Ecosystems & Oceans

System of
Environmental
Economic
Accounting

Overview

1. SEEA: A reminder

2. Ecosystems
   - Basic concepts
     - Ecosystems as "Assets"
     - Ecosystem Services Cascade
     - Accounting Principles
     - Ecosystem Accounting is Spatial
   - Accounts & Tools

3. Oceans
   - Why are they important?
   - Why are they different?
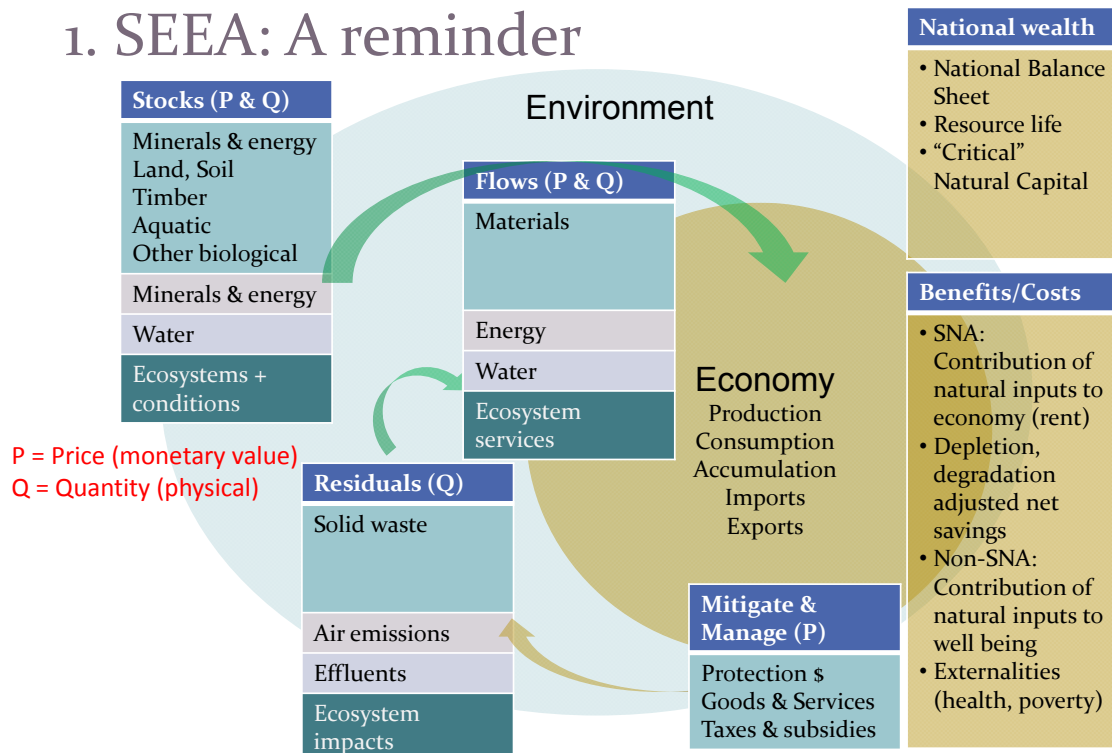   - How can the SEEA help?

SDGs – a reminder

- 17 goals
- 169 targets
- 232 unique indicators (based on best recommendations of international "custodians")
- Some "global" (e.g., number of countries...)

- **Tier 1**: Indicator is conceptually clear, has an internationally established methodology and standards are available, and data are regularly produced by countries for at least 50 per cent of countries and of the population in every region where the indicator is relevant.
- **Tier 2**: Indicator is conceptually clear, has an internationally established methodology and standards are available, but data are not regularly produced by countries.
- **Tier 3**: No internationally established methodology or standards are yet available for the indicator, but methodology/standards are being (or will be) developed or tested.
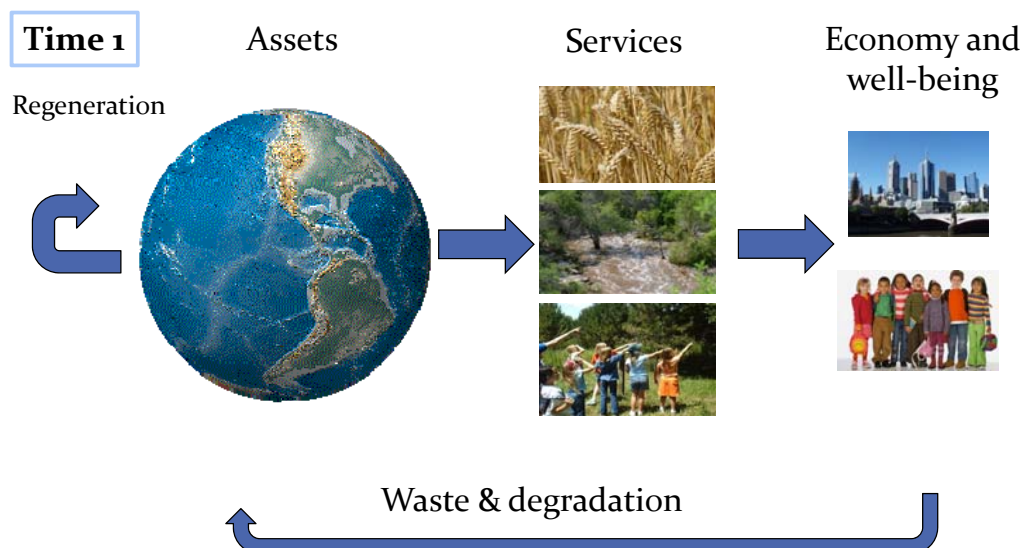
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1. SEEA: A reminder

National wealth
- National Balance Sheet
- Resource life
- "Critical" Natural Capital

Stocks (P & Q)

Minerals & energy
Land, Soil
Timber
Aquatic
Other biological

Minerals & energy

Water

Ecosystems + conditions

Environment

Flows (P & Q)

Materials

Energy

Water

Ecosystem services

Economy
Production
Consumption
Accumulation
Imports
Exports

Benefits/Costs
- SNA: Contribution of natural inputs to economy (rent)
- Depletion, degradation adjusted net savings
- Non-SNA: Contribution of natural inputs to well being
- Externalities (health, poverty)

P = Price (monetary value)
Q = Quantity (physical)

Residuals (Q)

Solid waste

Air emissions

Effluents

Ecosystem impacts

Mitigate & Manage (P)

Protection $
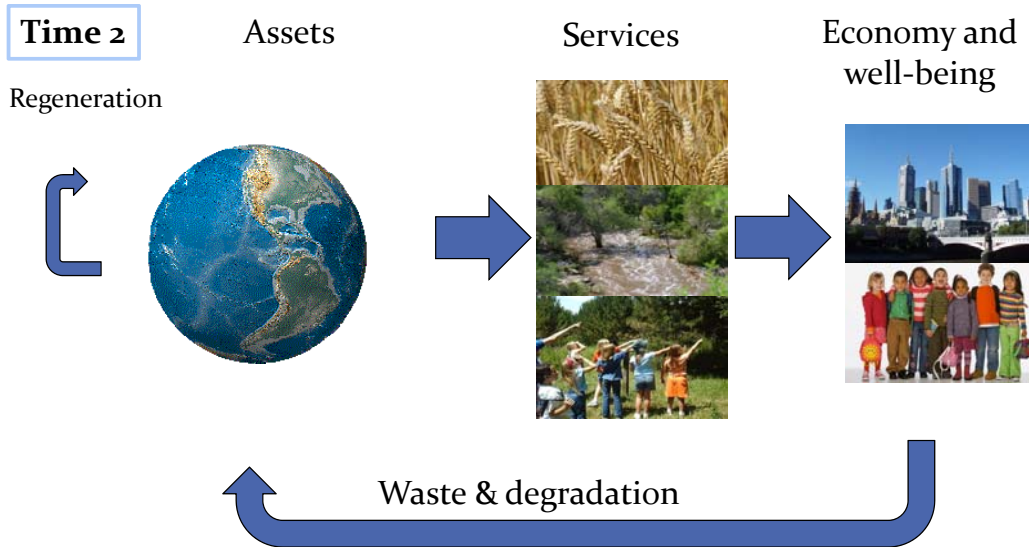Goods & Services
Taxes & subsidies

Accounting principles...

- **Apply to environmental data, too...**
  - **Double entry accounting**:
    - Beginning & end of time period → reconcile changes
    - Compare two sources → reconcile and find errors
  - **Time of recording**:
    - Referring to same time period (accounting period)
  - **Unit of measurement**:
    - Same units (physical or monetary)
    - Reconciliation and aggregation
  - **Consistent valuation rules**:
    - Market price: Basic, producer, purchaser
  - **Consistent concepts and classifications**
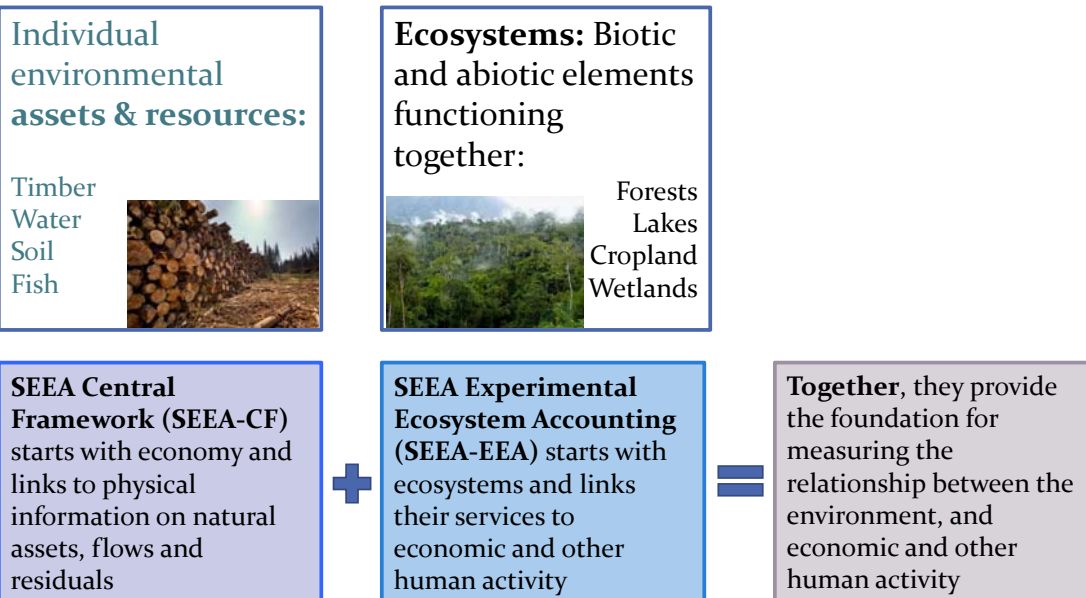 - **Stock → Flow (Asset → Service)**

Balancing the books of environmental assets

Time 1   Assets   Services   Economy and well-being

Regeneration

Waste & degradation

Balancing the books of environmental assets

Time 2   Assets   Services   Economy and well-being

Regeneration

Waste & degradation

One environment: Two perspectives

Individual environmental **assets & resources:**

Timber
Water
Soil
Fish

Ecosystems: Biotic and abiotic elements functioning together:

Forests
Lakes
Cropland
Wetlands

SEEA Central Framework (SEEA-CF) starts with economy and links to physical information on natural assets, flows and residuals

+

SEEA Experimental Ecosystem Accounting (SEEA-EEA) starts with ecosystems and links their services to economic and other human activity

=

Together, they provide the foundation for measuring the relationship between the environment, and economic and other human activity

Environment accounts and statistics

SEEA-CF (Central Framework)	• **Assets** • **Physical flows** • **Monetary flows**	• Minerals & Energy, Land, Timber, Soil, Water, Aquatic, Other Biological • Materials, Energy, Water, Emissions, Effluents, Wastes • Protection expenditures, taxes & subsidies
SEEA Water; **SEEA Energy;** **SEEA Agriculture, Forestry and Fisheries**	Add sector detail	As above for • Water • Energy • Agricultural, Forestry and Fisheries
SEEA-EEA (Experimental Ecosystem Accounting)	Adds spatial detail and ecosystem perspective	Extent, Condition, Ecosystem Services, Carbon, Water, Biodiversity
FDES (Framework for the Development of Environment Statistics)	Basic statistics for above plus...	• Extreme events and disasters • Human settlements and health • Protection, management & engagement

SEEA-CF – The Accounts

Assets (=stocks; physical and monetary):

• Opening balance; additions; removals. Closing balance

- Mineral and energy resources
- Land, Forest
- Soil
- Timber
- Aquatic resources
- Other biological resources
- Water

SEEA-CF – The Accounts

Physical flows

- Supply/use of materials (extract → consume)
- Material flows (through economy) to final demand (e.g., GHGs)
  - Water supply/use
  - Energy supply/use
  - Residuals
    - Air emissions
    - Water emissions
    - Wastes (generated and used/recycled)

SEEA-CF – The Accounts

Monetary flows

- Expenditures on protection, management and regulation
  - EPE: Environmental protection expenditures (demand side)
  - EGSS: Environmental goods and services sector (supply side)
  - Resource use and management
  - Environmentally-related payments by & to government (fines, fees, taxes, subsidies, concession payments)

2. Ecosystem Accounting

SEEA-EEA

- SDG Target 15.9: *By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts*

- "Experimental" = in progress

- Spatial framework of ecosystem units (30-100m)
  - *Extent* of ecosystem types
  - *Condition* of ecosystem asset
  - Classification and valuation of *ecosystem services*

- Links to SEEA-CF and SNA

- Tested in Australia, Canada, Mauritius, Netherlands, Philippines, pilot countries (Bhutan, Chile, Indonesia, Mexico, South Africa, Vietnam)

System of Environmental-Economic Accounting 2012
Experimental Ecosystem Accounting

Environment accounts and statistics

SEEA-CF (Central Framework)	• **Assets** • **Physical flows** • **Monetary flows**	• Minerals & Energy, Land, Timber, Soil, Water, Aquatic, Other Biological • Materials, Energy, Water, Emissions, Effluents, Wastes • Protection expenditures, taxes & subsidies
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2. Ecosystem accounting

Basic concepts and definitions

- Ecosystems as "Assets"
- The Ecosystem Services "Cascade"
  - Ecosystem structure and processes, function, services, benefits and values
  - Ecosystem services
  - Ecosystem types
- Ecosystem Accounting is Spatial
  - Geographic information systems (GIS)


Ecosystem assets, a definition

- ***Ecosystem assets*** *are spatial areas containing a combination of biotic and abiotic components and other characteristics that function together* (SEEA-EEA Sections 2.31, 4.1)

  What are "other characteristics?

- A **forest** is an area that:
  - Can be located on a map (spatial)
  - Contains trees, shrubs, grasses, soil biota, birds, mammals, insects... functioning together with
  - The soil, water, geology (rocks), sunlight, wind...

The Ecosystem Services Cascade
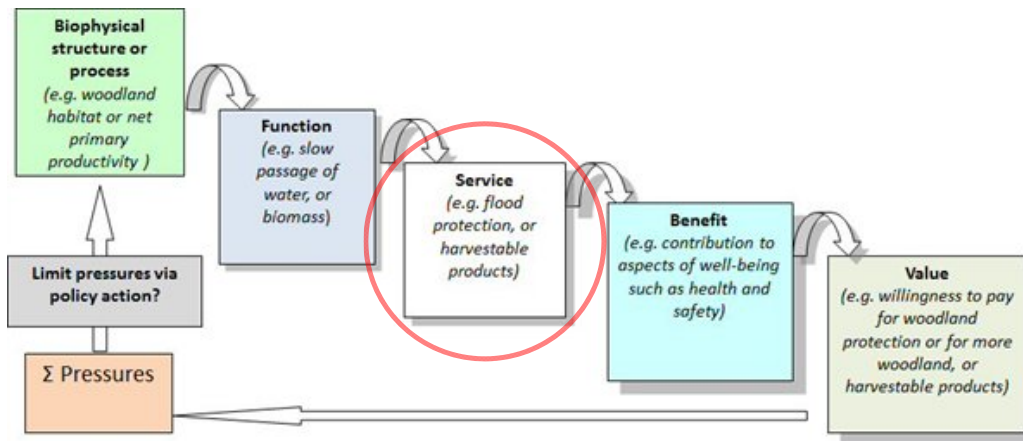
Source: Nottingham School of Geography

Ecosystem services are the **contribution** of ecosystems to a benefit for people…(not the conditions, processes, benefits or value)

Ecosystem services

- Based on **Common International Classification of Ecosystem Services** (CICES)
- Not mutually exclusive
- A list of "final" services
- Detailed (48 at 4-digit)
- Does **not** include "supporting" or "intermediate" services (= ecosystem processes & conditions)
- Physical measures and valuation methods not standardized (yet)

Why not mutually exclusive?

Section	Division	Group
01. Provisioning	01.01 Nutrition	01.01.01 Biomass
		01.01.02 Water
	01.02 Materials	01.02.01 Biomass
		01.02.02 Water
	01.03 Energy	01.03.01 Biomass-based energy sources
		01.03.02 Mechanical energy
02. Regulation & Maintenance	02.01 Mediation of waste, toxics and other nuisances	02.01.01 Mediation by biota
		02.01.02 Mediation by ecosystems
	02.02 Mediation of flows	02.02.01 Mass flows
		02.02.02 Liquid flows
		02.02.03 Gaseous / air flows
	02.03 Maintenance of physical, chemical, biological conditions	02.03.01 Lifecycle maintenance, habitat and gene pool protection
		02.03.02 Pest and disease control
		02.03.03 Soil formation and composition
		02.03.04 Water conditions
		02.03.05 Atmospheric composition and climate regulation
03. Cultural	03.01 Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]	03.01.01 Physical and experiential interactions
		03.01.02 Intellectual and representative interactions
	03.02 Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes [environmental settings]	03.02.01 Spiritual and/or emblematic
		03.02.02 Other cultural outputs

Source: CICES, 2013. www.cices.eu

Ecosystem types

- Good news! Start from SEEA-CF land cover

Land cover classification (SEEA-CF, Table 5.12, p.178; and Annex p. 299)

1 Artificial surfaces (including urban and associated areas)
2 Herbaceous crops
3 Woody crops ⎱ Crops
4 Multiple or layered crops
5 Grassland
6 Tree-covered areas
7 Mangroves
8 Shrub-covered areas
9 Shrubs and/or herbaceous vegetation, aquatic or regularly flooded ⎱ Swamps Bogs…
10 Sparsely natural vegetated areas
11 Terrestrial barren land ⎱ Sparsely vegetated/barren
12 Permanent snow and glaciers
13 Inland water bodies
14 Coastal water bodies and intertidal areas

15 Marine

Ecosystem accounting is spatial

- Ecosystems are different and function differently depending on **where** they are
  - Capacity to supply services depends on their **location**
  - Benefits depend on **accessibility**
- Therefore…Ecosystem accounting needs to integrate **spatial** and **non-spatial** data
  - Forests in Kalimantan may have timber, but are not **accessible** for harvest.
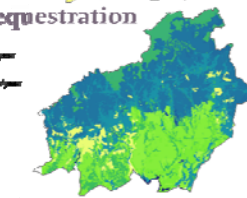 - Accounts should match official statistics of harvestable area
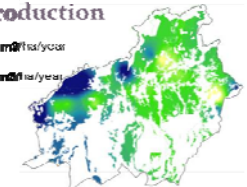

Orangutan habitat
High: 0.97
Low: 0.03
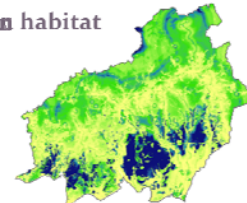
Carbon sequestration
High: 8.82 ton/ha/year
Low: -33.33 ton/ha/year

Timber production
High: 1.67 m3/ha/year
Low: 0.43 m3/ha/year

Source: Sumarga and Hein, 2014

Ecosystem accounting is spatial

- Geographic information systems (GIS)
  - Manage spatial information as layers
  - Have tools to integrate spatial information:
    - **Overlay** different data where space is the common denominator
    - **Aggregate** point information (e.g., water sampling station) to larger areas (polygons)
    - **Attribute** information from larger areas to smaller ones (downsampling)
    - **Apply geospatial statistics** (interpolation, modelling)
  - Generate tables based on common properties (e.g., land cover and land cover change)
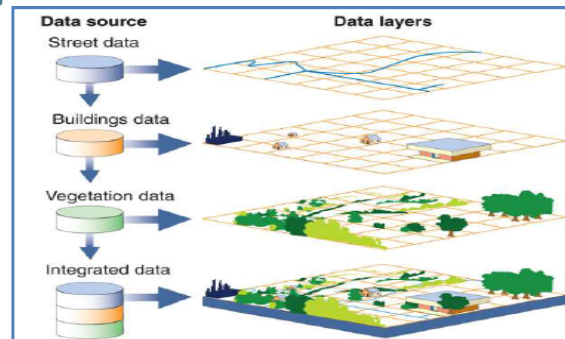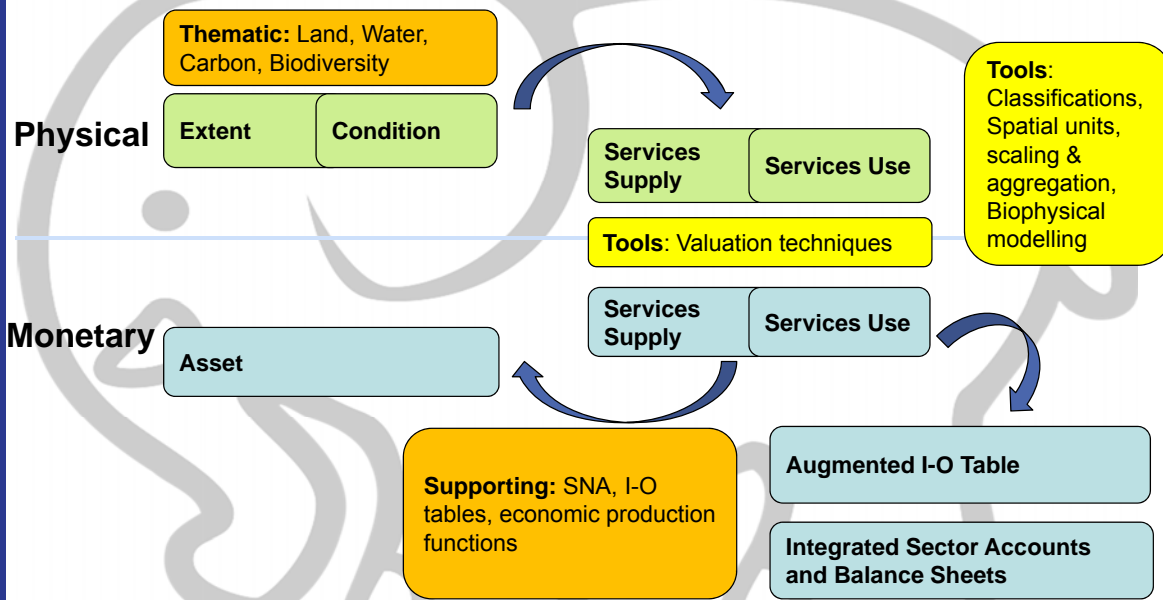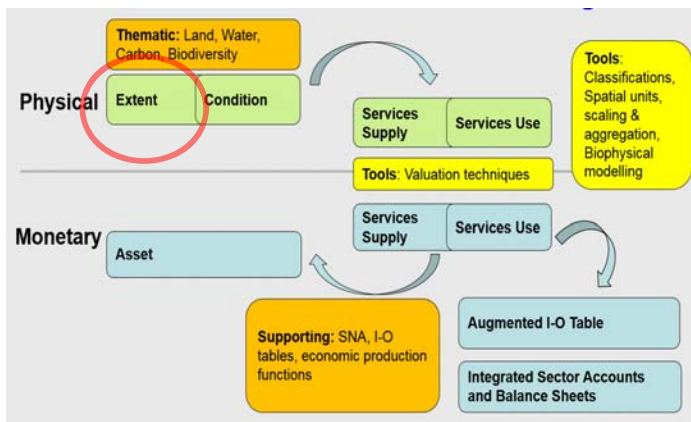

Source: GAO (2004)

Pop quiz!

What are examples of spatial data that you may wish to integrate into ecosystem accounting?

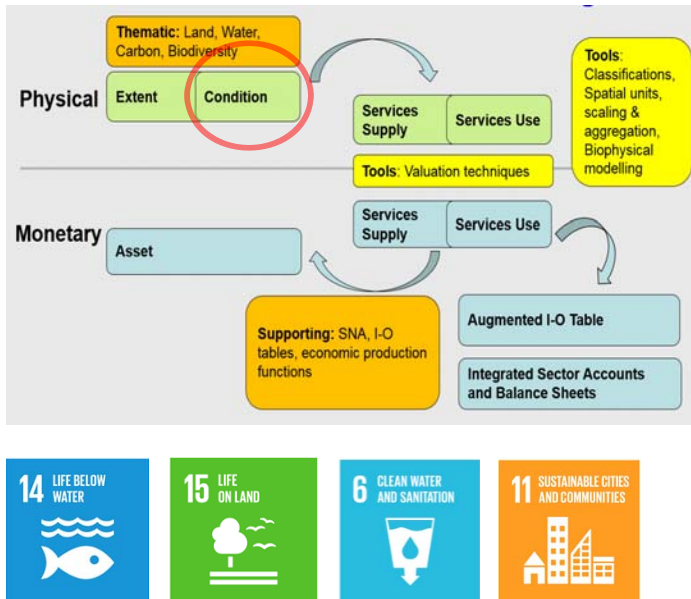SEEA-EEA Overview

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SEEA-EEA Accounts and tools

Extent account

- Land account + optional information (elevation, soil type…)
- Ecosystem type + ownership and use
- Changes over time
→ General agreement on what exists on surface of country
→ Land cover change (where, why?)
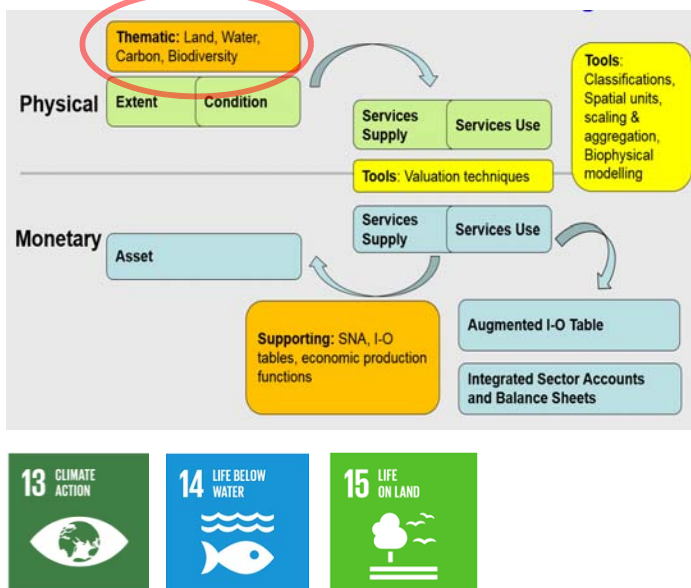
SEEA-EEA Accounts and tools

Condition account

- Quality and other biophysical measures important to Ecosystem Services (ES)
- Other measures include slope, streamflow, proximity to people...
- →Overall condition, changes, location of changes
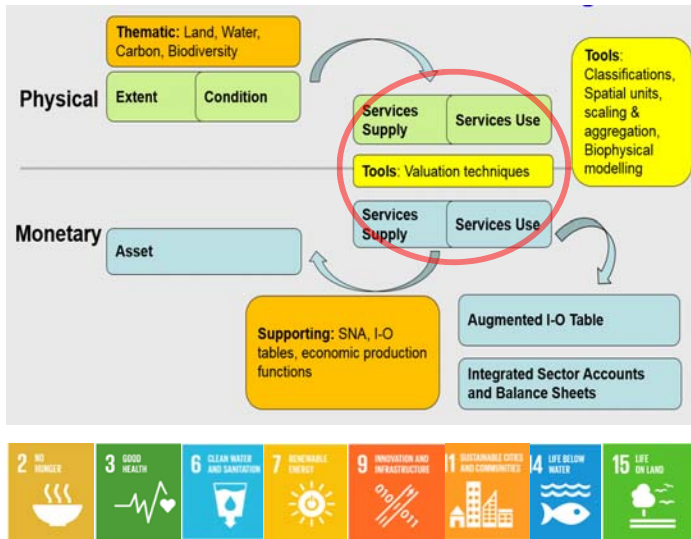- →Future flows of ES via scenarios & models

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SEEA-EEA Accounts and tools

Thematic accounts

- Land (+spatial detail)
- Water (spatial detail, quality, ecosystems as beneficiaries)
- Biodiversity (species ranges, characteristics, populations)
- Carbon (focus on biocarbon)
- →Contribute to **Condition Accounts**
- →Focus on specific issues

SEEA-EEA Accounts and tools

Ecosystem Services supply / use accounts

- Physical measures
- Use by beneficiaries
- **Valuation** to estimate monetary values
→ Contribute to monetary **Asset Account** & links to SNA

SEEA-EEA Accounts and tools
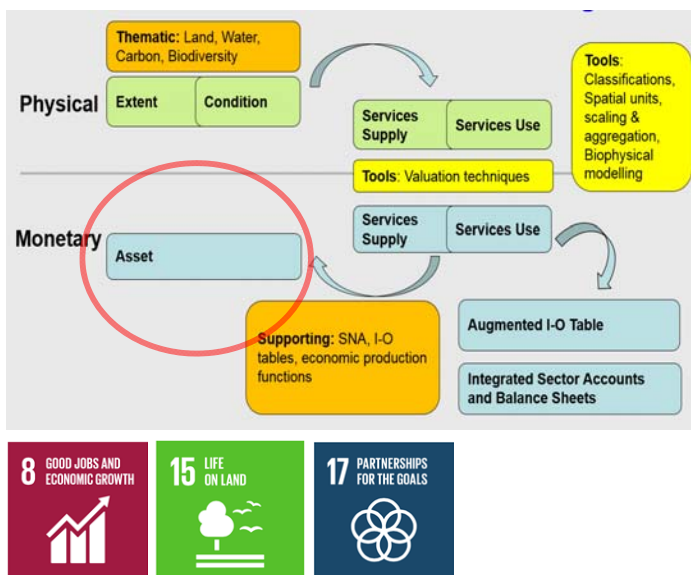
Monetary asset accounts

- Net Present Value of future flow of services
→ Trade-offs (e.g., what is best long-term use of an ecosystem asset?)
→ Contribute to **Balance Sheets**

SEEA-EEA Accounts and tools
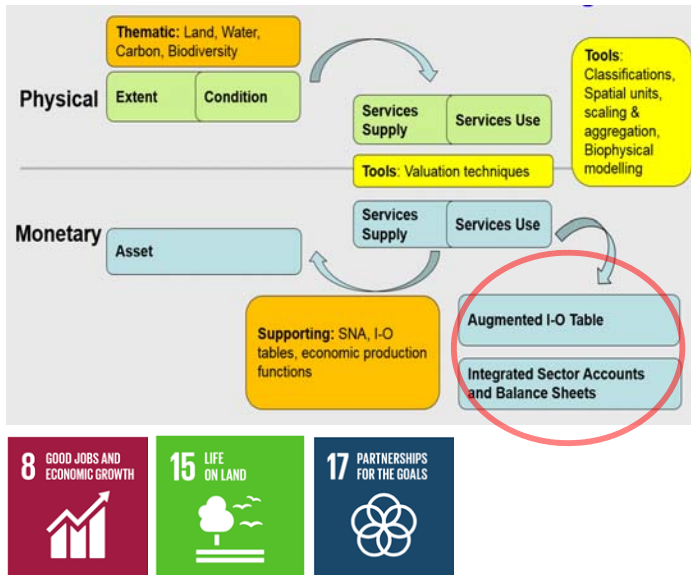
Links to SNA

- Ecosystem Services in economic production functions

- Degradation and depletion-adjusted aggregates (e.g., value added minus depreciation)

→ Trade-offs (e.g., is economic production at expense of future production?)

SEEA-EEA Accounts and tools
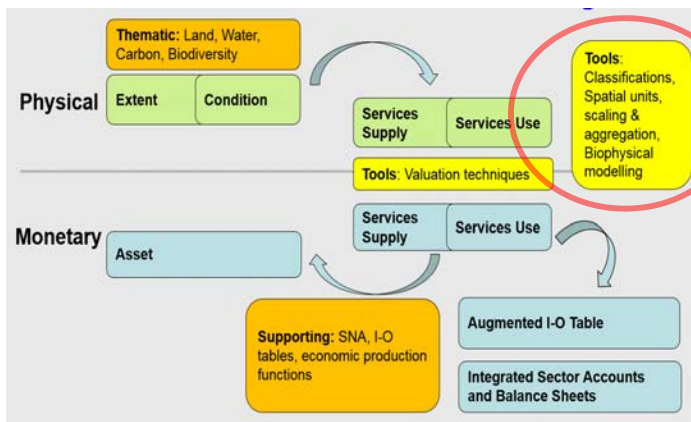
Tools

- Classifications (land cover, use, ecosystem services)

- Methods (Spatial units, scaling & aggregation)

- Biophysical modelling (future flows & filling gaps)

A note on valuation of ecosystem services

Section	Division	Group
01. Provisioning	01.01 Nutrition	01.01.01 Biomass
		01.01.02 Water
	01.02 Materials	01.02.01 Biomass
		01.02.02 Water
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		03.02.02 Other cultural outputs

SNA Benefits
- Should be in SNA
- Produced by economic units
- Potential to be marketed
- If require capital, labour…(e.g., timber)
  - Value ecosystem's contribution (rent)
- If no capital, labour…(e.g., wild food)
  - Can be valued at full value
→ Correct undercounting in SNA

Non-SNA Benefits
- Should NOT be in SNA
- Produced by ecosystems (e.g., water regulation, pollination, air purification)
- NO potential to be marketed (but have carbon markets and PES)
- Better to have reliable physical measures
- View as part of national wealth
→ Demonstrate "importance" to well-being

2. Ecosystem Accounting

Summary

- The SEEA-EEA is an extension of the SEEA-CF
  - Guidance to measure ecosystems, their conditions and services
  - Spatially detailed
  - Tools: classifications, spatial and valuation methods, biophysical modelling
- Some ecosystem services already in SNA
  - Correct undercounting
- Some ecosystem services should NOT be valued in SNA
  - Factors of economic production
  - Contribute to long-term ecological integrity or well-being

3. Oceans

Different kinds of "land cover" and "ecosystems"

- They're very large
- Water keeps moving (currents, upwelling)
- Multi-layer (pelagic, benthic)
- All looks the same from a satellite (water or ice)
- Trans-boundary / shared / Most outside of national jurisdictions
- Less studied / known / measured
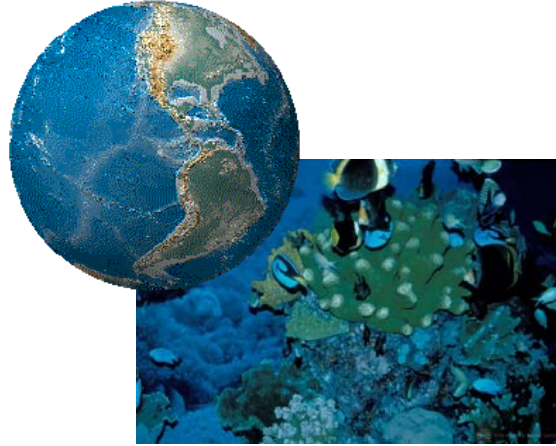
- ESCAP YouTube Video; UN Environment: Ocean Pollution

From the video...

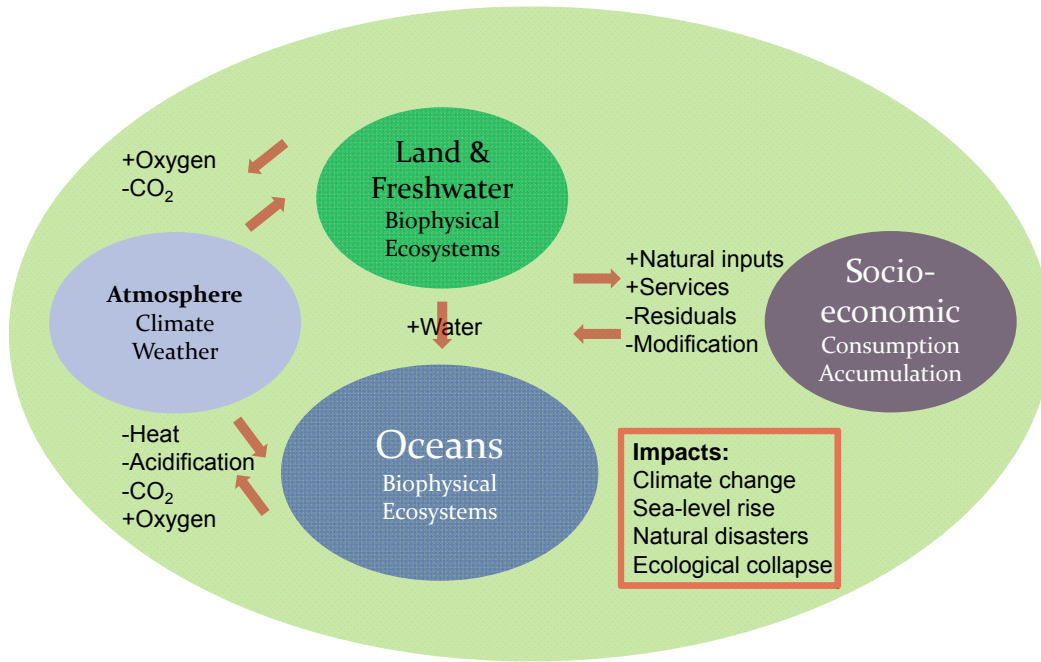| Oceans in the Asia-Pacific region cover 40% of the earth's surface	Yet land-based pollution, overfishing and habitat destruction are threatening ocean environments	Such losses expose coastal populations to natural disasters, threats to basic human rights (food and fresh water) and population displacement	If we act NOW to sustainably manage, protect and conserve our ocean resources and our future, we can reverse the damage to oceans
• They connect people, markets and livelihoods; 80% of world trade relies on this vast resource	• Warmer sea surface temperatures and ocean acidification are expected to cause significant loss of marine habitats • Low oxygen areas, also known as "dead zones" have been discovered in the Indian and Pacific Oceans	• Those particularly vulnerable are the Pacific island developing states	• ESCAP will focus on enhancing data and statistics and the building of oceans accounts and policies to effectively implement SDG14 in the region

Ocean Science 101

+Oxygen
-CO_2

Land & Freshwater
Biophysical Ecosystems

+Natural inputs
+Services
-Residuals
-Modification

Socio-economic
Consumption
Accumulation

Atmosphere
Climate
Weather

+Water

-Heat
-Acidification
-CO_2
+Oxygen

Oceans
Biophysical Ecosystems

Impacts:
Climate change
Sea-level rise
Natural disasters
Ecological collapse

Many SEEA accounts → many related SDGs

Energy — Emissions
Waste
Water — Effluents
Ecosystem conditions
Land — Ecosystem services
Aquatic resources
Agriculture, forestry and fisheries
Biodiversity
Environmental protection expenditures

SDG 2.3 Food producers
SDG 9.4 CO2 emissions
SDG 13.2 Climate change mitigation
SDG 14.1 Marine pollution
SDG 14.2 Manage coastal ecosystems
SDG 14.3 Ocean acidification
SDG 14.4 Sustainable fisheries
SDG 14.5 Protected areas
SDG 14.6 Fisheries subsidies
SDG 14.7 Sustainable use for SIDS
SDG 14.a Scientific knowledge
SDG 14.b Access to resources
SDG 14.c International law
SDG 15.5 Red list index
SDG 15.9 Value of ecosystems

GOOS background on what to measure

http://www.goosocean.org/index.php?option=com_content&view=article&id=120&Itemid=277

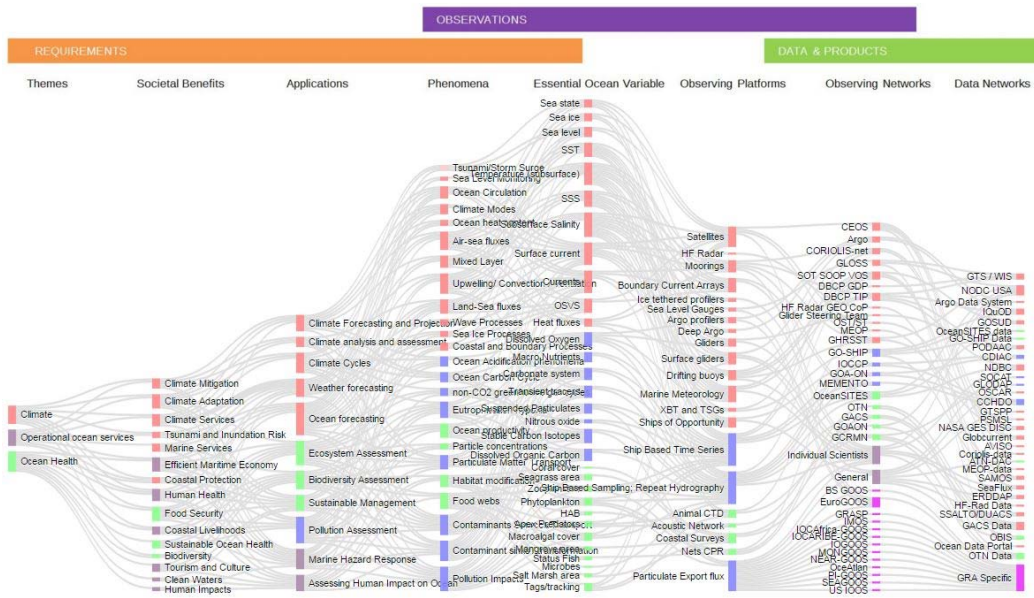# SDG 14 interactions

- SDG 1: + Poverty reduction;
  - conservation limits access

- SDG 2: + Food security;
  - conservation limits access

- SDG 8: + Growth of marine and maritime economy;
  - impacts on ocean ecosystems

- SDG 11: + urban development;
  - impacts on ocean ecosystems

- SDG 12: + efficient use of natural resources

- SDG 13: + Blue carbon sink;
  - adaptation to climate change may conflict with conservation

- Not mentioned:
  SDG 7: + renewable energy
  – non-renewable → increase GHGs
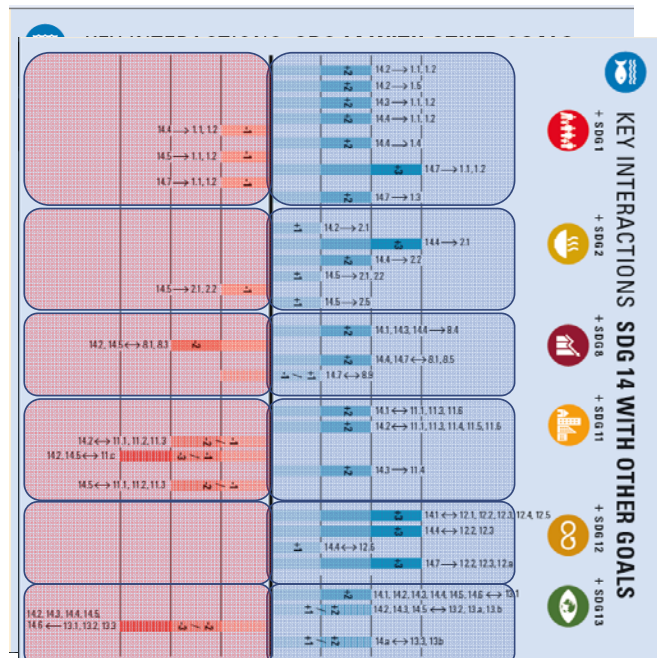
Source: Griggs et al. 2017

We have the technology!

Common spatial infrastructure
SEEA Ecosystem extent
- Ecosystem types (land cover)
- Coastal communities
- Coastal infrastructure
- Land-based sources of pollution
Oceans spatial units
- Ocean ecosystem types
- Marine protected areas
- Fishery, tourism, mining areas
- Water quality / temperature
National statistics
- Emissions, effluents, wastes
- Assets: fish stock
- Supply/use: catch, beneficiaries
Analyses
- Main sources of land-based pollution (by whom)
- Value of natural inputs (to whom)
- Cost/benefit of rehabilitation and protection
- Policy options → values at risk
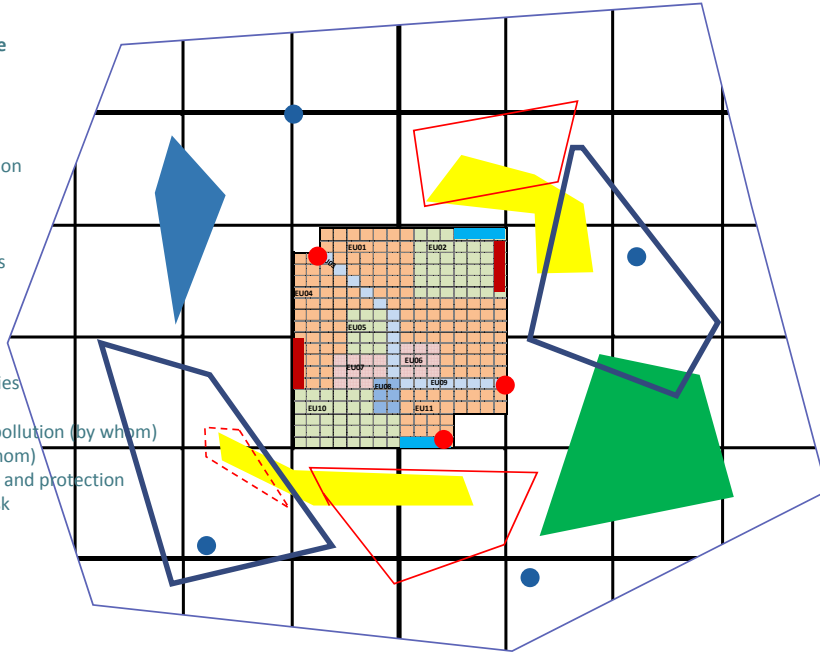
But there are some missing bits...

- Social dimension
    - SEEA views users (of natural inputs) and beneficiaries (of ecosystem services) as aggregate "economic units" (industry by class, government, households)
    - Would be useful to have detail by
        - Type of household (coastal, low income) and individual (female, disabled, young/old)
        - Some could be estimated from census and household surveys
        - See Poverty Environment Initiative (PEI)

But there are some missing bits...

- Economic dimension
    - SEEA views industries by sector
        - Would be useful to distinguish size of fishing operations (S/M/L)
        - Could be estimated from economic statistics
    - SEEA has no guidance on "technologies" used
        - Could be estimated from economic surveys
    - SEEA does not include spatial dimension for
        - Energy (e.g., offshore)
        - Waste production (e.g., flows to the sea)

But there are even more missing bits...

- Spatial dimension
    - SEEA-EEA specifies terrestrial and freshwater spatial units
        - Coastal and marine spatial units could be delineated using national management/fisheries areas or ecosystem types (See South Africa)
        - Or grid

But there are even more missing bits...

- Ecosystem dimension
    - CICES is not explicit on ocean-related services (EEA Workshop)
        - What's missing?
            - **FEGS** (Final Ecosystem Goods and Services) includes receiving discharge, power generation, placement of infrastructure, goods/people transport, medium for cultivating aquatic organisms
            - Abiotic processes (currents, upwelling, etc.)
            - Ecosystem processes (biocarbon cycle, water cycle)
            - Direct effects human well-being (non-economic: e.g., oxygen)

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

But there are even more missing bits...

- Environmental dimension
    - SEEA has no guidance on certain pollutants (e.g., nutrients, plastic bags) other than general "wastes" and "effluents"
        - UN Environment developing methodologies for plastic
        - Start with waste accounts (Where generated? Where flow?)

But there are even more missing bits...

- Institutional dimension
  - Already many stakeholders & much data; how to integrate?
  - SEEA has no guidance on measuring activities / conditions / services... from international waters
    - Could be viewed as international / regional / sub-regional responsibility (countries collaborate on shared ocean areas)
  - SEEA has no guidance on recording legislation / policies / regulations / actions (other than expenditures)
    - Requires mapping policies to national priorities, measures of enforcement [coherence with international and interlinkages]
  - SEEA has no guidance on management approaches (i.e., ecosystem-based management SDG 14.2.1)
    - UN Environment is developing methodologies (could use MSY)
  - SEEA has no guidance on recording scientific knowledge, research capacity, technology
    - Could be recorded in terms of expenditures, publications, institutions...

More good news!

- Accounts don't need to be complete to be useful
- There is international interest and support
  - Oceans Conference
  - Partnerships
  - Focus on governance
- ESCAP support
  - Resolved to support partnerships for governance, data and statistics
    - Horizontal (topic, country) and vertical (international, regional)
- Other countries have already done parts
  - European Environment Agency workshop (Mar. 2016)
  - Some national data online: Thailand
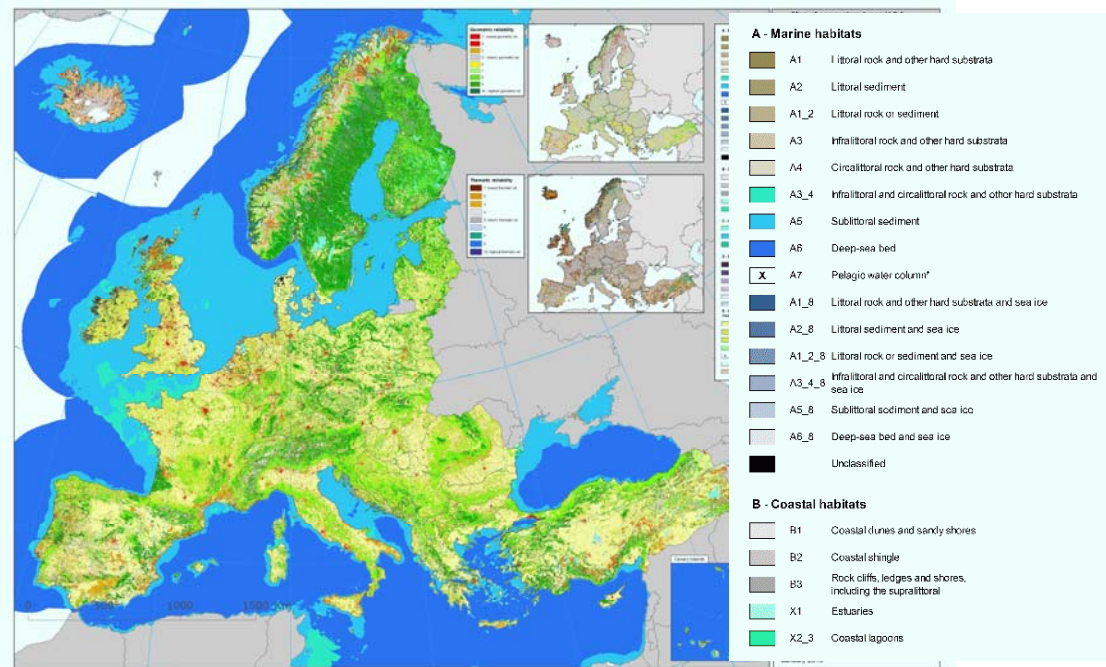 - Australia, NZ, NOAA: marine economy

ESCAP strategy

- Focus on governance and statistics: priority measures, standards and guidance to countries
  - Support capacity for countries to prioritize, compile, analyse and present locally-relevant data
- International partnerships (UN Oceans, UNESCO, NOAA…)
- Regional (ASEAN) and Sub-regional partnerships (CROP)
- Technical recommendations (approach and feasible statistics)
- Training module (integrated with existing SEEA training)
- Countries volunteer for Ocean Accounts case study
  - Capacity development needs assessment
    - priorities, policies, enforcement
  - Establish national working group
    - including international, regional and sub-regional agencies
  - Conduct training to address priorities (see Diagnostic Tool)
  - Inventory data (see Inventory Template)
  - Develop work plan (including developing new data: field & socio-econ)
  - Compile pilot accounts; discuss with senior stakeholders
  - Add to Oceans Account Platform (existing spatial or create one)
  - Document results
- Regional Expert Workshop: status and work plan (June 2018)
- Contribute to ESCAP knowledge distribution
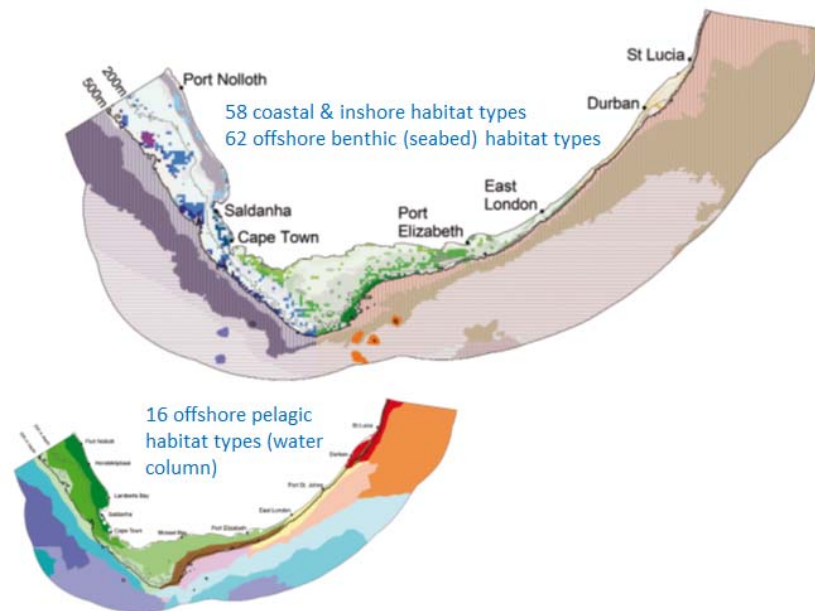
Country, Regional and Global Examples

- Defining ocean ecosystems
- The state of the ocean
- Pressures on oceans
- The contribution of oceans to the economy
- Our dependence on oceans

EU (MAES) Ecosystem types:

A - Marine habitats

A1	Littoral rock and other hard substrata	
A2	Littoral sediment	
A1_2	Littoral rock or sediment	
A3	Infralittoral rock and other hard substrata	
A4	Circalittoral rock and other hard substrata	
A3_4	Infralittoral and circalittoral rock and other hard substrata	
A5	Sublittoral sediment	
A6	Deep-sea bed	
A7	Pelagic water column*	
A1_8	Littoral rock and other hard substrata and sea ice	
A2_8	Littoral sediment and sea ice	
A1_2_8	Littoral rock or sediment and sea ice	
A3_4_8	Infralittoral and circalittoral rock and other hard substrata and sea ice	
A5_8	Sublittoral sediment and sea ice	
A6_8	Deep-sea bed and sea ice	
	Unclassified	

B - Coastal habitats

B1	Coastal dunes and sandy shores	
B2	Coastal shingle	
B3	Rock cliffs, ledges and shores, including the supralittoral	
X1	Estuaries	
X2_3	Coastal lagoons	

Source: http://biodiversity.europa.eu/maes/mapping-ecosystems/map-of-european-ecosystem-types

South Africa: marine ecosystem types

58 coastal & inshore habitat types
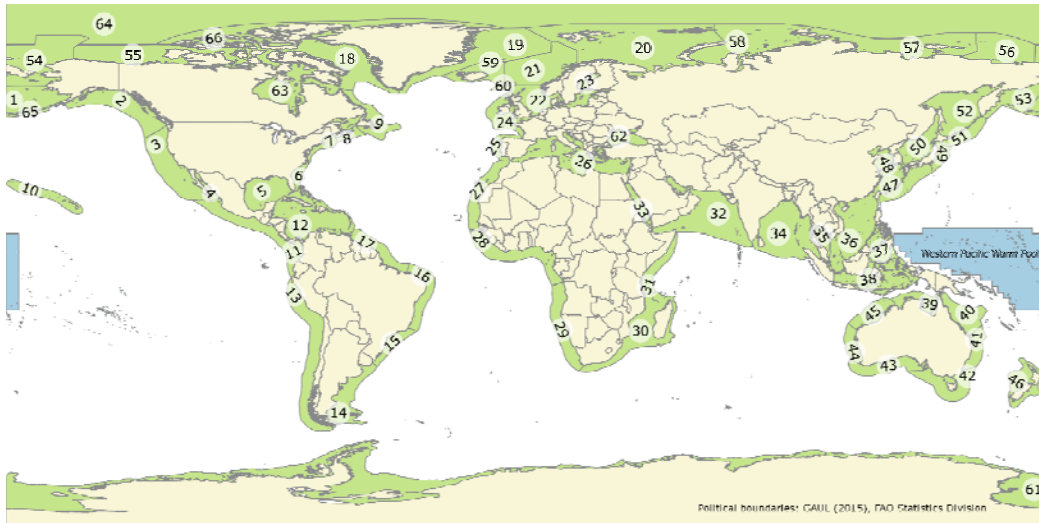62 offshore benthic (seabed) habitat types

16 offshore pelagic habitat types (water column)

SANBI. 2013. National ecosystem classification system. Concept note.

Large Marine Ecosystems (LMEs)

LMEs are vast regions of coastal ocean space of 200,000 km² or more, extending from river basins and estuaries seaward to the continental shelf break or slope or to the outward margins of major current systems. Unique defining ecological criteria of LMEs include bottom depth contours, currents and water mass structure, marine productivity, and food webs. (http://onesharedocean.org)

WRI: marine protected areas

Effective   Partially Effective   Not Effective
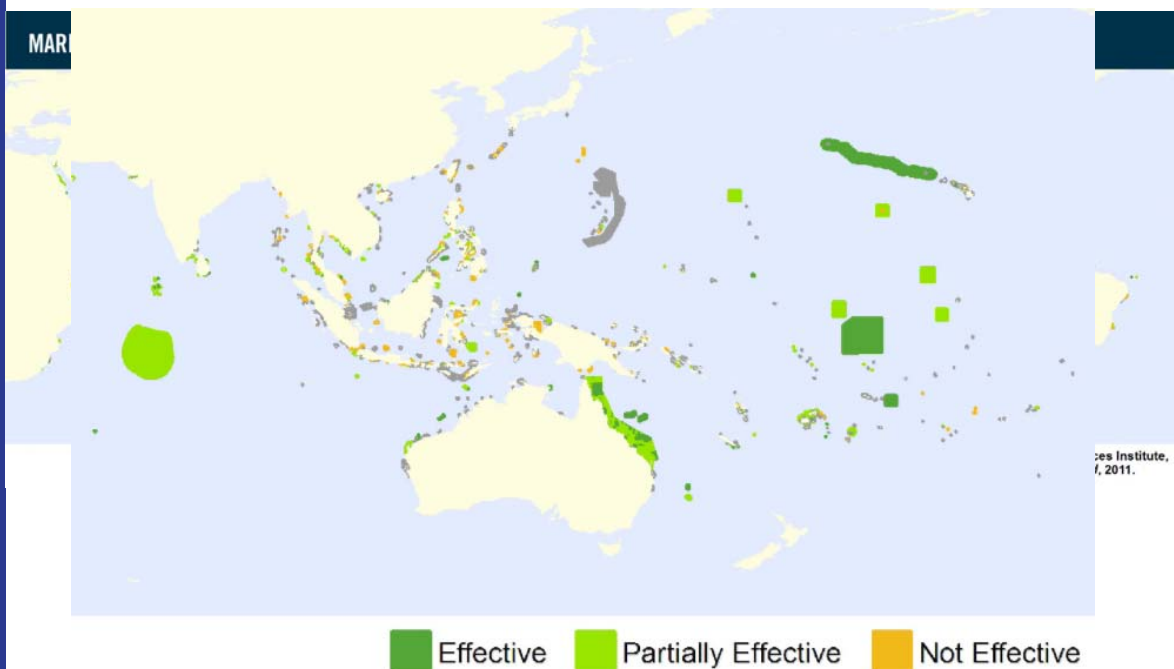
UNEP-WCMC: Marine species richness
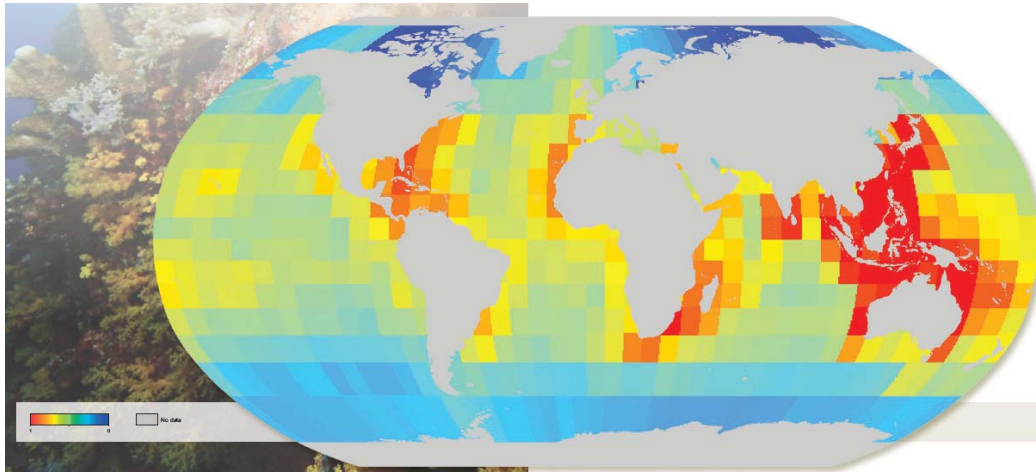
Original source: Tittensor, D. P., *et al.* 2010. Global patterns and predictors of marine biodiversity across taxa. Nature, vol. 466, No. 7310, pp. 1098-1101.

Hypoxia (dead zones)

"The concentration of dissolved oxygen in the ocean significantly influences the distribution and abundance of marine species, and ocean deoxygenation is one of the four major human-induced stressors on ocean ecosystems."

Zones with less than 80 μmol/kg are "dead zones"

Sub-surface oxygen concentrations averaged between 200m and 600m from World Ocean Atlas 2009 (μmol per kg)
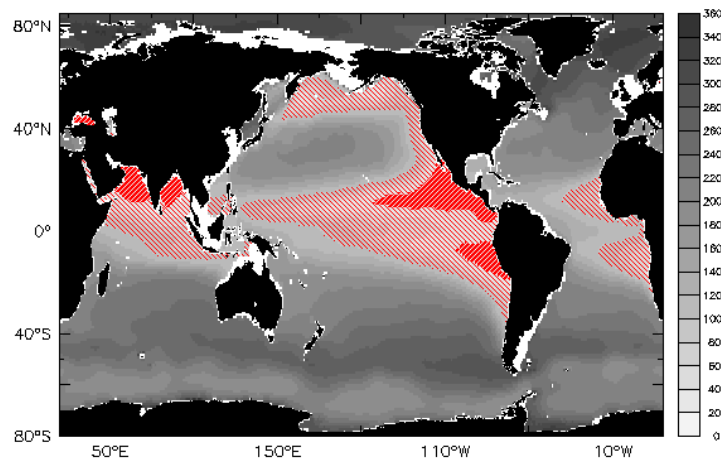
Light and dark red stripes indicate waters with O_2 <100 μmol per kg and O_2 <20 μmol per kg respectively.

Screenshot from http://onesharedocean.org/open_ocean/climate/oxygen

Coastal ecosystems store more carbon

- Note the log scale
- Salt marshes, mangroves and seagrass beds "bury" 30x the carbon of forests per unit area

Figure: Carbon Storage Abilities of Different Habitat Types
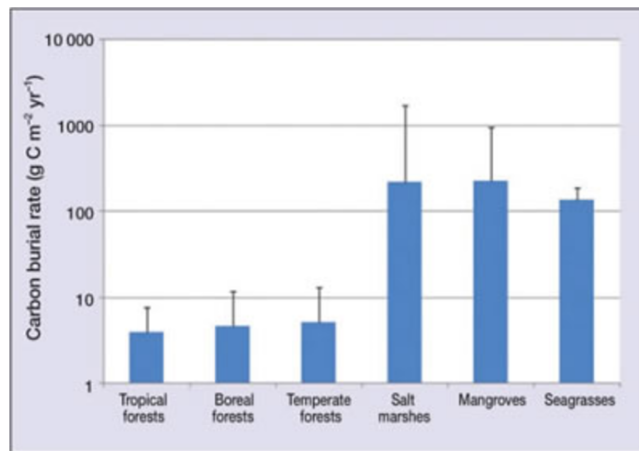
Mean long-term rates of C sequestration (g C m−2 yr−1) in soils in terrestrial forests and sediments in vegetated coastal ecosystems. Error bars indicate maximum rates of accumulation. Note the logarithmic scale of the y axis. (Source: Mcleod et al. 2011. A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering C02. Frontiers in Ecology 9(10): 552-560, DOI.)

Change in primary productivity 1996-2014

Primary productivity is the rate of organic matter production by plants. The bulk of marine Primary Productivity is carried out by phytoplankton, which can be seen from space due to their photosynthetic pigments (mainly chlorophyll).

(% change in $g.C.m^{-2}.d^{-1}$) ← What does this unit mean?
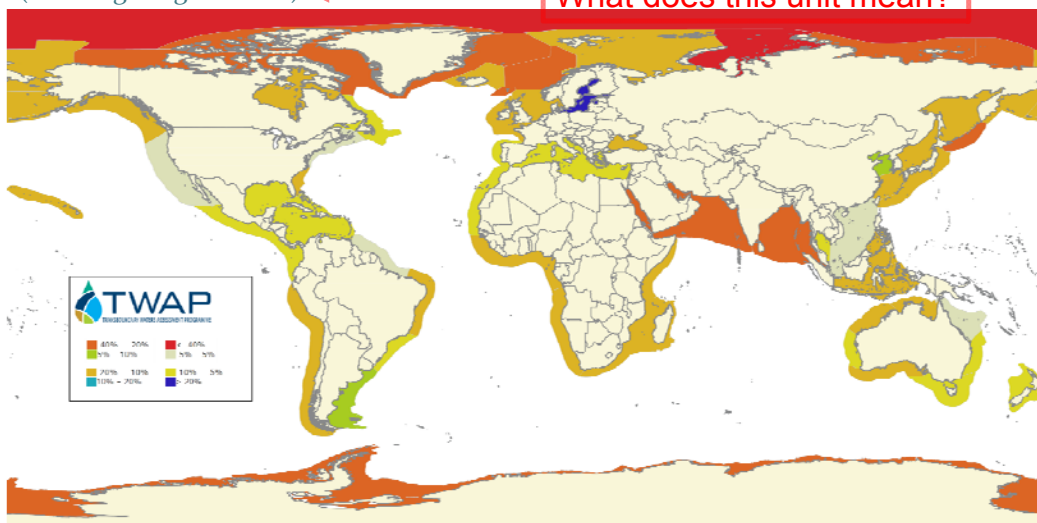
Projection of ocean surface temperatures
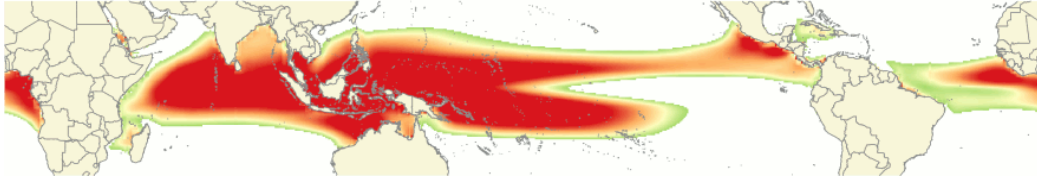
Projection of annually averaged surface temperature beyond 28°C, from 2010 to 2059, according to IPCC scenario RCP 8.5.

| 28.0°C | 28.5°C | 29.0°C | 29.5°C | 30°C |
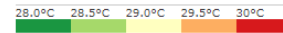
Screenshot from: http://onesharedocean.org/open_ocean/climate/physical_effects

Global network of ship movements
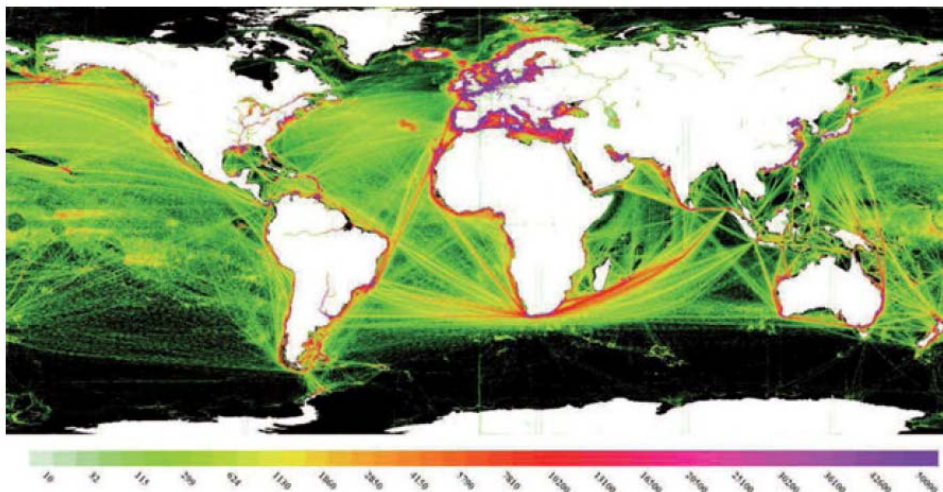
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Figure 2. Global Network of Ship Movements (data 2012). Data derived from daily Automatic Identification System (AIS) messages recorded for each 0.2º × 0.2º grid square. The coloured scale shows the number of messages recorded over the year for the grid squares. Source: IMO, 2014o.

From United Nations. 2016

Plastic waste ends up in the ocean

Source: GESAMP 2016

www.SeaAroundUs.org: Global fish yield
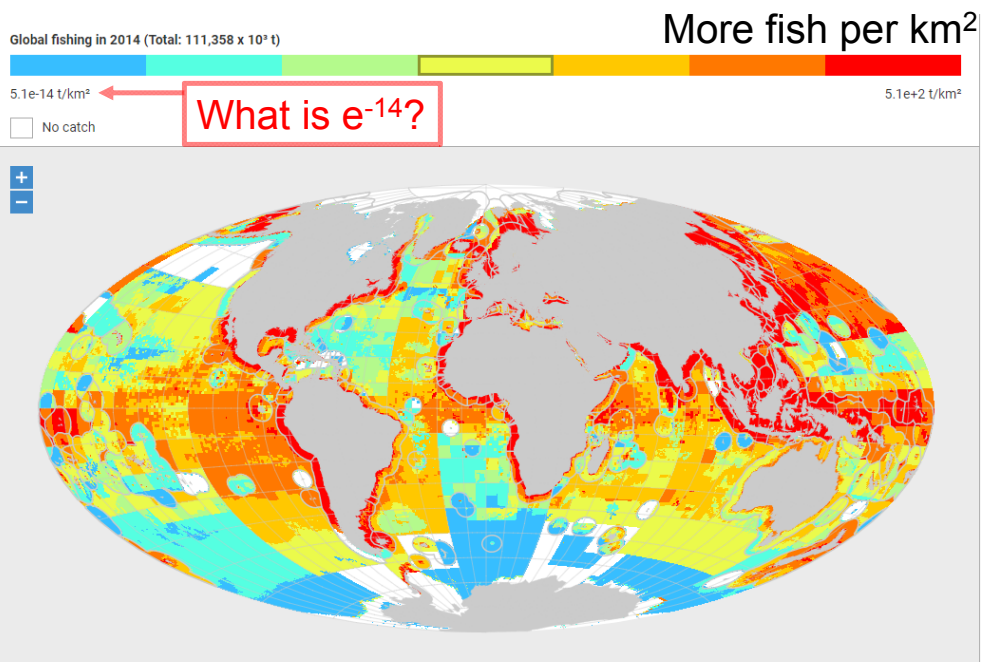
www.SeaAroundUs.org: Fiji fish catch

All fishing by the fleets of Fiji in 2014 (Total: 40 x 10³ t)

1.7e-15 t/km²   1.2e+0 t/km²

No catch

←Fiji
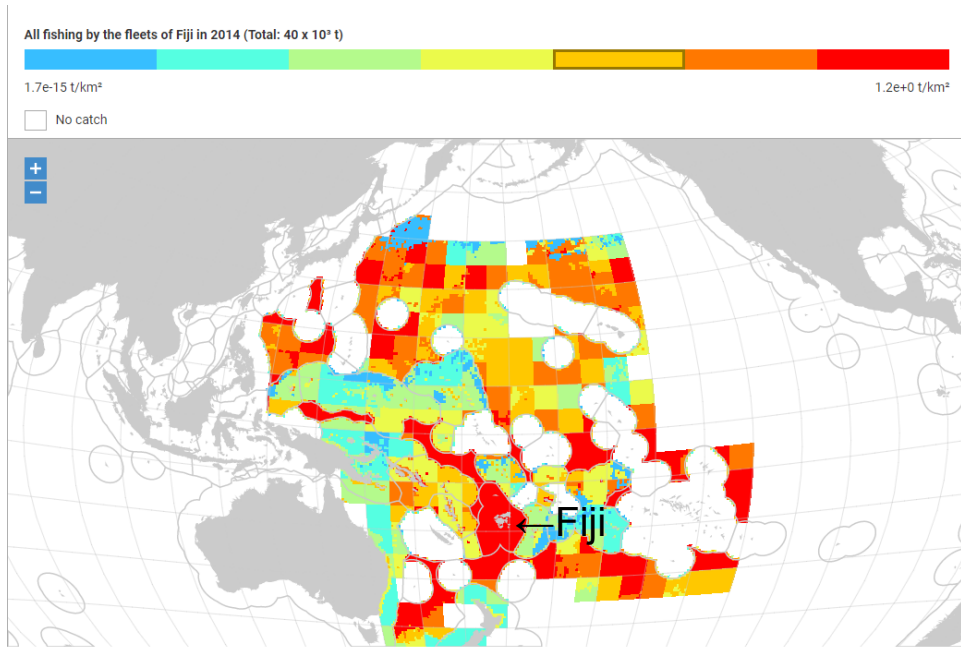
Biomass extraction including oceans

Canada example

Net biomass extraction for human use

Includes:
- Agricultural crops
- Livestock and poultry
- Milk
- Maple products and honey
- Forestry
- Fisheries (inland and marine)

Biomass extraction
(thousands of tonnes)
- ≥ 50,000
- 25,000 to < 50,000
- 10,000 to < 25,000
- 1,000 to < 10,000
- 100 to < 1,000
- < 100
- Data not available
- Extended economic zone
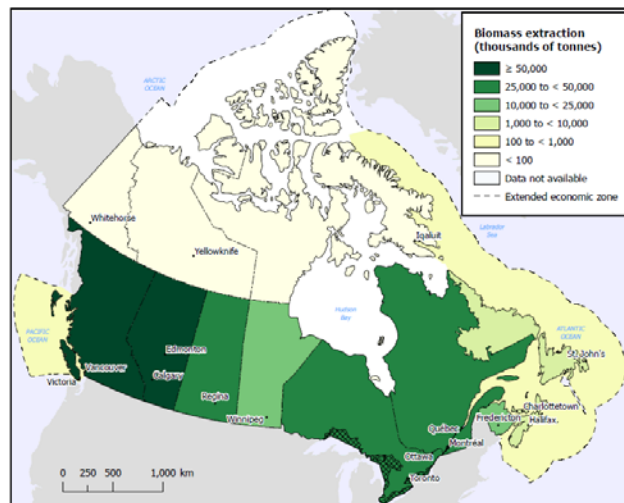
Source: Statistics Canada, 2013

Fish catch by management area

Canada example

Weight of commercial fish landings by marine statistical area

Includes:
• Groundfish
• Pelagic fish
• Shellfish

Also done for west coast

Statistical area defined by Ministry of Fisheries and Oceans

Source: Statistics Canada, 2013
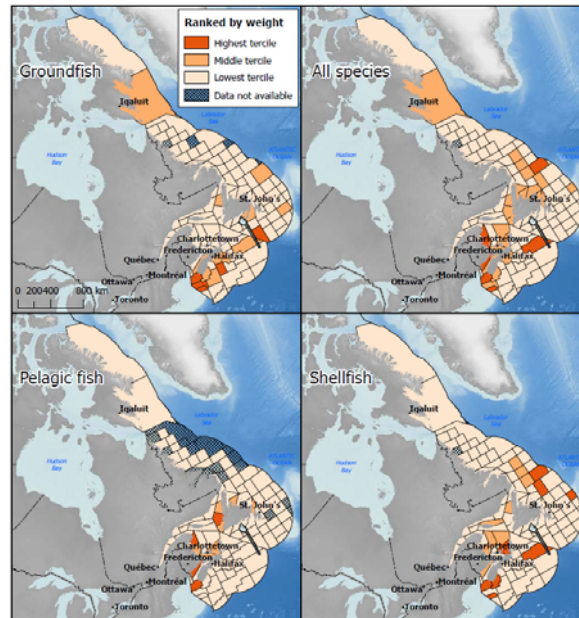
Canada: Dependence on marine fishery

• Community dependence on marine fishery by ecodistrict
• Also done for west coast
• Statistics from 2006 Census of Population
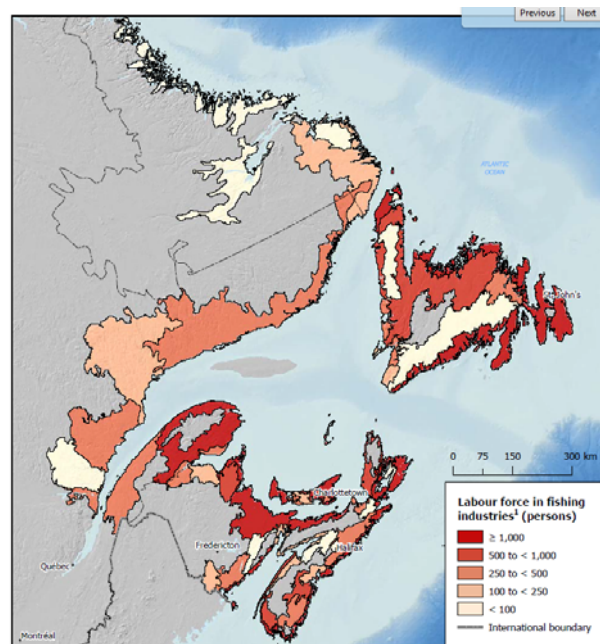
Source: Statistics Canada, 2013.
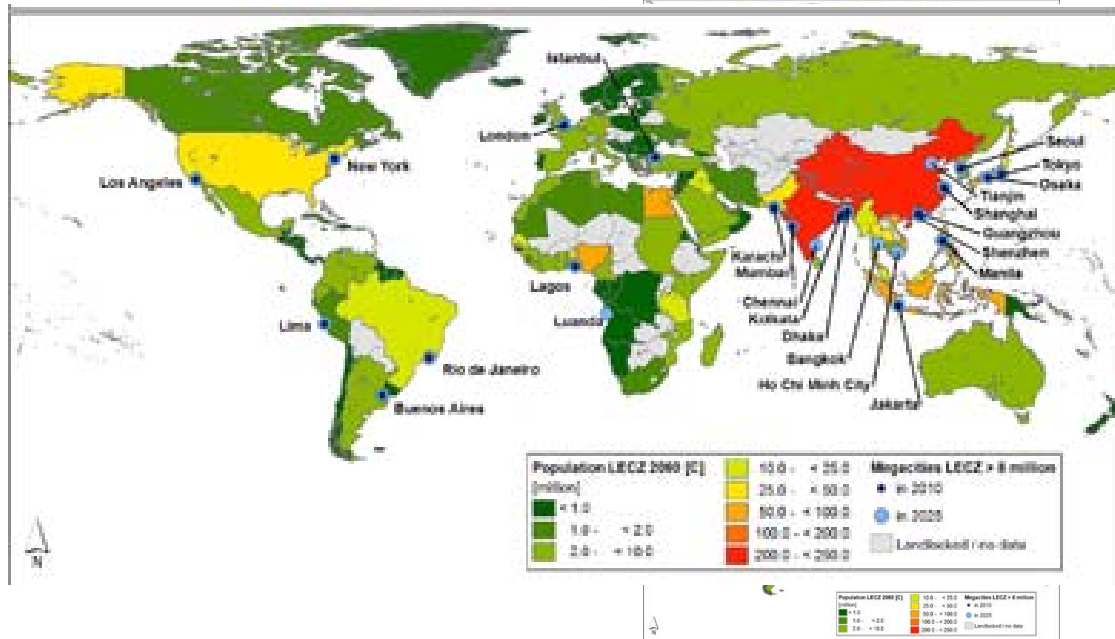
Neumann B, Vafeidis AT, Zimmermann J, Nicholls RJ (2015) Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding - A Global Assessment. PLOS ONE 10(3): e0118571. https://doi.org/10.1371/journal.pone.0118571
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0118571

Many stakeholders

UN Oceans

CBD CTED ESCAP FAO IAEA ILO IMO IOC ISA DESA DOALOS ODA

OHRLLS UNCTAD UNDP UNEP UNESCO UNHCR UNIDO UNITAR UNU UNWTO WMO World Bank
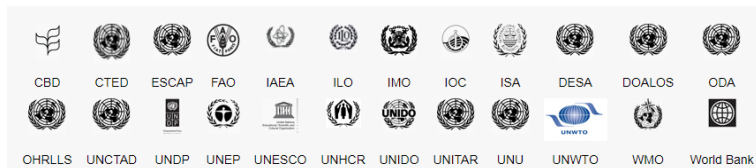
Plus other UN inter-agency and supported
- GESAMP: Joint Group of Experts on the Scientific Aspects of Marine Environment Protection
- GEF: Global Environment Facility
- IPCC: Intergovernmental Panel on Climate Change
- OneSharedOcean
- UNEP: Global Programme of Action for the Protection of the Marine Environment from Land-Bases Activities (GPA)
- DOALOS: The Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects

Regional
- APEC (Asia-Pacific Economic Forum): Ocean and Fisheries Working Group
- ASEAN: Southeast Asian Fisheries Development Centre (SEAFDC)
- CROP: Council of the Regional Organisations in the Pacific
- FAO: Asia-Pacific Fisheries Commission (APFIC)
- UN Environment: Coordinating Body on the Seas of East Asia (COBSEA); International Coral Reef Initiative (ICRI)
- World Bank: the Pacific Islands Regional Oceanscape Program (PROP)

Academic
- ICSU: International Council for Science
- Journal of Ocean and Coastal Economics

A partner mapping (to be continued)
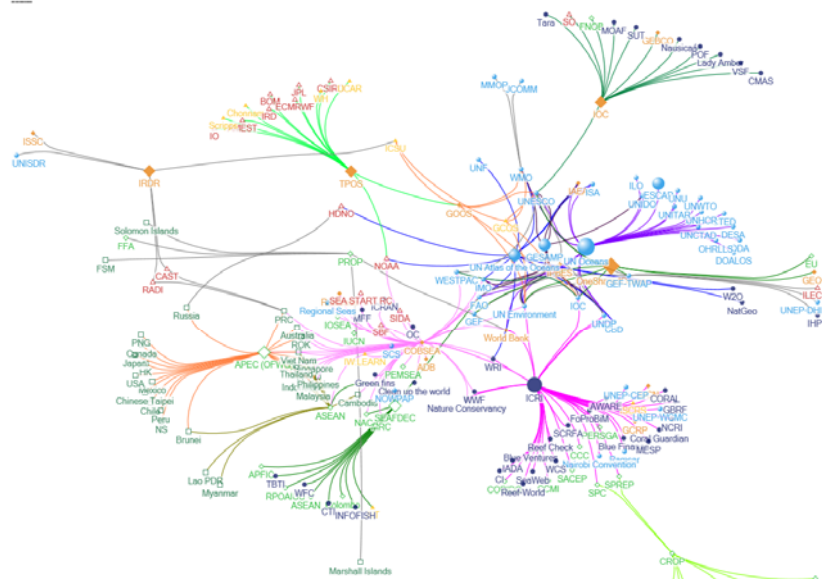
Take home points

- Land accounts and the spatial detail suggested by the SEEA-EEA will help countries build statistical capacity for addressing SDG 14 and SDG 15

- Ecosystem accounting is a spatially-detailed extension of the SEEA
    - It includes guidance on measuring ecosystem types, their condition, the services they provide
    - Especially SDG 15.9 (including ecosystem and biodiversity values)

- Oceans data and statistics are a new challenge since the SEEA has not been applied to oceans
    - There are many organizations working on different aspects of oceans and there are opportunities for harmonization of approaches to measuring SDG 14 and related indicators

Group discussion

- How important are oceans to your national context?

- Is there a national agency (or committee...) with a comprehensive view of oceans?

- Has your NSO conducted any work on oceans statistics?
  - If so, which topic?

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- Prepared by:
  - Michael Bordt
    - Regional Adviser on Environment Statistics
      ESCAP Statistics Division
      bordt@un.org

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  - Advancing Natural Capital Accounting, a collaboration between The United Nations Statistics Division (UNSD), United Nations Environment Programme (UNEP) and the Secretariat of the Convention on Biological Diversity (CBD) and is supported by the Government of Norway.
  - https://unstats.un.org/unsd/envaccounting/eea_project/default.asp
  - Contact: seea@un.org

- From report outline
  - What does SEEA NOT do? (partial lines in diagram?)
    - 2.3 Distinguish small/large scale fishers (beneficiaries)
    - 9.4 Technologies
    - 13.2 climate change measures in policies, plans
    - 14.1 (nutrient pollution)
    - 14.2 Legislation/policies/regulations/enforcement actions...
    - 14.3 Scientific cooperation
    - 14.4 Legislation/policies/regulations/enforcement actions...
    - 14.6 Legislation/policies/regulations/enforcement actions...
    - 14.7 Social dimension (beneficiaries)
    - 14.a Scientific knowledge, research capacity, technology
    - 14.b Social dimension (access to marine resources and markets)
    - 14.c Legislation/policies/regulations/enforcement actions...
    - General: International waters? CICES services? Spatial units?
  - EEA findings
    - Missing bits (e.g., CICES services → rethink)
  - Who's in charge?
  - Country examples (Canada, SA)
  - Global data sources (WCMC, others?)
  - Exercise?

SDG14 Targets and SEEA

SDG14 Targets	Issues/Cluster	Indicators	Related Environment Statistics/Accounts
14.1	Marine Pollution including from land based activities	14.1.1 Index of coastal eutrophication and floating plastic debris density	• SEEA Water, → SEEA Effluents • SEEA Waste • SEEA Ecosystem Conditions
14.2	Sustainable management and protection of marine and coastal ecosystems and strengthening resilience	14.2.1 Proportion of national exclusive economic zones managed using ecosystem-based approaches	• SEEA Environmental Protection Expenditures • SEEA Agriculture, Forestry and Fisheries • SEEA Aquatic resources
14.3	Climate change, ocean acidification and impact reduction on marine biodiversity and ecosystems (Cross cutting)	14.3.1 Average marine acidity (pH) measured at agreed suite of representative sampling stations	• SEEA Land → SEEA Ecosystem Condition; SEEA Ecosystem Biodiversity

SDG14 Targets and SEEA

SDG14 Targets	Issues/Cluster	Indicators	Related Environment Statistics/Accounts
14.4, 6	Sustainable management of fisheries and the elimination of fisheries subsidies that contribute to overfishing and IUU (Illegal, unreported and unregulated fishing)	14.4.1 Proportion of fish stocks within biologically sustainable levels 14.6.1 Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing	• SEEA Agriculture, Forestry and Fisheries • SEEA Aquatic Resources; • SEEA Environmental Protection Expenditures
14.7	Marine Protected Areas and effective management plans	14.5.1 Coverage of protected areas in relation to marine areas	• SEEA Land Accounts
14.8	Blue growth and increasing economic benefits for SIDS and LDCs from sustainable management of marine resources including fisheries, aquaculture and tourism **(Cross cutting)**	14.7.1 Sustainable fisheries as a percentage of GDP in small island developing States, least developed countries and all countries	• SEEA Agriculture, Forestry and Fisheries; SEEA Aquatic Resources

SDG14 Targets and SEEA

SDG14 Targets	Issues/Cluster	Indicators	Related Environment Statistics/Accounts
14.a, b, c	Means of Implementation including financial resources, capacity building and technology transfer and enhance conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea. **(Cross cutting)**	14.a.1 Proportion of total research budget allocated to research in the field of marine technology 14.b.1 Progress by countries in the degree of application of a legal/regulatory/policy/institutional framework which recognizes and protects access rights for small-scale fisheries 14.c.1 Number of countries making progress in ratifying, accepting and implementing through legal, policy and institutional frameworks, ocean-related instruments that implement international law, as reflected in the United Nation Convention on the Law of the Sea, for the conservation and sustainable use of the oceans and their resources	• SEEA Environmental Protection Expenditures

SEEA and SDG 14

Land

Water

Effluents

Aquatic

AFF

Waste

EPE

Ecosystem Conditions

Biodiversity

Ecosystem Services

14.1.1 Index of coastal eutrophication and floating plastic debris density

14.2.1 Proportion of national exclusive economic zones managed using ecosystem-based approaches

14.3.1 Average marine acidity (pH) measured at agreed suite of representative sampling stations

14.4.1 Proportion of fish stocks within biologically sustainable levels

14.5.1 Coverage of protected areas in relation to marine areas

14.6.1 Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing

14.7.1 Sustainable fisheries as a percentage of GDP in small island developing States, least developed countries and all countries

14.a.1 Proportion of total research budget allocated to research in the field of marine technology

14.b.1 Progress by countries in the degree of application of a legal / regulatory / policy/institutional framework which recognizes and protects access rights for small-scale fisheries

14.c.1 Number of countries making progress in ratifying, accepting and implementing through legal, policy and institutional frameworks, ocean-related instruments ...

SEEA and related SDGs

Energy

Emissions

Ecosystem Services

Biodiversity

2.3.2 Average income of small-scale food producers, by sex and indigenous status

9.4.1. CO_2 emissions per unit of value added

13.2.1 Number of countries that have communicated the establishment or operationalization of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development

15.5.1 Red List Index

15.9.1 Progress towards national targets established in accordance with Aichi Biodiversity Target 2 of the Strategic Plan for Biodiversity 2011-2020

SEEA and SDG 14

Land → Ecosystem Conditions

Water → Biodiversity

Effluents

Aquatic

AFF → Ecosystem Services

Waste

EPE

14.1 Reduce marine pollution

14.2 Manage and protect coastal ecosystems

14.3 Minimize and address the impacts of ocean acidification

14.4 Regulate harvesting, end overfishing, IUU and destructive fishing practices

14.5 Conserve at least 10% of coastal and marine areas.

14.6 Prohibit fisheries subsidies that contribute to overfishing and IUU.

14.7 Increase benefits to SIDS and LDCs from the sustainable use of marine resources

14.a Increase scientific knowledge, develop research capacity and transfer marine technology

14.b Provide access for small-scale artisanal fishers to marine resources and markets

14.c Enhance the conservation and sustainable use of oceans and their resources by implementing international law

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SEEA and related SDGs

Energy → Emissions

Ecosystem Services

Biodiversity

2.3 Double agricultural productivity and income of small-scale food producers [including fishers]

9.4 Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally-sound technologies...

13.2 Integrate climate change measures into national policies, strategies and planning

15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity, and prevent the extinction of species

15.9 Integrate ecosystem and biodiversity values into national planning, development processes, poverty reduction strategies and accounts.
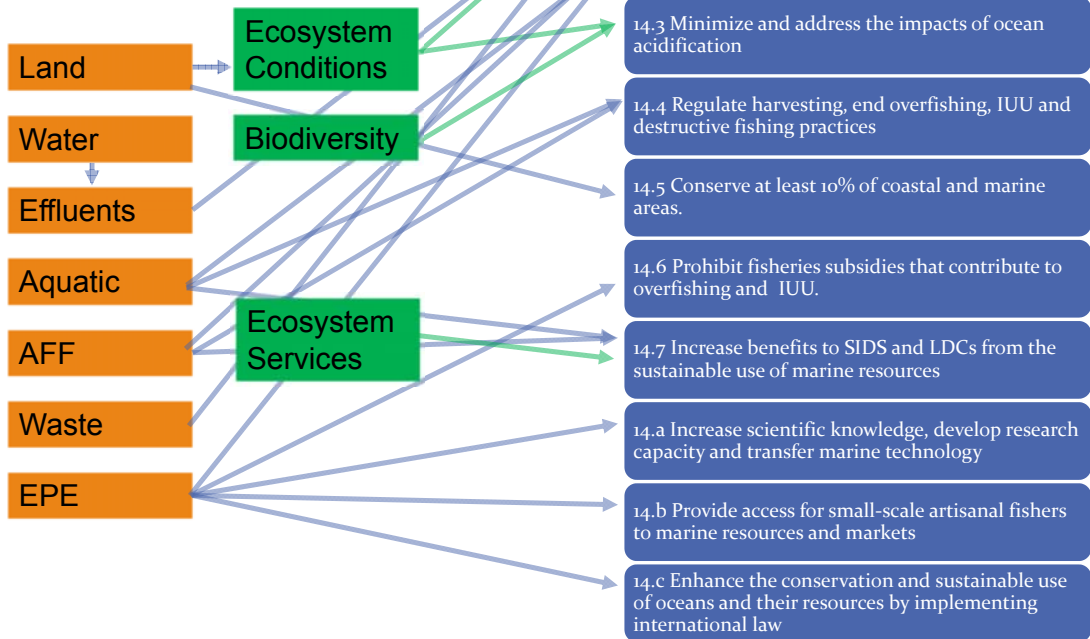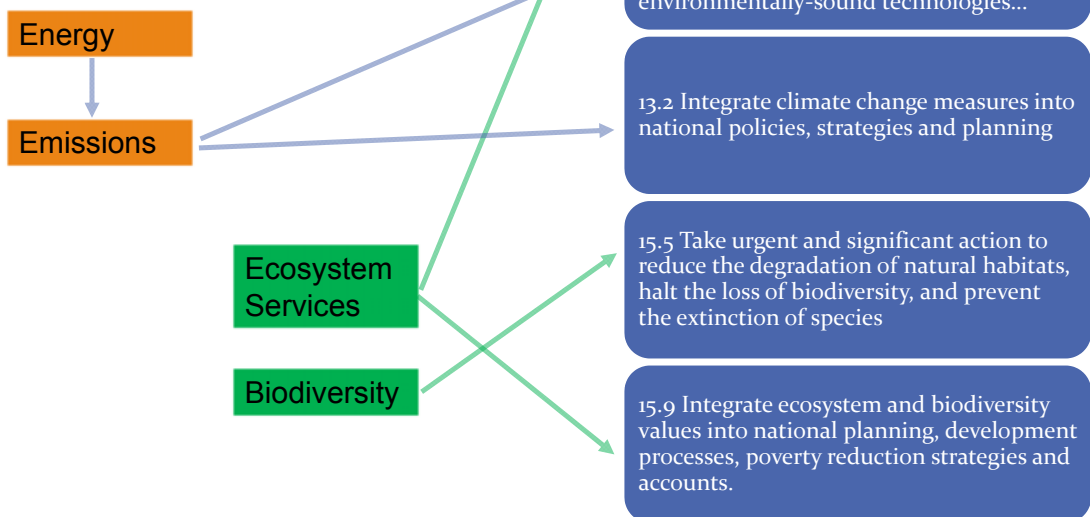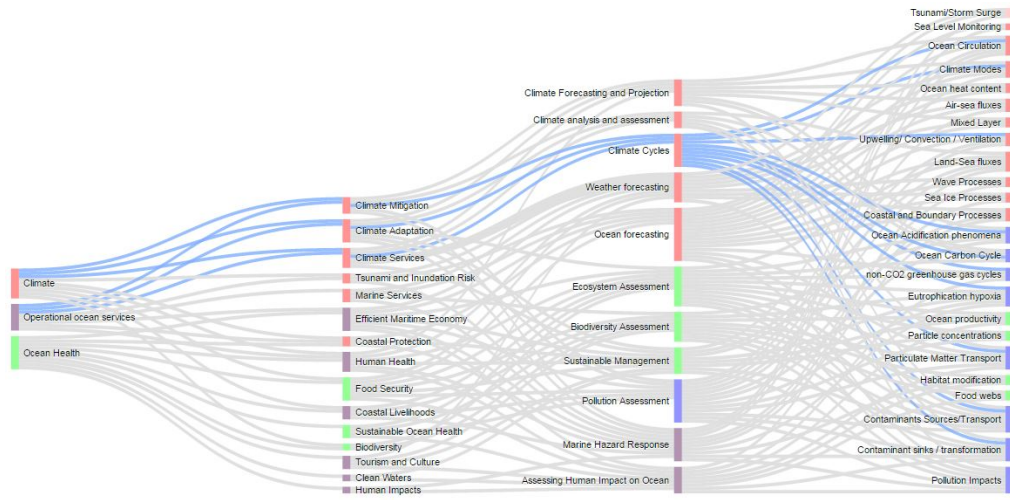
GOOS Strategic Mapping Tool

http://www.goosocean.org/index.php?option=com_content&view=article&id=120&Itemid=277