The Global Ocean Observing System

Session 2.5: Carbon and Greenhouse Gas Plan

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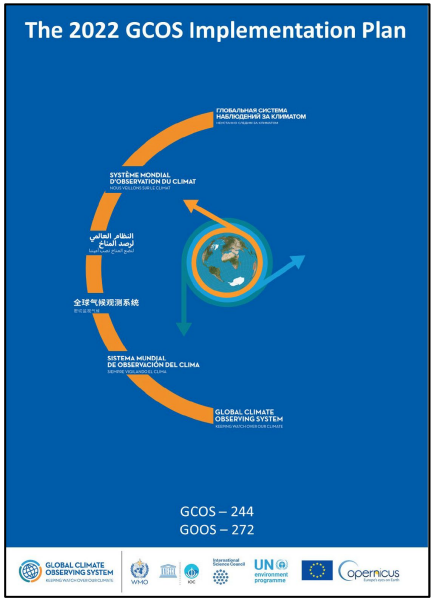
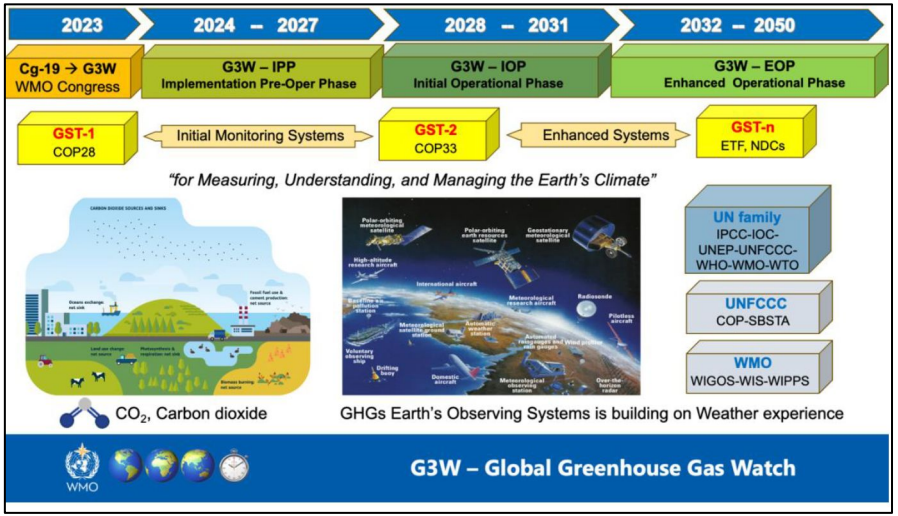
14th GOOS Steering Committee meeting (SC-14) | 19-21 February 2025 | Paris, France

GOOS is designated as the implementing body of ocean carbon actions in WMO and IOC plans

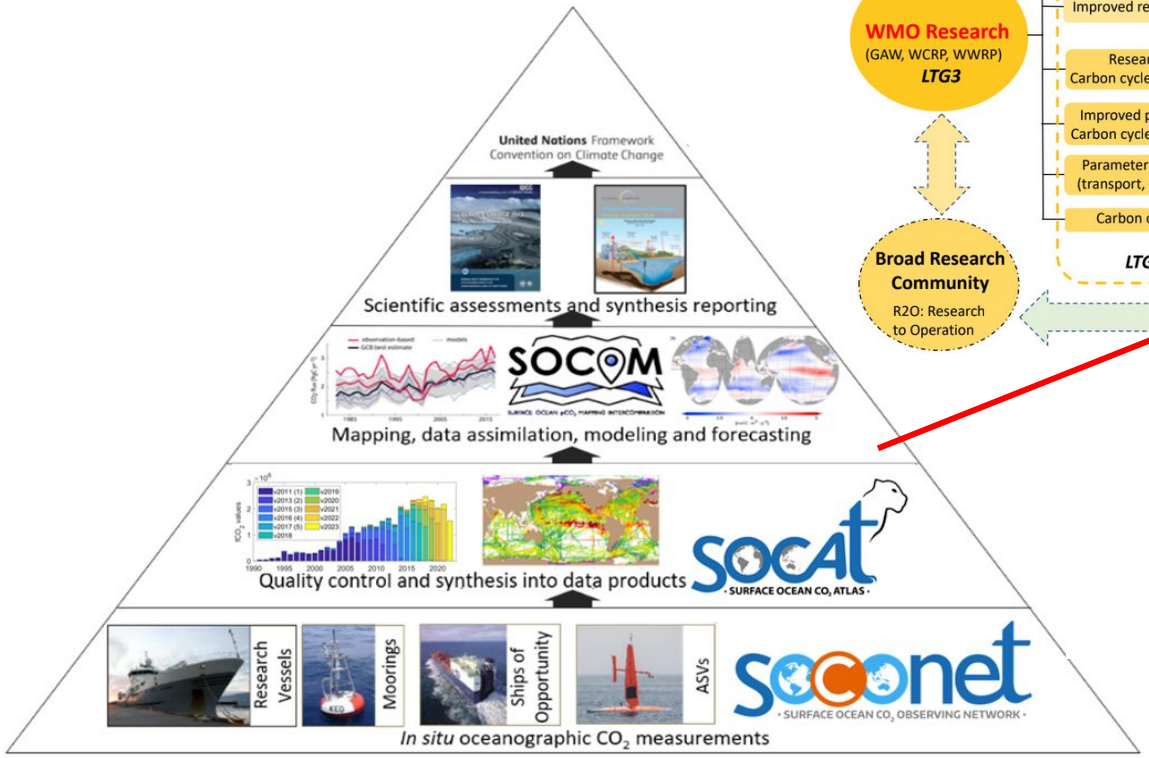


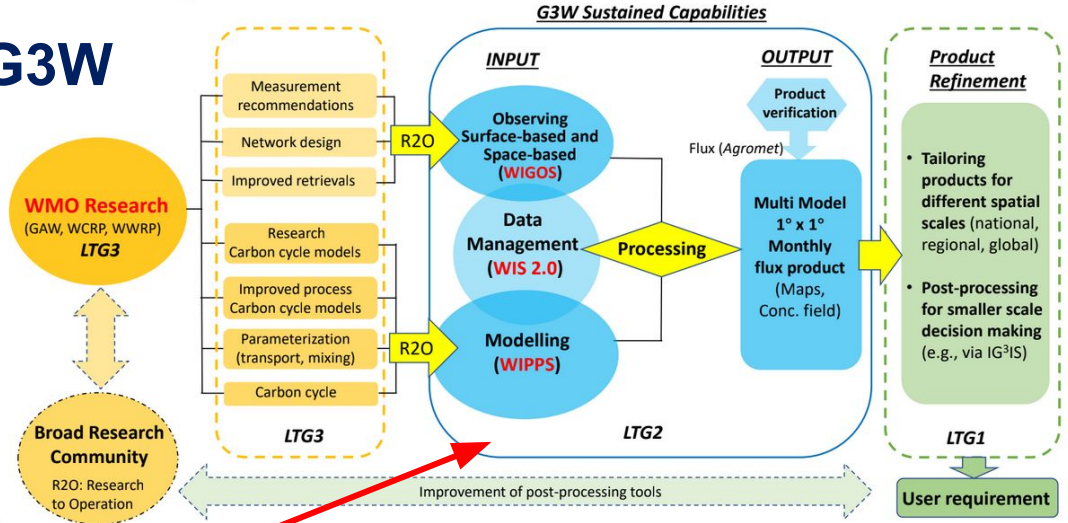


Actions fall within three focal areas:

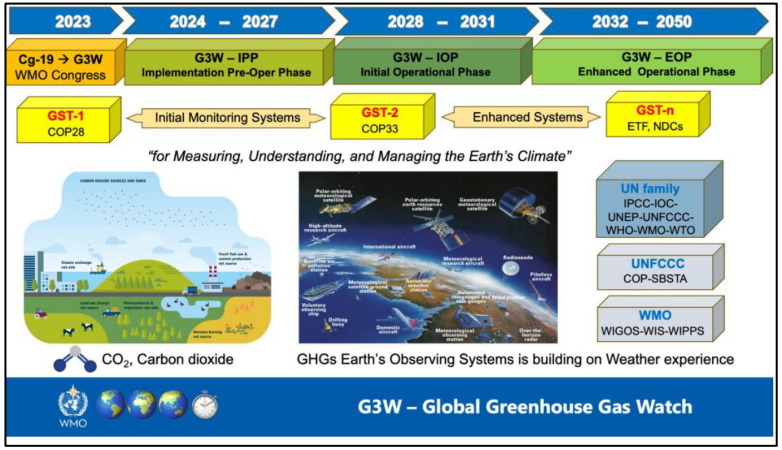
1. COORDINATION OF **OCEAN GHG NETWORKS**
2. ONGOING **CORE GOOS** RESPONSIBILITIES
3. OCEAN CARBON **NETWORK DESIGN** DEVELOPMENT

The ocean component of G3W





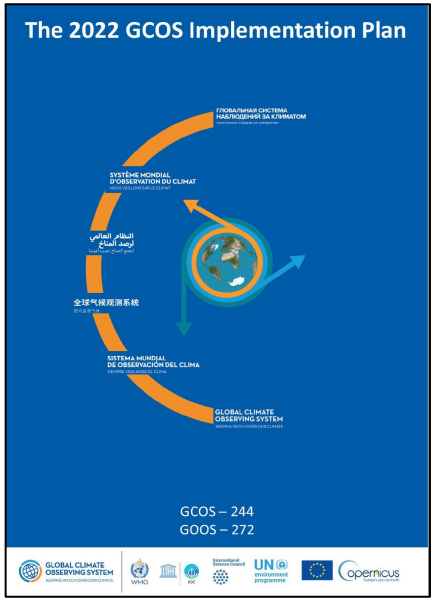
Summary and timeline of GOOS actions in G3W IP



Actions summarized	Lead GOOS elements	Status - timeline to complete	Focal area
Ocean GHG measurement inventory and standards	BGC Panel*	underway - 2027	Ocean GHG networks
Formalize (and enhance) SOCONET	BGC Panel	completed (ongoing)	Ocean GHG networks
Identify and deliver routine ocean flux products	BGC Panel (OCG)*	underway - 2031	Ocean GHG networks
Liaise with satellite community	BGC Panel*	not started - 2025	Ocean GHG networks
Establish data management life cycle	OCG (ETOOFS)*	underway - 2031	Core GOOS
WMO workshop to develop longer-term GHG activities	All GOOS to activate ocean participation	2026 workshop	Network design

* Supported through GOOS participation on G3W Task Teams:
Networks, Data, Modelling

Summary and timeline of GOOS actions in GCOS IP



Actions summarized	Lead GOOS elements	Status - timeline to complete	Focal area
Coordinate CO_2 and N_2O observations and products	BGC Panel	underway - ongoing	Ocean GHG networks
Identify gaps in ocean carbon observing system	BGC Panel (all panels, GRAs, networks)	not started - 2027	Network design
ECV standards, guidance, best practices	GOOS Panels	underway - ongoing	Core GOOS
Ensure existence of data centres for ECVs	OCG	underway - ongoing	Core GOOS
Develop integrated operational GHG system	BGC Panel (OCG, ETOOFS)*	underway - 2031	Ocean GHG networks

Ocean Carbon Network Design

Global ocean observing design prerequisites:

1. Research-oriented, cross-network strategy for GOOS networks w/ role in global ocean carbon observing
2. Enhance collaboration within modelling community and improve understanding between observationalists and modelers

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Biogeosciences

Assessing improvements in global ocean pCO_2 machine learning reconstructions with Southern Ocean autonomous sampling

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Abstract. The Southern Ocean plays an important role in the exchange of carbon between the atmosphere and oceans and is a critical region for the ocean uptake of anthropogenic CO_2. However, estimates of the Southern Ocean air–sea CO_2 flux are highly uncertain due to limited data coverage. Increased sampling in winter and across meridional gradients in the Southern Ocean may improve machine learning (ML)

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Research

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98/rsta.2022.0063

Sparse observations induce large biases in estimates of the global ocean CO_2 sink: an ocean model subsampling experiment

Judith Hauck[1], Cara Nissen[1,2], Peter Landschützer[3], Christian Rödenbeck[4], Seth Bushinsky[5] and Are Olsen[6,7]

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Estimates of ocean CO_2 uptake from global ocean biogeochemistry models and pCO_2-based

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Global Biogeochemical Cycles

RESEARCH ARTICLE
10.1029/2019GB006176

Reassessing Southern Ocean Air-Sea CO_2 Flux Estimates With the Addition of Biogeochemical Float Observations

Seth M. Bushinsky[1,2], Peter Landschützer[3], Christian Rödenbeck[4], Alison R. Gray[5], David Baker[6], Matthew R. Mazloff[7], Laure Resplandy[8], Kenneth S. Johnson[9], and Jorge L. Sarmiento[1]

Key Points:
- A combined ship and float carbon dioxide flux estimate for the Southern Ocean yields 0.4 Pg C/yr less uptake than a ship-only estimate
- Model subsampling indicates that some of the differences between ship and float flux estimates may be due to sampling times and locations
- An atmospheric inversion using the new ocean fluxes indicates that any compensating flux must be found in land or ocean south of 5°S

Supporting Information:
- Supporting Information S1

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Abstract New estimates of pCO_2 from profiling floats deployed by the Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM) project have demonstrated the importance of wintertime outgassing south of the Polar Front, challenging the accepted magnitude of Southern Ocean carbon uptake (Gray et al., 2018, https://doi:10.1029/2018GL078013). Here, we put 3.5 years of SOCCOM observations into broader context with the global surface carbon dioxide database (Surface Ocean CO_2 Atlas, SOCAT) by

scientific reports

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The importance of adding unbiased Argo observations to the ocean carbon observing system

Thea H. Heimdal & Galen A. McKinley

The current coverage of direct, high-quality ship-based observations of surface ocean pCO_2 includes large gaps in time and space, and has been declining since 2017. These ocean observations provide the basis for the data products that reconstruct surface ocean pCO_2 and estimate ocean carbon uptake. Improved data coverage is needed to advance our understanding of the ocean carbon sink and air–sea CO_2 exchange. Targeted sampling from autonomous platforms, such as biogeochemical floats, combined with traditional shipboard measurements represents a promising path forward to improve surface ocean pCO_2 reconstructions. However, floats provide indirect pCO_2 estimates derived from pH, and thus have higher uncertainty and are biased compared to direct shipboard measurements. Here, we use a Large Ensemble Testbed (LET) of Earth System Models and the pCO_2-Residual method

Ocean Observing Co-Design
by The Global Ocean Observing System

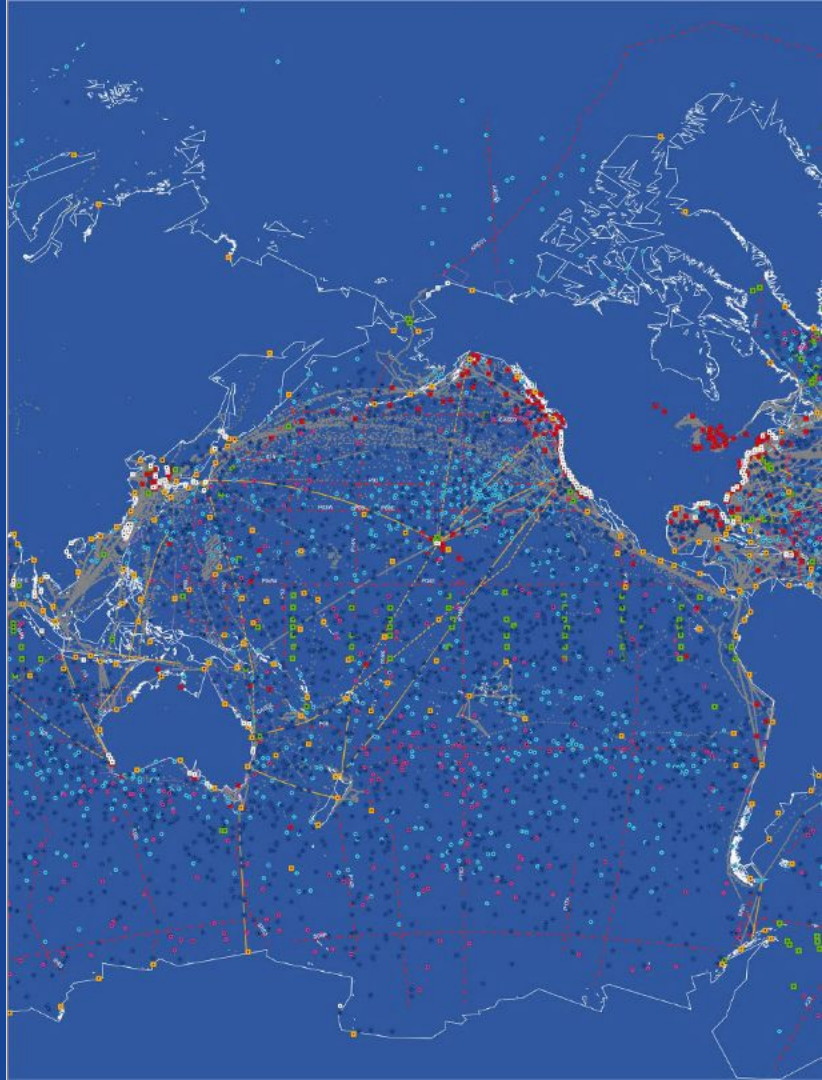
Ocean Carbon Cycle Exemplar

Ocean Observing Co-Design Contribution to Carbon Plan

Emma Heslop | Global Ocean Observing System, IOC-UNESCO
Richard Sanders | NORCE / ICOS
Anya Waite | Ocean Frontier Institute
Ronnie Noonan-Birch | Ocean Frontier Institute
Cristina Miño | UNESCO

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

This programme is endorsed by the **UN Decade of Ocean Science**



Section 3 – Co-Design Carbon Exemplar

Co-Design Ocean Carbon Exemplar → **Carbon Plan Contribution**

Focuses on

- Co-Designing the system for additional observations and services that respond needs of new user groups
- Exploring funding and governance models for private sector engagement
- Building connections between observations, models, services, and end users

Carbon Exemplar 2025 Plans

- Develop a Horizon Europe Proposal on Ocean Carbon Governance
- Engagement for advancing research with the Global multi-scale Ocean Carbon Observatory initiative (GOCO) - Ocean Visions Working Group.
- Convene Horizon Europe discussions at One Ocean Science and UNOC to align priorities and build momentum.

Expected outcomes for GOOS

- Recommendations for optimizing and enhancing ocean carbon observing networks
- Integration of ocean GHG data and products in an operational G3W

Resource needs and considerations

- BGC Panel plan to advance coordination of ocean GHG networks and ocean carbon network design in parallel over the past year was inhibited by funding uncertainties
- Prioritizing, consolidation where possible, and limiting engagement in other tasks will be key to our success
- Crucial need of 1 FTE to ensure a proper implementation of the carbon plan in the coming years (2025-2027)

Proposed decisions/recommendations:

- Adopt proposed work plan
- Determine ideal (existing) forum for communicating collective progress across GOOS elements

Questions and discussion…