Climate driven shifts in the biogeography of the global ocean

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Examinations of oceanographic samples collected since 1860 combined with the recent use of remote sensing observations has revealed that even if global ocean appears at first sight as a homogenous domain, it is composed by discrete ecological units separated by invisible frontiers. This ecological reality has been widely studied by Longhurst who have partitioned the oceanic realm into 4 biomes and 56 biogeochemical provinces (BGCPs), each division representing regional environmental and oceanographic specificities at a basin scale. Here, we use a recently developed biogeographical approach to identify the environmental envelops of each BGCPs according to a set of parameters (temperature, salinity, oxygen, sea ice, pH,bathymetry and Net primary productuin). Thus, we readapt the static paradigm proposed by Longhurst and allow the examination of the long term variability of the spatial distribution of each BGCP according to environmental conditions derived from 3 Earth system model (IPSL, MPI and GFDL) and for two emission scenarios (RCP 2.6 and 8.5). Spatial variations of the biogeography of the global are thus identified and confronted to observations. Furthermore, projection of the global biogeography reveals a drastic shift of the biogeographical systems of the ocean suggesting a profound reorganisation of present trophic webs. Biogeographical perturbation indices are here computed and could be of interest for guiding the near future management plan of ecosystems conservation.

Keywords: climate change, biogeography, Earth system model, Biogeochemical provinces, Longhurst, Non analogue Biogeographic state