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Spatial and temporal variability of Primary Production and POC export from different coupled model simulations

B. Schneider (1), L. Bopp (1), M. Gehlen (1), P. Cadule (1), J. Segschneider (2), T. Froelicher (3) and F. Joos (3)

(1) LSCE, Gif sur Yvette, France, (2) Max Planck Institut fuer Meteorologie, Hamburg, Germany, (3) Division of Climate- and Environmental Physics, University of Bern, Switzerland

Marine primary productivity (PP) is a key process in the global carbon cycle, controlling the uptake of dissolved inorganic carbon (DIC) in the surface water and its transfer into particulate organic carbon (POC). Subsequent gravitational sinking of detrital POC through the water column leads to the export of POC from the surface ocean to depth, where it becomes partly or entirely remineralized. The resulting DIC deficit in the surface water is either replaced by DIC upwelling from below or by CO2 from the atmosphere. Consequently, the more efficient the vertical transport of POC the stronger the oceanic sink for atmospheric CO2. However, neither temporal nor spatial variability of both PP and POC export (EP) are well constrained by field measurements and the mechanisms leading from PP to EP are largely unknown. To estimate the effect of future climate change on marine productivity and its feedback on climate a better understanding of the underlying processes is essential. The current study compares spatial and temporal variability of PP, EP and Chlorophyll concentrations obtained from present day simulations from different coupled climate general circulation models (GCMs) with estimates derived from satellite measurements of ocean color and inverse modeling of hydrographic properties and nutrient fields. The results show that both models and satellite estimates have strong regional/interannual variability in PP and EP. Comparing model results with both PP and Chl estimates derived from satellite data reveals a better match for the latter, showing that there is probably further uncertainty in the calculation of PP from ocean color. Fields of EP correlate poorly with observation based estimates. However, correlations among the

different observation methods are not significantly higher. Relating the efficiency of EP to PP by the PE-ratio (EP/PP) shows large differences between different models, which can partly be explained by model complexity, and which also indicate that high productive areas are not necessarily efficient in their POC export to depth.