Modelling the marine ecosystem of Iberia-Biscay-Ireland European waters for CMEMS operational applications

Marine Monitoring

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CMEMS IBERIA-BISCAY-IRELAND REGIONAL SEAS MFC

Contract IBI-MFC
Until 31 March 2021

COPERNICUS · MARINE ENVIRONMENT MONITORING SERVICE

European Commission | Copernicus Europe's eyes on Earth

Implemented by MERCATOR OCEAN INTERNATIONAL

IBI-MFC partnership

- Mercator Ocean International
- NOLOGIN
- CESGA (Centro de Supercomputación de Galicia)
- Meteo France
- AEMET (Agencia Estatal de Meteorología)
- Marine Institute

Model description

- **NEMO-PISCES 3.6**
- **Subset of Global ORCA grid: 1/36° (1.8 – 2 km)**
- **50 z-levels (with partial bottom cells)**
- **online coupling with PISCES**
- Runoff as 35 sources + climatology 2D
- **PHY Data Assimilation, NO BGC Data assim**

  SAM2:   SEEK filter

  T/S bias correction

  adaptive obs. error

For more details on the model description
and physical evaluation
→ please refer to the presentation by
Reffray et al in the same OS4.7 session:
D2447 | EGU2020-8804
"A new version of the IBI near real time system for
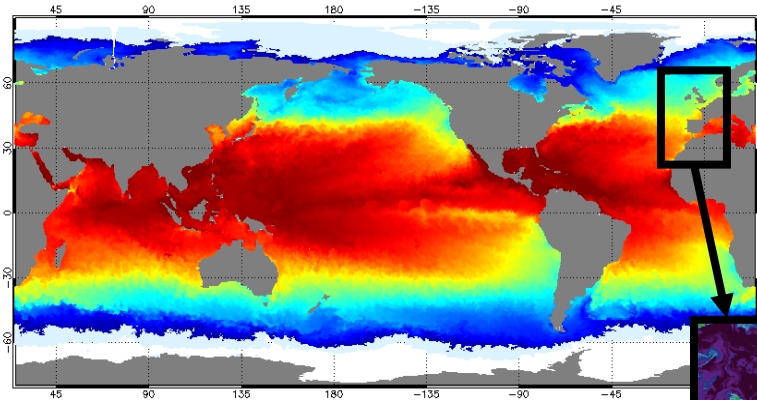November 2020: what will be changed? "

IBI NRT Forecasting System
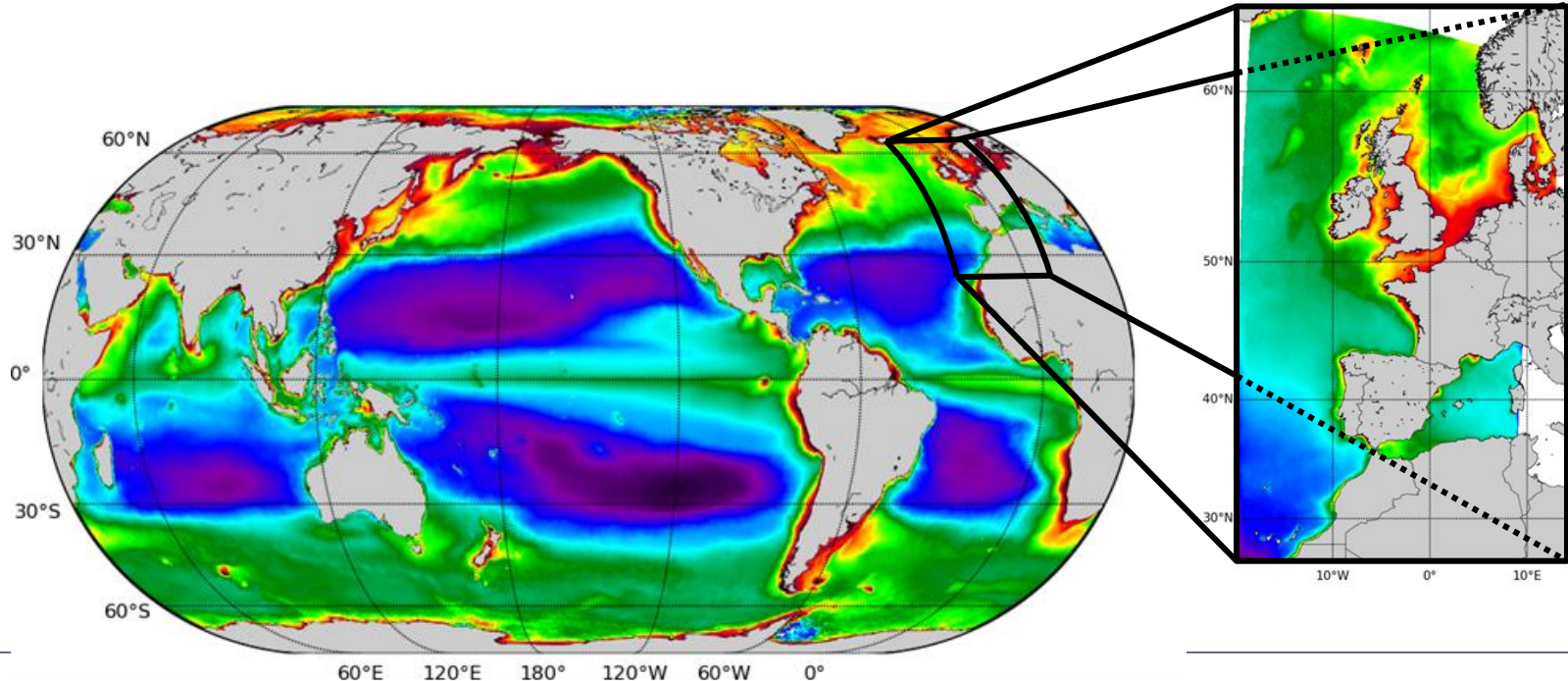
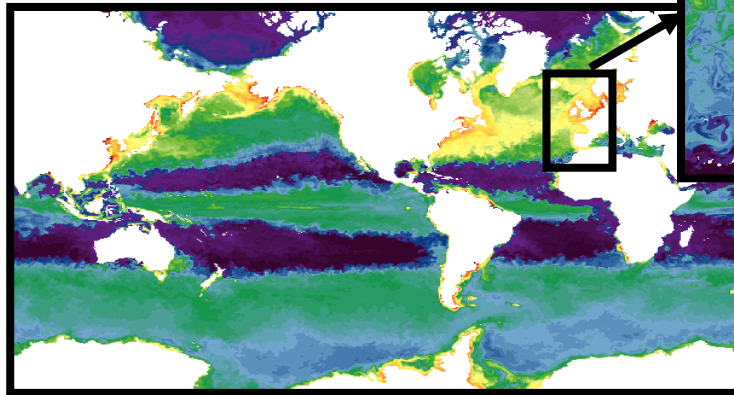**CI & OBCs:**

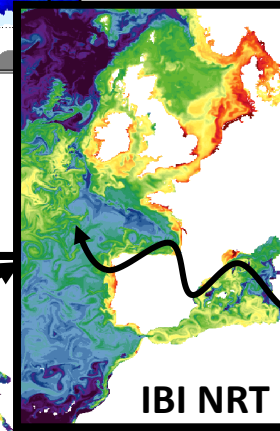**Nested to CMEMS Global systems**

Physics

Coarsening

Biogeochemistry
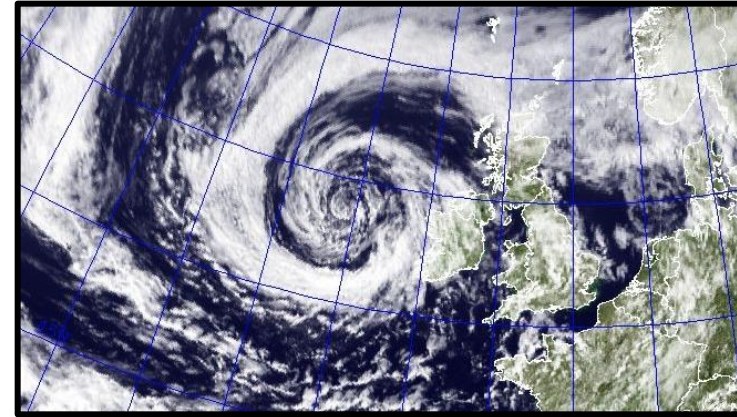
Daily CMEMS GLO forecasting system at 1/12° (PSY4)

Weekly CMEMS GLO forecasting system at 1/4° (BIOMER)

Atmospheric forcings

ECMWF (3h) + Core bulk formulae

IBI NRT

Data assimilation
CMEMS data: along-track SLA, SST
T, S in-situ profiles

Current IBI NRT Forecasting System:
From 01/2010 up to 7-day forecast
→ **Operated and distributed via CMEMS**
   since April 2018

New system since 1st Sept. 2019 but, previous system used up to now

Satellite and in-situ databases
to evaluate
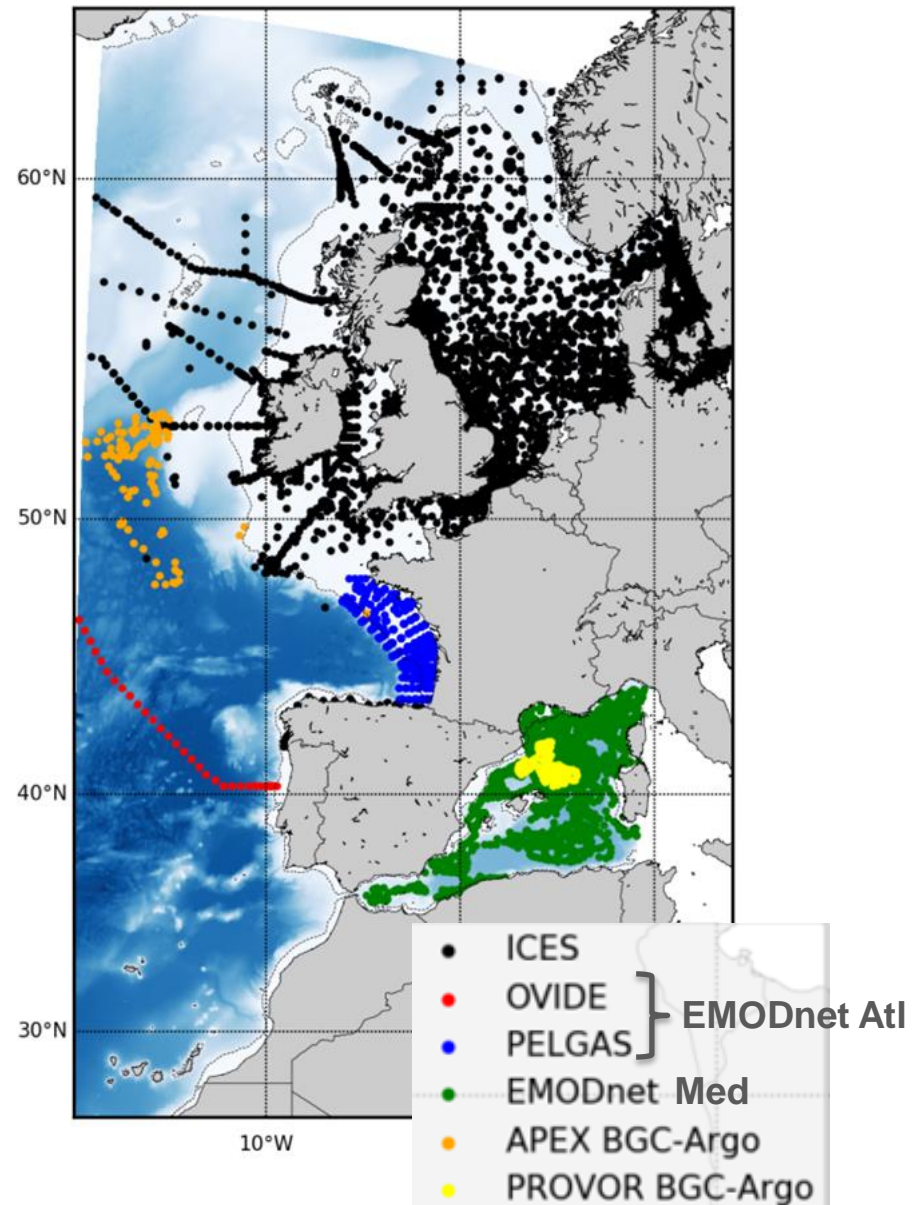the 7-year pre-operational qualification
simulation (01/2010 – 12/2016)

Satellite data:
Chl-a : CMEMS ESA OC-CCI product
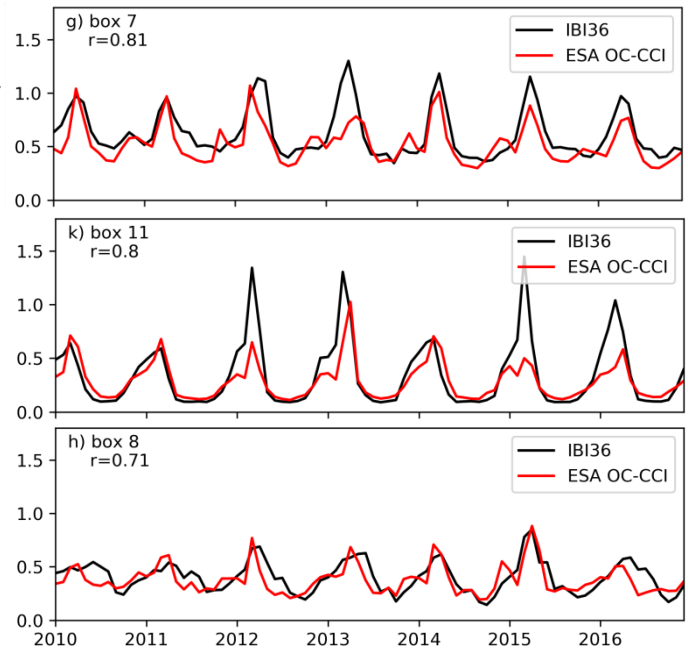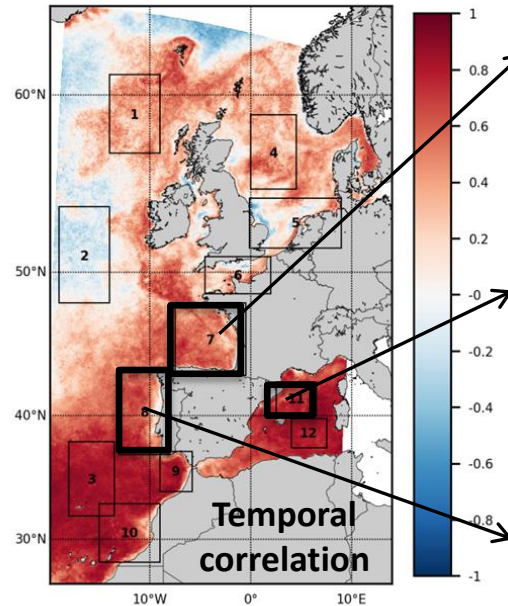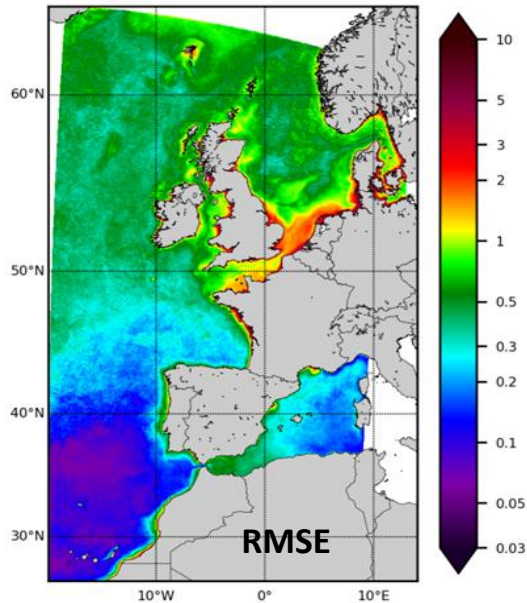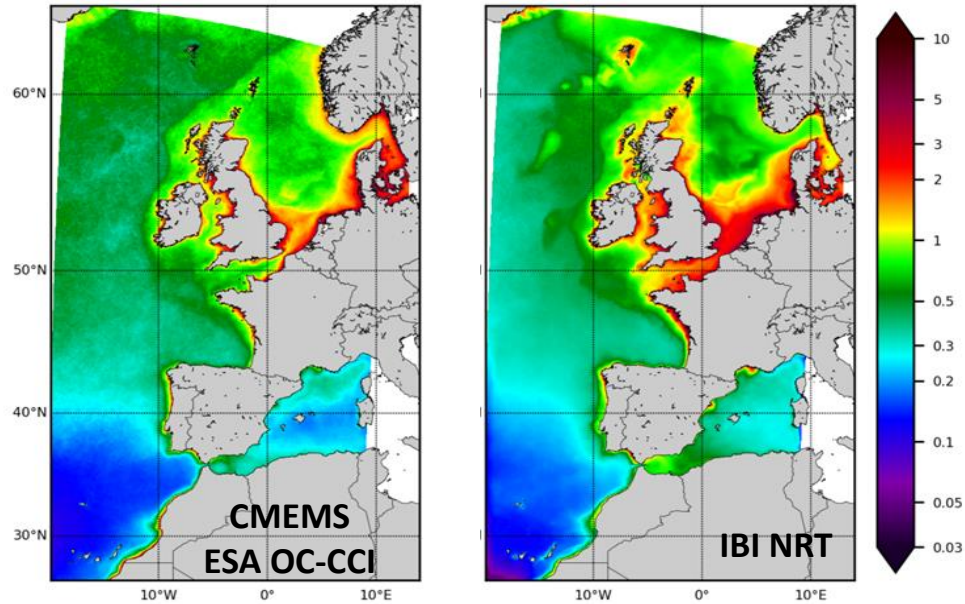NPP: VGPM, Eppley-VGPM, CbPM

In-situ databases:
O_2, nut., Chl-a: ICES, EMODnet, BGC-Argo

Gutknecht et al. (2019)
Ocean Sciences, special issue CMEMS

Sea Surface Chl-a

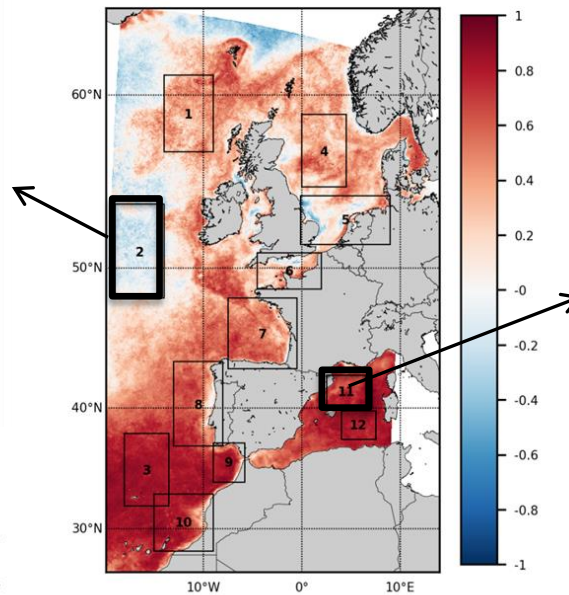## North East Atlantic
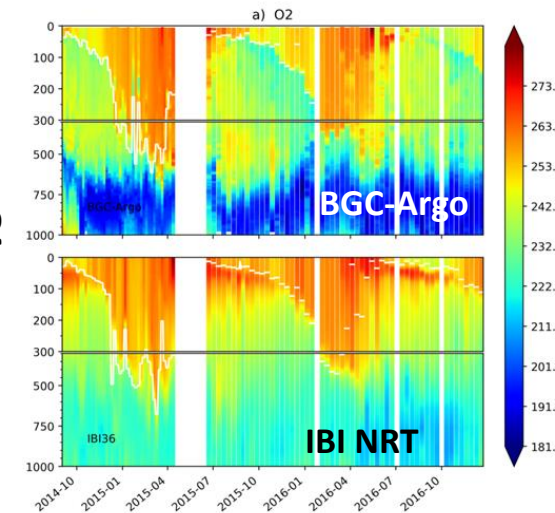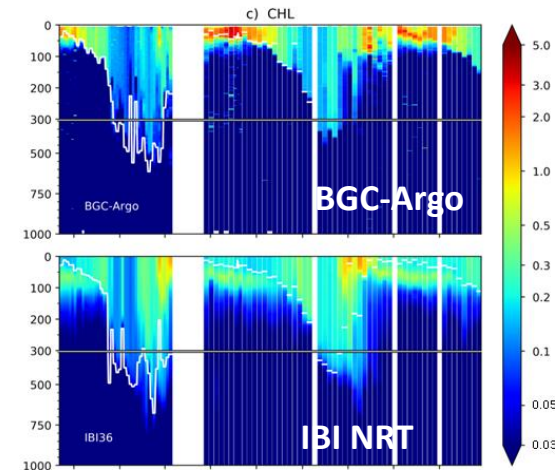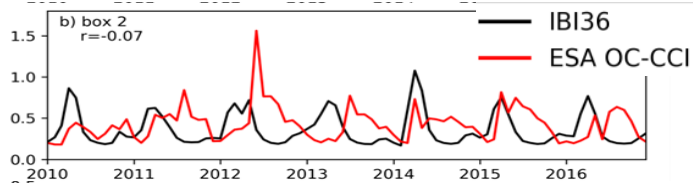
Vertical dynamics

Western Mediterranean
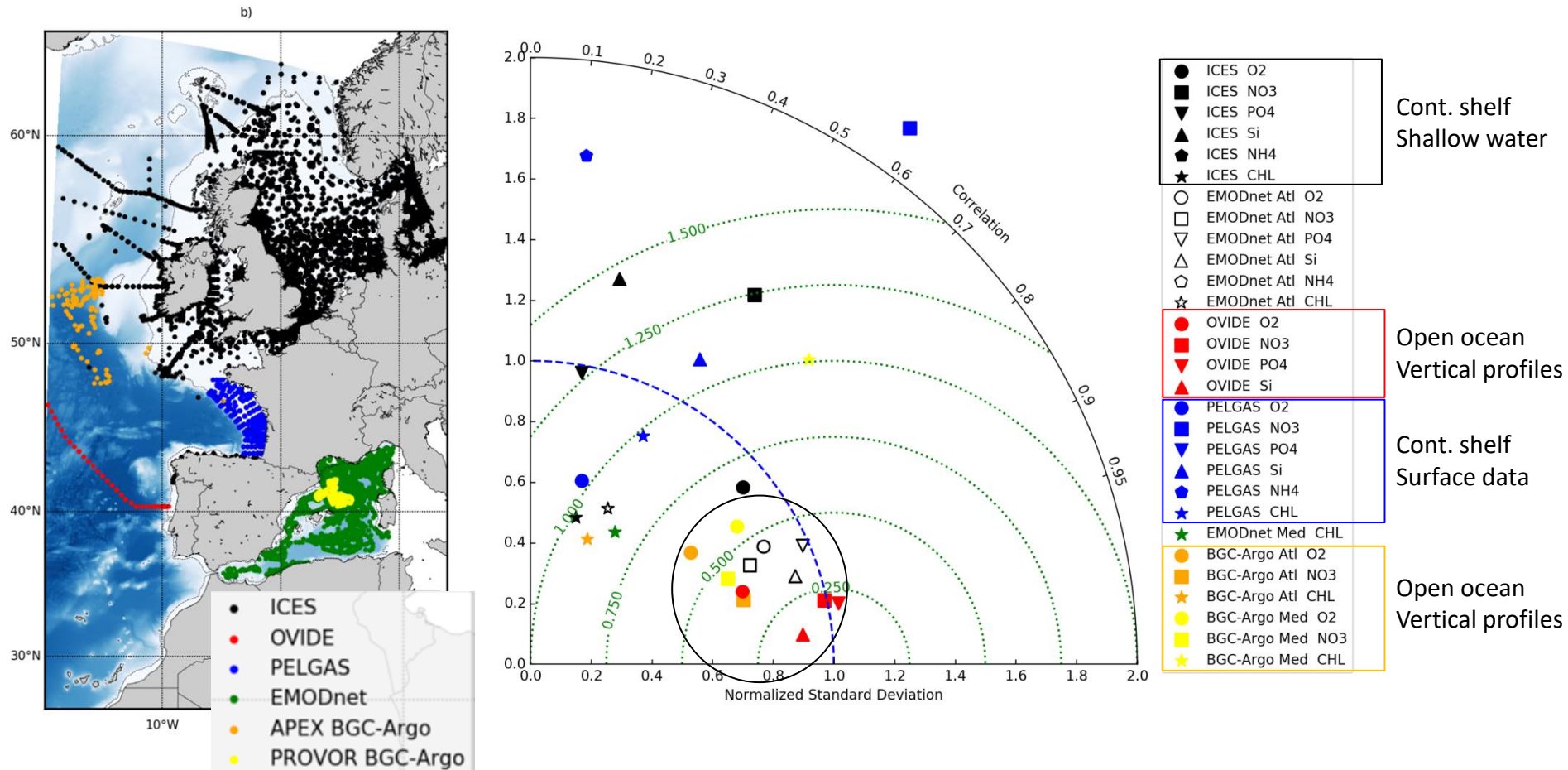
Time correlation
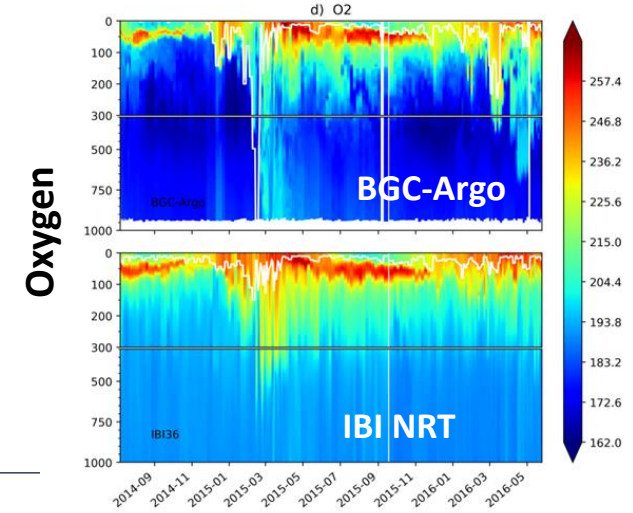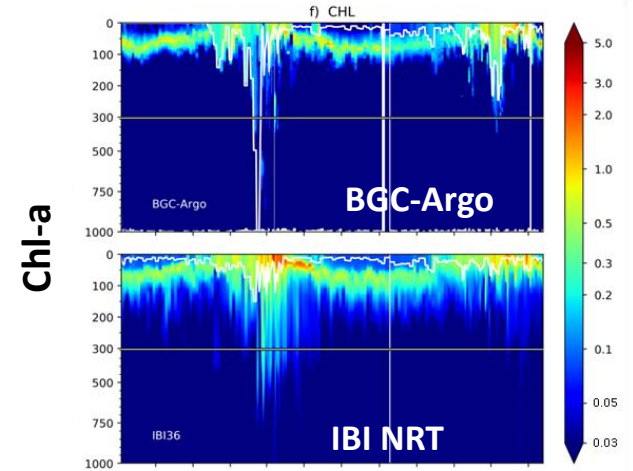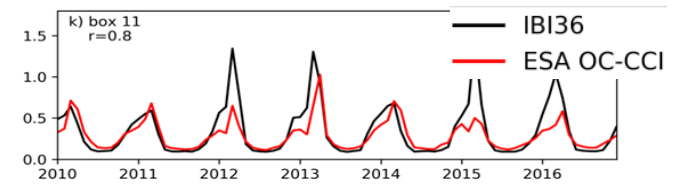
Summary of the evaluation against in-situ data

Detailled evaluation in Gutknecht et al. (2019, Ocean Sciences, special issue CMEMS)

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pH and surface pCO2 in the CMEMS catalogue since July 2019

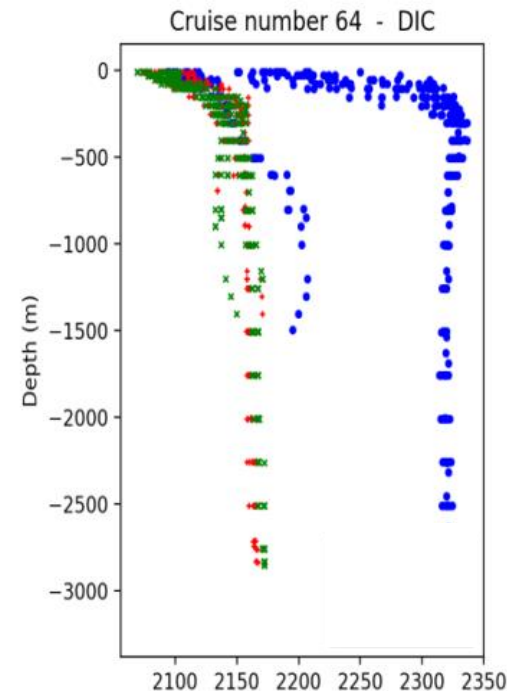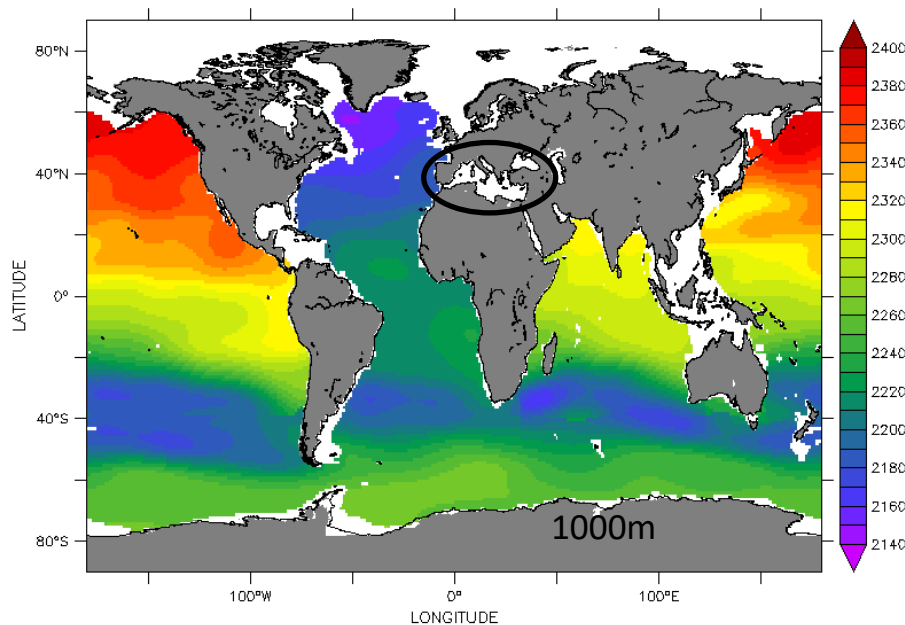Current IBI NRT System :   CI & OBCs from the GLO-BIO-NRT (previous system)
This GLO-BIO-NRT System: CI from GLODAPv1 for DIC and ALK

But GLODAPv1   → no data in the Mediterranean
                    →Western Mediterranean filled with Atlantic values WRONG

GLODAP climatology for DIC (µmol/l):
Initial conditions for GLO-BIO-NRT

Cruise number 64 - DIC
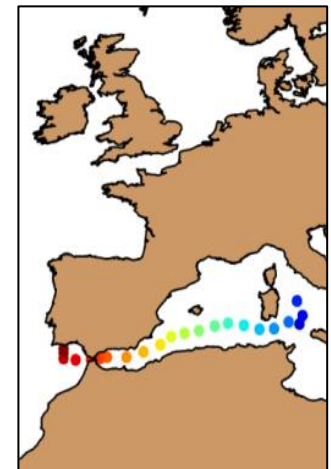
- In-situ data
+ GLO-BIO-NRT
× IBI-BIO-NRT

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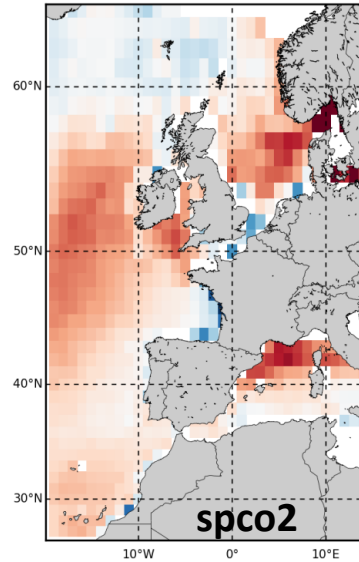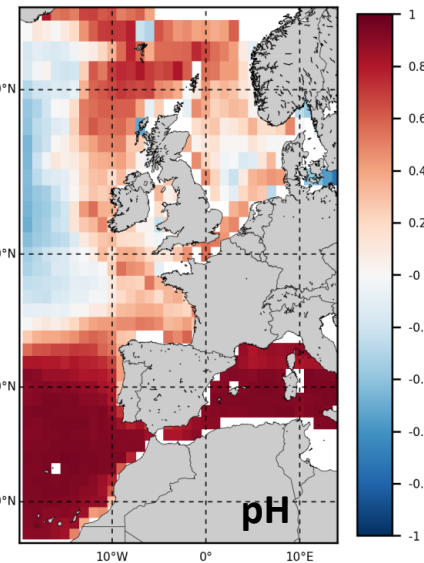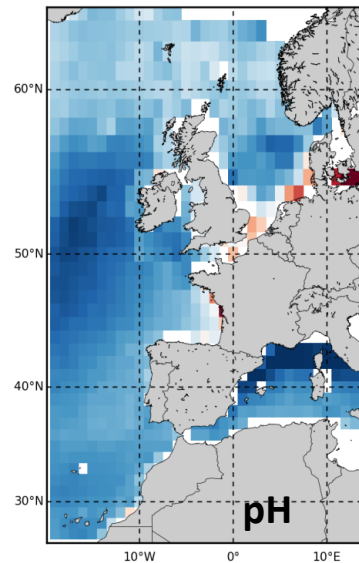
Carbon variables at sea surface
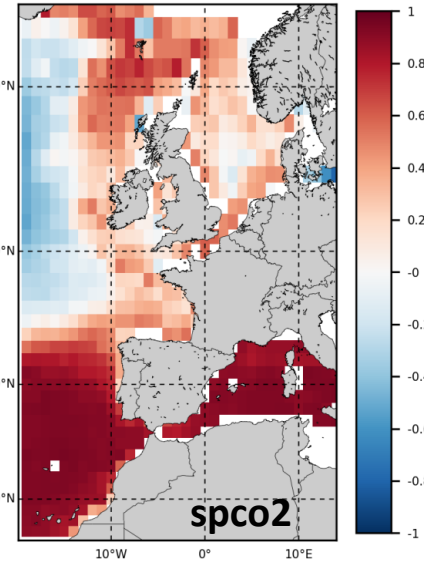
pco2

Mean bias of +20 uatm

pH

Mean bias of -0.05

Bias (IBI NRT – MOB TAC)

Time Correlation (IBI NRT and MOB TAC)

Correlation:
- Good in the south part of the domain
- Decrease on the wide shelf and when variability at OBCs increases

Surface pCO2

Hovmöller diagram at 15°W

CMEMS MOB-TAC

max in winter

Transition area (2 max/yr)

max in summer

IBI NRT

Transition area (2 max/yr)

max in summer
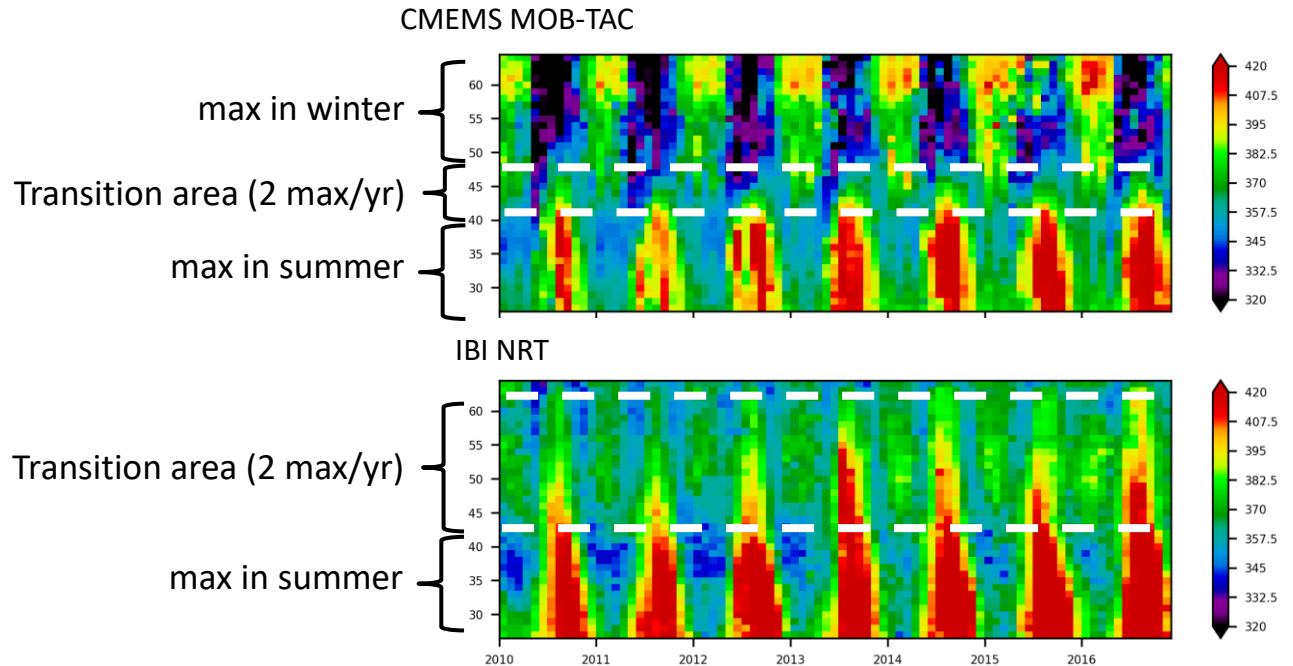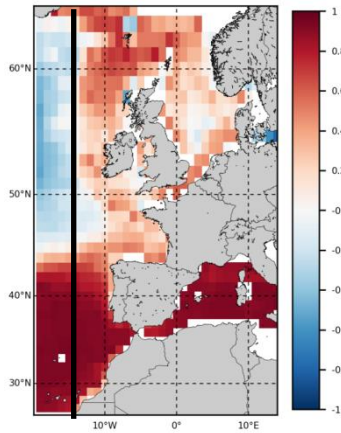
Relative importance of temperature and biology effects
(Takahashi et al. 1992)

→ Biology effect not strong enough in the northern part of IBI

Biology effect = photosynthesis
+ Alk alinity change
+ sea-air CO_2 flux
+ vertical mixing

CMEMS MOB-TAC

IBI NRT

Temperature effet is dominant

Biology effet is dominant

Preparation of the future PHY-BGC coupled system

From current to future IBI36 model system → will be operated in December 2020

NEMO-PISCES 3.6 → up-to-date with the NEMO community
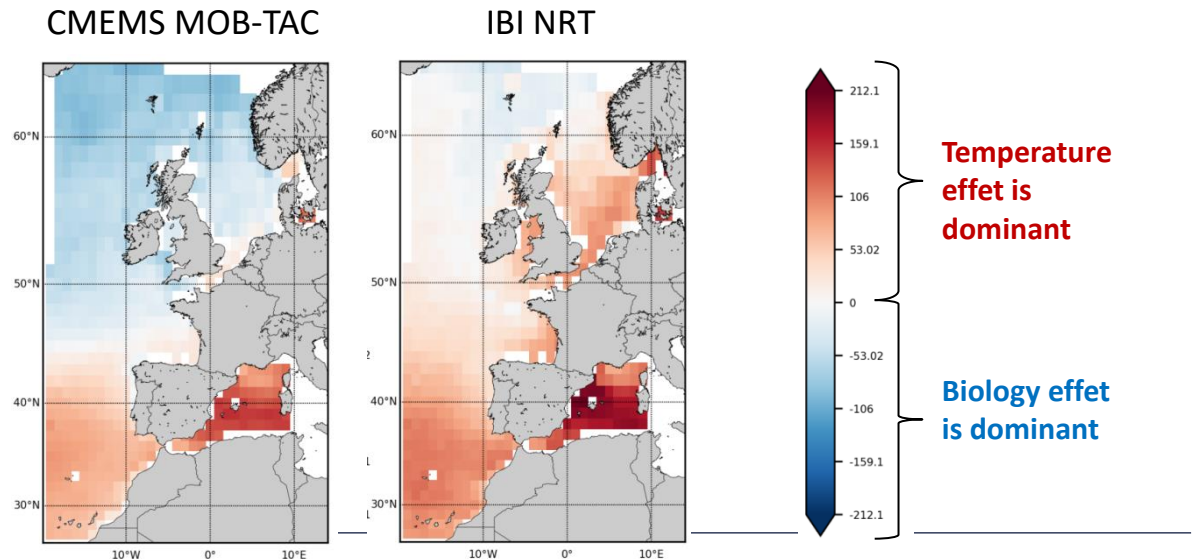
PHY part

|	Current IBI36	Next IBI36
Tidal mixing parametrization	no	yes
Advection scheme	QUICKEST + ULTIMATE	QUICKEST + Zalezak (same as BGC)
Solar penetration	2 bands + climatology kpar	5 bands + monthly SSC
Bulk formulae	CORE	IFS + variable air density (new formalism)
Diagnostics	hbar	Enhanced hbar, hdyn, steric, volume of dense water formation
Coarsened outputs	/	Factor 3 to recover exactly the IBI12 grid
IO server	xios	xios2
Data assimilation		Adjustment: New settings to overcome identified weaknesses

BGC part

	Current IBI36	Next IBI36
CI and OBC	Previous GLO-BIO-NRT (NEMO-PISCES 3.2)	New GLO-BIO-NRT (NEMO-PISCES 3.6, OC data assim + damping, CI: WOA2013, GLODAPv2)
Permanent deposition in the sediments	No deposition	Deposition is function of a bottom friction threshold
River input	Global News 2 + additional inputs (NO3, PO4) from EEA	Revised PO4 from EEA

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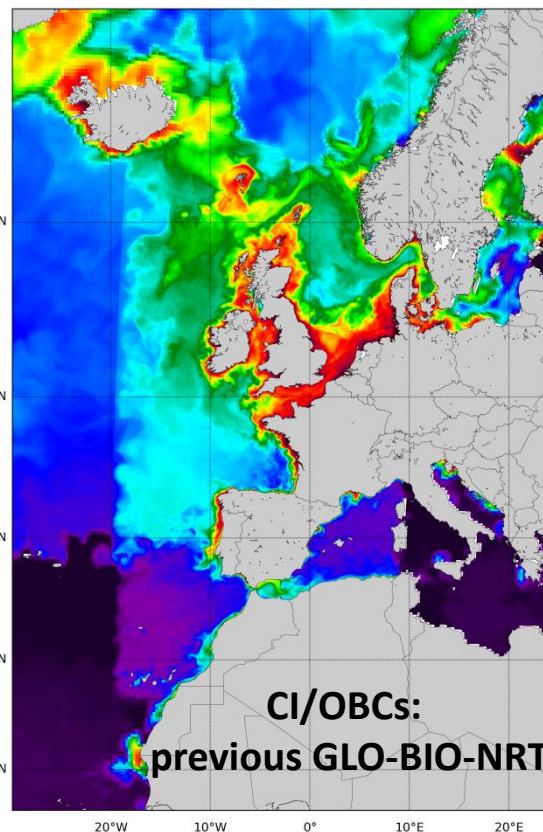
New CI and OBCs: Consistency between GLO and IBI models

Ex: Sea Surface Chloro (mgChl/m^3) in July 2011

ESA-CCI Regional North Atlantic product

Current IBI-BIO-NRT
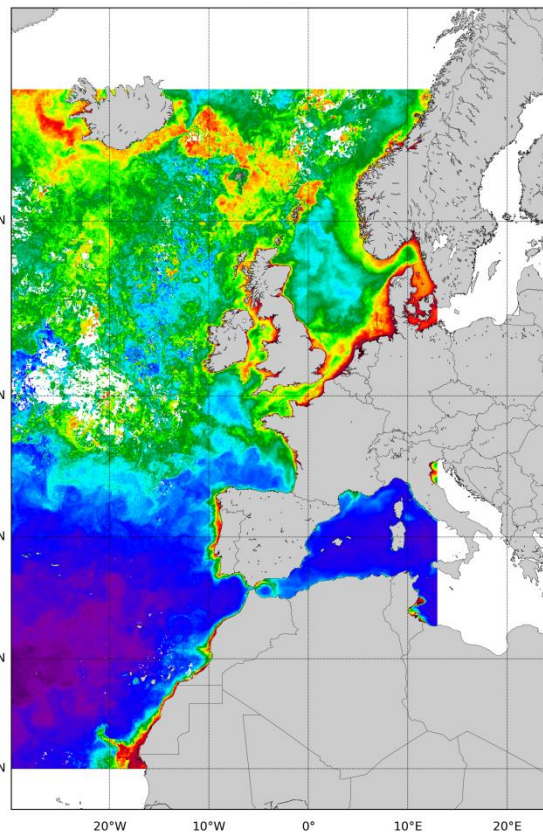
CI/OBCs: previous GLO-BIO-NRT
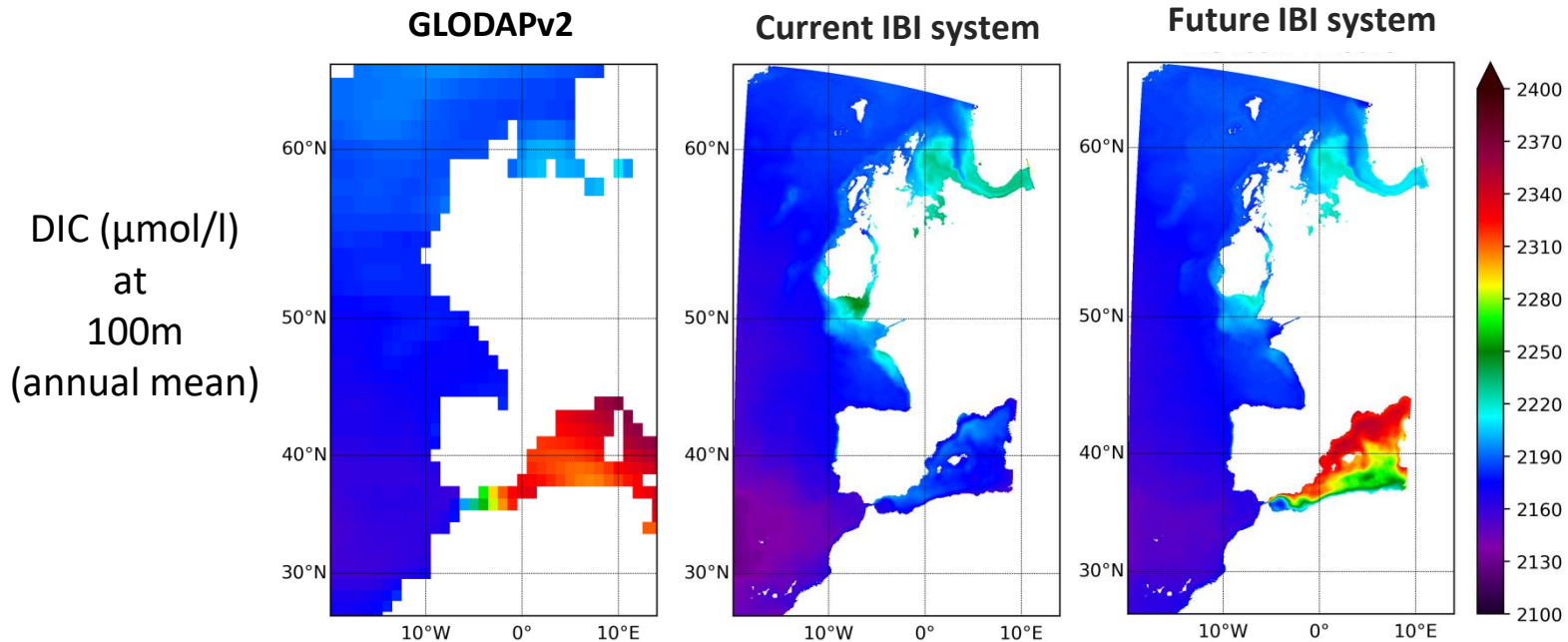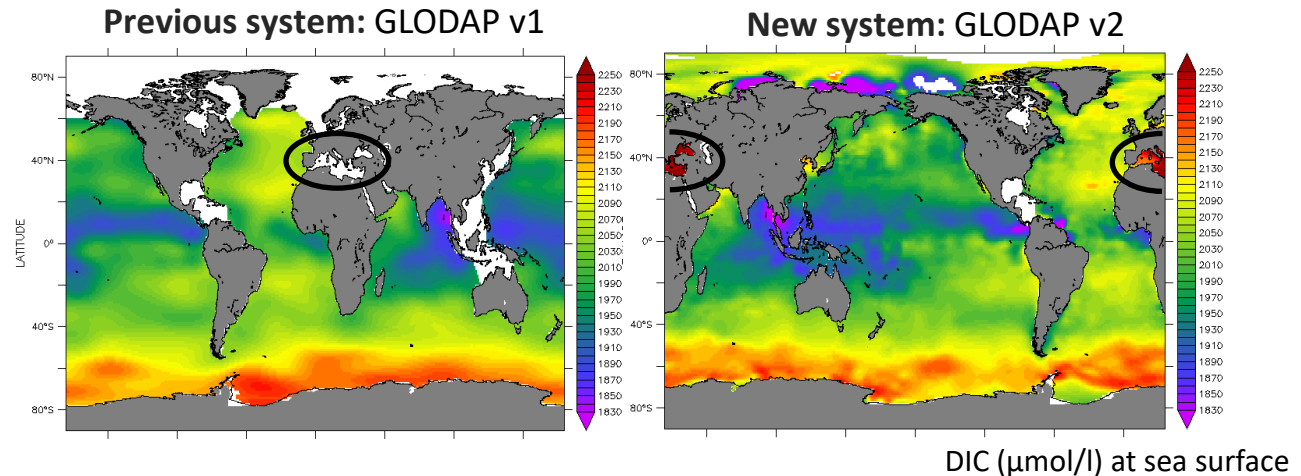
Future IBI-BIO-NRT

CI/OBCs: new GLO-BIO-NRT
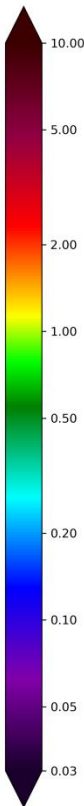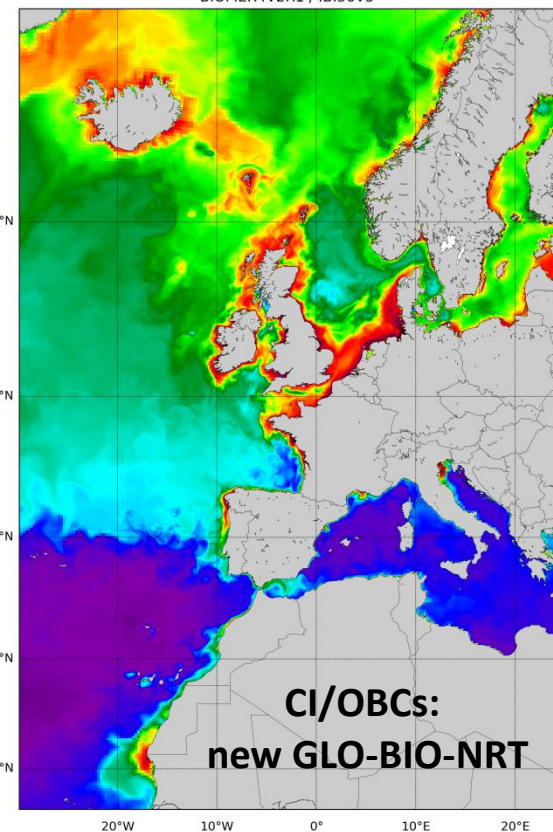
IBI-BIO6NRT is superimposed to the GLO-BIO-NRT

New CI and OBCs:

Carbon variables in Mediterranean Sea

CI for the GLO-BIO-NRT

Previous system: GLODAP v1

New system: GLODAP v2

DIC (µmol/l) at sea surface

GLODAPv2

Current IBI system

Future IBI system

DIC (µmol/l) at 100m (annual mean)

New CI and OBCs:

Carbon variables in Mediterranean Sea

pH

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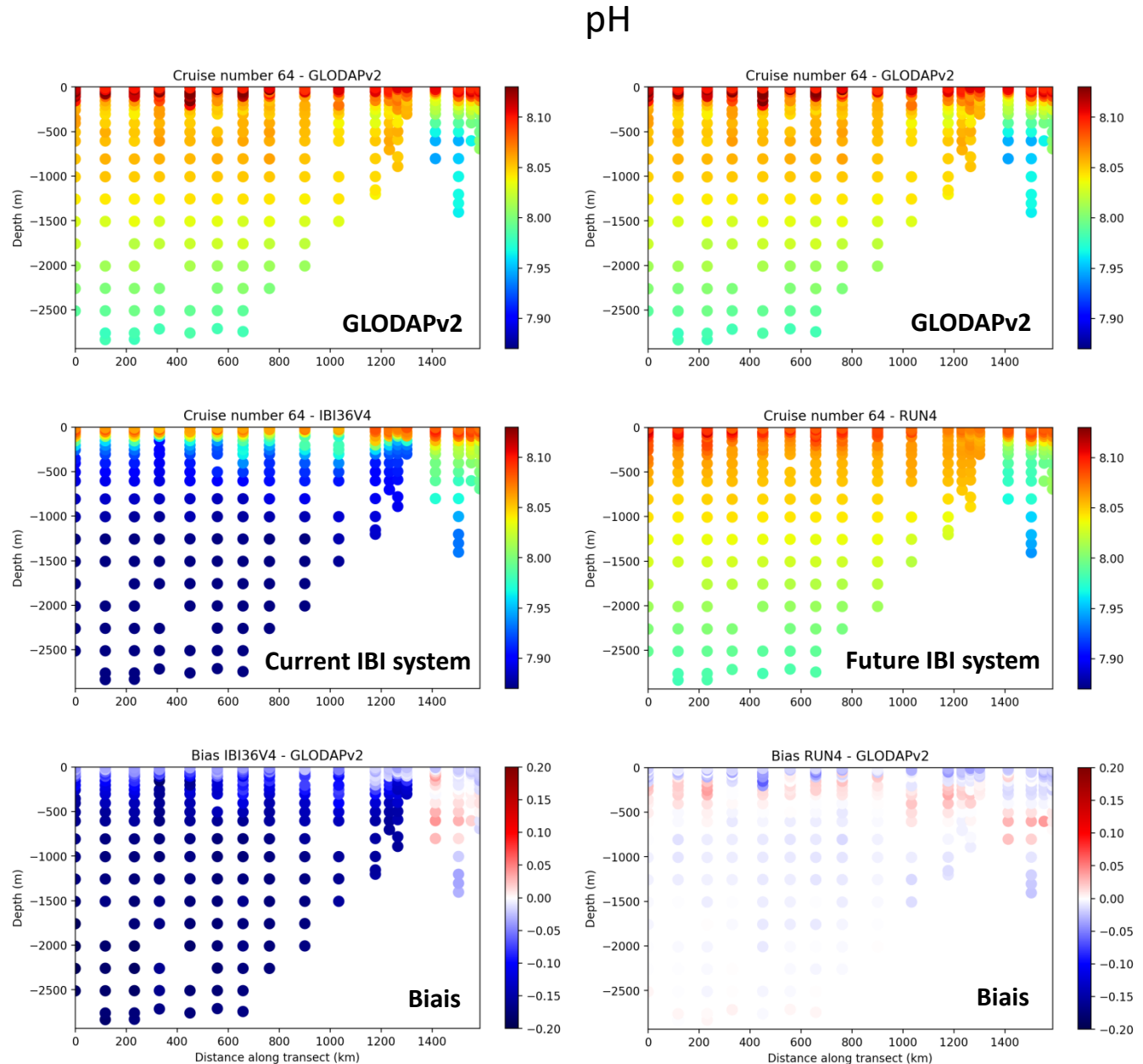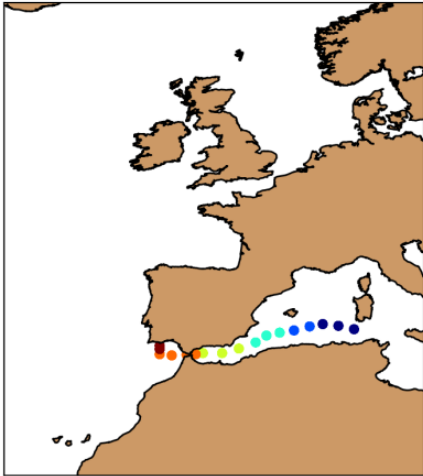
PO4 in North Sea
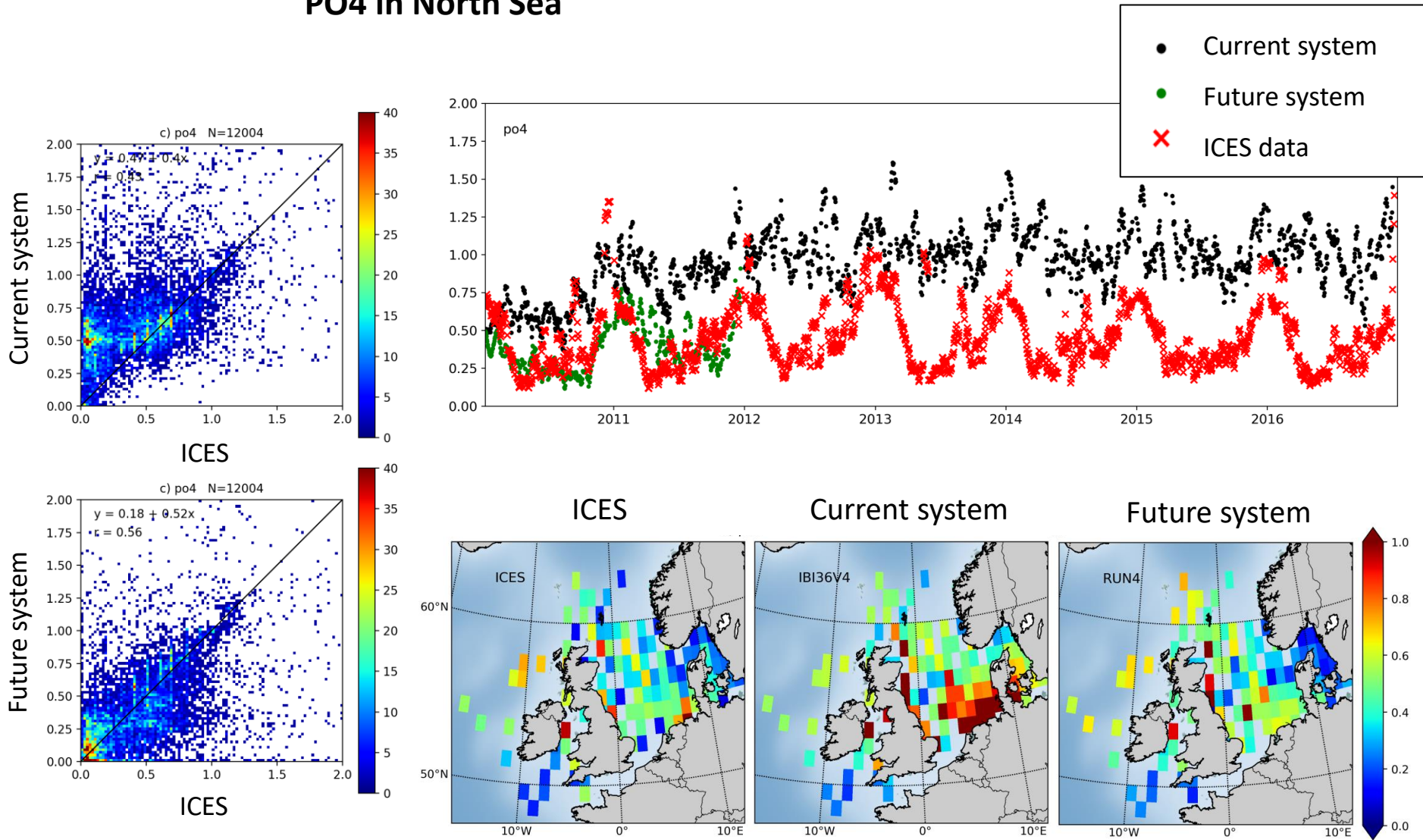
The future IBI system :

→ OBCs: better agreement between the GLO forcing system and the IBI system

→ More realistic PO4 values from the rivers

→ Realistic carbon variables in the Mediterranean

→ **will be operational in December 2020**

Ocean State Report :

→ Chl-a anomaly index

R&D plans:

→ Improve the North-East Atlantic spring bloom : phasing and vertical dynamics

→ Improve carbon variables : surface pH, air-sea CO_2 fluxes

→ BGC Data Assimilation:

    Ocean Colour, BGC-Argo DA ? or just a nudging to GLO-BIO ?

→ Boundary Conditions:

    - Rivers: Monthly climatologiy or interannual time series of nutrient and carbon inputs

    - Atmosphere: pCO_2, dust and N deposition

    - Sediment module