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National Oceanography Centre

Research excellence supporting a sustainable ocean

Assessing mid-century basin and regional climatic trends for Integrated Ecosystem Assessment: scenario vs model uncertainty.

Y. Artioli, L. de Mora, A. Katavouta, L. Conte, G. Galli, J. Holt

OGS Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

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UKRI Natural Environment Research Council

AtlantiS ATLANTIC CLIMATE AND ENVIRONMENT IMPACTS

The WHY: supporting Integrated Ecosystem Assessment

IEAs support the d**evelopment of management strategies** that will ensure **sustainable use of marine resources** and the **safekeeping of marine biodiversity** for generations to come

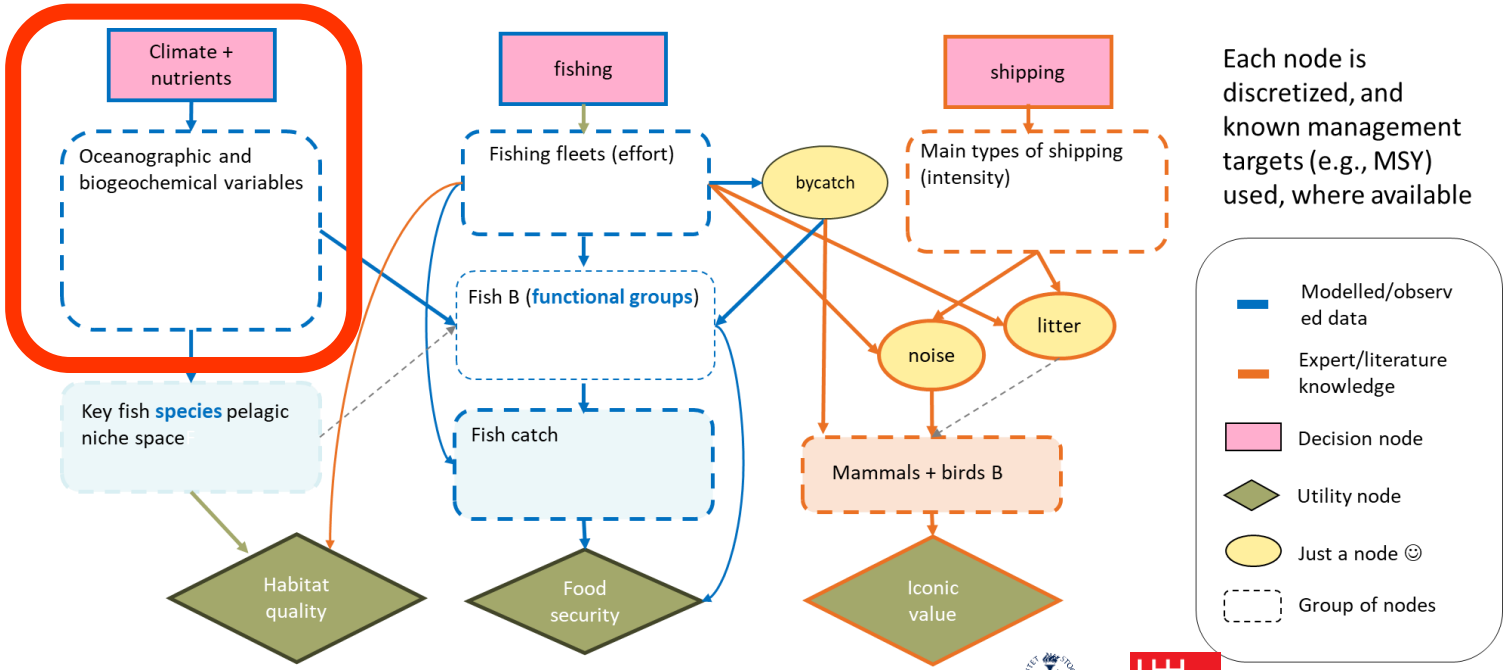

Diagram courtesy of Susa Niiranen and Saskia Otto

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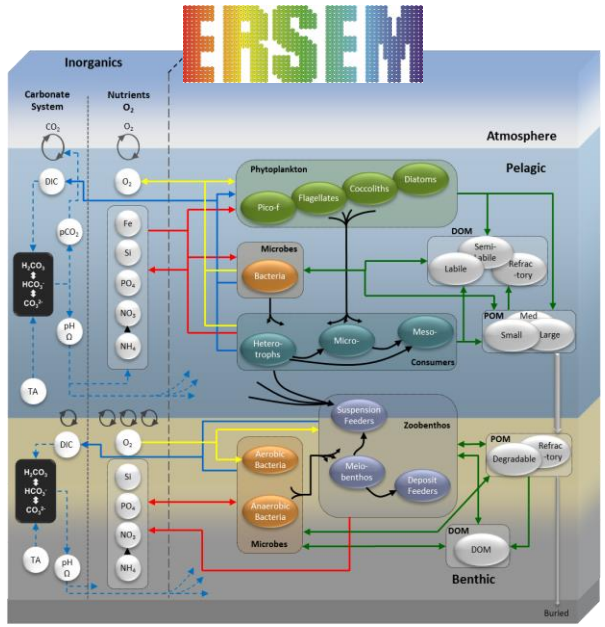
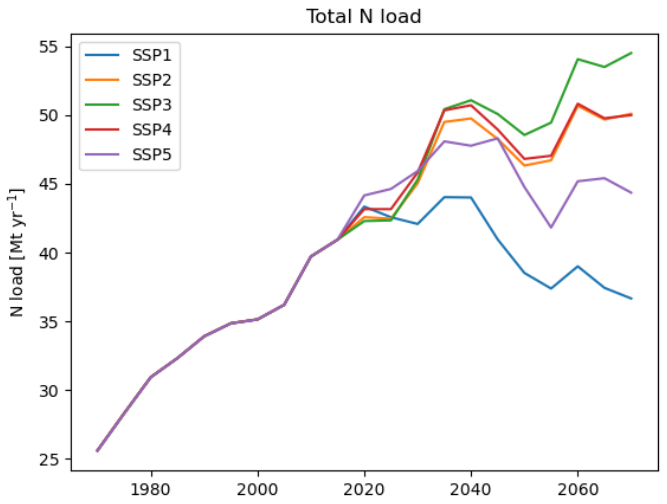
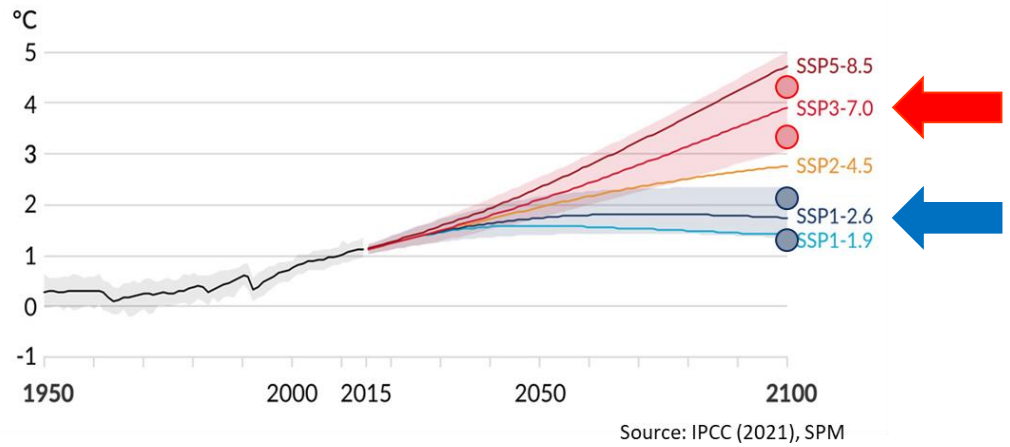
Global downscaling set-up

- Global Physics/Biogeochemistry NEMO-ERSEM model, horizontal resolution ¼ degrees.
- Atmospheric forcing from CMIP6 models.
- Initialisation from recent-past conditions.
- Rivers:
  - FW: seasonal climatology based on reanalysis + CMIP6 models interannual variability & trends.
  - Nutrients: IMAGE-GNP (Beusen et al., 2022)
- N deposition: from ISIMIP (Yang and Tian, 2020)
- 4 members ensemble: 2 scenarios x 2 CMIP6 models





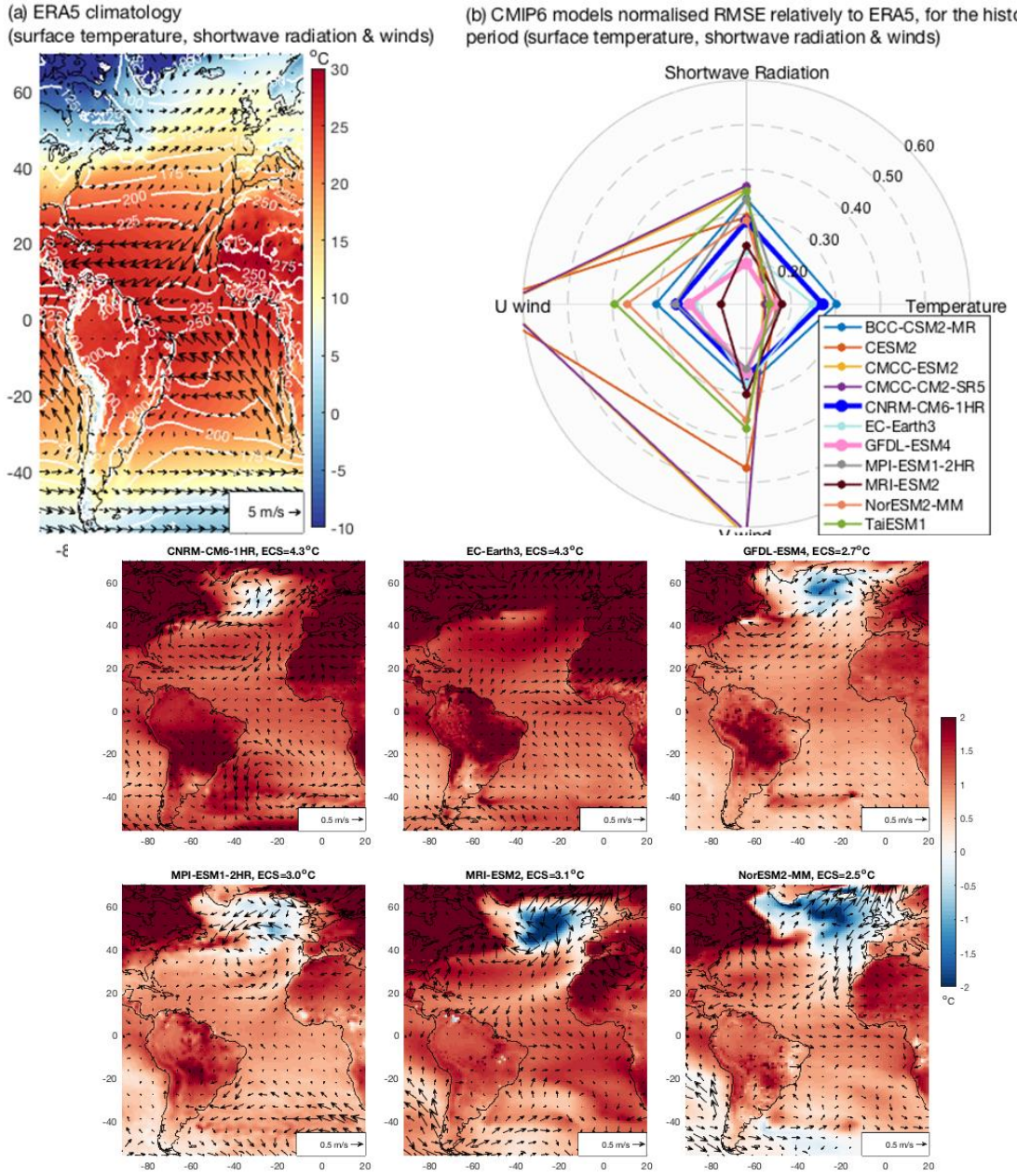
Scenarios and models selection



Source: IPCC (2021), SPM

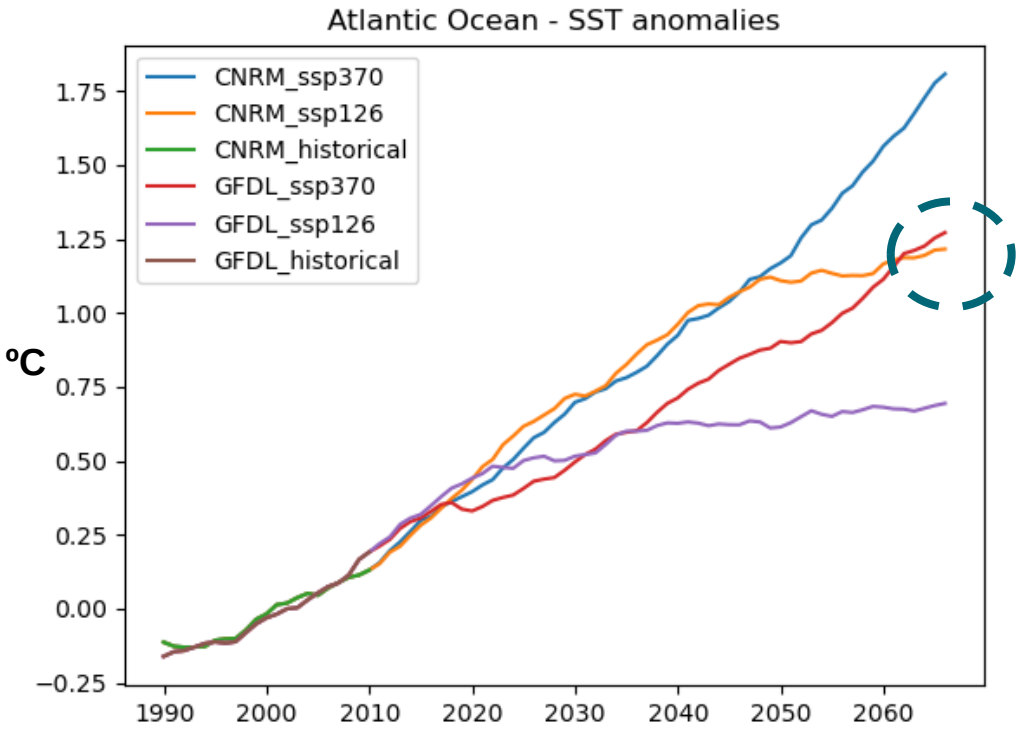
CNRM-CM6-1hr: ECS = 4.3 ºC

GFDL-ESM4: ECS = 2.7 ºC

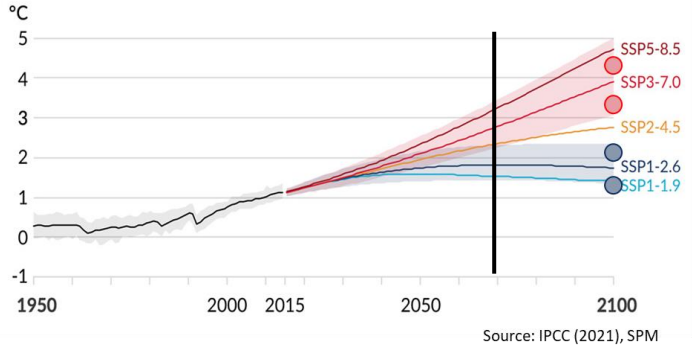


Model vs. scenario uncertainty – SST

10 years rolling means of anomalies wrt 1985-2014



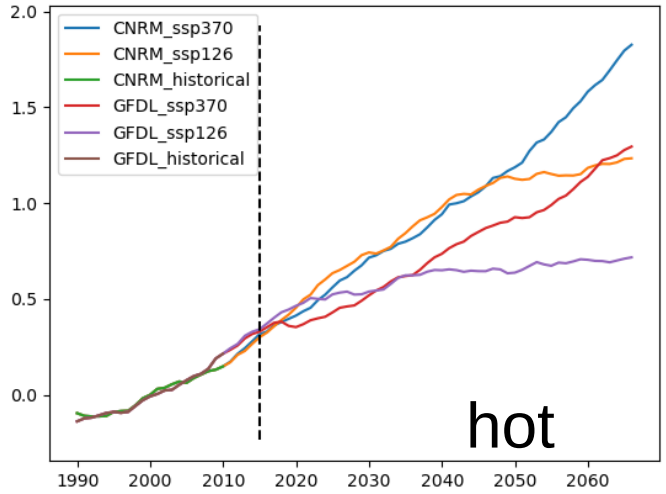
SSP1-2.6 high ECS model reaches same warming of SSP3-7.0 low ECS model



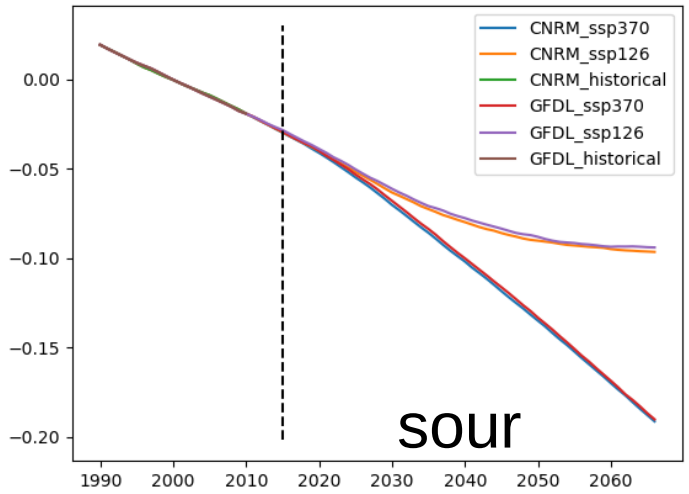
Source: IPCC (2021), SPM

All Atlantic surface

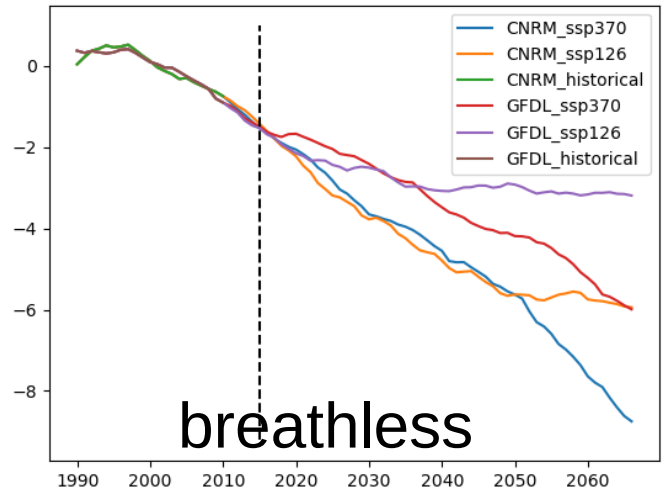
SST [ºC]



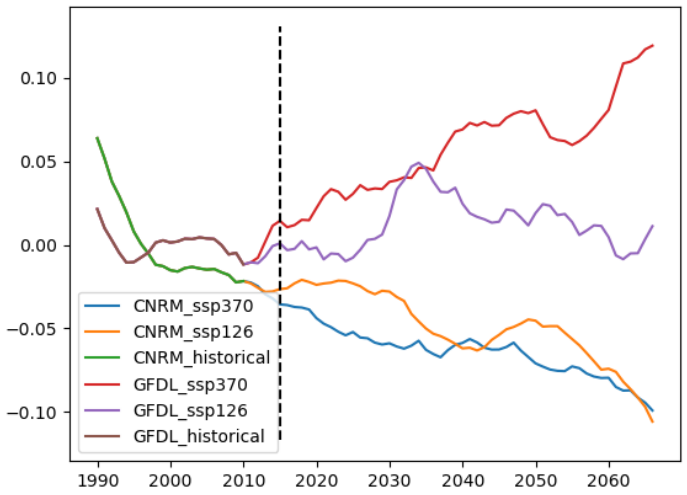
pH



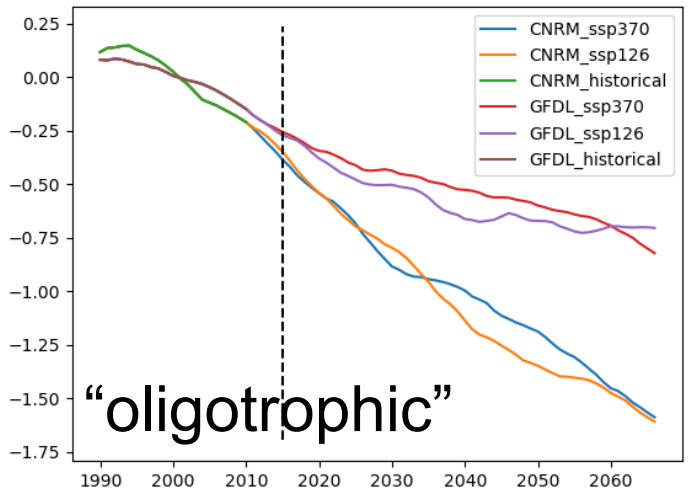
oxygen [mmol m^{-3}]



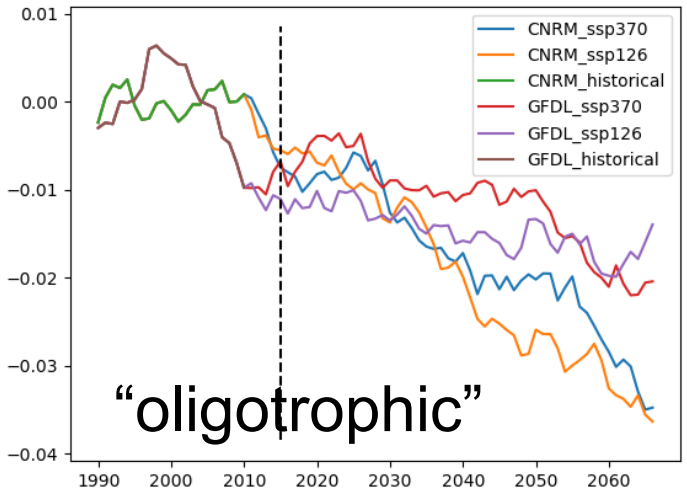
SSS [g kg^{-1}]



Nitrate

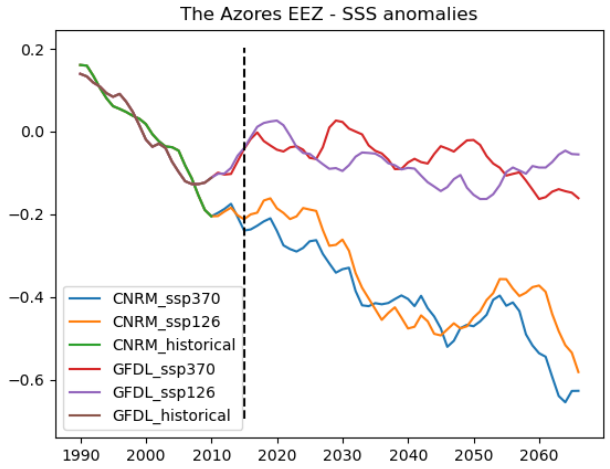


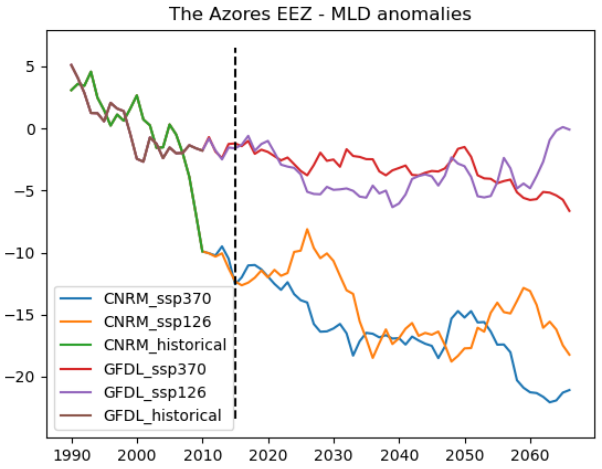
Chlorophyll [mg m^{-3}]

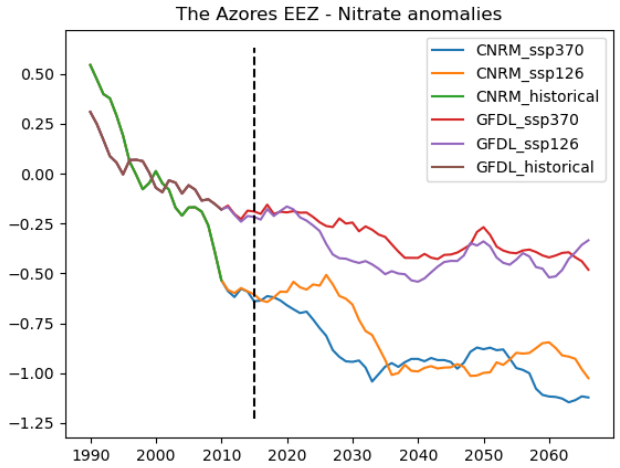


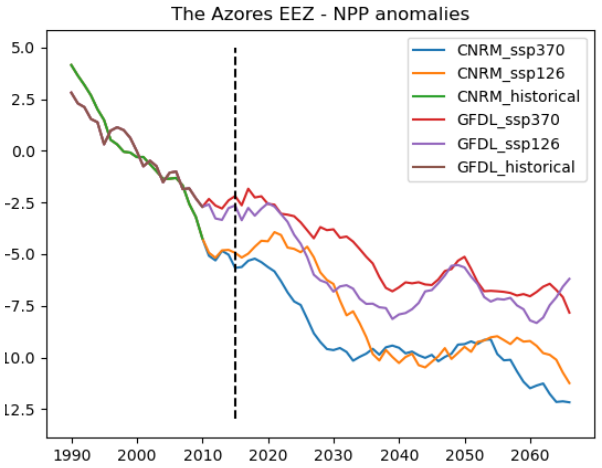
Case study – Azores

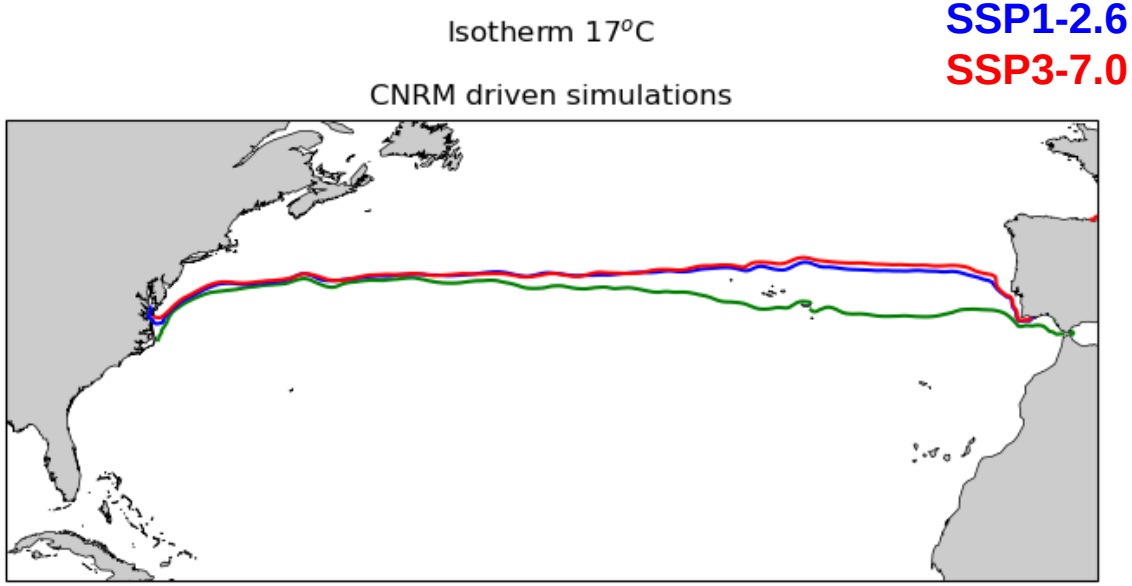
Historical
SSP1-2.6
SSP3-7.0

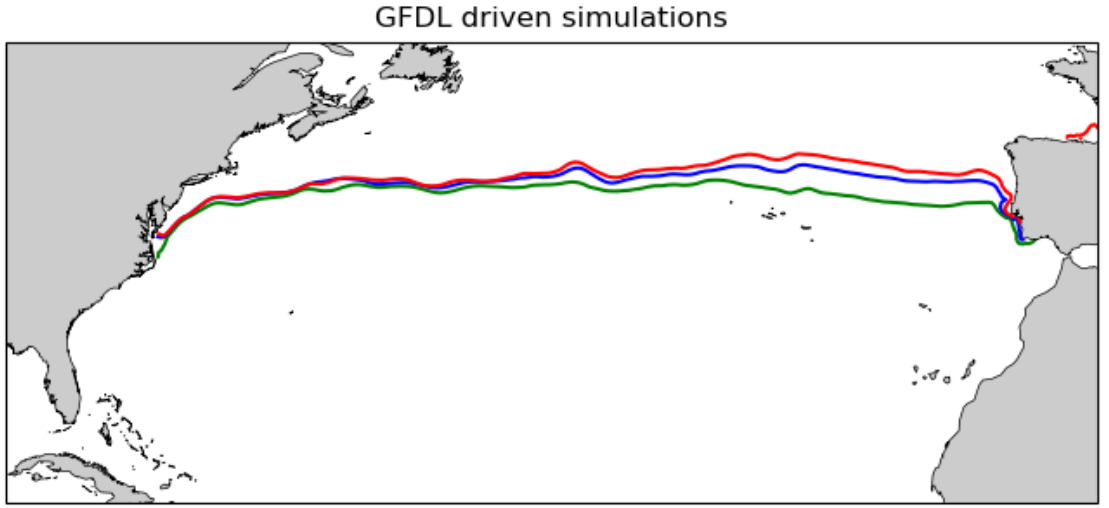






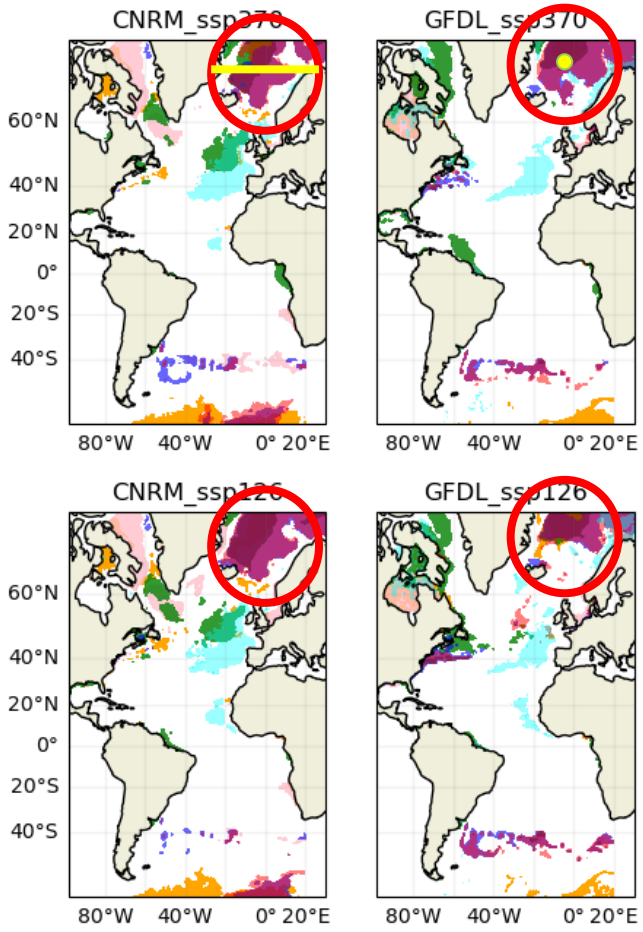


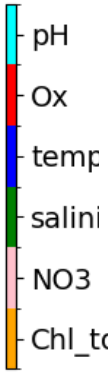


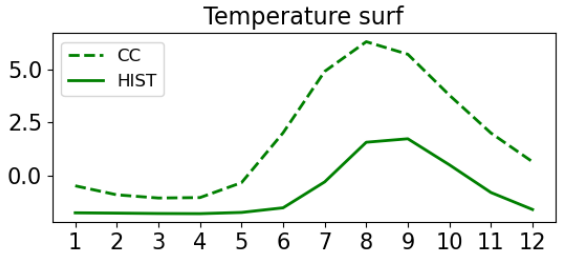


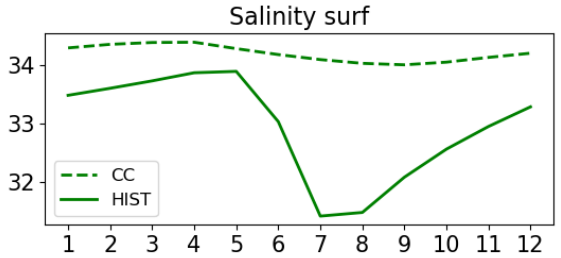
Hot-spots of change – the Norwegian Sea case study

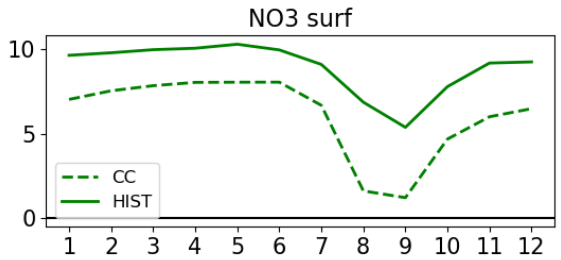
Hot-spots = areas where $|\Delta| > 95^{th}|\Delta_{Atl}|$

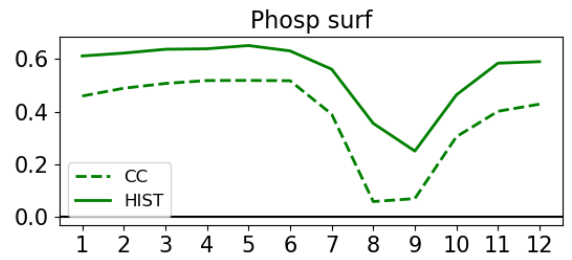


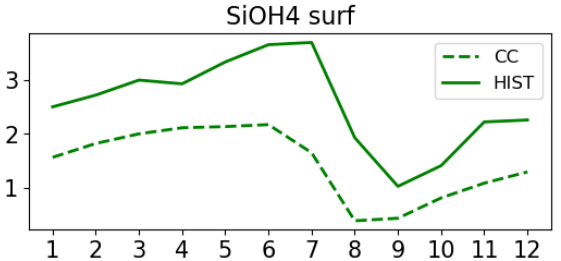


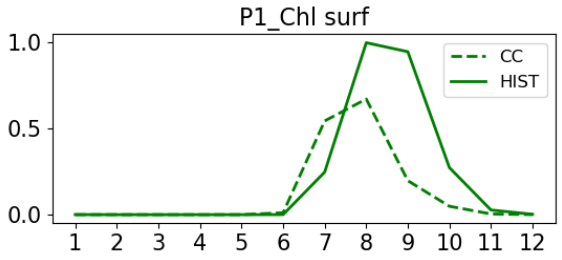


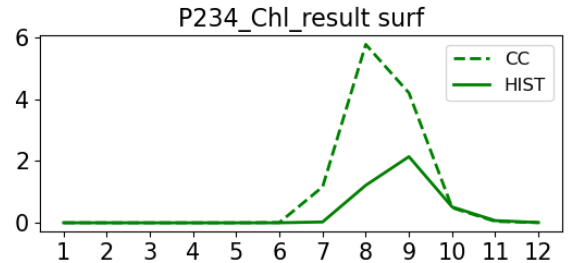


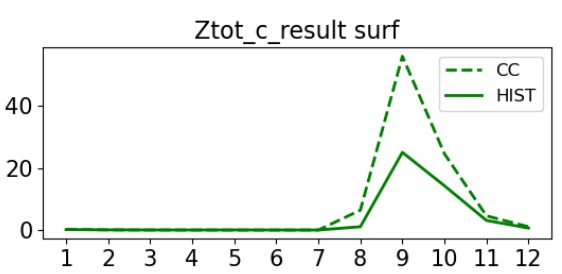






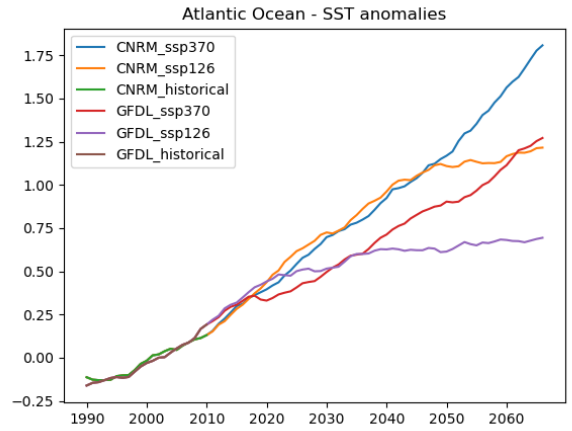






Conclusions

- Climate change impacts have a strong spatial variability, with the Norwegian Sea highlighted as hotspot
- In mid- and short- term, within scenario uncertainty can be as important as scenario's choice
- Therefore, ensemble approaches are strongly recommended also at regional and case study level
- Additional communication problem in the interaction with stakeholders



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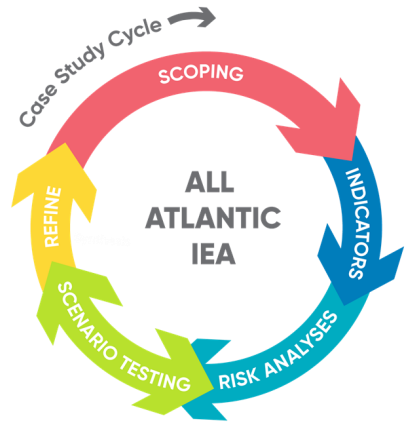

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