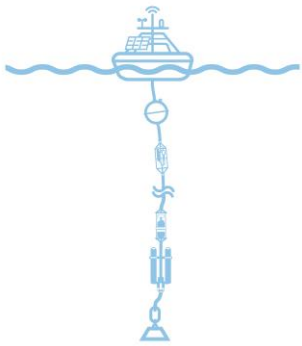
Observing Network Specification Sheet

OceanSITES Open-Ocean Timeseries

OceanSITES

Taking the pulse of the global ocean



Introduction

Motivation:

The mission of OceanSITES is to collect, deliver and promote the use of high-quality data from long-term, high-frequency observations at fixed locations in the open ocean. OceanSITES typically aims to collect physical, biogeochemical, and biology/ecosystem data worldwide from the open-ocean, covering the full-depth water column, the sea floor as well as the overlying atmosphere.

Photo credits: GOOS/JCOMM Community

Brief History:

The first sustained network of open-ocean time series sites was probably the Ocean Weather Stations (OWS), established shortly after WWII, measuring oceanic and atmospheric parameters at 13 sites in the North Atlantic and North Pacific Oceans. By the end of the 1980s regular ship survey based open ocean time series sites were established, such as HOTS and BATS. Since the 1960s subsurface moorings have been used to observe ocean currents and water properties and in the 1970s first mooring with surface sensor packages came into operations. The first sediment trap was installed on a deep-sea mooring in 1978. The mooring and sensor technologies improved very much over the years and modern moorings host a suite of multidisciplinary sensors that measure key physical, biogeochemical and biological/ecosystems variables. Deployment time can be several years and surface and subsurface data telemetry systems provide data in real-time.

OceanSITES time series sites are Eulerian observatories recording time series data of properties of interest at key locations in the ocean. Since 1999, the international OceanSITES science team has shared both data and costs in order to capitalize on the potential of moorings and ship-based time series. OceanSITES represents the interest of the operators and stakeholders of open ocean observatories in the Global Ocean Observing System (GOOS) and the Global Climate Observing System (GCOS) framework and via the JCOMM coordination.

Objectives:

The objective of the OceanSITES network is to ensure the optimal application of the time series technology for as much users as possible in the framework of a sustained GOOS and GCOS. The coordination includes documenting the network global extend and configuration, scientific and operational communalities across the sites, and standardization of deployment, sensor, and quality control procedures through exchange of knowledge and via documentation (Best Practices).

The time series stations coordinated in the OceanSITES network allow to record the temporal evolution of multidisciplinay properties covering the surface ocean/adjacent atmosphere, the water column, and the seafloor. OceanSITES provide a truly Eulerian view of ocean phenomena. The installations use automated systems with advanced sensor technology, yielding high time resolution, often in real-time. OceanSITES sites create long records of highest quality data. They serve multiple purposes defined by the regional needs. The three main objectives for operating the sites are:

- Transport moored arrays (TMA) – these sites are often composed by an array of moorings that monitor the transport and characteristic (physics, biogeochemical, ecosystem) and also serve as cal/val sites for satellite altimetric transport comparisons
- Air/sea flux reference sites – they have complex surface buoys accompanied by upper ocean

instrumentation and serve as cal/val sites e.g. for satellite derived products related to weather and wave forecasting

- Multidisciplinary Global Ocean Watch – these sites aim for long time series of properties across disciplines (physics, biology/ecosystem, biogeochemistry), and may also include calibration/validation components for satellite ocean colour products.

One of the main drivers for time series is to provide both monitoring and process observations with a temporal resolution from minutes to decades to detect, understand, and predict global physical, biogeochemical and ecosystem state and changes, including ocean warming, ocean carbon uptake/storage and acidification, but considering also the role of and impact on ecosystem.

Design & Data:

OceanSITES time series sites are operated in key regions of the global ocean. The locations are optimized to the regional requirements in sampling ocean phenomena linked to the three groups of primary scientific and monitoring objectives. Unlike other observing systems (quasi Lagranian), that aim for horizontal mapping of properties, OceanSITES sites are erected in focus areas and where Eulerian observations are most powerful.

(1) **The transport-moored arrays (TMA)** are optimized for ocean currents and observations in sufficient time and space resolution in order to derive volume and property transport estimates. Sampling must be undertaken in a temporal resolution that enables the isolation of drivers of variability, eventually from sub-diurnal to multidecadal. Sites contributing to TMA are in many cases arrays of moorings installed in regions where the flow is under topographic control. The major exchange gateways between ocean regions include flows through shallow (e.g. Denmark Strait, Bering Strait) as well as deep straits and channels (e.g. Vema Channel, Gibbs Fracture Zone, Owen Fracture Zone). Another group of TMA sites record western and eastern boundary current flow and properties (e.g. the East Australian Current, California Current, Deep Western Boundary Current) and again topography is to be considered in order to ensure a sufficient spatial sampling of the signals.

(2) **The air/sea flux reference sites** are located in ocean areas where particular ocean/atmospheric exchange and atmospheric boundary layer conditions exists, such as the cold tongue /warm pool regions, the high latitudes or the tropical region. At the sites surface meteorology and upper ocean variability is collected. The resulting meteorological and oceanographic observations provide a set of high quality air-sea fluxes of heat, freshwater and momentum as well as upper ocean heat and salt content. The scientific rationale for the collection of these flux products is manifold: (1) to describe the upper ocean variability and the local response to atmospheric forcing; (2) to motivate and guide improvement to atmospheric, oceanic, and coupled models; (3) to calibrate and guide improvement to remote sensing products and capabilities; and (4) to provide anchor points for the development of new, basin scale fields of the air-sea fluxes. These sites also include observations to study air/sea gas exchange processes (e.g. oxygen, pCO2).

(3) **The Multidisciplinary Global Ocean Watch sites** are located in areas where Eulerian Physics, Biogeochemistry and Ecology time series are expected to represent the temporal evolution of a region for example in the centre of oceanic gyres or biogeographic provinces or where specific forcing is expected to occur, such as deep convection regions. The sites are multidisciplinary and aim to obtain co-located (time/space) records that can be used to create Essential Ocean Variables (EOVs).

OceanSITES has adopted the CLIVAR data policy, which explicitly calls for free and unrestricted data exchange[1]. A major data related activity of the OceanSITES network is to comply to "FAIR" (Findable, Accessible, Interoperable, re-usable) data principles. OceanSITES has developed a common data format, OceanSITES netCDF, that is under continuous improvement and expansion by the OceanSITES Data Management Team (DMT) in response to network needs and in dialogue with other international and global data activities (e.g. JCOMM OPA). The heterogeneity of OceanSITES time series sites configurations generate physical, biogeochemical, and ecosystem observations that aid to derive Essential Ocean Variables (EOV) across domains. Not all data is suitable for OceanSITES netCDF file storage and links to data DOIs are provided as part of the JCOMM OPS metadata catalogue.

The primary objective of OceanSITES is to generate and distribute long time series data of highest quality and distribute the data openly and free of charge. It has been recognized by OceanSITES that knowledge about data quality (uncertainty estimates for each observation) is key for using data not only in climate studies but likewise for operational services. Data quality is closely linked to OceanSITES community agreed "Best Practices" that provide guidance for successful data acquisition and thus ensure reproducibility of the workflow from an OceanSITES sensor to an OceanSITES netCDF file. If technically feasible, some sites transmit data in real-time (GTS or BUFR format). However, the routine marine meteorology relevant data streams and technologies mounted on some of the OceanSITES platforms (e.g. Tropical arrays) are under the auspices of the DBCP. The metadata for each sites is a complex set of configuration parameters and hosted since 2018 at JCOMM OPS[2]. Each deployment/ship visit has to be documented in its total to make the network traceable and searchable. The OceanSITES steering committee is responsible for adding the metadata but with assistance from the OceanSITES technical coordinator (part time 33% FTE).

[1] See http://www.clivar.org/data/data_policy.php
[2] See: http://www.jcommops.org/

NETWORK SPECIFICATION	*Includes information on the observing network, the components, coordinating teams, mission, status and sustainability. Also describes the target, the phenomena addressed, GOOS phenomena and applications addressed, and the specific contribution of the network to the GOOS. With map of current network status.*
PLATFORM CHARACTERISTICS	*Specifies the platform characteristics, and temporal and spatial sampling, and the well resolved observation scales of the network (Stommel Diagram for network)*
SENSOR CHARACTERISTICS	*Details on the commonly used sensors, the variables measured, including the Essential Ocean Variables (GOOS EOVs) and Essential Climate Variables (GCOS ECVs), supporting variables, derived products and the level of sensor readiness.*
DATA MANAGEMENT	*Details on the network data management system for Real Time (RT) and Delayed Mode (DM) data delivery, including the team responsible for the oversight and coordination of the data system, the data centre/repository, and the products.*
LINKS	*Provides links to background information on standards and best practices, data management and quality control, products and visualizations.*
GLOSSARY	*Provides a glossary of common terms and a list of acronyms.*

NETWORK SPECIFICATION

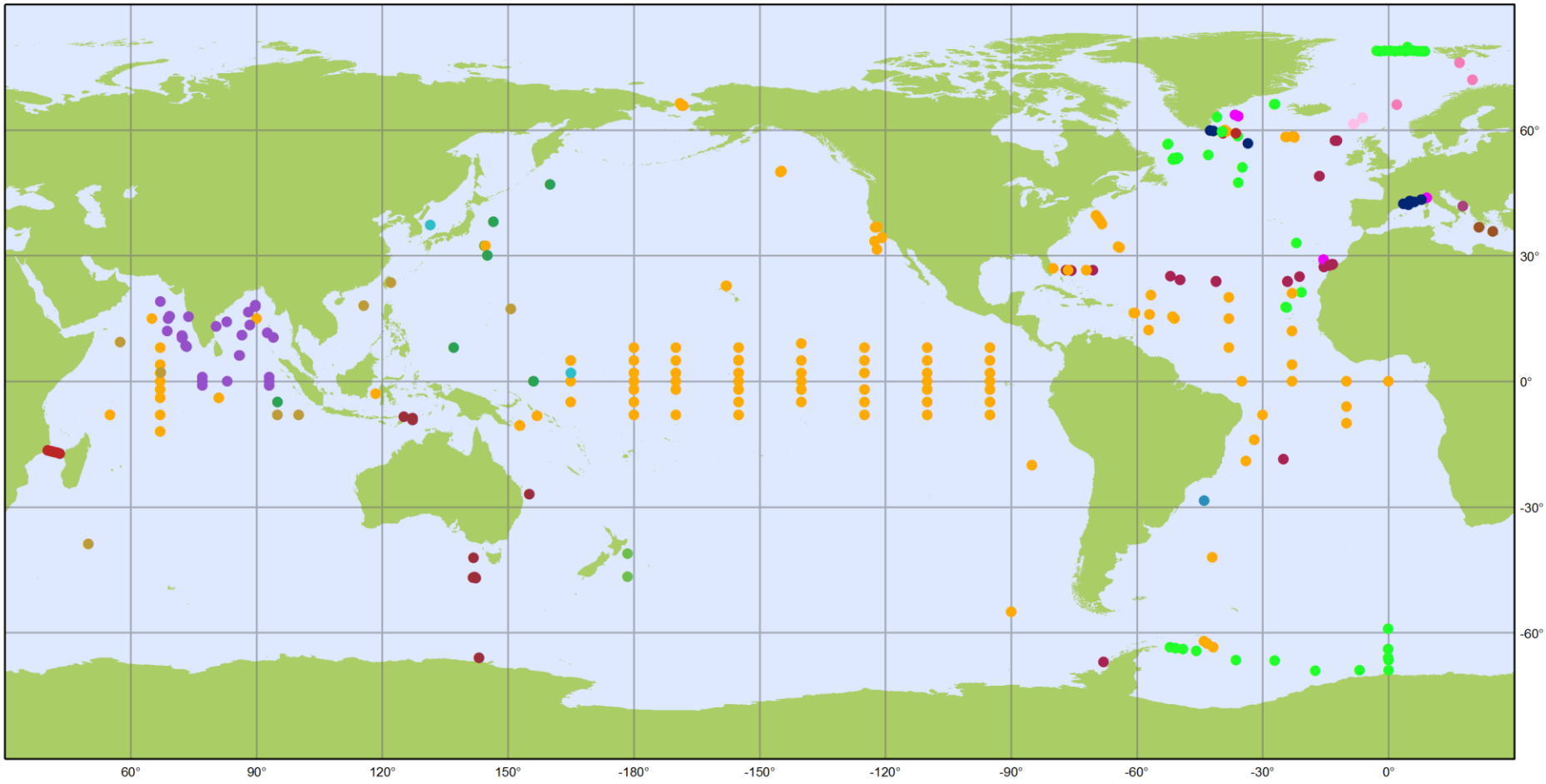
Name	**OceanSITES**		
Description[3]	Open-ocean multi-disciplinary fixed-point sustained time series using moorings, ships, and other fixed platforms with corresponding technology.		
Oversight and Coordination[4]	Oversight and coordination is provided by the site operators within the OceanSITES community. An Executive Committee (about 10 people) approves the decisions made by Investigators who are in the Steering Committee and Data Managers who are in Data Management Team. Two co-chairs (volunteers) and a technical coordinator (33% FTE shared with DBCP (67%)) organize the day-to-day business.		
Process for community evaluation	OceanSITES Executive Committee/Steering Committee JCOMM OCG for observing system targets/performance and across networks coordination OOPC/IOCCP/GOOSBioEco for Observing System Requirements, Observing system design and role of OceanSITES in multi-platform mix.		
Component/ Program(s)[5]	**Transport-moored arrays (TMA):**	**Air/sea flux reference sites:**	**Multidisciplinary Global Ocean Watch:**
Mission	Optimized for ocean currents and properties observations in order to derive volume and property transport through key sections	Provides anchors for the generation of new hybrid and blended air-sea flux fields and identifies errors and biases in gridded surface fields from numerical weather prediction models, remote sensing, and climatologies. Air/Sea gas exchanges (e.g. pCO2)	Eulerian time series sites (Physics, Biogeochemistry, Ecosystem) in representative regions were the temporal (e.g. oceanic gyres, biogeographic provinces, intense forcing). The sites are multidisciplinary and aim to obtain co-located (time/space) records.
Status	Mature	Mature	Mature
Target(s)	Coverage of all major boundary currents and topography flow. Augmenting arrays with biogeochemical sensors in order to derive property transports	Reference sites in all atmospheric regions with specific boundary layer conditions - particularly high latitude ocean regions. Heat flux: Full meteorological sensor suite Cal/Val satellite data retrievals; Gas Exchange: dissolved gases or gas tension devices	Biogeochemical and ecosystem parameters in representative biogeographical regions; Cal/Val satellite data retrievals (Ocean colour, SST, SSS)
GOOS Phenomena Addressed[6]	Circulation, Fronts/eddies, Tides Air-Sea fluxes Surface waves Freshwater cycle Sea level Stratification Mixed layer Water masses, Ocean acidity, Inorganic nutrient cycling Organic matter cycling Carbon sequestration Changes in fish distribution	Circulation, Fronts/eddies, Tides Air-Sea fluxes Surface waves Freshwater cycle Sea level Stratification Mixed layer Water masses, Ocean acidity Gas fluxes	Circulation, Fronts/eddies, Tides Air-Sea fluxes Surface waves Freshwater cycle Sea level Stratification Mixed layer Water masses, Ocean acidity, Inorganic nutrient cycling Organic matter cycling Timing and location changes of biomass Ocean productivity Carbon sequestration

[3] See link: http://www.oceansites.org/about.html
[4] See link : http://www.oceansites.org/contact.html
[5] See link : http://www.oceansites.org/documents/index.html
[6] See link : http://www.goosocean.org/strategicmapping

			Changes in fish distribution
Other important phenomena[7]	Heat/freshwater Deposition Biogeographical shift Ecological regime shift Change in sizes of individuals, species populations, and other taxonomic information	Momentum flux Gases Heat/freshwater	Momentum flux Gases, Heat/freshwater Deposition Primary production hotspots and diversity/functional groups Biogeographical shift Ecological regime shift Change in sizes of individuals, species populations, and other taxonomic information
Sustainability[8]	National resources, no long term strategies, some >10 years commitments	National resources, no long term strategies, some >10 years commitments (OOI ocean leadership)	National resources, no long term strategies, some >10 years commitments (OOI ocean leadership)
Unique contribution - coordination with other networks	• High-frequency time series reaching from seconds to decades; processes, events, inter-annual climate variability, regime changes. • High quality data (regular quality control against certified standards) provide temporal context or reference information to other observing platforms; climate time series reference stations		
GOOS themes addressed	• Climate • Services • Ocean Health		
Applications addressed[9]	• Heat storage changes • Decadal Predictability • Changes in Ocean Carbon (inorganic and organic) • Animal tracking • Deep Ocean Observing • NWP cal/val (boundary layer physics) • Particle fluxes (carbon sequestration) • Overturning volume and properties transport variability • Cal/Val satellite • Oxygen inventory changes • Sea Level changes • Deep Sea warming		

[7] Those phenomena are not on the GOOS list.
[8] Sustainability of network over long term (strengths, weaknesses, opportunities, and threats) -10 years.
[9] See: http://lists-ioc-goos.org/strategic-mapping/

Figure 1: Current status of the OceanSites open-ocean timeseries.



OceanSITES

Platforms by country

January 2019

Information received from the platform operators

AUSTRALIA (10)	DENMARK (4)	GREECE (3)	KOREA, REPUBLIC OF (3)	UK (45)
BRAZIL (1)	EUROPE (4)	INDIA (37)	NETHERLANDS (9)	USA (149)
CANADA (1)	FRANCE (11)	ITALY (1)	NEW ZEALAND (2)	
CHINA (8)	GERMANY (62)	JAPAN (8)	NORWAY (3)	

OceanSITES
Taking the pulse of the global ocean

Generated by www.jcommops.org, 06/02/2019

PLATFORM CHARACTERISTICS

Observing Platform(s) used	Moorings of different complexity, incl. surface elements; regular repeat ship surveys of a site (defined area).	
Component/ Program(s)[10]	**OCEANSITES**	
Spatial Sampling (standard)[11]	<u>Horizontal</u> Single site: Physically a point measurement, fixed location in flow integrates over several 10 s to 100 km Arrays of mooring: Tropical Arrays typically every 2-4° latitude, 10-15° longitude; Transport moored arrays covering flow feature (e.g. boundary current every 10-20km)	<u>Vertical</u> Atmosphere module: typically up 3 to 4 m above ocean surface. Water column: multiple fixed sensors, customized to phenomena under surveillance; surface to seafloor coverage; optional profiling modules allow continuous sampling
Temporal Sampling (standard)	Resolution: 1 minute (less is possible) to months (e.g. sediment traps) Duration: time series are up to several decades at some sites Platform deployment duration: typically 1 to 2 years	

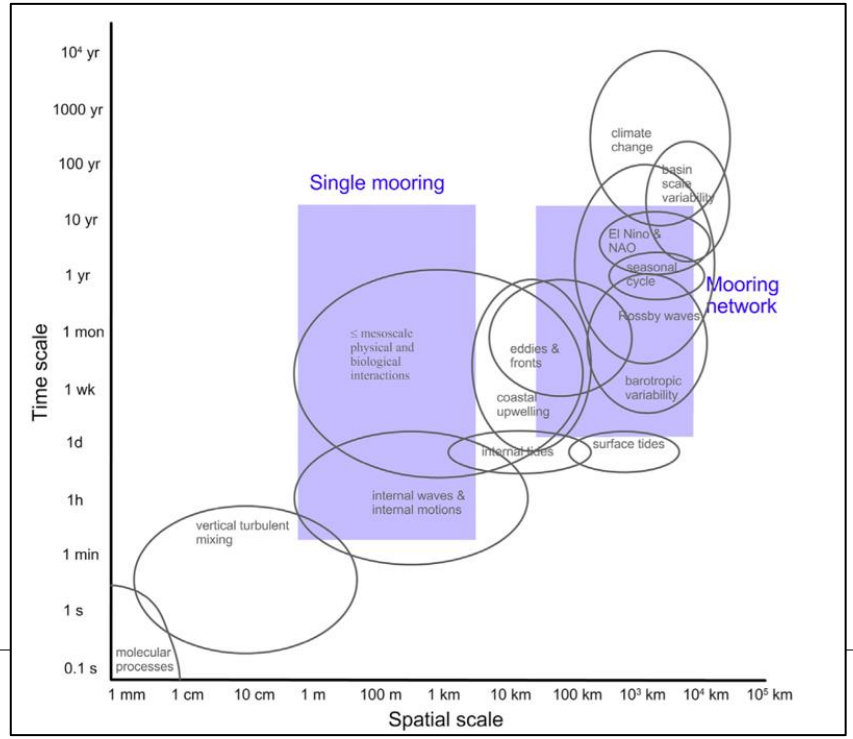


Figure 2. Showing the well resolved observation scales of the element

[10] Links to detailed descriptions/planning documents are provided on the last page.
[11] See Figure 2 - Stommel Diagram for Element

SENSOR CHARACTERISTICS

Sensors/ Technique	**Measured variables** (+ sub variables)	**Random uncertainty estimates** (one standard deviation)	**Uncertainty in bias** (one standard deviation)	**Supporting variables**	**Derived products**	**EOVs**[12] (measured or derived)	**Standard/ commonly used sensor**[13]	**Readiness of sensor or technique**[14]	**Ability to scale globally**
Sample Collector: sinking particle traps, also known as sediment traps	Downward fluxes of particulate materials, typically including core variables of dry mass, total carbon, total nitrogen, organic carbon, inorganic carbon, total silica, biogenic silica, lithogenic material. Many additional variables are possible, including trace elements, isotopic compositions, eDNA compositions and biological characteristics. n14C, δ13C of DIC CCl4 Dissolved Inorganic Carbon, Alkalinity, pH Nitrate, phosphate, silicate, CFCs, SF6, DOC, DON	See relevant EOV	See relevant EOV	Flow speed & direction, sediment trap tilt, sediment trap brine compositions to assess dissolution, e.g. TAlk, pH, O2, nutrients, CTD, Temperature, Salinity and pressure	Productivity, stoichiometry, carbon fluxes.	Particle fluxes	Mclane Parflux traps, Technicap PPS traps	Mature	Mature
Thermistor	Subsurface Temperature	n.a	n.a	n.a	n.a	n.a	Seabird, RBR,	Mature	Mature
Conductivity (need T and P)	Subsurface Salinity	n.a	n.a	n.a	n.a	n.a	Seabird, RBR,	Mature	Mature
Ultraviolet Analyzer	Nitrate (total)	n.a	n.a	n.a	n.a	n.a	Saclantic SUNA	Mature	Mature
Turbulence Sensor / small scale velocity shear and temperature fluctuations	Turbulence parameter	n.a	n.a	n.a	n.a	n.a	Wirewalker™ system, MATS	n.a	n.a
Stratification / T/S chain or wire profiler	Temperature and Salinity	n.a	n.a	n.a	n.a	n.a	McLane profiler with T/S sensor	Mature	Mature

[12] List of GOOS EOVs: http://www.goosocean.org/eovs
[13] If relevant to network/element.
[14] See: http://www.goosocean.org/improvingreadiness.

Membrane-introduction mass spectrometry (MIMS)	n.a	n.a	n.a	n.a	n.a	n.a	TETHYS	n.a	n.a
Particulate matter/filter	n.a	n.a	n.a	n.a	n.a	n.a	McLane Water Transfer Systems	n.a	n.a
Trace metals	n.a	n.a	n.a	n.a	n.a	n.a	McLane Phytoplankton Sampler (PPS)	n.a	n.a
Suspended particles	n.a	n.a	n.a	n.a	n.a	n.a	McLane Phytoplankton Sampler (PPS)	n.a	n.a
Phytoplankton samples	n.a	n.a	n.a	n.a	n.a	n.a	McLane Phytoplankton Sampler (PPS)	n.a	n.a
Sampler for biological, dissolved major and minor nutrient, dissolved trace metal, or dissolved organic carbon analyses	n.a	n.a	n.a	n.a	n.a	n.a	McLane Remote Access Sampler	n.a	n.a
Zooplankton sampler/ collect zooplankton on mesh	Collects up to 50 samples	n.a	n.a	n.a	n.a	n.a	McLane Zooplankton Samplers	n.a	n.a
Nutrient analyzer / wet chemistry for different nutrient	n.a	n.a	n.a	n.a	n.a	n.a	SaeBird HydroCycle	n.a	n.a
Wave Spectra	n.a	n.a	n.a	n.a	n.a	n.a	Triaxyss Axys Technologies	Mature	Mature
Acoustic backscatter from specialist (possibly multi-frequency) **instruments or ADCPs**	Particle concentration & Target strength	See relevant EOV	See relevant EOV	T, S, p, net catches	Biomass, vertical migration of species	Suspended particulates	ASL-AZFP	Level 5	Level 4
Optical Backscatter (possibly multi-frequency)	Particle concentration (and size)	See relevant EOV	See relevant EOV; pure water reference	See relevant EOV	Particle load	Suspended particulates	SBE/Wetlabs FLNTUS	Particulate matter	Pilot (interpretation/ Mature (measurement)
Transmissometer beam attenuation	Particle concentration	0.3% full scale	See relevant EOV	Temperature, Particle sampling	Particle load	Suspended particulates	(SBE/Wetlabs C-Star; Chelsea Technology)	Particulate matter	Pilot (interpretation/ Mature (measurement)
Chla- Fluorescence; optical	Chlorophyll-a	n.a	n.a	n.a	Productivity, plankton bloom, carbon uptake	Phytoplankton biomass and diversity	n.a	n.a	n.a

CDOM/FDOM; optical	Dissolved organic matter	n.a	n.a	n.a	carbon uptake, respiration	Suspended particulates	n.a	Mature	Mature
Photosynthetic active radiation (PAR)	light penetration	5% spectral error	5%	n.a	Productivity, carbon uptake	n.a	n.a	Mature	Mature
Passive Acoustics	Fish / animal migration	tbd	n.a	n.a	Biomass distribution, fishing pressure	Fish abundance and distribution	n.a	Mature	Mature
Sound/ Tomography	Heat content	n.a	n.a	T, P, 3d location (t)	Ocean heat content variability large scale	n.a	n.a	Mature	Mature
Currents (single point)	U/V/W currents	1% full range; direction 2°, T sensor (0.1K)	lab	T, S	Transport of water and properties, Eddy correlation/ mixing	Subsurface currents	n.a	Mature	Mature
Optodes/ luminescence quenching	O2, pH	pm 0.1 pH (AADI) 1 umol kg-1 O2	n.a	T, S, Pressure	Ocean acidification, air/sea flux, pCO2 long term monitoring	n.a	n.a	Mature	Mature
Gas tension /Pro Oceanus	total dissolved gases, dominated by N2+O2	pm 2ppm	zero compensation; drift 0.02% per year	T, S, Pressure	n.a	n.a	n.a	Mature	Mature
Water sampler/ (e.g. Aqua Monitor, Mclane Remote Access Sampler)	Carbon, CFC, salinity, nutrients, DIC, TALK, Phytoplankton microscopy, etc.	Respective analytical method	Respective analytical method	T, S, Pressure	Ocean acidification, air/sea flux, pCO2 long term monitoring	Subsurface salinity Nutrients Stable carbon isotopes Transient tracers	n.a	Mature	n.a
Diversity/ Camera systems	n.a	tbd	tbd	Hydrography, particles, acoustics	Biodiversity	Zooplankton biomass and diversity Fish abundance and distribution Marine turtles, birds, mammals abundance and distribution	Imaging FlowCytobot (IFCB)	Mature	Mature
Thermometer	Air/Sea surface Temperature	0.05°C	0.2°C (up to 3°C in low wind)/ 0.1°C (higher in presence of diurnal warming)	n.a	n.a	Sea surface Temperature Ocean surface heat flux	n.a	Mature	Mature

Precision Infrared Radiometer	Incoming Longwave	7.5 W-m-2	2 W-m-2	n.a	n.a	Ocean surface heat flux	n.a	Mature	Mature
Propeller/ Vane or Sonic Anemometer	Wind Speed and Direction	1.5%, 6 degrees	0.1m s-1	n.a	n.a	Ocean surface stress	n.a	Mature	Mature
Barometer	Barometric Pressure	0.3hpa	0.3hPa	n.a	n.a	n.a	n.a	Mature	Mature
Spectral Pyranometer	Incoming Shortwave	20 W-m-2	2 W-m-2	n.a	n.a	Ocean surface heat flux	n.a	Mature	Mature
R.M. Young Model 502502	Precipitation	20%	20%	n.a	n.a	n.a	n.a	Mature	Mature
Capacitive Thin Film sensor	Relative Humidity	1% RH but higher above 95% RH.	1% RH but higher above 95% RH.	n.a	n.a	n.a	n.a	n.a	n.a

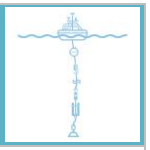
DATA MANAGEMENT

Oversight & Coordination	**OceanSITES Data Management Team**	
Data type	**Real Time**	**Delayed Mode**
Component/Program(s)[15]	OceanSITES	OceanSITES
Readiness Data Management System	Pilot (operational) level 6 – note the real-time part is part of DBCP (unless it is a pilot/testing activity)	Mature (7)
Data Centre/ Repository	GDACs at NDBC and Coriolis; DAC distributed	GDACs at NDBC and Coriolis
Data delivery (pathway)	Automated: from float to GDAC via satellite coms	Automated: Distributed to NODCs for DM QC
Data QC	Site documentation exists; global/network view under development	Site documentation exists; global/network view under development
Metadata readiness level	Pilot (operational) level 6	Pilot (operational) level 6 – currently in the process to implement the JCOMMOPS metadata system
Timeliness/latency	1 day	Months to 2 year
Products/Users	GTS users	Site dependent (centralized access GDACs at NDBC and Coriolis) Time series products test sites (AtlantOS, NDBC)

[15] Links to detailed descriptions/planning documents are provided on the last page.

This observing network specification sheet uses concepts from the Framework for Ocean Observing within the GOOS Strategic Mapping and the GCOS Implementation Plan. It was originally developed by the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC) and subsequently developed by the JCOMM Observations Coordination Group to document and communicate the unique contribution of the OCG networks and partner networks.

LINKS



Background Information	• OceanSITES overview: http://www.oceansites.org • Send, U., Weller, R., Wallace, D., Chavez, F., Lampitt, R., Dickey, T., Honda, M., Nittis, K., Lukas, R., McPhaden, M. and Feely, R., (2010). "OceanSITES" in Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society (Vol. 2), Venice, Italy, 21-25 September 2009, Hall, J., Harrison, D.E. & Stammer, D., Eds., ESA Publication WPP-306, doi:10.5270/OceanObs09.cwp.79. • Cronin, M. F., R. A. Weller, R. S. Lampitt, and U. Send (2011). Ocean reference stations. In: Earth Observation, R.B. Rustamov and S.E. Salahova (eds.), InTech, Rijeka, Croatia, ISBN: 978-953-307-973-8.
Standards & Best Practices (documents and links)	• Petihakis, G.; Sorensen, K.; Hernandez, C.; Testor, P.; Ntoumas, M.; Petersen, W.; Mader, J. and Mortier, L. (2012) JERICO Report on best practice in conducting operations and maintaining: D 4.4. (Version 1 - 27/02/2012). Issy-les-Moulineaux, France, Ifremer for JERICO Project, 176pp. DOI:10.13155/49741. • World Meteorological Organization 2014 Guide to Meteorological Instruments and Methods of Observation. Geneva, Switzerland, World Meteorological Organization, 1128p. (WMO-No.8, 2014) JCOMM Data Management Coordination Group (DMCG) (2015) http://hdl.handle.net/11329/365 • An Oceanographers' and Marine Meteorologists' Cookbook for Submitting Data and Metadata in Real-time and Delayed Mode. Geneva, Switzerland, Joint Committee on Oceanography and Marine Meteorology, 42pp. (JCOMM-TR-072-Data-Cookbook) http://hdl.handle.net/11329/401 • Coppola, L., Ntoumas, M., Bozzano, R., Bensi, M., Hartman, S. E.,Charcos Llorens, Mi., Craig, J., Rolin, J-F., Giovanetti, G., Cano, D., Karstensen, J., Cianca, A., Toma, D., Stasch, C., Pensieri, S., Cardin, V., Tengberg, A., Petihakis, G., Cristini, L. (2016) Handbook of best practices for open ocean fixed observatories. European Commission, FixO3 Project, 127pp. (European Commission, FixO3 project, FP7 Programme 2007-2013 under grant agreement n° 312463). http://hdl.handle.net/11329/302 • Karstensen, J. (2005) How to process mooring data? A cookbook for MicroCat, ADCP and RCM data. Kiel, Germany, IFM-GEOMAR, Universitat Kiel, 44pp. DOI: 10.13140/RG.2.1.2514.7044
Data References	• Collection of information has been initiated via the new OceanSITES metadata management system at JCOMMOPS : http://www.oceansites.org/data/index.html
Products & Visualisation	OceanSITES data servers: • IFREMER Coriolis (FTP). ftp://ftp.ifremer.fr/ifremer/oceansites • US NDBC (FTP). ftp://data.ndbc.noaa.gov/data/oceansites • OceanSITES Data Format Reference Manual http://www.oceansites.org/docs/oceansites_data_format_reference_manual.pdf • OceanSITES User Guide (accessible soon from http://www.oceansites.org/documents/index.html) Tropical Moored Arrays (shared with DBCP): • http://www.pmel.noaa.gov/tao/data_deliv/deliv.html • http://tao.ndbc.noaa.gov • ERDAP server compliant netCDF format

GLOSSARY

Glossary of terms	• A **Framework for Ocean Observing** (FOO) is a guide written for the ocean observing community to institute an integrated and sustained global observing system that addresses the variables to be measured, the approach to measuring them, and how their data and products will be managed and made widely available. FOO is available from: http://www.oceanobs09.net/foo/ • A **GOOS Essential Ocean Variable (**EOV**)** is a sustained measurement or a group of measurements necessary to assess state and change at a global level, and to increase societal benefits from the ocean [on scales from global to regional]. • **Derived Products** are value added products derived from the Essential Ocean Variables (EOV) or Essential Climate Variables (ECV). Derived products can include the use of other variables. • **JCOMMOPS** is **JCOMM in-situ Observations Programmes Support Centre**. It provides international coordination and support to the networks, namely by assisting in their implementation and deployment and by developing set of tools to monitor the status of the observing system and its attendant data and metadata distribution. • **Measured variables** can be the same as the EOV or ECV, but many are components to develop the EOV or ECV, for example seastate includes significant wave height, wave period and wave direction. • **Sub-variables** or **Supporting variables** are variables observed or known from instrumentation or metadata and used to calculate the desired EOV or ECV. If data from another network is used to improve calibration (reduce random errors and uncertainty in biases) then provide a short note stating which data are used and estimate the impact.
Acronyms	CTD – Conductivity Temperature and Depth EOV – Essential Ocean Variables GDACS – Global Disaster Alerting Coordination System GOOS – Global Ocean Observing System IMOS – Integrated Maritime Operations System IOOS – Integrated Ocean Observing System JCOMM – Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology OCG – Observations Coordination Group OOI – Ocean Observatories Initiative OOPC – Ocean Observations Panel for Climate

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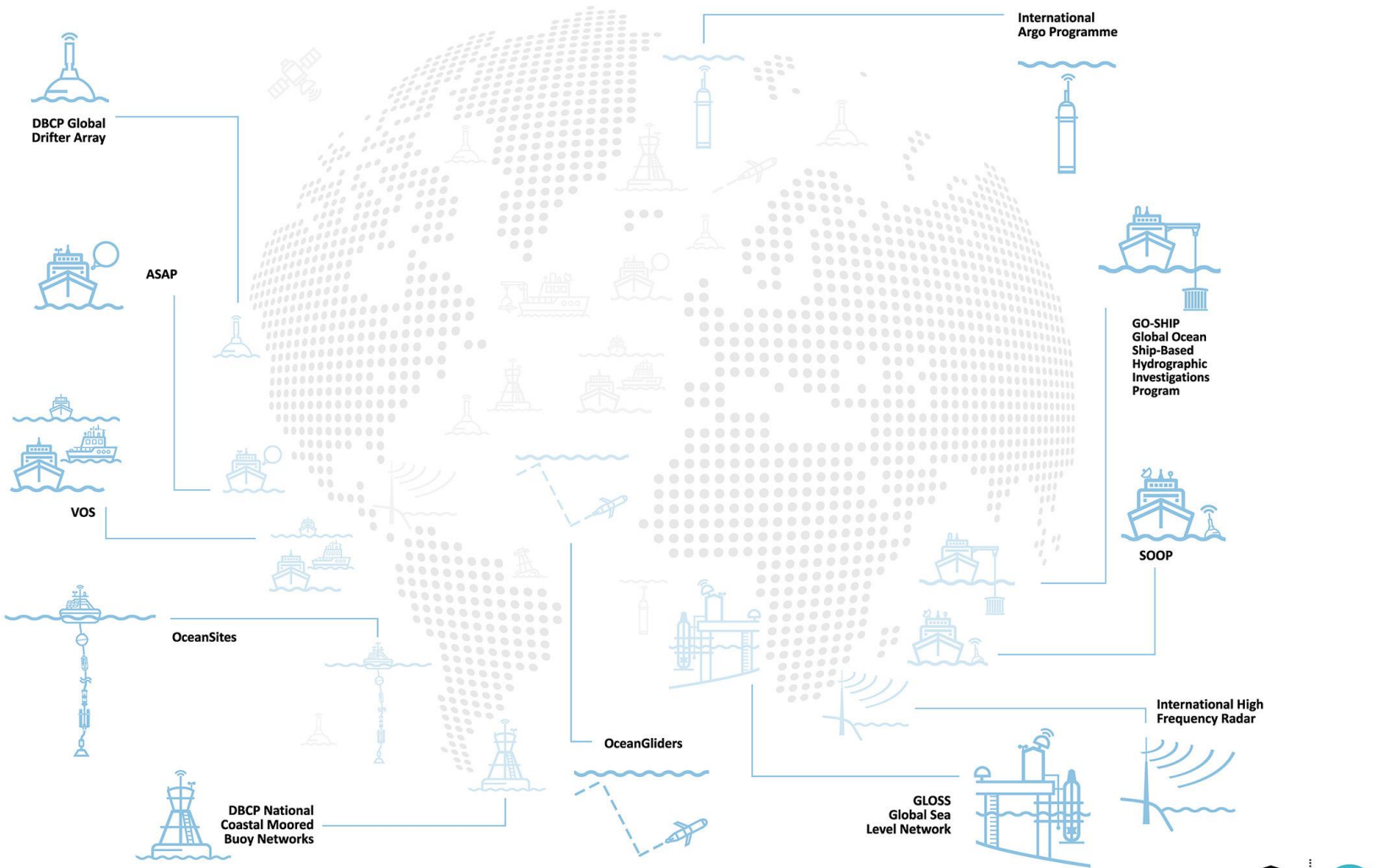
GLOBAL OCEAN OBSERVING NETWORKS



United Nations
Educational, Scientific and
Cultural Organization

Intergovernmental
Oceanographic
Commission