Execution Plans for a semi-automated system for Calibration and Validation of VIIRS ocean products.

Rehearsal Plans July 2011

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Introduction

NURC will support the execution plans for a semi-automated system for daily calibration and validation procedures for **Visible Infrared Imager Radiometer System (VIIRS)** ocean products. This system will be operationally in late 2011 (after the launch of VIIRS on the NPP satellite, October 2011). This presentation defines how NURC will contribute to the project; in particular we describe how the VIIRS ocean data will be processed and evaluated and what kind of support and products will be delivered. We also introduce on-going procedures and products that will be produced to evaluate and to monitor the NPP ocean EDR products and to provide feedback to the SDR team as to the accuracy of the ocean SDRs. VIIRS data will be pulled from NRL every day. The "clear" (cloud coverage < 10-15%) imagery will be archived and processed at NURC running a Matlab GUI that implements our techniques. Results from these analyses will be pushed back to SDR team that will be able to display and download products from our web site:

http://geos3.nurc.nato/VIIRS

The analysis will be focused on the following Golden Regions:

- **Aeronet-OC** sites (Venice and MVCO);
- **Moorings**: MOBY and Boussole;
- **Gyres.**

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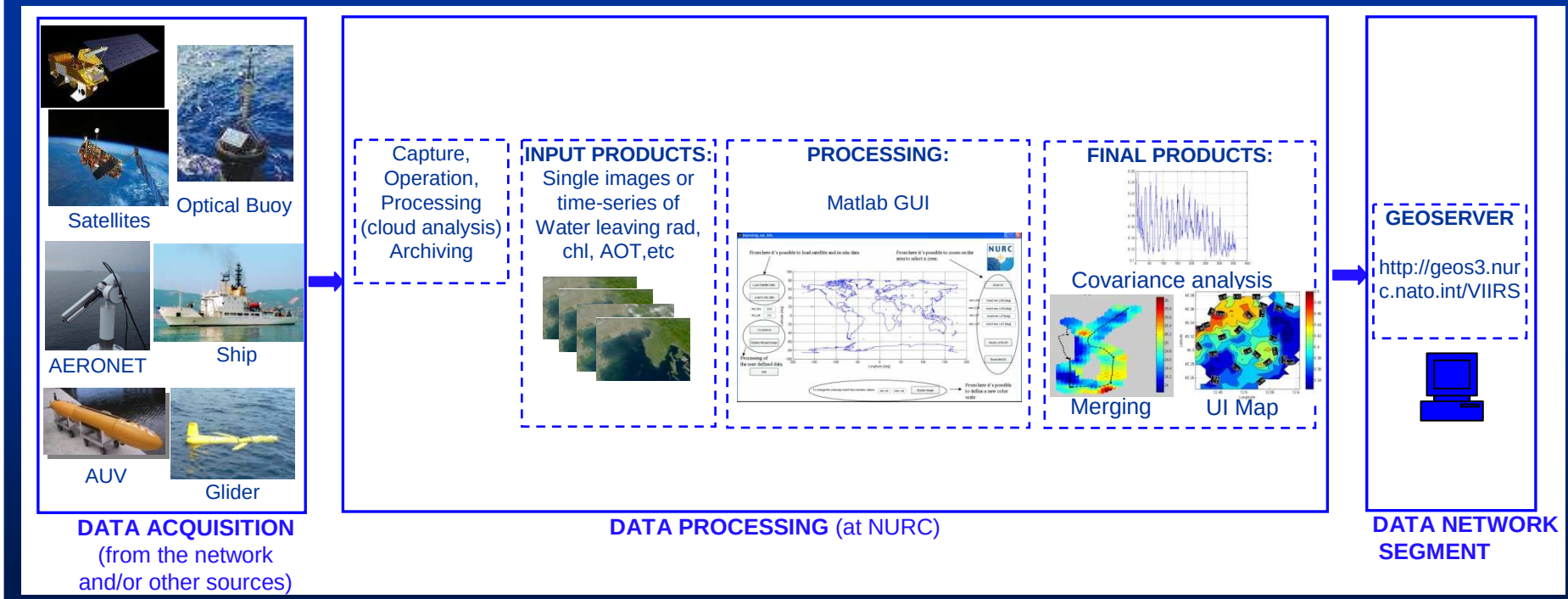
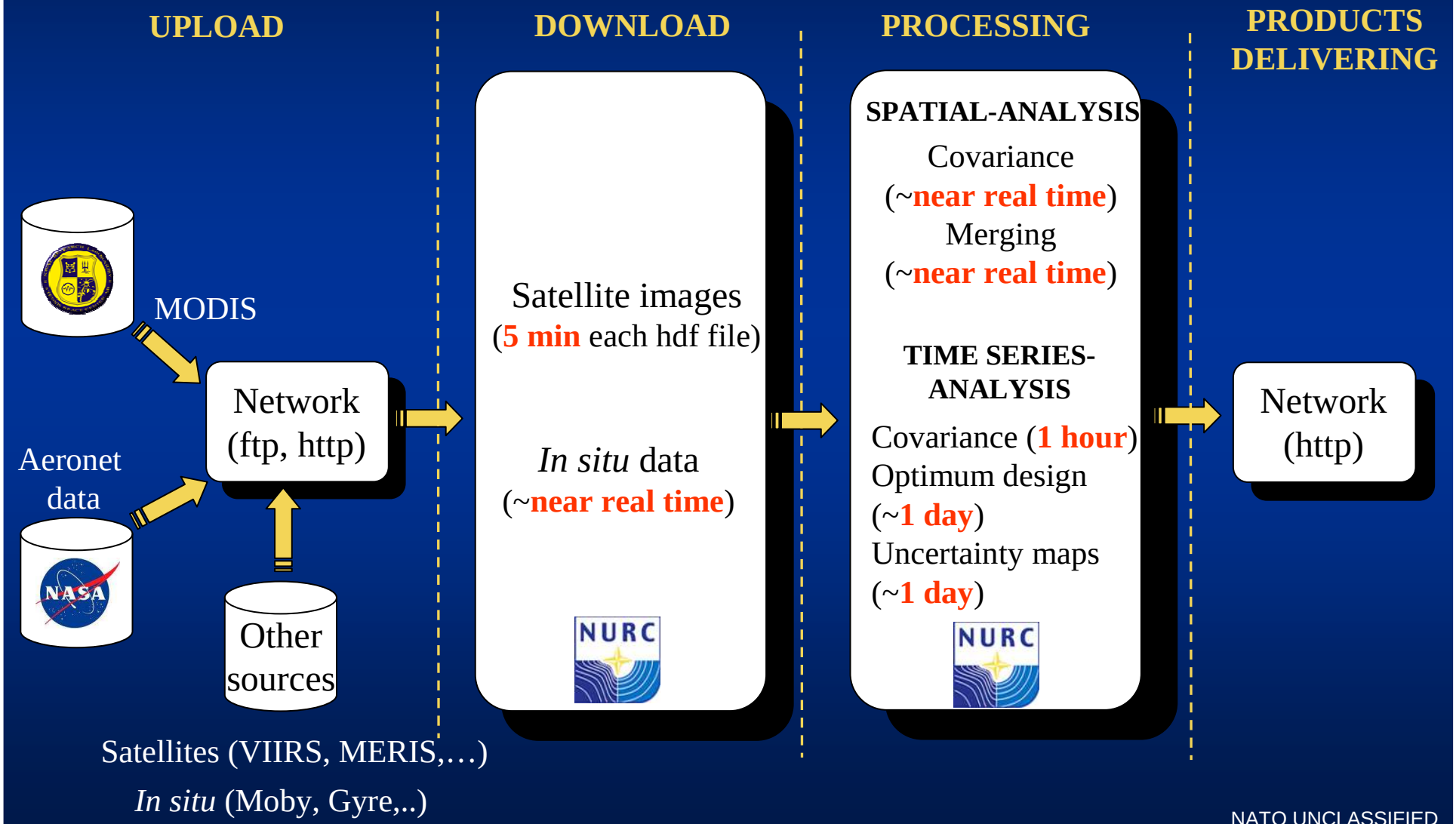
Overview of the operational system

An end-to-end process being developed at NATO research Centre as contribution to the semi-automated system for daily calibration and validation procedures for VIIRS ocean products. In particular:

- **Collecting Remote sensing data** (e.g. from MODIS, MERIS and VIIRS);
- **Collecting *in situ* data** (e.g. from AERONET or MOBY sensors);
- **Capture, processing and archiving** the available information in a format that can be ingest in the Matlab GUI;
- **Covariance Processing from single and time-series images** (at NURC using our MATLAB GUI);
- **Uncertainty Index analysis** (for the Golden region);
- **Integrating *in situ* data**, if available, for merging.
- **Display and discuss the final results** to support the team in Cal/Val operations.



Overview of the operational system



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The Matlab GUI

A Graphical User Interface (GUI) was developed to provide an user friendly software that can be employed on different satellite products to asses the locations where ***in situ*** data should be collected in order to determine the uncertainty of using these data for their calibration and validation.

When VIIRS clear images will be available, the GUI will be run at NURC so that we can produce near real time results. At sometime in the future, this tool could be moved to NRL for automated processing. A demo of that GUI can be downloaded here:

- Home
- Theoretical Approach
  - Covariance Analysis
  - Merging
  - Optimum Design
  - Uncertainty Indices
  - Matlab GUI
- Data
- Historical Results
  - AERONET-Gulf of Venice
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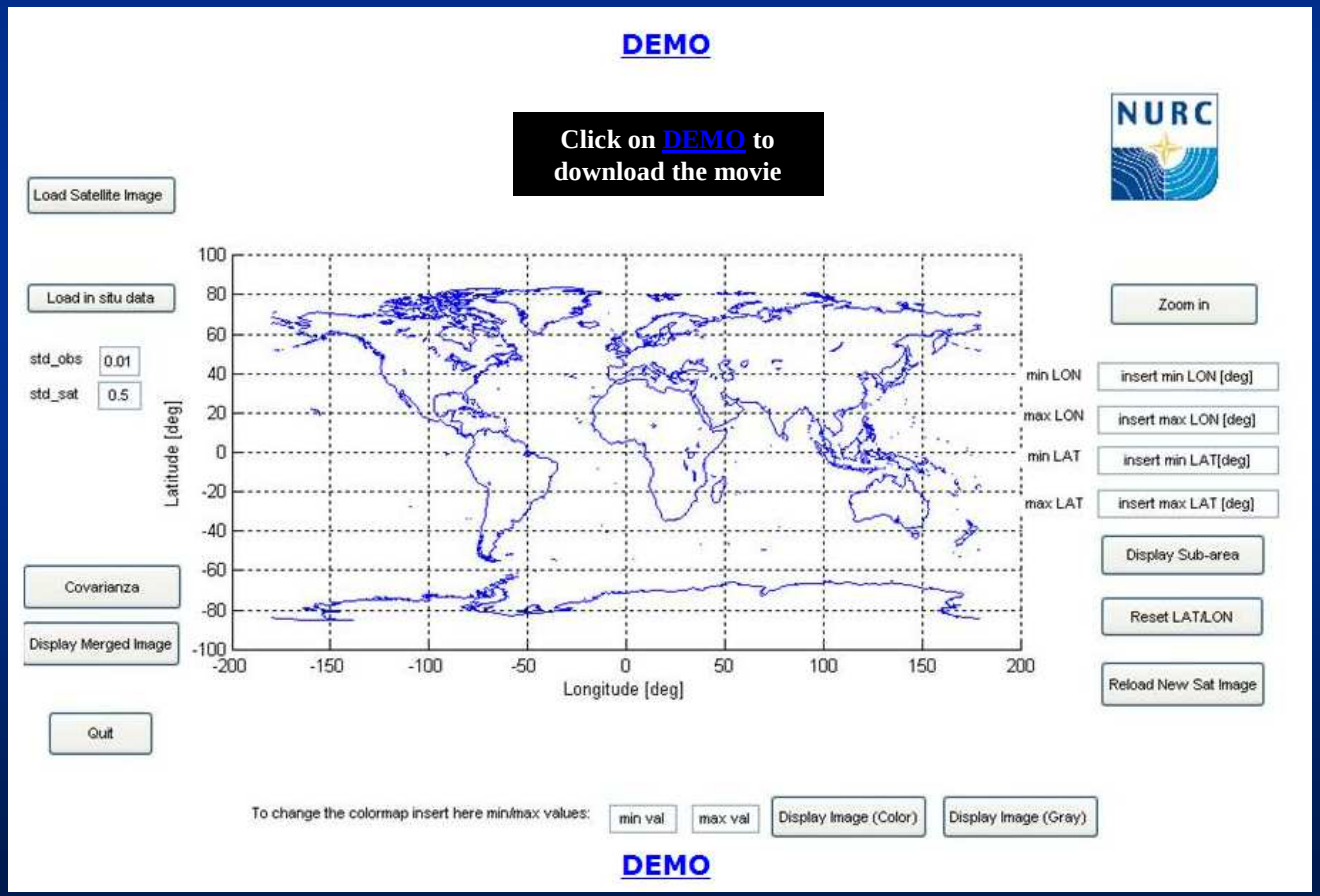
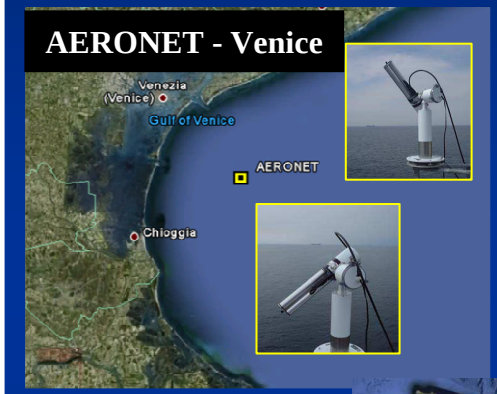
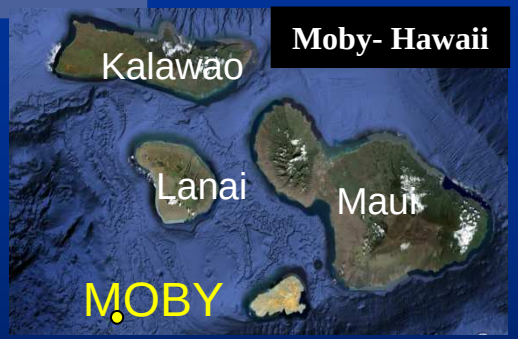


Present Applications

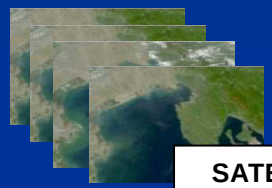
We study techniques to process and merge satellite data (MODIS, MERIS, VIIRS) with *in situ* measurements (gliders, drifters, buoys, moorings…) to support Cal/Val operations. These methodologies are used to:

Merge remote sensing data with *in situ* data

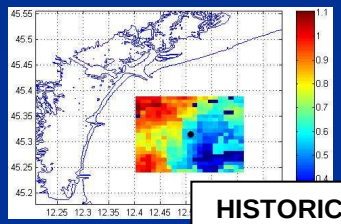




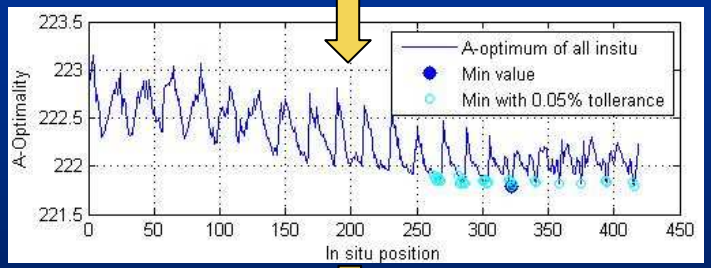
Evaluate the calibration capabilities of preexisting *in situ* (AERONET in Venice or MOBY in Hawaii) and asses the location sampling to define **where** they should be collected to achieve the best calibration and validation of satellite products.

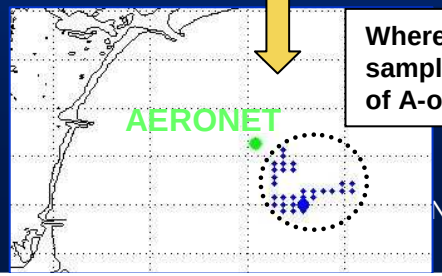


SATELLITE TIME SERIES ANALYSIS



HISTORICAL COVARIANCE





Where is better to sampling in terms of A-optimum design

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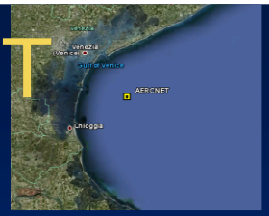
Results: Venice - AERONET

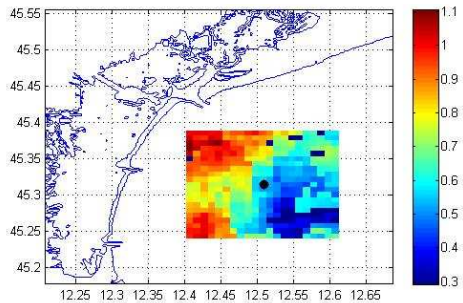


The objective is to monitor the temporal and spatial variation of that area to evaluate the actual AERONET location and to determine the best location(s) (lowest uncertainties) for *in situ* sampling. For this purpose we download (from NRL) and process daily MODIS imagery that have been acquired from January 2005 to December 2009, for a total of 2135 images.

Month	2005	2006	2007	2008	2009	MODIS ORIGINAL IMAGES	Sub-area selection (box of 21 x 21 Km around Venice station)
Jan	No	No	No	Yes	Yes	151 images	8 frames
Feb	No	No	No	Yes	Yes	143 images	29 frames
Mar	No	No	No	Yes	Yes	156 images	27 frames
Apr	No	No	No	Yes	Yes	144 images	30 frames
May	Yes	Yes	Yes	Yes	Yes	275 images	73 frames
Jun	No	No	No	Yes	Yes	148 images	32 frames
Jul	No	No	No	Yes	Yes	149 images	46 frames
Aug	No	No	No	Yes	Yes	154 images	52 frames
Sep	Yes	Yes	Yes	Yes	Yes	365 images	81 frames
Oct	No	No	No	Yes	Yes	150 images	29 frames
Nov	No	No	No	Yes	Yes	150 images	16 frames
Dec	No	No	No	Yes	Yes	150 images	15 frames

For each month:

+ Uncertainly map of 21km^2 (historical covariance)



+ Covariance of the time series;

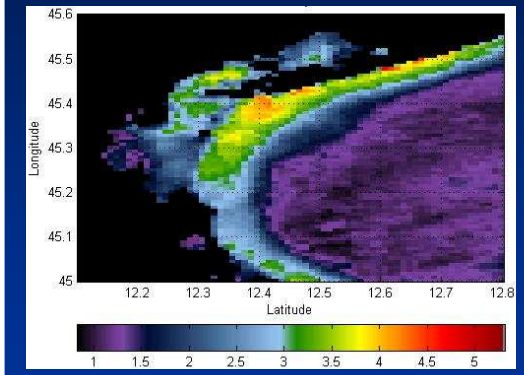
+ Mean of the time series.

All the "clear" images (**438 images**) were processed (and archived) focusing the attention on a box area of 30 by 30 km around the AERONET site. Each monthly time series were processed to retrieve: mean value, "Historical Covariance Map" (CHIST) and spatial – temporal covariance.

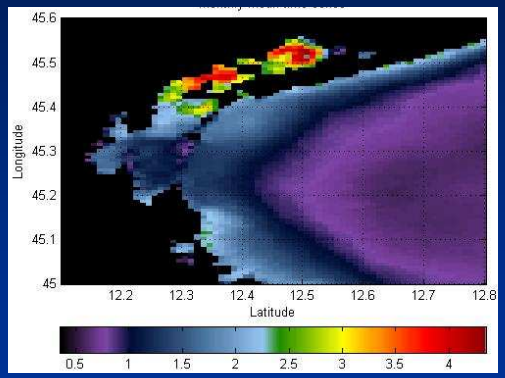
Results: Venice - AERONET

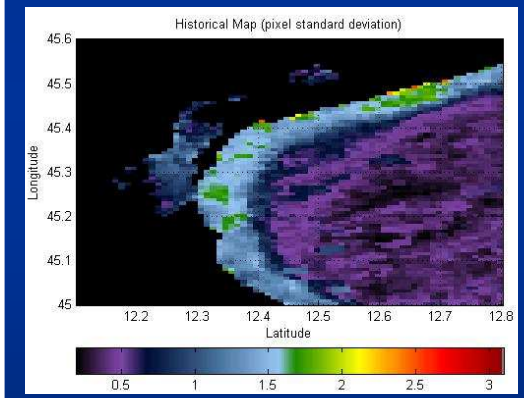
JANUARY

JULY

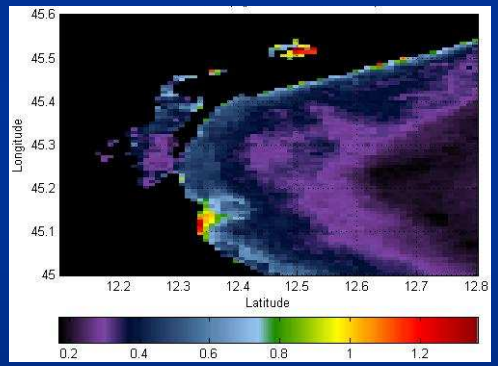


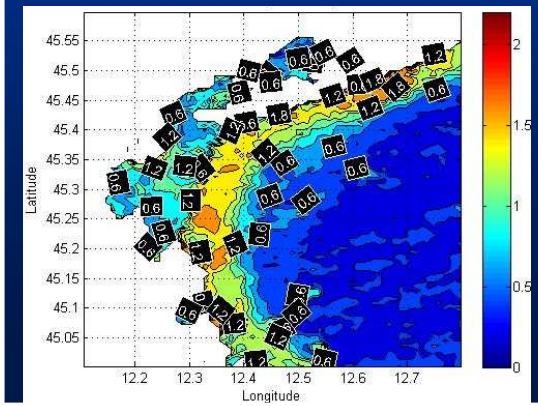
Time series mean
(normalized water leaving radiance at 547 nm)



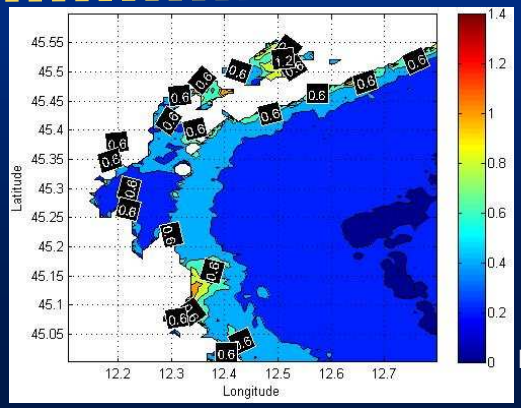


Historical Map
(pixel standard deviation)





Uncertainty Index Map
(where it's better to place an in situ?)



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Results: Hawaii-MOBY

MODIS satellite acquisitions (1 Km at nadir of ground resolution) have been provided (11 July 2011) by NRL (Adam Lawson) via ftp in hdf format.

MODIS
(2005, 2006 and 2007)

Network
(ftp, http)

MOBY Data
http://data.moby.mlml.calstate.edu/

Download,
Process (cloud free)
and archive
all images
~2 days

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  - Remote Sensing
    - MODIS
    - MERIS
    - VIIRS
  - In situ
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Statistical Analysis
0.5~ day for each month
6 days!

Merging
1-2 day for all 2007 available data

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More details during the rehearsals

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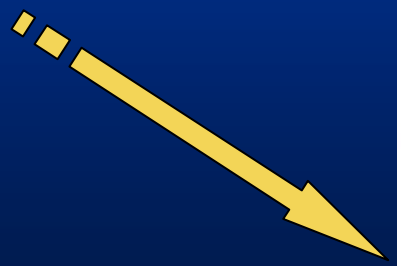
Conclusion

We have present methodologies and results to support the project Calibration/Validation (Cal/Val) Plan for Oceans Environmental Data Records (ERDS) for the Visible Infrared Imager Radiometer System (VIIRS) sensor on the Preparatory Project (NPP) and National Polar Orbiting Operational Environmental Satellite System (NPOESS).

Focus the attention on the execution plans for a semi-automated system for daily calibration and validation procedures for VIIRS ocean products. This system will be operationally running after the launch of VIIRS on the NPP satellite. Details on our work can be found in our web-site that defines how NURC will contribute to the project.

Waiting the VIIRS launch (October 2011)…
Work in progress

VIIRS data will be pulled from NRL every day. The “clear” (cloud coverage < 10-15%) imagery will be archived and processed at NURC. Every two week, results from these analyses will be pushed back to SDR team that will be able to display and download products from our web site.

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