A Net Primary Production (NPP) algorithm for application to PACE OCI

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Overarching goal

Develop an algorithm for estimating Net Primary Production (NPP)

Improvements over heritage approaches will derive from use of hyperspectral products available through PACE Project or other SAT efforts:

- phytoplankton absorption, $\boldsymbol{a_{ph}(\lambda)}$
- particulate backscattering, $\boldsymbol{b_{bp}(\lambda)}$
- Fluorescence Line Height, ***FLH***

Phytoplankton taxonomy and physiology are conveyed directly and indirectly through $\boldsymbol{a_{ph}(\lambda)}$ and $\boldsymbol{b_{bp}(\lambda)}$

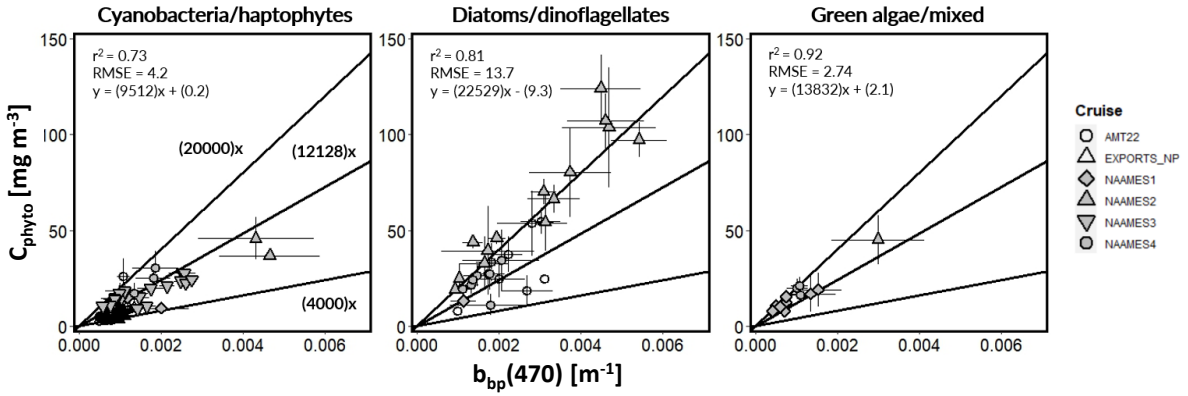
Unique physiology related to iron stress is conveyed in chlorophyll fluorescence signal ***(FLH)***

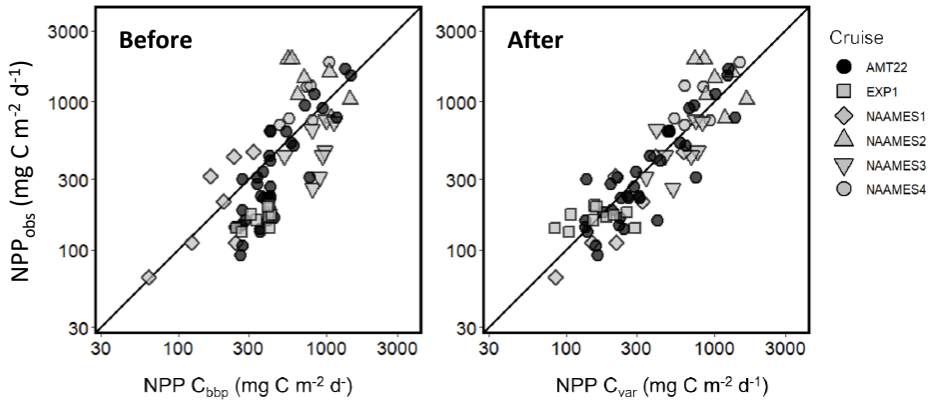
Efforts thus far

- Compiled NPP and μ "validation" datasets
- Compiled merged algorithm development dataset (mostly from NASA field campaigns, SABOR Ex., NAAMES, EXPORTS)
- **Exploratory analyses looking at $b_{bp}(\lambda)$, C_{phyto}, NPP and community composition**
- **Exploratory analyses linking FLH to NPP**
- Working with pyTOAST data to develop product pipelines
- Working on invited review article for *Earth-Science Reviews* (will include PACE-oriented vision for future)

Linking $b_{bp}(\lambda)$, C_{phyto}, and community composition

- C_{phyto}: b_{bp} should vary with particle characteristics (i.e., phyto community composition)
- If we stratify data based on HPLC measurements (Kramer et al., 2020), we get some sense of different C_{phyto} : b_{bp} across phyto groups
- We can use shape of $a_{ph}(\lambda)$ to estimate variable C_{phyto}:b_{bp}, and subsequently NPP





Improved NPP predictability

Fox et al., in review *L&O Letters*

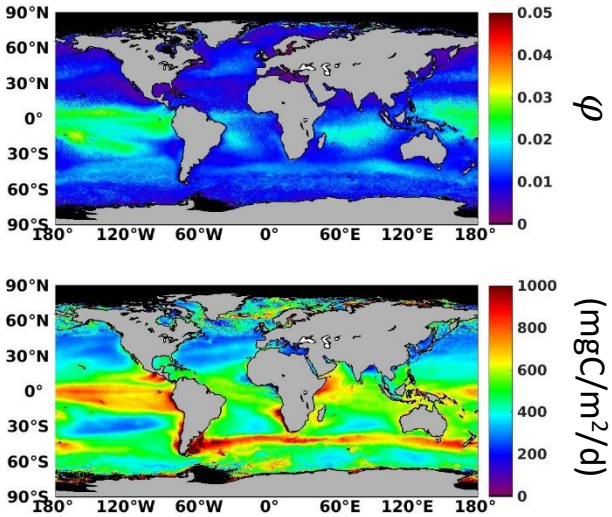
Chlorophyll fluorescence and NPP

- Iron availability limits NPP in ~1/3 of the global ocean
- FLH is linked to degree of iron stress (Behrenfeld et al., 2009, 2013; Westberry et al., 2013, 2016, 2019)

2 steps towards using PACE fluorescence signal to improve NPP estimates:

a. Improve FLH knowing $nL_w(\lambda)$

b. Use FLH to correct NPP for iron stress effects



Assume NPP reduction in presence of iron stress is linearly proportional to fluorescence quantum yield

$$\Delta NPP = \left(\frac{\varphi}{\varphi_{thresh}} - 1\right)$$

∫ΔNPP = 10.9 Pg C