AIRS Channel Stability Using OE Fit Residuals
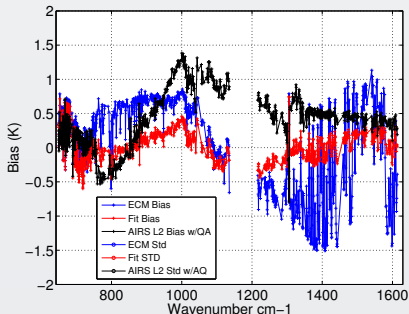
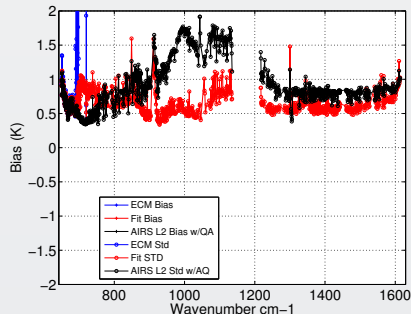L. Larrabee Strow and Sergio de Souza-Machado

February 10, 2015

Overview

- Examine AIRS radiometric stability and channel mis-behavior using retrieval residuals (Obs-Fit)
- Simplify by using 1-day averages of clear, ocean scenes in tropics (± 30 deg. latitude)
- Note: Level 2 retrievals do not provide radiance closure!


L2 Bias

L2 Std.

Approach

- Generate 10-year time series for clear ocean scenes
- Match each observation to ERA-Interim (very stable)
- Compute bias (2378 channnges x 3650 days). ERA "1st guess"
- Compute d(bias)/d(time), OE fit for geophysical rates (CO_2, T, SST, etc.)
- For bias anomaly by removing geophysical time dependencies (and offsets)
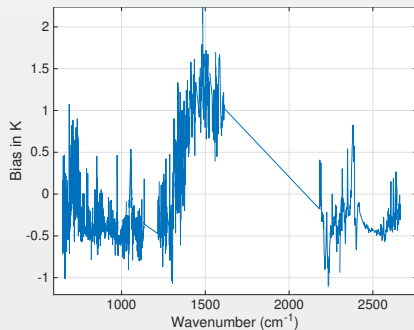
Final Time Series

- Daily averaged BT anomaly time series
- Still contains non-linear (in time) differences between ERA and AIRS
- Perform OE retrieval on anomaly (3650 days) for all geophysical variables (fast, 15 minutes).
- Only use longwave channels
- Final output: 2378 x 3650 fit residuals
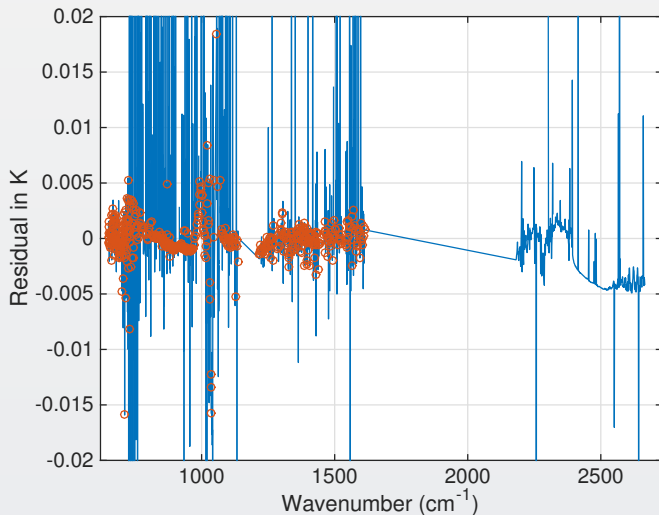
Raw Bias Time Series

Sample Channel Time Series
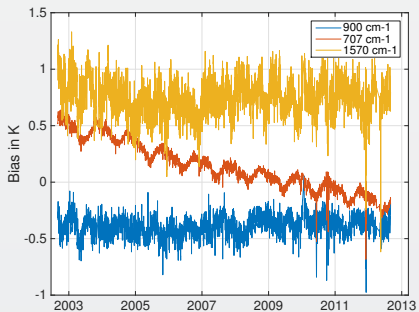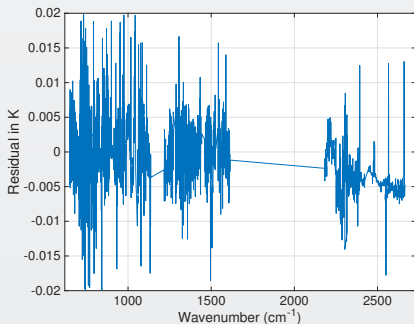
Mean Bias

Channel Used in Fit
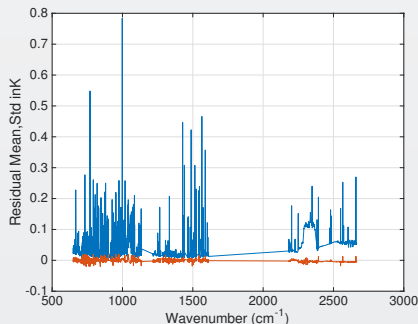

- Easy to change and re-do.
- Note "drift" in shortwave

Residual Time Series Statistics

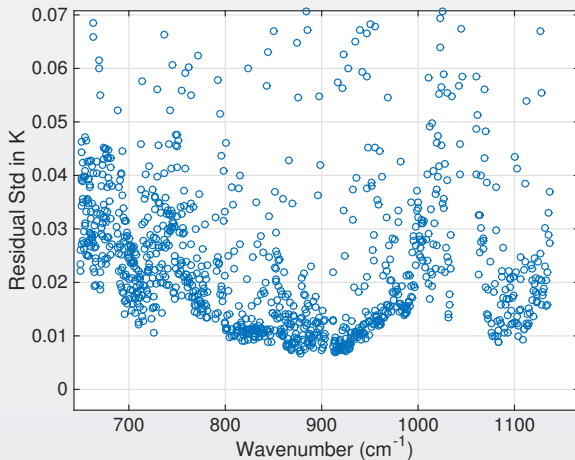Remove "really bad" channels by only including channels that at least have one day with a residual < 1K.
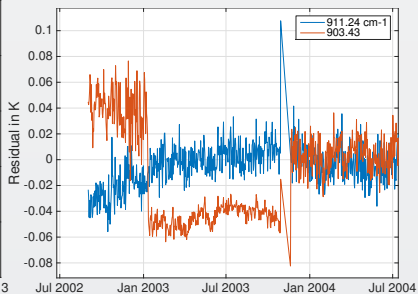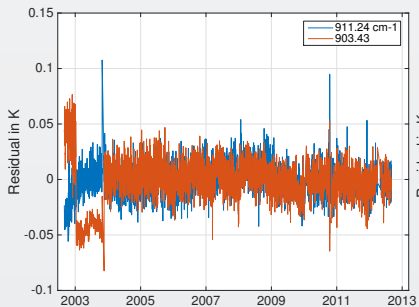
Zoom of Average Residual Std.

- Longwave surface channels show lower envelope of mean std near 0.01K.
- Noise floor more like 0.002K (11,000 Obs/Day)
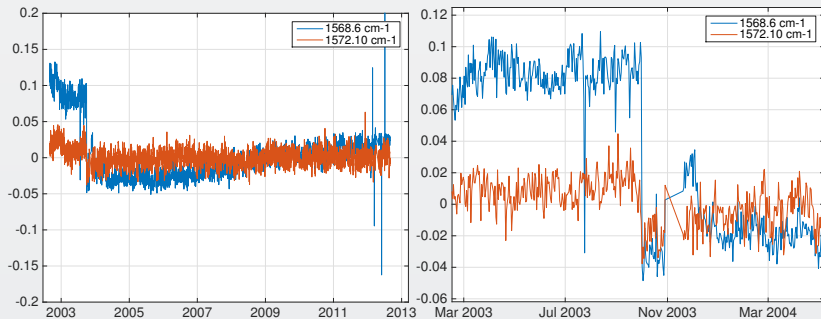
900 cm^{-1} Example

Shows:

- Well behaved time series
- Another well-behaved time series, but with A/B changes
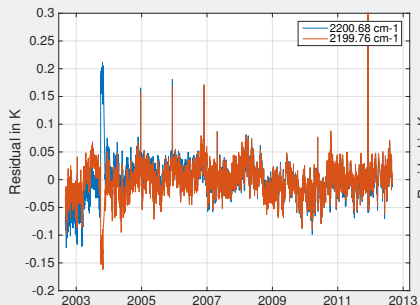
1570 cm^{-1} Example

Shows:

- Well behaved time series
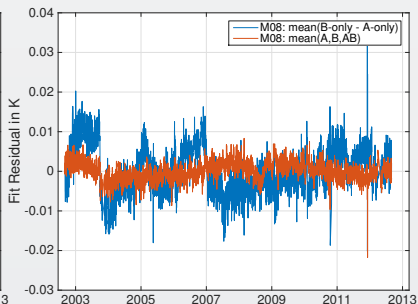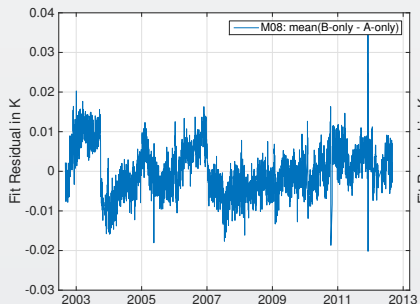- Another well-behaved time series, but with A/B changes

Fringe Shifts and RTA Fix

- Two channels sensitive to fringing.
- RTA (part of bias) "fixes" fringes pre/post Nov 2003
- We mistakenly applied the "fix" on Oct. 1, 2003 instead of in late Nov. 2003
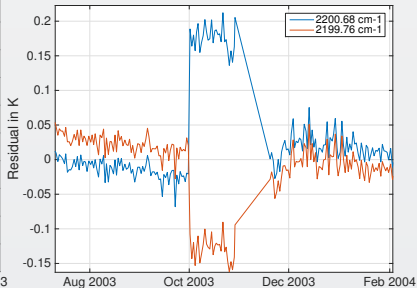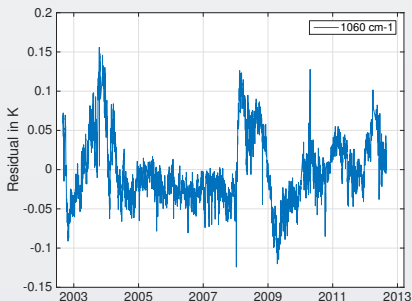
M08 Observations

- Starting to examine M08 channels
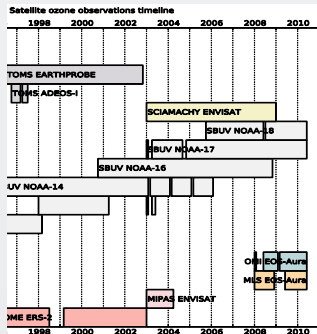- There are A/B differences, but also difference among individual channels

Liens on Ozone

- We only used an offset to the ozone profile in these fits
- That is not good enough, easily fixed
- BUT, this really hurt us because ERA-Interim did not do a good job on ozone stability!

Ozone Channel Time Series

ERA Ozone Data Inputs

More Liens and Future Work

Start trying to understand and document bad channels

Liens

- Apply fringe corrections at the correct time (easy)
- Finish 2012-2015 (next 2 weeks I hope)
- Add more ozone layers in fit (relatively easy)
- Frequency shift the AIRS data (and use L1c?)
- Do two series:
    - Only scenes with calflag "good"
    - All scenes and track calflag average values

Longer Term

- We are successfully using our "all-sky" retrievals, using ECMWF as first-guess for T/Q and clouds
- This OE approach allows closure! (Won't be as good as clear. . .)
- Determine bad channels are a per-fit basis using residuals