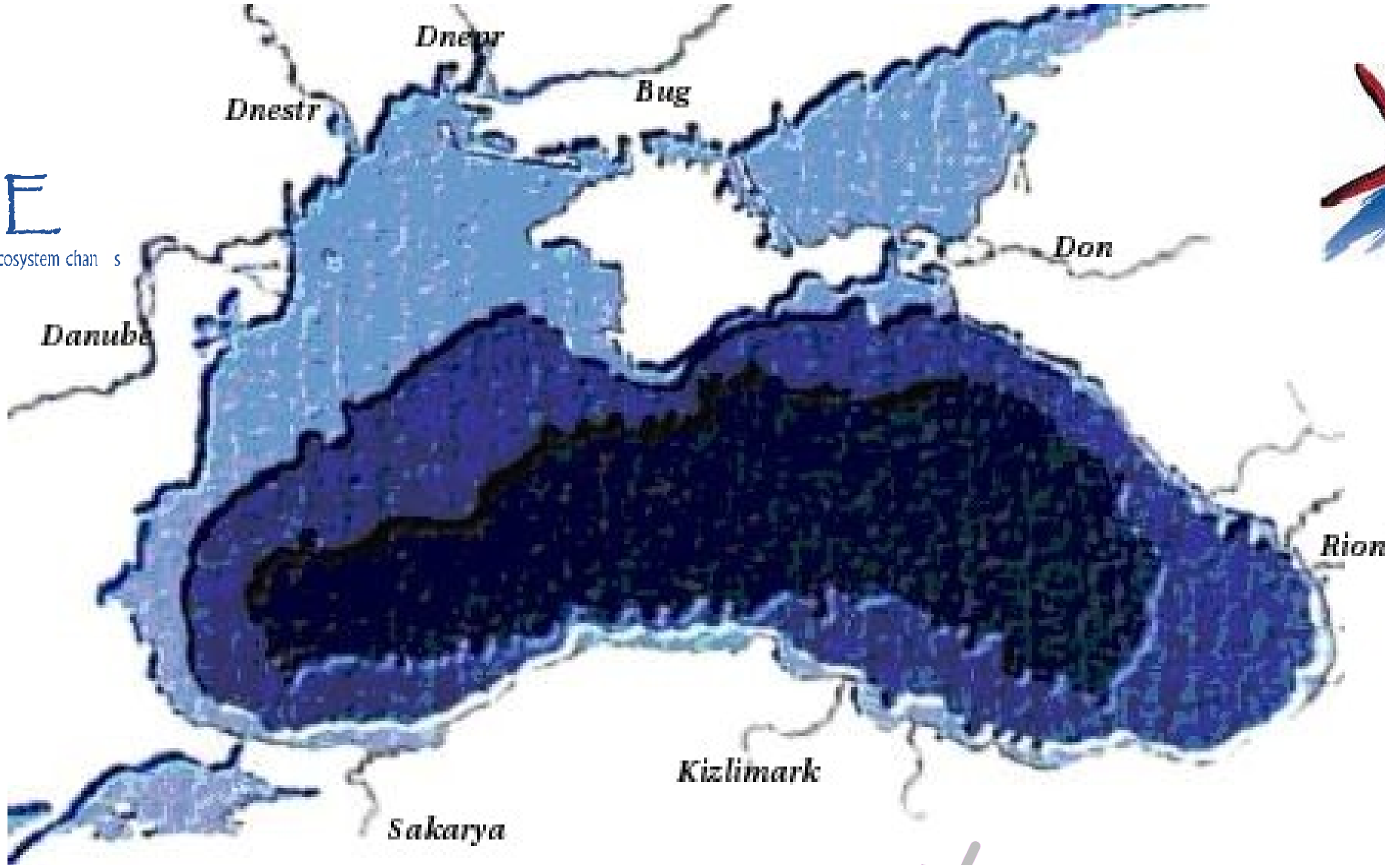
3D MODELLING OF THE BLACK SEA NORTH WESTERN SHELF ECOSYSTEM

SESAME
Southern European Seas: Assessing and Modelling Ecosystem chan s
WP 4 - 6



39th CIESM CONGRESS

Université de Liège

MARE
INTERFACULTARY CENTER FOR MARINE RESEARCH - LIEGE UNIVERSITY

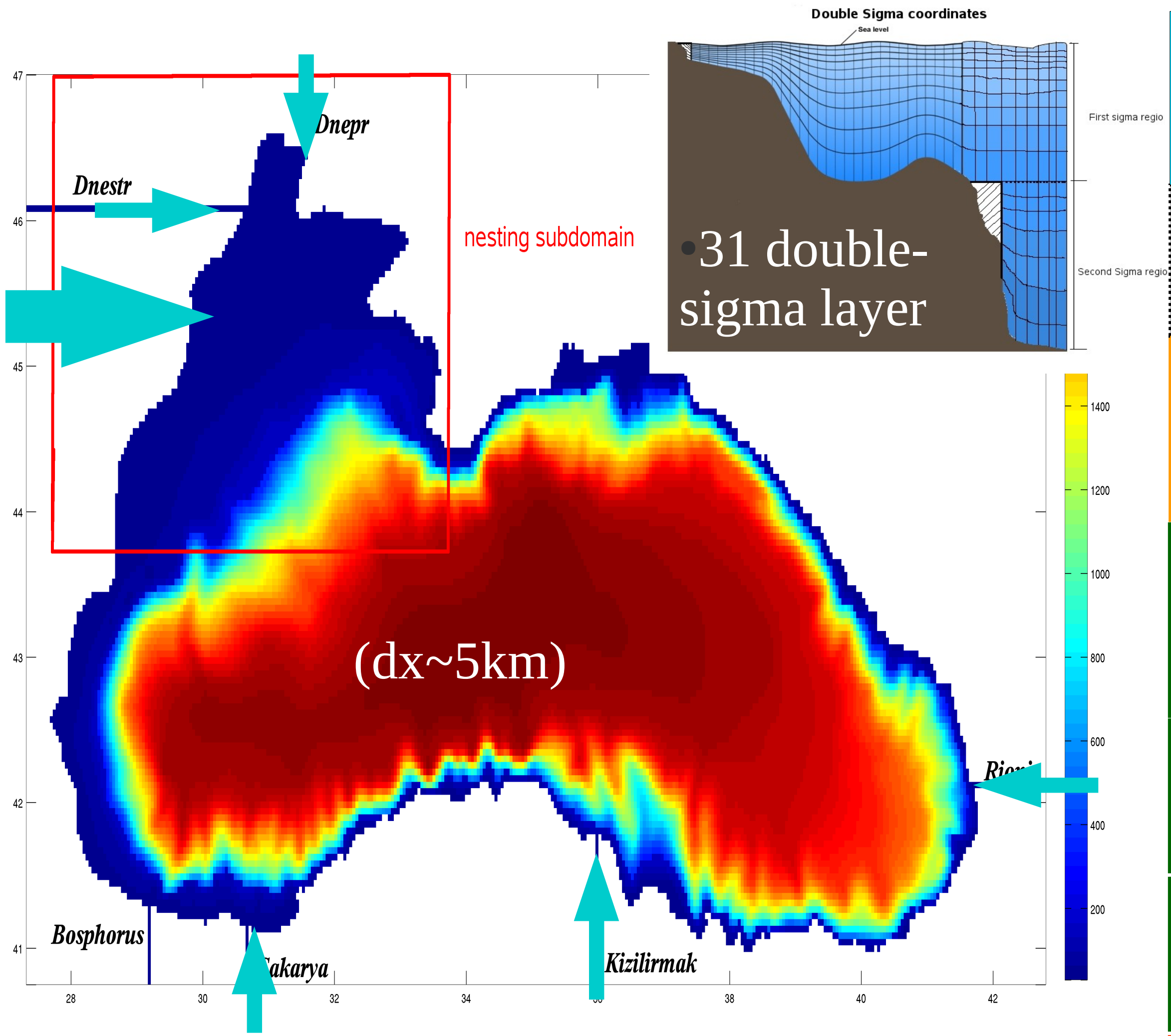
GHER
GeoHydrodynamics and Environment Research

FNRS

Capet Arthur, Grégoire M, Beckers, JM.,Joassin P., Naithani J., Borges A.V., Soetaert K., Vandenbulcke L

The Model

36 States variables



Monthly RIVERS fluxes and nutrients flows (from SESAME & A. Cociasu)

6h-atmospheric forcings from ECMWF (1.125°). (from ERA40)

Physics (5)
Currents, T°, Salinity, Surface elevation, Turbulence

Oxygen and Dissolved Inorganic Carbon (2)

Inorganic nutrients (5)
SiO,NO3,NH4,PO4,"Reducers"

3 Phytoplankton (6) (free C/N)
Diatoms,Flagellates, Small Flagellates

Zooplancton (2)
Micro, Meso.

Gelatinous zooplankton(2)
Omnivorous , Carnivorous

Detrital matter (8)
Particulate, Semi-labile and Labile forms
Silicious Detritus, Aggregates

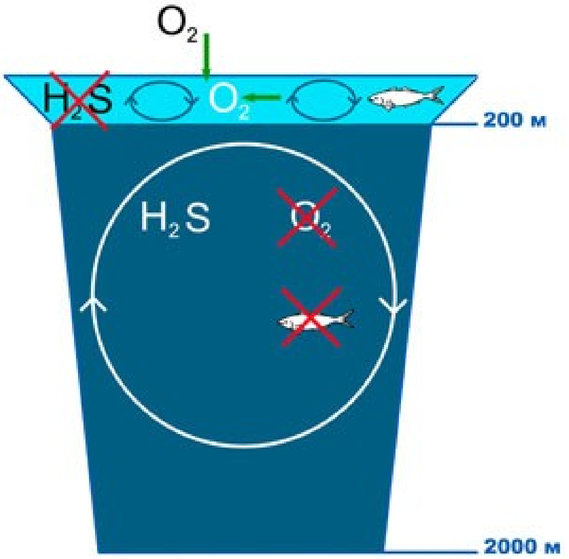
Bacteria(1)

Sediments (5 2D)
Fast and slow decaying C and S pool, Ncratio

Model's Specificity

•<u>No data assimilation </u>: Necessity to construct specific Bosphorus representation to ensure conservation of volume and total salt content.

•<u>Anoxic waters</u> : The biological model explicitely includes anoxic chemistry trough the use of a variable 'Oxygen demanding Units', as a proxy for reducers acting in the anoxic zone.



•<u>Sediments coupling</u> : Due to the importance of sediments dynamics for the shelf area we had to include a parametrisation of sediments taking into accounts deposit history, and bottom concentrations to express remineralisation fluxes.

Validation : Biology-climatic run

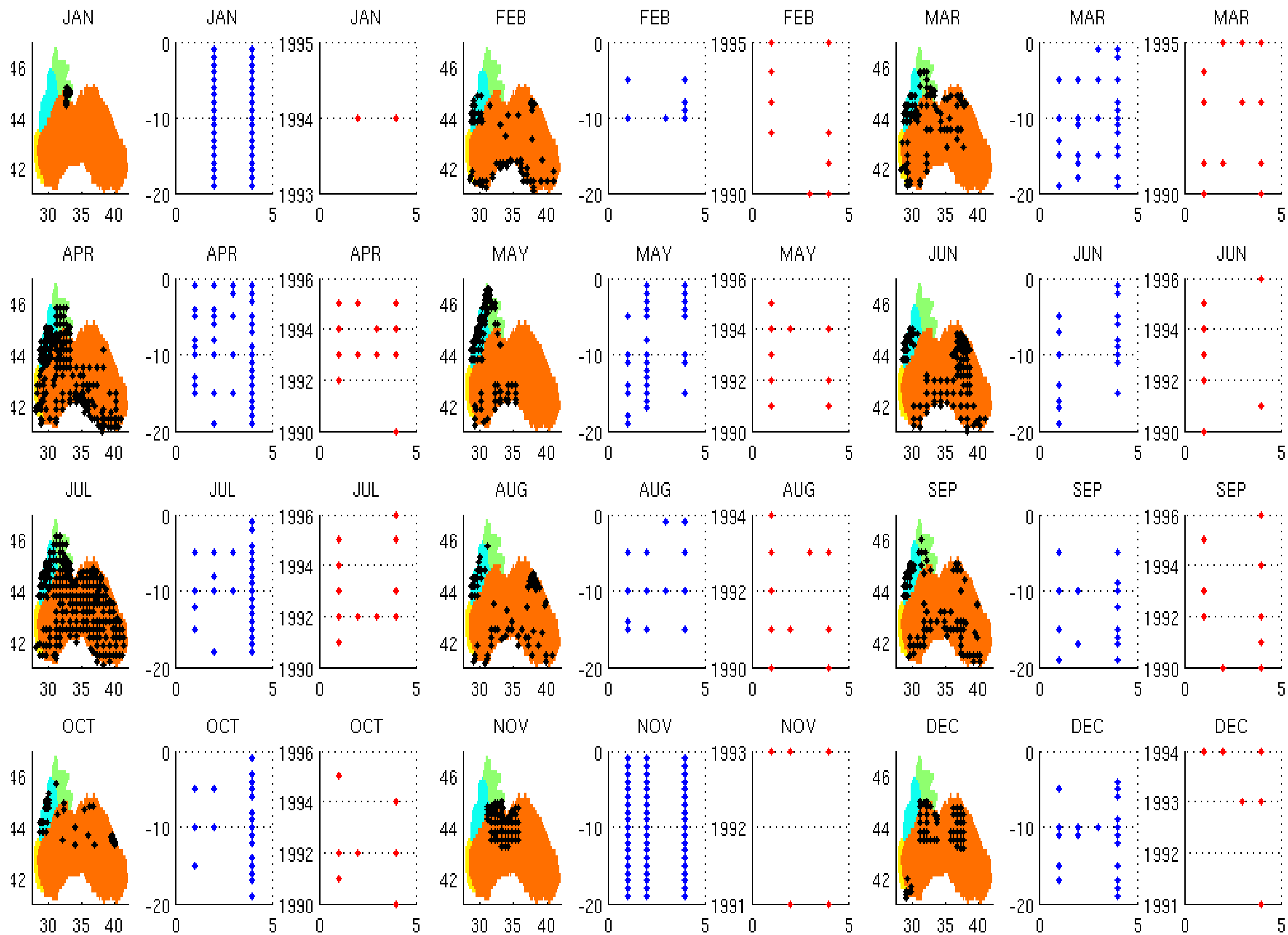
Spatio-temporal repartition of point-2-point statistics

Atmospheric and river forcings are averaged on decadal periods in order to construct a “climatological” seasonal cycles.

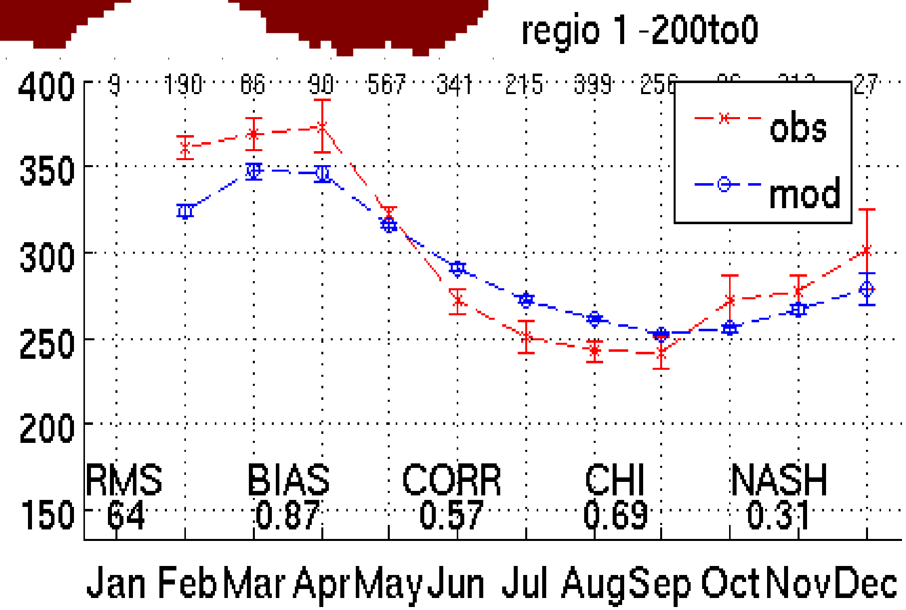
Those climatic runs are run under repetition of those seasonal forcings, in order to study equilibrium states in response to some typical environmental conditions.

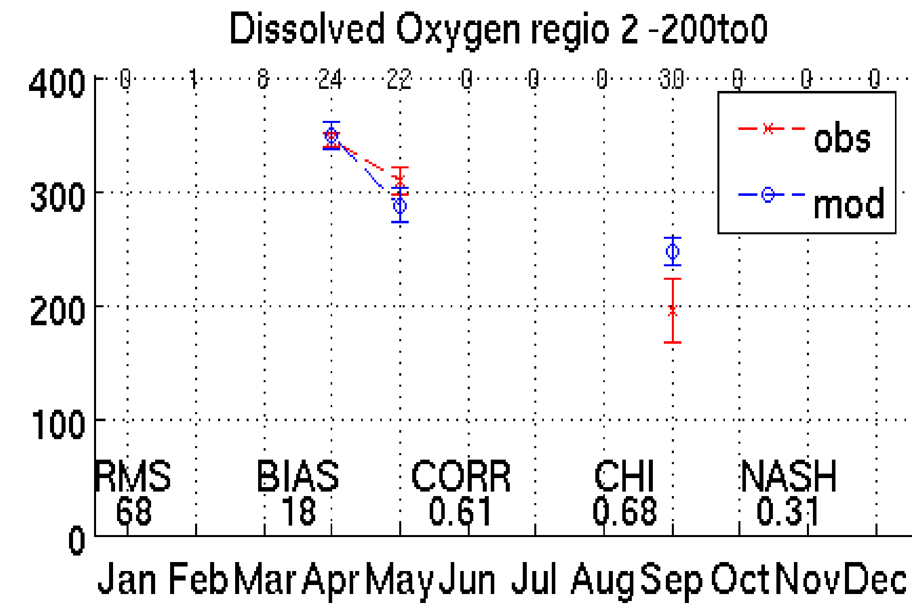
This allow us to better analyse the interannual runs

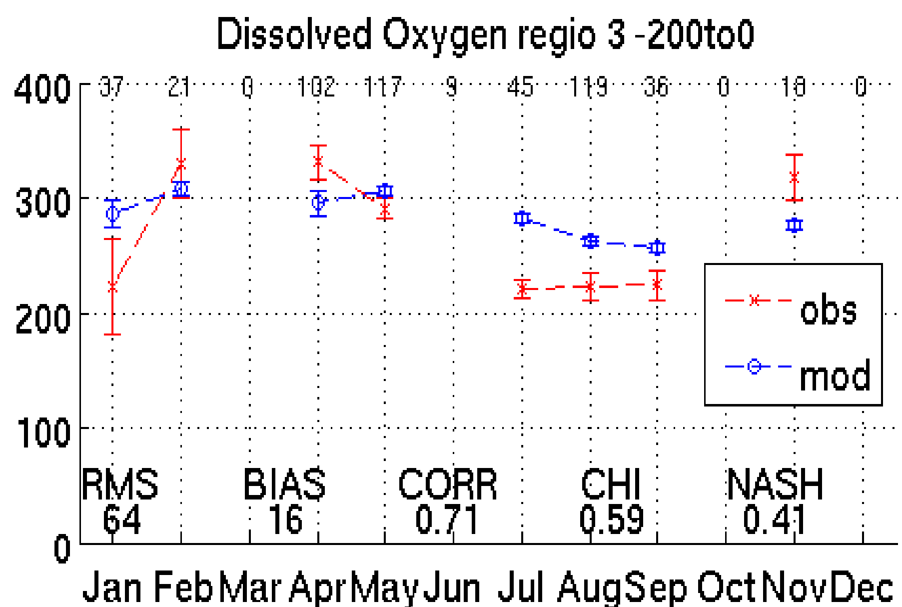
Validation of those runs is done by gathering in-situ data from those decades, and comparing each data by its model spatio-temporal equivalent.

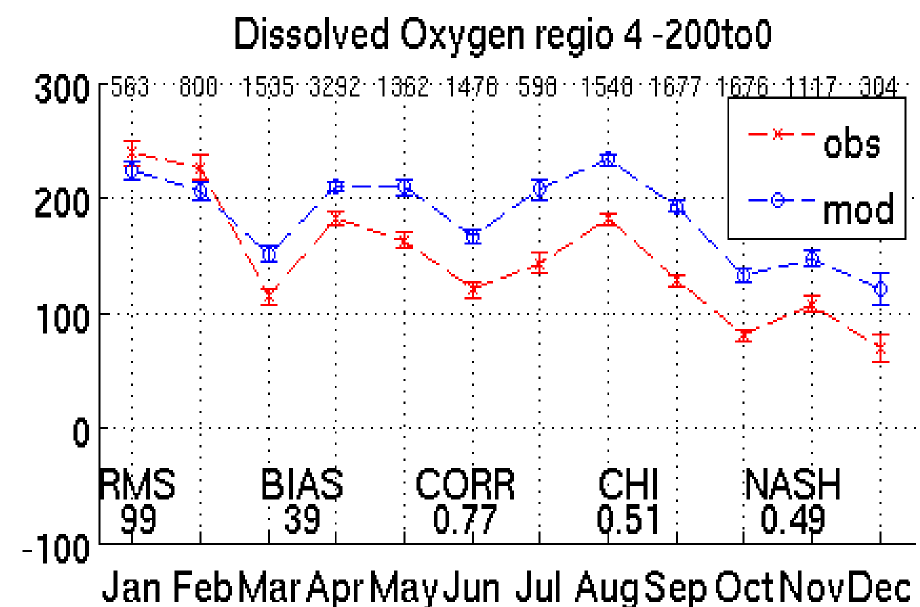


Validation: Horizontal

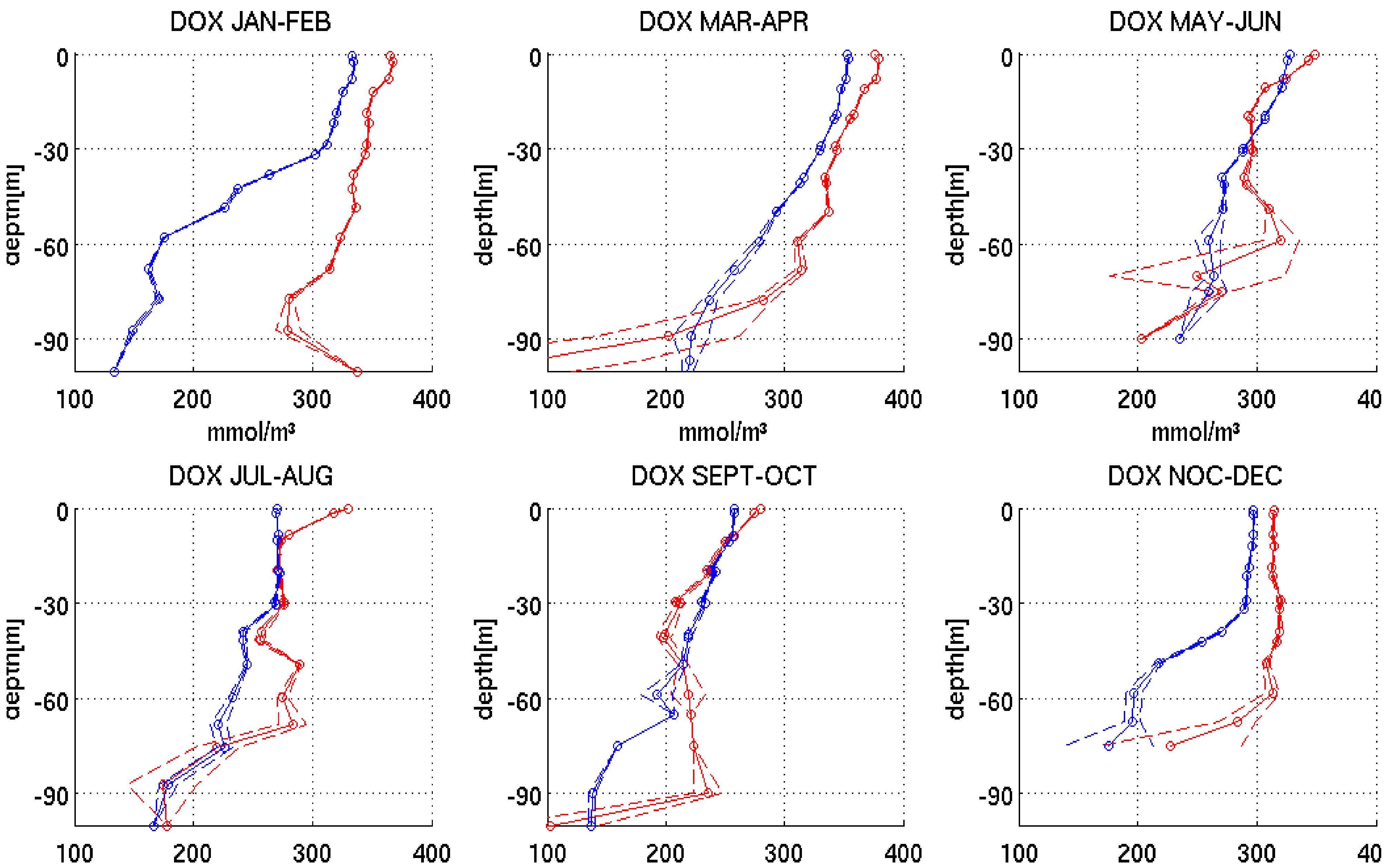




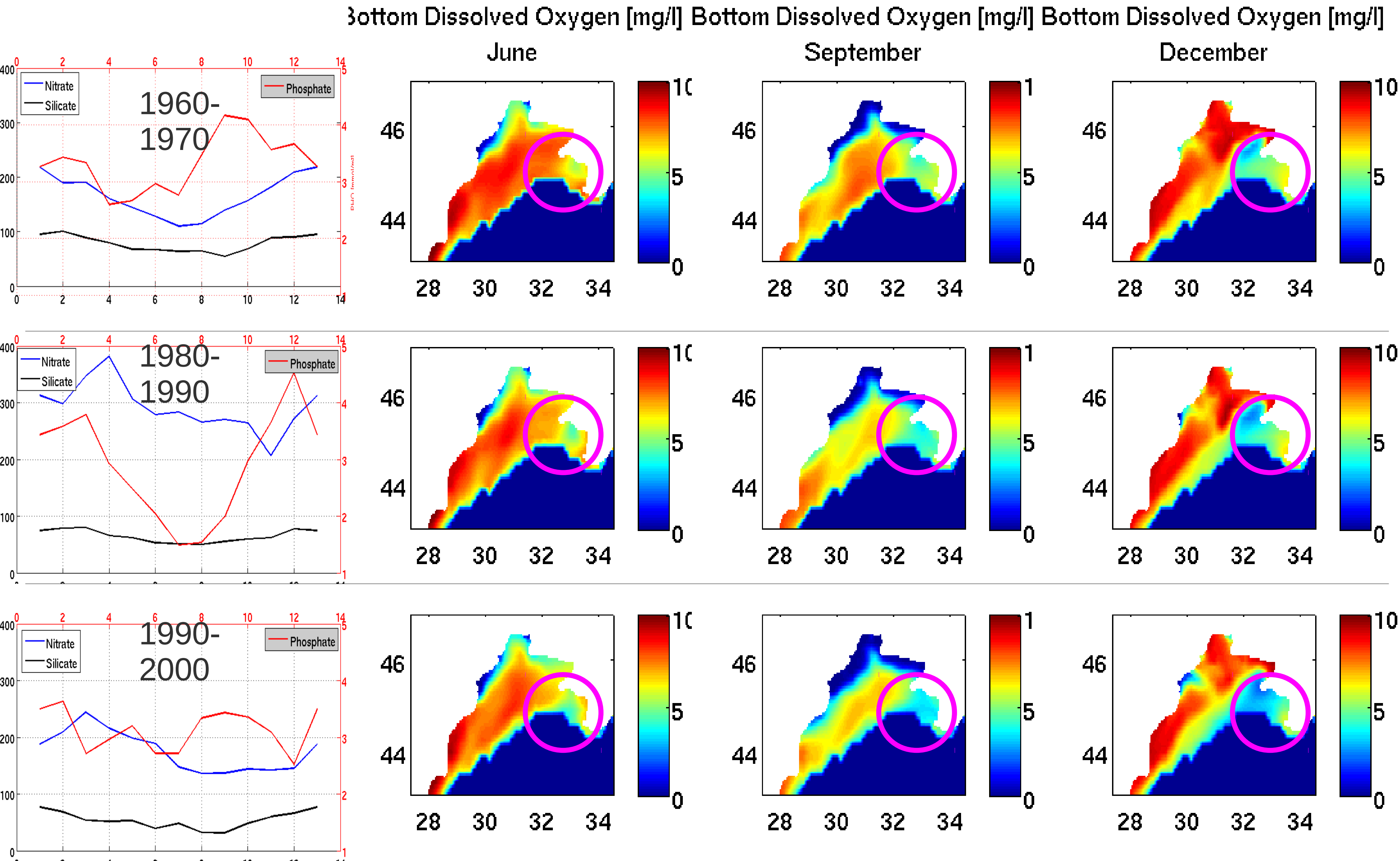




Validation biology : profiles (SHELF)

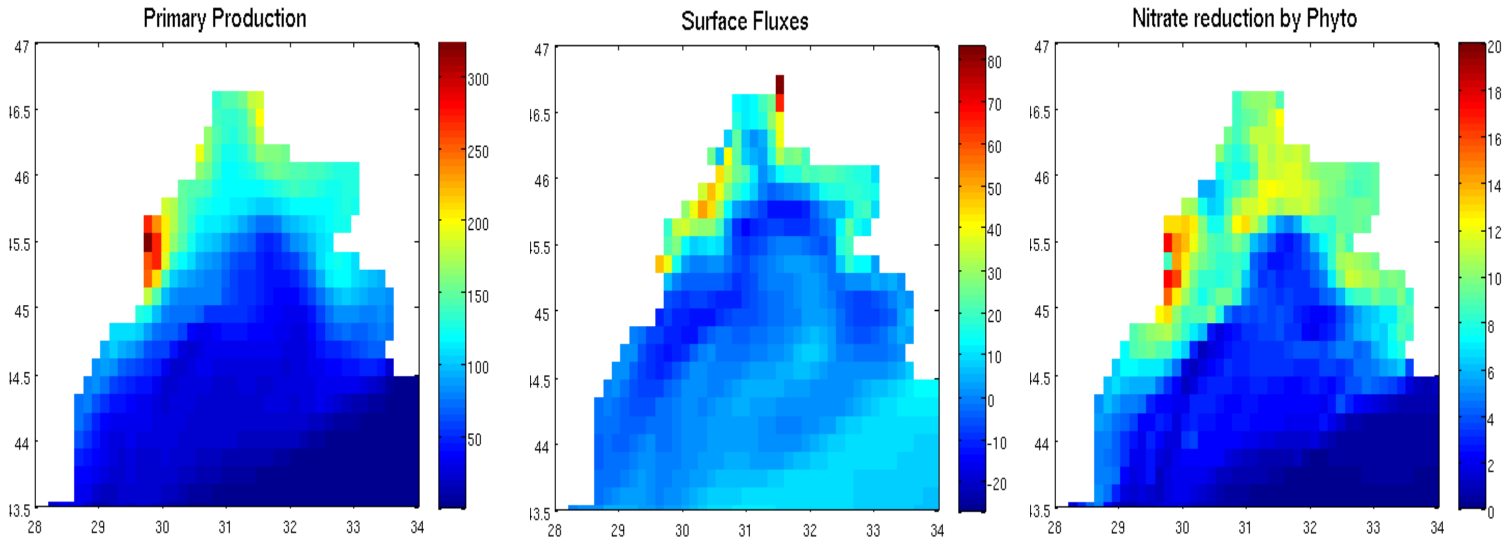


Outputs :
“inter-climatology” evolution of ecosytem conditions



Oxygen Dynamics

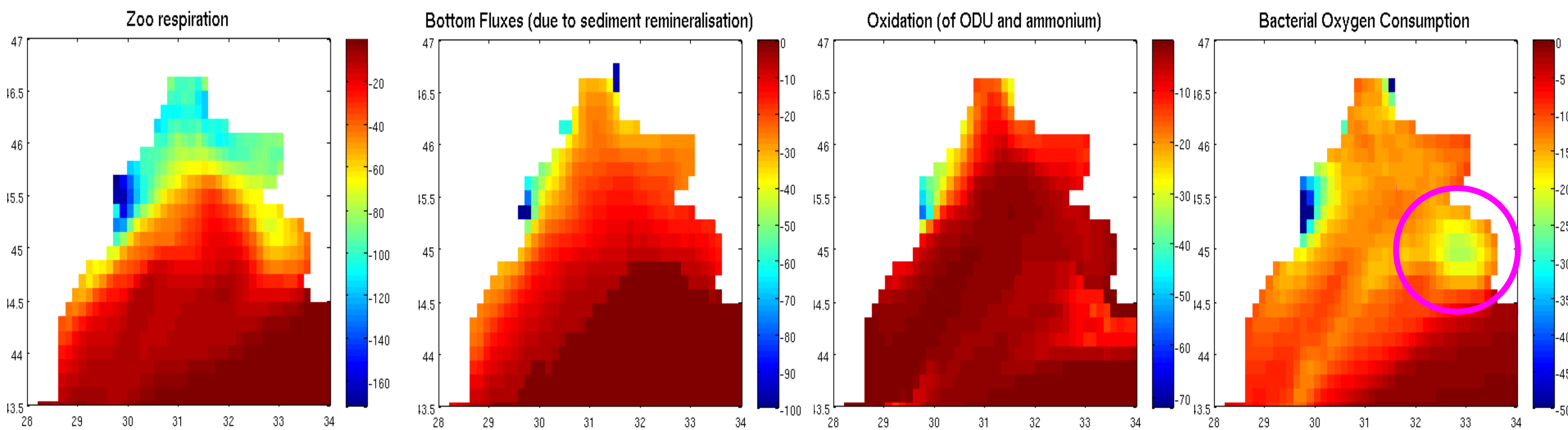
SOURCE



The model allows to analyse different parts of an element's dynamic.

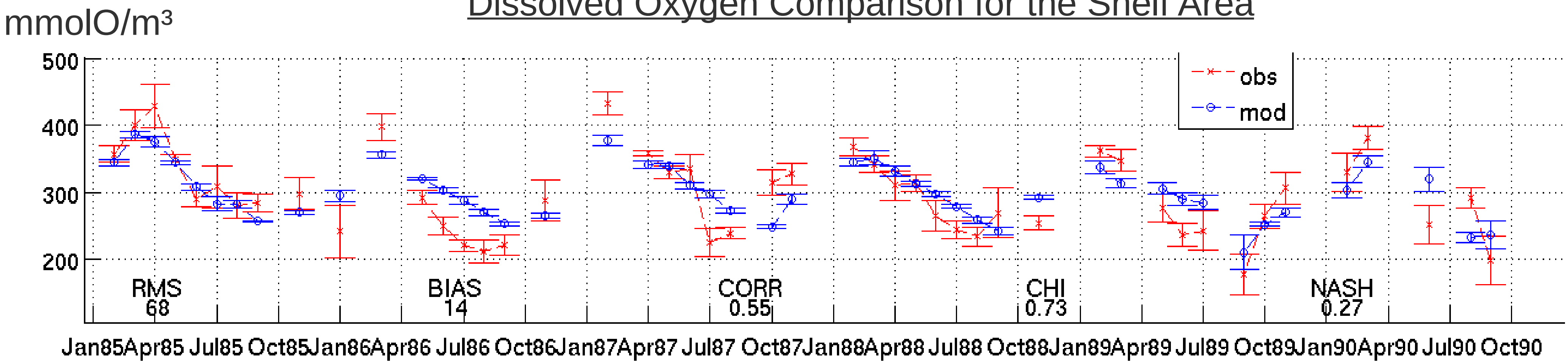
Annual mean of oxygen fluxes, vertically integrated. Units : mmolO/m²

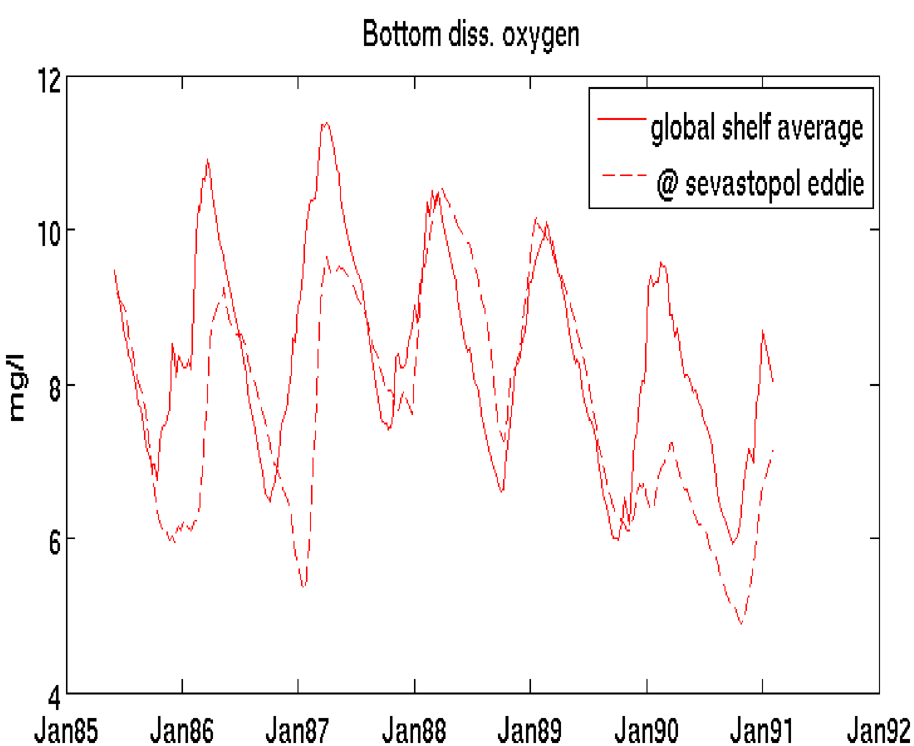
SINK

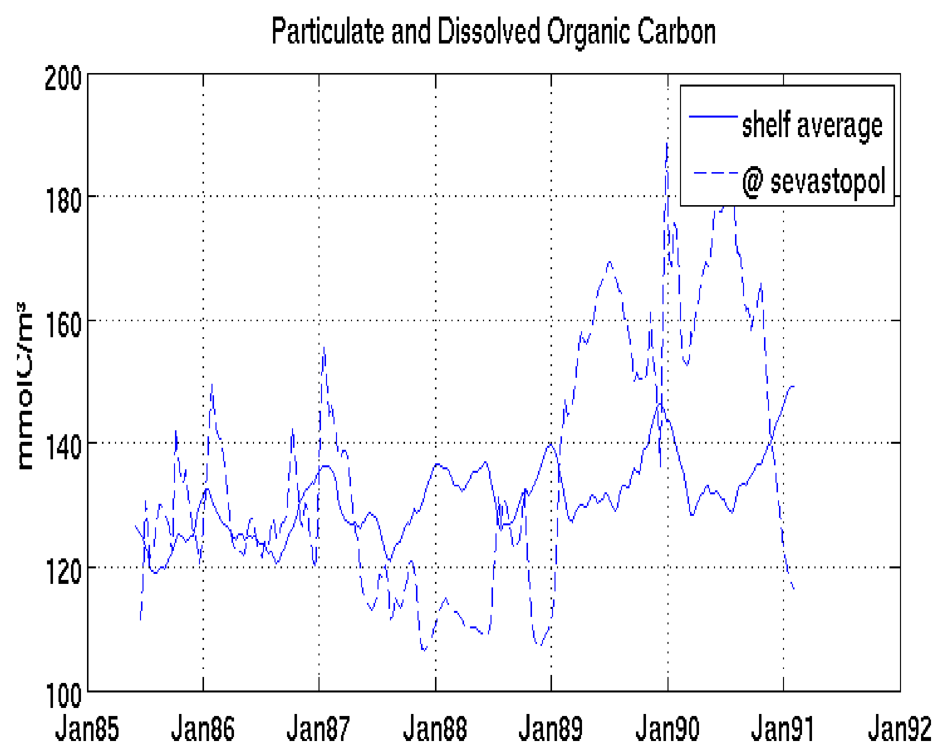


Interannual Run

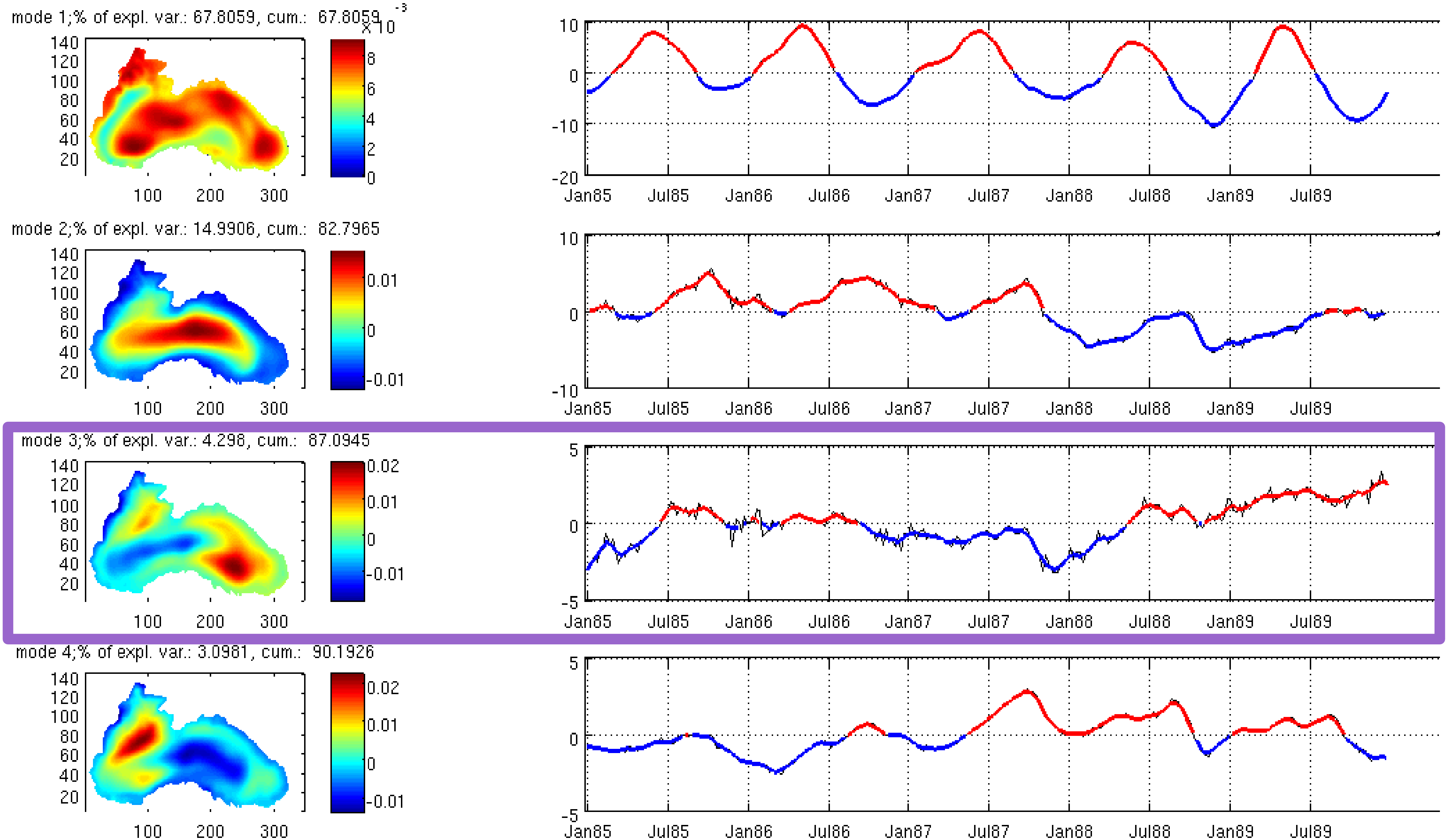
Dissolved Oxygen Comparison for the Shelf Area







Surface Elevation principal modes



Conclusions

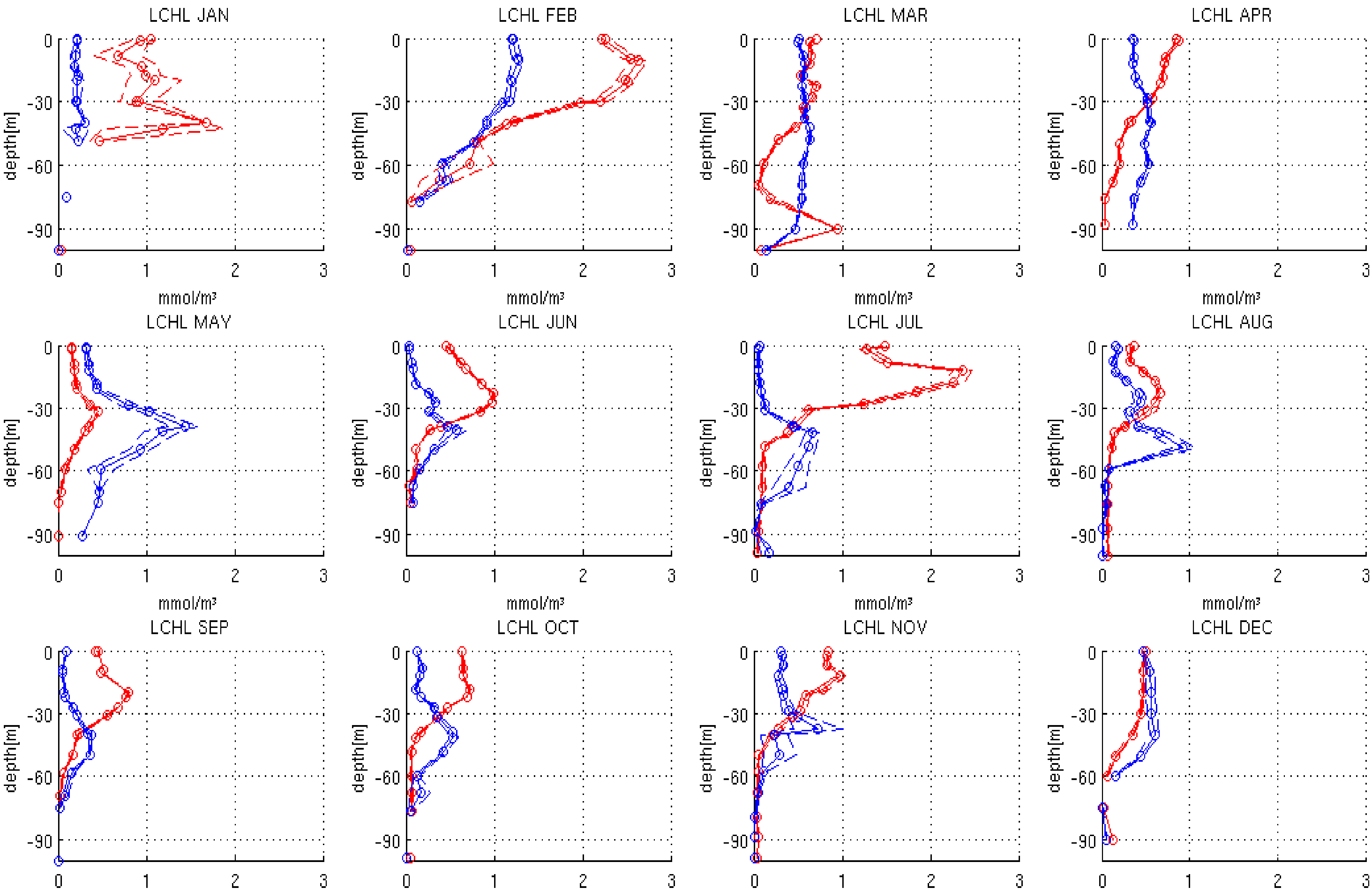
- Once validated (!), 3D models allows to get an usefull insight in detailled dynamics of the ecosytems.

- As 3D complex models generates a big amount of data, climatologic run help to identify relevant indices to analyse interannual run.

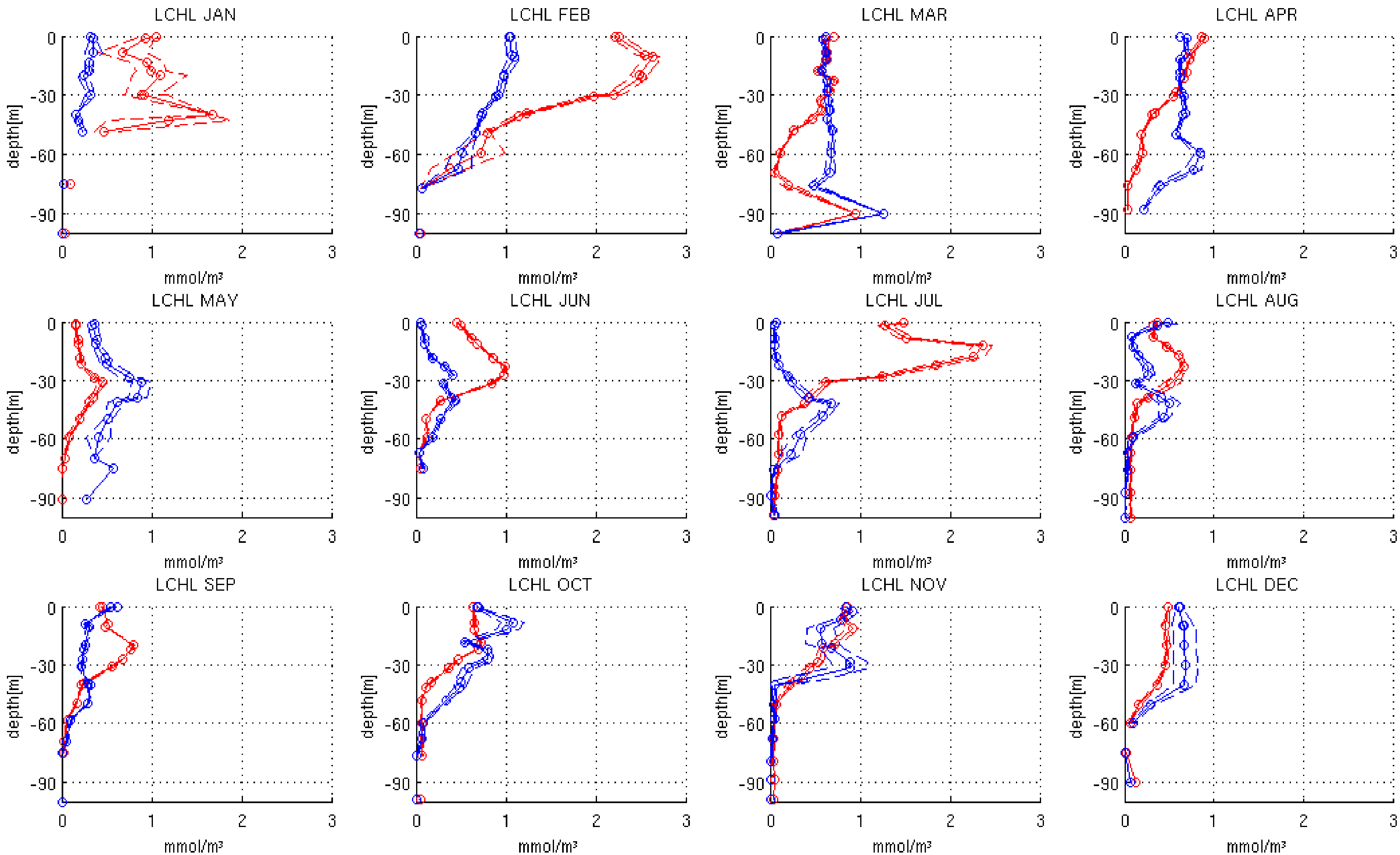
The Black Sea, P. Alechinsky

Thanks for patience, attention and for your questions

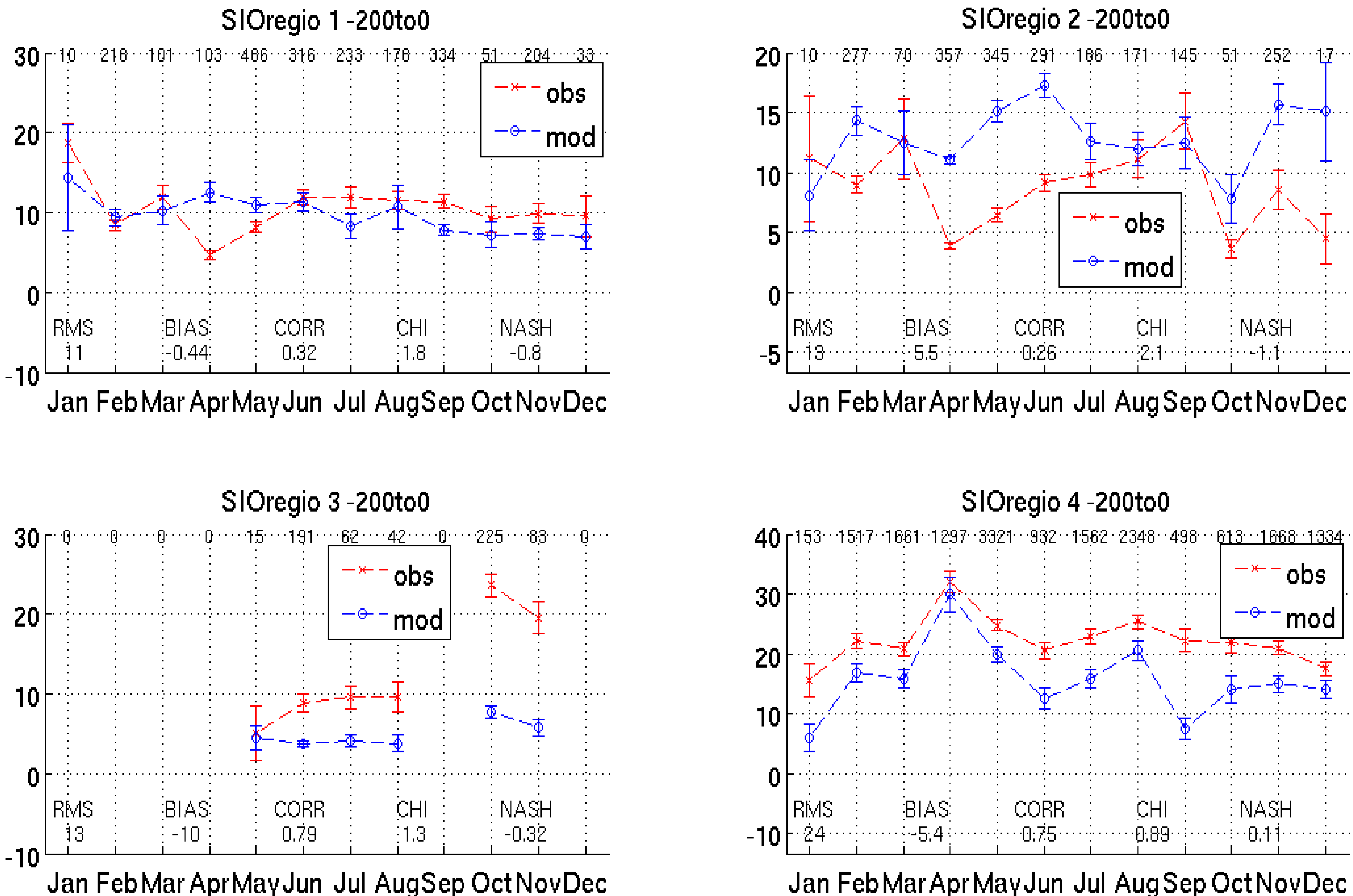
Validation BIO SED 6



SED_5

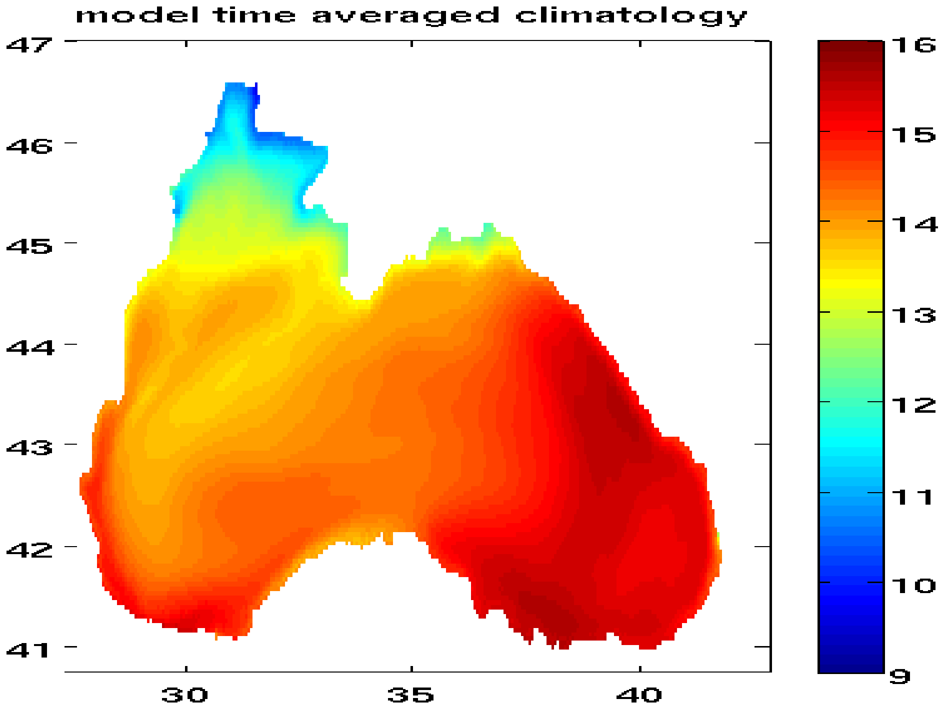

LCHL JAN
LCHL FEB
LCHL MAR
LCHL APR
LCHL MAY
LCHL JUN
LCHL JUL
LCHL AUG
LCHL SEP
LCHL OCT
LCHL NOV
LCHL DEC
depth[m]
mmol/m³
0
-30
-60
-90
0
1
2
3

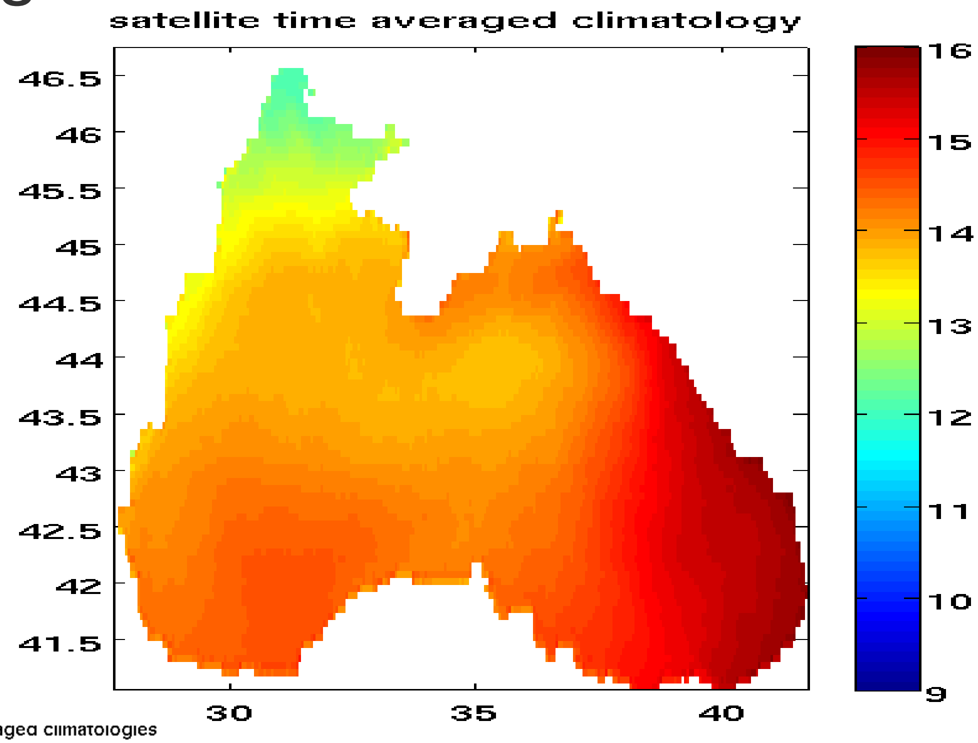
Validation BIO



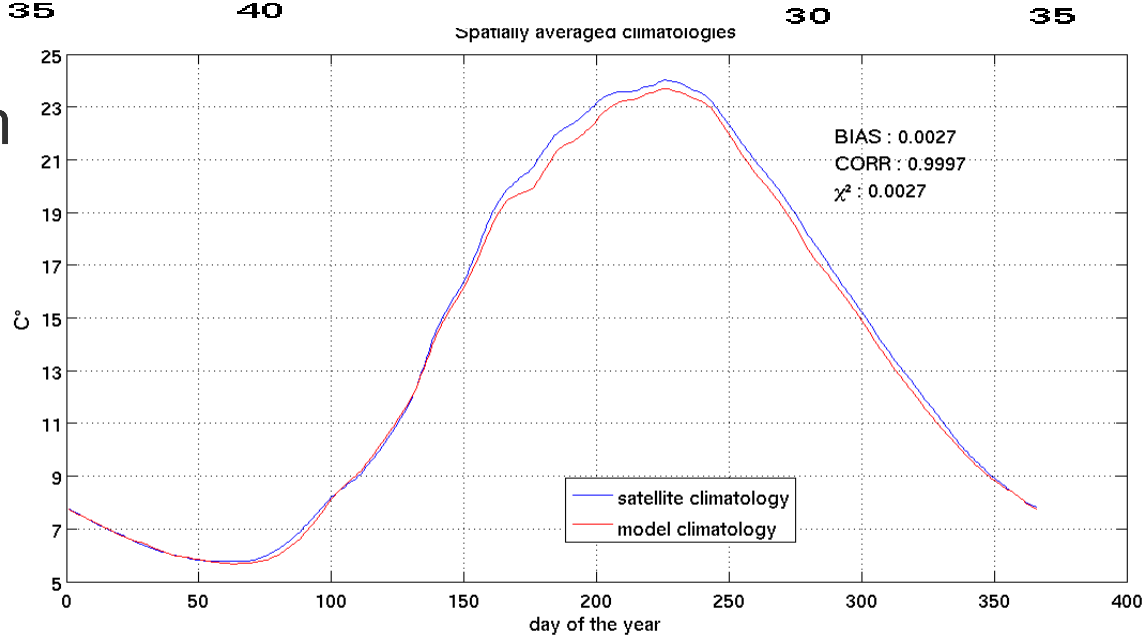
Validation : Physics

Comparison of SST climatologies from model and satellite



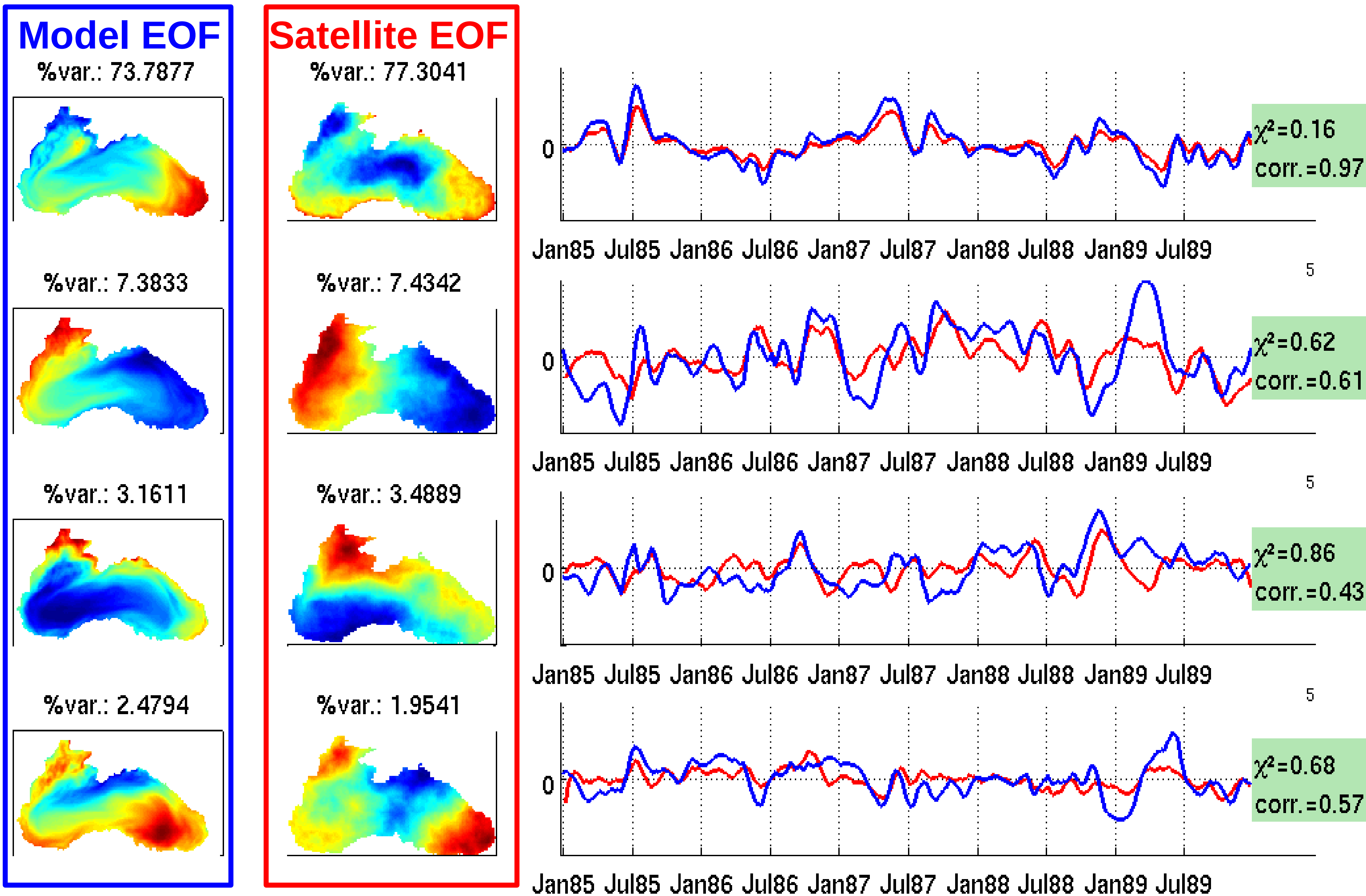


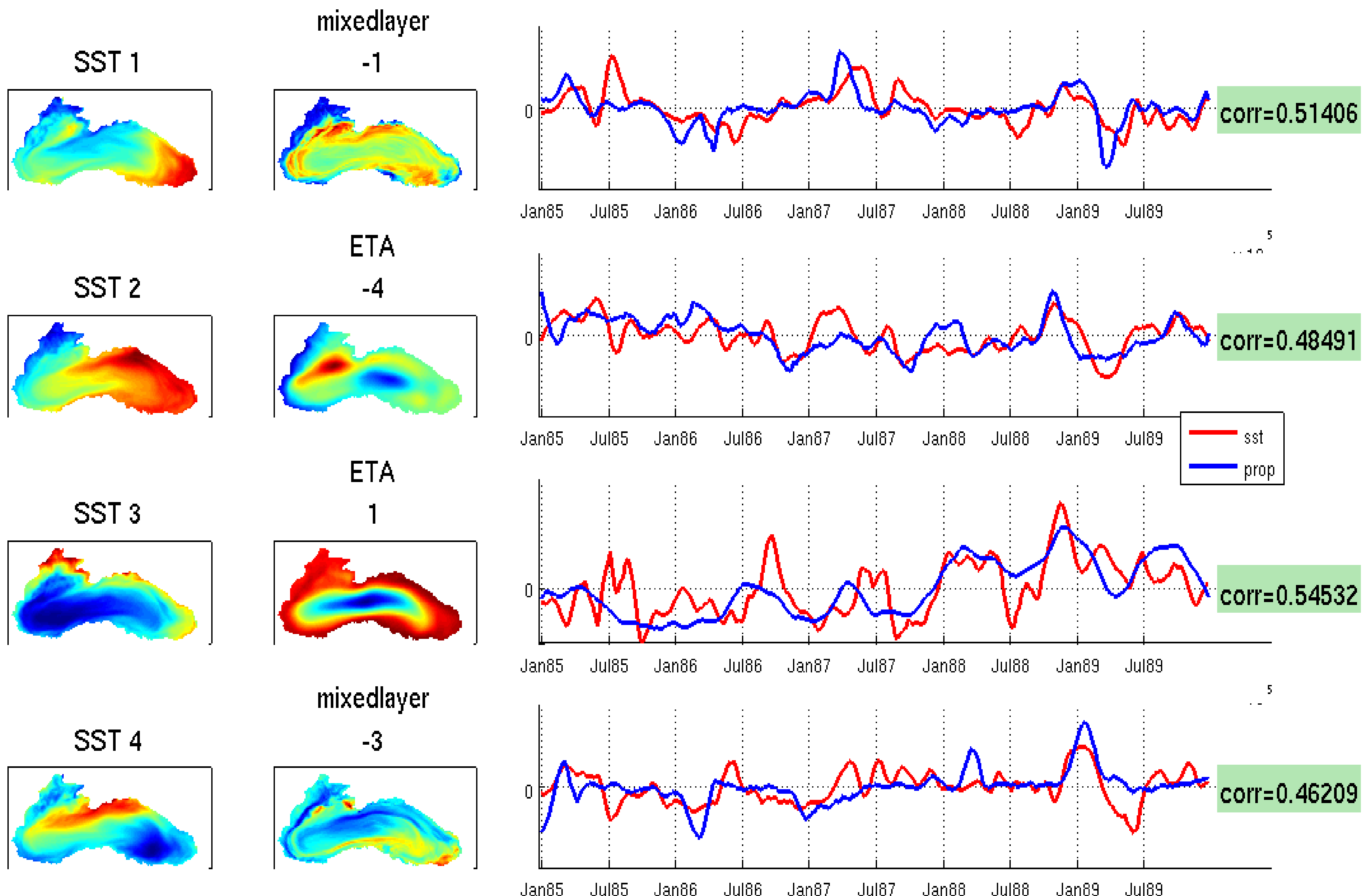
interranual run
85 to 90



Validation : Physics (interranual run 85 to 90)

Comparison of SST modes of interannual variability with satelitte





mixedlayer
SST 1
-1
corr=0.51406
ETA
SST 2
-4
corr=0.48491
ETA
SST 3
1
corr=0.54532
mixedlayer
SST 4
-3
corr=0.46209
sst
prop
0
Jan85
Jul85
Jan86
Jul86
Jan87
Jul87
Jan88
Jul88
Jan89
Jul89

Reduction in anoxic water

$$(CH_2O)_x(NH_3)_y\ (H_3PO_4) + 2xMnO_2 + 4xH^+ \rightarrow 2xMn^{2+} + \underline{xCO_2} + yNH_3 + H_3PO_4 + 3xH_2O$$

$$2xH_2O + 2xMn^{2+} + \underline{xO_2} \rightarrow 2xMnO_2 + 4xH^+$$

$$(CH_2O)_x(NH_3)_y\ (H_3PO_4) + 2xFe_2O_3 + 8xH^+ \rightarrow 4xFe^{2+} + \underline{xCO_2} + yNH_3 + H_3PO_4 + 5xH_2O$$

$$4xH_2O + 4xFe^{2+} + \underline{xO_2} \rightarrow 2xFe_2O_3 + 8xH^+$$

$$(CH_2O)_x(NH_3)_y\ (H_3PO_4) + 0.5xSO_4^{2-} \rightarrow 0.5xS^{2-} + \underline{xCO_2} + yNH_3 + H_3PO_4 + xH_2O$$

$$0.5xS^{2-} + \underline{xO_2} \rightarrow 0.5xSO_4^{2-}$$

$$(CH_2O)_x(NH_3)_y\ (H_3PO_4) + An\ oxidant \rightarrow xODU + \underline{xCO_2} + yNH_3 + H_3PO_4 + xH_2O$$

$$ODU + \underline{xO_2} \rightarrow An\ oxidant$$

(OxygenDemanding Unit = 0.5H2S + 2Mn2+ + 4Fe2+).

Soetaert et al., 1996. A model of early diagenetic processes from the shelf to abyssal depths. Geochimica et Cosmochimica Acta.

Validation : Biology-climatic run

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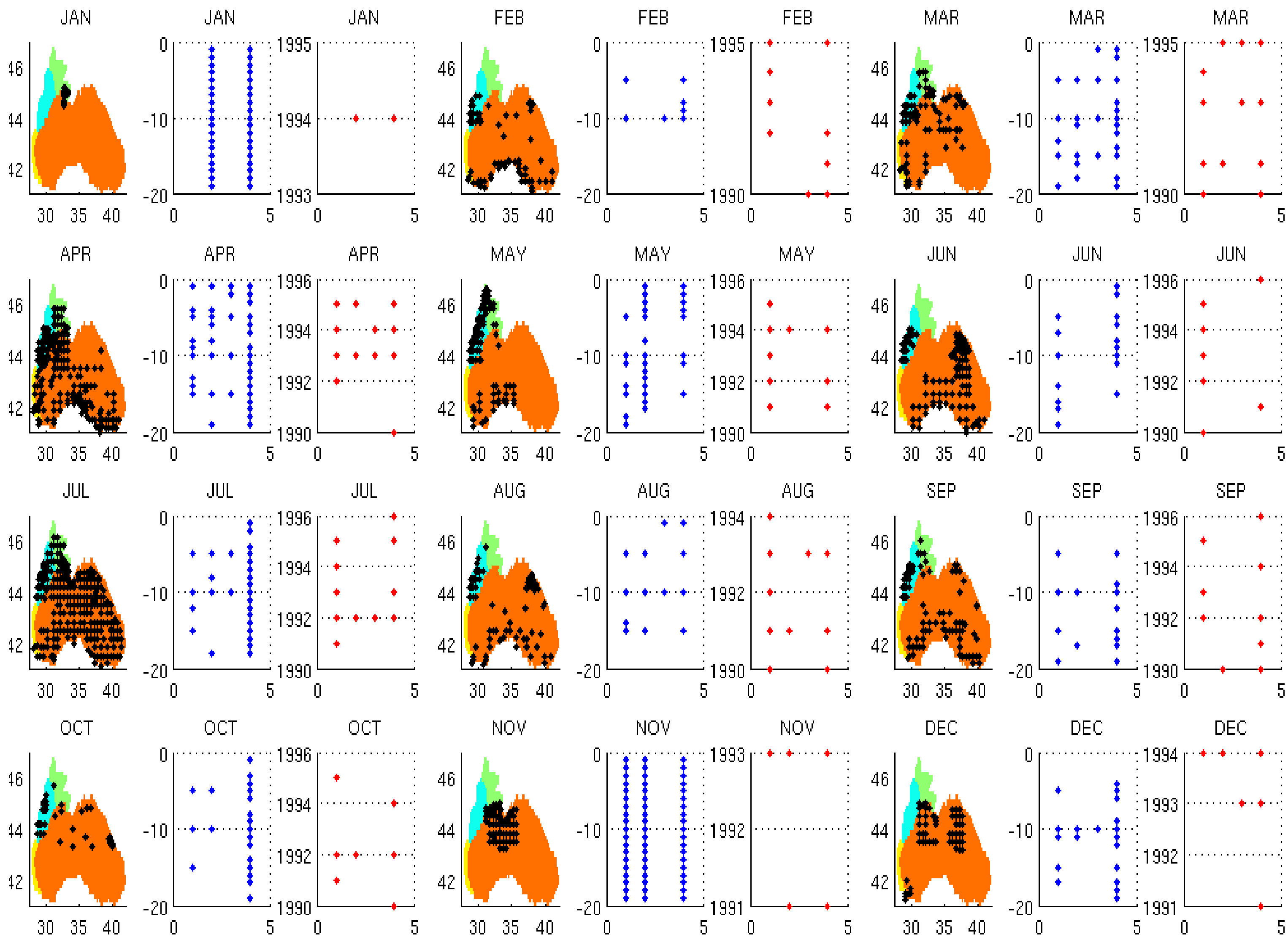

Validation BIO