Global Basic Observing Network (GBON)
&
WMO Information System 2.0 (WIS2.0)

DBCP Capacity Building Workshop on Ocean Observations for Operational Services in the Indian Ocean Region

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(WMO)

05-07 August 2025
INCOIS, Hyderabad, India

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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**

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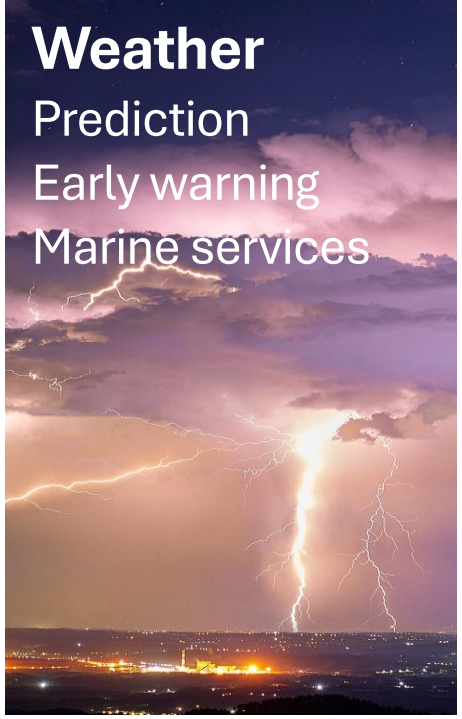
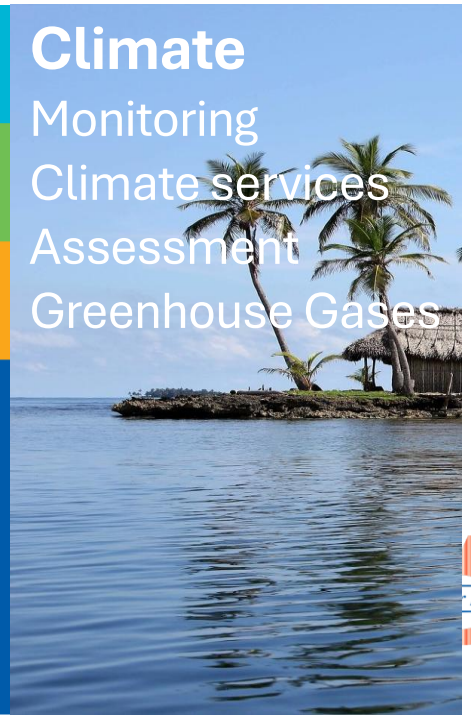
https://library.wmo.int/records/item/68578-wmo-strategic-plan-2024-2027





2 Infrastructure

Enhance Earth system observations and predictions

- 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**

WMO Strategic Objectives

WMO Integrated Global Observing System (WIGOS)

WMO Information System (WIS)

WMO Integrated Processing and Prediction System (WIPPS)

WIGOS

— WMO Integrated Global Observing System

Purpose

To integrate and coordinate all WMO observing systems and contribute to global, regional, and national observations supporting:

- Weather forecasting
- Climate monitoring
- Disaster risk reduction
- Environmental protection

Key Functions

Standardize observations

Improve data interoperability

Enable data sharing across domains

WIGOS Tools

WIGOS Data Quality Monitoring System (WDQMS)

OSCAR

Components

1 Global Observing Systems
- GCOS (Global Climate Observing System)
- GAW (Global Atmosphere Watch

2 National Meteorological & Hydrological Services
- Surface weather stations
- Upper-air obseryations (balloons, alrcraft)

3 Partner Contributions

Data from non-WMO aystems (e.g,, research networks, private sector)

Global Impact

Supports the Early Warnings for All initiative

Contributes to UN SDGs (esp, climate, water, and disaster resilience)

Powers international weather & climate services

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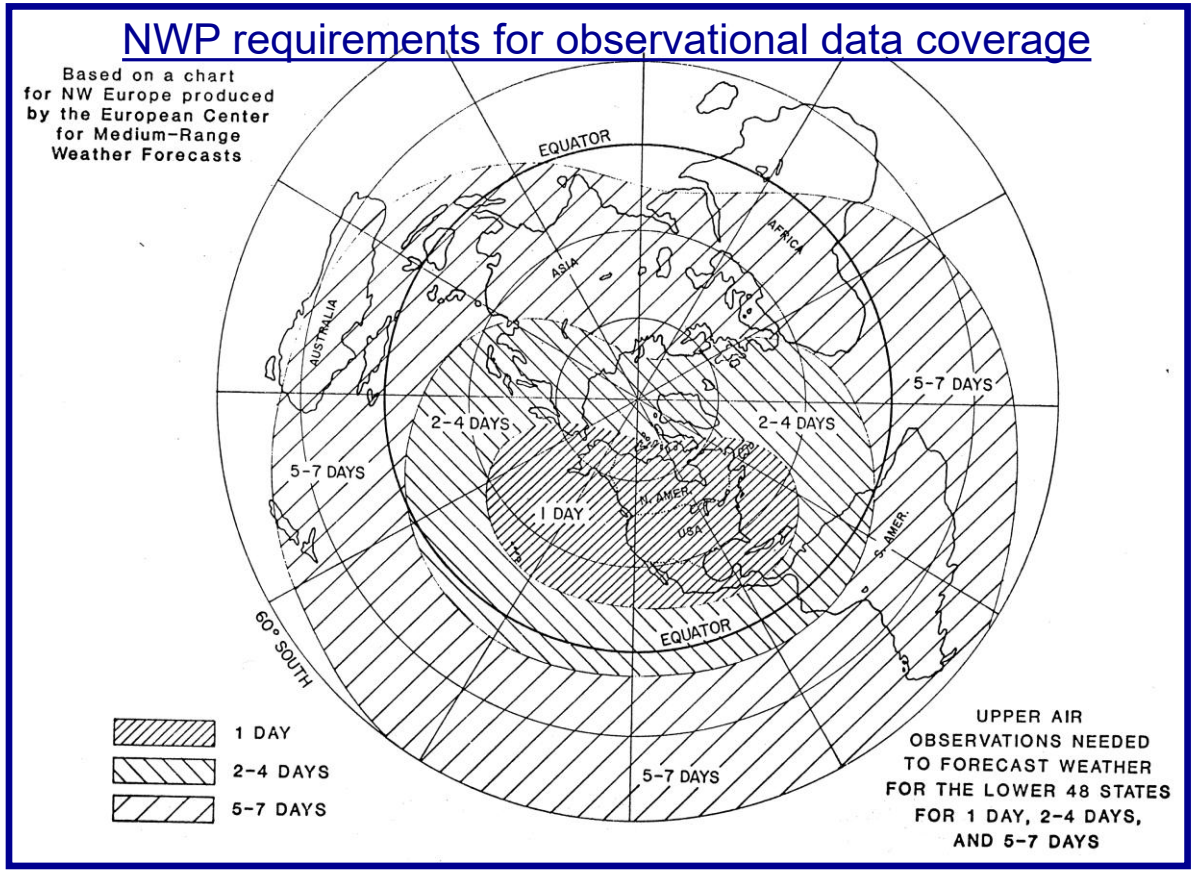
Why is it important to have observations everywhere?

- Generally, any lack of observations over one area of the globe will limit our ability to understand and predict weather and climate patterns everywhere else.

"In meteorology, ignorance knows no boundaries"

- Global Numerical Weather Prediction is a foundational capability for all weather prediction and most climate monitoring activities;
- Global Numerical Weather Prediction depends on availability of global coverage of observations;



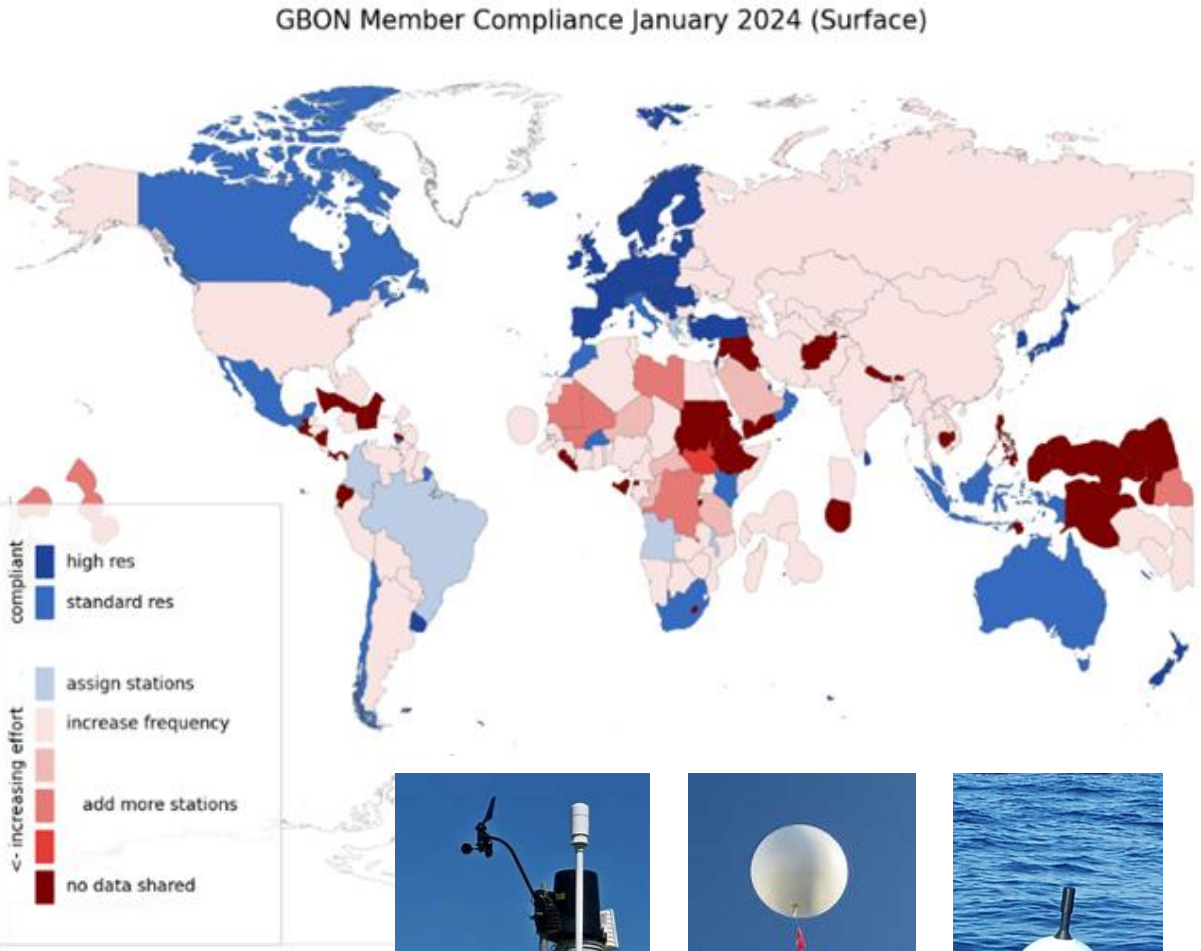
Global Basic Observing Network (GBON)

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 the **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



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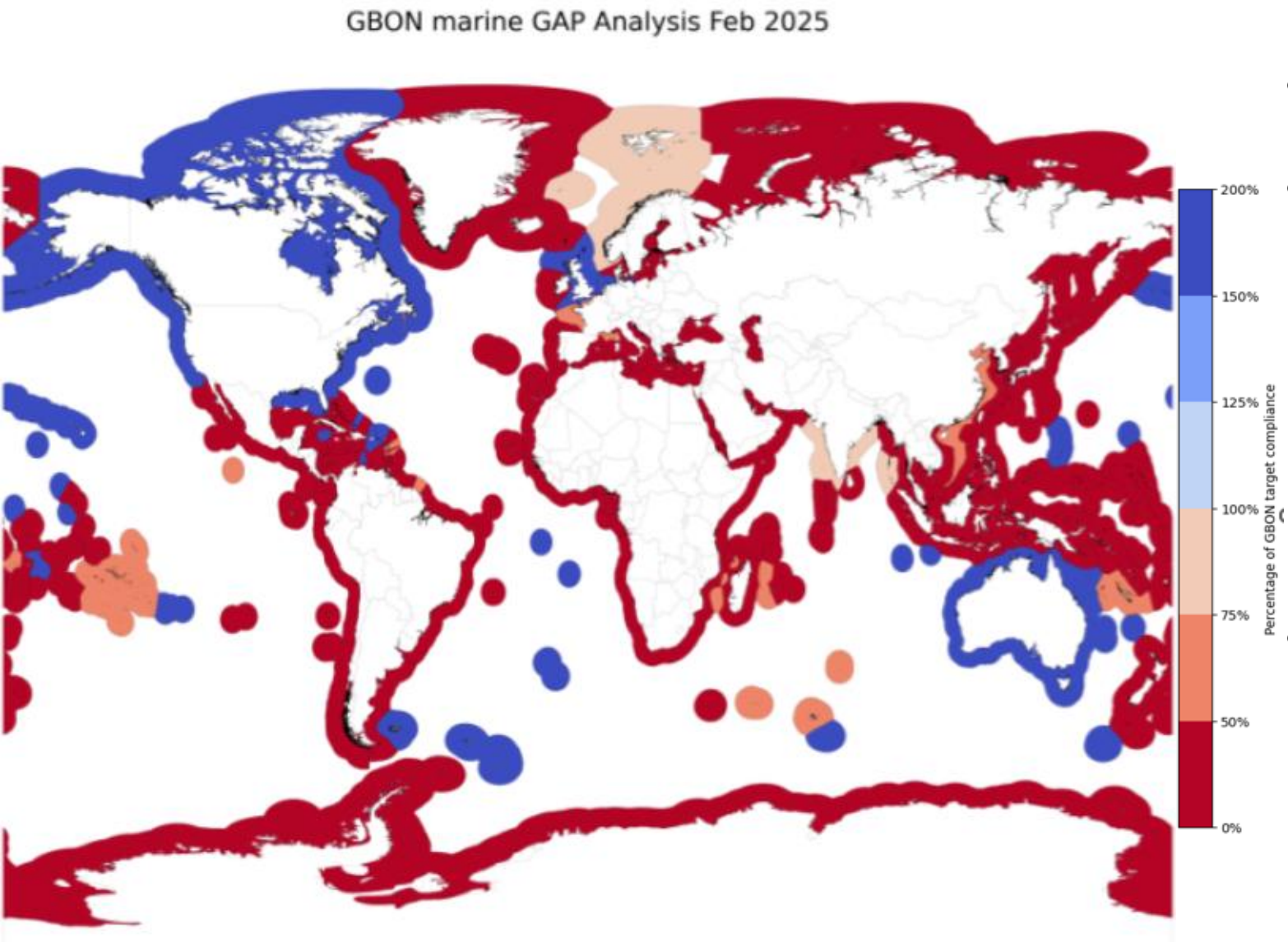
GBON Requirements

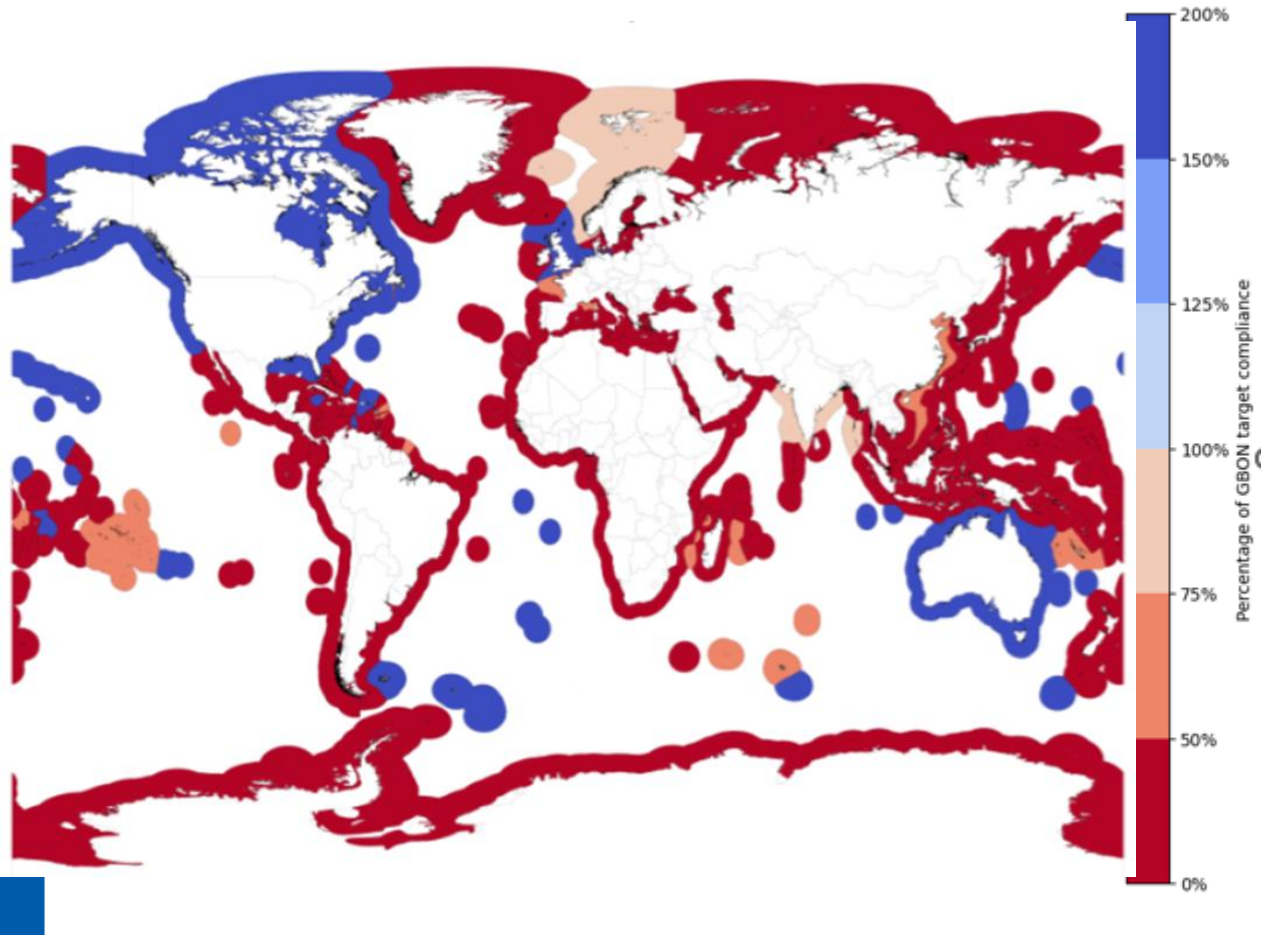
Type of observing station	HR	VR	Obs Cycle	Variables	Other Requirements
Surface land stations	***200km*** *100km*	*n/a*	***1h***	***SLP, T, U,*** ***Wind, precip, snow depth***	***Exchanged in real time through WIS2***
Upper air stations operated from land	***500km*** *200km*	***100m***	***2/24h***	***T, U, wind***	***Up to 30 hPa, exchanged in real time through WIS- 2***
Subset of upper air stations	*1000km*	*100m*	*24h*	*T, U, wind*	*Up to 10hPa,* *Exchanged in real time through WIS2*
Surface marine stations in EEZs	***500km***	*n/a*	***1h***	***SLP, SST***	***Exchanged in real time through WIS2***
Upper air stations operated in EEZs	***1000km***	***100m***	***2/24h***	***T, U, wind***	***Up to 30 hPa, exchanged in real time through WIS2***
Aircraft data	*100km at flight level*	*300m for profiles*	*1h*	*T, U, wind*	*Data exchange per licensing agreement*
Remote sensing profiler observations	*Where available*	*100m*	*1h*	*T, U, wind*	*n/a*

GBON: surface marine observations in EEZ

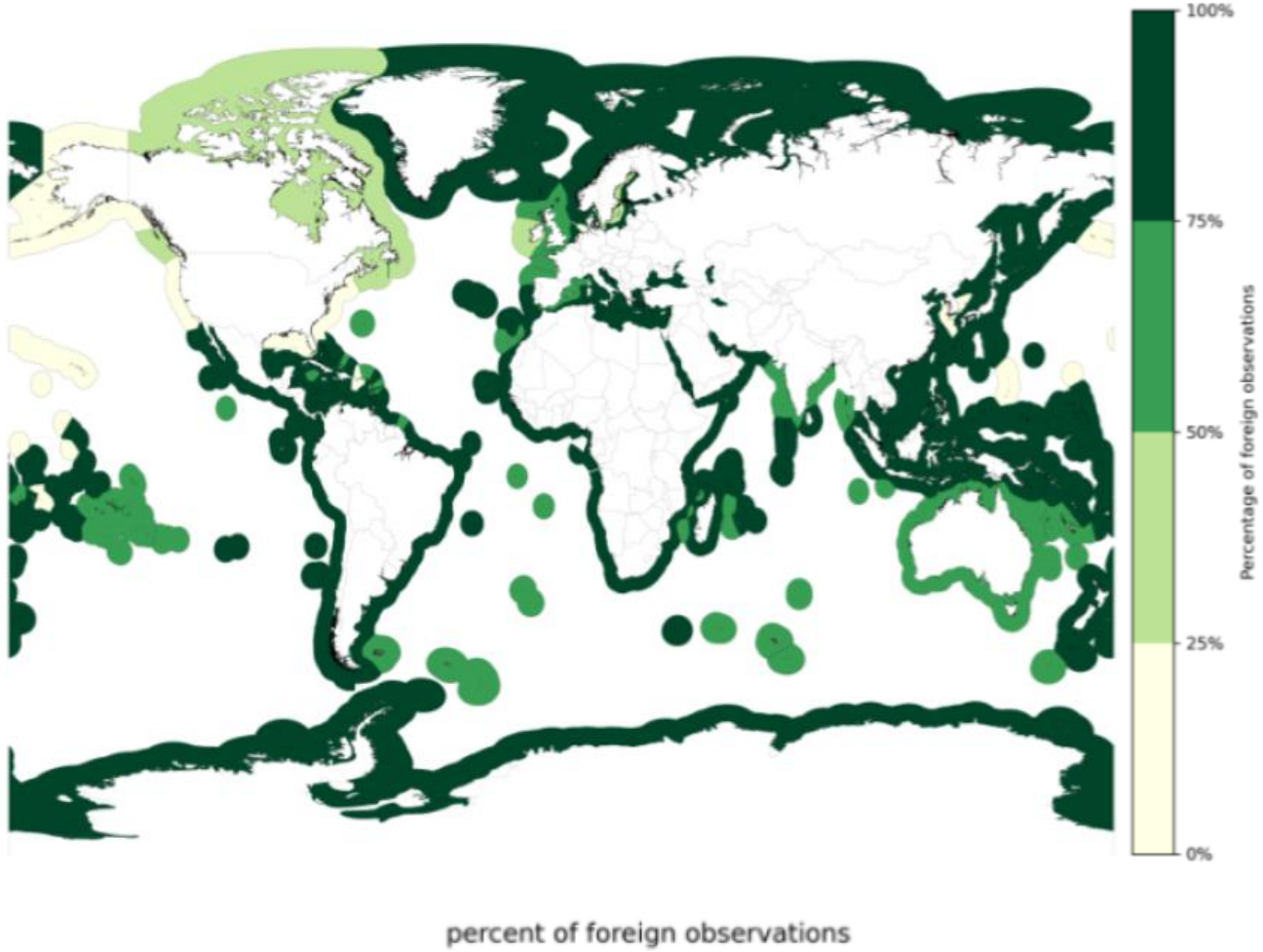


- No need to formally assign surface marine observations to GBON – all obs considered
- All observations – “domestic” or “foreign” are counted
  - Might be variable in time, make planning more complex
  - in context of SOFF, potentially reduces GBON marine gap
  - But, reflects reality of the observations 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

GBON Marine Gap analysis based on SLP observations in Feb 2025



Surface Pressure Observations from domestic Ships and Buoys in EEZ in February 2025 (data from WDQMS Marine Quality Module)



percent of foreign observations

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Systematic Observations Financing Facility (SOFF)

What is SOFF?

- United Nations multi-partner financing mechanism.
- Support the generation and international exchange of basic weather and climate observations, particularly from countries with limited capacity.
- Helps bridge a critical data gap that hinders accurate weather forecasts and climate services worldwide.

Why SOFF matters?

- Many developing countries, especially Small Island Developing States (SIDS) and Least Developed Countries (LDCs), lack adequate weather observation systems.
- Improves the availability of surface-based observations, which are essential for:
  - Weather forecasting
  - Early warning systems
  - Climate monitoring and adaptation
- Supports the implementation of the GBON standard developed by the WMO.

How SOFF works?

Three-Phase Approach:

- **Readiness Phase** – Support countries in assessing their observational gaps and developing national plans aligned with GBON.
- **Implementation Phase** – Provide financing and technical support to install and maintain observational infrastructure.
- **Results Phase** – Monitor data availability and quality, and ensure sustained data sharing with the global system.

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SOFF is a United Nations Multi-Partner Trust Fund (UNMPTF) created by World Meteorological Organization (WMO), United Nations Development Programme (UNDP) and United Nations Environmental Programme (UNEP) in 2021.

MENU

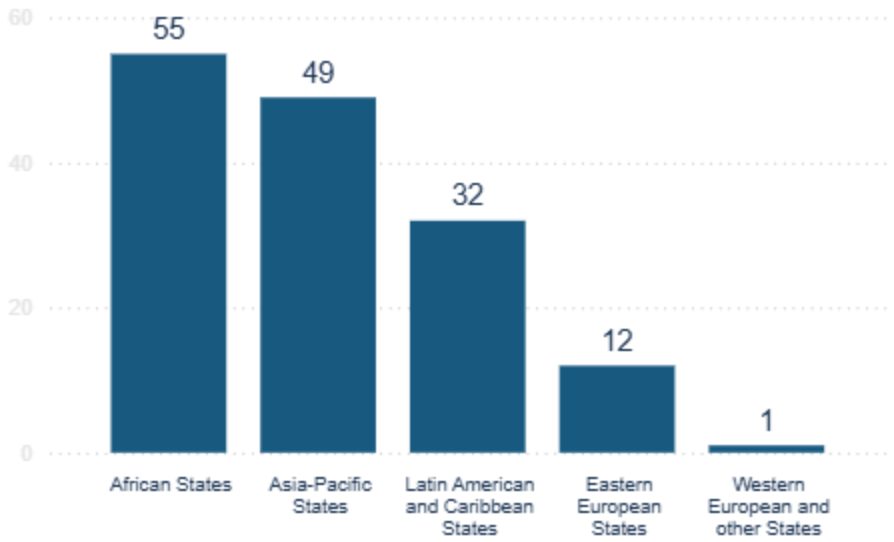
- Home
- Readiness
- Investment
- Compliance

Portfolio | Overview | SOFF Partners

SOFF Eligible Countries	Countries Requesting SOFF Support	Countries Receiving SOFF Support
149	101	61

Allocated Country Budget	Contributions to SOFF UN Fund	Funders
$100M	$101M	12

SOFF Eligible Countries by Region



Hover over each bar to view the allocated country budget per region

SOFF Coverage

SIDS and LDC | SIDS | LDCs | FCS

Percentage of Coverage for SIDS and LDCs

SIDS and LDCs Receiving SOFF Support

59

Country Budget Allocated to SIDS and LDCs

$100M

**Total Number of SIDS and LDCs including countries classified as SIDS or LDCs at the time of funding request approval | FCS: Fragile and Conflict-Affected Situations | LDCs: Least Developed Countries | SIDS: Small Island Developing States*

MENU

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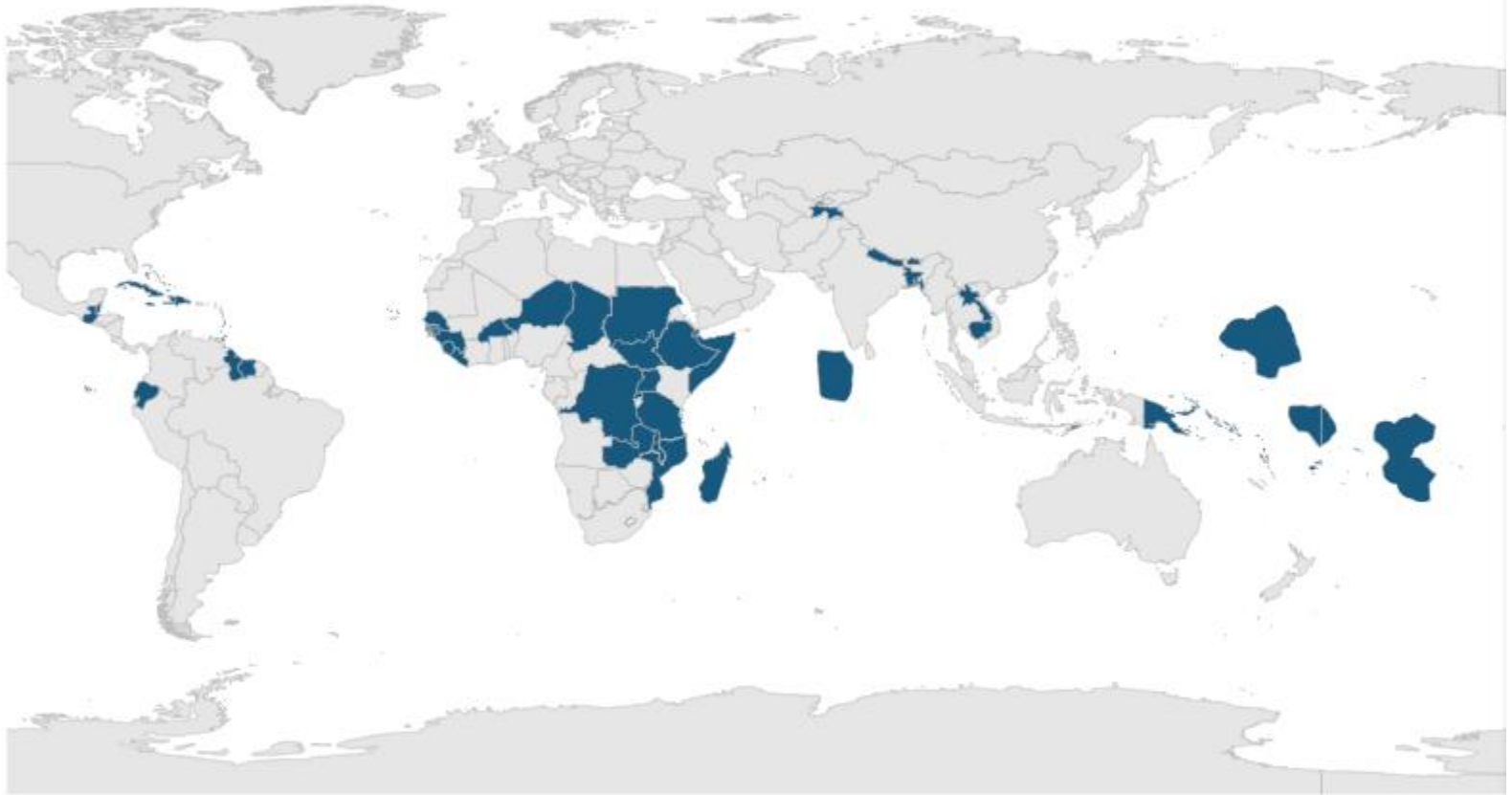
Portfolio | Overview | SOFF Partners



** Countries represented by their EEZ*

Hover over each country for detailed information. For easy navigation to countries with small surface area, use the table on the right to select the country, the map will be zoomed to show the selected country. Hover over it to get detailed information.

ⓘ Disclaimer

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SOFF

WIGOS Data Quality Monitoring System (WDQMS)

(Tool to monitor the performance of all WIGOS observing components)

Purpose:

WDQMS monitors the **quality and availability** of observational data that is exchanged globally under WMO frameworks. It ensures that the data used in weather, climate, water, and environmental services is **reliable, timely, and meets established standards**.

Key functions:

Track Observation Performance: Monitors **timeliness, availability, and quality** of observational data (Focuses primarily on **GBON)** (Global Basic Observing Network)

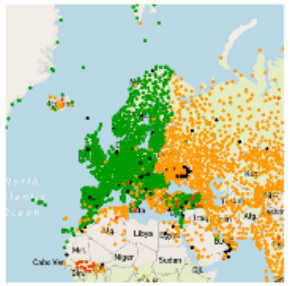
How it works:

- **Monitoring Centers:** Operated by WMO-designated Global Data Monitoring Centres (e.g., ECMWF, JMA, NCEP).
- **Dashboards & Reports:** Interactive **online dashboards** show real-time monitoring data and historical trends.
- **Performance Indicators:** Include % availability, number of observations, data timeliness, and quality control flags.

WDQMS

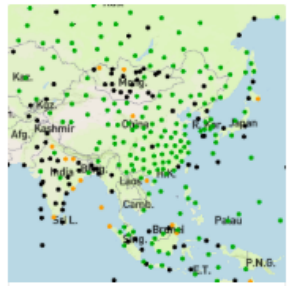
Three modules are currently available for the WIGOS monitoring:

Global Basic Observing Network (GBON)



Surface land observations

Station Compliance



Upper-air land observations

Station Compliance

Near-real-time NWP monitoring of the Global Observing System networks

Surface land observations

Availability & Quality

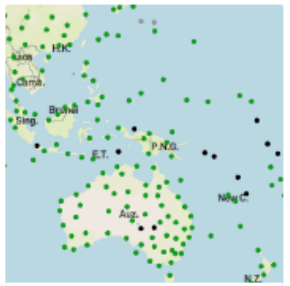
Upper-air land observations

Availability & Quality

Marine Surface observations

Quality

Monitoring of the Global Climate Observing System networks



Surface land observations

Availability & Completeness

Upper-air land observations

Availability & Quality

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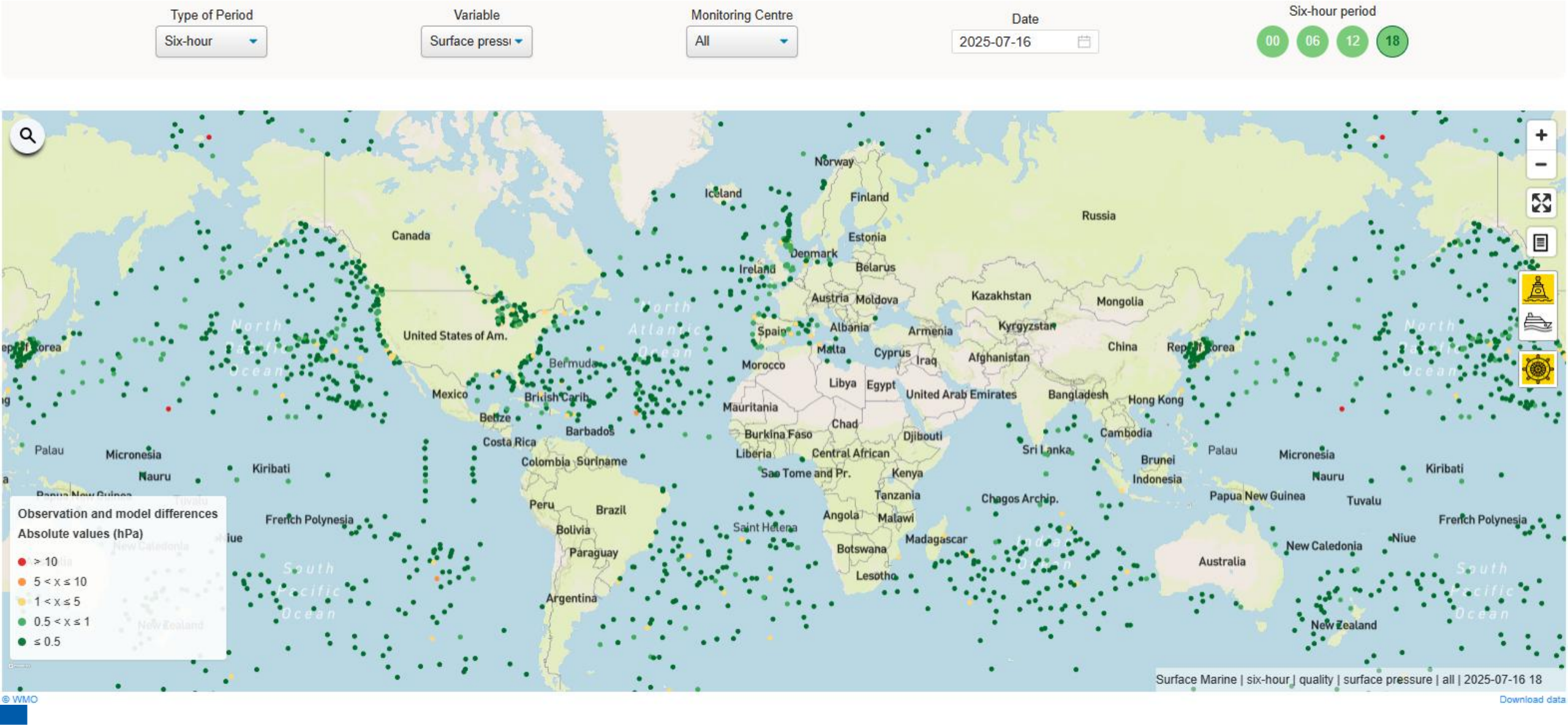
Quality of Marine Surface Observations

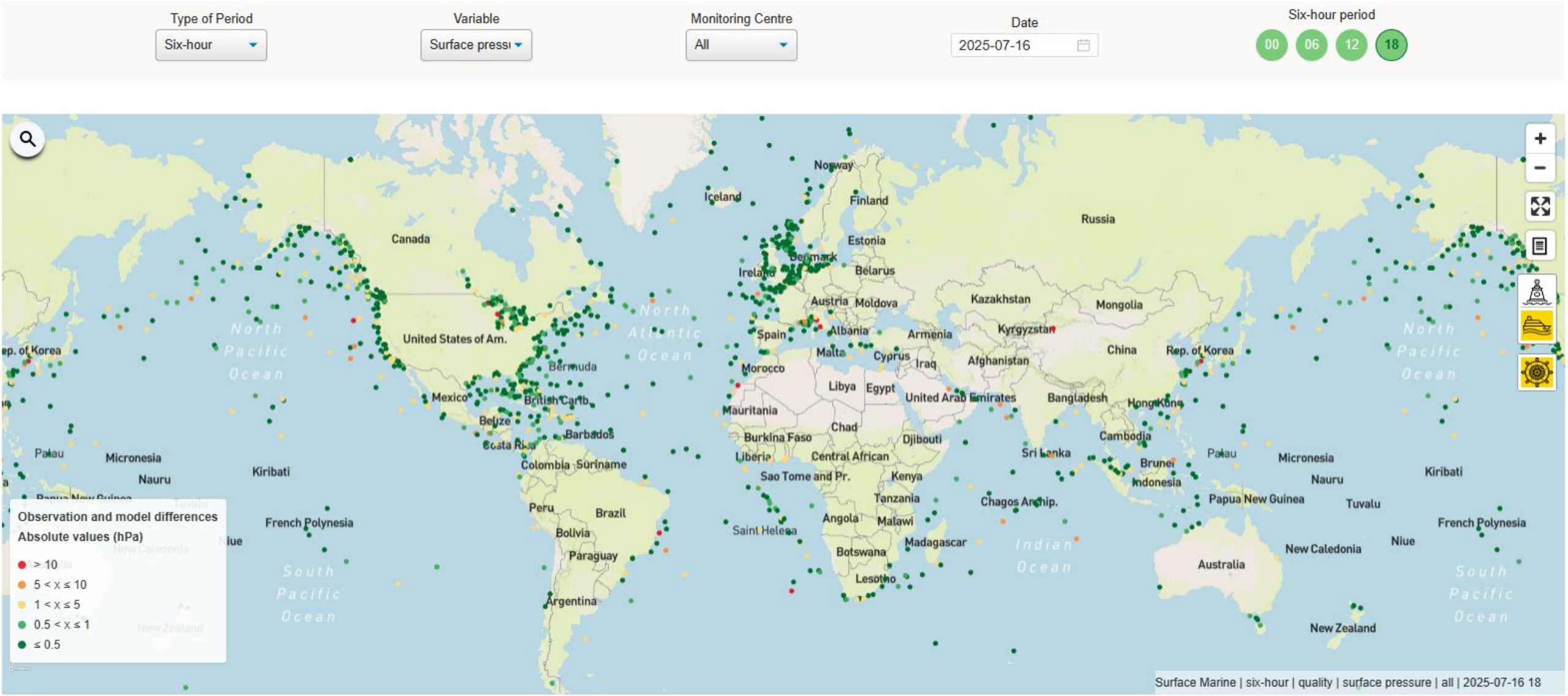
Type of Period: Six-hour | Variable: Surface pressi | Monitoring Centre: All | Date: 2025-07-16 | Six-hour period: 00 06 12 18

Download data

Quality of Marine Surface Observations (Buoys)



Quality of Marine Surface Observations (Ships)



Quality of Marine Surface Observations (without metadata)

Type of Period: Six-hour | Variable: Surface pressi | Monitoring Centre: All | Date: 2025-07-16 | Six-hour period: 00 06 12 18

Download data

WMO Information System 2.0

(WIS2)

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GTS / WIS2.0 Comparison

WMO Global Telecommunication System (GTS)

- Data exchange system developed in the 1970s
- Exchange based on routing tables and point to point Message Switching System (MSS)
- Closed system, both for input and output
- Observations / reports packaged into bulletins prior to exchange
- Contents of bulletins published in WMO-No. 9 (Weather reporting) Volume C1 – Catalogue of meteorological bulletins, indexed by GTS header
- WMO Information System (v1) developed in mid 2000s, some data available via GISC portals and searchable WIS catalogues – requires knowledge of GTS headers
- Other project provide indirect access, e.g. OpenGTS project, including decoding of BUFR data

WMO Information System 2.0 (WIS2.0)

- New system developed based on open standards and open software, designed around Web architecture
- Availability of new data advertised via MQTT notifications, data download via HTTP
- Global services component became operational in early 2025 (more on next slide)
  - Global broker
  - Global cache
  - Global discovery catalogue
- Simplified discovery metadata standard, with less granularity (larger granules) at the dataset level
  - Multiple bulletins combined into single metadata record
- However, increased granularity at the data exchange level, with reports exchanged individually
- Headers and routing tables replaced by WIS2.0 topics
- WMO Core data open for anyone to discover and download

WIS2 Key Concepts

- **WIS2 node**: data publisher, **publishing metadata records**, notifications of new data and providing access to the data. Includes non-real time data access.

- **WIS2 notification message**: MQTT notification published by a WIS node, **alerting subscribers to the availability of new data**. Used for low latency and (near-)real-time data and metadata exchange.

- **WIS2 topic:** standardized label/subject assigned to notification:
  - E.g. origin/a/wis2/<centre-id>/data/core/weather/surface-based-observations/ship

- **Global Broker(s)**: High availability, scalable MQTT broker that **republishes notifications** from WIS nodes.

- **Global Cache(s)**: High availability, scalable cache of WMO 'core' data published on the WIS 2.0.

- **WIS2 discovery metadata (WMO Core Metadata Profile v2)**: WIS discovery, **access and retrieval metadata**. Based on OGC-API Records (note: distinct from the WIGOS metadata and that provided through OceanOPS).

- **Global Discovery Catalogue(s)**: global **catalogue of all the datasets registered** in the WIS 2.0.

WIS2 Components: Global Services

Global Services

Global Monitoring

Global Discovery Catalogue

Provides an API to discover datasets and services

Global Broker

Sends notifications of new data to be downloaded from Global Caches or WIS2 nodes

Global Cache

Provides users HTTP download of core data cached from WIS2 nodes

Discovers datasets

Subscribes to topics

Downloads core data

Data users

Downloads recommended data

Downloads recommended data

Downloads recommended data

WIS2 node

WIS2 node

WIS2 node

Scale to highly-available, global data sharing

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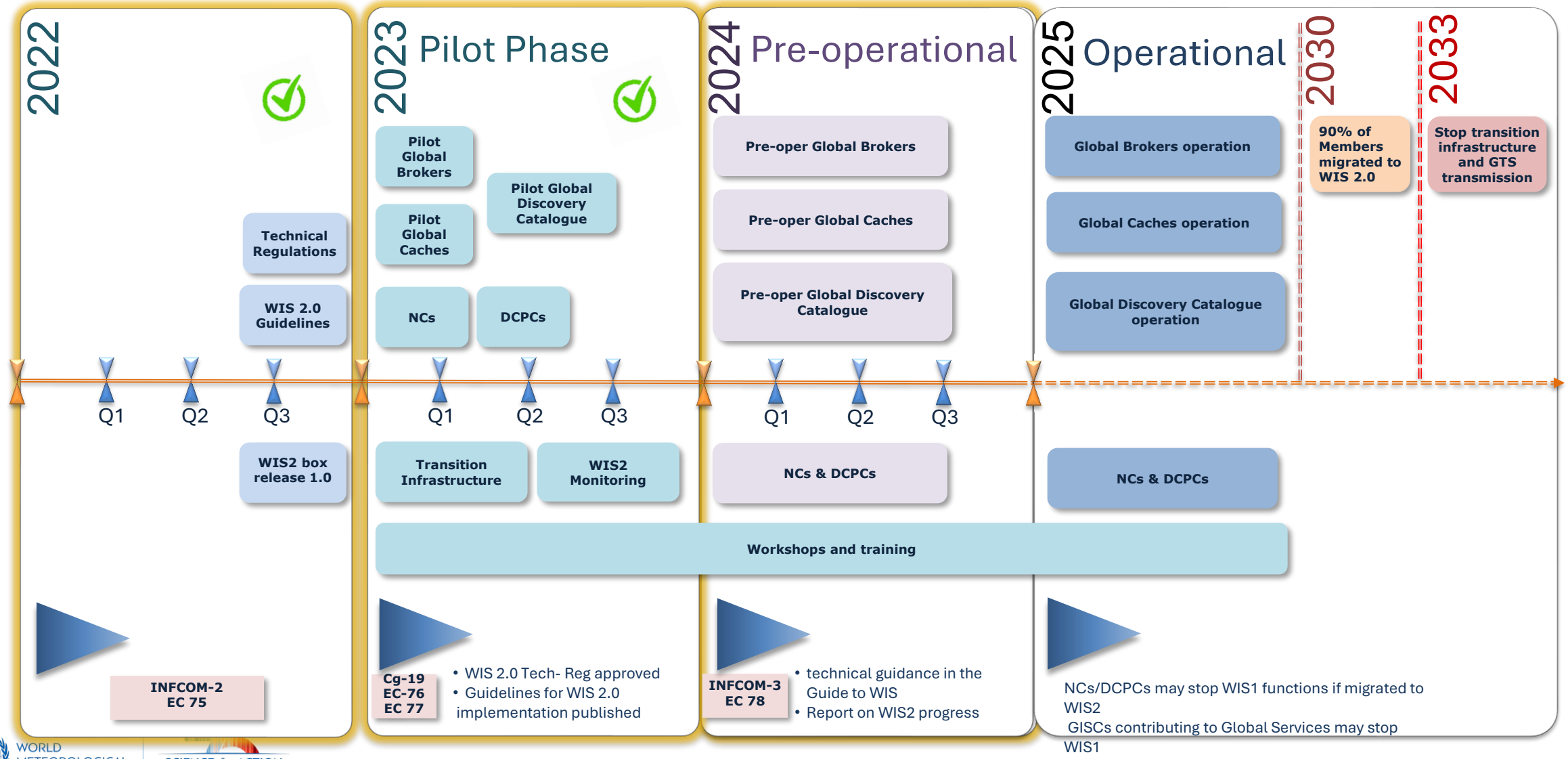
WIS2 progress: Pre-operational Phase completed



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For more information on WIS2

Webinars

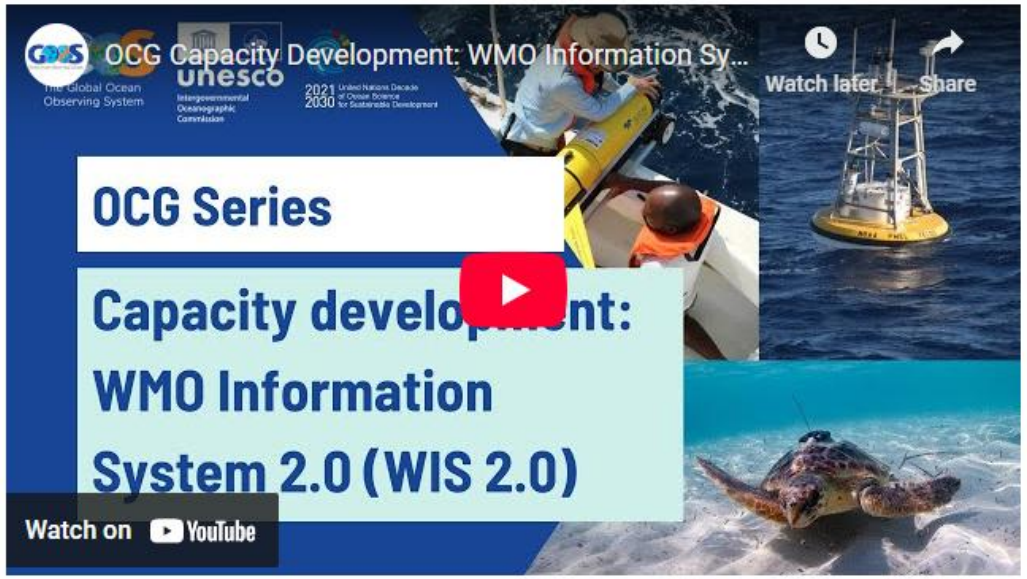
OCG Capacity Development Webinar Series: WMO Information System 2.0 (WIS 2.0)

August 28, 2023

Date and Time: 13 April 2023, 14:00-15:00 (CEST)

Presenter: Hassan Haddouch, WIS 2.0 Manager, WIS Branch, WMO

Moderator: Champika Gallage



Webinar : Watch recording

Webinar : Download slides

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For any question related to WIS2 contact :

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Thank you

cgallage@wmo.int

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