



# Sea to Space Particle Investigation

Chasing that beautiful little phytoplankton

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<https://schmidtocean.org/cruise/sea-space-particle-investigation>

# PHYTOPLANKTON

*Many shapes, colors and sizes..  
Those traits define their role in oceanic  
ecosystems and carbon cycle*

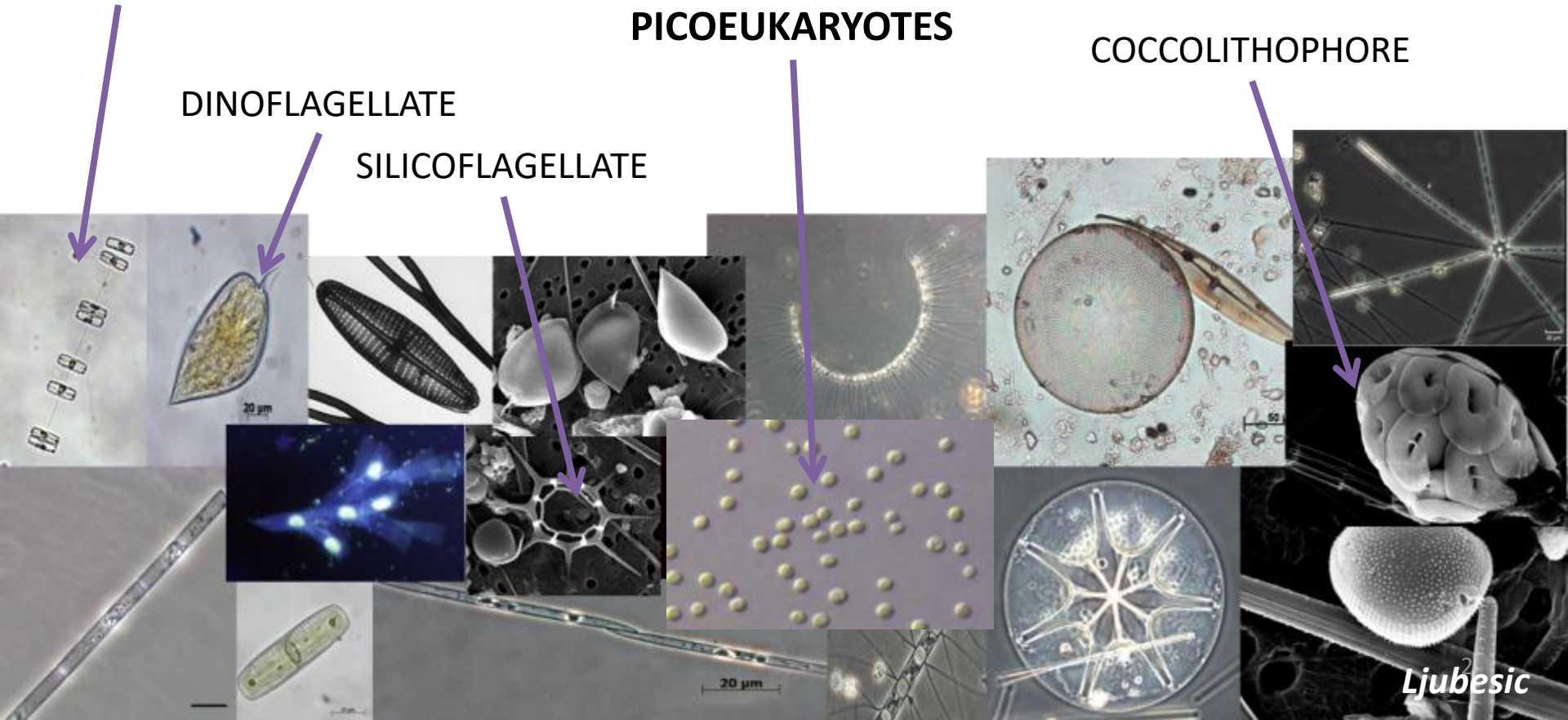
DIATOM

PICOEUKARYOTES

COCCOLITHOPHORE

DINOFLAGELLATE

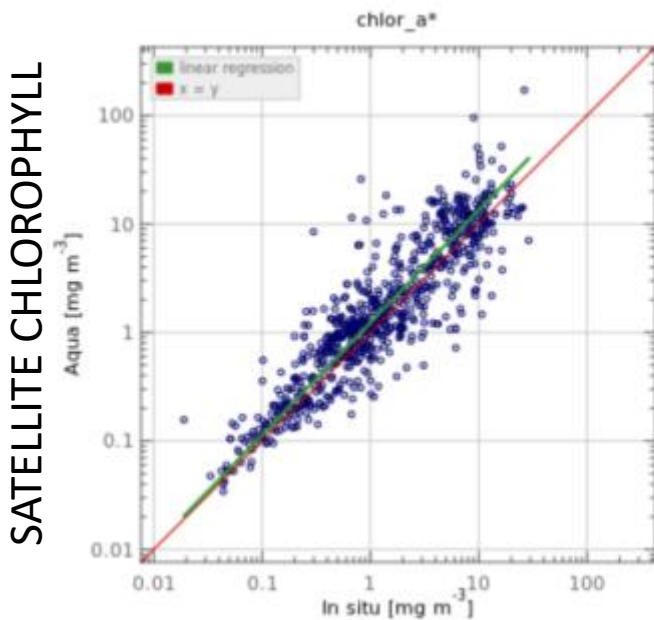
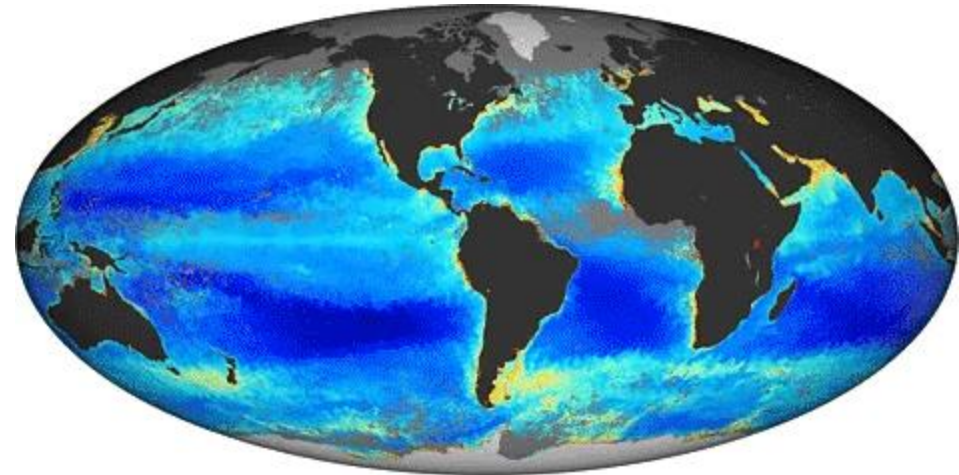
SILICOFLAGELLATE





# Quantity?

- Phytoplankton biomass from space
  - Chlorophyll – pigment of life



MODIS Chlorophyll 2009-2012

In Water CHLOROPHYLL

<https://seabass.gsfc.nasa.gov/>



# Quality over Quantity?

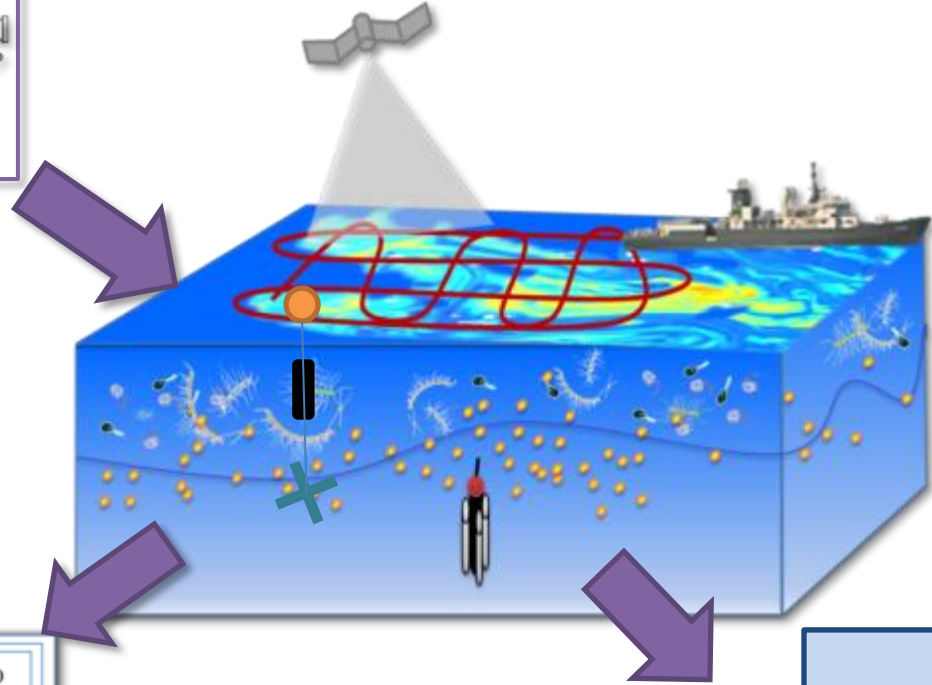
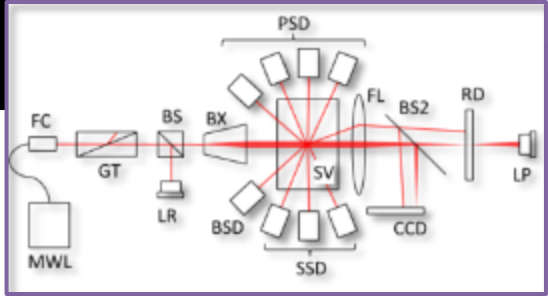
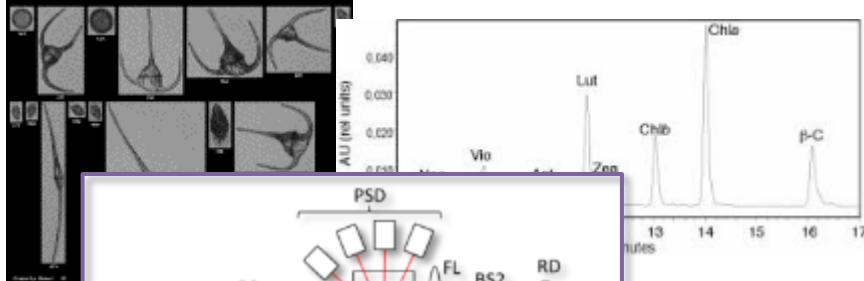
- Seeing types of phytoplankton from space ... is not that easy..
- There are many phytoplankton type algorithms
- Limitation of current approach(es):
  - Active ocean color satellites see only several colors of the visible spectra (5 – 7 wavelengths)
  - Lack of good validation datasets (time consuming, expensive, many different methods)



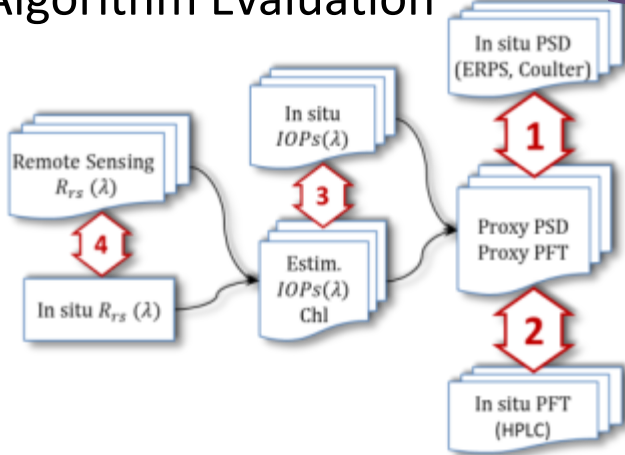
# What can we do?

- Build a better satellite
  - in progress – PACE hyperspectral ocean color satellite being build at NASA GSFC  
<https://pace.gsfc.nasa.gov/>
- Gather better ground-truth datasets and evaluate the performance of the current phytoplankton type algorithms over diverse range of oceanic ecosystems

# What will we do?



## Algorithm Evaluation

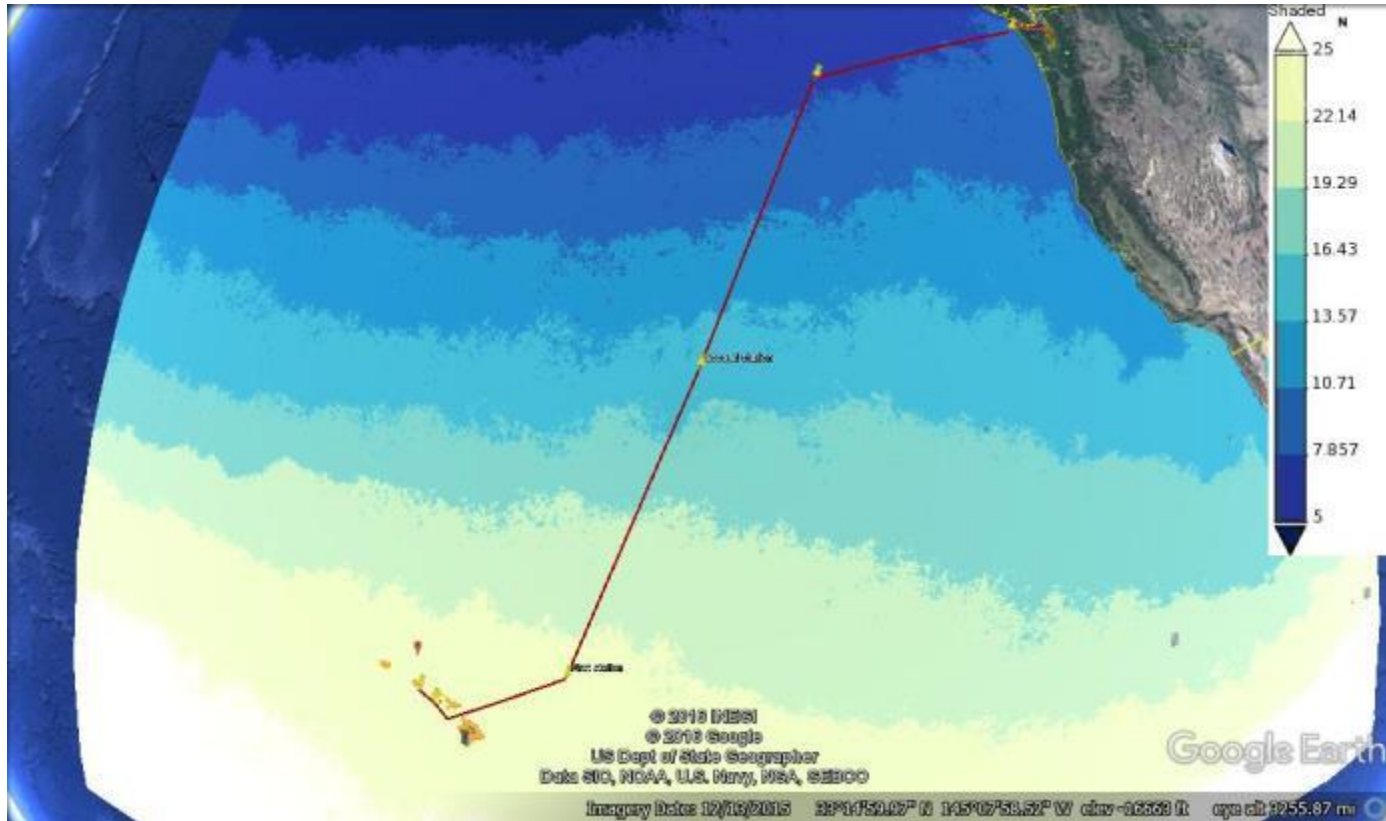


Carbon Cycle  
(Carbon uptake, carbon consumption, carbon export)





# Where will we go? When?

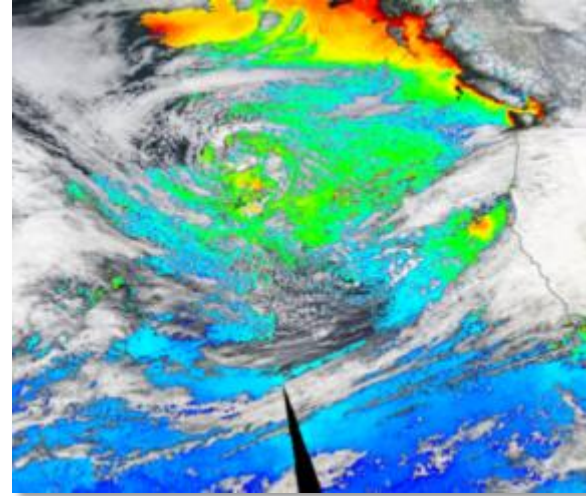


Hawaii to NW US, Jan 24 – Feb 20, 2017

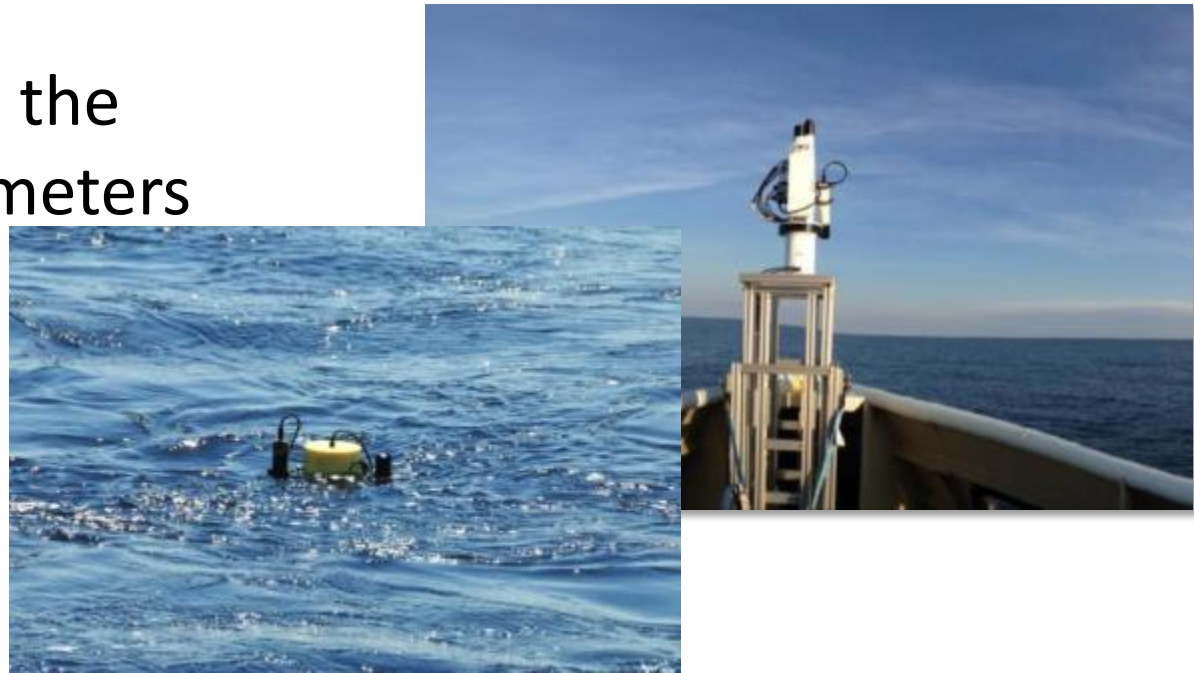


# Measuring ocean color

- Ocean color satellites
  - MODIS Aqua & Terra
  - VIIRS
  - Landsat
- Ocean color from the ship – with radiometers
  - Continuous
  - On stations



MODIS  
Chlorophyll,  
Jan 10, 2017

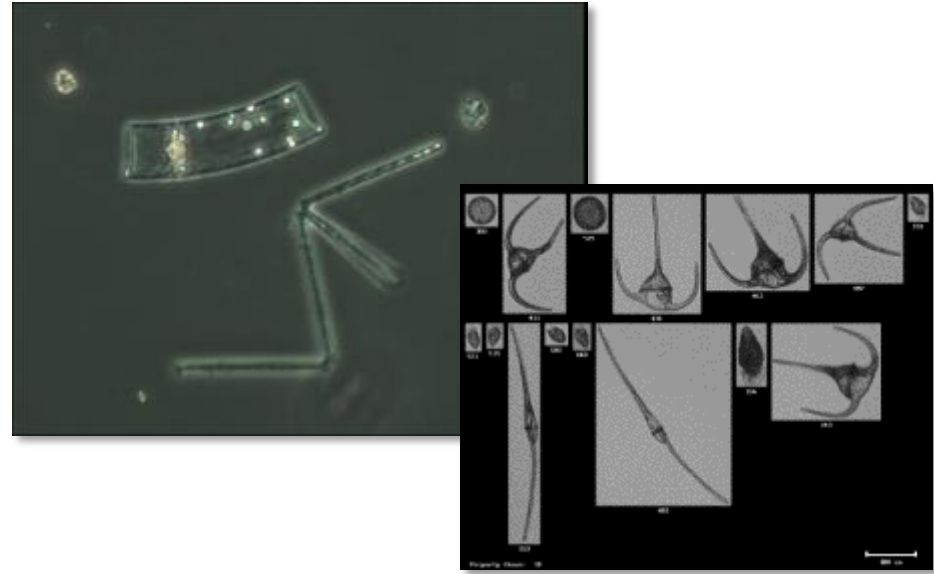




# Measuring phytoplankton

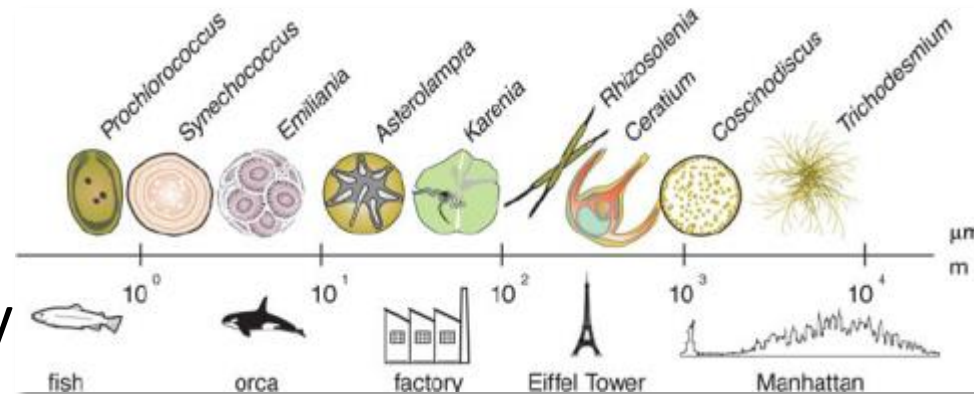
## Imagery

- Continuously + vertical profiles on the station
  - Flowcam, Imaging flow cytobot, Holographic (3-D) camera, classical microscopy
  - Calculation of Carbon



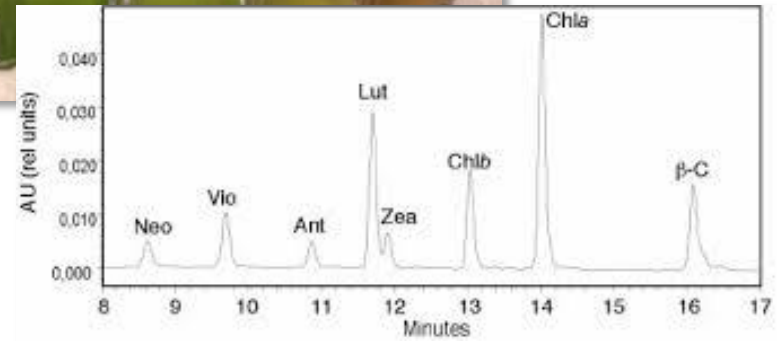
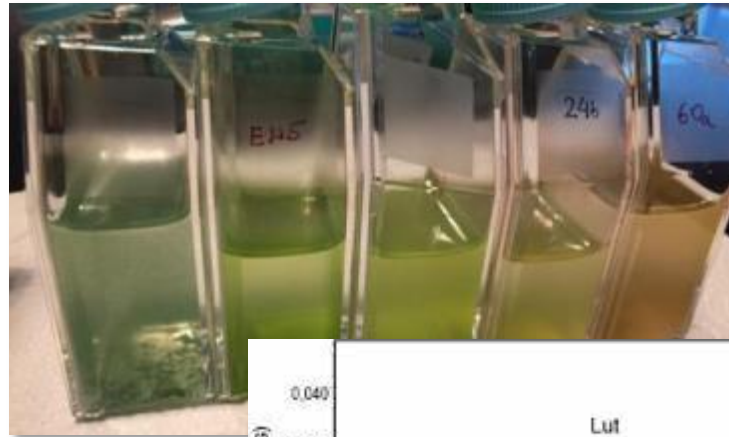
- Particle size distribution

- newly developed instrument – funded by NASA



# Measuring phytoplankton

- Pigments
  - High Performance Liquid Chromatography (HPLC)
- Molecular tools
  - 18s and 16s rRNA



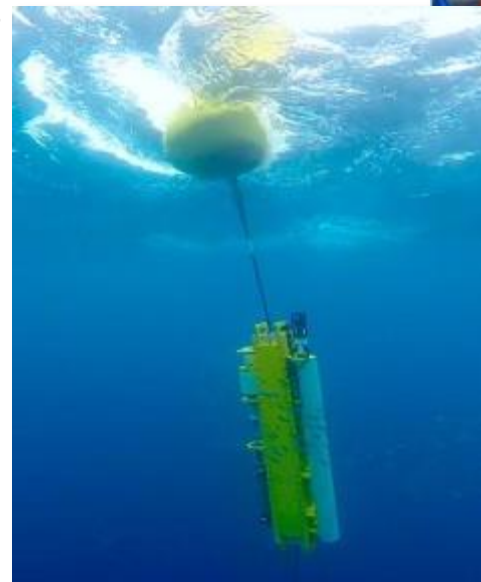


# Many other measurements

- Physical and Optical parameters
- Carbon cycle parameters



<https://schmidtocean.org/cruise/sea-space-particle-investigation>



Wirewalker



Bio-optical  
Profiling Float

# Sea to Space Particle Investigation

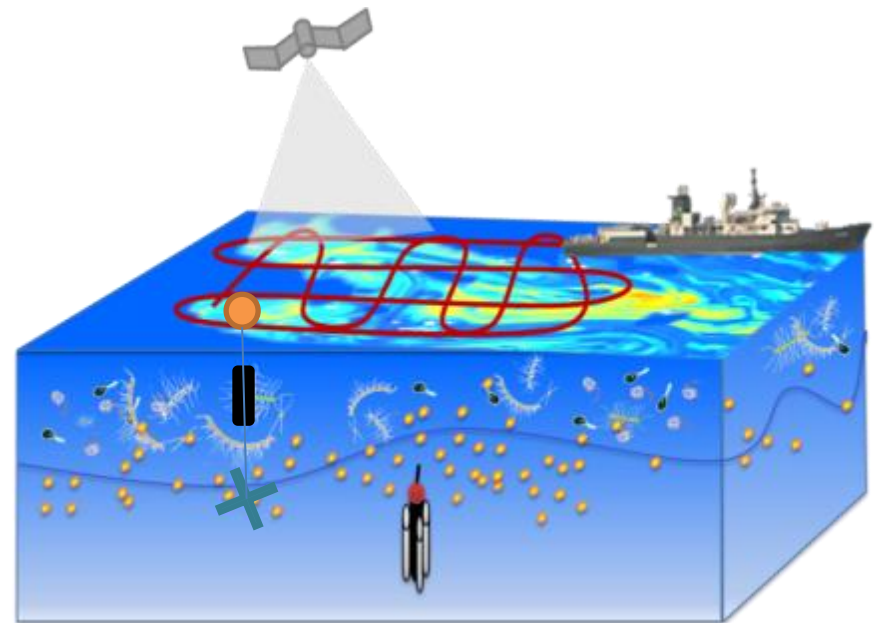
Chasing that beautiful little phytoplankton

Understand the uncertainties in remote sensing estimates of phytoplankton types, with the emphasis on carbon cycle and ecosystem roles...

Schmidt Ocean Institute R/V Falkor

Hawaii to Portland

Jan/Feb 2017



# Phytopia – dive into the phytoplankton

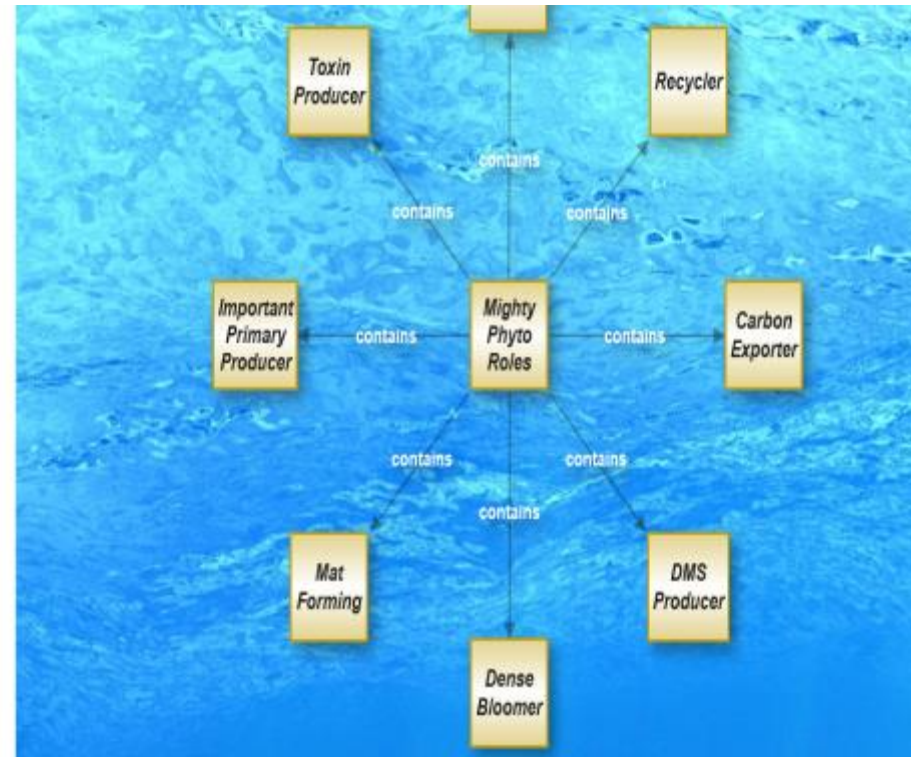
<https://pace.oceansciences.org/phytobia.htm>

- Interactive online tool
- Exploration of:
  - physical characteristics
  - distribution,
  - harmfulness,
  - classification system (taxonomy),
  - pigments and storage products.





# Phytopia – Mighty Phytos





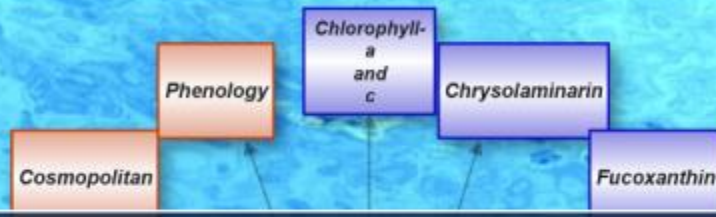
# Emiliana huxleyi

CHARACTERISTICS





# Emiliana huxleyi

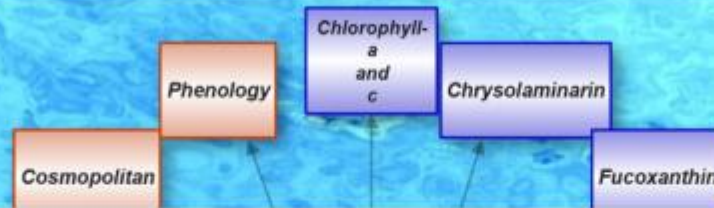


Blooms of *Emiliana huxleyi* trap carbon in their coccolith plates, which can sink to the ocean floor. Over geologic time, this accumulation process has formed limestone and chalk. Large blooms can turn the seas an opaque turquoise color, reflecting sunlight and slightly cooling the ocean. This species emits large quantities of a compound called dimethyl sulfide (DMS) that enhances cloud formation, influencing weather and reducing sunlight available for photosynthesis. Thus it may play a significant role in climate change and the oceanic carbon cycle. *Emiliana huxleyi* cell diameter is 5-10 micrometers and diameter of individual coccolith plates is about 3 micrometers.



Information about the parameter (species) in focus (central box)

# Emiliana huxleyi



Objective Lens Magnification    Epifluorescence    **SEM**    X

Carbon Exporter    low property    low property    Oil or Lipids

**SEM**

DMS Producer

Coc

Images on different magnifications (for some species videos)



# Emiliana huxleyi

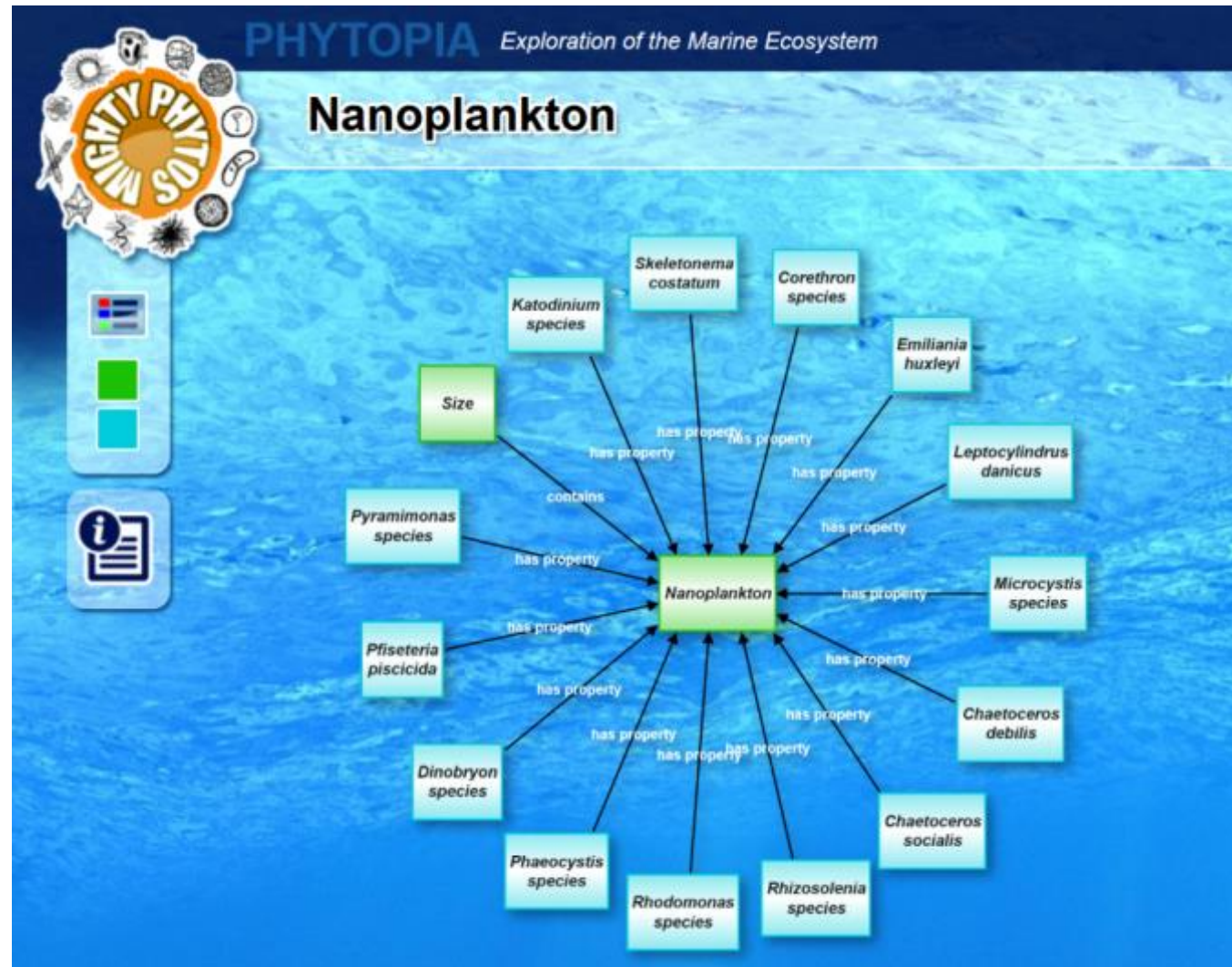




# Phytopia – web of information

<https://pace.oceansciences.org/phytopia.htm>

Use it as  
a learning  
tool,  
a teaching  
tool,  
or just go and  
dive in ...



# Learn more:

- **Feb 1: 2pm EST shipboard webinar for students (45 min) – EarthEcho**
- **Feb 6: 2 *pm EST*- Facebook live on @NASAEarth**
- **Feb 15: 7pm EST shipboard webinar for educators**

**Check out Stephanie Uz slides from earlier webinars – more links with awesome citizen science material**