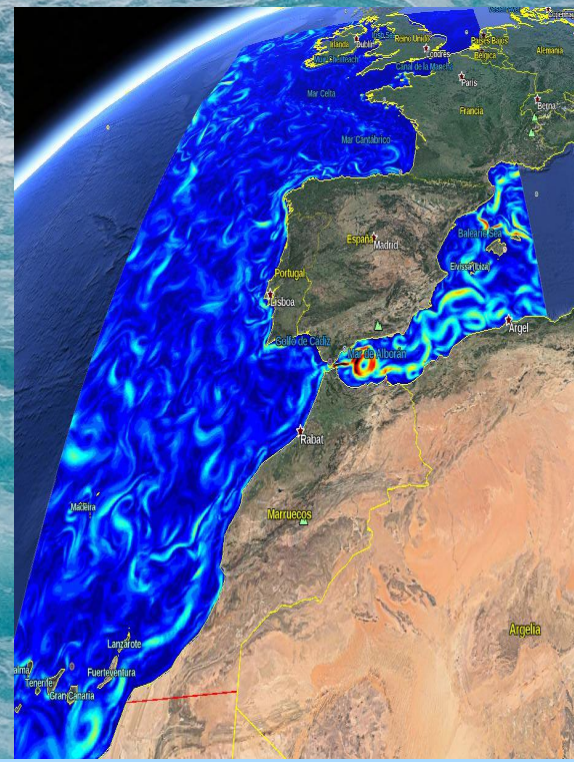
Copernicus Marine IBI-MFC

Un Servicio Europeo de Predicción Regional para la fachada Atlantica generado desde Galicia.



IBI-MFC Delivering regional ocean model products for the IBI area.

now Systems

CESGA

Jornada CESGA (18/06/2024) sobre: “Infraestructuras digitales para Servicios Ecosistémicos Marinos y la ordenación y gestión integrada del litoral de Galicia”.

EL SERVICIO IBI-MFC: Desde Galicia para el mundo…

- ✓ El Servicio Europeo Copernicus Marine IBI-MFC: Evolución y contexto.

- ✓ NOW Systems: una compañía nueva (¡pero, no tanto!)
  - ✓ ¿Quienes somos? ¿De donde venimos? ¿A donde vamos?

- ✓ El servicio Copernicus IBI-MFC hoy.
  - ✓ Misión del Servicio.
  - ✓ Portfolio de Productos.
  - ✓ Evolución del servicio (a user & science driven service).
  - ✓ Usuarios.
  - ✓ Recursos de HPC

- ✓ El Servicio IBI-MFC @ Galicia. Sinergias.
  - ✓ Aplicaciones Costeras & Servicios de valor añadido (diferentes sectores economía azul)
  - ✓ Contribución a una mejor evaluación del clima (servicios climáticos, riesgos e impactos costeros)
  - ✓ Oportunidad para propuestas de Digital Twin (a nivel europeo, nacional, regional)

EL SERVICIO IBI-MFC: desde Galicia para el mundo…

✓Servicio IBI-MFC: Partenariado actual

✓IBI Ops Team: Nologin/NOW Systems + CESGA

✓Servicio IBI-MFC: Evolución y Contexto.

MyOcean Project(s)
2009-2015
PdE+CESGA+MF(+MOI)
Finisterrae

Copernicus (Phase 1)
2015-2022
PdE=>Nologin
+CESGA+MF(+MOI)
Finisterrae-2 => Finisterrae-3

Copernicus (Phase 2)
2022-2028
Nologin => NOW Systems
+ CESGA+MF(+MOI)
Finisterrae-3 => Finisterrae-4?

¿Qué es NOW Systems?

NOLOGIN OCEANIC WEATHER SYSTEMS

Empresa constituida en 2022

spin-off de Nologin Consulting S.L.U

nueva empresa focalizada al 100% en prestar servicios oceanográficos operacionales.

engloba el know-how, la propiedad intelectual y el negocio de Nologin centrado en el entorno marino desde hace más de 20 años.

www.nowsystems.eu

NOW@Santiago en: feuga fundación empresa universidad gallega

Santiago de Compostela

Madrid

Zaragoza

El equipo

El equipo técnico de NOW Systems está compuesto por un equipo **altamente cualificado** en el área STEM:

Javier Sánchez
CEO

Marcos Sotillo
CTO

INGENIERÍA
Informática, Caminos, Canales y Puertos, Industrial, Medioambiental

FÍSICA APLICADA
Ciencias de la Atmósfera, Marinas, Meteorología, Geofísica y Oceanografía

CIENCIAS MATEMÁTICAS
Modelos matemáticos, numéricos e IA

Compañía muy centrada en I+D+i:

21 expertos (9 Doctores + 3 Doctorandos -2 PhD Industrial-).

Colaboración Univ. Santiago, Complutense y Zaragoza (estudiantes en prácticas)

now Systems

VISIÓN Y MISIÓN

Ser un socio fiable,

garantizando los mejores y más avanzados servicios operacionales en el ámbito marino (modelo 24x7).

Desarrollándolos con el mejor equipo e infraestructura.

Co-desarrollar Gemelos Digitales del Océano y la Costa, tal y como los imaginan nuestros clientes….

Propuesta de Valor

Aportar soluciones, conocimiento y servicios para una gestión más sostenible y rentable de las actividades desarrolladas en el medio marino.

MONITORIZACIÓN

Integración de datos observacionales en tiempo cuasi-real

PREDICCIÓN

Modelos numéricos (+ asimilación datos) para simular el océano pasado, presente y futuro

SOLUCIONES IA

Mejora de productos de previsión y monitorización mediante soluciones basadas en IA

CLIMA

Evaluación climática, presente y futura, del estado de los océanos a escala regional y costera

APLICACIONES

Servicios de valor añadido (por ejemplo, sistemas de alerta) e interfaces de usuario a medida

now Systems

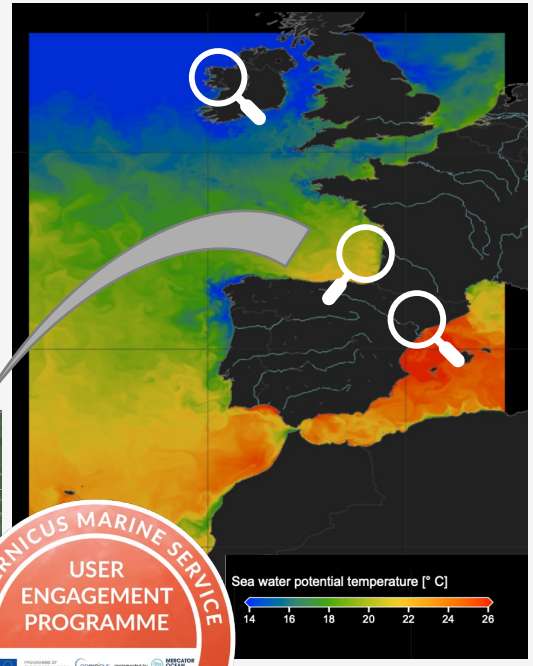
PROGRAMME OF THE EUROPEAN UNION | Copernicus Europe's eyes on Earth | implemented by MERCATOR OCEAN INTERNATIONAL

Core Services

Copernicus Marine Service

Nologin / NOW Systems:
EC Copernicus Marine Service Provider

IBI-MFC Consortium



COPERNICUS MARINE SERVICE USER ENGAGEMENT PROGRAMME 2022-2028

Copernicus Marine Coastal Pilot Services

Forecasting

IBI-MFC (Iberia-Biscay-Ireland Monitoring & Forecasting Centre)

Nologin co-leads with MOI the IBI-MFC since 2018 (responsible of operations; partnership with CESGA & MF)

Observation

INS-TAC (In-Situ Obs. Thematic Assembly Centre)

Nologin in the InS-TAC partnership, responsibility (shared with PdE) in operations, validation and service evolution for the IBI area.

Other Services (around CMS)

PQ-Dashboard (Developing Copernicus Marine Web services)

e-Training (provider of training materials for User Training WSs & Managing the Copernicus Marine e-Training Platform)

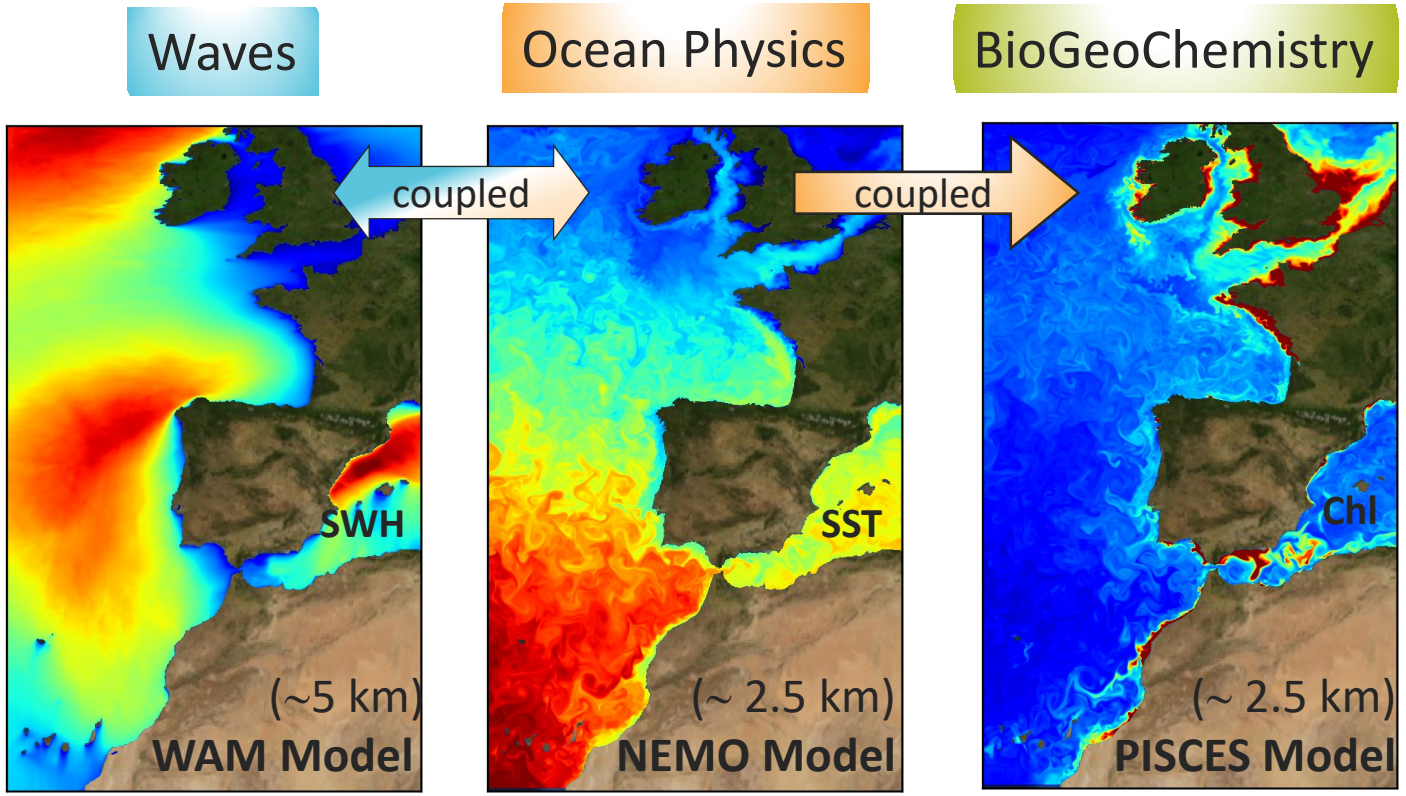
Ocean Prediction Decade Collaborative Centre (supporting MOI in this UN Ocean Decade's initiative)

Coastal Pilot Services (@ Ireland, Gulf of Biscai & Delta Ebro)

The IBI Mission!

To provide regional short-term ocean **forecasts and reanalysis** products for the Atlantic European façade (**IBI area**).

- Covering Blue (ocean physic and waves) & Green (biogeochemical) ocean components
- Using high resolution models (& coupling components!)
- Integrating observations through Data Assimilation schemes (analysis & re-analysis production)
- IBI product quality assessed (reliable science-based products)



The IBI Catalogue

Near Real Time Analysis & Forecast 2020- today (1/36º)

NRT

PHY

Temperature, Bottom temperaturE, Salinity, UV components, Mixed Layer Depth & Sea Surface Height.

IBI_ANALYSISFORECAST_PHY_005_001
cmems_mod_ibi_phy_anfc_0.027deg-2D_PT15M-m → 15min2D
cmems_mod_ibi_phy_anfc_0.027deg-2D_PT1H-m → hourly2D
cmems_mod_ibi_phy_anfc_0.027deg-3D_P1D-m → daily3D
cmems_mod_ibi_phy_anfc_0.027deg-3D_P1M-m → monthly3D
cmems_mod_ibi_phy_anfc_0.027deg-3D_PT1H-m → hourly3D
cmems_mod_ibi_phy_anfc_0.027deg-3D_static

BIO

Chl, Fer, NH4, NO3, O2, PO4, Si, Phytoplanckton, Primary Production, CO2 partial pressure, Dissolved Inorganic Carbon, PH & Euphotic Depth

IBI_ANALYSISFORECAST_BGC_005_004
cmems_mod_ibi_bgc_anfc_0.027deg-3D_P1D-m → daily3D
cmems_mod_ibi_bgc_anfc_0.027deg-3D_P1M-m → monthly3D
cmems_mod_ibi_bgc_anfc_0.027deg-3D_static

MYP Multi-Year 1993 – 2019 (1/~~36º~~)

ΔRes (@1/36°) (in 2025)

Temperature, Bottom temperaturE, Salinity, UV components, Mixed Layer Depth & Sea Surface Height.

IBI_MULTIYEAR_PHY_005_002
cmems_mod_ibi_phy_my_0.083deg-2D_PT1H-m → hourly2D
cmems_mod_ibi_phy_my_0.083deg-3D_P1D-m → daily3D
cmems_mod_ibi_phy_my_0.083deg-3D_P1M-m → monthly3D
cmems_mod_ibi_phy_my_0.083deg-3D_static

Chl, Fer, NH4, NO3, O2, PO4, Si, Phytoplanckton, Primary Production, CO2 partial pressure, Dissolved Inorganic Carbon, PH & Euphotic Depth

IBI_MULTIYEAR_BGC_005_003
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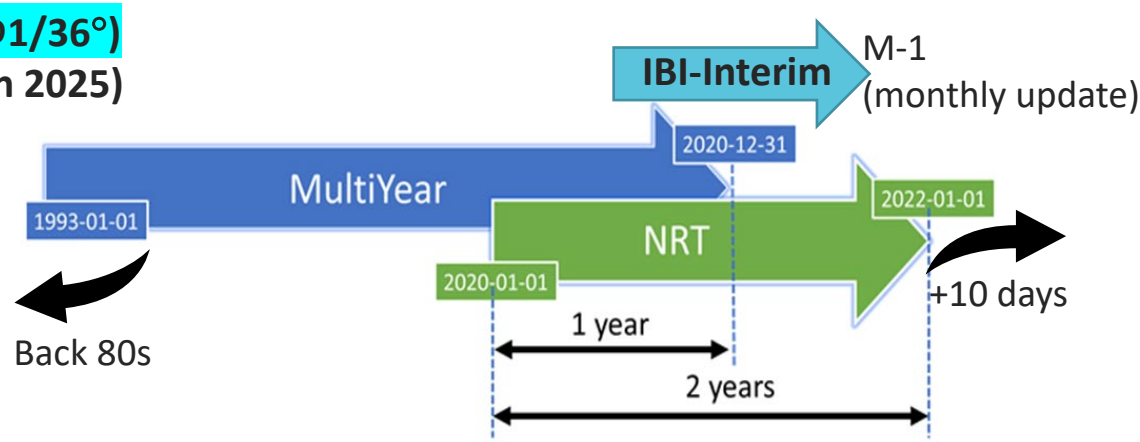

Near Real Time Analysis & Forecast 2020- today (1/~~36º~~)

ΔRes (@1/36°)

WAV

Wave Significant Heigh, Mean Period & Mean Direction; Period at Peak; height, period and direction of Wind Wave, Primary Swell Wave & Seconday Swell Wave; Stokes Drift

IBI_ANALYSIS_FORECAST_WAV_005_005
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dataset-ibi-analysis-forecast-wav-005-005-statics

Multi-Year 1993 – 2020 (1/~~36º~~)

ΔRes (@1/36°)

Wave Significant Heigh, Mean Period & Mean Direction; Period at Peak; height, period and direction of Wind Wave, Primary Swell Wave & Seconday Swell Wave; Stokes Drift

IBI_MULTIYEAR_WAV_005_006
cmems_mod_ibi_wav_my_0.083deg-2D_PT1H-i → hourly2D
cmems_mod_ibi_wav_my_0.083deg-2D_static

IBI-MFC: Roadmap for Copernicus-2 (2022-2027)

- All IBI products in **common single grid**
- **MY & NRT @ same resolution (2.5Km)**
- Ocean physical forecast till **+10 Days**.
- Extend MY Products (**back 80**).
- Get MY prods update closer to present (**New MY Interim Streams**)

IBI-MFC: A service in continuos evolution

A science based service

	C-1 start (2015)	C-1 Phase 2 (2018)	@ end of 2021
IBI-PHY-NRT	- 1/36º NEMO3.4 App. - Sequential Periodic restart - ATM: ECMWF-1/8º (3-h)	- NEMO3.6 - DA (SST, SSH, InSitu TS) - ATM: 1-h ECMWF.	- IBI Wave coupling (in FCs) - Updated tidal forcing
IBI-BIO-NRT	✘	- 1/36º PISCES3.6 - No permanent burial - Improved carbon cycle - Carbon vars distributed	- Revised inputs from rivers - Permanent burial - Improved OBC (CMEMS GLO)
IBI-WAV-NRT	✘	- 1/10º MFWAM App	- 1/20º MFWAM + DA - IBI Currents inputs
IBI-PHY-MY	- 1/12º NEMO3.2 (ERA-Int) - DA (SST, SSH, InSitu TS) - Coverage: 2002-2011	- 1/12º NEMO 3.6 - Coverage: back to 1993	- ATM: ECMWF ERA5 - improved DA - New OBS (OSTIA SST)
IBI-BIO-MY	- 1/12º PISCES 3.2 - Non-assimilative hindcast - Coverage: 2002-2011	- 1/12º PISCES 3.6 - No permanent burial - Improved carbon cycle - Carbon vars distributed - Coverage: back to 1993	- Revised inputs from rivers - Permanent burial - Improved OBC/IC (CMEMS GLO)
IBI-WAV-MY	✘	- 1/10º MF-WAM - Winds: ERA-int - OBC: ECMWF	- 1/20º MFWAM + DA (SWH) - Winds: ERA5 - OBC: CMEMS GLO - IBI Currents inputs

IBI-MFC Improvement lines along Copernicus-Phase1:

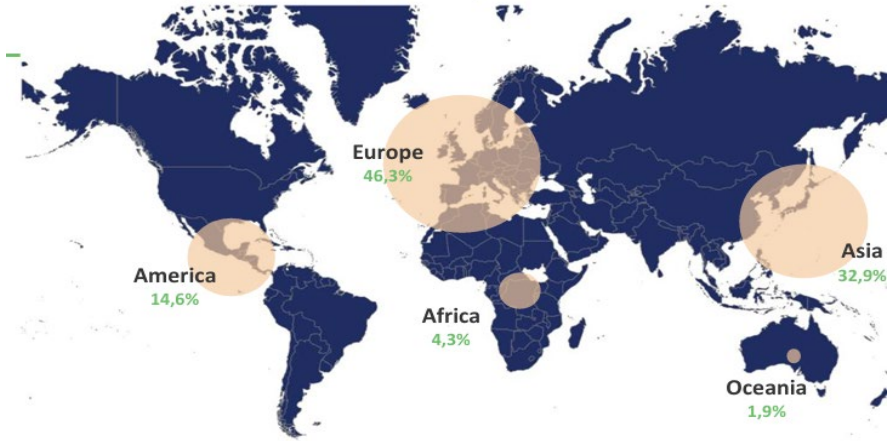
- **A complete IBI Portfolio.**
- **System interactions (Coupling).**
- **New/Update Data Assimilation**
- **Product Improvement: New vars, ⇑ Resolution, ⇑ Coverage.**
- **Model Configuration improv. (inc. Forcing).**

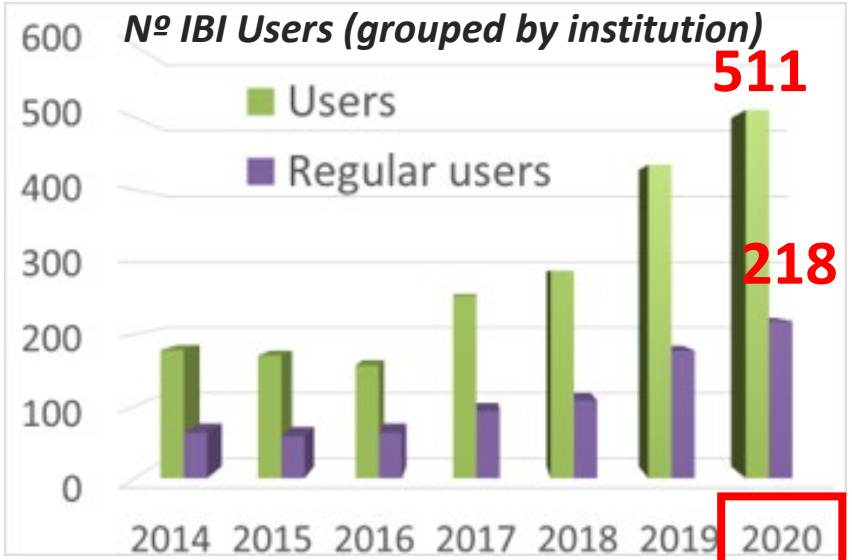
28 Sci papers on IBI products & service evolution.
IBI-MFC, SE & H2020 Projects.

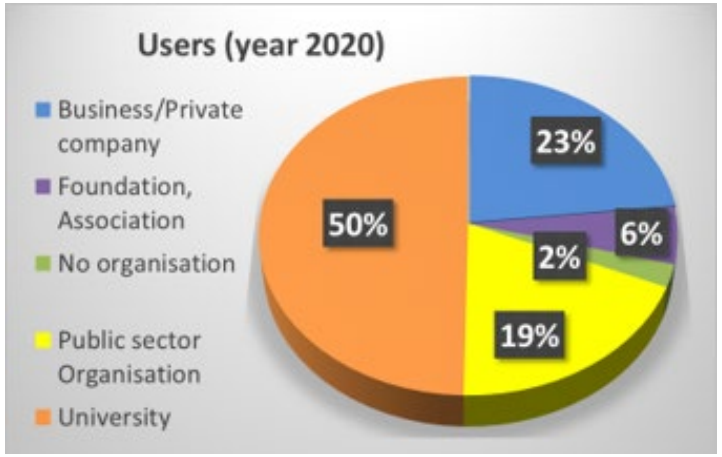
The IBI-MFC Users: what users?

A (growing!) IBI-MFC User Community

Copernicus Marine Users (+30%per year)

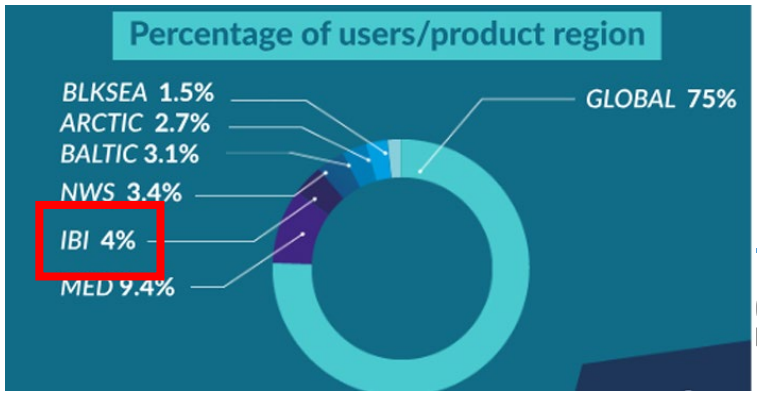


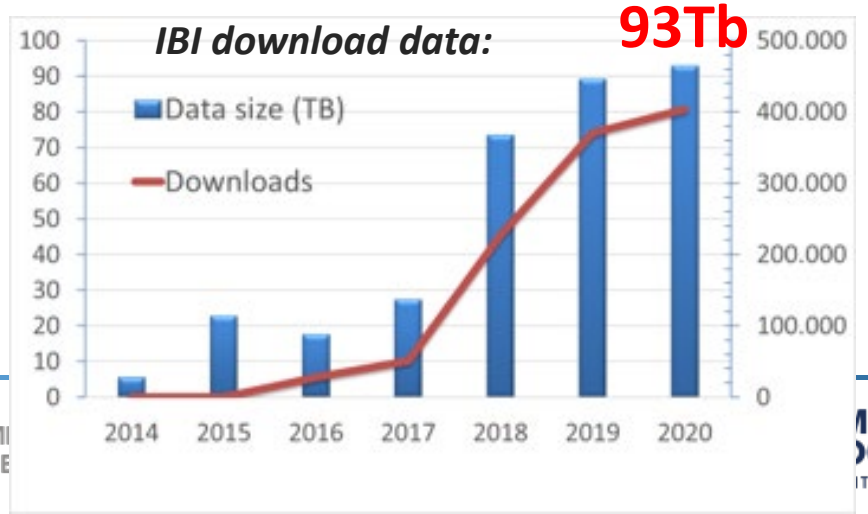


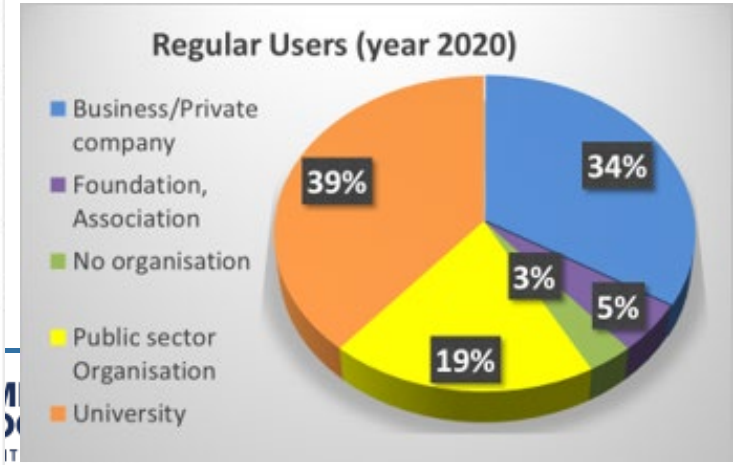


Type of IBI Users

- **66 000** Subscribers by end 2023
- **73 260** Subscribers now!



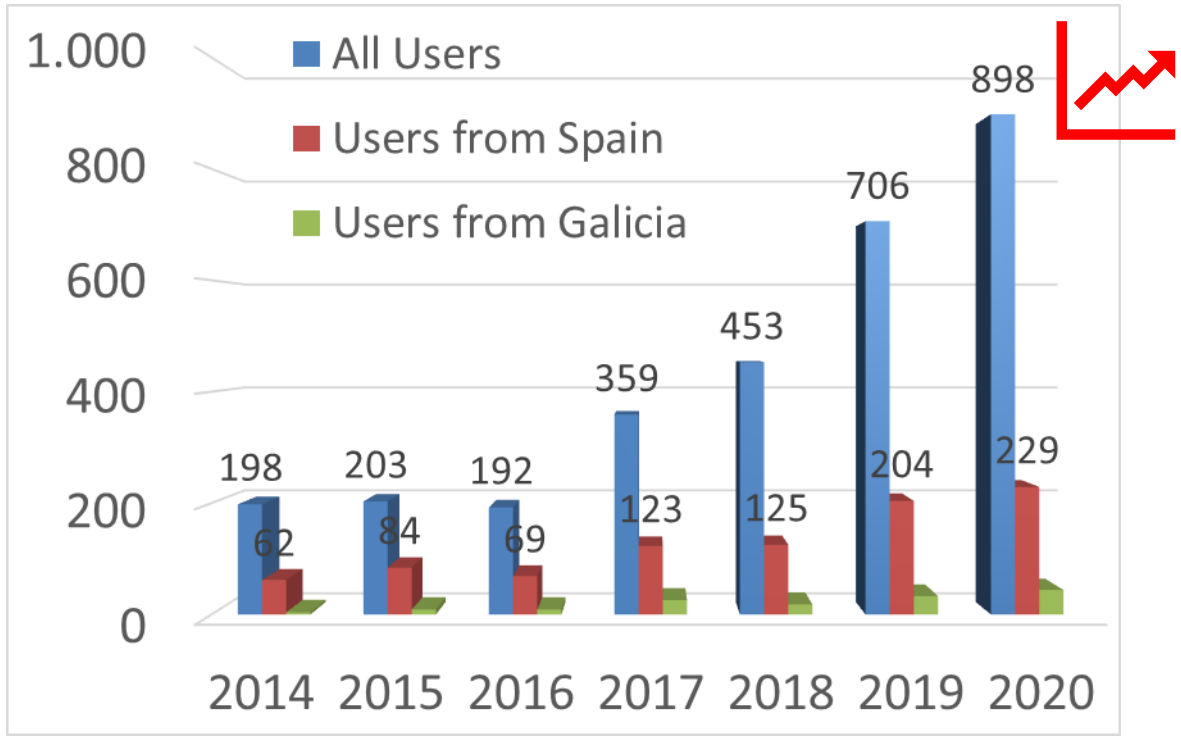


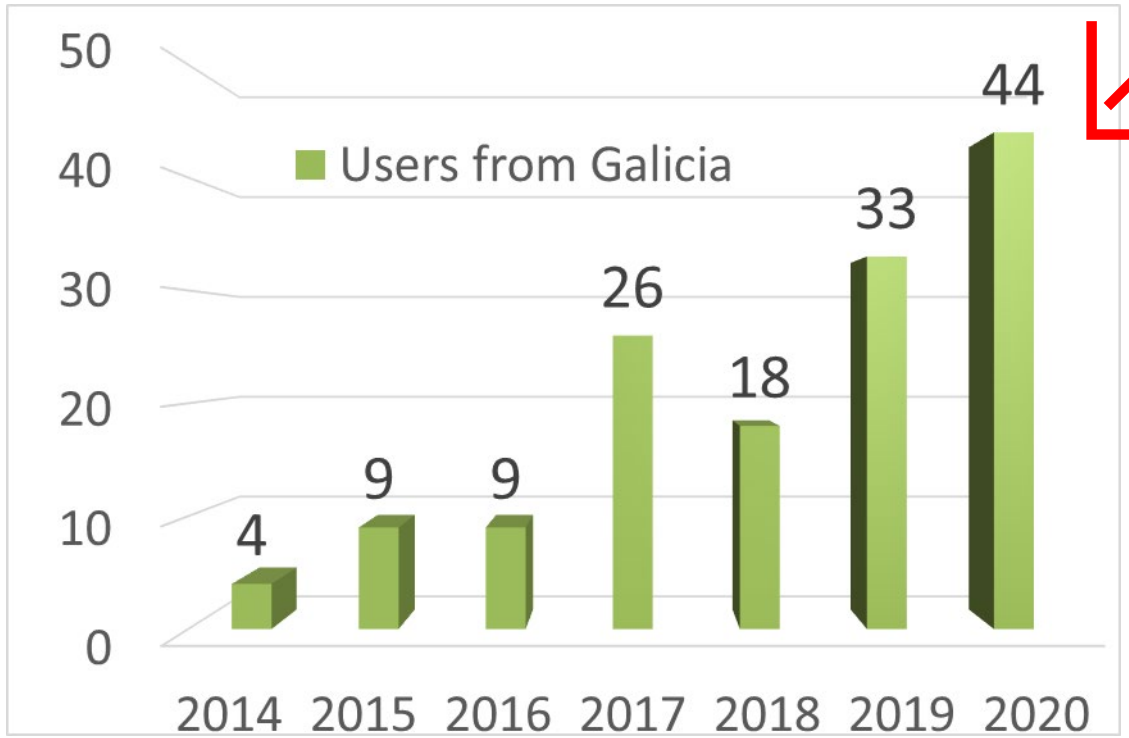


The IBI-MFC Users: what users?

A (growing!) IBI-MFC User Community

Usuarios en España y Galicia…





* Datos hasta 2020

The IBI-MFC: HPC Resource needs

Supercomputing: Key element for IBI Operations & Service Evolution

IBI-MFC Operational Production in ***Finisterrae-3 (CESGA)***

High IBI-MFC HPC Needs

2019 IBI production*:

- > 1.300.000 hours (CPU time)
- ~ 50 TB (Storage)
- Only operations. HPC Resources for Sci. Devs not included.

Continuos increase!

- More needs, more upgrades, but also more optimization!

The IBI-MFC Service: ***A challenge for an HPC Center!***

- Complex to be managed in shared clusters.
- Lots of resources needed in specific times:
  - To run an IBI PHY forecast, need: >1000 cores (for 2h) & ~1.5 TB (big IO!)
  - 24 IBI cycles launched every week.

The IBI-MFC: HPC Resource needs

Supercomputing: Key element for IBI Operations & Service Evolution

Optimization: A must!

Nologin Action to improve eficienciency in nodes uses PHY-FOR-FREE ~70%

	Sep-Dec 2018	2019	2020	2021
% of nodes reservation use	44,89%	37,09%	57,65%	64,02%

HPC dedicated to IBI Operations

	2019	2020	2021
*Hours*CPU*	1 089 812	1 441 350	1 491 840 **estimated*

Total CMEMS-1 Phase2: **4 450 454 hours*CPU**

(based on Jan21 consumes)

Other HPC uses (R&D, Transition into Ops, & MY production)

	1 031 074	734 373	298 368 **estimated*

Total CMEMS-1 Phase2: **2 063 815 hours*CPU**

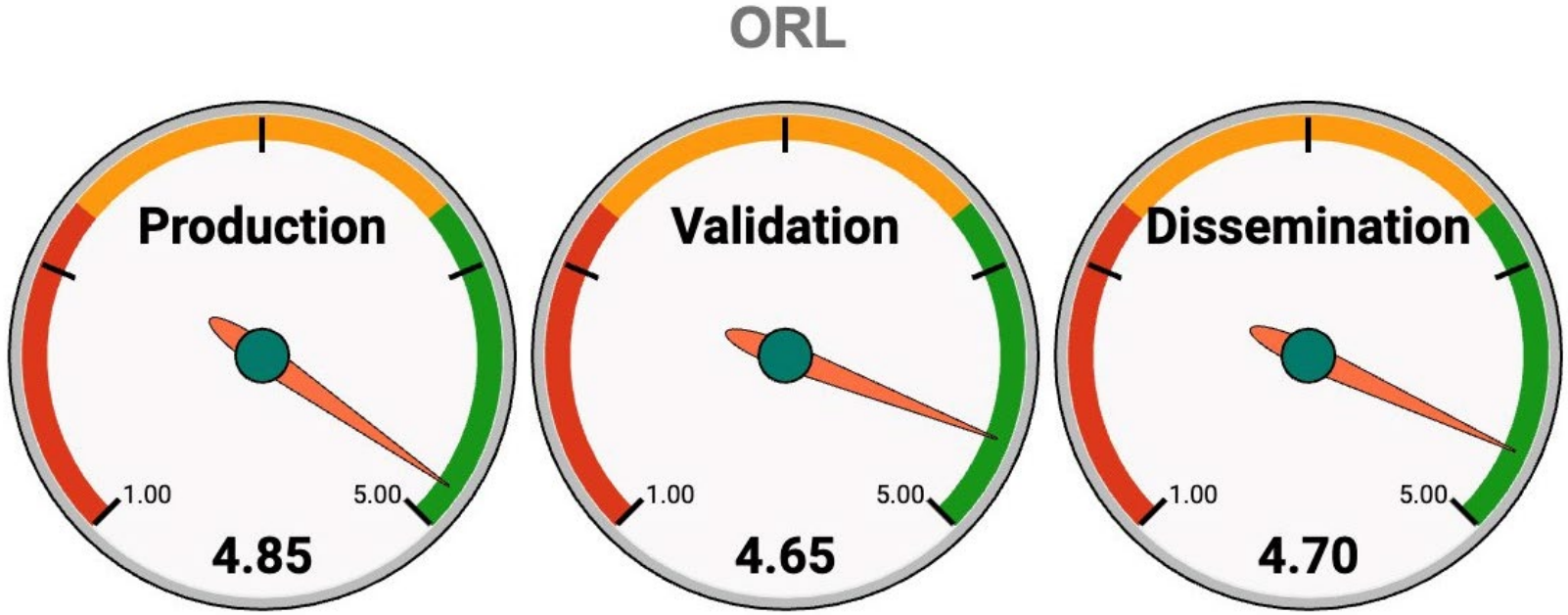
Total IBI-MFC CPU*Hours: 6 086 817 hours*CPU

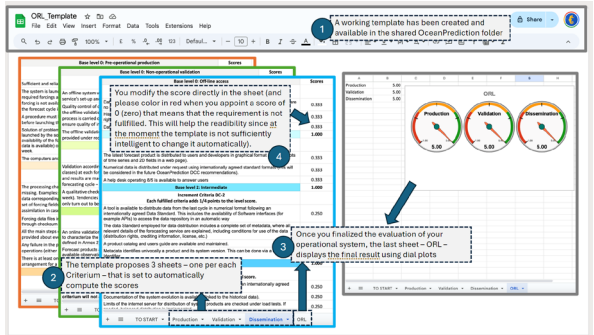
CPU hours used for the IBI-MFC Service in C-1

IBI-MFC: a Reliable Operational Service

Ocean Prediction | UN DECADE COLLABORATIVE CENTRE

Operational Readiness Level:



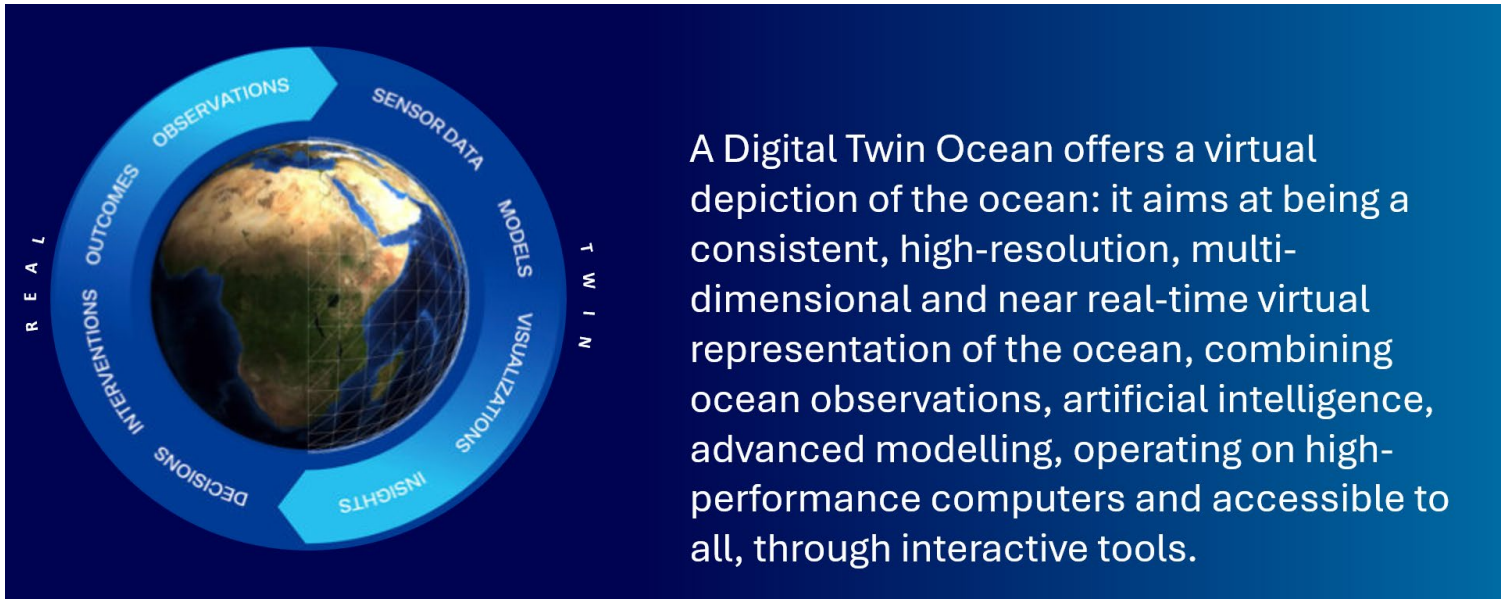


✓The IBI-MFC service, a (pro) Operational Ocean Forecast

(*Ciliberti et al. 2024*)

IBI-MFC (& NOW Systems): where do we go?

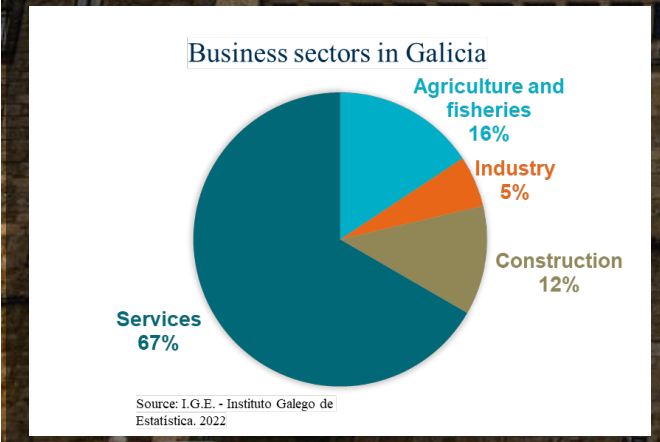
- ✓IBI-MFC (as Copernicus Marine Service) supporting the European Digital Twin of the Ocean.
- ✓ NOW Systems' Vision to build DTs of the Ocean (& the Coast) to support local initiatives.



now Systems

feuga
fundación empresa universidad gallega

NOW Systems
New Office in Santiago!!!



NOW aims building a collaborative framework in Galicia to:

Improve existing services

Using best available Model & Observational products

Promote generation of new Services

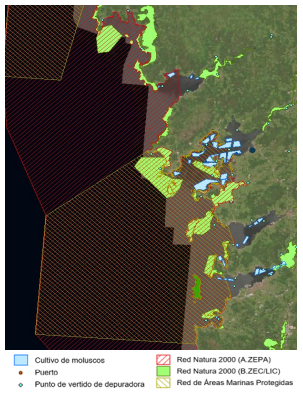
Based on the best R&D (+i)

Advanced coupled model configurations; forecast/climate monitoring ; AI-based solutions

Following a Digital Twin spirit…

New Added Value Applications

Proyecto AGORA.



Predicción Avanzada en Galicia: preservando el Océano y su ResilienciA.

Reliable knowledge and predictions to achieve efficient management

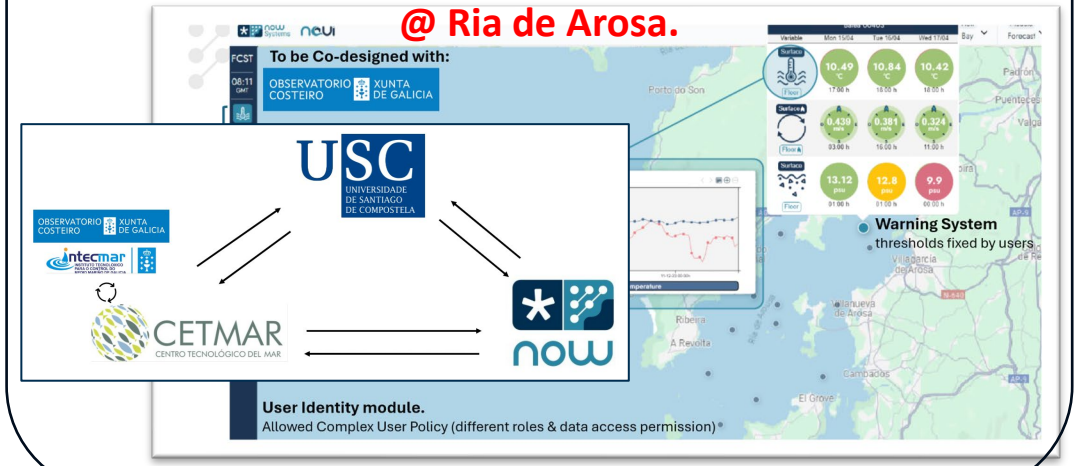
PHD Industrial @ NOW Systems.

XUNTA DE GALICIA

Project Proposal

Demostrator of Copernicus Coastal Thematic Hub

@ Ria de Arosa.



NOW aims building a collaborative framework in Galicia.

NOW Systems @ Galicia can contribute to promote:

Agreements with providers & users

Strong Networking

Attraction of R&D resources

Ensure Transfer into Ops Services.
User uptake + Benefits for society