

Toward Long-Term Consistency
in
Ocean Color Measurements

Bryan Franz

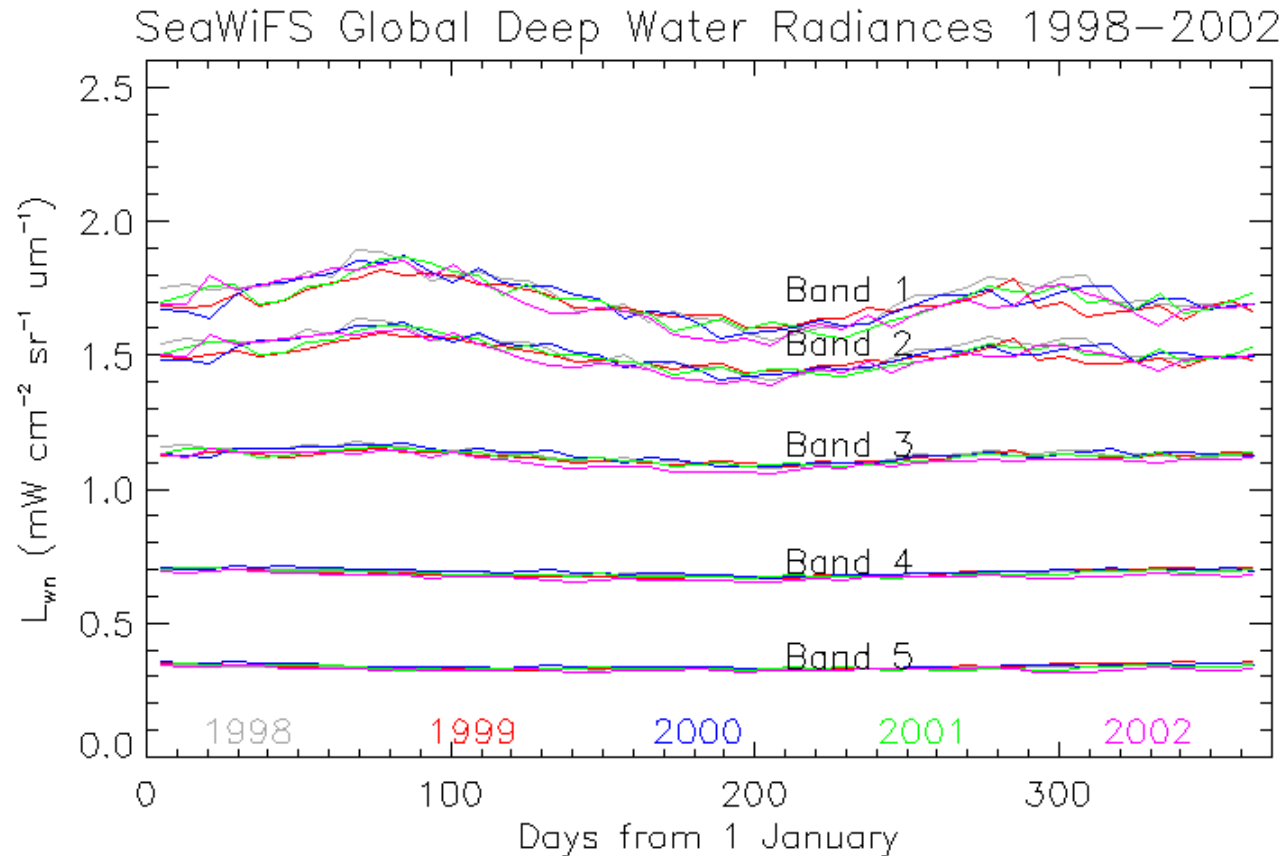
Ocean Discipline Processing Group

*the project formerly known as
SeaWiFS/SIMBIOS/SeaDAS/SeaBASS*

17 February 2004

SeaWiFS Annual Repeatability in nLw

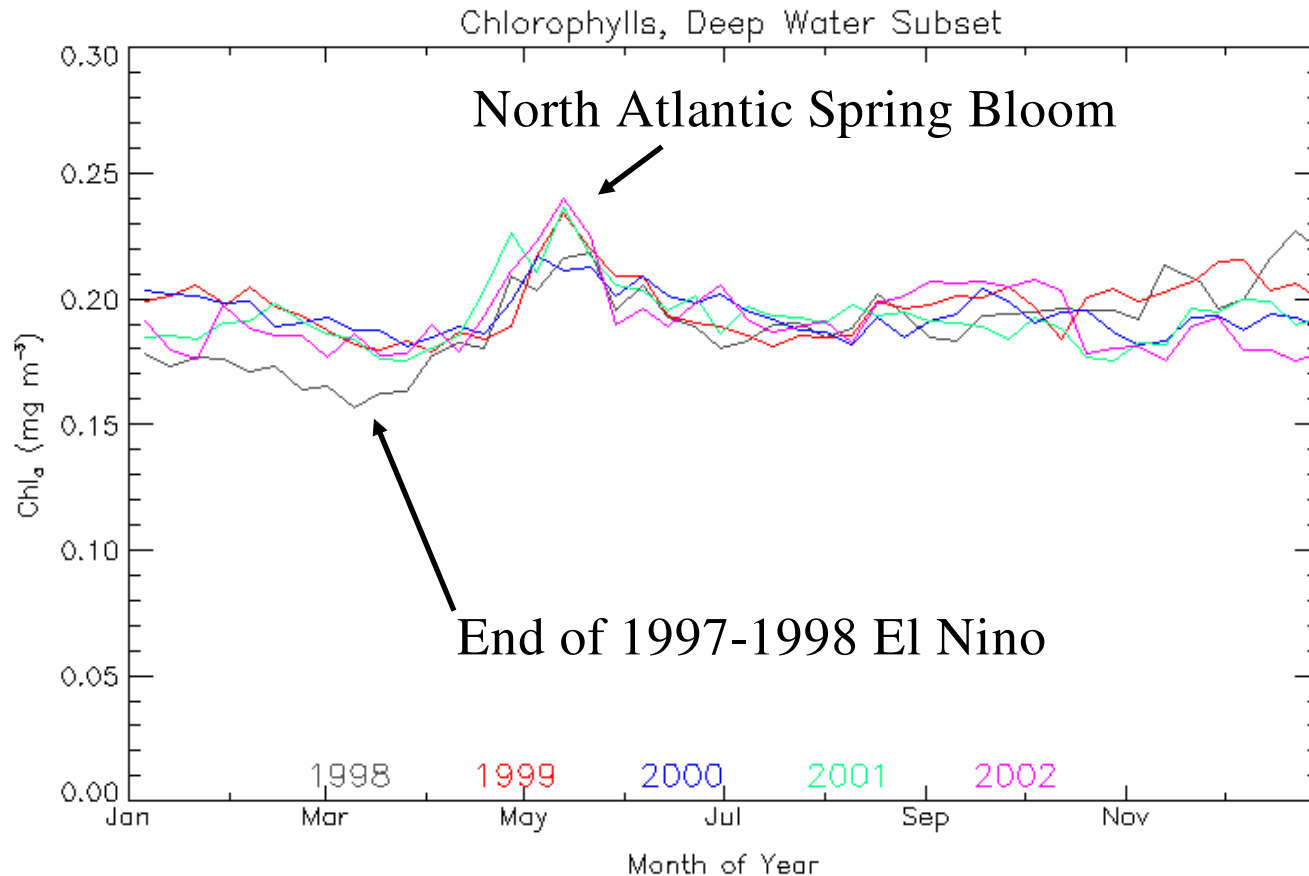
Deep-Water Subset, 8-Day Bins



Long-term temporal stability is a fundamental requirement for climate data records.

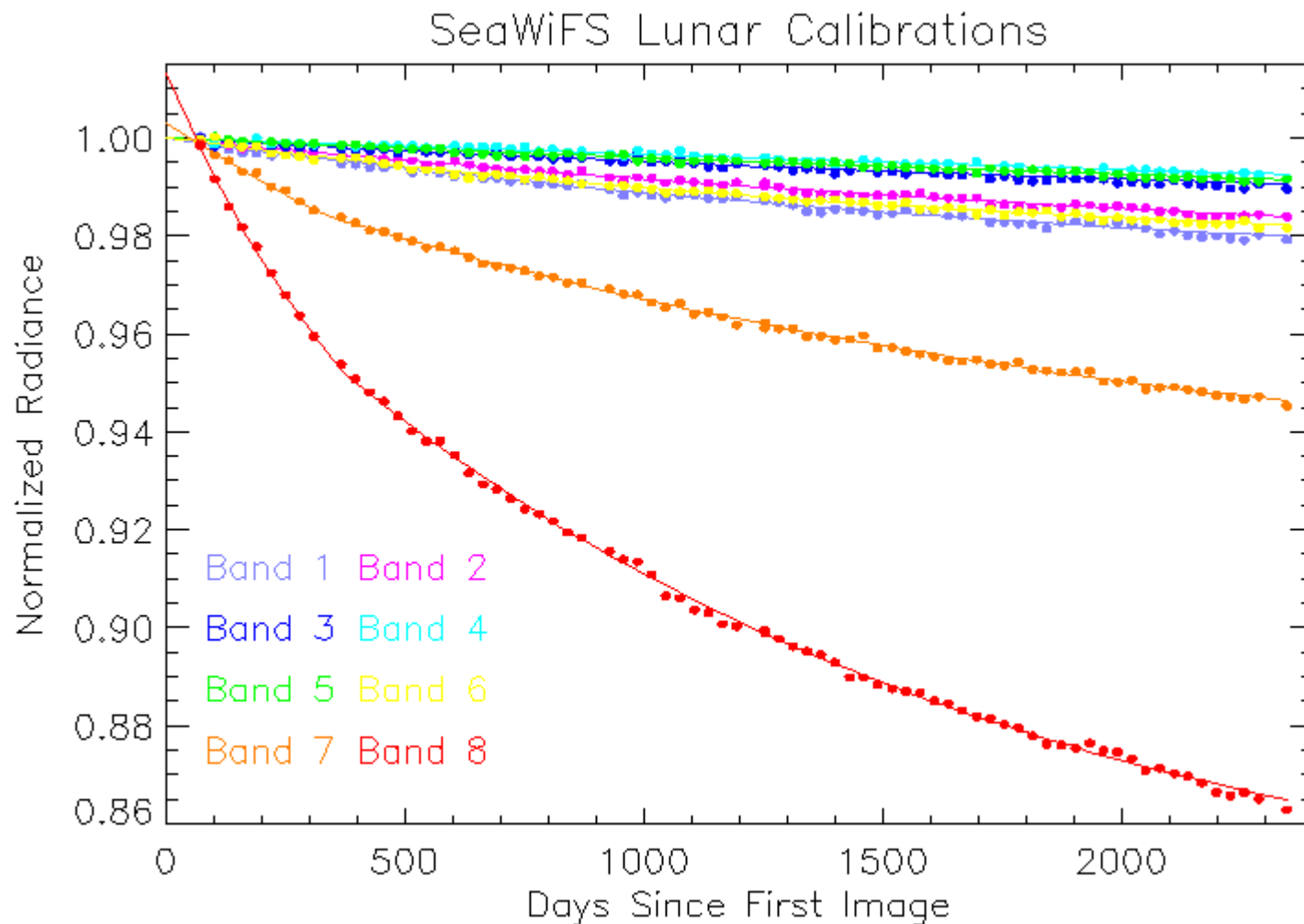
Annual Cycles in SeaWiFS Chlorophyll

Deep-Water Subset, 8-Day Bins



Demonstrated sensor stability, and ultimately **mission to mission consistency**, allows for geophysical interpretation of long-term changes.

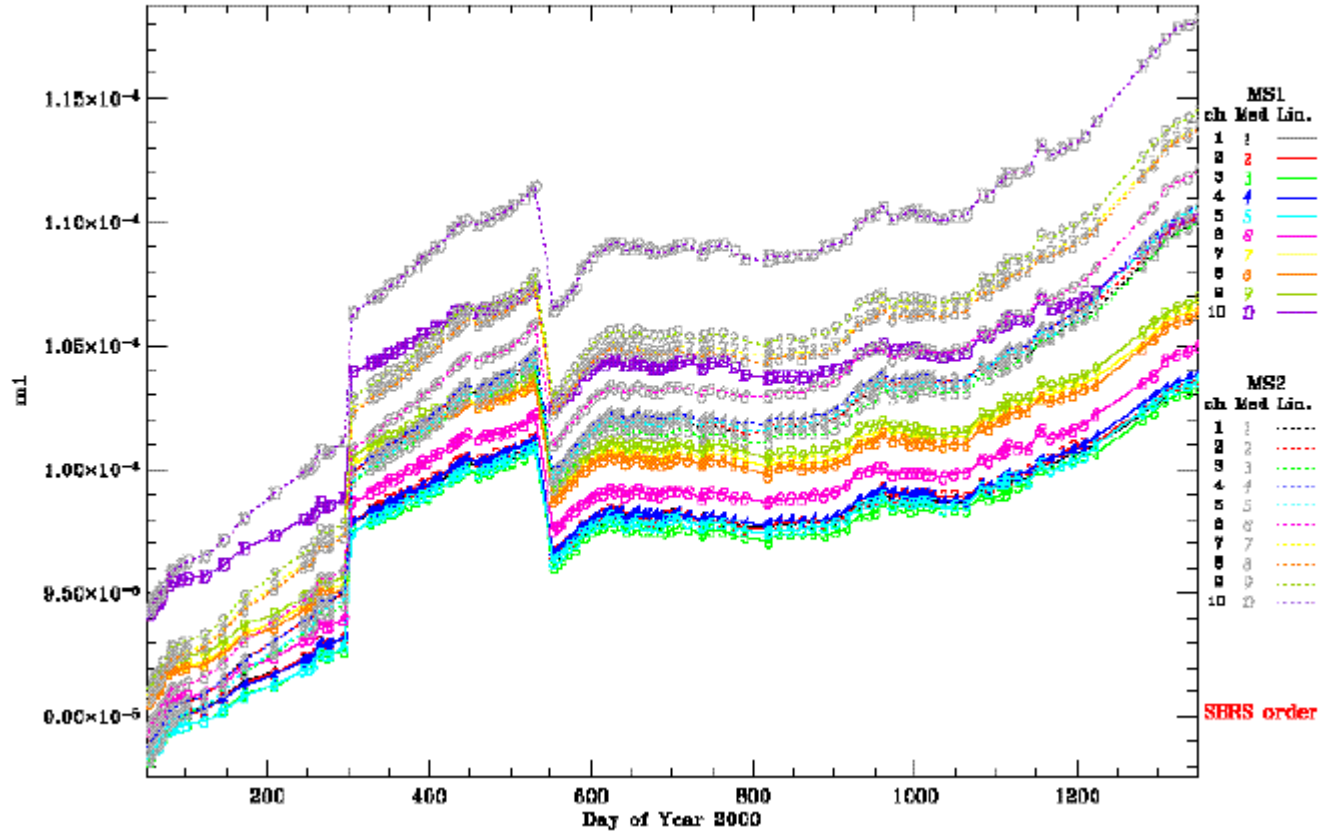
SeaWiFS Lunar Calibration Time-Series



Changes in SeaWiFS response over time are tracked and corrected exclusively through monthly observations of the moon. Degradation is well behaved and predictable. **No need for routine updates.**

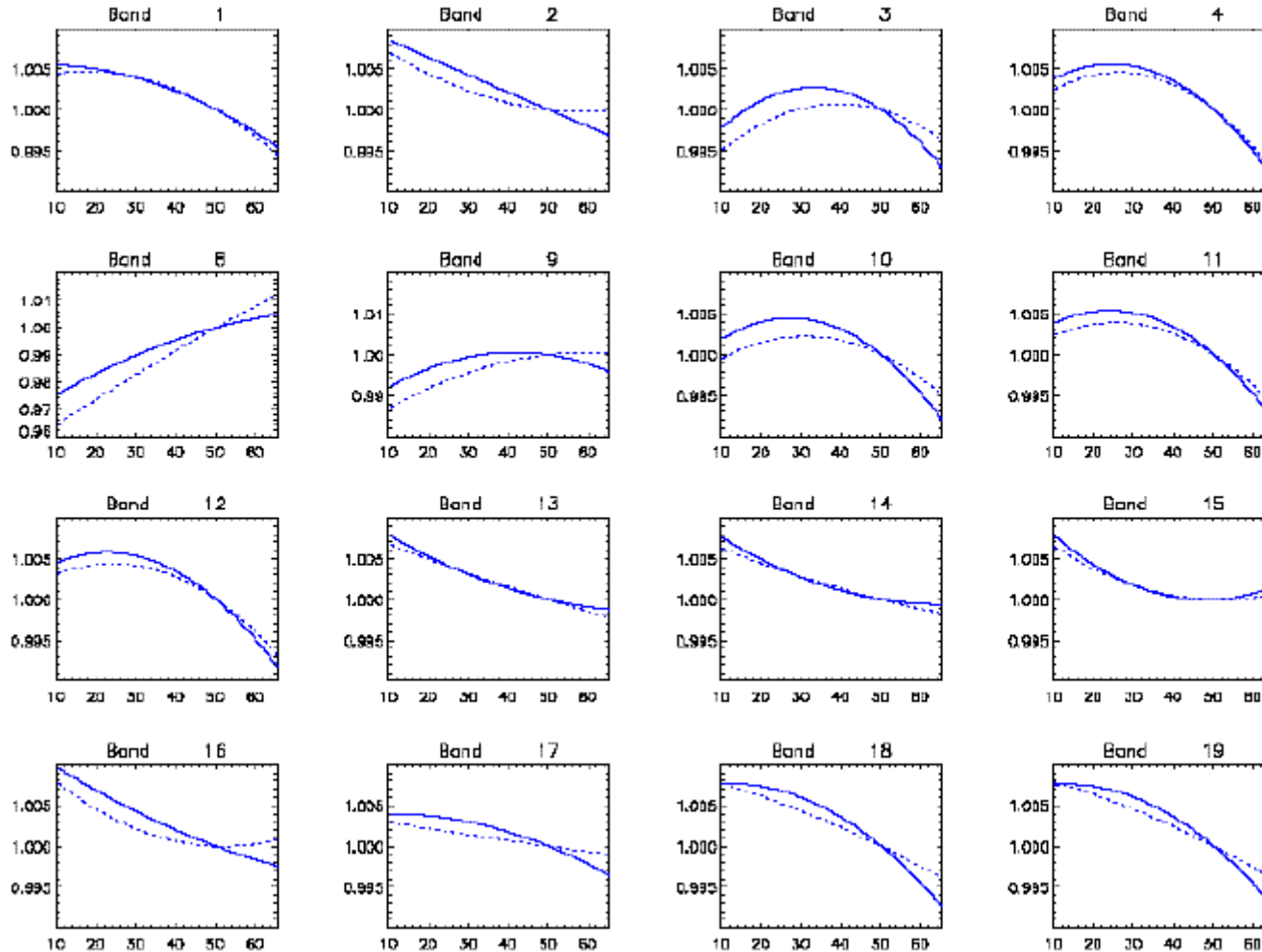
MODIS/Terra Solar Diffuser Trends

412 nm, 2 Mirror Sides, 10 Detectors



MODIS/Terra temporal calibration has not been predictable, thus requiring routine calibration updates to maintain long-term stability.
Degradation of mirror + state changes + SD measurement error.

MODIS Response vs Scan Angle



MODIS response varies significantly across the scan (different mirror AOI). Mirror is degrading => RVS is changing => **polarization sensitivity is changing**. Effects vary by detector and mirror-side.

Sensor-to-Sensor Comparative Analysis

SeaWiFS Band	MODIS Band	SeaWiFS λ (nm)	MODIS λ (nm)
1	8	412	412
2	9	443	443
3	10	490	488
4	11	510	531
5	12	555	551
6	13L	670	667
7	15	765	748
8	16	865	869

Water-Leaving Radiance Products

- 8-Day mean Level-3 products binned at 9 km resolution
- common bins selected between sensors (**equal area bins**)
- means computed and trended with time

Deep Water Subset

- all bins deeper than 1000 meters

MODIS/Terra Collection 4.1

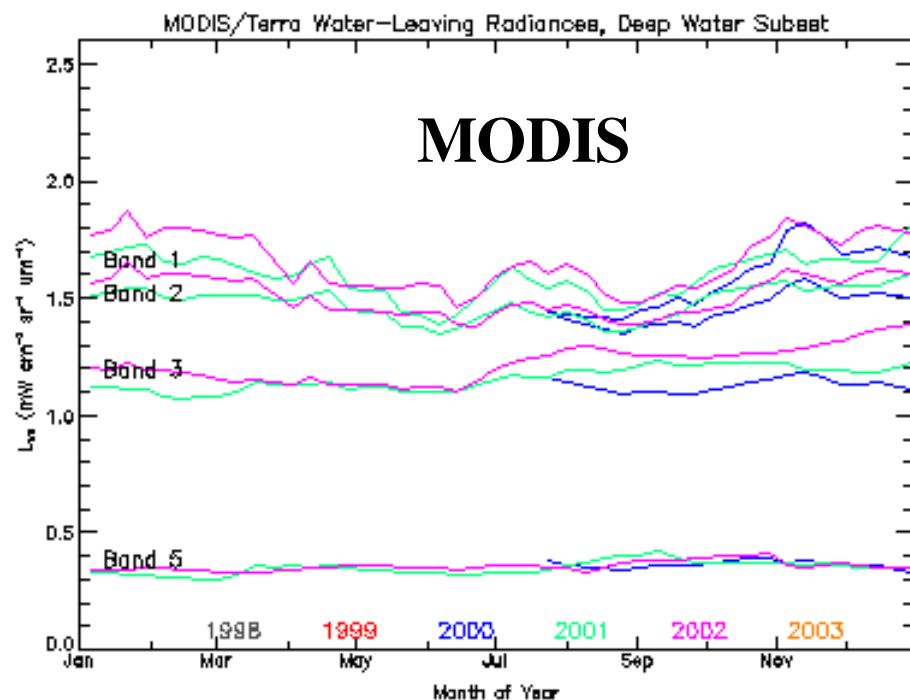
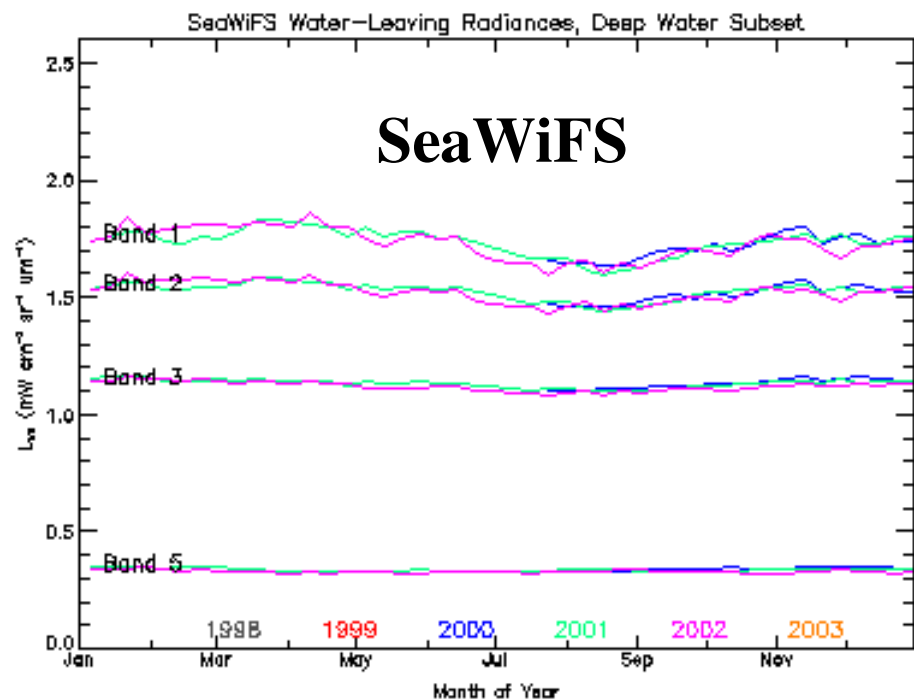
comparison with

SeaWiFS 4th Reprocessing

MODIS and SeaWiFS Annual Repeatability

MODIS/Terra Collection 4.1 vs SeaWiFS 4th Reprocessing

Deep-Water Subset, 8-Day Means

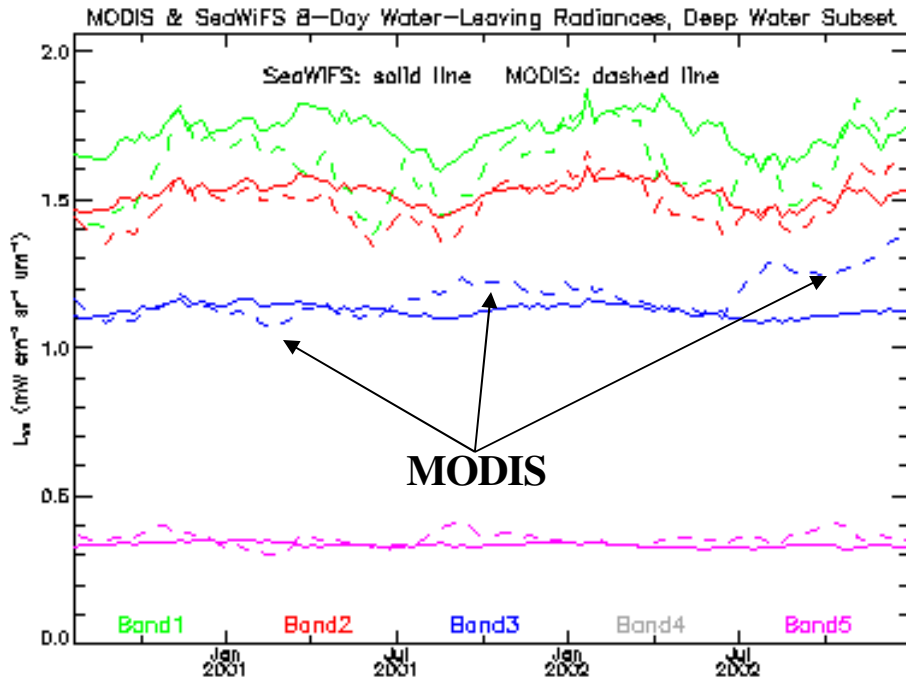


The annual repeatability of MODIS/Terra Collection 4.1 is not at the level observed with SeaWiFS. **Variability may not be geophysical.**

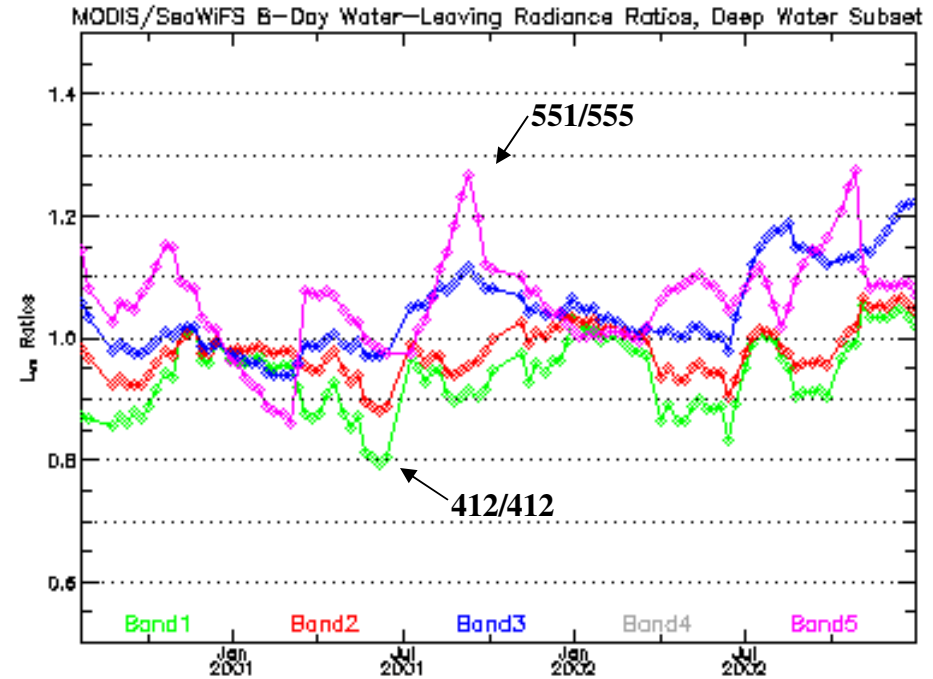
MODIS and SeaWiFS nLw Trends

MODIS/Terra **Collection 4.1** vs SeaWiFS 4th Reprocessing
Deep-Water Subset, 8-Day Means

SeaWiFS & MODIS



MODIS/SeaWiFS



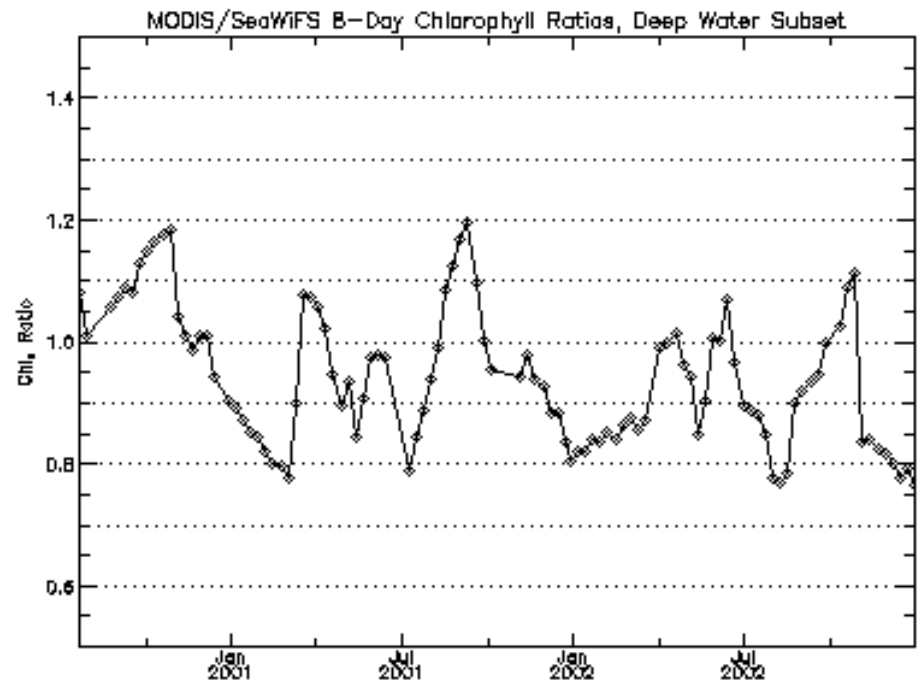
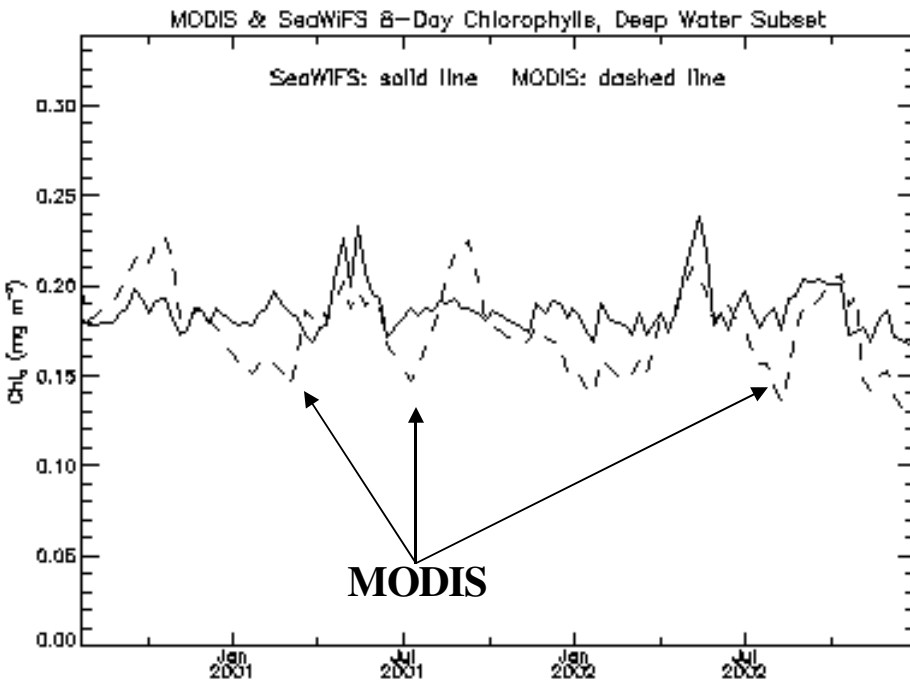
SeaWiFS radiances are relatively stable with time, while MODIS/Terra Collection 4.1 shows long-term increases at 488 and 551-nm and large deviations from SeaWiFS over shorter time-scales.

MODIS and SeaWiFS Chlorophyll Trends

MODIS/Terra **Collection 4.1** vs SeaWiFS 4th Reprocessing
Deep-Water Subset, 8-Day Means

SeaWiFS & MODIS

MODIS/SeaWiFS

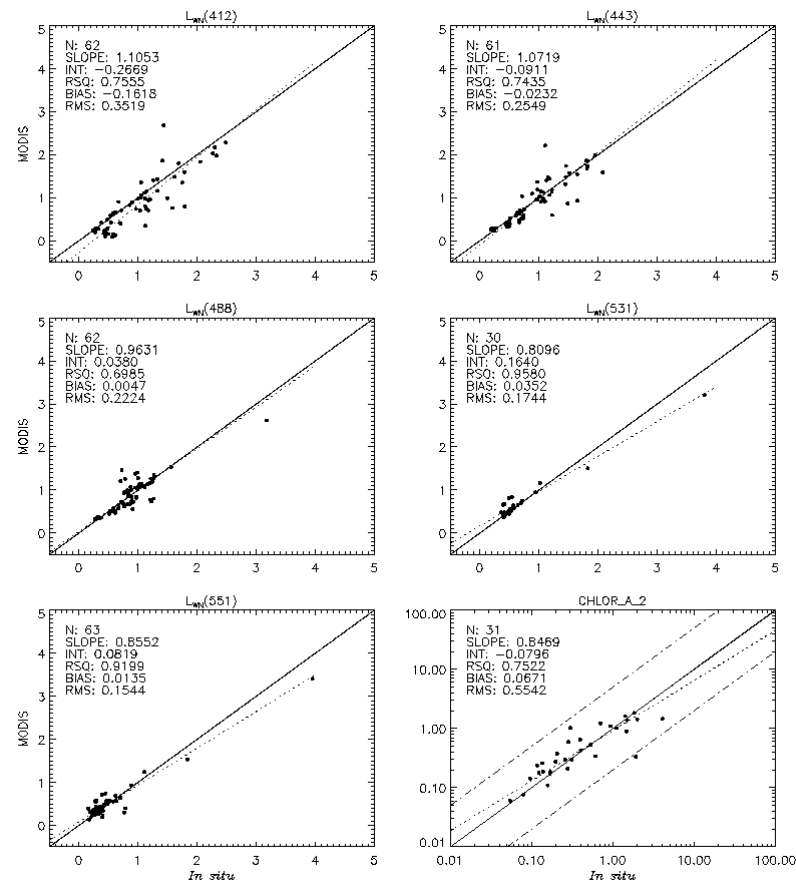
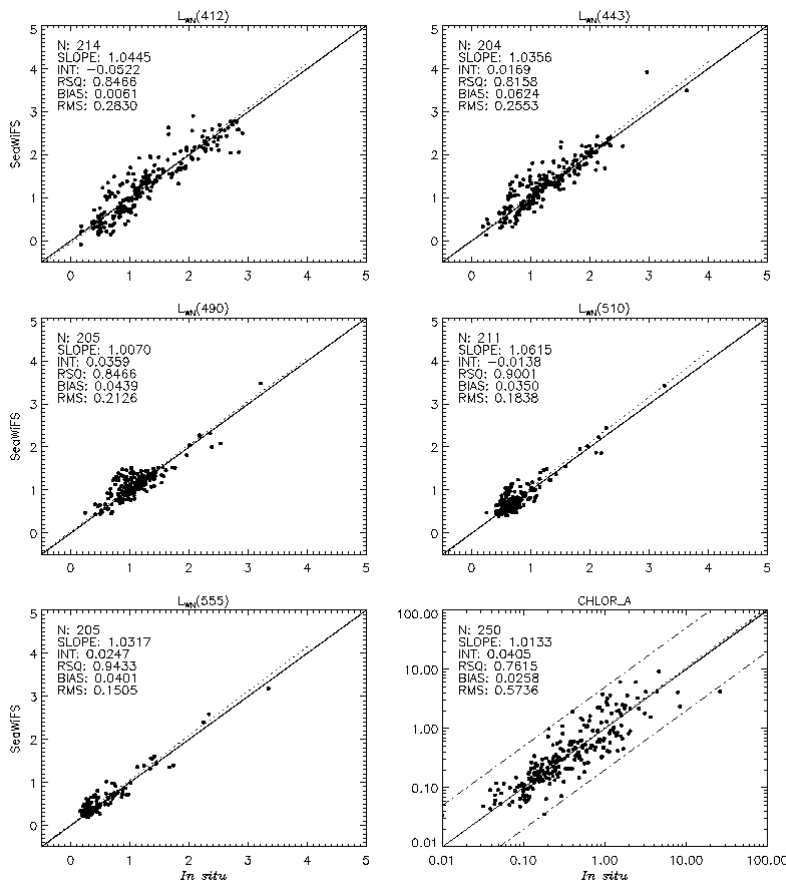


Variability in MODIS/Terra radiances translates to +/- 20% differences in global-averaged deep-water chlorophyll retrievals between sensors. Note that the **agreement is good when averaged over years.**

Water-Leaving Radiance and Chlorophyll Comparison with *In Situ*

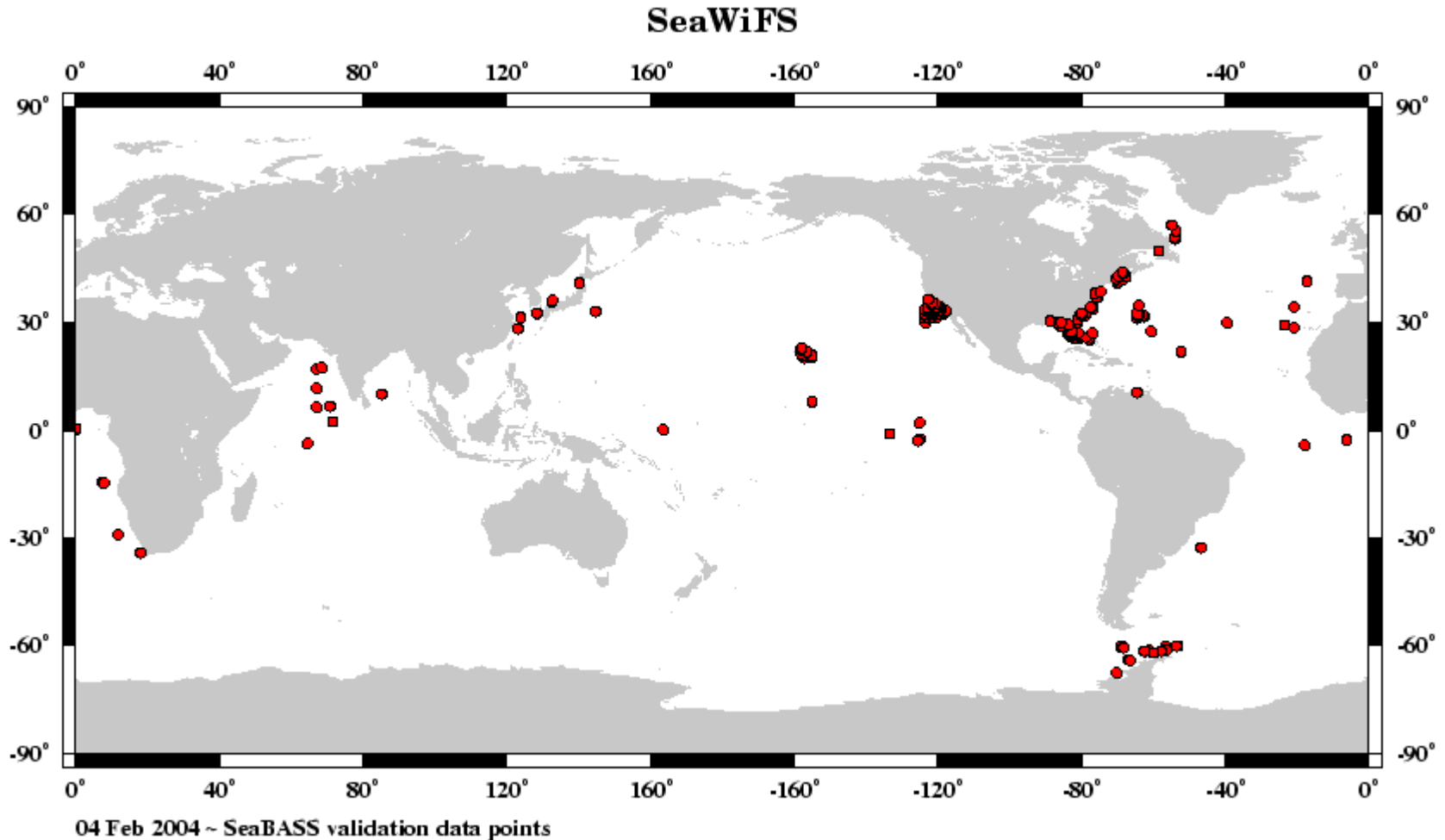
SeaWiFS 4th Reprocessing

MODIS/Terra Collection 4.1



Both sensors show a similar level of agreement with *in situ* data.

Geographic Distribution of SeaBASS *In Situ* Match-ups Over SeaWiFS Mission Lifetime

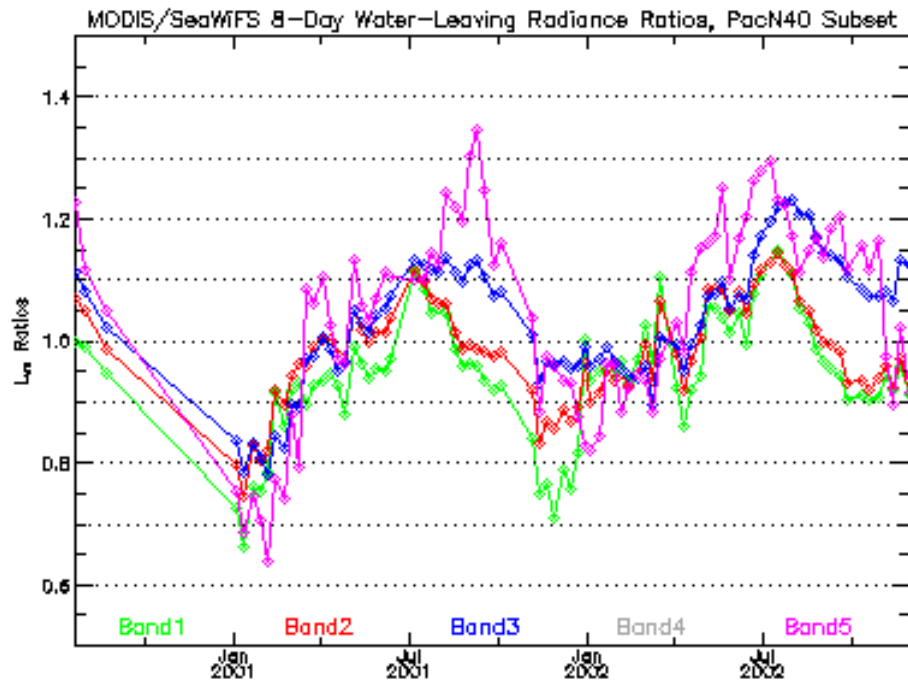


However, match-up distribution is heavily biased to mid-latitude NH,

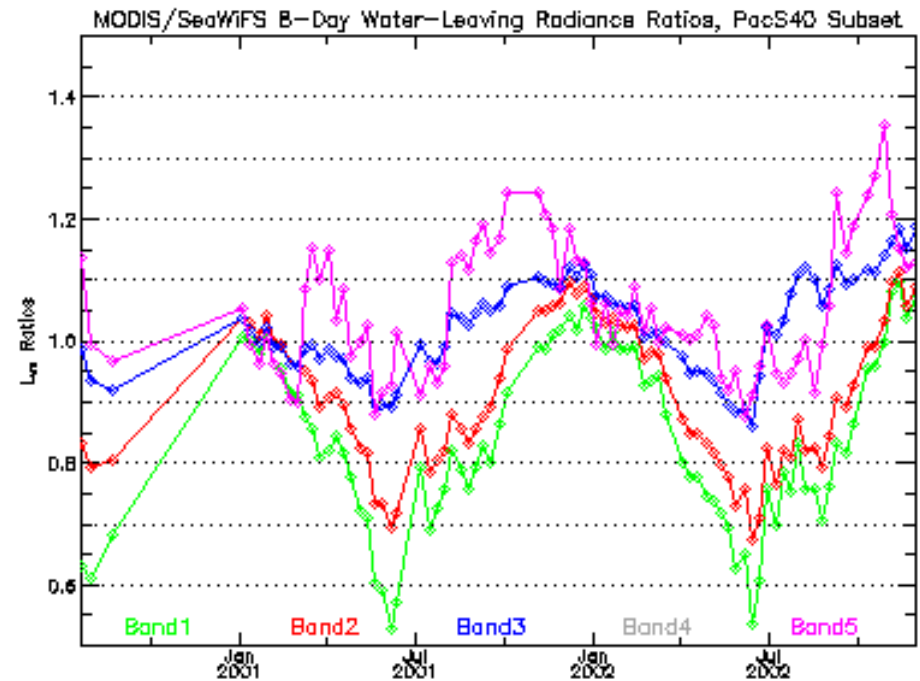
MODIS/SeaWiFS nLw Ratios

MODIS/Terra **Collection 4.1** vs SeaWiFS 4th Reprocessing
Zonal Pacific Subsets (**150-170W**), 8-Day Means

30N to 40N Latitude



30S to 40S Latitude



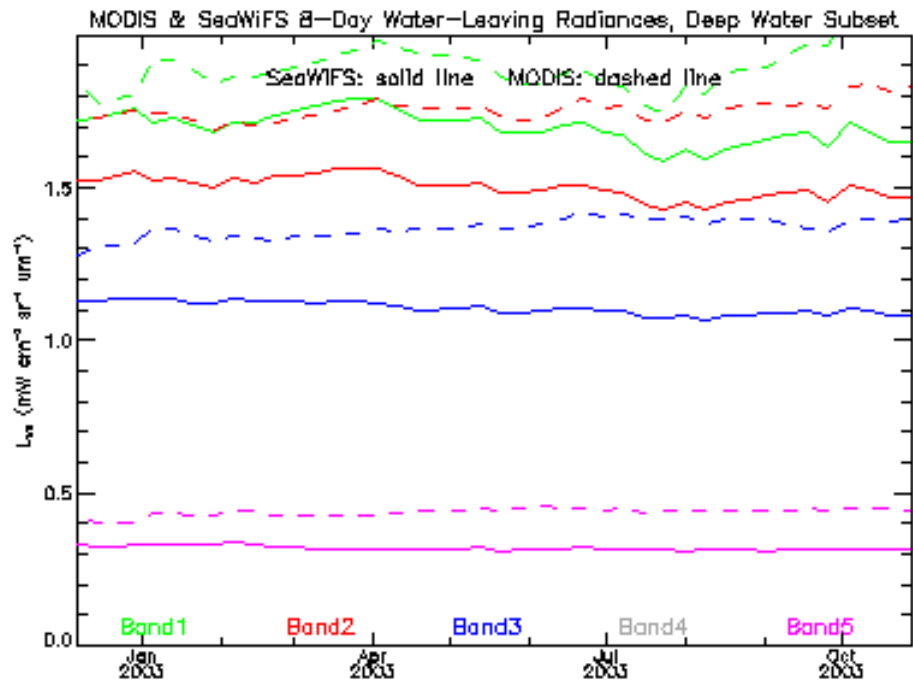
and differences between the two sensors vary geographically with a strong seasonality that increases with latitude (solar zenith angle). This may be uncorrected polarization, BRDF, other

What about Aqua?

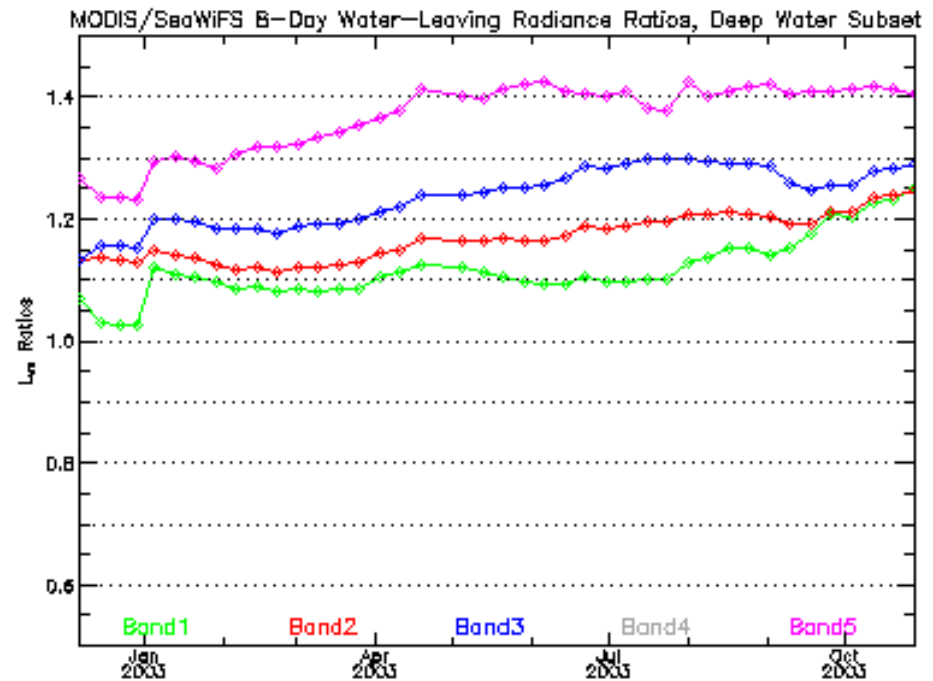
MODIS and SeaWiFS nLw Trends

MODIS/Aqua Collection 3.0 vs SeaWiFS 4th Reprocessing
Deep-Water Subset, 8-Day Means

MODIS & SeaWiFS



MODIS / SeaWiFS



MODIS radiances are 10-40% higher than SeaWiFS, and increasing with time in all bands. **Few resources have been focused on characterization of MODIS/Aqua, due to difficulties with Terra.**

MODIS/Aqua Reprocessing

within the

Ocean Discipline Processing System
(ODPS)

Differences from MODAPS Processing

File Formats and Standard Product Suite

- SeaWiFS-like file formats for Level-2 and higher.

- SeaWiFS-like product suite + 11um SST.

nLw_412	normalize water-leaving radiance at 412 nm
nLw_443	normalize water-leaving radiance at 443 nm
nLw_488	normalize water-leaving radiance at 488 nm
nLw_531	normalize water-leaving radiance at 531 nm
nLw_551	normalize water-leaving radiance at 551 nm
nLw_667	normalize water-leaving radiance at 667 nm
chlor_a	OC3M chlorophyll (MODAPS chlor_a_2)
sst	11um sea surface temperature
eps_78	750/869 SS aerosol reflectance ratio
angstrom_531	Angstrom exponent 531/869
tau_869	aerosol optical thickness at 869

- Reduced Level-2 file size of 80MB (**5-30MB** compressed).

Differences from MODAPS Processing Calibration

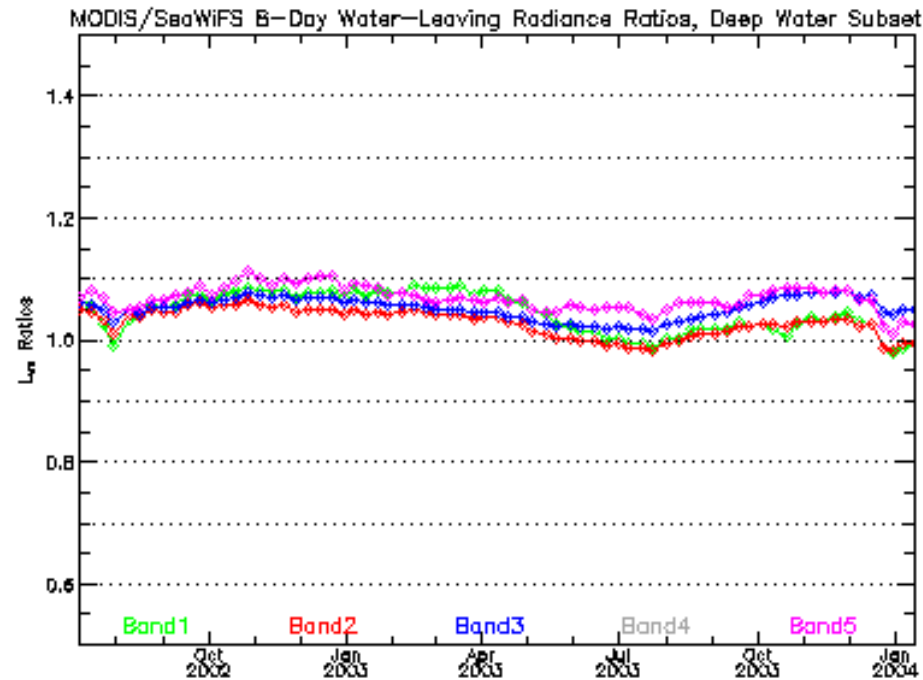
- Instrument Calibration (MCST)
 - Revised temporal calibration based on smoothed solar diffuser measurements and OBC-determined RVS corrections.
- Vicarious Calibration (ODPS)
 - No time dependence.
 - NIR ratio fixed at Tahiti (well characterized AERONET site, chosen for consistency of aerosol type over time).
 - Visible calibration determined at MOBY (6-point average).

412	443	488	531	551	667	749	869
0.9801	0.9846	0.9875	1.0003	0.9984	0.9913	0.9915	1.0000

MODIS/SeaWiFS nLw Ratio Trends

Deep-Water Subset, 8-Day Means

ODPS 1st Reprocessing

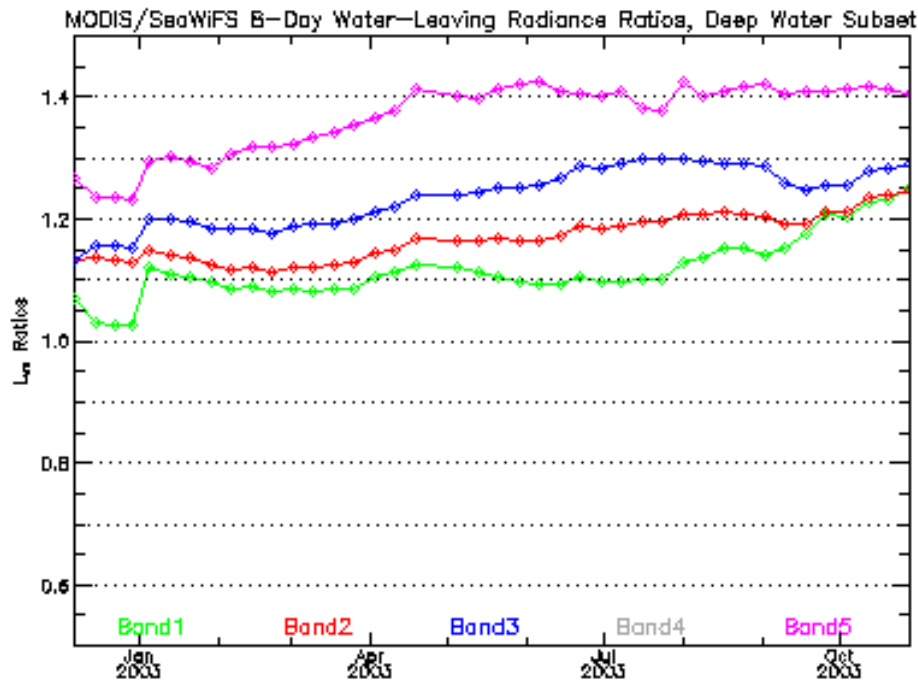


After ODPS reprocessing, MODIS/Aqua radiances are at most 5-10% higher than SeaWiFS, but with seasonal variability in differences.

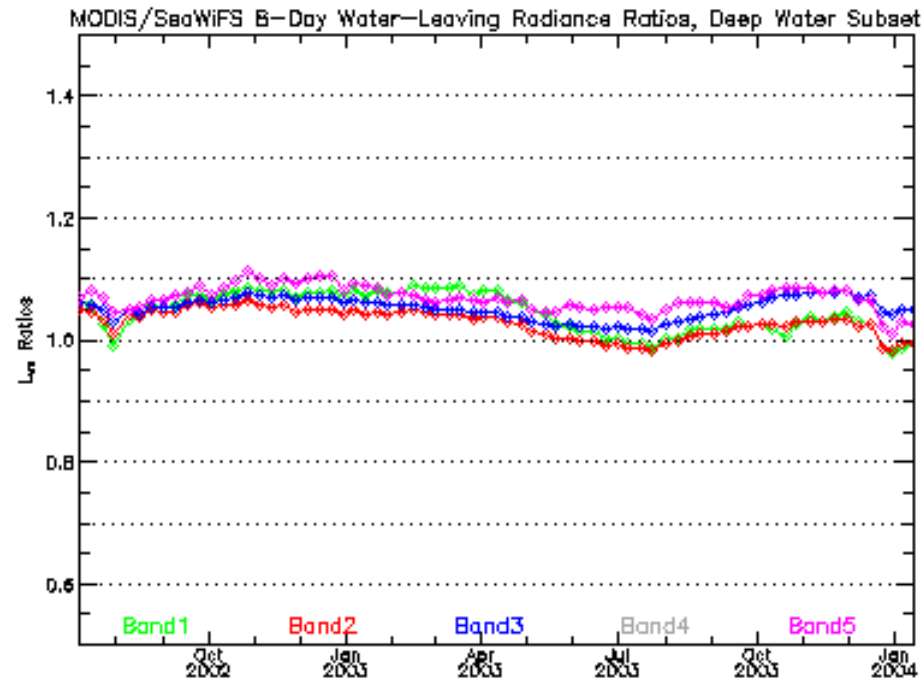
MODIS/SeaWiFS nLw Ratio Trends

Deep-Water Subset, 8-Day Means

MODAPS Collection 3



ODPS 1st Reprocessing

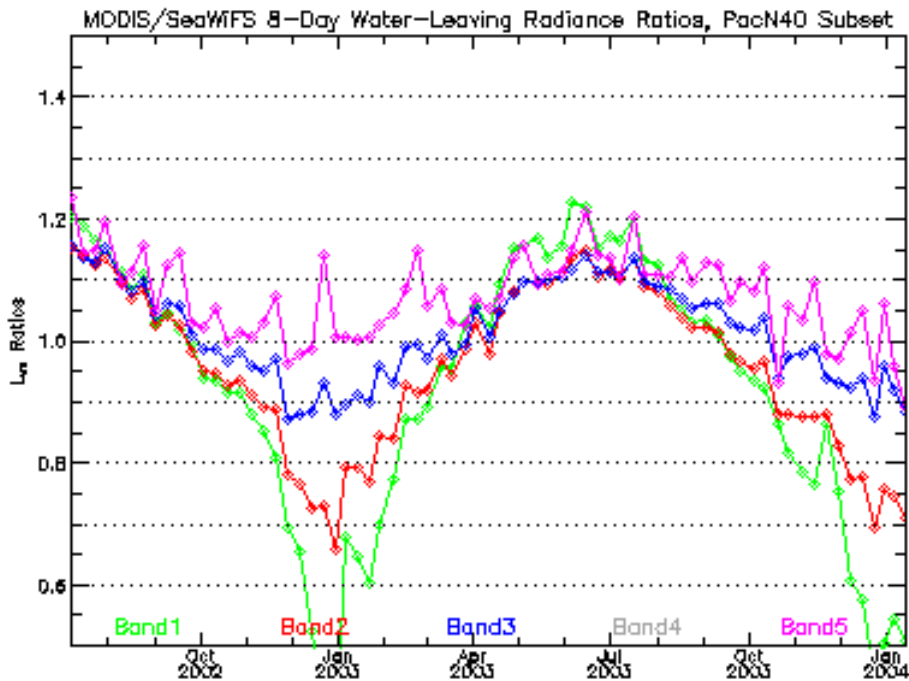


After ODPS reprocessing, MODIS/Aqua radiances are at most 5-10% higher than SeaWiFS, but with seasonal variability in differences.

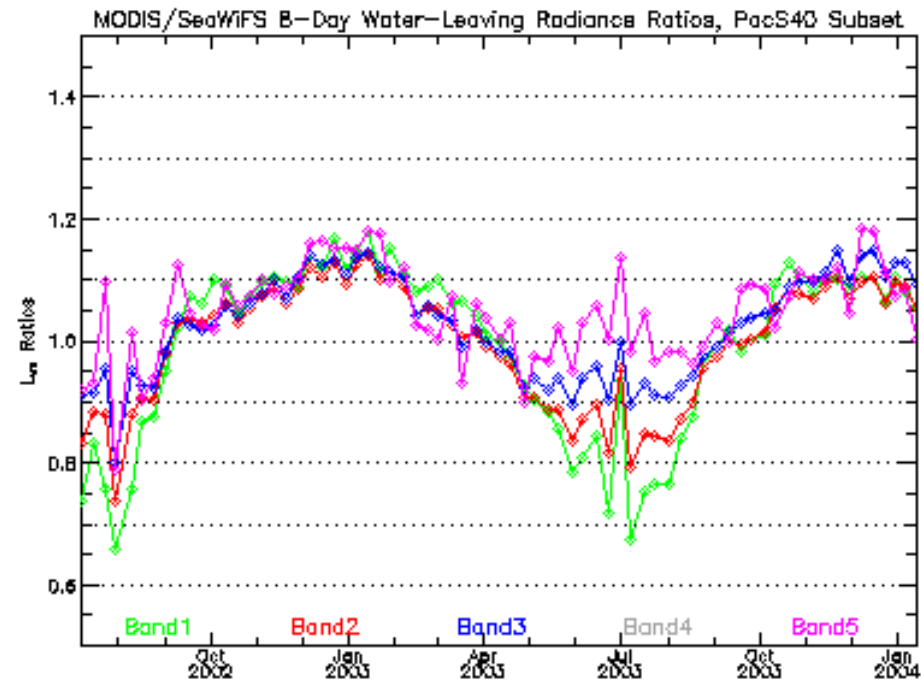
MODIS/SeaWiFS nLw Ratios

MODIS/Aqua ODPS Reprocessing vs SeaWiFS 4th Reprocessing
Zonal Pacific Subsets (**150-170W**), 8-Day Means

30N to 40N Latitude



30S to 40S Latitude



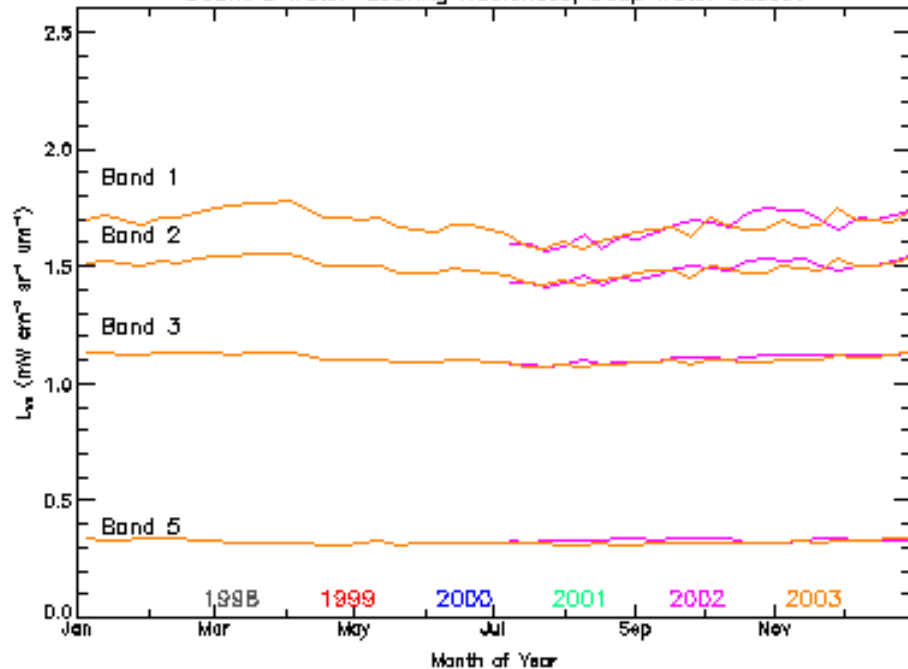
Seasonality in high-latitudinal differences is clear. Magnitude and phase are very similar to comparisons with MODIS/Terra 4.1. This results in high-lat chlorophylls which are 30-50% higher than SeaWiFS in winter.

MODIS and SeaWiFS Annual Repeatability

MODIS/Aqua **ODPS** Reprocessing vs SeaWiFS 4th Reprocessing
Deep Water Subset, 8-Day Means

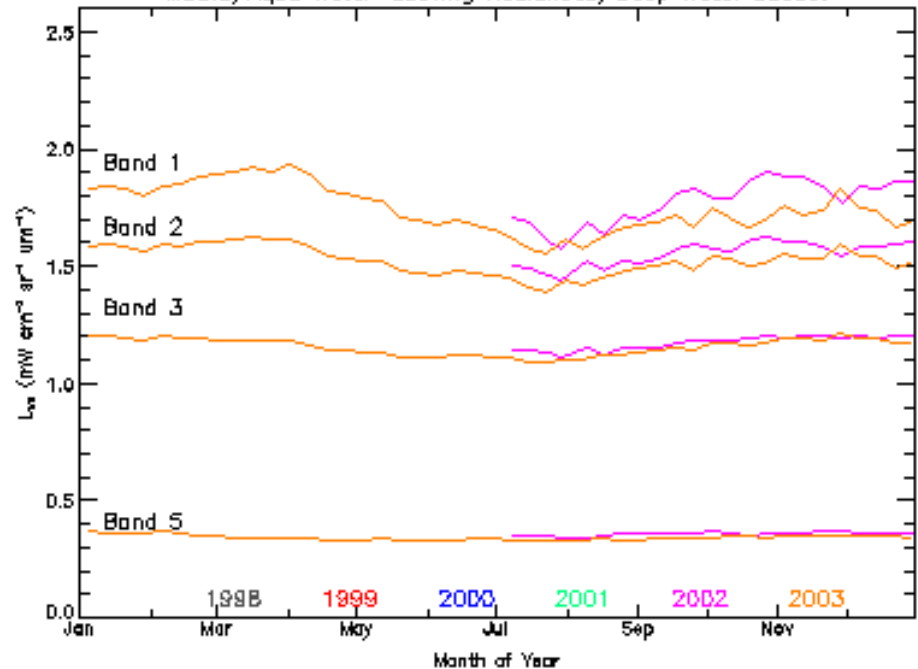
SeaWiFS

SeaWiFS Water-Leaving Radiances, Deep Water Subset



MODIS/Aqua

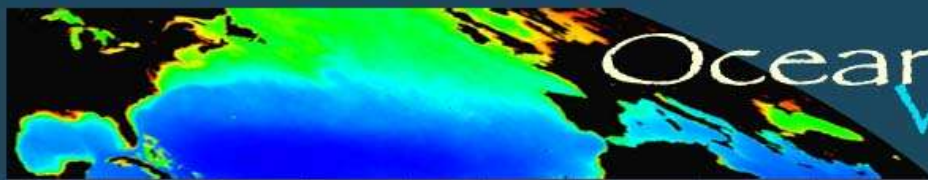
MODIS/Aqua Water-Leaving Radiances, Deep Water Subset



Additional algorithm development and/or characterization work is needed to achieve the level of stability observed with SeaWiFS.

ODPS Data Distribution

- Currently MODIS/Aqua only
- Aqua data available within 2-4 hrs of observation
- Level-1A + ancillary files for processing in **SeaDAS**
- Level-2 standard product suite
- Level-3 mapped (chlorophyll, K490, tau_869, nLw_551)
- Web-based browse, search and order + point and click direct access.
- Direct ftp access to most recent L1A, L1B, Geolocation, L2, and entire mission archive of L3 maps at 4 and 9-km.



OceanColor WEB

[MODIS](#) [SeaWiFS](#) [IOCCG](#) [Products](#) [News](#) [People](#) [Documents](#) [Validation](#) [Questions](#)

Data Access

Level 1 and 2 Browser

Visually search the ocean color data archive and directly download and/or order data from single files to the entire mission. Extensive online [HELP](#) and tutorials available.

Level 3 Browser

Browse the entire Level 3 global ocean color data set for many parameters and time periods and download either JPEG images or digital data in HDF format.

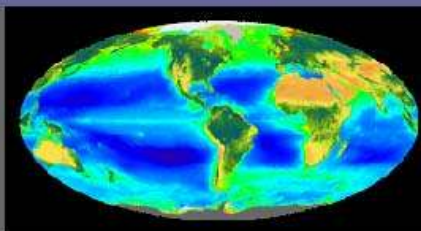
Oceans FTP Site

The Oceans FTP site contains the most recent 10 days worth of all MODIS/Aqua data and products, as well as the complete Level 3 mapped data archive.

GES DAAC

The GES DAAC hosts the recently reprocessed MODIS/Terra ocean color data, the SeaWiFS, OCTS, and CZCS data sets and Terra and Aqua SST data (in conventional MODIS format).

Latest News



Welcome to the new OceanColor Web. This site is intended to serve as the entry point into all of NASA's ocean color-related activities as part of the [evolution of the individual ocean mission-based activities](#) into an integrated ocean measurement-based program.

We have just begun the process of integrating the various mission-specific services, information, and documentation that have been developed over a number of years, so we expect that this website will be evolving quite rapidly. We encourage everyone to use the online forum, which is linked through the [Questions](#) button above, to provide feedback, ask questions and offer suggestions.

[Subscribe: Ocean Mailing List](#)

Support Services

SeaDAS

SeaDAS is a comprehensive image analysis package for the processing, display, analysis, and quality control of ocean color data

SeaBASS

SeaBASS is an archive of in situ oceanographic and atmospheric data used for algorithm development and satellite validation.

Cruise Support Services

Overflight predictions;
Near real-time imagery and data for cruise support.

MQABI

MODIS (Ocean) Quality Assurance Browse Imagery Tool that allows access to MODIS Sea Surface Temperature products and statistics



online repository for anonymous ftp downloads containing:

- 1- the most recent 10 days of ALL MODIS/AQUA products
- 2- the complete Level-3 mission archive at multiple time/space resolutions
- 3- the complete ancillary met/ozone data and attitude and ephemeris

MODIS/Aqua data available within hours of observation

oceans.gsfc.nasa.gov

Anonymous access granted, restrictions apply.

Path: [oceans.gsfc.nasa.gov]

Name	Size	Kind	Last Modified
Aqua SMI	-	Folder	Wed, Jan 28, 2004, 3:29 AM
METOZ	-	Folder	Tue, Feb 3, 2004, 7:56 PM
MODISA	-	Folder	Wed, Feb 4, 2004, 6:51 PM
README	2K	Text Readme	Wed, Feb 4, 2004, 8:09 PM
Recent Aqua	-	Folder	Tue, Feb 10, 2004, 5:30 AM
Recent Aqua Night	-	Folder	Tue, Feb 10, 2004, 5:31 AM

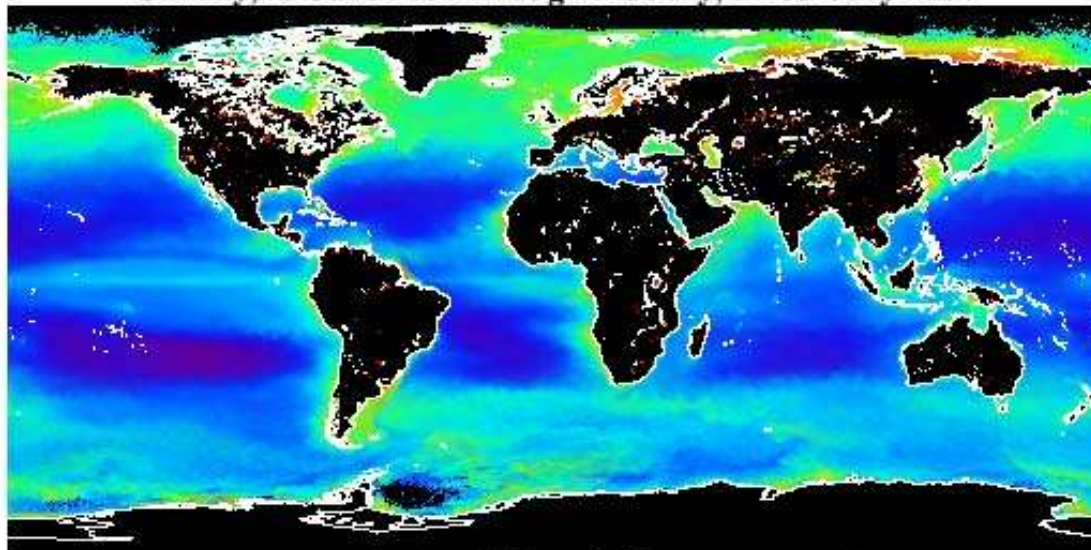
Multi-Mission Browse and Order Page - Showing navigation tools

Selection = Full MODIS/Aqua Mission - Chlorophyll

Navigation icons: Home, Back, Forward, Search, SST, Color palette

SeaWiFS
 GAC LAC HRPT MLAC
 MODIS (Aqua)

Sunday, 23 June 2002 through Monday, 9 February 2004



Chlorophyll

Comment

Help

Select one or more regions:

- AdriaticSea
- AegeanSea
- Antarctica
- ArabianSea
- AralSea
- Australia
- Azores

or specify boundary coordinates or a single location:

N:
 W: : E
 S:

or check this box to select all of this time period's scenes.

Find swaths

Reconfigure page

Radius (km) about map click or typed-in location:

36 400 800 1200 1500

Select swaths containing (at least):

any part 25 % 50 % 75 % all of the area of interest.

Display results at a time.

Mission	2002	J	F	M	A	M	J	J	A	S	O	N	D
	2003	J	F	M	A	M	J	J	A	S	O	N	D
	2004	J	F	M	A	M	J	J	A	S	O	N	D

December 2003						
S	M	T	W	T	F	S
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
	***	***	xxx	xxx	xxx	xxx
	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>
	xxx	xxx	xxx	xxx	^^^	^^^
	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>
	^^^	^^^	^^^	^^^	^^^	000
	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>
	000	000	000	000	000	000
	<u>28</u>	<u>29</u>	<u>30</u>	<u>31</u>		
	***	***	***	***		

January 2004						
S	M	T	W	T	F	S
				<u>1</u>	<u>2</u>	<u>3</u>
				000	000	000
	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>
	000	000	000	000	000	000
	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>
	***	***	***	***	***	***
	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>
	xxx	xxx	xxx	xxx	xxx	xxx
	<u>25</u>	<u>26</u>	<u>27</u>	<u>28</u>	<u>29</u>	<u>30</u>
	^^^	^^^	^^^	^^^	^^^	^^^

February 2004						
S	M	T	W	T	F	S
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
	^^^	000	000	000	000	000
	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>
	000	000	***	***	***	***
	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>
	***	***	***	xxx	xxx	xxx
	<u>22</u>	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>
	xxx	xxx	xxx	xxx	^^^	^^^
	<u>29</u>					
	^^^					

Selection = Single Day MODIS/Aqua Mission - Sea Surface Temperature

For next screen, click on map near Central America

Navigation icons: Home, Back, Forward, Home, CHL, SST, Color palette

- GAC
- SeaWiFS
- LAC
- HRPT
- MLAC
- MODIS (Aqua)

Radius (km) about map click or typed-in location:

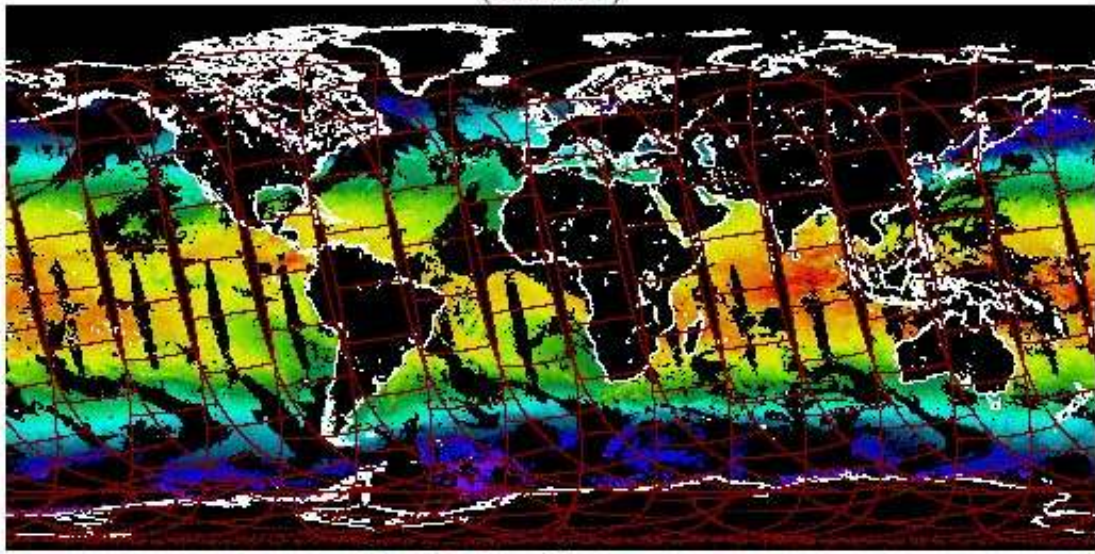
36 400 800 1200 1500

Select swaths containing (at least):

any part 25 % 50 % 75 % all of the area of interest.

Display results at a time.

Saturday, 7 February 2004
(2004038)



Sea Surface Temperature

Comment

Select one or more regions:

- AdriaticSea
- AegeanSea
- Antarctica
- ArabianSea
- AralSea
- Australia
- Azores

or specify boundary coordinates of single location:

N:

W: : E

S:

or check this box to select all this time period's scenes.

Mission	2002	J	F	M	A	M	J	J	A	S	O	N	D
	2003	J	F	M	A	M	J	J	A	S	O	N	D
	2004	J	F	M	A	M	J	J	A	S	O	N	D

December 2003						
S	M	T	W	T	F	S
	1	2	3	4	5	6
	***	***	xxx	xxx	xxx	xxx
	7	8	9	10	11	12
	xxx	xxx	xxx	xxx	^^^	^^^
	13	14	15	16	17	18
	^^^	^^^	^^^	^^^	^^^	000
	19	20	21	22	23	24
	000	000	000	000	000	000
	25	26	27	28	29	30
	000	000	000	000	000	000
	31					



January 2004						
S	M	T	W	T	F	S
				1	2	3
				000	000	000
	4	5	6	7	8	9
	000	000	000	000	000	000
	10	11	12	13	14	15
	000	000	000	000	000	000
	16	17	18	19	20	21
	000	000	000	000	000	000
	22	23	24	25	26	27
	000	000	000	000	000	000
	28	29	30	31		
	^^^	^^^	^^^	^^^	^^^	^^^

February 2004						
S	M	T	W	T	F	S
	1	2	3	4	5	6
	^^^	000	000	000	000	000
	7	8	9	10	11	12
	000	000	000	000	000	000
	13	14	15	16	17	18
	000	000	000	000	000	000
	19	20	21	22	23	24
	000	000	000	000	000	000
	25	26	27	28	29	30
	000	000	000	000	000	000
	31					
	^^^					

Single file (level-1 or level-2) browse and download page

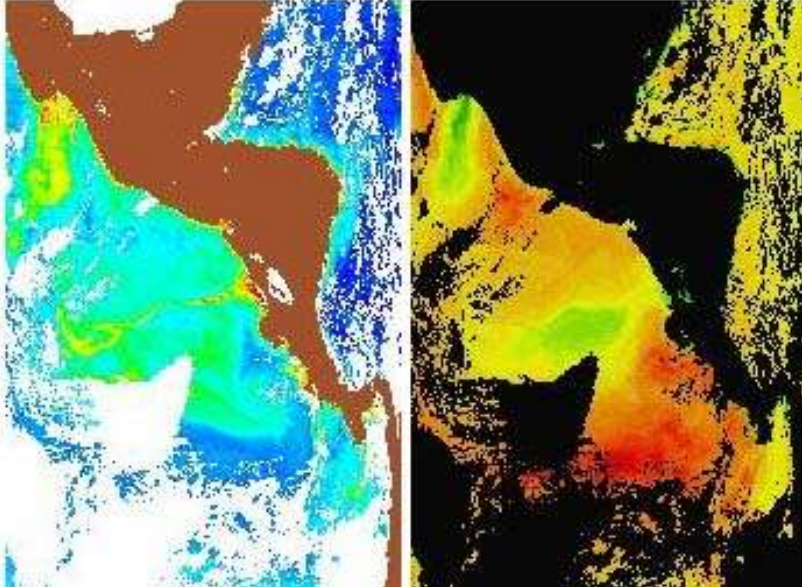
From this page one can directly download the compressed data Files in either level-1 or level-2 format as well as the supporting documentation.

The next example shows how to order all the files acquired over a week covering a given geographic region.

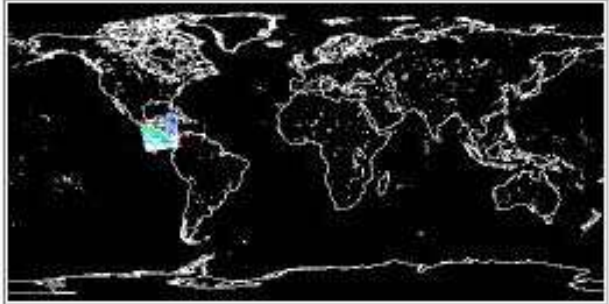
Navigation icons:  TO CHL SST 

[A2004038191500.L1A_LAC](#) 50,998,234 bytes
[A2004038191500.L2_LAC](#) 20,472,527 bytes
(The above hyperlinks point to [bzip2-compressed HDF files](#).
Documentation on these **prototype** products can be found [HERE](#).)

Chlorophyll **Sea Surface Temperature**



Comment **Help**

Saturday, 7 February 2004
2004038


Search Criteria
Time Period: Saturday, 7 February 2004
Sensors: MODIS(Aqua)
Area of Interest: Within 36 km of 16.5N,90.4W
Percentage of AOI that swaths must include: Any part

Number of swaths: 1 swath found

Selection = Eight Day MODIS/Aqua Mission

Next Screen: select ALL the Aqua files that cover east coast of the United States during this period by clicking on the map

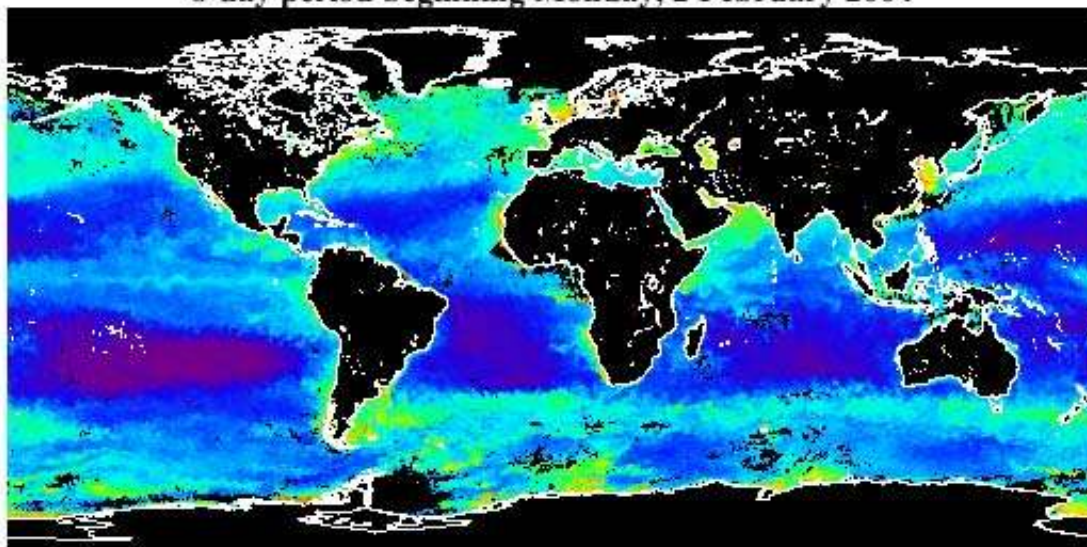


SeaWiFS

GAC LAC HRPT MLAC

MODIS (Aqua)

8-day period beginning Monday, 2 February 2004



Chlorophyll

Radius (km) about map click or typed-in location:

36 400 800 1200 1500

Select swaths containing (at least):

any part 25% 50% 75% all of the area of interest.

Display results at a time.

Comment

Help

Select one or more regions:

- AdriaticSea
- AegeanSea
- Antarctica
- ArabianSea
- AralSea
- Australia
- Azores

or specify boundary coordinates or a single location:

N:

W: : E

S:

or check this box to select all of this time period's scenes.

Mission	2002	J	F	M	A	M	J	J	A	S	O	N	D
	2003	J	F	M	A	M	J	J	A	S	O	N	D
	2004	J	F	M	A	M	J	J	A	S	O	N	D




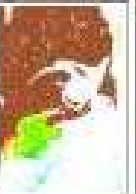
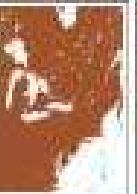

December 2003						
S	M	T	W	T	F	S
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
	***	***	xxx	xxx	xxx	xxx
	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>
	xxx	xxx	xxx	xxx	^^^	^^^
	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>
	^^^	^^^	^^^	^^^	^^^	000
	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>
	000	000	000	000	000	***
	<u>28</u>	<u>29</u>	<u>30</u>	<u>31</u>		
	***	***	***	***		

January 2004						
S	M	T	W	T	F	S
				<u>1</u>	<u>2</u>	<u>3</u>
				000	000	000
	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>
	000	000	000	000	000	***
	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>
	***	***	***	***	***	***
	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>
	xxx	xxx	xxx	xxx	xxx	xxx
	<u>25</u>	<u>26</u>	<u>27</u>	<u>28</u>	<u>29</u>	<u>30</u>
	^^^	^^^	^^^	^^^	^^^	^^^

February 2004						
S	M	T	W	T	F	S
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
^^^	000	000	000	000	000	000
<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>
000	000	***	***	***	***	***
<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>
***	***	***	xxx	xxx	xxx	xxx
<u>22</u>	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>	<u>28</u>
xxx	xxx	xxx	xxx	^^^	^^^	^^^
<u>29</u>						
^^^						

These are all the Aqua files that covered the geographic region you Chose during the first 8 day period in February 2004. You can individually select which files you may want to order by clicking on the little box above the image (based on coverage, cloud cover, etc.) or just order them all.

▲ < > ☺ TC CHL SST  Display at a time.
 ORDER DATA
Comment
Help

↵ A2004039182500.L2 LAC		↵ A2004036175500.L2 LAC		↵ A2004033172500.L2 LAC					
		↵ A2004037184000.L2 LAC		↵ A2004035171500.L2 LAC					
8Feb2004	7Feb2004	6Feb2004		5Feb2004	4Feb2004		3Feb2004	2Feb2004	
****	****	****	****	****	****	****	****	****	
									
		↵ A2004038174500.L2 LAC		↵ A2004035185000.L2 LAC					
		↵ A2004037170000.L2 LAC		↵ A2004034181000.L2 LAC					

Search Criteria

Time Period: 8-day period beginning Monday, 2 February 2004

Sensors: MODIS(Aqua)

Area of Interest: Within 36 km of 39.7N,74.2W

Percentage of AOI that swaths must include: Any part

Number of swaths: 1st through 9th of 9 swaths

Choose which products you want and what level of interaction with the ordering system you prefer.



Comment

Help

Enter your email address.

gene.c.feldman@nasa.gov

Pick which data products you want for your selected scenes.

- Level 1
- Level 2
- Meteorology & Ozone
- Attitude & Ephemeris

- Remind me when my order is about to expire.
- Require my email confirmation for early file deletion.
- Notify me when my data have been deleted from the staging area.

Review order

Review your order and if correct, submit it. In a few minutes after you submit Your order, you will receive an automated confirmation message from the Ordering system that by replying to, will trigger your order to be filled. Currently, orders are staged within 3-5 minutes after confirmation.



[Comment](#)

[Help](#)

You are about to order the following 18 files from the SeaWiFS Data Processing System.

A2004039182500.L1A_LAC	A2004037184000.L1A_LAC	A2004036175500.L1A_LAC	A2004035171500.L1A_LAC	A2004034181000.L2_LAC
A2004039182500.L2_LAC	A2004037184000.L2_LAC	A2004036175500.L2_LAC	A2004035171500.L2_LAC	A2004033172500.L1A_LAC
A2004038174500.L1A_LAC	A2004037170000.L1A_LAC	A2004035185000.L1A_LAC	A2004034181000.L1A_LAC	A2004033172500.L2_LAC
A2004038174500.L2_LAC	A2004037170000.L2_LAC	A2004035185000.L2_LAC		

The total volume of the above files (*in the compressed form in which they are stored in our archive*) is **475,250,680** bytes.

You are also about to order the ancillary data (*Meteorology & Ozone and Attitude & Ephemeris*) that correspond to the scenes in your search results.

You **do** wish to be reminded by email when your order is about to expire, and you **do** require email confirmation when you use the Web to request early deletion of your staged order, and you **do** wish to be notified when your order has been deleted from our staging area.

The email address you have entered is **gene.c.feldman@nasa.gov**.

If all this information is correct and you wish to submit your order to be filled, then click the "Submit order" button below.

[Submit order](#)

Work in Progress

- Frequent reprocessing for evaluation (80-100x processing capacity)
- Running various sensitivity analyses over temporal subset of MODIS/Aqua mission.
 - Various polarization correction approaches
 - Various BRDF correction options
 - Various Level-1B LUT approaches (working closely with MCST personnel)
- Additional distribution options (parameter and geographic subsetting, subscriptions)



<http://oceancolor.gsfc.nasa.gov/>

Data Browse and Order

Data Products and Format Information

SeaDAS Display and Processing Software

Ocean Color Mailing List Subscription

User Forums for Q & A

Calibration & Validation Information

Extra Slides

Some issues raised in recent calibration reviews reflect a difficulty in separating changes in instrument from changes in SD measurements.

Challenging Issues and Concerns

- BRF error's impact on RSB calibration
- Instrument and focal plane temperature effects
- On-orbit RVS characterization limits
- Polarization (SBRs/MCST/Miami)
- SD screen vignetting effect – observations and simulation results (Xiong/Waluschka)
- Scattering (SBRs/Waluschka)
- Earth shine (Wolfe)
- Calibration (detector's response) stability

MODIS Oceans Calibration

- **MCST pre-launch calibration**
 - DN to reflectance, temperature corrections, response versus scan angle (RVS)
- **MCST on-orbit calibration (solar, lunar, srca)**
 - time dependent gains
 - RVS adjustments
 - detector normalization (destriping)
- **RSMAS (Univ. of Miami) vicarious calibration**
 - time dependent gains, offsets to match water-leaving radiances from MOBY
 - time dependent RVS correction, detector normalization, mirror-side correction by flat-fielding near Hawaii.

MODIS Calibration Issues

Class 1: Potential Level-1 calibration coefficient sources of error

- Excess radiance on the MODIS solar diffuser (SD) due to Earthshine
- Excess radiance on the MODIS SD due to uncertainties in attenuation screen
- Uncertainty in the SD bi-directional reflectance (BRF) correction
- Uncertainties in the focal plane temperature corrections

Class 2: Maintaining calibration intra-orbit and inter-season

- Stray light in the optical path from Earth view
- Detector-based temperature correction estimates
- **Changing polarization sensitivity**
- Uncertainties in the focal plane temperature correction

Differences from MODAPS Processing

Processing Algorithms

- SeaWiFS Level-2 and Level-3 processing software applied.
- Updated polarization sensitivity tables.
- Minimal BRDF correction (no f/Q).
- Alternate NIR water-leaving radiance correction (Arnone & Stumpf rather than Seigel).
- Additional correction of nLw for out-of-band response.
- Reduced aerosol model suite (12 models).
- Glint correction (SeaWiFS algorithm + polarization terms).
- Whitecap correction (SeaWiFS algorithm).
- Different solar irradiance model (Thuillier 2003).
- No NIR smoothing.

Simplified RSMAS Calibration Model (RADCOR)

only what is active for ocean color

$$L'(b,d,p,t) = [L(b,d,p,t) - O_v(b,t)] G_v(b,t) G_d(b,d,t) G_r(b,m,p,t)$$

where:

O_v is the vicarious offset

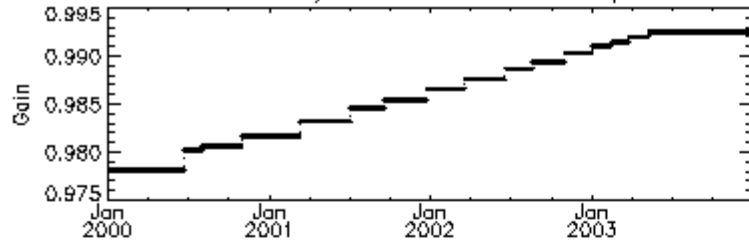
G_v is the vicarious gain

G_d is the detector relative gain (destriping)

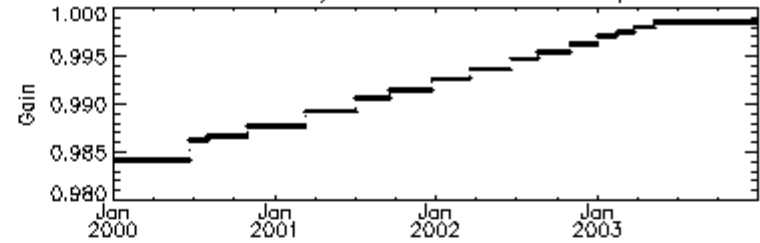
G_r is the RVS adjustment

b=band, d=detector, m=mirror-side, p=scan-pixel, t=time

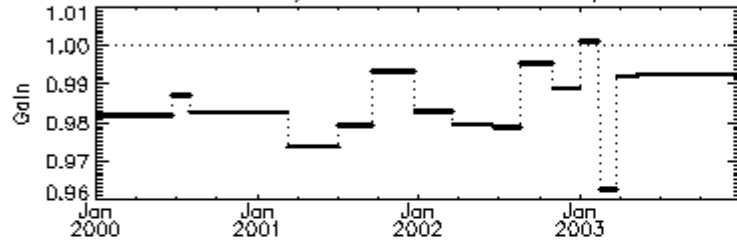
Vicarious Gain, Radcor terra_21_19sx, Band 8



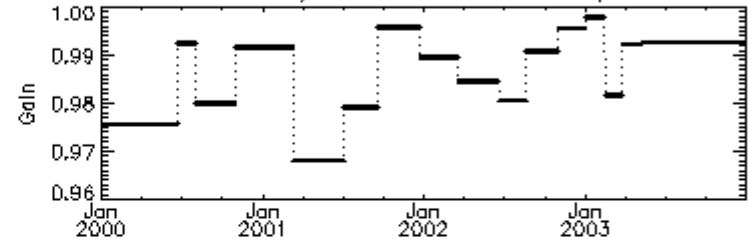
Vicarious Gain, Radcor terra_21_19sx, Band 9



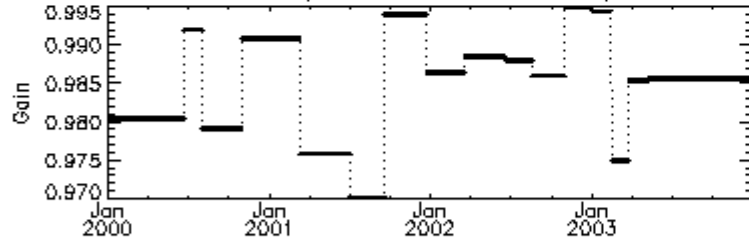
Vicarious Gain, Radcor terra_21_19sx, Band 10



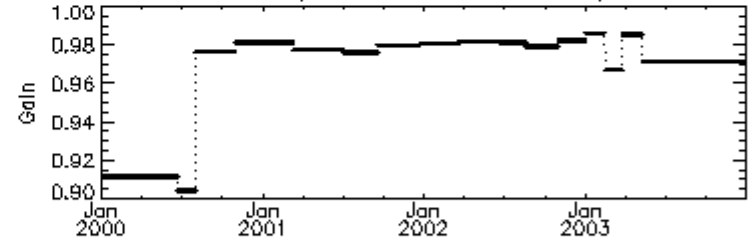
Vicarious Gain, Radcor terra_21_19sx, Band 11



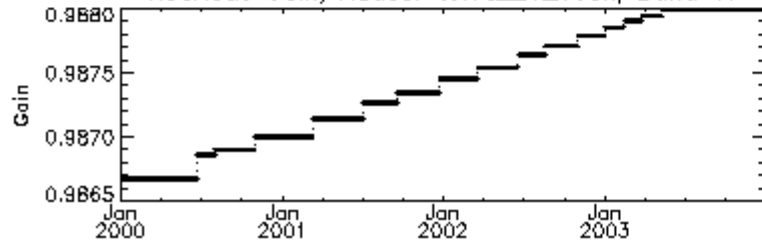
Vicarious Gain, Radcor terra_21_19sx, Band 12



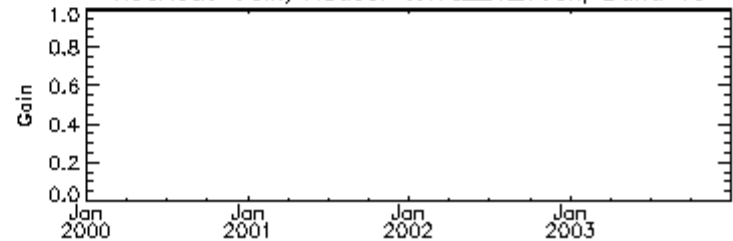
Vicarious Gain, Radcor terra_21_19sx, Band 13

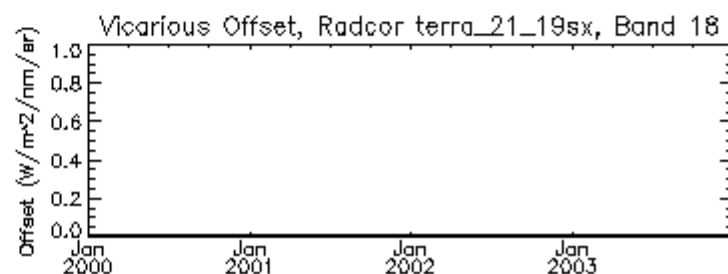
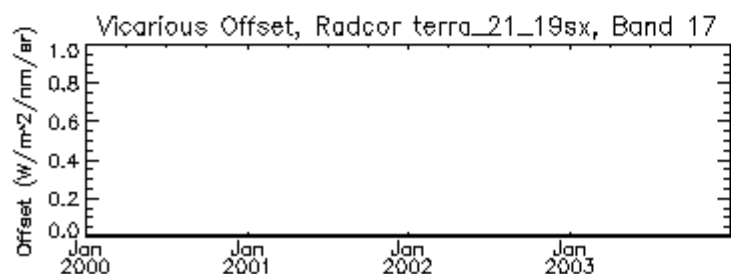
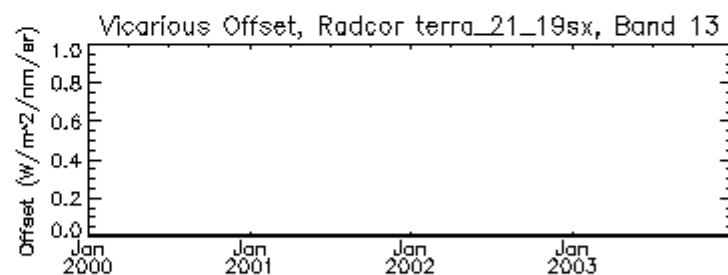
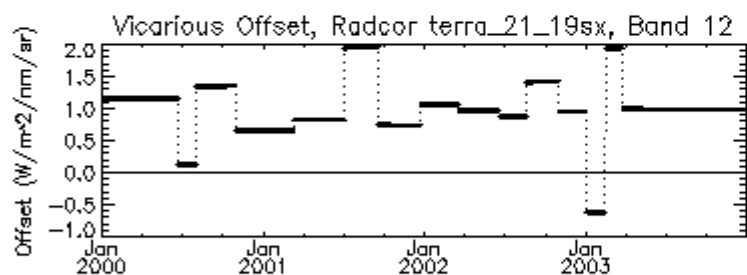
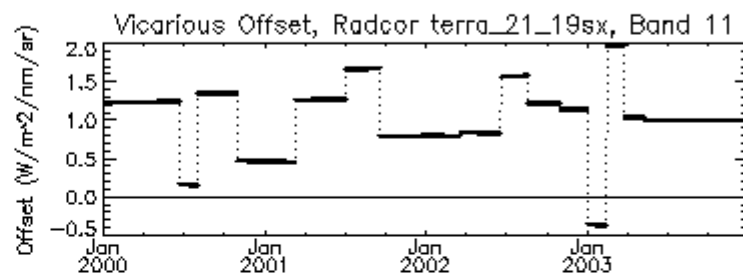
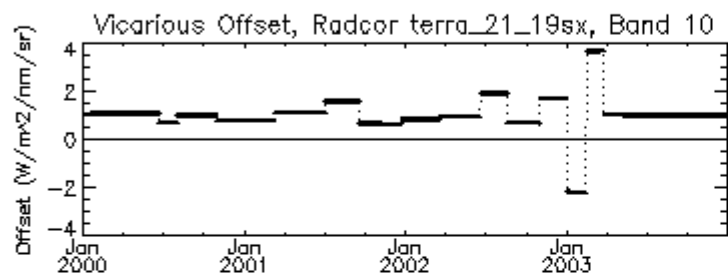
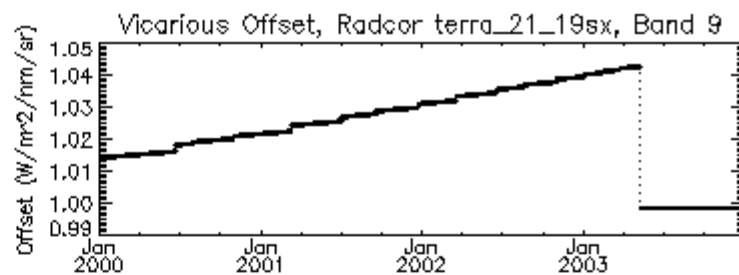
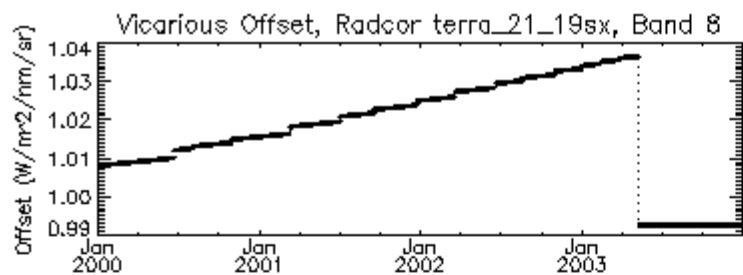


Vicarious Gain, Radcor terra_21_19sx, Band 17



Vicarious Gain, Radcor terra_21_19sx, Band 18



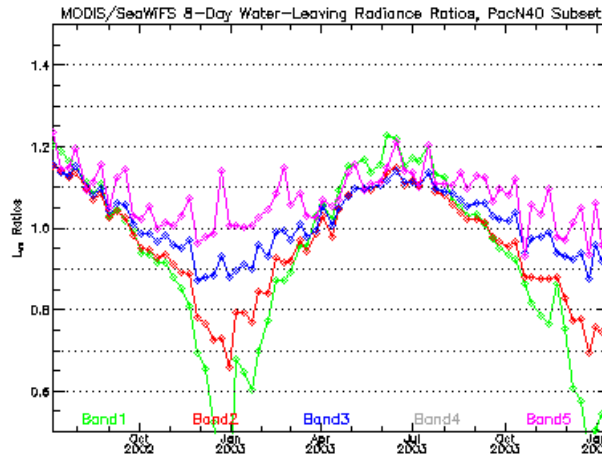


MODIS/SeaWiFS nLw Ratios

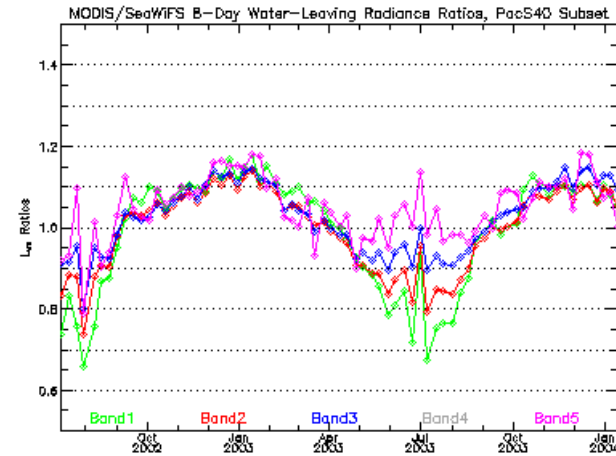
Zonal Pacific Subsets (150-170W), 8-Day Means

**Aqua
ODPS
Repro 1**

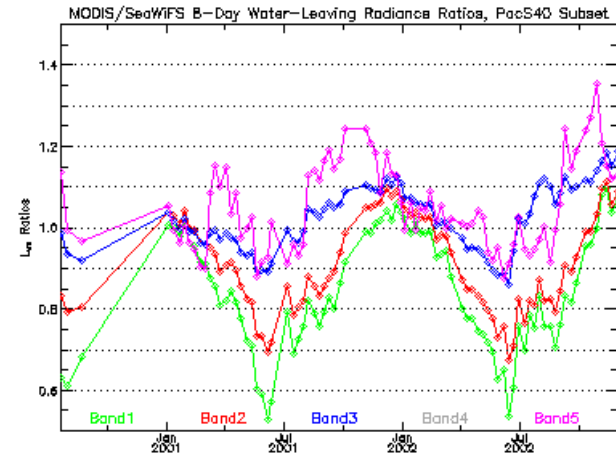
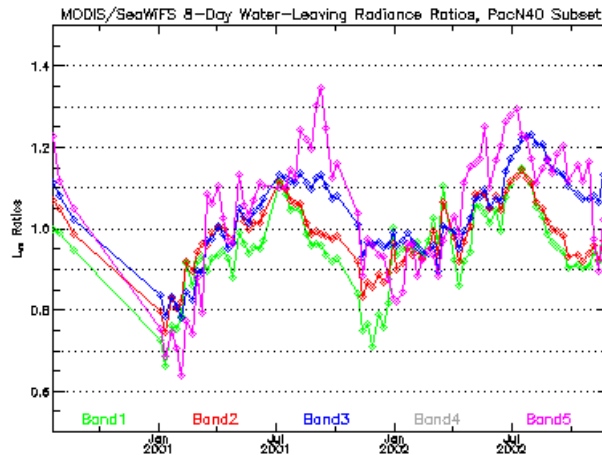
30N to 40N Latitude



30S to 40S Latitude



**Terra
MODAPS
Collection 4.1**



Magnitude and phase of high-latitude differences are very similar for MODIS/Terra (MODAPS) and MODIS/Aqua (ODPS).