Sonderforschungsbereich 754
Climate-Biogeochemistry Interactions in the Tropical Ocean

Dear all,

Please note next SFB 754 colloquium:
Friday, 24th Oct, 10:00h, Seeburg

Guest Scientist:
Dr. Joachim Segschneider, Max-Planck-Institut für Meteorologie Hamburg (http://www.mpimet.mpg.de/mitarbeiter/joachim-segschneider.html)

Title:

Temperature-dependent remineralization in a warming ocean increases surface pCO2 through changes in marine ecosystem composition.

Abstract:
Temperature-dependent remineralization of organic matter is, in general, not included in marine biogeochemistry models currently used for Coupled Model Intercomparison Project Phase 5 (CMIP5) climate projections. Associated feedbacks have therefore not been quantified. In this study we aim at investigating how temperature-dependent remineralization rates (Q10=2) in a warming ocean impact on the marine carbon cycle, and if this may weaken the oceanic sink for anthropogenic CO2. We perturb an Earth system model used for CMIP5 with temperature-dependent remineralization rates of organic matter using representative concentration pathway (RCP)8.5-derived temperature anomalies for 2100. The result is a modest change of organic carbon export but also derived effects associated with feedback processes between changed nutrient concentrations and ecosystem structure. As more nutrients are recycled in the euphotic layer, increased primary production causes a depletion of silicate in the surface layer as opal is exported to depth more efficiently than particulate organic carbon. Shifts in the ecosystem occur as diatoms find less favorable conditions. Export production of calcite shells increases causing a decrease in alkalinity and higher surface pCO2. The redistribution of nutrients in the upper ocean also has consequences for the production and consumption of oxygen. In a large belt in the tropical and subtropical regions, there is a weak decrease of oxygen of about 3–9 μM when averaged between 100 and 400 m depth. Increased hypoxia in the upper ocean causes increased denitrification and, in particular, in high productive upwelling regions, this is seen to increase by up to 0.4 mol N /m2/yr. With regard to future climate projections, the results indicate a reduction of oceanic uptake of anthropogenic CO2 of about 0.2 PgC/yr toward the end of the 21st century in addition to reductions caused by already identified climate-carbon cycle feedbacks. Similar shifts in the ecosystem as identified here, but driven by external forcing, have been proposed to drive glacial/interglacial changes in atmospheric pCO2. We propose a similar positive feedback between climate perturbations and the global carbon cycle but driven solely by internal biogeochemical processes.

Hope to see you there,

SFB 754 Coordination