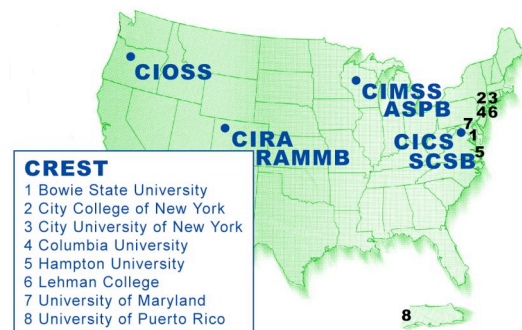
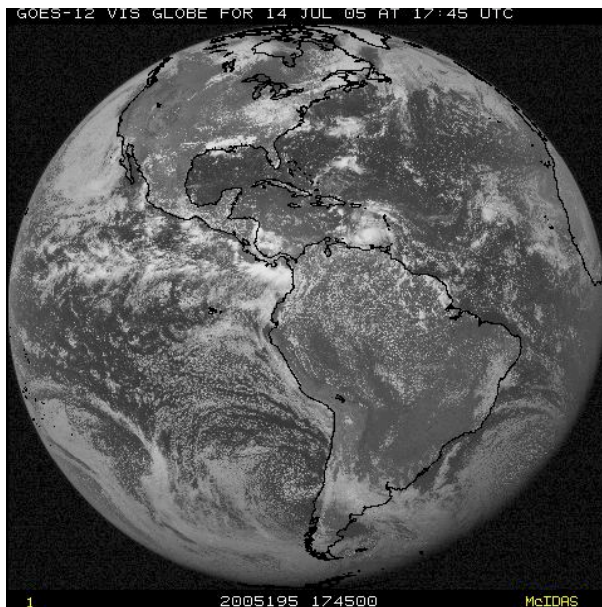


# 2nd NOAA NOAA/NESDIS Cooperative Research Program Second Annual Science Symposium

## SATELLITE CALIBRATION & VALIDATION

July 13-14, 2005

*Pyle Center, 702 Langdon Street*  
University of Wisconsin-Madison



At the  
University of Wisconsin-Madison  
Cooperative Institute for Meteorological Satellite Studies  
Madison, WI



NOAA Satellite and Information Services  
*National Environmental Satellite, Data, and Information Service*

Report on the

**2nd NOAA NOAA/NESDIS  
Cooperative Research Program Second Annual Science  
Symposium**

**SATELLITE CALIBRATION & VALIDATION**

JULY 13-14, 2005

at the  
University of Wisconsin-Madison  
Space Science and Engineering Center  
Madison, WI

Sponsored by the NOAA National Environmental Satellite, Data, and Information Service (NESDIS) Office of Research and Applications (ORA) and the Cooperative Institute for Meteorological Satellite Studies (CIMSS)

Report compiled by  
Advanced Satellite Products Team  
Office of Research and Applications  
National Environmental Satellite, Data, and Information Service  
National Oceanic and Atmospheric Administration

*July 15, 2005*



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## Executive Summary

The 2nd NOAA NOAA/NESDIS Cooperative Research Program (CoRP) Second Annual Science Symposium was held July 13-14, 2005 in Madison, Wisconsin. The topic was calibration and validation, both of radiances and higher-level products. There were more than 60 total participants from the government and academia, associated with the various NOAA/NESDIS Cooperative Institutes (CI). The CIs represented include CIMSS, CIRA, CICS, COISS, and CREST. Several participants came from as far away as Puerto Rico.

All the goals of the meeting were fulfilled, although only minimal time was spent discussing future plans and field experiments. The symposium goals were to:

- foster student/young scientist interaction,
- survey current satellite cal/val activities,
- educate students regarding satellite cal/val,
- search for synergy in on-going activities at the cooperative institutes and NOAA, and
- discuss future plans for cal/val, including field experiments.

Presentations were given on a wide range of topics showing the breath and depth of the calibration and validation activities at the CIs. The presentations are on-line at <http://cimss.ssec.wisc.edu/corp>.



The workshop was hosted by NOAA National Environmental Satellite, Data, and Information Service (NESDIS) Office of Research and Applications (ORA) Advanced Satellite Products Team Branch (ASPB) at the Space Science and Engineering Center (SSEC), University of Wisconsin-Madison (UW) and by the Cooperative Institute for Meteorological Satellite Studies (CIMSS). The meeting was held at the Pyle Center on the University of Wisconsin-Madison campus.

## Recommendation

The main recommendation from the workshop was to continue this symposium series, as it allows for positive interaction between many levels within the government and the cooperative institutes.

## Meeting Summary

This section includes summary notes from the presentations. It is not intended to be a comprehensive summary of the presentations and posters.

### *Introduction*

**Al Powell**, NOAA NESDIS ORA gave a summary of the NOAA NESDIS cooperative institutes and their role in NESDIS, along with the many recent changes. For example:

- **Science into Operations**
    - **Improved processes**
  - **Cooperative Institutes**
    - **Changing Landscape**
    - **NAO, Ops Manual, Competitive Process**
  - **Coordinating Scientific Research**
    - **Setting Priorities**
    - **Focus on the Future**
  - **Changing Infrastructure**
    - **IT Working Group**
    - **Plan for the Future**
- **Many Good Things Are Happening!!!**  
– **AWG and the GOES-R Risk Reduction**



**W. P. Menzel**, NOAA NESDIS ORA gave a summary as to the “big picture” of calibration and validation. He noted the four “building blocks” of a calibration/validation system:

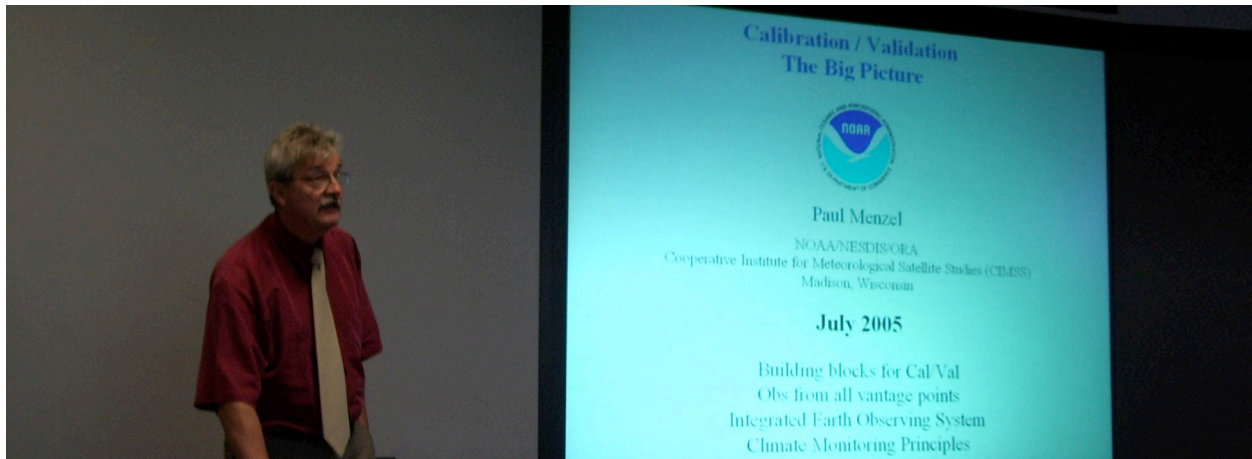
- (1) **on-board calibration devices (e.g. black bodies, solar diffusers),**

**(2) in situ measurements of the state of the surface and atmosphere (e.g. DOE Cloud and Radiation Testbed (CART) site, aircraft instruments with NIST calibrations),**

**(3) radiative transfer models that enable comparison of calculated and observed radiances, and**

**(4) assimilation systems that merge all measurements into a cohesive consistent depiction of the earth-atmosphere system.**

Other topics discussed include: Observations from all vantage points, Integrated Earth Observing System and Climate Monitoring Principles.



A representative from each of the CI gave an overview of calibration and validation activities. The range of activities cover the atmosphere, ocean, land, while the spectral ranges from the visible, near-infrared, infrared and microwave.

### ***Radiance Calibration and Validation***

There were presentations on a host of applications of radiance calibration and validation. Only select points are summarized here; more information was given during each presentation. See the online presentations for more information.

“AVHRR Visible Band Calibration/Intercalibration” was presented by **Andy Heidinger**, NOAA/NESDIS/ORA ASPB. Among other conclusions, he showed that SNO’s (Simultaneous Nadir Observations) coupled with a new MODIS-based vicarious desert calibration target appear to have produced an AVHRR reflectance calibration that is consistent for all AVHRR’s (and is consistent with MODIS).

“MODIS Radiance Calibration” was described by **Chris Moeller**, CIMSS. He summarized that: cal/val of MODIS L1B is viable, even necessary, from high altitude aircraft; MODIS meets specification in almost all bands, detector striping is corroborated by cal/val; and finally that MODIS radiometric biases can be cautiously applied to Level 2 products, e.g. CO<sub>2</sub> cloud heights.

**Dave Tobin** and Mat **Gunshor**, CIMSS spoke on “Using AIRS to Calibrate MODIS Radiances” and “Using High-Spectral Resolution IR Measurements to Intercalibrate Broad-Band Channels”, respectively. They showed the power of using high spectral resolution data to calibrate broad-band radiometers.

**Bill Tahnk**, CIOSS spoke on “Using Sun Glint and Antarctic Ice Sheets to Calibrate MODIS and AVHRR Observations of Reflected Sunlight”. In part, he summarized that the Antarctic ice sheets and ocean glint areas were used to check the calibration of solar reflectance channels on Terra and Aqua MODIS and NOAA16 and NOAA17 AVHRR and that Terra and Aqua MODIS observations at 0.64, 0.84, and 1.6  $\mu\text{m}$  are consistent with each other and internally consistent through the period analyzed.

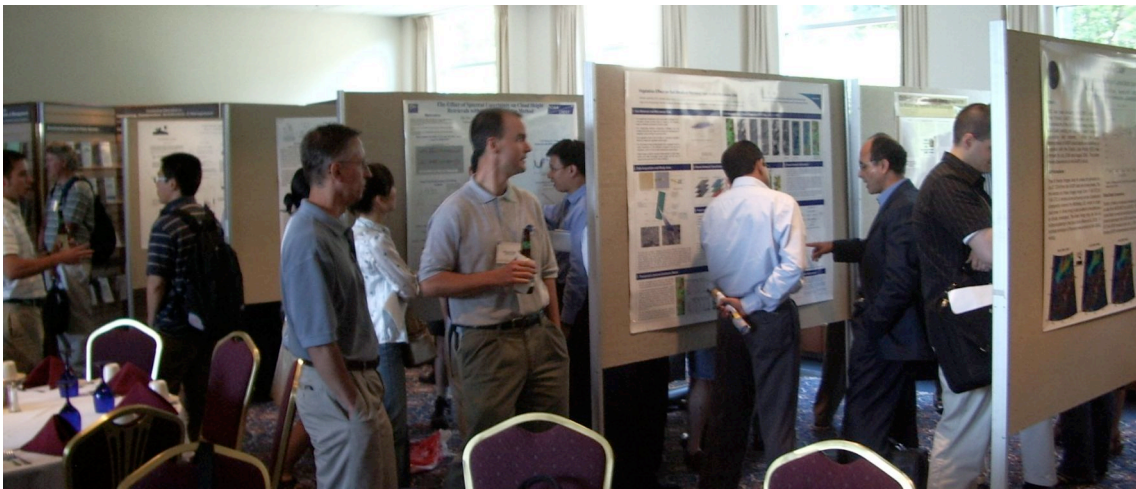
## ***Poster Session***

There were 20 posters presented on a number of calibration and validation activities. The list of posters were:

1. Use of Tide Gauges in Altimeter Calibration and Validation: Estimating Altimeter Drift to Estimate Long-Term Sea Level Rise Ted Strub, CIOSS
2. Improved SST retrieval in tropical regions using GOES-R ABI Leona Charles, CREST
3. Validation of Satellite-Based NESDIS Rainfall Products CREST/CUNY Walid Harrouch,
4. Vegetation Effect on Soil Moisture Retrieval from Active Microwave Data Tarendra Lakhankar, CUNY
5. Capabilities and limitations of neural networks in snow cover mapping from passive microwave data Juan Arevalo, REST/CUNY
6. Validation of Satellite-derived Polar Clouds Xuanji Wang, CIMSS
7. Accuracy of Satellite-derived Temperature Inversions Yinghui Liu, CIMSS
8. Validation of Coastwatch ocean color products Sathyadev Ramachandran, NOAA
9. Cloud Detection: Optical Depth Thresholds and FOV Considerations Steve Ackerman, CIMSS
10. Calibration of Radar Remote Sensing as Applied to Soil Moisture and Vegetation Health Determination Mairim Ramos, CREST/UPRM
11. Calibration and Validation Fundamentals Vazjier Rosario, CREST/UPRM
12. Validation of Hydro-Estimator Algorithm for Puerto Rico Region Beatrice Cruz, CREST/UPRM
13. Validation of Cloud Top Height Retrieval by MODIS and MISR Instruments Ana Picon, CREST/UPRM
14. Seawifs Validation in Coastal Waters of Western Puerto Rico CREST/UPRM Patrick Reyes,



15. The effect of Calibration Uncertainties on Cloud Height Retrievals from HIRS  
Min Min Oo, CREST
16. A Comparison of High Spectral Resolution Infrared Cloud Top Pressure Algorithms Using S-HIS Measurements  
Bob Holz, CIMSS
17. Windsat Vector Wind Accuracy from Buoy and QuikSCAT Comparisons  
Mike Freilich, CIOSS
18. Visibility Analysis of Class I Areas Using Multiple Satellite Products and In Situ Ground Based Measurements  
Nikisa Jordan, CREST/UMBC
19. GASP Optical Depth Animations and Optical Depth Comparison with an Elastic Lidar  
Ray Rogers, CREST/UMBC
20. Windsat Observations of Ocean-Atmosphere Interaction in the Eastern Tropical Pacific  
Dudley Chelton, CIOSS



## *Ocean and Land Applications*

**Joe Santanello** of CICS showed that while MODIS and AIRS retrievals are poorly resolved in the lower troposphere, but do contain significant information on the general structure and evolution of the PBL that can be used to infer surface conditions.

SST and physical radiance bias correction by **Andy Harris**, CICS. His path is to pursue physically-based methodologies to provide (in part): an improved SST retrieval capability (including the diurnal signature).

“Ocean color products: the challenge of going from stocks to rates” by **Sam Laney**, CIOSS stated that to improve remote sensing via Fluorescence Line Height (FLH), need to know its diurnal dynamics.

**Peter Strutton**, CIOSS, summarized “Coastal carbon fluxes from satellite ocean color, SST and winds.” He pointed out that in many areas we don’t even know the sign of the CO<sub>2</sub> flux.



“Ocean Vector Wind Workshops and the Role of Cal/Val in Preparing for Future Satellite Wind Sensors” was presented by **Dudley Chelton**, CIOSS. **Paul Chang**, NOAA/CIOSS in his talk “Satellite Vector Winds and Extreme Events in an Operational Environment at NOAA/NESDIS” reminded us that operational or scientific applications may require different approaches toward cal/val and product development.

Retrieval of water properties in shallow water using the GOES-R Coastal Imager was presented by **Marco Vargas**, CREST/CCNY.

Retrieval of ocean properties using multispectral methods was presented by **Sam Ahmed**, CREST. Some very significant results were shown from simulations. In general, most of the derived parameters were approximately five (or more) times better than would be derived from only multiple spectral data. Hyperspectral channels are very important for shallow water retrieval. Preliminary tests compared multispectral vs hyperspectral sensing schemes based on Hydrolight Radiative transfer derived bio-optical model.

## *Atmosphere Applications*

“Validation of CIRA Tropical Cyclone Algorithms” was given by **Julie DeMuth**, CIRA and focused on AMSU intensity and wind radii estimation.

**Matt Nielsen**, CIRA spoke on “Use of GPS for validation of microwave moisture retrievals over land” and showed that antenna pattern correction fixed a consistent ~3 K bias from observed brightness temperatures.

SGP CART Site: Temperature and Humidity Profile Validation by **Wayne Feltz**, CIMSS. He noted that there are several types of Facilities: Permanent Continuous Site, Field Experiment, Non-traditional (other than traditional WMO radiosonde launches) and validation data types: Satellite, Aircraft, Surface and in situ, remotely sensed.

3-Dimensional Validation of Satellite AOD Products and the Numerical Aerosol Forecast Models that Use Them by **Ray Hoff**, CREST/UMBC concluded, in part, Lidar profiles provide PBL and Mixing layer heights than can be used to validate models/forecasts and that information on the vertical distribution of aerosol loading is essential to forecasting aerosol transport.

**Barry Gross**, CREST/CCNY spoke on Aerosol Retrieval and ground albedo in urban areas using V/NIR and MIR Hyperion Channels and showed that Spatial Regression over urban areas using high spatial resolution sensors can isolate aerosol Path Radiance directly and help decouple ground albedo from atmosphere.

Improving correlation of AOD and surface PM2.5 using Lidar Data, Implications for CALIPSO **Fred Moshary**, CREST. He concluded that, Lidar profiles provide PBL (Planetary Boundary Layer) and Mixing layer heights than can be used to validate models/forecasts and information on the vertical distribution of aerosol loading is essential to forecasting aerosol transport.

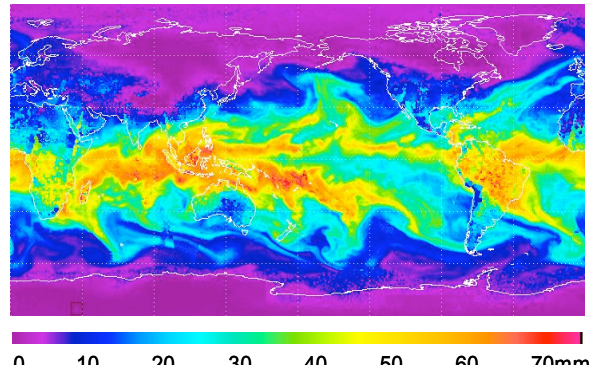


Calibration/Validation Efforts at UPRM (University of Puerto Rico at Mayagüez) by **Hamed Parsiani** discussed a wide range of calibration/validation efforts.

## *Climate Applications*

Using fluctuations in hyperspectral satellite observations to estimate climate sensitivity by **Daniel Kirk-Davidoff**, CICS.

“On the validation and intercomparison of global water vapor Climate Data Records from satellites” by **John Forsythe**, CIRA concluded that the blended NVAP global TPW anomalies have no significant trend from 1988 – 1999, the operational TOVS record is discontinuous and has a downward trend and finally SSM/I and radiosonde show upwards global trends in TPW.



Inter-satellite calibration of HIRS OLR time series by **Hai-Tien Lee**, CICS. He concluded that some large OLR differences that might point to the limb correction and/or modeling for extreme conditions and called for revision of the Operational algorithms.

Using GLAS to Characterize Errors in Passive Satellite Cloud Climatologies by **Mike Pavolonis**, CIMSS, concluded, that a more complete error analysis can be performed when CloudSat/CALIPSO are launched. *Aqua* MODIS data can be used to simulate various cloud masks and cloud properties. This is the best way to tie together past and future data records (e.g. AVHRR/VIIRS) and to understand the differences between climatologies and help in the development of an “optimal” multi-sensor long-term cloud climatology (e.g. AVHRR/HIRS).

## **Concluding Remarks**

In summary, this workshop was a productive one. It improved the lines of communication between those doing calibration and validation activities in the CI communities. Each of the presenters, poster presenters and attendees are to be thanked.

Progress was made on each of the symposium goals:

- Foster student/young scientist interaction
- survey current satellite cal/val activities
- educate students regarding satellite cal/val
- search for synergy between on-going activities at the cooperative institutes and NOAA
- discuss future plans for cal/val, including field experiments

## **Appendix 1: Organization List**

**ASPB (Advanced Satellite Products Branch)  
Madison, WI**

**CICS (Cooperative Institute for Climate Studies)  
University of Maryland**

**CIOSS (Cooperative Institute for Oceanographic Satellite Studies)  
Oregon State University**

**CIMSS (Cooperative Institute for Meteorological Satellite Studies)  
University of Wisconsin-Madison**

**CIRA (Cooperative Institute for Research in the Atmosphere)  
Colorado State University**

**Cooperative Remote Sensing  
Science and Technology Center (CREST)**

**A consortium of the City College of the City University of New York (CCUNY)  
With:**

**Bronx Community College  
Bowie State University  
Columbia University  
Hampton University  
Lehman College  
University of Maryland, Baltimore  
University of Puerto Rico**

## Appendix 2: Participant list – roster of attendees

### CoRP Calibration and Validation Symposium

Steve Ackerman	CIMSS/University of Wisconsin-Madison, Madison, WI
Juan Arevalo	NOAA-CREST, New York, New York
Robert Aune	NOAA/NESDIS/ORA/CORP/ASPB, Madison, WI
Sarah Bedka	UW-Madison CIMSS, Madison, WI
Changyong Cao	NOAA/NESDIS/ORA, Camp Springs, MD
Paul Chang	NOAA/NESDIS/ORA/ORAD, Camp Springs, MD
Dudley Chelton	CIOSS/OSU, Corvallis, OR
Sung-Rae Chung	Korea Meteorological Administration, Seoul, South Korea
Chu-Yong Chung	Meteorological Research Institute / Korea Meteorological Administration, Seoul, South Korea
Linwood Creekmore	Center for Atmospheric Sciences at Hampton University, Hampton, VA
Beatriz Cruz	CREST/UPRM, Moca, Puerto Rico
Jaime Daniels	NOAA/NESDIS/ORA, Camp Springs, MD
Julie Demuth	Cooperative Institute for Research in the Atmosphere (CIRA), Fort Collins, CO
Wayne Feltz	SSEC/CIMSS UW-Madison, Madison, WI
John Forsythe	Cooperative Institute for Research in the Atmosphere, Colorado State University, Fort Collins, CO
Kallol Ganguli	NOAA CREST, CCNY, CUNY, WOODSIDE, NY
Iliana Genkova	UIUC/DAS, Urbana, IL, IL
Mathew Gunshor	CIMSS, Madison, WI
Andrew Harris	NOAA Cooperative Institute for Climate Studies, University of Maryland, Annandale, VA
Andrew Heidinger	NOAA/NESDIS/ORA/CORP/ASPB, Madison, WI
Charles Hill	The Center for Atmospheric Sciences, Department of Physics, Hampton University, Hampton, VA
Don Hillger	CIRA/Colorado State University, Fort Collins, CO
Raymond Hoff	CREST at UMBC, UMBC Physics and JCET, Baltimore, MD
Jay Hoffman	CIMSS grad student, Madison, WI
David Hogan	Atmospheric and Environmental Research, Inc., Lexington, MA
Lacey Holland	National Center for Atmospheric Research, Boulder, CO
Robert Holz	CIMSS, Madison, WI
Zorana Jelenak	UCAR/NOAA/NESDIS/ORA, Camp Springs, MD
Kim Jhoon	Yonsei University, Seoul, South Korea
Yoon JongMin	Yonsei University, Seoul, South Korea
Nikisa Jordan	University of Maryland, Baltimore County, Lanham, MD
Jeff Key	NOAA/NESDIS/ASPB, University of Wisconsin-Madison, WI
Reza Khanbilvardi	NOAA-CREST, The City University of New York, New York
Daniel Kirk-Davidoff	University of Maryland, Takoma Park, MD
Tarendra Lakhankar	NOAA-CREST, CUNY, New York, Corona, NY

Sam Laney	Oregon State University, Corvallis, OR
Hai-Tien Lee	CICS/ESSIC, University of Maryland College Park, Ellicott City, MD
Kwang Mog LEE	Kyungpook National University, Dept. of Astronomy and Atmospheric Sciences, Daegu, South Korea
Zhenglong Li	CIMSS, University of Wisconsin-Madison, WI
Chian-Yi Liu	SSEC/CIMSS, Madison, WI
Brent Maddux	University of Wisconsin-CIMSS, Madison, WI
Sean Madine	Colorado State University/Cooperative Institute for Research in the Atmosphere, Boulder, CO
Shayesteh Mahani	NOAA-CREST Center at the City University of New York (CUNY), New York, NY
Paul Menzel	NOAA/NESDIS and University of Wisconsin-Madison, Madison, WI
Matthew Nielsen	Colorado State University/Cooperative Institute for Research in the Atmosphere, Fort Collins, CO
Michael Pavolonis	CIMSS, Madison, WI
Ana Picon	NOAA CREST UPRM(University of Puerto Rico at Mayaguez), Arecibo, PR
Al Powell	NOAA/NESDIS, Camp Springs, MD
Sathyadev Ramachandran	NOAA/NESDIS/ORA/Coastwatch, Fairfax, VA
Mairim G. Ramos	University of Puerto Rico - Mayaguez (UPRM), Cabo Rojo, PR
Patrick Reyes-Pesaresi	Department of Marine Science, University of Puerto Rico, Mayaguez Campus, Cabo Rojo, Puerto Rico
Raymond Rogers	University of Maryland, Baltimore County, Baltimore, MD
Vazjier M. Rosario	UPRM/NOAA/CREST, Mayaguez, PR
Joseph Santanello	ESSIC/UMDCP, Washington, DC
David Santek	SSEC/CIMSS, Madison, WI
Tim Schmit	NOAA/NESDIS, Madison, WI
Eun-Jin Seo	Korea Meteorological Administration, Seoul, South Korea
Richard Slonaker	Raytheon Information Solutions, Upper Marlboro, MD
Maciek Smuga-Otto	Space Science and Engineering Center, UW-Madison, WI
Ned Snell	Atmospheric and Environmental Research, Inc., Lexington, MA
William Straka III	CIMSS/SSEC, Madison, WI
P. Ted Strub	CIOSS - Cooperative Institute for Oceanographic Satellite Studies, Corvallis, OR
Peter Strutton	College of Oceanic & Atmospheric Sciences, Oregon State University, Corvallis, OR
William Tahnk	CIOSS, Corvallis, OR
David Tobin	CIMSS/SSEC/UW-Madison, Madison, WI
Gary S. Wade	NOAA/NESDIS/ORA/ARAD/ASPT, Madison, WI
Fang Wang	CIMSS, Madison, WI
Xuanji Wang	CIMSS/SSEC, University of Wisconsin-Madison, madison, WI
Xuebao Wu	University of Wisconsin - Madison, Space Science & Engineering Center, Madison, WI
Hong Zhang	CIMSS/SSEC, University of Wisconsin-Madison, Madison, WI

## Appendix 3: Agenda

# 2nd NOAA NOAA/NESDIS Cooperative Research Program Second Annual Science Symposium

## SATELLITE CALIBRATION & VALIDATION

July 13-14, 2005  
Pyle Center, 702 Langdon Street  
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<http://cimss.ssec.wisc.edu/corp/>

### *Wednesday Afternoon 13 July 2005*

#### **Introduction**

**Chair: Jeff Key, NOAA**

1300	Introductory Remarks/Logistics/Agenda	Jeff Key, NOAA
1310	Welcome	Steve Ackerman, SSEC
1320	The Cooperative Institutes and NESDIS	Al Powell, NOAA
1335	The Big Picture of Cal/Val	Paul Menzel, NOAA
1400	Overview of CI Cal/Val Activities	
	Cal/val for Oceanographic Satellite Sensors	Ted Strub, CIOSS
	Cal/val activities at CIMSS	Steve Ackerman, CIMSS
	Cal/val activities at CIRA	Don Hillger, NOAA/CIRA
	Cal/val activities at CICS	Andy Harris, CICS
	Cal/val activities at CREST	Reza Khanbilvardi, CREST

#### **1500 Break**

#### **Radiance Calibration and Validation**

**Chair: Tim Schmit, NOAA**

1515	AVHRR Visible Band Calibration/Intercalibration	Andy Heidinger, NOAA
1530	MODIS Radiance Calibration	Chris Moeller, CIMSS
1545	Using AIRS to Calibrate MODIS Radiances	Dave Tobin, CIMSS
1600	Using High-Spectral Resolution IR Measurements to Intercalibrate Broad-Band Channels	Mat Gunshor, CIMSS
1615	Using Sun Glint and Antarctic Ice Sheets to Calibrate MODIS and AVHRR Observations of Reflected Sunlight	Bill Tahnk, CIOSS



1630 Poster Introductions  
1645 *Poster Session*

Poster authors  
Poster authors

**1800- Banquet** – Pyle Center Faculty Lounge

### ***Thursday 14 July 2005***

0825 Intro/Logistics

Jeff Key, NOAA

#### **Ocean and Land Applications**

**Chair: Ted Strub, CIOSS**

0830 Using satellite-derived PBL properties to infer land surface fluxes

Joe Santanello, CICS

0845 SST and physical radiance bias correction

Andy Harris, CICS

0900 Ocean color products: the challenge of going from stocks to rates

Sam Laney, CIOSS

0915 Coastal carbon fluxes from satellite ocean color, SST and winds

Peter Strutton, CIOSS

0930 Ocean Vector Wind Workshops and the Role of Cal/Val in Preparing for Future Satellite Wind Sensors

Dudley Chelton, CIOSS

0945 Vector winds and severe storm detection

Paul Chang, NOAA/CIOSS

#### **1000 Break**

1015 Retrieval of water properties in shallow water using the GOES-R Coastal Imager

Marco Vargas,  
CREST/CCNY

1030 In situ validation of Ocean Color products in Case II waters

Sam Ahmed, CREST

1045 Discussion

#### **Atmosphere Applications**

**Chair: Bob Aune, NOAA**

1115 Validation of CIRA Tropical Cyclone Algorithms

Julie DeMuth, CIRA

1130 Use of GPS for validation of microwave moisture retrievals over land

Matt Nielsen, CIRA

1145 SGP CART Site: Temperature and Humidity Profile Validation

Wayne Feltz, CIMSS

#### **1200 Lunch** – Pyle Center

1330 3-Dimensional Validation of Satellite the Numerical Aerosol Forecast Models that Use Them

AOD Products and  
Ray Hoff, CREST/UMBC

1345 Aerosol Retrieval and ground albedo in urban areas using V/NIR and MIR Hyperion Channels

Barry Gross, CREST/CCNY

1400 Improving correlation of AOD and surface PM<sub>2.5</sub> using

1415 Lidar Data, Implications for CALIPSO  
Overview of Cal/Val at UPRM

Fred Moshary, CREST  
Hamed Parsiani, UPRM

**Climate Applications**

1445 Using fluctuations in hyperspectral satellite observations  
to estimate climate sensitivity

**Chair: Don Hillger,**  
NOAA/CIRA

Daniel Kirk-Davidoff, CICS

**1500 Break**

1530 On the validation and intercomparison of global water  
vapor Climate Data Records from satellites

1545 Inter-satellite calibration of HIRS OLR time series

John Forsythe, CIRA

Hai-Tien Lee, CICS

1600 Cloud Climatology Validation

1615 Discussion and closing

Mike Pavolonis, CIMSS

**1645 End of workshop**



**NOAA Satellite and Information Services**  
*National Environmental Satellite, Data, and Information Service*