GOOS SC-10 Part 2: Suggestions for the GOOS Steering Committee on an initial GOOS contribution to the WMO Global Basic Observing Network (GBON)
Background Information

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Background

The Global Basic Observing Network (GBON) – approved by the World Meteorological Congress in 2018 – represents a new approach in which the basic surface-based observing network is designed, defined and monitored at the global level. The GBON is based on a global design that has been agreed between all WMO Members. Once implemented, it is expected that GBON will significantly increase the flow of surface-based observations to global NWP systems used for weather and climate monitoring and prediction.

GBON presently comprises hourly surface observations at high resolution and twice daily radiosonde observations at a set maximum horizontal spacing wherever geography allows. For example, with a three-tiered specification of horizontal resolution for surface pressure: 100 km or better for high density networks in developed countries or densely populated areas; 200 km or better for baseline networks in countries with large, very sparsely populated areas; and 500 km or better in Small Island Developing States which have large marine areas relative to their population.

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The Congress approved a number of amendments (Resolution 5.2/1 (Cg-Ext(2021))) to the Technical Regulations related to establishment of the GBON. The resolution included:

- a request to its Infrastructure Commission to 'Explore, in collaboration with the Joint WMO-IOC Collaborative Board, possible initiatives to strengthen the exchange of surface-based Earth system observations over the global ocean, for example via an extension of GBON into this domain', and
- a further request to the WMO Secretary-General … 'In partnership with the Intergovernmental Oceanographic Commission (IOC) and the Global Ocean Observing System (GOOS) co-sponsors to explore the possibility of leveraging international collaboration on marine observations in the implementation and further development of GBON'.

Further, with regard to marine observations, the amended regulations state:

3.2.2.5 Members shall make available internationally through WIS[1] all GBON observations in real time or near-real time according to the overall WMO data policy.

3.2.2.10 Where applicable, Members shall maintain the continuous operation of a set of surface marine meteorological observing stations/platforms within their Exclusive Economic Zone, or the corresponding marine areas of their jurisdictions, that observe, at a minimum, atmospheric pressure and sea surface temperature located such that where opportunity exists, GBON has a horizontal resolution of 500 kilometres or higher, over the marine areas of their jurisdictions, for these variables, with an hourly frequency.

3.2.2.11 Where applicable, Members should facilitate other Members sharing surface marine meteorological observations within their Exclusive Economic Zone, or the corresponding marine areas of their jurisdictions, subject to the data being made available internationally according to 3.2.2.5.

At the same time a recent paper for the WMO Bulletin[2], prepared by a number of GOOS leaders, made a series of recommendations, one of which was to augment the WMO GBON with a global basic ocean observing system, designed to meet WMO's priority needs for observations and data sharing. Hence there is not just a 'pull' from WMO for ocean observations, but also a 'push' from the GOOS community and the suggestions in this paper are a first attempt to quantify this.

Marine surface-based observations

Our weather and climate forecasts demand ocean information; the further ahead we need to forecast, the deeper we need to go to tap into the ocean memory. In WMO parlance the definition of surface-based observations includes both those that are made by surface-based platforms (e.g., ships and buoys) and those that are launched from the surface (e.g., floats) so encompasses sub-surface observations. Specifically, GBON has a focus on meeting the requirements of Global NWP, including reanalysis in support of climate monitoring; such global NWP provides medium-range forecasts and also provides higher resolution regional models used to generate most forecast products with boundary data. Hence, it is considered that the key surface-based marine/ocean variables presently of most relevance to GBON are:

- surface air pressure – critical for anchoring NWP models, where drifter air pressure measurements have been shown to have a significant impact on global NWP and without which the models would 'run off the rails'[3];

[1] WIS is the WMO Information System that includes the Global Telecommunications System (GTS) for data exchange.
[2] Thurston et. al, 2021. The Global Ocean Observing System: Oceans of Data for Earth System Predictions. WMO Bulletin Vol. 70(2) – 2021, pp 47-54.
[3] Quote from Lars Peter Riishojgaard, WMO Infrastructure Commission.

- sea surface temperature (SST) – provides the lower boundary condition over the oceans for many NWP modelling systems and is also critical for ground truthing satellite SST products used by the models;

- upper ocean temperature – important for tropical storm forecasting as it quantifies how much ocean heat is available to intensify hurricanes, cyclones or typhoons; also critical for running coupled ocean-atmosphere forecasting models.

Suggested GOOS contribution to GBON

Given the above and based on maturity and readiness of some surface-based observation systems, it is suggested that the following observations are considered to be offered as initial GOOS contributions to GBON. This does not preclude other GOOS observations and/or networks becoming part of GBON in the future.

- Air pressure and SST measurements from drifting buoys. For both of these variables the global drifter array (and Arctic/Antarctic buoy programmes) provide the majority of the data over the oceans. Presently only 60% of drifters carry pressure sensors and tangible benefits would be realized if this proportion was increased;
- Surface meteorological observations from Voluntary Observing Ships (VOS). This would encompass both automated and manual observations from VOS from both Members Exclusive Economic Zones (EEZs) and over the High Seas;
- Upper ocean temperature data from the global array of Argo floats. In virtually all cases the temperature data are distributed alongside salinity profiles, where both are used to give the ocean density structure that drives the ocean thermohaline circulation;
- Surface meteorological observations and, where available, upper ocean temperature (and salinity) data from moored data buoys. Many of these are moored in Members Territorial Waters or EEZs, together with the global Tropical Moored Buoy Array that has components in the Pacific, Atlantic and Indian Oceans.

Becoming a component of GBON implies a commitment to exchange the data. In the short term (at least) the data will need to be exchanged via the WMO Global Telecommunications System (GTS) as this is the primary vehicle for data exchange between National Meteorological Services. In order to benefit NWP, atmospheric measurements need to be made available in real-time (typically within 30 minutes of the observation time), however for sub-surface measurements near real-time data (ideally within 6 hrs of collection) is sufficient. However, it should be recognised that other GOOS networks, that may be less mature, or deliver data less frequently or are less global in scale, also collect data that are of benefit to NWP where delivery of those data to the GTS is encouraged.

A key element of GBON is that the observations are routinely monitored for both completeness and timeliness at the global level. For the above GOOS elements, some

performance indicators and such monitoring against observations targets is, and would continue to be, carried out through the WMO-IOC Joint Centre for Oceanography and Marine Meteorology in situ Observations Programmes Support (OceanOPS) and managed under the GOOS Observations Coordination Group. Additional, EOV-focused indicators and monitoring systems are still required and should be recommended for development.

Actions requested of the GOOS Steering Committee

1. GOOS concurs with the prioritization of SST, surface air pressure, and upper ocean temperature as initial priority EOVs for the ocean elements of WMO-GBON

2. Request to WMO Standing Committee on Earth Observing Systems and Monitoring Networks (SC-ON) that the indicated observing networks be identified and included in the Global Basic Observing Network (GBON).