

# Ocean integration: The needs and challenges of effective coordination within the Ocean Observing System

**Based on a collective work from:**

Révelard A, Tintoré J, Verron J, Bahurel P, Barth JA, Belbéoch M, Benveniste J, Bonnefond P, Chassignet EP, Cravatte S, Davidson F, deYoung B, Heupel M, Heslop E, Hörstmann C, Karstensen J, Le Traon PY, Marques M, McLean C, Medina R, Paluszkiwicz T, Pascual A, Pearlman J, Petihakis G, Pinardi N, Pouliquen S, Rayner R, Shepherd I, Sprintall J, Tanhua T, Testor P, Seppälä J, Siddorn J, Thomsen S, Valdés L, Visbeck M, Waite AM, Werner F, Wilkin J and Williams B (2022) **Ocean Integration: The Needs and Challenges of Effective Coordination Within the Ocean Observing System**. *Front. Mar. Sci.* 8:737671. doi: [10.3389/fmars.2021.737671](https://doi.org/10.3389/fmars.2021.737671)

# Ocean integration: what does it mean?

Ocean = **complex system** → need to **combine**

- multiple **disciplines**
- multiple ***in-situ* + *remote* observations**
- multiple **numerical models**
- multiple **(*and nested!*) spatiotemporal scales**

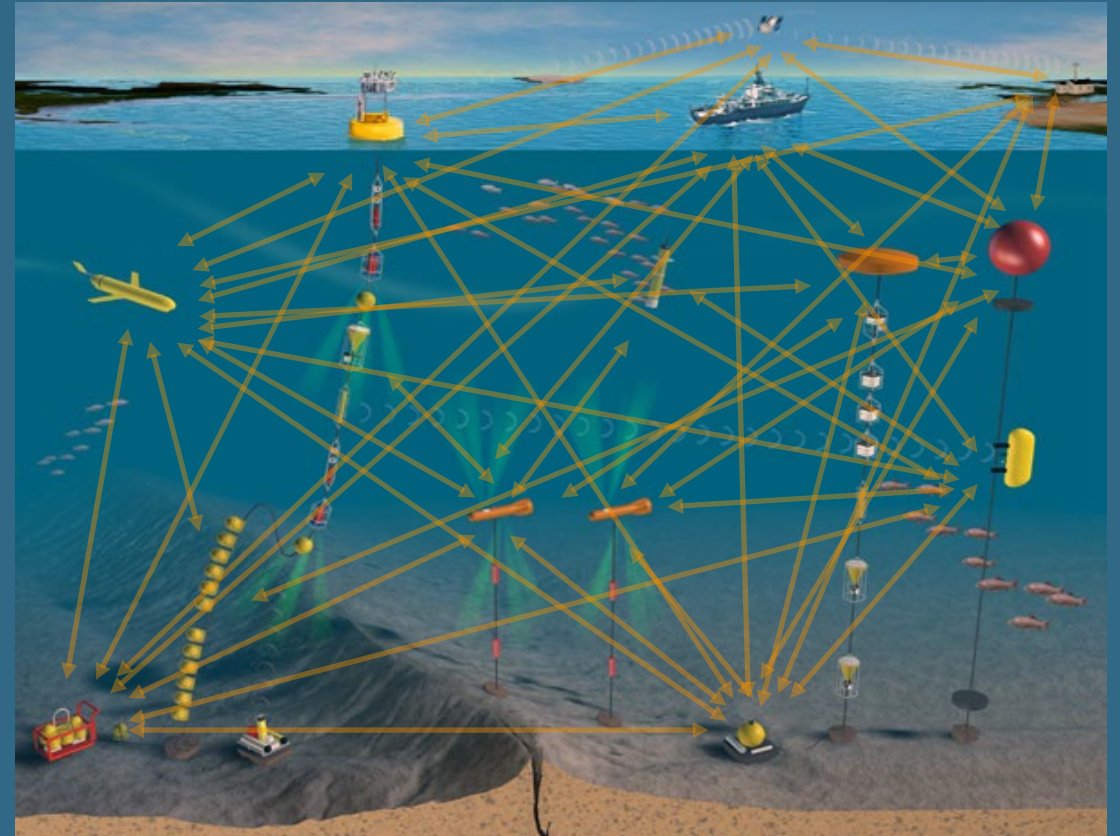
“Ocean integration”

=

**optimally coordinate** all these elements

so they are **shaped to each other**

and **form a coherent whole**



Adapted from NOAA

# Ocean integration: why do we need it?

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## Current issues:

- **Observing networks only partially adequate**
  - Gaps in ocean observing coverage
  - Some processes insufficiently measured
- **Most observations cannot be used to their full extent**
  - Most observations are not FAIR
  - Most observations are not fit-for-multiple purposes
- **Duplication of effort**
  - Little communication between teams, institutions or nations
  - Non-optimum use of resources

*Global Ocean Science Report, 2017; 2020  
IOC, 2017;  
NASEM, 2017; 2020  
EOOS, 2018;  
IPCC, 2019;  
EMB, 2013, 2019;;  
OceanObs'19;  
Tanhua et al. 2019;  
Davidson et al. 2019*

# Ocean integration: why do we need it?

## Current issues:

*Global Ocean Science Report, 2017; 2020*  
*IOC, 2017;*  
*NASEM, 2017; 2020*  
*EOOS, 2018;*  
*IPCC, 2019;*  
*EMB, 2013, 2019,;*  
*OceanObs'19;*  
*Tanhua et al. 2019;*  
*Davidson et al. 2019*

- **Gaps in ocean observing coverage**

- Important processes insufficiently measured
- Observing networks only partially adequate for addressing new scientific challenges
- Observing networks do not resolve multiple spatiotemporal scales

- **Insufficient sharing**

- Lots of observations are not FAIR
- Most observations cannot be used to their full extent
- Difficulties in implementing data assimilation and model verification

- **Duplication of effort**

- Little communication between teams, institutions or nations
- Observations generally not fit-for-multiple purposes
- Non-optimum use of resources



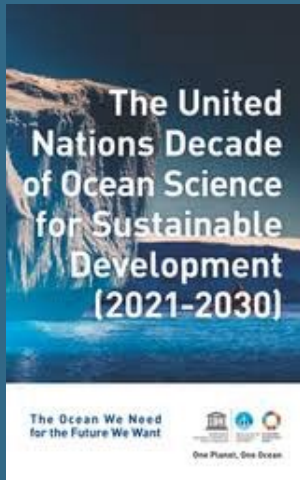
Data do not exist

Data exist but they are not available

Data exist but they are not fit-for-use

(EOOS, 2018)

# Ocean integration: why do we need it?



Strong societal expectations

Ocean integration is **essential** to

**commensurate** with the **ambition** of

the **UN Decade of Ocean Science**

and the **Digital Twin of the Ocean**



# Ocean integration: why do we need it?

“Building a Digital Twin will require  
**more than connecting and  
improving what we already have”**

It will require:

- A **complete disruption and paradigm shift in the way we think and work**
- Building a **common vision and framework**



A Digital Ocean Forum  
For Europe

**HIGHLIGHTS**



## » The European DTO is launched

At the One Ocean Summit hosted by the French Presidency of the Council of the EU in February 2022, more than 40 countries united to put the Ocean at the heart of the international political agenda.

To strengthen EU leadership in protecting the Ocean, European Commission President von der Leyen launched the European Digital Twin Ocean (DTO) to support the framework of the EU Mission Restore Our Ocean and Waters by 2030 and to enable the ambition of the European Green Deal.

At the One Ocean Summit, von der Leyen explained:

*"The ocean is still largely a great mystery for humankind. That is why Europe is building a digital twin of the ocean. We are connecting our assets – like the Copernicus satellites, marine infrastructure like icebreakers, buoys and underwater drones, and high-performance computing. We will gather the raw data and turn it into real-time knowledge and longer-term predictions. We are putting the power of the digital revolution at the service of our climate. (...) Thanks to the EU and its Member States, a digital twin should be operational by 2024. It will make ocean knowledge open-access, available to citizens, scientists and policymakers around the world. It will be a platform for global cooperation. It is about putting the capabilities in place to achieve the commitments we make at this Summit. Together, with the digital twin, we will turn the lights on in the ocean."*

The European Commission is investing €13 million to develop a core European DTO. This complements the €19 million project, *Iliad*, funded under the Green Deal Call for research proposals to pilot the DTO concept.

On 20 April 2022, more than 70 experts from 20 countries across Europe came together in Paris to develop a common vision for a European DTO and agreements on how to move forward together to meet this transformational challenge.

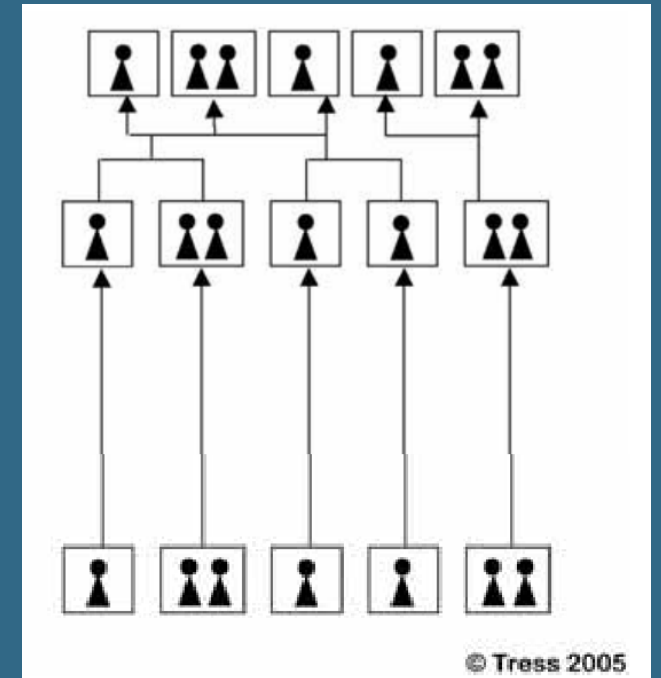
# Ocean integration: why is it challenging?

Ocean observing suffer from **organisational silos** because:

- **Research-based** system, driven by discovery and understanding
- **Discipline/platform-oriented** organization
- **Disparate** landscape
- **Fragmented** governance, with weak leadership
- **Hypercompetitive** culture, driven by scientific “excellence”
- **Unpredictable** funding



Platforms/networks/disciplines tend to run in parallel



# Ocean integration: why is it challenging?

Ocean integration requires to  
**transcend** the traditional  
**silos of expertise**



*Photo by: libertygall/Getty Images*

A challenge in many **transdisciplinary research areas...**  
and also **in the private sector and economy!**



# Ocean integration: why is it challenging?

The **silos of expertise** = a problem in many **transdisciplinary research areas...**

...and also **in the private sector!**

## Common solutions for connecting silos:

1. Define a **common goal**
2. Have a **strong leadership**
3. Stimulate high-level **interpersonal skills**
4. Remove **internal competitiveness**
5. Redesign the **organizational structure**



Photo by: libertygal/Getty Images

# Ocean integration: a call for transformative changes

## Ocean integration could be achieved through:

- **Building a mission-based organisation**

- Redesigning a robust governance structure
- Agreeing on a common agenda & principles
- Establishing clear design & implementation plan

- **Reaching sustainability**

- Elaborating sustainable funding strategies
- Efficiently communicating the value of ocean observing
- Facilitating the transition from research to operations

- **Promoting a culture shift**

- Connecting the diverse communities
- Fostering FAIR data and best practices
- Redefining scientific "excellence"

**frontiers**  
in Marine Science

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## Ocean Integration: The Needs and Challenges of Effective Coordination Within the Ocean Observing System

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