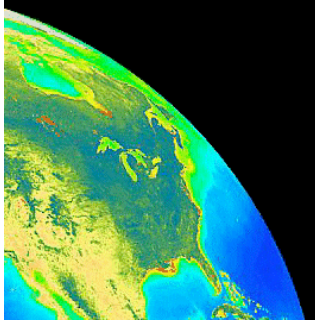
OBPG Status Report

Chuck McClain & Gene Feldman

Ocean Biology Processing Group Leaders

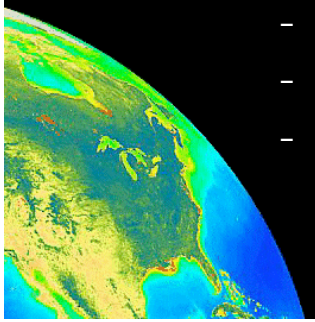
NASA Ocean Biogeochemistry Science Team Meeting

April 11-13, 2007



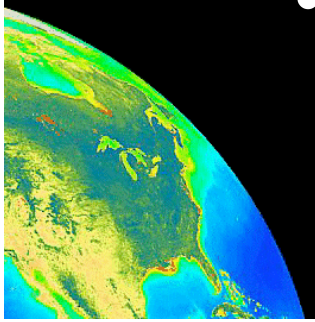
Presentation Outline

- **Ocean Biology Data Processing**
  - SeaWiFS
    - Updated temperature sensitivity
    - Intergain analysis
  - MODIS/Terra
  - OCTS and CZCS reprocessing
  - MODIS HiRes
  - NO2 sensitivity analyses & global data set development
  - Chesapeake Bay analyses
    - Chlorophyll-a algorithms
    - Aerosol model evaluations
  - NPP VIIRS
  - SeaWiFS, MODIS reprocessing proposal
  - SeaBASS
- **Sea Surface Temperature Data Processing: Aqua & Terra**
- **Aquarius**
- **SeaDAS**
- **Data Distribution**
- **HQ Program Support**
- **Recent OBPG Publications**



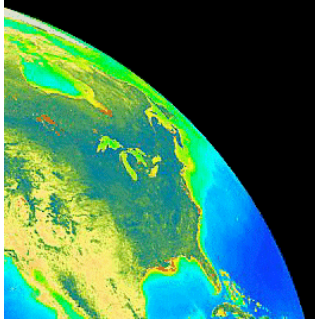
OBPG Primary Tasks for Next Year: 2006 OCRT Mtg.

- ✓ Complete MODIS/Terra SST processing transition from MODAPS (early summer)
- ✓ Complete MODIS/Aqua HIRES module
- ✓ Finalize OCTS and CZCS reprocessings
- ✓ Aqua/SeaWiFS Merged Chlorophyll Product
- Work on MODIS/Terra ocean color data quality - ongoing
- Continue analysis of VIIRS prelaunch test data & data system development - ongoing
- Continue preparations for Aquarius data processing - ongoing



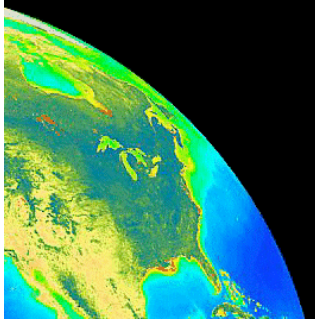
SeaWiFS

- Contract renewal in place
  - NASA funded for this year
  - 1 year with four 1-year options
- Instrument performance
  - Slight shift between lunar and science gains determined through analyses of daily calibration pulse data
  - Temperature sensitivity reassessed as result of orbit drift



MODIS/Terra OC Data Evaluation

- Temporal degradation much more severe than MODIS/Aqua
- Using SeaWiFS Lwn fields to assess RVS (response vs. scan) and polarization time-dependent sensitivities
- Bryan Franz presentation (next)

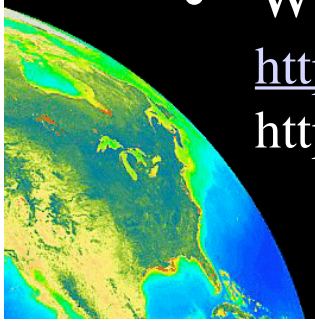


CZCS & OCTS Reprocessing

- Standardized algorithms to degree possible (calibration, bio-optical, atmospheric correction)
  - Calibration: **Jeremy Werdell presentation later this morning**
- CZCS
  - Renavigated entire mission (next reprocessing will include an additional navigation refinement)
  - Radiometric data quality issues after 1982 (sensor behavior at 550nm)
  - El Chichon aerosol effects in level-2 products
  - Apparent polarization sensitivity artifacts
- OCTS
  - NASDA tilt-dependent calibration removed
  - Two-epoch NIR degradation incorporated
- Websites:

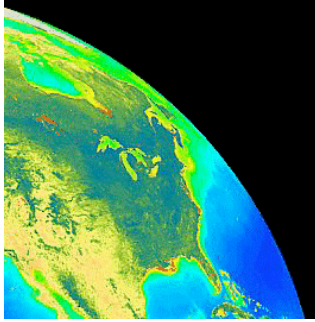
  http://oceancolor.gsfc.nasa.gov/CZCS/

  http://oceancolor.gsfc.nasa.gov/OCTS/



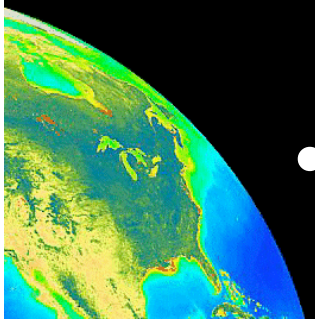
MODIS HiRes Data Processing

- Utilizes 250 m & 500 m land bands, & 1 km ocean color bands data
- Allows options for using 1240, 1640, and 2130 nm bands for aerosol corrections
- Supported in SeaDAS
- Bryan Franz presentation (next)



NO_2 Global Data Set Development

- Correction algorithm and sensitivity analysis completed (Ahmad, et al., *Applied Optics*, in press)
- Global time series constructed using GOME, SCIAMACHY, & OMI data sets
- Evaluation of NO_2 correction on SeaWiFS and MODIS derived product time series underway
- See Robinson et al. poster

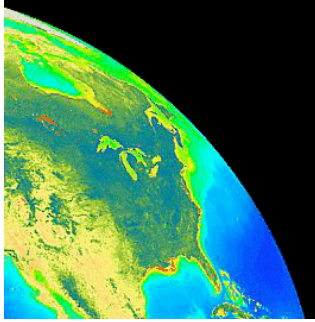


Chesapeake Bay Analyses

- **Objectives:**

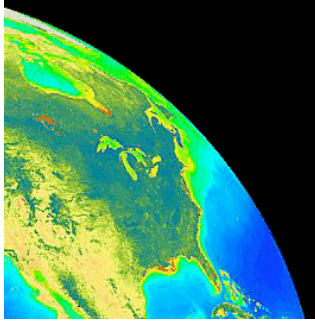
1. Provide high quality ocean color data products to the Chesapeake Bay Program for water quality assessments
2. Refine methodologies for assessing product quality and improving algorithm performance in coastal areas

- **Current Activities**
  - Evaluation of bio-optical algorithms & derived product quality in coastal waters
    - **Jeremy Werdell presentation (later this morning)**
  - Development of regional coastal aerosol models
    - See **Ahmad et al. poster**



NPP VIIRS

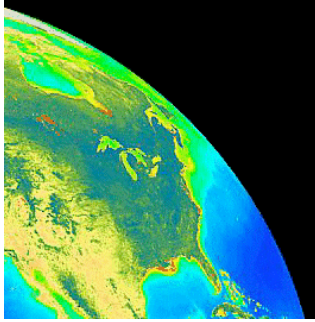
- EDU test data
  - Worked closely with NPP Instrument Characterization Support Team (GSFC) on test data analyses
  - Developed archive of test data
- Preparing for FU1 test data
- Sensor Performance Issues:
  - Optical and electronic crosstalk
  - Polarization sensitivity
  - Relative Spectral Response (RSR)
  - Money & Schedule constraints on characterization testing



SeaWiFS & MODIS Reprocessing

- **Ocean Biology**
  - Last reprocessing in June 2005
  - Primary algorithm improvements
    - SeaWiFS: temperature & lunar gain corrections
    - MODIS/Aqua: band center change from 551 nm to 546 nm
    - SeaWiFS & MODIS: NOMAD-based Chl-a algorithm, $K_d(490)$ (Morel et al. 2007)
    - MODIS/Aqua: aerosol polarization correction
    - SeaWiFS & MODIS: NO_2 correction
    - Updated aerosol models
  - Products
    - SeaWiFS & MODIS: Calcite
    - MODIS: PAR (Frouin), FLH, Lwn(678)
    - Others ?
- **MODIS SST Reprocessing**
  - GHRSST format
  - Prior to Ocean Biology reprocessing

Planned
Under study

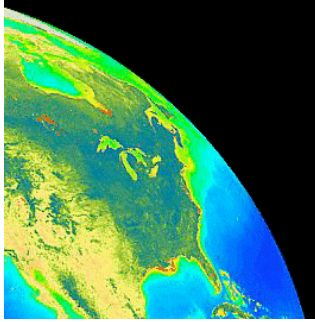


SeaBASS

- SeaBASS data submission rate on the rise (Giulietta Fargion presentation later this afternoon).
  - AOPs and Chl-a requisite, but IOPs, carbon, CTD, partical size distributions, etc. all useful and desired.

- NOMAD updated to include HPLC pigments (~1,000 stations affected) and coincident SeaWiFS Rrs (~300 stations affected).
  - NOMAD "version 2" expected to be released in Fall 2007.

- Operational OBPG validation "cookbook" published in May 2006.
  - Bailey, S. W., and P.J. Werdell, A multi-sensor approach for the on-orbit validation of ocean color satellite data products, *Remote Sens. Environ.*, 102, 12-23, 2006.

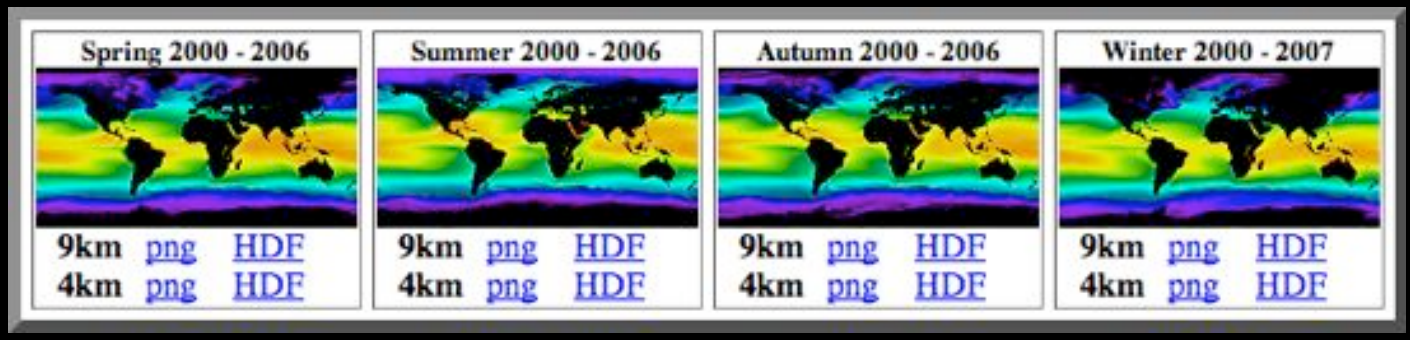


MODIS Sea Surface Temperature

- Complete Aqua (500,000 files/ July 2002 - present) and Terra (730,000 files/Feb. 2000 - present) SST products available at 1, 4 and 9 kilometer resolution.

- Operationally providing GHRSST-formatted global Level-2 SST data to JPL for both Aqua and Terra within 4 hours of acquisition by satellite.

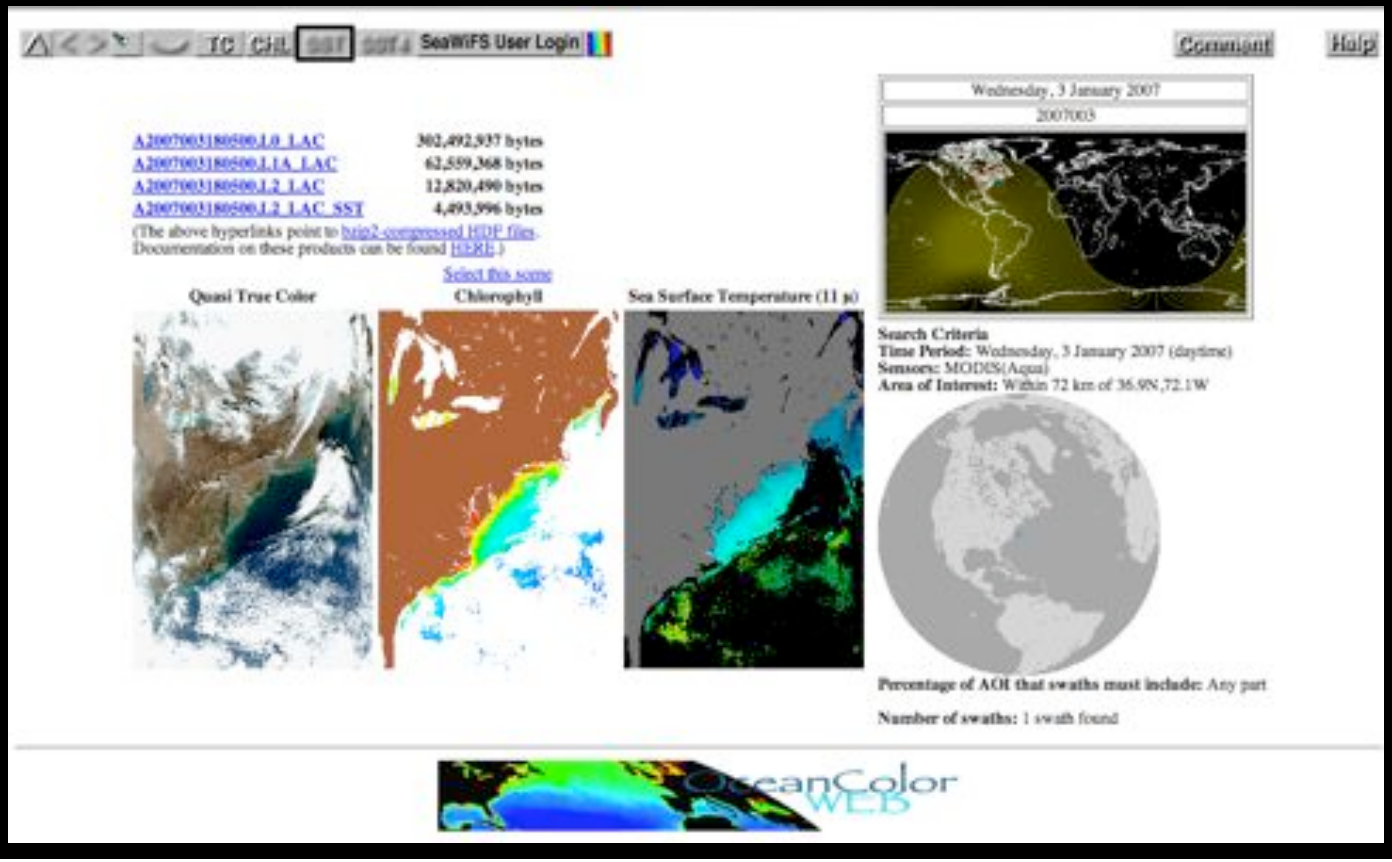
- Mission-long climatologies available at 8-day, monthly, seasonal, and cumulative time scales



MODIS Sea Surface Temperature

- Consolidated web browse, order, subscription and data extraction tools for all missions / all parameters

- 15 million Ocean Color products and 2 million SST products distributed via web and FTP.



AQUARIUS Support

Salient Features

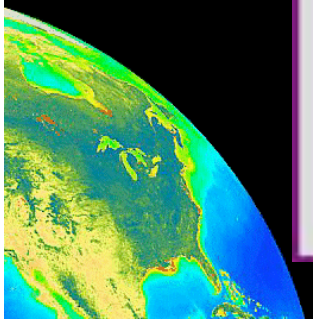
- *Earth System Science Pathfinder (ESSP) Mission*
- *NASA-CONAE Partnership Science Mission*
- *NASA provides L-band Radiometer / Scatterometer*
- *CONAE provides Service Platform & MOC*
- *Dedicated Delta II launch vehicle provided by NASA*
- *Launch Readiness Date (LRD) : July 2009 **
- *Aquarius Operational life: 3 years*

** new LRD will be established by JSG in May 2007*

JPL CONAE Goddard Space Flight Center NASA

Science

- *Investigate the links between the global water cycle, ocean circulation and climate*
- *Make global, space-based measurements of Sea Surface Salinity (SSS)*
- *Provide 0.2 psu (practical salinity unit) accuracy at monthly, 150 km resolution*
- *Observe and model seasonal and year-to-year variations of SSS, and how these relate to changes in the water cycle and ocean circulation*
- *Aquarius will yield an unprecedented view of ocean's role in climate and weather*



1- Extensive user support with over 500 sites, active online Forums. > 3500 posts

2- SeaDAS ported to the Macintosh OS X including new Intel architecture. Also runs on Linux, Sun, SGI

3- Redesigned GUI and website are now much more user-friendly

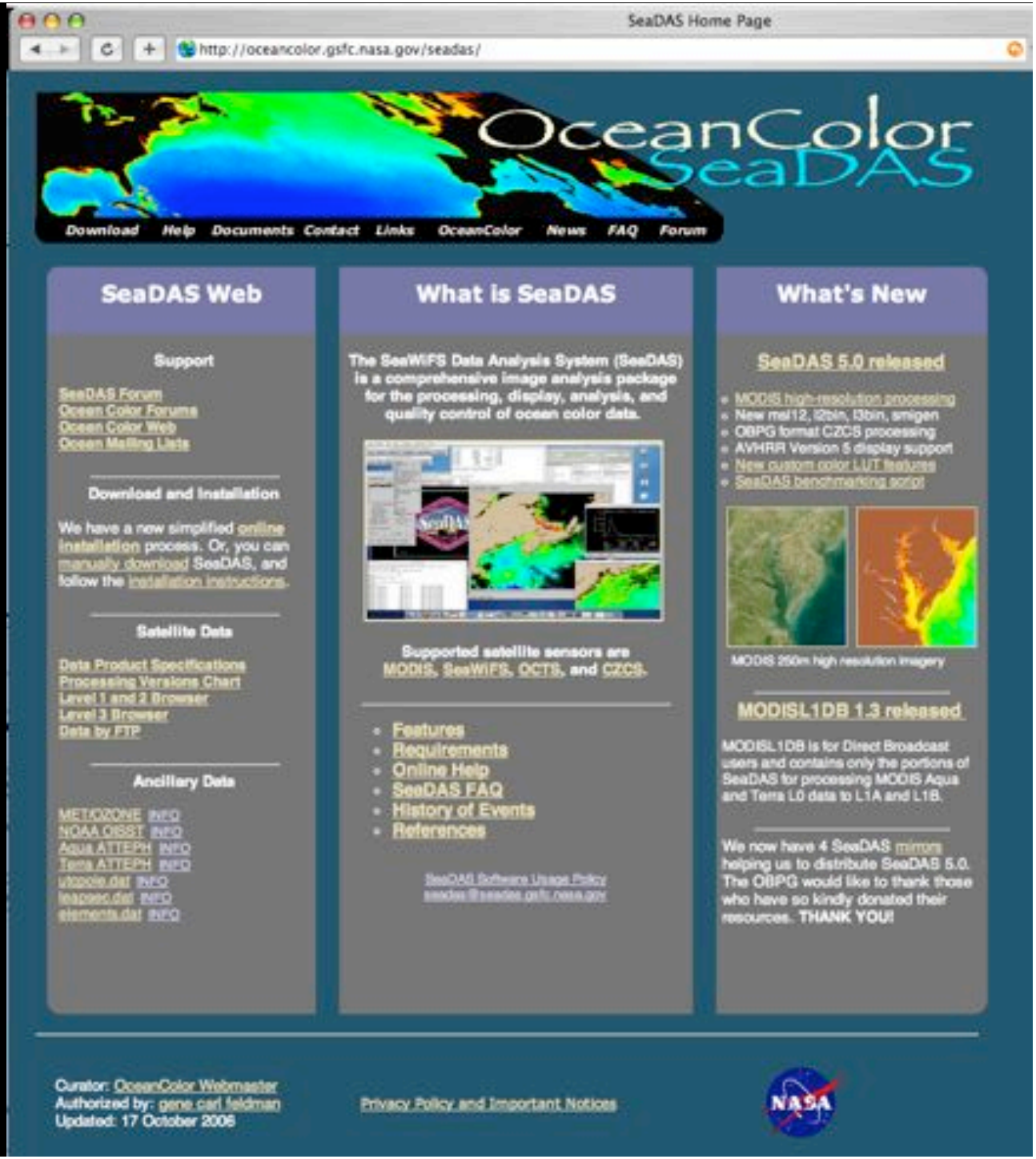
4- New simple online installer and four SeaDAS ftp mirrors (Australia, Brazil, Japan, UK)

5- Automated ancillary data download during processing

6- SeaDAS-lite option for display/analysis only

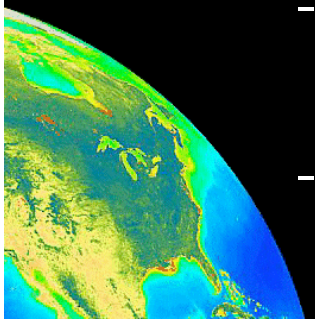
7- MODIS Direct Broadcast And High Resolution processing module.

8- User training workshops



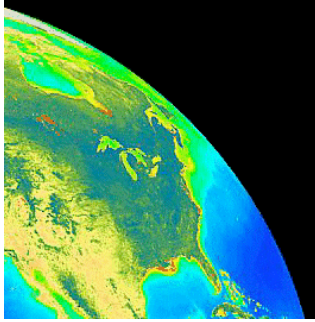
NASA HQ Program Support

- Formulation of the NASA Ocean Biology & Biogeochemistry long-term measurement strategy
  - "Earth's Living Ocean: The Unseen World"
- Formulation of a calibration & validation program strategy
  - "A Comprehensive Plan for the Long-Term Calibration &Validation of Oceanic Biogeochemical Satellite Data" – Stan Hooker presentation this afternoon
- Satellite mission formulations
  - Global Ocean Carbon, Ecosystems, & Coastal Processes mission
  - Aerosol-Cloud-Ocean Biology mission



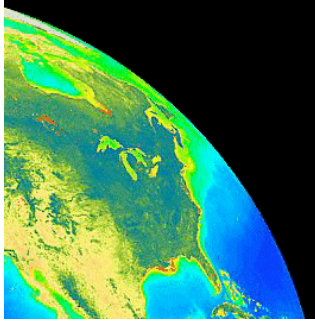
OBPG Publications

- **Conference papers**
  - Meister, G., E. K. Kwiakowska, and C. R. McClain, Analysis of image striping due to polarization artifacts in remotely sensed ocean scenes, Proc. SPIE, Earth Observing Systems XI, 6296, San Diego, 12 pp., 2006.
  - Eplee, R. E., Jr., F. S. Patt, R. A. Barnes, C. R. McClain, SeaWiFS long-term solar diffuser reflectance trend analysis, Proc. SPIE, Earth Observing Systems XI, 6296, San Diego, 10 pp., 2006.
  - Eplee, R. E., Jr., S. W. Bailey, R. A. Barnes, H. H. Kiefer, and C. R. McClain, Comparison of SeaWiFS on-orbit lunar and vicarious calibrations, Proc. SPIE, Earth Observing Systems XI, 6296, San Diego, 7 pp., 2006.
  - Franz, B. A., P. J. Werdell, G. Meister, E. J. Kwiatkowska, S. W. Bailey, Z. Ahmad, and C. R. McClain, MODIS land bands for ocean remote sensing applications, Proc. Ocean Optics, Montreal, 12 pp., 2006.
  - Werdell, P. J., B. A. Franz, S. W. Bailey, and C. R. McClain, Recent advances in the operational vicarious calibration of visible and near-infrared ocean color satellite radiometry, Ocean Optics, Montreal, 12 pp., 2006.
  - Ahmad, Z., C. R. McClain, J. R. Herman, B. Franz, E. Kwaitkowska, W. Robinson, E. J. Bucsela, and M. Tzortziou, Atmospheric correction for NO2 absorption in retrieving water-leaving radiances from SeaWiFS and MODIS measurements, Ocean Optics, Montreal, 11 pp., 2006.

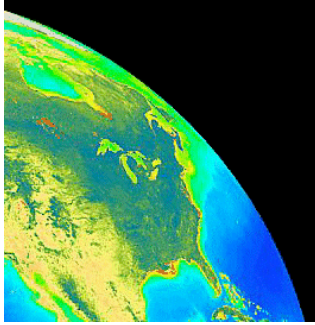


OBPG Publications *cont.*

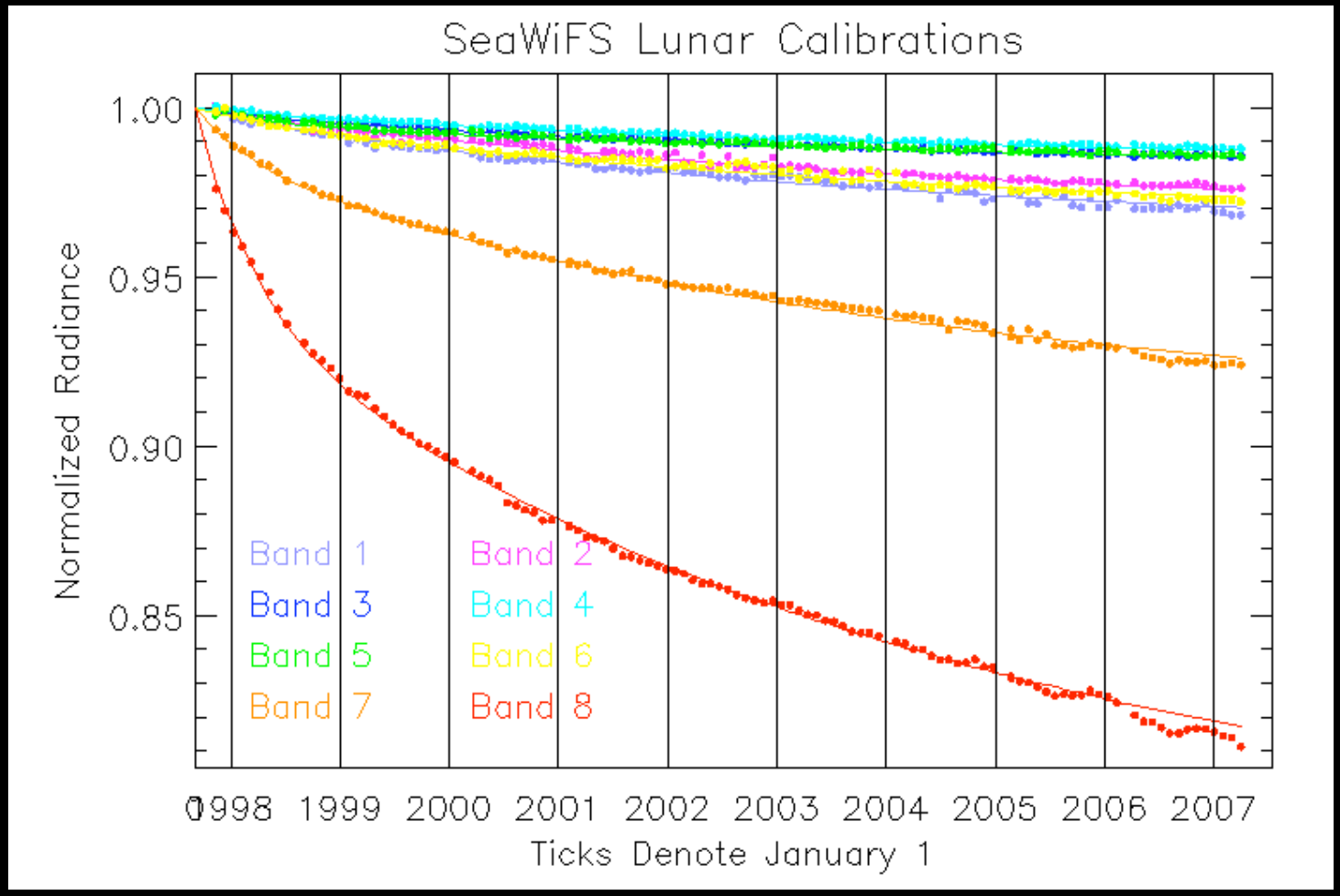
- **Journal articles**
  - Bailey, S. W., and P.J. Werdell, A multi-sensor approach for the on-orbit validation of ocean color satellite data products, *Remote Sens. Environ.*, 102, 12-23, 2006.
  - McClain, C., S. Hooker, G. Feldman, and P. Bontempi, Satellite Data for Ocean Biology, Biogeochemistry, and Climate Research, *Eos, Trans. Am. Geophys. Union*, 87(34), 337, 2006.
  - Eplee, R. E., Jr., F. S. Patt, R. A. Barnes, and C. R. McClain, SeaWiFS long-term solar diffuser reflectance and sensor signal-to-noise analyses, *Appl. Opt.,* 46(5), 762-773, 2007.
  - Franz, B. A., S. W. Bailey, P. J. Werdell, and C. R. McClain, Sensor-independent approach to the vicarious calibration of satellite ocean color radiometry, *Appl. Opt.*, in press.
  - Ahmad, Z., C. R. McClain, J. R. Herman, B. A. Franz, E. J. Kwaitkowska, W. D. Robinson, E. J. Bucsela, and M. Tzortziou, Atmospheric correction of NO2 in retrieving water-leaving reflectances from the SeaWiFS and MODIS measurements, *Appl. Opt.*, in press.
  - Eplee, R. E., Jr., F. S. Patt, B. A. Franz, S. W. Bailey, G. Meister, C. R. McClain, SeaWiFS on-orbit gain and detector calibrations: impact on ocean products, to be submitted to *Appl. Opt.*

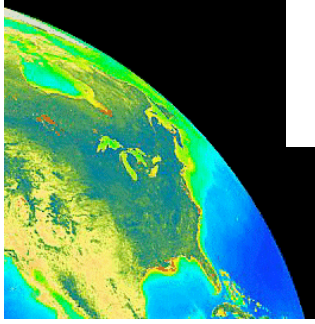


BACK-UP SLIDES



SeaWiFS Temperature Dependence: Current





SeaWiFS Temperature Dependence: Revised