CHIRP Radiance Corrections/Offsets Connecting AIRS, SNPP, JPSS-1, and IASI

AIRS Virtual Science Team Meeting

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Summary

- What is CHIRP
- What are radiance offsets for connecting AIRS, CrIS and IASI.
- Data and methods used to derive the radiance offsets.
- Results and Discussion.
- Integration of offsets into the CHIRP L1C.

What is CHIRP

- Climate Hyperspectral InfraRed Product is derived sequentially from multiple similar sensors in low earth orbit to create an on-going radiance record from the start of AIRS to the present.
- CHIRP data are available as level 1 calibrated, geolocated granules. (Details are provided in the accompanying presentation and on-line documentation).
- Current working version of CHIRP connects AIRS to CrIS from SNPP and JPSS1.
- and has the spectral resolution of CrIS in medium resolution, equivalent to: 0.8/0.6/0.4 cm interferometric OPD (LW/MW/SW).
- Of concern in this work is that the radiometric calibration is stable (has a fixed relationship to absolute truth, known to be 'small'), and there is no radiometric change in CHIRP going from one parent (AIRS) to another (CrIS).

What are the Radiance Offsets

- The radiance offset betwen two sensors is the radiometric calibration difference observed when they are both measuring the same scene at the same time.
- In principle, radiometric calibration offsets could be a function of time and brightness temperature and may be non-linear.
- Ideally the best result would be to cross-calibrate the sensors against a primary standard black body - instead must use data available during the missions.
- Fortunately there is a lot of mission overlap between AIRS, CrIS and IASI (more details to follow).
- In the first version of CHIRP the radiometric offset is a single valued vector representing the difference for each channel of the CHIRP spectral grid.

Data and Methods

- Data used: SNOs and global random statistical samples.
- Periods analyzed include all available mission overlaps.
- Available mission overlaps for
  - AIRS:NPP from Apr 2012 to present (Dec 2015 at FSR).
  - AIRS:J1 from Jan 2018 to present.
  - NPP:J1 from Jan 2018 to present.
  - AIRS:IASI1 from May 2007 to present.
  - NPP and J1:IASI1. (Note: SNOs are not available for NPP:J1).
- The transition date for parent AIRS to parent CrIS SNPP is 01-Sep-2016.
- The switch to JPSS1 is proposed 01-Sep-2018 to avoid the 2019 SNPP CrIS shutdown.

Data and Methods 2

- Two Sources of intercalibration data are available: SNOs and global random samples.
- SNOs have the advantage of being matched pairs of observations, but are spatially less uniformly distributed than global random.
  - AIRS:CrIS SNOs are global but weighted to high latitudes,
  - IASI:CrIS SNOs are restricted to a very narrow latitude band near 70-deg.
- both SNOs and random samples can be used for trending and for scene dependencies.

Results 1. AIRS:NPP bias and AIRS modules

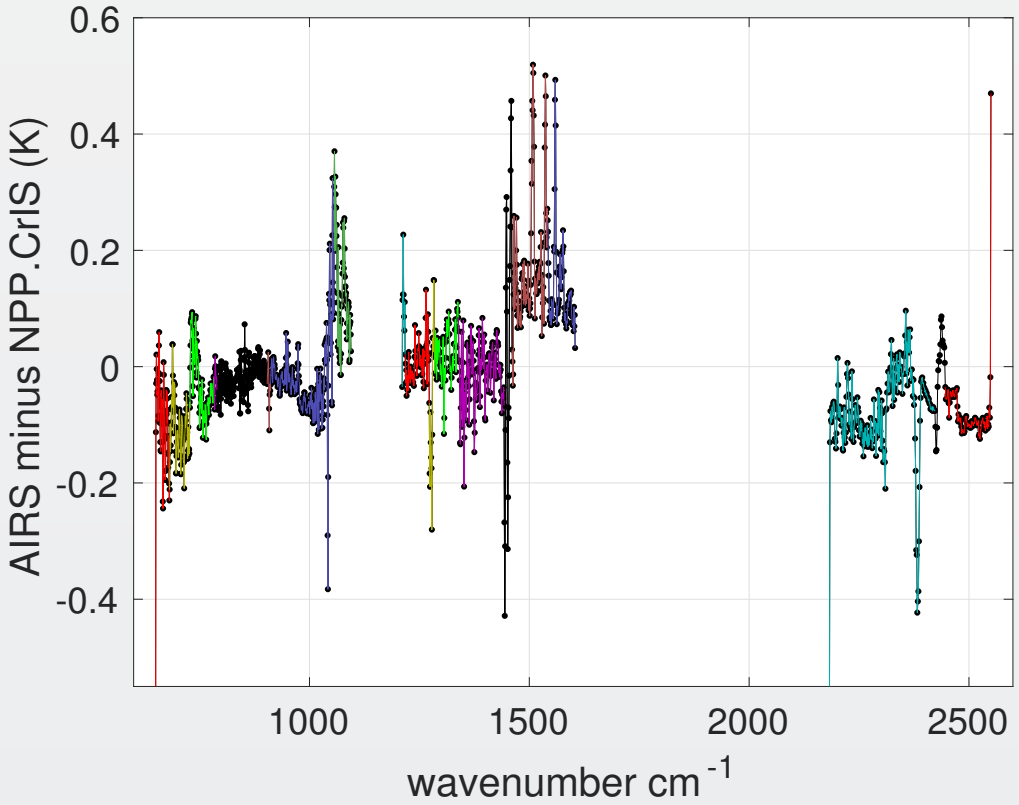

Figure 1: CHIRP channels. AIRS bias relative to SNPP from global statistics. Showing AIRS module bands.

Results 2. AIRS:NPP bias with fill and bad channels

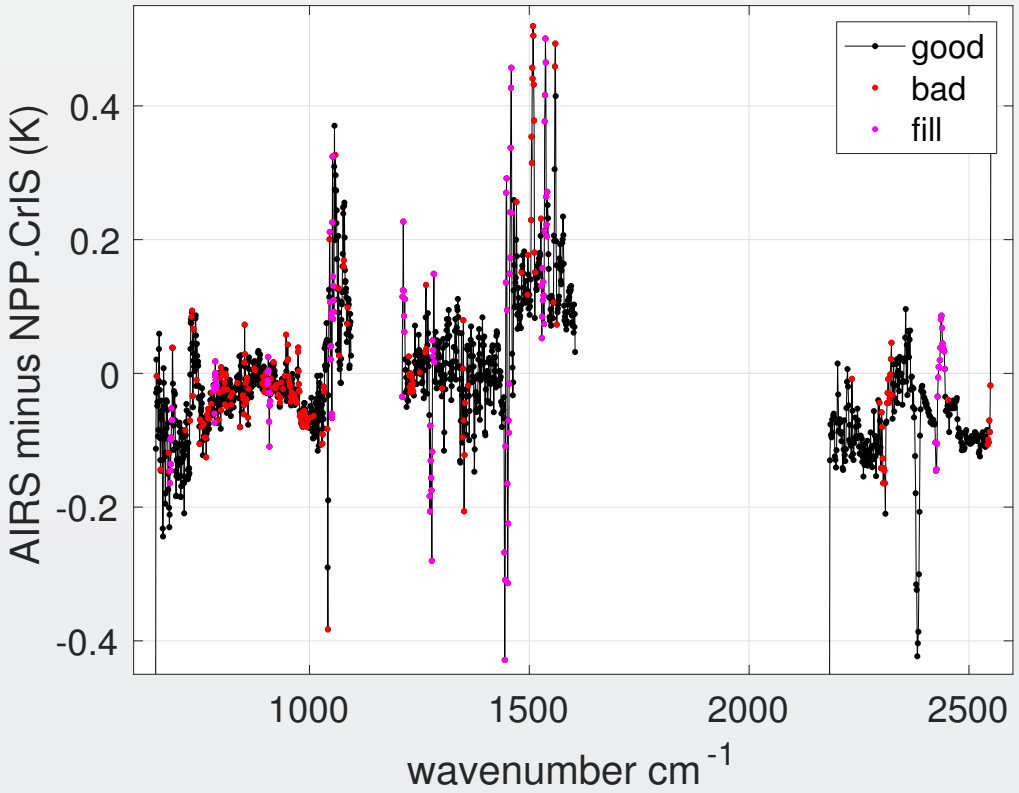

Figure 2: CHIRP channels. AIRS bias relative to SNPP from global statistics. Showing parent bad and fill channels (There are 356 such channels.

Results 3. AIRS:NPP and AIRS:J1 bias

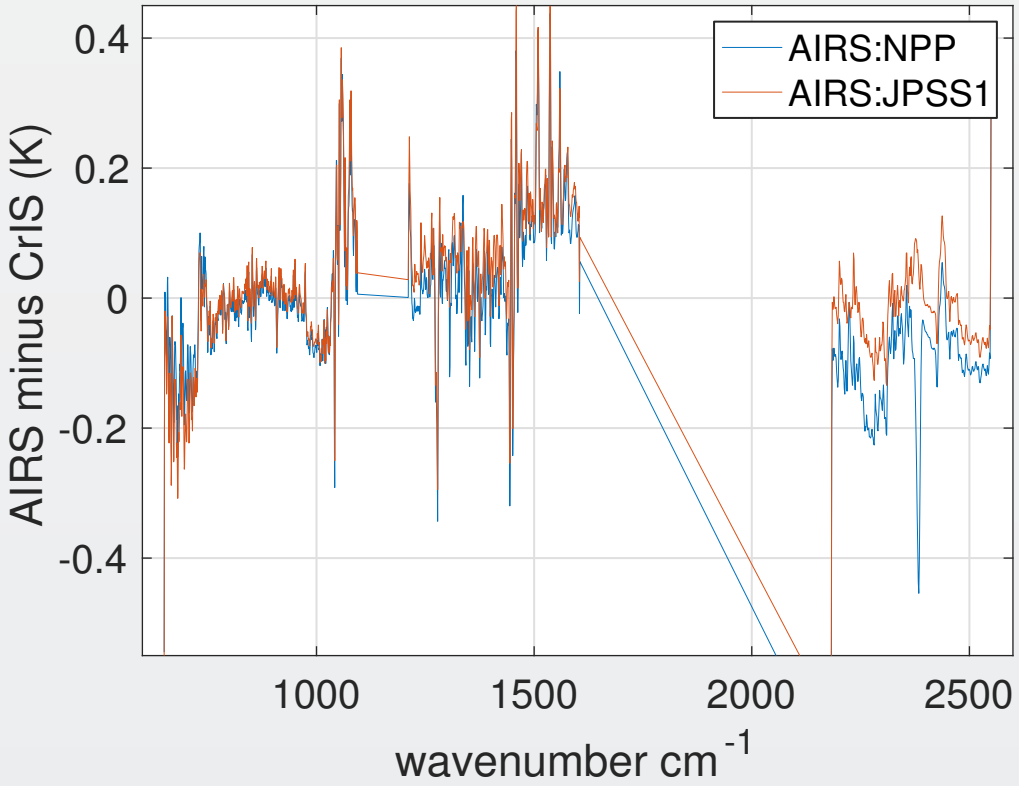

Figure 3: CHIRP channels. AIRS bias relative to SNPP and J1 from SNO. One year of data. Double difference can be used for NPP:J1 bias.

Results 4. AIRS:NPP bias From Stats and SNOs

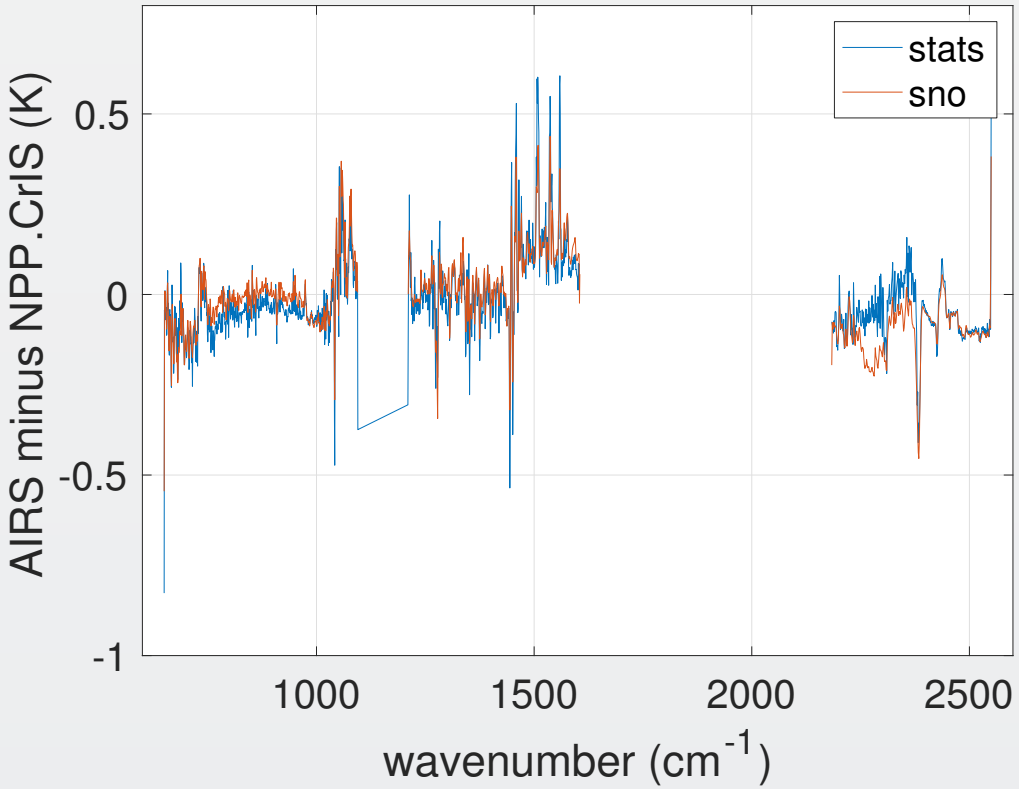

Figure 4: CHIRP channels. AIRS bias relative to SNPP from SNO and global stats. showing very close 30 mK compliance.

Results 5. J1:NPP bias

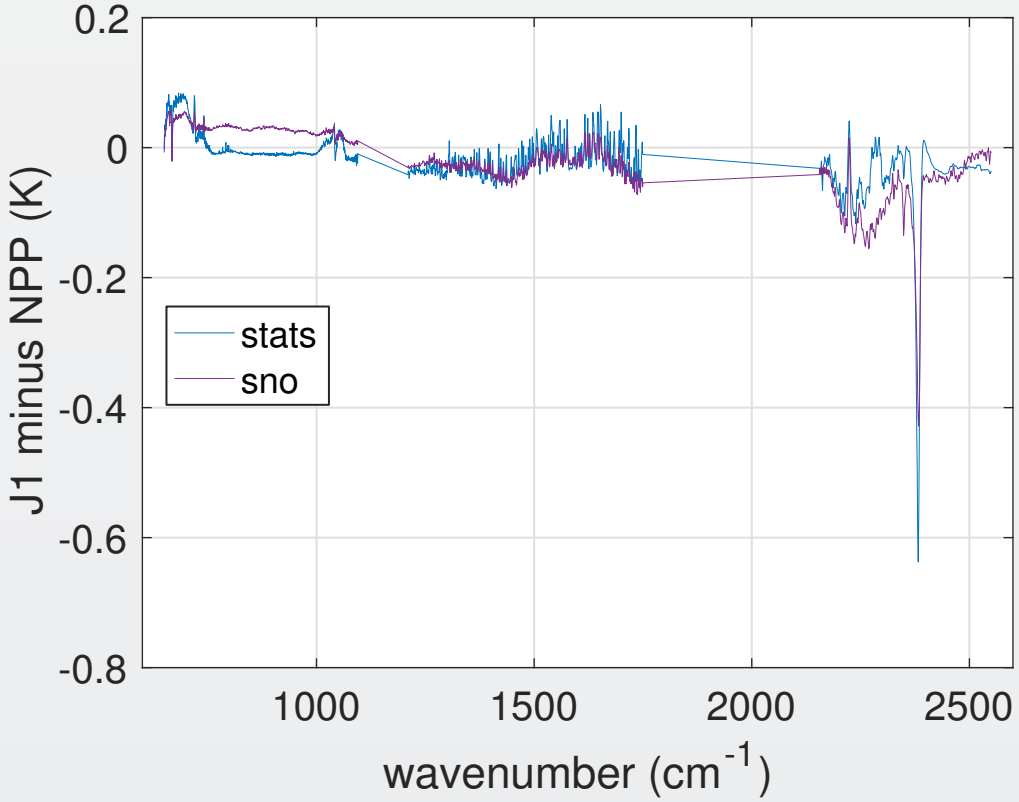

Figure 5: CHIRP channels. CrIS bias from JPSS-1 relative to SNPP from SNO using IASI.1 as cross reference and from global random stats.

Results 6. Bias variation with irradiance.

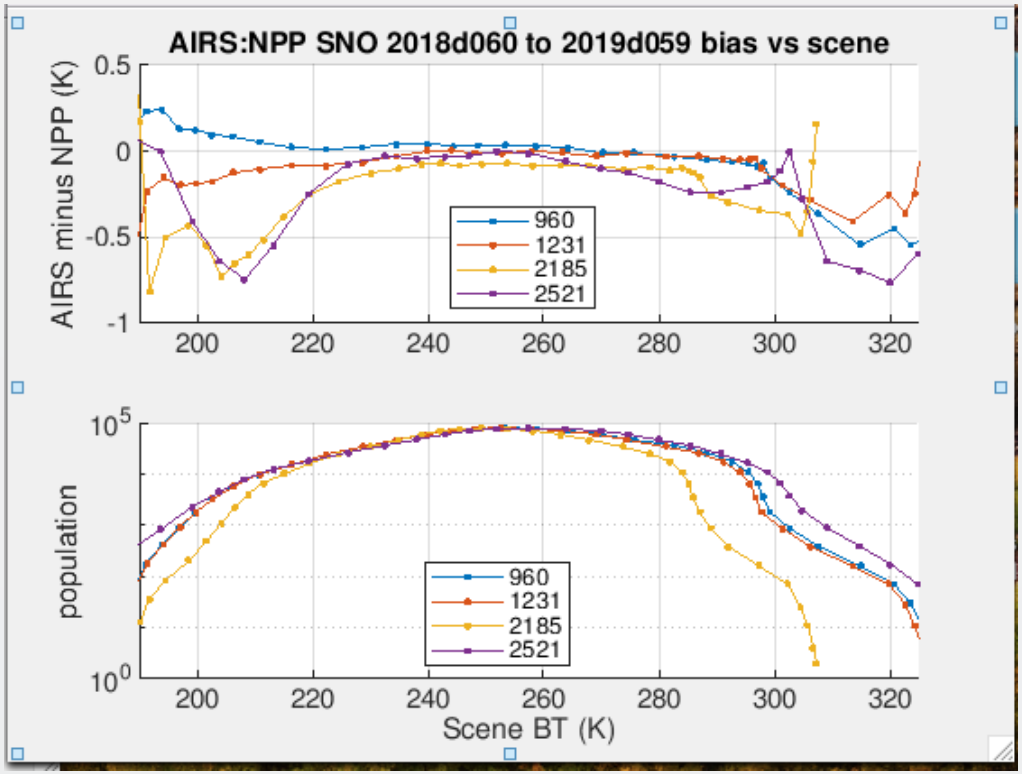

Figure 6: Four CHIRP channels. Bias variation with irradiance from SNO.

Results 7. Sample of bias stability.

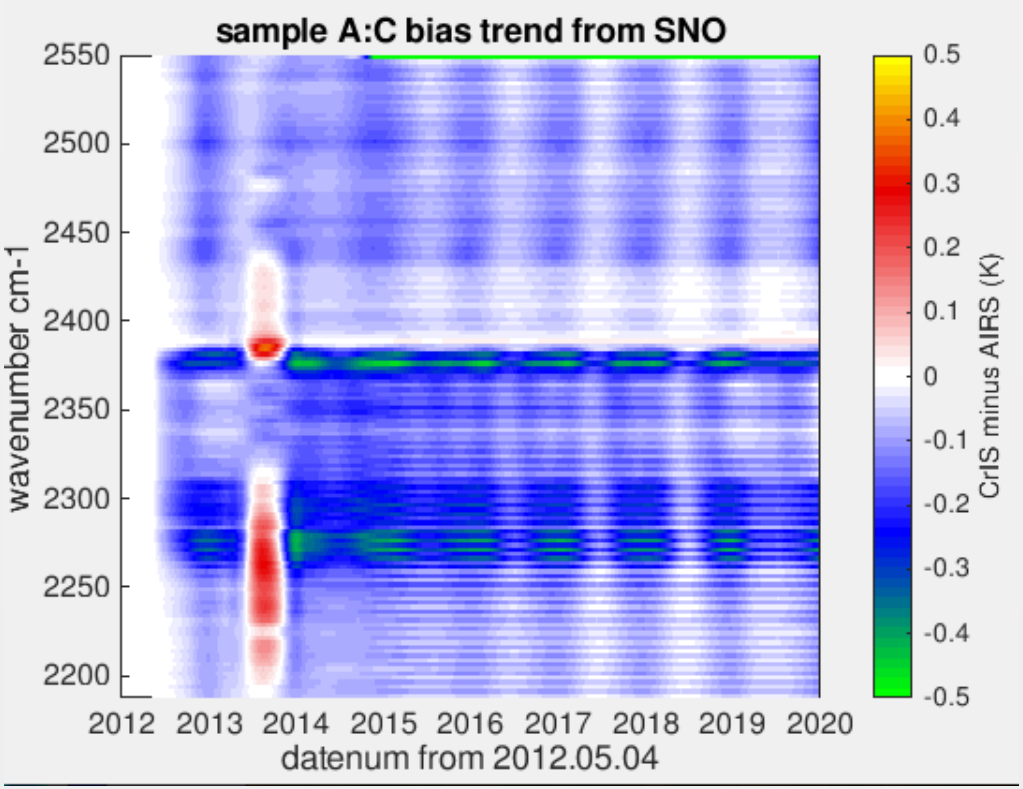

Figure 7: CHIRP short wave channels. Bias variation from AIRS:CrIS SNOs. Note residual variation mostly from AIRS solar beta- dependent variation, and 2013 jump to be investigate further.

Summary, Conclusions and Future Work

- Radiometric offset vectors have been determined to tie CHIRP derived from AIRS to NPP:CrIS and J1:CrIS.
- The current CHIRP product includes a single valued vector for every channel.
- The bias has been found to be stable over the period of interest, which is 2016 to 2019.
- The dependency of bias on irradiance has been investigated, and some examples have been illustrated.
- Future work includes validation of the CHIRP product with particular attention to equivalence of trends of parents sensor.