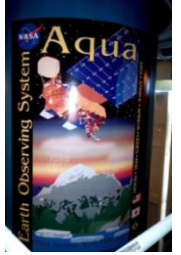

Evaluating Calibration of MODIS Thermal Emissive Bands Using Infrared Atmospheric Sounding Interferometer Measurements

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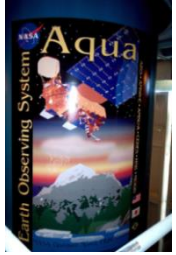
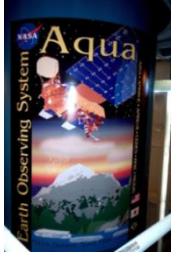


Outlines

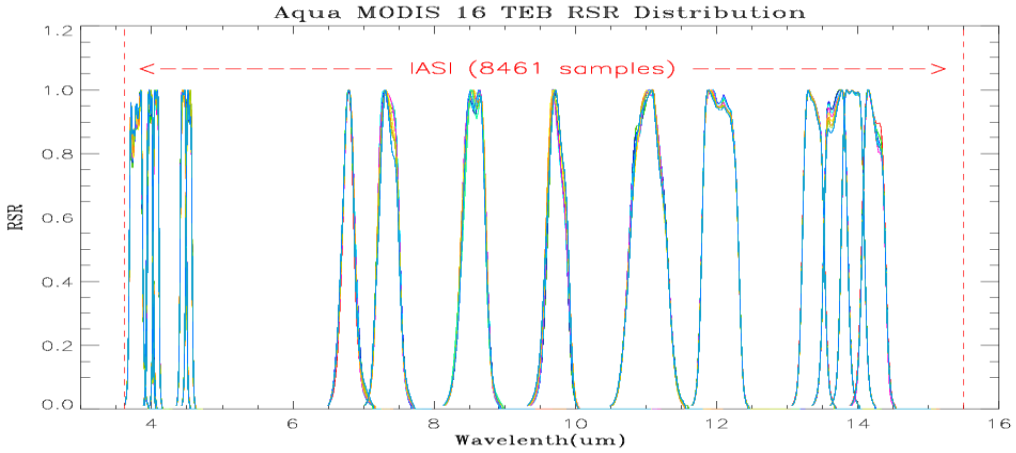
- **Introduction**
- **Methodology**
  - Data processing
- **Results**
  - Data collected
  - Terra/Aqua MODIS C5 vs. C6 inter-comparison
  - Long-term comparison time series
  - Assessment of Aqua CFPA temperature anomaly impact (IASI and AIRS)
- **Summary**

Introduction

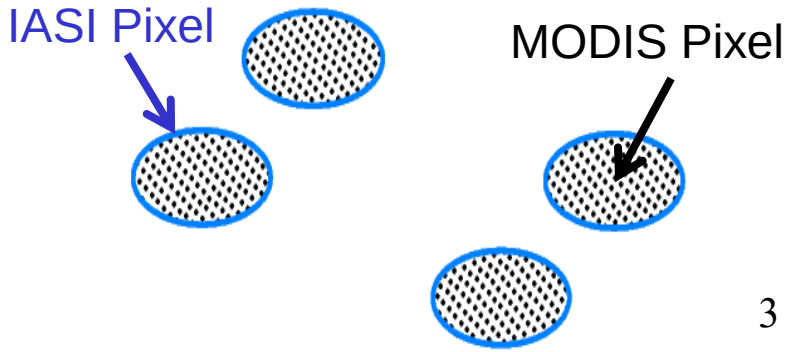


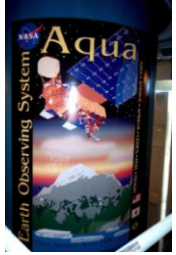
- Terra/Aqua MODIS intercomparison is conducted using IASI measurements as a transfer reference
- IASI hyperspectral measurements are converted to MODIS spectral band radiances
- Measurements from multiple MODIS pixels geo-collocated within an IASI instantaneous fields of view (IFOV) are aggregated

Spectral Channels



Spatial Resolution





Introduction

- MODIS inter-comparison is focused on L1B products
  - current calibration version Collection 5 (C5) has produced L1B products since 2005
  - recently released Collection 6 (C6) contains a major adjustment in calibration coefficient estimate to handle known issues with the aging MODIS sensors
- Terra/Aqua MODIS differences are estimated in brightness temperature (BT) for all thermal emissive bands (TEB), except B21 (low gain band for fire detection)

Methodology

Data Processing

- IASI simulated MODIS radiance

$$rad_{IASI}(\lambda) = \frac{(\lambda - \lambda_{IASI(low)}) \cdot rad_{IASI(up)} + (\lambda_{IASI(up)} - \lambda) \cdot rad_{IASI(low)}}{\lambda_{IASI(up)} - \lambda_{IASI(low)}}$$

$\lambda_{IASI(low)}$, $\lambda_{IASI(up)}$: adjacent wavelengths in IASI spectral samples lower and higher than λ.

$$rad_{simulated(MODIS)} = \frac{\sum \int_{\lambda_1}^{\lambda_2} rad_{IASI}(\lambda) \cdot RSR(\lambda) \cdot d\lambda}{\sum \int_{\lambda_1}^{\lambda_2} RSR(\lambda) \cdot d\lambda}$$

$[\lambda_1, \lambda_2]$: range of Relative Spectral Response (RSR) wavelength

$rad_{simulated(MODIS)}$: band average.

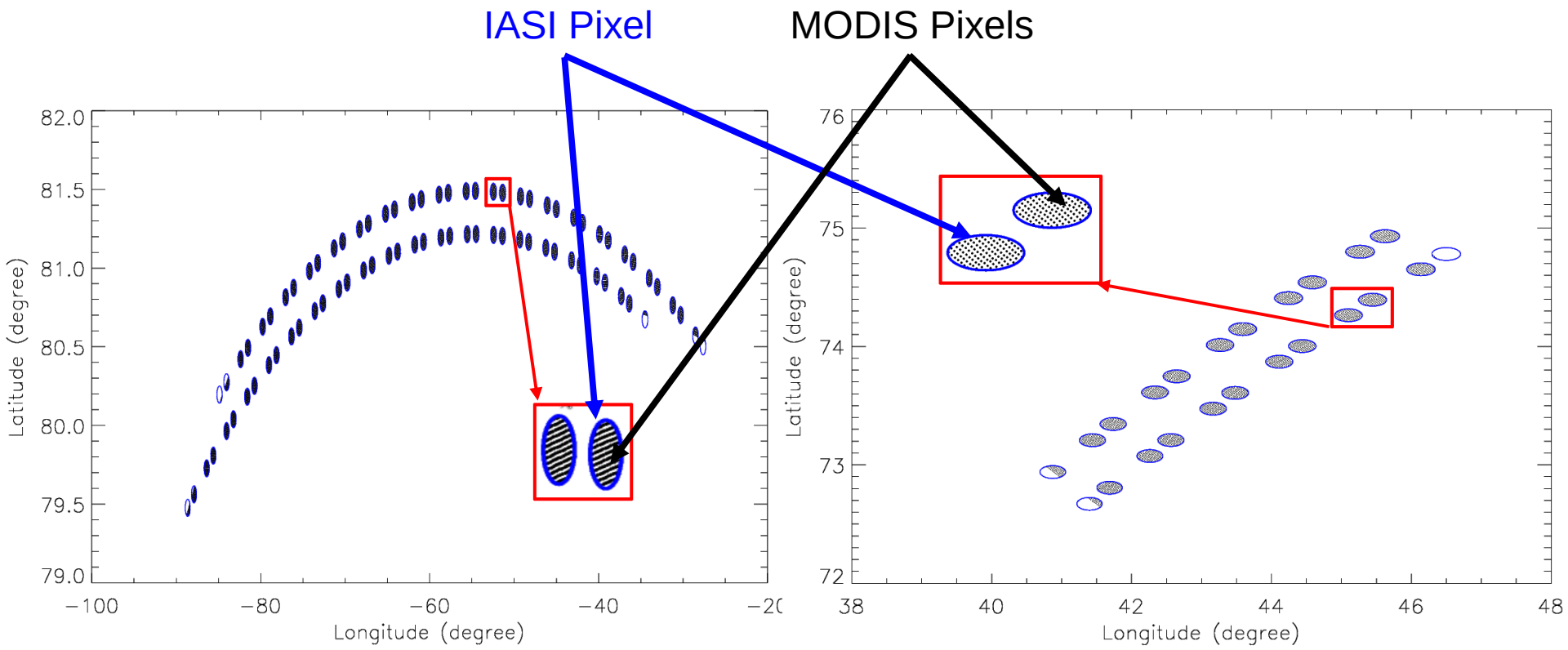
- Multiple MODIS pixel measurements in an IASI IFOV are aggregated
  - MODIS 1-km pixels are collocated with an IASI 12-km IFOV
  - A radius of 6-km is used to represent one IASI IFOV
  - Typically >100 MODIS pixels are collocated within one IASI IFOV
  - Only IFOVs with >70 MODIS pixels are considered in SNO data collection

Results

MODIS / IASI SNO Match Pixels

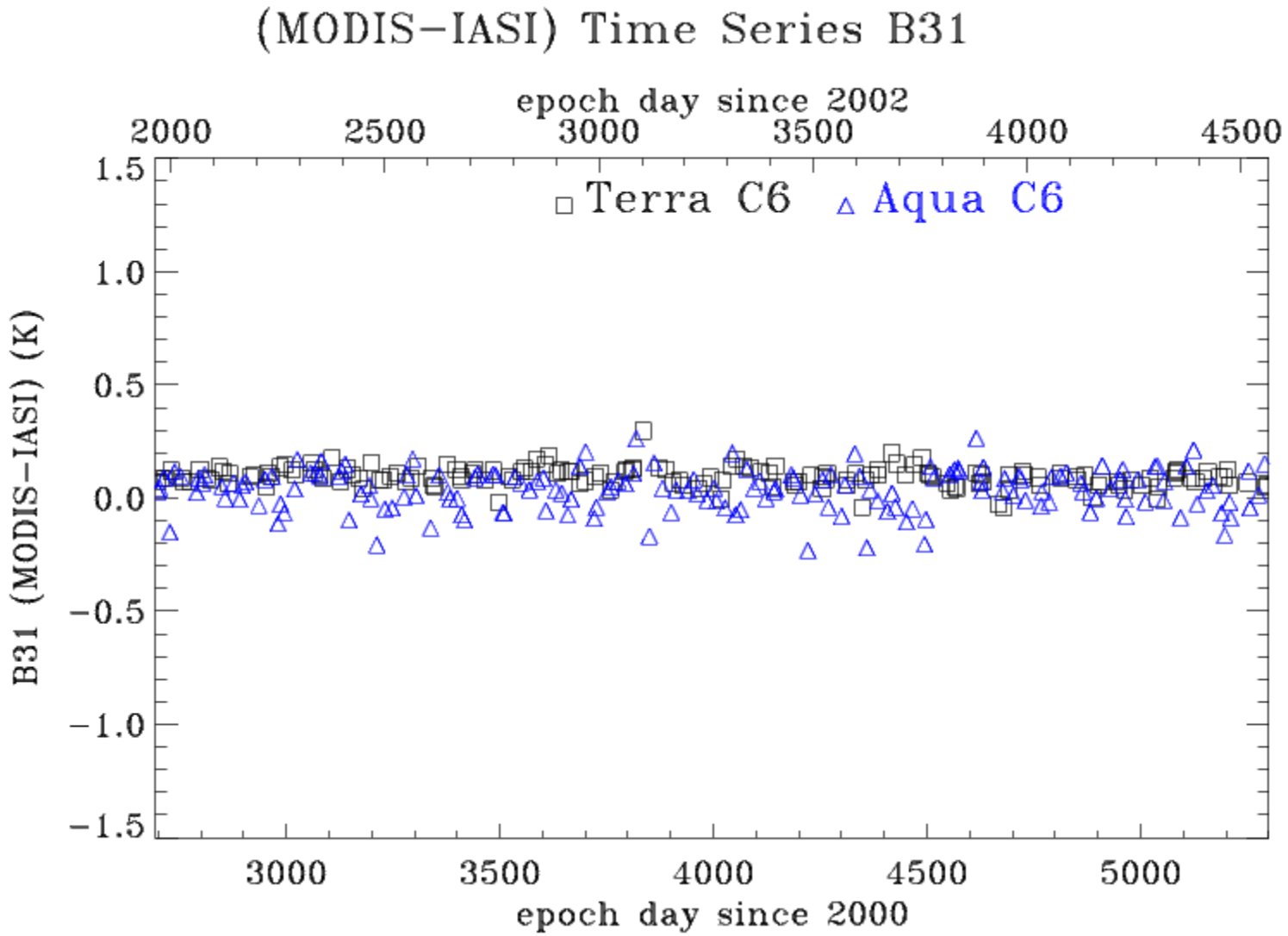
Terra C6 Sept.01, 2012

Aqua C6 Sept.02, 2012



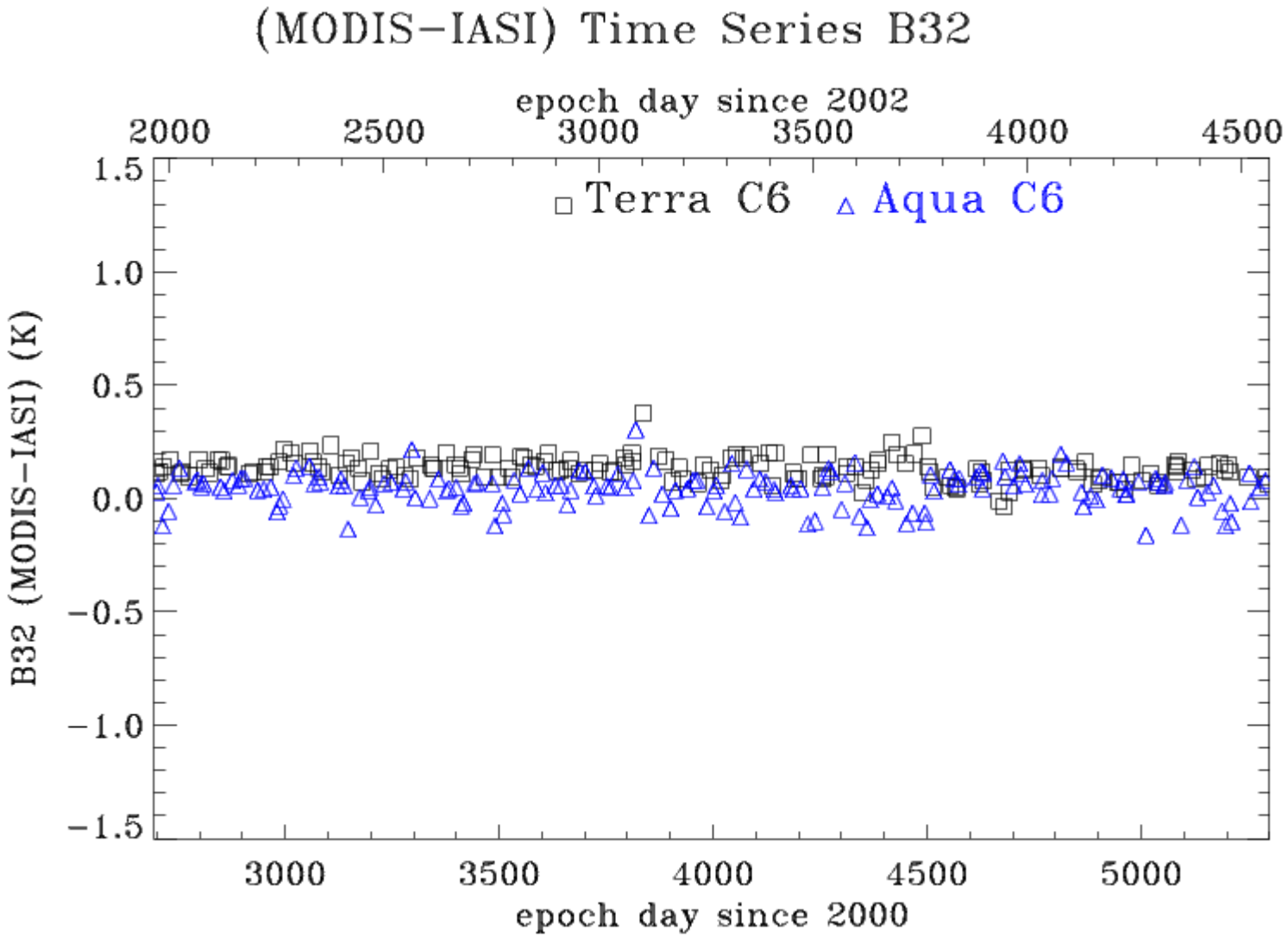
Results

Long-term Comparison Time Series

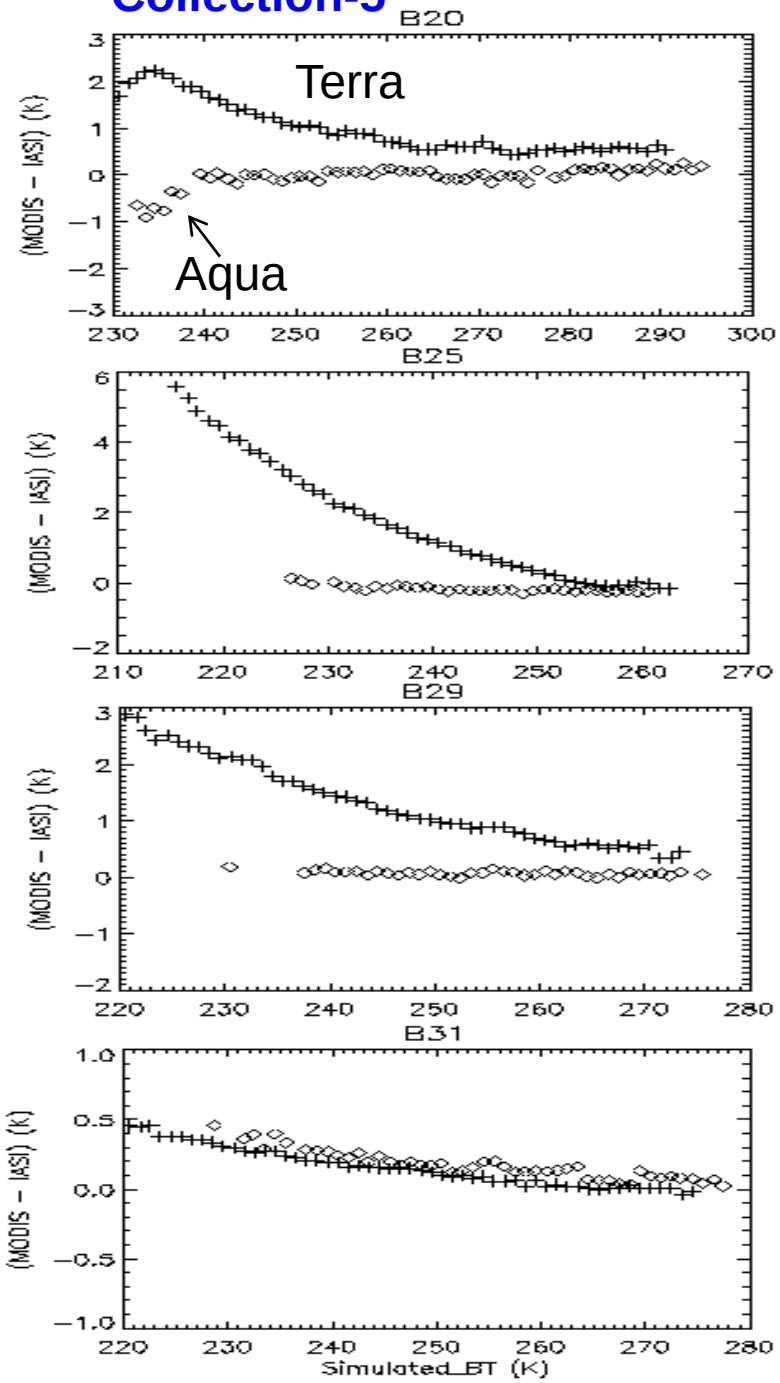


Results

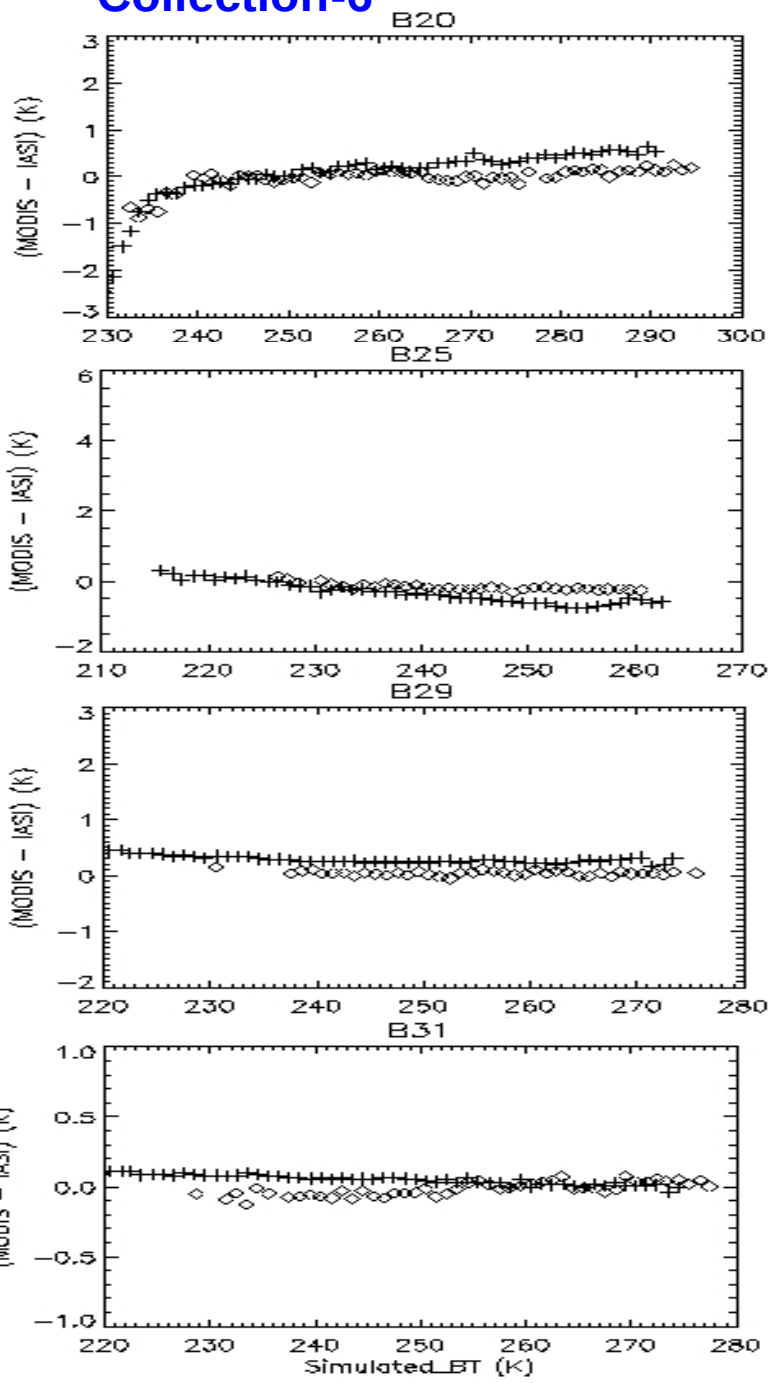
Long-term Comparison Time Series



Collection-5

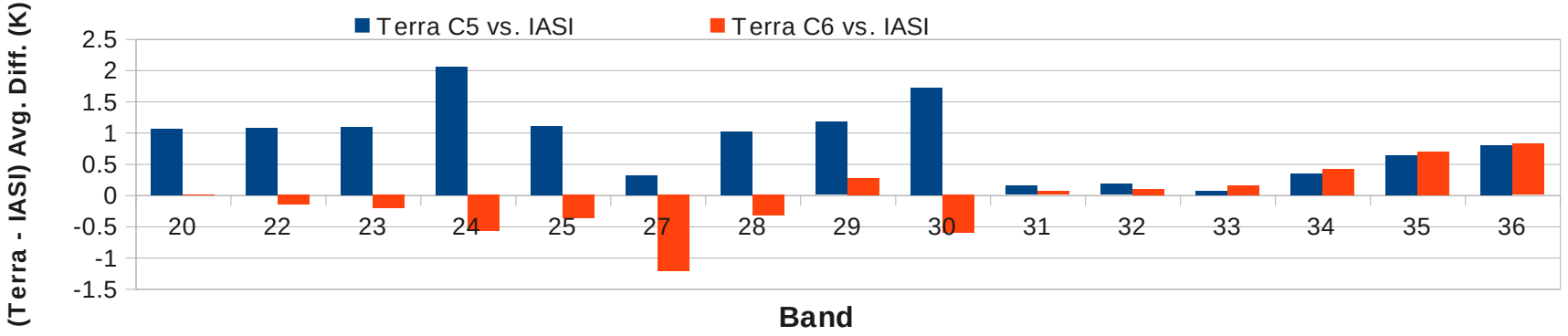


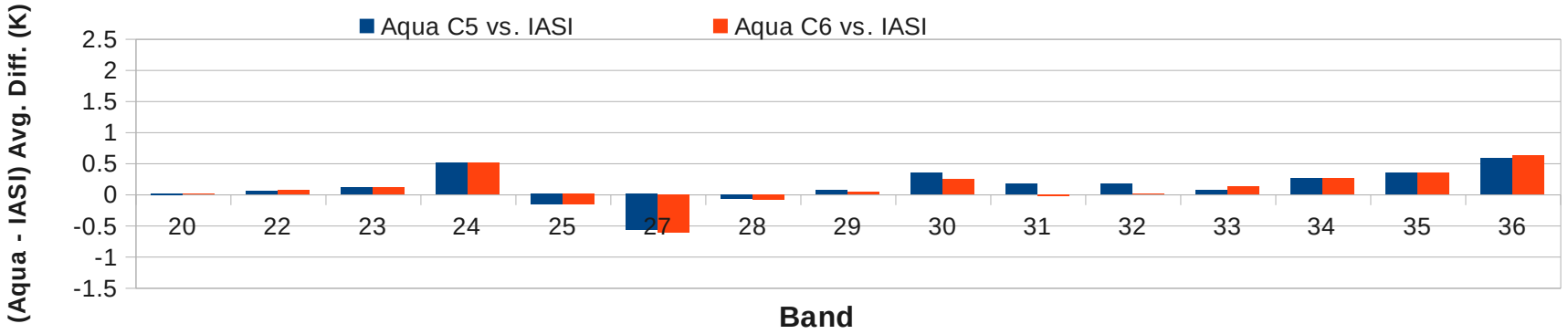
Collection-6

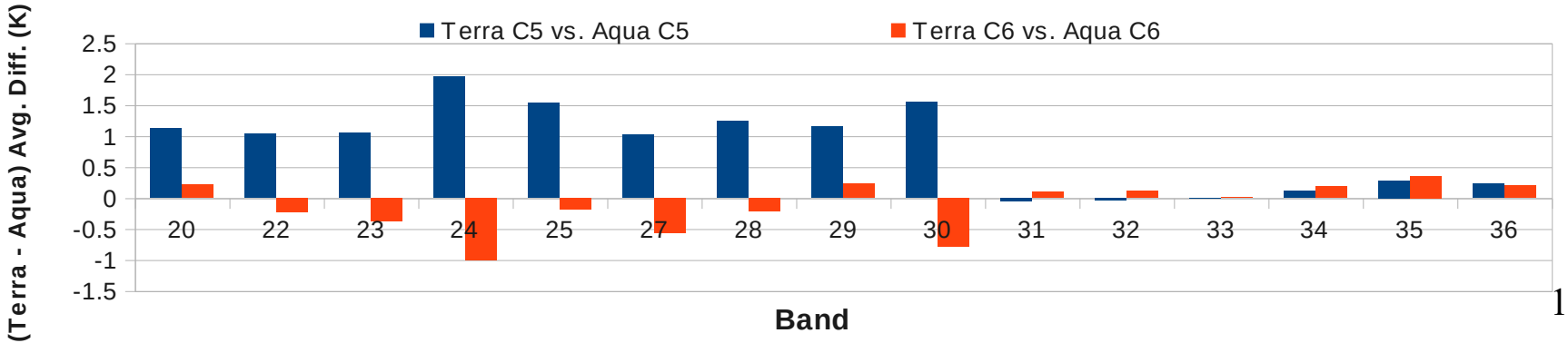


Results

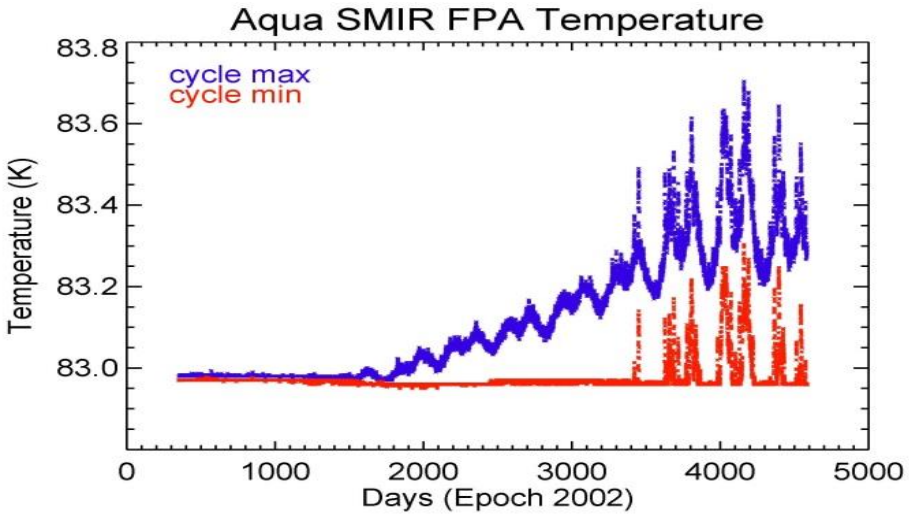
Average Differences between MODIS and IASI Measurements

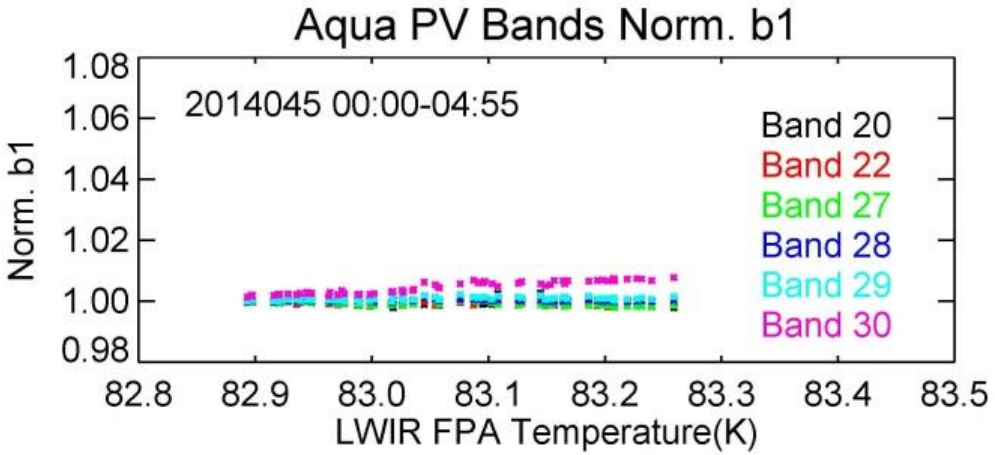


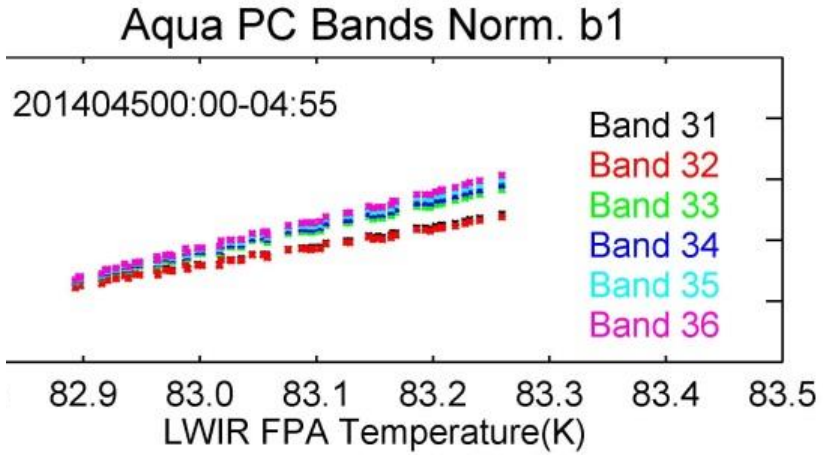




Results


Aqua SMIR FPA Temperature
cycle max
cycle min
Temperature (K)
83.8
83.6
83.4
83.2
83.0
0
1000
2000
3000
4000
5000
Days (Epoch 2002)


Aqua PV Bands Norm. b1
2014045 00:00-04:55
Band 20
Band 22
Band 27
Band 28
Band 29
Band 30
Norm. b1
1.08
1.06
1.04
1.02
1.00
0.98
82.8
82.9
83.0
83.1
83.2
83.3
83.4
83.5
LWIR FPA Temperature(K)


Aqua PC Bands Norm. b1
201404500:00-04:55
Band 31
Band 32
Band 33
Band 34
Band 35
Band 36
82.9
83.0
83.1
83.2
83.3
83.4
83.5
LWIR FPA Temperature(K)

Results

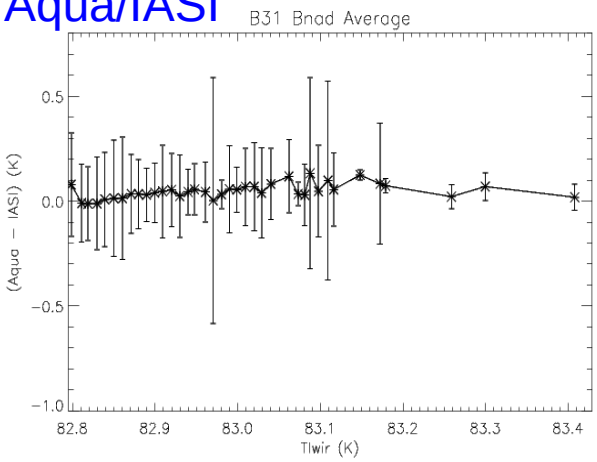
---- Equator ocean

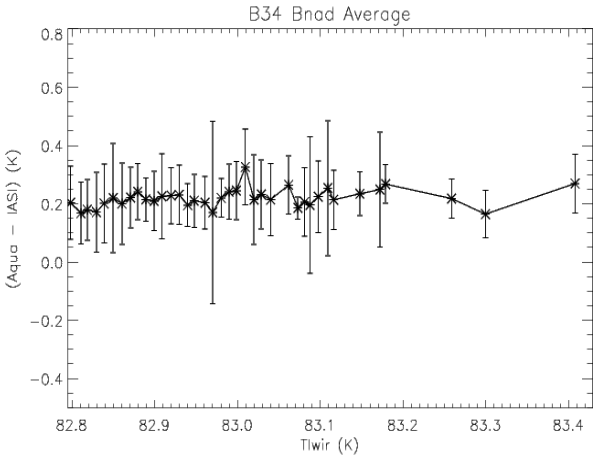
(MODIS(Aqua C6)−IASI) vs. Tlwir Plot

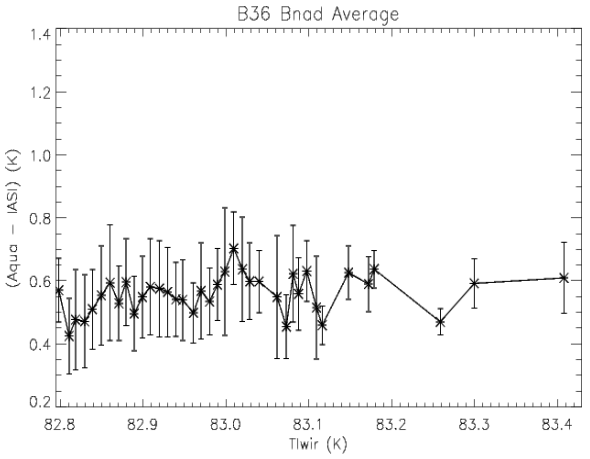
(MODIS(Aqua C6)−IASI) vs. Tlwir Plot

(MODIS(Aqua C6)−IASI) vs. Tlwir Plot

Aqua/IASI





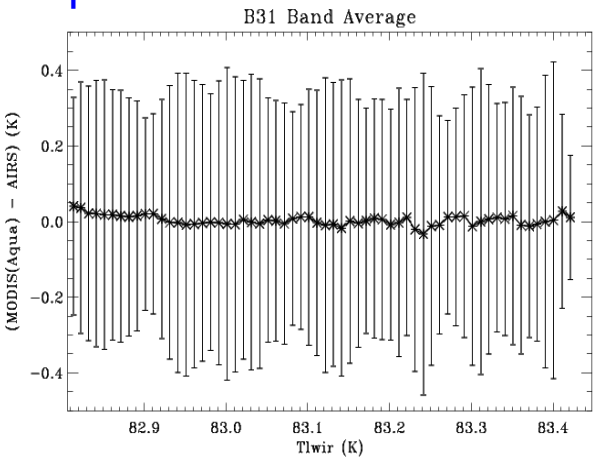


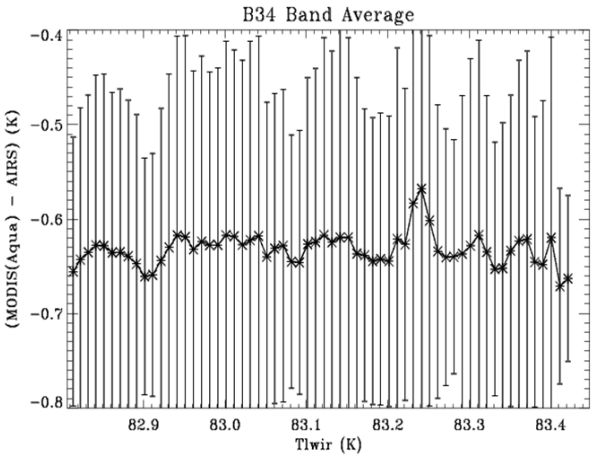
(MODIS(Aqua C6)−AIRS) vs. Tlwir Plot

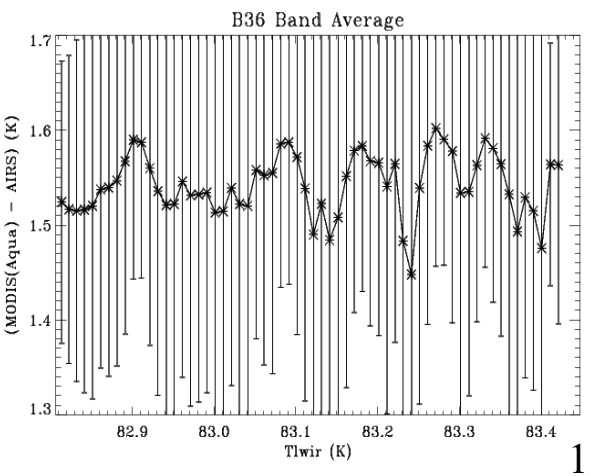
(MODIS(Aqua C6)−AIRS) vs. Tlwir Plot

(MODIS(Aqua C6)−AIRS) vs. Tlwir Plot

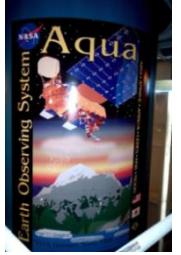
Aqua/AIRS







Summary



- In comparison with MODIS C5, C6 significantly reduces the differences between MODIS and IASI measurements as well as differences between Terra/Aqua MODIS
- Long-term MODIS/IASI comparison time series show a stable trend for key MODIS TEB
- No apparent Aqua CFPA temperature anomaly impact is observed on L1B