AIRS/CrIS Radiometricc Stability Improvements Needed for the CHIRP Climate Data Record

AIRS Virtual Science Team Meeting

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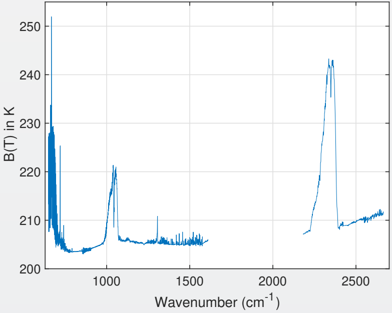
Introduction

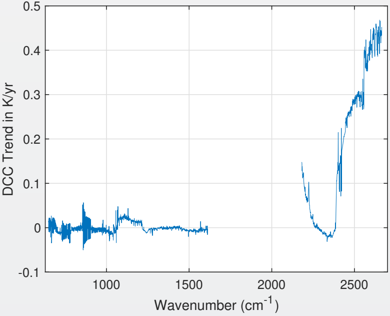
Something

AIRS Radiometric Drifts via DCC's

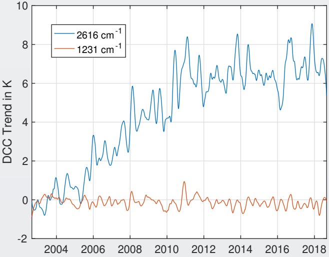
Mean DCC Spectrum



15-Year DCC Trend



Time Dependence of Trends



- DCC's defined here by BT(960 cm^{-1}) < 215K
- DCC's often used for calibration since extremely stable
- Trends are NOT seen in IASI shortwave
- A/B trends (longwave) and AIRS frequency shifts have similar time-dependencies!
- Shortwave sensitive to space view (SV) drifts.
- Suspect focal plane/optics shifts that change location of SV's

Using DCC Emission to Determine Calibration Drifts

- Simplified to ignore non-linearity and polarization
- Written differently than in ATBD, show Space View (SV) explicitely

$$R = \frac{EV - SV}{OBC - SV} R_{OBC}$$

- R is calibrated radiance
- EV/SV/OBC are the earth/space/blackbody counts
- R_{OBC} is the computed OBC (blackbody) radiance

Sensitivity of R to SV

$$\frac{\partial R}{\partial SV} = \frac{1}{OBC - SV}(R - R_{\mathrm{OBC}})$$

Solve for SV

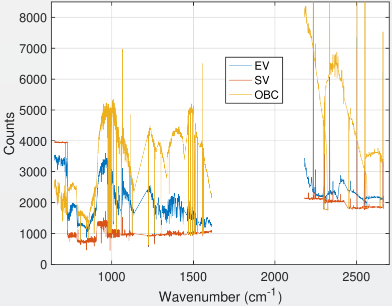
$$\delta SV = \frac{OBC - SV}{R - R_{\mathrm{OBC}}} \delta R$$

Approach

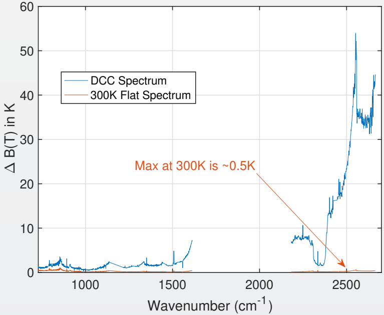
- Use DCC trends for δ R, solve for δ SV ($\equiv$ SV drift/year)
- Compute δ R trends for various scene types (R = DCC, clear, etc.)
- Convert to BT trends
- Ignore regions where emission exists above DCC's, ie stratospheric emission that could be varying in time
- Lien #1: used a single, randomly selected AIRS L1a scene to estimate (OBC - SV)
- Lien #2: DCC drift maximum near equator, drops 30% by ± 30° latitude (orbit phase or T. Pagano's FOV idea?)

SV Trend Results

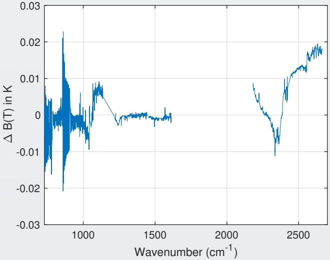
Sample Set of AIRS L1a Counts



δ BT for 1% SV drift for BT = DCC, 300K

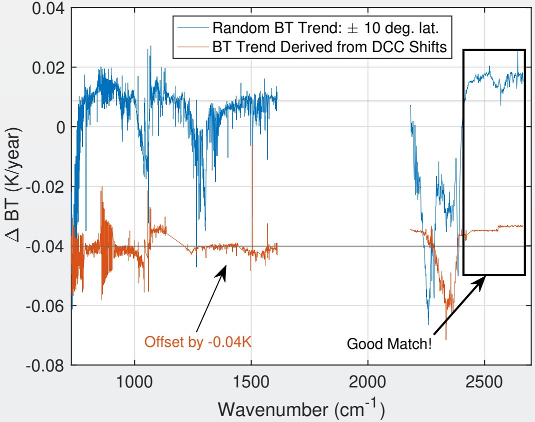


δ SV BT Trend for SV = 265K



- AIRS scene produces window BT ~275K
- Note high A/B variability in SV counts!
- Setting SV = 265K is just to illustrate magitude of SV drift
- SV drifts *small* but DCC's allow quantification
- Key conclusion: this approach predicts scene dependence

Do the DCC SV Drifts Predict All-Sky Trends?



- Blue is 17-year all-sky AIRS BT trend (black line denotes 1231 cm^{-1} channel)
    - CO_2, CH_4, N_2O, and O_3 exhibit greenhouse effect
    - H_2O also shows greenhouse effect
- Red are shifts predicted by SV drift. Nicely reproduces shortwave "false" extra warming
- Nominal agreement for detector side A/B ringing in window regions
- LIEN: SV trend likely orbit phase dependent!