Geophysical Research Abstracts
Vol. 18, EGU2016-4268, 2016
EGU General Assembly 2016


# Impact of improved soil climatology and intialization on WRF-chem dust simulations over West Asia

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Meteorological forecast models such as WRF-chem are designed to forecast not only standard atmospheric parameters but also aerosol, particularly mineral dust concentrations. It has therefore become an important tool for the prediction of dust storms in West Asia where dust storms have the considerable impact on living conditions. However, verification of forecasts against satellite data indicates only moderate skill in prediction of such events. Earlier studies have already indicated that the erosion factor, land use classification, soil moisture, and temperature initializations play a critical role in the accuracy of WRF-chem dust simulations.
In the standard setting the erosion factor and land use classification are based on topographic variations and post-processed images of the advanced very high-resolution radiometer (AVHRR) during the period April 1992–March 1993. Furthermore, WRF-chem is normally initialized by the soil moisture and temperature of Final Analysis (FNL) model on 1.0x1.0 degree grids.
In this study, we have changed boundary initial conditions so that they better represent current changing environmental conditions. To do so, land use (only bare soil class) and the erosion factor were both modified using information from MODIS deep blue AOD (Aerosol Optical Depth). In this method, bare soils are where the relative frequency of dust occurrence (deep blue AOD > 0.5) is more than one-third of a given month. Subsequently, the erosion factor, limited within the bare soil class, is determined by the monthly frequency of dust occurrence ranging from 0.3 to 1. It is worth to mention, that 50 percent of calculated erosion factor is afterward assigned to sand class while silt and clay classes each gain 25 percent of it. Soil moisture and temperature from the Global Land Data Assimilation System (GLDAS) were utilized to provide these initializations in higher resolution of 0.25 degree than in the standard setting. Modified and control simulations were conducted for the summertime of 2008-2012 and verified by satellite data (MODIS deep blue AOD, TOMs Aerosol Index and MISR AOD 550nm) and two well-known modeling systems of atmospheric composition (MACC and DREAM). All comparisons show a significant improvement in WRF-chem dust simulations after implementing the modifications. In comparison to the control run, the modified run bears an average increase of spearman correlation of 17-20 percent points when it is compared with satellite data. Our runs with modified WRF-chem even outperform MACC and DREAM dust simulations for the region.