Global Retrieval Algorithms for Phytoplankton Functional Types (PFTs): toward the Applications to OLCI and GlobColour Merged Products

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**Objectives**

We focus on PFT retrieval algorithms that are then applied to Sentinel-3 (S3) OLCI data and merged ocean colour (OC) products from CMEMS GlobColour archive:

- Two algorithms were investigated for their capability in PFT retrievals, namely the adapted generalized IOP (AGIOP) and the empirical orthogonal function (EOF)-based algorithm, using in situ measurements, matchups between in situ and satellite data, and satellite OC products.
- The retrieved PFTs (mainly the diatoms, haptophytes, prokaryotic phytoplankton (cyanobacteria)) based on in situ data sets are compared with the in situ diagnostic pigment analysis (DPA) based PFTs.
- The two algorithms are also preliminarily applied to the GlobColour merged OC products and OLCI data.

**Methods**

**Adapted Generalized IOP (AGIOP)**

- Adapted from GICP by Werdell et al. (2013), assuming that \(a_j(x)\) is a linear sum of subcomponents with unique spectral dependencies.
- \(a_j(x)\) is decomposed into absorption by 3 PFTs – diatoms, haptophytes, and cyanobacteria. Specific absorption of the three PFTs were obtained from natural waters where one PFT was dominating.
- Using \(R_m\) at different wavelengths and the spectral shapes of the IOPs as input, eigenvalues (the Chl-a concentrations of the 3 PFTs, \(a_{Sp}(440)\), and \(b_{Sp}(440)\)) can be derived via linear or nonlinear least squares inversions.

**EOF-based algorithm**

- Regressions between observed (obs) and predicted (pred) PFTs using EOF modes derived from GlobColour merged \(R_m\) products at 9 bands. Top panel: using \(R_m\) 1x1 pixel, bottom panel: \(R_m\) 7x3 pixels.

**Results**

**AGIOP**

- PFT retrievals from in situ \(R_m\) data sets. AGIOP conducted with NMS. \(R_m\) at OLCI bands.

**Conclusions**

- Both AGIOP and EOF based PFT retrieval algorithms can well retrieve diatoms and haptophytes but perform less accurate for cyanobacteria mainly due to their general low concentration resulting weak signal in the reflectance spectra.
- By both algorithms (especially EOF) total Chl-a were generally overestimated typically at small values therefore in oligotrophic regions for global retrievals.
- AGIOP generally works but is unstable when using different minimization inversion methods. Inversion by LMI is robust for global data but less coverage of valid retrievals.
- EOF outperformed the AGIOP from both prediction accuracy of in-situ matchups and valid retrieval coverage for global data.