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Radiative semi-direct effect of mineral dust aerosols on atmospheric profile during the AMMA Campaign.

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Mineral dust aerosols have a significant radiative effect on the global radiative budget of the atmosphere, but its quantification still remains with large uncertainties. Dust aerosols can influence the solar radiation by direct, indirect and semi-direct effects. We address the third one in the present work, which was first observed ten years ago. However, the mechanism of semi-direct effect is still not clearly defined and understood. In the literature, authors have different theories about this semi-direct effect. Globally, by semi-direct effect, aerosols change the thermodynamic parameters of atmosphere and consequently can modify the cloud convection. In particular, some authors suggest that radiative effects of mineral dust from western Africa reduce the occurrence of hurricanes formation over Atlantic Ocean. The mechanism is the following : when some dust outbreaks propagate over the Saharan desert where thermic wind are stable and warm, they enhance the heating of air layers. This reduces and cuts the convection needed for formation of tropical cyclones. Other authors consider that by the semi-direct effect, aerosols act on the standard formation of droplets inside clouds.
The study of this semi-direct effect is addressed in several scientific campaigns, such as AMMA (African Monsoon Multidisciplinary Analysis, 2006) and FENNEC (2011). Those projects study the interactions between aerosols clouds, atmosphere and solar radiation in the western African region. In the FENNEC project, the study of the semi-direct effect mechanism and the one of the heat low, where mineral dusts play a significant role around the latitude of 30°N, take a large place in the scientific objectives.
In this context, we propose to simulate with a meso-scale atmospheric model the radiative semi-direct effect of mineral dust during an event observed in the AMMA campaign.
The RAMS model is used to simulate the 3D-dynamic transport. The radiative GAME code is coupled to RAMS to simulate the radiative effect of aerosols. To consider the radiative effect of aerosol on the thermodynamic parameters (such as temperature, humidity...) of the atmosphere, RAMS and GAME are coupled "on-line". Thus, the radiative effect of aerosols computed by GAME is directly taken into account by RAMS for the temperature computation, and then influences all the other atmospheric parameters. To estimate the radiative effect of aerosols, two sets of simulations are performed : one for which the aerosols are considered as tracers, with their optical properties deactivated, and one for which the optical properties of aerosol are taken into account. The comparison of those two sets of simulations enables to characterize the influence of semi-direct effect of mineral dust on the atmospheric profile. Preliminary results show that the semi-direct effect of aerosol is responsible of a difference of 1 to 2 degrees C. in the atmosphere temperature and locally reduces the cloud cover. More results will be presented at the conference.