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Atmospheric Infrared Sounder

Level-1B and Level-1C Status 2010-04-23

Evan Manning

Jet Propulsion Laboratory, California Institute of Technology

Level-1B

- **New Level-1B spectral calibration has been developed**
  - ***> 2x as accurate as old one***
  - ***Still not as good as the UMBC offline Level-2 spectral cal using cloud-cleared radiances and retrieved atmospheric state***

- **Margie Weiler has developed improved radiometric calibration coefficients**
  - ***But improvements are impossible to validate with existing data sets.***

- **No reprocessing of Level-1A or Level-1B is planned for v6.**
  - ***Any update might prompt users to download newer versions***
  - ***Users would not be served well by a new version without significant and verified improvement***

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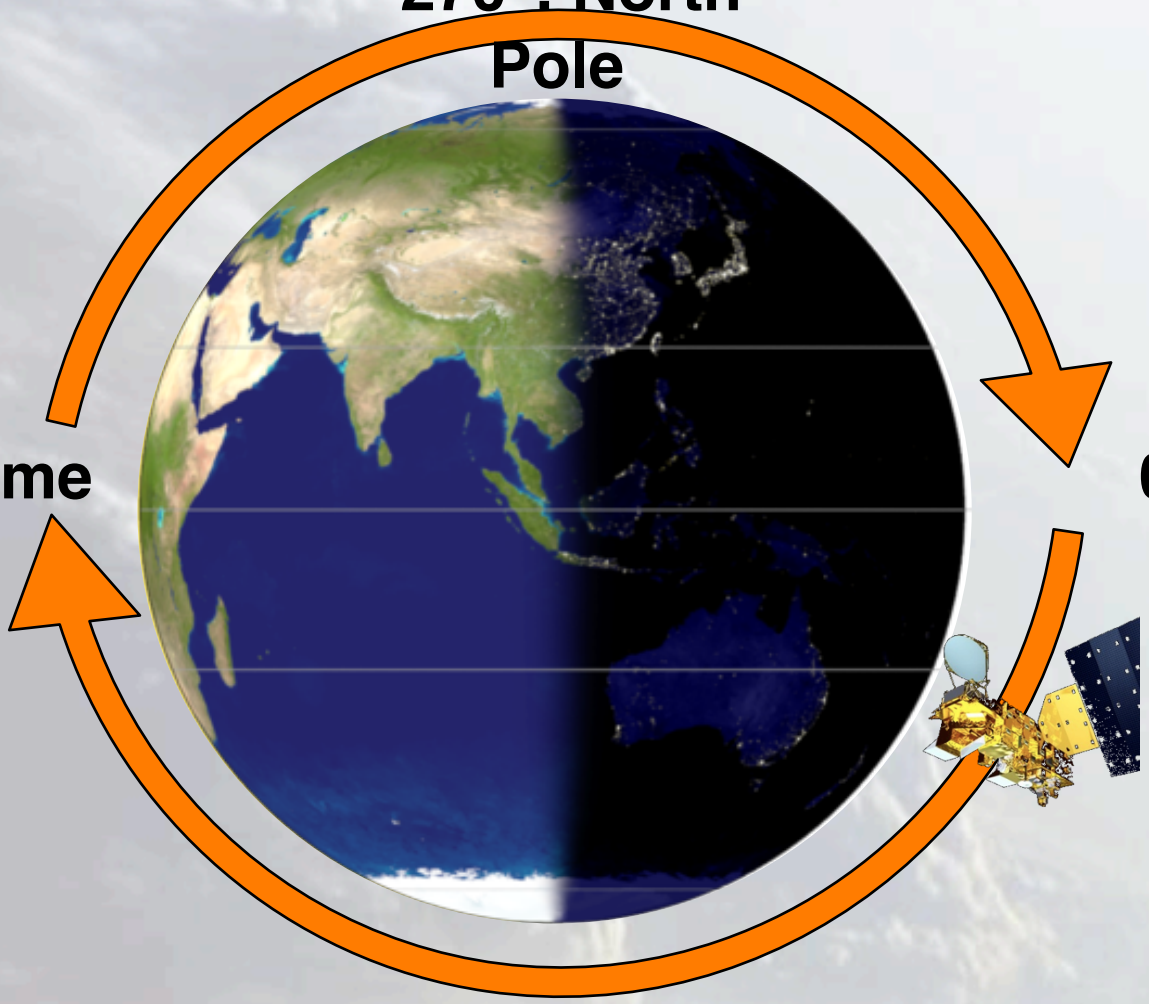
Orbital Phase



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AIRS Focal Plane

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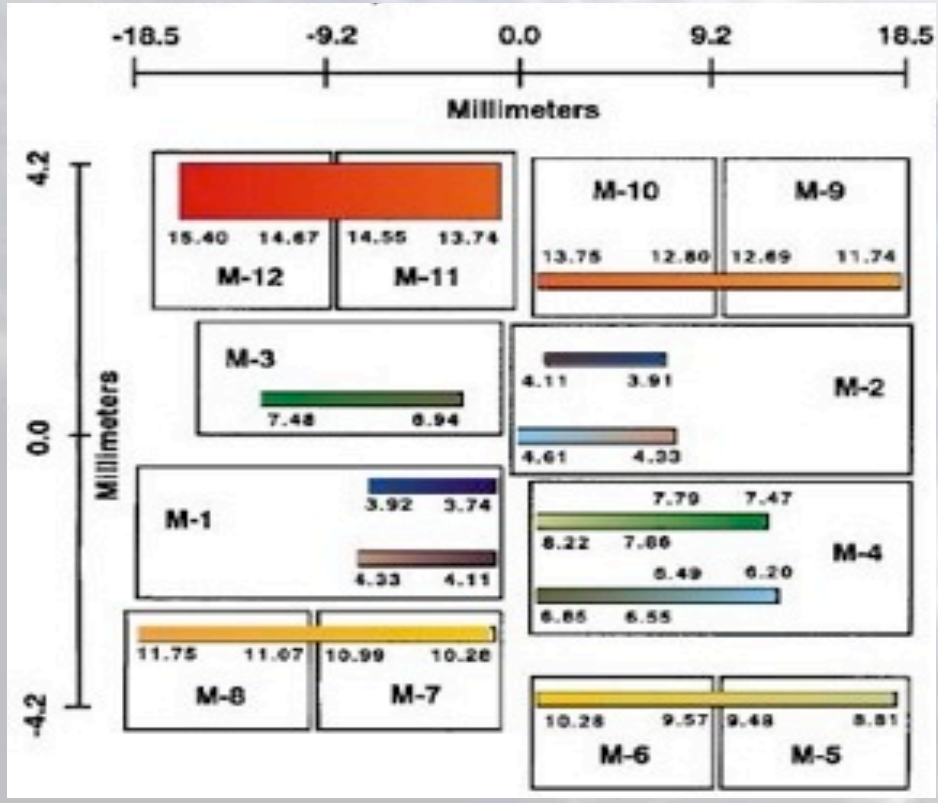

Direction of effective focal plane motion

Note on units:

- **1 μm in focal plane dimensions is:**
  - ***2% of channel spacing***
  - ***~20 cm^{-1} @1000 cm^{-1}***
  - ***~8.4 ppmf***
  - ***0.02 μm wavelength at 10 um wavelength***
- **0.1 μm in focal plane dimensions is:**
  - ***0.2% of channel spacing***
  - ***~2 cm^{-1} @1000 cm^{-1}***
  - ***~0.84 ppmf***
  - ***0.002 μm wavelength at 10 um wavelength***

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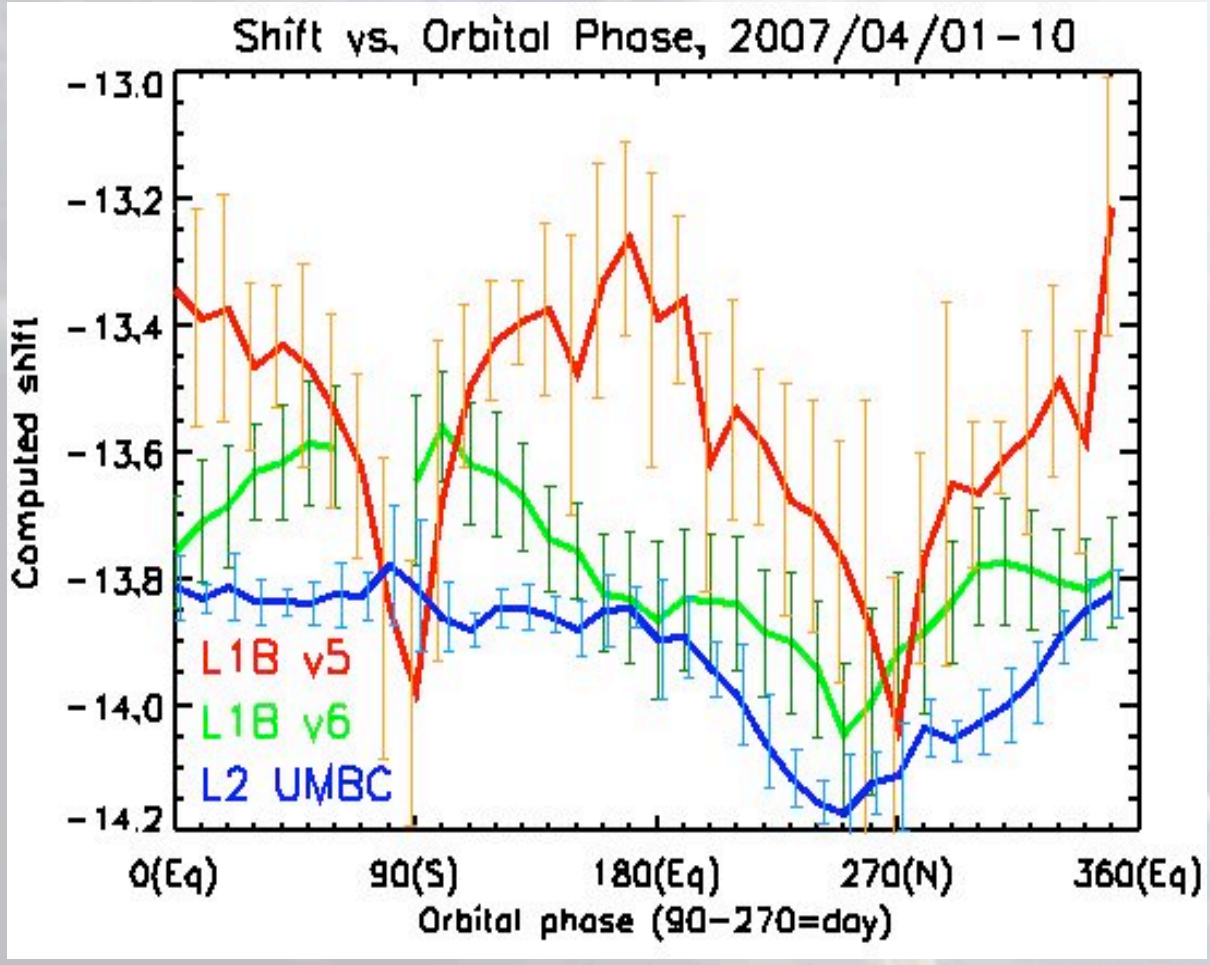
Level-1B Spectral Cal



- **UMBC L2 has the smallest error bars and smoothest orbital pattern**
- **New v6 L1B is a significant improvement over v5 L1B**

Level-1C

- **Level-1C is similar to Level-1B but removes instrument artifacts**
  - ***Cleans up problem channels***
  - ***Compensates for spectral shifting***
  - ***Applies improved correction for radiometric effects***

- **Level-1C v6 will be a research product only**
  - ***Maybe available to the public but with many caveats***
  - ***Maybe only available to the science team***
  - ***Maybe available as a software package, not a product***

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Level-1C Channel Clean-Up

- **Channels are replaced when:**
  - ***NEdT > 2.0 K***
  - ***5 permanently replaced channels:***
    - #121, 122 (679.6, 679.9 cm-1)
    - #132, 133, 134 (687.9, 688.1, 688.4 cm-1)
    - These PC channels are cross-wired
  - ***Pop or other rare calibration problem***
  - ***Typical number of replaced channels:***
    - ~125 out of 2378 => ~5%

- **Version 7 Level-1C may also estimate radiances for additional virtual channels in spectral gaps between modules**

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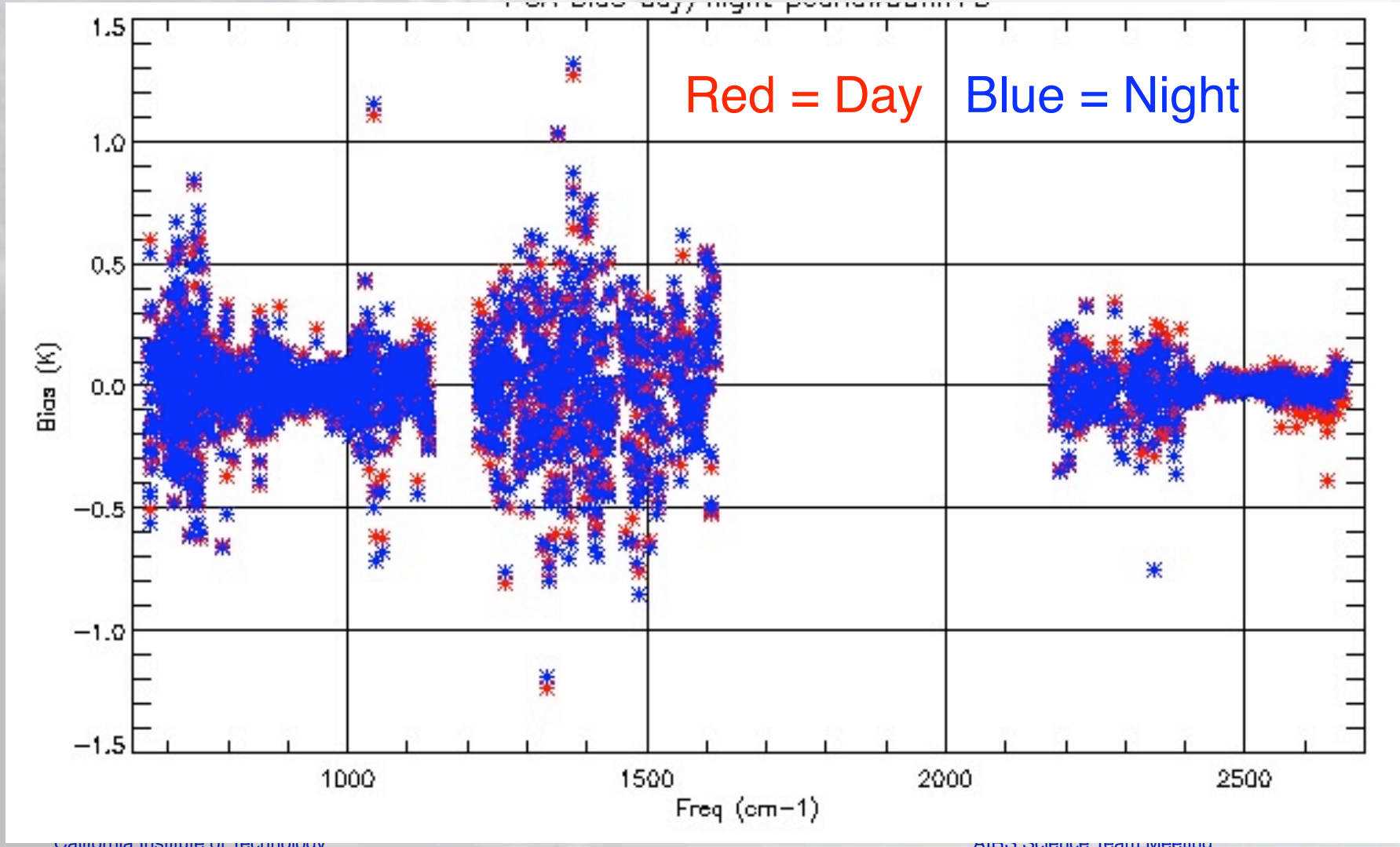
Level-1C Fill Bias



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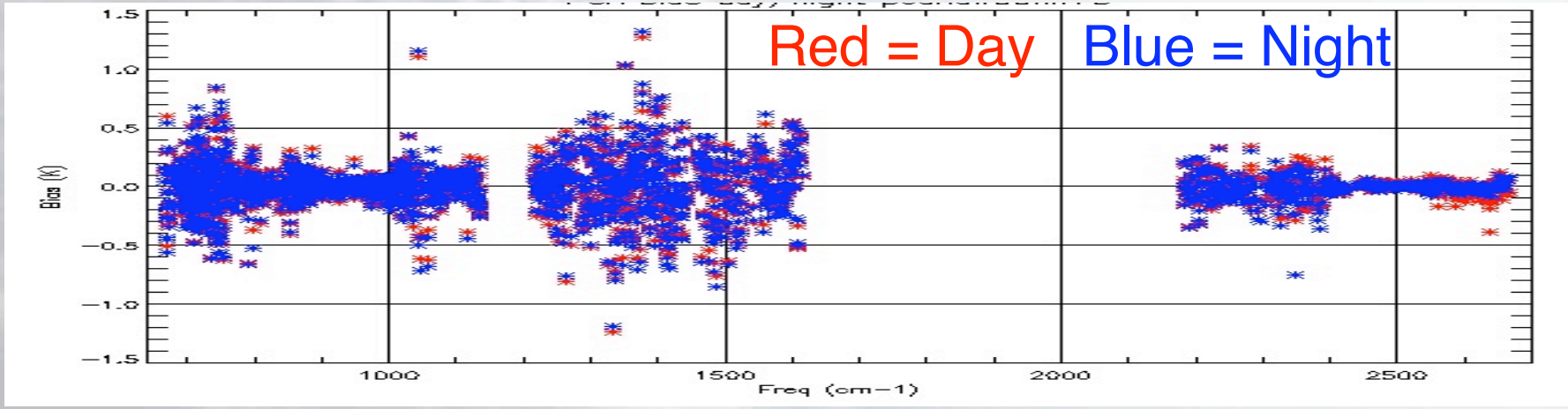
Level-1C Fill Bias



- **Residual biases are generally < 0.2 K but in rare cases may be over 1.0 K.**
- **Filled channels are marked and are not recommended for individual science use**
  - ***They can be used as inputs to a regression***
  - ***They can be used when simulating wider bands for comparison to MODIS etc.***

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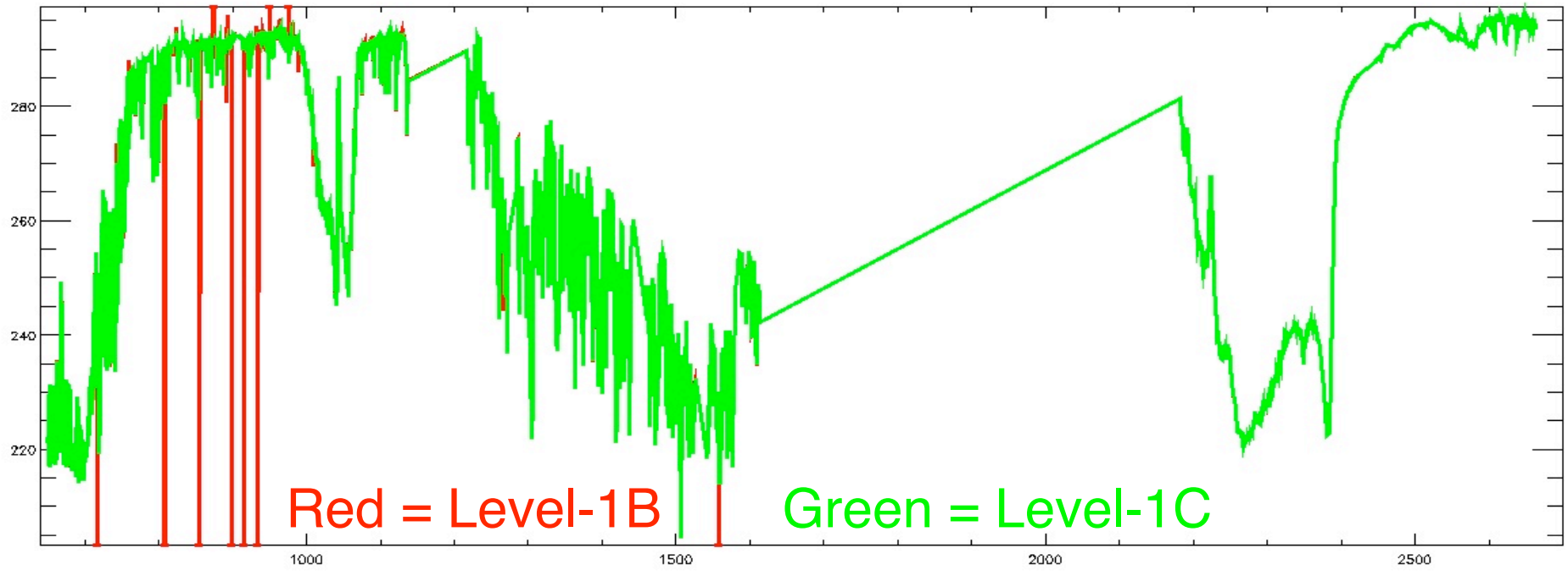
Typical Spectrum Level-1B vs. Level-1C



- Level-1C channel filling eliminates all of the worst outliers

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Level-1C Spectral Correction

- **UMBC has produced a model of spectral shifting**
  - ***Based on their offline L2 spectral determination***
  - ***Includes:***
    - Orbital cycle (orbital cycle cut into 180 2-degree bins)
    - Seasonal cycle
    - Long-term drift (including projection into the future)
    - Discontinuity at Nov 2003 solar flare
    - Different patterns per module

- **We'll use this model with minor modifications:**
  - ***Use module M-10 values for all modules***
    - Module M-10 contains the best spectral feature
  - ***Smoothed orbital pattern***

- **Once shift is known, radiances are adjusted to a static frequency set using a spline plus second-order correction**
  - ***See my presentations from last year***

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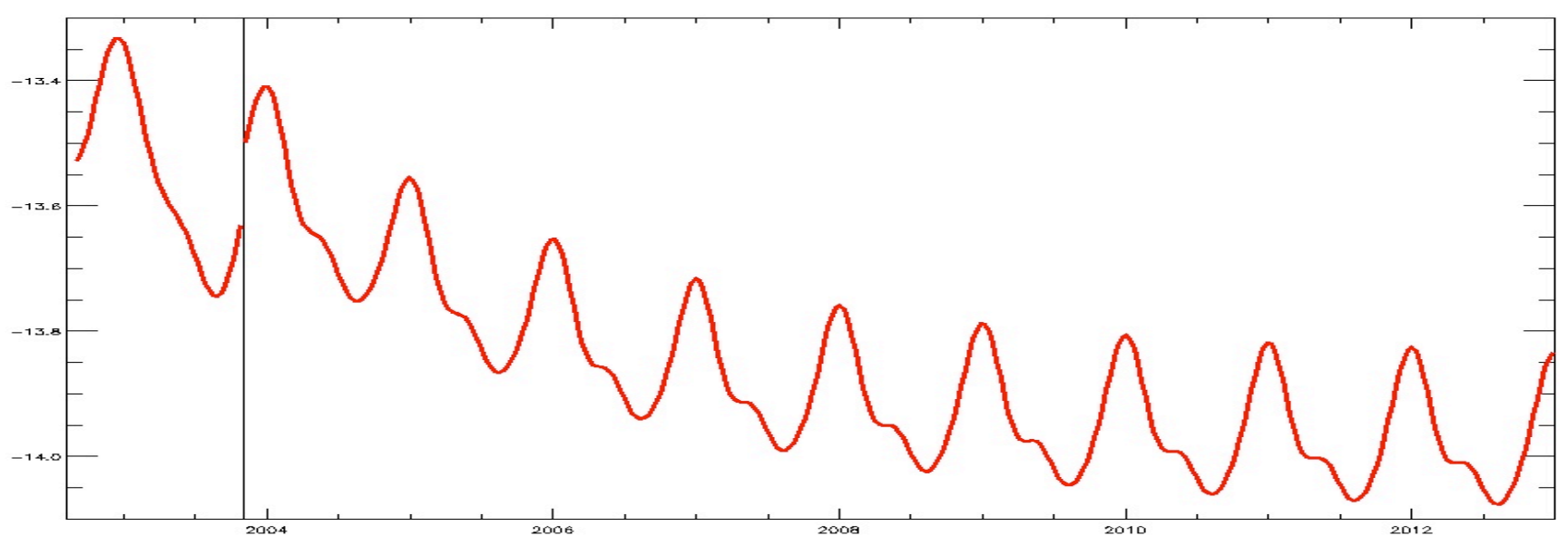
Long-Term Model Shift for M-10



- Includes a strong seasonal cycle of ~0.2 um peak-to-peak
- About 0.5 um long-term drift over the mission
  - Slowing
- Solar flare discontinuity in late 2003

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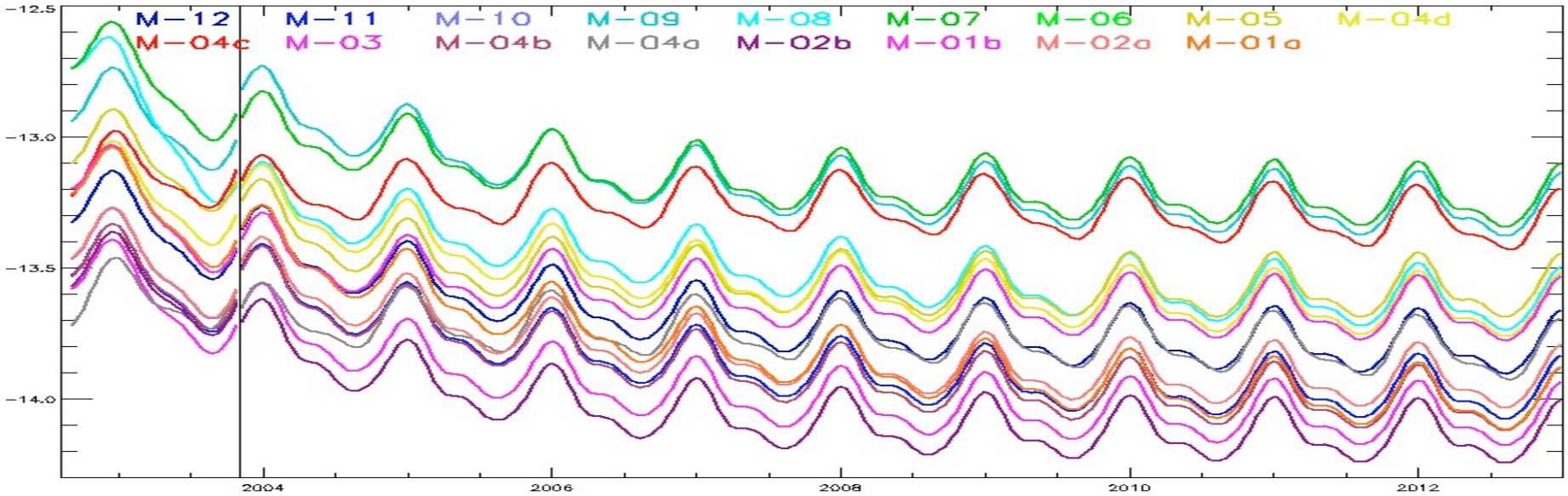
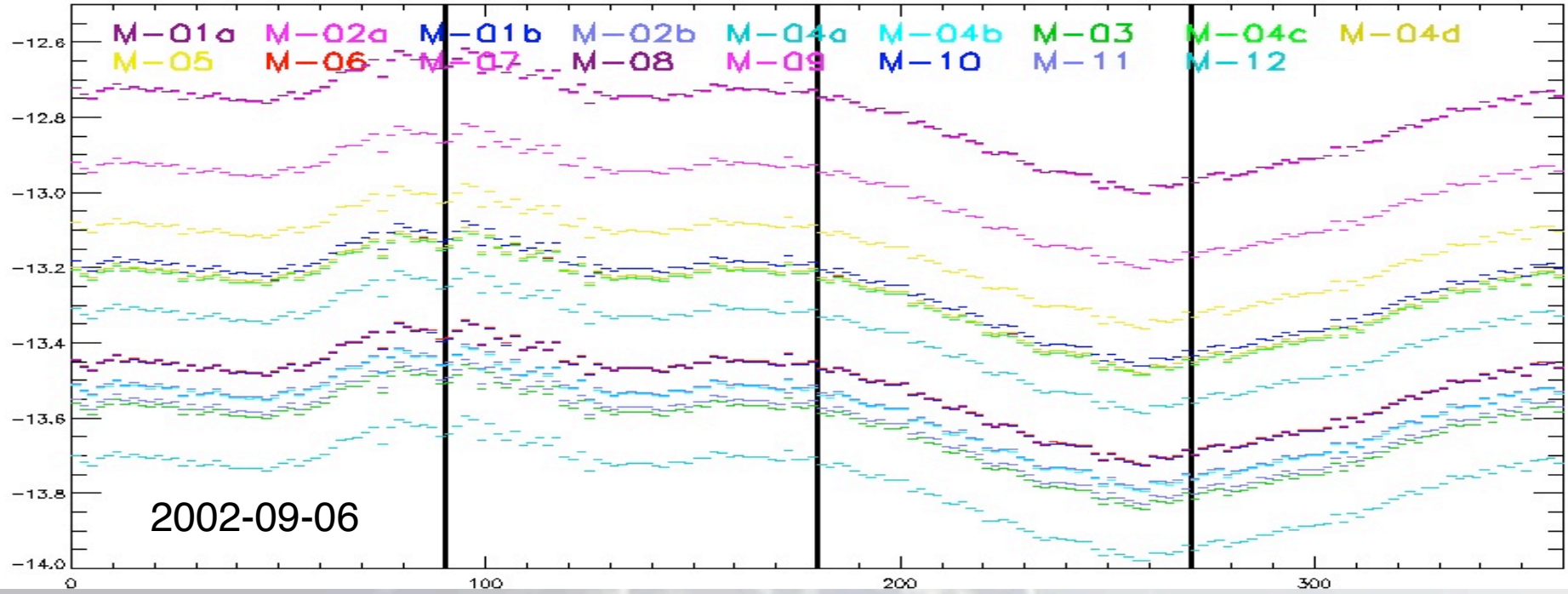
Long-Term Model Shift for All Modules



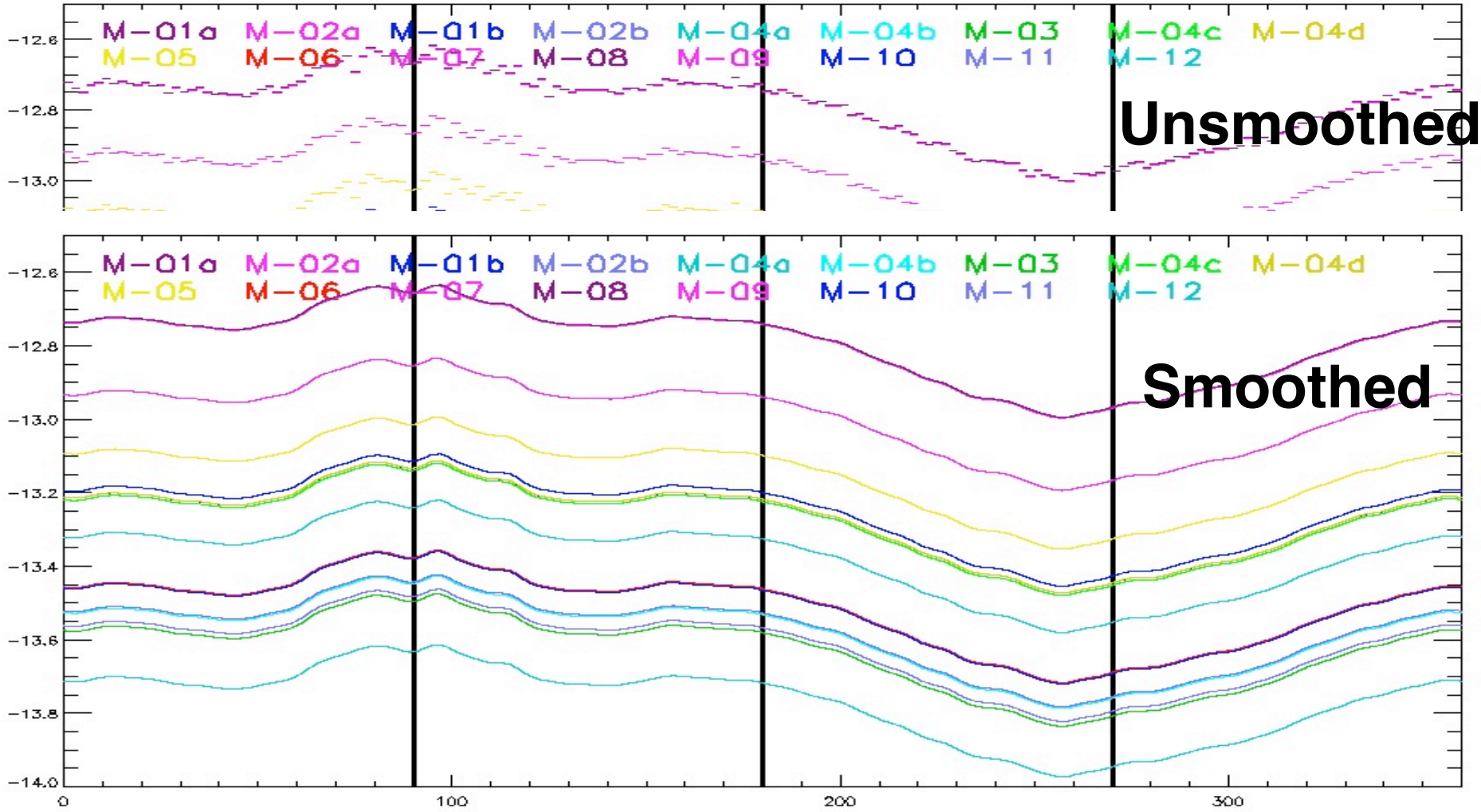
- All modules have similar patterns
  - Some, like M-04a and M-04c, have much less change with time
- The physical mechanism behind different trends per module is not understood
- V6 L1C will apply M-10 modeled shifts to all modules

Orbital Model Pattern for All Modules



- Discontinuities up to 0.05 um are visible at boundaries of 2-degree bins
- V6 L1C will apply smoothed shifts

Orbital Model Pattern for All Modules



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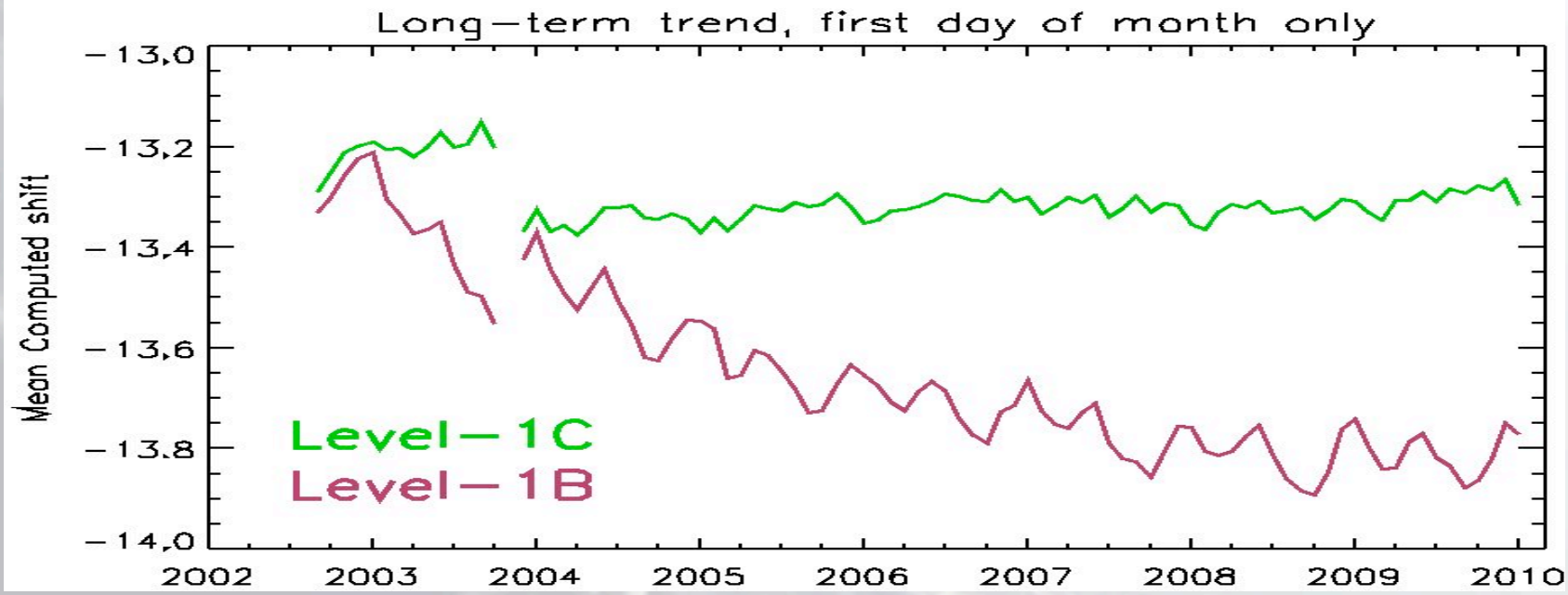
Final Test: Applying new L1B Spectral Calibration to L1C



- Peak-to-peak range of daily average has decreased >3x from ~0.7 um in Level-1B to only ~0.2 um
- The solar flare discontinuity in late 2003 is the main residual signal

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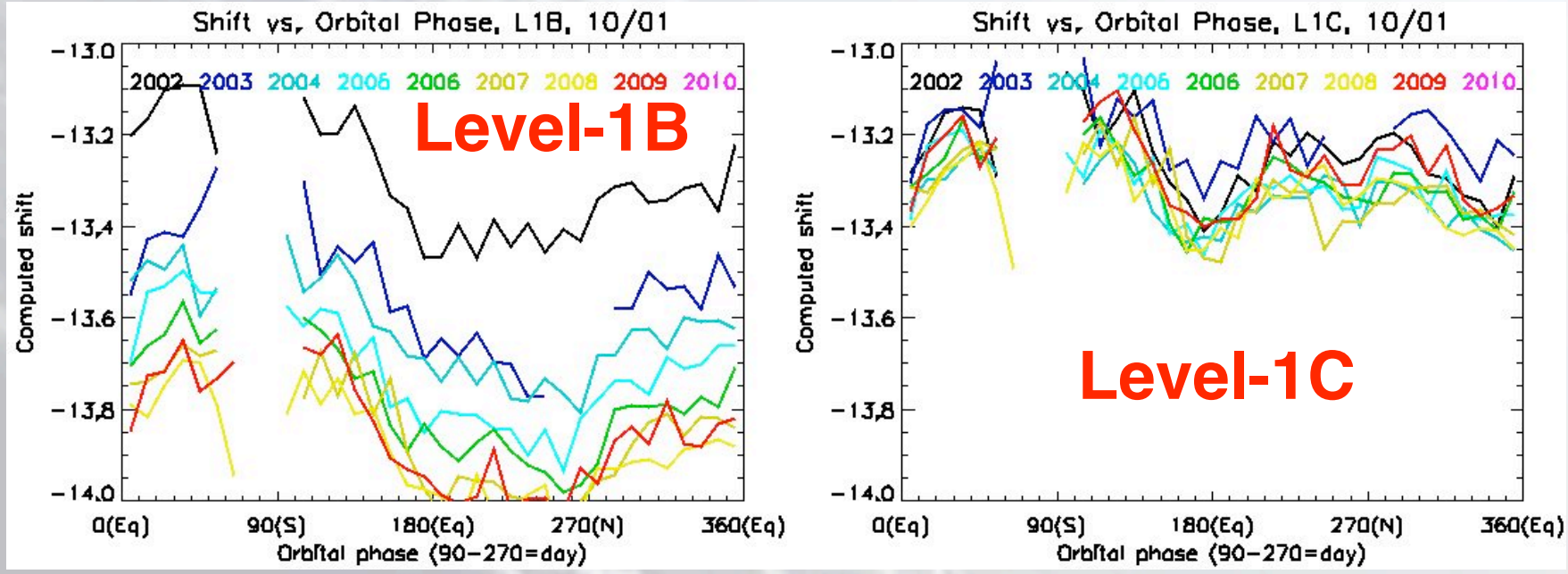

- Level-1C year-to-year scatter is much smaller than Level-1B
- The Level-1C orbital cycle is more compact
  - The residual Level-1C orbital cycle is due to differences in JPL v6 L1B vs. UMBC L2 CC spectral determination

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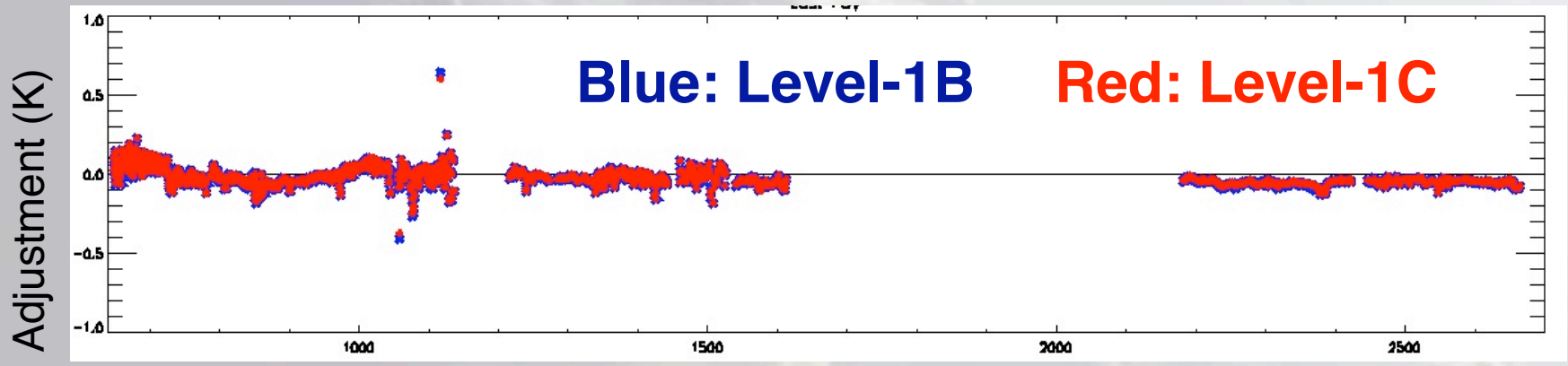
Level-1C Radiometric Correction

- **Denis Elliott already discussed the N40rab radiometric coefficient set**
- **These Radiometric changes would be applied directly in Level-1B if we were reprocessing Level-1B.**
- **The graph below shows the difference between applying the new coefficients "native" in Level-1B vs. as a post-processing step in Level-1C**



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Level-1C Radiometric Correction