WMO as co-sponsor of GOOS

Albert Fischer, *Director, WIGOS Branch, Infrastructure Department, WMO*
with input from many colleagues

13th GOOS Steering Committee
14 April 2024, Barcelona, Spain

WORLD METEOROLOGICAL ORGANIZATION

WMO Strategic Plan 2024–2027

VISION 2030

By 2030, we see a world where all nations, especially the most vulnerable, are more **resilient** to the socioeconomic consequences of **extreme weather, climate, water and other environmental events**; and underpin their sustainable development through the **best possible services**, whether over land, at sea or in the air

MISSION

To facilitate worldwide cooperation on **monitoring and predicting changes in weather, climate, water** and other environmental conditions through the **exchange of data, information and services**, standardization, application, research and training.

LONG-TERM GOALS	1 Services	2 Infrastructure	3 Science & Innovations	4 Member Services	5 Smart Organization
	Better serve societal needs	**Enhance Earth system observations and predictions**	**Advance targeted research**	**Close the capacity gap**	**Strategic realignment of structure and programmes**
STRATEGIC OBJECTIVES	• National **multi-hazard early warning/alert** systems • **Climate** information and services • **Hydrological services** • Decision-supporting **weather information and services** • Address global risks associated with **irreversible changes in the cryosphere**	• Optimize **observation data acquisition** • Improve access to, exchange and management of **Earth system observation data and products** • Enable access and use of **numerical analysis and prediction products**	• Advance **scientific knowledge of the Earth system** • Enhance **science-for-service value chain** to improve predictive capabilities • Advance **policy-relevant science**	• Enable developing countries to **provide** and **utilize essential weather, climate, hydrological** and related **environmental services** • Develop and sustain **core competencies** and **expertise** • Scale up **partnerships**	• Optimize WMO **constituent body structure** • Nurture WMO **strategic partnerships** • Advance **equal, effective** and **inclusive participation** • **Environmental sustainability**

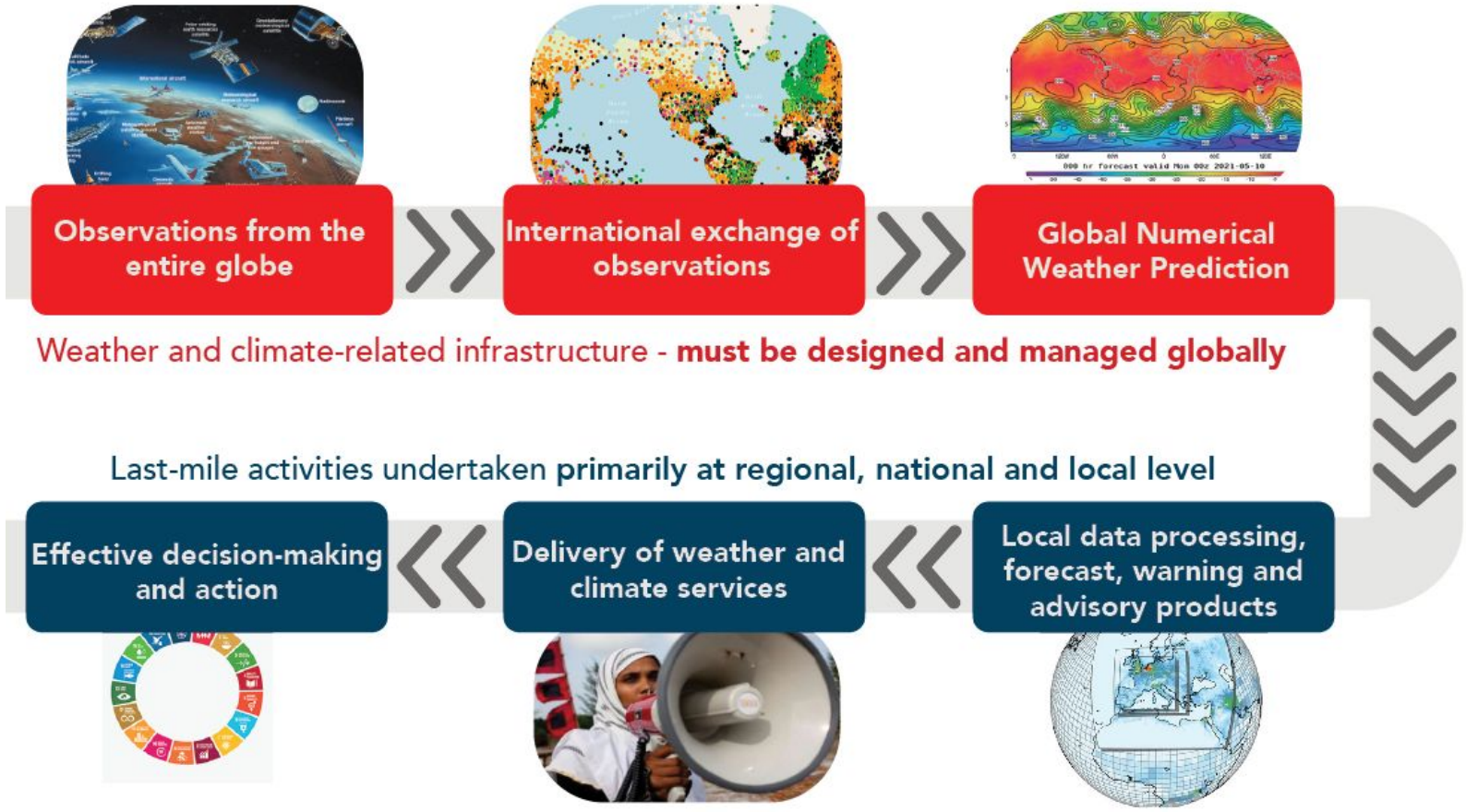
Secretary-General's priorities

Celeste Saulo, WMO SG

Supporting **Members**

- accelerating **Early Warnings for All**
- **Global Greenhouse Gas Watch**
- **Closing the gaps** in the basic **observing system**, including through SOFF

Successful application of weather and climate services depend on a functioning meteorological value chain

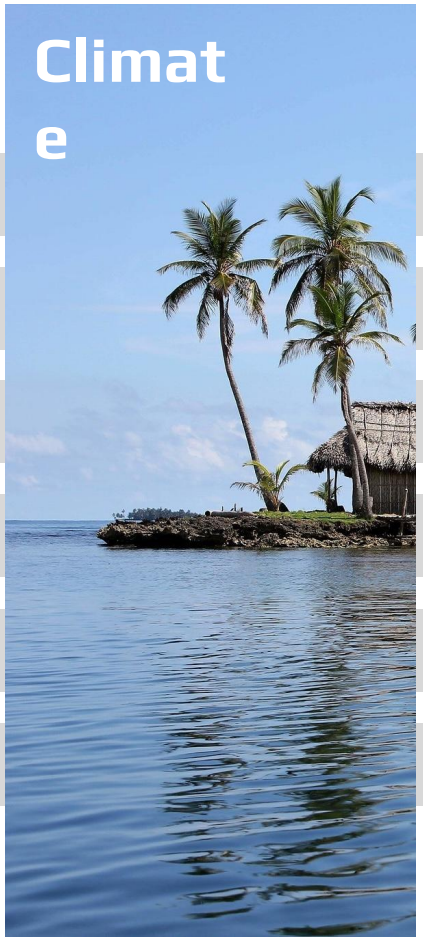


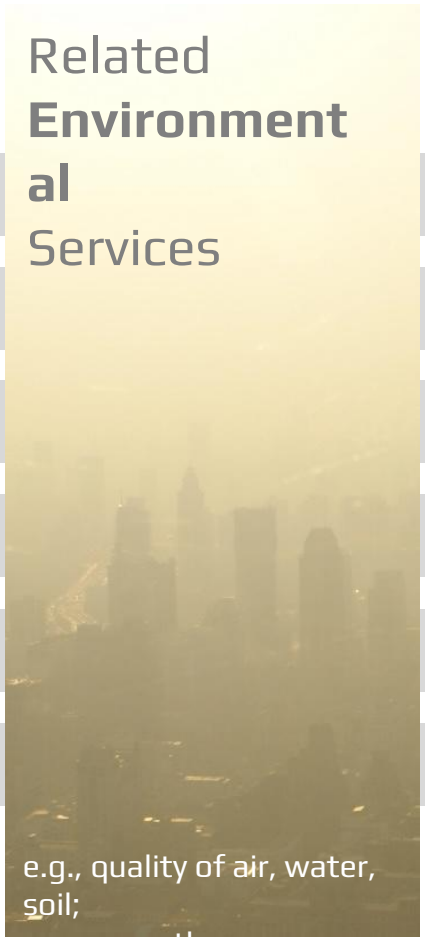
Ocean observations and prediction (coupled or not) are used in a wide variety of **weather, climate, and marine services** as well as research and assessment

GOOS already well partnered with WMO observation, data exchange activities

Weather, climate, water applications

Drivers of an Earth System approach





space-based

Atmosphere

Hydrology

Cryosphere

Ocean

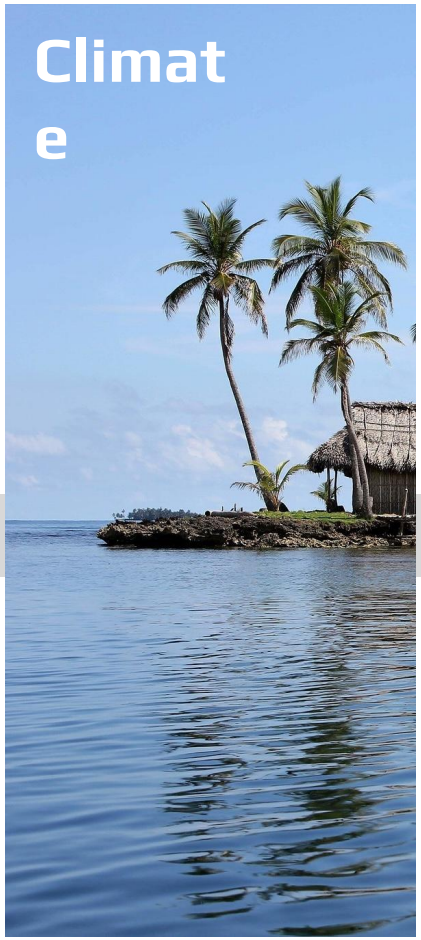
Terrestrial

Space weather

surface-based

Photos: Various authors, WMO Calendar Competition

Lifting GOOS from all co-sponsors



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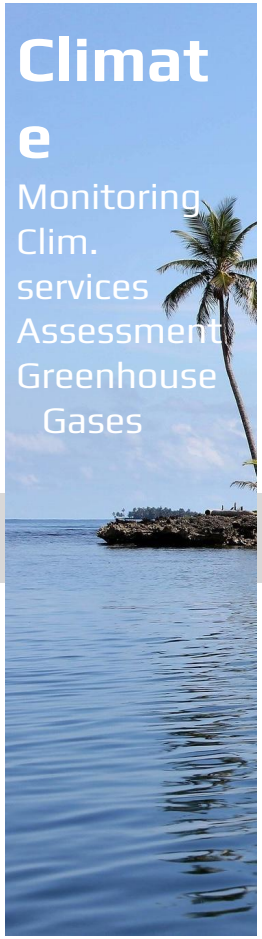
GOOS

Photos: Various authors, WMO Calendar Competition

Lifting GOOS from all co-sponsors

Weather
Prediction
Early warning
Marine services



Climate
Monitoring
Clim. services
Assessment
Greenhouse Gases

Ocean Climate Nexus
Acidification
Carbon
Impacts
Solutions

Ocean Health
Sustainable

Development
Conservation
Restoration
Planning

Ocean-related hazards

Ocean economy

Transform. change for people & nature
Climate
Nature & biodiversity loss
Pollution & waste

Science for sustainability

GOOS

WMO

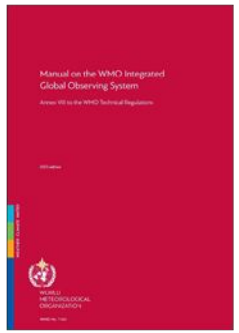
IOC/UNESCO and the Ocean Decade

UNEP

ISC

Photos: Various authors, WMO Calendar Competition 2024, cc

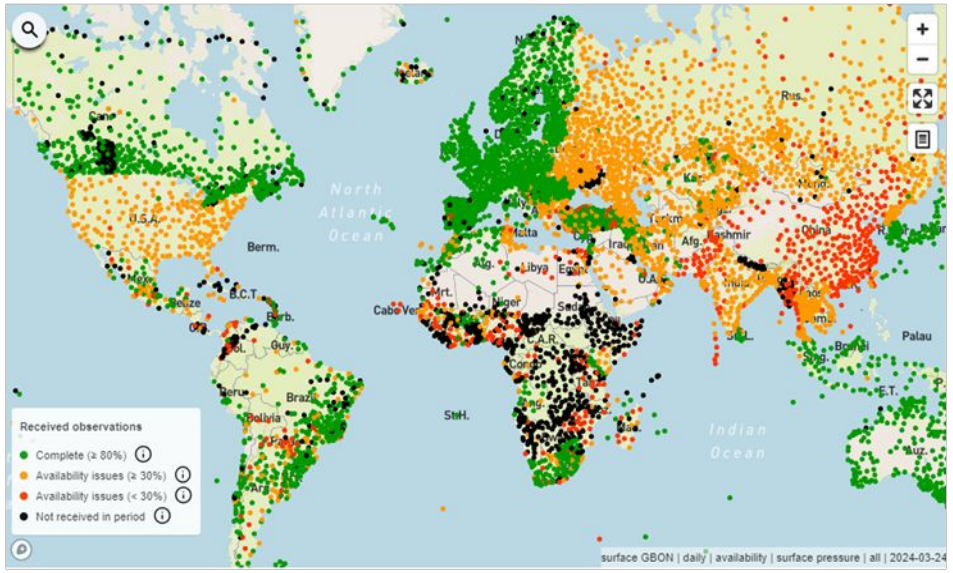
WMO Regulatory material: significance of Manuals and Guides



Manual → specifies the obligations of Members

Manual on WIGOS

a) specifies the implementation and operation of WIGOS;
b) facilitates cooperation in observations among Members;
c) ensures adequate uniformity and standardization in a & b



Guide → provides guidance material to regulations

Guide to WIGOS explains and describes WIGOS practices, procedures and specifications and aims to assist the technical and administrative staff

Need to be compliant
→ SHALL
→ SHOULD

Members of WMO

provides assistance to be compliance

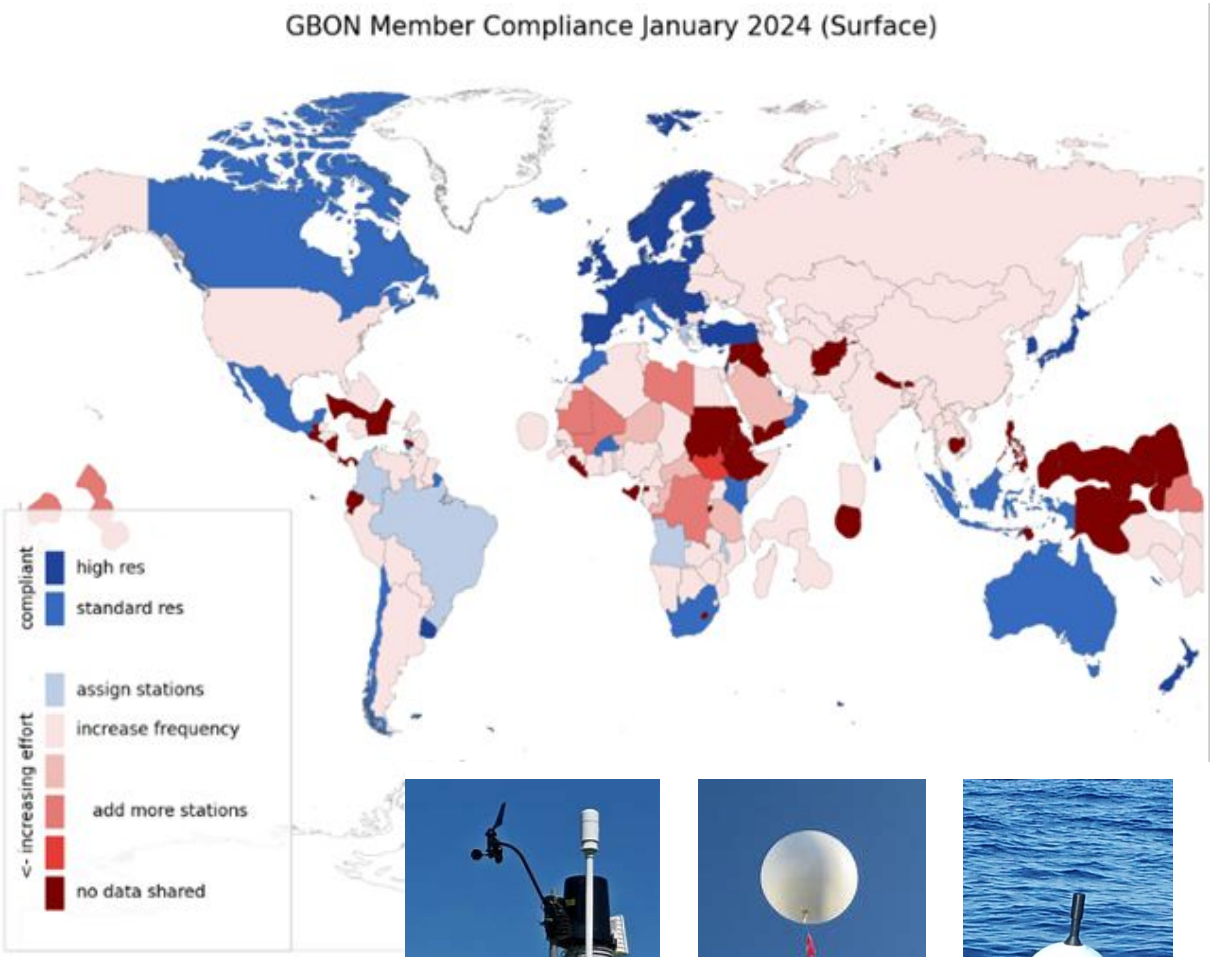
Global Basic Observing Network (GBON)

A global public good for improved weather prediction and climate reanalysis

- Worsening gaps in the basic surface-based observations that keep weather predictions on track - full implementation estimated to bring USD 5 billion in annual benefits

- Members in 2021 accepted **obligation to take and share** GBON observations at **minimum horizontal and time resolution**
  - **Surface land at 200 km, hourly**
  - **Upper air over land at 500 km, 2x daily**
  - **Surface marine in EEZ at 500 km, hourly**

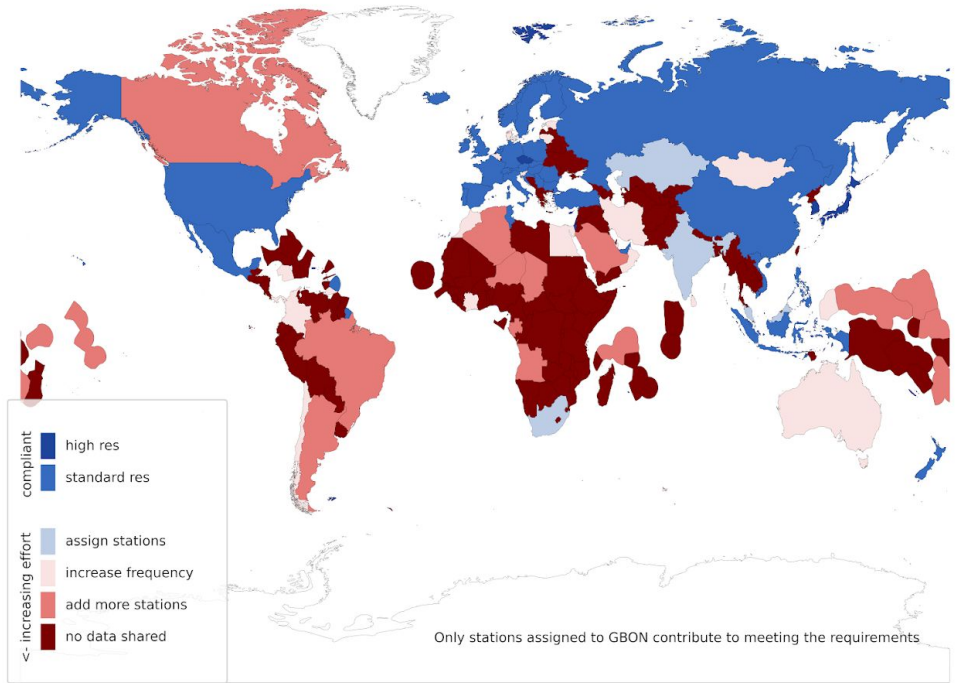
- WMO co-created the **Systematic Observations Financing Facility (SOFF)** to help Members meet that GBON obligation, with priority on support to LDCs and SIDS



The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Meteorological Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

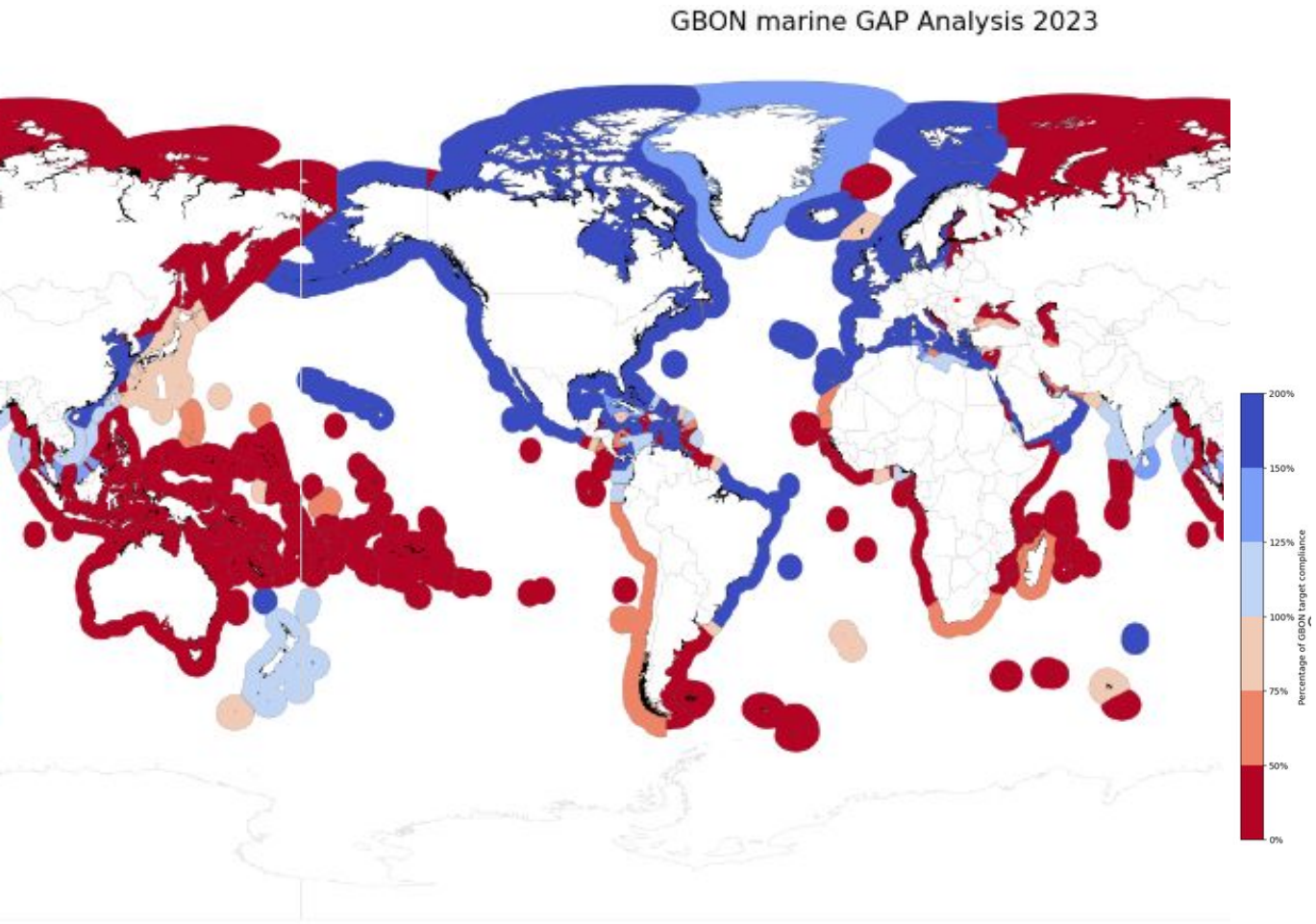
Systematic Observations Financing Facility

GBON Member Compliance January 2024 (Upper-air)



- SOFF provides **long-term technical and grant-based financial assistance** to enable countries to acquire and internationally exchange GBON observations
- It focuses on the **sustainability of investments** by providing **open-ended result-based finance** upon **verification of data sharing** through WMO Tools
- SOFF prioritizes Small Island Developing States (SIDS) and Least Developed Countries (LDCs) to close the largest data gaps
- **Fast-moving**: 83 $million raised, 60 countries approved for readiness funding, 11 countries in investment phase

WIGOS Guide: surface marine observations in EEZ



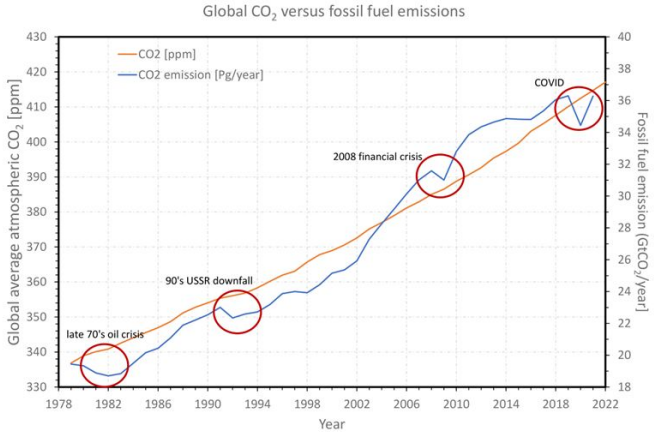
- calculation of GBON targets for marine Exclusive Economic Zones, based on all platforms reporting within EEZ – global gap 465
- no need to formally assign surface marine observations to GBON – all obs considered
- All observations – “domestic” or “foreign” are counted
  - Might be variable in time, make planning more complex
  - in context of SOFF, potentially reduces GBON marine gap
  - But, reflects reality of the observations available, and the non-exclusive responsibility for observations in EEZ
- Best value monitoring platform for GBON variables are surface drifters and ships, but these drift – could drive to more fixed platforms (more expensive, requiring more technical capacity, exposed to vandalism) – but these may also have greater local value

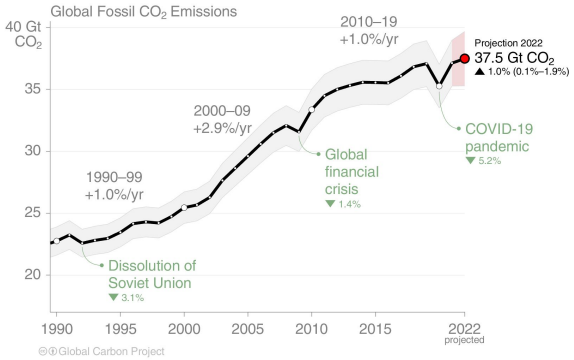
8.1(4) GBON: implementation and expansion including SOFF, metadata and tools

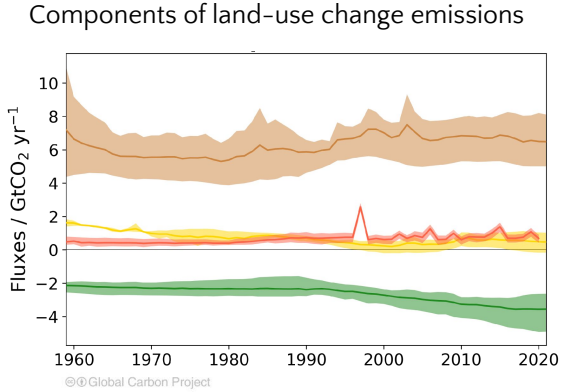
1. Executive Council recommendation:
   - Encouraging Member compliance,
   - Urging Members to consider of financial contributions to SOFF,
   - **Invitation to SOFF Steering Committee to consider expansion to marine GBON in EEZ,**
   - Invitation to SOFF SC to develop mechanism for Member feedback jointly to INFCOM & SOFF.
2. GBON Expansion
   - Continued work on hydrological variables,
   - Within present scope of GBON (global numerical weather prediction) for different domains and in cooperation with Global Climate Observing System / climate reanalysis,
   - **Considering climate monitoring application areas**, in cooperation with Global Greenhouse Gas Watch.
3. GBON metadata
   - Request SC-ON to examine WIGOS Metadata Standard and WIGOS Information Resource tools based on Member needs and feedback,
   - Report back to INFCOM-4 on implications and costs of associated changes.

Global Greenhouse Gas Watch (G3W)

From research efforts to a more integrated global system

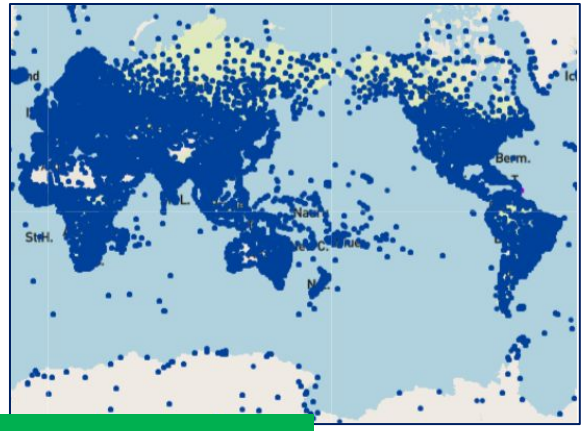




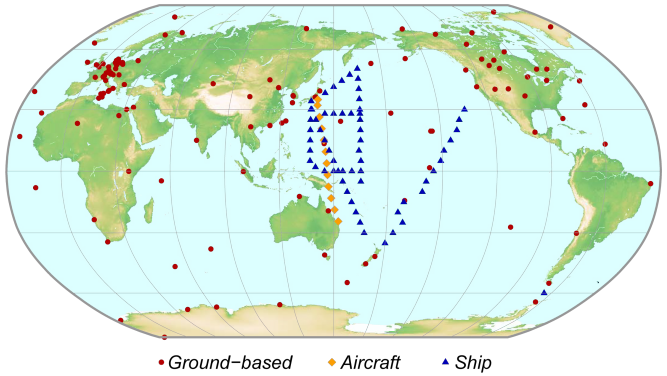


"We do not yet have an integrated global system that operates the way weather prediction and climate analysis is done."

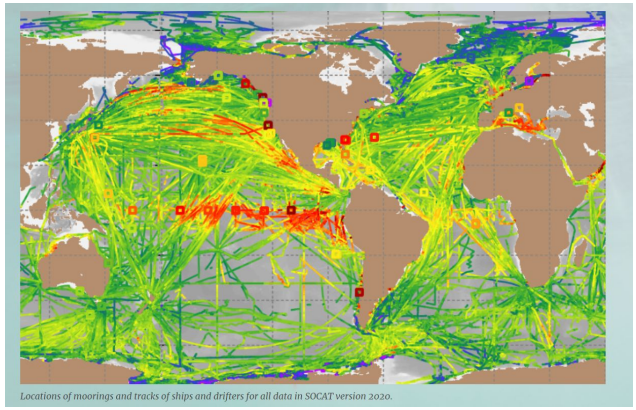
Research efforts have provided much insight, but cannot guarantee sustained funding, cannot deploy a truly global observing system, fund operational modeling and data assimilation and do not lead to near-real time exchange of



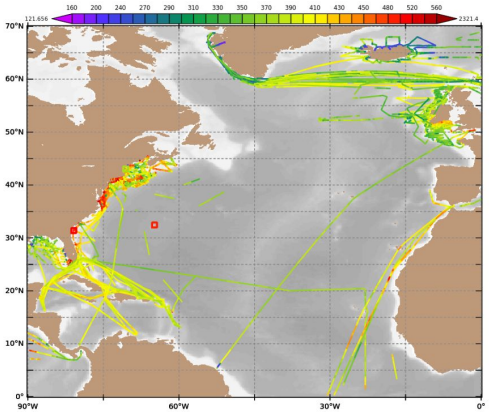
Weather network



GAW Greenhouse Gas network



SOCAT PCO2; all data since 1970



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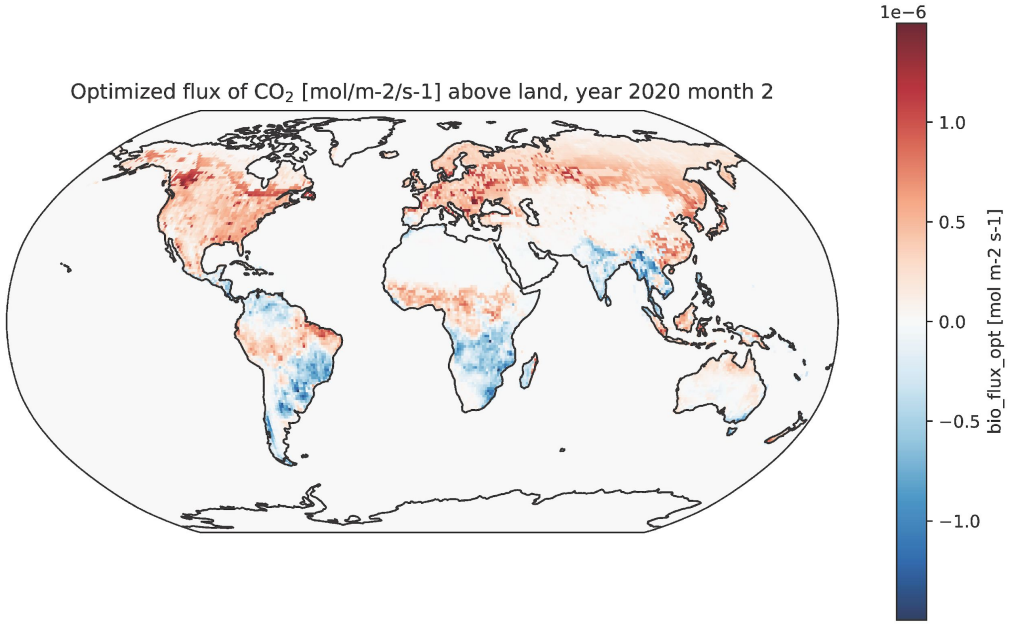
Global Greenhouse Gas Watch (G3W)

Following the approved Cg-19 (2023) concept note

The G3W routine and sustained output include:

- Monthly CO_2 and CH_4 net fluxes between the Earth surface and the atmosphere with 1x1 degree horizontal resolution delivered with a maximum delay of one month
- 3D fields of atmospheric CO_2 and CH_4 abundance with hourly resolution and the latency to be defined through user requirements and further consultation (tentatively on the order of a few days).
- N_2O abundances and net fluxes with resolution and latency still to be defined.

G3W support comes from global modelling centers (similar to World NWP Center)



Initial configuration has been agreed through the technical workshop in May 2022 and adopted by Cg-19 as a part of the G3W concept

2023	2024 -- 2027	2028 -- 2031	2032 -- 2050
Cg-19 □ G3W WMO Congress	**G3W – IPP** **Implementation Pre-Oper Phase**	**G3W – IOP** **Initial Operational Phase**	**G3W – EOP** **Enhanced Operational Phase**

GST-1
COP28

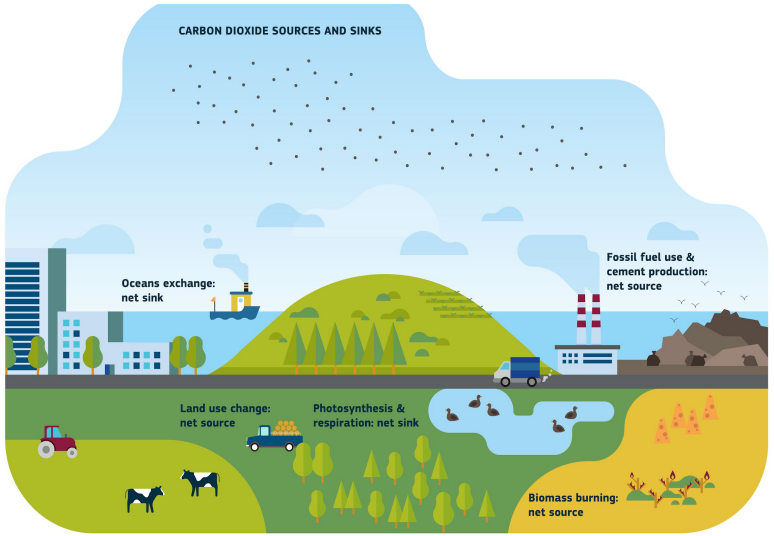
Initial Monitoring Systems

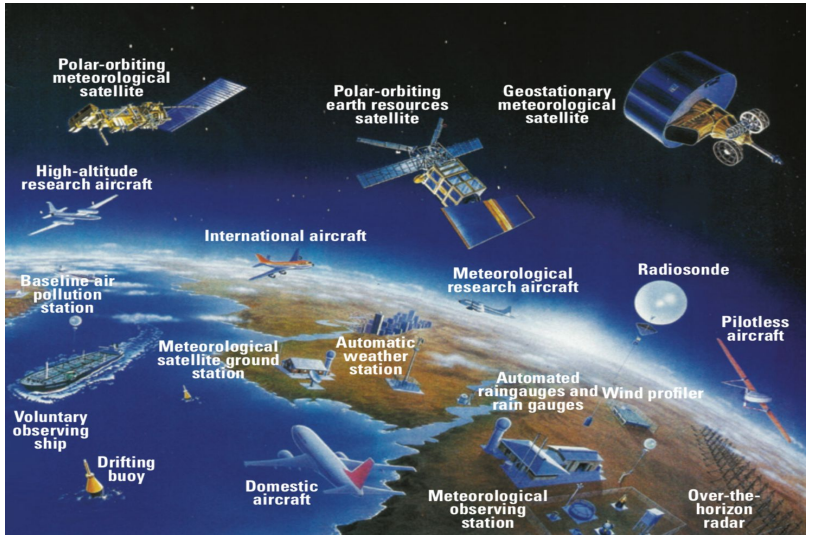
GST-2
COP33

Enhanced Systems

GST-n
ETF, NDCs

"for Measuring, Understanding, and Managing the Earth's Climate"





UN family
IPCC-IOC-
UNEP-UNFCCC-
WHO-WMO-WTO

UNFCCC
COP-SBSTA

WMO
WIGOS-WIS-WIPPS

Public-Private Partnerships

CO_2, Carbon dioxide

GHGs Earth's Observing Systems is building on Weather experience

Implementation plan: G3W stages and timeline

Where WMO and GOOS are well-connected

Requirements
- Rolling Review of Requirements: climate (GCOS/OOPS), other ocean application areas (incl. marine services)
- Ocean Observing Co-Design: WMO co-investment 70 kCHF for 2024

Implementation
- Support to Observation Coordination Group and networks
- OceanOPS metadata & integration with WIGOS tools
- consultation on GBON expansion
- G3W Implementation Plan: GOOS BGC engagement

Delivery
- Real-time data delivery through WMO Information System

Administrative
- WMO is employer of 6.5 members of the GOOS Management Team (OOPC, OCG support, OceanOPS; 1.5 on regular budget)
- Operating Plan foresees regular funding contribution for GOOS

GOOS *in situ* networks [1]	Implementation	Data & metadata			Best practices [6]	GOOS delivery areas [7]		
	Status [2]	Real time [3]	Archived high quality [4]	Metadata [5]		Operational services	Climate	Ocean Health
Ship based meteorological - SOT	★★☆	★★☆	★★☆	★★½	★★☆	✓	✓	
Ship based oceanographic – SOT	★★½	★★½	★★★	★★☆	★★★	✓	✓	
Repeated transects - GO-SHIP	★★★	Not applicable	★★★	★½☆	★★★		✓	✓
Sea level gauges - GLOSS	★★½	★★☆	★★★	½☆☆	★★☆	✓	✓	
Time series sites - OceanSITES	★★☆	Not applicable	★★½	★☆☆	★★☆		✓	✓
Coastal Moored buoys – DBCP	★★★	★★★	★★★	★☆☆	★★½	✓	✓	✓
Tsunami buoys - DBCP	★★½	★★★	★★★	★★☆	★★★	✓		
Tropical moored buoys - DBCP	★★½	★★★	★★★	★★★	★★☆	✓	✓	✓
HF radars	★½☆	★½☆	½☆☆	½☆☆	★★★	✓	✓	
Drifting buoys - DBCP	★★★	★★½	★★½	★★½	★★★	✓	✓	
Profiling floats - Argo	★★★	★★★	★★★	★★★	★★½	✓	✓	
Deep & biogeochemistry floats - Argo	★½☆	★★½	★★½	★★★	★★☆	✓	✓	✓
OceanGliders	★½☆	★★☆	★☆☆	★★☆	★★☆	✓	✓	✓
Animal borne sensors - AniBOS	½☆☆	★☆☆	★★☆	½☆☆	★★☆	✓	✓	✓

unesco
Intergovernmental Oceanographic Commission

The Global Ocean Observing System
Observations Coordination Group

OceanOPS

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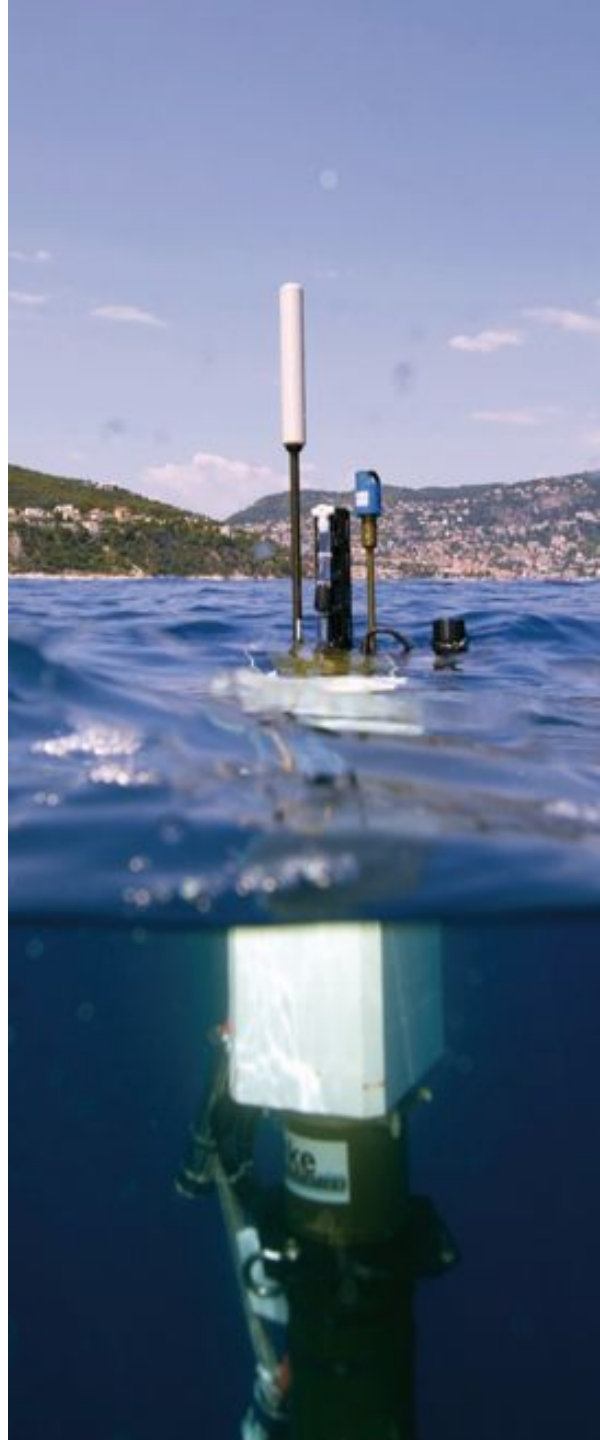
Where there are opportunities to exploit

- **prediction** and ETOOFS connection to relevant WMO groups: WIPPS, SC-MMO, model development; consultation on ETOOFS ToRs – as WMO has a responsibility with IMO to issue maritime safety warnings, it needs an ocean prediction standards-setting body, and would prefer to do this jointly with GOOS
- clearer routes for GOOS contributions to WMO Technical Regulations including Manuals and Guides of INFCOM and SERCOM
- strong connectivity from surface meteorological networks under GOOS to WMO service delivery. Opportunity of WMO-IMO Symposium, September 2024
- WMO Polar activity (sea ice & safety services, regional climate center) and the proposed GOOS Arctic task team
- Clearing up sticking points in governance to *efficiently* prioritize win-win solutions for GOOS and for WMO
    - using JCB, INFCOM Management Group - GOOS SC, evolving AG-Ocean, ensuring connection to SERCOM (early warning, marine, climate services)



Looking forward

Good ingredients to pull together in parallel directions with all the mechanisms at our disposal

- new generation of leadership at IOC and WMO
- increasing international focus on the ocean, on climate action
- increasing need for ocean observations for operational weather, climate, and marine services

Thank you.

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