Phytoplankton composition algorithms for PACE

Cecile Rousseaux, Watson Gregg

Objective:
“Attempt to develop relationships between water leaving radiances and phytoplankton composition using a radiation model, in situ data, and an established global biogeochemical model”

This is achieved by:
1. **Using the Ocean-Atmosphere Spectral Irradiance Model (OASIM) to generate water leaving radiances for individual and assemblages of phytoplankton functional groups, as well as other optically active constituents (water, detrital material, CDOM, and particulate inorganic carbon)**
2. Using in situ phytoplankton composition data to develop an algorithm(s) and derive bias and uncertainty statistics
3. Using the NOBM to simulate a real environment, validate the algorithm and assess bias and uncertainty quantitatively
OASIM Atmosphere

(Gregg and Carder 1990, Slingo 1989, Gregg & Casey, 2008)

Winds, ozone, humidity, pressure, clouds, aerosols

Sea ice

Winds, precipitation

pCO\textsubscript{2}\text{atm}

\(E_u(\lambda)\), \(E_d(\lambda), E_s(\lambda)\)

\(a_w, b_w\) Smith and Baker 1981 (200-300 nm), (730-800 nm), Morel et al 2007 (325-475), Pope and Fry 1997 (500-720), Circio and Petty 1951 (800nm-2.5um), and Maul 1985 (2.5-4um). Lee et al 2015 (350-550) \(a_w\) only

\(b_b\) probability 0.5

\(a_c^*, b_c^*\) Morel 1987, Bricaud and Morel 1986 and Bricaud et al. 1988, Ahn et al. 1992 (mass-specific coefficients)

\(a_d^*, b_d^*\) Gallegos et al 2011 (mass-specific coefficients)

\(S_a=0.013\) Gallegos et al 2011

\(b_b\) probability Gallegos et al 2011

\(a_{CDOM}^*\) Yacobi et al 2003; Tzortziou et al 2007 (mass-specific coefficient)

\(S_{aCDOM}=0.014\) Gallegos et al 2011

\(b_{pic}\) Gordon et al 2009

\(b_b\) probability Balch et al 1996

ET irradiance Thiullier et al 2003

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Achievements:

- Running now with the MOM Circulation model instead of Poseidon (better spatial resolution, coverage of coastal waters >10m)
- Added dinoflagellates, *Phaeocystis*, CDOC
- Now assimilating not only chlorophyll but also aCDM (Maritorena) and PIC (Balch)
<table>
<thead>
<tr>
<th>Model</th>
<th>difference</th>
<th>r</th>
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<tr>
<td>Nitrate</td>
<td>-1.5%</td>
<td>0.978</td>
</tr>
<tr>
<td>Silicate</td>
<td>-0.2%</td>
<td>0.969</td>
</tr>
<tr>
<td>Iron</td>
<td>25.6%</td>
<td>0.695</td>
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<tr>
<td>Diatoms</td>
<td>17.4%</td>
<td>0.836</td>
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<tr>
<td>Chloro</td>
<td>-20.0%</td>
<td>-0.361</td>
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<td>Cyano</td>
<td>-3.2%</td>
<td>0.708</td>
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<tr>
<td>Cocco</td>
<td>7.0%</td>
<td>0.744</td>
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