Abstract

The influence of atmospheric processes on deposition of inorganic nitrogen into the southern North Sea was investigated. The three dimensional mesoscale chemistry transport model MECTM (model system: 'Gas') was extended by a simple aerosol scheme (model system: 'Gas + einf. Aero') and by the sectional aerosol model SEMA (model system: 'Gas + SEMA'). The calculated aerosol ions are NO_3^-, SO_4^{2-}, Cl^-, NH_4^+, Na^+, H^+. For the gas phase chemistry, 60 species (e.g. HNO_3, NO, NO_2, O_3, SO_2) are used. Calculations with the three model systems for concentration and for deposition of species were performed for the period of June 16 - 20, 1998. The results of all model systems were compared with measurements of the campaign of the EU-project ANICE and measurements from the ETC/ACC - network.

The mean concentrations from the model systems agree well with observations for the species NH_3, NO_3^- and NH_4^+. The concentrations calculated by all model systems for HNO_3 were too high, but the model system 'Gas + SEMA' yielded the smallest deviation. The results of all model systems were compared with measurements of the ETC/ACC - network. In the beginning of the simulated period the modelled concentrations of O_3 were too low and at the end too high. The simulated concentrations of NO, NO_2, NH_3, and SO_2 were within the allowed deviations. With the model systems 'Gas' and 'Gas + einf. Aero' maximum nitrogen depositions of $3.3\,mg\,m^{-2}\,day^{-1}$ were calculated whereas the model system 'Gas + SEMA' calculated a deposition of up to $12.8\,mg\,m^{-2}\,day^{-1}$. Investigating the influences on the input of nitrogen in coastal waters led to the conclusion that the sedimentation velocity is a key factor for the amount of deposition.

Scenarios of changing emissions of NO_x and $NMVOC$ were calculated with the model system 'Gas + einf. Aero'. The scenarios showed that changing the fraction of emission of NO_x and $NMVOC$ considerably influenced the concentration of O_3. The spatial and temporal patterns of the concentrations of O_3 and HNO_3 and the deposition of nitrogen differ from the reference case. The scenarios show a nonlinear effect of changes in NO_x and $NMVOC$ emissions on the concentration of O_3 and HNO_3.