Operational data assimilation within MyOcean and medium term plans

Eric Dombrowsky – Mercator Océan

MyOcean

Marine Core Service

Outline

- The MyOcean Projets
- Where assimilation is in MyOcean and what it is
- Plans for the future within MyOcean II

1

What is MyOcean ?

MyOcean

Marine Core Service

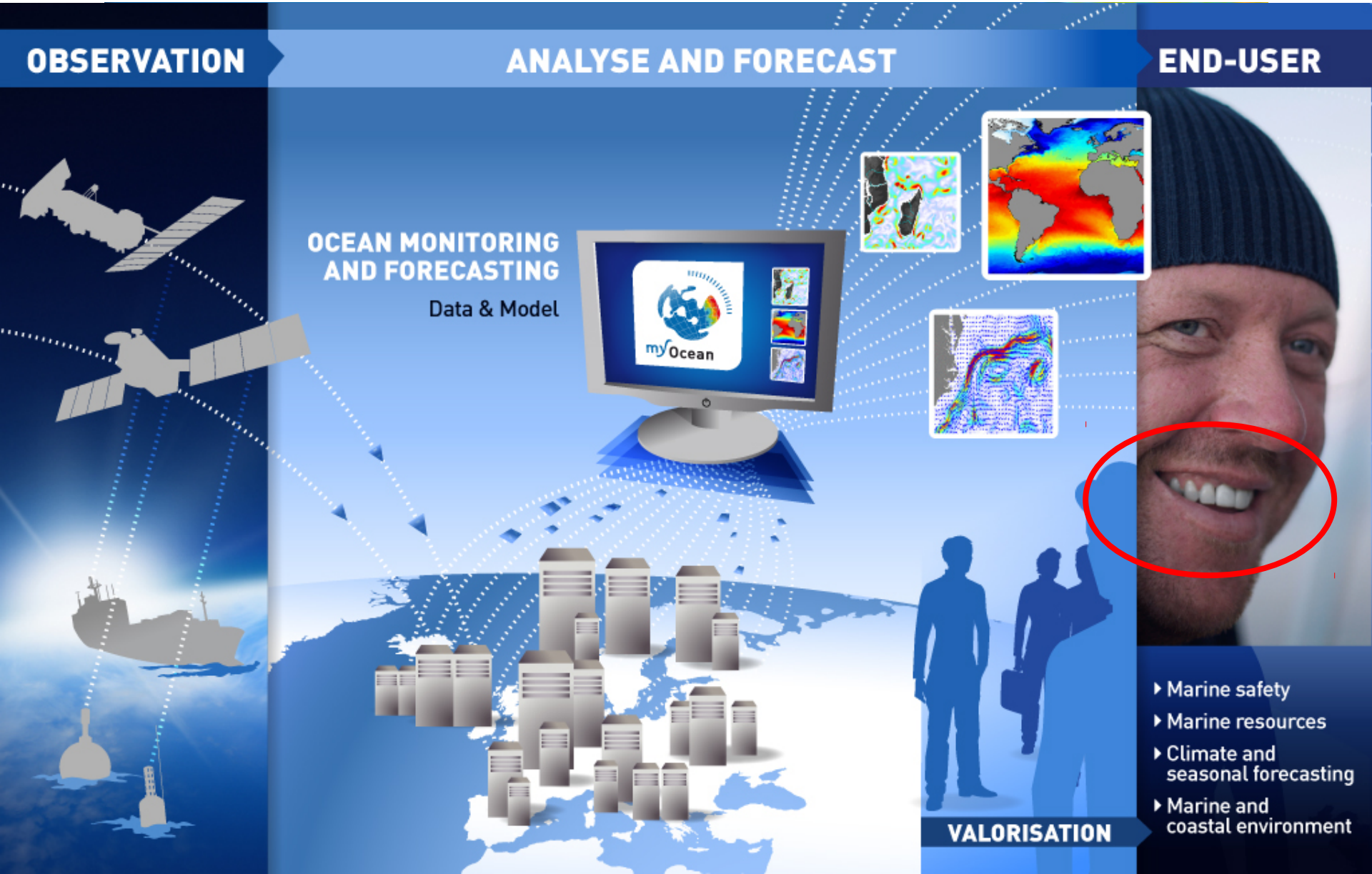
MyOcean in a nutshell

- **MyOcean is a PROJECT**
  - An FP7 project, the GMES « Marine Fast Track » project
  - 3 years ; has started on 1st April 2009, will end 31 March 2012
  - Cost 20 M€/year, with 11 M€/year EC funding
    - **2009 – 2010 – 2011 – (2012)**

- **MyOcean is a SERVICE**
  - The main component of the « **GMES** » Marine Core Service
  - Global & regional Ocean monitoring and forecasting
    - **Marine Core Service**

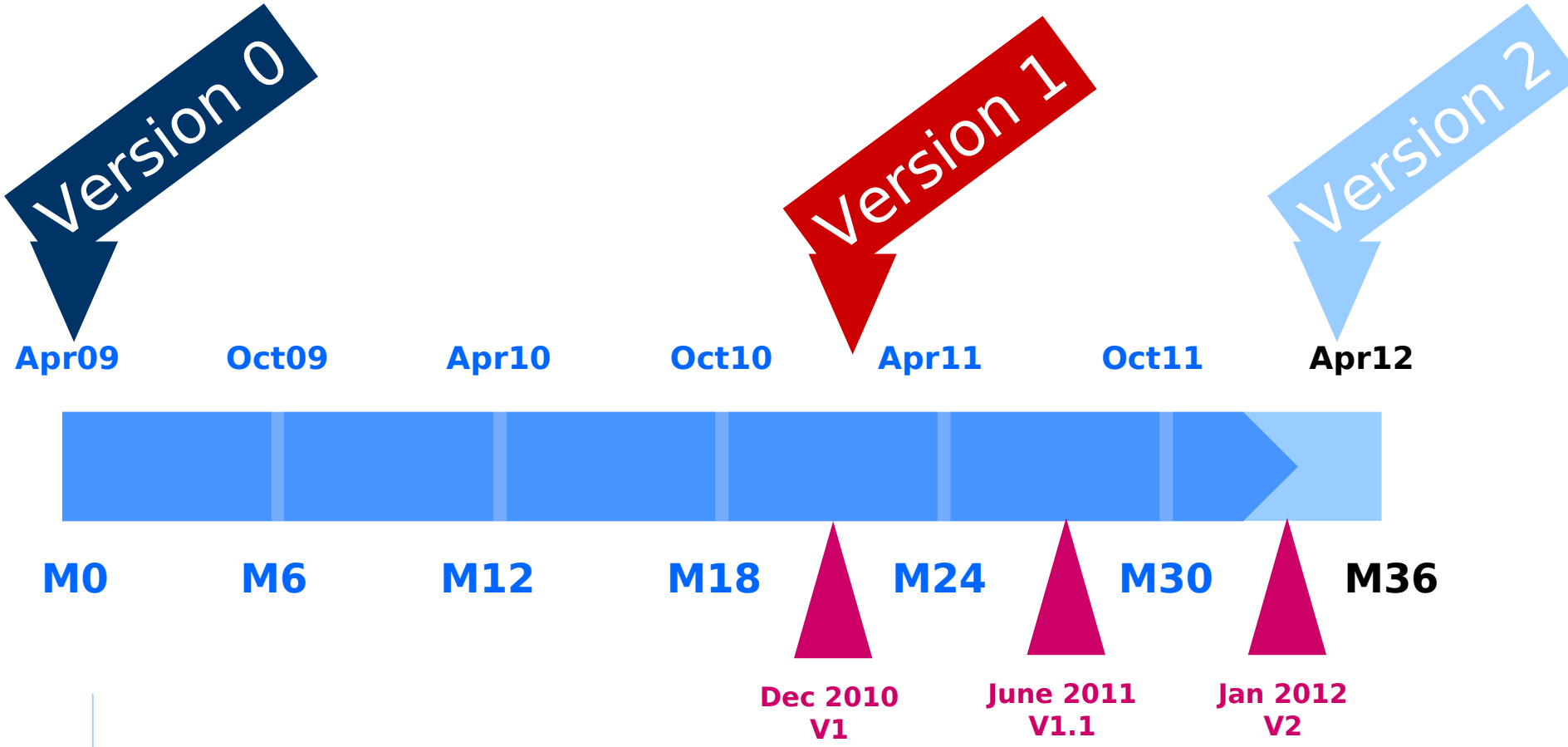
- **MyOcean is a TEAM of European partners**
  - 61 partners, out of 29 countries ; an effort of ~150 person/year
  - 20 core partners committed for operations; european best monitoring and forecasting systems
    - **Pan-European team**

The Mission

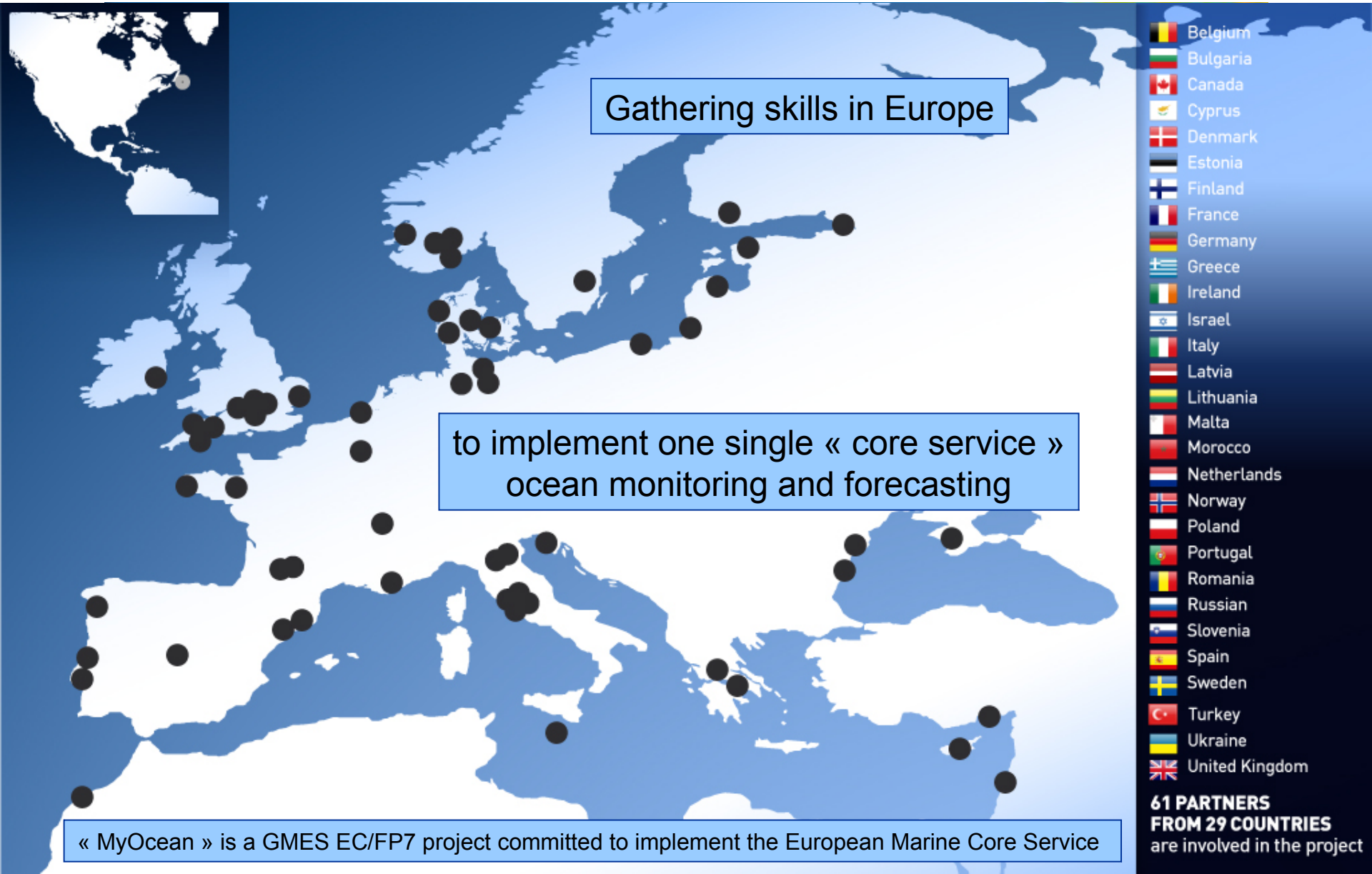

OBSERVATION
ANALYSE AND FORECAST
END-USER
OCEAN MONITORING AND FORECASTING
Data & Model
myOcean
VALORISATION
Marine safety
Marine resources
Climate and seasonal forecasting
Marine and coastal environment

Timeline

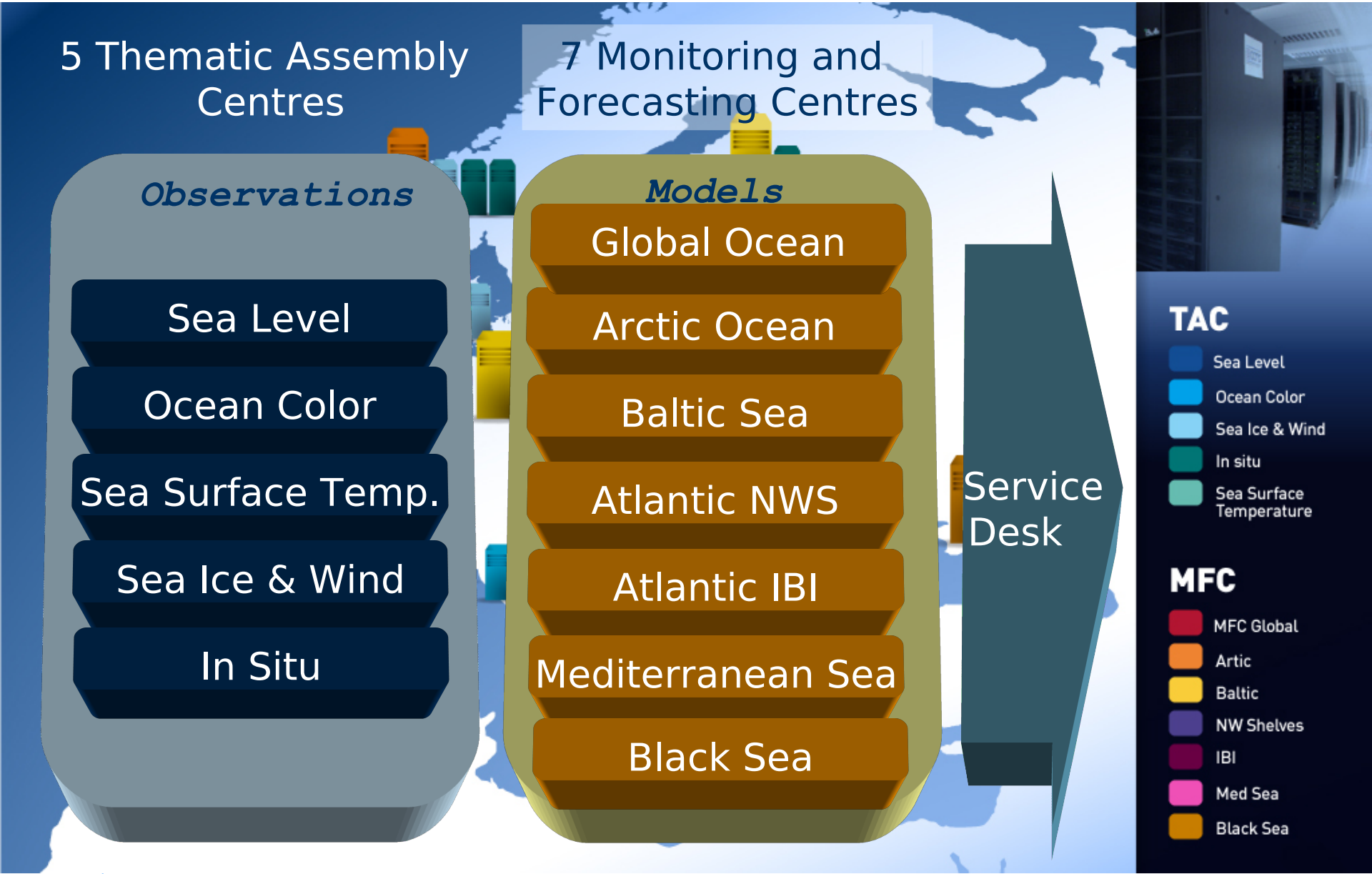
Marine Core Service



Gathering skills in Europe to implement an *integrated* Marine Core Service

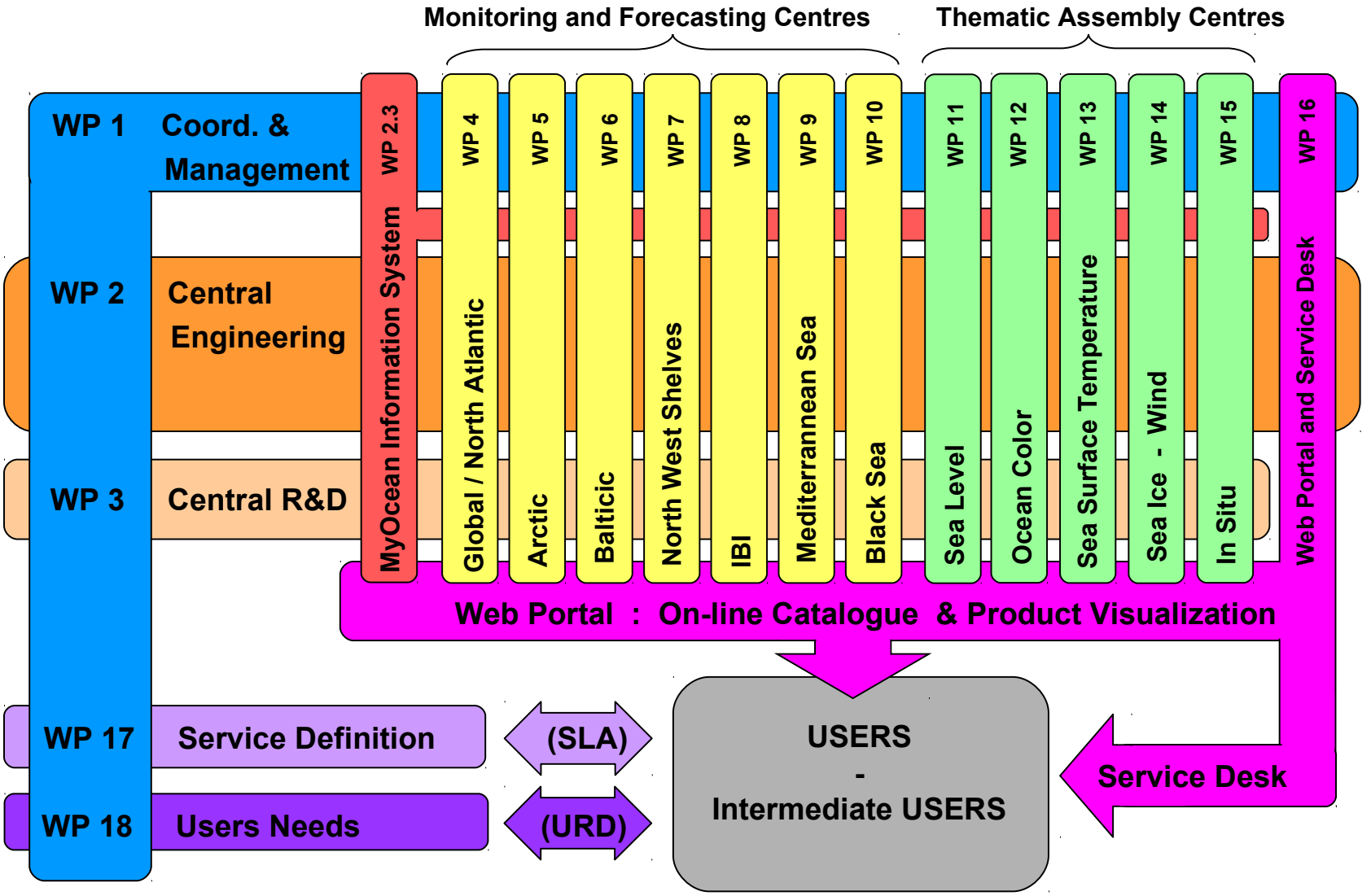


Organization in Production Centres



MyOcean : a System of Systems

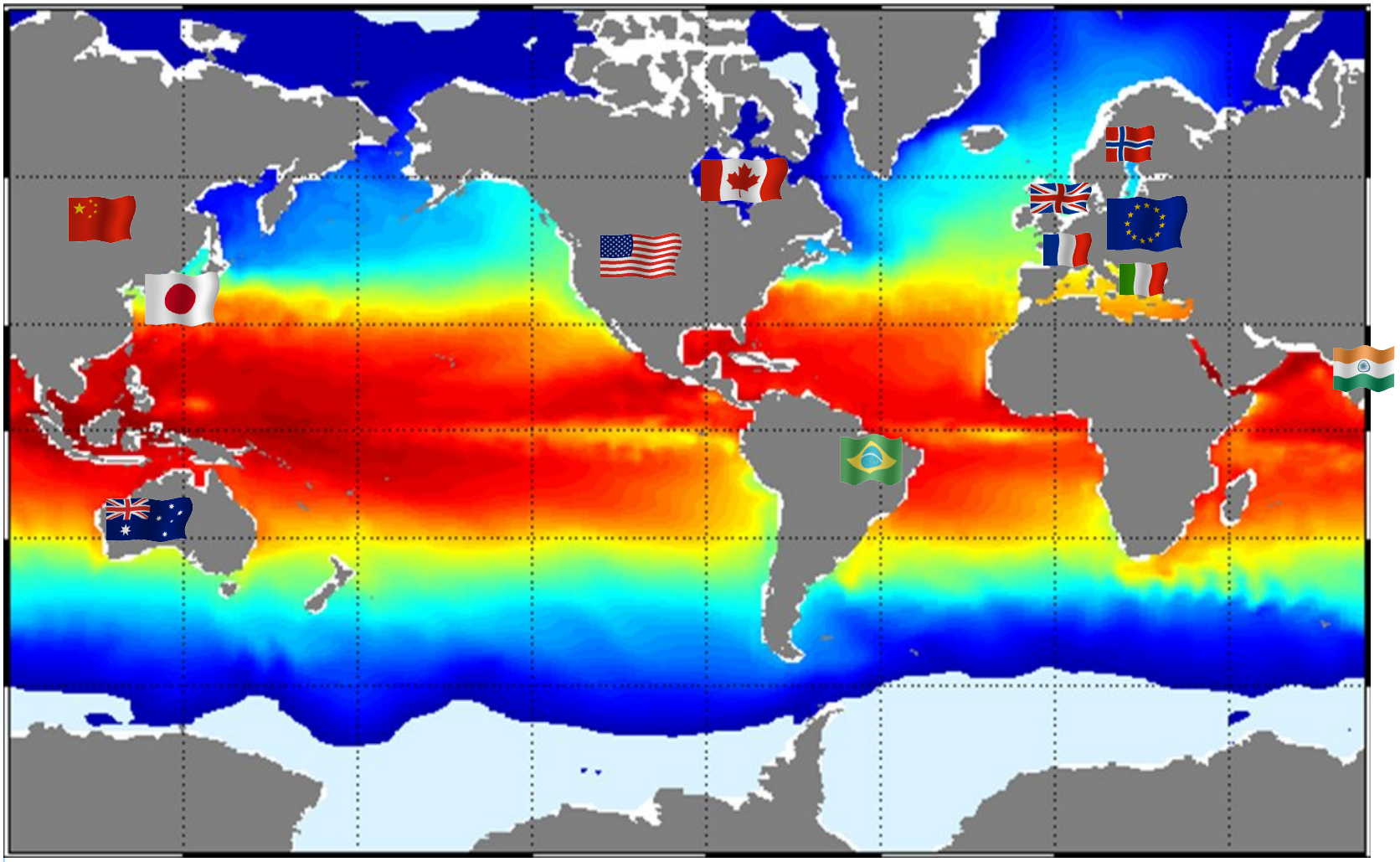
Marine Core Service



GODAE OceanView

Ocean Monitoring and Forecasting Services in the world

Marine Core Service



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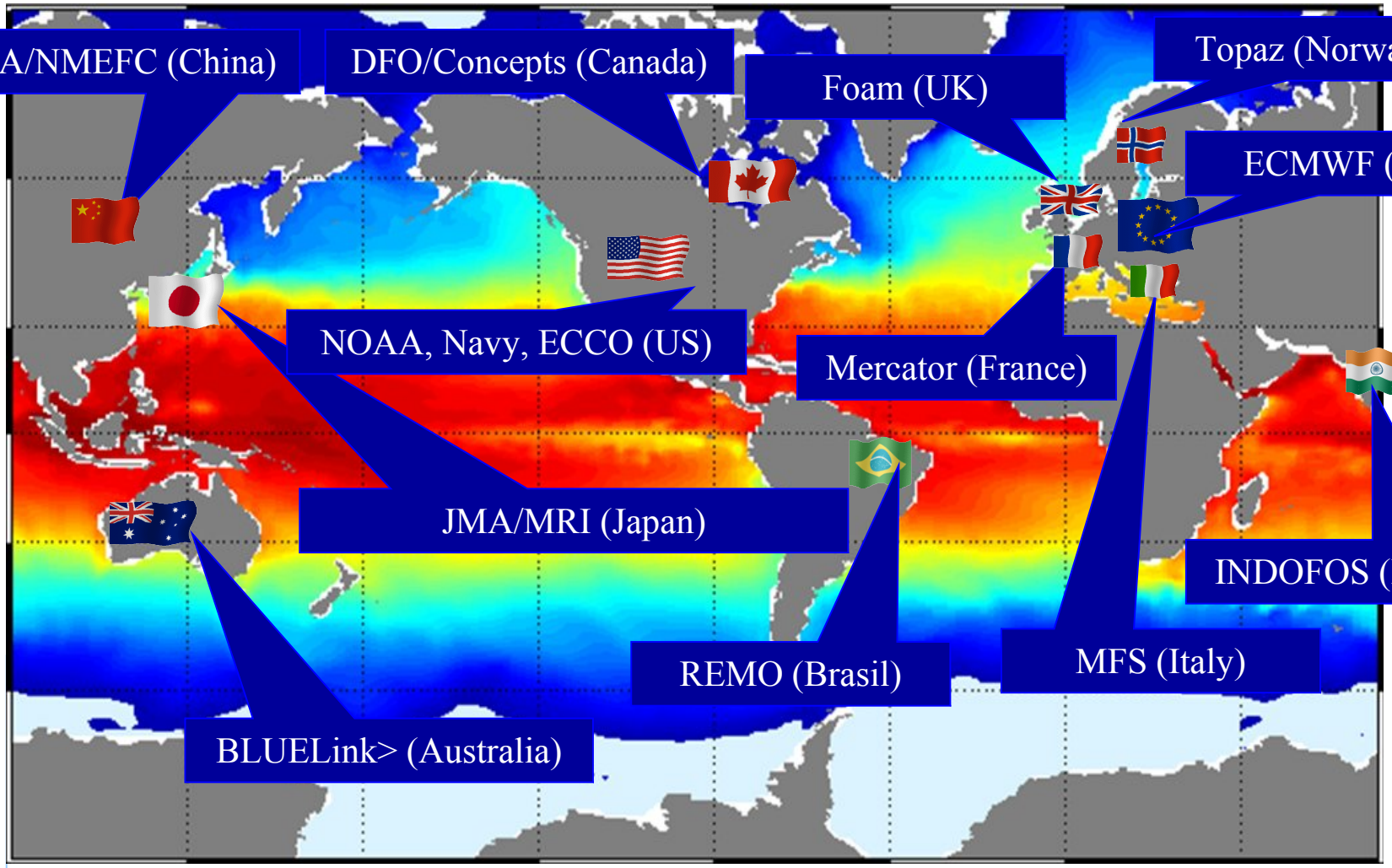
Ocean Monitoring and Forecasting Services in the world

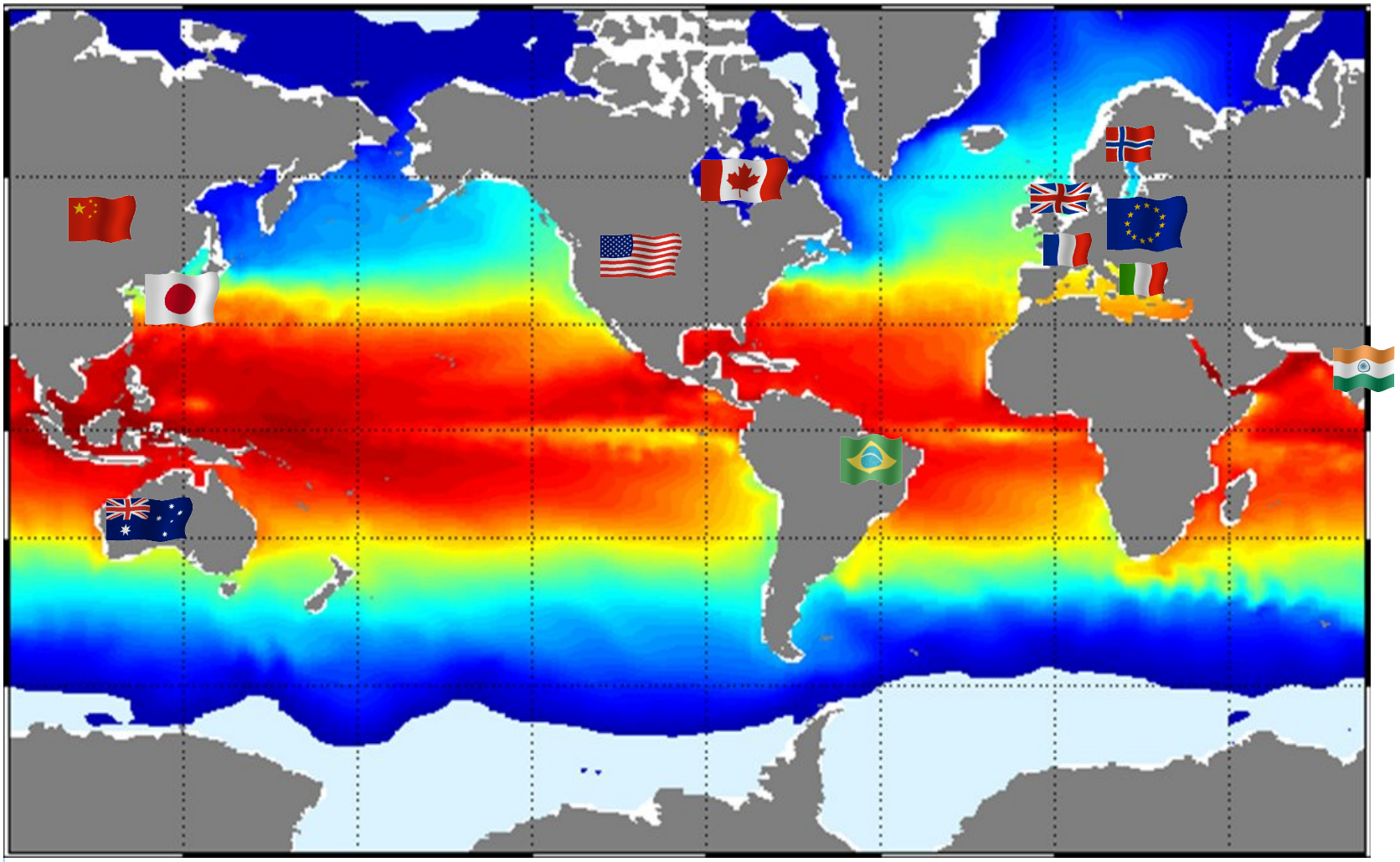
Marine Core Service



GODAE OceanView

An international team:
GODAE OceanView

Marine Core Service



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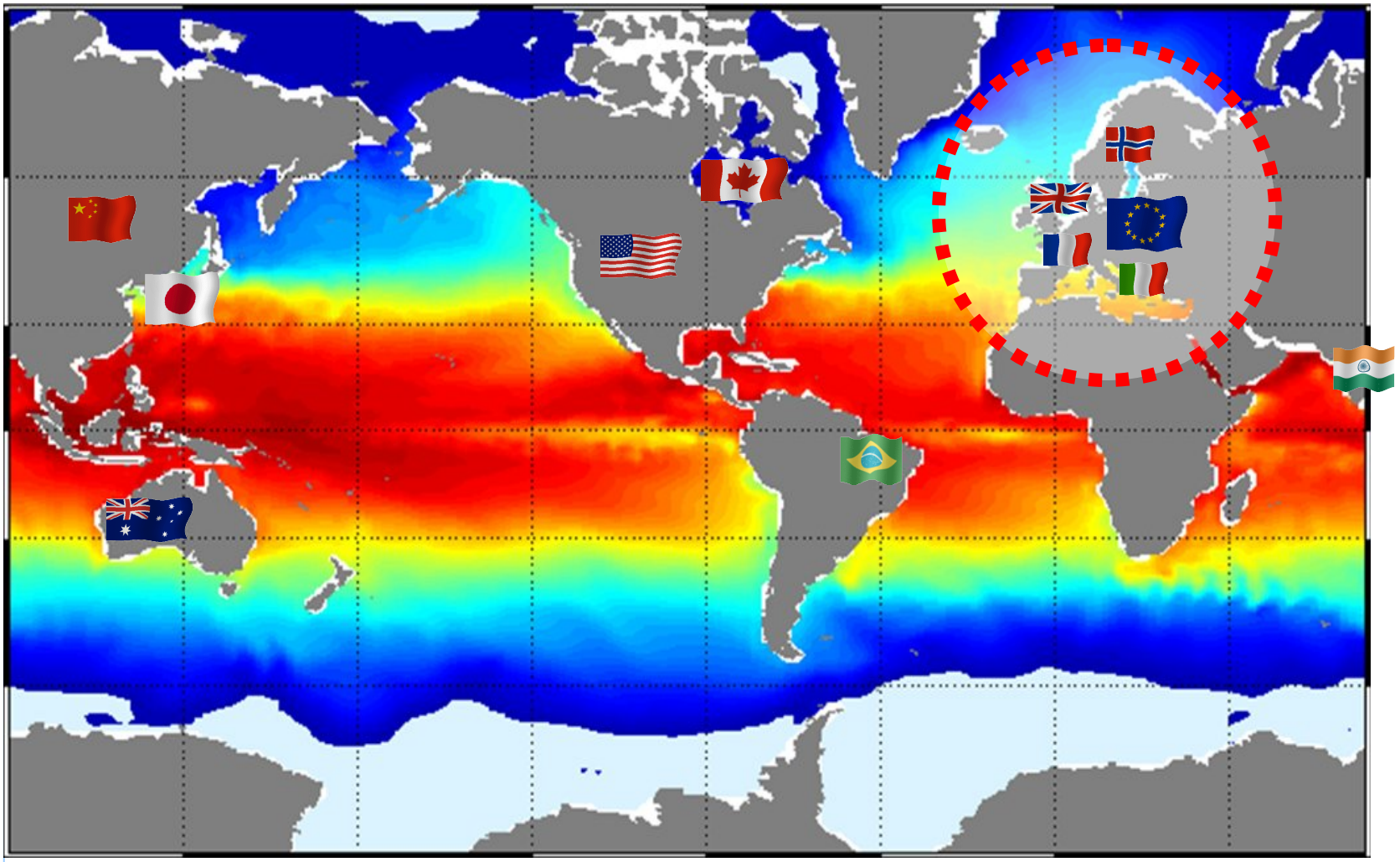
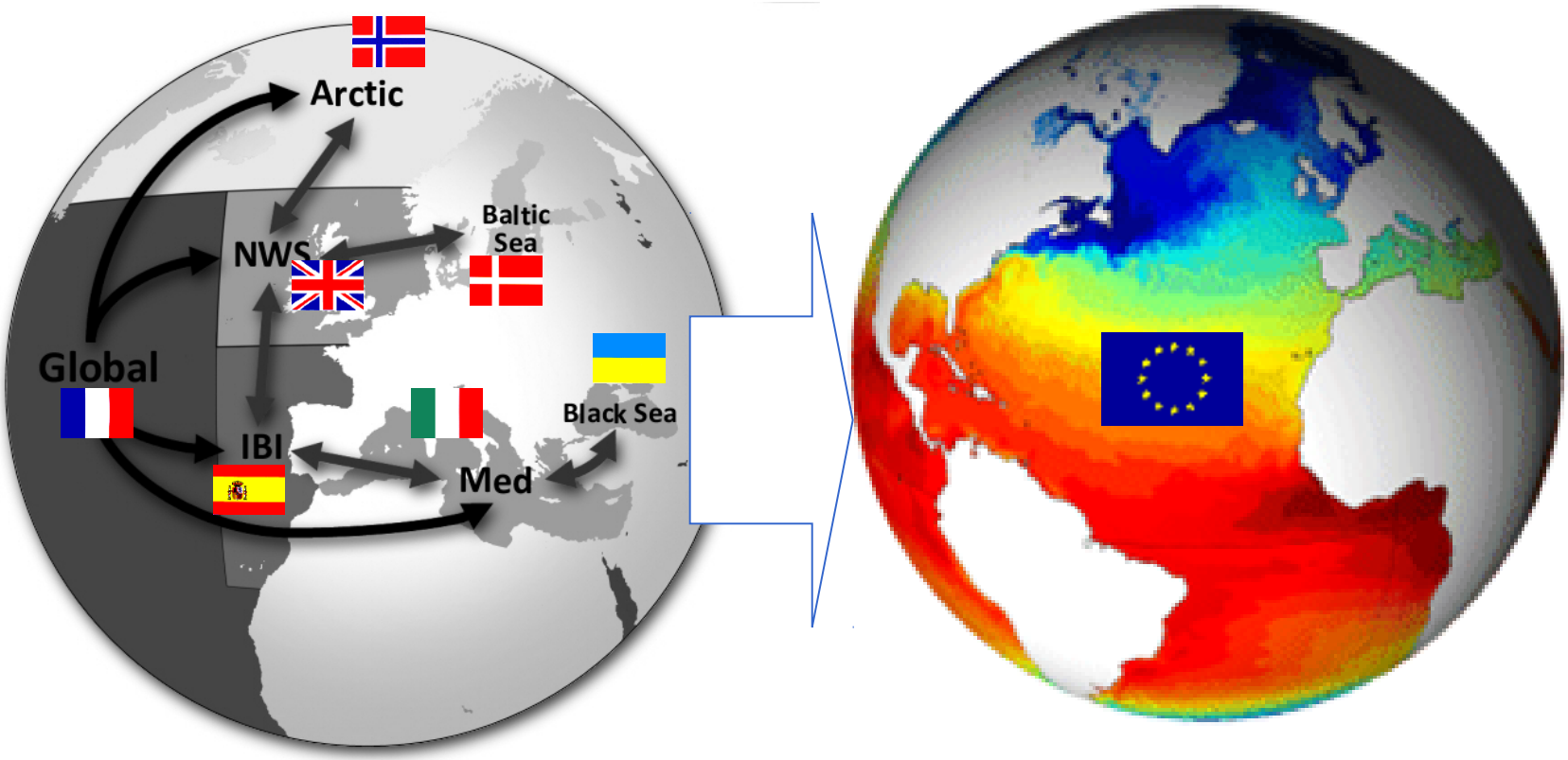


The MyOcean project in Europe

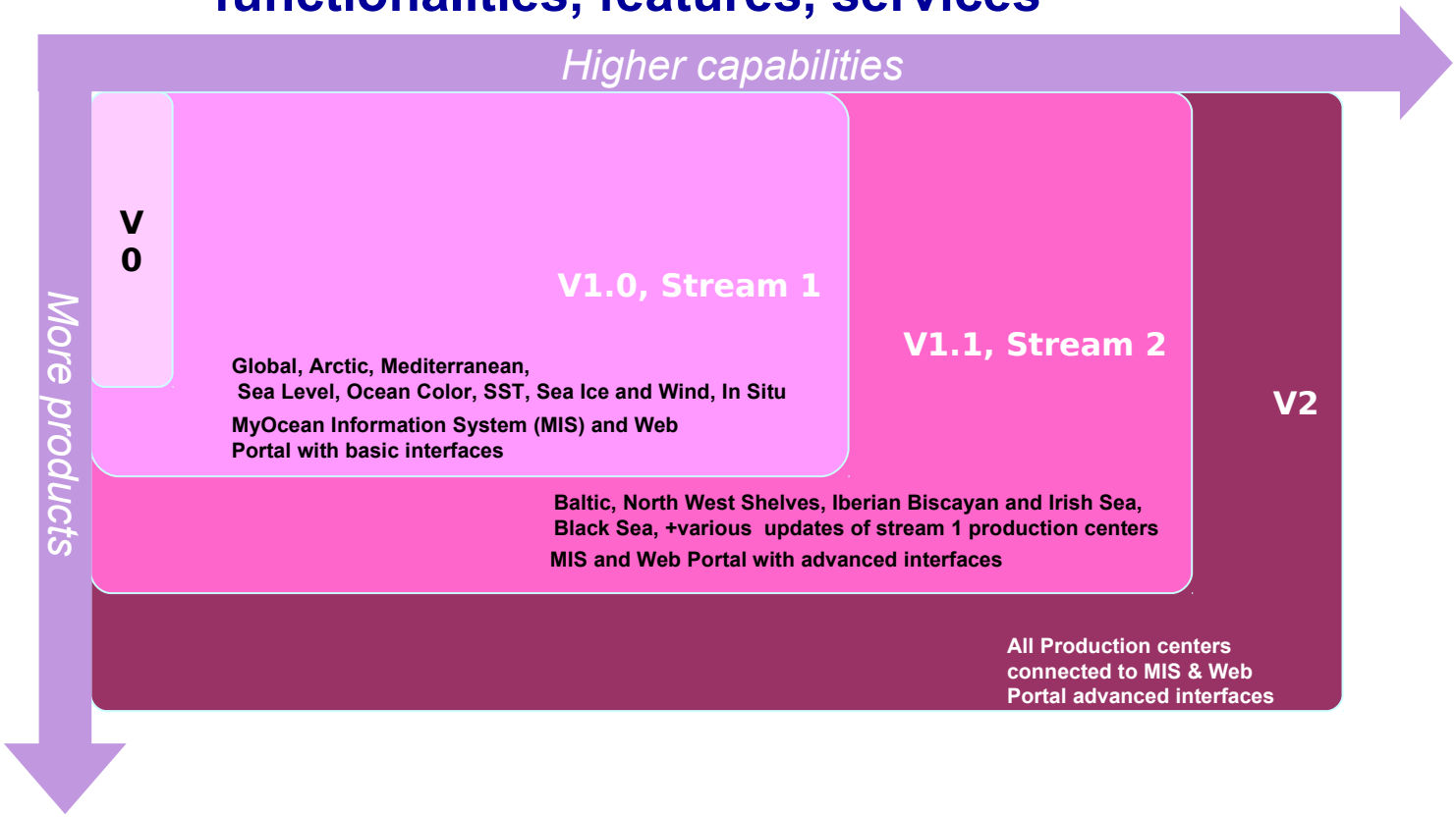
Marine Core Service



Europe/GMES (Global Monitoring for Environment and Security)
The monitoring and forecasting component of the European Marine Service (the core service)

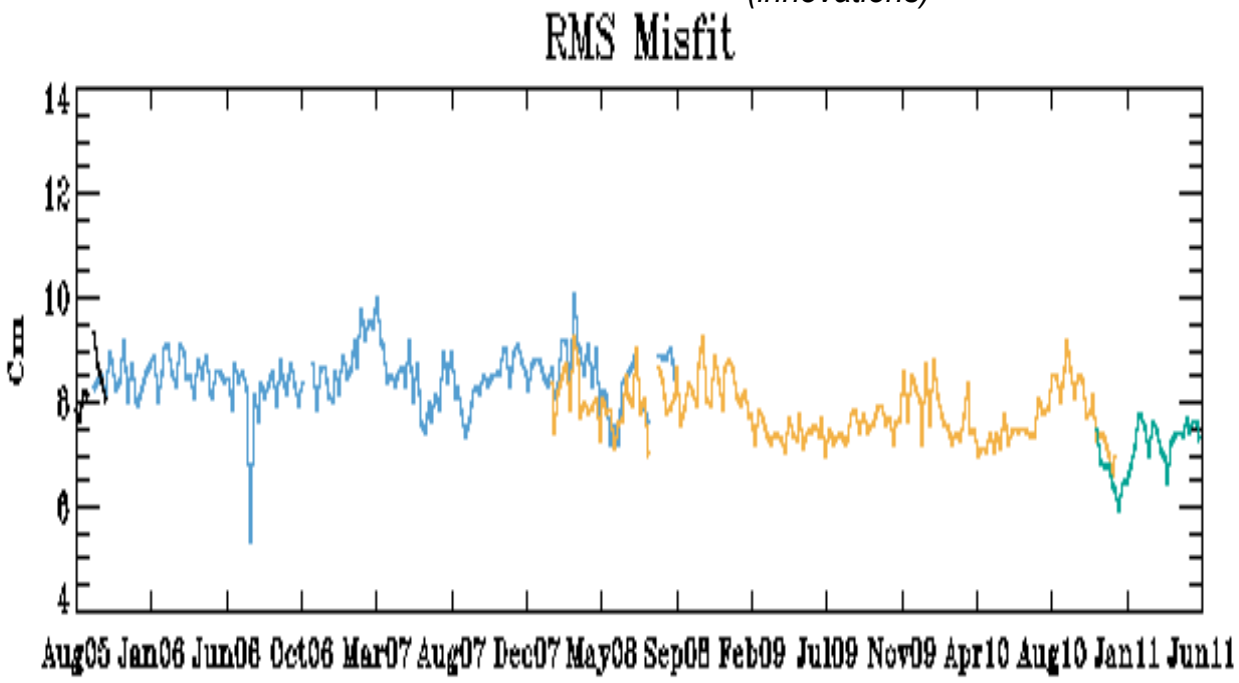
MyOcean System maturity growth

More capabilities: functionalities, features, services



Transitioning from one version to the next

(innovations)



ATL zoom 1/12°:
*PSY2*V1
*PSY2*V2
*PSY2*V3
*PSY2*V4

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- This has been done before the launch of V1, V1.1, and is currently done for V2.

Contact point

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2

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Assimilation in MyOcean

MyOcean : a System of Systems

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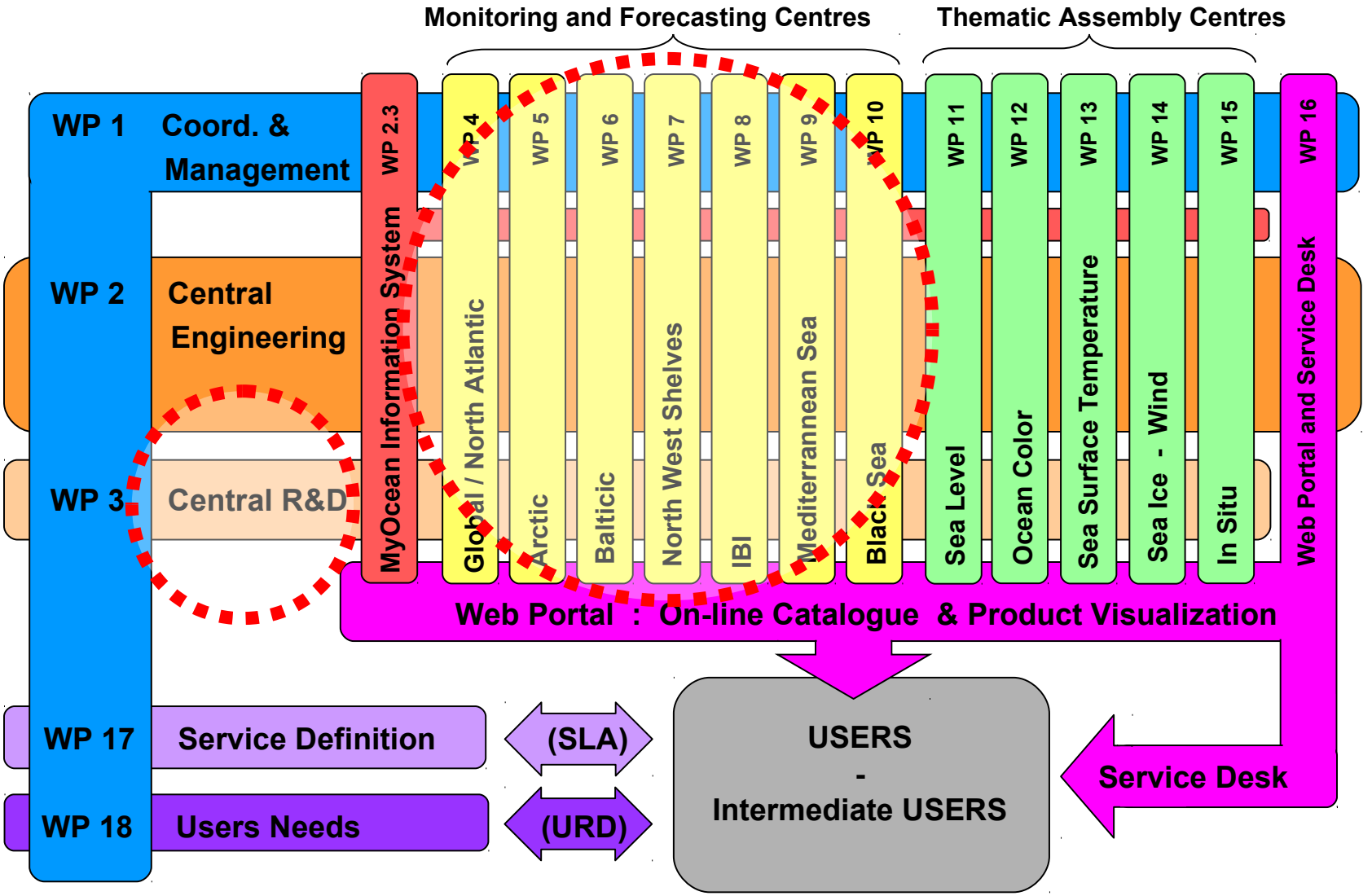

Operational assimilation ingredients

- Get the best input data
  - This is done (mostly) via the Thematic Assembly Centers (TACs)
  - Sea Level Anomalies, Sea Surface Temperature, T/S profile, Sea Ice and Wind, Ocean Color data
  - Quality Control is shared between TACs and MFCs
- Compute the innovations (y-Hx)
  - One costly component (the model is used to forecast obs)
  - Implies good H operators (collocation and also filtering, superobing…)
- Compute the analysis: the Kernel
  - Should be efficient (parallel computing, large amount of data) and suitable for operations (should not fail)
  - Except for the Arctic (EnKF), the choice is not to cost more than the direct model cost→ simple sequential methods: OI, 3DVAR, SEEK…
- Provide the best initial conditions for the forecast
  - Could be costly too (model run) if Incremental Analsis Update is used

Assimilation is also used to provide reanalysis products

- Schemes mostly derived from the ones used for the real-time assimilation systems
- Products are part of the service offered to users: available on the catalogue
  - Mostly physics
- Global + allmost all the regions: NWS, ARC, MED, BAL, …
  - The goal is to cover the recent altimetry period: 1993→today, and to best use the existing GOOS (ARGO)
- Example; the Global reanalysis (1/4°, physics only) is done by 3 groups, using 3 different analysis kernels, same data, same model, and a concerted protocol (e.g. to assess the product quality).

The monitoring and forecasting centers

EU Ocean Modeling Centers committed to Operations

ercator Océan (GLO)
et.no/NERSC (ARC)
MI (BAL)
he Met Office (NWS)
uertos Del Estado (IBI)
IGV (MED)
HI (BS)

The Arctic system (NERSC – Met.no)

- TOPAZ system (HYCOM + EnKF) Coupled to NORWECOM Biogeochemical component system
- Details to be presented by Laurent Bertino during this meeting
- They assimilate SLA, SST, T/S profiles, ice data with a deterministic EnKF (DEnKF, 100 members)
- Weekly assimilation cycle

Baltic sea (DMI)

- Most of the work consisted in merging the different models into one and converging towards its use in the Baltic
  - BSH-CMOD, HIROMB → one single model: HIROMB BOOS model
  - 3 ecosystem components (BSH, SMHI, DMI) → one component: ERGOM
- The nominal real-time system (DMI) assimilates
  - SST satellite data, using a 3DVAR system with an anisotropic recursive filter to compute the error covariances
  - Ice data using an insertion procedure (not real assimilation)
- Several other assimilation system reported (EnOI, assimilation of T/S + ice + SST at SMHI, …)

North Western Shelves (The Met Office)

- They have successfully implemented NEMO (replacement of POLCOMS)
- BGC component is based on ERSEM
- They assimilate SST products (Not Altimetry, nor T/S profiles) in the physical system
  - From various satellites
  - + some in situ data (available in real-time only)
  - Using a correction scheme (Martin et al, 2007, ~Iterative OI, same as for the global)
  - They use IAU (Increments applied from the surface to the bottom of the mixed layer)
  - Daily cycle going back 2 days every day

    → Only a few in situ obs are used

IBI system (Puertos Del Estado)

- 1/36° NEMO including tides + HF + R/T runoffs developed by Mercator Océan, and operated by Puertos Del Estado
- Not yet assimilating any observations
- Regularly initialized and forced at the boundaries from the global system

- Development of assimilation on its way at Mercator Océan
  - Use of the same system as for the global: SEEK
  - Using a 1/12° version of the system
  - A reanalysis is currently being produced (not yet available)
- Assimilation R&D tasks done with the LEGOS (coordinated by Pierre De Mey)

The Mediterranean system (INGV/OGS)

- Based on the MFS system (for physics)
  - NEMO coupled with WAM
  - 3DVAR (Dobricic and Pinardi 2008) assimilation of SLA, SST, T/S profiles (weekly cycle)
  - Daily Sat SST is inserted using nudging
- Biogeochemical system (BFM) operated by OGS (provides forecast coupled to physics)
- Reanalysis performed

Black Sea (MHI)

- They have both a physical system and a biogeochemical system used to provide attenuation coefficient products
- They assimilate SLA and SST (not profiles) in the physics using a OI scheme similar to Mellor and Ezer
- They assimilate also some chlorophyll data in the biogeochemical model

The global MFC (Mercator Océan)

- Physics global + regional configuration, target is 1/12° global (Ready) – weekly cycle (going back 2 weeks every week)
  - SLA, SST, T/S (not yet ice data)
  - SEEK (Fixed base) + IAU
- Reanalysis
  - Global at ¼° - Three 17-year reanalysis and 1 reference forced simulation produced
- Biogeochemistry
  - No assimilation yet (model improvements judged priority)
  - Assimilation R&D development
    - assessment of anamorphosis
    - characterization of the errors (comp with OC)
- A backup system at the Met Office: FOAM
  - They work on the transition to NEMOVAR (3D-VAR) at ¼°
  - They have implemented OC data assimilation in their BCG component

The R&D workpackage in MyOcean

- WP3 lead CNRS (Pierre Brasseur)
- Tasks to improve the models, and the assimilation systems
  - Improvements within NEMO (modeling)
  - Assim: extension to 4D, improvements related to atm. forcing, extension to non gaussian
  - Improvement of biogeochemical components (incl assimilation)
  - Improvements for shelf seas and coastal domains (incl. assim)
- Mechanism of “open calls” (restricted to the MyOcean partners)
  - 2 calls issued
    - The projects were evaluated by the Scientific Advisory Committee (SAC)
    - Some (a few) projects were concerning data assimilation
- The scientific results of MyOcean will be published in a special issue of Ocean Science
  - The MyOcean project: scientific advances for operational ocean monitoring and forecasting

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Next MyOcean II

How does it compare to MyOcean ?

- (Almost) same partnership, same budget, not a revolution: transition towards a fully operational service after is end in 2014 (→ ECOMF)
- Same Production Units (TACs and MFCs), continuity of the service
- New funding rules: mix between Collaborative Projects and Coordination and Support Actions (CP-CSA)
- Even more user/service oriented than MyOcean is
- Reanalysis for every region put into one single WP (Leadership CMCC)
- Cal/Val for every region put in one single WP (Leadership the Met Office)
- R&D restricted to Tier-1 R&D
  - Short term (R&D needed to prepare Vi+1), non competitive
  - Tier 2: e.g. non competitive but longer term
    - Some activities are present in the MyOcean II project (at least links to the corresponding projects)
  - Tier 3 (long term, competitive, typically SANGOMA: out of the scope of MyOceanII)
- R&D WP leadership transferred from CNRS to HZG (former GKSS, Germany)
- Service Desk transferred from the Met Office to Mercator Océan
- …

Assimilation activities within MyOceanII

- Still present in the MFCs workpackages
  - GLO, ARC, NWS, IBI, MED and BS
  - Towards a better use of the GOOS, and product quality improvements
- Some activity in the R&D WP: WP19.3
- Global (1/4°) coupled Atm/Ocean implementation planned by the Met Office

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To conclude

« Op. Service » versus « Science »

- An Operational Service benefits from Science
  - Is based on continuous research activities
  - Needs continuous and rigorous Cal/Val activities

- Science also benefits from Operational Services
  - Provides “reference” information
  - Provide continuity in monitoring : long time series, reanalysis, sustainability, …
  - Known and assessed Product Quality

- Users’ requirements are often challenging (e.g. better resolution…) ➔ R&D

- An operational service without proper associated R&D is “dead in the egg” (personal comment)