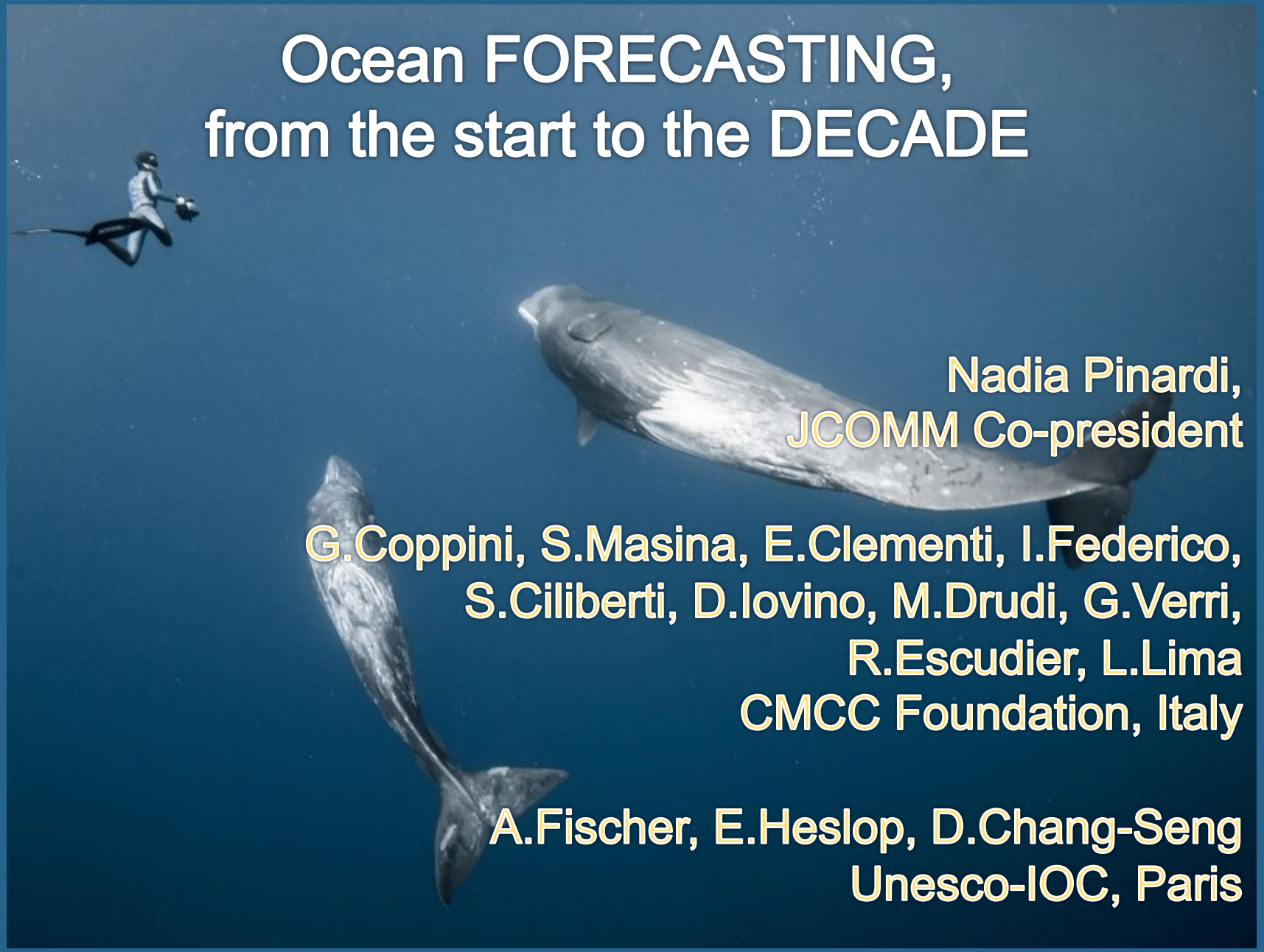
Ocean FORECASTING, from the start to the DECADE



Nadia Pinardi,
JCOMM Co-president

G.Coppini, S.Masina, E.Clementi, I.Federico,
S.Ciliberti, D.Iovino, M.Drudi, G.Verri,
R.Escudier, L.Lima
CMCC Foundation, Italy

A.Fischer, E.Heslop, D.Chang-Seng
Unesco-IOC, Paris

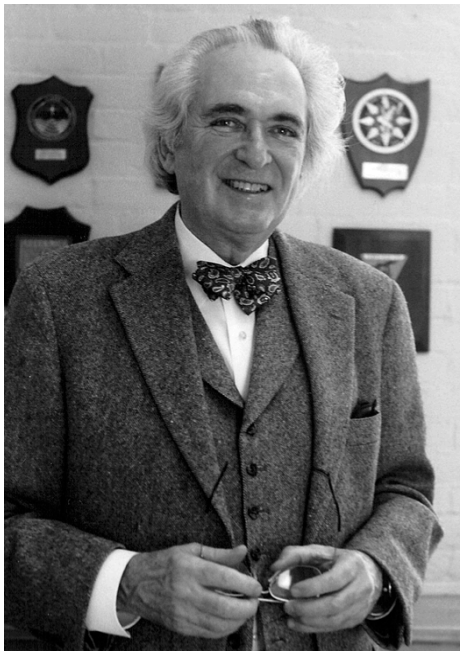
OUTLINE

- Ocean forecasting AT ITS START: the early 80's
- Today's ocean predictions: a system approach to monitoring and forecasting
- Tomorrow: GOOS <-> GODAE and the DECADE of OCEAN SCIENCE

IOC jcomm WMO

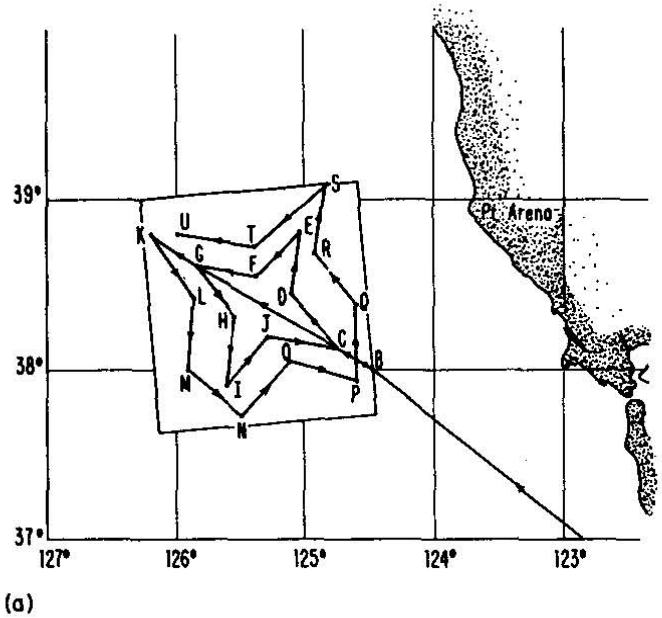
The first real time ocean forecast: Harvard and Monterey in 1983

The key ingredients:



A.R.Robinson, 1930-2007

High quality synoptic data for initial conditions

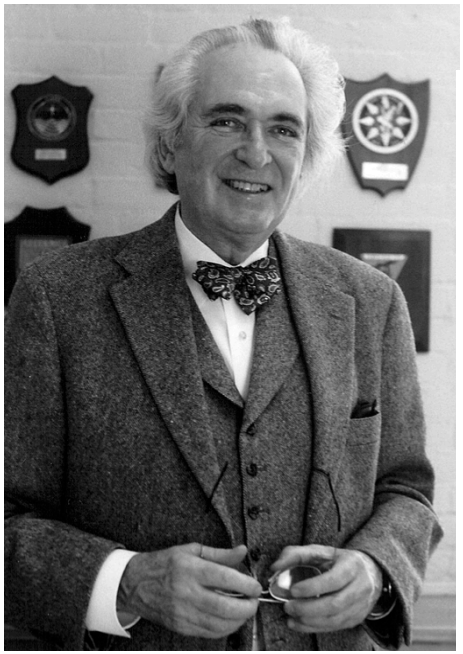


Pinardi et a., 2017. From Weather to ocean predictions: an historical viewpoint. Journal of Marine Research. The Sea Special Volume

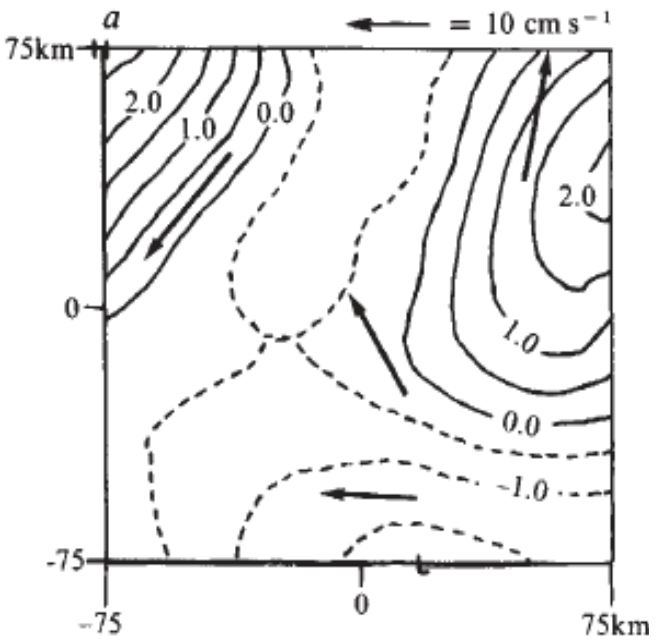
The first real time ocean forecast: Harvard and Monterey in 1983

The key ingredients:

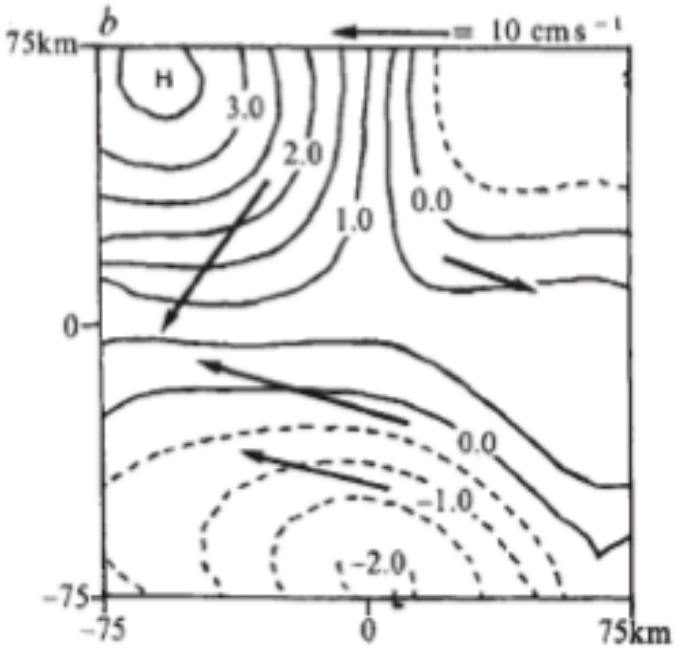
Skillful model for forecasting



A.R.Robinson, 1930-2007



Forecast Day 0



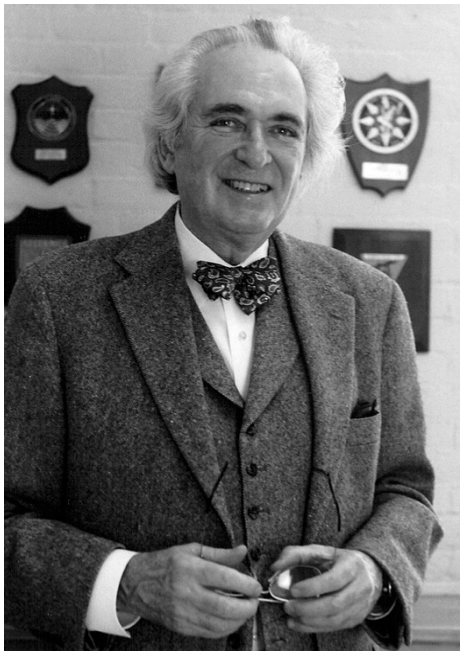
Forecast Day 14

Pinardi et a., 2017. From Weather to ocean predictions: an historical viewpoint. Journal of Marine Research. The Sea Special Volume

The first real time ocean forecast: Harvard and Monterey in 1983

The key ingredients:

Forecast Verification



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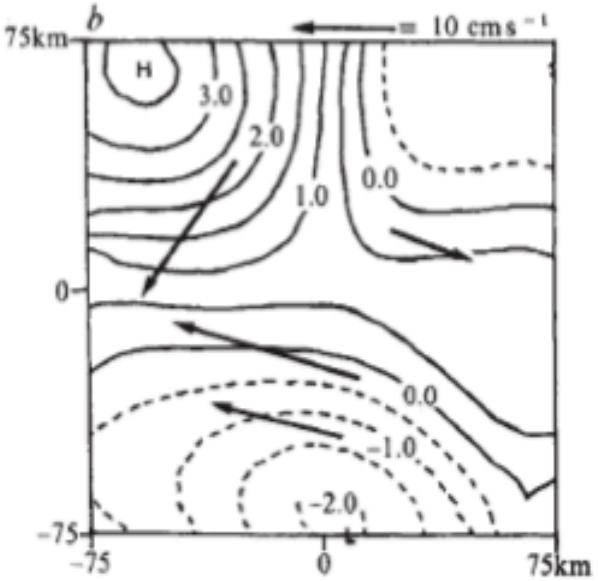
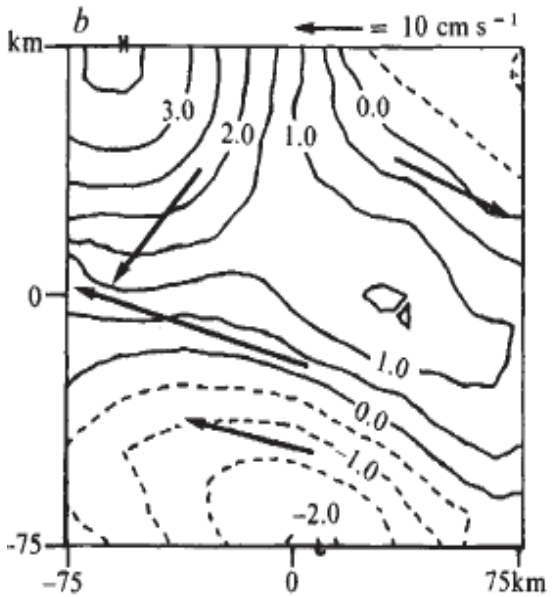


Forecast Day 14



Observations at day 14

Pinardi et a., 2017. From Weather to ocean predictions: an historical viewpoint. Journal of Marine Research. The Sea Special Volume

The system approach

Information: Value Adding Knowledge Chain

Upstream Data Providers	Intermediate Data Providers & Users	Downstream Providers & Users	
Input data systems and data management	Generic Information Services	Customised Products & Services	Societal Benefit

WMO and IOC Information systems
Satellite Systems
DBCP
GLOSS
VOT
ARGO
Ocean-sites
Regional OS

Met-hydro-ocean Forecasting, data products, climatologies

Maritime safety, Disaster risk, Marine pollution

Future requirements

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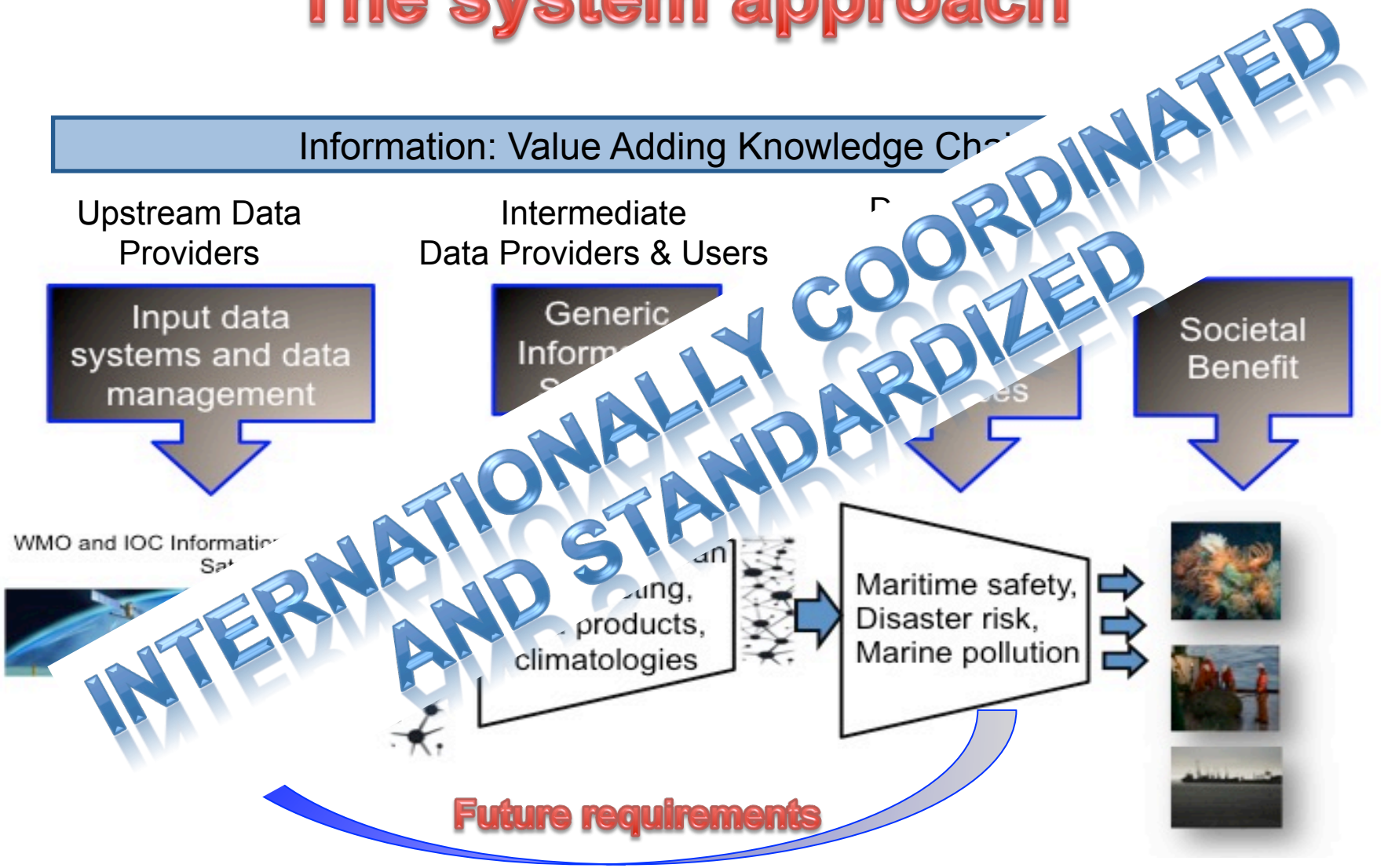
The system approach



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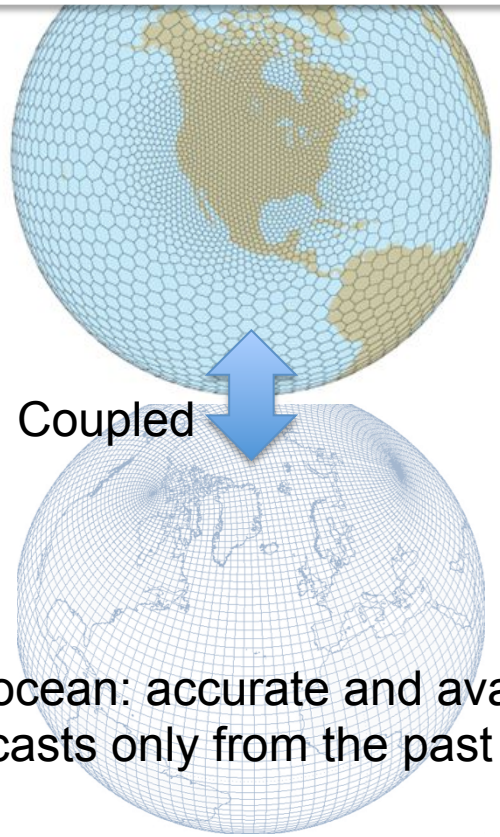
The system approach at work: analysis and forecasting across-scales

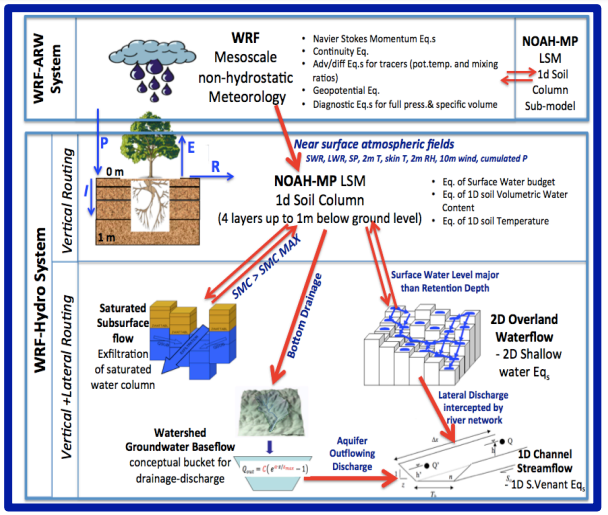
Global Atmosphere, Land, hydrology, ocean
OPERATIONAL, > DAILY, 10 days time lead

Limited area atmosphere,
land and land-hydrology, 5 days forecast

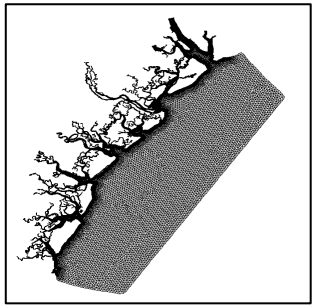


Coupled

Coupled



For ocean: accurate and available forecasts only from the past 10 years



Structured and
Unstructured
grid ***R***elocatable
ocean
platform for ***F***orecast

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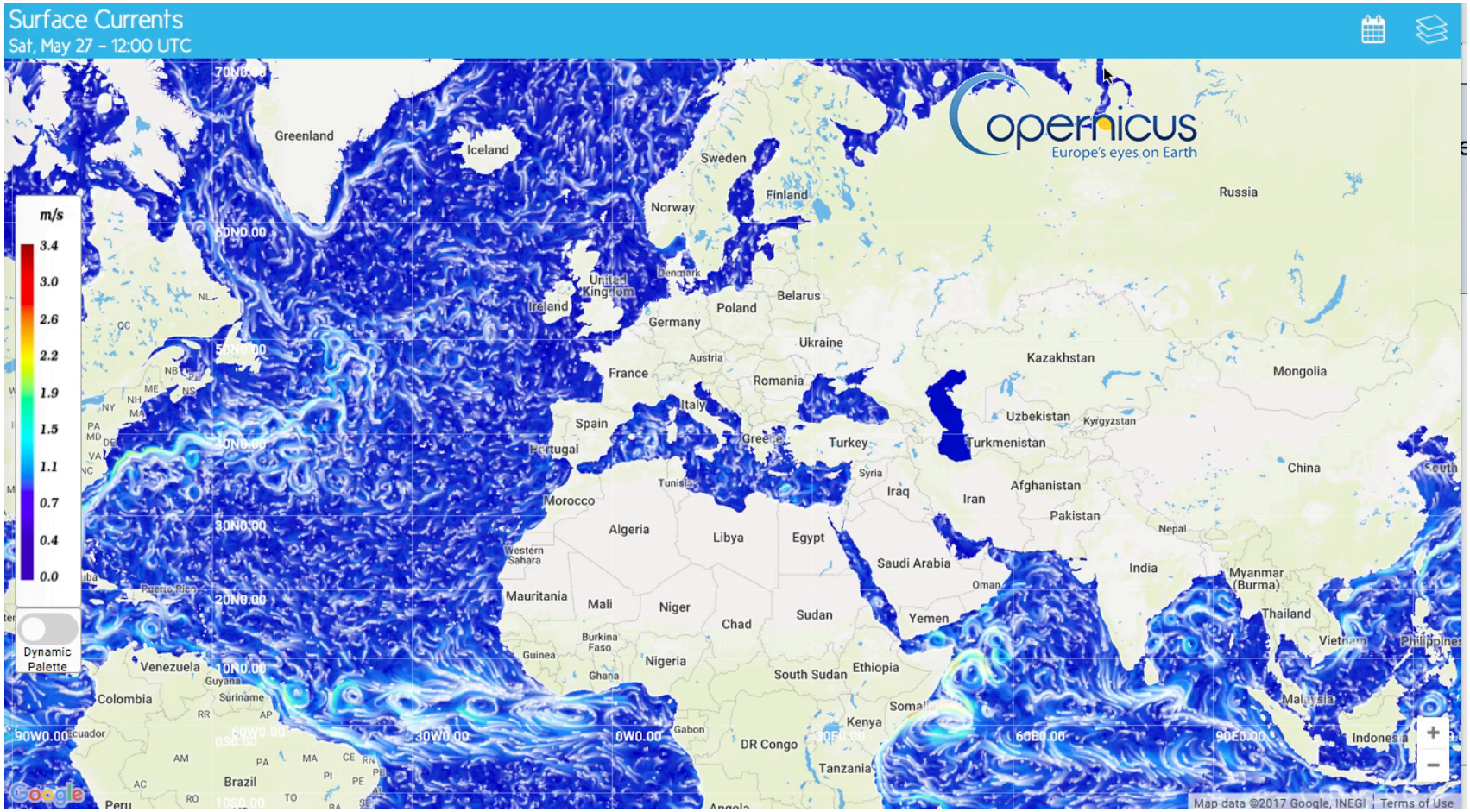
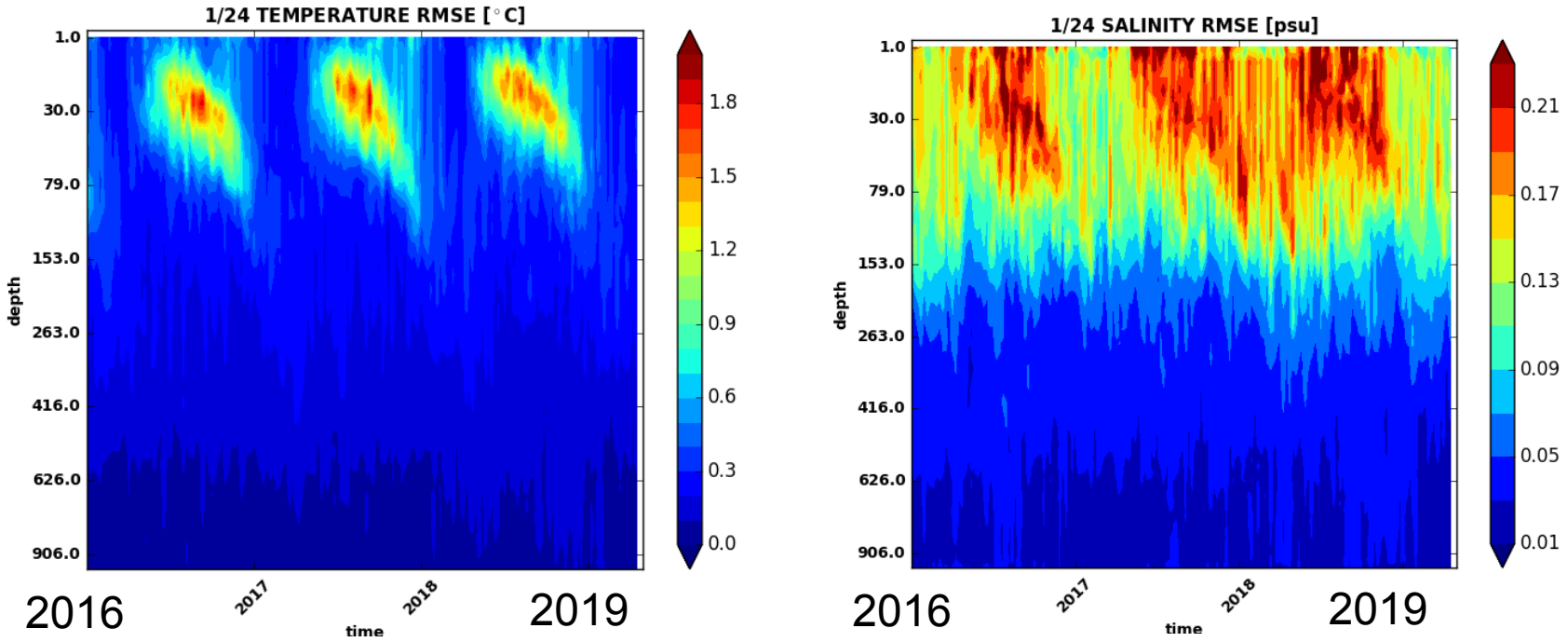
Every day a picture of the realistic ocean: 1/12 deg, ~100 levels



Every day a test of the “theory”: comparison of the forecast with the observations

Mediterranean Sea Basin averaged root mean square error



Three main uncertainties concur:
1) Air-sea fluxes parameterization
2) Mixing parameterization (including waves)
3) Advection of water masses in the subsurface

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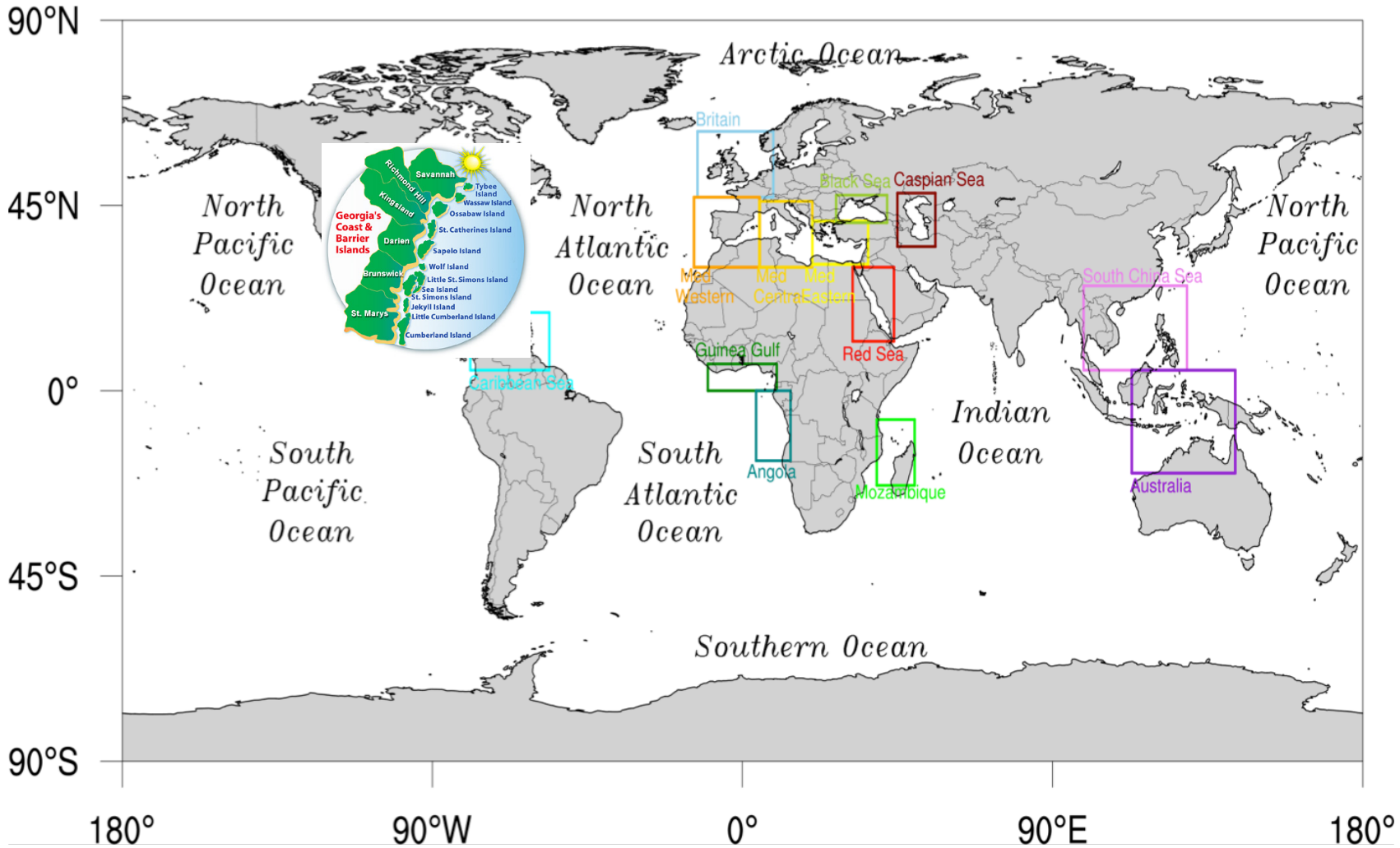
The system approach: increase the resolution and the physics when and where it is needed



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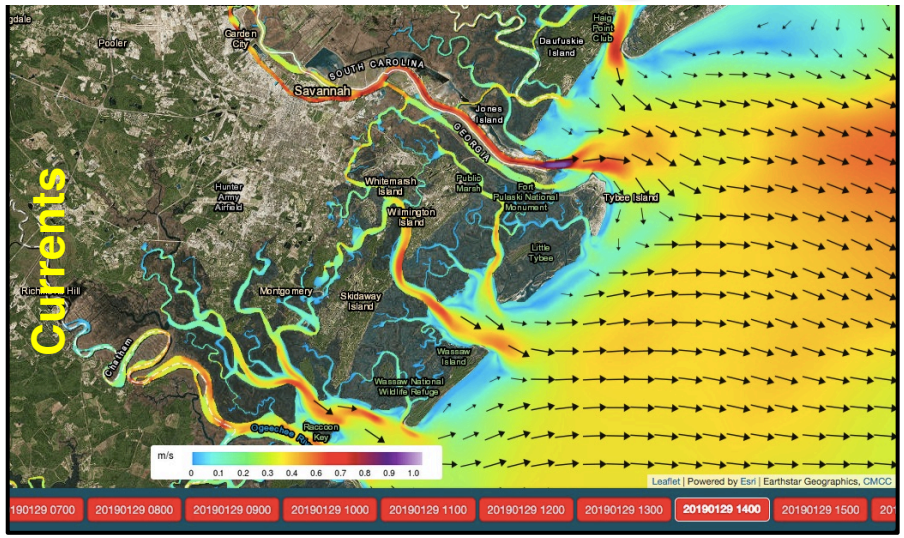
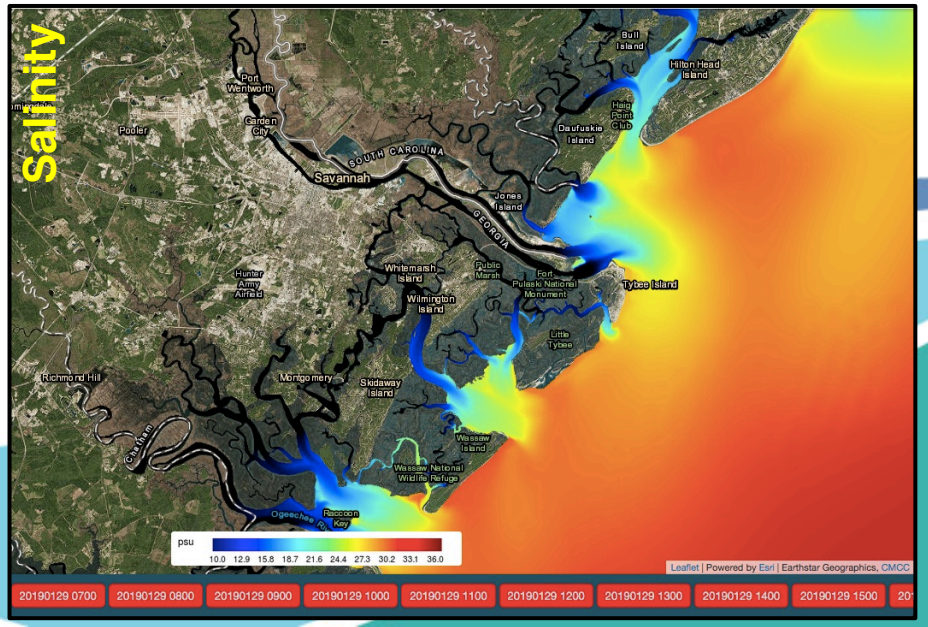
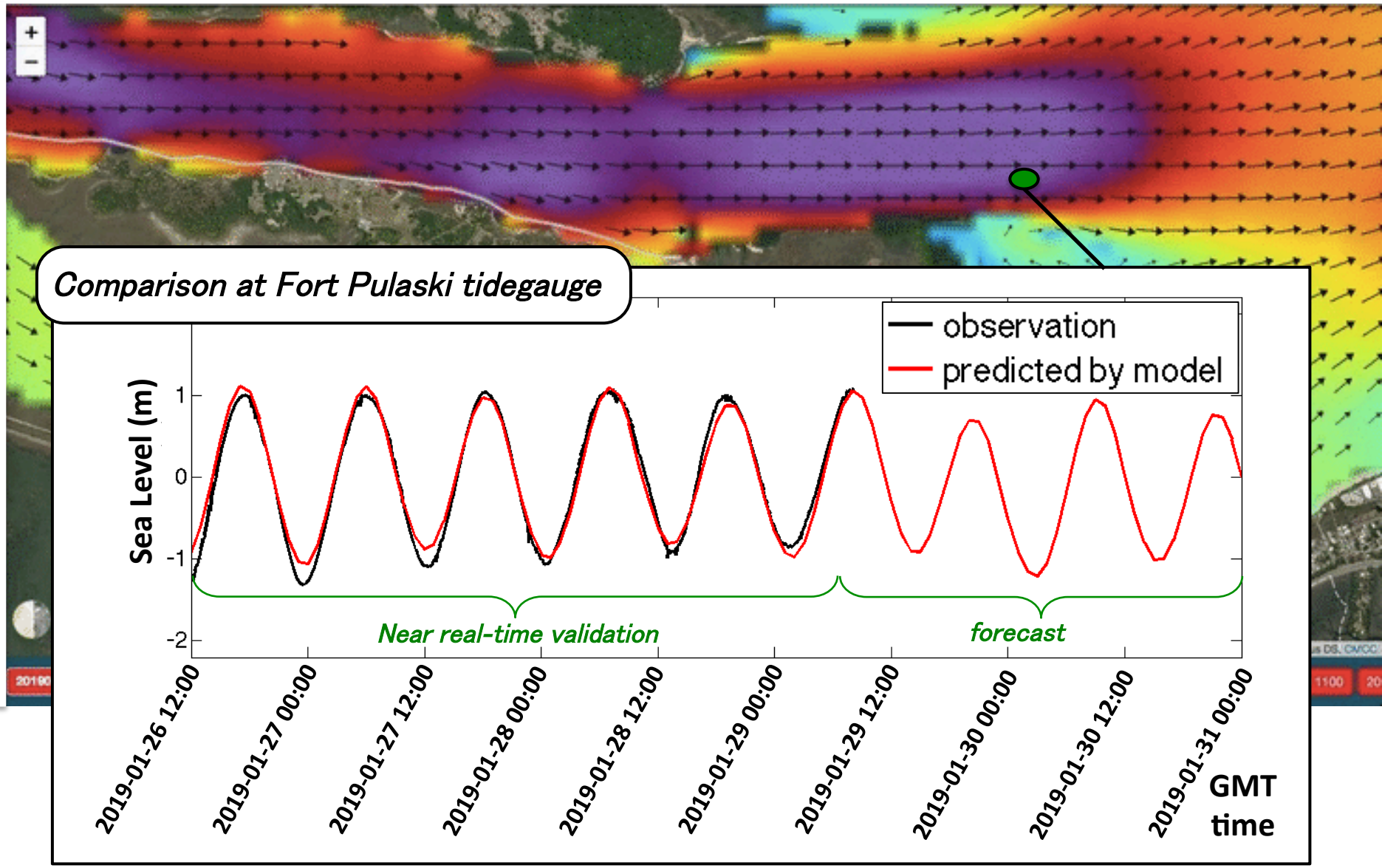
Coupled hydrological and oceanographic forecasting with unstructured grids



http://savannah.cmcc-opa.eu/

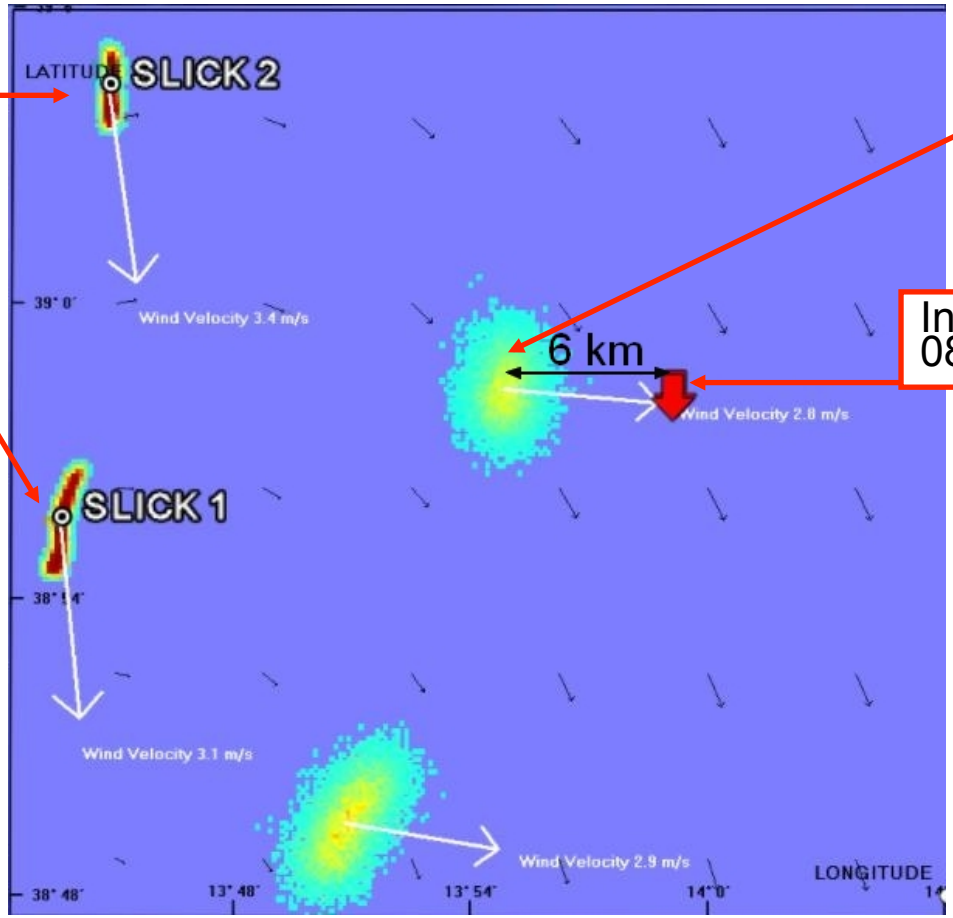


Coupled hydrological and oceanographic forecasting with unstructured grids



The system approach: customized services for Ocean Health are now possible

Satellite Observation 07.08.09 04:48 UTC



MEDSLIK-II forecasted position 08.08.09 10:00 UTC

In situ sampling 08.08.09 09:30 UTC

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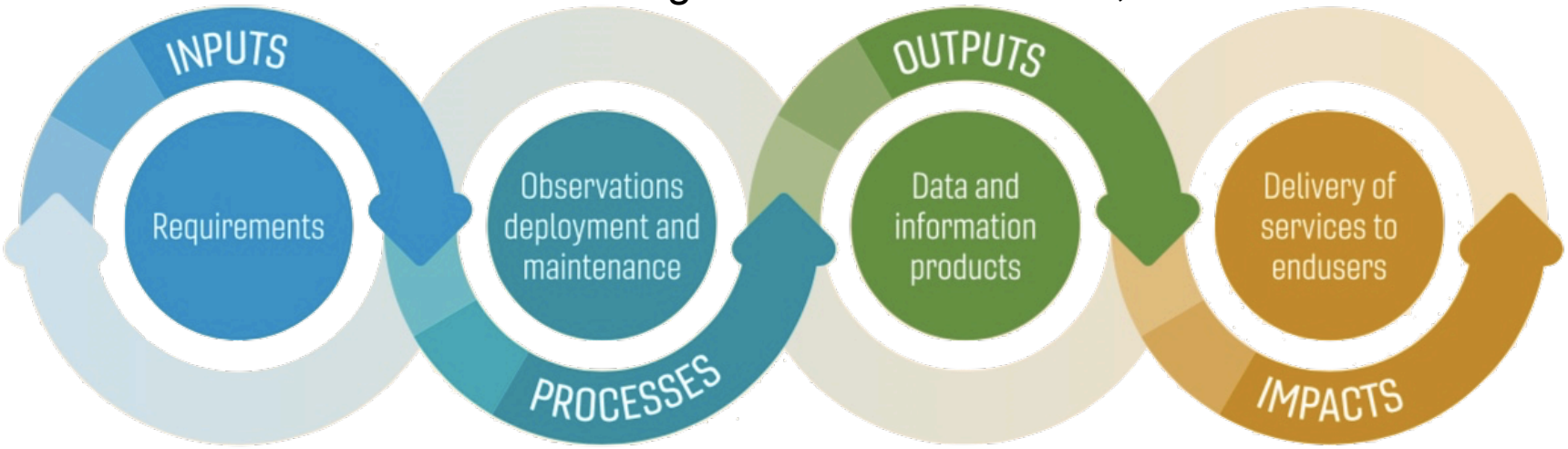
The ocean of tomorrow: how do we get there?

Many challenges are ahead of us, among others:

- **Challenge 1:** Build End-to-End Met-Ocean services and a global infrastructure for sharing observations, model output and best practices
- **Challenge 2:** Building resilience and preparedness to natural and man-made ocean and coastal hazards with the right combination of observations and numerical models
- **Challenge 3:** understand uncertainties and communicate them in a proper way
- **Challenge 4:** ocean literacy

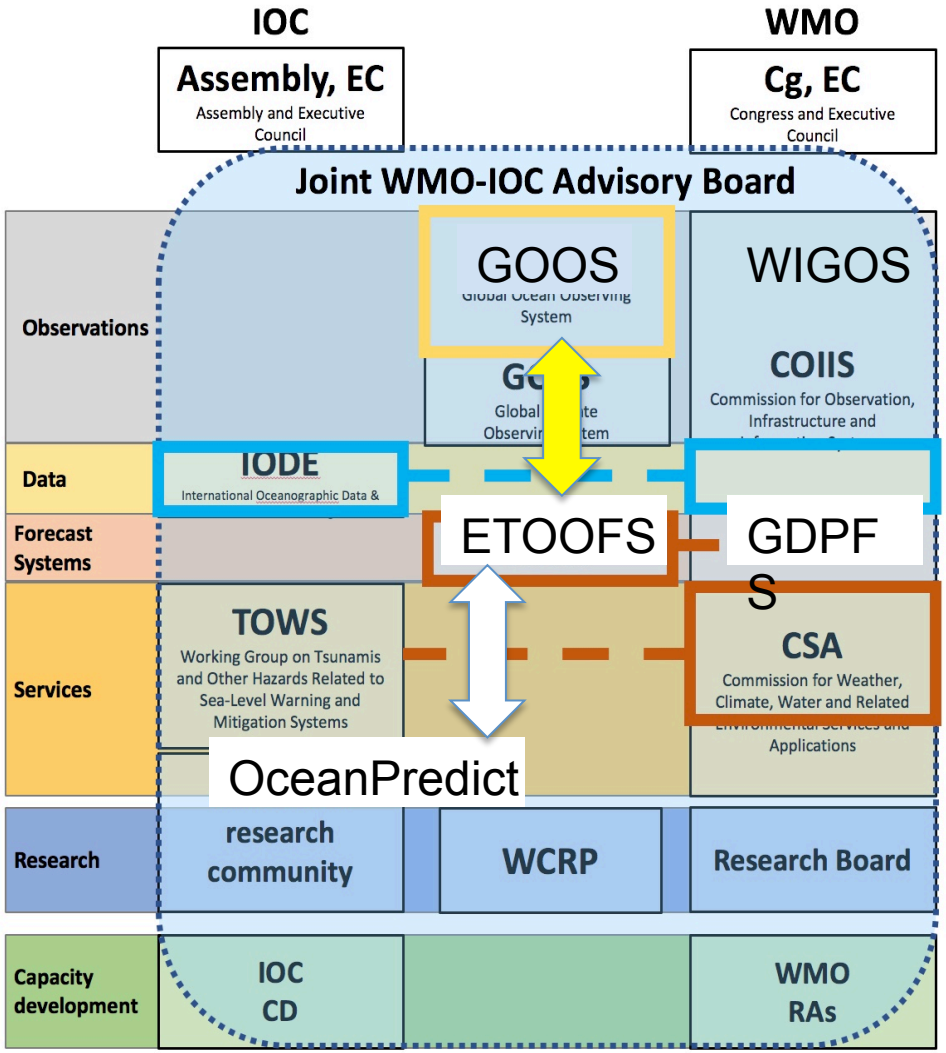
Connecting down the value chain, from GOOS 2030 Strategy



JCOMM restructuring is an opportunity: many activities enter GOOS

Notional placements of existing JCOMM activities

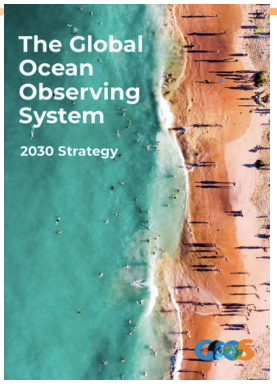
- JCOMM Observations Programme Area
- JCOMM Data Management Programme Area
- JCOMM Services and Forecast Systems Programme Area
- Joint Advisory Board creates **opportunities for additional connections and activities**



It is time to act: partnership is central to facilitate responsiveness and research to operations

WMO GDPFS2.0 Building Community Earth System

The Global Ocean Observing System



GOOS Regional Alliances

+TPOS, ATLANTOS, DOOS, etc.

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It is time to act: the UN Decade of Ocean science for sustainable development will start in 2021

The United Nations
Decade of Ocean Science
for Sustainable Development
(2021-2030)

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

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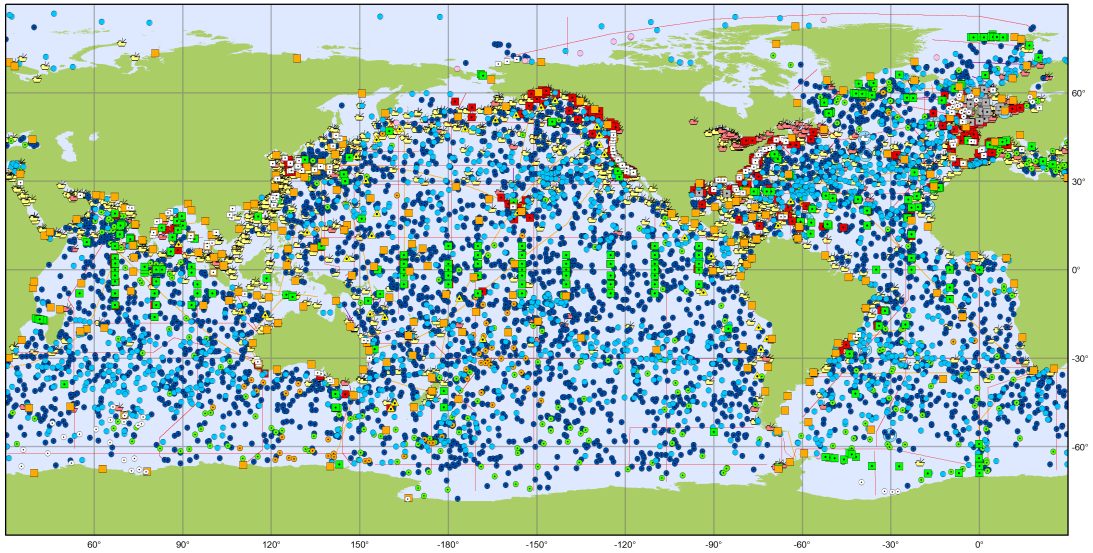
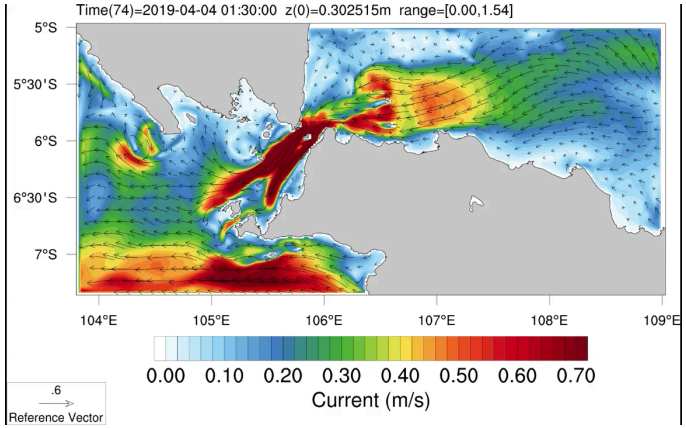
It is time to act: the UN Decade of Ocean science for sustainable development will start in 2021

Propose a massive-scale UN Decade Project: a comprehensive observing system for a predicted ocean



Main in situ Elements of the Global Ocean Observing System

March 2019



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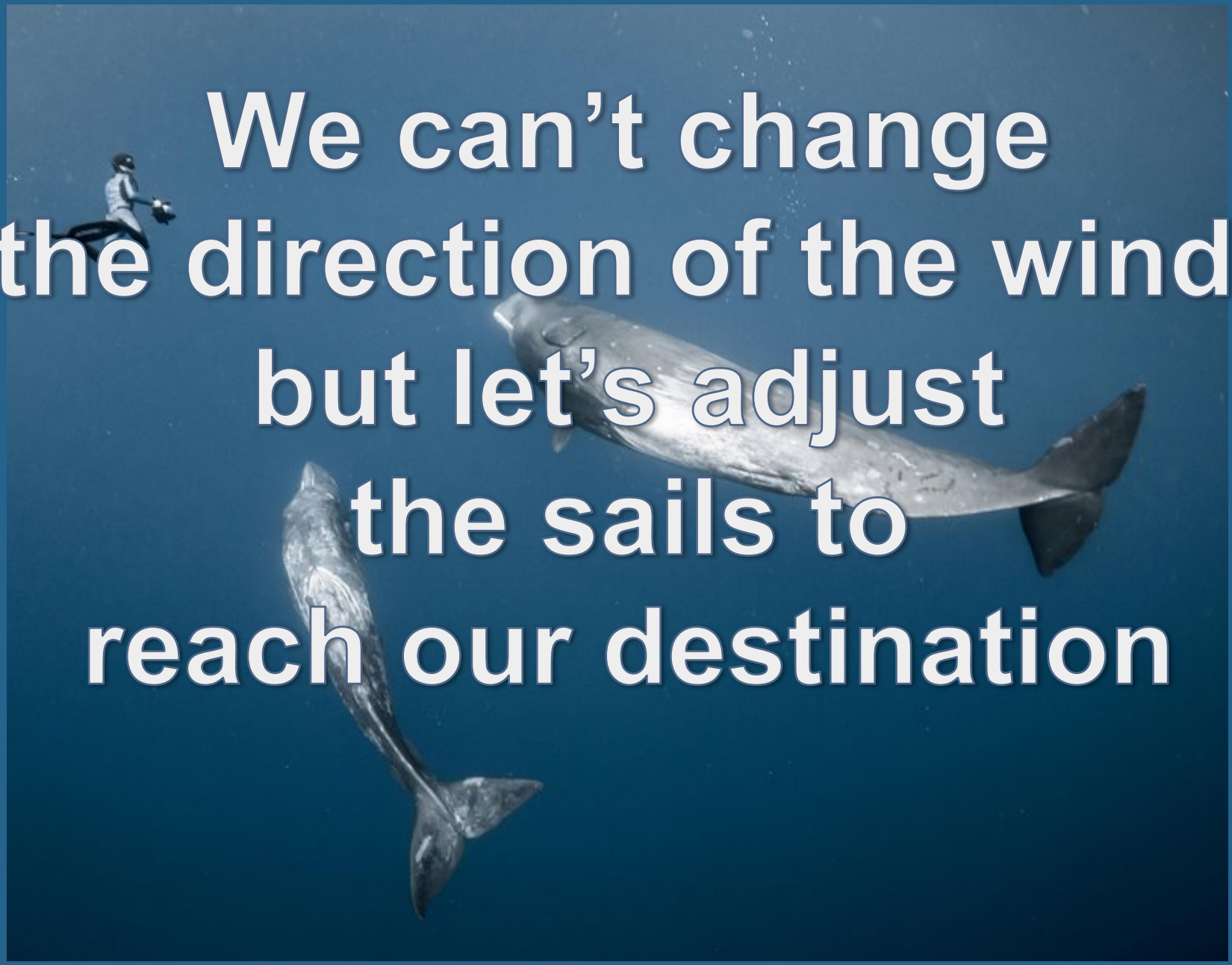
We can't change
the direction of the wind,
but let's adjust
the sails to
reach our destination