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# Calibration Status of the Atmospheric Infrared Sounder (AIRS) on Aqua

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## **AGENDA**

### **AIRS Calibration Status**

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- **Instrument Status**
- **Algorithm Status**
- **Level-1B Data Usage**



## **Instrument Status AIRS Calibration Status**

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- **Instrument continues to exceed requirements and expectations**
- **Radiometric accuracy excellent, unchanged**
- **Radiometric stability excellent, as shown by Aumann**
- **Spectral stability excellent, variability now modeled by Strow**
- **Spatial performance described below**
- **Polarization performance not studied; open area for research**
- **Recent scan mirror stoppage had no effect beyond the data dropout (19+ hours)**



## **Spatial Performance AIRS Calibration Status**

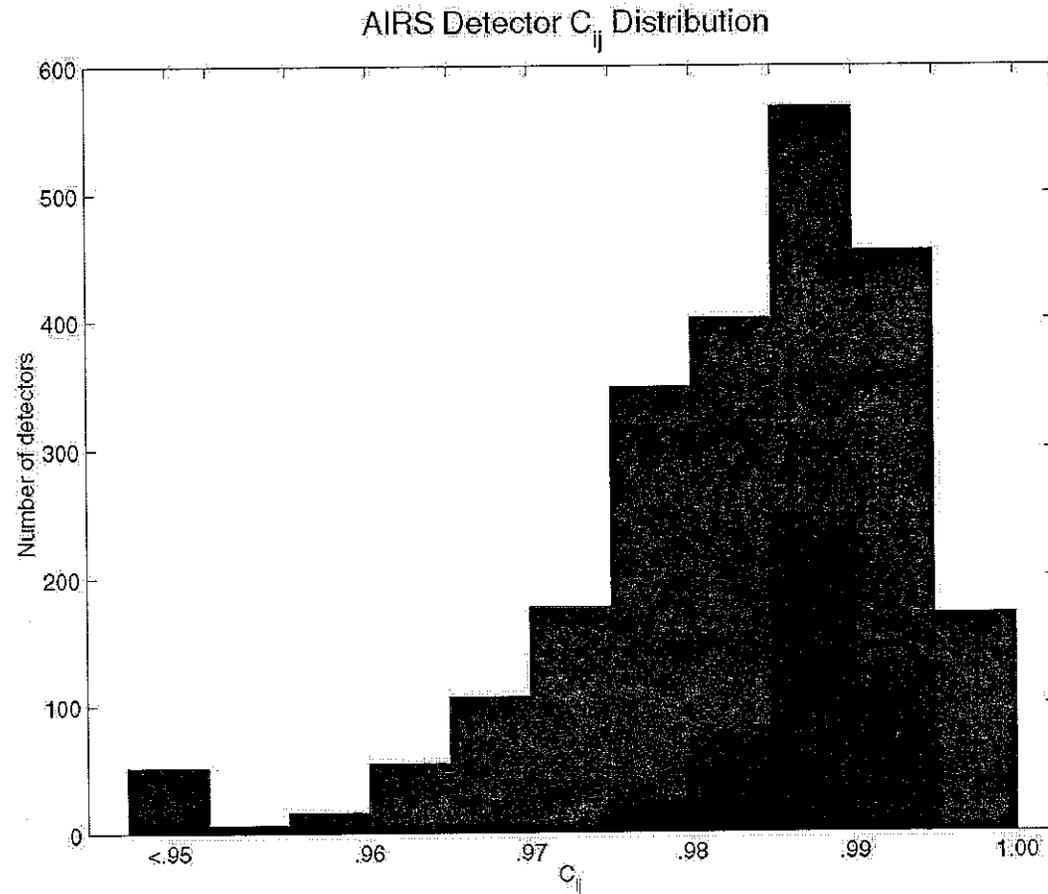
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- **Spatial performance falls in two categories: geolocation and coalignment**
- **Geolocation has been validated to better than 2.5 km (1/5 IFOV) at nadir based on analysis of coastline crossings with AIRS IR and AIRS VIS/NIR (Gregorich)**
- **Coalignment is good and well characterized in well-publicized sources (the Channel Properties File)**
- **Details of measured IFOVs as well as calculated smeared FOVs as a function of scan angle will be made available through the AIRS website.**



## Cij Distribution AIRS Calibration Status

- **Coregistration shown for all 2378 channels**
- **Median = 0.985**





## Algorithm Status AIRS Calibration Status

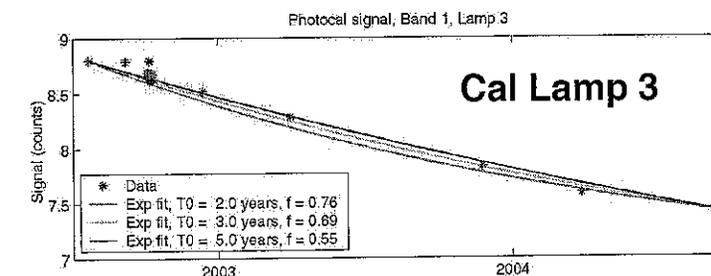
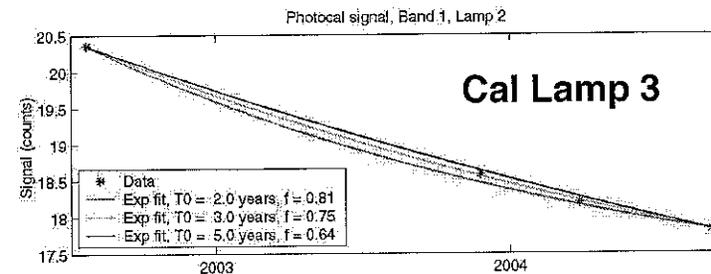
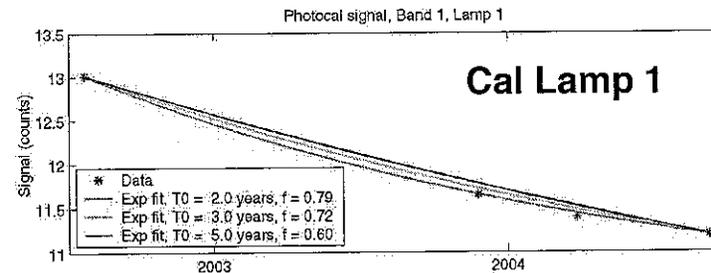
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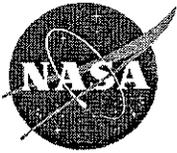
- **Stable overall, except VIS Band 1**
- **Many small changes (listed below)**
- **Small impact**



## VIS Band 1 AIRS Calibration Status

- **Decrease in responsivity observed**
- **Attributed to scan mirror coating change**
- **Corrected for, assuming exponential decay, 3-year time constant**
- **28% total decay predicted for band 1 at  $T=\infty$**
- **0.8% total decay predicted for band 2 at  $T=\infty$**





## Algorithm Changes for v4.0 AIRS Calibration Status

Change	Description	Radiance impact?	QA Flag impact?
CR-808	New channel properties	No	Yes
CR-760	Offset smoothing	Yes	Yes
CR-769	Radiance Rounding	Yes	No
CR-797	Cold scene noise	No	Yes
NR-694	VIS trend	Yes	No
AR-1768	Bad gain bit	No	Yes
CR-778	Focal Map Update	No	No
CR-764	Gain filtering	Yes	No
CR-822	Overflow warning	No	No



## Channel Property File Changes AIRS Calibration Status

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- Revised frequencies for M5
- Better noise estimates (decreased for M11, M12, increased slightly for other modules)
- Revised spatial centroid data
- Corrected  $C_{ij}$  values (old values were junk)



## **Offset Smoothing AIRS Calibration Status**

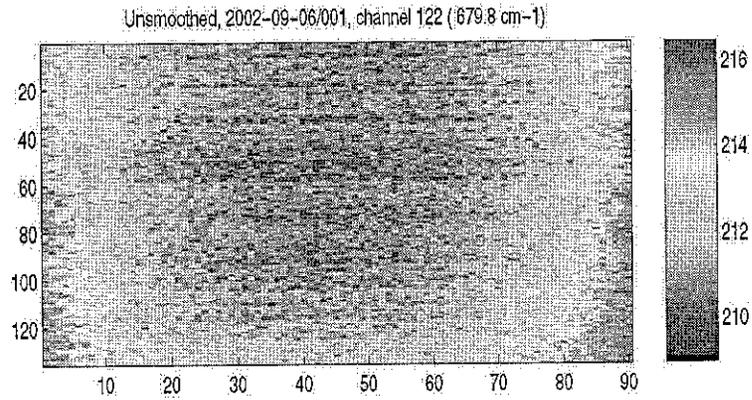
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- **Previous algorithm calculated offset as median of 8 space views**
- **New algorithm calculates offset by linear fit across 10 scan lines**
- **Changes (corrects) biases by up to 5 mK in some channels**
- **Slightly improves noise estimates**

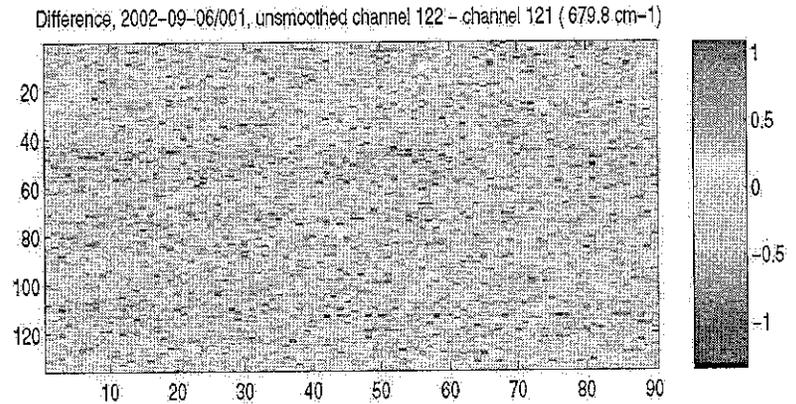


# Offset smoothing example AIRS Calibration Status

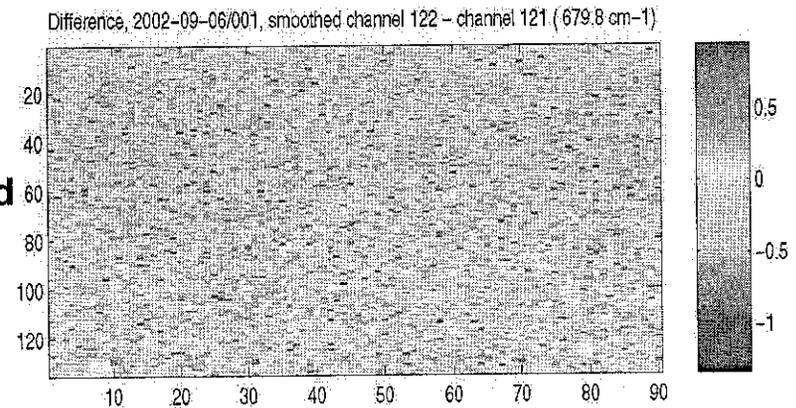
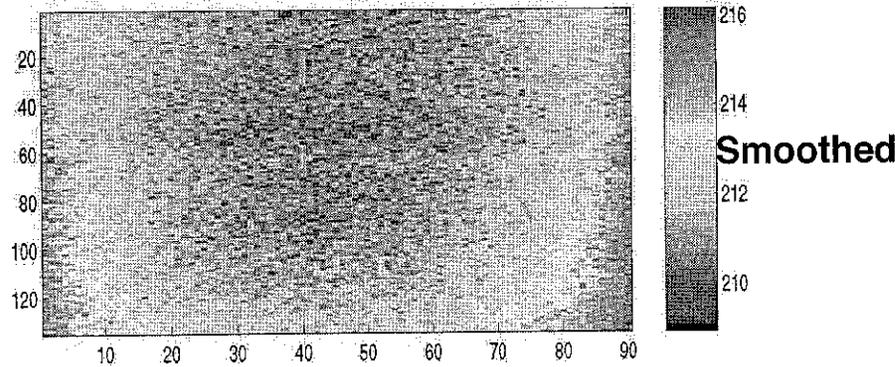
### Ch 122 image



### Ch 122 - ch 121



### Smoothed, 2002-09-06/001, channel 122 (679.8 cm<sup>-1</sup>)

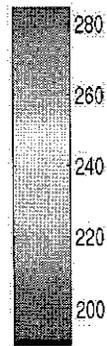
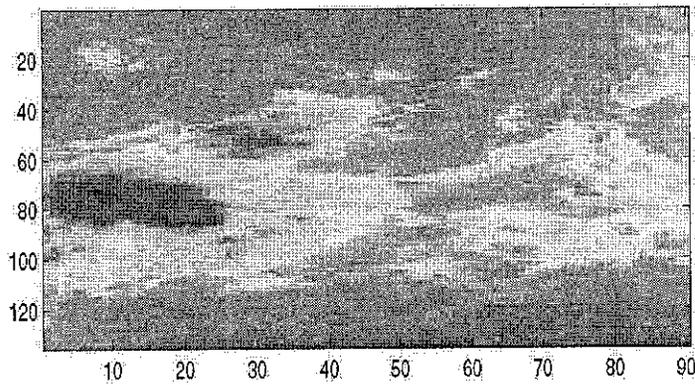




# Offset smoothing example AIRS Calibration Status

### Ch 461 image

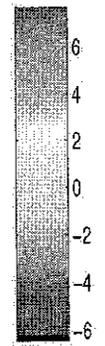
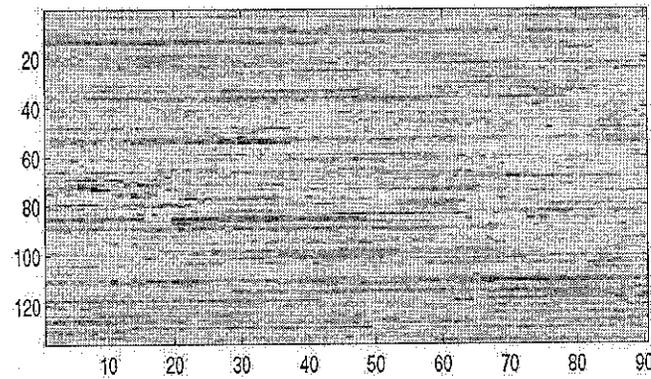
Unsmoothed, 2002-09-06/001, channel 461 (795.9 cm<sup>-1</sup>)



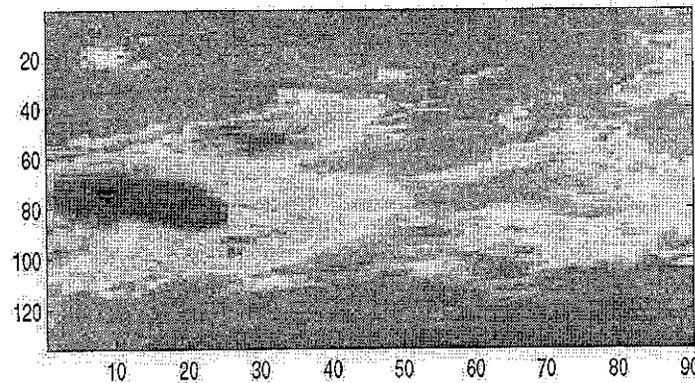
Orig

### Ch 461 - ch 461

Difference, 2002-09-06/001, unsmoothed channel 461 - channel 460 (795.9 cm<sup>-1</sup>)

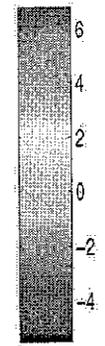
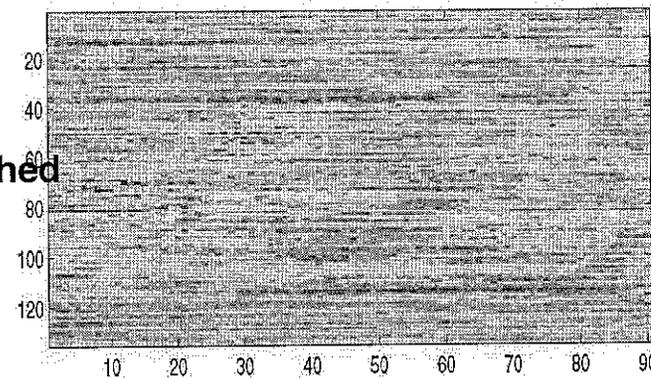


Smoothed, 2002-09-06/001, channel 461 (795.9 cm<sup>-1</sup>)



Smoothed

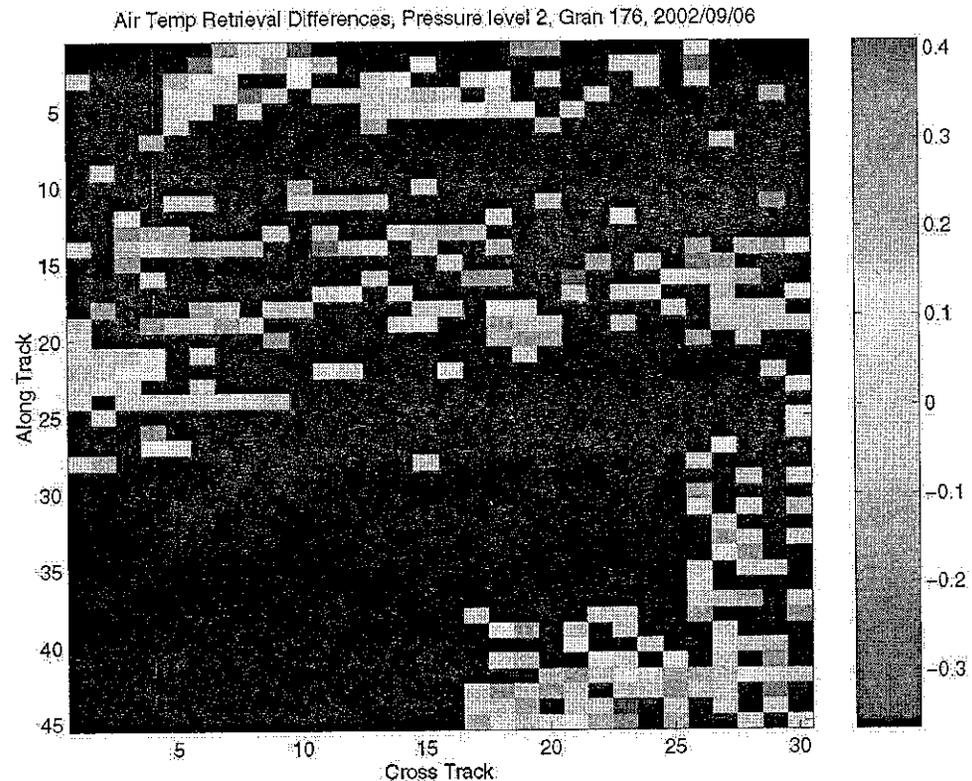
Difference, 2002-09-06/001, smoothed channel 461 - channel 460 (795.9 cm<sup>-1</sup>)





## Algorithm changes, retrieval impact AIRS Calibration Status

- **V3.7.12 retrieval**
- **V3.7.12 and v3.7.3 radiances**
- **Changes include radiance rounding and offset smoothing**
- **For this granule, for RetQAFlag = 0:**  
**Mean = 0.0046K**  
**Std = 0.17K**  
**Max = 0.97K**  
**Min = -0.77K**
- **Hearty performed a more detailed analysis, found no impact**





## AIRS Data Usage AIRS Calibration Status

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- **Using data quality indicators is the users' responsibility**
- **Providing those quality indicators is the AIRS team responsibility**
- **Quality indicators are provided statically in the form of channel properties files, and dynamically with data present in the standard Level-1B products.**
- **The channel properties file contains a static estimate of the channels' characteristics, including properties which were only measured pre-launch (boresight, SRF)**
- **The L1B radiance products contain on-the-fly estimates of noise, as well as indicators of abnormal behavior by the instrument or algorithms**



## **AIRS L1B Data Quality Sources AIRS Calibration Status**

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### **Channel Properties File**

**Frequency centroids, widths**

**NEdTs (static)**

**Spatial centroids**

**“AB\_States”**

### **L1B Data Product**

**CalFlag, CalChanSummary,  
CalScanSummary,  
CalGranSummary**

**NeNs (dynamic)**

**SceneInhomogeneous flag**

**Rdiff indicators**

**Radiances**



## AIRS L1B QA Filtering Prescription AIRS Calibration Status

**Consider a candidate channel measurement.**

**Evaluate it radiometrically:**

- **If  $AB\_State > 2$ , the channel has known radiometric problems, so don't use it.**
- **Pick a noise limit. Filter on it based on the Channel Properties File (OK) or on dynamic NeN estimates (better).**
- **Look at CalChanSummary: If any of these bits are set**
  - 6: Anomaly in offset calculation**
  - 5: Anomaly in gain calculation**
  - 4: Pop detected**
  - 3: High noise**

**then don't use that channel for that granule.**



## **AIRS L1B QA Filtering Prescription (cont.)**

### **AIRS Calibration Status**

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**Evaluate it spatially:**

**If you are sensitive to channel co-registration, you must either**

**1) Use  $C_{ij}$  and/or boresight centroids to limit yourself to co-aligned channels (and only you can determine what your requirement is),**

**OR**

**2) Use the SceneInhomogenous flag, the Rdiff values, and/or the radiances themselves to restrict yourself to uniform scenes, where coregistration isn't a concern. Again, only you know how sensitive you are.**



## **AIRS L1B QA Filtering Prescription (cont.)**

### **AIRS Calibration Status**

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**Evaluate it spectrally:**

**You are sensitive to the shape of the spectral response function if you are using the AIRS RTA or if you are brewing your own radiative transfer algorithm. If so, avoid using channels with the “SRF shape” comment in the Channel Properties File.**

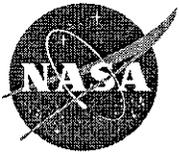


## **SUMMARY**

### **AIRS Calibration Status**

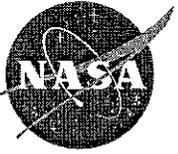
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- **The AIRS instrument continues to function excellently.**
- **The AIRS L1B algorithms and QA indicators are working well, and have been subject to only minor changes.**
- **Data users must filter data based on their own needs, using static and dynamic radiometric, spectral, and spatial QA indicators.**

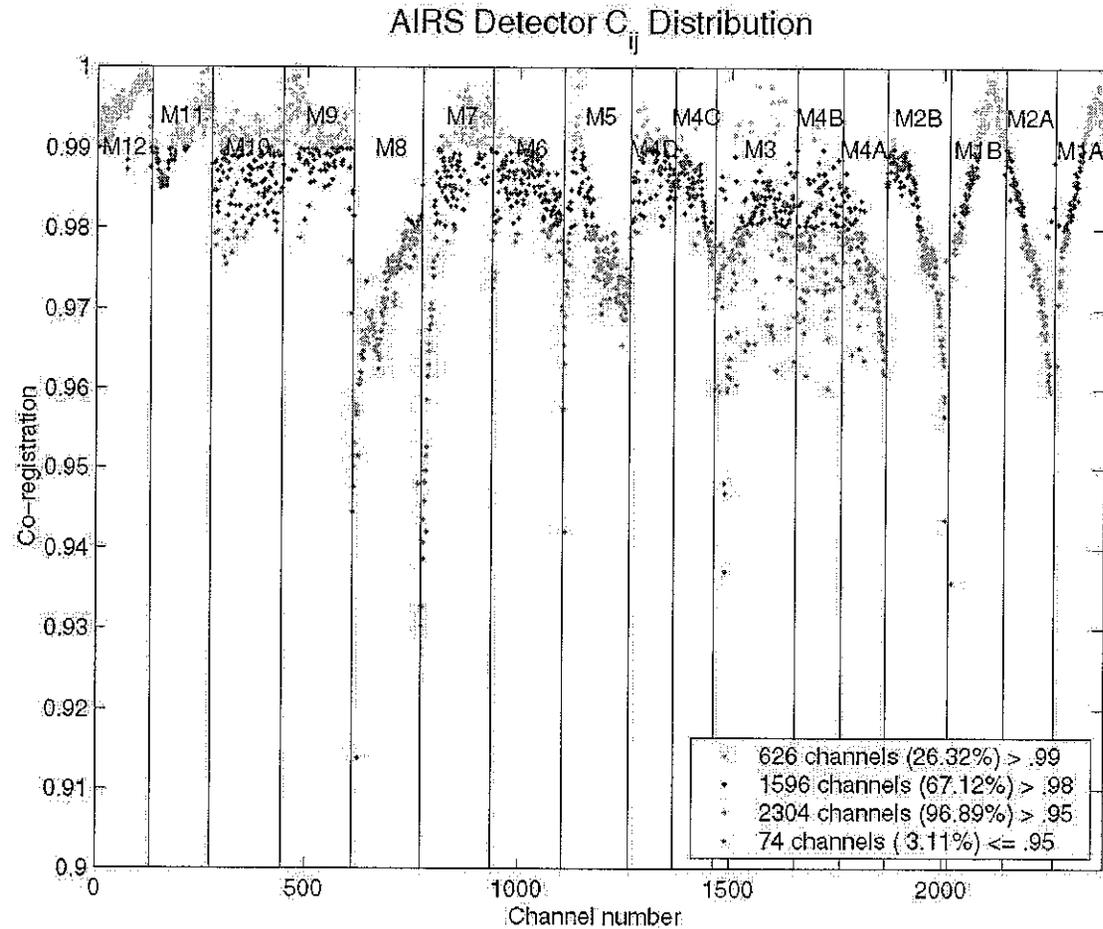


## **Backup Slides AIRS Calibration Status**

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# Cij Distribution AIRS Calibration Status





# Centroid Distribution AIRS Calibration Status

