MDRAF: Effects of Mediterranean desert dust outbreaks on radiation, atmospheric dynamics and forecasting

Description

The main objective of this project (MDRAF) was to describe the 3D structure of Mediterranean desert dust outbreaks and study their effects on radiation and atmospheric dynamics by means of numerical modeling (NMMB/BSC Chemical Transport model-NMMB/BSC-CTM). Moreover, the meteorological feedbacks and the forecasting accuracy of NMMB/BSCCTM when dust effects are considered were assessed. The study region covers the broader Mediterranean basin and the analysis extends over the period 2002-2012. For the identification of desert dust outbreaks, an objective and dynamic algorithm was set up where as initial conditions various aerosol optical properties derived by MODIS-Aqua, EP-TOMS and OMI platforms were used. Additionally, satellite (CALIPSO) and ground (EARLINET) measurements providing the vertical profile of dust loads were analyzed.

The accuracy of algorithm's outputs were evaluated against optical (AERONET) and physical (PM10) measurements. The direct radiative effect (DRE) was then estimated at the top of atmosphere, into the atmosphere and at surface for the shortwave (SW), longwave (LW) and net (SW+LW) radiation. The induced radiative effects were expected to affect the vertical atmospheric heating profile leading to a modification of the atmospheric dynamics. For this purpose, the project team studied how dust DREs affect the temperature vertical structure, the surface temperature and sensible/latent heat fluxes, stability/instability conditions, the convective available potential energy (CAPE), clouds and precipitation formation. Also, the possible feedbacks induced by dust particles affecting thus their production/removal rates as well as the atmospheric circulation patterns related with their transport processes were examined. At the final stage of the project, the forecasting accuracy of the NMMB/BSC-CTM were examined for several atmospheric parameters, locally and spatially, when dust effects are considered.

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