

Abstract

The goal of this PhD work is to improve the numerical modeling of the processes related to the onset, transport and deposition of ground-originating aerosols, namely desert sand dust. The first part of this work is to integrate a global physical parameterization of dust emissions more compatible with ECOCLIMAP and FAO databases used in the surface model SURFEX, taking into account the soil size distribution and soil texture, in order to improve the representation of surface fluxes in SURFEX. The second part is to model the transport and deposition (wet and dry) in the atmospheric model ALADIN. This should ultimately give more reliable predictions of dust concentrations, their optical properties and their feedback on the forecast weather.

The evaluation of the coupled system ALADIN-SURFEX on the situation of 6-13th March 2006 demonstrated the ability of this system to simulate dust events both in intensity and extension. The changes proposed in the dust emission model provoke a substantial increase of dust emission in areas that are well known and well documented for these phenomena, like the Bodélé region. They also greatly improve simulated optical thicknesses observed in the areas of Ilorin and Mbour.

This coupled system was used then to establish a simulated climatology of emission and optical properties of dust aerosols for North Africa. The ALADIN simulations show that this region is a major source of emissions on a global scale with an average of 878 Mt.an^{-1} dust aerosols and locate the Bodélé region as the area with the highest average issuing $2 \text{ kg.m}^{-2}.\text{an}^{-1}$.

Eventually, the results obtained when studying the impact of dust on the behaviour of the numerical weather prediction model are found satisfactory since this is the first time desert dust is introduced in ALADIN. However, these results, when analyzed in more details, show some defects related to the interaction between radiation and dust. These defects suggest that more analysis, along with experimental tests, is required, which is part of the perspectives of this study.