GLOBAL OCEAN ASSET DATA GUIDE

A guide for the use of global ocean asset data in ocean accounting

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Contents

List of Figures and Tables

Acronyms and abbreviations

ARIES	ARtificial Intelligence for Environment and Sustainability
CBD	Convention on Biological Diversity
CMECS	Coastal and Marine Ecological Classification System
CEOS	Committee on Earth Observation Satellites
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization
GEO	Group on Earth Observations
GIS	Geographical Information System
GOAP	Global Ocean Accounts Partnership
GOOS	Global Ocean Observing System
IBAT	Integrated Biodiversity Assessment Tool
IUCN GET	International Union for Conservation of Nature Global Ecosystem Typology
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
SDG	Sustainable Development Goal
SEEA	System of Environmental-Economic Accounting
SEEA CF	System of Environmental-Economic Accounting Central Framework
SEEA EA	System of Environmental-Economic Accounting Ecosystem Accounting
SEEA EEA	System of Environmental-Economic Accounting Experimental Ecosystem Accounting
UN	United Nations
UNEP	United Nations Environment Programme
UNEP-WCMC	UN Environment Programme World Conservation Monitoring Centre
UN ESCAP	United Nations Economic and Social Commission for Asia and the Pacific

1 Introduction

1.1 About the Guide

This Guide provides practical support to countries for the use of global data on ocean assets in developing national ocean accounts. It supports a **Global Ocean Asset Data Inventory** that updates an initial inventory produced by the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP) and the Global Ocean Accounts Partnership (GOAP) in 2019. The Guide aims to enable national ocean accounts compilers to make informed decisions on the use of global ocean datasets that are varied in quality, accessibility and purpose.

The updated Inventory and accompanying Guide are part of the technical support provided by GOAP for the advancement of ocean accounting. Both are aligned with the GOAP Technical Guidance on Ocean Accounting for Sustainable Development (hereafter referred to as 'GOAP Technical Guidance')[1] and with the System of Environmental-Economic Accounting (SEEA)[2] produced under the auspices of the United Nations Statistics Division.

Ocean asset accounts provide the biophysical foundation for ocean accounting. Consequently, many countries are prioritising ocean asset accounts as a starting point for compiling national ocean accounts. Ideally, ocean asset accounts are produced using national data. However, many countries face challenges if data of suitable quality is not available within their national statistical systems, or from other custodians of national ocean data.

Global data on ocean assets can be used to fill gaps where national data are not available in order to enable the development and pilot testing of national ocean asset accounts. These pilot accounts, in turn, can help to demonstrate the utility of ocean accounts to inform ocean policy decisions for sustainable development and make the case for investments in improved national data availability.

1.2 The Global Ocean Asset Data Inventory

A review of the status of ocean data conducted in 2019 by UN ESCAP and GOAP found that existing ocean data inventories did not fully meet the needs of ocean accounting. In response to this finding, the initial OCEAN ACCOUNTS Global Ocean Data Inventory[3] was developed. The initial inventory was designed to align with the structure of accounts proposed by the SEEA Experimental Ecosystem Accounting (SEEA EEA) and the SEEA Central Framework (SEEA CF). It included 138 datasets and other resources relevant to ocean ecosystem extent, ecosystem condition, designated use, assets, ecosystem services supply and use, as well as ecosystem typologies. By identifying and describing a broad range of global resources relevant to ocean accounts, the initial inventory provided a valuable resource for early national ocean pilot accounting studies.

Since the compilation of the initial inventory, there has been significant progress in the fields of both ecosystem and ocean accounting. Physical ecosystem accounting became an official international statistical standard via the SEEA Ecosystem Accounting (SEEA EA)[4] in 2021. Further, through the efforts of GOAP and other initiatives, the state-of-the-art in ocean accounting has progressed substantially since 2019. Therefore, it was timely to update the original inventory to better evaluate

[1] GOAP Technical Guidance on Ocean Accounting for Sustainable Development: https://www.oceanaccounts.org/technical-guidance-on-ocean-accounting-2/
[2] System of Environmental Economic Accounting (SEEA): https://seea.un.org/
[3] The 2019 OCEAN ACCOUNTS Global Ocean Data Inventory can be accessed here: https://stat-confluence.escap.un.org/display/RPOES/Regional+Ocean+Accounts+Platform
[4] SEEA Ecosystem Accounting (SEEA EA): https://seea.un.org/ecosystem-accounting

global ocean datasets and capture key metadata that will be helpful to practitioners in evaluating their use for national ocean accounting.

The current update aims to increase the usability and uptake of the inventory. Building on the original work, the Global Ocean Asset Data Inventory version 2.0 (hereafter referred to as 'the Inventory') focuses the scope on global data relevant to ocean assets. Ocean asset accounts organise information about the state of the ocean's natural capital stocks. They provide an important biophysical basis for determining and valuing the benefits that the economy and society receive from the ocean. As such, accounting for ocean assets provides the foundation for wider ecosystem and environmental accounting. As many countries are prioritising ocean asset accounts, having a robust Inventory of global datasets focused on ocean assets is both timely and relevant. An important extension to the original inventory, as identified by GOAP, was the need to provide accompanying advice on the selection of suitable datasets and more detailed metadata to inform that selection.

Updates to the Inventory include:

- An improved structure based on key data needs for physical asset accounts and criteria for assessing data quality.
- Added functionality through filter options and increased searchability of standardised entry formats.
- Inclusion of available global datasets on produced assets and other pressures.
- Addition of datasets that have become available since 2019.

1.3 Methodology for updating the Inventory

To ensure user relevance, the methodological approach to updating the Inventory was guided by a consultation on user needs. Meetings were held with those involved GOAP pilot studies and other ocean accounting efforts from different regions of the world and at various stages of implementation. The consultation highlighted data needs, as well as key criteria that are important or useful to countries when considering datasets for ocean accounts. Suggestions were also made on account components and asset types to include (e.g. for ocean carbon accounts). Some of the experiences that were discussed in the consultations are presented in the Guide in 'country experience boxes'.

The selection of criteria for the updated Inventory structure was further informed by a review of different data quality assessment frameworks for national statistics and environmental-economic accounting. From these frameworks, the most commonly used criteria were selected as the basis for the Inventory to ensure that the Inventory aligns with other data assessment frameworks and accounting data standards national statistical offices will be familiar with. More details about the consultation process and criteria selection, as well as an overview of the types of datasets included in the updated Inventory are available in Annex I.

1.4 Intended use of the Inventory and Guide

The Inventory provides a resource for identifying global datasets that can be used to fill national data gaps. It is not intended to be the starting point for compiling national ocean accounts. Before turning to the Inventory, countries should have consulted their national data and established whether availability and quality of national data meet the requirements for the intended ocean accounts.

The Guide provides practical advice for using the Inventory to identify relevant global ocean asset datasets and assess their suitability for application in national (and subnational) ocean accounts. Given the diversity of global datasets and national contexts, the Guide does not attempt to provide prescriptive instructions on which datasets could or should be used in specific cases. Instead, the

Guide provides information about the limitations and other key considerations that may help determine whether a particular dataset is suitable for compiling ocean asset accounts in a specific national context. It offers a practical stepwise approach that guides national ocean account compilers through the decisions that lead to the selection of appropriate global datasets. The Guide also provides illustrative examples and experiences from existing applications intended to help share lessons learned and offer inspiration.

The Global Ocean Asset Data Inventory and accompanying Guide are primarily aimed at national ocean accounts compilers who are developing and piloting ocean asset accounts. Besides this, the Guide may be a useful resource for policy experts, statisticians, scientists and researchers to better understand the role that global ocean datasets can play in accounting. It is also anticipated that the Guide and Inventory may be of interest to international data providers to help understand the gaps in global datasets and build the case for investing in the development of data products that address key data needs for ocean accounts.

1.5 Structure of the following Chapters

- Chapter 2 provides some context on ocean asset accounts in line with the GOAP Technical Guidance on Ocean Accounting and the SEEA, as well as specifications for the Inventory (including the ocean asset typology and ecosystem classification used for the Inventory, data needs addressed by the Inventory and an overview of the updated Inventory structure).
- Chapter 3 explains at what point in the ocean account development process the Inventory should be consulted, discusses some of the advantages and limitations of global data and points to additional sources of global ocean data.
- Chapter 4 presents a stepwise approach for selecting datasets to support the compilation of national ocean asset accounts.
- Chapter 5 concludes the main part of the Guide with a summary of key reflections on the opportunities, limitations, gaps, and future prospects for global ocean data and their use in ocean accounts.
- Annex I describes the process and methodology applied to improve the structure and user functionality of the existing Global Ocean Data Inventory, including an overview of the datasets covered by the updated Inventory.
- Annex II shows the physical ocean asset accounts tables, as described in the GOAP Technical Guidance, for reference.
- Annex III provides a ‘check list’ template, which can be used to record any considerations on the stepwise process for assessing and selecting datasets.

2 Ocean asset accounts: context and specifications for the Inventory

2.1 Ocean asset accounts within the Ocean Accounts Framework

Ocean environmental asset accounts are a fundamental component of the Ocean Accounts Framework presented in the GOAP Technical Guidance. The Ocean Accounts Framework, as illustrated in Figure 1, is designed to be compatible with a number of international statistical frameworks and standards[5]. Ocean assets are represented in the 'Environmental assets' box (a) of Figure 1. They include ecosystem assets as defined by the SEEA EA[6] and individual environmental assets as defined by the SEEA CF[7].

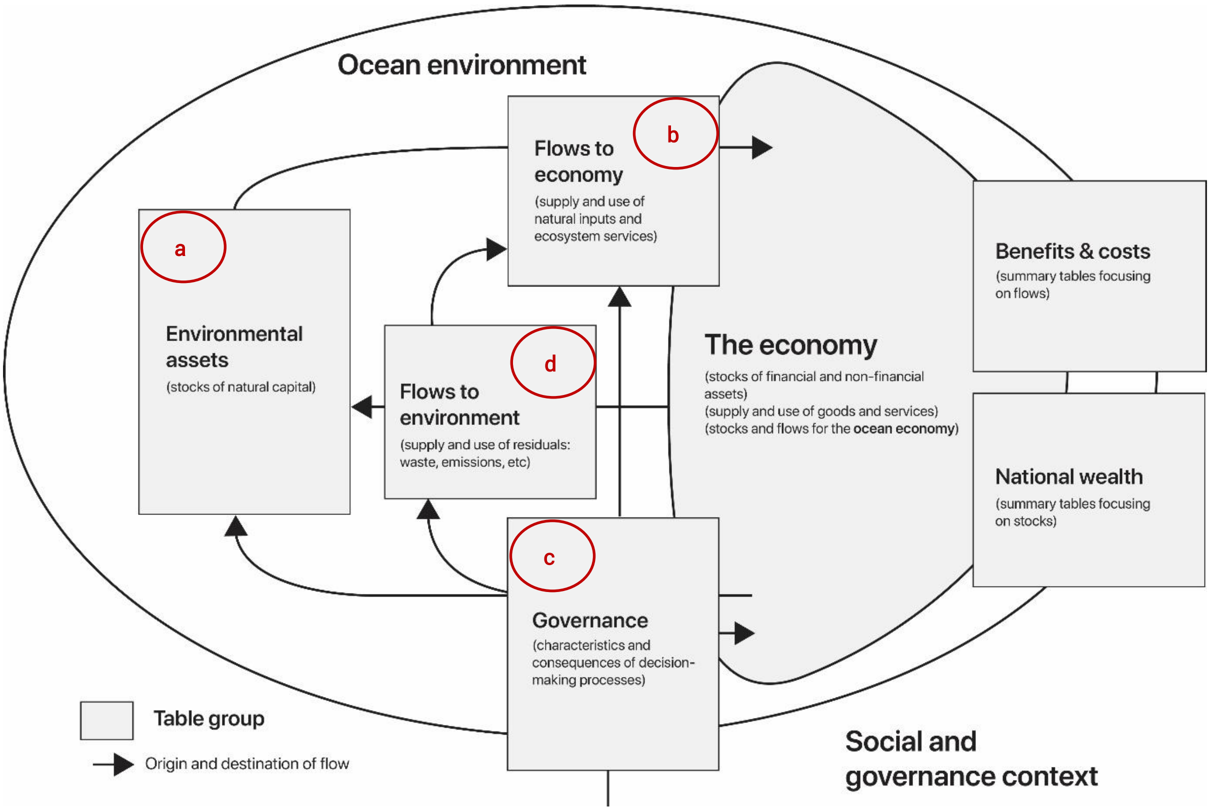

Figure 1: General structure of the Ocean Accounts Framework as presented in the GOAP Technical Guidance. *In the Figure, ocean assets are described as 'Environmental assets'.

Following the SEEA EA, **Ocean ecosystem assets** are classified by type (e.g. mangroves, seagrasses, coral reefs) and characterised by extent (quantity) and condition (quality). Ecosystem extent is accounted for in terms of area of ecosystem types. Ecosystem condition can be assessed in terms of biodiversity, productivity, levels of pollutants, etc. Some of the most frequently assessed key condition variables, as listed in the GOAP Technical Guidance, include:

- Acidification (pH)
- Eutrophication (BOD, COD, Chlorophyll A, or primary productivity

[5] See GOAP Technical Guidance, chapter 1.2: https://www.oceanaccounts.org/technical-guidance-on-ocean-accounting-2/

[6] SEEA Ecosystem Accounting defines 'ecosystem assets' as "contiguous spaces of a specific ecosystem type characterized by a distinct set of biotic and abiotic components and their interactions" (SEEA EA 2021, p. 354).

[7] SEEA Central Framework defines 'individual environmental assets' as "those environmental assets that may provide resources for use in economic activity. They comprise mineral and energy resources, land, soil resources, timber resources, aquatic resources, other biological resources and water resources." (SEEA CF 2014, p. 316). https://seea.un.org/content/seea-central-framework

- Biodiversity (species diversity or ecosystem diversity, e.g. Shannon index of diversity)
- Concentration of floating plastics (g/m^3)
- Sea surface temperature (SST)
- Coral condition (cover, % living, % bleached)
- Seagrass and mangrove cover (%)

Individual ocean environmental assets are listed in Table 1 as specified in the GOAP Technical Guidance (p. 46, section 2.3.2). This broadly follows the framing of environmental asset accounts described in the SEEA CF.

Table 1: Individual ocean environmental assets as specified in the GOAP Technical Guidance

Individual environmental ocean assets	What they include
Minerals and energy resources	Oil, natural gas, coal, peat, non-metallic minerals, metallic minerals (incl. dissolved minerals).
Land and seabed	The space in which economic activities and environmental processes take place and within which environmental and economic assets are located; also includes areas covered by water at high tide, the seabed within a country's exclusive economic zone (EEZ) and a country's continental shelf.
Soil and seabed substrata	Semi-terrestrial soils of the intertidal area, seabed substrata types (e.g. rock, coarse sediment, mixed sediment, sand, muddy sand, mud, sandy mud).
Coastal timber resources	Defined by the volume of trees (living or dead), principally mangroves.
Aquatic resources	Cultivated or naturally occurring fish, crustaceans, molluscs, shellfish, other aquatic organisms (e.g. sponges, seaweed), aquatic mammals (e.g. whales). For a given country, aquatic resources include those that live within their EEZ throughout their life cycle and migrating and straddling fish stocks during the period when they inhabit the EEZ.
Other biological resources	Cultivated or naturally occurring animals and plants other than timber and aquatic resources (e.g. coastal crops, livestock and wild foods).
Water resources	Fresh and brackish water in inland water bodies, groundwater and soil water, focusing on abstraction from and outflows to the ocean; seawater has not been treated as an asset in the past, but supply and use are included in water accounts.

The **quantity and quality of individual environmental assets** is determined by measures that are specific to the asset. For example:

- Minerals: quantity in tonnes; quality in high grade/low grade.
- Fish stocks: quantity in tonnes of fish catch, number of fish; quality as healthy/unhealthy.

The global ocean datasets listed in the Inventory are intended to support the development of accounts for the extent and condition of ecosystem assets and the quantity and quality of individual environmental assets. To enable integration of both types of assets into one set of ocean asset accounts, the GOAP Technical Guidance combines ecosystem and individual environmental assets in three physical asset account tables: physical asset extent accounts, physical asset condition accounts (using biophysical variables) and summary asset condition accounts (using condition indicators). These are the accounts tables that the Inventory and Guide aim to inform. The physical asset accounts tables are included in Annex II for reference. It should be noted that some ocean assets can also be presented in monetary accounts (see GOAP Technical Guidance section 2.3.5). However, the current version of the Inventory and this Guide focus only on physical asset accounts.

2.2 Account component typology for the Inventory

The Inventory is structured to assist practitioners in easily identifying data for ocean asset accounts. The approach taken by the Inventory is to consider data relevant to both the direct measurable state of ocean assets, as described in the GOAP Technical Guidance (box a, Figure 1), and the indirect drivers of changes in state. The measures for indirect drivers of change in ocean assets relate to their governance (e.g., designated use, box c, Figure 1), the flows from the economy that can impact on the assets (e.g., pollution, box d, Figure 1) and the level of economic exploitation of these assets (e.g., fishing effort, box b, Figure 1). The relevant account components covered by the Inventory are presented in Table 2.

Table 2: Account component typology for the Global Ocean Asset Data Inventory

Ocean asset account component	Rationale for inclusion in the Inventory
Ecosystem extent **Ecosystem condition**	Information on **ecosystem extent** and **ecosystem condition** is directly relevant to the measurement of ocean ecosystem assets under the SEEA EA. Understanding extent and condition of ecosystem assets helps to determine their capacity to provide services to people. These components relate to box a in Figure 1.
Individual environmental assets	Data on the **individual environmental assets** presented in Table 1 are included as considered by the SEEA CF. Information on the quantity and quality of individual environmental assets helps monitor the state of natural resources and whether they are being used sustainably. These components relate to box a in Figure 1.
Carbon	Accounting for climate change is highlighted as an accounting in theme in the final SEEA EA. There is also widespread policy interest in the role of ocean ecosystems in sequestering and storing carbon and how to best mange this in the context of climate change. Responding to this interest, the Inventory includes available global datasets on ocean-based **carbon**. Whilst these could be considered indicators of condition, consultations have identified that there is utility in presenting these separately to support thematic ocean accounting more directly. This component relates to box a in Figure 1.
Produced assets	As shown in box b and box d in Figure 1, ocean assets are linked to the economy through the inputs they provide and the residuals they receive. These residuals can impact on ocean assets, sometimes positively but often negatively. A category for **produced assets** is included to capture data on where anthropogenic activity may be assumed to be creating pressures (see below) that are likely to impact on the condition of ocean assets. This could include coastal development, ports, shipping, etc. In some cases, produced assets may have a positive impact on ocean assets, such as the introduction of artificial reefs.
Pressures	The **pressures** category is intended to capture specific data on individual flows between the environment from the economy. As shown in box d in Figure 1, these include the residues that arise from economic activities, such as solid wastes, water emissions and atmospheric deposition. Where available, data relevant to evaluating overuse of ocean assets is also included in the pressures category (box b in Figure 1). For example, this may refer to fishing effort or recreational diving intensity. The data in this category will be important for understanding future prospects for ocean assets, particularly where other data is limited.
Designated use	The **designated use** category aligns with the land use accounts of the SEEA CF. Information on designated use also provides a link to the governance

Ocean asset account component	Rationale for inclusion in the Inventory
	arrangements pertaining to ecosystem assets, as per box c in Figure 1. The rationale for including this data in the Inventory is that ocean assets that are afforded long-term protection are likely to be in better condition than those subject to open access arrangements or designated for resource use. Therefore, data on designated use may provide further information for understanding the condition and future prospects of ocean assets.

For each of the account components listed in Table 2, the 'Ocean asset' column in the Inventory identifies different types of ocean assets and indirect drivers of change in ocean assets for which global data are available. This comprises different marine and coastal ecosystem types, ecosystem condition parameters, types of individual environmental assets and carbon parameters. It also includes different types of produced assets, other pressures parameters and types of designated uses. All specific types and conditions for the 'Ocean asset' column of the Inventory are listed in full in Table 5, Annex I. In total, the updated Inventory provides 88 datasets for seven distinct account components, covering 59 different ocean asset types or conditions (Table 3).

Table 3: Overview of the number of datasets in the updated Global Ocean Asset Data Inventory by account component and ocean asset (type/condition)

Account component	Ocean asset (type/condition)	Number of datasets
Ecosystem extent	10	14
Ecosystem condition	32	49
Individual environmental asset	2	2
Carbon	5	8
Produced asset	2	2
Pressures	7	10
Designated use	1	3
Total	**59**	**88**

2.3 Data needs for ocean asset accounts

The Inventory supports the development of physical ocean asset accounts using data on the direct measurable state of ocean assets and the indirect drivers of changes in state. Types of data needed for this include:

- Georeferenced location and spatial extent of marine and coastal ecosystems,
- Georeferenced condition variables and indicators for marine and coastal ecosystems,
- Statistics on the quantity and quality of marine and coastal natural resources,
- Georeferenced location of areas at sea with specific designations (marine protected areas, fishing zones, shipping lanes, etc.),
- Georeferenced location and statistics for man-made structures on the coast, at sea, on the seafloor or on the seabed (wind farms, ports, wrecks, subsea cables, oil and gas platforms, mariculture installations, artificial reefs, etc.),
- Spatially explicit carbon storage, sequestration and release rates.
- Spatially explicit information on flows of economic residuals to the ocean environment, such as pollution release and atmospheric deposition rates.

- Georeferenced information on the level of use of different ocean assets, such as fishing effort or recreational diving activity.

The Inventory lists spatially explicit and spatially independent datasets (e.g. statistical data) for these data needs. These datasets are selected based on fulfilling the following fundamental data requirements for ocean asset accounting:

1. Ocean asset accounts track change over time. They compare the state in ocean asset stocks at the beginning and end of the accounting period. This requires timeseries data for at least two points in time.
2. Ocean ecosystem accounts are spatially explicit and require georeferenced data. This may be vector data (point, polyline, polygon)[8], raster data or spatially referenced data in tabular format.
3. To enable meaningful comparisons, accounts require data on ocean assets that are generally consistent over space and time.

2.4 Ecosystem classifications for ocean asset accounts

Ecosystem classifications play an important role for ocean ecosystem accounts. Ecosystem extent and condition are determined by ecosystem type. Classifications ensure that these ecosystem types are defined consistently. Applying internationally agreed classifications ensures alignment and comparability of national ocean accounts across countries.

Currently, there is no agreed international standard classification for ocean ecosystems. To enable international comparisons, the SEEA EA recommends the use of the International Union for Conservation of Nature Global Ecosystem Typology (IUCN GET)[9] as a reference classification.

The GOAP Technical Guidance suggests the United States' National Ocean and Atmospheric Administration's (NOAA) Coastal and Marine Ecological Classification System (CMECS)[10] as another useful option. The CMECS may provide more detailed classes for some marine ecosystems.

The Inventory does not apply any specific typology for describing ecosystem asset types. Instead, it uses the indicative list provided in the GOAP Technical Guidance of coastal and marine ecosystems often considered in assessments. These ecosystems, as listed below, are used in the 'Ocean asset' column of the Inventory to describe datasets on ecosystem extent:

- **Coastal:** Beaches, coastal dunes, coastal flats, coastal water bodies (e.g. bays), estuaries, mangroves, rocky shores, warm water coral.
- **Marine (to shelf):** cold water coral, lagoons, seagrass beds (by type), seaweed, warm water coral reefs, pelagic and benthic.
- **Marine (shelf to exclusive economic zone (EEZ)):** Cold water/deep water coral, crustacean habitat, fish habitat, glass sponges, sea cucumber habitat, uninhabited sand, uninhabited rock, pelagic and benthic.

[8] 'A Gentle Introduction to GIS' included in the QGIS Documentation provides detailed explanations of vector and raster data. This can be accessed here: https://docs.qgis.org/3.16/en/docs/gentle_gis_introduction/index.html

[9] International Union for Conservation of Nature Global Ecosystem Typology (IUCN GET): https://global-ecosystems.org/

[10] United States' National Ocean and Atmospheric Administration's (NOAA) Coastal and Marine Ecological Classification System (CMECS): https://iocm.noaa.gov/standards/cmecs-home.html

2.5 Inventory structure

The Inventory is structured around **a) key data needs for physical asset accounts** and **b) generally established data quality assessment criteria for national statistics**. The updated structure seeks to provide national ocean account compilers with information that can be used to rapidly assess the relevance, utility, strengths and weaknesses of each dataset. The information should enable the users to decide whether a dataset is of suitable quality for their specific national context and ocean accounting priorities. Table 4 presents an overview of the Inventory structure, including explanations of the information captured under each column. The Inventory covers five high-level data quality assessment criteria:

1. **Relevance:** Is the dataset relevant for different national ocean asset accounting requirements?
2. **Interpretability:** Is information available to enable correct interpretation of the dataset?
3. **Institutional environment:** Is the production and provision of the dataset impartial, objective and authoritative?
4. **Accuracy:** Is the dataset reliable, valid and consistent?
5. **Accessibility:** Is the dataset easy to access and use? Are there any use restrictions?

Each of the five high-level criteria is broken down into a set of sub-criteria. These sub-criteria address key data requirements for ocean asset accounts as well as user needs that were identified during the consultation process for the Inventory with national ocean accounting and GOAP pilot studies (for more information about the consultation process see in Annex I).

Table 4: Overview of the updated Inventory structure. The structure is hierarchical, with high level data quality criteria and accounting relevant sub-criteria.

*	Column headings		Information captured under each column**
A	No.		Inventory entry number
B	Account component		For which ocean account component is the dataset relevant? (as per Table 2)
C	Ocean asset (type/condition)		For which ocean asset type, condition or indirect driver of change in ocean assets is the dataset relevant?
D	Dataset name		Official name of the dataset
E	Data measure and unit		What is being measured and in what units? (e.g. Coral (ha), Dissolved oxygen (mg/L), Ports (location))
F	Relevance for national ocean asset accounts	Spatial resolution	What is the spatial resolution of the data?
G		Geographic constraints	Does the data have any geographic constraints with regards to global coverage? (e.g. areas not covered)
H		Time series availability	Are data observations available for different periods or points in time? (e.g. for different years, five-year periods, decades)
I		First observation	Time series: What is the first year in the time series for which data observations are available? No time series: This criterion does not apply.
J		Latest observation	Time series: What is the latest year in the time series for which data observations are available? No time series: What is the year for which the data is available/that the data is intended to represent?
K		Frequency of recent observations	Time series: What is the interval/period of time between the last two observations? (e.g. one year, five years, ten years) No time series: This criterion does not apply.
L		Publication date of dataset	What year was the dataset published or released?
M		Likelihood of future production	Are further editions/versions of the dataset likely to be produced in the future?
N	Interpretability	Data format	In what format is the dataset? (e.g., raster, polygon, point, tabular)
O		File format	In what file format(s) is the dataset available?
P		Acquisition method	How was the dataset produced? (in-situ/remote sensing; raw/processed/modelled)
Q		Metadata availability	Is information available to enable correct interpretation of the dataset? (e.g. concepts, sources, methods, assumptions, data accuracy)
R		How to access the metadata	Web link or other access details (e.g. email)
S		Supporting documentation	Is supporting documentation available to enable use of the data? (e.g. user guides, manuals)

*	Column headings		Information captured under each column**
T	Institutional environment	Data custodian	Which organisation or institution looks after and provides the data?
U		Global policy relevance	Is the dataset produced, formally listed, recognised or proposed for an official global policy process? (e.g. SDG indicator, CBD target)***
V		Authoritativeness	Has the dataset been produced on the basis of scientific/expert peer-review, by a UN agency or programme (e.g. FAO statistics)***, or by a national government agency (e.g. NOAA)**?
W	Accuracy	Quality assurance	Is documentation on quality assurance and validation available for the dataset?
X		Errata and known issues	Is information available about errata and/or known issues?
Y	Accessibility	Availability online	Is the dataset easily accessible online in different open access formats?
Z		Terms of use	What are the terms of use for the data? (freely available/paid, use restrictions)
AA		How to access	Web link or other access details (e.g. email)
AB	Comments on the dataset		Any additional information about the dataset, where relevant

* Column references in the Excel sheet of the Inventory.

** More detailed explanations are provided in Chapter 4.

*** Abbreviations: SDG – Sustainable Development Goal; CBD – Convention on Biological Diversity; UN – United Nations; FAO – Food and Agriculture Organization; NOAA – National Oceanic and Atmospheric Administration

3 Using global ocean asset data

3.1 At what point in account development to consider global data

The Inventory aims to enable the initial development and pilot testing of national ocean accounts where suitable national data are not available. As outlined in the GOAP Technical Guidance (Chapter 3) and the draft Implementation Strategy for the SEEA EA[11], key data sources and available data should be identified in the initial strategic planning and implementation preparation phase of the account development process (Figure 2).

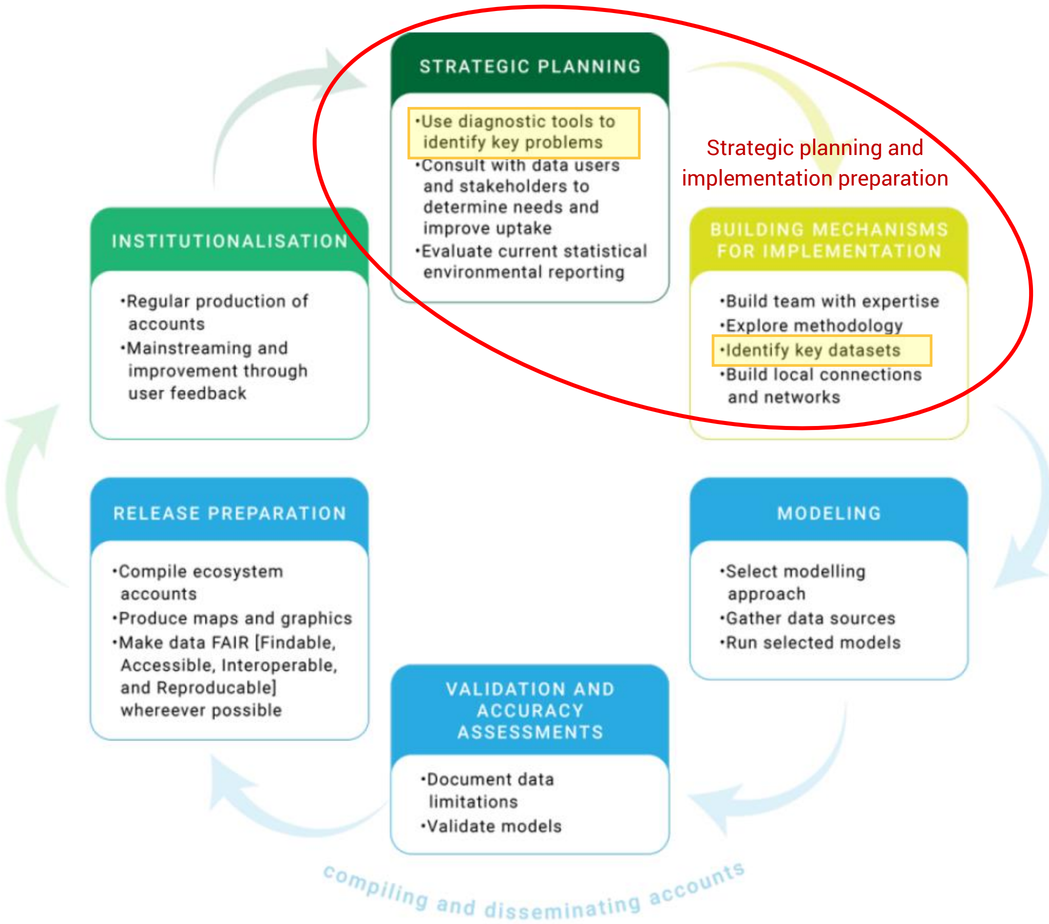

Figure 2: National implementation process presented in the draft implementation strategy for the SEEA EA. The red circle highlights the initial strategic planning and implementation preparation phase. The two yellow boxes indicate activities that the Inventory can support.

The first step in the process is **strategic planning** of the priorities for the account development. The strategic planning process should begin by convening key stakeholders a) from the organisations that contribute data and expertise to the compilation of ocean asset accounts and b) from the agencies that will use the accounts in planning and decision-making. In consultation with these stakeholders, the planning process should then determine 1) the policy question (or analytical objectives) that the ocean accounts are intended to address, 2) the type of accounts needed, and 3) what account development is feasible with the available resources (including data). One of the central activities is the identification of relevant data sources and the evaluation of availability and quality of the data.

[11] Draft Implementation Strategy for the SEEA EA: https://seea.un.org/sites/seea.un.org/files/seea_ea_implementation_strategy_draft_11june.pdf

The priority should be to investigate national data sources. Where national data of suitable quality are not available, **the Global Ocean Asset Data Inventory can support the strategic planning by providing an overview of possible global data sources**. For example, the Inventory can be used as part of diagnostic tools for strategic account planning (see Box 1).

Box 1. Using the Inventory as part of diagnostic tools for strategic account planning

Ecosystem accounting experiences and ocean accounts pilots have shown that account development should be a collaborative process involving account producers, data providers and account users. To facilitate the collaboration, diagnostics tools such as the SEEA Diagnostic Tool[12] or the Diagnostic Tool for Strategic Planning[13] from the UN ESCAP ocean accounts pilot studies, can be used in the strategic account planning step. One of the areas covered by the diagnostic tools is 'Knowledge', i.e. the identification of national data sources and availability. Where the diagnostic tool reveals gaps in national data that would prevent moving forward with the account development, the Inventory can be reviewed as part of the consultation exercise. This would provide an initial overview of available global data.

By the end of the strategic planning, it should be clear what policy question (or analytical objective) the ocean accounts are intended to address, what accounts will be developed for this and what national data is available. The next step is building **mechanisms for implementation of the accounts** (see Figure 2). As part of this, the specific key datasets need to be identified that can be used to build the accounts. National data should be prioritised where available at suitable quality. **Where national data are not available or not possible to obtain** (e.g. through data sharing options, original fieldwork or socio-economic surveys)**, the Inventory can be consulted to identify and select suitable global datasets.**

At this point, available global datasets in the Inventory should be critically assessed. The filter and search functions in the Inventory allow users to identify datasets that are relevant to the policy priorities and accounts to be developed. If relevant datasets are available, the stepwise approach described in Chapter 4 can help guide the critical assessment of quality and relevance of the data. This should enable an informed decision about what global data to use in the specific national context for ocean accounts determined in the strategic planning process.

3.2 Advantages and limitations of global ocean asset datasets

Whether global data is useful for developing national ocean accounts, and what the limitations are, will depend on the specific national context and ocean accounting priorities and on the global datasets that are relevant to these. Nonetheless, a few general observations can be made on the advantages and limitations of global ocean asset datasets. These observations can be helpful when considering the use of global data.

3.2.1 Advantages

- **Consistency over large scales:** Global datasets apply consistent methodologies and standards over large scales. This is particularly **relevant for large countries with multiple and/or extended coastlines and large ocean areas within their EEZ**. While data held in the country might be more accurate, or at higher resolution, it may not always be consistent and comparable across different parts of the national ocean environment. Data that comes from

[12] The SEEA Diagnostic Tool is included as Annex II in the SEEA Implementation Guide: https://unstats.un.org/unsd/envaccounting/ceea/meetings/ninth_meeting/UNCEEA-9-6d.pdf
[13] Environment Statistics: Diagnostic Tool for Strategic Planning, Version 1.1, 2016 (Draft)

different regional or local monitoring programmes, or individual site-specific studies, might have been produced using different methodologies and standards. This makes it more difficult to aggregate up to national ocean asset accounts.

Country experience:

In creating an initial pilot for Canada's ocean accounts, key condition indicators were sea surface temperature and salinity. Although Canadian data exist, the datasets that were located were not considered suitable for the accounts. Data were either point data with limited spatial coverage or raw spatial data that would have required a significant amount of compilation work. Through using the World Ocean Atlas[14] data, which has a common granularity across all of Canada's EEZ, a first estimate of sea surface temperature and salinity change could be made. This allowed conditions to be compared across the Atlantic, Arctic and Pacific Ocean regions as data had the same time period and spatial granularity.

- **Consistency over time:** The consistent methodologies underpinning global datasets also serve to ensure temporal (as well as spatial) consistency. In particular, satellite and derived data now offer quality assured, regular time-series global data on the environment. These datasets can provide global information on ecosystem extent, condition (habitat type, area, density, water depth, pollution, etc.) and other ocean assets. This can often be made available at high temporal frequencies, as some data are produced daily or weekly. Some satellite data services have been provided since the 1980s[15].

- **International comparability:** Consistent methodologies and standards applied in global datasets also facilitate international comparisons between countries. This is particularly **relevant where national ocean accounts are intended to be used for reporting against international targets and commitments** such as the Sustainable Development Goals, the post-2020 global biodiversity framework or nationally determined contributions to the Paris Agreement.

- **Expert support:** Where datasets are actively maintained by scientific or expert organisations, it may be possible to get support and guidance from the data providers. It may also be possible to work with these data providers to improve the useability of global data at the national level.

3.2.2 Limitations and sources of error

When using global data, it is important to know how the datasets were produced in order to understand their limitations and sources of error. There are three main approaches for creating global maps[16]: 1) by combining different local or regional datasets (e.g. World Atlas of Seagrasses[17]), 2) by using satellite imagery or other remotely sensed data (e.g. Global Mangrove Watch), or 3) by combining remote sensing and in-situ data in a hybrid approach (e.g. Global Distribution of Coral Reefs[18]). In their paper on 'Spatial Data Collection for Conservation and Management of Coastal

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[14] World Ocean Atlas: https://www.ncei.noaa.gov/products/world-ocean-atlas

[15] Pruckner S., McOwen C.J., Weatherdon L.V. and McDermott Long O. 2021. Spatial Data Collection for Conservation and Management of Coastal Habitats. In: Leal Filho W., Azul A.M., Brandli L., Lange Salvia A., Wall T. (eds) Life Below Water. Encyclopedia of the UN Sustainable Development Goals. Springer, Cham. https://doi.org/10.1007/978-3-319-71064-8_136-1

[16] Pruckner S., McOwen C.J., Weatherdon L.V. and McDermott Long O. 2021. Spatial Data Collection for Conservation and Management of Coastal Habitats. In: Leal Filho W., Azul A.M., Brandli L., Lange Salvia A., Wall T. (eds) Life Below Water. Encyclopedia of the UN Sustainable Development Goals. Springer, Cham. https://doi.org/10.1007/978-3-319-71064-8_136-1

[17] World Atlas of Seagrasses: https://archive.org/details/worldatlasofseag03gree

[18] Global Distribution of Coral Reefs, available on the Ocean Data Viewer: https://data.unep-wcmc.org/datasets/1

Habitats', Pruckner et al. (2021) identify a number of limitations and sources of error that these global ocean ecosystem maps have:

- Different combined maps (e.g. for seagrasses) may show contradictory results. It is therefore important to understand the methods used to produce the different maps and what exactly the maps are showing. For example:
  - Are the maps at different spatial and temporal scales?
  - Are habitats classified differently?
- Most global maps only show the presence of ecosystems. They do not provide information about ecosystem health. Moreover, it may not be clear whether blank areas on the map are due to absence of ecosystems or lack of data.
- Most existing global ocean ecosystem maps only provide a static snapshot for a given ecosystem type at one point, or period, of time. Currently, only changes in global extent of mangroves can be tracked, using Global Mangrove Watch. However, efforts are under way to provide regularly updated coral data in the Allen Coral Atlas[19].

Other limitations and sources of error for global datasets include:

- For maps produced by combining different datasets, it may be difficult or impossible to identify the date and sources of individual datasets used to generate extent. For example, this is the case for the Allen Coral Atlas.
- Remote sensing data requires in-situ validation (ground truthing) to ensure that they are interpreted correctly for different national circumstances. Especially for sub-tidal ecosystems like coral reefs and seagrass beds. This is because artefacts from satellite imagery present a common source of error.
- Predictive modelling can be used to close data gaps, including for satellite images. However, modelled data can only provide a best estimate. For example, potential ecosystem extent based on presence/absence criteria. When using this type of modelled data it is important to understand if they have been trained correctly and ground truthed thoroughly for national circumstances.
- Global data often have low spatial resolution. This may limit their usefulness for areas where granular data is required, e.g. to understand habitat fragmentation.

3.3 Additional global data sources

The Inventory focuses on a specific selected set of datasets relevant to ocean asset accounts. It is not meant to be an exhaustive list of all available datasets that might be relevant to ocean asset accounts. Other data sources may provide additional useful resources to support the initial compilation of national ocean accounts. A growing number of platforms, portals, repositories and initiatives are working to increase and facilitate access to global ocean data. Some of these global ocean data sources were identified during the search for global ocean asset datasets and are listed in a separate tab in the Inventory (see 'Portals, Repositories' tab).

Two of these additional global ocean data sources are the UN Biodiversity Lab and Ocean+. The **UN Biodiversity Lab**[20] is a free, open-source spatial data platform brought together by the United Nations

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[19] Allen Coral Atlas: https://allencoralatlas.org/

[20] UN Biodiversity Lab: https://unbiodiversitylab.org/

Development Programme, the United Nations Environment Programme (UNEP) and the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC). The platform provides access to over 400 global spatial datasets on nature, climate change and sustainable development. This includes 25 datasets with marine relevance, providing data on:

- Marine and coastal ecosystems,
- Fishing effort,
- Territorial seas, contiguous zones and EEZs,
- Coral reef connectivity and ecosystem service values,
- Global mangrove soil carbon,
- Cumulative ocean impact, marine pollution index,
- Global intertidal change, global surface water,
- Marine ecoregions, pelagic provinces and wilderness.

Ocean+[21] is UNEP-WCMC's umbrella initiative for marine biodiversity data and information. One of the products under the initiative is the **Ocean+ Library**[22] which guides the user to a range of selected, high quality marine datasets and online resources with applicability to marine decision making. This includes both global and regional resources, as well as detailed metadata on each dataset.

Efforts are also on going to support ocean accounting using global and other readily available data via the Group on Earth Observations for Ecosystem Accounting[23] initiative and via the ARIES for SEEA project[24]. These platforms are aiming to provide data and applications for ecosystem accounting in the near future. Within the Group on Earth Observations (GEO), the GEO Blue Planet initiative is also working to develop global ocean data for policy and decision-making.[25]

The GOAP Technical Guidance (section 4.2) highlights two key sources for ocean satellite remote sensing, in-situ and modelling observational data:

- **The Committee on Earth Observation Satellites (CEOS)**[26] brings together 55 space agencies from around the world to ensure international coordination of satellite Earth observation programmes, facilitate data sharing and disseminate resources to support the access and use of satellite data ('Data & Tools'[27]).
- **The Global Ocean Observing System (GOOS)**[28] is an initiative of the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization, co-sponsored by the World Meteorological Organization, the United Nations Environment Programme and the International Science Council. GOOS supports the international ocean observing community in developing tools, technology, information systems, scientific analysis and foretastes for ocean observations. They provide access to ocean observation data through the Ocean OPS[29] dashboard.

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21 Ocean+: https://oceanplus.org/

22 Ocean+ Library: https://library.oceanplus.org/

23 Group on Earth Observations for Ecosystem Accounting initiative: https://www.eo4ea.org/

24 ARIES stands for Artificial Intelligence for Environment and Sustainability. ARIES for SEEA project: https://seea.un.org/content/aries-for-seea

25 GEO Blue Planet: https://geoblueplanet.org/

26 Committee on Earth Observation Satellites (CEOS): https://ceos.org/

27 CEOS Data & Tools: https://ceos.org/data-tools/

28 Global Ocean Observing System (GOOS): https://www.goosocean.org/index.php?option=com_content&view=article&id=272&Itemid=411

29 Ocean OPS dashboard: https://www.ocean-ops.org/board

For information related to marine activities or produced assets, commercial, sector specific data service providers may be an additional source of data. These data services will generally involve a cost. However, paid services may provide the benefit of getting quality assured data tailored to specific user needs. These services might be worth considering in some cases where a country might have a very specific data need.

4 A 'check list' for selecting global ocean asset data from the Inventory

This Chapter guides account compilers through a stepwise approach to using the Inventory to identify and assess the suitability of different global datasets. The stepwise approach works through the columns in the Inventory from the left to the right:

> **Step 1:** Identify global datasets that are relevant to ocean asset account components and asset type or condition of interest (columns B-E in the Excel Inventory).
>
> **Step 2:** Check datasets against the quality assessment criteria to help inform the selection of global datasets that are appropriate/suitable to the national context and ocean accounting priorities (columns F-AA in the Excel Inventory).

Step 2 provides **a 'check list' of key considerations** to keep in mind when deciding on suitable global data to fill national ocean asset data gaps. If documented, these considerations will provide important justification for decisions on global datasets used in national ocean asset accounts. This documentation will also support data quality assurance processes for account compilation. The Inventory is purposefully structured to support the consideration of criteria that are central to many data quality assurance processes implemented by national statistical offices: **relevance, interpretability, institutional environment, accuracy and accessibility**. A 'check list' template is provided in Annex III, which can be used to record any considerations on the data quality criteria in a structured way.

Whilst the assessment steps and 'check list' follow the structure of the Inventory, they are not intended to be prescriptive. The different criteria do not have to be considered in any particular order, or comprehensively. Users may choose to go through all criteria or select specific criteria that are particularly relevant to their interests and needs. It will depend on the national context, ocean accounting priorities and resources available which criteria are applied to decide whether to use or not use a dataset.

Step 1: Identify available datasets

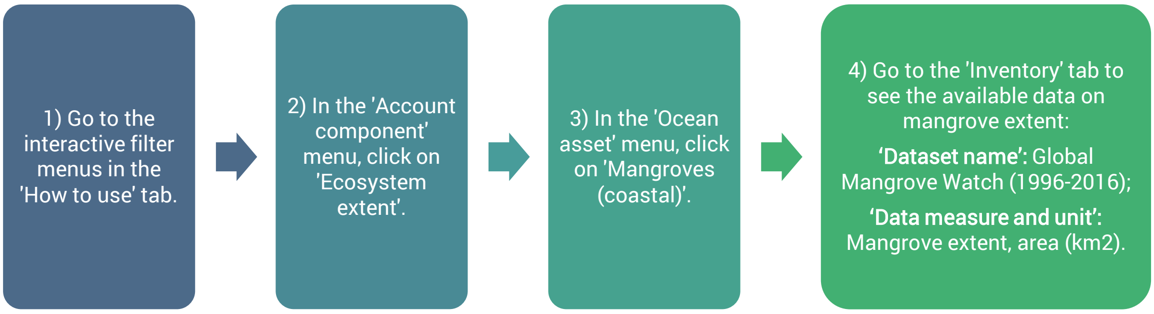
The Inventory is organised by account component and ocean asset:

- **'Account component'** identifies the components of ocean accounts for which the datasets are relevant (as per Table 2). These include: Ecosystem extent, Ecosystem condition, Individual environmental assets, Carbon, Produced assets, Pressures, and Designated use.
- **'Ocean asset (type/condition)'** refers to the type of ocean asset or related conditions that the datasets are relevant for. These include: marine and coastal ecosystem types, marine and coastal condition parameters and indicators, marine and coastal environmental resources (as listed in the GOAP Technical Guidance), carbon parameters related to marine and coastal ecosystems, marine and coastal produced assets, use designations for marine and coastal areas/activities, and parameters and indicators for four types of pressures (water emissions, solid wastes, atmospheric deposition, intensity of use).

Filter options: The 'How to use' tab in the Inventory provides two interactive filter menus that allow to pre-select the datasets shown in the 'Inventory' tab. Use these filter options to find datasets relevant to the account component and asset type or condition for which data is needed. Once a pre-selection is made, Columns D and E in the 'Inventory' tab provide further information about:

- The official **'Dataset name'**.
- **'Data measure and units'**.

For example, Fiji used global data to develop pilot mangrove ecosystem accounts (Box 2). To find available datasets for ecosystem extent of mangroves in the Inventory:



After completing a search, clear the selections in the filter menus in steps 2 and 3 before starting a new search.

Box 2. Fiji used Global Mangrove Watch to develop pilot mangrove ecosystem accounts

Fiji's ocean accounts pilot study used the Global Mangrove Watch[30] dataset. As shown above, this dataset would be identified in the Inventory by selecting 'Ecosystem extent' as the 'Account component' and 'Mangroves (coastal)' as the 'Ocean asset'. Fiji's pilot ocean accounts were led by Aberystwyth University and solo Earth Observation and generated preliminary mangrove ecosystem accounts for 10 of 14 provinces within Fiji. The Global Mangrove Watch dataset provided spatial coverage of Fijian islands and timeseries data (1996, 2007 – 2010, 2015, 2016), which facilitated alignment with other environmental, economic, and social mangrove-related datasets in Fiji. The dataset was used to produce ecosystem extent accounts for mangroves, calculating the change in cover per province between 2008 and 2016 (inclusive). The extent of mangroves was integrated with modelled indicators of condition, such as tree height and above ground biomass, to estimate ecosystem service supply.

To assess the suitability of the Global Mangrove Watch data for use in Fiji's pilot ocean accounts, the dataset was compared with available regional and national datasets on mangrove extent. The comparison found both strengths and limitations for the use of the global dataset:

- (−) At a higher resolution, mangroves in urban areas were poorly represented within the Global Mangrove Watch dataset. Further, smaller coastal mangroves (< 0.2 ha) on exposed coasts were often not captured.
- (+) The strength of Global Mangrove Watch was that it provided greater resolution and accuracy in the coverage of deltaic mangroves, relative to national datasets.

The experience from Fiji shows that, for the future development of Global Mangrove Watch, it would be useful to consider how multiple datasets could be best integrated through ground truthing, to increase the accuracy and quality of the dataset for use at the national and sub-national scale.

[30] Global Mangrove Watch: https://www.globalmangrovewatch.org

Step 2: Check available datasets against the quality assessment criteria

Structure of this section:

x) DATA QUALITY ASSESSMENT CRITERIA in the Inventory (relevance, interpretability, institutional environment, accuracy and accessibility)

Data quality assessment action.

Inventory columns to check:

- Tells you which column of the Inventory provide relevant information.

Things to consider:

- ○ Highlights points to think about when making a decision on using a dataset.

Country experience:

→ The criteria, assessment action and Inventory columns to check follow the structure of the Excel Inventory from left to right.

a) RELEVANCE of the datasets for the national ocean accounting priorities

Assess whether the spatial resolution and coverage of the available datasets is suitable.

Inventory columns to check:

- **'Spatial resolution'** refers to the spatial resolution of the available data.
- **'Geographic constraints'** refers to whether the available data has any geographic constraints with regards to global coverage.

Things to consider:

- ○ What spatial resolution is needed? This will depend on the question that the accounts are meant to address. It is advisable to consider spatial resolution together with other criteria as the data options with the highest resolution might not necessarily be the best suited for the national context and data with high resolution may come with trade-offs and computational challenges. As the experience from Vietnam's pilot seagrass extent accounts (Box 3) shows, there may be country-specific reasons for selecting datasets with lower resolution.
- ○ Some datasets that are described as 'global' may not provide full or equal global coverage. Certain areas may not be covered, and/or that the quality of the data may vary between different geographic areas (e.g. data quality may be poor for specific locations). Where geographic constraints exist, check if these apply to your accounting area. The example from Fiji (Box 2) and experiences from Canada (Box 4) illustrate the importance of cross-referencing global data with national data to critically evaluate its fitness for purpose for national ocean asset accounting.

- Where data does not provide the necessary spatial resolution or coverage, are there suitable techniques to downscale or extrapolate that could be employed with the available resources?
- Are the geographical coverage and spatial resolution consistent with other interesting existing (national) data? This will open-up opportunities for further, integrated analysis.

Box 3. Global ocean data enabled the development of pilot ecosystem accounts for mangroves, seagrasses and coral reefs in the Quảng Ninh region of Vietnam

In 2019, Vietnam developed its first pilot ecosystem extent accounts for mangroves, seagrasses and coral reefs, as well as condition accounts for water quality. A national inventory on mangroves and their extent was available to support the pilot mangrove extent accounts. However, Vietnam did not have spatially explicit data on the location and extent of seagrasses and corals. To fill this gap in the national data inventories, the pilot study team supplemented the available national information with spatial data from global datasets for seagrasses and corals. The Global Distribution of Seagrasses and Global Distribution of Coral Reefs datasets, provided by UNEP-WCMC on the Ocean Data Viewer[31], were used to calculate the proportion of seagrass and coral for each marine basic spatial unit in the Quảng Ninh pilot accounting area. This enabled the initial development of a more comprehensive set of pilot ocean ecosystem extent accounts in Vietnam.

Vietnam updated its initial ocean ecosystem accounts in 2021 with a second pilot study for the Quảng Ninh region. This time, satellite imagery data from Landsat 8 was trialled for the seagrass ecosystem accounts. For the coral ecosystem accounts, the study team used the Allen Coral Atlas provided by the Allen Coral Atlas Partnership and Arizona State University. It is also proposed to use this satellite imagery to compile an ecosystem condition accounts for mangroves, using the satellite data to derive condition variables such as canopy cover or fragmentation.

Box 4. Global data supported pilot ocean ecosystem accounts in Canada

Data hosted on UNEP-WCMC's Ocean Data Viewer[32] were used to help map several ocean ecosystems in Canada's pilot ocean account as they provided a quick and reliable way to access data across Canada's exclusive economic zone (EEZ). As the pilot project had limited resources, using a dataset that had already compiled the data from multiple jurisdictions reduced the workload. The global datasets provided a good foundational layer. Canadian data were used for assessment purposes and to supplement the global data where applicable.

The global modelled kelp dataset, created by the University of Auckland and hosted by UNEP-WCMC, was not used. This dataset misses areas in Canadian waters where kelp has been mapped, and also mapped too large an area of potential kelp in more southern waters on the Atlantic and Pacific coasts. Good, mapped kelp data exist for the Pacific coast of Canada, which were preferred to the modelled area.

Assess if the temporal resolution and likelihood of future production of the datasets is suitable.

Inventory columns to check:

- **'Time series availability'** refers to whether data observations are available for different periods or points in time (e.g. for different years, decades, five-year periods). The time series may be available in one dataset (see e.g. GMCSD-2 Global Mangrove Carbon, 2000-2012) or in multiple, comparable editions of the same data product (see e.g. Global Ocean Gridded

[31] Ocean Data Viewer: https://data.unep-wcmc.org/

[32] Ocean Data Viewer: https://data.unep-wcmc.org/

L4 Sea Surface Height and Derived Variables; University of Hamburg-Sea level SSH from C3S)[33].

- **'First observation'** refers to the first year in the time series for which data observations are available (where time series exist).
- **'Latest observation'** refers to the latest year in the time series for which data observations are available (where time series exist), or to the year that the data are intended to represent (where time series do not exist).
- **'Publication date of latest observation'** refers to the year in which the dataset was published or released.
- **'Likelihood of future production'** refers to the likelihood that further editions of the dataset will be produced in the future. This has been assessed based on available indicative information and should not be taken as a guarantee of future production.

Things to consider:

- o Are time series available? If yes, do they align with your accounting periods of interest?
- o Can the datasets be used in combination, or in combination with national data, to cover the accounting period of interest?
- o Can data be extrapolated to the accounting period?
- o Is there flexibility to adapt the accounting period to available data to enable initial account development?
- o Accounts are intended to be updated regularly. The likelihood of a dataset being updated or produced in the future will determine whether it can be used consistently for account production moving forward or whether it will have to be replaced by other data.
- o Where future production or updates are unlikely, e.g. where a dataset is a 'one off' product or a time series is not likely to be continued, a dataset can still be useful to start with the initial development and testing of pilot accounts or to create a baseline. For example, 'one off' global maps of seagrasses and corals were used as a starting point for developing Vietnam's first pilot ocean ecosystem accounts for Quảng Ninh (Box 5). It may also be possible to use this data for creating time series, for example in the context of training remote sensing observations for local/national ocean asset identification or integrating this baseline data with other time-series data (e.g., spatial data on designated use, Box 5).
- o It is not always clear whether a dataset is likely to be produced or updated in the future. Different factors may give an indication whether future production is likely or not. For example, where time series data are available across multiple editions of the same data product, this may be an indication that the time series will be continued in the future through production of further editions. Metadata on the INSTITUTIONAL ENVIRONMENT of the dataset may provide further indications for the likelihood of future production (e.g. see **'Data custodian'** and **'Global policy relevance'**).
- o The publication date of the latest observation shows how soon after the production of the data it is made available. This is an indicator of the timeliness of the data that should be considered in the context of future production of the accounts. For example, where there is a substantial gap (e.g., several years) this may imply that the availability of this data may

[33] Terminology explained: **Observations** refer to data in the dataset for individual points/periods in time. **Dataset** refers to the specific data described in the row. Where multiple distinct editions or versions of comparable datasets are available, this should be the latest version. **Data product** refers to a specific type of data, for which multiple comparable editions/versions are available.

be a constraint for the timeliness of future accounts production. This could limit their ability to influence decision-making cycles.

Box 5. Vietnam used the Global Distribution of Seagrasses and Global Distribution of Corals datasets to develop their first ocean ecosystem accounts.

As part of the Quảng Ninh pilot study in 2019, Vietnam used the Global Distribution of Seagrasses and Global Distribution of Corals datasets provided on UNEP-WCMC's Ocean Data Viewer for the development of seagrass and coral ecosystem accounts. These global seagrass and coral distribution maps are based on point and line data, providing information about the location of seagrasses and corals. However, they do not give information about the boundaries or extent of the ecosystems, which limits their application in the development of extent accounts.

To calculate the extent of seagrass and corals in the Quảng Ninh accounting area, the pilot study team combined the global datasets with available information from national reports. This included information about the location and area by hectare of these ecosystems. For each location, a small, conservative buffer was created to determine the ecosystem asset area. This was then overlayed with management areas to determine the relative proportion of ecosystem for each marine unit.

b) INTERPRETABILITY of the datasets and processing steps required

Assess if the format of the data is suitable.

Inventory columns to check:

- **'Data format'** refers to the type of the data. This may be vector data (point, polyline, polygon), raster data or data in tabular format. Where spatially explicit ocean ecosystem asset accounts are being developed, these will require suitable georeferenced data formats, such as raster or vector data, or means of creating these formats.
- **'File format'** refers to the format in which the dataset is available. Data may be available as Shapefile, TIFF, GeoTIFF, KML, File Geodatabase, ASCII grid, CSV, XLSX, Web Map Service, Web Feature Service, netCDF, GRD98, mpk, or other formats.

Things to consider:

- Point or polyline data provide information about the location of an ecosystem, but not about ecosystem boundaries or extent. They are therefore less suitable for developing ecosystem extent accounts. However, it might be possible to estimate the extent of ecosystems based on point or polyline data by combining them with other data types (e.g. location of ecosystems, non-spatially explicit data on area by hectare or km^2). For example, this was done for Vietnam's first pilot seagrass and coral accounts (Box5). Consider also whether the data can be extrapolated to make estimations for a larger area.
- Is the dataset in a file format that can be used with the available the computational resources and technical expertise?
- Many ocean accounts are developed using Geographical Information System (GIS) techniques and the data formats described above. Further details on the technical terms and features of these data are available via online resources such as the QGIS training materials: https://docs.qgis.org/3.16/en/docs/gentle_gis_introduction/index.html

Assess the wider interpretability of the data, including its underlying assumptions, limitations and possible sources of error.

Inventory columns to check:

- **'Acquisition method'** refers to how the dataset was produced. The Inventory presents information on whether the dataset provides raw or processed data, and whether the data were generated using in-situ collection, remote sensing or modelling.
- **'Metadata availability'** refers to the availability of information that enables the correct interpretation and use of the dataset. **The metadata will provide important information** to determine suitability of a dataset for a specific national context and what limitations and possible sources of error might need to be considered when using it.
- **'Supporting documentation'** refers to the availability of user guides, manuals or similar documents that enable use of the dataset.

Things to consider:

- Are there any caveats for aggregated products that were produced by combining different datasets? For example, do they include data that may be outdated?
- Are any sources of error described that should be factored in when using the data? Have other users shared any information on use constraints?
- For raster or polygon data, consider whether there were any assumptions in how the data were assigned spatially that might result in errors, such as an under- or overestimation of ecosystem extent. For example, the HELCOM seagrass dataset was composed of presence/absence XY points provided by several partner countries, which were re-sampled to a coarser grid (5 km^2). By rasterising point data in this manner, and without thorough metadata, seagrass extent was 5 to 8 times higher than the estimate from literature values. To correct this overestimation, the extent was limited using factors such as depth and seabed type, using known parameters for seagrass distribution. (see **'Data format'**)
- What are the assumptions, criteria, parameters used in the production of the dataset?
  - Does the dataset account for ecosystem fragmentation?
  - Is extent based on actual observations or modelled based on assumptions of presence/absence?
- For remote sensing and modelled data:
  - Was the model used to process satellite data or predict ecosystem extent trained in the accounting area or in an area with comparable conditions? The experience from Vietnam's second pilot study on seagrass ecosystem accounts shows that satellite data calibrated for different conditions may still be useful for calculating ecosystem extent in the absence of better data. However, in some cases, this may lead to an overestimation (see Box 6) or underestimation of extent.
  - How well has the data been ground truthed? How many data points were used for the validation? Ideally, multiple data points that adequately cover the different locations and environmental conditions of the accounting area should have been used.
  - Where has the data been ground truthed? Has it been tested in locations with similar conditions to those in the accounting area? If not, this might have

implications for the validity and accuracy of the data for the specific country context. It may require additional work to validate the data for the accounting area.

Country experience:

How global datasets are ground truthed can have serious implications for data quality. Many areas of Canada experience a wide range of temperatures and significant amounts of snow and ice. Global datasets on biomass or land cover that have only been ground truthed in areas with less seasonal variation, (particularly if only positive temperatures are experienced) can significantly misrepresent Canadian regions. This is particularly true for the far North. Global datasets that have been ground truthed in a wide variety of locations and climates are more likely to be accurate across the globe.

- Is additional work needed and is sufficient technical and computational capacity available to process the data to make it consistent and applicable to the accounting area?
- In what state are data needed? 1) Raw data can be processed using local algorithms and models for interpretation targeted to the national context. 2) Pre-processed, analysis-ready data for streamlined account production but might have limited scope for localised interpretation. This choice may depend on the priority for the national ocean account development (e.g. rapid initial account development or targeted, precise accounts), and/or on the resources, technical and computational capacity available. For example, satellite imagery data for which local classification algorithms specific to the area of interest can be developed. This may be better for national or local applications; however, this requires more technical expertise and resources than using pre-processed data.

Country experience:

In Indonesia, the national geospatial agency highlighted that they refer to global satellite data as their initial source of data. The satellite data is then validated further using ground truthing and/or primary data from other research agencies. This process allows the interpretation of the global satellite data to be tailored to the national context. Testing the use of this satellite data at the pilot scale allowed an assessment of the potential to extend its use for compiling ecosystem asset accounts at the national scale (envisaged in 2022).

- Different satellite imagery may be best for different regions of the world, as illustrated by the experience from Vietnam's second pilot study for seagrass ecosystem accounts (Box 6). This should also be critically evaluated.

Box 6. In their second pilot study for seagrass ecosystem accounts, Vietnam trialled the use of satellite data to estimate ecosystem extent.

In their 2021 ocean accounts pilot study for Quảng Ninh, Vietnam used satellite imagery data to develop seagrass extent accounts. Landsat 8 provided the best imagery for the study and was consistent with studies from other regions that used parameters based on Landsat 8 imagery. To calibrate the Landsat data to identify seagrass, a baseline of known seagrass extent areas was required. From this an algorithm was developed and trained for seagrass identification. This worked well for identifying seagrass in clear water areas. However, for Vietnam Landsat 8 is calibrated using the water profile of a central region where the water is clearer than in Quảng Ninh, where turbidity is higher. As a result, the area of seagrass calculated based on the satellite data was an overestimation of extent. Nonetheless, the approach also allowed for 'potential' areas of seagrass to be identified, which could be verified via in-situ assessment.

In the absence of a comprehensive set of local spatial data for seagrass, the satellite data enabled the pilot study team to identify and map areas of potential seagrass in the accounting area. In the future, to enable better estimations from satellite data, local ground truthing would be needed to calibrate the satellite data, especially in areas of higher turbidity.

c) INSTITUTIONAL ENVIRONMENT for the datasets production

Assess if the institutional environment surrounding the data production is suitable for how the accounts will be used.

Inventory columns to check:

- **'Data custodian'** refers to the organisation or institution that looks after and provides the dataset. Data custodians may be national government agencies or institutions (e.g. NOAA), UN agencies or programmes (e.g. UNEP), expert organisations (e.g. UNEP-WCMC), universities, research facilities (e.g. Woods Hole Oceanographic Institution), non-governmental organisations (e.g. The Nature Conservancy), or data service providers for specific sectors (e.g. Axiom EMI).
- **'Global policy relevance'** refers to whether the dataset is produced, formally listed, recognised or proposed for an official global policy process such as the Sustainable Development Goals or the post-2020 global biodiversity framework.
- **'Authoritativeness'** refers to whether the data producer can be considered to be objective, independent, professional and mandated to collect and provide data. The criterion provides information on whether the dataset has been produced on the basis of scientific/expert peer-review, by a UN agency or programme (e.g. FAO statistics), or by a national government agency (e.g. NOAA).

Things to consider:

- Information about the institutional environment can be helpful when deciding whether a dataset can be used with confidence or whether additional work is required to validate the data. Consider:
  - Does the data custodian have an official mandate to collect and provide data?

    For example, is the dataset produced by a national government agency or as part of official UN statistics? Is the dataset linked to an official global policy process?
  - Is the data producer considered to be objective and independent?

    For example, is the dataset produced by a recognised expert organisation or research institution?
  - Can it be assumed that the dataset has been produced following robust scientific methods and internationally agreed standards?

    For example, has the dataset been through scientific or expert peer review? Has it been produced as part of official statistics? Has it been produced, formally listed, recognised or proposed to provide indicators for targets under multilateral environmental agreements and associated policy processes (e.g. the Sustainable Development Goals or the post-2020 global biodiversity framework)?
- If a dataset is linked to an official global policy process, this may give further indication of the likelihood of future production and application of internationally agreed standards.

- If a dataset is produced by an organisation with a mandate and funding for regular data production this will also provide confidence of future production. One example for this would be the National Aeronautics and Space Administration (NASA).

d) ACCURACY of the datasets

Assess if the accuracy and reliability of the data are suitable for how the accounts will be used.

Inventory columns to check:

- **'Quality assurance'** refers to whether documentation on quality assurance and validation is available for the dataset.
- **'Errata and known issues'** refers to whether information about corrected errors and/or known issues is available for the dataset. Where information is available, these issues may be highlighted in in 'Errata' documentation, providing short descriptions on the nature of the issue.

Things to consider: The Inventory identifies whether information and documentation about quality assurance, known errors and issues is made available by the data provider. However, the Inventory does not provide details about quality assurance, validation and ground truthing, sources of error or known issues as the relevance of these will depend on the national context and priorities for ocean account development.

- Where information about quality assurance and/or errors and issues is available, this provides confidence that accuracy, reliability, validity and consistency have been considered, and data quality standards applied, in the data production.

  Country experience:

  Indonesia's ocean accounts pilot study used satellite data for tropical ecosystem extent (coral reefs, seagrass, mangroves) and condition parameters (sea surface temperature, chlorophyll). One important selection criterion for using MODIS[34] and Landsat data was the resolution and data quality assurance integrated into the production of the satellite data by NASA and the United States Geological Survey.

- Where available, the information about quality assurance and/or errors and issues should be reviewed before using a dataset to check whether:
  - The applied data quality standards conform with any relevant national data quality standards.
  - Existing validation and ground truthing of the data are relevant for the national context.
  - Any known issues of the global data and their quality that affect their use in the accounting area of the national ocean accounts.
  - Additional work is needed to ensure and/or increase the accuracy and reliability for the national context (e.g. ground truthing for the accounting area).
- Where information about quality assurance and/or errors is NOT available, this does not necessarily mean that the data is inaccurate, unreliable, inconsistent or not valid. However,

[34] MODIS stands for Moderate Resolution Imaging Spectroradiometer.

caution should be applied when using the data. Additional work may be required to do quality assurance checks and validation before the data can be used with confidence. The available metadata, including information about the acquisition method, should be reviewed carefully to identify any relevant methodological assumptions, criteria, parameters or sources of error that might be described there.

e) ACCESSIBILITY of the datasets

Assess if the data are easy to access and use.

Inventory columns to check:

- **'Availability online'** refers to whether the dataset is easily accessible online and downloadable (in one or multiple open access formats), or whether the data provider must be contacted for access and/or permission.

Things to consider:

- Is the data easy to access and download online? Are instructions provided?
- Do you have the right software and know how to access and use the data in the available formats? (see **'File format'** under INTERPRETABILITY)
- Where the data is not available to download, are clear instructions given for how it can be accessed? Is an email address provided? Is there an online request form?
- In some cases, the link to access the data is at the bottom of the page or on a separate page. The link in the Inventory should guide you directly, or as close as possible to the place on the website where the data can be downloaded.

Assess if the data are available for free and can be used for national ocean accounts without restrictions.

Inventory columns to check:

- **'Terms of use'** refers to the terms of use for the data. This includes information on a) whether the data is available for free or requires payment, and b) whether there are any restrictions or requirements for the use of the data (e.g. attributions required; permission required; no derivate products; non-commercial use only; etc.).

Things to consider:

- Most of the datasets in the Inventory are available for free and with minimal use restrictions (usually requiring attribution).
- In some cases, use may be restricted. Restrictions are often related to commercial use, which should not affect the use of the data for national ocean account development. For example, data from the World Database on Protected Areas is freely available for non-commercial use, whereas commercial users must pay a fee via the IBAT[35] Alliance.
- The Inventory currently includes one dataset that is available at a cost: Axiom EMI Oil & Gas and Renewables Data (Global): Offshore Wind Database (Renewables). Fees are more

[35] IBAT stands for Integrated Biodiversity Assessment Tool. https://www.ibat-alliance.org/

likely to apply for datasets related to specific industries/sectors that are provided by commercial data service providers. In some cases it may be worth considering the use of paid data services, where they exist, to fill specific data gaps.

5 Conclusions on global ocean asset data for ocean accounts

5.1 Opportunities and limitations

Data availability is a key challenge for ocean account development. This is a common finding shared by most GOAP pilot studies and other ocean accounting efforts from different regions of the world. Many countries face challenges where national data of suitable quality is not available. Limited available resources for research and monitoring often mean that gaps in national data cannot be closed in the short term through national data generation. Global data on ocean assets can be used to fill some of these gaps in order to enable the initial development and pilot testing of national ocean asset accounts. These pilot accounts, in turn, can help to make the case for investments in improved national data availability where it is needed most.

The consistent methodologies and standards often characterising global ocean datasets may offer potential advantages for use in ocean accounts as they provide:

- Consistency over large spatial scales,
- Consistency over time, and
- International comparability.

In turn, global ocean datasets currently still have weaknesses that limit their suitability for ocean accounts and/or need to be carefully considered when using these data. Key limitations include:

- Lack of time series, in particular for ecosystem extent data,
- Condition data are largely limited to oceanographic parameters as proxies for ecosystem condition,
- Global data often have low spatial resolution, and
- Errors and uncertainties may arise from the production of global datasets based on the assumptions and models they apply and how they combine different data.

It is important to highlight that global data should not be considered as the starting point for national (or subnational) ocean accounting. The priority should be to identify suitable national data first before consulting global data sources. However, as the country experiences from Vietnam, Indonesia, Fiji and Canada show, in the absence of suitable national data, global ocean asset data can support the development of initial ocean asset accounts.

The Global Ocean Asset Data Inventory and this Guide provide practical advice for the identification and selection of global ocean asset data for national ocean accounts. Advising on the best global data to use is difficult as this will be dependent on the national context, including ocean accounting priorities and available resources. For example, not all global datasets provide full and/or equal geographical coverage, and different satellite imagery may be best for different regions of the world. Data may require different levels of additional processing (e.g. point or polyline data need to be combined with other data types to calculate ecosystem extent) or computational capacity and technical expertise for use in accounting (e.g. raw data that can be processed using local algorithms for targeted interpretation, or pre-processed, analysis-ready data that allow streamlined account production).

The stepwise approach to using the Inventory guides national ocean accounts compilers through key considerations that will help them make informed decisions on the use of global ocean datasets that are varied in quality, accessibility and purpose. The Inventory is purposefully structured to support the consideration of criteria that are central to many data quality assurance processes implemented by national statistical offices: relevance, interpretability, institutional environment, accuracy and accessibility.

5.2 Gaps and future considerations

The updated Inventory presents 87 datasets for seven distinct account components and 59 different ocean asset types or conditions. While this represents a considerable volume of diverse data, the process of updating the Inventory also revealed a number of gaps in available global ocean data. Only a small number of marine and coastal ecosystems are represented in global datasets. For individual ocean environmental assets, produced assets and designated use, only a very limited number of spatial datasets were found. Another key gap remains the limited availability of time series data for marine and coastal ecosystems. Currently, only changes in extent of mangroves can be tracked using global data.

These gaps indicate areas where improving the availability of global ocean data would further support the development of ocean accounts. This may include efforts to use satellite data to track change in seagrasses and coral reefs.

The country experiences described here focused mainly on ecosystem extent. As countries move forward with their ocean account development, data for ecosystem service supply and use, as well as better data for ecosystem condition, will likely also be needed. Fiji and Vietnam have already started on this, working on estimating ecosystem service supply and tracking condition of mangroves.

One key point that came up across the consulted countries, is the importance of adequate ground truthing of global remote sensing and modelling data. While the experience from Vietnam shows that satellite data can provide an estimate of ecosystem extent, and identify new areas of seagrass, even if not perfectly calibrated, this did result in an overestimation of seagrass extent. For a country like Canada with a wide range of temperatures and a large ocean environment, datasets that have only been validated in areas with less seasonal variation or temperature extremes can lead to significant misrepresentations. To increase accuracy across their global coverage, it is therefore important to ground truth global datasets in a wide variety of locations and climates.

The United Nations Decade of Ocean Science for Sustainable Development (2021-2030) aims to drive the creation of a strong scientific knowledge foundation for improved management and sustainable development of the ocean, supporting delivery of the Sustainable Development Goals. Ocean accounts can play and important part in supporting science-based decision making for the ocean. The push to improve the global ocean knowledge base through the Decade is an opportunity to improve the availability and accessibility of global ocean data that can enable ocean account development.

Besides increasing the availability of ocean data, a key priority over the next decade for data producers and providers will be to work towards global ocean data that are FAIR – Findable, Accessible, Interoperable and Reusable[36] – for human users and for computers. As the data search for the updated Inventory suggests, there is still room for improvement on the findability and accessibility of global ocean data, in particular for individual environmental assets, produced assets and designated use. For the development of ocean accounts under the SEEA framework, data interoperability is particularly important, as these accounts require the integration of a large diversity of data. To support this, in 2021, the United Nations Statistics Division, UNEP and the ARIES team have released an *'Interoperability strategy for the next generation of SEEA accounts'*[37]. The strategy outlines proposed roles and responsibilities of data providers, modellers and data holding institutions in delivering interoperability for SEEA, as well as four steps for achieving the objectives set out by the strategy.

[36] Wilkinson, M., Dumontier, M., Aalbersberg, I. *et al.* 2016. The FAIR Guiding Principles for scientific data management and stewardship. *Sci Data* 3, 160018. https://doi.org/10.1038/sdata.2016.18

[37] 2021 Interoperability strategy for the next generation of SEEA accounts': https://seea.un.org/sites/seea.un.org/files/seea_interoperability_strategy.pdf

Annex I: Improvements and updates to the Inventory – Methodology report

This Annex describes the process and methodology applied to improve the structure and user functionality of the existing Global Ocean Data Inventory, including an overview of the datasets covered by the updated Inventory.

I.1 Consultation on user needs

To ensure the user relevance of the updated Inventory, the restructuring was guided by a consultation on user needs. Six bilateral consultation meetings were held with different GOAP members and countries working on ocean accounts. The consultation encompassed GOAP pilot studies and other ocean accounting efforts from different regions of the world and at various stages of implementation. Meetings were held with contacts in Viet Nam, Indonesia, Fiji, Canada, United Kingdom, and at the Centre for Sustainable Oceans at the Cape Peninsula University of Technology (who provided input from three GOAP ocean accounts pilots in South Africa, Mozambique and Kenya).

The consultation highlighted a number of key criteria and information that are important or useful to countries when considering datasets for ocean accounts. These include:

- Spatial resolution of the data.
- Temporal resolution of the data, including availability of long-term time series, reference periods, timeliness of data provision and frequency of updates.
- Data accuracy and limitations, including errors, ground truthing and assumptions made in data production.
- Clear metadata to enable interpretability of the data, including production methodology and data standards.
- Access to raw data and to easy to use, accounting-ready data.
- Easy access and use, including information on how to get to the data, whether datasets are available in open access formats, downloadability, use restrictions and costs.
- Case study experiences from application of the data.

Suggestions were also made on account components and asset types that would be useful to cover in the Inventory. Following discussions with countries, carbon accounts and produced assets were added to the scope of the Inventory. Information was also added to distinguish between coastal and marine ecosystems.

During the consultation discussions, questions were raised on reference levels for good ecosystem condition, links of ecosystem condition to ecosystem function and services, as well as the suitability of global ocean asset datasets for modelling. While beyond the scope of the current Inventory update and user Guide, these questions provide relevant pointers for future work to support ocean accounts.

Following the consultation meetings, the Inventory structure was updated, and a draft was shared with the contacts for feedback. Comments received were integrated into the final restructuring.

I.2 Updating the Inventory structure

The aim of updating the structure of the Inventory was to improve its useability and relevance. To achieve this, the information in the original version was reorganised and new columns were added to capture more details about the datasets. Ensuring that the identified user needs are addressed was a key consideration when determining the information to be included. The Inventory is structured around a) key data needs for physical asset accounts and b) generally established data quality assessment criteria for national statistics. The updated structure is intended to provide national ocean account compilers with information that enables them to rapidly assess the relevance, utility, strengths and weaknesses of each dataset for their particular national context.

To select the criteria for the updated Inventory structure, different existing data quality assessment frameworks were also reviewed. The review included the data inventory for the Geographe Marine Park ocean accounting pilot in Australia[38], Statistics Canada's data quality took kit[39], the Taskforce on Nature-related Financial Disclosures, the Biodiversity Indicators Partnership[40] and ENCORE[41]. From these frameworks, the most commonly used criteria were selected as the basis for the Inventory. The selection of commonly used criteria should ensure that the criteria used for the Inventory are widely agreed and that the Inventory aligns with other data assessment frameworks and accounting data standards. The selected criteria are:

1. **Relevance:** Is the dataset relevant for different national ocean asset accounting requirements?
2. **Interpretability:** Is information available to enable correct interpretation of the dataset?
3. **Institutional environment:** Is the production and provision of the dataset impartial, objective and authoritative?
4. **Accuracy:** Is the dataset reliable, valid and consistent?
5. **Accessibility:** Is the dataset easy to access and use? Are there any use restrictions?

Each of the five high-level criteria is broken down into a set of sub-criteria. Key data requirements for ocean asset accounts and identified user needs are integrated into these sub-criteria, including spatial resolution, temporal resolution and timeliness, and data format. The information provided should enable the user to decide whether a dataset is of suitable quality for their specific context.

To improve the useability of the Inventory, more functionality was also added to the Inventory. The updated Inventory is available in Excel, which allows to filter for specific datasets. A 'How to use' tab provides instructions for using the two interactive filter menus that allow to pre-select the datasets shown in the 'Inventory' tab. Standardised entries and dropdown lists were applied as much as possible to improve the searchability of the Inventory. An Appendix tab provides explanations of the information provided in the different columns.

I.3 Updates to the Inventory datasets

The initial, 2019 version of the OCEAN ACCOUNTS Global Ocean Data Inventory listed 138 entries covering datasets, portals and other resources relevant to ocean ecosystem extent, ecosystem condition, designated use, assets, service supply, service use, as well as ecosystem typologies. By identifying and describing a broad range of global datasets relevant to ocean accounts, the original inventory provided a valuable resource for early national ocean pilot accounts.

The updated Inventory is focused on datasets for ocean assets following the typology described in Chapter 2.2 of the Guide and puts a greater emphasis on providing metadata for datasets. Ecosystem service supply and use, as well as ecosystem typologies are not included in this version. Data portals and repositories identified during the search for global ocean asset datasets and are listed in a separate tab in the Inventory (see 'Portals, Repositories' tab).

The updated Inventory provides 172 resources in total. Eleven duplicates from the previous inventory were removed, and "non-specific classifications" that did not link to any ocean account component

[38] https://eea.environment.gov.au/sites/default/files/2020-12/data_inventory-gmp_ocean_accounts.pdf
[39] https://www.statcan.gc.ca/en/data-quality-toolkit
[40] https://www.bipindicators.net/resources/governance-documents/bip-organisational-structure-and-operational-principles
[41] ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure). https://encore.naturalcapital.finance/en

were replaced or removed. Approximately 40 new resources were added, and metadata entries were standardized and updated for easier usability.

The new Inventory presents 88 datasets for seven distinct account components, and 84 data portals and repositories. The 88 datasets cover 59 different ocean asset types or conditions. Table 3 gives an overview of the number of datasets per account component and ocean asset.

Table 3 (repeated): Overview of the number of datasets in the updated Global Ocean Asset Data Inventory by account component and ocean asset (type/condition)

Account component	Ocean asset (type/condition)	Number of datasets
Ecosystem extent	10	14
Ecosystem condition	32	49
Individual environmental asset	2	2
Carbon	5	8
Produced asset	2	2
Pressures	7	10
Designated use	1	3
Total	**59**	**88**

The largest number of global datasets are available for ecosystem condition and extent. These datasets represent a variety of different ecosystems, including seagrasses, mangroves, warm-water coral reefs, cold-water corals, saltmarshes and tidal flats. Some ecosystems missing from the Inventory, for which no global datasets could be found, are beaches, coastal dunes, seaweed and deep-sea habitats. All ocean asset types and conditions covered in the Inventory are listed in Table 5.

For other account components, including individual environmental assets, produced assets and designated use, only 2-3 datasets were identified during the current update. It may be that further data exists that was not found with the resources available for this update. It may also be that these gaps in the Inventory point to gaps in availability of global data of relevance to ocean asset accounts. For example, for designated use, the Inventory includes spatial data for marine protected areas, whereas other uses such as shipping lanes, fishing zones, or deep-sea mining zones are not covered. For individual environmental assets, only petroleum and plankton data were identified, while no data was found on other minerals or energy resources, coastal timer resources, or aquatic resources. For produced assets, only wind farms and oil and gas platforms were included; data on wrecks, cables, urban development or artificial reefs were not found.

Table 5: Ocean asset types and conditions per account component listed in the Global Ocean Asset Data Inventory

Account component	Ocean asset (type/condition)
Ecosystem extent	Bathymetry
	Warm-water coral reefs
	Cold-water corals
	Islands
	Mangroves
	Saltmarsh
	Seafloor geomorphic features
	Seagrass
	Shoreline

Account component	Ocean asset (type/condition)
	Tidal flats
Ecosystem condition	Acidity
	Carbon
	Current
	Downward heat flux at surface
	Marine Microplastics
	Ocean Colour
	Ocean Conductivity
	Ocean Density
	Ocean Heat Content
	Ocean Heat Content Anomaly
	Ocean Mixed Layer Depth
	Ocean Nutrients
	Ocean Oxygen
	Ocean Salinity
	Ocean Salt Content Anomaly
	Ocean Temperature
	pCO2 (fCO2) autonomous
	pH
	Potential Temperature
	Primary Productivity
	Revelle Factor
	Salinity
	Salt Flux
	Sea level
	Sea Level Anomaly
	Sea Subsurface Salinity
	Sea Subsurface Temperature
	Sea Surface Height
	Sea Surface Height Relative to Geoid
	Sea Surface Temperature
	Threatened species
	Warm-water corals; Sea Surface Temperature
Individual environmental asset	Petroleum
	Plankton
Carbon	Carbon budget
	Carbon sink
	Carbon storage rates
	Mangrove carbon stocks
	Ocean-air carbon dioxide
Produced asset	Oil and gas platforms
	Wind farms
Pressures	Atmospheric deposition (nitrogen)
	Atmospheric deposition (sea salt)
	Atmospheric deposition (sulphur)
	Cumulative human impacts

Account component	Ocean asset (type/condition)
	Intensity of use (fishing effort)
	Intensity of use (shipping effort)
	Water emissions (Human wastewater)
Designated use	Marine Protected Areas

Annex II: Physical ocean asset account tables

To enable integration of ecosystem and individual environmental assets into one set of ocean asset accounts, the GOAP Technical Guidance combines both types of assets in three physical asset accounts tables: physical asset extent accounts (Table 6), physical asset condition accounts (using biophysical variables) (Table 7) and summary asset condition accounts (using condition indicators) (Table 8). These are the accounts tables that the Global Ocean Asset Data Inventory and Guide aim to inform.

Table 6: Physical asset extent account. (Example table, could be expanded to include several different ecosystem assets and individual environmental assets.)

	Ecosystem assets			**Individual environmental assets**	
	Mangroves	Seagrass	Coral reef	Minerals	Fish stocks
Opening stock					
+ Additions to stock					
Managed expansion					
Natural expansion					
Reclassifications					
Discoveries					
Reappraisals (+)					
TOTAL additions to stock					
– Reductions in stock					
Managed regression					
Natural regression					
Reclassifications					
Extractions/harvesting					
Reappraisals (-)					
TOTAL reductions in stock					
= Closing stock					
Measurement Units	*Area*	*Area*	*Area*	*Weight, litres*	*Weight, number*

Notes: Darkly shaded areas represent undefined measures for ecosystem assets (extractions/harvesting) and expansion of minerals stocks. Terminology still requires harmonization between SEEA CF and SEEA EA. For example, extraction/harvesting refers to individual environmental assets in the SEEA CF. Ecosystem assets are treated in the SEEA EA like land cover types, which are added to and reduced by area through managed/natural expansion/regression.

Table 7: Physical asset condition account by marine basic spatial unit (MBSU) for each depth layer at end of accounting period. (Example table, could be expanded to include several different ecosystem assets and individual environmental assets, as well as different condition variables.)

	Variable Examples	**Ecosystem assets**			**Individual environmental assets**	
		Mangroves	Seagrass	Coral reef	Minerals	Fish stocks
Area	ha					
Acidification	pH					
Eutrophication	BOD, COD, Chlorophyll-A					
Temperature	℃					
Plastics	g/m³					
Quality	Appropriate measure					
Accessibility	km from population centre					
Biodiversity	Shannon Index					
Health	Index					
Repeated for end of accounting period						
Repeated for change in condition						

Notes: This physical asset table can be combined with other tables that record information for each spatial unit in the accounting framework, for example governance account tables (see GOAP Technical Guidance section 2.7.2, Table 16).

Table 8: Summary asset condition account by ecosystem type and individual environmental asset type at end of accounting period. (Example table, could be expanded to include several different ecosystem assets and individual environmental assets, as well as different condition indicators.)

indexed with respect to reference condition	**Indicator Examples**	**Reference level**	**Ecosystem assets**			**Individual environmental assets**	
			Mangroves	Seagrass	Coral reef	Minerals	Fish stocks
Area	ha						
Acidification	pH						
Eutrophication	BOD, COD, Chlorophyll-A						
Temperature	℃						
Plastics	g/m³						
Quality	Appropriate measure						
Accessibility	km from population centre						
Biodiversity	Shannon Index						
Health	Index						
Repeated for end of accounting period							
Repeated for change in condition							

Annex III: 'Check list' for selecting global ocean asset data

The 'check list' template provided in Table 9 is aligned with the stepwise approach to using the Global Ocean Asset Data Inventory described in Chapter 4 of the Guide. The 'check list' can be used to record any considerations on the data quality criteria in the Inventory in a structured way.

Table 9: Check list for selecting global ocean asset data from the Global Ocean Asset Data Inventory

Step 1: Identify available datasets	
Data for which 'Account component'	
Data for which 'Ocean asset (type/condition)'	
Step 2: Check available datasets against the quality assessment criteria	
Data quality assessment action	**Documentation of considerations**
RELEVANCE	
Assess whether the spatial resolution and coverage of the available datasets is suitable.	
Assess if the temporal resolution and likelihood of future production of the datasets is suitable.	
INTERPRETABILITY	
Assess if the format of the data is suitable.	
Assess the wider interpretability of the data, including its underlying assumptions, limitations and possible sources of error.	
INSTITUTIONAL ENVIRONMENT	
Assess if the institutional environment surrounding the data production is suitable for how the accounts will be used.	
ACCURACY	
Assess if the accuracy and reliability of the data are suitable for how the accounts will be used.	
ACCESSIBILITY	
Assess if the data are easy to access and use.	
Assess if the data are available for free and can be used for national ocean accounts without restrictions.	