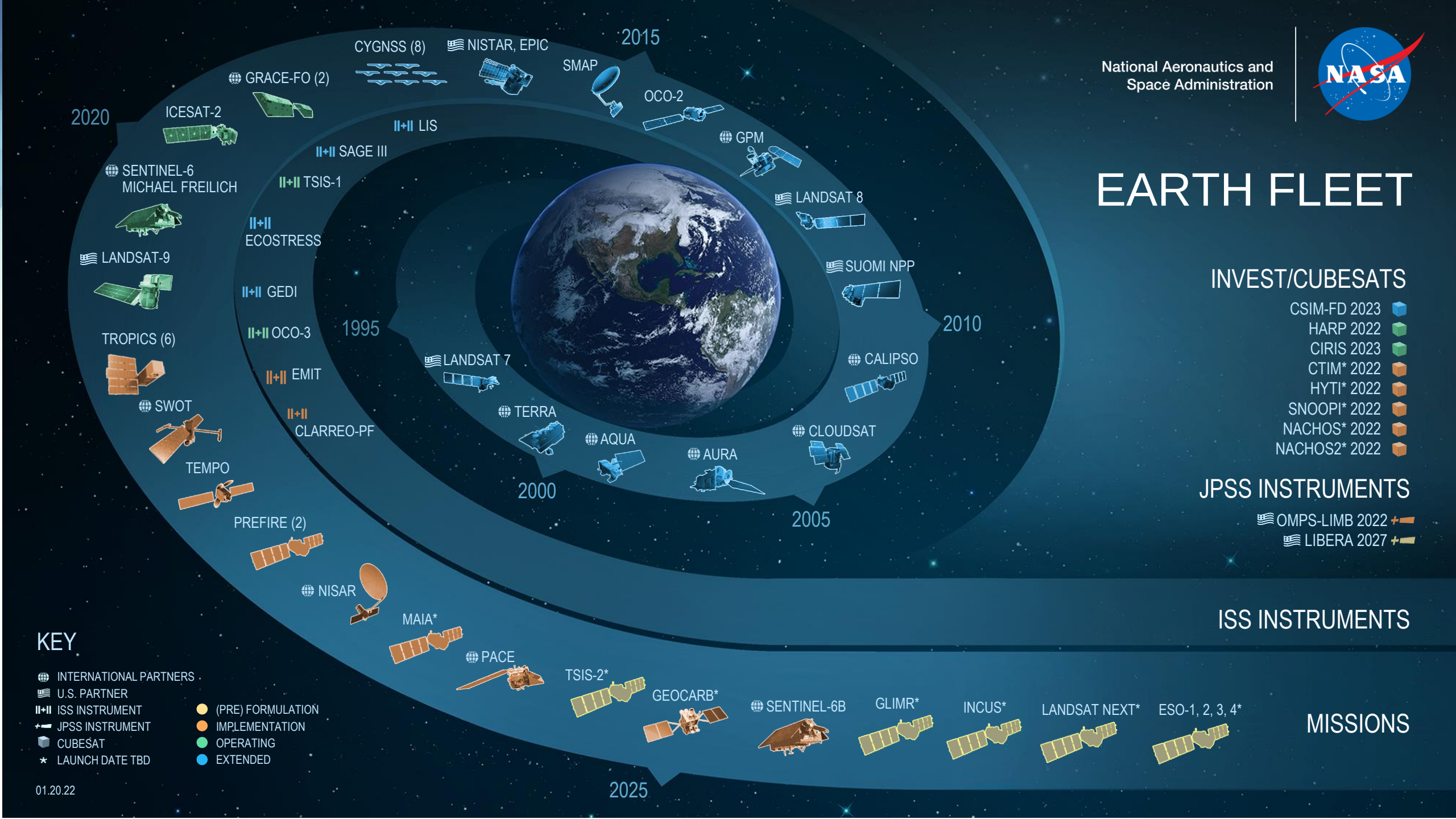
NASA Ocean Carbon Initiatives

Laura Lorenzoni
Ocean Biology and Biogeochemistry Program

Tug of war between winter and spring on the heart-shaped Lake St. Clair along the U.S./Canadian border near Detroit.

Landsat 8 image acquired on March 6, 2021; natural color composite.

https://mars.nasa.gov/free-holiday-ecard/love-valentine/#Send-A-Card
https://svs.gsfc.nasa.gov/12861
https://svs.gsfc.nasa.gov/14094


National Aeronautics and Space Administration
NASA
EARTH FLEET
2015
2020
1995
2010
2000
2005
2025
CYGNSS (8)
NISTAR, EPIC
SMAP
OCO-2
GRACE-FO (2)
ICESAT-2
LIS
SAGE III
GPM
SENTINEL-6 MICHAEL FREILICH
TSIS-1
LANDSAT 8
ECOSTRESS
LANDSAT-9
SUOMI NPP
GEDI
TROPICS (6)
OCO-3
LANDSAT 7
CALIPSO
EMIT
SWOT
TERRA
CLOUDSAT
CLARREO-PF
AQUA
AURA
TEMPO
PREFIRE (2)
NISAR
MAIA*
PACE
TSIS-2*
GEOCARB*
SENTINEL-6B
GLIMR*
INCUS*
LANDSAT NEXT*
ESO-1, 2, 3, 4*
INVEST/CUBESATS
CSIM-FD 2023
HARP 2022
CIRIS 2023
CTIM* 2022
HYTI* 2022
SNOOPI* 2022
NACHOS* 2022
NACHOS2* 2022
JPSS INSTRUMENTS
OMPS-LIMB 2022
LIBERA 2027
ISS INSTRUMENTS
MISSIONS
KEY
INTERNATIONAL PARTNERS
U.S. PARTNER
ISS INSTRUMENT
JPSS INSTRUMENT
CUBESAT
LAUNCH DATE TBD
(PRE) FORMULATION
IMPLEMENTATION
OPERATING
EXTENDED
01.20.22

PACE
Plankton, Aerosol, Cloud, ocean Ecosystem

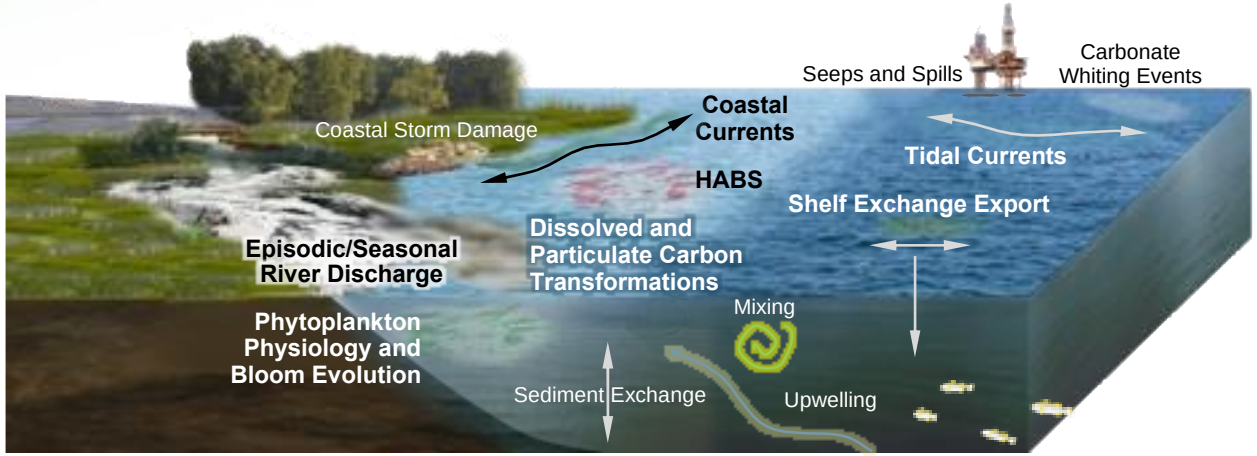
GLIMR – Geostationary Littoral Imaging and Monitoring Radiometer

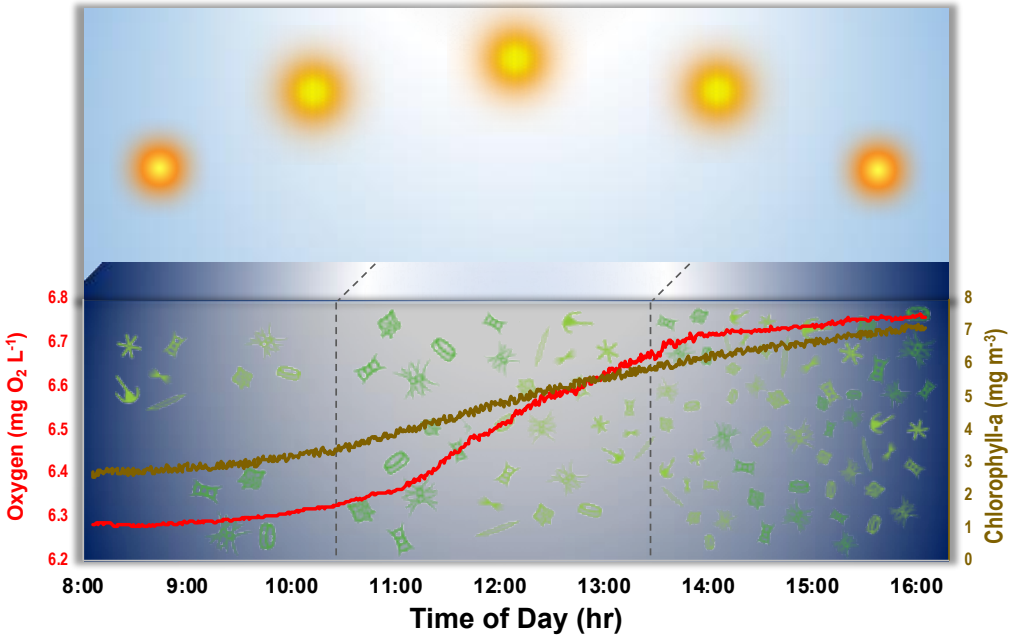
Hyperspectral (350-1040 nm) ocean color sensor in Geostationary orbit (launch ~2026/2027)

- Targeting Gulf of Mexico and other coastal waters of N. and S. America including Chesapeake Bay
- **Sub-hourly imaging** frequency; spatial res. of 300 m (nadir) or ~400 m over Chesapeake Bay

Short Term Coastal Processes: How high frequency fluxes of sediments, organic matter, and other materials between and within coastal ecosystems regulate the productivity and health of coastal ecosystems.

Phytoplankton Growth and Physiology Understanding processes contributing to rapid changes in phytoplankton growth rate and community composition.



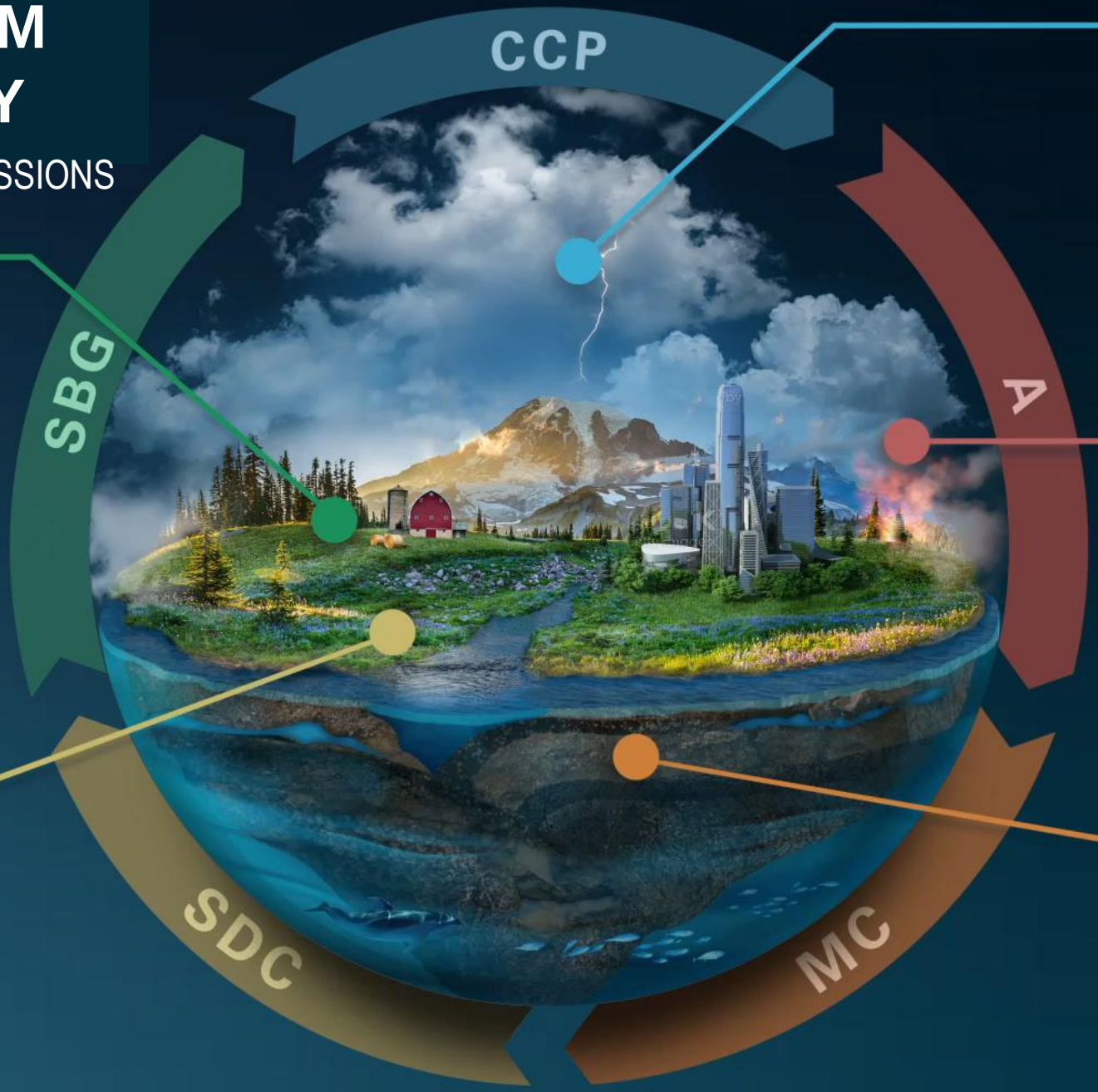


APPLICATIONS: Formation, magnitude, and trajectory of harmful algal blooms (HABs) and oil spills

EVI-5 Managed by UNH: Joseph Salisbury (PI), Antonio Mannino (Deputy PI); Data Processing by NASA OBPG; Instrument by Raytheon

EARTH SYSTEM OBSERVATORY

INTERCONECTED CORE MISSIONS



CLOUDS, CONVECTION AND PRECIPITATION

Water and Energy in the Atmosphere

AEROSOLS

Particles in the Atmosphere

MASS CHANGE

Large-scale Mass Redistribution

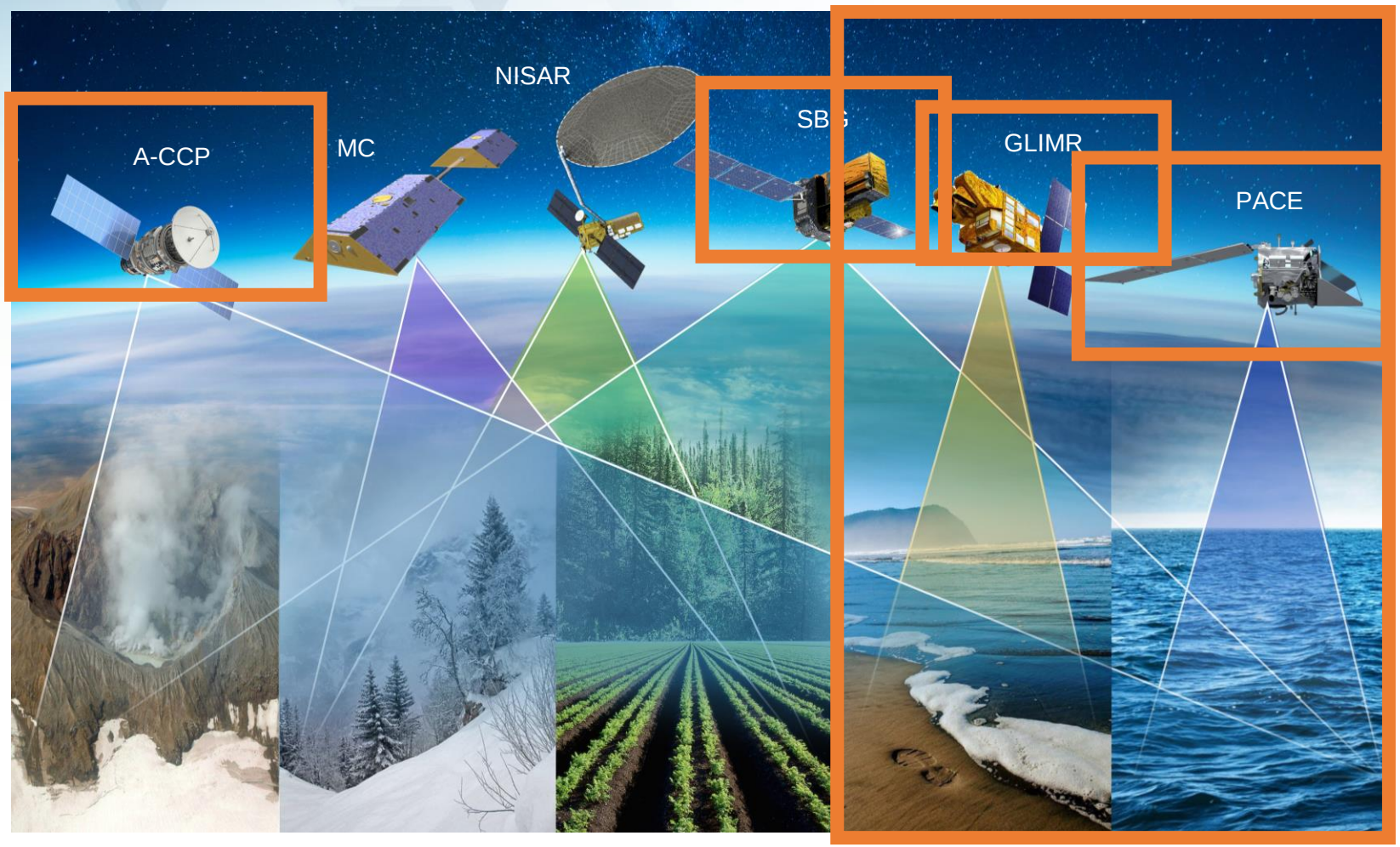
SURFACE DEFORMATION AND CHANGE

Earth Surface Dynamics

SURFACE BIOLOGY AND GEOLOGY

Earth Surface & Ecosystems

EARTH SYSTEM SYNERGY ACROSS MISSIONS FOR RESEARCH AND APPLICATIONS



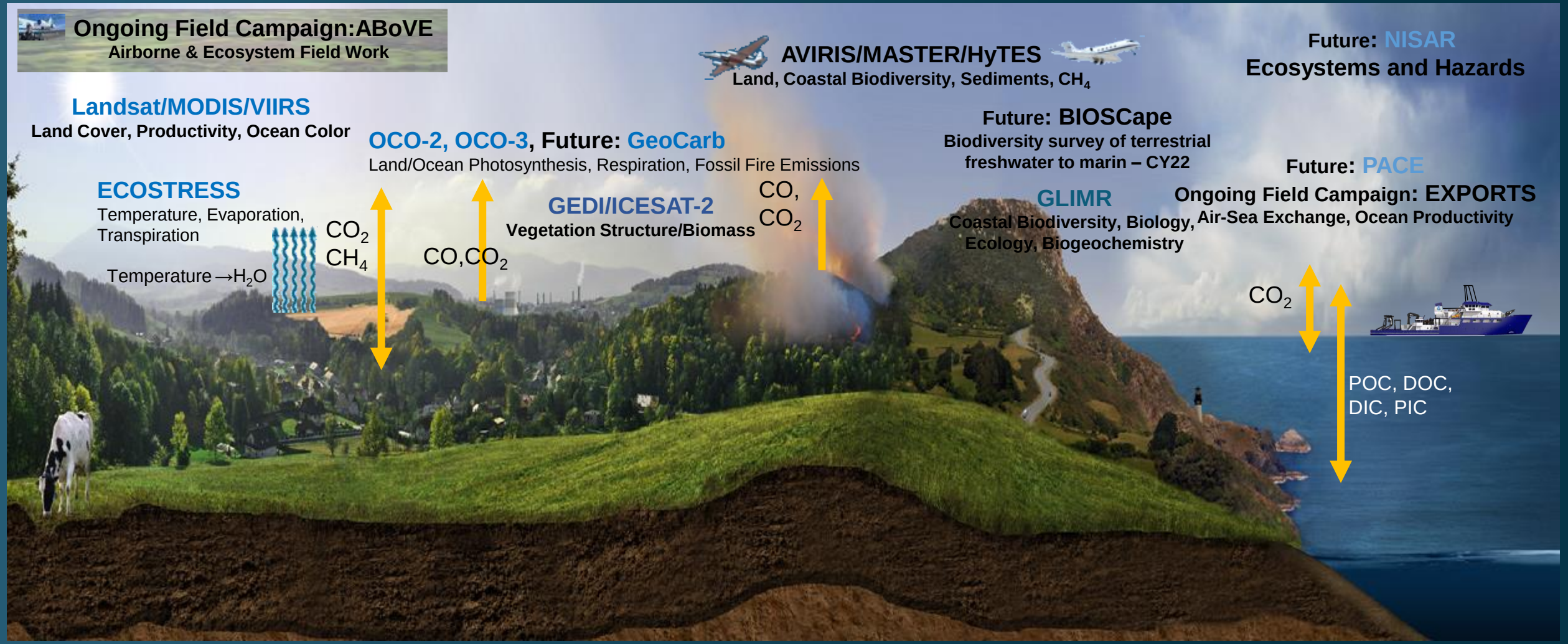
Aerosols — A-CCP
Gases — SBG
Surface Deformation — NISAR
Surface Composition and Geologic Hazards — SBG

Precipitation — A-CCP
Ice Mass Evolution — NISAR
Snow Albedo and Melt — SBG
Water storage-MC

Boundary Layers — A-CCP
Ecosystem Structure — NISAR
Vegetation Type and Physiology — SBG

Phytoplankton, Organic Matter, Sediment — SBG, GLIMR, PACE

Carbon Cycle & Ecosystems Focus Area: Integrating from surface *in situ* to satellite



https://cce.nasa.gov/cce/index.htm

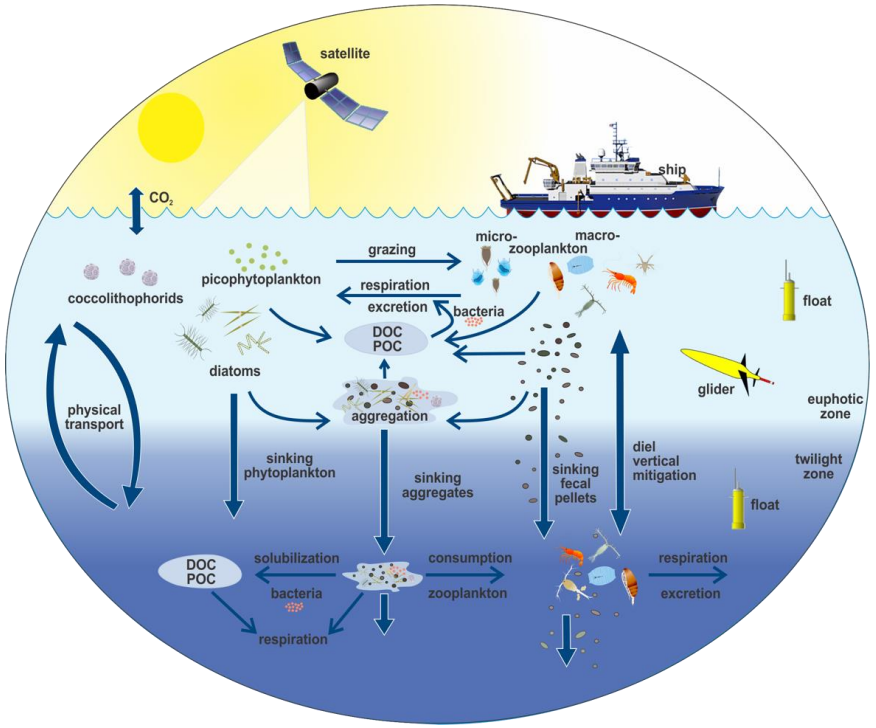
Carbon-related research

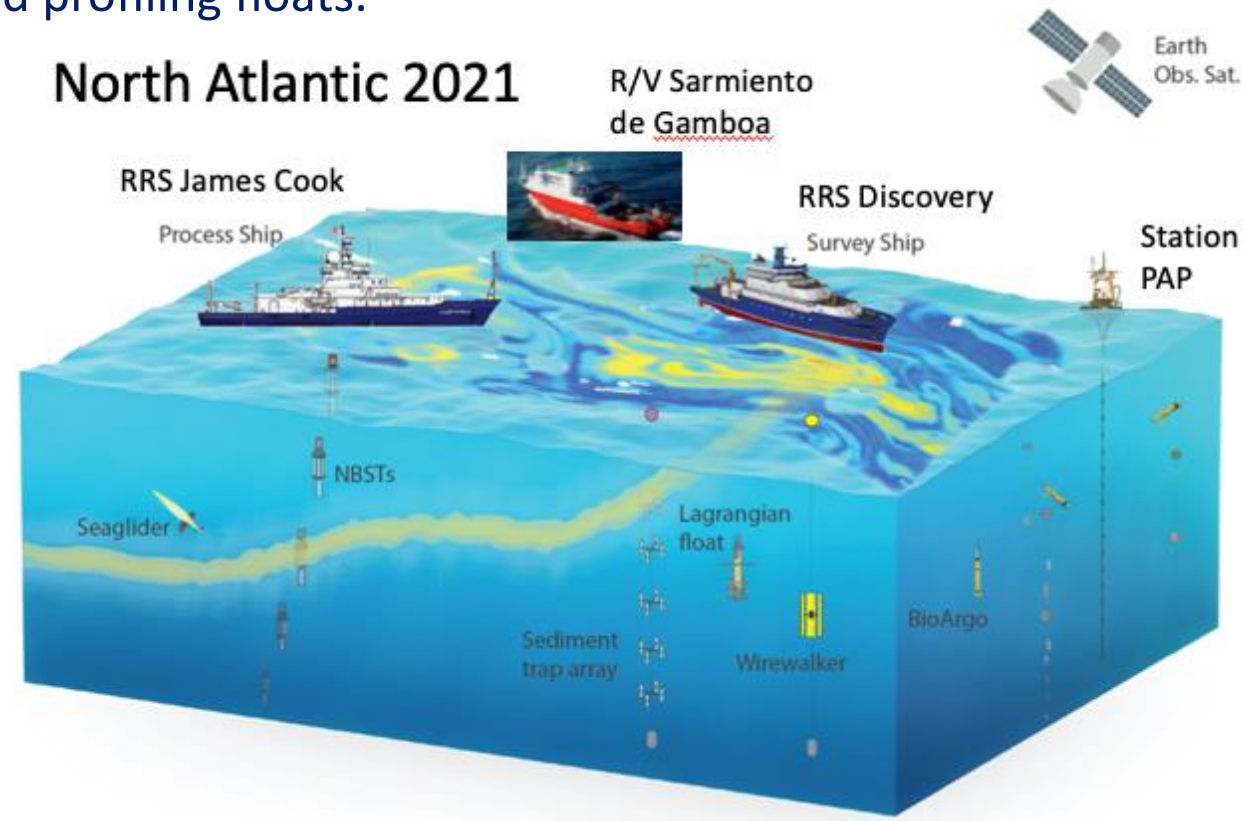
Research funded mainly through

- Core OBB
- Core PO
- RRNES
- IDS
- CCS
- T/A/SNPP
- Student/young investigator programs

EXport Processes in the Ocean from Remote Sensing (EXPORTS)

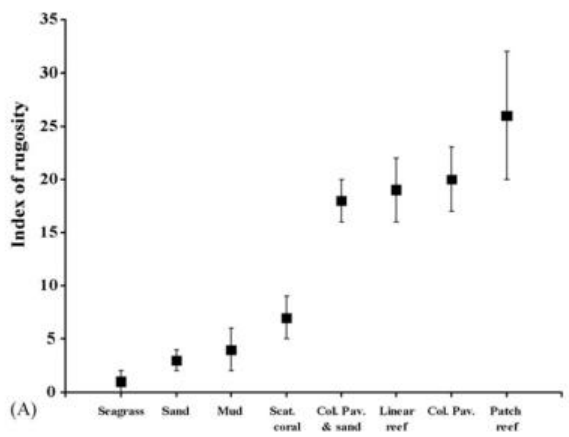
Through North Atlantic (2021) and North Pacific (2018) campaigns, EXPORTS sought to better understand the fate of carbon in the ocean, combining satellite and ship-based observations with in-water autonomous glider and profiling floats.

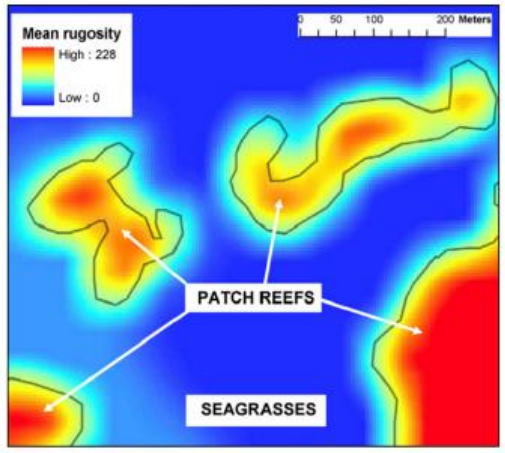


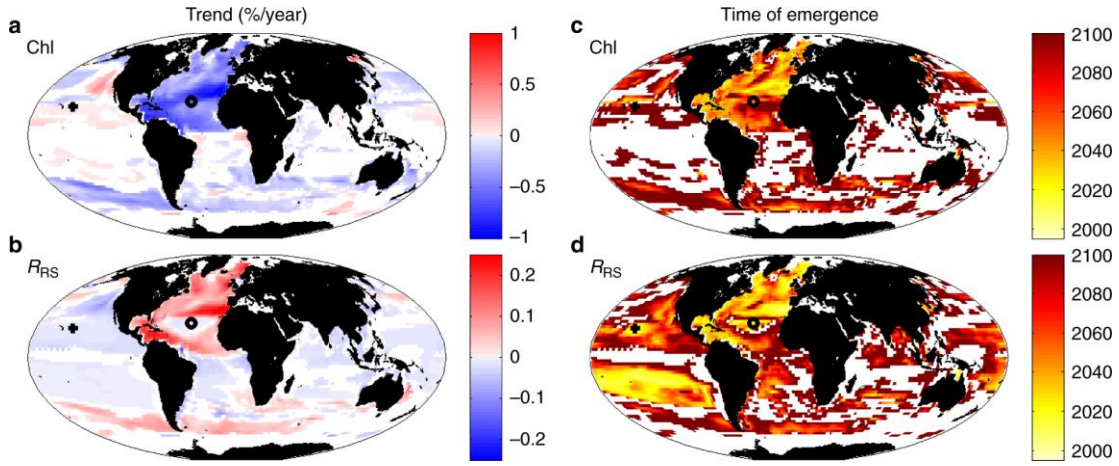


Some examples of Carbon Research

Using ICESat 2 data for Coastal Ecosystem Structure

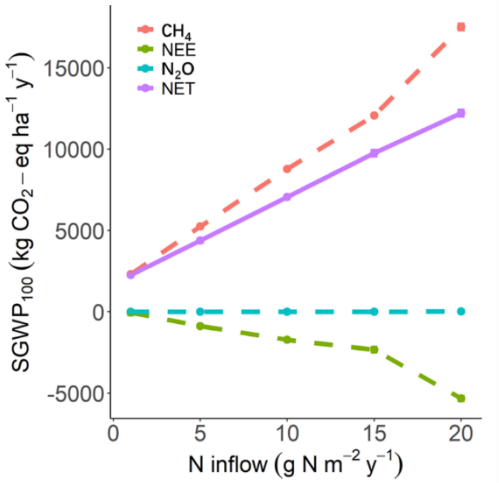






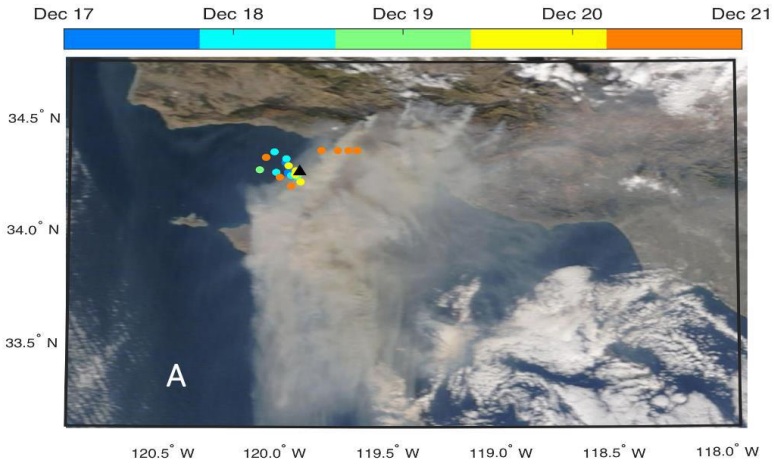
Understanding ToE for C-relevant parameters;
https://doi.org/10.1038/s41467-019-08457-x

Wetland Carbon Cycle & Greenhouse Gas Fluxes



doi: 10.1029/2021JG006242

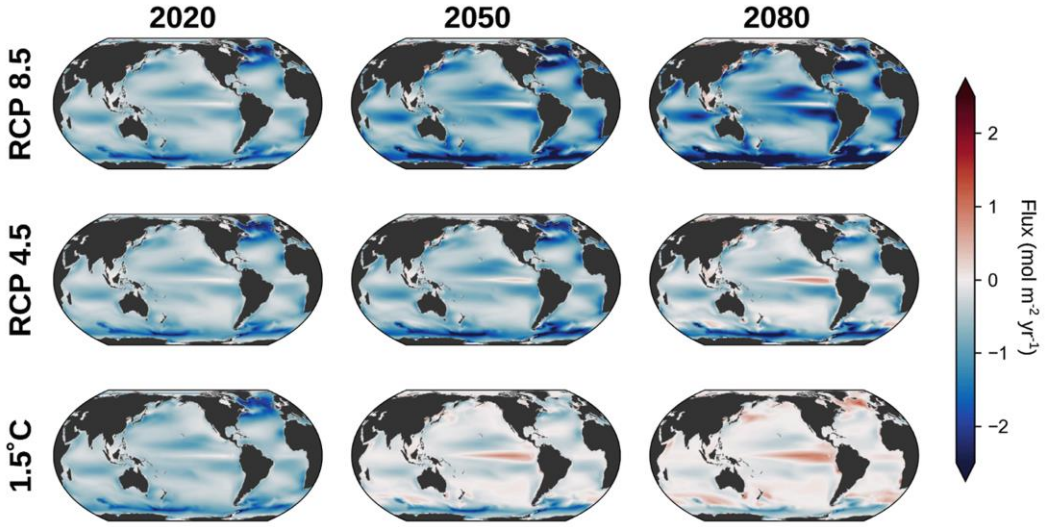
Impact of ash on ocean primary productivity



https://doi.org/10.1029/2020JC016851

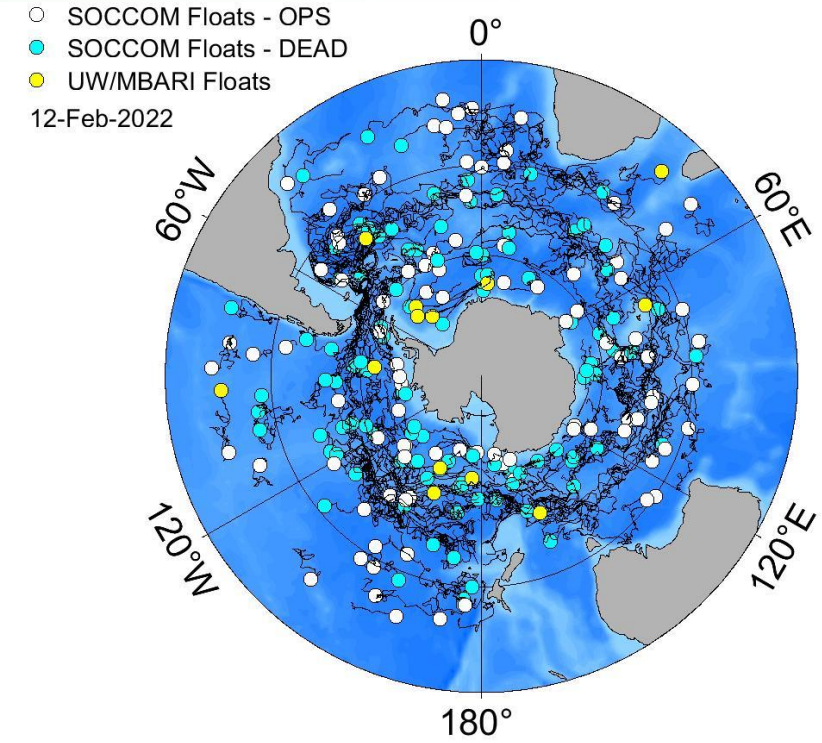
Air-sea CO2 fluxes

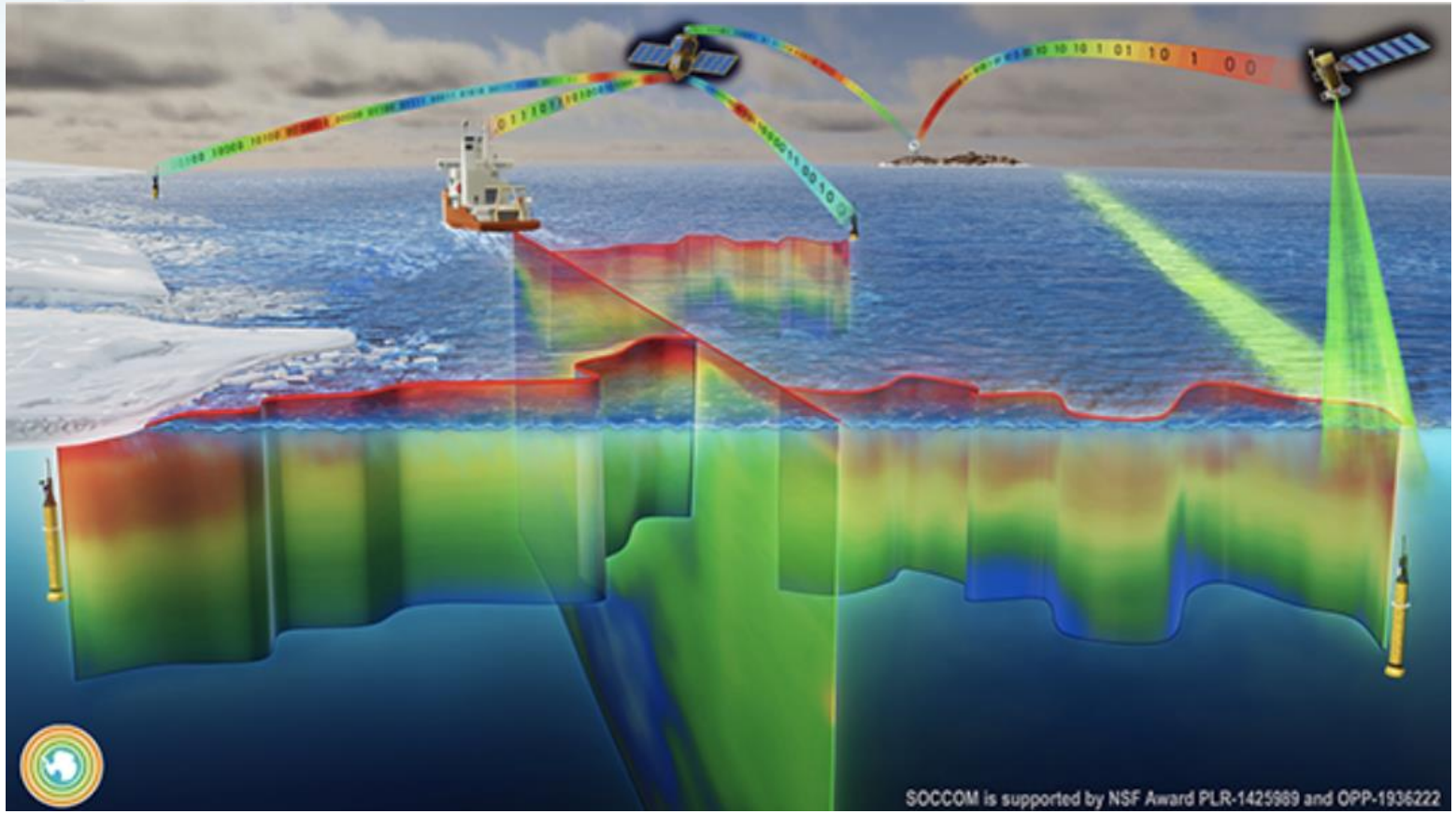
https://doi.org/10.5194/bg-18-2711-2021



In situ assets – GO-BGC and SOCCOM

1) Bio-Argo is opening the possibilities for resolving the 4D ocean phytoplankton & carbon dynamics
2) The combined satellite – Argo array may allow us to address long standing problems
3) 157 NASA-optical augmented SOCCOM floats have been deployed to date

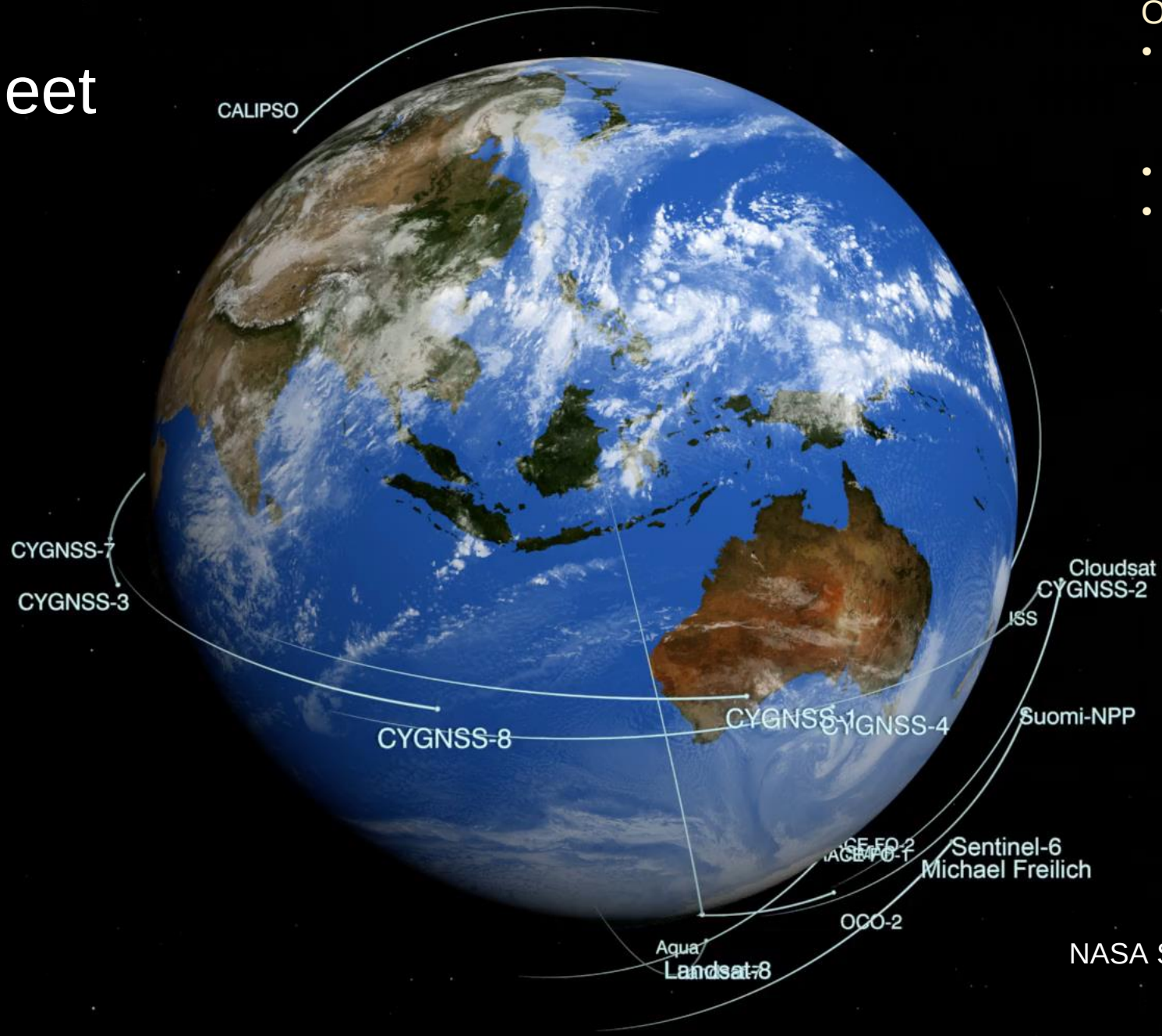




GO-BGC
Global Ocean Biogeochemistry Array

Slide courtesy of Oscar Schofield (Rutgers University)

NASA Earth Observing Fleet



International, Integrated Observing System:

- RS (polar and geo) - OC radiometry and Lidar
- Suborbital (drones)
- In situ - Autonomous and process-based studies to characterize signals from space.

August 2021

NASA Scientific Visualization Studio
svs.gsfc.nasa.gov/4931

NASA
EARTH DAY
FIFTY YEARS