BiO GO-SHIP

Sustained Global Scale Biological Observations

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Are ocean plankton biodiversity and their ecosystem functions affected by climate change?

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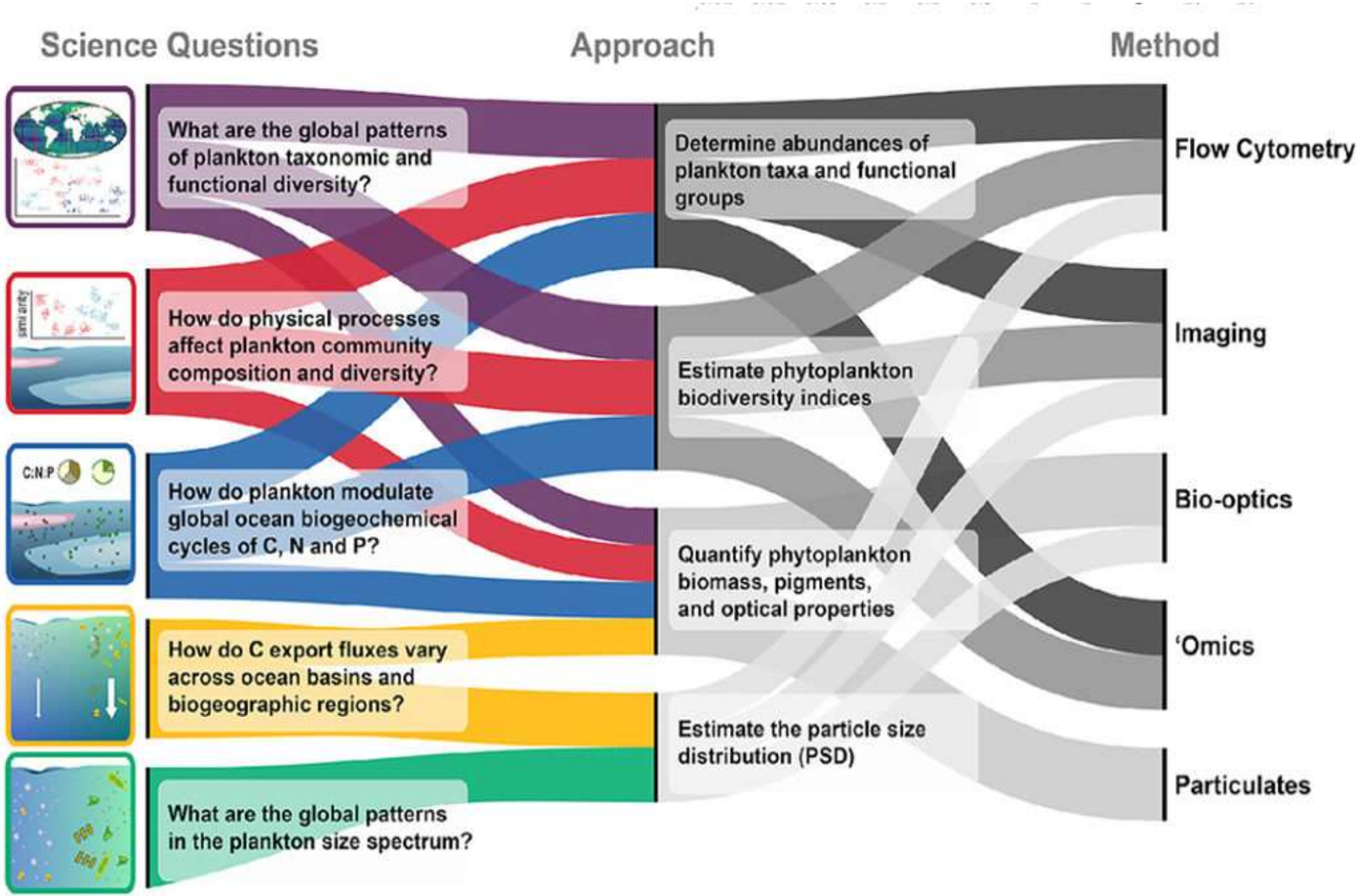
The **vision** of **Bio-GO-SHIP** is to develop a deep understanding of the link between the physio-chemical environment and the *diversity of global ocean plankton* and their *biogeochemical roles* in the context of a changing ocean.


Science Questions
Approach
Method
What are the global patterns of plankton taxonomic and functional diversity?
How do physical processes affect plankton community composition and diversity?
How do plankton modulate global ocean biogeochemical cycles of C, N and P?
How do C export fluxes vary across ocean basins and biogeographic regions?
What are the global patterns in the plankton size spectrum?
C:N:P
Determine abundances of plankton taxa and functional groups
Estimate phytoplankton biodiversity indices
Quantify phytoplankton biomass, pigments, and optical properties
Estimate the particle size distribution (PSD)
Flow Cytometry
Imaging
Bio-optics
'Omics
Particulates

Growing international effort

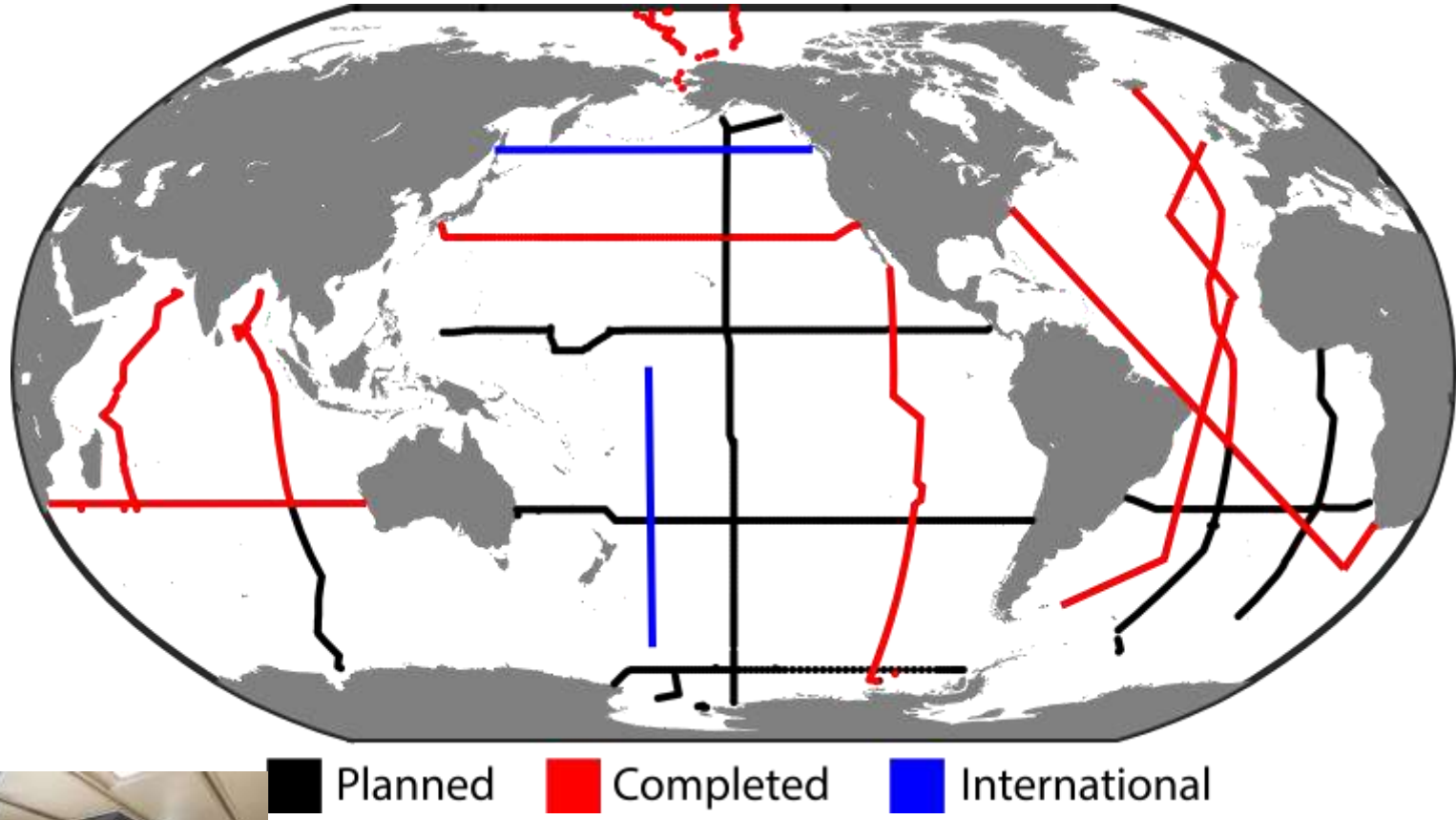
Started in 2016 w. I09N

Completed 10 sections (+1 ongoing)

Largest pelagic ocean assessment of biodiversity

International partners

Supporting opportunities for diverse students



Initial phase has revealed many challenges

- Measurement standardization
  - We are working with the wider research community on intercalibration, validation, and protocol development
- Data sharing
  - We hosted a NOAA supported workshop to initiate store and share the diverse forms of biological observations. We now have several working groups aimed at organizing data sharing.
- Stakeholder products
  - We have formed working groups to develop higher-level data products

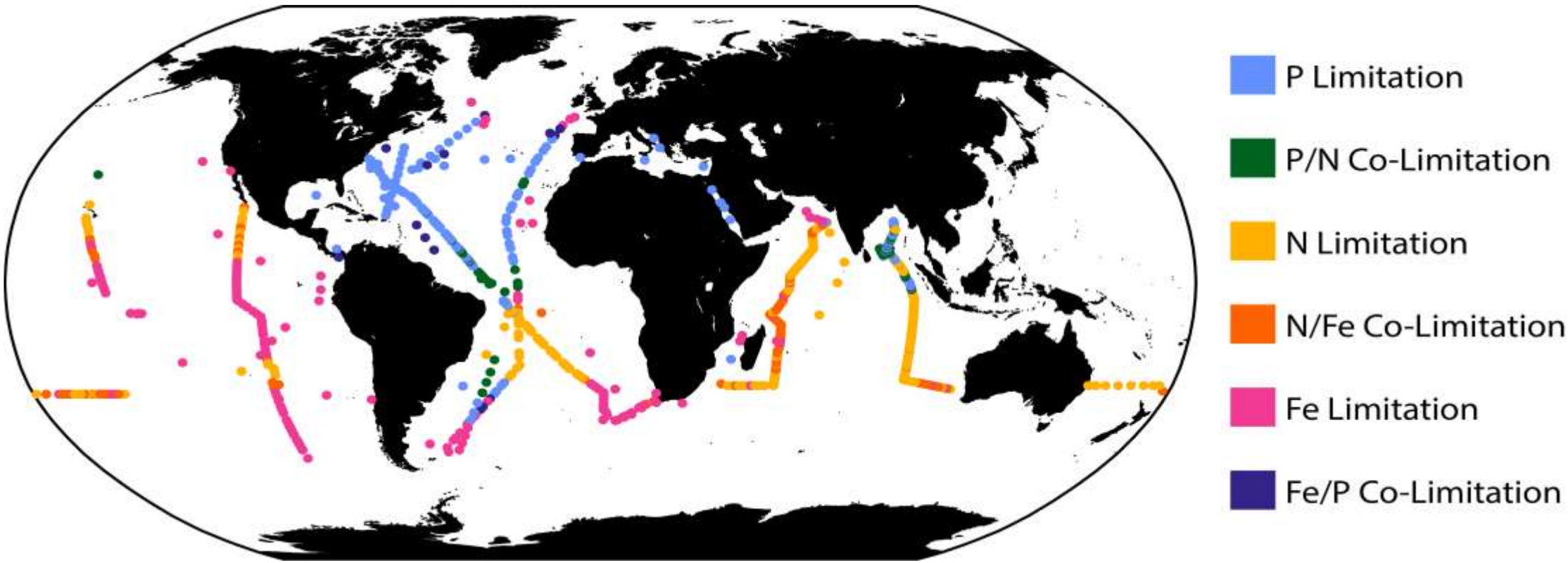
    (e.g., size structure, biodiversity, biogeochemical indices)

RESEARCH

OCEAN MICROBIOLOGY

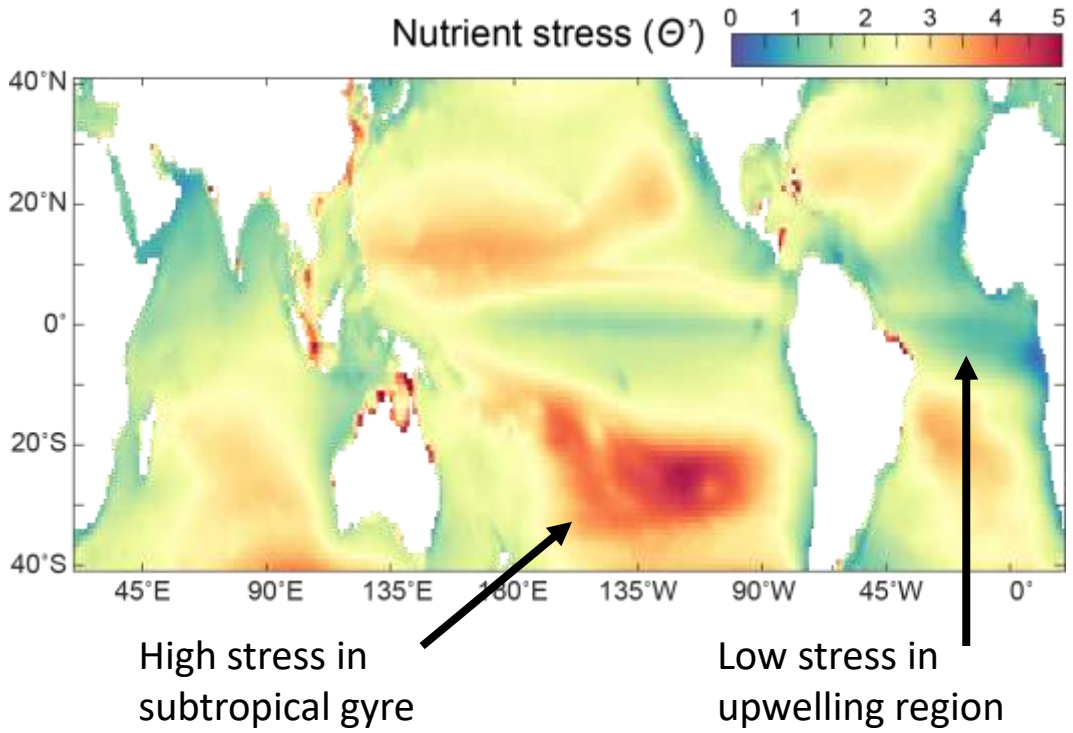
Metagenomic analysis reveals global-scale patterns of ocean nutrient limitation

Lucas J. Ustick[1]†, Alyse A. Larkin[2]†, Catherine A. Garcia[2], Nathan S. Garcia[2], Melissa L. Brock[1], Jenna A. Lee[2], Nicola A. Wiseman[2], J. Keith Moore[2], Adam C. Martiny[1,2]*

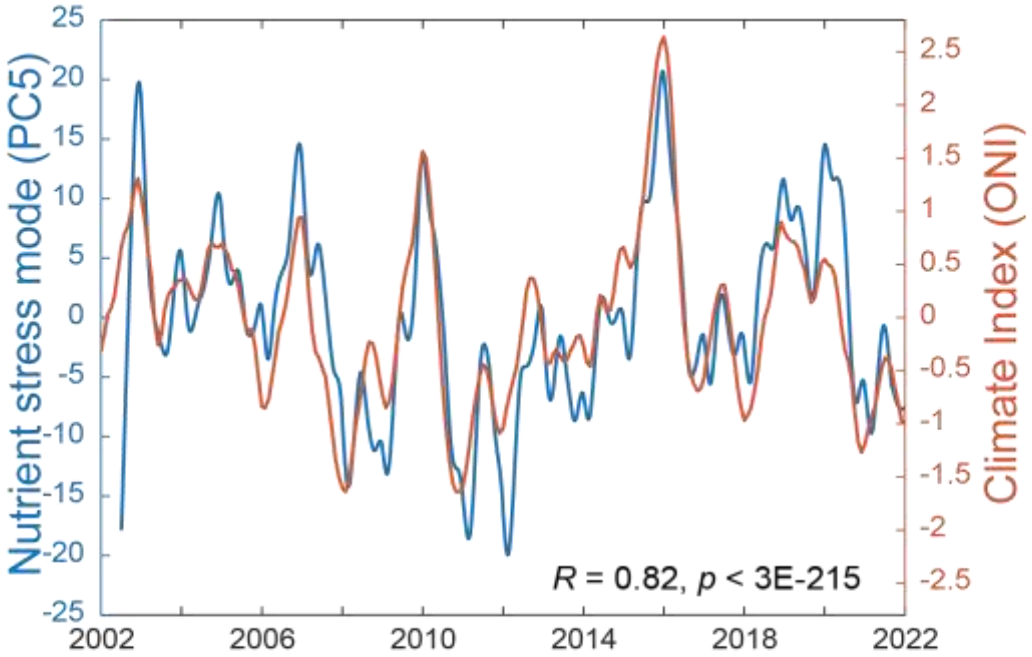


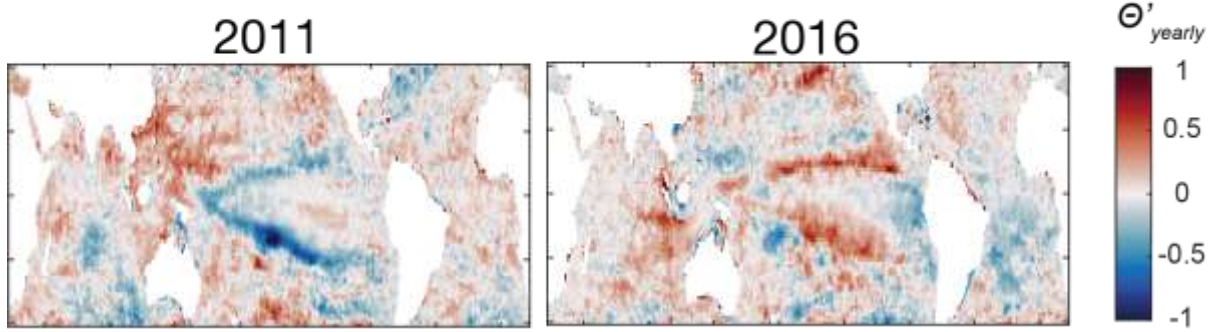
Genomic biomarkers describe type and severity of nutrient stress

Integration of genomics and satellite remote sensing provide first global nutrient stress product



Top multi-annual mode follows ONI (ENSO cycles)





Martiny, Ustick, Westberry, Behrenfeld. Genomic-to-space measurements reveal global ocean nutrient stress. In review, *Nature*.

Summary

- Sustained biological parameters are chronically undersampled in time and space, specifically Essential Ocean Variables (EOVs).
- Mature technologies exist enabling consistent and routine observations of biological EOVs.
- A ship-based global biological observing program will form the backbone for supporting innovation in new biological sensors and sampling technologies.
- QA/QC, methods intercalibration and a clear and consistent data policy is key to making biological data FAIR, this will drive new innovations in model parameterization, data science and cal/val.
- Integration between GO-SHIP and Bio-GO-SHIP facilitate novel ways of detecting ocean changes