AIRS L1C, Freq Cal, RTA

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Overview

- RTA upgrades
- Frequency Calibration
- L1C issues
- A new method for deriving spectroscopy from radiances??
New RTA ready, now IASI and AIRS RTA’s have identical physics
More recent HITRAN used, so ozone and water changed
Empirical RTA tuning not yet done using coincident sondes
Minor coefficient changes; additional CO$_2$ coefficient and Non-LTE coefficient
RTA has several regression coefficient sets to account for frequency variability, fringe movements (Nov. 2003), and base CO$_2$ amounts.

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<thead>
<tr>
<th>name</th>
<th>yoffset (um)</th>
<th>Tef (K)</th>
<th>CO2 (ppmv)</th>
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<tbody>
<tr>
<td>m130x370</td>
<td>-13.0</td>
<td>155.770</td>
<td>370</td>
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<tr>
<td>m140x370</td>
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<td>156.339</td>
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Implementation at JPL?
Frequency Calibration

- Use a cross-correlation technique on M12 (LW) for $\nu$ calibration
- Cross-correlate L2CC radiances with Calc radiances. Calcs done using ECMWF.
- One $\nu$ calibration per granule.
Δ B(T) for a dx = 1 um
ν Calibration

Binned by 2 deg in latitude, 16 days in time
Time Dependent Drift: Raw Data

Good news, drift is slowing down
Raw $\nu$ calibrations were binned by 2 deg. in orbit phase, giving 180 data sets which were fit to the following expression:

$$\nu(t) = \nu_0 - b_1 \exp(-t/b_2) + \sum_{i=1}^{3} [a_i \sin(2\pi t + \phi_i)]$$


Fast behavior in which of the 180 equations you use (orbit phase). Slower behavior is in time.
Derived $d\nu$ Time Constant
Amplitude of Sinusoidal Terms

![Graph showing amplitude of sinusoidal terms across orbit phase. The graph has three curves representing the fundamental, 1st harmonic, and 2nd harmonic.](image-url)
Observed and Computed $dx$

Highest error obs removed (1.5%).
Zoom of Obs and Computed dx
Zoom of Obs and Computed dx
Zoom of Obs and Computed dx
Max B(T) Errors Over 5.8 Years
Includes Orbital Swings
Basic idea: Once know $\Delta \nu$, create two RTA calculations with nominal atmospheric state to determine $dR/d\nu$. Then

$$R_{L1c} = R_{obs} + dR/d\nu \times \Delta \nu.$$ 

1. Calibrate with reasonably clear FOVS
2. Develop smooth model for calibration
3. Use model to: (1) produce L1c (2) modify CC’d radiances in L2;

Calibration

- Inputs: Clear only (poles?), CC’d radiances?
- Auxillary info: ECMWF, AVN, limited climatology?
- CPU intensive

Corrections

- Create L1c, need “cloudy” state for RTA calcs
- Create $\Delta B(T)$ for L1b, for ACDS only?
- Correct L2cc radiances instead for retrievals?
Biases vs ECMWF Vary with Secant of Viewing Angle

- Empirical corrections used average biases
- Spectroscopy, constituent abundance errors will vary with viewing angle/secant
- Assume ECMWF errors do not depend on secant angle
- Fit $dbias = offset + slope \times \Delta secant$; offset very small
- If assume $bias = (inst\_bias, model\_bias) + slope \times secant$ can use above fit to determine slope, and then solve for $(inst\_bias, model\_bias)$
- Still need atmospheric constituent amount/profile to get spectroscopy
Fit Results: Slope of dbias/dsec

Secant varies from 1 to 1.37
Fit Results: Slope of dbias/dsec, zoom

\[ R^2 < 0.7 \]
Fit Results: Slope of dbias/dsec, zoom

![Graph showing the slope of dbias/dsec with wavenumber on the x-axis and d(BT)/d(sectant) on the y-axis. The graph compares IASI (red) and AIRS (blue) data.](Image)