

A AIRS Plus CrIS/IASI Multi-Decadal Trends and Anomalies with Full Spatial Sampling and Rigorous Error Characterization

AIRS Science Team Meeting

L. Larrabee Strow^{1,2}, Sergio De-Souza Machado^{1,2}, Steven Leroy³, Howard Motteler², Chris Hepplewhite², and Steven Buczowski²

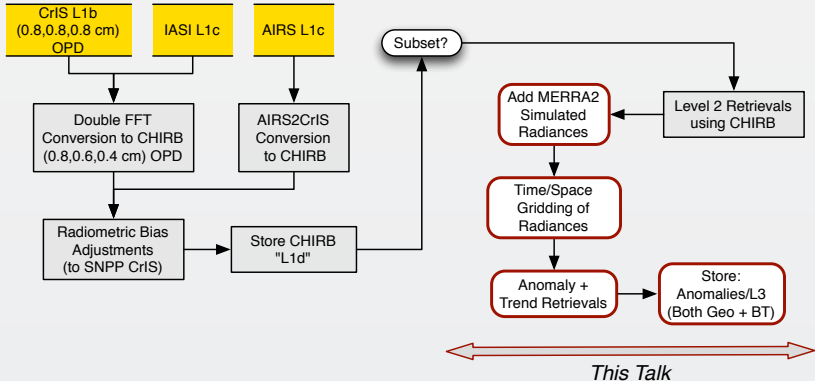
April 25, 2018

¹UMBC Physics Dept.

²UMBC JCET

³AER

Introduction

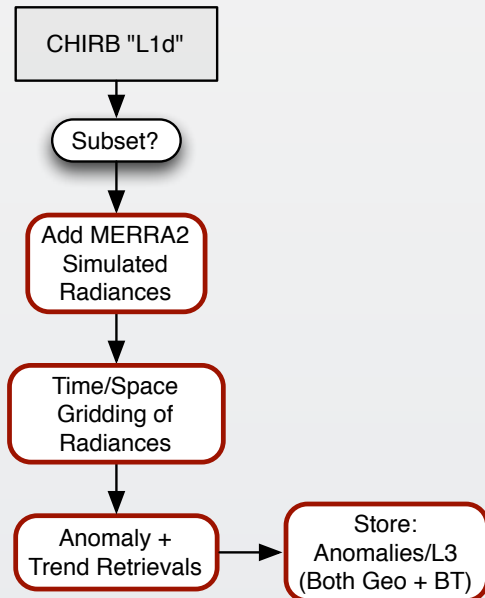


CHIRB: (Common or Climate) Hyperspectral InfraRed Basis

0.8 / 0.6 / 0.4

0.0625 / 0.0833 / 0.1250

Introduction



Overview: Two Products Proposed

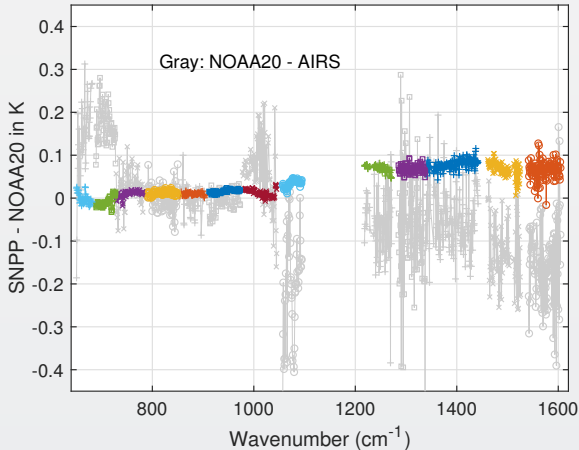
(1) Multi-Instrument Hyperspectral Climate Time Series

- 1:30 Orbit: AIRS + CrIS, 9:30 Orbit: IASI
- Convert to common ILS, CrIS 0.8/0.6/0.4 cm OPD (LW/MW/SW)
"Hybrid Time Series"
- Allows inter-instrument radiance calibration, needed for climate
- Allows use of a common forward model
- Emphasize routine/fast processing of data for validation and Level 3

(2) Level 3 Products: Radiance and Geophysical

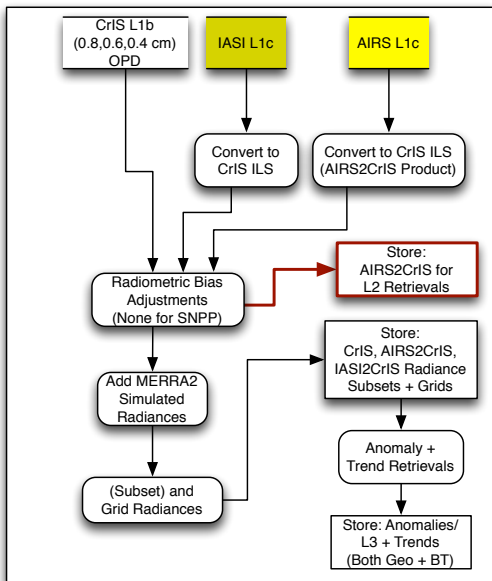
- Produce time/space grids of radiance time series and anomalies for climate analysis
- Generate geophysical (T/Q, etc.) "Level 3" anomaly time series and trends
- Generating radiance trends/anomalies first reduces errors and influence of a-priori
- Optimal estimation for Level 2 anomalies, proposal emphasis on applicable covariance estimates and total system uncertainties

SNPP vs NOAA20 CrIS (via AIRS Snos)



- AIRS and CrIS radiometric calibration differences after putting AIRS on the CrIS ILS grid. (AIRS - NOAA20 CrIS) and (SNPP CrIS - NOAA20 CrIS) shown.

Data Processing Flow

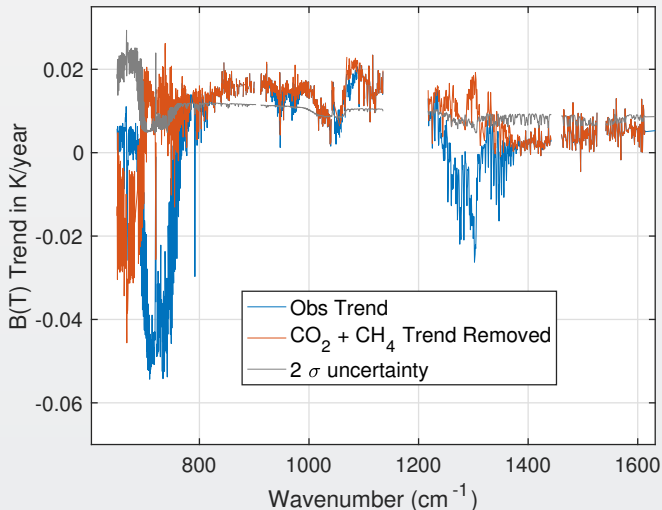


AIRS2CrIS for Level 2 Retrievals? (Summary)

- Continuity requires adjusting for satellite differences
- Only way I can see is to use a common ILS
- Which allows you to use a common RTA
- Instrument noises can be adjusted to be identical if needed (AIRS noise will be lowered when converted to CrIS ILS)
- DOFs of CrIS (NSR or FSR) very similar to AIRS
- "AIRS2CrIS" product samples will hopefully be ready soon for testing

Example Product Slides Below

Global B(T) Trend (hardest case)

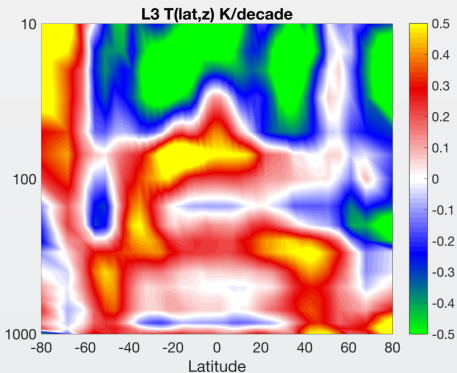


Uncertain on fit vs specify CO₂, CH₄ etc. trends. We have done both.
Specifying OK for long-term trends.

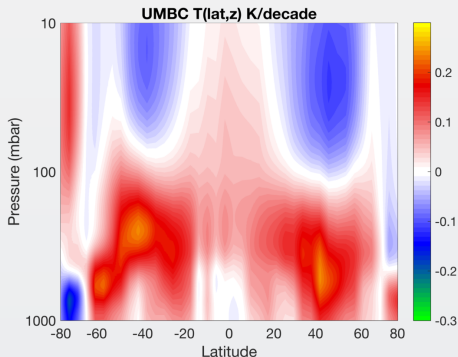
Example: 14-Year Zonal Temperature Trends

NOTE larger color scale on left.

From Level 3



From Radiance Derivatives

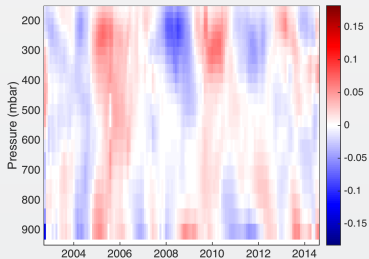


Interannual variability (observation covariance) regularizes OE solution.

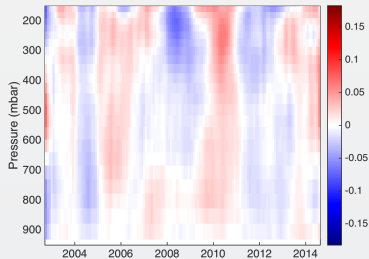
Need to work on off-diagonal obs covariances to get uncertainties right.

Anomaly Example: Water Vapor (27N to 30N Latitude Zonal)

From radiance anomaly



ERA \times Avg Kernel



AIRS Level 3

