

Seamless earth system approach for European ocean observing

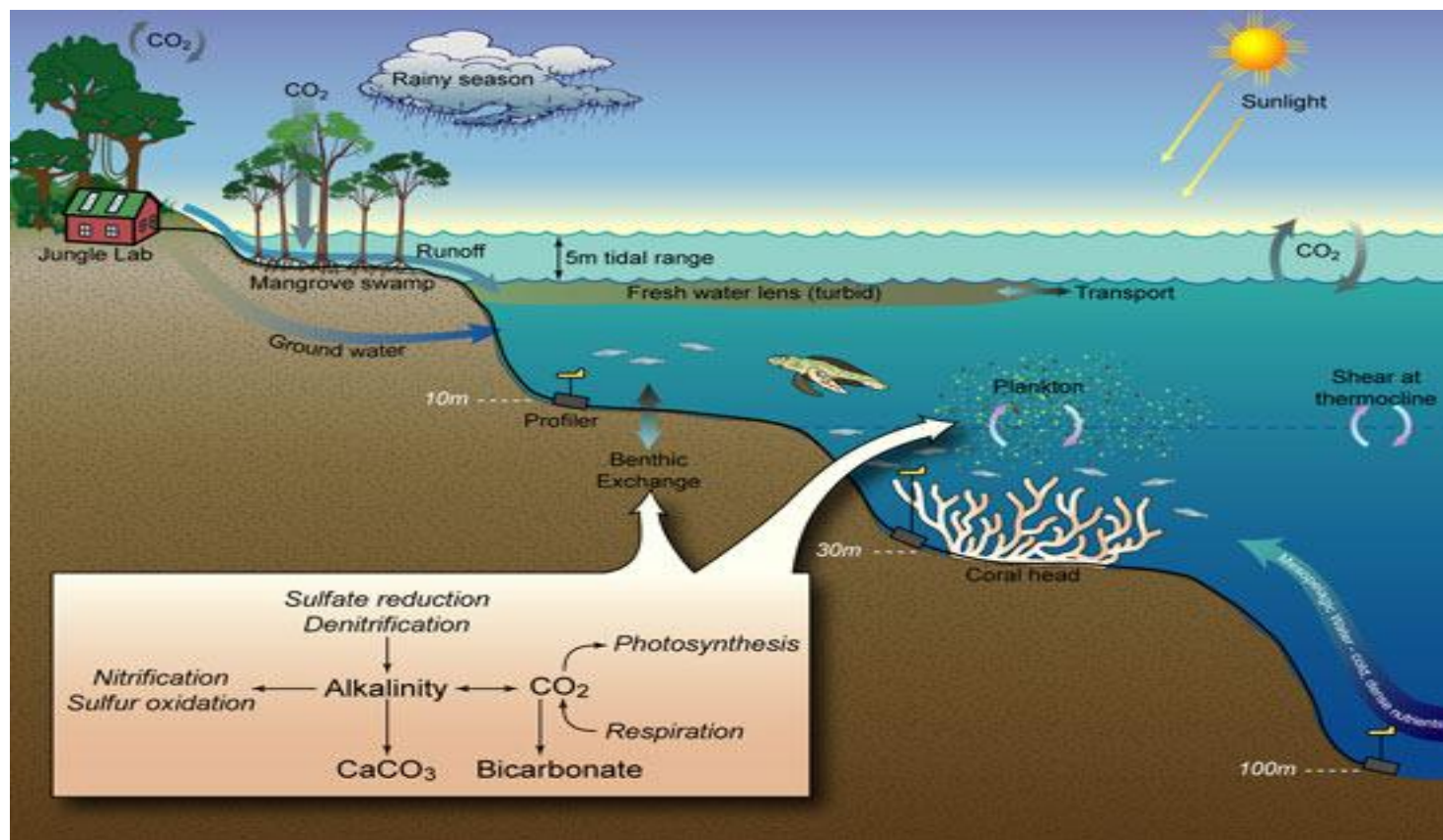
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Operational oceanography: an evolving concept

- **Users need marine system information for**
 - A healthy ocean for sustainable development
 - Safe and efficient ocean-related planning/operations
 - Implementing Green Deal

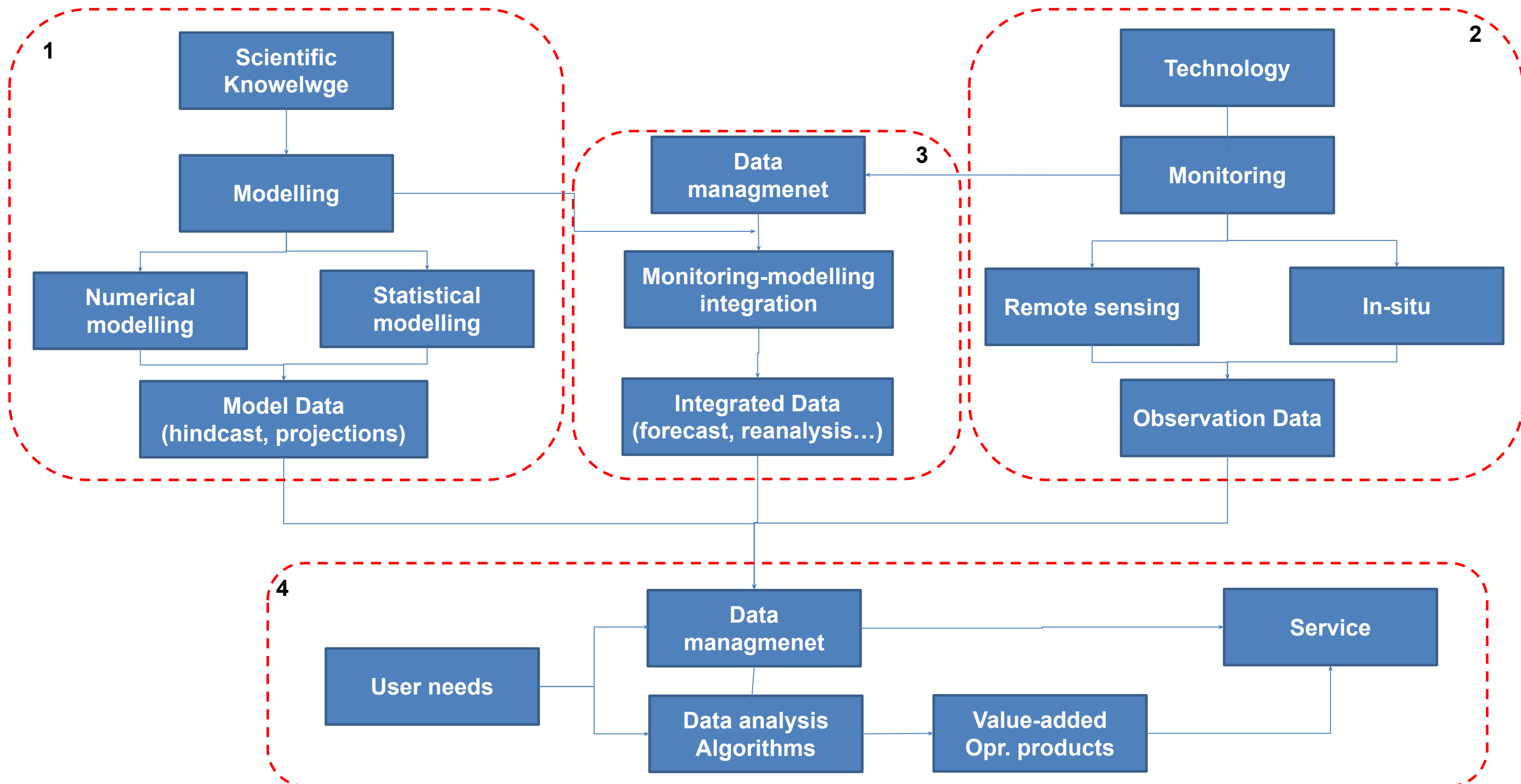


Operational Oceanography aims to provide seamless information service in:

- **Space:** air-water-seabed; estuary-coastal-open sea
- **Time:** real time – seasonal – climate; past-present-future
- **Subsystems:** physical-BGC-high trophic-anthropogenic

OO needs an integrated, seamless marine earth system monitoring and modelling.

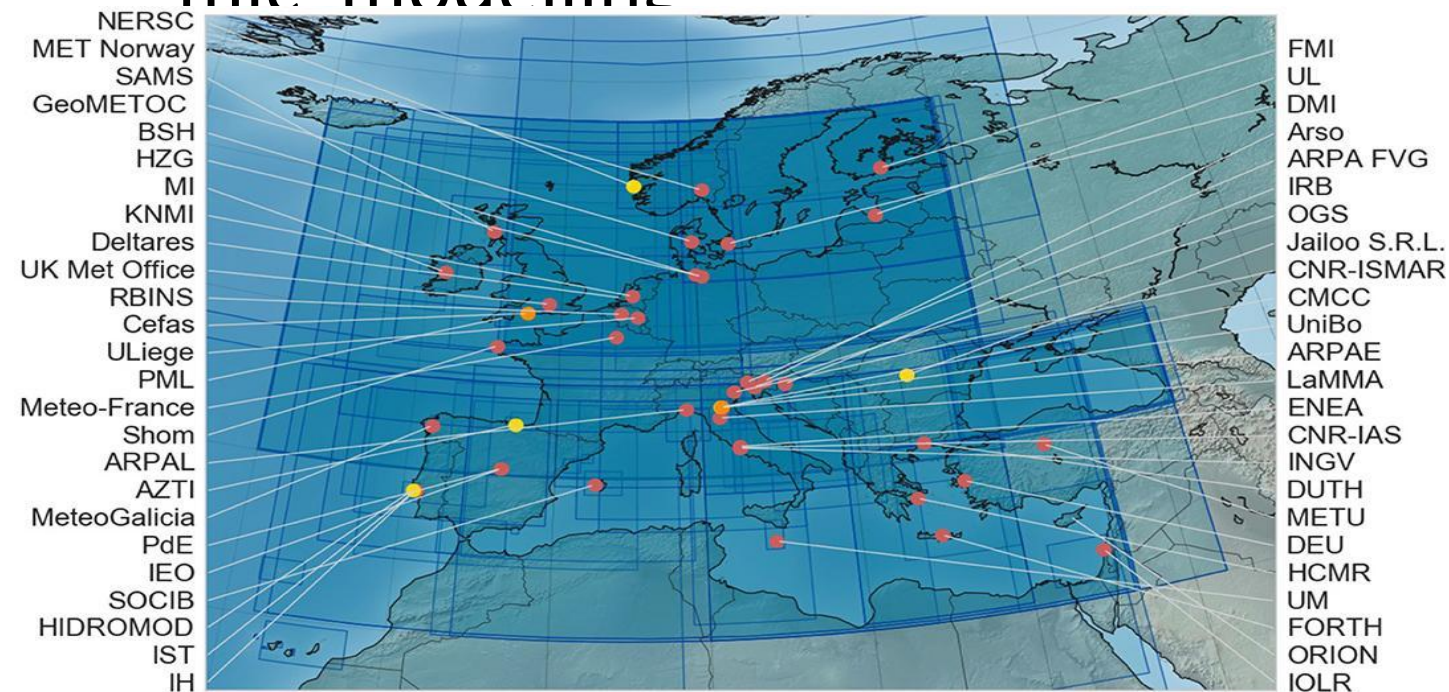
Operational Oceanography Workflow



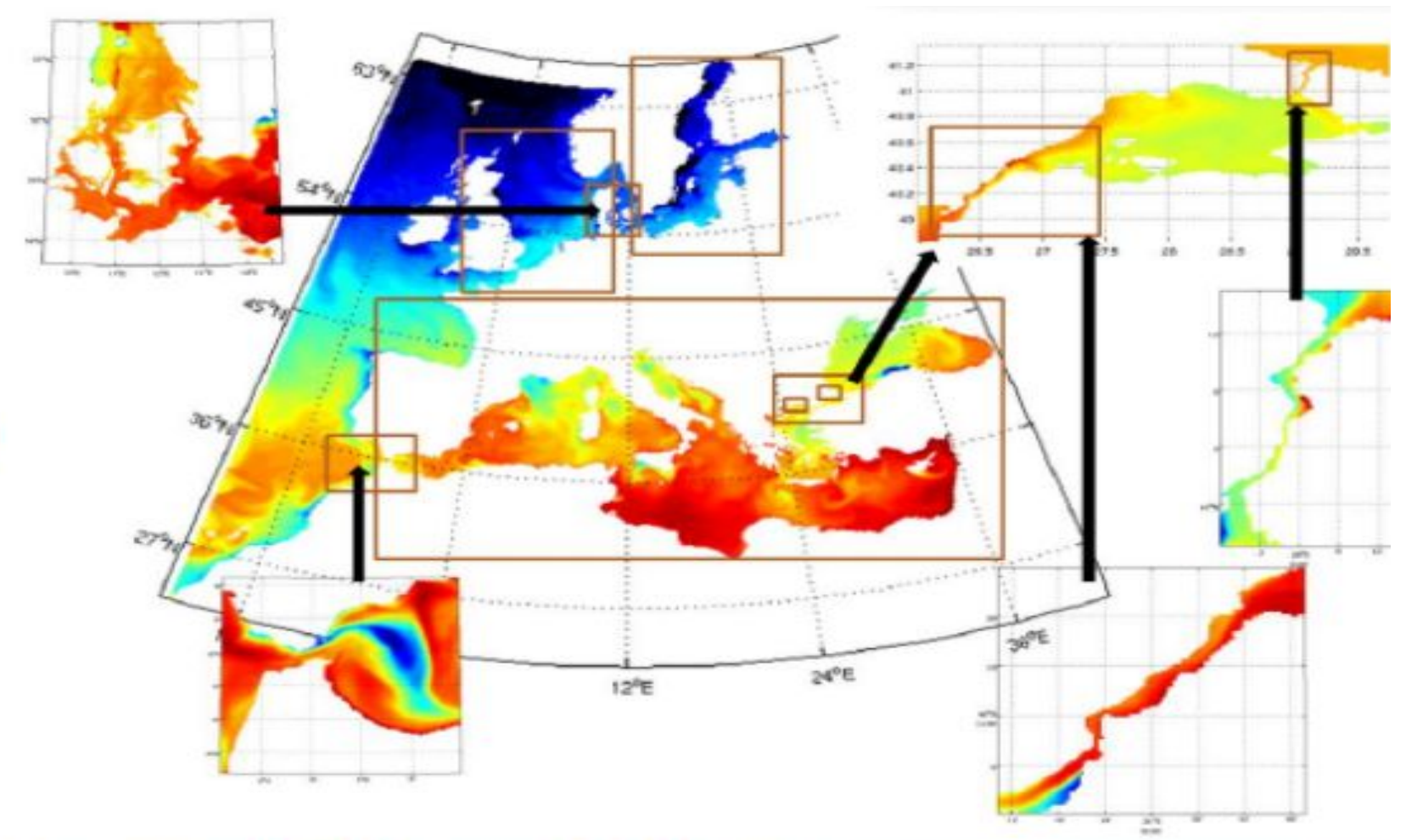
1 - Modelling; 2 - Monitoring; 3 – Monitoring-modelling integration; 4-Production and Service

Seamless modelling capacity developed in member states

- Open sea-coastal-estuary;
- Synoptic-climate (hindcast, nowcast, forecast and projections);
- End2end human pressure-physical-BGC-biological-socioeconomic modelling



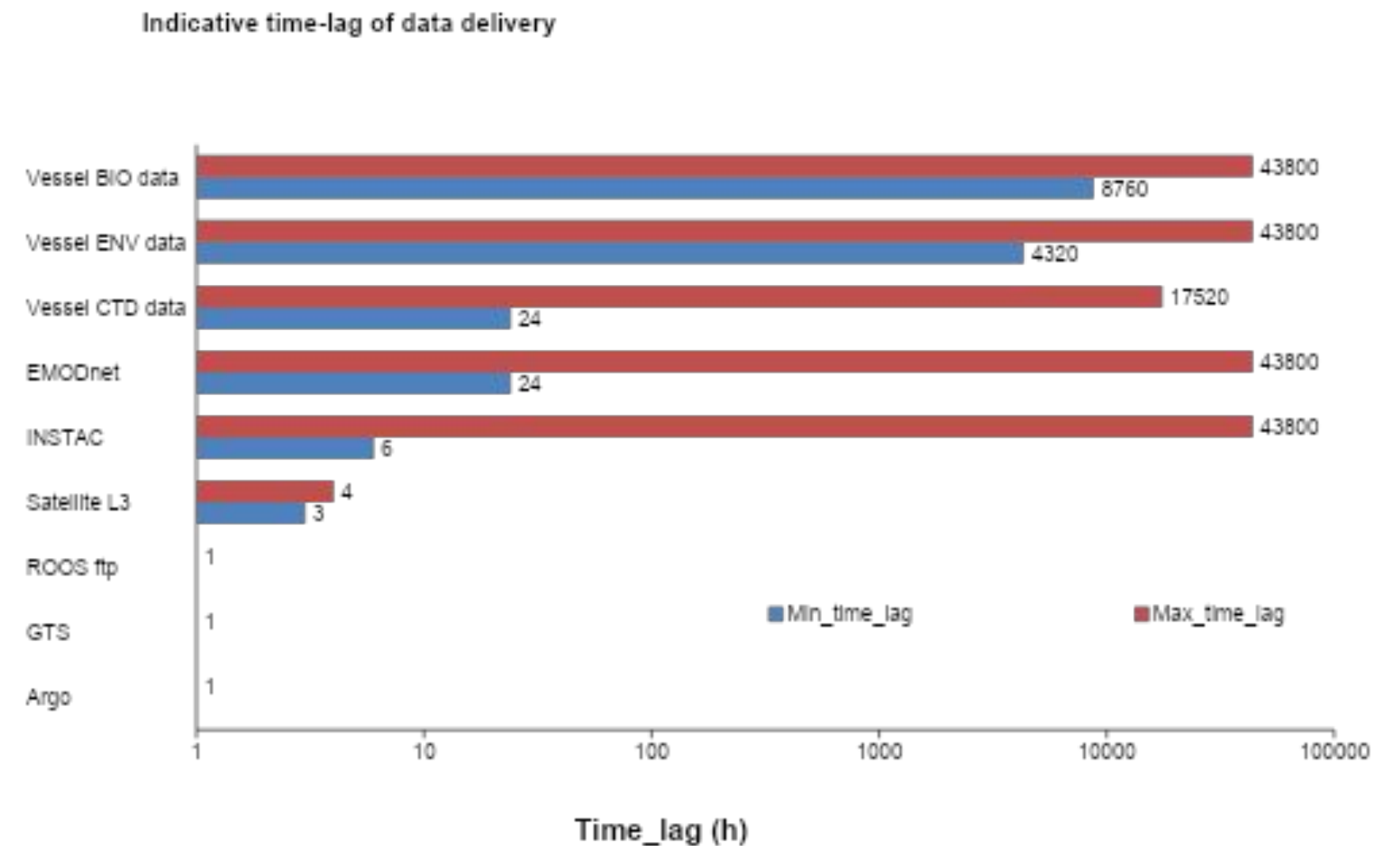
European operational ocean models, Capet et al., 2020



Pan-European Two-way nested ocean model HBM: 0.1-3nm resolution

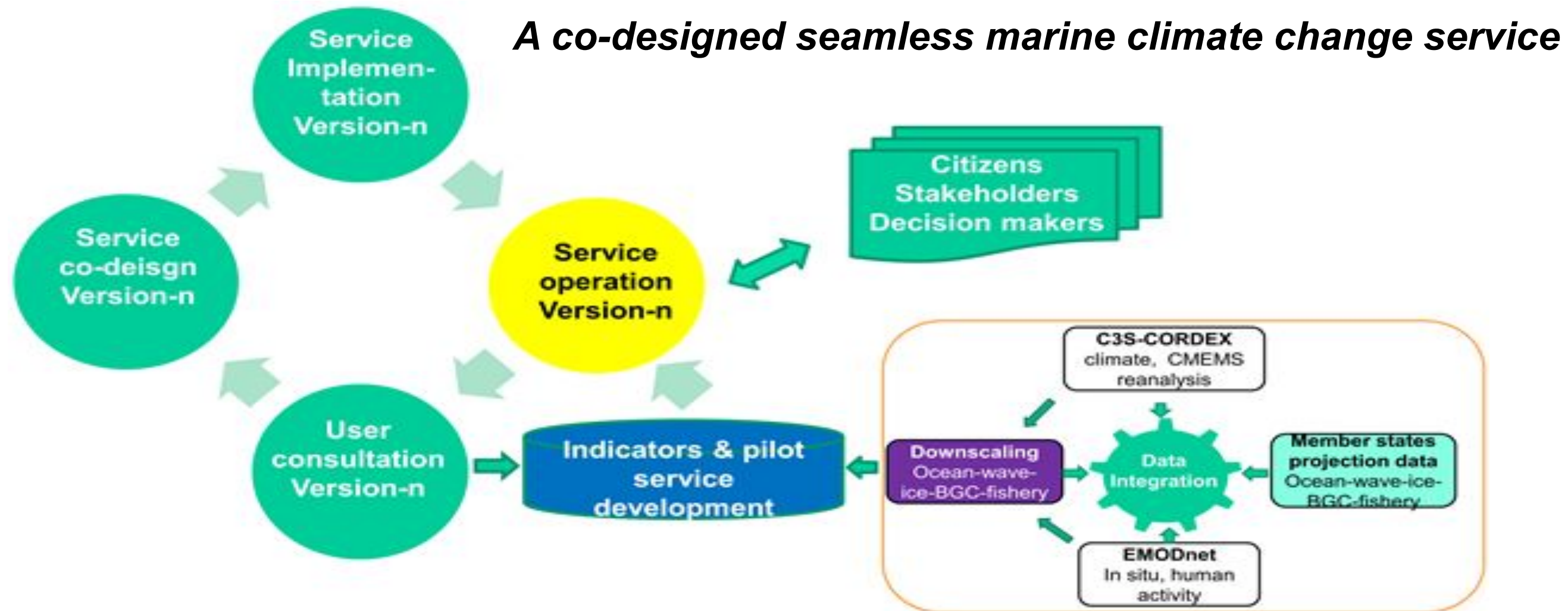
Fit-for-purpose data management

- **Integrated accessibility:** EMODnet, SeaDataNet, ICES, INSTAC etc.
 - Collect once, use many times
 - human activity-physical-BGC-biological-bathymetry-habitat
- **Needs for timely data**
 - Forecasting: 2-4 times/day; within 4h delay
 - Climate change adaptation: interim scale, max 1M delay
 - Ocean health: interim scale, 1-12M delay
- **Quality control**
 - Big challenge in NRT QC
 - Offline QC should also be improved



Marine climate service: Challenges and solutions

- **Marine pathways for Green Deal:** blue carbon, green shipping, blue energy, Aqua-farming & fishery, resilient coastal zone
- **Marine climate projection database:** quantify uncertainties
- **Develop marine climate analysis tools:** extremes and statistics of complex data
- **Climate indicators**

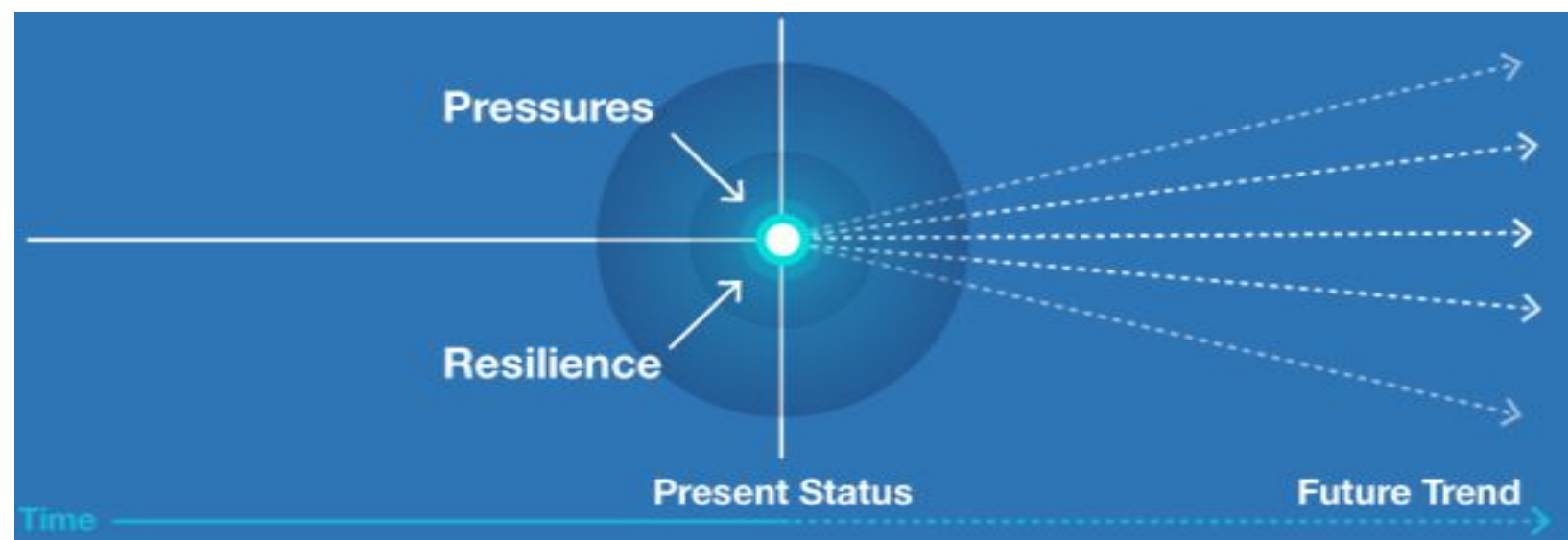


Information service for ocean health

- **Ocean health concerns**

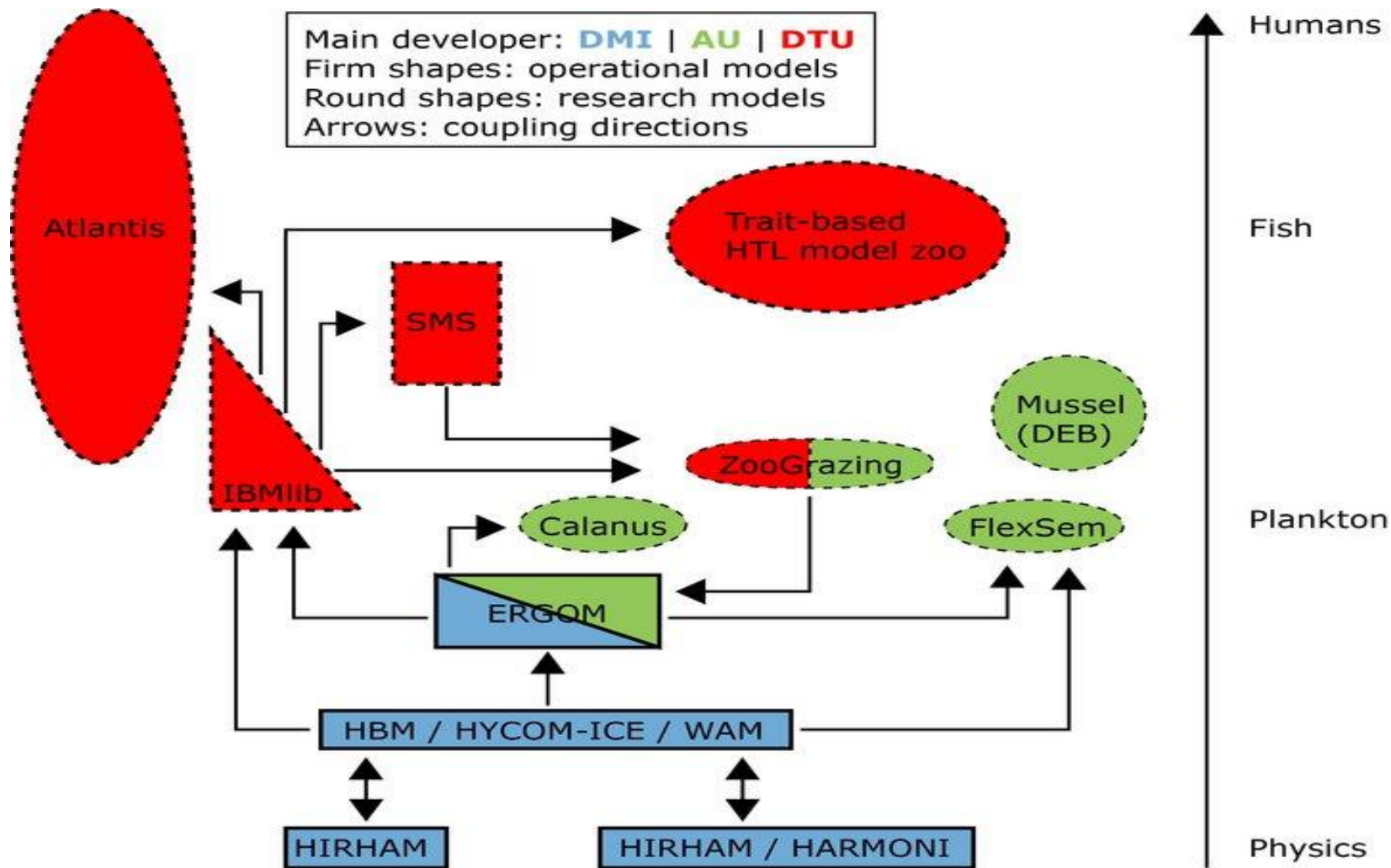
- Marine pollution
- Ecosystem Resilience
- Biodiversity

$$\text{Likely Future Status} = \text{Present Status} \times \{1 + (0.67 \times \text{Trend}) + 0.33 \times (\text{Resilience} - \text{Pressures})\}$$



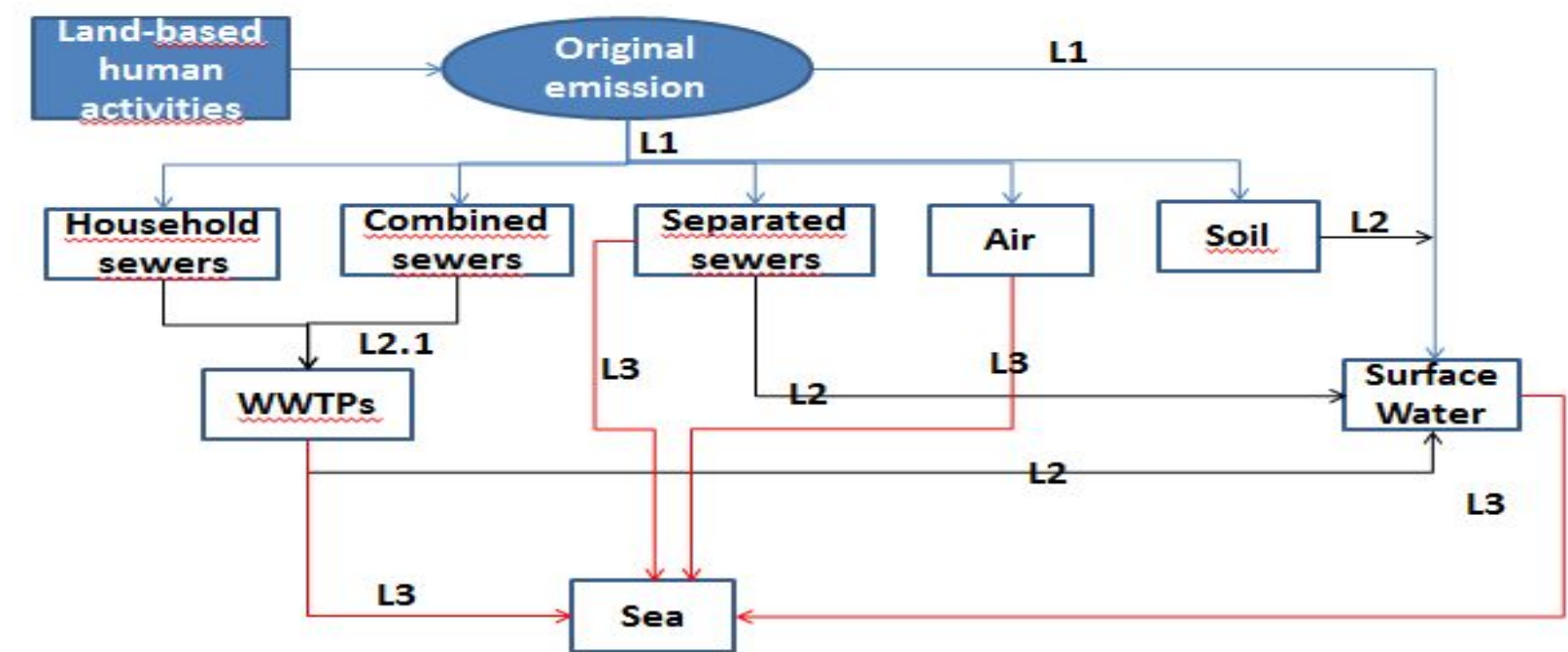
- **Operational Ecology** is a major EuroGOOS instrument for ocean health service, with products e.g.:
 - Interim reanalysis (1-12M)
 - Scenario projections
- Operational Ecology is based on monitoring-modelling integration and seamless modelling, with R&D priorities on e.g., filling knowledge gaps in interactions between climate change, ecosystem dynamics and human pressure
- Integration between ROOSs and climate communities, environmental and fishery monitoring and research communities are essential

Operational Ecology for clean ocean: examples

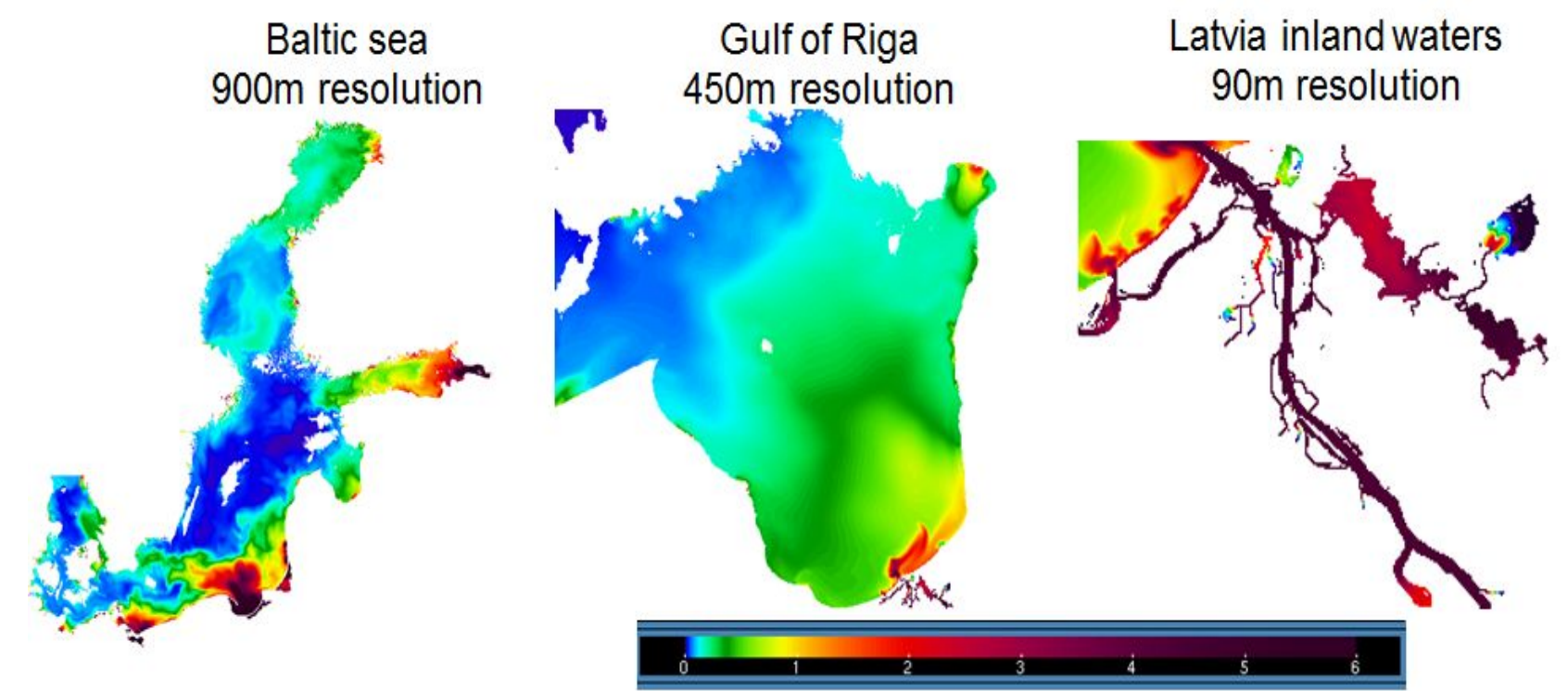


Danish Marine Ecological Modelling Centre Modelling Framework (www.memc.dk, since 2006)

Develop a MP source modelling framework

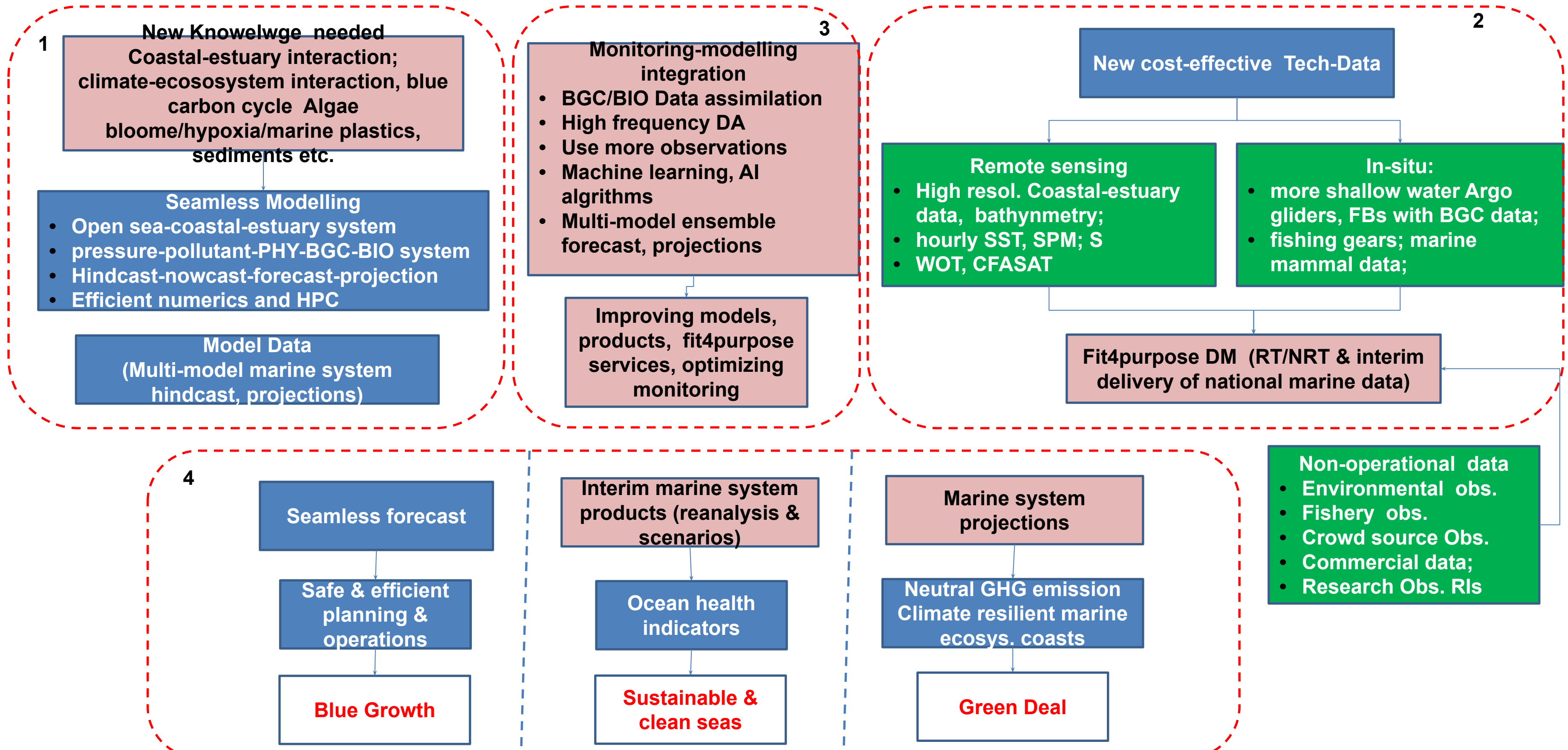


Transmission level in MP pathway:
 Level 1: to air, to sewers, to soil, to water
 Level 2: from L1 to separate sewers, combined sewers then to WWTPs and rivers
 Level 3: from surface waters, sewers, air and coastal catchments to the sea



Marine plastic modelling from open sea to coastal to inland rivers

Emerging OO capacities, gaps and opportunities





Thank you!