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Dispersion of aerosol particles in the atmosphere: Fukushima

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Investigation of dispersion and deposition of aerosol particles in the atmosphere is an essential issue, because they have an effect on the biosphere and atmosphere. Moreover, aerosol particles have different transport properties and chemical and physical transformations in the atmosphere compared to gas phase air pollutants. The motion of a particle is described by a set of ordinary differential equations. The large-scale dynamics in the horizontal direction can be described by the equations of passive scalar advection, but in the vertical direction a well-defined terminal velocity should be taken into account as a term added to the vertical wind component. In the planetary boundary layer turbulent diffusion has an important role in the particle dispersion, which is taken into account by adding stochastic terms to the deterministic equations above. Wet deposition is also an essential process in the lower levels of the atmosphere, however, its precise parameterization is a challenge. For the simulations the wind field and other necessary data were taken from the ECMWF ERA-Interim database.
In the case of the Fukushima Daiichi nuclear disaster (March-April 2011) radioactive aerosol particles were also released in the planetary boundary layer. Simulations (included the continuous and varying emission from the nuclear power plant) will be presented for the period of 14-23 March. Results show that wet deposition also has to be taken into consideration in the lower levels of the atmosphere. Furthermore, dynamical system characteristics are evaluated for the aerosol particle dynamics. The escape rate of particles was estimated both with and without turbulent diffusion, and in both cases when there was no wet deposition and also when wet deposition was taken into consideration.