**OCG Task Team on Observational Network Metrics (TT Metrics) Report**

Submitted to OCG-15 (13-17 May 2024, Victoria, BC, Canada)

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1. **Introduction**

As the scope of ocean observing continues to expand, there arises a pressing need for a comprehensive set of metrics for assessing the performance, efficacy, and reliability of the Global Ocean Observing System (GOOS) networks assembled under the Observation Coordination Group (OCG) umbrella as a whole, as well by individual network. By examining these metrics, we can gain valuable insights into the operational status, strengths, weaknesses, and even guide potential areas for improvement within the networks. At the 14th session of Observations Coordination Group ([OCG-14, 6-8 June 2023, Cape Town, South Africa](https://oceanexpert.org/event/3820)), a brainstorming session: Network Readiness Level was convened. At this session, [an initial draft of the 3 tiered metrics](https://www.goosocean.org/index.php?option=com_oe&task=viewDocumentRecord&docID=32513) was proposed for discussion by the OCG team. Subsequently, upon the decision of OCG-14 as outlined in the [OCG-14 summary report](https://goosocean.org/index.php?option=com_oe&task=viewDocumentRecord&docID=33368), the OCG Task Team on Observing Network Metrics (TT-Metrics) was established.

By leveraging the [Framework for Ocean Observing (FOO)](http://www.ioccp.org/images/D2backgroundDoc/Framework%20for%20Ocean%20Observing.pdf), the agreed OCG synthesis on the maturity of networks (OCG Network Attributes - [GOOS 266](https://oceanexpert.org/downloadFile/47751)), assessments done for European observation coordination groups within EuroGOOS ([Deliverable D3.2](https://doi.org/10.3289/eurosea_d3.18) and [D3.16](https://oceanrep.geomar.de/id/eprint/59979/1/D3.18_Observing_Networks_final_Assessment.pdf)), and integrating insights gathered from discussions at OCG-14, the TT-Metrics was tasked with developing an initial suite of OCG cross-network relevant metrics designed to function as evaluation criteria for network status and performance.

As decided at the OCG-14, the TT-Metrics is co-lead by Johannes Karstensen, Chair of OceanSITES，jkarstensen@geomar.de, and Mathieu Belbeoch, mbelbeoch@ocean-ops.org, Head of OceanOPS. It was requested to report at [OCG-15 (13-17 May 2024, Victoria, BC, Canda)](https://oceanexpert.org/event/3981) on Metrics Development.

**2. Methodology**

The TT-Metrics’s first meeting was convened on 3 Oct 2023 to draft the Terms of Reference ([ToRs) of the TT](https://docs.google.com/document/d/1p8UTKjfyzNIDS6vRFnu80-WnNxAYUtX_n7BROLQrl54/edit%22%20%5Cl%20%22heading%3Dh.9f2kdccqzqgz) (Annex 1), identify the membership, the tasks for the intersessional period and other working arrangements. Representatives of all observational networks have been invited to attend the meetings. It was collectively agreed that TT-Metrics would convene monthly via video conferencing, each session lasting approximately one hour. Additionally, ad-hoc meetings may be scheduled to address specific objectives as needed. [Running agenda and notes](https://docs.google.com/document/d/1PWcIB7i5U3OtGOxlX9MoCD1o2SBHurEfe1sn-tAV4FE/edit?usp=sharing) is documented to capture the discussions and disseminate information to the TT members.

After the first call, to furnish attendees with comprehensive background information, the secretariat prepared [a presentation](https://docs.google.com/presentation/d/162xyaqdn8UuL9xR_wRG0Ih9mfG06Yl5s_J6xf0lbc2Y/edit?usp=sharing) outlining the genesis of the initiative and the overarching objectives of TT-Metrics. Then TT-Metrics decided that the discussions will be anchored in existing documentation, including:

* [Framework for Ocean Observing (FOO)](http://www.ioccp.org/images/D2backgroundDoc/Framework%20for%20Ocean%20Observing.pdf)
* OCG Network Attributes ([GOOS Report No. 266](https://oceanexpert.org/document/24002) ),
* [Report Cards](http://www.ocean-ops.org/reportcard2022) Networks status evaluation,
* OCG Cross-Network Data Implementation Strategy ([GOOS Report No. 296](https://goosocean.org/document/33970))

A structured timeline was collectively agreed upon, with each month dedicated to a specific thematic focus:

* December 2023: Data/Metadata
* January 2024: Governance
* February 2024: Best Practices and Capacity Building
* March 2024: Implementation/Sustainability
* April 2024: Report/Metrics Production and Review
* May 2024: Overall Review - Final Delivery

**3. Metrics development so far**

The TT-Metrics has now discussed 8 out of the foreseen 10 areas highlighted in the OCG Network Attributes, plus others that came from the OCG-14 discussion, namely sustainability. During the discussion, the TT-Metrics agreed that the metrics would ideally encompass various facets such as effectiveness, progress, sustainability, data availability, recommendations for determining data quality, best practices guidelines for various sectors (including sensor handling, metadata vocabularies, data delivery), engagement in knowledge transfer and capacity building, documenting value and impact, stakeholder engagement, and governance structure. Ultimately, these metrics will be instrumental in assessing both the technical and logistical status of individual observational networks under the OCG umbrella and, by extension, the overall system.

Without yet finding a universal definition for network maturity (readiness level). However this is because the TT-Metrics has discussed a number of issues that need OCG collective input, before the team can progress to creating cross network definitions. Discussions around specific metrics areas were conducted.

**3.1 ‘Scoring’ the level of maturity**

Each ‘attribute’ could have several parts to its maturity

* so do we have a **YES / NO** (achieve all) attainment of maturity, or do we star for achievement of ¾?
* Other approaches were based on % of achievement and an average.

The TT would like to recommend that we need something **simple enough to be operable**. So the following questions were raised and discussed.

* How many attributes should each level have?
* How many levels?
	+ Just maturity and emerging, or
	+ 9 like the TRLs (all networks would start at 4)?
* The EuroSea Project's practice is self-evaluation using OCG Network Attributes, demonstrating how funding impacted network development. Can we learn from the EuroSea applying TRL levels to observing system methodology.
* So a big question is how detailed do we want these metrics?
	+ The attributes are very simple,
	+ The FOO TRLs have many different levels, with say 3 characteristics each, against which you would need to produce an estimate of fulfillment, or more precise definitions for say mature for data along say 5 characteristics (deliver x % to X), that could each be given a score (%) and thus an average of how mature a network is produced…
	+ The TT also discussed reorienting emerging networks as "intermediate" and referenced a previous agreement on network rating criteria ([Report Card- Network Status](https://docs.google.com/document/d/1-nzVCGSvLj_QWr0eMPZIU0jbanVoFhqV/edit?usp=sharing&ouid=108797881453146828655&rtpof=true&sd=true) by OceanOPS), offering a potential framework for TT Metrics' work.
* The need for clear definitions to **compute metrics**, is emphasized. The criteria and considerations used in selecting and designing metrics also needs full discussion. It is a challenge across networks.
* It is suggested that deriving **core indicators** from GOOS networks' quantitative analysis for easier assessment.
* Automatic extraction of attributes from OceanOPS's metadatabase is crucial, encouraging networks to prioritize metadata implementation.



 **Figure 1. The sketch of FOO levels and OCG Attributes discussed by the TT**

**3.2 Data and Metadata**

Clarification is needed on terminology discrepancies, such as the definition of a "station" in GO-SHIP compared to meteorology. Discussions also centre around the categorization of data maturity levels, considering the inclusion of new networks like SOCONET, which will soon apply to become OCG networks.

* **Capacity building** in data management **at the network level is crucial** and should be funded by contributing countries, tailored to each network's needs, such as hosting data and metadata webinars.
* **Simplification is key**, balancing simplicity with effectiveness, combining metrics without overcomplicating the TT-Metrics task at hand. The proposed approach might involve pass/fail criteria with carefully selected thresholds, utilizing a limited number of levels or attributes for tracking purposes.
* The responsibility for setting requirements lies with OceanOPS as the facilitator, with networks defining their specific needs. **OceanOPS plays a central role** in harmonizing metadata across networks and providing data and metadata services, as agreed upon in previous OCG sessions and roundtables.
* Within GO-SHIP, efforts include assigning unique WMO/OSCAR IDs and establishing consistent vocabulary for manual instruments. Metadata quality, including licenses and unique identifiers, is paramount, considering multidisciplinary data and distinguishing between platform and discovery metadata quality.
* Some networks like SOT have a combination of number of platforms and completeness of metadata - not sure how that gets handled. There is a need to **separate platform level metadata and network level metadata**. Both are important to track but they are different.

**Table 1 The draft metrics group on Data Implementation**

| **CATEGORY** | **METRIC** | **DESCRIPTION** |  | **LVL0** | **LVL1** | **LVL2** |
| --- | --- | --- | --- | --- | --- | --- |
| INFRASTRUCTURE | DATA TEAM members & diversity | measure how widely the organizations in the network are represented | pass/no pass | 1-2 people | 3 to 10 people | over 10 |
| DATA TEAM meeting frequency | measure how often the data team works collaboratively on data issues |  | once a year | every 3 month | every month |
| GLOBAL DATA NODES | are global web based data nodes defined for data distribution/access |  | GTS or WWW (RT) | GTS and WWW (RT) | WWW (RT & DM) |
| RAW DATA ARCHIVED | are raw data archived and accessible for e.g. reprocessing |  | some | all | all accessibles |
| BEST PRACTICES DOCUMENTS | documents available for data strategy, data formats, metadata formats, qc |  | 0 to 1 doc | 2 to 3 | 4 docs |
|  | COMBO | average of the 4 above (0-33-67-100) |  |  |  |  |
| INFRASTRUCTURE | TC SUPPORT @oceanOPS |  |  |  |  |  |
| METADATA | STRATEGY ESTABLISHED | Has a metadata strategy been established? | pass/no pass |  |  |  |
| QUANTITY | for what percentage of the network/platforms provide metadata we do have metadata |  | 0-33 | 34-66 | 67-100 |
| QUALITY & COMPLETENESS | This could go along with defining a "hierarchy of metadata", e.g. Minimum is country, PI; lat/long/ time; next is sensor (which is internally in OcesanOPS linked to parameters measured), next is link to observation data exist, .... are OceanOPS minimum metadata requirements met, including 5 categories of mandatory metadata  |  | minimum | enhanced | extras |
| NETWORKS SPECIFICS EXTRAs | use of controlled vocabulary - key metadata (sensor height) |  |  |  |  |
| ROBUSTNESS | how metadata are exchanged with OceanOPS |  | manual, ad hoc | web GUI routine | m2m routine |
| DELIVERY | % of metadata made available to WMO/OSCAR or/and IOC/ODIS |  | 0-33 | 34-66 | 67-100 |
| DATA | QUANTITY RT | % of platforms delivering data in RT vs expected (target) and with required timeliness |  | 0-33 | 34-66 | 67-100 |
| QUANTITY DM | % of platforms delivering data in DM vs target and with required timeliness - encourage submissions and avoid disincentive -adapt |  | 0-33 | 34-66 | 67-100 |
| QUALITY | % of platforms providing data of known (uncertainty) quality - per variable measured? requires doc. |  | 0-33 | 34-66 | 67-100 |
| UPTAKE | need feedback from an operational centre (ECMWF e.g.) and others (EMODnet) on whitelists/blacklists |  | 0-33 | 34-66 | 67-100 |
| DISCIPLINE | PHYS - BGC - BIOECO -ATM/OCEAN - doubting about this metric. |  | 1 | 2 | 3 |
| READY FOR EOV | % of parameter data that also is accompanied by uncertainty(heterogenity measure to estimate EOVs |  | 0-33 | 34-66 | 67-100 |

The draft set of metrics developed by the TT could be found at [Draft GOOS OCG Metrics. xlsx](https://docs.google.com/spreadsheets/d/1acbjjYByAnZum_7m1PwmEaeDU5CptCjU/edit?usp=sharing&ouid=108797881453146828655&rtpof=true&sd=true)

(<https://docs.google.com/spreadsheets/d/1acbjjYByAnZum_7m1PwmEaeDU5CptCjU/edit?usp=sharing&ouid=108797881453146828655&rtpof=true&sd=true>)

**3.3 Governance and Organization**

The TT-Metrics highlighted the significance of governance structures (Executive Board, Steering Committee, etc.) within networks, emphasizing the need for uncertainty assessment, particularly in relation to Best Practices. **Succession planning and inclusivity** were also discussed, with a focus on early career professional development and exposure to network operations. **Transparency** emerged as a critical aspect, with suggestions to establish clear rules of procedures. It was recommended to implement a formal or informal process for transparency, although challenges were acknowledged in grading and evaluation.

The suggestion was to adopt a simple approach, perhaps using a checklist format to facilitate **Yes or No** assessments.

**3.5 Best Practices** (BP)

The importance of BP, including instrumentation, was highlighted. Suggestions were made to develop best practices guidelines for various aspects such as 1) governance Terms of Reference (ToR), 2) data (variable/instrument) quality control (QC), and 3) field operations. It was emphasized to keep these guidelines simple and straightforward. Reference ot the IOC-Ocean Best Practices System were made and where methodologies, Standard operating procedures, and (Good, Best) Practises should always be archived. A direct link between the entries at the IOC-OBPS repository and the respective entries in the OceanOPS metadata repository can be discussed.

Reference was made to the World Meteorological Organization (WMO) practice of tiered networks. Caution was advised in defining tiers and subnetworks within the framework of tiered networks, underscoring the need for careful consideration and clarity in defining such structures.

**3.6 Definition/concept of sustainability**

The discussion primarily focused on the sustainability and funding of network operations, with particular attention to distinguishing between sustained and experimental components within networks. It is concluded that we are facing the complexities of funding, and assessment processes, when addressing the sustainability within different scientific observation networks.

Key points discussed included:

* **Funding classification and challenges in its tracking**: Differentiating between sustained (e.g. operational) and short-term research funding (e.g. experimental/project-based) within networks like GO-SHIP, with considerations for tracking funding sources and categorizing sustained versus experimental components. TT also highlighted difficulties in tracking funding sources and categorizing sustained versus experimental components, especially in networks with diverse participation and funding structures. Discussions revolved around defining the percentage of funded components and funding cycles, and distinguishing between core and experimental measurements. TT-agreed it was important to find solutions to track and evaluate programs funding sources (agencies), frequency, etc. through an improvement of OceanOPS metadata structure.
* **Rolling Reviews of Requirements (RRR)**: A debate ensued regarding the applicability of rolling review processes for assessing network sustainability, with concerns raised about its effectiveness and suitability for different observation types. The importance of continuing examination and potential future changes in review processes were discussed.
* **International Contribution and Network Maturity**: Considerations were made for assessing a network's contribution to international infrastructure, with concerns raised about transparency and guidelines for evaluating network maturity. It was emphasized that assessment processes should be clear, objective, and involve input from network operators.
* **Suggested Metrics**: Proposed metrics included the number of years since a network achieved its target, trend analysis (whether the network is increasing, decreasing, or stable), and evaluation of infrastructure support for data processing and governance, funding stability, and governance coordination, emphasizing the importance of international contributions and network maturity.

**4. Questions for the OCG and future directions**

The work of TT-Metrics marks a significant milestone in initiating the discussion on enhancing the evaluation criteria for network status and performance within the context of OCG. Through a collaborative and iterative process involving network representatives, OceanOPS staff and the GOOS Secretariat, TT-Metrics has made substantial progress toward achieving its objectives, by overviewing most categories of metrics that would be useful for Networks and GOOS progress, and by discussing potential scoring systems for several specific metrics. However the work now needs to go to a “micro level”, with a first selection of core metrics to be calculated and exposed to Networks for feedback.

The development of an initial suite of cross-network data and metadata metrics reflects the dedication and expertise of TT-Metrics members in synthesizing existing frameworks, guidelines, and best practices, and has laid the groundwork for fostering the drafting of metrics on other thematic areas.

During the discussion, the TT-Metrics recognized the importance of harmonizing metadata and ensuring data quality, aligning with the FAIR principles. Establishing a shared vocabulary and definitions is essential to enable better communication about the progress made in ocean observing over the past three decades. The TT-Metrics' work might also benefit emerging observing networks by guiding them in developing metrics and striving for maturity and sustainability.

Considering the diverse nature of ocean observing networks, the TT-Metrics proposed several questions for the OCG to make a decision on the next steps.

**4.1 Users: Who are these metrics for?**

* Who are the intended users of the proposed metrics?
* What specific purposes are these metrics designed to serve?

**4.2 Discuss complexity and preferred pathway**

* How complex does the OCG want this set of metrics to be? How many tiers/levels?
* Do we want to define metrics in a way that allows for as much as possible “automatized” creation based on the OceanOPS metadata holdings? (Note: this requires that also OceanOPS need to adjust/sharpen the metadata attributes they defined, and develop further new areas (funding sources, projects, e.g.)
* What are the key attributes that need to be considered when tracking the network’s progress towards readiness/maturity?
* How does OCG plan to ensure the metrics are adaptable and applicable across networks with varying structures, objectives, and operational capacities?

**4.3 Need input from networks to help next phase**

* In what ways does the OCG envision engaging with network leaders/operators and stakeholders to gather input and feedback on the proposed metrics?
* How to refine and validate the metrics to ensure their relevance and effectiveness in addressing the needs of the ocean observing community?

**5. Next steps and action proposed**

Actions from the TT-Metrics calls that could be considered for the next intersessional period:

* To propose a first list of core metrics in each identified category for feedback
* To develop first mechanisms/algorithms to implement these metrics
* To share these results with networks for feedback
* Ask the networks to define how they see themselves according to the OCG attributes.
* Invite networks to provide links for the respective documents on structures, governance, data, etc.
* A set of tables/spreadsheets with detailed description of each metric, including its purpose, scope, and measurement criteria will be created with maybe categories and submitted for review.

|  |
| --- |
| *Proposed action/decision to be discussed at OCG-15** Extend the life cycle of TT-Metrics to the next intersessional period, to further exploit the material and inputs gathered so far, and to report at OCG-16.
* Welcome new representatives from the networks to join this open ended TT.
* Continue the work on metrics development (~monthly basis) based on/to reflect the discussions/comments made at OCG-15.
 |

**Annex**

TT- Metrics [ToRs](https://docs.google.com/document/d/1p8UTKjfyzNIDS6vRFnu80-WnNxAYUtX_n7BROLQrl54/edit#heading=h.9f2kdccqzqgz) (including membership and meeting schedule)