Geophysical Research Abstracts
Vol. 15, EGU2013-3472, 2013
EGU General Assembly 2013

A Case-Study of Dust Aerosol Uplift Mechanisms in North Africa during the Saharan Mineral Dust Experiment

Georgiy Stenchikov (1), Bernadett Weinzierl (2), Basit Ali Khan (1), and Stoitchko Kalenderski (1)
(1) King Abdullah University of Science and Technology, Thuwal, Kingdom of Saudi Arabia (Georgiy.Stenchikov@kaust.edu.sa), (2) Deutsches Zentrum fur Luft- und Raumfart, Oberpfaffenhofen, Germany

Dust particles mixed in the free troposphere have longer lifetimes than airborne particles near the surface, suggesting that they could have strong cumulative radiative impact on the earth's radiative balance. One example is the elevated Saharan dust layer over equatorial North Atlantic, which cools the sea surface and likely suppresses hurricane activity. However, the uplift mechanisms of dust are complex and not well understood. In this study, we combined model simulations and dust observations collected during the Saharan Mineral Dust Experiment (SAMUM) to study the formation mechanisms of the Saharan elevated dust layer. SAMUM aimed to investigate the microphysical, optical, chemical, and radiative properties of Saharan mineral dust. Here, we focus on data from SAMUM-1, the first field experiment. During SAMUM-1, three large-scale dust events that extended from Morocco to Portugal occurred. Whereas the dust layers close to the source region of the dust were found to extend across the entire boundary layer from the surface to altitudes of about 4-6 km above sea level, in Casablanca situated on the Atlantic coast of Morocco, only elevated dust layers were observed.

We employed the Weather Research Forecast model coupled with the Chemistry/Aerosol module (WRF-Chem) to interpret the observations. We configured WRF-Chem with the RADM2 (Regional Acid Deposition Model 2) photochemical mechanism, the Fast-J photolysis scheme, and the MADE/SORGAM (Modal Aerosol Dynamics Model for Europe (MADE) and Secondary Organic Aerosol Model (SORGAM) aerosol model. The GOCART dust emission scheme was coupled with the MADE/SORGAM aerosol model to account for the dust emission processes. The experimental domain covered northwest Africa including the southern Sahara, Morocco and part of the Atlantic Ocean, an area from 15°N to 36.5°N and 16°W to 11°E, with 550x484 grid points, 5 km horizontal grid spacing, and 51 vertical layers. To study convective processes in the region, simulations with 1.5 km grid spacing were also performed. The experiments were run from May 20 to June 10, 2006 to cover the periods of flight observations. Comparison of the model results with available airborne and ground-based observations showed that WRF-Chem reproduces observed meteorological fields and the aerosol distribution in the entire region and along the airplane tracks. We identified and tested a few aerosol uplift mechanisms that included deep convective updrafts, haboob/density currents, dust entrainment into the free troposphere during the night when the boundary layer collapsed, and mixing of aerosols in the front of the breezes near the Mediterranean coast.