EPIC Atmospheric Correction: Aerosol and Water Leaving Reflectance of the Global Ocean

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DSCOVR EPIC STM

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Earth Polychromatic Imaging Camera (EPIC)

- 2048 x 2048 pixel CCD;
- 8 km pixel size;
- One full set of images

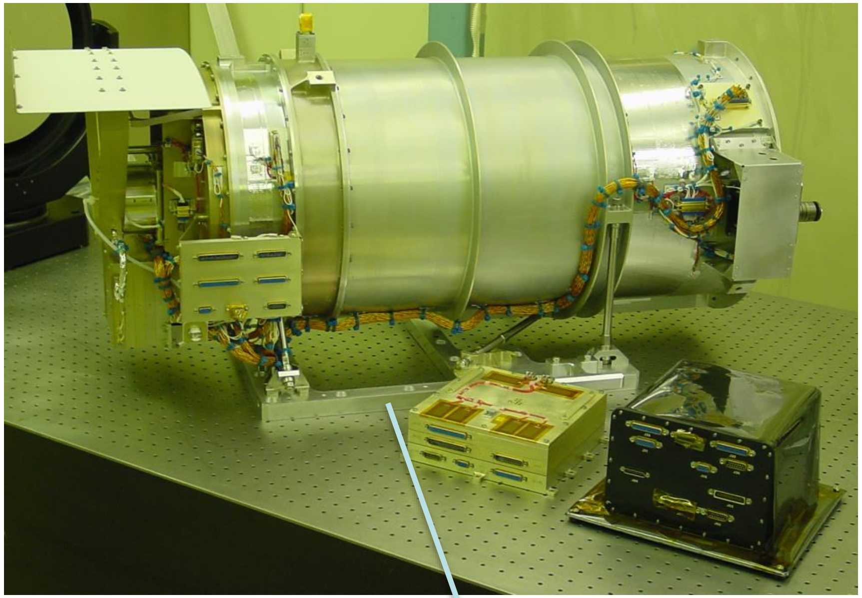
6/day in winter

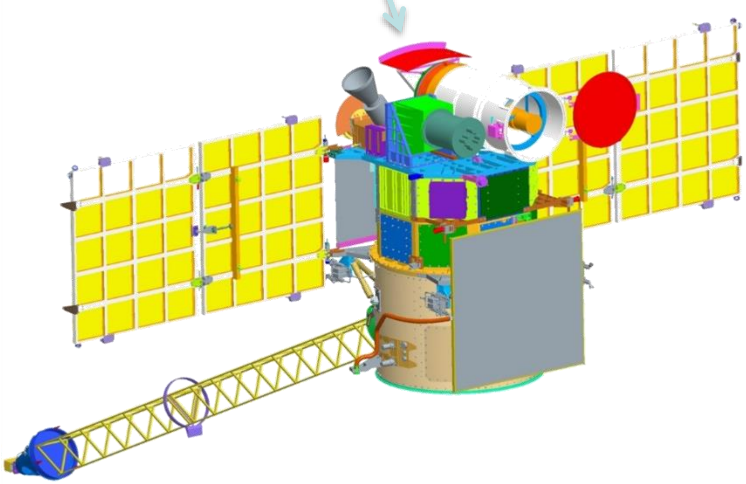
8-12/day in summer

Wavelength (nm)	Full width (nm)	Primary Applications
317.5 ±0.1	1 ±0.2	Ozone, SO_2
325 ±0.1	2 ±0.2	Ozone
340 ±0.3	3 ±0.6	Ozone, Aerosols
388 ±0.3	3 ±0.6	Aerosols, Clouds
443 ±1	3 ±0.6	Aerosols
551 ±1	3 ±0.6	Aerosols, Vegetation
680 ±0.2	2 ±0.4	Aerosol, Vegetation, Clouds
687.75 ±0.2	0.8 ±0.2	Cloud Height
764.0 ±0.2	1 ±0.2	Cloud Height
779.5 ±0.3	2 ±0.4	Clouds, Vegetation

AOD-FMF Retrieval

Atmospheric Correction





MAIAC Ocean Processing

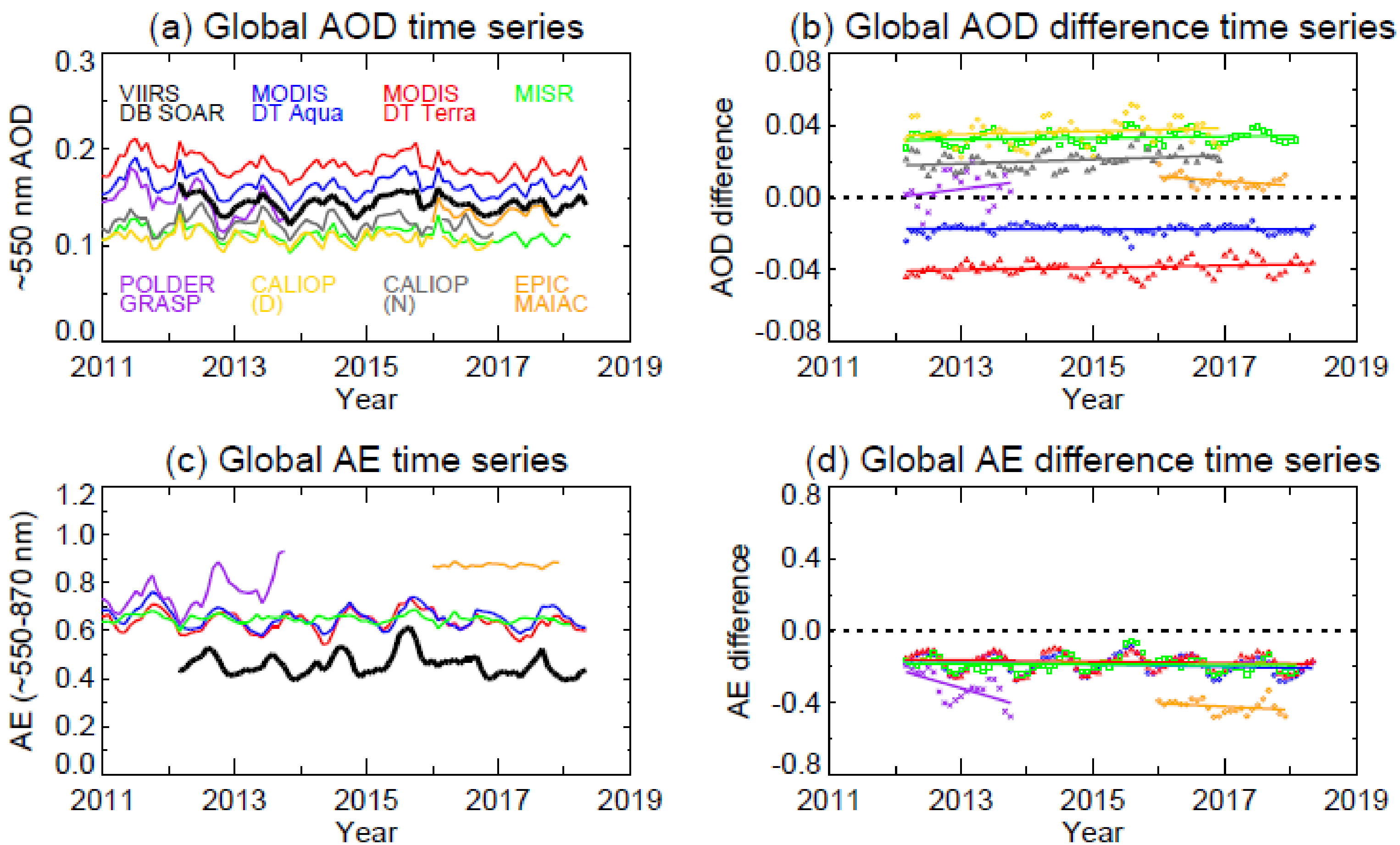
1. Calibration UV: X-cal. to OMPS – Herman et al., 2018;
Vis-NIR: X-cal. to MODIS – Marshak et al., 2018,
Geogdzhaev, Marshak, 2018.

2. The Multi-Angle Implementation of Atmospheric Correction (MAIAC) algorithm has been adapted to DSCOVR EPIC processing. MAIAC products include CM, AOD, FMF, water leaving reflectance at 340, 388, 443, 551, 680 and 780nm. All products are at 10km spatial resolution on global Sinusoidal grid.

3. The data available at LARC and EarthData (https://www.nesdis.noaa.gov/content/dscovr-deep-space-climate-observatory)
(https://epic.gsfc.nasa.gov/science/products/vis)

Aerosol Over Ocean

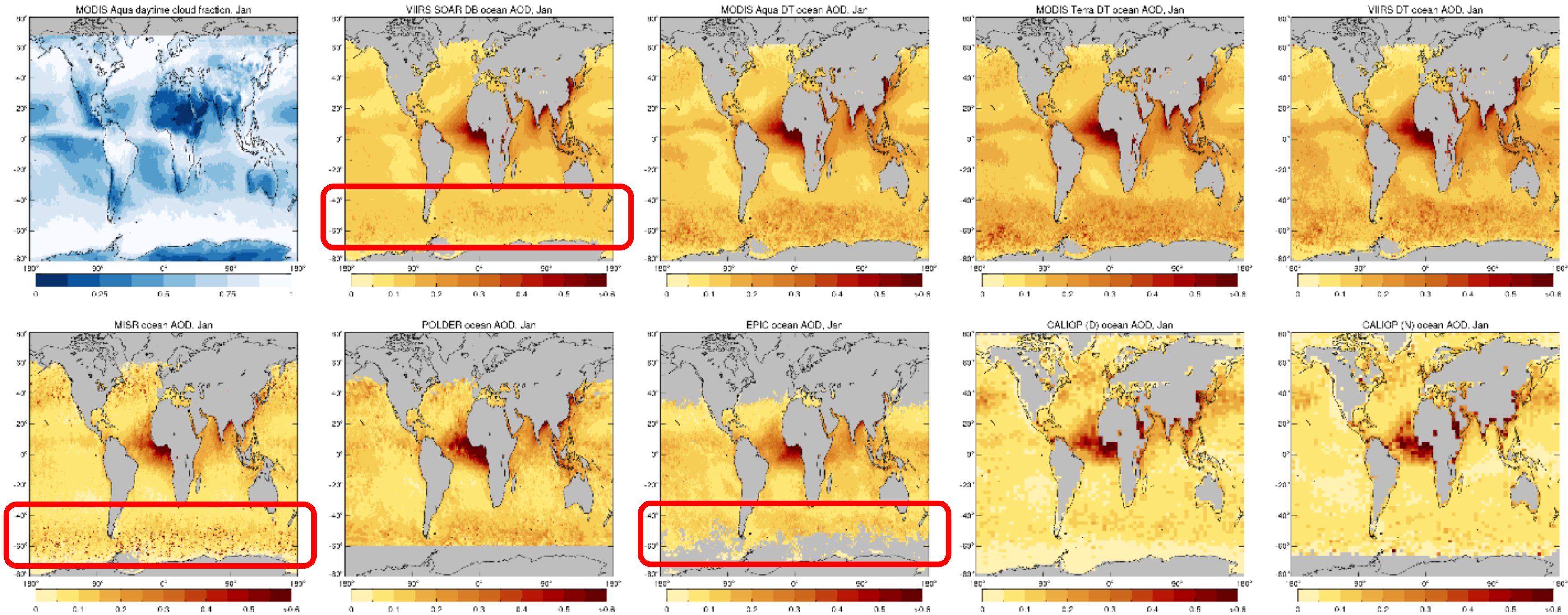
(courtesy of A. Sayer: Sayer et al. 2018, Validation of SOAR VIIRS over-water aerosol retrievals, and context within the global satellite aerosol data record, JGR, in review.)

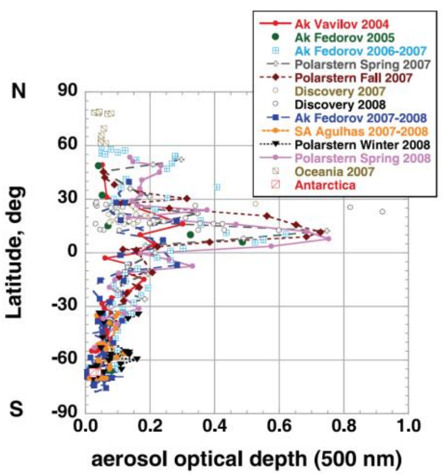


1. *MAIAC EPIC AOD is closest to SOAR among all products*
2. *MAIAC EPIC AE (FMF) is on the upper boundary of the "family" and lack of seasonality. 2 issues identified, will be corrected in V3.*

Cloud Detection *(from A. Sayer)*

January





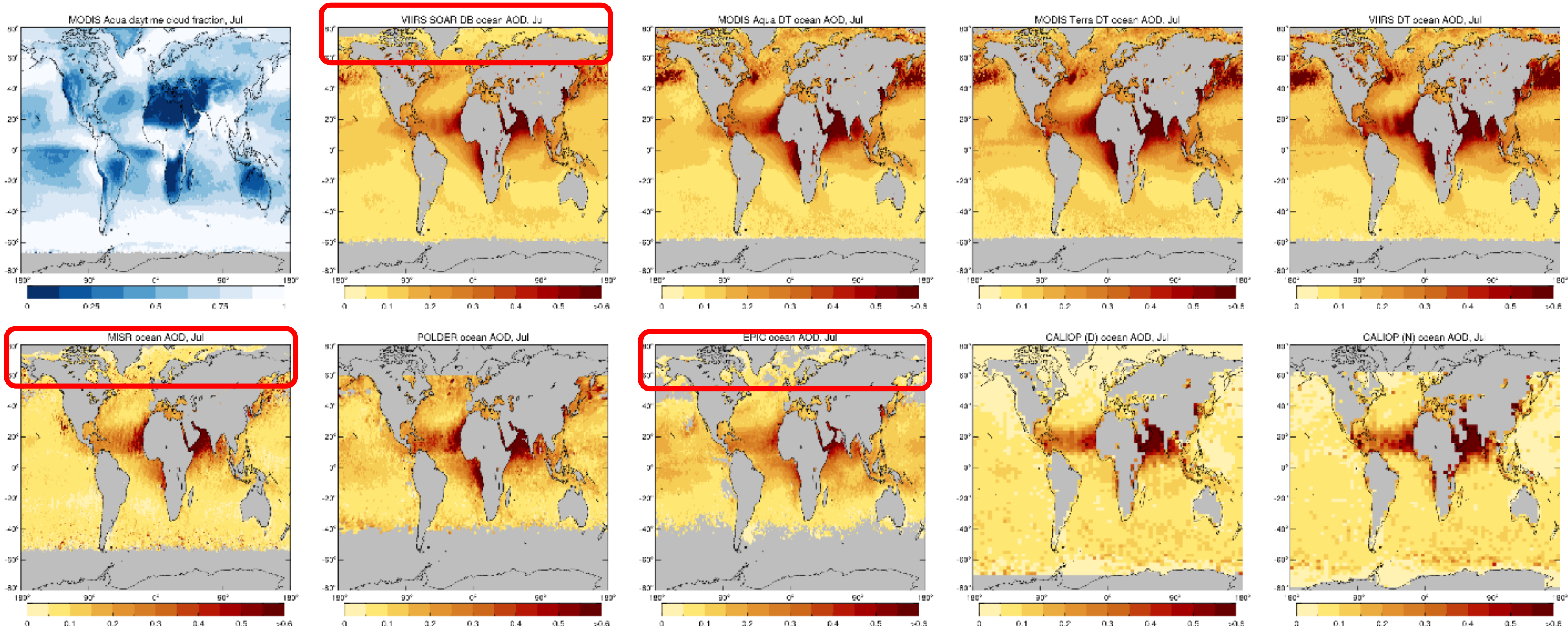
Smirnov et al., Marine Aerosol Network as a component of Aerosol Robotic Network, JGR, 2009

Performance Over Southern Ocean

1. *CM Ranking:* *SOAR (VIIRS)*, *MISR (filtered noise)*, *MAIAC EPIC*
2. *Agreement with MAN:* *MISR (filtered noise)*, *SOAR*, *MAIAC EPIC*

Cloud Detection *(from A. Sayer)*

July

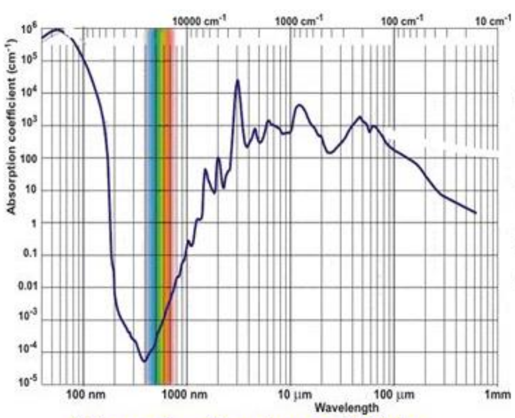


<u>Performance Over Arctic Ocean</u>

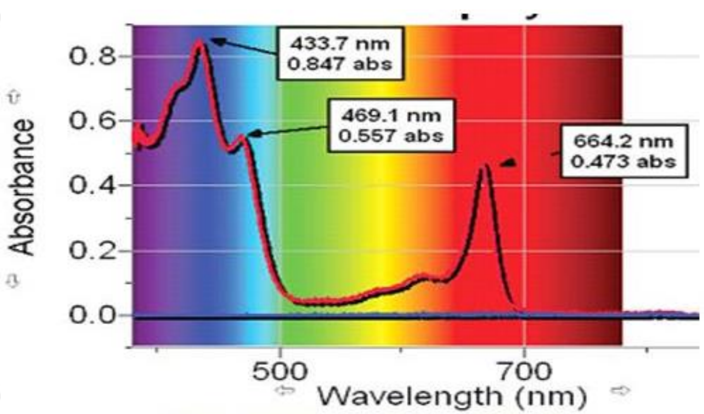
1. *CM Ranking:* *SOAR (VIIRS);*
   MISR;
   MAIAC EPIC

Intro into Ocean Optics in near-UV

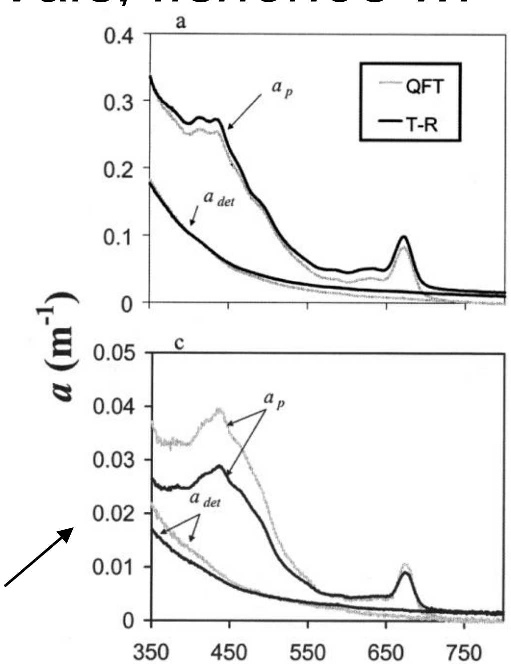
- *Min absorption of pure water at 418nm;*
- *Rapid increase of absorptance into UV;*
- *Strong Chl absorption at 388nm and 340nm;*
- *Even stronger absorption by CDOM (colored dissolved organic matter)*
- *More phytoplankton (eutrophic) – less $\rho^{w} \rightarrow$ upwelling regions*
- *Need to know for atm. gas & aerosol retrievals; fisheries …*



Absorption Spectrum of Water



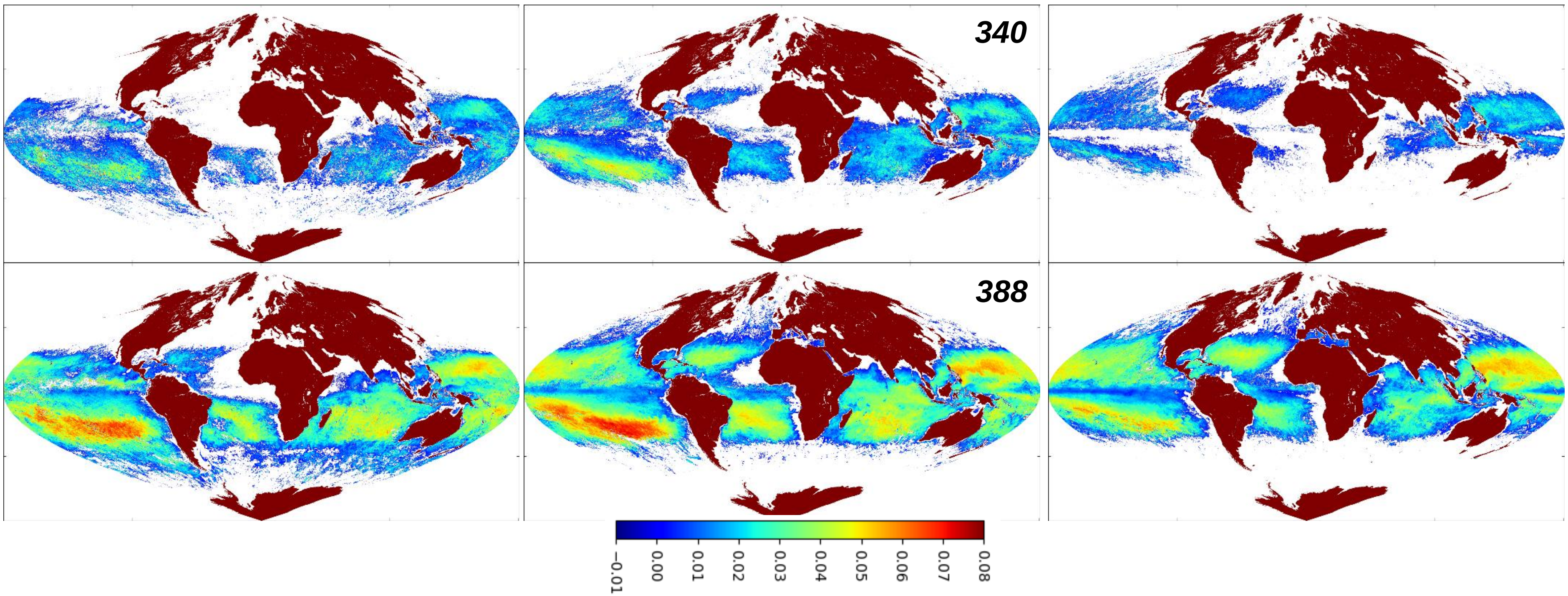
Specific Absorption Spectrum of [Chl]

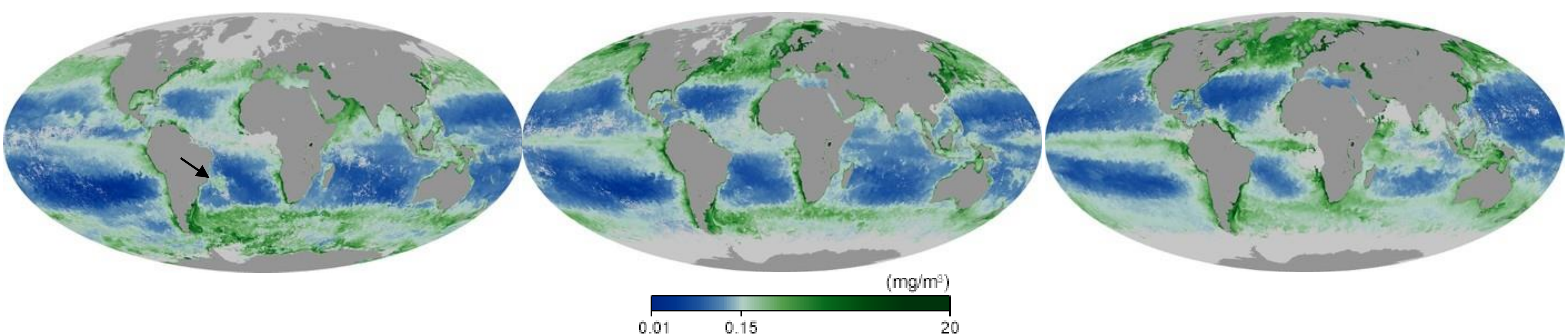


Measured absorption coeff. of phytoplankton and colored dissolved detrital and organic material, from ***Lohrenz et al., J. Plankton Research, 25, 35-61, 2003***

EPIC Monthly ρ^w vs MYD Chl

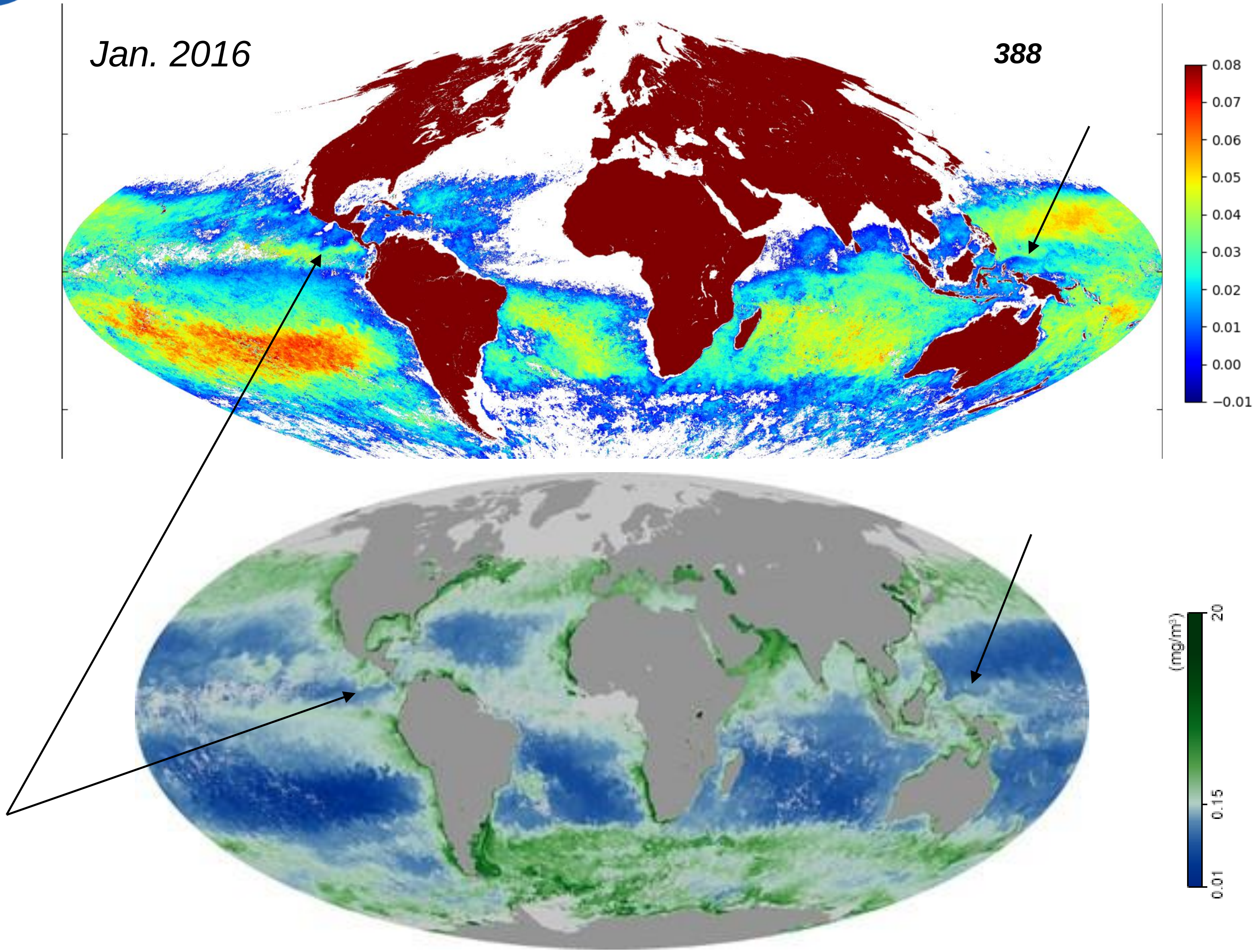
Jan. 2016 *Apr. 2016* *Aug. 2016*





Source: NASA Earth Observatory, Global Maps, Chlorophyll MODIS Aqua

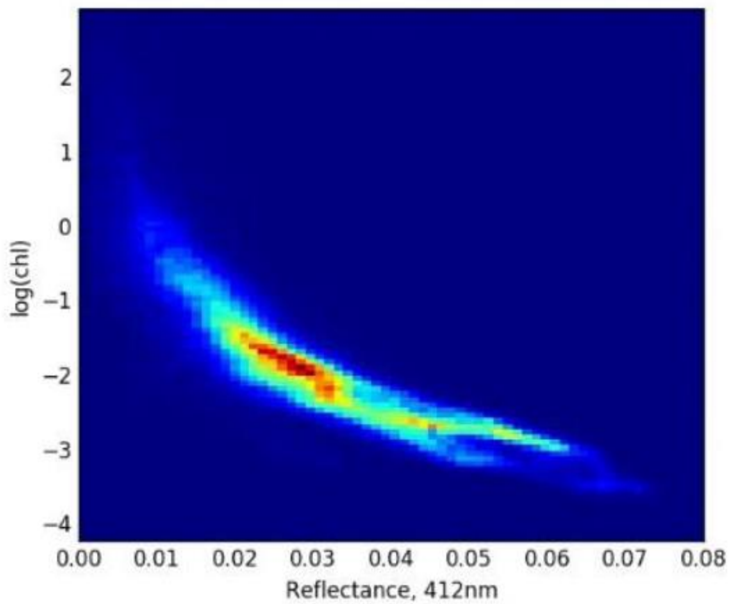
… in Detail



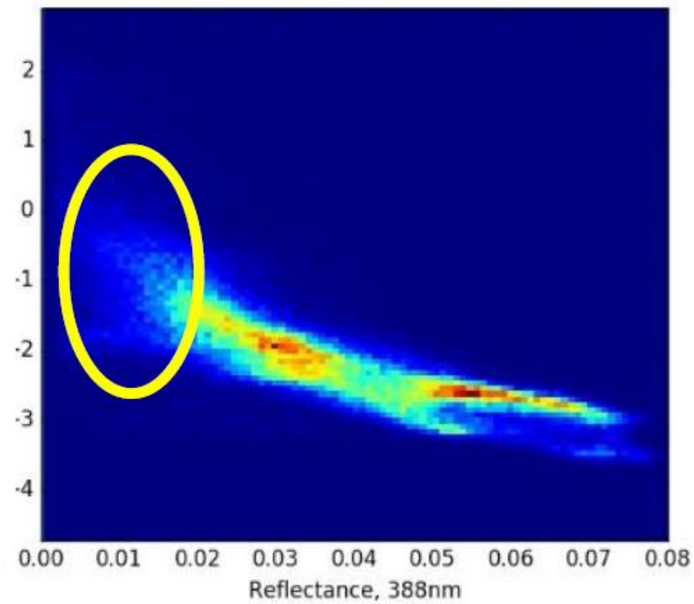
Jan. 2016
388
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
−0.01
(mg/m³)
20
0.15
0.01

Global ρ^w vs MYD Chl

MODIS Aqua 412nm



EPIC 388nm

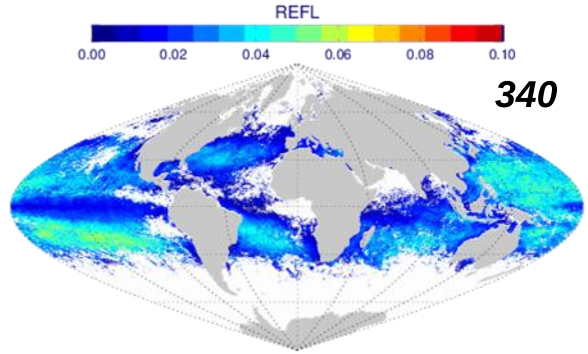


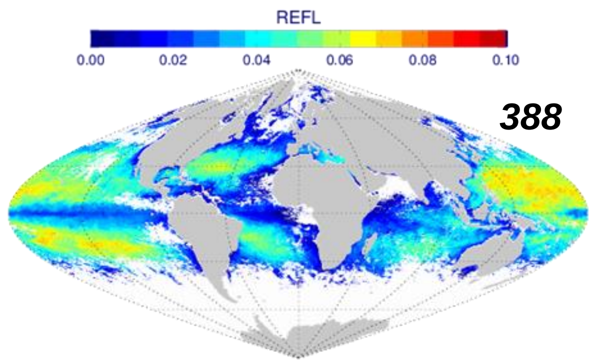
1. *Correlation coefficient ρ^w vs lg(Chl): 0.83 (MODIS 412nm): 0.82 (EPIC 388nm)*
2. *EPIC 388nm is much more affected by detritus+CDOM absorption*
3. *Use combination of MODIS Chl and ρ^w at 412nm with EPIC ρ^w at 388, 340nm to prototype Chl – CDM retrieval for PACE (e.g., Siegel et al., JGR, 2002)*

Comparison with OMI Climatology

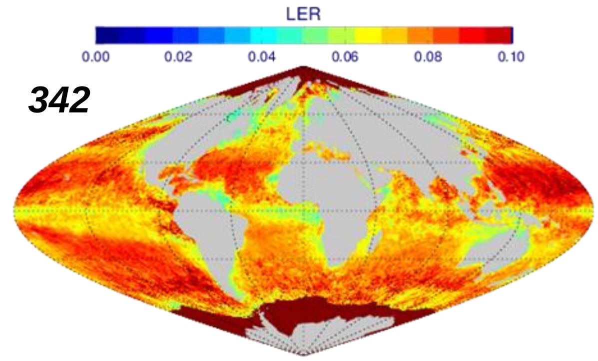
Vasilkov et al., UV Reflectance of the Ocean from DSCOVR/EPIC: Comparisons with a Theoretical Model and Aura/OMI Observations, J. Atm. Ocean Technol., submitted

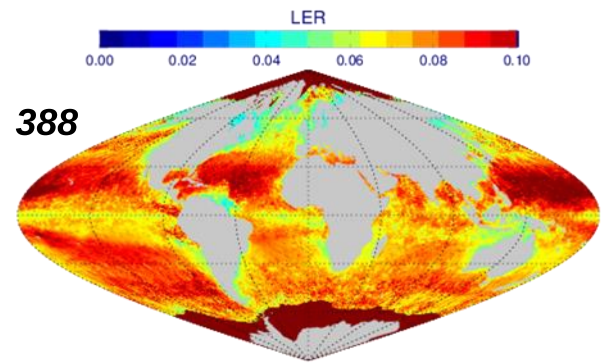
July 2016





2005-2009 min refl., July





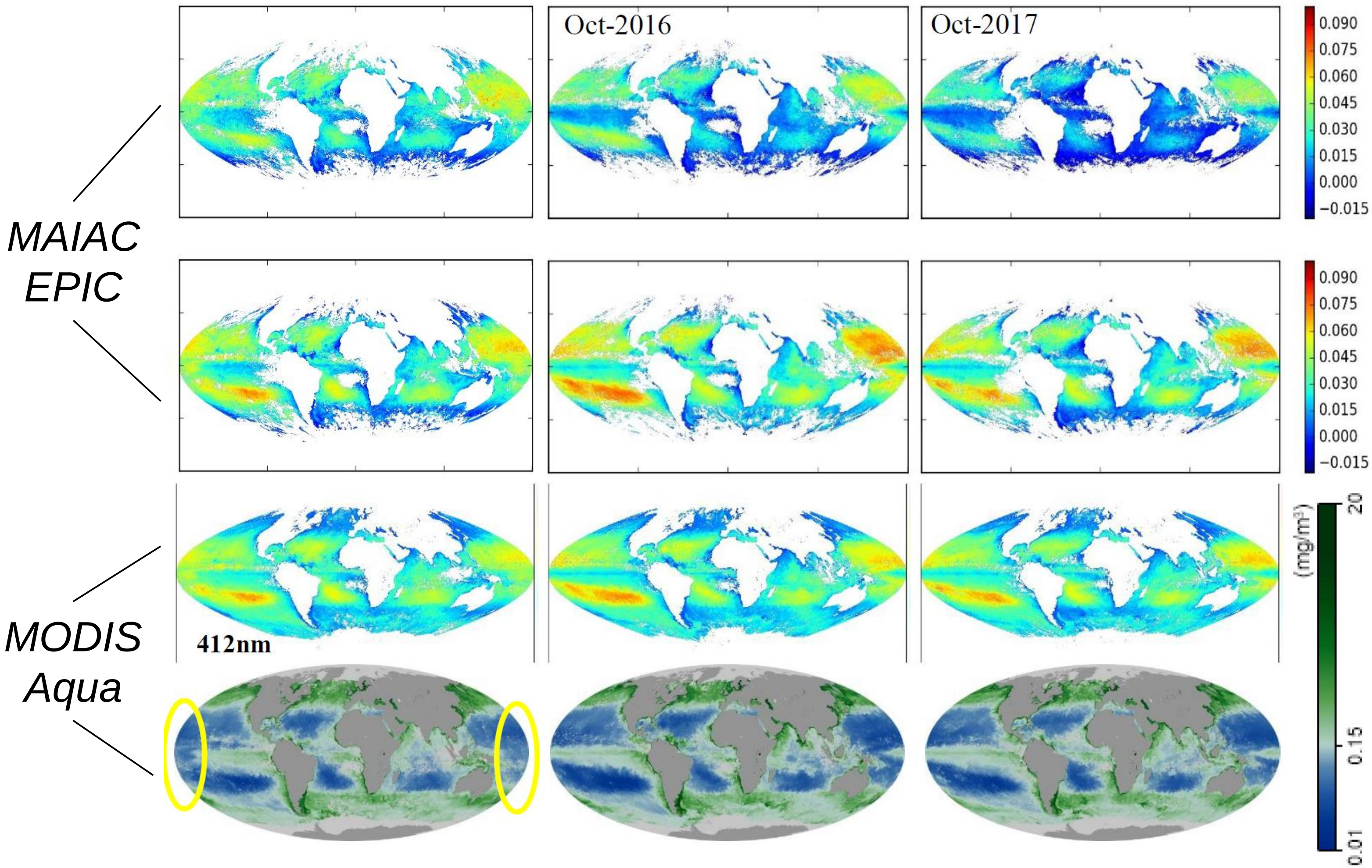
(*Kleipool et al., JGR, 2008*)

OMI ρ^w is higher by 0.04 because of contamination by aerosol and glint reflection of diffuse sky irradiance

Interannual Variability

Lyapustin, A., D. Huang et al., UV Ocean Reflectance from DSCOVR EPIC: Algorithm and Data Analysis, to be submitted, 2018.

From strong El Niño of 2015 which lingered into 2016, to a regular 2017.



1. MAIAC EPIC ρ^w shows short-term climate variations.
2. This vicarious analysis reveals small calibration bias at 340nm in 2015.

Conclusions

1. Cloud detection and aerosol algorithm performance over ocean are good: need to correct spectral dependence (FMF/AE).

2. The near-UV ρ^w has a strong spatial and seasonal inverse correspondence with MODIS Aqua Chl.

3. The quality of atmospheric correction ($\rho^w(\lambda)$) is reasonable: opportunity to explore CDOM (CDM) mapping of the global ocean using MODIS Chl as ancillary.

4. EPIC improves quality of ***monthly*** *ρ^w compared to the* ***multi-year OMI monthly*** *climatology.*

5. EPIC ρ^w shows both seasonal and interannual variability.

6. Several issues identified in validation/analysis will be fixed in V3. Plan to add new developments (e.g., full spherical RT etc.).

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