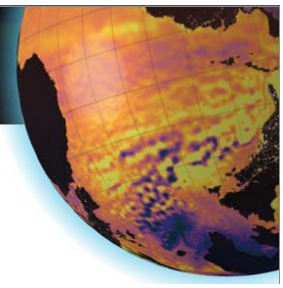
Assessing mid-century basin and regional climatic trends for Integrated Ecosystem Assessment: scenario vs model uncertainty

Integrated Ecosystem Assessment (IEA) is a framework organise scientific evidence in support of an ecosystem-based management of the marine environment. It provides a structured method to analyse the pressures and threats to the marine environment, identify the key indicators, assess the level of risk, evaluate alternative management plans, and monitor their implementation. Coupled marine models can be of great support to IEA especially, but not exclusively, to provide information on impact of climate change. Here we will present a new set of ocean-only climate projections for the Atlantic Ocean from a coupled hydrodynamic-biogeochemical model in support of IEAs in several Atlantic regions. For the first time, we used a global implementation of the coupled model system NEMO-ERSEM at a resolution of 0.25 degrees to project the future state of the Atlantic Ocean under two SSP scenarios (SSP3-7.0 and SSP1-2.6). The projections were driven by the outputs of two different CMIP6 models (CNRM-CM6-1-HR and GFDL-ESM4), chosen based on their ability to represent the historical patterns of atmospheric variables and because of their contrasting equilibrium climate sensitivity (ECS, respectively 4.3oC and 2.7oC. Furthermore, changes in nutrients inputs were adopted from other global modelling efforts (IMAGE-GNM and ISIMIP). The historical period (1990-2014) of these simulations has been validated against observation derived products and showed a significant improvement compared to the parent CMIP6 model. The projections were run for a policy relevant temporal horizon (2070) and the trends of the main environmental indicators are analysed both at Atlantic scale as well as regional scale, highlighting the strong spatial variability both regionally but also across the water column. While the average trend of the surface Atlantic waters shows the expected behaviour of the ocean becoming warmer (between 0.7^{o}C and 2^{o}C), more acidic (pH will decrease between 0.08 and 0.2 units), de-oxygenated (between -2 and -10 mmolO m-3) and more oligotrophic (nitrate will decrease between 0.06 and 0.15 mmolN m-3), the projections highlight a significant scenario and model uncertainty. In particular, for many indicators (e.g. temperature, oxygen, nutrients) the difference in the trends projected in the two contrasting scenarios (scenario uncertainty) was smaller than the difference between the projections run under the same scenario but forced by the two different CMIP6 models (model uncertainty). Given the mid-term horizon of most IEAs, including



model uncertainty in addition to multiple climate scenarios becomes therefore of key importance to provide a more comprehensive assessment of climate impacts.

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