Coordination between GOOS OCG & GOOS Biogeochemistry Expert Panel

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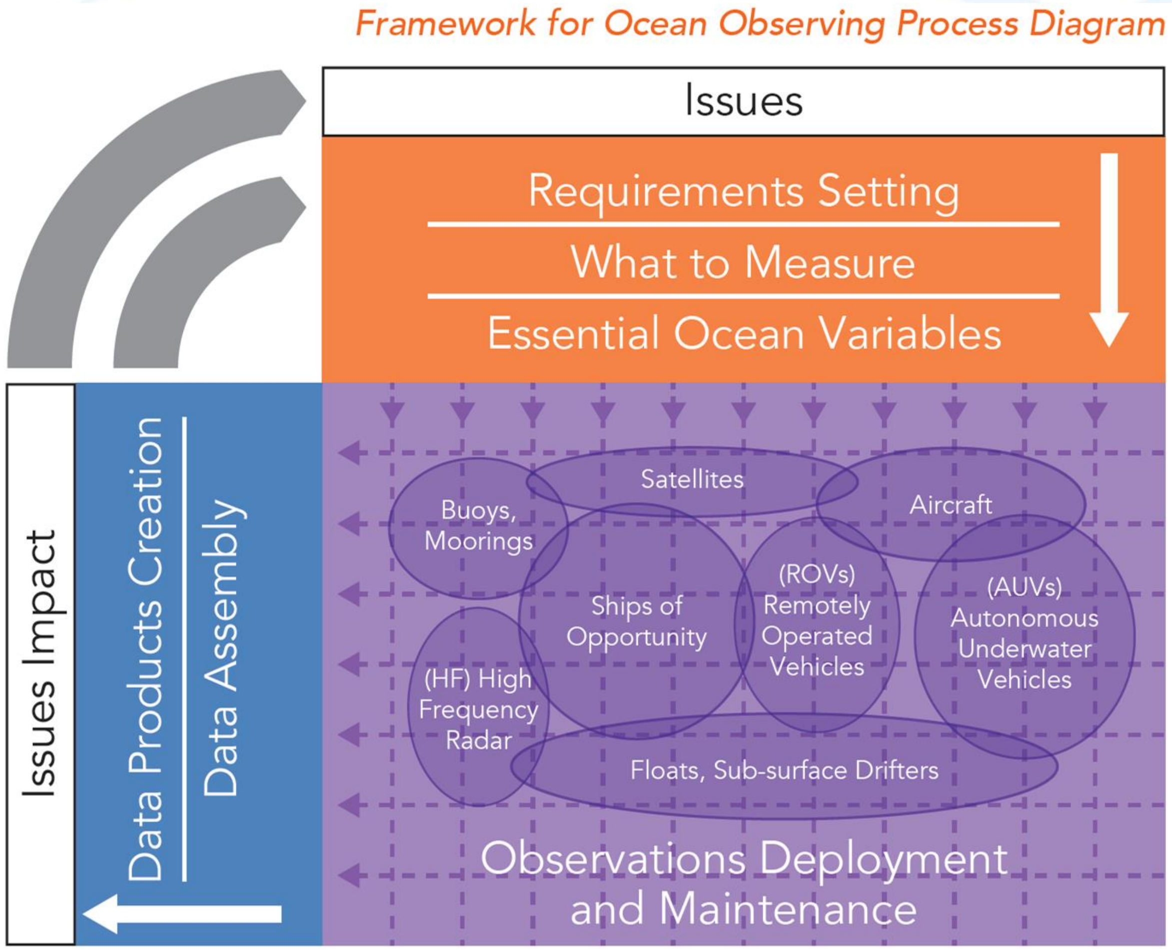
- **Session aims:**
  - This session will look at the **(3) current priorities of the GOOS Expert Panels**, where there is a need to **(1) better coordinate the work of the OCG with the work of the Panels**, and parallels and differences between the OCG networks and the BioEco communities, and the **(2) priorities for observations that the Panels have identified and how we can address them**.

- **Discussion questions**
  - How well or not does the relationship between the OCG and the GOOS BGC Panel work?
  - Main areas of connection? Implementation, harmonization, data and metadata?
  - How can the OCG help address the key priorities for observations of the GOOS BGC Panel?



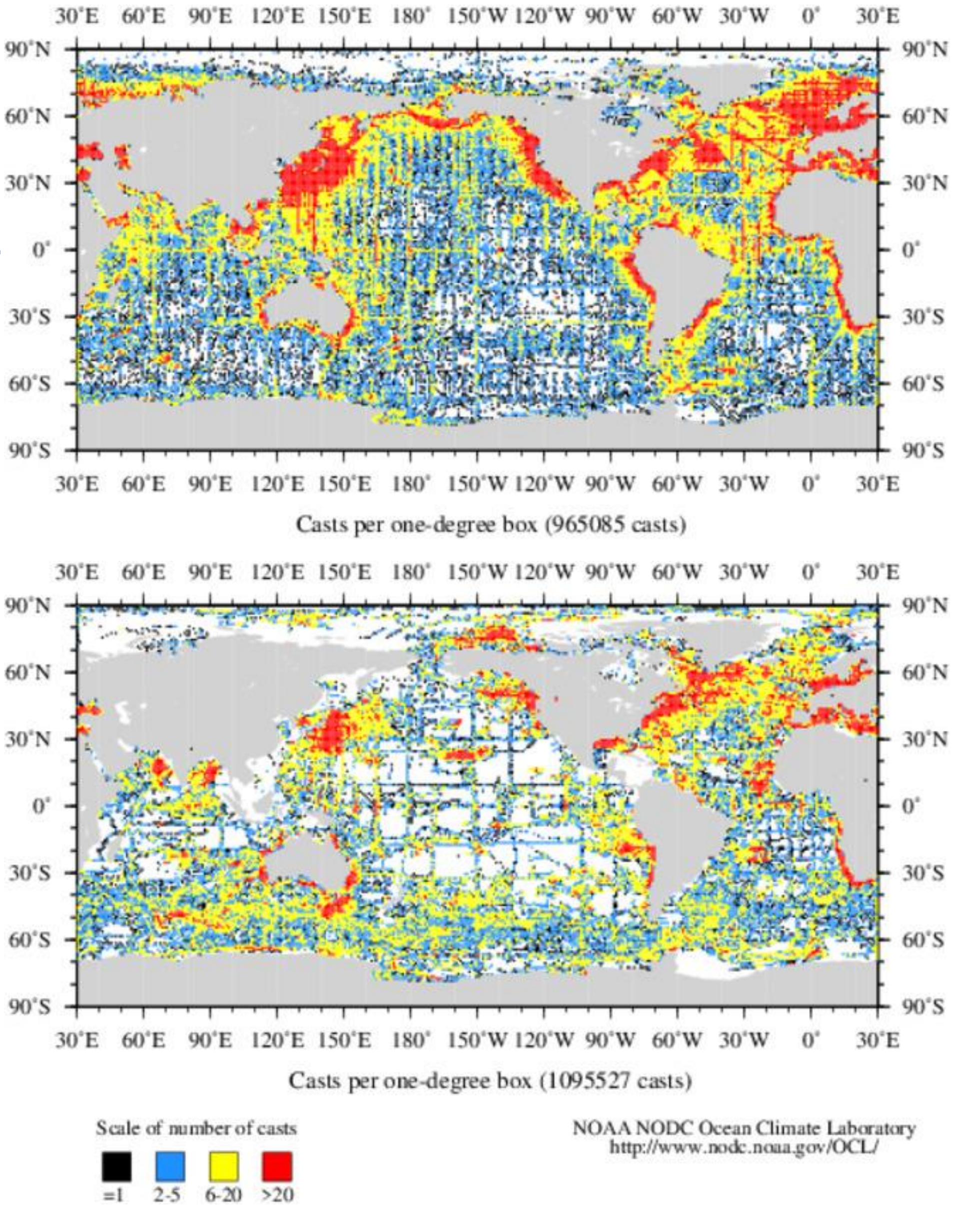
Priorities for observations - Understanding the oxygen cycle

- ✓ The ocean is responsible for about 50% of the oxygen produced on the planet
- ✓ Oxygen decline (deoxygenation) is increasing in the coastal and open ocean, due to human activities (CO_2-induced warming) and increasing loads of nutrients, **but we are still not able to contain the rate of deoxygenation**
- ✓ Scientists as well as policy and decision makers should have access to ocean oxygen data of known quality to take action to limit dead zones and open ocean deoxygenation, **but much more high quality data are needed to enable quantifying of ocean deoxygenation trends and to advance our understanding of extreme events**
- ✓ Ocean oxygen data should be translated into knowledge to allow more robust understanding of the connection between oxygen loss, climate change and ocean and human health, **but no single entry point (or federated system with heterogeneous procedures across databases, GDACs, regional hubs**) **exists to obtain oxygen data**.

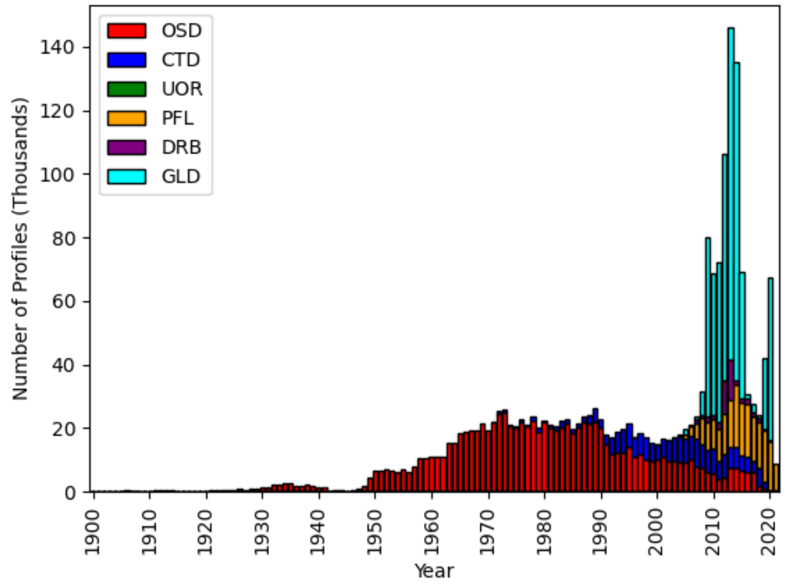
WHY NOW? CHANGE OF PARADIGM IN OUR CAPABILITIES TO OBSERVE O_2

Winkler data

Sensor data



 # Winkler data since 1900 ≅
 # sensors data over the last 10 years



THE MAGNITUDE OF DEOXYGENATION IS NOT WELL CONSTRAINED

Deoxygenation trend over 1960–2000 differs between 0.6% and 2 %.

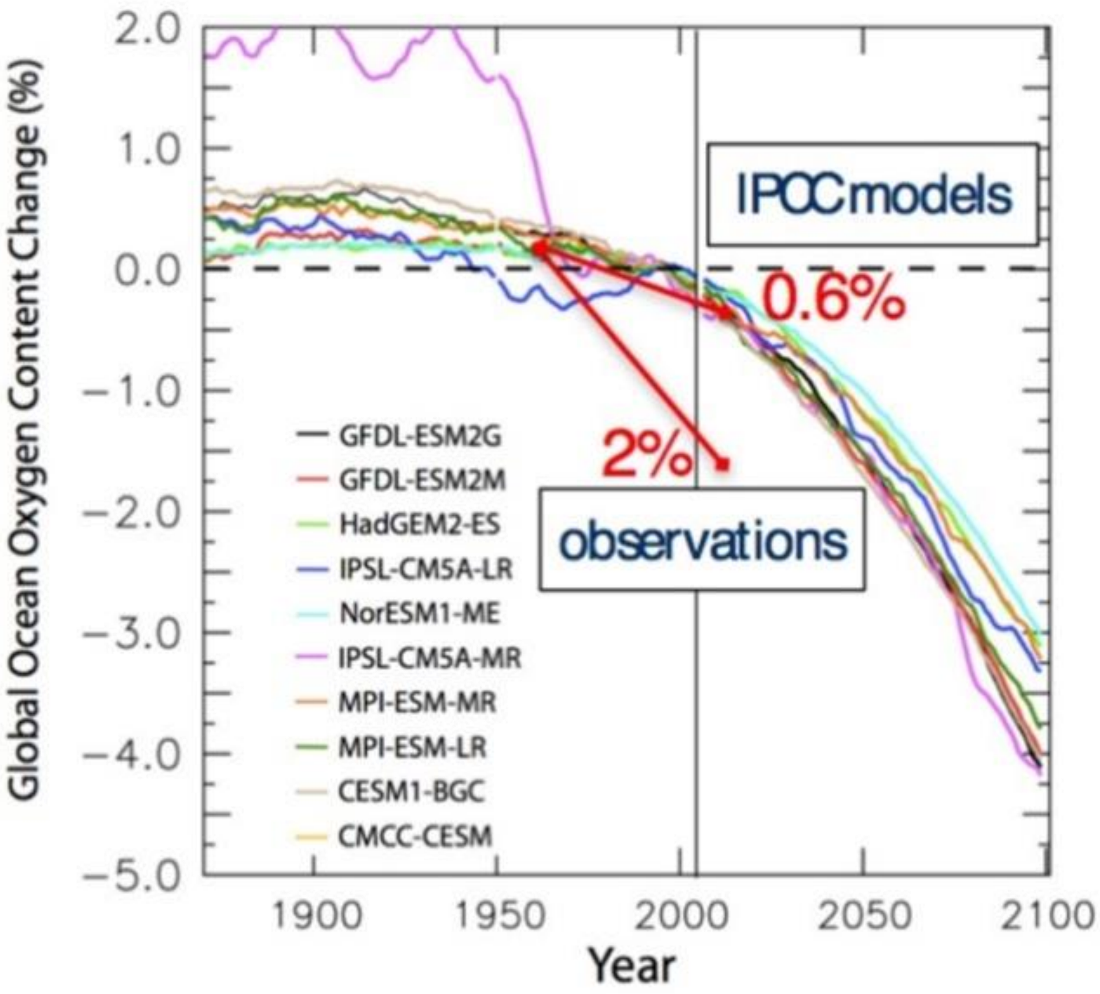
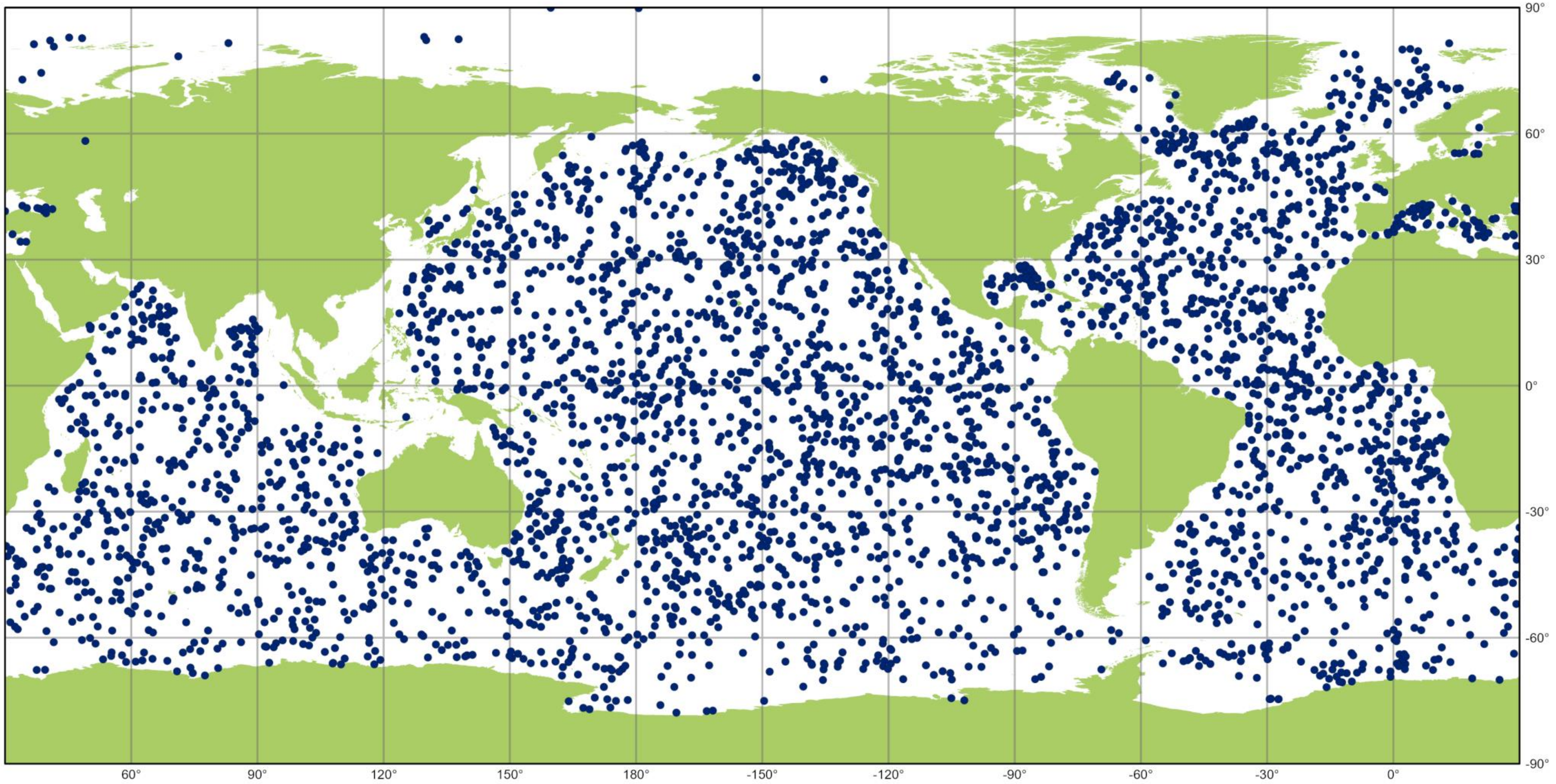


Figure from Oschlies et al., 2018



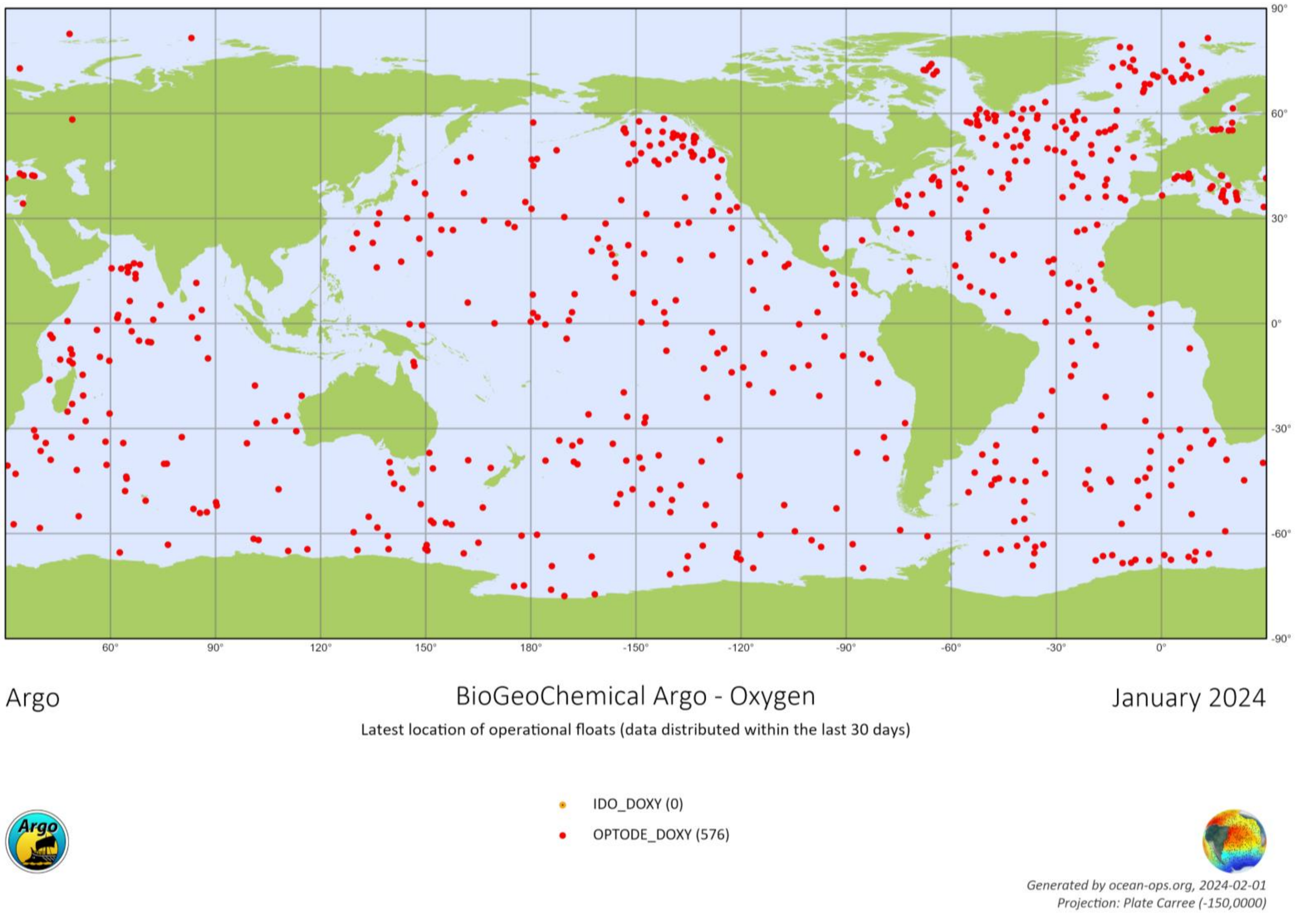
Argo 3879 Operational Floats January 2024

Figure courtesy of Mathieu Belbéoch and Magali Krieger, OceanOPS

Generated by ocean-ops.org, 2024-02-01
Projection: Plate Carree (-150,0000)

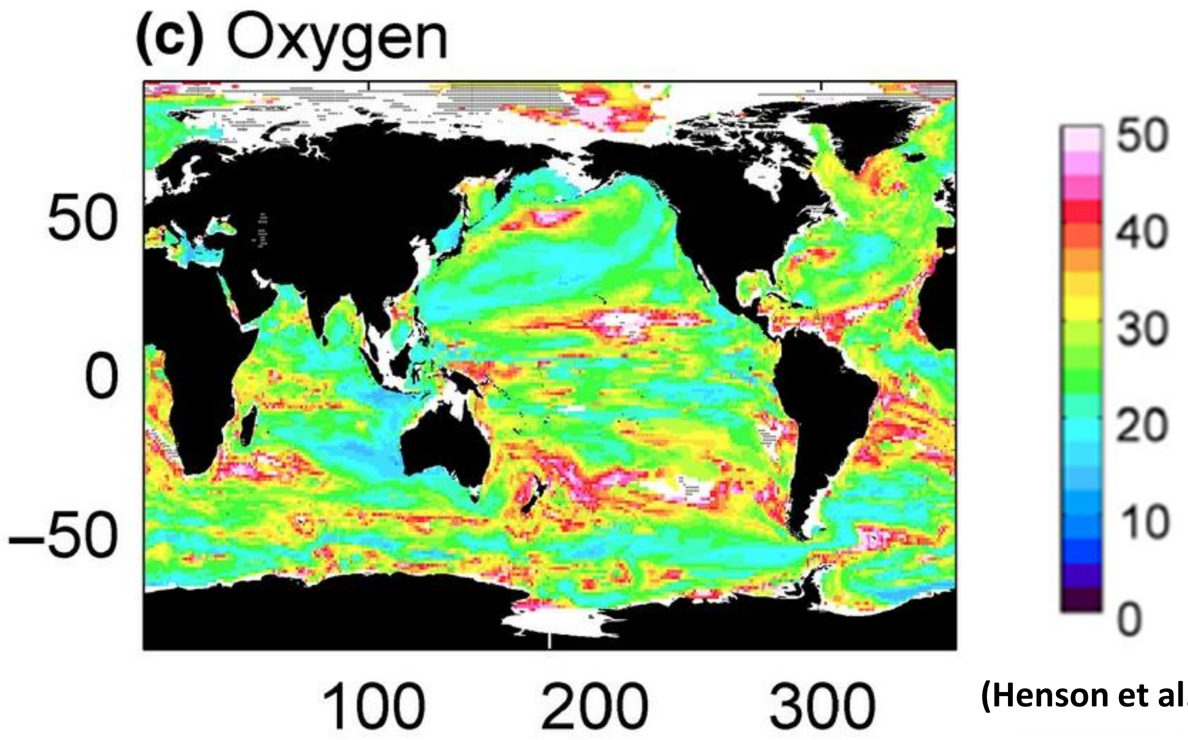
Profiling Floats

Courtesy of Mathieu Belbéoch and Magali Krieger, OceanOPS



- ✓ 15% of core Argo (576) floats are equipped with oxygen sensor
- ✓ **at least 80% of all Core ARGO should be equipped with Oxygen sensors by 2030**

Moored Fixed-point Observatories

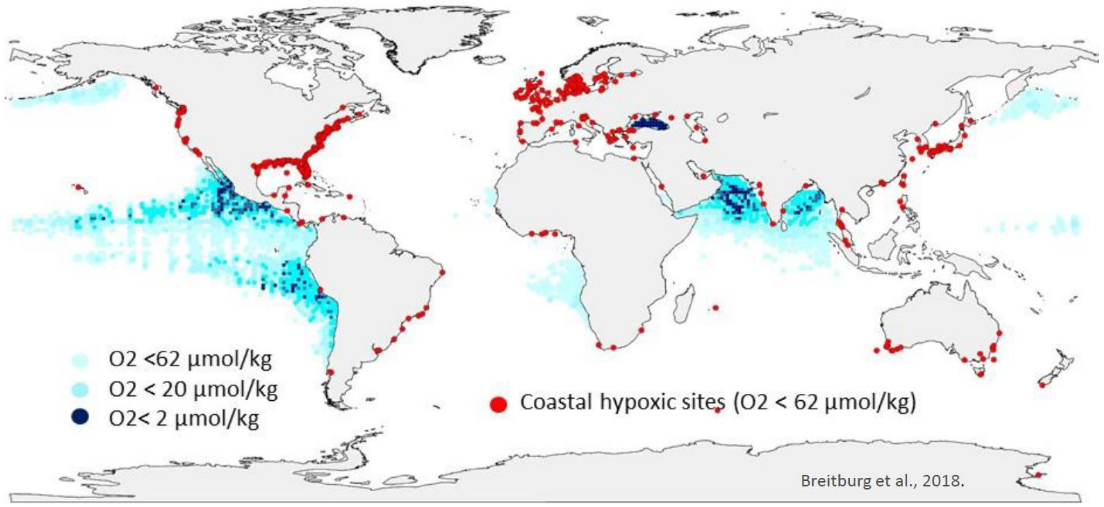


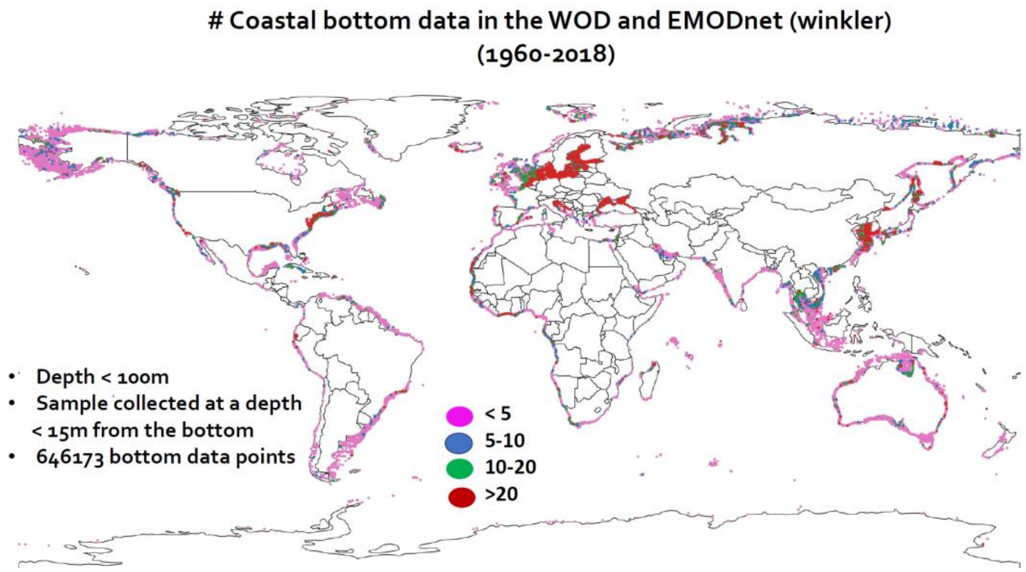
(Henson et al., 2016)

Number of years of data needed to distinguish between a climate change-driven trend from natural variability for oxygen. White areas are regions where less than half of the 8 models used agree on the sign of the trend.

- ✓ **deploy observatories in regions where the emergence time for detection of climate change-driven trend above background variability is predicted to be short**
- ✓ **All moored fixed point observatories from OceanSITES should be equipped with oxygen monitoring capability**

Gliders





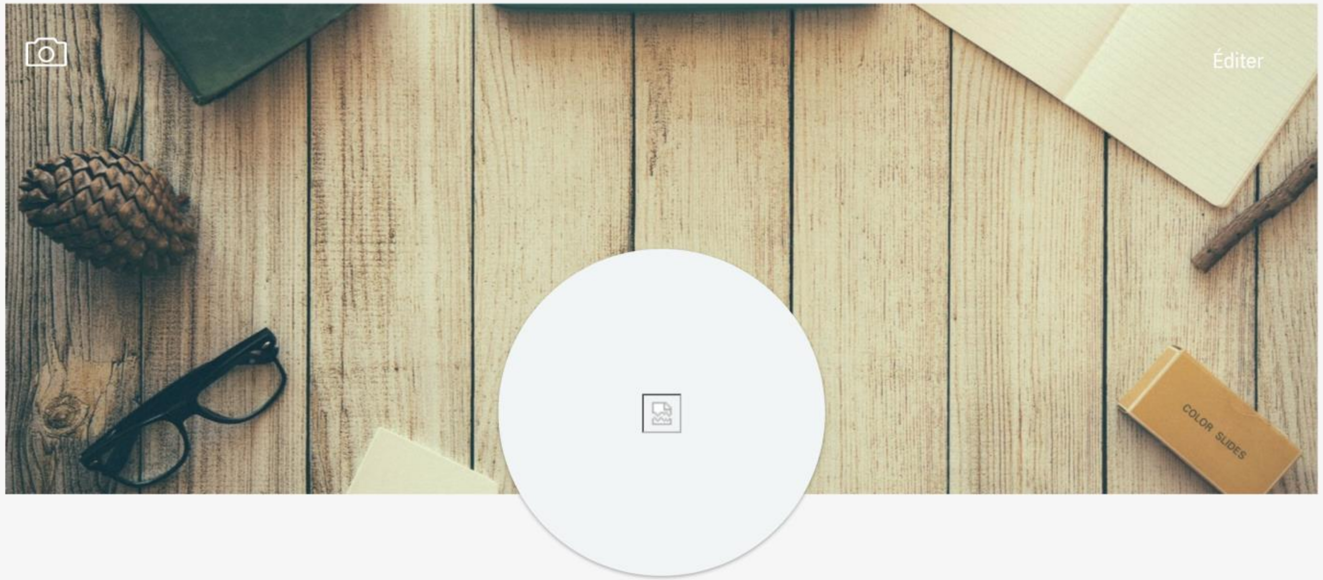
Insufficient coverage to characterize hypoxia dynamics in the coastal ocean

- ✓ **Perfect vehicles for coastal inflow monitoring to enhance the predictive capacity of coupled biogeochemical models used to forecast harmful algal blooms, to document air-sea fluxes of O2, changes in storage of O2, extent of hypoxia, net community production and export, etc.**

- ✓ **A dedicated global glider focus is recommended in Oxygen Minimum Zones (OMZs) in the next decade as oxygen concentrations are predicted to reach levels below nano/picomolar, and this may induce loss of aerobic habitat for socio-economically relevant species and have unknown impact on ecosystem services**

GOOD

Global Ocean Oxygen Decade



Global Ocean Oxygen Database and Atlas

France

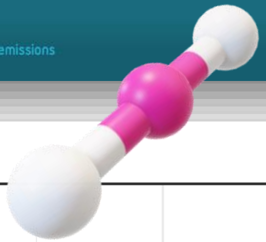
The aim is to launch an internationally coordinated effort towards the building of an open-access Global Ocean Oxygen Database and ATlas (GO2DAT), complying with the FAIR principles, combining data from the coastal and open ocean, measured from Eulerian and Lagrangian platforms, adopting a community-agreed metadata format, fully documented quality control and flagging procedures.

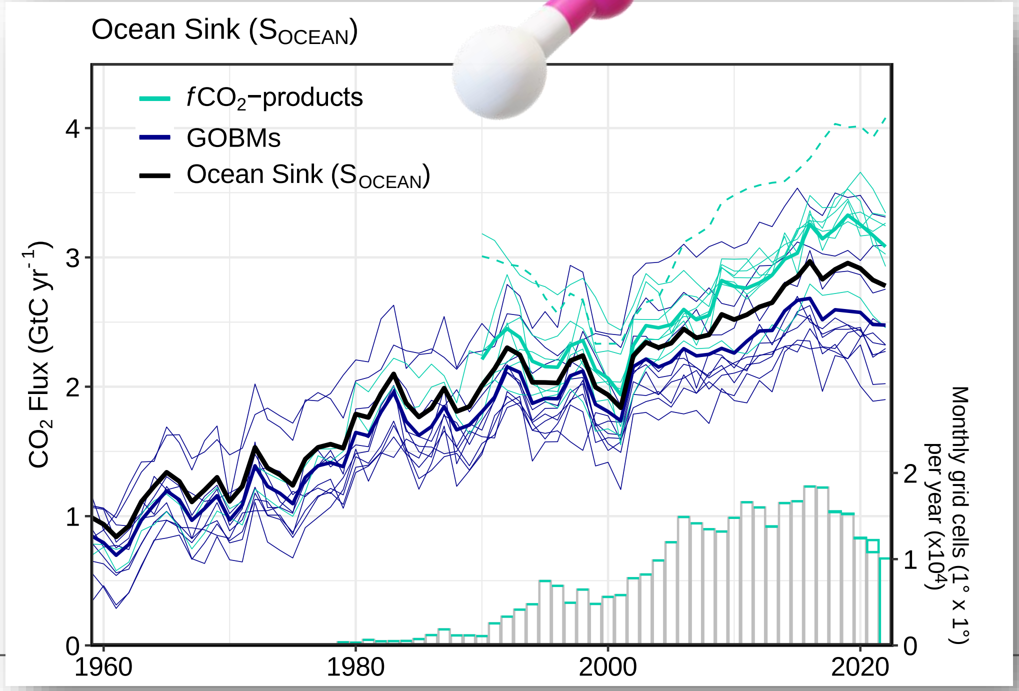
A roadmap towards GO2DAT, involving data providers, data managers and end-users was published in 2021(Grégoire et al., 2021). GO2DAT will harness the potential of the increasing number of O2 profiles, expected to quadruple in the future. It will allow the user to make an informed choice on data that are fit for purpose and will facilitate the dissemination of information on ocean deoxygenation to a wide community of stakeholders.

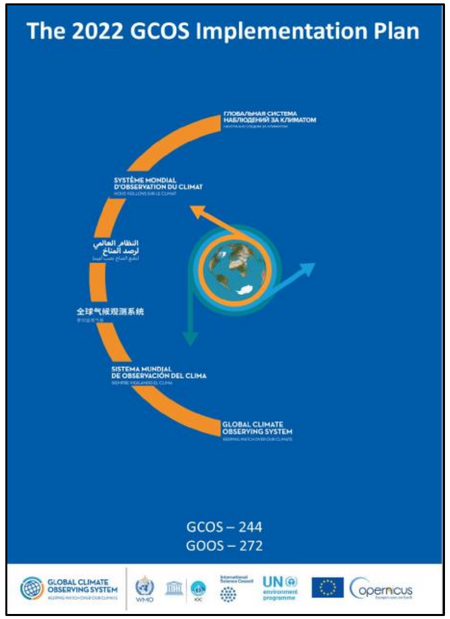
Current priority of the GOOS BGC Panel –

Develop a coherent GOOS-wide Carbon and Nitrous Oxide Action Plan in response to mandates from our sponsors

- **Background and plan for the Plan**
  - Unpacking the mandates driving the need for GOOS to have a carbon plan: GCOS IP 2022, WMO G3W IP 2024, IOC IOCR Report 2021
  - Draft zero of the table of content (ToC), mainly focused on general scope
  - Mode of operation (process and activities) and timeline







GCOS IP 2022

Collects and documents the data needs for monitoring the climate system and for assessing the impacts of climate variability and change. Submitted every 5 years to the United Nations Framework Convention (UNFCCC) and is recognized by the Conference of the Parties (COP).

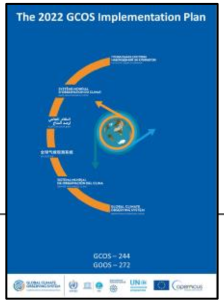
GGGW IP 2024

GGGW provides an integrated, operational framework in relation to GHG monitoring, striving to reduce the uncertainty in assessing the efficacy of climate action. Approved by WMO Congress and recognized by SBSTA59 at COP28. IP Requested by WMO Congress to allow Member States to facilitate actions required in 2024-2027

IOC IOCR WG 2021

The IOC-R addresses key issues in ocean carbon research through a combined strategy of investigative and observational goals around changing ocean carbon sink and impact that increasing CO2 levels have on ocean ecosystems. Reports to SBSTA and IOC Member States.

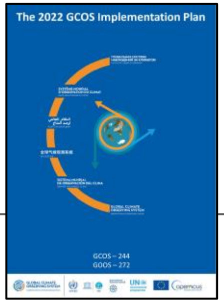
Theme	Actions	Implementing Bodies											
		WMO	NMHS	Space agencies	GOOS	Reanalysis Centers	Global Data Centers	Research organizations	National Agencies	Parties to UNFCCC	Academia	Funding Agencies	GCOS
A: ENSURING SUSTAINABILITY	A1. Ensure necessary levels of long-term funding support for in situ networks, from observations to data delivery	x	x					x			x	x	x
	A2. Address gaps in satellite observations likely to occur in the near future			x									
	A3. Prepare follow-on plans for critical satellite missions			x									
B: FILLING DATA GAPS	B1. Development of reference networks (in situ and satellite Fiducial Reference Measurement (FRM) programs)	x	x	x				x				x	x
	B2. Development and implementation of the Global Basic Observing Network (GBON)	x	x		x								x
	B3. New Earth observing satellite missions to fill gaps in the observing systems			x									
	B4. Expand surface and in situ monitoring of trace gas composition and aerosol properties		x					x	x			x	
	B5. Implementing global hydrological networks	x	x	x			x						
	B6. Expand and build a fully integrated global ocean observing system		x	x	x			x	x		x		
	B7. Augmenting ship-based hydrography and fixed-point observations with biological and biogeochemical parameters				x			x					
	B8. Coordinate observations and data product development for ocean CO_2 and N_2O	x			x			x	x				
	B9. Improve estimates of latent and sensible heat fluxes and wind stress		x	x	x			x			x		
	B10. Identify gaps in the climate observing system to monitor the global energy, water and carbon cycles							x				x	x
C: IMPROVING DATA QUALITY, AVAILABILITY AND UTILITY, INCLUDING REPROCESSING	C1. Develop monitoring standards, guidance and best practices for each ECV	x		x	x								x
	C2. General improvements to satellite data processing methods			x				x			x		
	C3. General improvements to in situ data products for all ECVs		x					x			x		
	C4. New and improved reanalysis products			x		x					x		
	C5. ECV-specific satellite data processing method improvements			x		x							
D: MANAGING DATA	D1. Define governance and requirements for Global Climate Data Centres	x					x						x
	D2. Ensure Global Data Centres exist for all in situ observations of ECVs	x	x		x				x			x	x
	D3. Improving discovery and access to data and metadata in Global Data Centres						x					x	x
	D4. Create a facility to access co-located in situ cal/val observations and satellite data for quality assurance of satellite products	x	x	x				x					
	D5. Undertake additional in situ data rescue activities	x	x							x		x	x
E: ENGAGING WITH COUNTRIES	E1. Foster regional engagement in GCOS	x			x					x			x
	E2. Promote national engagement in GCOS		x							x	x		x
	E3. Enhance support to national climate observations									x		x	x
F: OTHER EMERGING NEEDS	F1. Responding to user needs for higher resolution, real time data	x	x	x				x			x		x
	F2. Improved ECV satellite observations in polar regions			x				x			x		
	F3. Improve monitoring of coastal and Exclusive Economic Zones		x	x	x			x			x		
	F4. Improve climate monitoring of urban areas	x	x					x	x		x		x
	F5. Develop an Integrated Operational Global GHG Monitoring System	x		x				x	x		x		x

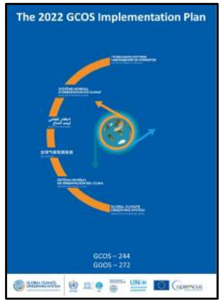


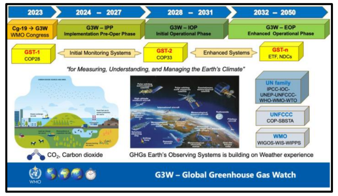
Action B8: Coordinate observations and data product development for ocean CO_2 and N_2O	
Activities	1. Develop a strategy and implementation plan to operationalize the data production and delivery of surface ocean CO_2 information. 2. Coordinate the existing nitrous oxide (N_2O) ocean observations into a harmonised network.

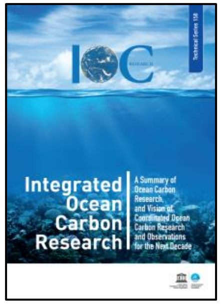
Action D2: Ensure Global Climate Data Centres exist for all in situ observations of ECVs	
Activities	1. Identify ECVs for which adequate global centres do not exist or are insufficiently supported and facilitate and support the creation or improvement of global data centres for these ECVs. 2. Promote regional data centres, their interoperability, where possible, synchronisation of their data holdings, and the provision of data in their archives to global data centres.

Action F5: Develop an Integrated Operational Global GHG Monitoring System	
Activities	The overall aim here is to develop an integrated operational global greenhouse gas monitoring infrastructure. The first steps are: 1. Design and start to implement a comprehensive global set of surface-based observations of CO_2, CH_4 and N_2O concentrations routinely exchanged in near-real time suitable for monitoring GHG fluxes.









GOOS Ocean Carbon and Nitrous Oxide Plan

(Implementation, Strategic or simply a Plan)

Draft 0 (20240412)

- **Executive Summary**
  - "This document will outline GOOS'es goals related to ocean carbon and nitrous oxide observing and describe the timeline for delivery of these goals through coordination, communication and implementation efforts over the next 3-5 years."
- **Introduction**
  - Motivation based on justification for the mandate documents
  - Motivation based on relevant elements of GOOS'es vision, mission and strategy
  - Description of usefulness of implementation of the Plan in supporting stakeholders (scientific community across GOOS elements, national and international efforts, funders of the ocean carbon observing system, others….)
- **Strategic approach**
  - Mandates
    - GCOS IP 2022
    - WMO G3W Implementation Plan 2024
    - IOC Integrated Ocean Carbon Research Report 2021
    - Other….?
  - Capacities and priorities across GOOS elements in the context of the mandates
    - Panels
    - OceanOPS
    - OCG
    - Networks
    - GRA's?
    - ETOOFS?
    - Partners: IODE, others?
  - Partnerships for implementation
  - Description of elements of mandates which are beyond GOOS'es capacity
- **Goals**
  - 4-5 Goals
    - 3-4 Objectives per goal
    - Each objective needs to have a clear description of action with timeline, named responsible GOOS element, measure of success
- **Conclusion and Next Steps**

Goals

Work around each goal focuses on gap analysis and development of 3-4 most pressing delivery objectives.

- <u>Goal 1: Fill ocean carbon and nitrous oxide observational gaps</u>
  - Synthesis of observing system design efforts (partnership?)
  - Critical domain gaps (e.g., ocean surface, coastal ocean, interface/exchange with seafloor)
  - Critical regional sampling gaps (e.g., Polar, Tropical Pacific, Indian Ocean, etc.)
  - Critical temporal sampling gaps (e.g., observations during winter)
  - Critical parameters gaps (e.g., co-located sampling, more holistic set of parameters on existing platforms)
  - Critical innovation and technological gaps (sensors, platforms)
- <u>Goal 2: Provide useful climate information for modeling/forecasting, product development, mitigation, adaptation</u>
  - Ocean carbon data management
    - Per network?
    - Per application? (e.g., ocean acidification, mCDR)
  - Existing and new data synthesis products
    - Per network (SOCAT, GLODAP, SPOTS)?
    - Per application (e.g., fluxes, storage)
    - More holistic?
  - Gaps filling efforts (e.g., Machine Learning)
- <u>Goal 3: Sustain funding for observations and data management</u>
  - Identification of infrastructural and personnel needs based on filling the gaps described in Goals 1 and 2
  - Identification of public and private stakeholders benefiting from filling those gaps
  - Identification of mechanisms allowing the stakeholders to invest in filling these gaps
- <u>Goal 4: Develop optimal support structure for ocean carbon coordination efforts within GOOS</u>
  - Existing structure
  - Specific coordination needs (within GOOS, across the community involved in delivering the GOOS Carbon Plan
  - Optimal structure

- **Mode of operation:**
  - Plan to be written as response to identified mandates and not beyond
  - A Task Team led by GOOS BGC Panel of limited size: volunteers primarily from GOOS elements (beyond if expertise needed)
  - Distributed responsibilities with agreed check-points and milestones (e.g. Trello board, dedicated teleconference calls, in-person workshop to gather wider input)
  - Dedicated GMT staff (consultant) hired to help coordinate
  - Description of limited number of specific, timeline'd objectives with final delivery within 3-5 years from publication of the Plan
  - Plan published/released around the UN Ocean Conference in June 2025
- **Discussion questions**
  - How well or not does the relationship between the OCG and the GOOS BGC Panel work?
  - Main areas of connection? Implementation, harmonization, data and metadata?
  - How can the OCG help address the key priorities for observations of the GOOS BGC Panel?

International Council for Science
SCOR
Scientific Committee on Oceanic Research

INTERNATIONAL OCEAN CARBON COORDINATION PROJECT
IOCCP

The Global Ocean Observing System
GOOS
Biogeochemistry Panel

UNESCO
United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

A communication and coordination service for marine biogeochemistry

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Thank You!