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Space Administration

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Pasadena, California

Atmospheric Infrared Sounder

AIRS Calibration Software Status And Plans For V6

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October 11, 2007

Introduction

- **The AIRS radiometric calibration is both accurate and stable—there are no plans to change the basic radiometric calibration algorithm for V6**
- **We did make one small change between V4 and V5**
- **We intend to make two changes in V6 which will not affect the L1B calibrated radiances**

Outline

- **Moon-in-space-view algorithm summary (V5)**
- **V6 changes/additions**
  - ***Spectral calibration and Level 1C***
  - ***Proposed changes to channel properties and calibration properties files***
- ***(Interesting addendum)* IASI/AIRS NEΔT comparison**

Acknowledgements

- **Moon-in-view improvements**
  - ***Steve Gaiser***
  - ***Steve Licata***
- **Spectral calibration**
  - ***Larrabee Strow and his team***
  - ***George Aumann***
- **Calibration properties files**
  - ***Margie Weiler***
  - ***Evan Manning***
- **IASI/AIRS NEΔT Comparison**
  - ***Rudy Schindler***

Moon In Space View

- **The moon sometimes passes through a space view. If this goes unaccounted for, the radiometric calibration will be compromised because it assumes space views contain no IR signal.**
- **The V4 moon detection algorithm often failed to detect events where the moon crossed away from the center of the field (many false negatives)**
  - ***Only 15 detectors were used, one from each PV array***
- **The new algorithm for V5 uses hundreds of short and long wavelength detectors (skips the mid-wave) and has thresholds which depend on the expected position of the moon**
  - ***Far fewer false negatives***
- **Neither V4 nor V5 have a significant false positive count**

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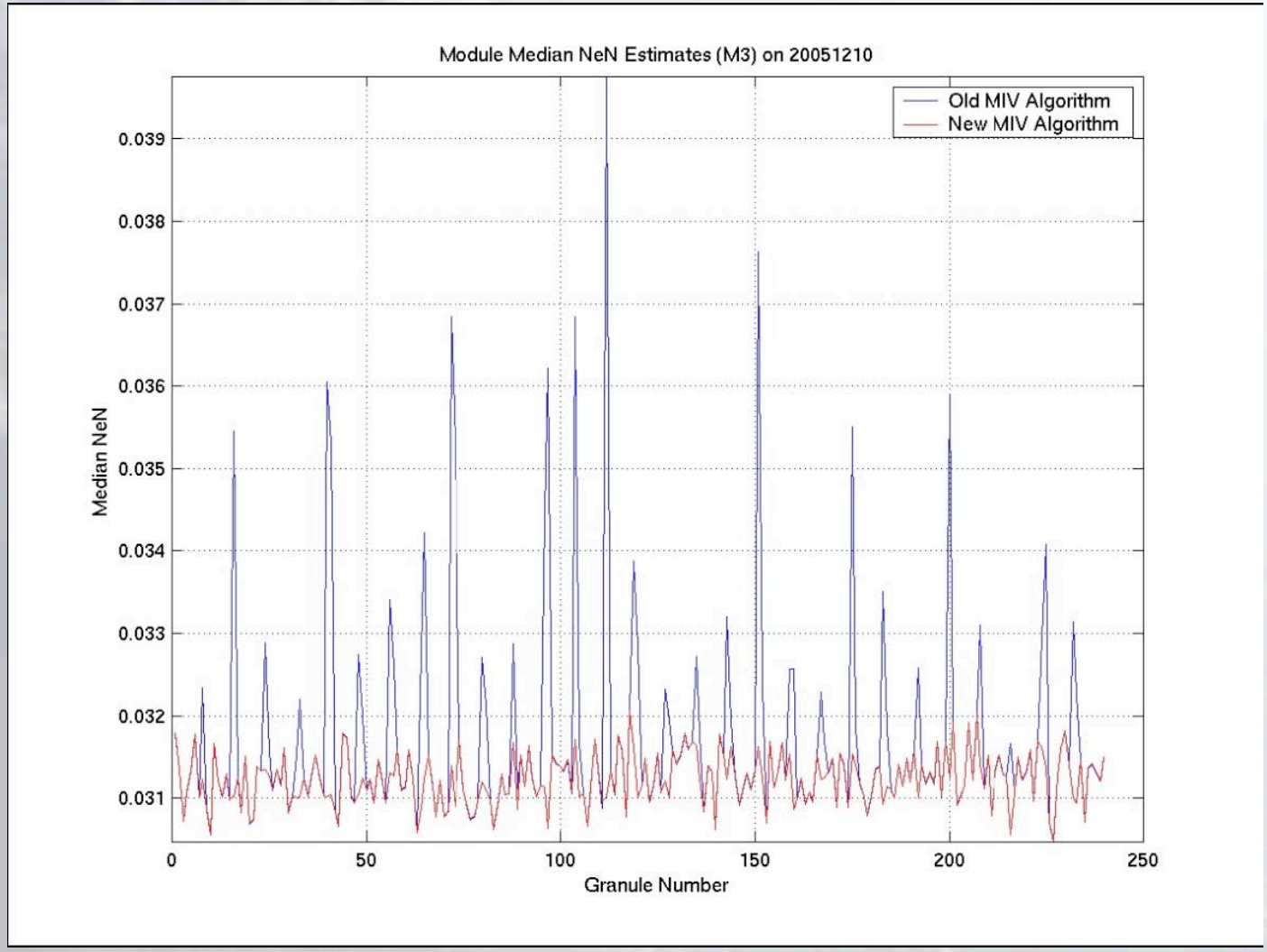
New vs. Old MIV Results—M3



Spectral Calibration

- **Channel spectra**
  - ***There are differences in the entrance filter channel spectra before and after the shutdown in October–November 2003***
  - ***L2 RTA needs to handle this—calibration team will not be involved***
- **Level 1C for dynamic spectral calibration changes**
  - ***Larrabee Strow is characterizing spectral calibration changes versus time***
    - Orbital
    - Seasonal
    - Secular
  - ***The calibration team will use his prescription to implement a new product—L1C—calibrated radiances resampled to a fixed frequency grid***

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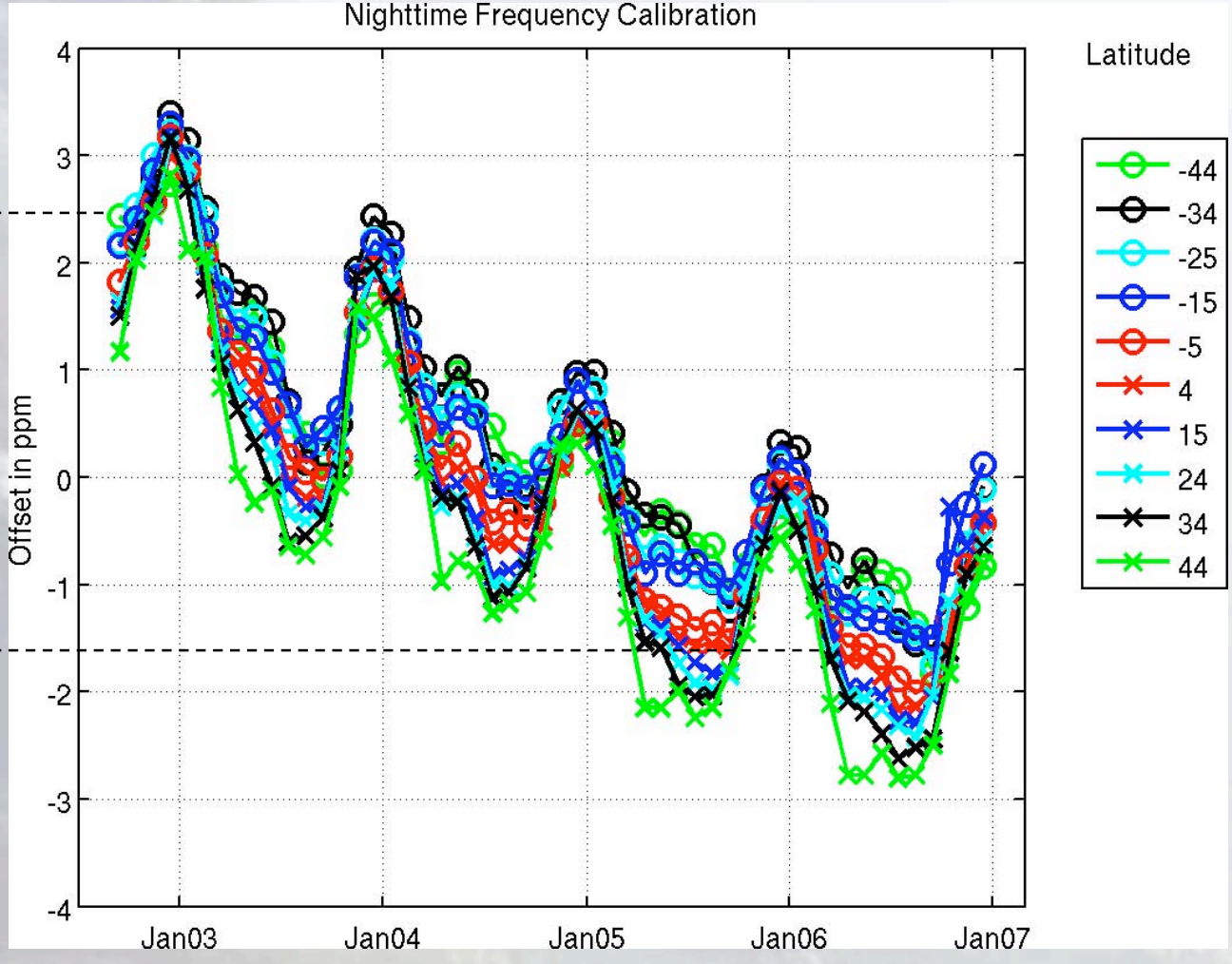
AIRS Spectral Calibration Stability—(3) In-Flight Results

< 1 ppmf/yr



Spectral Calibration Stability Discussion

- 1 ppmf amounts to 1/1000th of the width of a single channel
- Thus, the frequency trends shown on the previous chart represent extremely small changes—it takes a highly sensitive method and a very stable instrument for such tiny effects to be detectible at all
- The frequency changes are completely negligible for all non-climate-related products and studies, including weather prediction
- Results from CO_2 and H_2O channels are very similar which implies that all the detector modules are shifting together
- Latitude is used here as a rough proxy for orbital position and optical bench temperature—note that the dependence on latitude is small
- The seasonal oscillation with peak-to-peak amplitude 3 ppmf tracks the solar beta angle (solar illumination of the spacecraft)
- There is a secular change of approximately 1 ppmf/yr

L1C

- **The observed frequency shifts, small as they are, are measurable**
- **For climate studies it would be best to account for the shifts**
- **The AIRS L1B products (calibrated radiances) will not be changed**
- **A new L1C product, calibrated radiances resampled to a fixed frequency grid, will be generated starting with V6**
- **Work at JPL has just begun and the detailed requirements are not fully worked out**
  - ***Implementation of L1C will be worked on by a new member of the AIRS calibration team—Yibo Jiang***

Calibration Properties File Current Status (1 of 2)

- **V4 and earlier had a channel properties file which has**
  - ***Six epochs covering the entire mission, usually corresponding to episodes of instrument temperature cycling***
  - ***Fixed values of mean NEΔT at one reference temperature for each channel in each epoch, based usually on special calibration sequence data taken early in the epoch***
  - ***L2-related information on channel quality which hid details of how the quality rating was determined and led to confusion on channel usability***
- **These fixed values are used by L1B to set thresholds for high noise and pop flags**

Calibration Properties File Current Status (2 of 2)

- **In V5 the channel properties file remains, but users are encouraged to use the calibration properties file which**
  - ***Gives backup detail for information only summarized in the channel properties file***
  - ***Adds new fields, including an NEΔT for each channel at a second reference temperature***

Calibration Properties File Problem Statement

- **The contents of the file are not sufficiently dynamic, so noise and pop flags can be misleading in some cases**

- **In L1B, flag roll up software uses a fixed set of "good" channels—this method fails if only a few of those channels change noise characteristics due to radiation hits**

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Dynamic Calibration Properties Files Proposal

- **The channel properties file will no longer be distributed or used**
- **A new calibration properties file will be generated every month**
- **A partial list of the contents includes for each channel:**
  - ***Data from the most recent space view noise test***
    - Gain
    - Noise
    - Pop behavior
  - ***Data from the most recent six months of operational data***
    - Mean NeN
    - Mean and standard deviation of daily maximum NeN
    - High noise flag and pop flag counts per day
- **Corresponding changes in L1B**
  - ***Use the latest calibration properties file when channel noise characteristics are needed (such as flagging noisy channels)***
- **This proposal is still being refined and some details will probably change before it is submitted to the CCB**

IASI/AIRS NEΔT Comparison Introduction

- **Rudy Schindler has recently done a comparison of AIRS and IASI noise characteristics and distributed it as ADF 766**
- **He used one full day of actual AIRS data**
- **He used published IASI information**

IASI/AIRS NEΔT Comparison Methodology—AIRS

- **For each channel, calculate AIRS NEΔT as follows**
  - ***Std dev (SV_{rm} - SV_3) referred to 250 K where***
    - SV_{rm} = running mean of all 4 space views, width of window is 11 scan lines
    - SV_3 is instantaneous value of space view #3
- **Sort results and average by module**

IASI/AIRS NEΔT Comparison Methodology—IASI

- Read NEΔT values off of a figure in the IASI Cal/Val Team report
- Convert to a reference temperature of 250 K from IASI's 280 K
- Fill in straight-line segments from the figure using cubic spline interpolation with output resolution (x-axis spacing) equal to an AIRS frequency resolution element
- Sort the results into AIRS-equivalent modules and averaged

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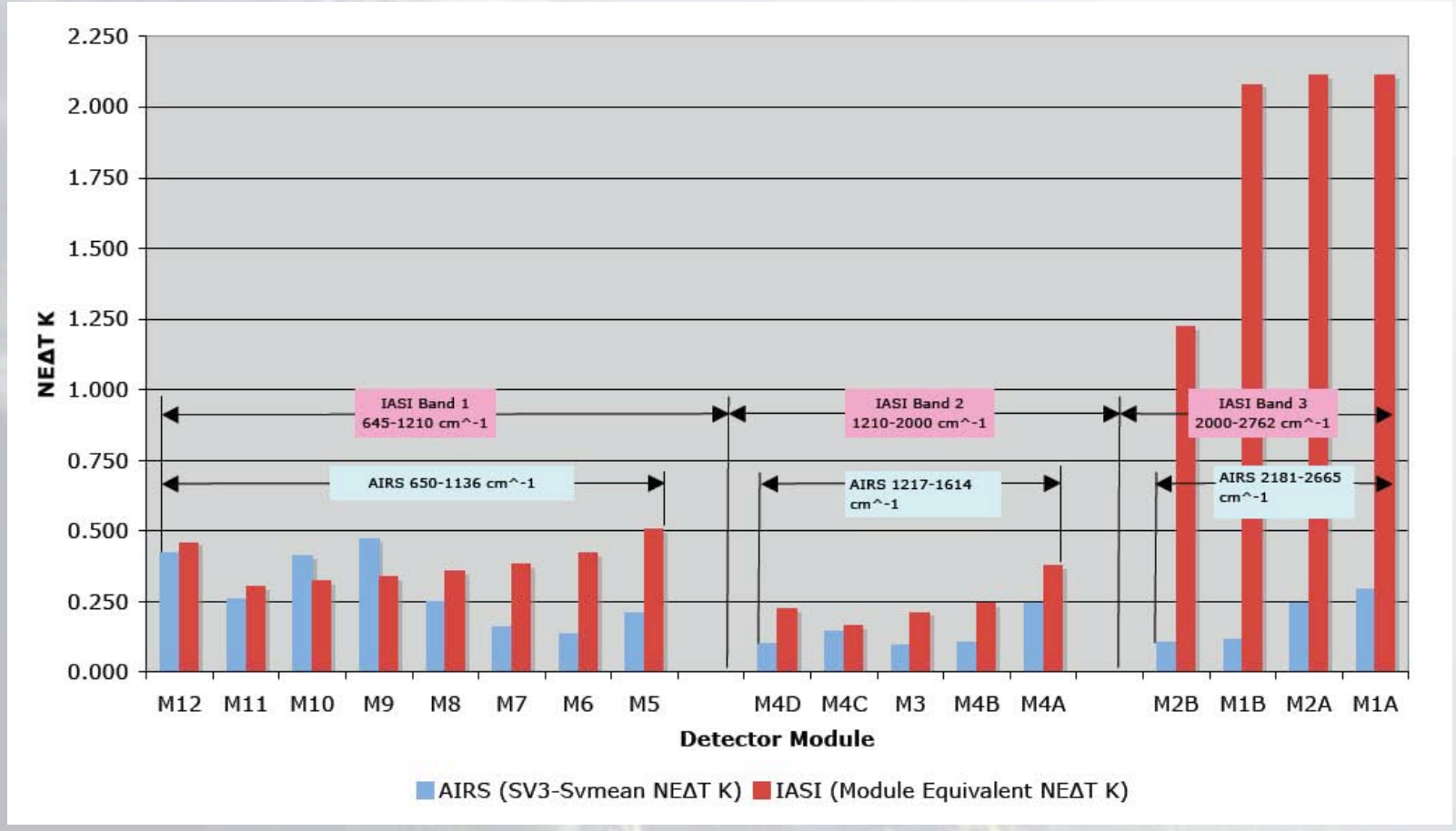
IASI/AIRS NEΔT Comparison Results

Long-wave—similar NEΔT

Mid-wave—IASI a little higher

Short wave—IASI much higher



- **BACKUP**

The Calibration Team (1 of 2)

- **The work I am describing here was done by various members of the AIRS calibration team. It consists of knowledgeable people who work on AIRS part time or who have multiple duties on the AIRS Project or other JPL projects**
- **Members who attend regular telecons**
  - ***Denis Elliott (JPL)***
  - ***Steve Licata (JPL)***
  - ***Evan Manning (JPL)***
  - ***Yibo Jiang (JPL)***
  - ***Ken Overoye (BAE Systems)***
  - ***Rudy Schindler (JPL retiree now a contractor)***
  - ***Margie Weiler (BAE Systems retiree now a consultant)***

The Calibration Team (2 of 2)

- **People we consult (all at JPL)**
  - ***George Aumann***
  - ***Steve Broberg***
  - ***Bjorn Lambrigtsen***
  - ***Tom Pagano***
- **Steve Gaiser was a major contributor—he has left JPL**
- **We also consult with science team members**

IASI/AIRS Noise Comparison Methodology—AIRS

- **For each channel, calculate AIRS NEΔT as follows**
  - ***std dev (OBC - SV_{rm}) referred to 250 K where***
    - OBC = counts from the on-board calibrator
    - SV_{rm} = running mean of space views, width of window is 11 scan lines
  - ***Std dev (SV_{rm} - SV_3) referred to 250 K where***
    - SV_3 is instantaneous value of space view #3
- **Sort results and average by module**