Processus et incertitudes impactant les cycles biogéochimiques marins

- Fer particulaire d’origine sédimentaire (LEFE MOBIDIC/ANR BISI/ Thèse de Houda)
- Migration du Zooplancton
- Incertitudes liées aux projections climatiques (projet “thon & climat” : CPS)

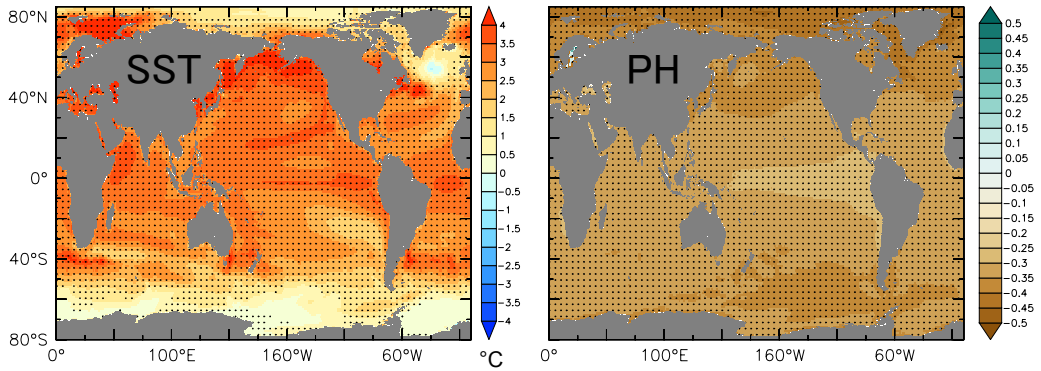
Sur les thématiques de l’équipe:
Les locaux ! Houda, Morgane Dessert, Jorge Martinez, Hélène Planquette, Laurent Memery, etc ...
Collab. Externes : O. Aumont, C. Menkes, M. Lengaigne, P. Lehodey, A. Tagliabue, J. Resing, J. Murray, etc ...

LOPS

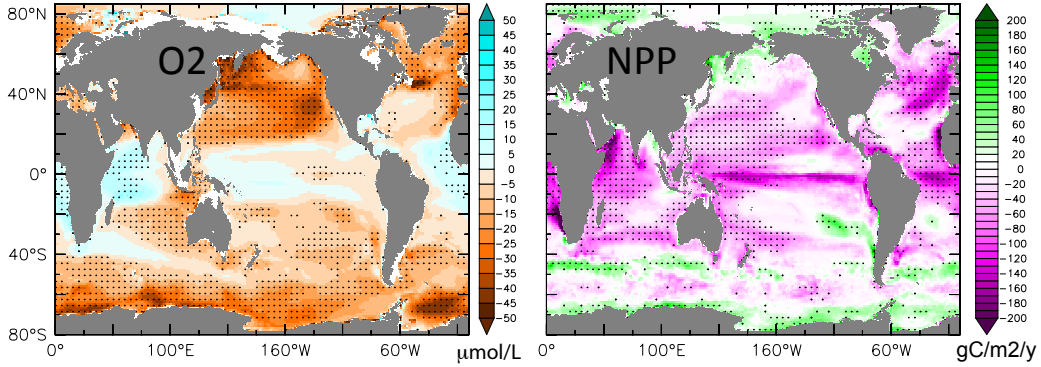
Institut de Recherche pour le Développement
FRANCE

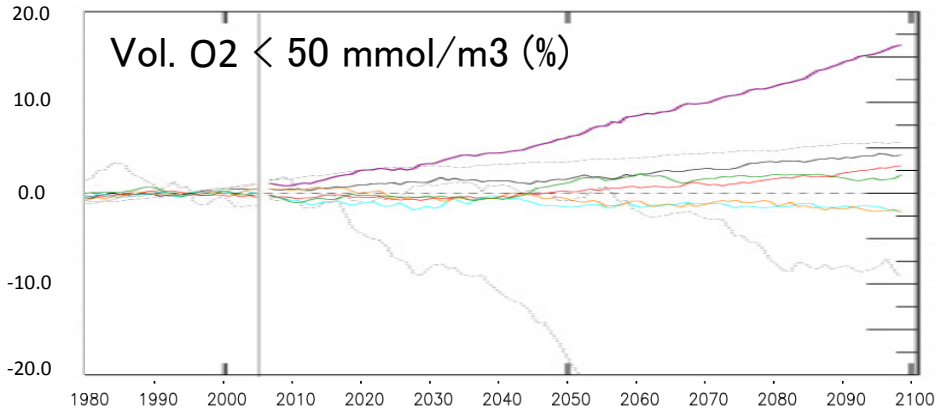
RCP8.5 projections

High Robustness

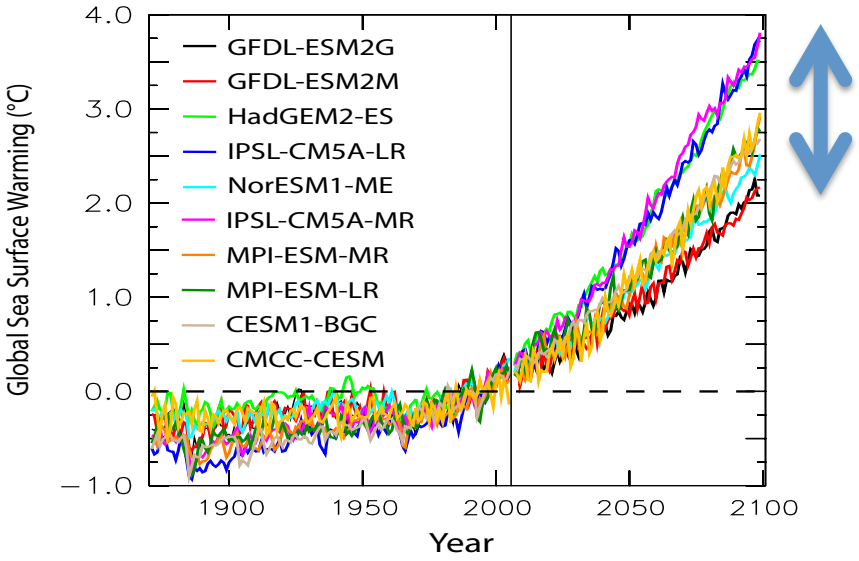


Not so robust …





Adapted from Bopp et al, 2013



Uncertainties in marine biogeochemical predictions :

Ocean dynamic

≠ ocean/atm coupled models

and/or

Ocean Biogeochemistry

≠ biogeochemical models

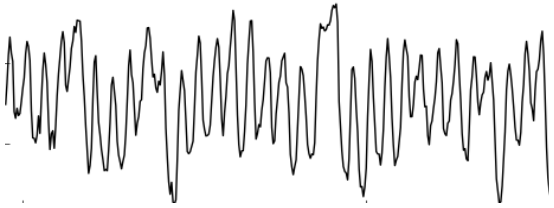
?

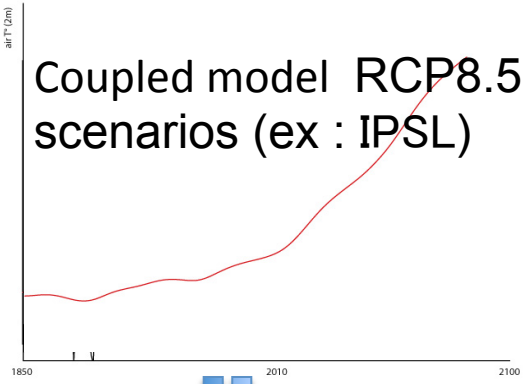
Biogeochemical inter-model differences is a major driver of the uncertainties in biogeochemical projections (*Laufkötter et al., 2015*).

What if we get rid of those inter-model differences ?

Same ocean and biogeochemical models : NEMO-PISCES
only ≠ are the hybrid forcing sets

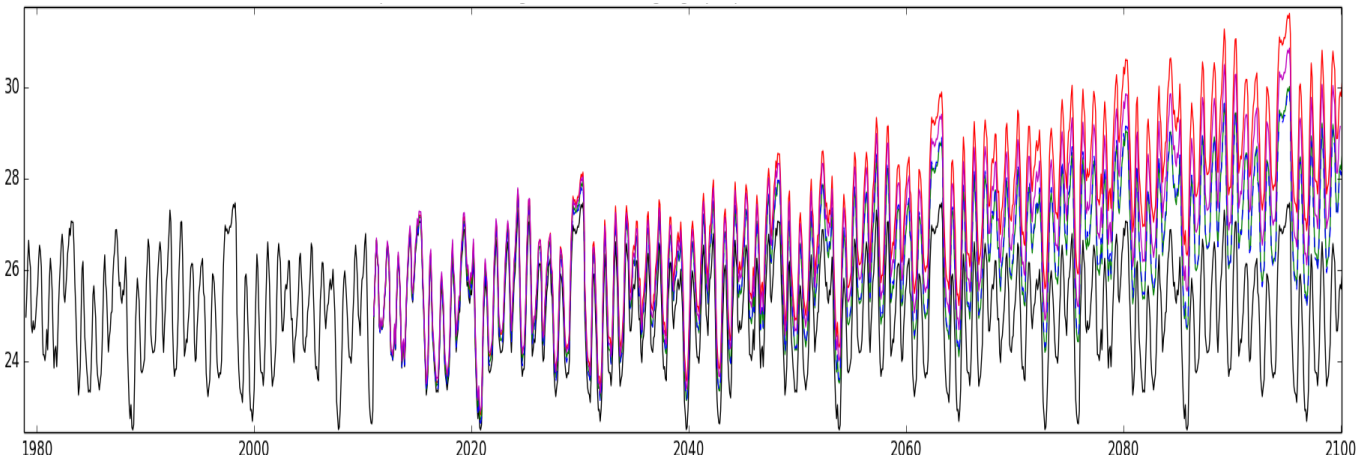
Realistic forcings « DFS5 »





Coupled model RCP8.5 scenarios (ex : IPSL)

Hybrid DFS5-CMIP5 forcings



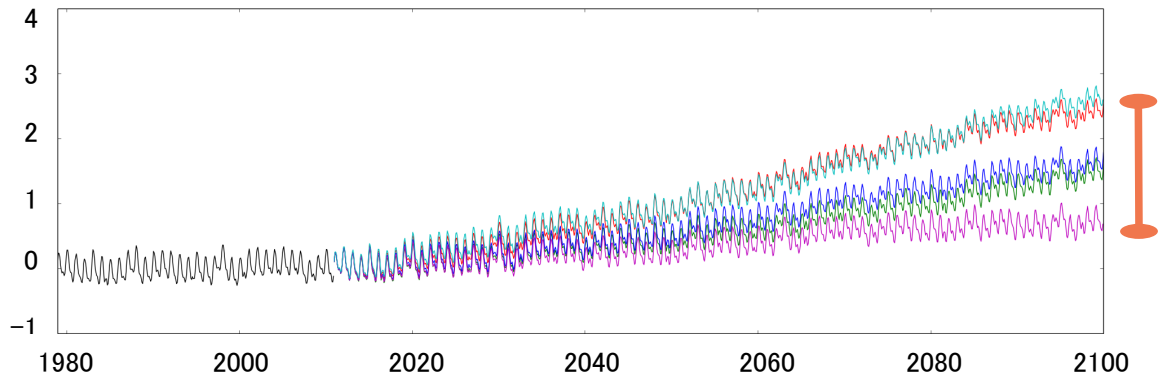
Air temperature at 2m averaged over the El Nino3.4 area

5 sets of predictions for the atmosphere

- DFS5.2
- **IPSL-DFS5-hybrid**
- **GFDL-DFS5-hybrid**
- **NorESM-DFS5-hybrid**
- **MPI-DFS5-hybrid**
- **MIROC-DFS5-hybrid**

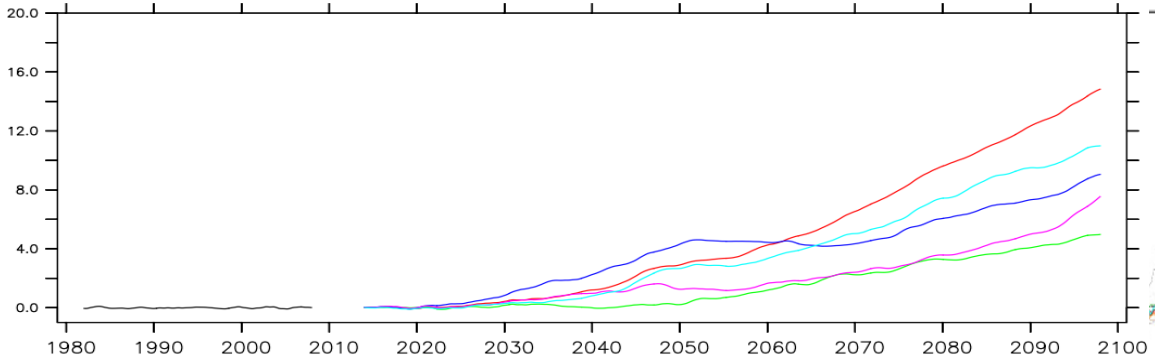
Spread of O2 projections

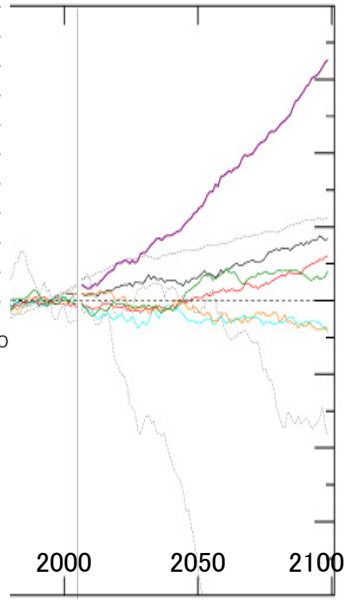
ΔSST (°C)



$Spread_{SST}$=**2°C**
Same order in coupled models

Vol. O2 < 50 mmol/m3 (%)

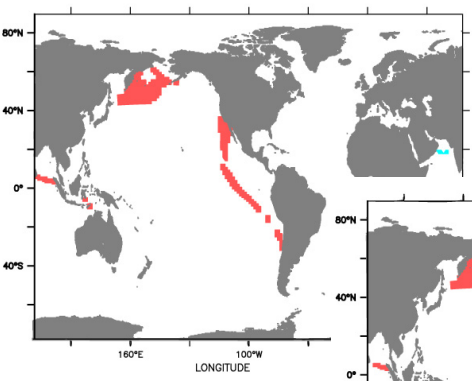




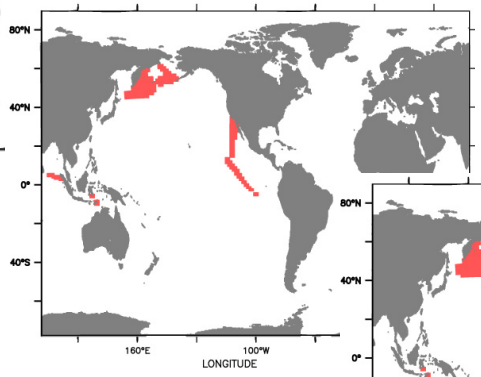
Biogeochemical inter-model differences is a major driver of the O2 uncertainties

Extension of the OMZs

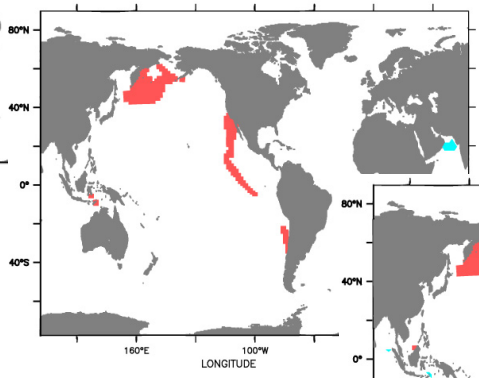
Volume of the OMZs



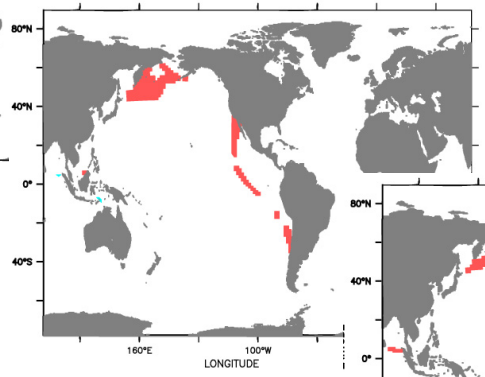
IPSL



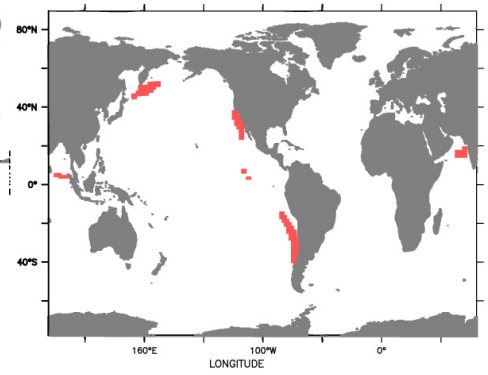
GFDL



MIROC



NorESM



MPI

Extension

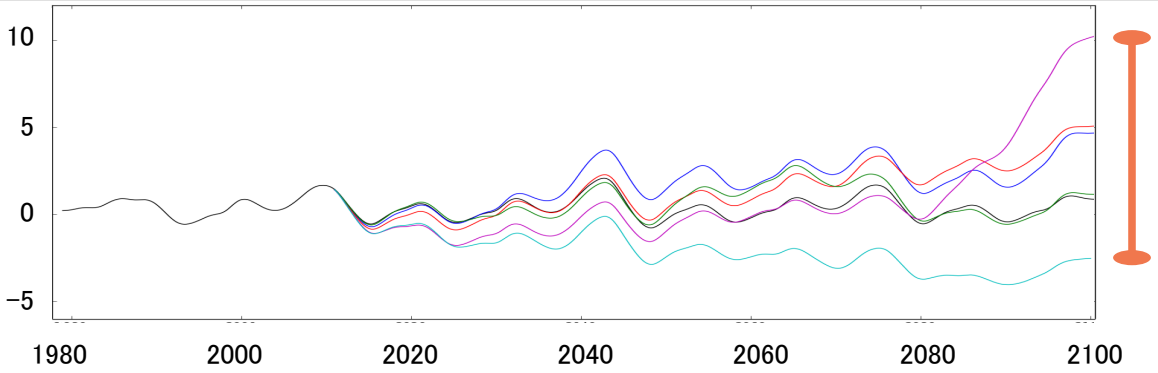
Contraction

Outputs used to run ensemble simulations of higher trophic model (i.e. Tuna with SEAPODYM)

An unexpected result

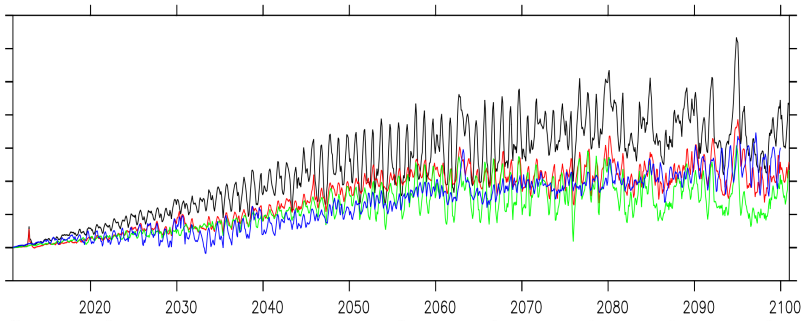
Change in % (compared to the historical period) for Global NPP

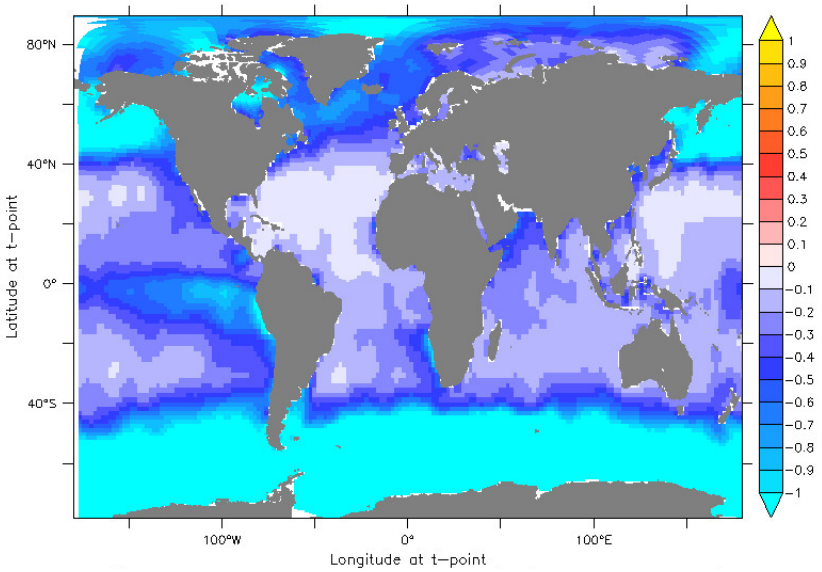
- DFS5.2
- **IPSL**
- **GFDL**
- **NorESM**
- **MPI**
- **MIROC**



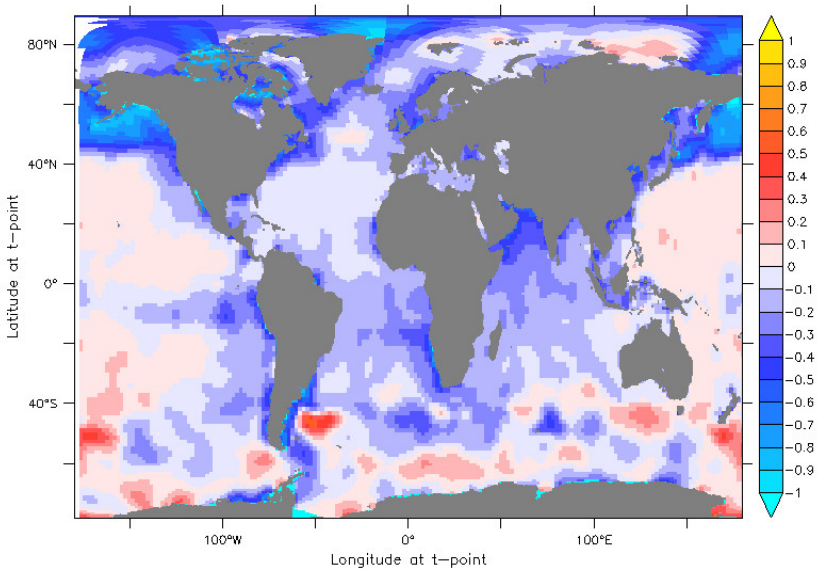
$Spread_{NPP}$=**12%** vs. 11% * in coupled models.

***but most coupled models predict a decrease in NPP !**





PO4 : IPSL Coupled model - WOA



PO4 : IPSL forced model - WOA

Conclusion

- Uncertainty in O2 in coupled models mainly due to the inter-model difference of the biogeochemical component
- Forced models with same ocean & biogeochemical component **increase the robustness** of the predictions

Perspectives :

- New sets of experiments with long term trends & trends in the variability
- Role of nitrogen fixation, pO4 initial concentration, on the NPP predictions