**D-SOLAS Issue 1: Biogeochemical response to dust deposition** 

Genehmigtes Teilprojekt des BMBF Verbundvorhabens SOPRAN (surface Ocean Processes in the Anthropocene)

"Aggregation and joint sedimentation of mineral dust and organic particles: modelling the enhanced removal of iron and organic carbon from the mixed layer of the subtropical Atlantic"

## 1. Objectives

Atmospheric deposition of trace constituents to the surface ocean can have significant effects on upper ocean biological processes and has fundamentally changed our understanding of biogeochemical cycling, nutrient limitations, and atmospheric versus sub-surface control of organic productivity. Of particular interest is the atmospheric deposition of dust, from which iron is released upon partial dissolution, and the possible effects of iron on nitrogen fixation and enhanced biological productivity in the surface ocean. Thus, one of the most important impacts of dust deposition is the proliferation of dissolved micronutrients, such as iron, to the euphotic zone.

The overall release of dissolved iron per unit area of surface ocean does not only depend on the rate of dust deposition, on the thermodynamics and kinetics of dissolution processes and on possible contributions by photochemical processes. The total amount of micronutrient release also depends on the duration the dust particles are subject to dissolution, i.e. the dust particle residence time in the mixed layer. Owing to the the small grain size of remotely deposited dust particles they hardly sink by themselves, its removal from the surface ocean via sedimentation rather depends on aggregation with biogenic particles to form faster sinking particulate units and on inclusion into faecal pellets.

The aggregation of mineral and biogenic particles may also have additional significance for the carbon cycle in that the dust in the aggregates may serve as "ballast" component and enhance the sinking speed during joint sedimentation. Thus, the scavenging of dust by organic particles may reduce the residence time also of the organic particles in the surface ocean shifting the relation between regenerated and export production to the latter side and increasing the efficiency of the "biological pump" for the draw-down of atmospheric  $CO_2$ .

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Aims and objectives of the proposed study are:

1. Develop/refine a 3D-physical/biogeochemical model for the subtropical Atlantic which involves aggregation/disaggregation between all particles, i.e. also between dust and biogenic particles. Add modules for calcium carbonate and biogenic silica as "ballasting" hard-part materials to the model.

2. Improve model parameterizations and coefficients for the various involved processes by comparing model simulations with existing data bases (literature and own unpublished data) of fluxes of biogenic phases and dust to the deep sea and with existing water column profiles of Al in the SPM.

3. Quantify the influence of the joint export from the surface ocean of mineral and biogenic particles on the residence time of iron-containing dust particles in the mixed layer.

4. Quantify the influence of this joint sedimentation on the carbon cycle (residence time of carbon in the surface ocean, export production)

5. Evaluate consequences for the carbon cycle arising from possible future changes of the dust deposition regime and other processes in the context of Global Change

punkt 2+3: genutzt warden etablierte, am DKRZ installierte Modelle

4. Das Vorhaben steht in Zusammenhang z.B. mit dem Nordatlantik PROJEKT AP3.1

genutzt werden die selben Modelle, für effektiven Datenaustausch ist Betrieb am DKRZ wünschenswert.

Notwendigkeit für Massivparallelität wird nicht vorliegen

Es werden etwa 10 Sensitivitätsexperimentte über je 25 Jahre nötig sein, jedes Experiment benötigt 100 cph.