal Average of near nadir scenes

Wavenumber (cm$^{-1}$)

B(T) in K

AIRS L1c
CrIS NSR
CrIS and AIRS are Stable: Capture Same Trends

Here AIRS L1c converted to CrIS ILS
This just shows that our AIRS - CrIS differences are within estimated uncertainties.
Connecting AIRS and CrIS: Radiometric
Intercalibration Issues

Previous Issues

- UMBC and JPL used "AIRXBCAL" like data: random nadir subsets
- These do not provide good enough sampling for statistical intercomparisons (mostly due to time differences in scene sampling)
- *This Work*: CrIS Q/A based on imaginary radiance values too severe, we only limit min radiance (3 values for LW/MW/SW)
- *This Work*: Full all-scan sampling (every scene, yearly statistics!)
AIRS2CrIS shown. Statistical errors very small. Small scale variability likely AIRS ILS uncertainties!
Use SNOs to Improve AIRS Longwave ILS?

AIRS TVAC ILS Uncertainties

AIRS Sensitivity to ILS Errors

![Graphs showing AIRS TVAC ILS Uncertainties and AIRS Sensitivity to ILS Errors.](image-url)
AIRS Entrance Filter Fringe Effects

Our Least Favorite Array

Fringes in H$_2$O $\nu_2$ Band Center (good sounding region)
Extrema and Spatial Differences
AIRS Spatial Footprint vs CrIS (Work by Chris Barnet)

AIRS spatial response is broader, significant impact for cloud response (and cloud-clearing), extrema detection.
Longwave Count Histograms (700 Million per Year)

Note land counts only agree with change in CrIS Q/C
Longwave Ocean Count Differences (due to spatial diffs?)

AIRS FOV is slightly smeared relative to the CrIS FOV.
Percentage differences in counts vary much more with year than between instruments.
CrIS stopped far below max before change in CrIS Q/C. This is a remarkable result!
Absolute Count Differences

Percentage Difference in Counts

Final Thoughts

- FOV spatial have an impact on radiometric differences.
- Small, but possibly important, especially for cloud-clearing!
- Less important for single-footprint retrievals
Conclusions

- SNOs provide radiometric offsets between AIRS2CrIS and AIRS
- All-scene Channel PDFs indicate excellent agreement for hot scenes if remove imaginary radiance Q/C
- Slight differences in colder scene histogram, spatial issue?
- CrIS sees more clear scenes (in ocean testing), changes cloud-cleared statistics (Aumann: 8% more variability FOV to FOV)
- Simulation confirms AIRS FOV wings can lower hot histogram counts (not shown)

UMBC: Next Steps

- Re-do AIRXBCAL (and CrIS) random subsetting to use all scan angles
- Determine if small ILS modifications within TVAC uncertainties can improve AIRS2CrIS vs CrIS SNO differences
- Test climate level trends and anomalies between AIRS and AIRS2CrIS
  - Create 10-year AIRS T/Q trends based on radiance trends
  - Create 5-year AIRS + 5-Year CrIS radiance product and then compare T/Q trends from this product to the AIRS-only product
- Continue histogram counts studies to more opaque channels, hopefully find even smaller differences