A Call from NOAA Operational Product Community for JCSDA-CRTM Improvement Applicable for Ocean Color Data Assimilation

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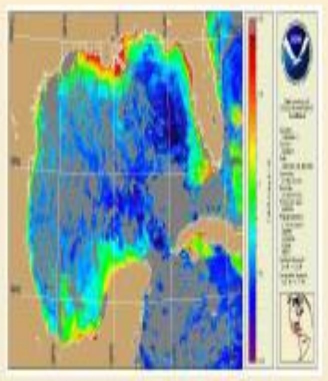
ABSTRACT

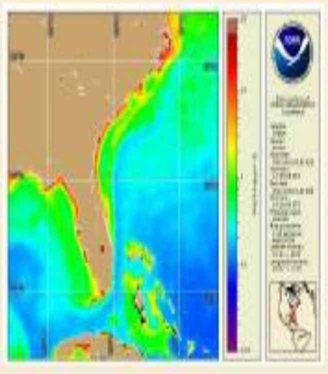
Water-leaving radiance (WLR) (ocean color signal) plays an important role in satellite data assimilation. In the visible region, the WLR component can be up to 10% of satellite radiance, while at the near-infrared region, it can be around 1 % of satellite radiance over coastal regions. Currently, ocean color (OC) data hasn't been assimilated into operational numerical weather prediction models. An obstacle comes from limitation in existing JCSDA-CRTM in assimilation of OC data. Early in 2007, it was even suggested that the CRTM capability should be improved by including proper bi-optical model and atmosphere-ocean coupling radiative transfer process (Yan and Weng 2007). This study further addresses this significance by briefing the NOAA CoastWatch Okeanos operational OC products and their applications. In the operational system, a series of OC–related products are processed and distributed, e.g., daily chlorophyll concentration, water-leaving radiance, water turbidity, and remote sensing reflectance primarily from MODIS/Aqua and MERIS/Envisat (see http://www.osdpd.noaa.gov/ml/ocean/index.html). Many of them have been widely used for coastal and regional forecasting of ocean water quality, phytoplankton, primary production, etc. For example, the chlorophyll concentration product has been used to predict harmful algal blooms by the NOAA Center for Operational Oceanographic Products and Services (http://tidesandcurrents.noaa.gov/hab/). This feasibility is being investigated of assimilating chlorophyll concentration and water turbidity into the Weather Forecasting Research weather forecast model to improve forecasting of air quality (isoprene emission) (Tong et al. 2011). It is thus expected that ocean color data could play a non-trivial role in advancing forecast skill in NWP models through an improved CRTM.

❑ Briefing Overview of NOAA Ocean Color Operational System

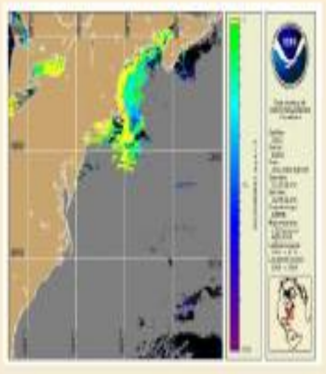
Operational Ocean Color Products



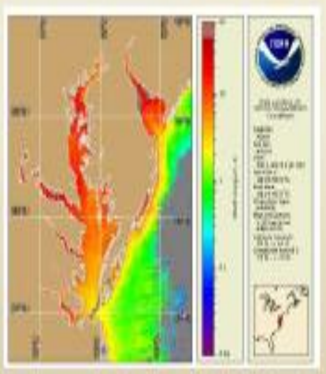
Daily chlorophyll concentration



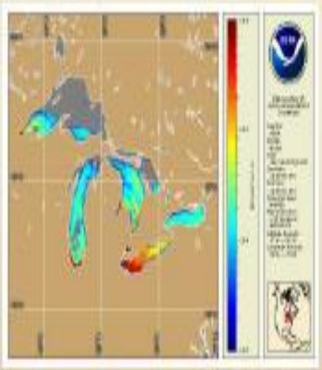
Bimonthly-mean chlorophyll concentration



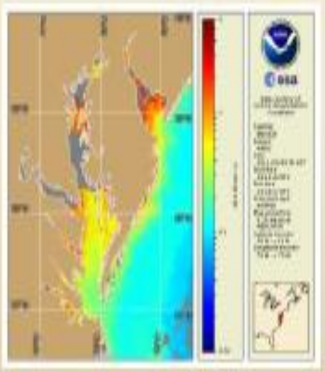
New algal growth (Positive chlorophyll concentration anomaly)



Chesapeake Bay daily chlorophyll concentration



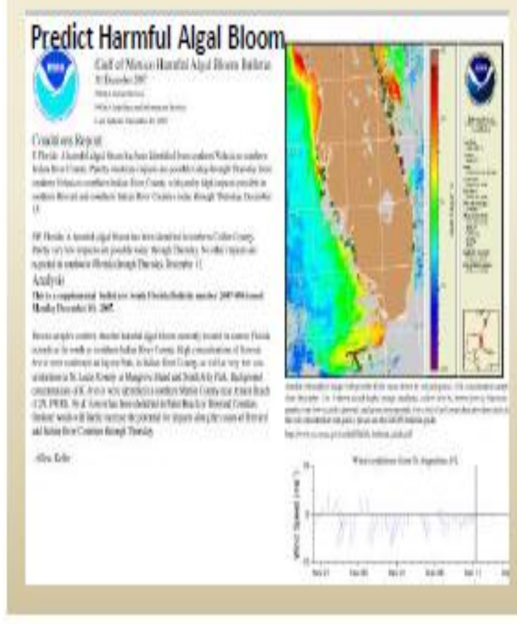
Suspended sediment proxy (Remote sensing reflectance at 667 nm)

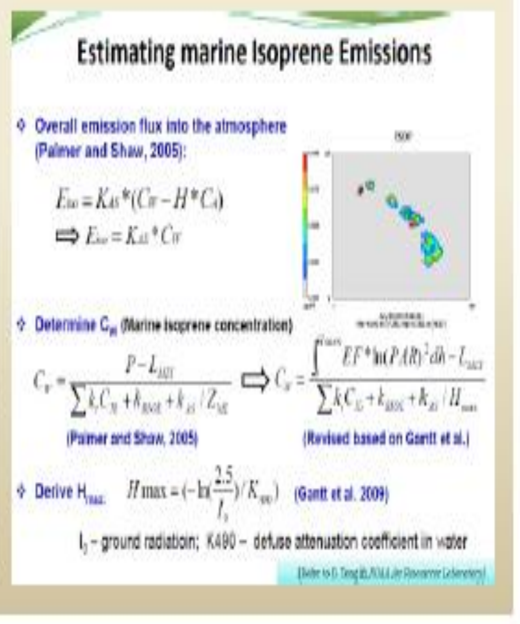


Water turbidity(Diffuse attenuation coefficient at 490 nm)

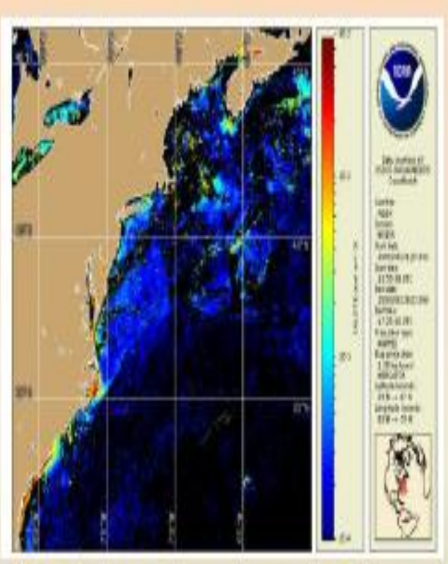
Products Users and Applications

Users	Applications
- National Ocean Service & NESDIS - Federal, state and local marine scientists, and coastal resource managers - Fisheries managers - General public	- Track potential harmful algal blooms - Assess air quality through marine isoprene fluxes - Assess water quality - Assess habitat - Review ocean features

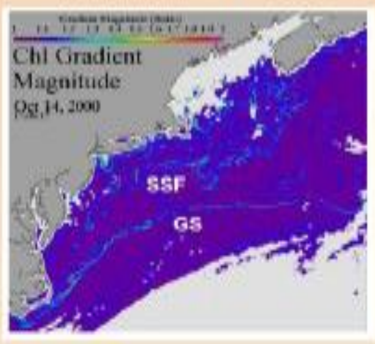




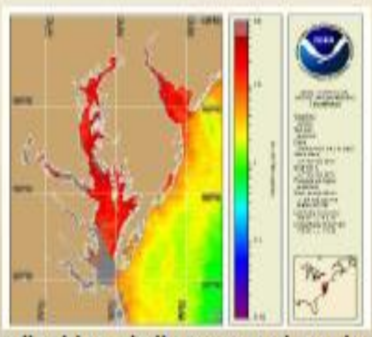
Ocean Color Products in Development



8-day, 4-km composite of suspended calcite concentration (Courtesy of Christopher Brown)

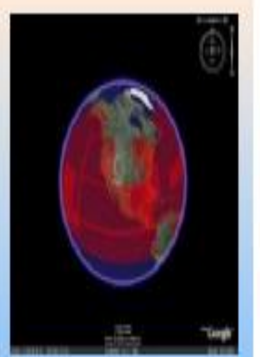


Daily chlorophyll front (Courtesy of Igor Belkin)



Daily chlorophyll concentration using SWIR (Courtesy of Menghua Wang)

Additional Information



- **Satellites:** MODIS/Aqua, MERIS/ENVISAT and MODIS/TERRA
- **Coverage:** 1/3 of the globe (13 regions)
- **Access Information:**
  - *Okeanos ftp server:* ftp://okeanos.noaa.gov/
  - *CoastWatch web portal:* http://coastwatch.noaa.gov
  - *HAB Bulletin Web Portal:* http://tidesandcurrents.noaa.gov/hab/
- **Team Members:** B. Yan (lead), K. Hughes, H. Gu, P. Keegstra, S. Ramachandran, R. Williamson, J. Guo, X. Liu, M. Soracco, and R. Vogel.
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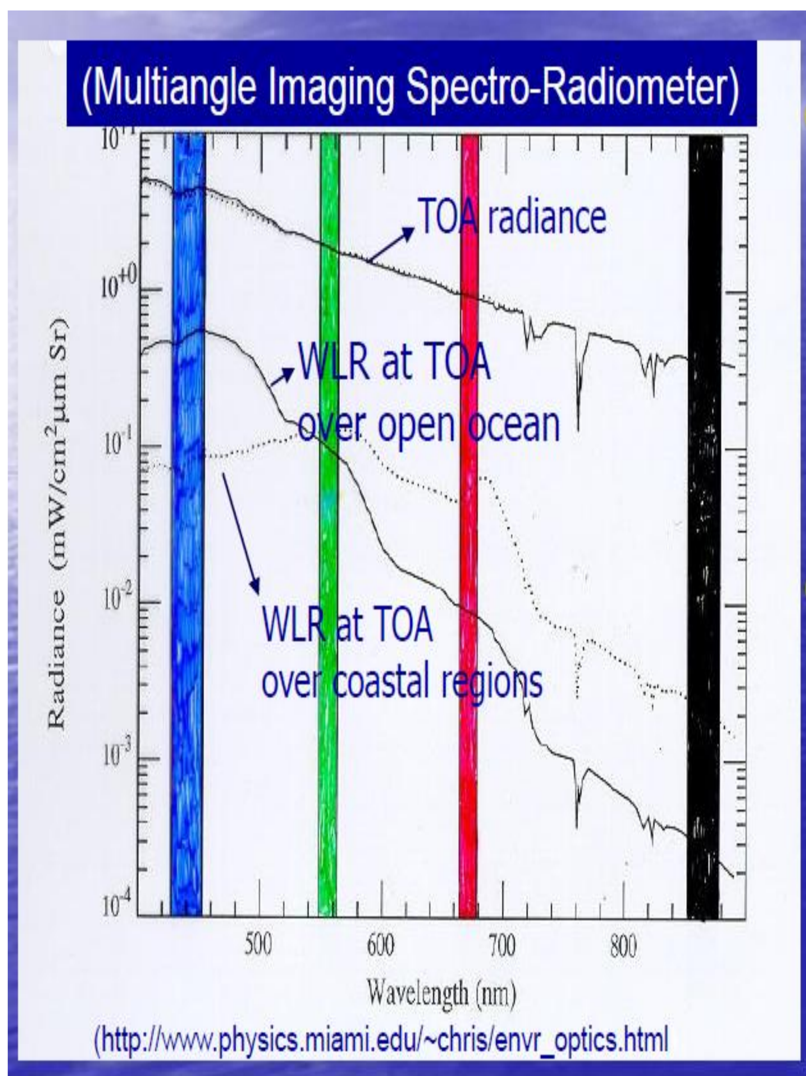
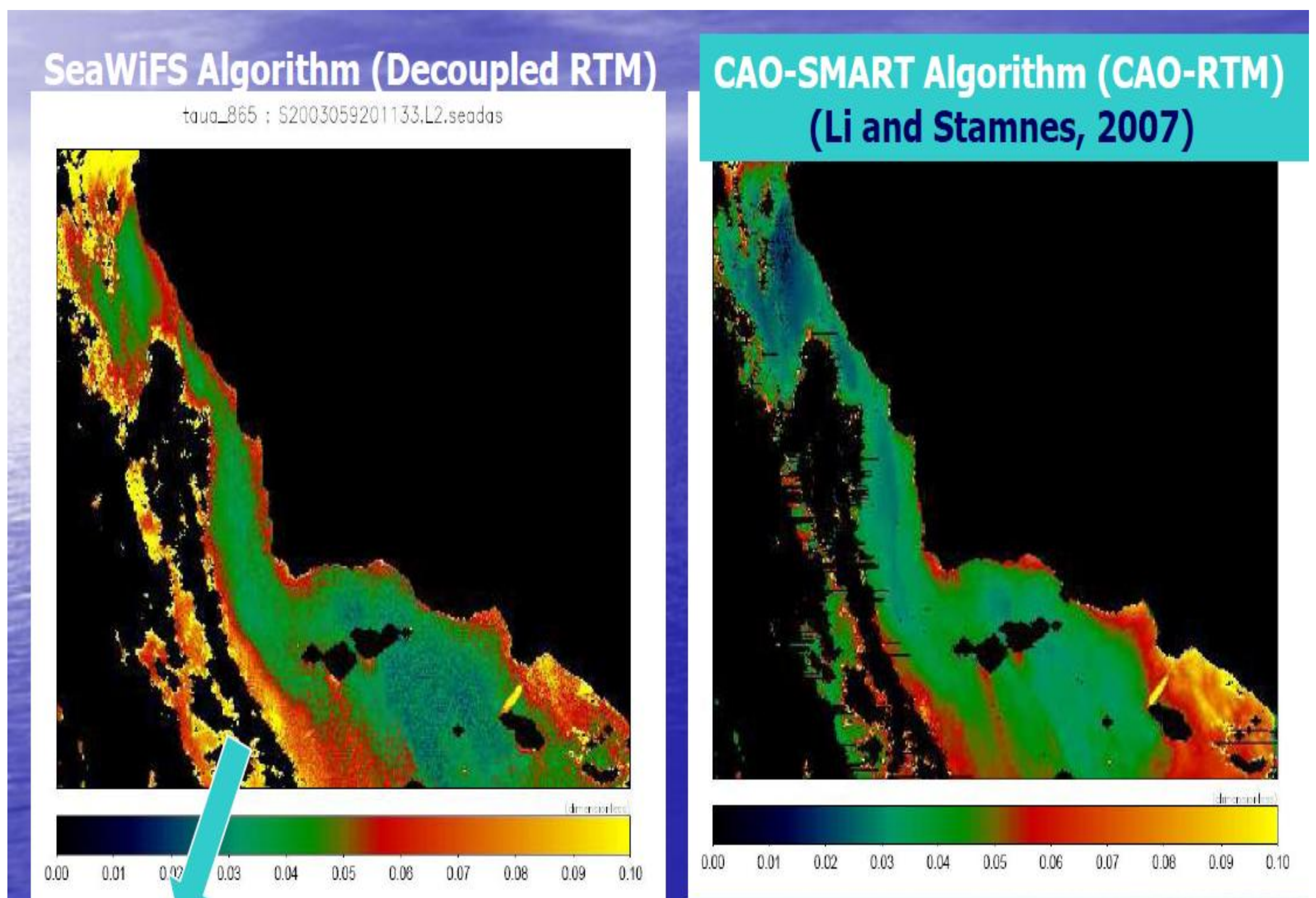
❑ Role of Water-Leaving Radiance in Satellite Radiance Assimilation



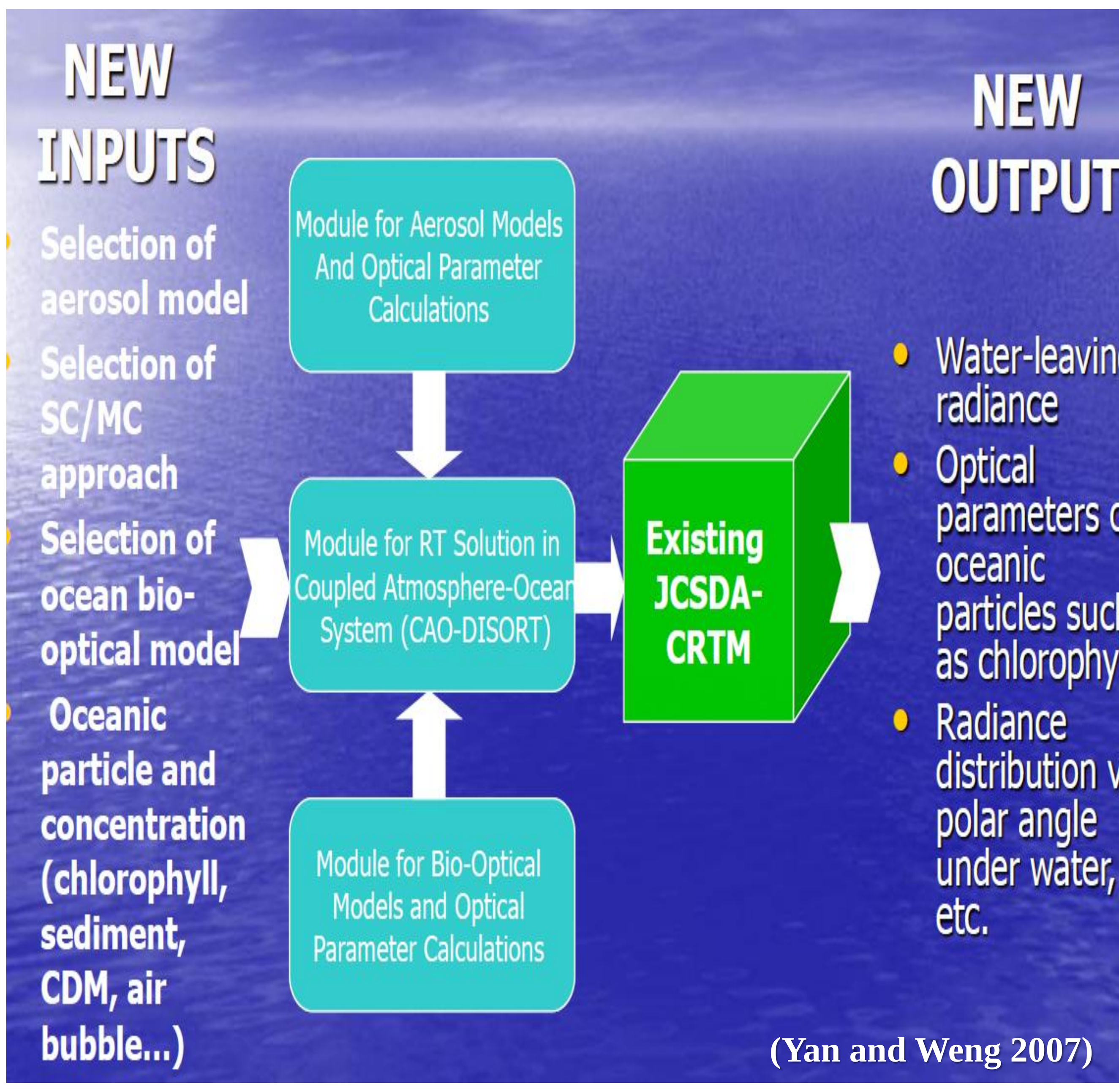
- In visible region, WLR component is at most 10% of satellite radiance.
- At near-infrared region, the WLR component can be around 1 % of satellite radiance over coastal regions.

❑ Role of Atmospheric-Ocean Coupled RTM



There remains a large discontinuity in retrieved atmospheric aerosol optical depth over some regions, as a decoupled RTM is used. (Courtesy of Li and Stamnes)

❑ Enhanced CRTM Structure Applicable for Assimilation of Ocean Color Data



(Yan and Weng 2007)

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NOAA CoastWatch Okeanos (Greek god of the great 'river ocean' and the waters surrounding the Earth) Ocean Color (OC) operational product system is a flexible, expandable software system for generating ocean color products.

Ocean color is the water hue due to the presence of tiny plants containing the pigment chlorophyll, sediments, and colored dissolved organic material.