Navy NPOESS/VIIRS SST Validation

1) Define a VIIRS Proxy Data Stream

2) Define the required in situ data

3) Tuning of algorithms and LUTS (Vicarious

4) Ocean Algorithm, stability evaluation and

5) Product validation and product long-term

6) Satellite inter-comparisons, robustness,

Presenter/Affiliation: Doug May / NAVOCEANO

Performers: May, McKenzie, Cayula, Lakin

Thrust area: 1, 4, 5

Award date: Summer 2009

Total Man-Months Effort:

FY09	FY10	FY11
• 5.5	7	7

Navy NPP/VIIRS SST Validation

Project Objectives

-NPP will replace NOAA POES satellites (N-18 and N-19)
-Need to determine the potential of VIIRS to meet operational SST requirements
-Can VIIRS replace AVHRR for operational users?
-Since VIIRS will be similar to MODIS, evaluate MODIS and proxy VIIRS data

Major FY09 Challenges/Issues

-Implement MOVICON proxy VIIRS generation software
-Moved operational and test sw to new hw Nov09 – Mar10

Milestones / Deliverables

		FY 09 1 2 3 4	FY10 1 2 3 4	FY11 1 2 3 4
1.	MODIS SST	2		
2.	Proxy VIIRS		2	
3.	VIIRS Seatemp		3	

Major Progress

-Support proxy VIIRS data development
-Evaluate SST algs using VIIRS proxy data
-Demonstrate real time continuity of SST products

Navy NPP/VIIRS SST Validation

Collaboration and Coordination with Inside and Outside Activities

NRL-Stennis: Arnone, Vaughan
U. Miami: Evans, Minnett
NESDIS: Ignatov
U. Colorado: Emery, Baldwin
IPO: Zajic

Transition Partners

NAVO – NP3- MCSST
IPO - GRAVITE

Leveraged RDT&E Projects

Examples: Leveraged RDT&E Projects

6.4 NRL – Ocean Surface Layer
6.4 NRL – NPOESS Readiness

International Partnerships

GHRSST

Navy NPP/VIIRS SST Validation

FY 09- MILESTONES Completed In Progress

Goal – Reduce the risk associated with modifying MCSST software to process NPP VIIRS data.

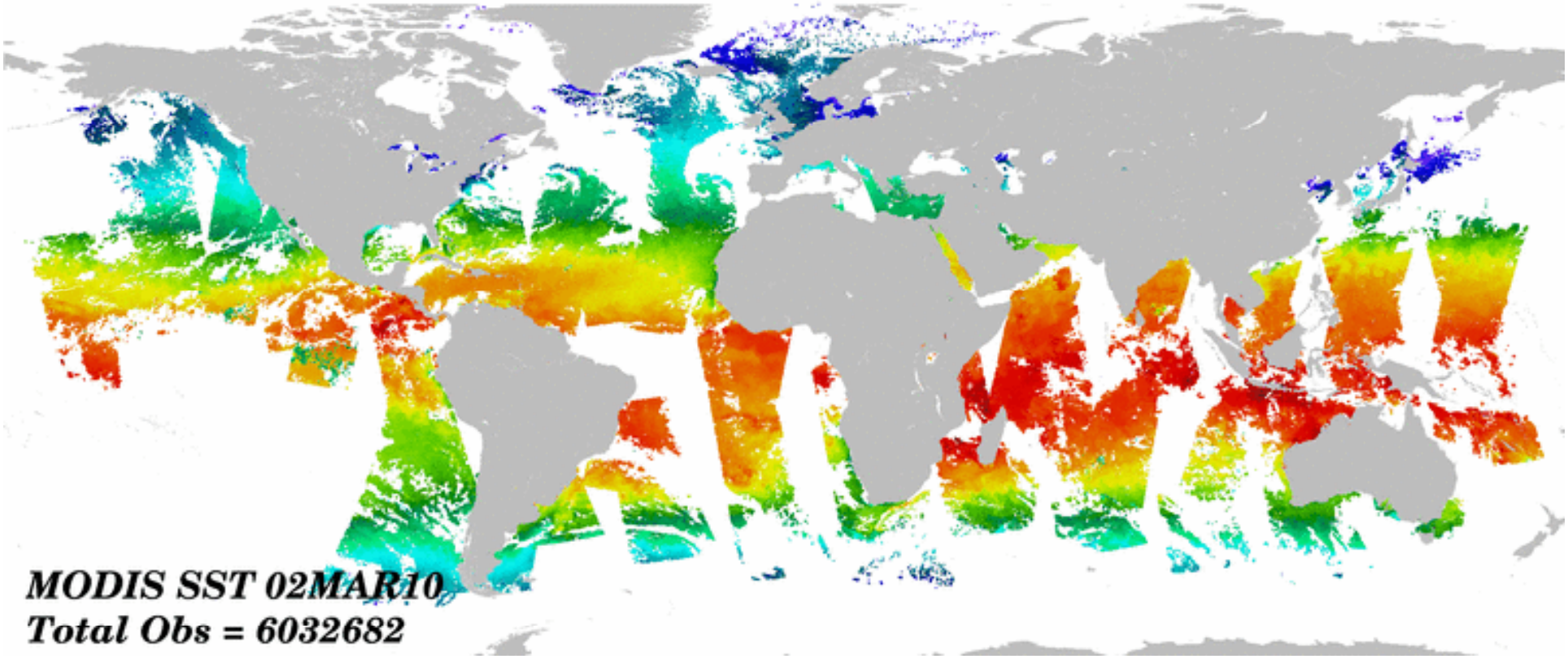
- **Evaluate accuracy of MODIS within NAVOCEANO Seatemp cloud detection and SST algorithm approach.**
- **Establish real-time proxy VIIRS data stream production from MODIS data**
- **Integrate proxy VIIRS data into Seatemp cloud detection and SST algorithm approach and also the supplied cloud mask information**
- **Integrate proxy VIIRS SST into the automated global drifting buoy data matchup process**
- **Attend and participate in NPOESS Central Forum, VOAT and VIIRS ocean cal/val meetings**

Navy NPP/VIIRS SST Validation

Milestone 1: Evaluate accuracy of MODIS using NAVO Seatemp cloud detection and SST algorithm approach

- Modified NAVO AVHRR Seatemp MCSST software to read MODIS HDF4 data files
- Modified cloud detection tests to account for differing channel scaling, offsets and noise associated with the MODIS instrument.
- Computed new coefficients for NLSST and MCSST equations using MODIS channels in the 3, 11 and 12 um bands.
- Matched MODIS SST retrievals to buoy SST measurements and evaluated results.

Navy NPP/VIIRS SST Validation



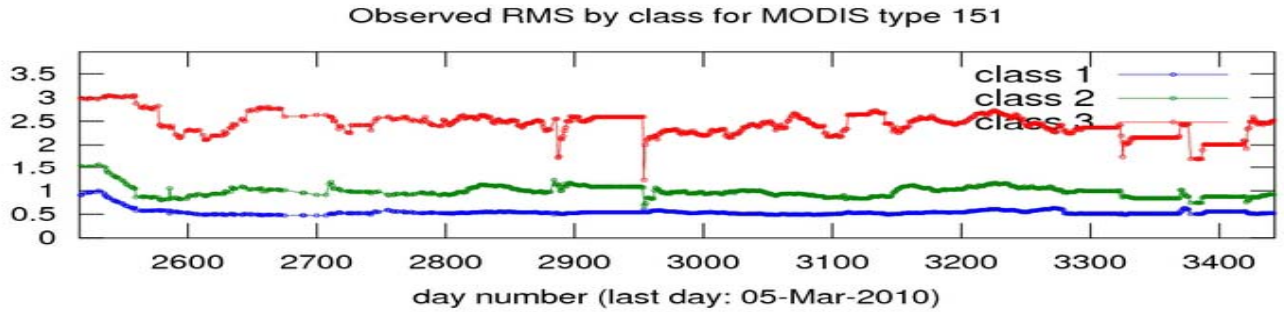
NAVOCEANO obtains MODIS SDR files in near real time each day from the NASA/NOAA Near Real Time Processing Effort (NRTPE).

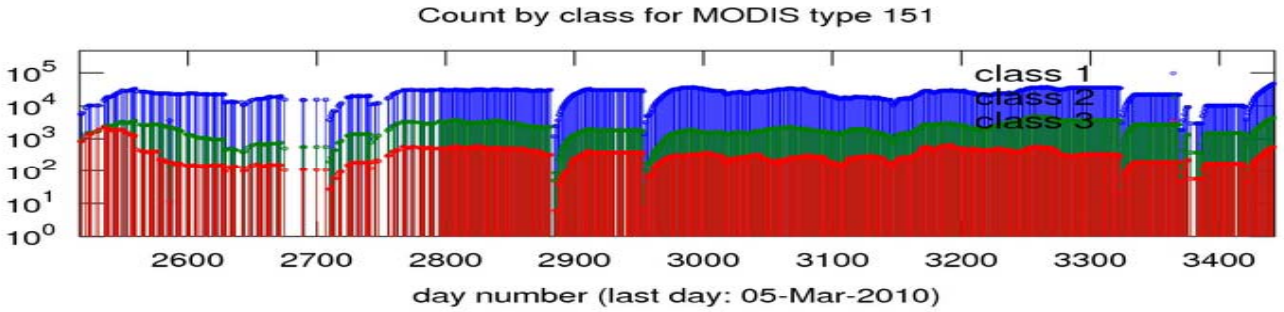
Navy NPP/VIIRS SST Validation

- Included MODIS SST results in buoy matchup error metrics processing
  - Matching MODIS SST to buoy SST within 4 hrs and 25km
  - Calculations performed for various Categories of data reliability (Category 1=Clear, Category 2=Probably Clear, Category 3=Questionable)
    - Categories determined by cloud detection test proximity to failure results

Navy NPP/VIIRS SST Validation

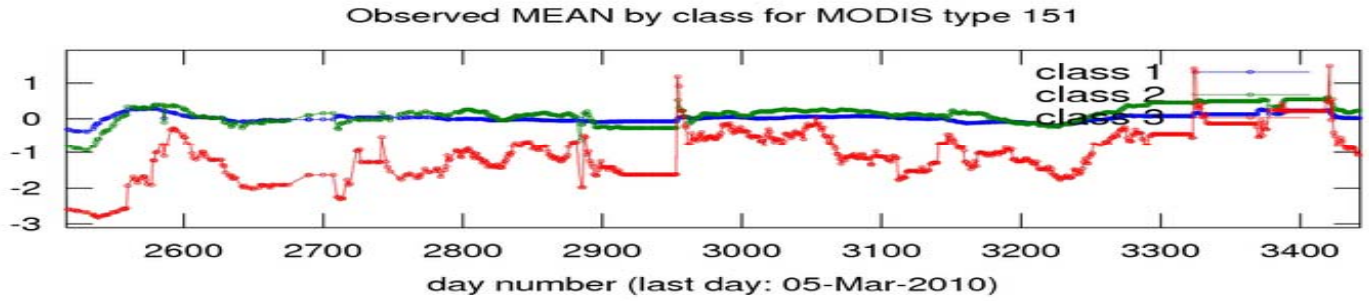
- Daytime Results
  - Category 1 (90% of daytime data) RMS = .52
  - Category 2 RMS = .92
  - Category 3 RMS = 2.51

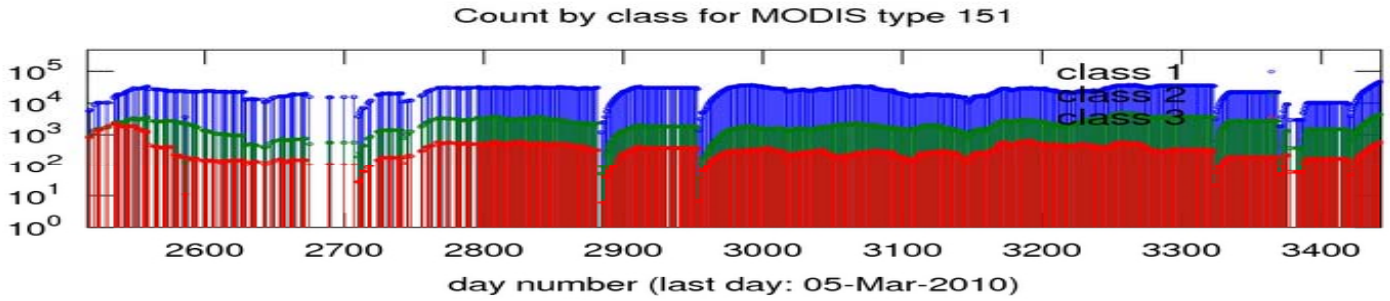




Navy NPP/VIIRS SST Validation

- Daytime Results
  - Category 1 (90% of daytime data) Bias = .02
  - Category 2 Bias = .23
  - Category 3 Bias = -1.07





Navy NPP/VIIRS SST Validation

- VIIRS SST System Specification requires:
  - Bias < 0.1 RMS < .50
- MODIS Category 1 Daytime SST data has the potential to meet the System Specification requirements

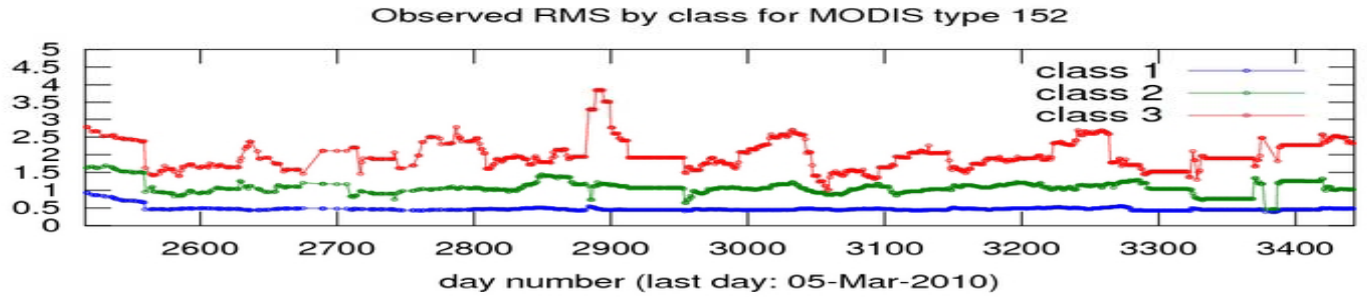
Navy NPP/VIIRS SST Validation

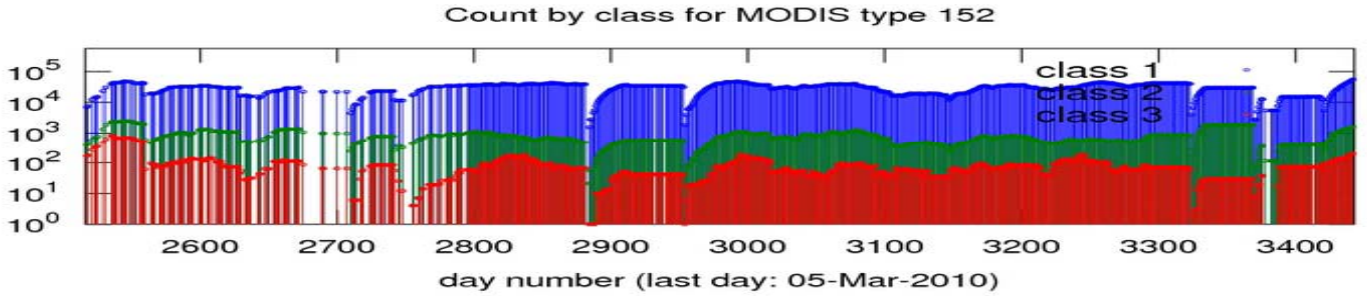
- Comparison to other satellite daytime data sources:

Satellite	Category 1 RMS
N-18 GAC	.42
N-19 GAC	.42
METOP GAC	.40
N-19 LAC	.49
METOP FRAC	.46
AMSR-E	.58
AATSR	.54
GOES-11	.46
GOES-12	.43
MSG	.62

Navy NPP/VIIRS SST Validation

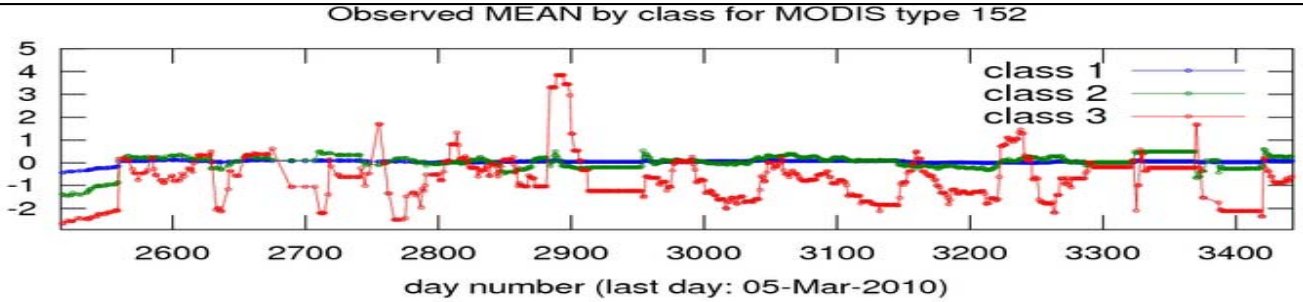
- Nighttime Results
  - Category 1 (97% of nighttime data) RMS = .48
  - Category 2 RMS = 1.02
  - Category 3 RMS = 2.32

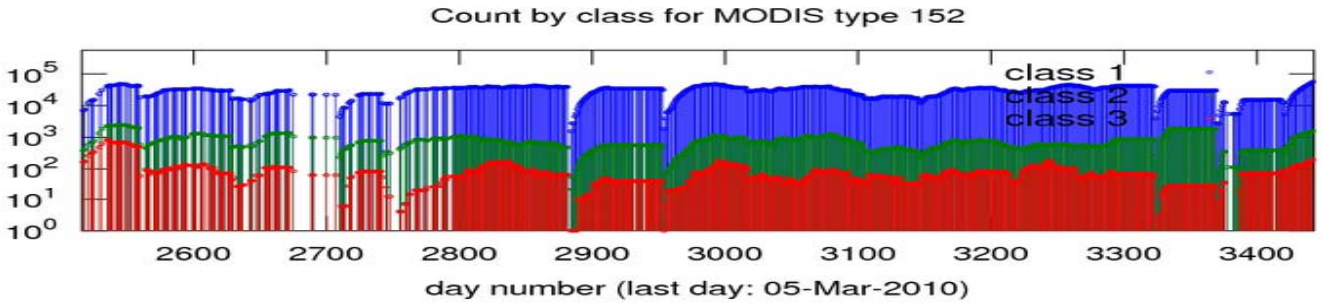




Navy NPP/VIIRS SST Validation

- Nighttime Results
  - Category 1 (97% of nighttime data) Bias = .09
  - Category 2 Bias = .28
  - Category 3 Bias = -.64





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Navy NPP/VIIRS SST Validation

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MSG	.62

Navy NPP/VIIRS SST Validation

Milestone 2: Establish real time proxy VIIRS data stream production from MODIS data

- **GRAVITE provided latest version of proxy generation software (MOVICON)**
  - **Formats MODIS into VIIRS hdf5 format**
  - **MODIS data converted to VIIRs spatial resolution**
  - **No spectral interpolation calculated yet**
- **Completed capability to automatically run MOVICON on real-time MODIS data stream and convert into proxy VIIRS data in HDF5 format (Jan 2010)**

Navy NPP/VIIRS SST Validation

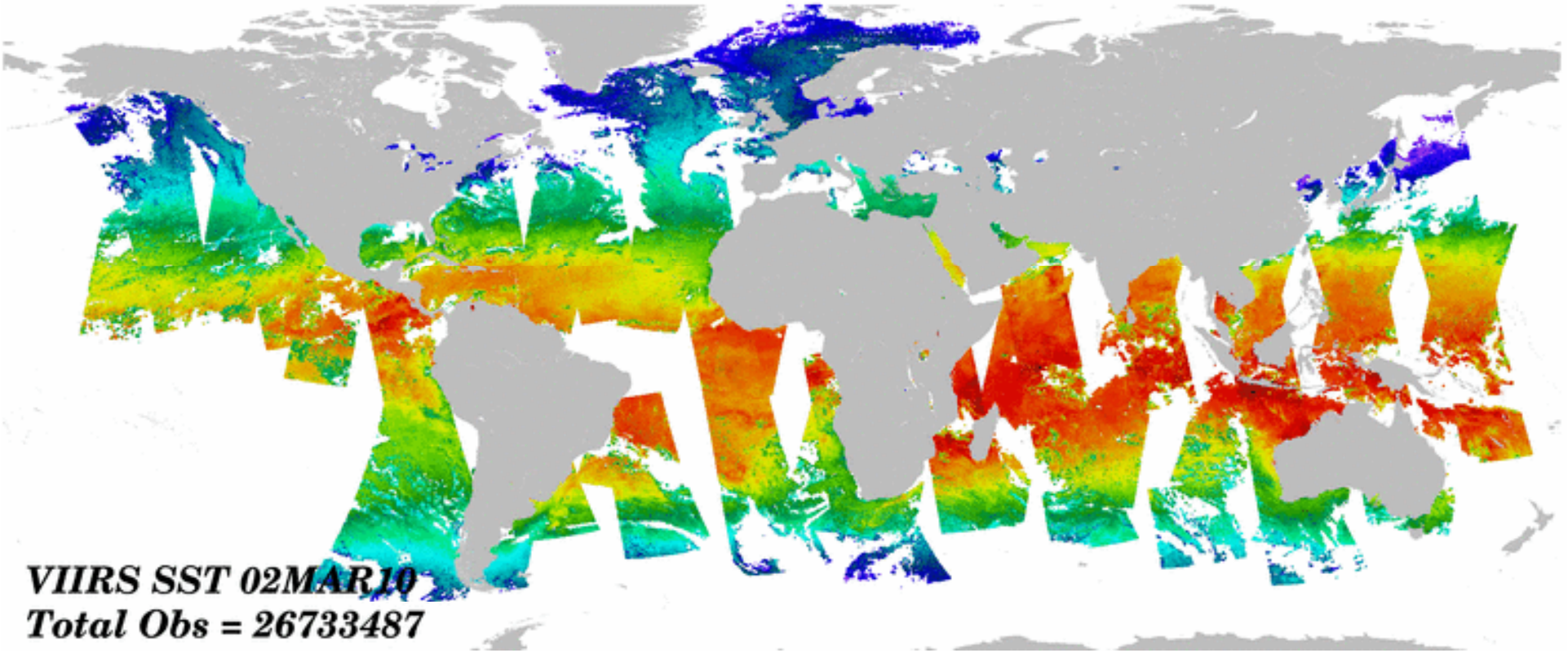
Milestone 3: Integrate proxy VIIRS data into Seatemp using Seatemp cloud detection and user supplied cloud detection

- **Implemented proxy VIIRS data into Seatemp Jan 2010.**
- **Waiting on user supplied cloud mask information to be provided within proxy VIIRS data**

Milestone 4: Integrate the proxy VIIRS SST data into the automated global drifting buoy matchup process

- **In progress**

Navy NPP/VIIRS SST Validation



Proxy VIIRS SST calculated using Seatemp cloud detection and algorithm approach.

Navy NPP/VIIRS SST Validation

Milestone 5: Participate in NPOESS Customer Forum, VOAT and ocean cal/val meetings

- Customer Forum is customer's primary vehicle to surface technical/programmatic issues to NPOESS management.
- NAVO participates to identify shortcomings that will impact delivery of NPOESS data/products.
  - E.g. communications, facilities, security, IA requirements, data formats and public release of sample data
- The VOAT is the vehicle to surface technical issues regarding the VIIRS sensor
- Ocean cal/val is the vehicle to establish and execute validation of the VIIRS sensor ocean products
- New JPSS program customer forum, VOAT?

Navy NPP/VIIRS SST Validation

FY 10- MILESTONES

1) Integrate next version of proxy VIIRS data set into the modified Seatemp software
2) Evaluate the proxy VIIRS bulk SST retrieval accuracy relative to global drifting buoy ground truth data and current AVHRR data
3) Investigate Seatemp cloud detection approach and modify procedures where necessary
4) Attend and participate in Central Forum, VOAT and VIIRS ocean cal/val meetings

Navy NPP/VIIRS SST Validation

Status and Issues:

- Deliverable: Report on accuracy of MODIS SST using NAVO Seatemp approach
  1. Ongoing. First report July 2009
  2. Development status: 95% complete
  3. Major technical issues and their impacts: None
- Deliverable: Demonstrate generation of proxy VIIRS data stream from near real-time MODIS data
  1. Accomplished Jan 2010
  2. Development status: 95% complete
  3. Major technical issues and their impacts: None

Navy NPP/VIIRS SST Validation

Summary : Impact of Deliverables on Program:

Determining the potential of VIIRS to meet operational SST requirements

Identifying which algorithm and cloud detection approaches have the best chance to meet operational requirements

Milestones coordinated with milestones from U. Miami, U. Colorado and NOAA/NESDIS milestones

Most operational accuracy issues should be known prior to launch by using proxy data. Access to real VIIRS data will determine further efforts required.

Navy NPP/VIIRS SST Validation
Schedule with Major Deliverables

Red background indicates delays and green indicates on or ahead of schedule (as compared to FY09 DD1498)

Title																				
Milestones	FY08				FY09				FY10				FY11				FY12			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Accuracy of NAVO Seatemp MODIS SST					S			R				R								
Establish proxy VIIRs data stream					S					D										
Integrate proxy VIIRS into NAVO seatemp							S			D			R							
Integrate proxy VIIRS into buoy matchup process									S			D			R					

Note: Timeliness of deliverables science and transition (i.e., documents/demo/software, etc). Indicate changes from FY09 1498 by highlighting original planned time in red. You can use this table legend:
S – Start, C – Complete, D – Demo, I-Issues, M - Manual/Documentation, R – Final Report, T- Transition

Navy NPP/VIIRS SST Validation

1) Define a VIIRS Proxy Data Stream

2) Define the required in situ data stream for Cal/Val

3) Tuning of algorithms and LUTS (Vicarious calibration and SDR feedback)

4) Ocean Algorithm, stability evaluation and uncertainty

5) Product validation and product long-term stability

6) Satellite inter-comparisons, robustness, seasonal and product stability

Questions ?