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Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Dynamical and chemical coupling between ocean and atmosphere

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Ocean and atmosphere are strongly coupled systems. To investigate the impact of the ocean on the atmosphere not only physical fluxes between the two domains, but also chemical fluxes have to be taken into account. These chemical fluxes are established by direct air-sea gas exchange, wet and dry deposition of chemical compounds into the ocean and the import of nutrients to the ocean by rivers.
Chemical fluxes do not only alter the oceanic and atmospheric composition, but also impact the radiative forcing and therefore the dynamics of both domains. As a consequence, the atmospheric chemistry has an impact on the ocean, and the changed ocean forcing by changed radiation and changed gas fluxes influence the bio-geochemical ocean system, which in return impacts the atmospheric chemistry and dynamics. To study the impacts and feedback mechanisms of this complex system, we aim to couple the chemistry climate model "ECHAM5/MESSy atmospheric chemistry (EMAC) model" to an ocean general circulation model (Max Planck Institute Ocean Model; MPIOM) including oceanic bio-geochemistry (Hamburg Ocean Carbon Cycle model; HAMOCC).
The first step was the dynamical coupling of EMAC to MPIOM using the MESSy (Modular Earth Sub-model System) interface to form an AO-GCM (Atmosphere Ocean-General Circulation Model). The MESSy interface is a flexible framework to couple 'processes' (sub-models) to a global circulation model (GCM).
We are using EMAC as atmospheric component to assess the impact of the ocean bio-geochemistry model on chemical composition and dynamic of the atmosphere, and the feedback on atmospheric chemistry and radiation. A sub-model was developed for simulating air-sea gas exchange, to include the chemical coupling between atmosphere and ocean bio-geochemistry via oceanic uptake and emission of gaseous compounds.
Further couplings between the atmospheric and oceanic model components are input of chemical species by deposition of aeolian mineral dust and nutrients import by rivers into the ocean. These processes also act on the ocean bio-geochemistry, change the oceanic chemical composition and with it alter atmospheric composition.
Simulation results of the dynamically coupled AO-GCM, first results of air-sea gas exchange and the impact on ocean bio-geochemistry by riverine nutrients import into the ocean will be presented. An outlook of utilizing atmospheric sub-models of EMAC for calculating aeolian mineral dust input into the ocean, to form a "fully" coupled - i.e. dynamically and chemically coupled - atmosphere ocean model system, will be given.