



UW Study-2: Infrared Cross-calibration Accuracy Evaluation Using Aqua & Metop-A Data Sets

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CLARREO Mission Study Team Meeting

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CLARREO Inter-calibration Objective

- An objective of the CLARREO mission is to serve as an on-orbit high-accuracy reference for operational infrared sounders such as AIRS, IASI and CrIS to enhance the observations available for process studies.
- Our baseline assumption is that CLARREO is a stand-alone mission that does not rely on the operational sensors in order to produce the infrared benchmark climate observations.



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Study Objectives

- Following a nominal mission concept optimized for producing the primary climate benchmark observations, investigate the accuracy to which CLARREO can be used to inter-calibrate operational infrared sensors.
- Investigate the impact of mission/sensor design parameters (e.g. orbits, noise, footprint size, ...) on the accuracy of such inter-calibrations.



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Inter-calibrate ?

1. Determine mean bias between two sets of observations ?
2. Provide improved uncertainty estimates ?
3. Attribute source of bias ?
4. Refine calibration to produce more accurate operational radiance products ?

Are all of these always possible ?



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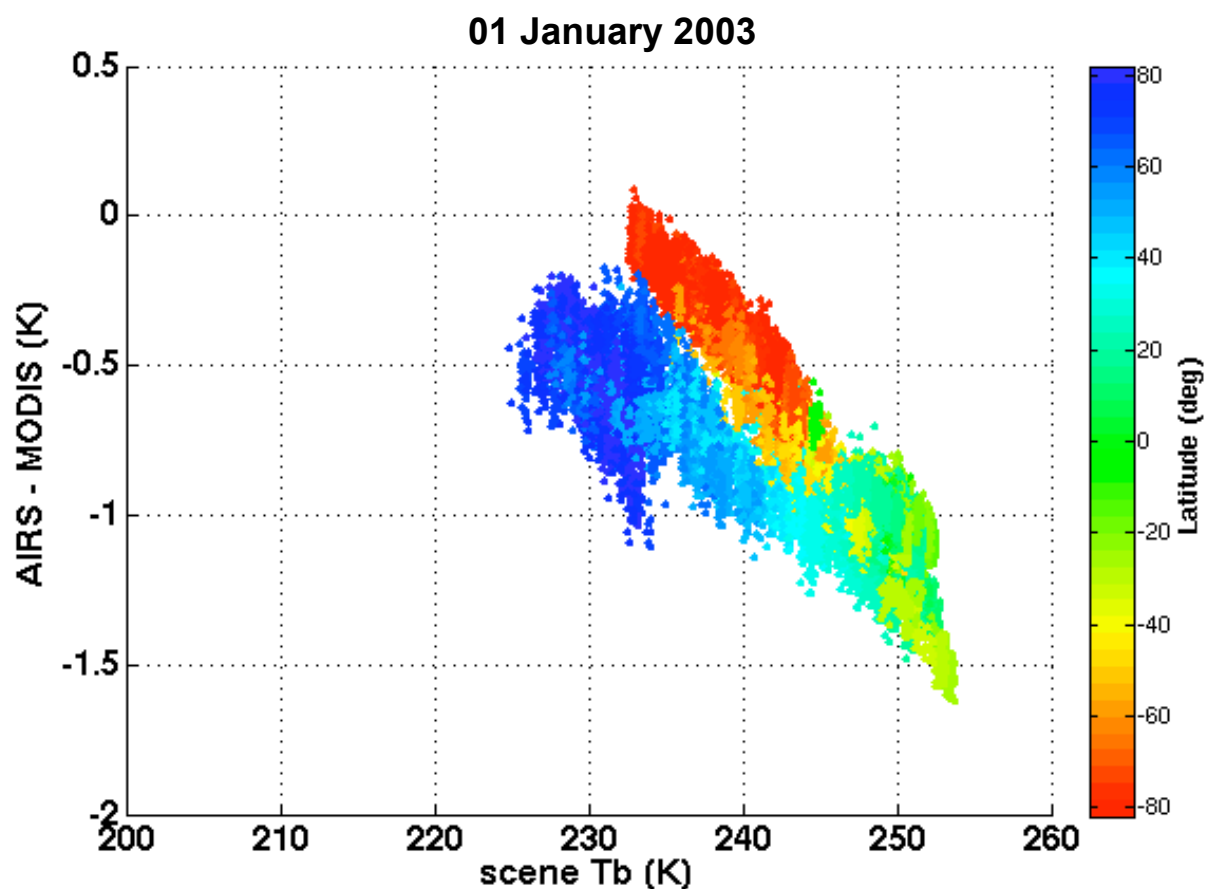
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The utility of an in-orbit reference. An example

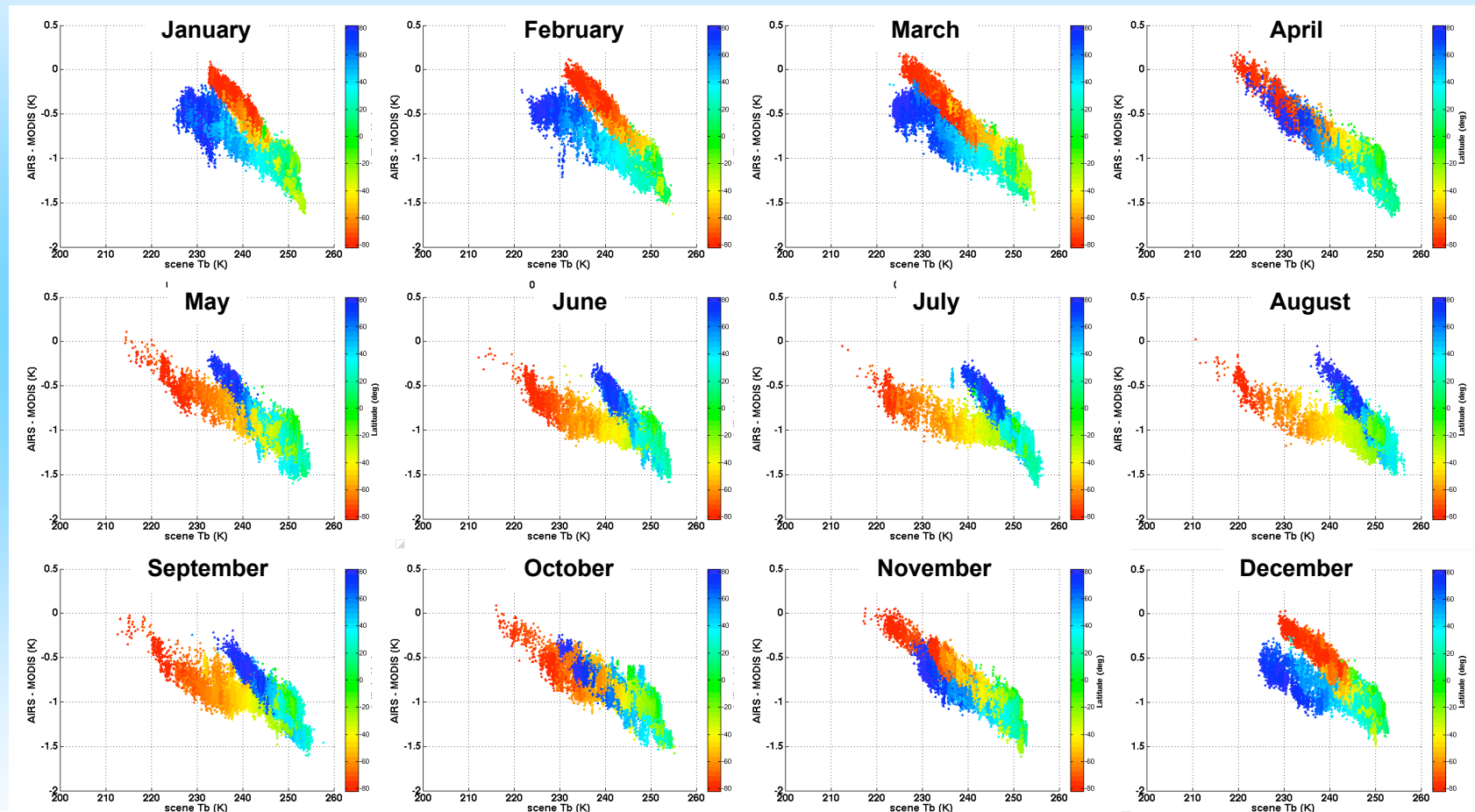
Five years of Aqua AIRS/MODIS IR radiance comparisons

MODIS Band 35 ($13.9\ \mu\text{m}$)



The utility of an in-orbit reference. An example

Five years of Aqua AIRS/MODIS IR radiance comparisons MODIS Band 35 (13.9 μm)



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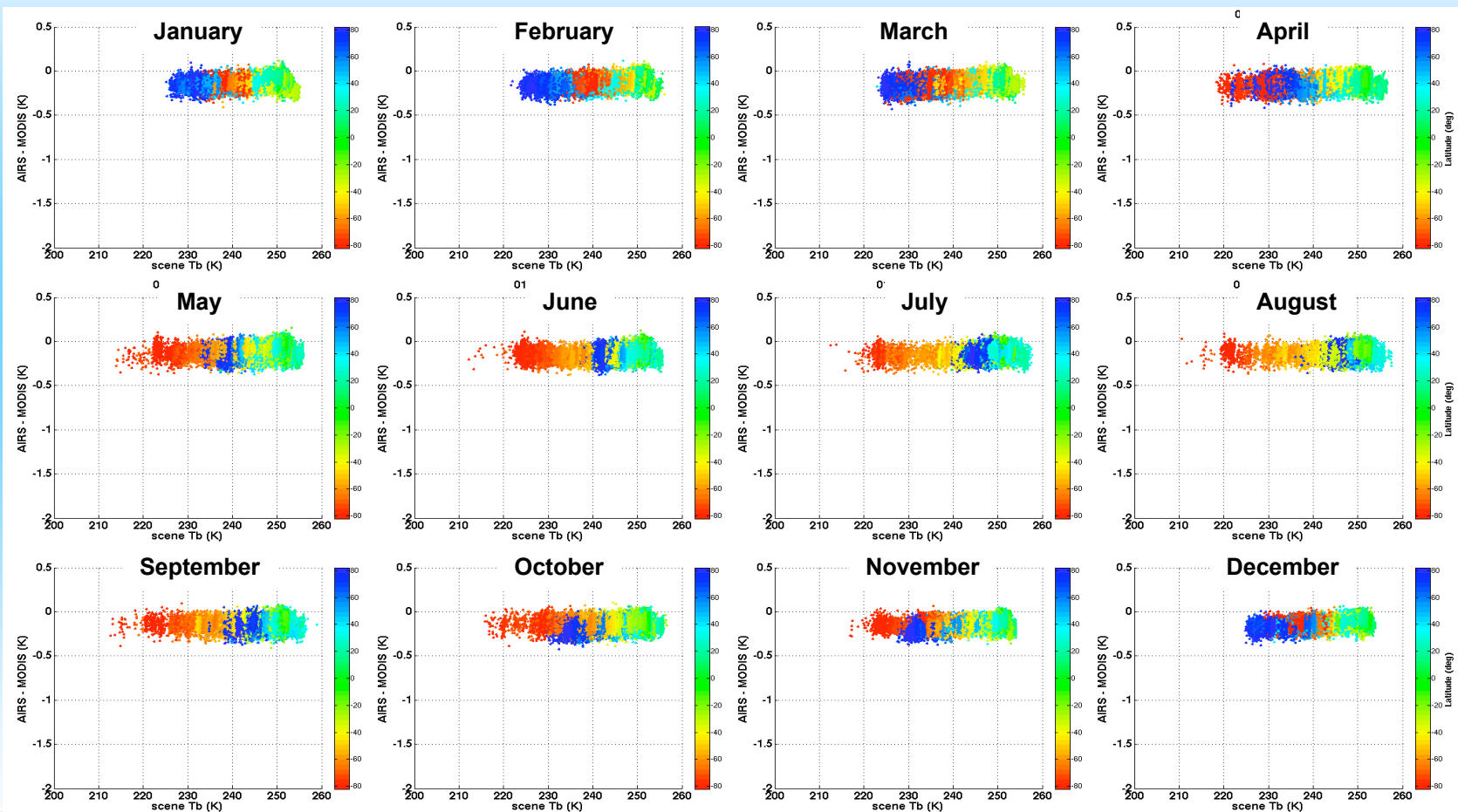
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The utility of an in-orbit reference. An example.

Five years of Aqua AIRS/MODIS IR radiance comparisons

MODIS Band 35 ($13.9\ \mu\text{m}$), with MODIS SRF shifted by $0.8\ \text{cm}^{-1}$



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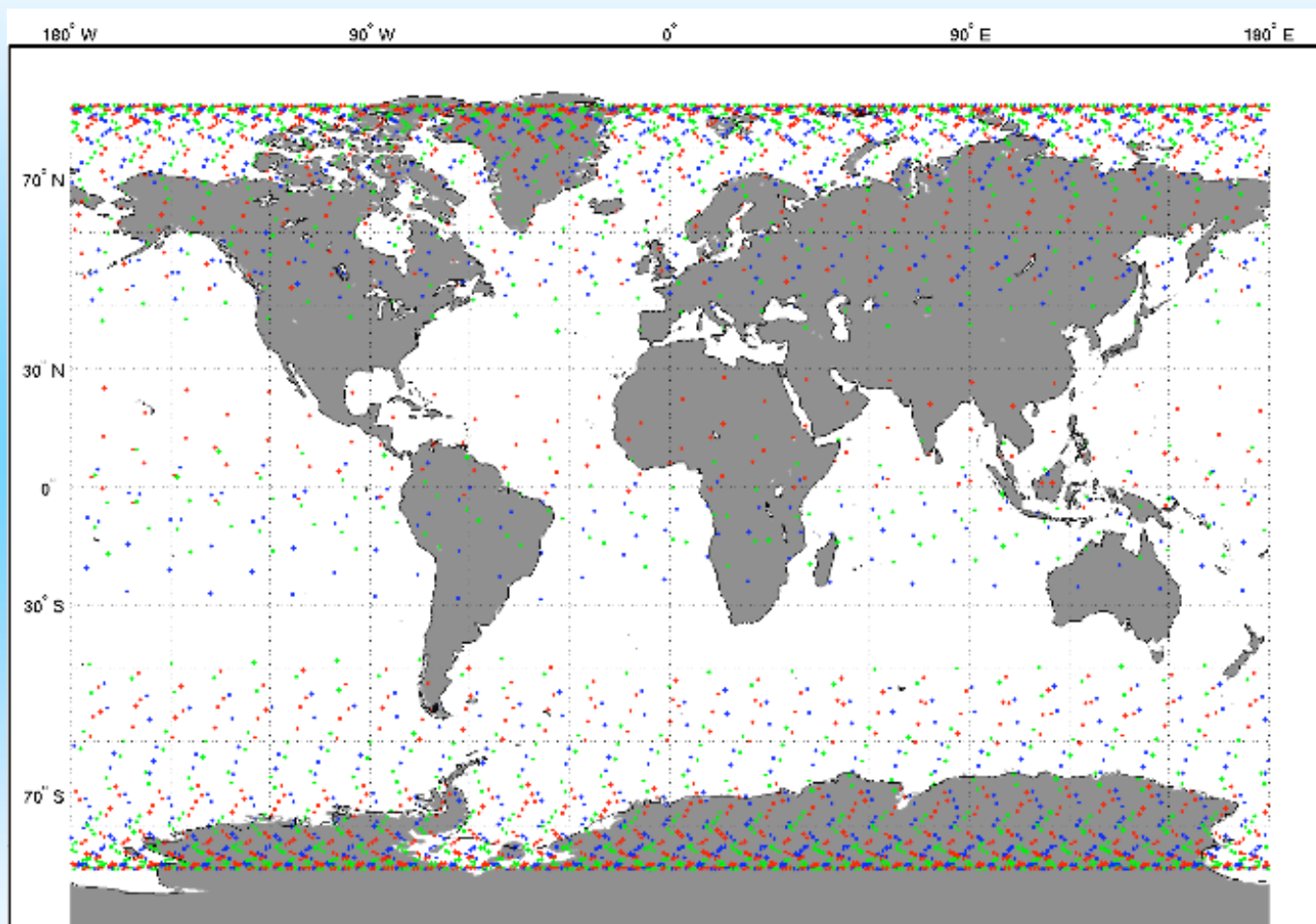


CLARREO Inter-calibration Simulation Study: Approach

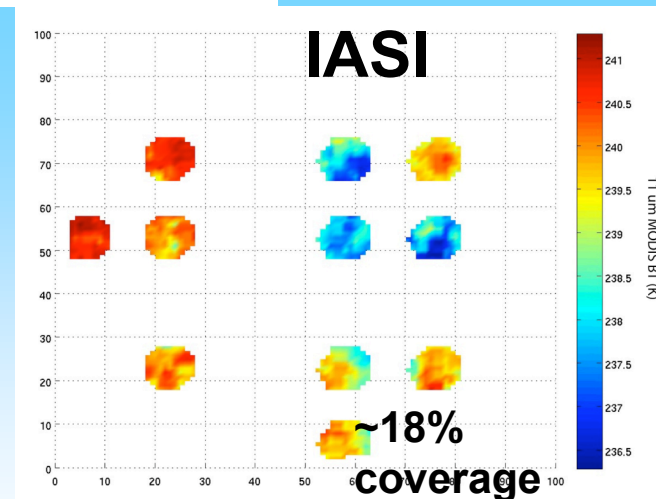
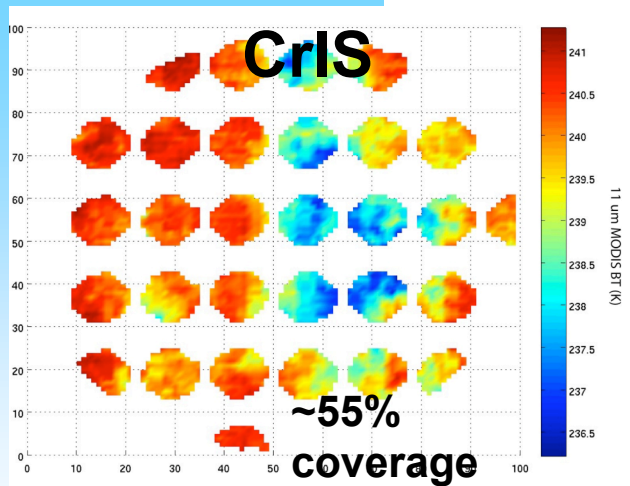
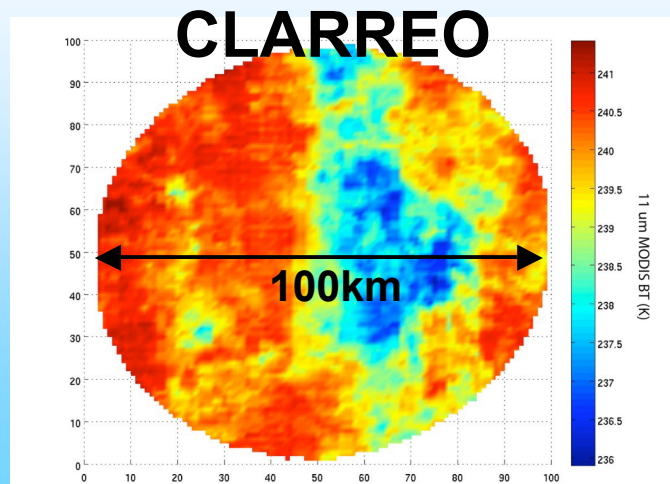
- Using Aqua MODIS observations, create ensembles of simulated CLARREO and operational sounder (IASI, CrIS, etc.) observations for Simultaneous Nadir Overpasses (SNOs).
- Estimate the inter-calibration uncertainties due to temporal and spatial co-location differences, sensor noise, sampling rate, and other potential observational differences (e.g. view angle differences, non-contiguous spectral coverage, ...)
- (Inherently assumes the satellite payload being inter-calibrated includes a high spatial resolution (~ 1 km) IR imager)



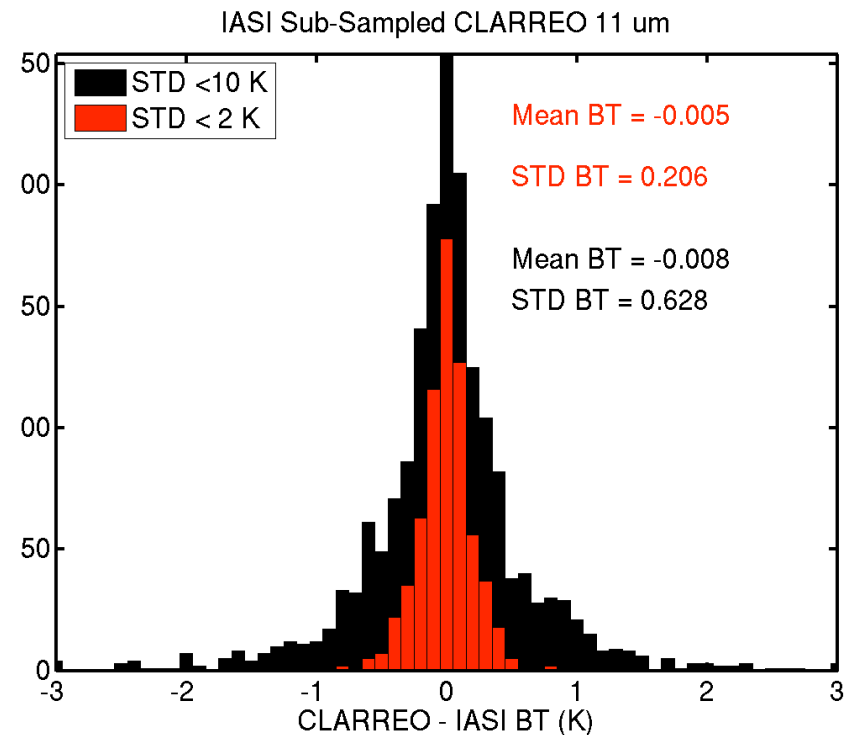
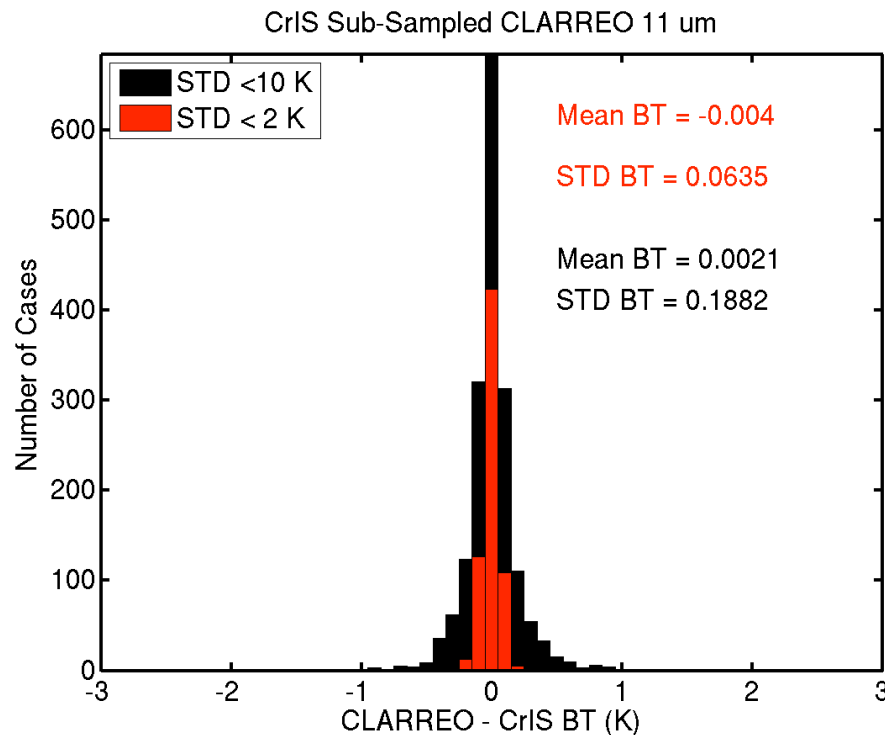
Locations of CLARREO/Aqua SNOs for 2006



Spatial sampling differences. One SNO



CLARREO minus CrIS/IASI BT Differences



with a 100 km CLARREO footprint every 10 seconds for August 2006

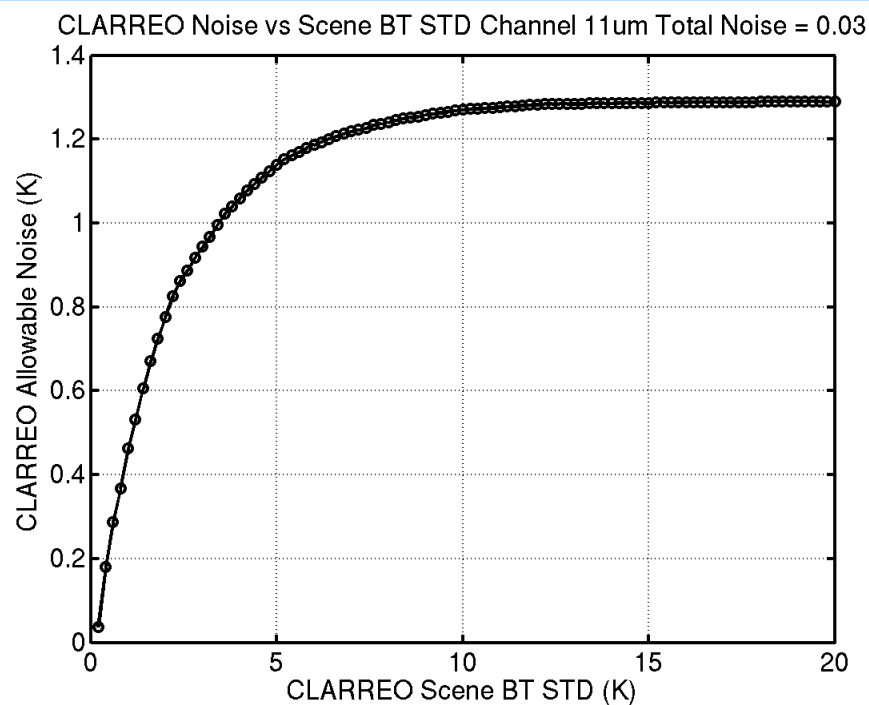


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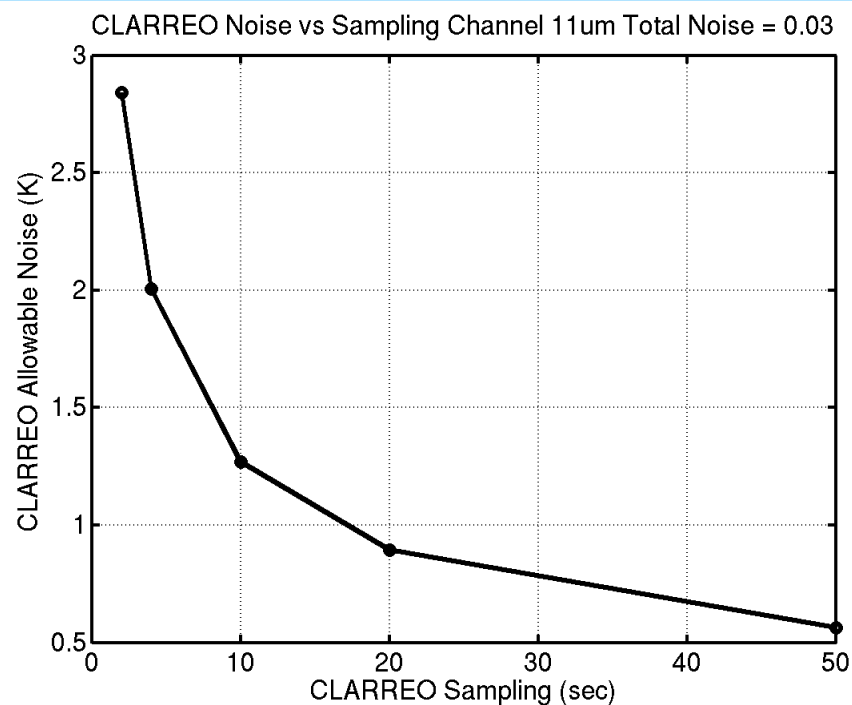
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Allowable single channel CLARREO noise for monthly intercal uncertainty budget (space, time, IASI noise, CLARREO noise) of 0.03 K



with a 100 km CLARREO footprint every 10 seconds for the year 2006



with scene BT STD < 10 K



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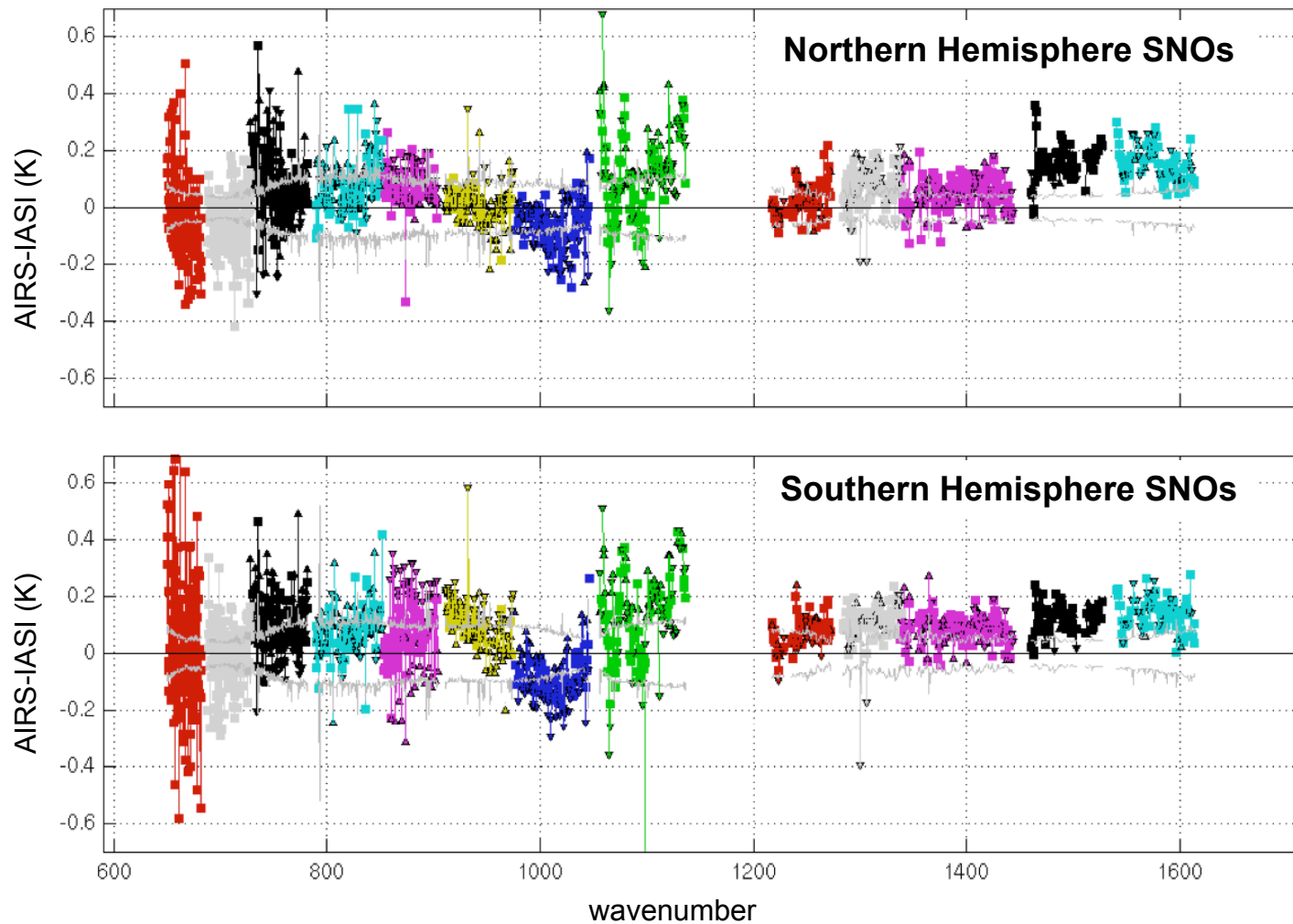


Next Steps

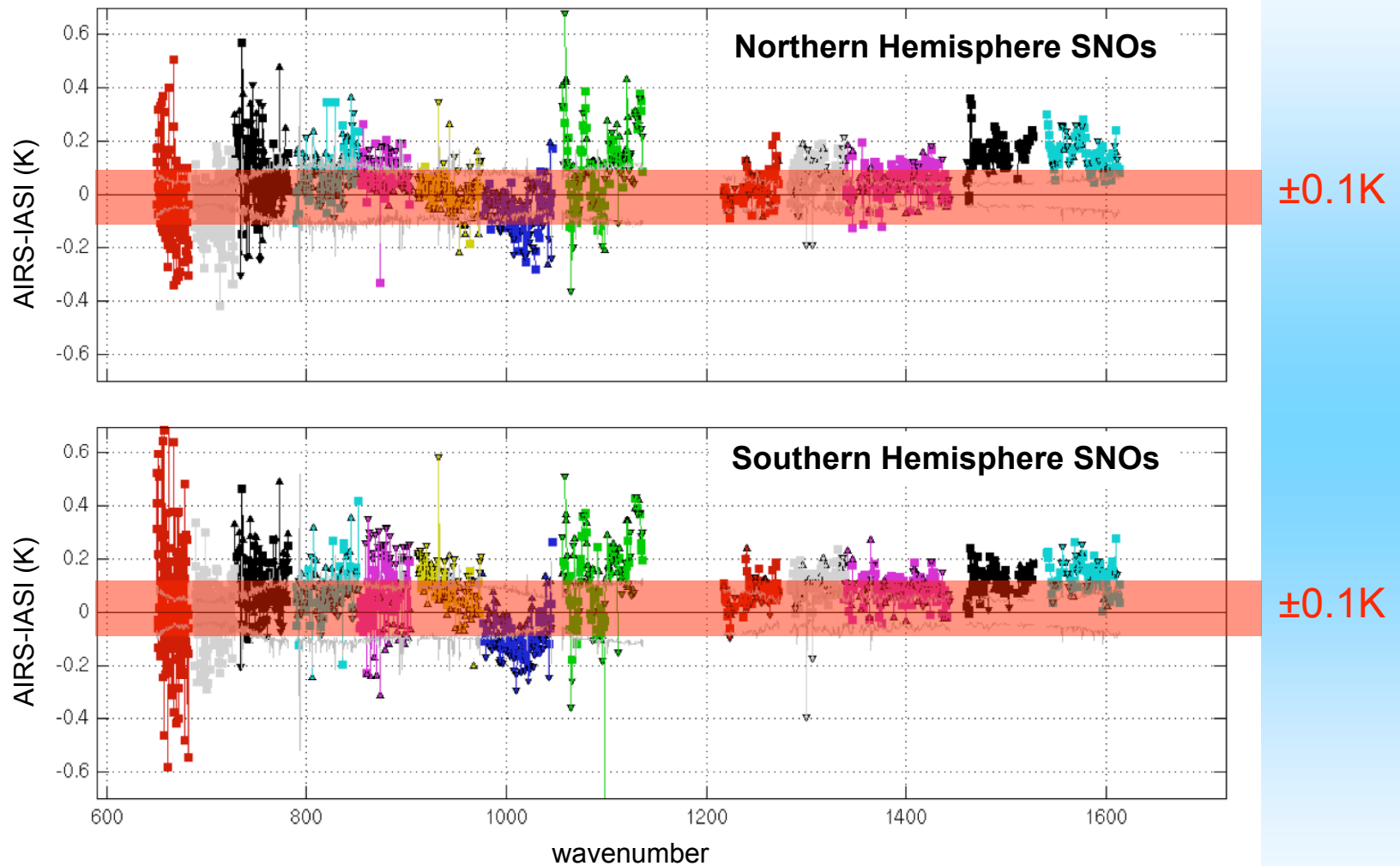
- In the simulation study, vary:
 - Footprint size
 - Orbits
 - and other suggestions
- Apply same methodology to SNOs for real observations to assess the approach



Comparisons of Aqua AIRS and METOP IASI using SNOs



Comparisons of Aqua AIRS and METOP IASI using SNOs



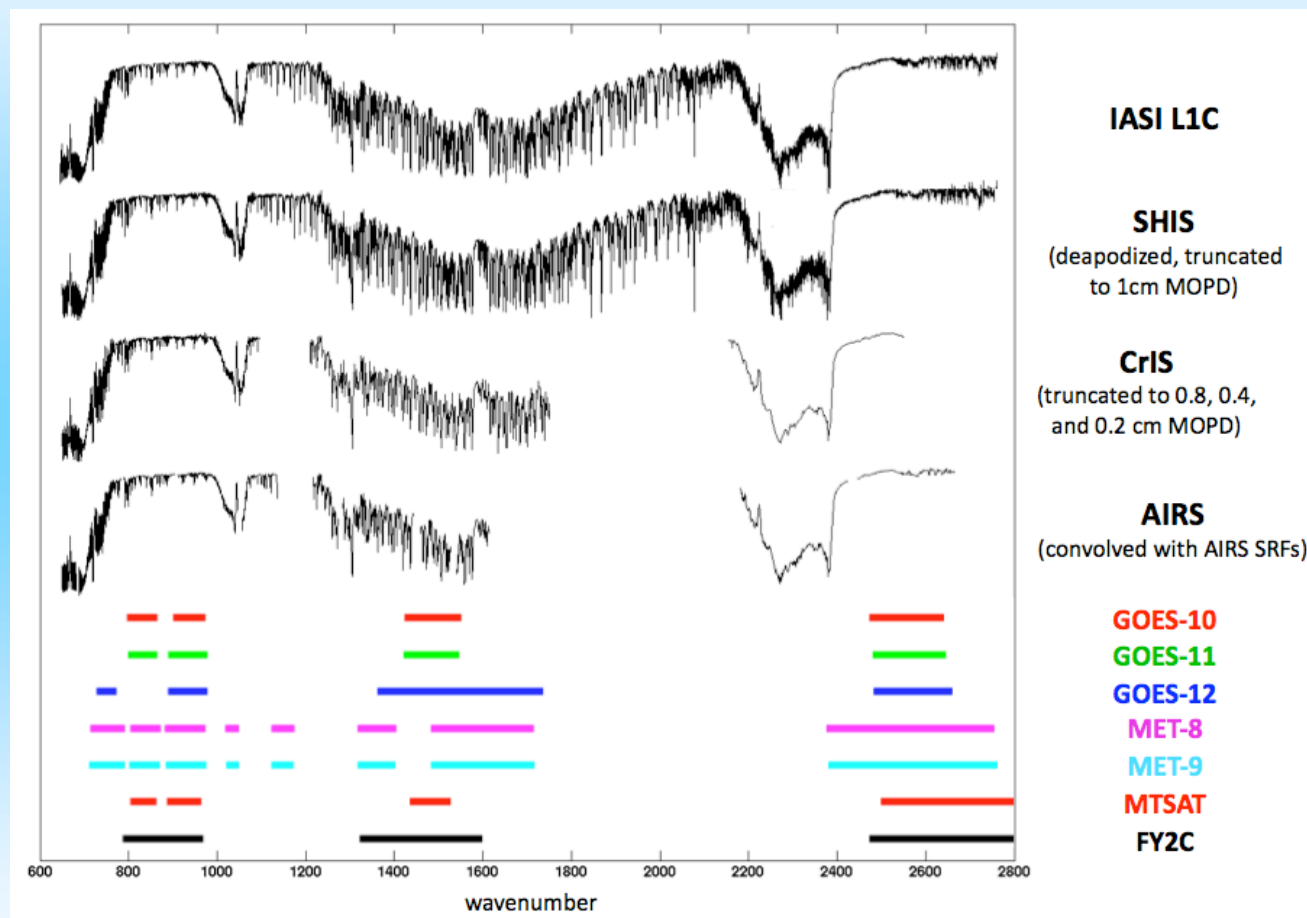
Comparisons of Aqua AIRS and METOP IASI using SNOs

- Preliminary conclusions
 - Biases between IASI and AIRS can be determined with SNOs with an uncertainty of approximately 0.1K.
 - While many channels show agreement on the few tenths of K level, differences for some spectral regions are considerably larger.
 - It is not readily apparent how to identify the source of bias or to formulate robust refined calibrations which would reduce the observed biases to the 0.1K 3-sigma level.
- Next step
 - Incorporate MODIS data with simulation methodology into this analysis.



Spectral Coverage and Resolution

Study requirements
with respect to
inter-calibration
accuracy



Synergies with other mission team studies

- Daniel Kirk-Davidoff orbit/sampling study
- LaRC intercalibration study
- Others

Global Space-based Inter-Calibration System (GSICS)



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