Geophysical Research Abstracts
Vol. 12, EGU2010-6874, 2010
EGU General Assembly 2010

Direct and indirect radiative effects of aerosols using the coupled system of aerosol HAM module and the Weather Research and Forecasting (WRF) model

Rabab Mashayekhi (1), Parviz Irannejad (1), Johann Feichter (2), and Abbas Ali Ali Akbari Bidokhti (1)

(1) University of Tehran, Institute of Geophysics, Tehran, Islamic Republic Of Iran (rababmashayekhi@gmail.com), (2) Max Planck Institute for Meteorology, Hamburg, Germany

The fully coupled aerosol-cloud and radiation WRF-HAM modeling system is presented. The aerosol HAM model is implemented within the chemistry version of WRF modeling system. HAM is based on a "pseudo-modal" approach for representation of the particle size distribution. Aerosols are grouped into four geometrical size classes and two types of mixed and insoluble particles. The aerosol components considered are sulfate, black carbon, particulate organic matter, sea salt and mineral dust. Microphysical processes including nucleation, condensation and coagulation of aerosol particles are considered using the microphysics M7 scheme. Horizontal transport of the aerosol particles is simulated using the advection scheme in WRF. Convective transport and vertical mixing of aerosol particles are also considered in the coupled system. A flux-resistance method is used for dry deposition of aerosol particles. Aerosol sizes and chemical compositions are used to determine the aerosol optical properties. Direct effects of aerosols on incoming shortwave radiation flux are simulated by transferring the aerosol optical parameters to the Goddard shortwave radiation scheme. Indirect effects of aerosols are simulated by using a prognostic treatment of cloud droplet number and adding modules that activate aerosol particles to form cloud droplets. The first and second indirect effects, i.e. the interactions of clouds and incoming solar radiation are implemented in WRF-Chem by linking the simulated cloud droplet number with the Goddard shortwave radiation scheme and the Lin et al. microphysics scheme.
The simulations are carried out for a 6-day period from 22 to 28 February 2006 in a domain with 30-km grid spacing, encompassing the south-western Asia, North Africa and some parts of Europe. The results show a negative radiative forcing over most parts of the domain, mainly due to the presence of mineral dust aerosols. The simulations are evaluated using the measured downward radiation in Tehran. It is shown that the inclusion of aerosol - cloud feedback in the shortwave radiation scheme improves the simulated daily mean shortwave radiation flux in Tehran.