SYMPOSIUM OP'24

Ocean Predict

In partnership with unesco Intergovernmental Oceanographic Commission

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Assessment of the Operational Readiness Level of the Spanish Ports Forecasting System

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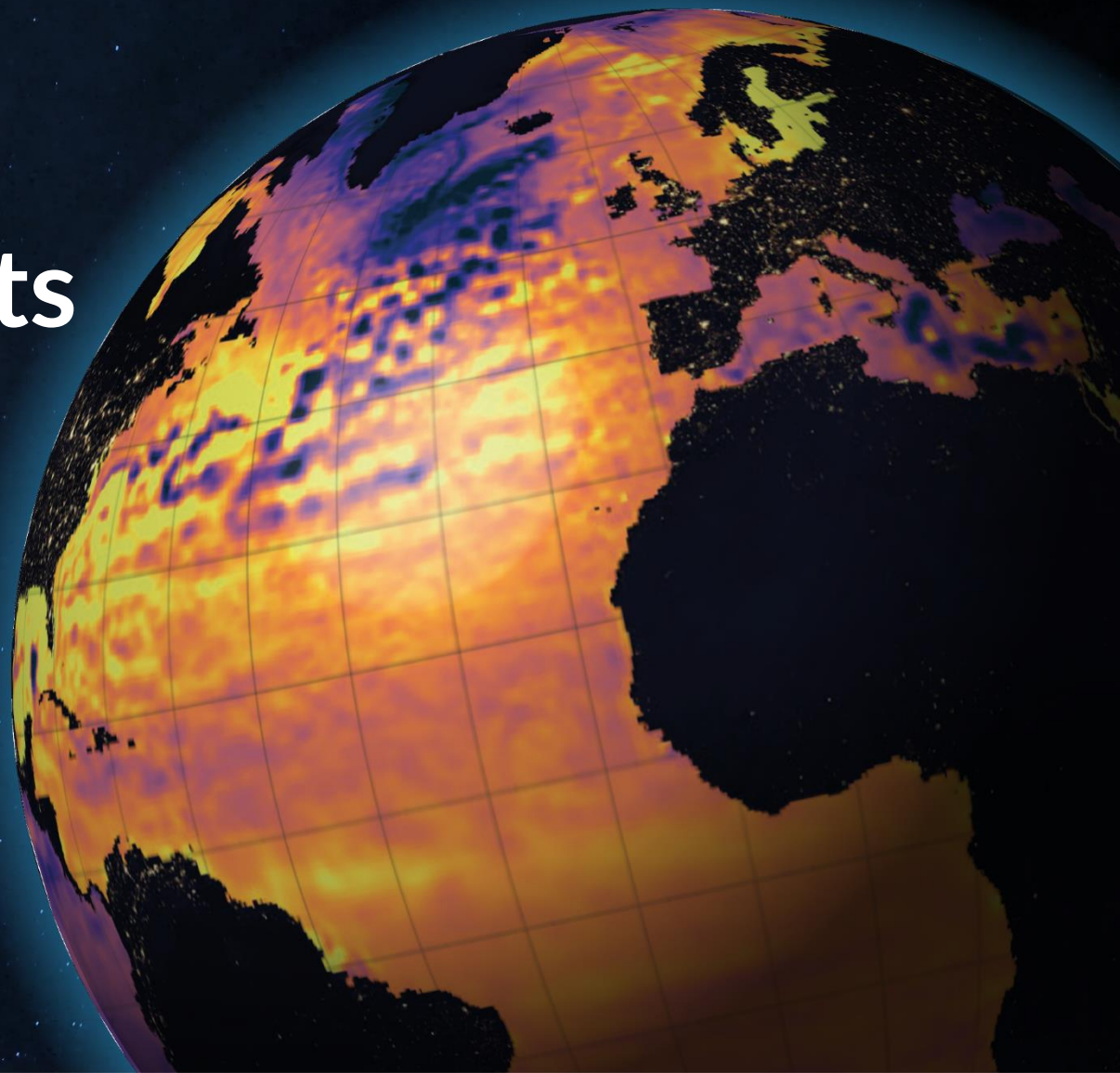
On behalf of Physical Environment Team

Puertos del Estado



Spanish State-owned System

48 Ports of general interest managed by **28 Port Authorities**

Coordination and efficiency control by **Puertos del Estado** (Ministry of Transports and Sustainable Mobility)

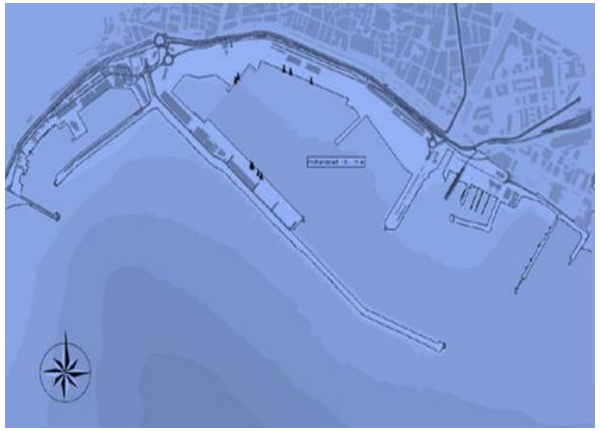
60% of exports and 85% of imports pass through the ports.

Contributes close to **20% of the transport sector GDP**(1.1% of Spain's GDP)

Vital for national economy

Ports needs coastal services and data

Exposed to the extreme events caused by wind, waves and sea level



Design phase

Viability, budget, execution plans,…

Climatology description (from models & measurements)

Construction phase

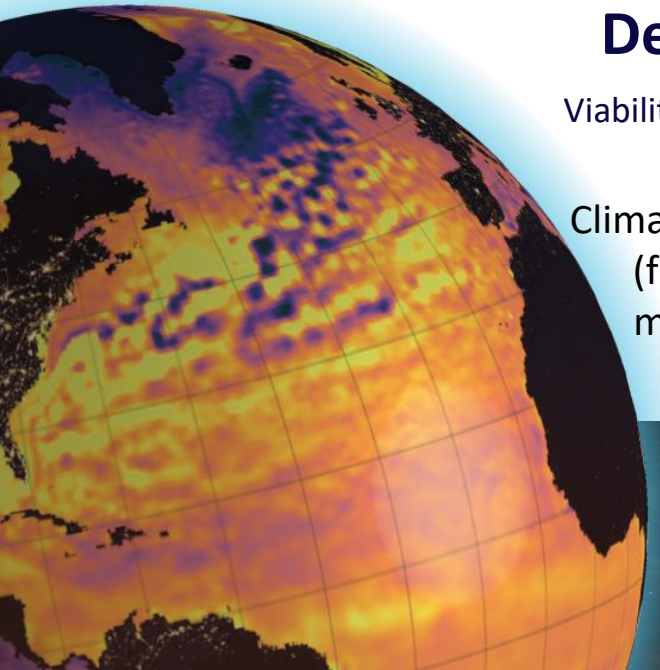
Safety, short-term build planning

Real time alert systems and short-term forecasts

Exploitation phase

Operations & port closing, piloting, environmental management

Real time alert systems and short-term forecast



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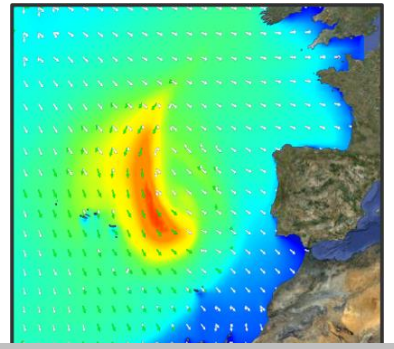
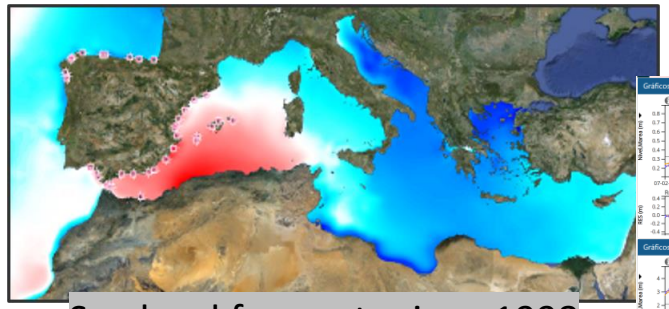
Production

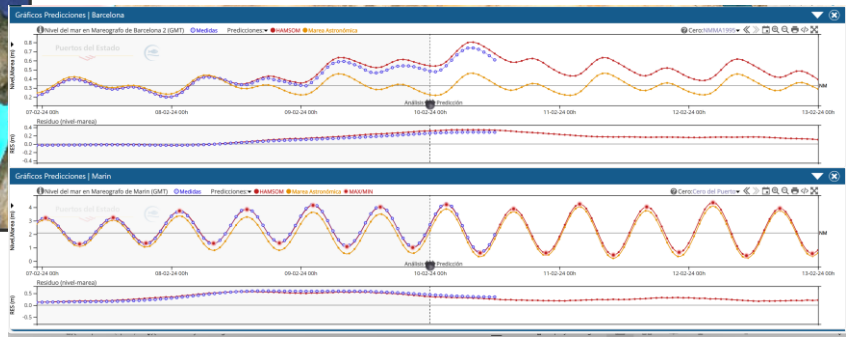
From regional scale forecast services…



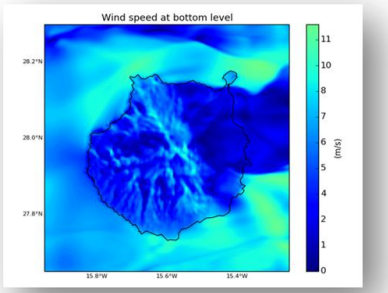
Wave forecasts since 1995



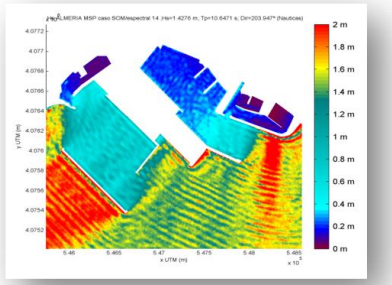
Sea level forecasts since 1998



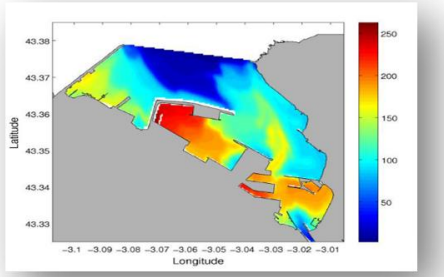
…to **coastal/harbour scale downscaled models** (some nested in Copernicus MF Systems):



35 HR Atmospheric systems (200m & 50m resolution)



25 HR Wave systems in 2 nesting steps (5m)



31 HR circulation systems in 2 nesting steps (50m)

More than

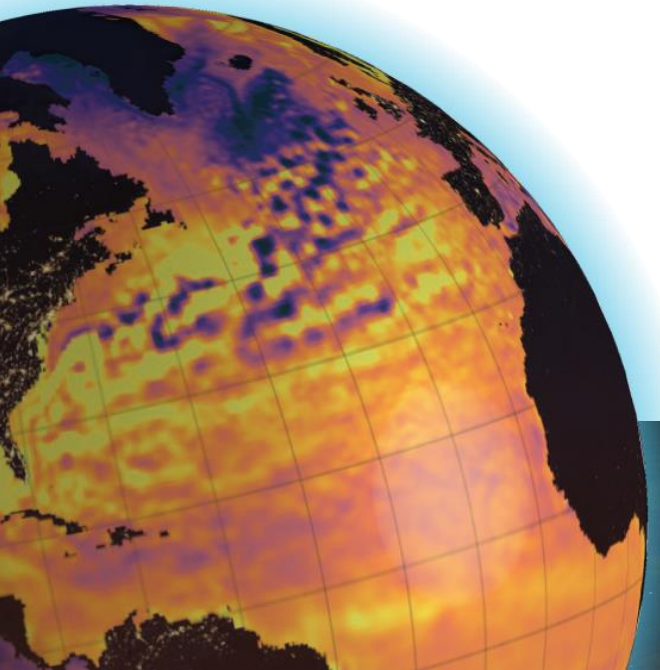
100

models

applications providing

daily forecasts

Validation



Validocean (https://validocean.puertos.es): on-line validation tool

Regional, coastal and port domains validated with in situ data in real time and delayed mode (monthly, seasonal and annual scales). Graphics and CLASS-2 metrics

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Dissemination

Tools and **downstream service**s to fit general public needs

The web:

- 8.000 users daily
- 6.000 data downloads in 2022

portus.puertos.es

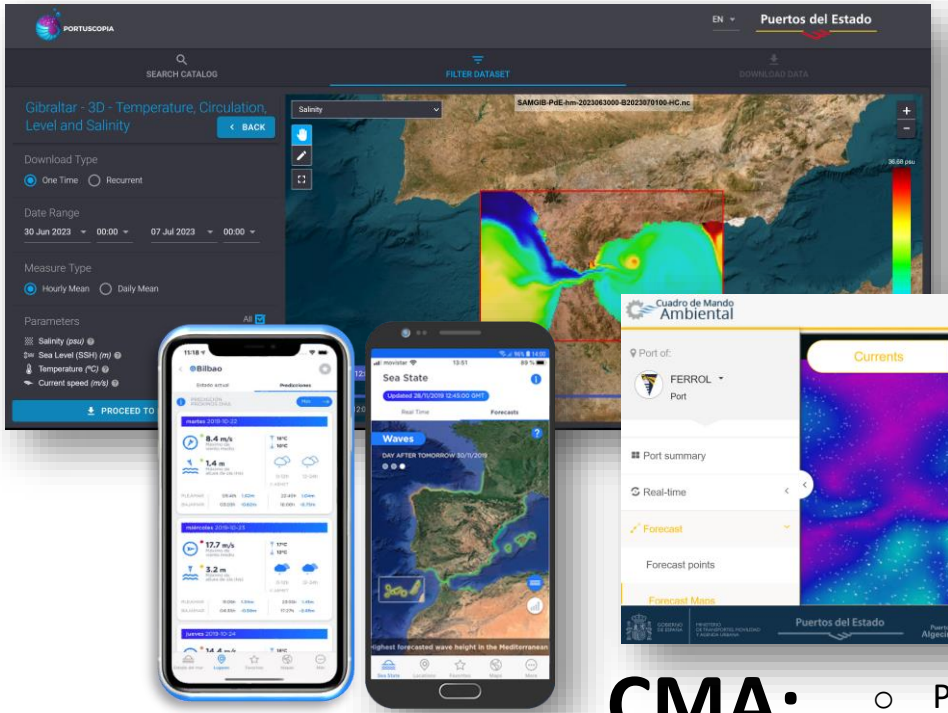
The App: iMar — Google Play — Apple Store

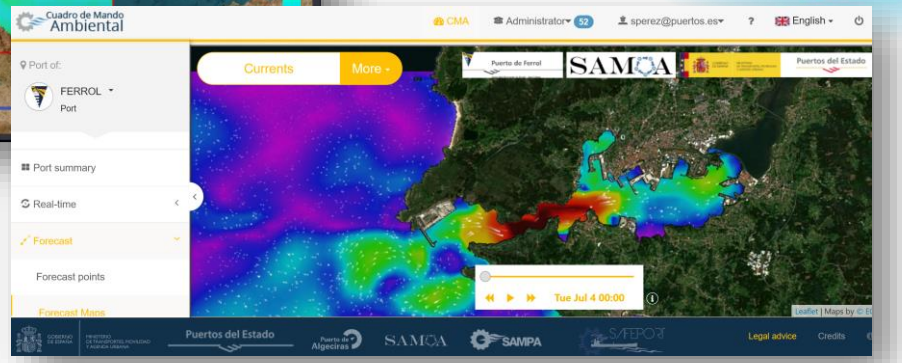
- Latest data, forecast and real time

Portuscopia:

portuscopia.puertos.es

- Massive download datasets: model outputs, 2Hz sea level data, HF radar data



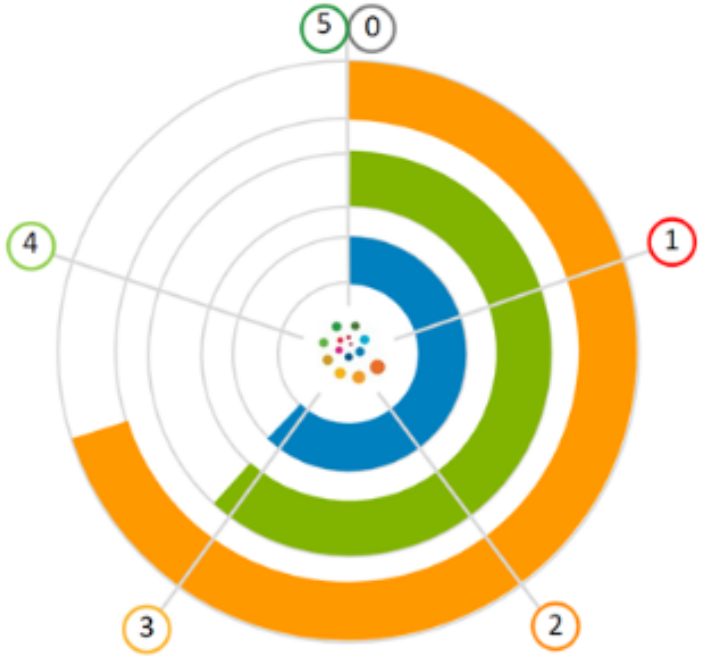


CMA:

- Port Environmental Control Panel to support daily operations

cma.puertos.es

Assessment of Operational Readiness Level



#1: Production

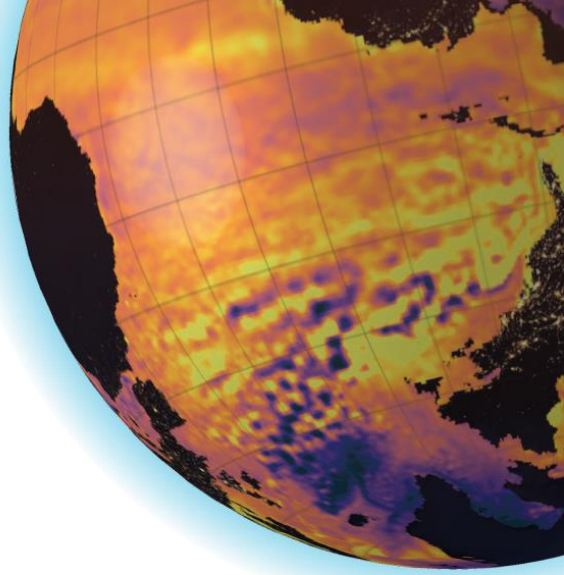
The first digit - **#1** - reflects the reliability of the service, focusing on operational aspects rather than product quality.

#2: System Validation

The second digit - **#2** - monitors the level of validation for the service.

#3: Product Dissemination

The third digit - **#3** - assesses the various degrees of product dissemination achievable by the system.



Objectives:

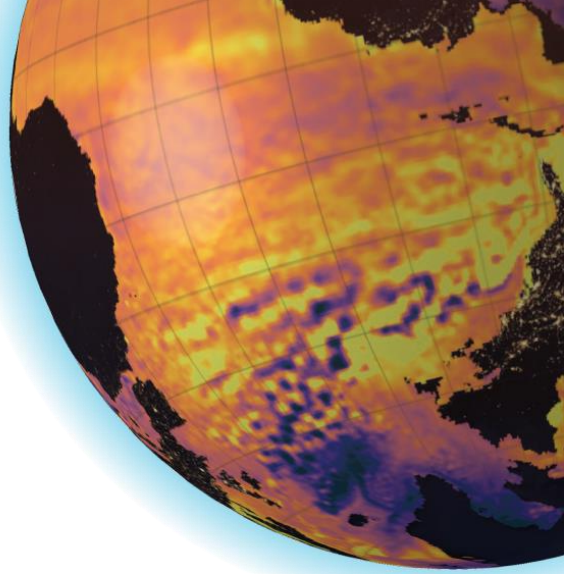
- ensure alignment with international best practices,
- find out our operational level score
- identify gaps and potential lines of future developments.

Álvarez Fanjul et al., 2024: Promoting Best Practices in Ocean Forecasting through an Operational Readiness Level. Front. Mar. Sci. Sec. Ocean Observation. Volume 11 - 2024 | doi: 10.3389/fmars.2024.1443284

#1: Production

The first digit - #1 - reflects the reliability of the service, focusing on operational aspects rather than product quality.

QUALIFICATION: 4.3/5



- Strong operational chain and organised modularity for each operational step
- Monitorisation to solve automatically any potential failure that can compromise delivery of final products to end users.
- Dedication of technical expert staff to control production daily for troubleshooting

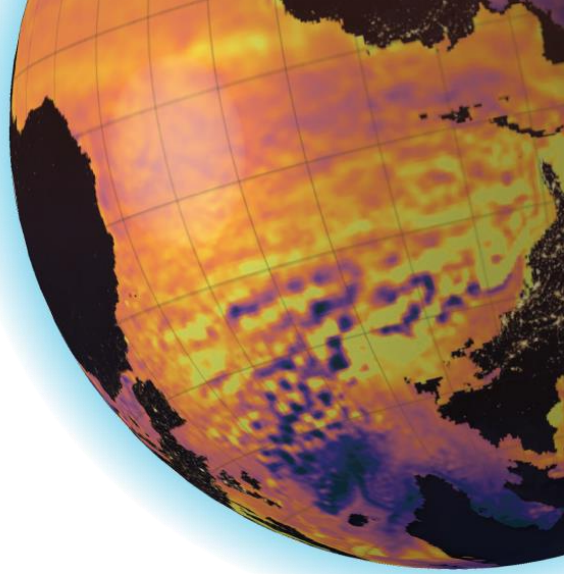
Lesson learnt:

- Improve documentation of our systems, including a repository with a clear versioning policy for software and documents. One of our main limitations nowadays
- Implementation of automatic checks of selected physical variables in our ocean forecasting service as a potential improvement
- Improve product metadata information provided to users, with limitations of upstream data when needed, up to now only registered for internal logs
- Define and implement adequate KPIs to monitor the performance of the service
- Improve the mechanism of roadmap for next years service evolution

#2: System Validation

The second digit - **#2** - monitors the level of validation for the service.

QUALIFICATION: 3.6/5



- Performs a pre-operational model qualifications for all new services to assess accuracy, and capacity in reproducing main oceanographic features in all Spanish coasts and ports
- Validation tool performs a daily online validation of the operational forecasts which allows to validate the hindcast of the regional wave model and hindcast of coastal circulation models, using for this aim observations provided by tides gauges and coastal buoys

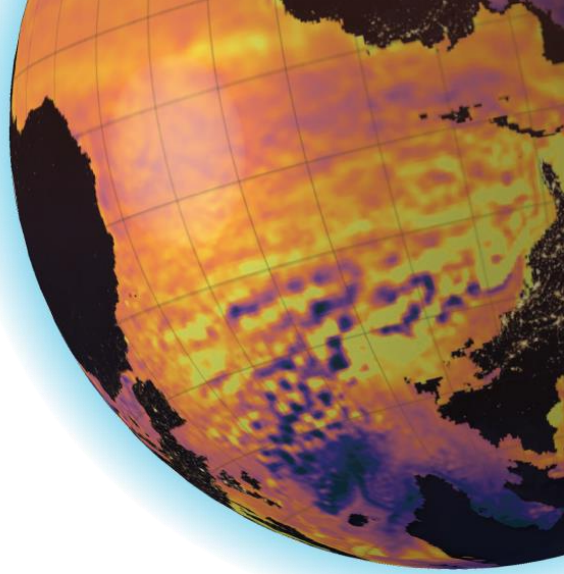
Lesson learnt:

- Skill scores for different forecast horizons need to be implemented in all our systems
- Intercomparison of the validations with other similar systems covering the same domain is only partially done for the sea level forecast.
- Operational comparison of downscaled models against parent models remains to be implemented in the validation tool
- Forcing data are not validated for now in our systems. We consider this aspect a relevant improvement in the near future
- Possible future validation of our regional wave forecast with satellite data (CLASS-4 metrics)

#3: Product Dissemination

The third digit - **#3** - assesses the various degrees of product dissemination achievable by the system.

QUALIFICATION: 4.1/5

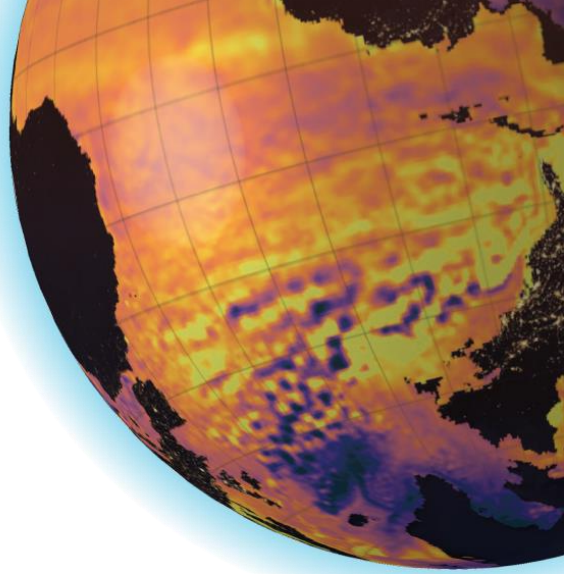


- Data produced by the system is stored in a well-described forma and is available online
- The latest forecast product is distributed to users in graphical format on web site
- A tool for accessing online historical data is available

Lesson learnt:

- Lack of adequate identification of our products and system versions (e.g. via DOIs)
- Need to upgrade the product catalog (metadata and list of products) and user guide with more detailed and specific information relevant to users
- Provide information on the quality of the products
- Detailed analysis of fulfillment of FAIR principles remains to be done
- Improve dissemination mechanism of roadmap for next years Service evolution for the users

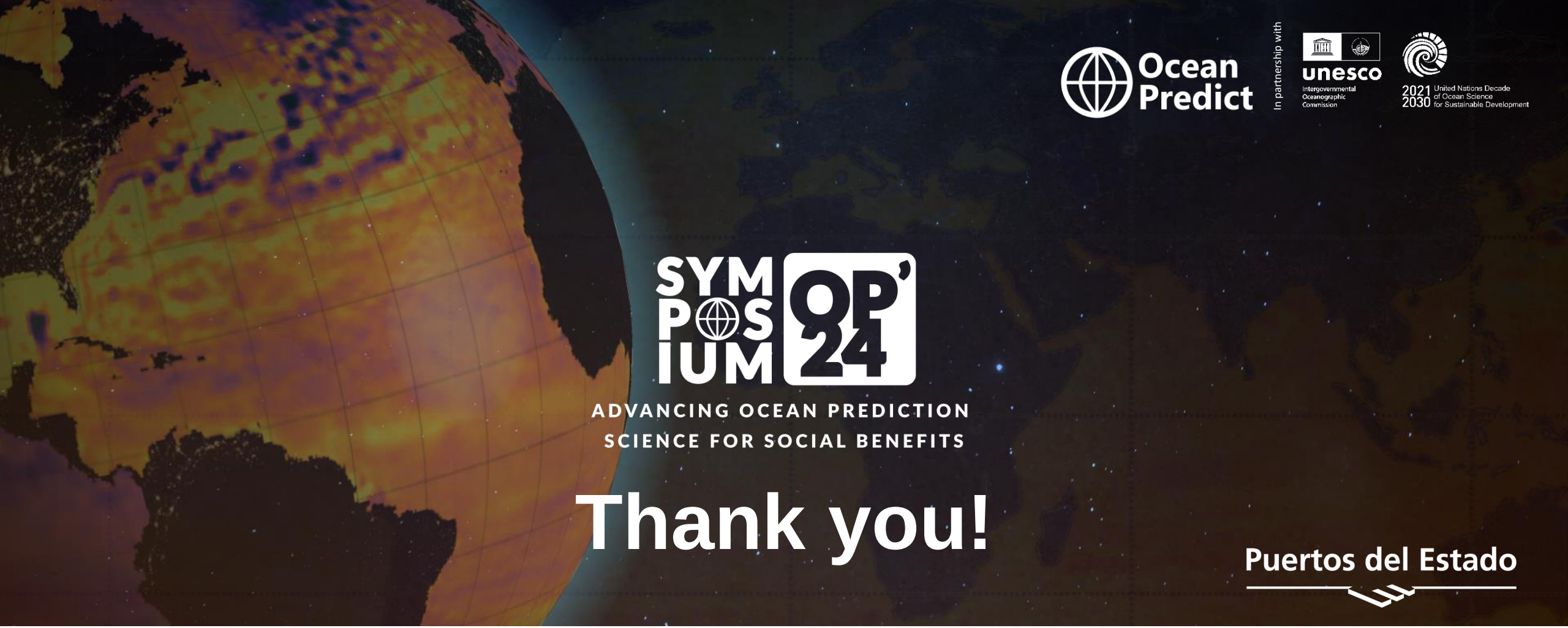
CONCLUSIONS



- PdE operates a complex forecasting system with up to 100 models running daily
- The number of models and operational suites complicates the assessment of the ORL to the whole system as one
- PdE Systems reach highly advanced levels for Production and Dissemination, and an advanced level for the validation component
- The exercise showed that we have solid and strong operational chain but as well it allowed us to identify the main limitations and gaps, some of them already known and planned, others new and interesting to be included in our future plans

SHORT TERM PLANS:

- Improve the dissemination mechanism of roadmap for next years Service evolution for users
- Skill scores of forecast horizons, intercomparison of models and downscaled/parent domains
- Creation of a repository with a clear versioning policy for software and documents.



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SYMPOSIUM OP'24

ADVANCING OCEAN PREDICTION
SCIENCE FOR SOCIAL BENEFITS

Thank you!

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European Commission

Copernicus Marine Service

EU4oceanobs
INTERNATIONAL OCEAN GOVERNANCE
EU COMPONENT TO GLOBAL OCEAN OBSERVATIONS

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