Global Ocean and Climate Change STM

IOCCG International Ocean Colour Coordinating Group

We can say "what will it be..." as a future forecast?

Question: It mentions about phytoplankton or any marine organisms?

Category	Scientific Questions*	Approach using space OC data	Maps to Science Question	Space Product Requirements	Space Measurement Requirements
Global Ocean Science and Climate Change	1 What are the standing stocks, composition, & productivity of ocean ecosystems? How and why are they changing?	Quantify phytoplankton biomass, pigments, optical properties, key groups (functional/HABS), and productivity using bio-optical models & chlorophyll fluorescence (Quantify relationship between physiological state and bio-optical properties)	1, 2, 6	1km spatial resolution grid Global and Daily ? Level 2 and/or Level 3 ? ▸ Basic product : *Hyperspectral is a point of discussion ?* nLw Normalized water-leaving radiances in UV, VIS, and NIR (μW/cm²/μm/sr) set of spectral bands, or hyperspectral ? ▸ Derived product: Chl (mg/m3) Chlorophyll concentration for case-1, case-2 and merged cases YSBPA (m-1) Yellow substance and bleached particle absorption CDOM (g/m3) Colored dissolved organic matter TSM (g/m3) Total suspended matter Kd(490) diffuse attenuation coefficient at 490nm (m-1) PAR (μEin/m²) daily photosynthetic available radiation (about iPAR ?) a absorption coefficient (m-1) for bb backscattering coefficient (m-1) FLH Fluorescence Line Height CFE Chlorophyll Fluorescence Efficiency PIC/POC Particle inorganic/organic carbon (moles/m3) Eutrophic depth (m) Secchi depth (m) Classification : Phytoplankton type (PHYSAT) Aerosol load (τa and α) ?	**Ocean Radiometer** •total radiances in UV, VIS, and NIR ex : 5 nm resolution from 350 to 755 nm 1000 – 1500 SNR for 15 nm aggregate bands UV & visible and 10 nm fluorescence bands (665, 678, 710, 748 nm) 10 to 40 nm width atmospheric correction bands at 748, 765, 820, 865, 1245, 1640, 2135 nm • total radiances in NIR and SWIR for both atmospheric correction and cloud assessment
	1.5 How are the structure and function of ocean ecosystem are varying and changing? What makes the variation and change? What is the impact to fisheries resources?: *They are included in the "1"?*	Measure particulate and dissolved carbon pools, their characteristics and optical properties	1.5, 2, 3		
	2 How and why are ocean biogeochemical cycles changing? How do they influence the Earth system? How to monitor them?	Quantify ocean photobiochemical & photobiological processes	2, 4		
	Recommendation from Dr. Ishizaka ~~What~~ How are the material exchanges between	Estimate particle abundance, size distribution (PSD), & characteristics	1, 1.5, 2, 3		
	3 land & ocean varying and changing? How do they influence coastal ecosystems, biogeochemistry & habitats? How are they changing? (What is the impact to human activities, including fisheries?)	Assimilate observations in ocean biogeochemical model fields of key properties (cf., air-sea CO_2 fluxes, export, pH, etc.)	1.5, 2		
	We should include impacts of "human activities"? 4 How do aerosols & clouds influence ocean ecosystems & biogeochemical cycles? How do ocean biological & photochemical processes affect the atmosphere and Earth system?	Compare observations with ground-based and model data of biological properties, land-ocean exchange in the coastal zone, physical properties (e.g., winds, SST, SSH, etc), and circulation (ML dynamics, horizontal divergence, etc)	3, 4, 5, 6		
	5 How do physical ocean processes affect ocean ecosystems & biogeochemistry? How do ocean biological processes influence ocean physics?	Combine ocean & atmosphere observations with models to evaluate (1) air-sea exchange of particulates, dissolved materials, and gases and (2) impacts on aerosol & cloud properties	4		
	6 What is the distribution of algal blooms and their relation to harmful algal and eutrophication events? How are these events changing? What are the distributions and magnitudes of algal blooms. Are those blooms harmful to human activity and ocean ecosystem? How does the human activities, such as eutrophication, and climate change affect to the blooms.	Assess ocean radiant heating and feedbacks	5		
	Recommendation from Dr. Ishizaka *Especially latter part.*				
	7 How to monitor the mutual influence of the climate change and the ocean ecosystem?				
	8 How to investigate and monitor coastal ecosystems?				

* Derived from ACE STM (NASA) - focused questions are traceable to the four overarching science questions of NASA's Ocean Biology and Biogeochemistry Program [OBB1 to OBB4] as defined in the document: *Earth's Living Ocean: A Strategic Vision for the NASA Ocean Biological and Biogeochemistry Program* (under NRC review)

** See ACE Ocean Ecosystem white paper for specific vicarious calibration & validation requirements

NASA Ocean Biogeochemistry Derived Products

Validated

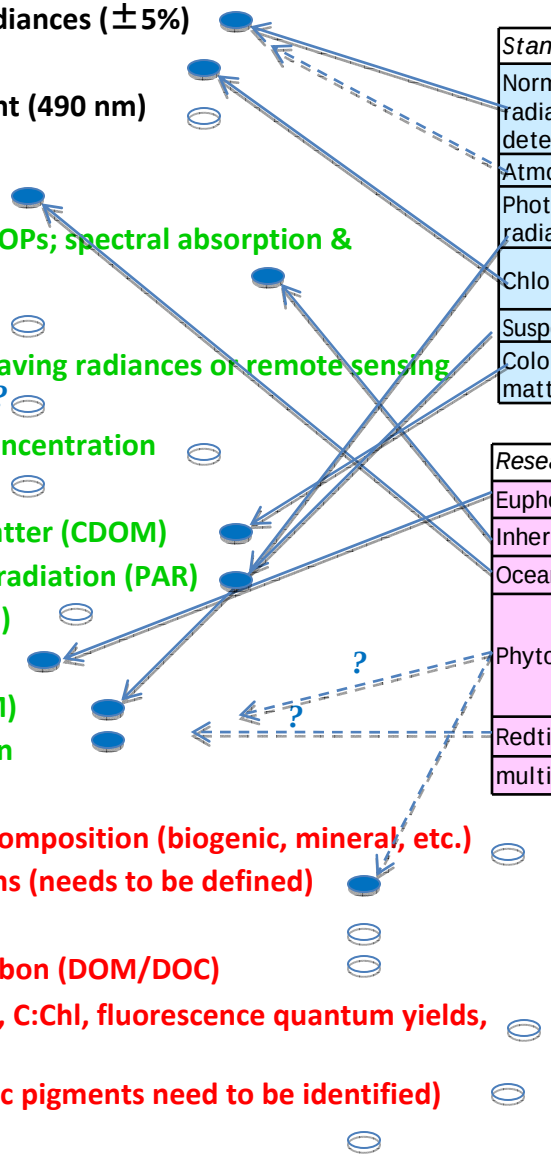
- **Normalized water-leaving radiances (±5%)**
- **Chlorophyll-a (± 35%)**
- **Diffuse attenuation coefficient (490 nm)**

Unvalidated

- **Primary production**
- **Inherent optical properties (IOPs; spectral absorption & scattering coefficients)**
- **Spectral diffuse attenuation**
- **Spectral normalized water-leaving radiances or remote sensing reflectances**
- **Particulate organic carbon concentration**
- **Calcite concentration**
- **Colored dissolved organic matter (CDOM)**
- **Photosynthetically available radiation (PAR)**
- **Fluorescence line height (FLH)**
- **Euphotic depth**
- **Total suspended matter (TSM)**
- **Trichodesmium concentration**

Exploratory

- **Particle size distributions & composition (biogenic, mineral, etc.)**
- **Taxonomic group distributions (needs to be defined)**
- **Phytoplankton carbon**
- **Dissolved organic matter/carbon (DOM/DOC)**
- **Physiological properties (e.g., C:Chl, fluorescence quantum yields, growth rates)**
- **Other plant pigments (specific pigments need to be identified)**
- **Export production**



GCOM-C definition

Standard Products	**Standard accuracy**	**Target accuracy**
Normalized water leaving radiance (incl. cloud detection)	50% (<600nm) 0.5W/m²/str/um (>600nm)	30% (<600nm) 0.25W/m²/str/um (>600nm)
Atmospheric correction param	50% (AOT@865nm)	30% (AOT@865nm)
Photosynthetically available radiatioin	15% (10km/month)	10% (10km/month)
Chlorophyll-a concentration	–60~+150%	–35~+50% (offshore), –50~+100% (coast)
Suspended solid concentration	–60~+150%	–50~+100%
Colored dissolved organic matter	–60~+150%	–50~+100%

Research Products	**Target accuracy**
Euphotic zone depth	30%
Inherent optical properties	a(440): RMSE<0.25, bbp(550): RMSE<0.25
Ocean net primary productivity	70% (monthly)
Phytoplankton functional type	error judgment rate of large/ small phytoplankton dominance<20%; or error judgment rate of the dominant phytoplankton functional group <40%
Redtide	error judgment rate <20%
multi sensor merged ocean color	–35~+50% (offshore), –50~+100% (coast)