

# **MODIS STATUS OVERVIEW**

by

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and  
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**MODIS Project Scientist**

**VIIRS/MODIS Science Teams Meeting**  
**Hilton BWI Airport**  
**May 14, 2008**

## MODIS IS ON THE EOS TERRA AND AQUA MISSIONS



**Terra Launch: Dec. 18, 1999**

**First Image: Feb. 24, 2000**

**(over 8+ years of operation as of April 2008)**

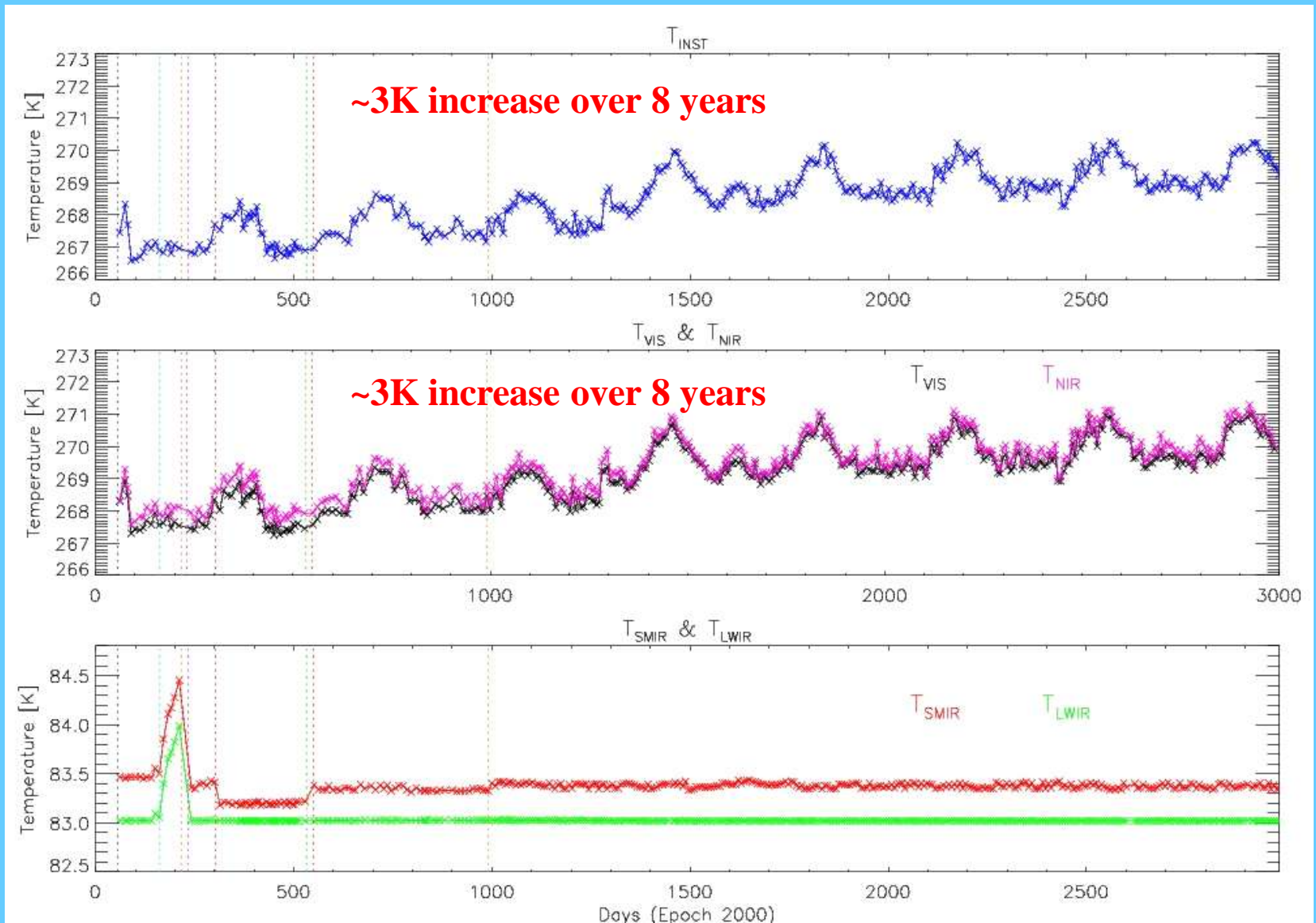


**Aqua Launch: May 04, 2002**

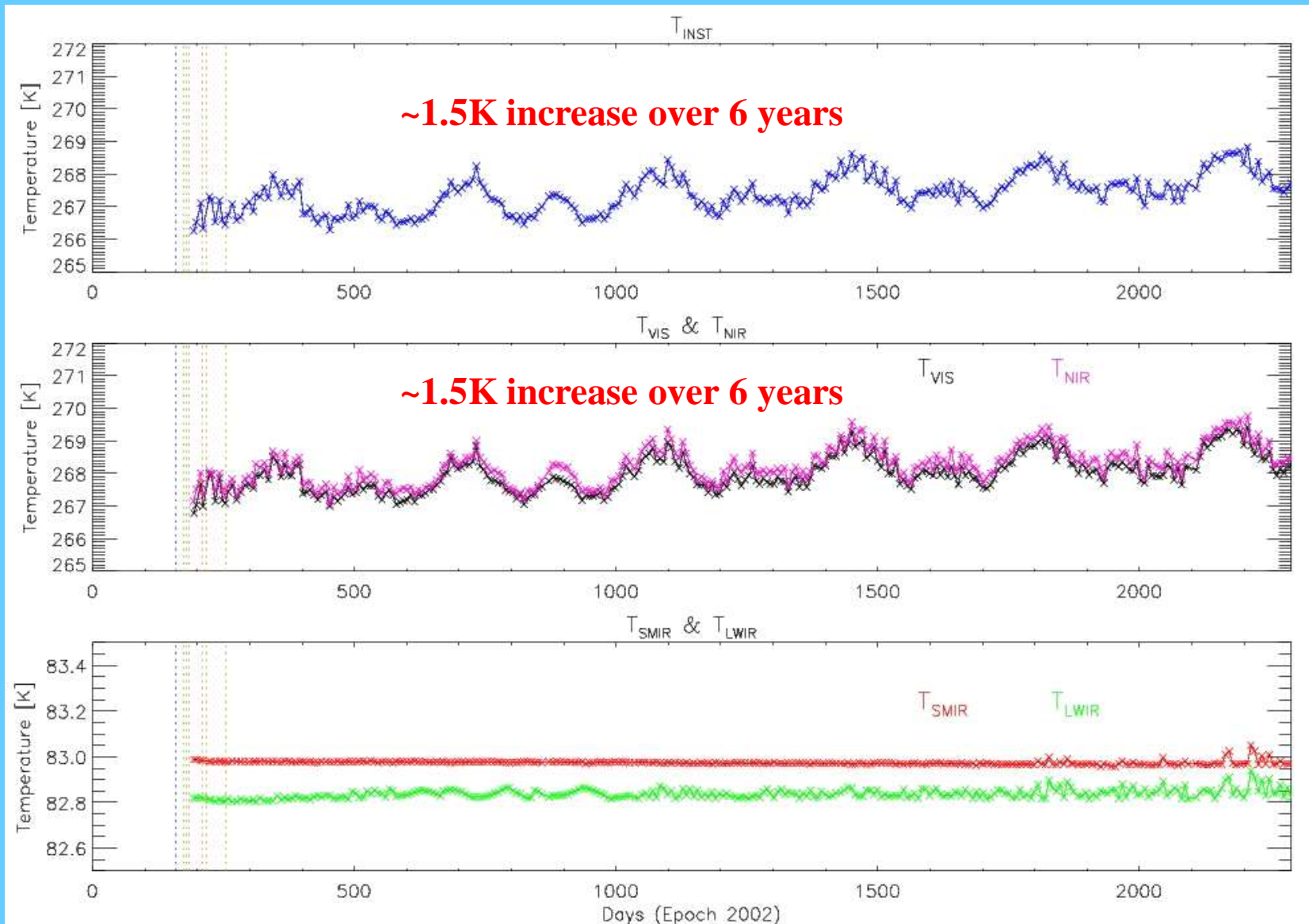
**First Image: June 26, 2002**

**(~ 6 years of successful operations)**

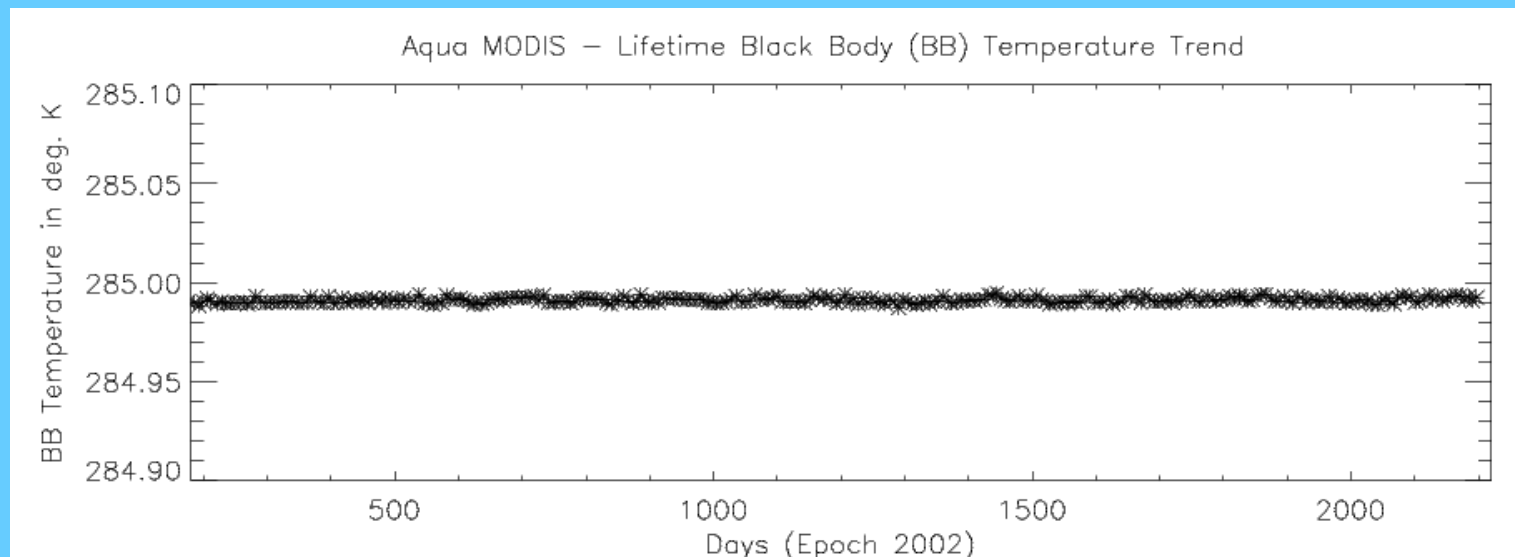
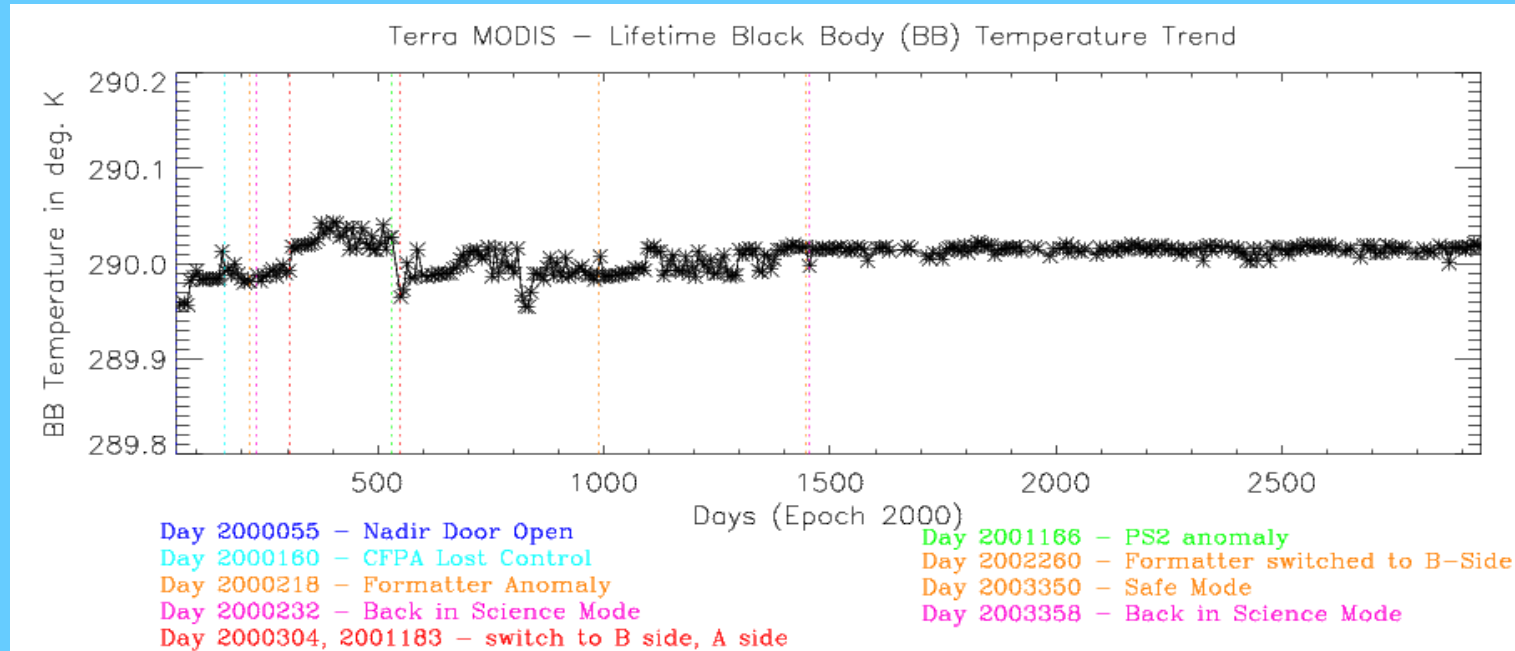
# Terra Instrument and FPA Temperatures



# Aqua Instrument and FPA Temperatures

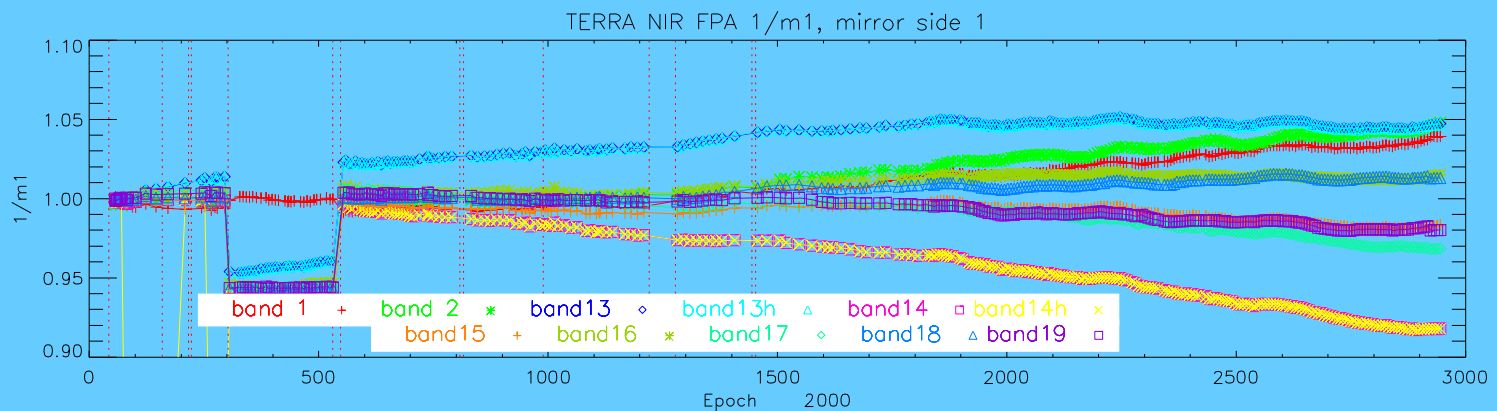
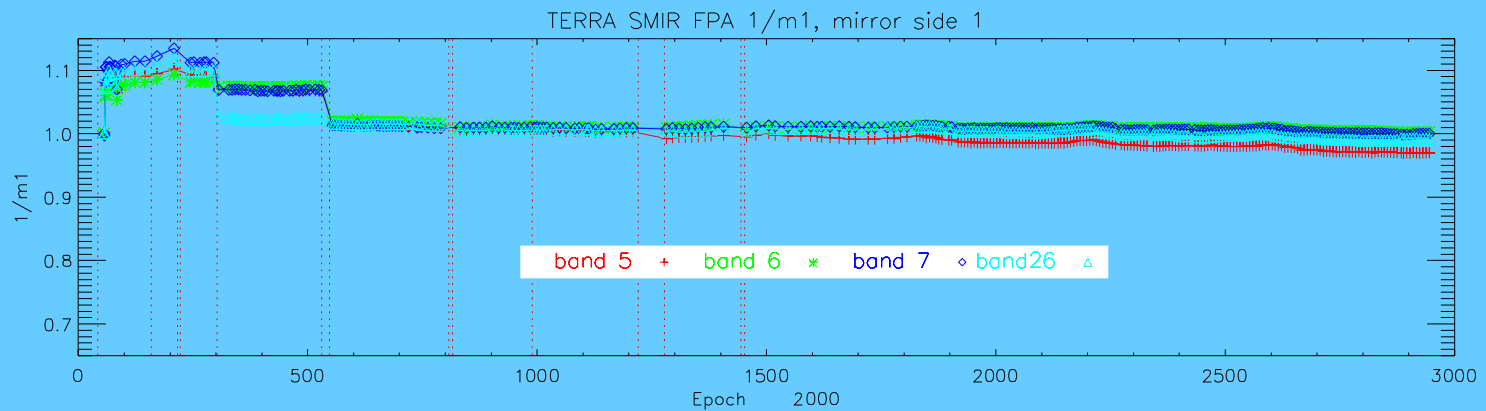
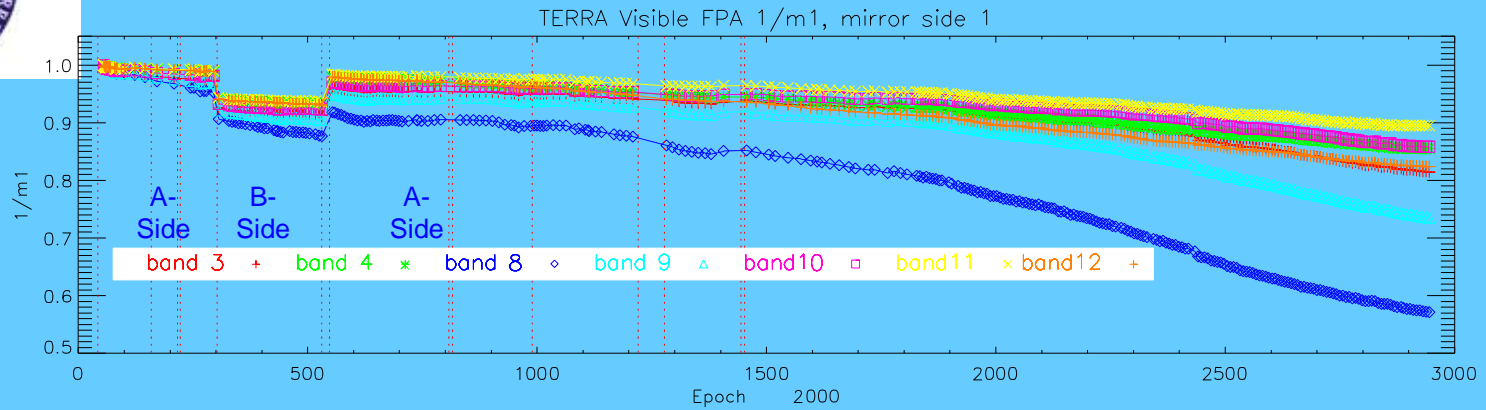


# MODIS BB Temperatures

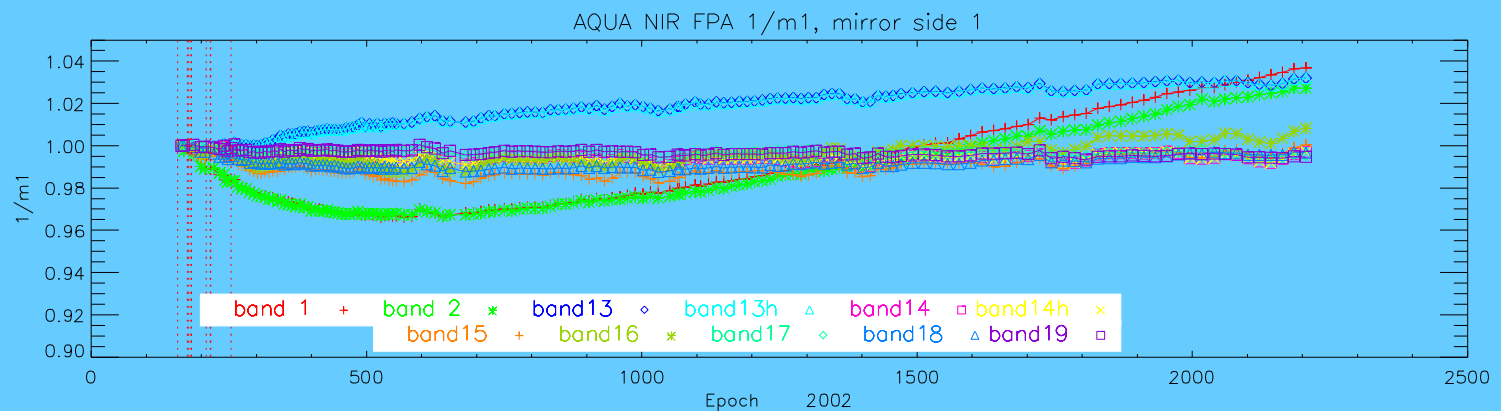
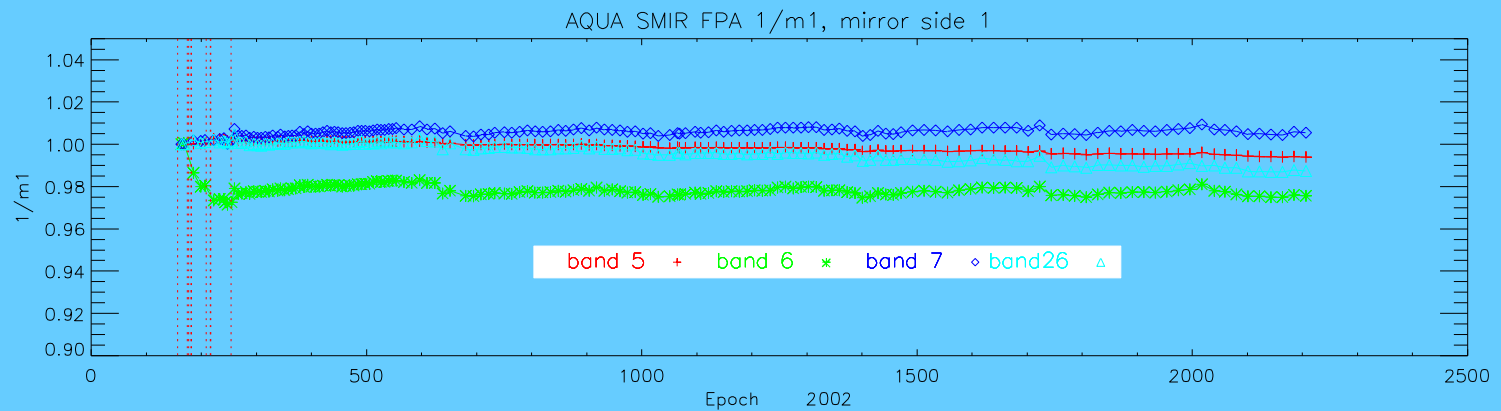
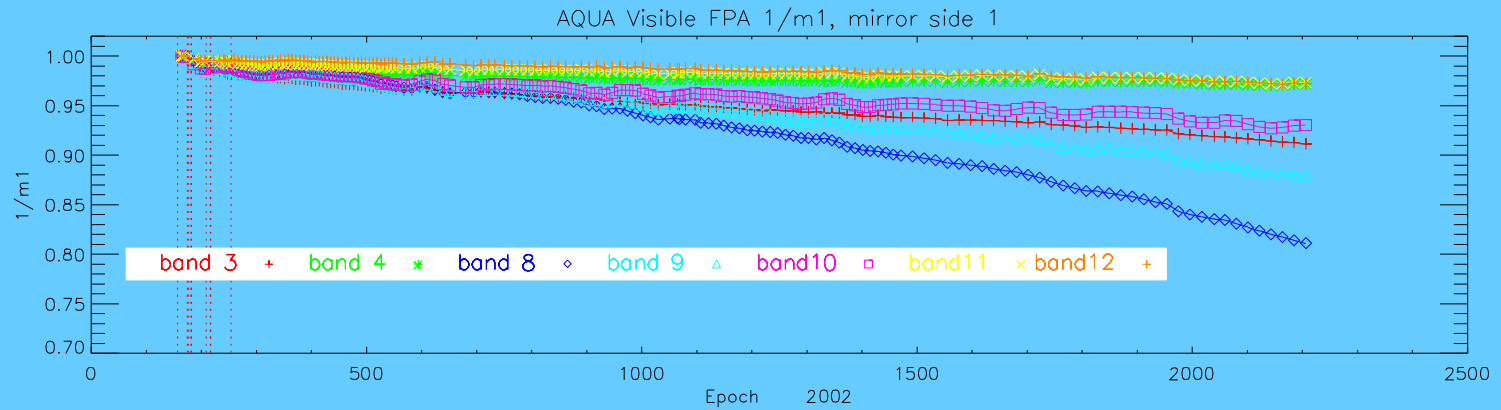




# RSB Response Trending (Terra MODIS)



# RSB Response Trending (Aqua MODIS)



# MODIS RSB Noisy & Inoperable Detectors

- No QA updates for RSB detectors since last workshop (01/2008)

## Terra

Day/Year	Band	5										6			7		
	SNR Spec	74										275			110		
	Detector	2	4	6	11	13	16	17	18	19	20	3	7	8	1-10	11-13,15-20	14
055/2000	Nadir Dorr Open	0	0	60	80	0	30	0	0	80	0	0	0	100	100	110	0
160/2000	CFPA Lost Control	95	95	60	80	80	30	80	80	80	80	0	0	100	100	110	0
232/2000	Back from FPA recyle	75	95	50	0	80	50	80	0	70	0	0	0	100	100	110	0
304/2000	B Side	85	20	85	80	80	60	80	80	80	80	350	350	275	90	100	100
183/2001	A Side	95	10	90	90	90	90	90	90	90	90	380	380	380	100	110	110
259/2002	A Side B Formatter	100	10	100	100	100	100	100	100	100	100	380	380	380	100	110	110

## Aqua

Day/Year	Band	5	6									
	SNR Spec	74	275									
	Detector	20	2	4	5	6	7	9	10	12-16	17	18-20
175/2002	Nadir Dorr Open	0	0	0	0	0	470	470	0	0	100	0
189/2002	Back from Safe Mode	0	0	470	470	0	470	470	0	0	470	0
255/2002	Back from Safe Mode	0	0	0	0	0	470	470	0	0	470	0
266/2002	Back from Safe Mode	0	0	0	0	0	150	400	0	0	470	0
110/2003		0	0	0	0	0	260	470	0	0	320	0
160/2003		0	0	0	0	0	290	400	0	0	470	0
265/2003		0	0	150	0	0	290	400	0	0	275	0
360/2003		0	0	200	0	0	290	275	0	0	270	0
080/2006		0	0	200	0	0	0	350	0	0	270	0
314/2006		0	0	200	0	0	472	350	0	0	270	0

 In Spec

 Near Spec

 Out Spec

 Inoperable

Detectors in Production order



# Terra MODIS Noisy Detector History

Day/Year	Band	27				28					29		30				33	34				36
	Spec NE $\Delta$ T[K]	0.25				0.25					0.05		0.25				0.25	0.25				0.35
	Detector #	1	3	6	8	1	3	8	9	10	4	6	2	3	5	8	1	5	6	7	8	1-10
Pre-launch	-	0.10	0.08	0.10	0.03	0.05	0.05	0.04	0.05	0.04	0.02	0.02	0.08	0.10	0.09	0.09	0.14	0.20	0.20	0.21	0.20	0.45
055/2000	Nadir door open	0.09	0.10	0.09	0.03	0.05	0.06	0.06	0.05	0.05	0.02	0.02	0.10	0.06	0.11	0.11	0.28	0.23	0.26	0.27	0.29	0.43
232/2000	Back from FPA recycle	0.10	0.10	0.24	0.03	0.05	0.05	0.05	0.05	0.05	0.02	0.03	0.11	0.07	0.31	0.11	0.27	0.24	0.33	0.37	0.38	0.42
030/2001	-	0.10	0.11	0.27	0.03	0.05	0.06	0.05	0.05	0.05	0.02	0.02	0.12	0.07	0.29	0.30	0.25	0.24	0.33	0.37	0.37	0.43
087/2002	Back from safe mode	0.11	0.10	0.24	0.03	0.06	0.32	0.05	0.05	0.04	0.02	0.02	0.10	0.06	0.26	0.64	0.25	0.24	0.29	0.32	0.33	0.43
022/2003	-	0.10	0.10	0.23	0.03	0.05	0.30	0.27	0.04	0.04	0.02	0.02	0.10	0.06	0.25	0.65	0.27	0.25	0.33	0.37	0.37	0.43
086/2003	After DSM <sup>1</sup>	0.11	0.10	0.23	0.03	0.05	0.29	0.08	0.05	0.05	0.03	0.02	0.10	0.06	0.47	0.65	0.26	0.24	0.33	0.36	0.36	0.44
118/2004	-	0.26	0.10	0.26	0.03	0.05	0.16	0.36	0.05	0.16	0.02	0.03	0.10	0.06	0.33	0.41	0.27	0.21	0.29	0.32	0.32	0.43
158/2004	-	0.28	0.09	0.25	0.03	0.05	0.16	0.37	0.05	0.21	0.03	0.03	0.10	0.07	0.31	0.40	0.27	0.22	0.28	0.31	0.31	0.43
162/2004	-	0.26	0.10	0.27	0.03	0.05	0.16	0.37	0.05	0.20	0.02	0.03	0.14	0.06	0.32	0.42	0.27	0.22	0.30	0.34	0.34	0.43
175/2004	-	0.28	0.10	0.26	0.03	0.12	0.17	0.35	0.05	0.17	0.03	0.02	0.17	0.06	0.30	0.41	0.27	0.21	0.28	0.32	0.32	0.43
034/2005	-	0.28	0.10	0.22	0.03	0.10	0.16	0.45	0.05	0.16	0.04	0.02	0.17	0.06	0.31	0.39	0.26	0.21	0.28	0.31	0.31	0.43
130/2005	-	0.31	0.10	0.22	0.03	0.40	0.15	0.40	0.05	0.14	0.03	0.06	0.17	0.07	0.40	0.40	0.26	0.21	0.31	0.34	0.34	0.43
309/2005	-	0.30	0.10	0.21	0.03	0.09	0.14	0.35	0.30	0.18	0.03	0.04	0.18	0.06	0.31	0.40	0.24	0.21	0.27	0.30	0.30	0.43
053/2006	-	0.30	0.10	0.21	0.27	0.13	0.15	0.40	0.19	0.16	0.03	0.04	0.16	0.11	0.33	0.39	0.28	0.21	0.28	0.31	0.31	0.43
155/2006	-	0.26	0.10	0.21	0.11	0.10	0.14	0.46	0.10	0.15	0.03	0.05	0.14	0.26	0.31	0.41	0.24	0.21	0.28	0.31	0.31	0.44
241/2006	-	0.26	0.10	0.22	0.10	0.10	0.14	0.36	0.10	0.11	0.03	0.11	0.15	0.16	0.29	0.39	0.25	0.22	0.28	0.32	0.32	0.43
193/2007	<b>NEW</b>	0.28	0.19	0.20	0.11	0.07	0.14	0.35	0.10	0.11	0.03	0.10	0.13	0.14	0.27	0.36	0.25	0.21	0.27	0.30	0.30	0.43

<sup>1</sup>Spacecraft Deep Space Maneuver

		In Spec		Near the Spec		Out of Spec		inoperable	
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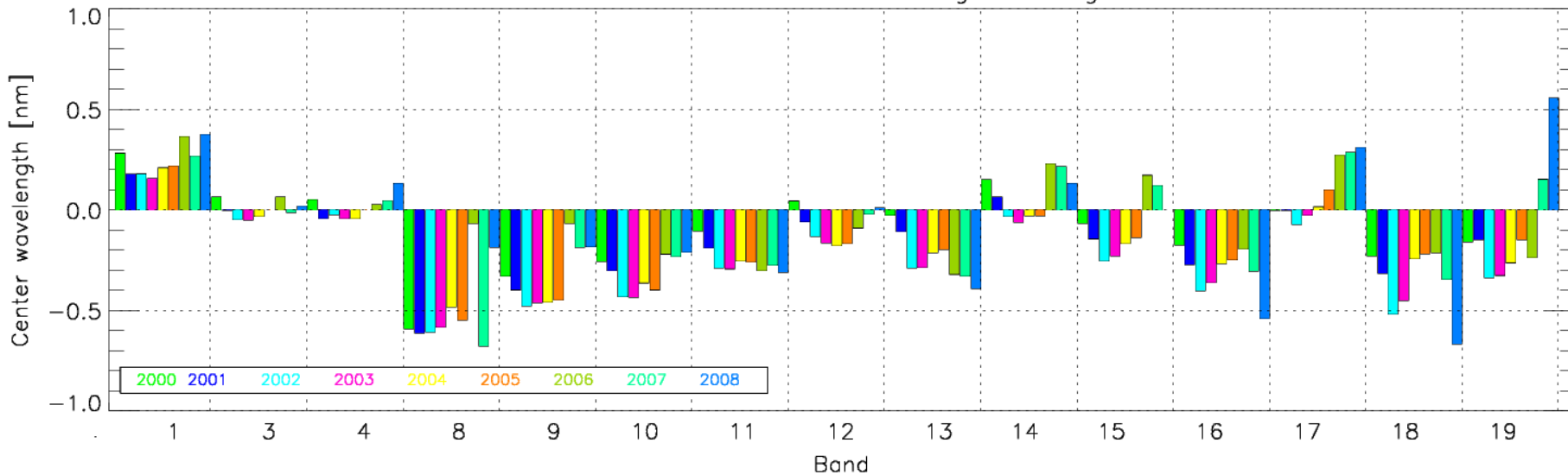
# Aqua MODIS Noisy Detector History

## Detectors in Product Order

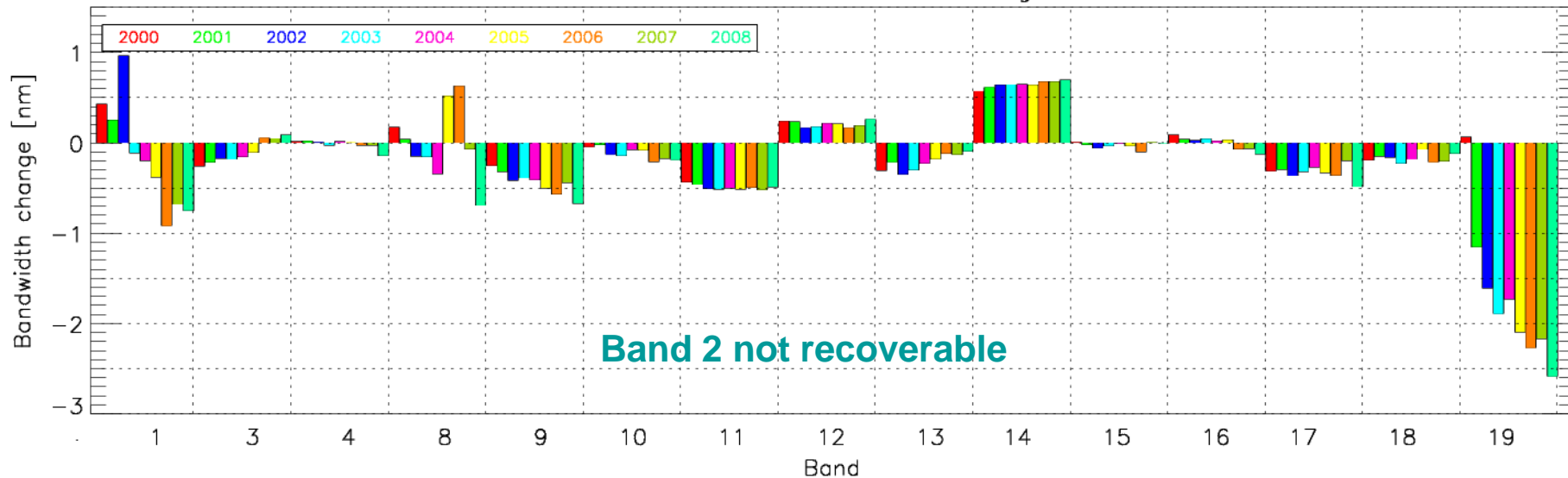
Day/Year	Band	20	21			27	29		B36
	Spec NEdT [K]	0.05	0.20			0.25	0.05		0.35
	Detector #	10	3	9	others	3	2	8	5
Pre-launch	-	0.05	0.16	0.28	near 0.2	0.10	0.02	0.02	1.34
175/2002	Nadir door open	0.03	0.23	0.23	near 0.2	0.09	0.02	0.02	1.28
183/2002	Back from safe mode	0.03	0.20	0.25	near 0.2	0.09	0.02	0.02	1.31
218/2002	Back from safe mode	0.03	0.19	0.26	near 0.2	0.09	0.02	0.02	1.32
255/2002	Back from safe mode	0.03	0.23	0.20	near 0.2	0.09	0.02	0.02	1.36
102/2003	-	0.03	0.43	0.19	near 0.2	0.09	0.02	0.02	1.31
201/2003	-	0.03	0.18	0.18	near 0.2	0.09	0.02	0.02	1.29
010/2005	-	0.03	0.17	0.19	near 0.2	0.23	0.02	0.02	1.35
359/2007	-	0.03	0.18	0.21	near 0.2	0.13	0.02	0.05	1.34
038/2008	-	0.03	0.19	0.19	near 0.2	0.14	0.05	0.05	1.34

# Terra MODIS Spectral Characterization Results

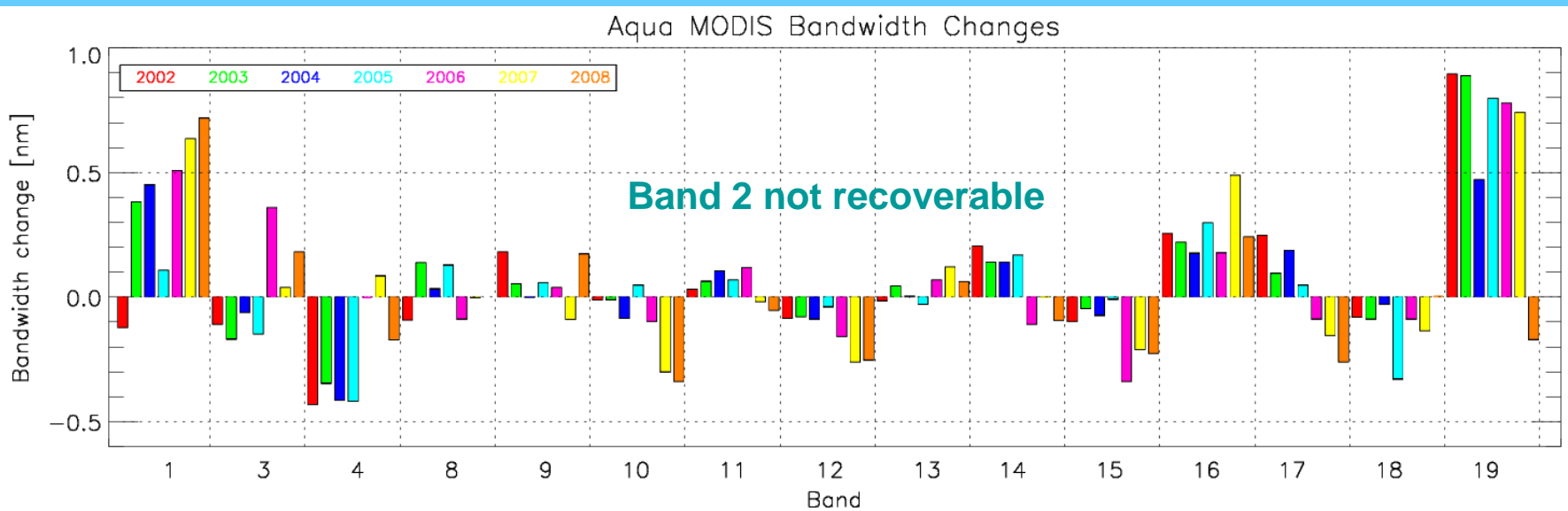
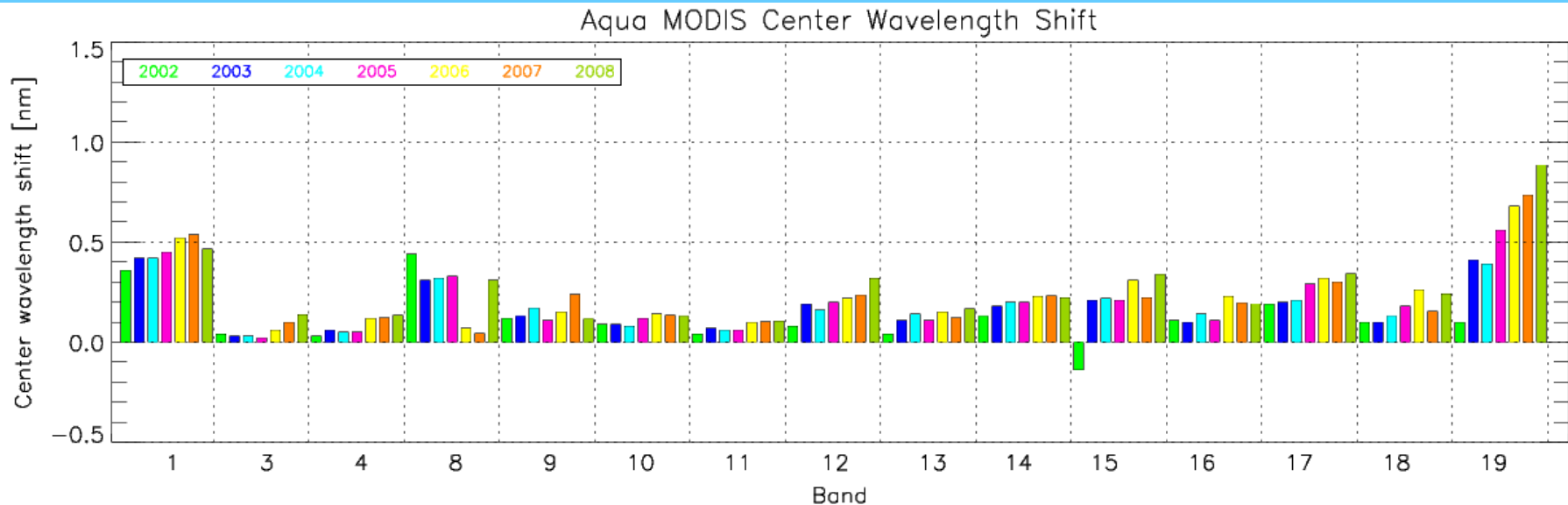
## Terra MODIS Center Wavelength Changes



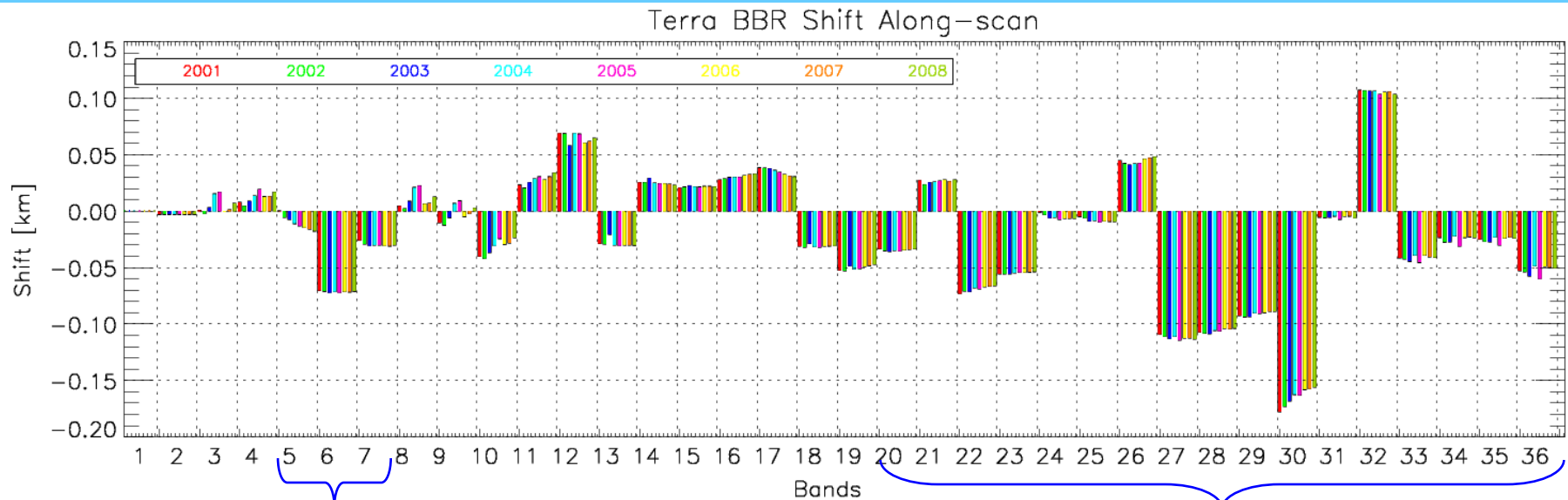
## Terra MODIS Bandwidth Changes



# Aqua MODIS Spectral Characterization Results

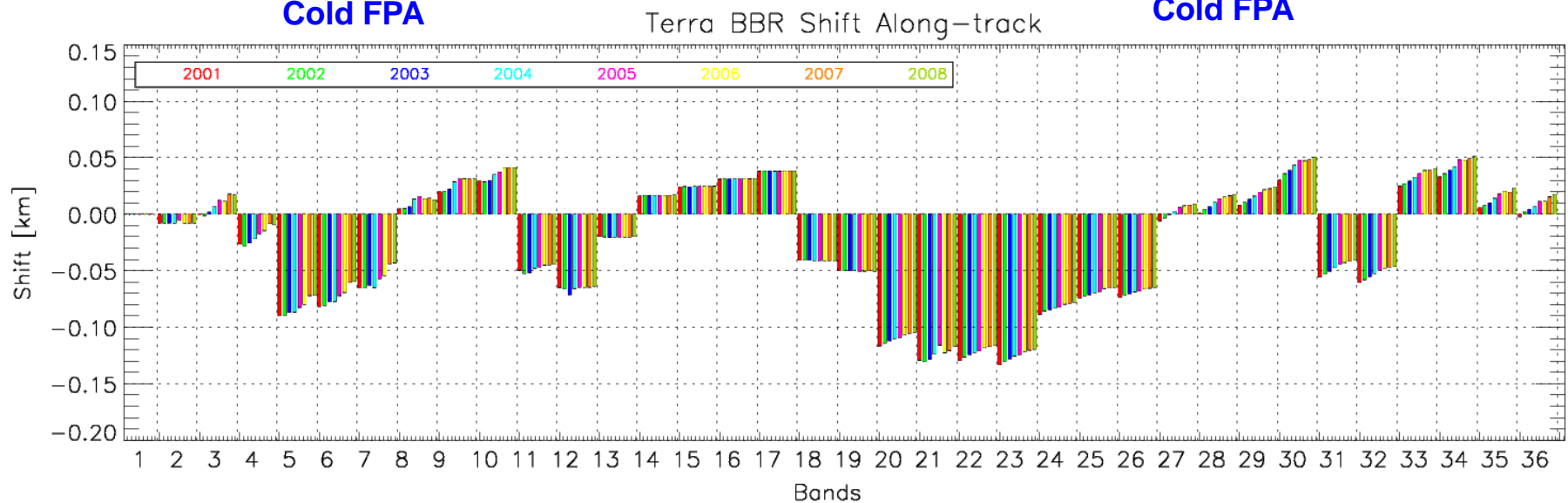


# Terra MODIS Spatial Characterization Results



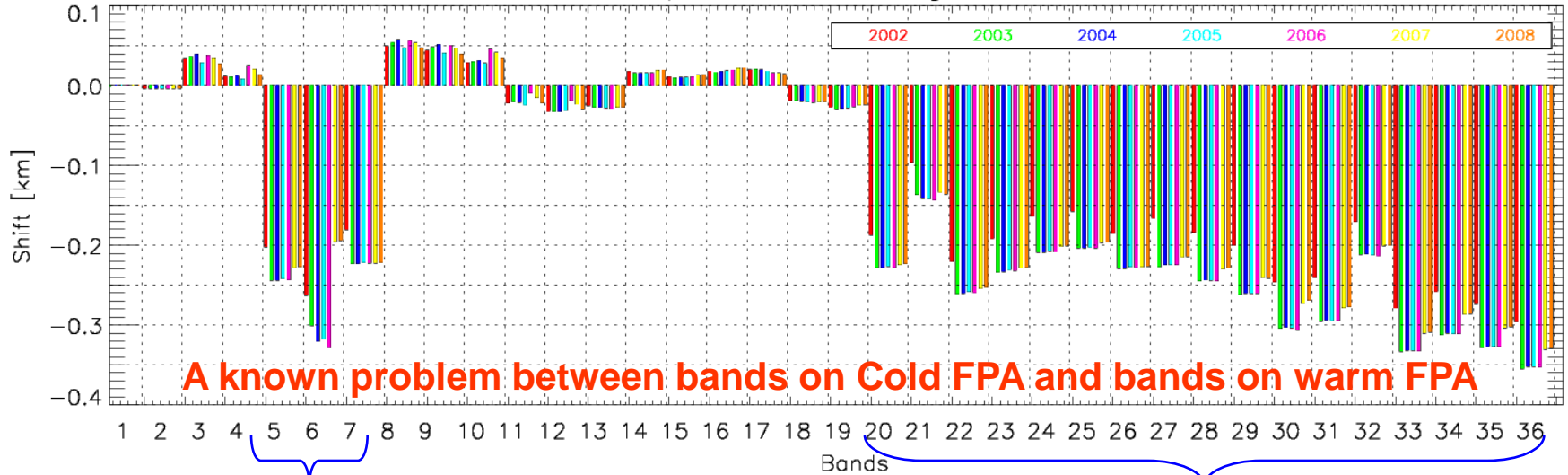
Cold FPA

Cold FPA



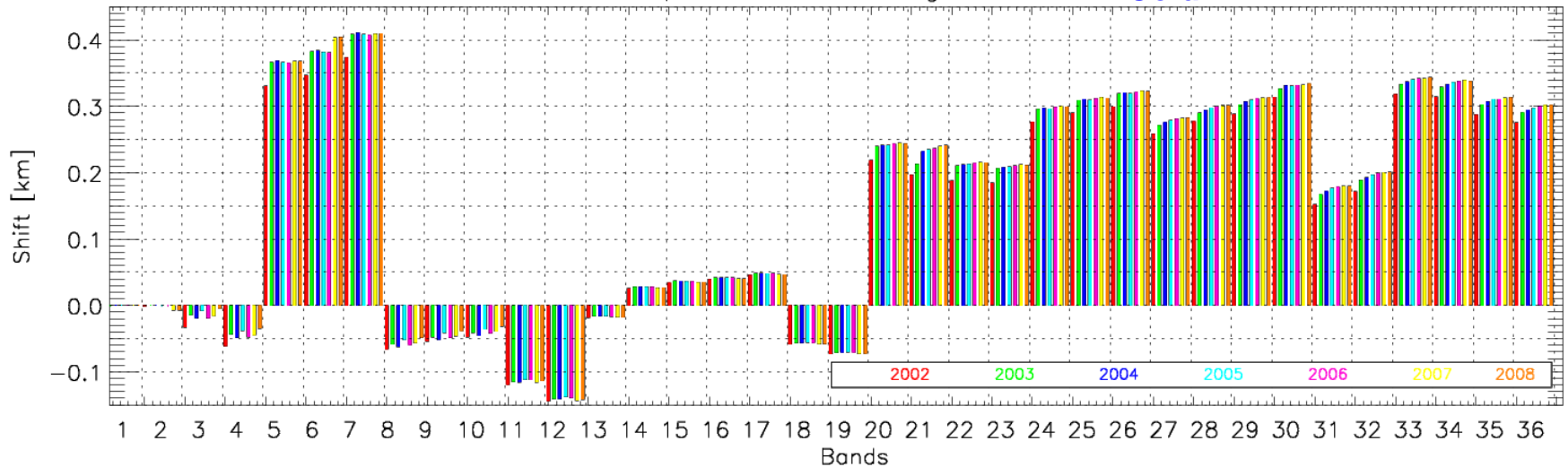
# Aqua MODIS Spatial Characterization Results

Aqua BBR Shift Along-scan



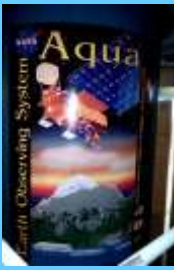
Cold FPA

Aqua BBR Shift Along-track

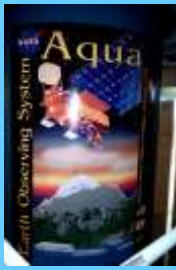




# Future Work



- MSCN impact on PC bands 33-36
  - Limited progresses made
- Improvement of B21 calibration
  - Preliminary results show scan-to-scan calibration is an alternative approach
- TEB calibration source long-term drifting (progress made)
  - On-orbit changes of BB temperature and emissivity?
- Update on-orbit calibration uncertainty
  - Time dependent
- **Calibration consistency between Terra and Aqua MODIS**
  - **RSB and TEB — e.g. some evidence that band 1& 2 differences are growing and affects NDVI, polarization effects Terra versus Aqua**
- **Cross-sensor calibration of MODIS with other sensors**
  - **Approaches developed and limited effort and progress made; e.g., MODIS and AIRS, MODIS and MISR, etc.**



## Summary

- Both Terra (~8.5 years) and Aqua MODIS (~6 years) have shown satisfactory operation and performance
  - Key on-board calibrators continue to function well
  - Overall performance of Aqua MODIS is better than Terra MODIS
- Collection 6 issues have been identified with implementation plan and progresses made
  - Coordination (issues and schedule) with science groups is required
- Large optics (SD and scan mirror) degradation remains challenging
  - Detector dependent RVS will be applied in C6
  - **Polarization correction parameters are proposed for C6**
- Continuous effort must be made to maintain instrument calibration and data quality, including Terra and Aqua MODIS calibration consistency
  - In addition to MCST effort, input and support from science groups, instrument vendor (SBRS), and other expertise are needed



## MODIS Data Production and Archiving

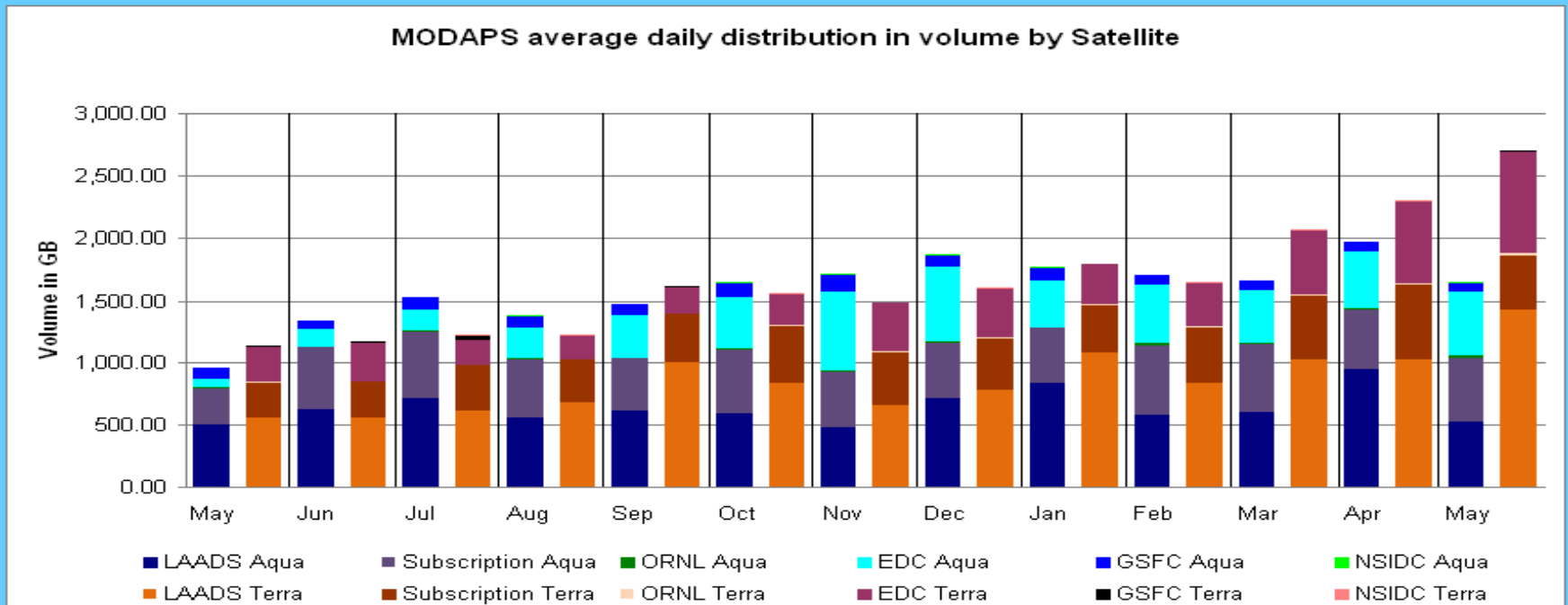
MODIS data are produced, archived and distributed by 4 separate, distributed systems; i.e.,

- the Goddard MODIS Adaptive Processing system that produces all Level 1 products leading to all land and atmospheres products, archives these products and distributes them to the public
- the Goddard Ocean Color Data Processing System (OCDPS) produces archives and distributes all ocean-related products (ocean color, SST) to scientists and the public
- the U.S.G.S. Land Processes Distributed Active Archive Center (DAAC) in Sioux Falls, SD archives and distributes all MODIS land products (except cryosphere products)
- the National Snow and Ice Data Center (NSIDC) in Boulder, Colorado archives and distributes all MODIS cryosphere (snow and ice) products

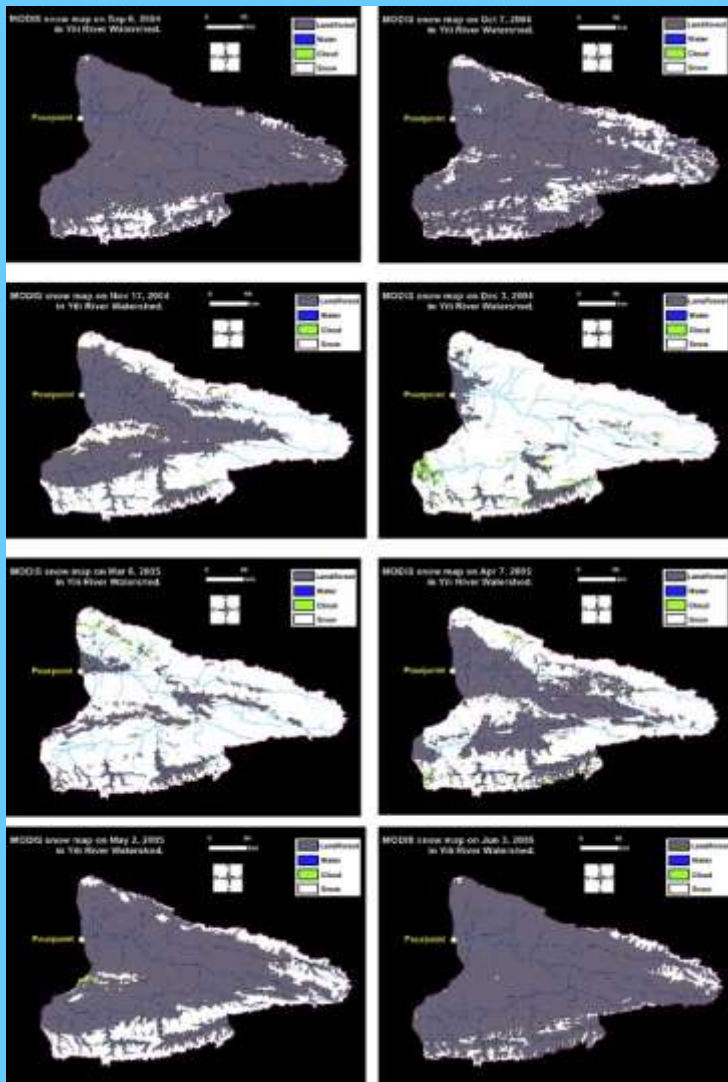
**Collection 5 is nearly finished!!**

**At present the amount of MODIS Level 0 data coming from the two MODIS Instruments is ~0.14 Terrabytes per day (“input”) and ~3.5-4 Terrabytes of data in the form of geophysical products is being distributed to the Public (“output”)**

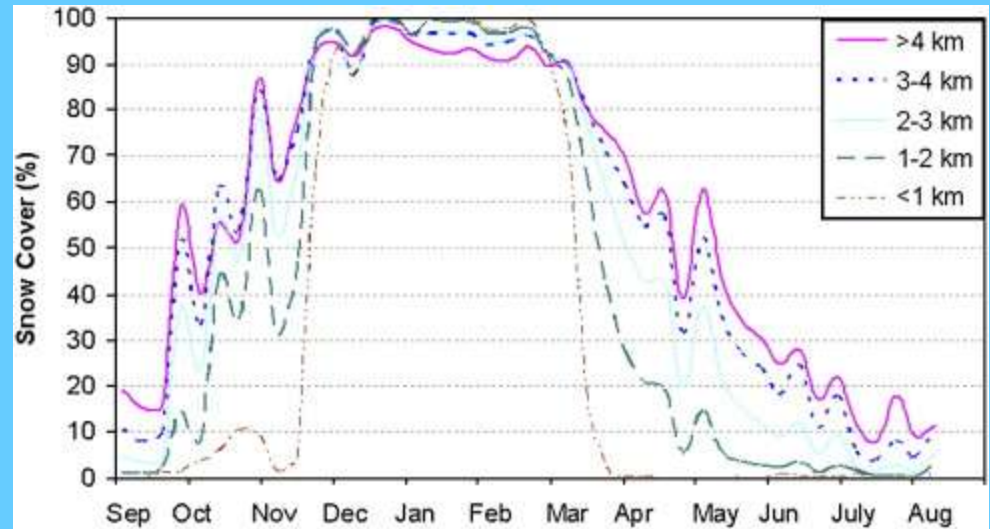
# Example: Some MODAPS Specifics



Note: MODAPS, for example, archives or creates on demand a total of 86GB/day+165GB/day= 251GB/day and 2,054 files/day. MODAPS in April shipped 2,400GB/day and 163,000 files/day to the Public. This equates to roughly 10x the volume archived and 80x the number of files archived.

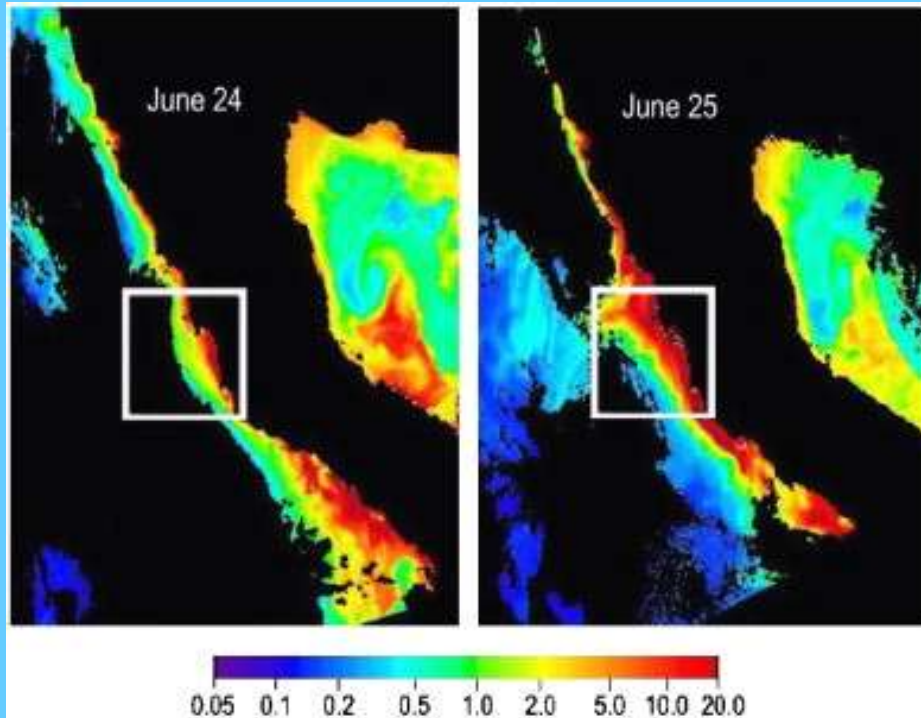


**Snow coverage in the Ili River Watershed in 2004–2005 hydrologic year.**

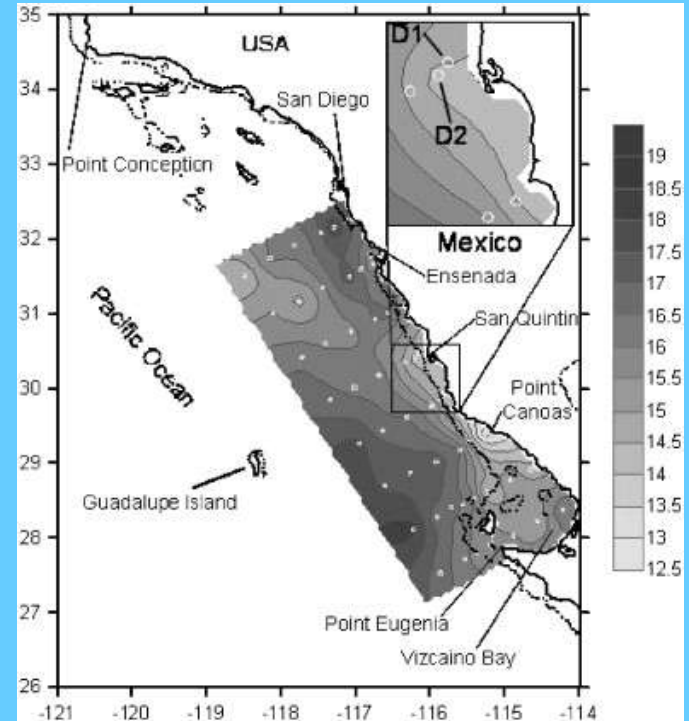


**Mean snow area extent at different elevations in the Ili River Watershed during 2000–2001 to 2005–2006 hydrologic years.**

**Ref: Xianwei Wang, Hongjie Xie, and Tiangang Liang, “Evaluation of MODIS snow cover and cloud mask and its application in Northern Xinjiang, China” , Remote Sensing of Environment Volume 112, Issue 4, 15 April 2008, Pages 1497-1513 Remote Sensing Data Assimilation Special Issue**

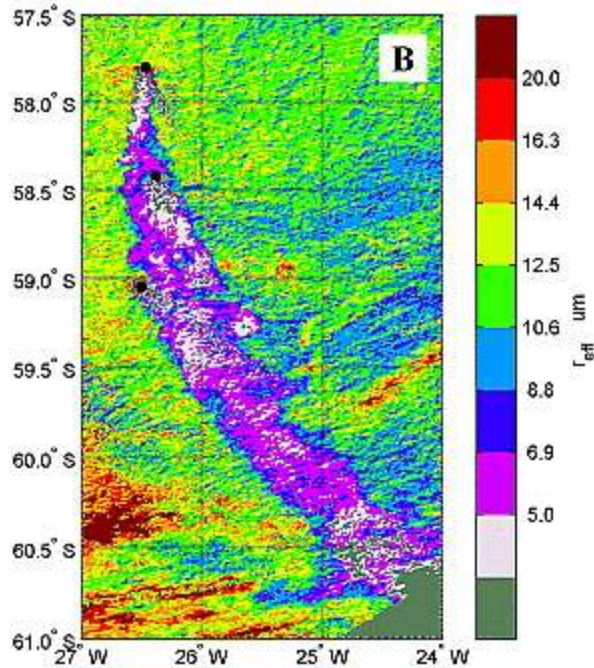
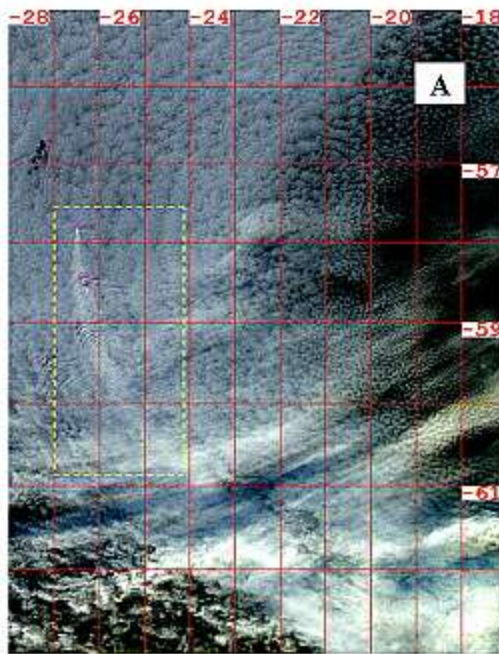


LAC MODIS/Aqua images showing chlorophyll *a* concentration ( $\text{mg m}^{-3}$ ) on June 24 (left) and 25 (right), 2003. Stations D1 and D2 are located within the white squares, which correspond to the zoom view in Figure to the right.

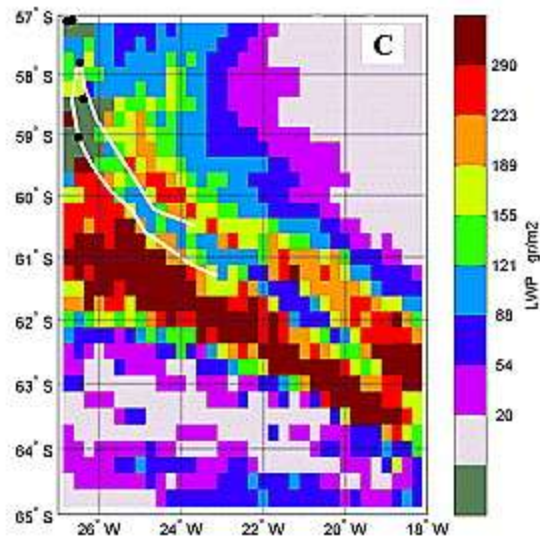


Map of study area showing CTD temperature at 4 m depth ( $^{\circ}\text{C}$ ) and location of stations near San Quintin Bay. The bloom was sampled at station D1 and D2 on June 24. The dotted line indicates the 200 m isobath.

Ref: Barocio-León, O. A., Millán-Núñez, R., et al., *Continental Shelf Research*, Volume 28, Issues 4-5, 30 March 2008, Pages 672-681



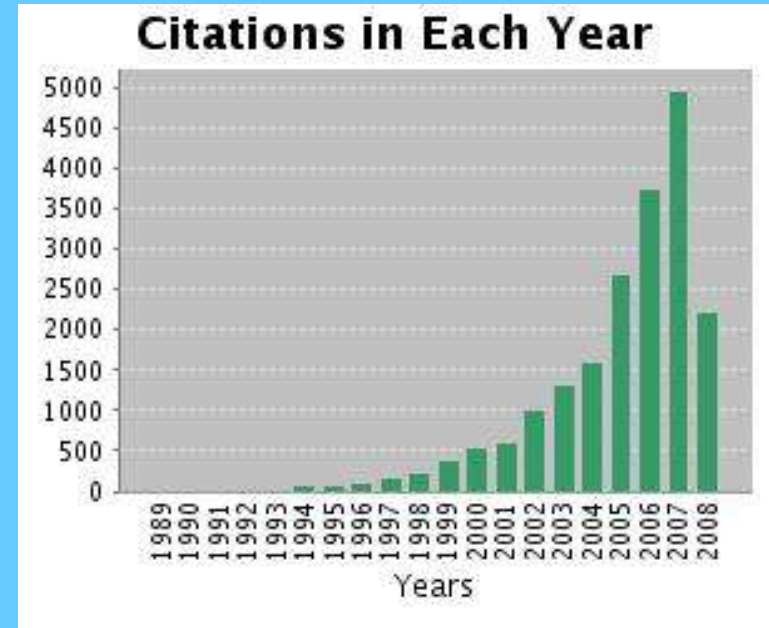
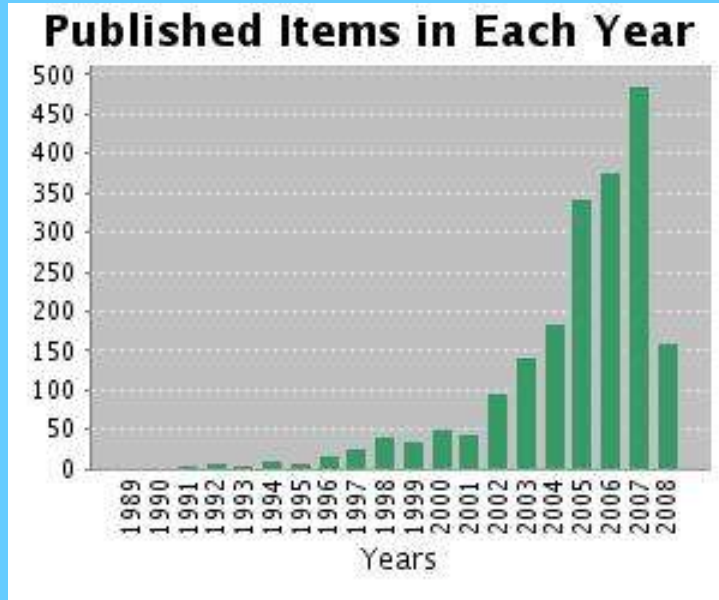
(a) Visible image of the South Sandwich area from MODIS-Aqua for 27 April 2006 (1615 UTC). (b) Cloud effective radii ( $r_{eff}$ ) retrieved by MODIS-Aqua for the box shown in Figure 2a. (c) A regional view of the distribution of cloud water path retrieved by AMSR-E on board the Aqua satellite. The white line is the envelope of  $10 \mu\text{m}$   $r_{eff}$  from Figure 2b.



Ref: S. Gassó,  
 Satellite observations of  
 the impact of weak  
 volcanic activity on  
 marine clouds  
 JOURNAL OF  
 GEOPHYSICAL RESEARCH,  
 VOL. 113, D14S19,  
 doi:10.1029/2007JD009106,  
 2008

# MODIS PUBLICATION METRICS

(as of May 7, 2008)



Results found in Web of Science:2,041 (all years)

--485 (2007)—more than 1/day

Sum of the Times Cited :19,871

Average Citations per Item :9.74

2007 Fall AGU abstracts: 295

>200/meeting from 2005 to present

Direct Broadcast to over 150 stations and ~800-1000 users

## GOOGLE SCHOLAR “HITS”

19,000 for NASATERRA

8,750 for NASA AQUA

**14,800 for NASA MODIS.**

5,650 for NASA CERES

3,990 for NASA AIRS

2,200 for NASA AMSR

3,040 for NASA MISR

7,380 for NASA ASTER

1,040 for NASA MOPITT

# MODIS Instrument Panel (~ 1984)

	Name	Affiliation
1	Wayne Esaias (Chairman)	NASA Headquarters (HQ)
2	William Barnes (Secretary)	NASA Goddard Spaceflight Center (GSFC)
3	Mark Abbott	Scripps/Jet Propulsion Lab. (JPL)
4	Steve Cox	Colorado State University
5	Robert Evans	University of Miami
6	Robert Fraser	NASA/GSFC
7	Alexander Goetz <sub>1</sub>	NASA/JPL
8	Howard Gordon (Ex-officio)	University of Miami
9	Christopher Justice	University of Maryland
10	E. Paul McClain	National Oceanic and Atmospheric Administration
11	Marvin Maxwell	NASA/GSFC
12	Robert Murphy	NASA HQ
13	John Prospero	University of Miami
14	Barrett Rock	NASA/JPL <sub>1</sub>
15	Steven Running	University of Montana
16	Raymond Smith	University of California, Santa Barbara
17	Jerry Solomon	NASA/JPL
18	Michael Spanner (Ex-officio)	NASA/Ames Research Center (ARC)
19	Joel Susskind	NASA/GSFC

# MODIS ORIGINAL SCIENCE TEAM (~1988 — 20 years ago!! )

V. Salomonson (Team Leader)

NASA GSFC

	Atmospheres Group	Affiliation
1	Michael King (Group Leader)	NASA GSFC
2	Bo-Cai Gao	NASA GSFC
3	Yoram Kaufman	NASA GSFC
4	Paul Menzel	NOAA/University of Wisconsin
5	Didier Tanré	University of Lille, France
	Land Group	
1	Christopher Justice (Group Leader)	University of Maryland
2	Alfredo Huete	University of Arizona, Tucson
3	Jan-Peter Muller	University College London, UK
4	Ranga Myneni	Boston University
5	V. Salomonson	NASA GSFC
6	Steven Running	University of Montana, Missoula
7	Alan Strahler	Boston University
8	John Townshend	University of Maryland
9	Eric Vermote	NASA GSFC
10	Zhengmin Wan	University of California, Santa Barbara



## MODIS ORIGINAL SCIENCE TEAM (cont---~1988)

	Oceans Group	
1	Wayne Esaias (Group Leader)	NASA GSFC
2	Mark Abbott	Oregon State University
3	Ian Barton	CSIRO, Australia
4	Otis Brown	University of Maimi
5	Janet Campbell	University of New Hampshire
6	Kendall Carder	University of South Florida
7	Dennis Clark	NOAA NESDIS
8	Robert Evans	University of Miami
9	Howard Gordon	University of Miami
10	Frank Hoge	NASA GSFC
11	John Parslow	CSIRO, Australia
	Calibration Group	
1	Phil Slater (Group Leader)	University of Arizona
2	Kurt Thome	University of Arizona
3	William Barnes	NASA GSFC

## **SOME THOUGHTS ABOUT THE FUTURE**

- **COLLECTION 6 FOR LEVEL 1, ATMOSPHERES, and LAND IS COMING UP—NEED INVOLVEMENT OF ALL TEAM MEMBERS TO ENSURE THAT THIS REPROCESSING GOES WELL. OCEANS WILL CONTINUE TO REPROCESS AS NEEDED.**
- **ANOTHER SENIOR REVIEW FOR TERRA AND AQUA WILL OCCUR IN 2009—NEED GOOD RESULTS TO KEEP COMING TO SHOW THE VALUE OF CONTINUING MISSIONS INCLUDING MODIS**
- **NPP&NPOESS VIIRS IS EMERGING. THIS IS VERY EXCITING IN TERMS OF CONTINUING THE IMPACT OF MODIS-LIKE PRODUCTS FOR GLOBAL STUDIES INTO THE FUTURE. CONTINUED EVALUATION AND STUDY OF PRODUCTS INCLUDING THE IMPORTANCE OF REPROCESSING NEEDS TO BE KEPT IN MIND.**

## OVERALL SUMMARY

- TERRA AND AQUA MODIS INSTRUMENTS WORKING WELL AFTER 6-8 YEARS
- EXCELLENT MODIS PRODUCTS HAVE BEEN DEVELOPED AND ARE INCREASINGLY USED FOR SCIENCE AND APPLICATIONS
- DATA PRODUCTS ARE BEING PROCESSED, ARCHIVED AND DISTRIBUTED WELL
- DIRECT BROADCAST OF MODIS PRODUCTS A GREAT SUCCESS
- THE FUTURE BEYOND MODIS LOOKS PROMISING WITH NPP/NPOESS VIIRS

