Geophysical Research Abstracts, Vol. 8, 09835, 2006
SRef-ID: 1607-7962/gra/EGU06-A-09835

The influence of atmospheric processes and model complexity on the dry deposition of nitrogen in coastal waters

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With the three dimensional MEsoscale Chemistry Transport Model MECTM the influence of atmospheric processes on deposition of inorganic nitrogen into the southern North Sea was investigated. The model system includes three configurations for the chemistry; all use for the gas phase chemistry the RADM2 mechanism. Aerosols are calculated size dependent with the sectional multicomponent aerosol model SEMA. The particle-size-dependent uptake of gases H_2SO_4 / HNO_3 / HCl / NH_3 are simulated by SEMA and the aerosol chemistry considers the ions SO_4^{2-} / NO_3^- / Cl^- / NH_4^+ / Na^+. A resources saving alternative of the SEMA aerosol model is to simulate only NH_4NO_3 and [$(NH_4)_2SO_2$ / $(NH_4)HSO_4$] formation without resolving the particle size.

The simulated concentration values were compared with measurements of the ANICE (Atmospheric Nitrogen Inputs into the Coastal Ecosystem) field campaign that took place June 15-20, 1998 and with measurements from the ETC/ACC-network (European Topic Centre on Air and Climate Change).

The objective of this study is to determine the necessary complexity of atmospheric chemistry for dry deposition of inorganic nitrogen into the southern North Sea. Calculation with the model using gas phase chemistry and size resolved aerosols showed ten times higher dry deposition values for nitrogen than calculations without aerosols. Furthermore, the input of nitrogen depends on the meteorological situation, which amplifies or attenuates the transport over the North Sea and thereby the input of several nitrogen substances.