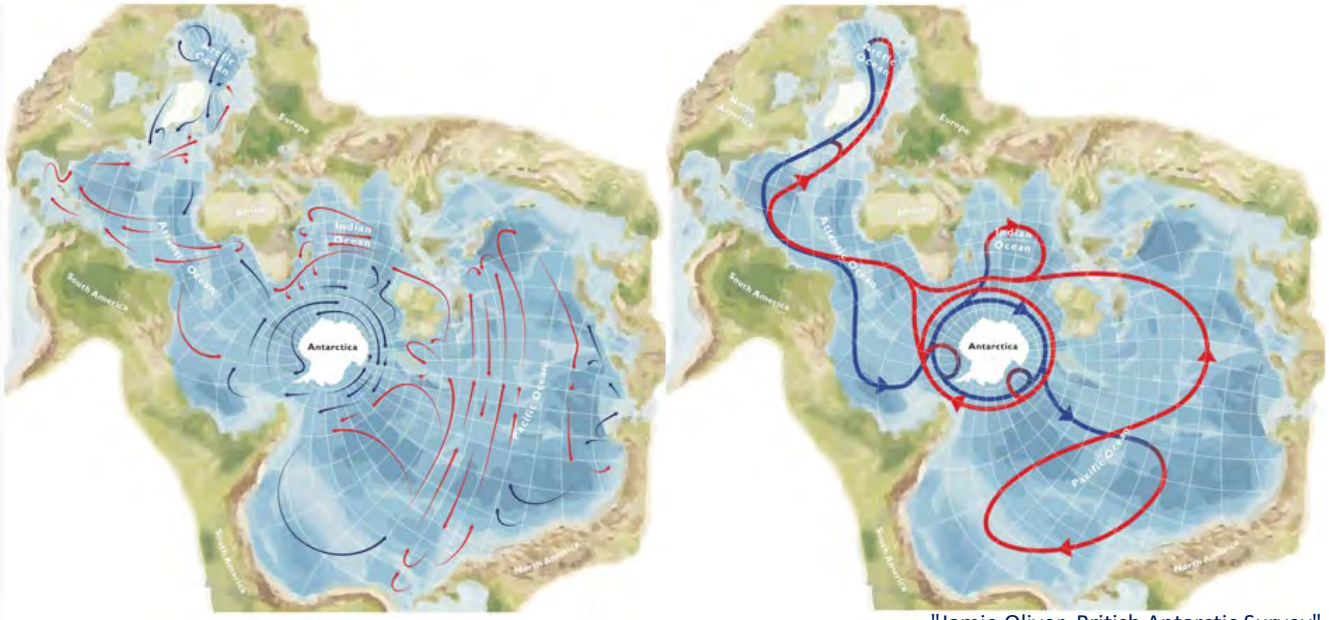
Digital Twins of the Ocean - DITTO

DITTO Digital Twins of the Ocean

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Opportunities of Digital Twins of the Ocean to Future-Proof Sustainable Development



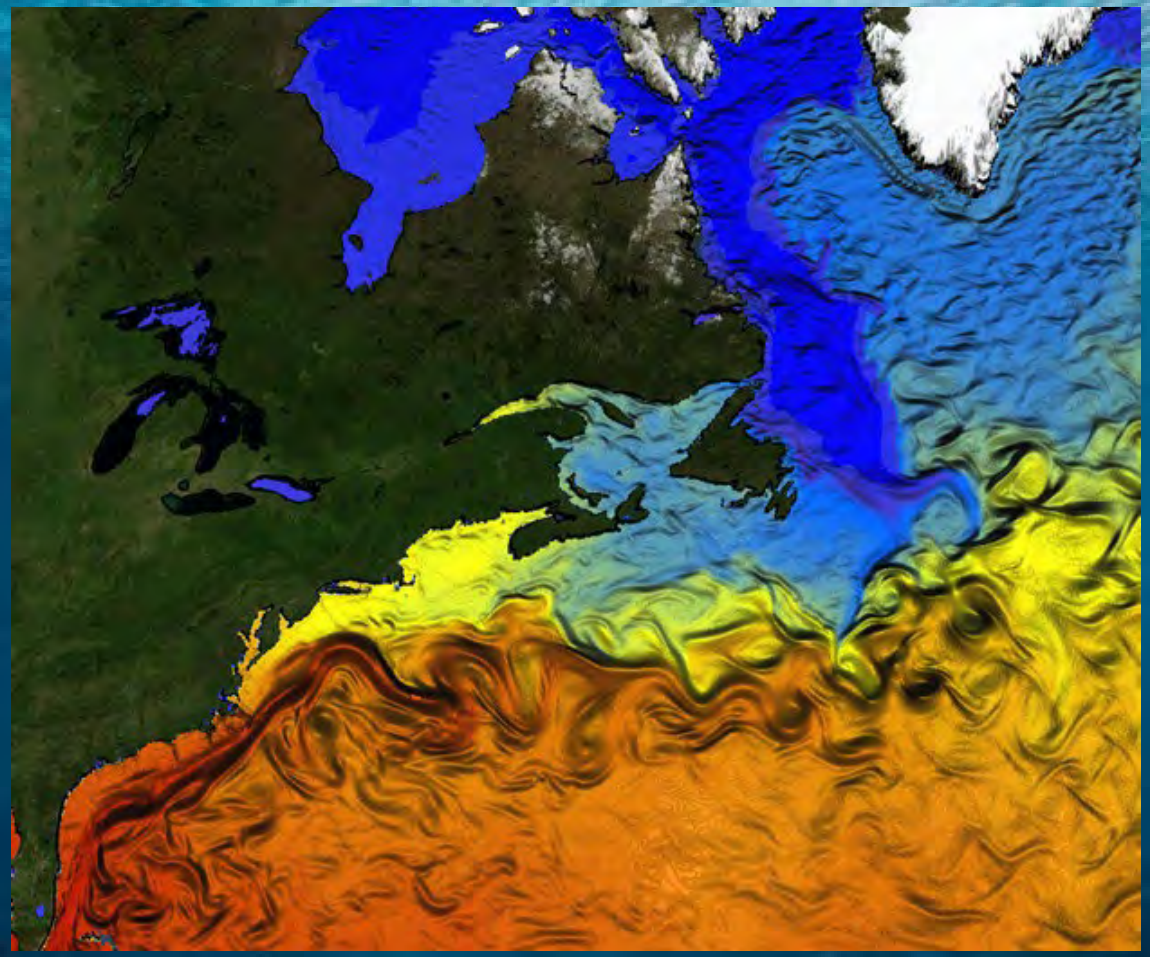
"Jamie Oliver, British Antarctic Survey"

GEOMAR

Martin Visbeck
GEOMAR Helmholtz Center for Ocean Research Kiel
Kiel University, Germany

https://ditto-oceandecade.org

Ocean Observations and Models



Digital Twins of the Ocean

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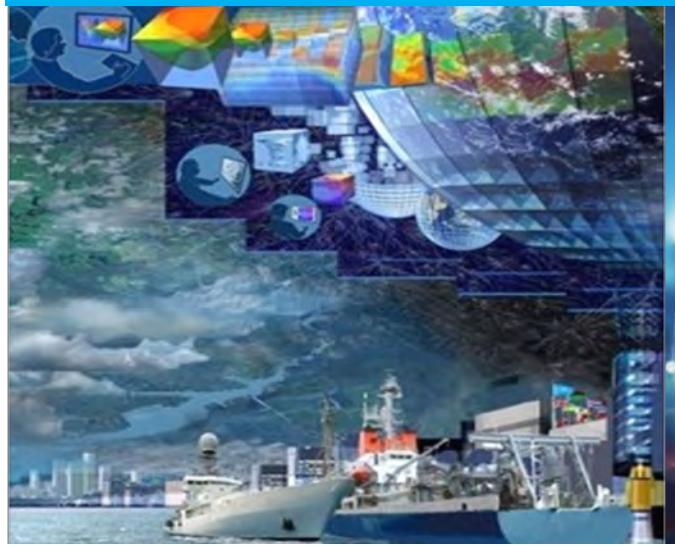
Observations	Data	Knowledge



Digital Twins of the Ocean are a virtual representation of the real ocean and have a two-way connection with it. Observations from the real ocean change and refine the twin; manipulating the twin can highlight regions of the real ocean in need of better or different observations.

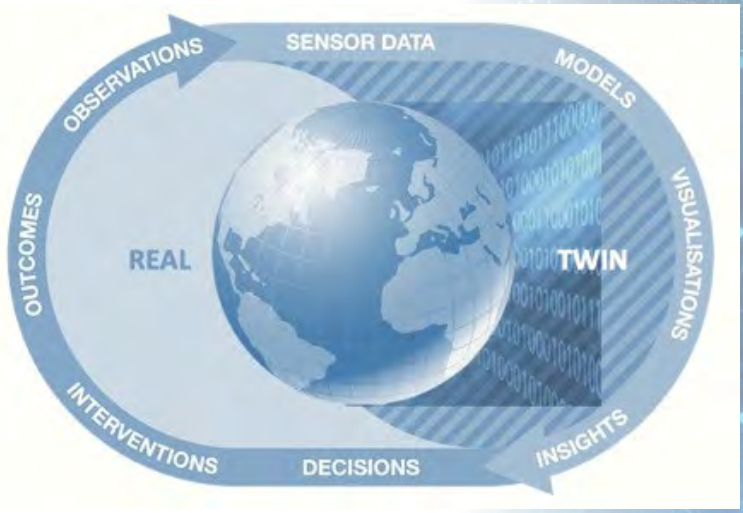
Digital Twins will enable users to address 'What if' questions based on shared data, models and knowledge.

Digital Twins of the Ocean - DITTO

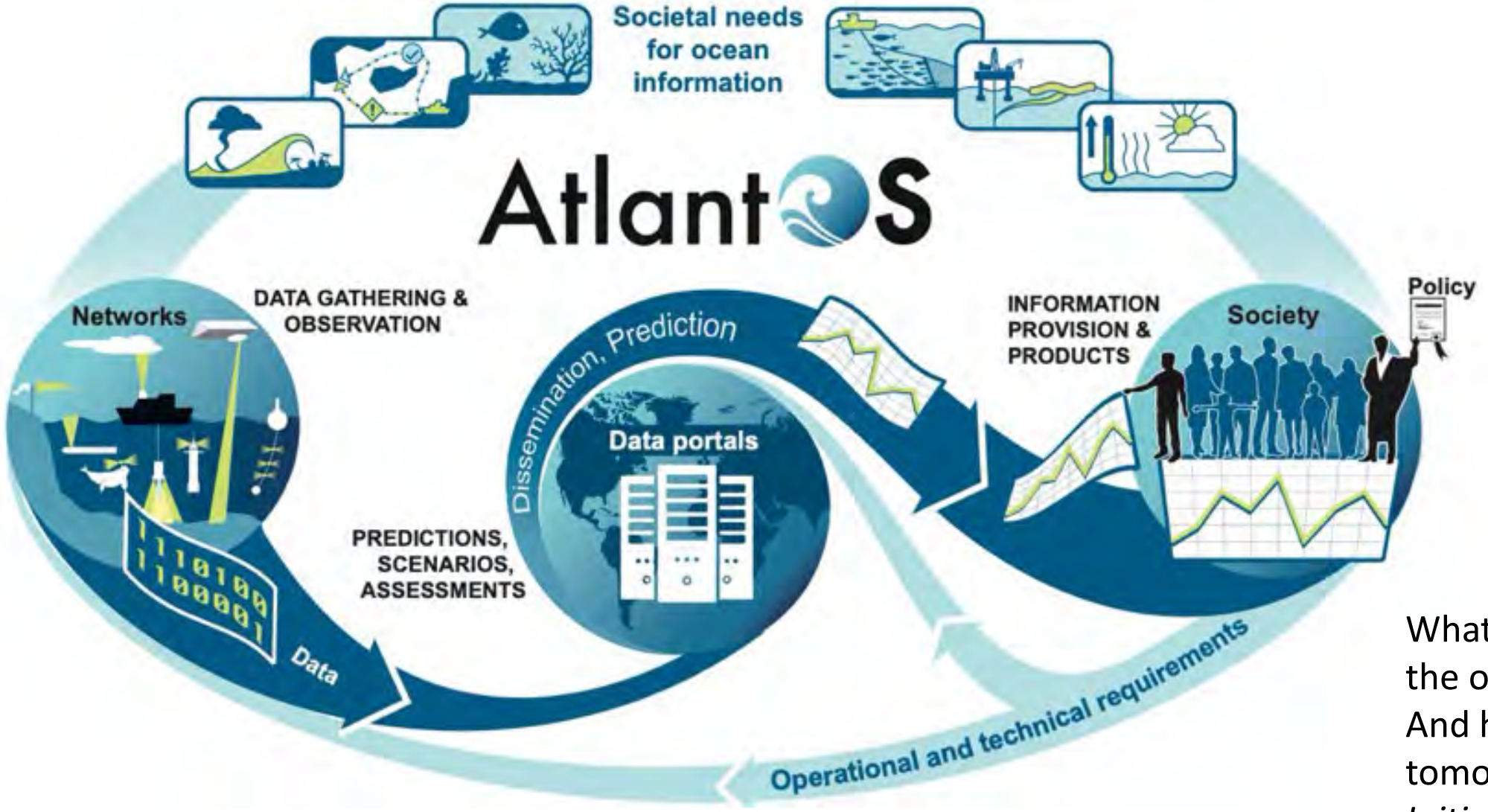
Value chain and frames of intervention

Ocean Information **supporting Services**

Ocean Information **assessing Interventions**



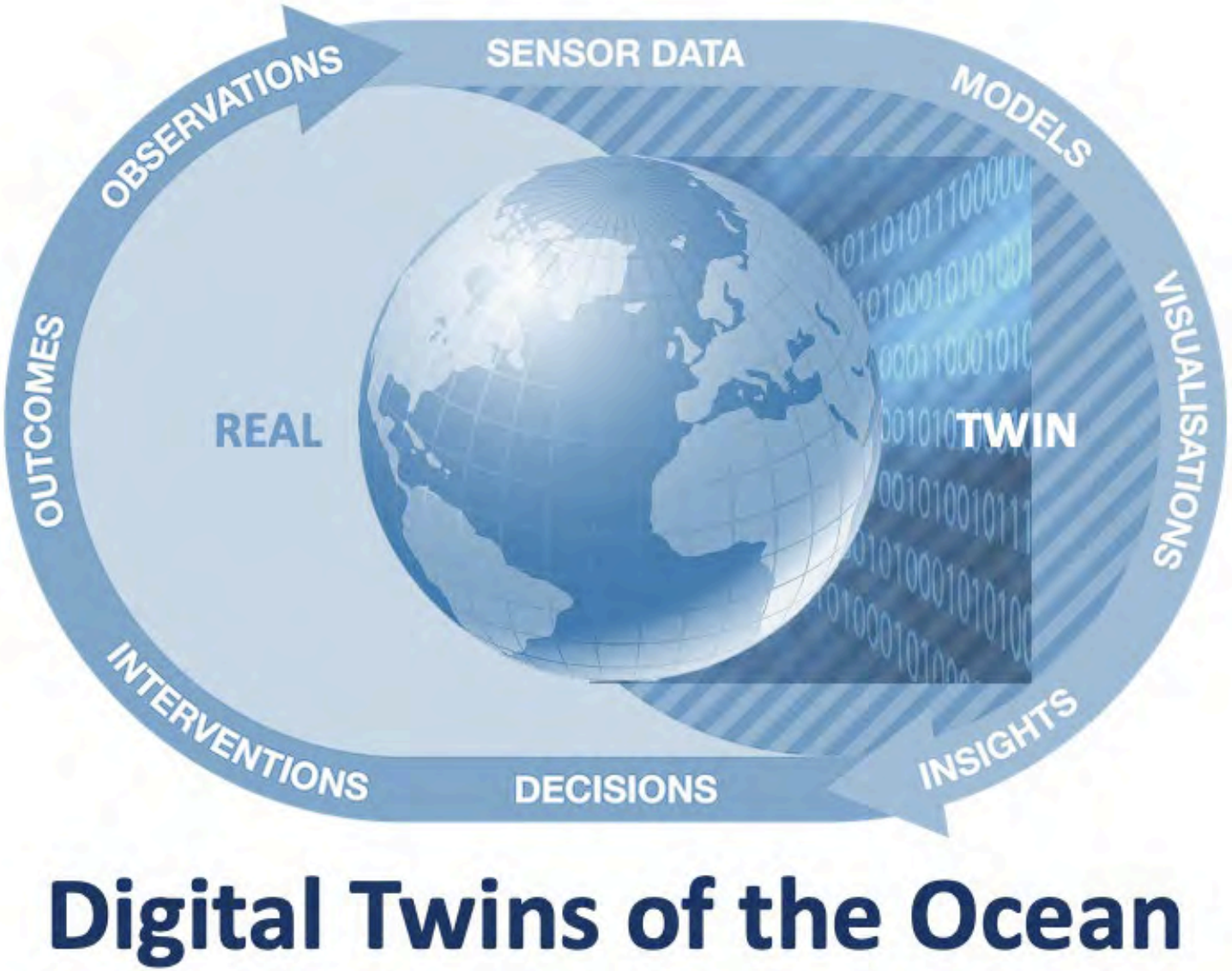
Ocean Observation and Information Value Chain



Ocean Information **supporting Services**

What is the state of the ocean today?
And how will it change tomorrow?
Initial Value Probelm

Ocean Simulation Digital Twin Framework

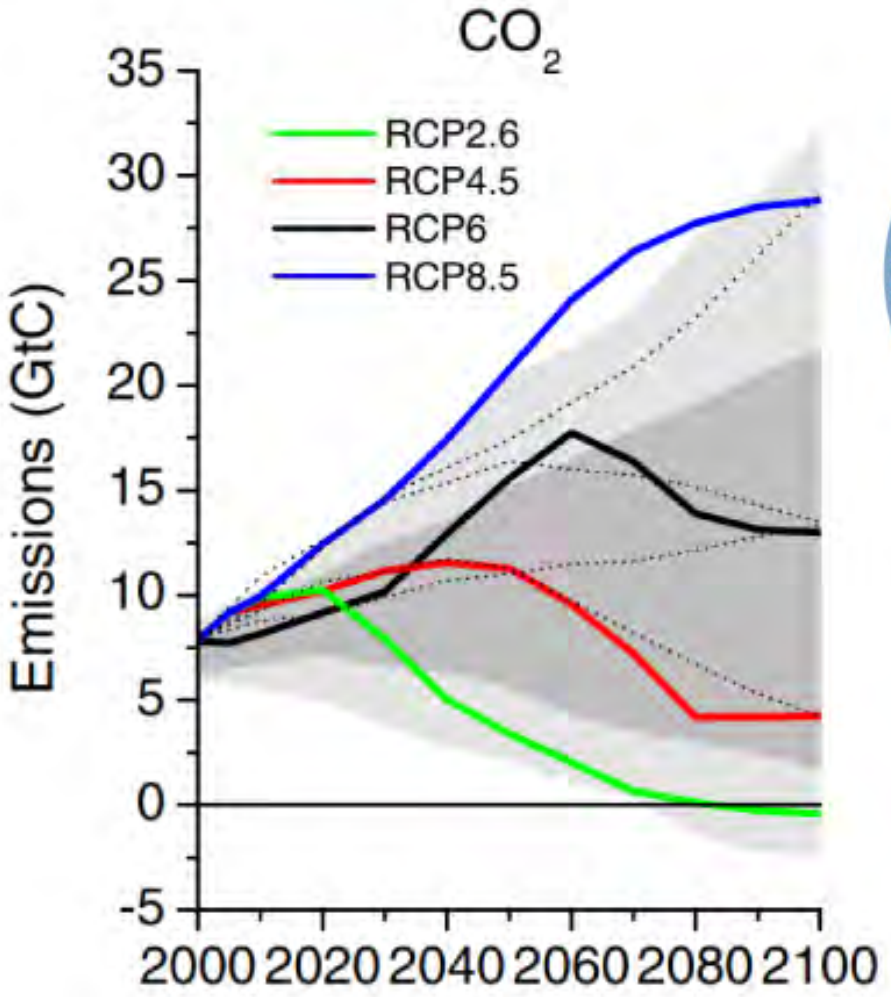


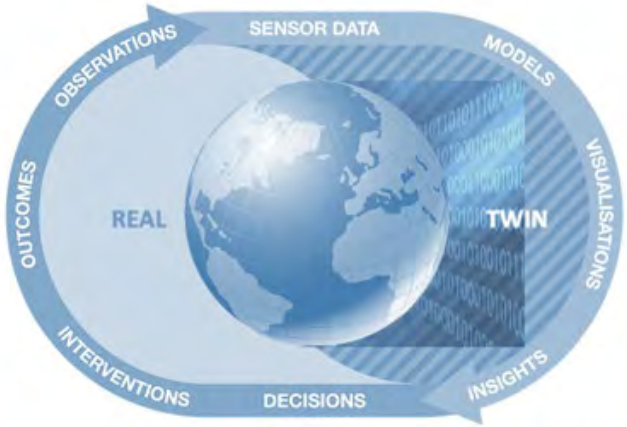
Ocean Information **assessing Interventions**

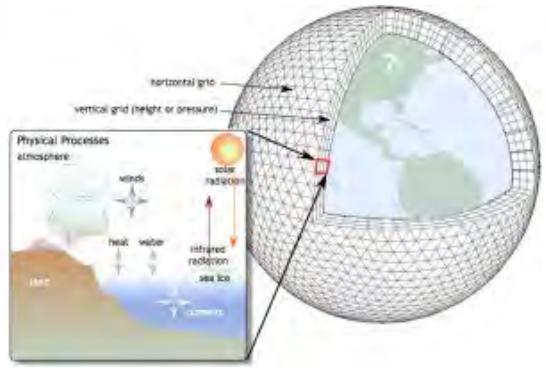
What – If Scenarios
How will the ocean change if humans act?
Boundary Value Probelm

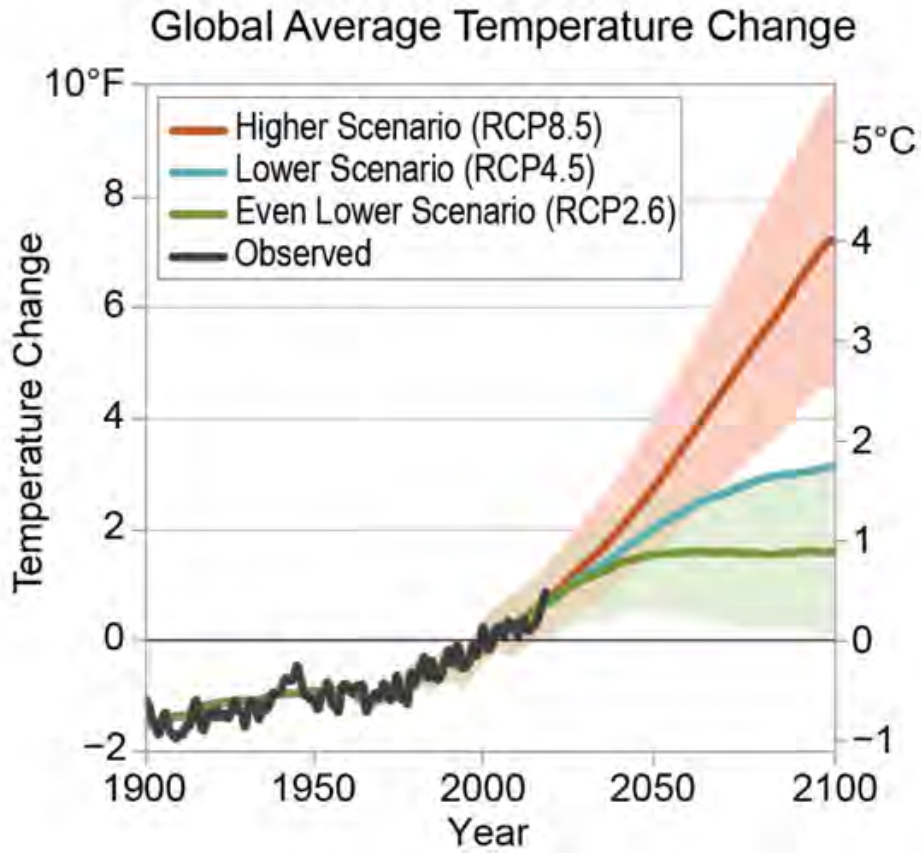
Digital Twin ‚Prototype‘

What would the global temperature look like if we put CO2 in the atmosphere?









Digital Twin ‚Prototype‘

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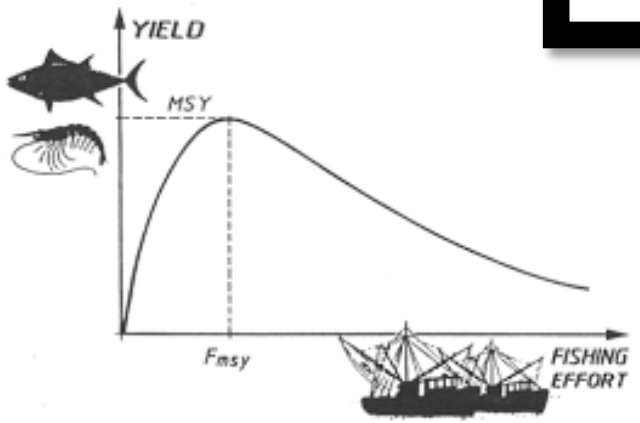
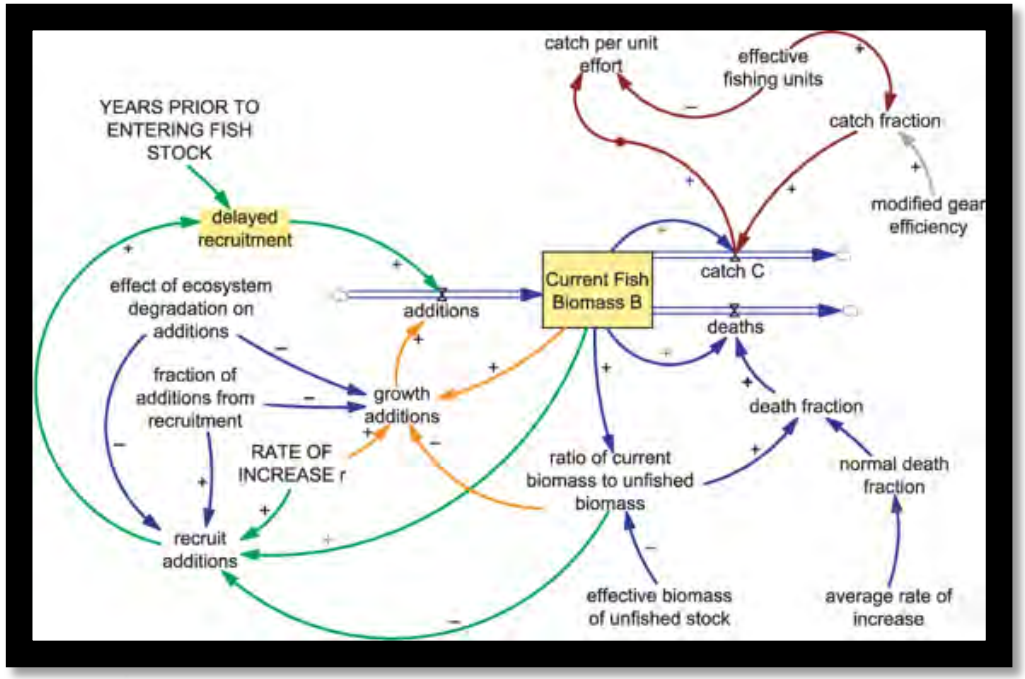
What is the most sustainable way to capture wild fish?





Digital Twin “Prototype”

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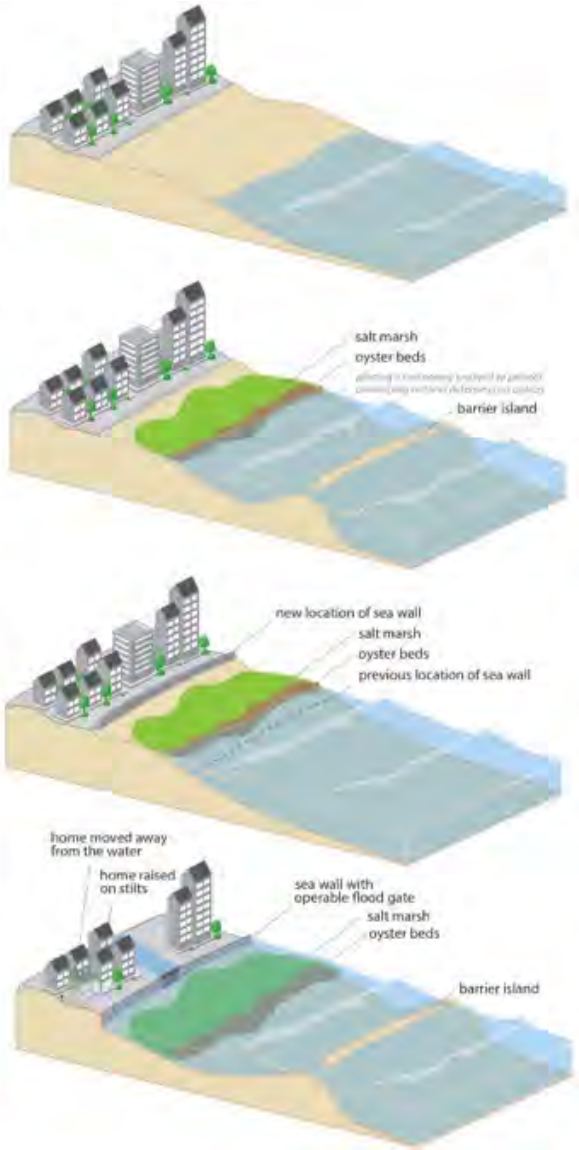
Minimal Defense
Many communities have developed right along the ocean with only minimal natural defenses from a small strip of beach between them and the ocean.

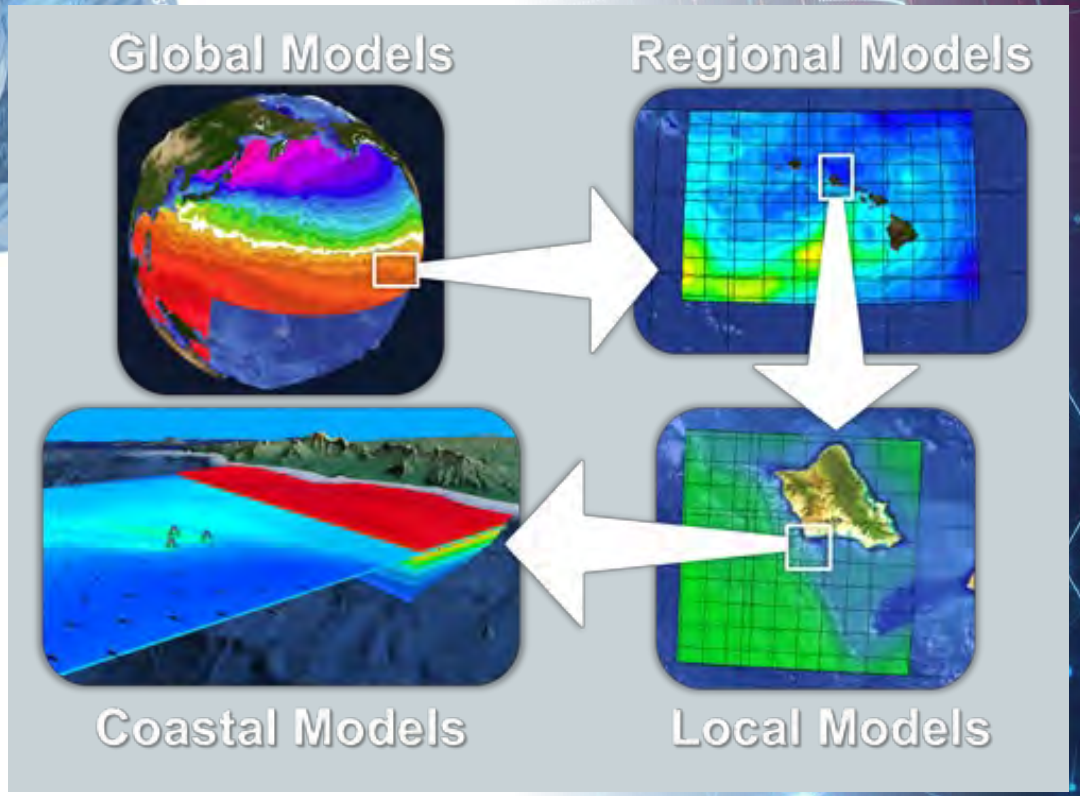
Natural
Natural habitats that can provide storm protection include salt marsh, oyster and coral reefs, mangroves, seagrasses, dunes, and barrier islands. A combination of natural habitats can be used to provide more protection, as seen in this figure. Communities could restore or create a barrier island, followed by oyster reefs and salt marsh. Temporary infrastructure (such as a removable sea wall) can protect natural infrastructure as it gets established.

Managed Realignment
Natural infrastructure can be used to protect built infrastructure in order to help the built infrastructure have a longer lifetime and to provide more storm protection benefits. In managed realignment, communities are moving sea walls farther away from the ocean edge, closer to the community and allowing natural infrastructure to recruit between the ocean edge and the sea wall.

Hybrid
In the hybrid approach, specific built infrastructure, such as removable sea walls or openable flood gates (as shown here) are installed simultaneously with restored or created natural infrastructure, such as salt marsh and oyster reefs. Other options include moving houses away from the water and raising them on stilts. The natural infrastructure provides key storm protection benefits for small to medium storms and then when a large storm is expected, the built infrastructure is used for additional protection.



What is the most cost effective option to mitigate the coastal impact of sea level rise?



Digital Twin ‚Challenge‘

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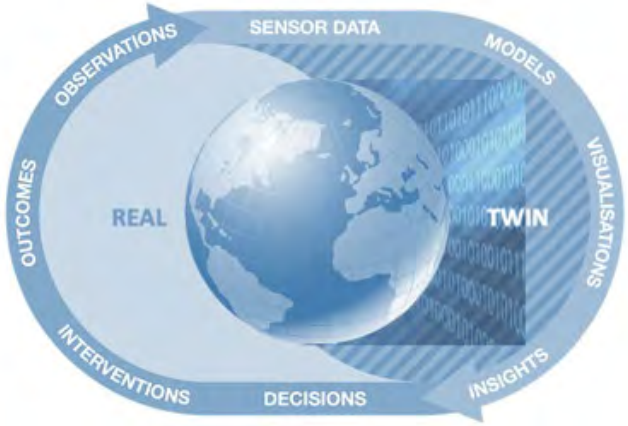
How can we best implement wind energy capture systems at sea?



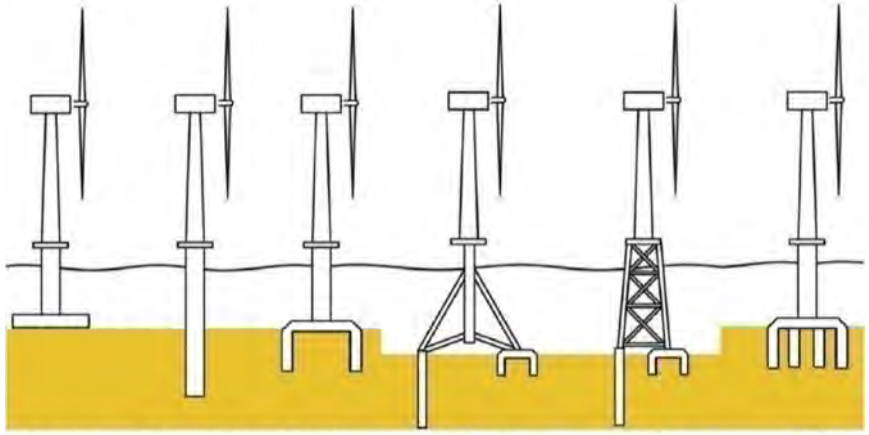
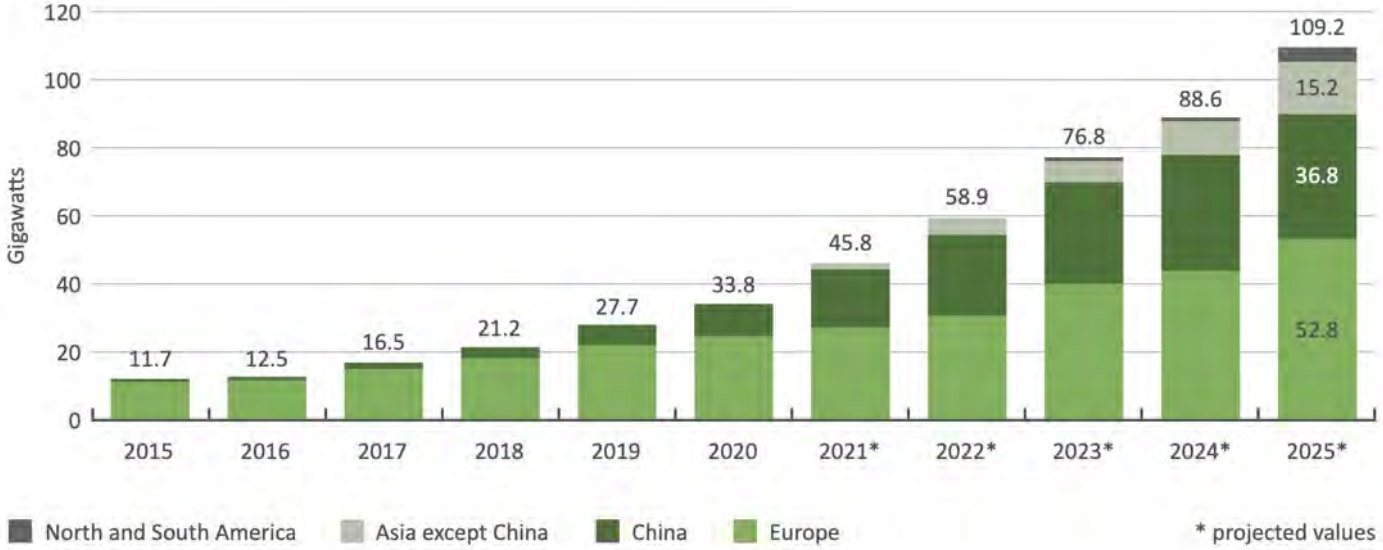
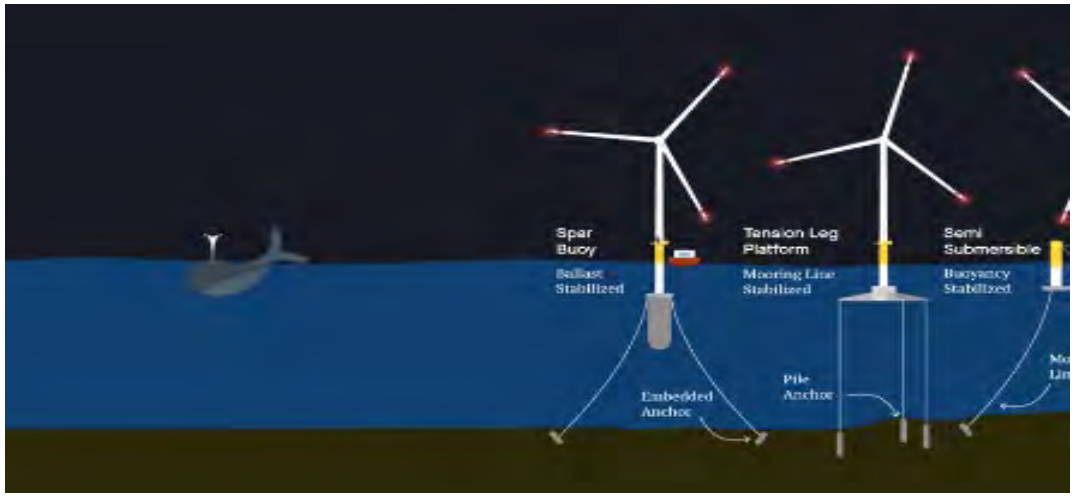


Figure 5: Installed Offshore Wind Power (OSW) Capacity





Digital Twin ‚Challenge‘

Digital Twins of the Ocean

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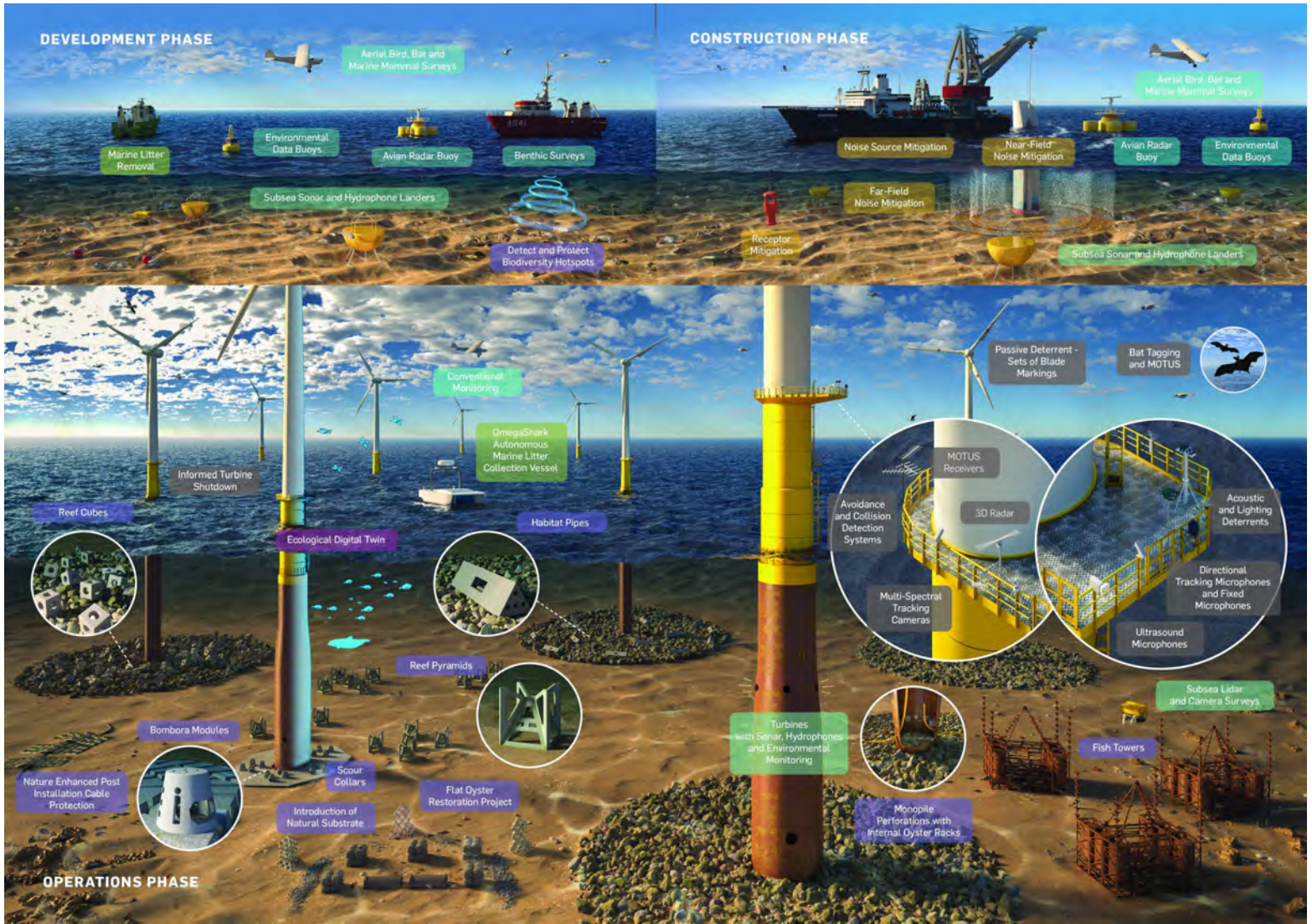

SSE Renewables, Microsoft and Avanade are working together to create Azure Digital Twins of offshore windfarms and their local environment, which they hope will encourage the sector to develop renewable energy solutions that have a positive impact on ecosystems. A digital twin is an exact replica of an object in the physical world that can be studied and changed to help improve the real-life version.

Digital Ocean - Ocean Observing Needs

An observing system is the fundamental underpinning to any digital twin

- **Detailed Hydrography is critical**
- **A co-design approach to developing the observing networks needed for Digital Twins**
- **DTOs will create a ‘virtuous circle’, where information from the Digital Twin can be used to provide key inform**
- **DTOs will optimise the observing network, whilst benefiting from it.**

Digital Ocean - Ocean Prediction

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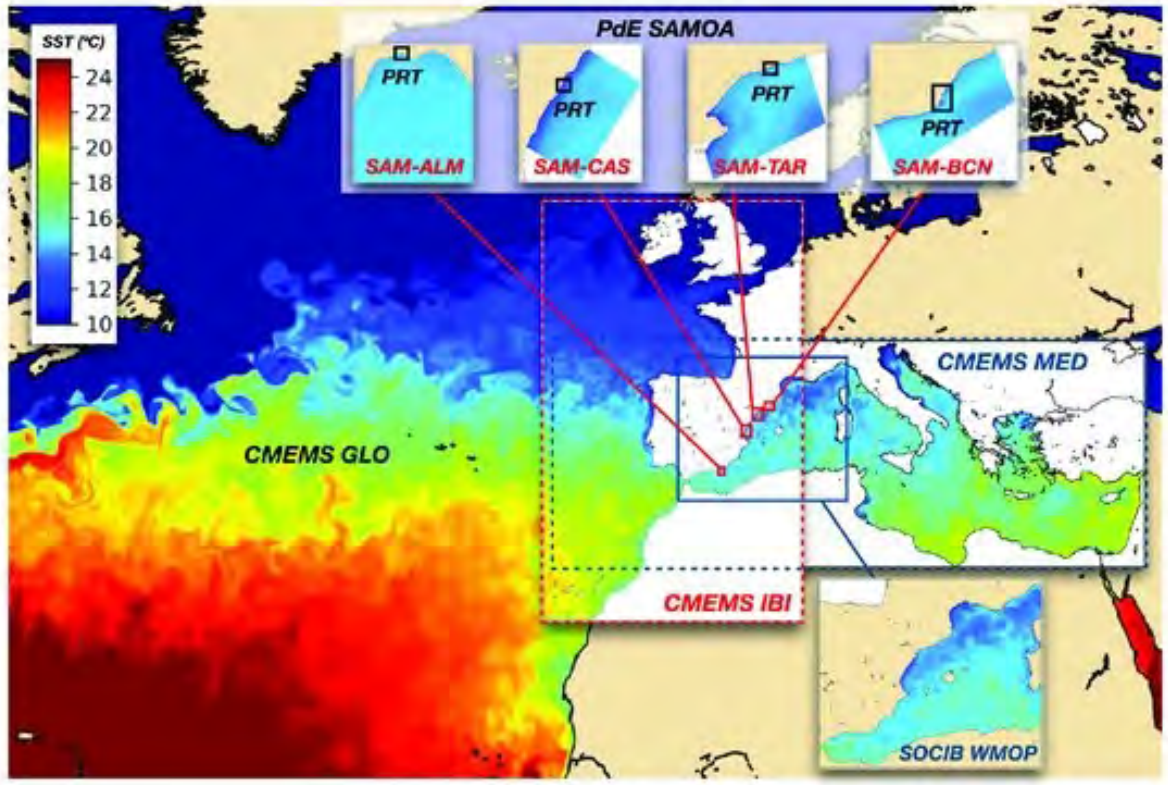
OceanPredict
Advancing the science of ocean prediction

GOOS | CoastPredict
with The Global Ocean Observing System

Copernicus
Marine Service

The Decade Collaborative Centre for Ocean Prediction



- Ocean predictive multi scale modelling frameworks.
- Artificial intelligence / machine learning to create, manipulate and analyse marine information.
- The ability to simulate change to the system by human intervention and to explore their consequences.


ITU Events
AI for Good
Discovery
Physics-informed machine learning to push the ocean frontier in climate
https://www.youtube.com/watch?v=20NnFCrCAj8
aiforgood.itu.int
40 UN PARTNERS
ITU

Digital Ocean - Data Perspective – Digital Ecosystem Needs

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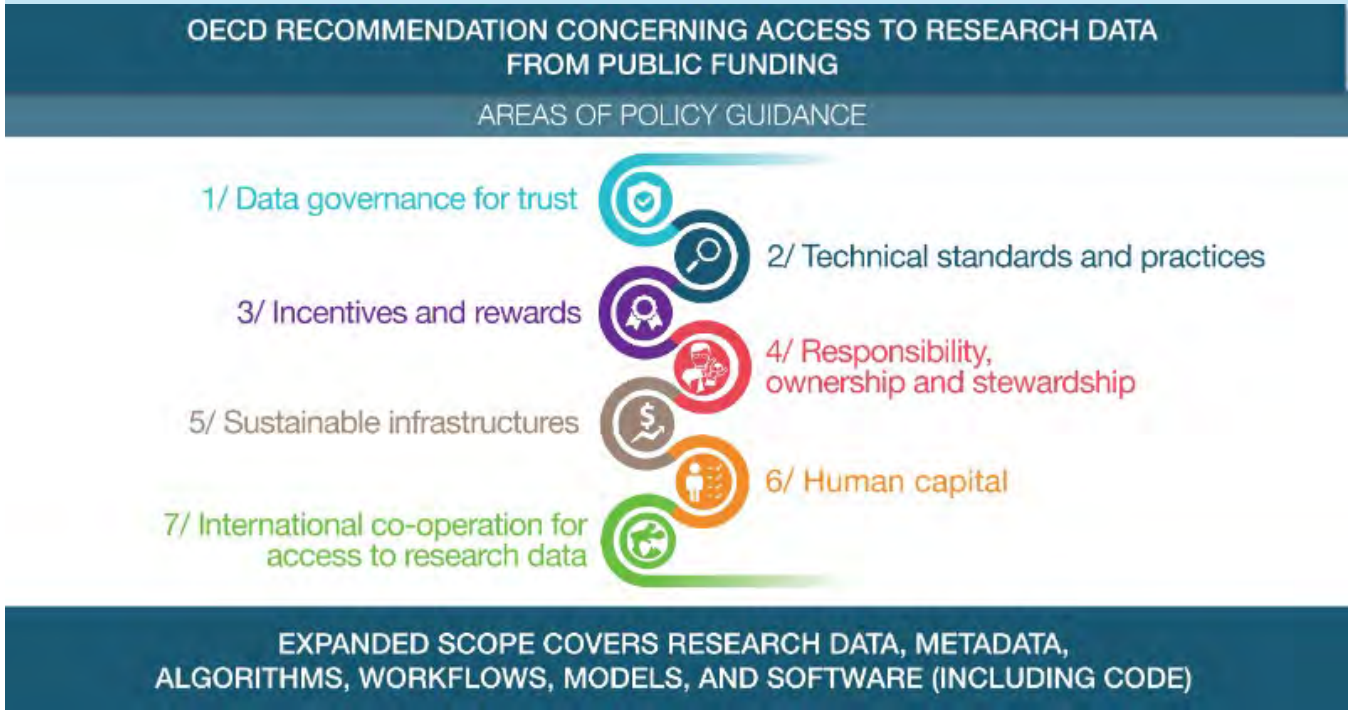
IODE ODIS Copernicus Marine Service EMODnet European Marine Observation and Data Network

The Mission: Creating a robust and extensible foundation of our planet's digital ocean ecosystem



- **We need to 'democratize' the data world.**
- **We need to establish 'trust' in open data.**
- **Who need to ensure wide and equitable access.**

Delivering Digital Twin Information

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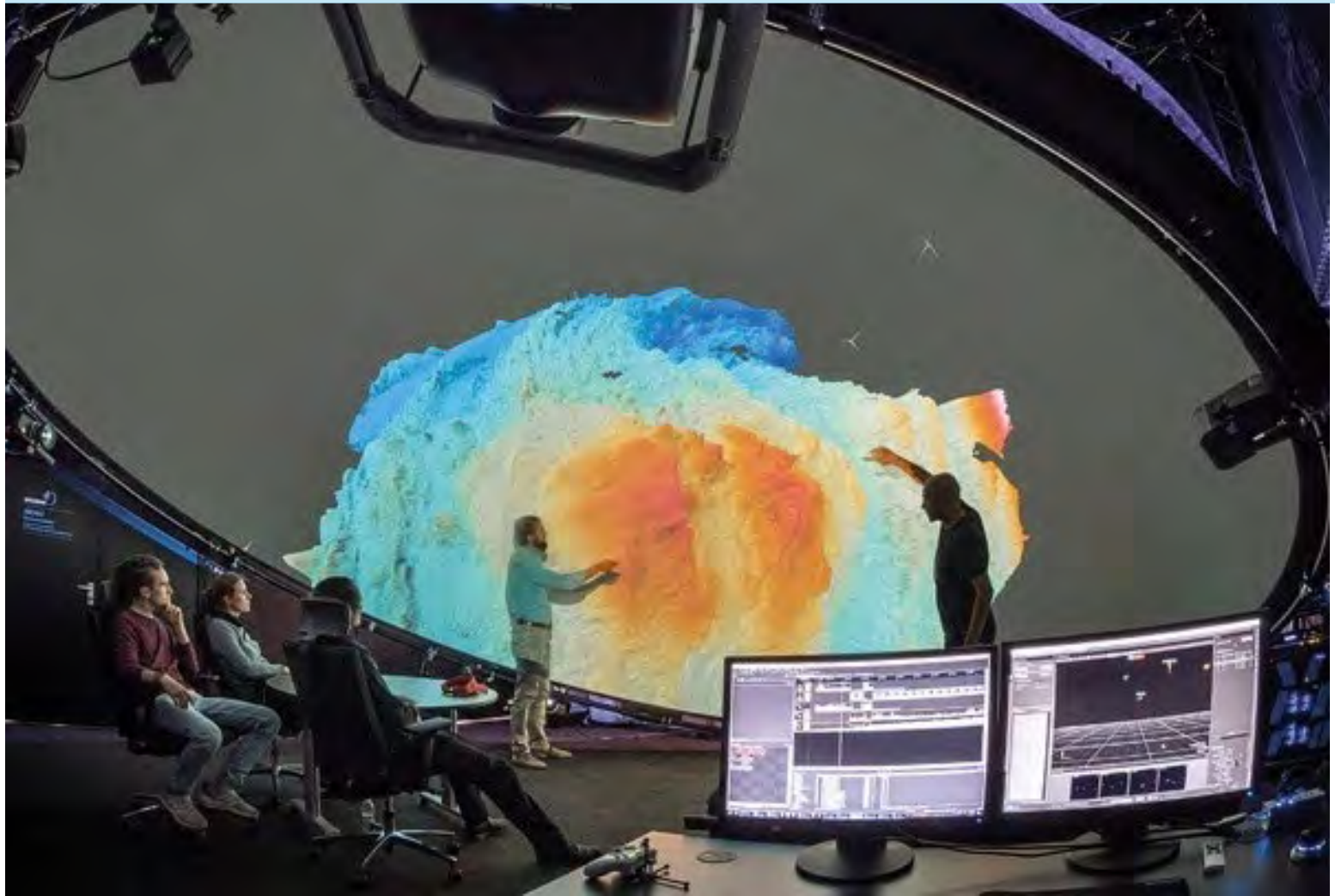
Decision making theaters – Browser based systems – Jupiter Notebooks – 3D immersive environments



Digital Twin Opportunities

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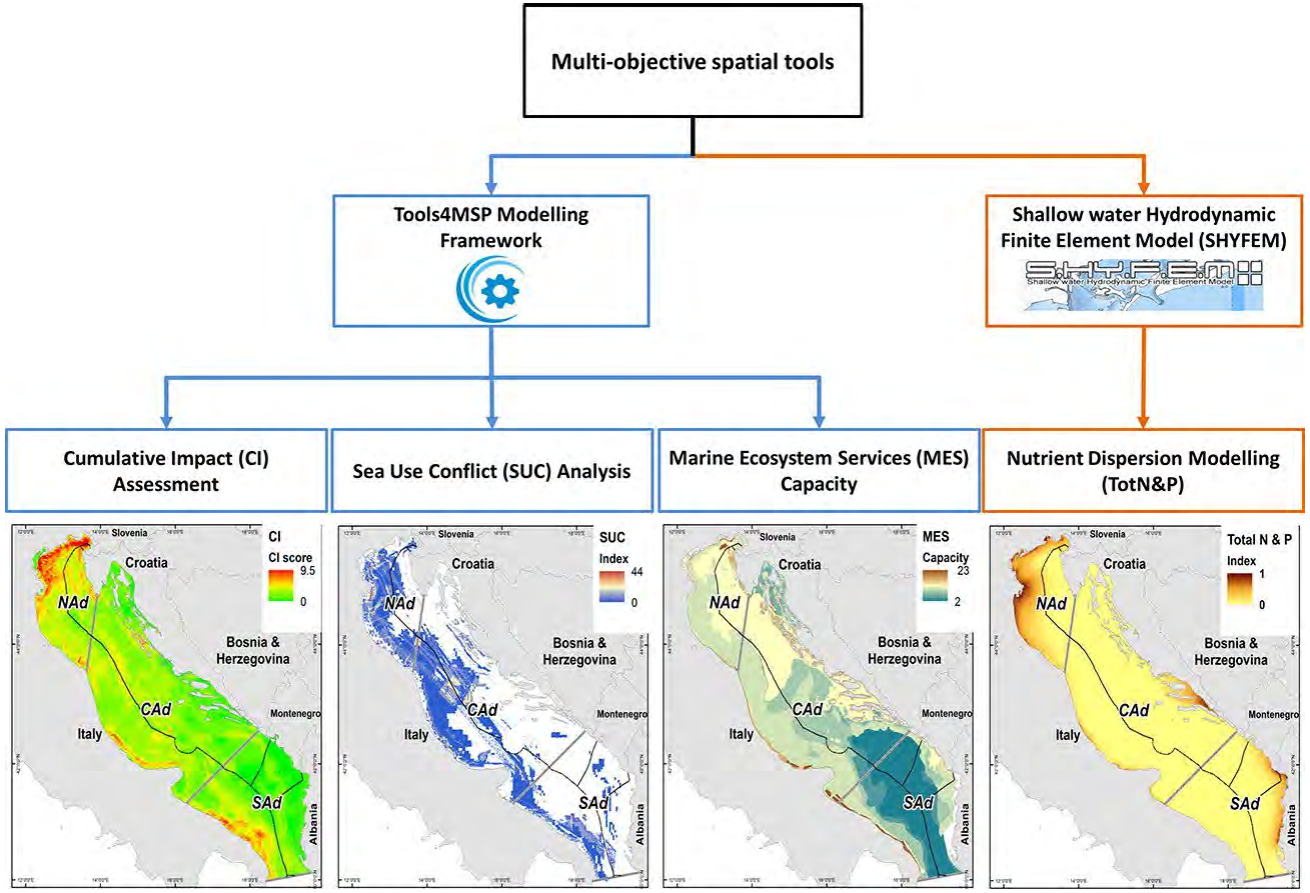
Marine Spatial Planning



Map by hand

GIS overlay

Digital Twins

ADRIPLAN

ADRiatic Ionian maritime spatial PLANning

Digital Twins of the Ocean – DITTO Working groups

DITTO establishes and advances a digital framework to explore ocean related development scenarios and develop a comprehensive digital representation of the ocean.

WG1. Supportive ocean observations and data systems
WG2. Data analytics and prediction engines
WG3. Data lakes and interoperability
WG4. Interactive layers and visualizations
WG5. Framework - architecture, design and implementation (TURTLE)
WG6. Education, training and capacity development
WG7. Outreach and communication

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UK Government | National Oceanography Centre | G7 | G7 | United Nations Decade of Ocean Science 2021-2030 | DITTO | GEOMAR | MERCATOR OCEAN INTERNATIONAL | DITTO Digital Twins of the Ocean

International Digital Twins of the Ocean Summit

DIGITAL TWINS OF THE OCEAN

4 to 5 May 2022

High-level in-person event in Central London, UK, with live strea

www.g7fsoi.org/digital-twin-ocean-summit

International Digital Twins of the Ocean Summit 2023

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2021 2030 United Nations Decade of Ocean Science for Sustainable Developr

Scan for the website

Xiamen International Conference Center Hotel

November 9-12, 2023

16th World Ocean Week (WOW) in Xiamen

Please join us in Xiamem
November 9-12, 2023

Become a Partner of the Digital Twins of the Ocean (DITTO) Programme

Partner Application

The objective of the partnership is to support each other through a network of DITTO partners.

- Once you have submitted the application the DITTO team will review the information and
- send you a **memorandum of understanding (MOU)** to be mutually agreed on.

Interested to join the DITTO community?

ditto-oceandecade.org
/join-the-ditto-community

BLB
SEA GUST

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