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DUST MODELING : A FOCUS ON EMISSIONS AND DEPOSITION

par **Gilles BERGAMETTI**

Directeur du LISA, Président du TOSCA (CNES)

en salle Joël Noilhan

Résumé :
Dust is a major contributor to the atmospheric aerosol burden. The global annual input of mineral aerosols into the atmosphere is estimated to be within the range of 1 to 2 billion metric tons per year, representing about half of the annual total emissions of tropospheric aerosols by both natural and anthropogenic sources. Dust emissions are strongly dependent on climatic parameters such as wind speed or precipitation, which could change in the context of the global change. Moreover, dust emissions are also very sensitive to the surface features (roughness and vegetation cover, soil grain-size distribution, soil texture…) and, thus the increasing human pressure exerted on semi-arid lands should lead to an increase of the atmospheric dust content. Beside satellite observations, which provide relevant pictures of the present dust sources, transport and atmospheric load, models of the dust cycle have to be developed to link observations and processes and to predict what could be the future dust cycle.

The new generation of dust emissions models try to describe at the pertinent scale the physical processes linking the atmospheric and surface properties. One of the key issues is the modeling of the threshold wind friction velocity for erosion since his parametert controls both the frequency and the intensity of the dust emissions. This threshold depends on various surface properties among which surface roughness, vegetation cover, soil moisture and soil texture are the most important. The presentation will illustrate how we can parameterize the threshold friction velocity, how we can access to the relevant surface properties for different desert area and what are the resulting uncertainties of the dust emissions simulated for African or Asian deserts.

Dust deposition is also a key process of the dust cycle since, in term of mass, deposition is obviously equal to emissions. Moreover, dust deposition being a size dependent process, the evolution of the size distribution during the atmospheric transport is in a large part controlled by the intensity of the deposition pathways. When deposited, the dust material removed from the atmosphere is a key component of many biogeochemical cycles: far from the source regions, atmospheric dust deposition supplies surface seawater with soil-derived elements, many of them (Fe, P. . .) being suspected to be limiting (micro) nutrients for oceanic ecosystems while in the continental areas, deposition contributes to soil formation in many surrounding desert areas. Finally, dust archives from deep ocean sediments, ice cores, lakes or continental loess deposits are used as proxies of past environmental and climate conditions. Thus, dust deposition is of high environmental interest and a special attention should be given to properly assess its intensity and spatio-temporal fields.

Despite the major role and the various impacts of dust deposition, little attention was given to both deposition measurements and modelling. However, a better knowledge of the spatial and temporal distribution of the deposition fields would greatly help to better constrain the dust cycle. Indeed, even if recent progresses have been made in dust emission modelling, it could remain large uncertainties on the intensity of the simulated dust emissions. Having a good estimate of the deposition will contribute to better assess the relevance of simulated dust emissions.

Pour tout renseignement, contacter Y. Poirier (05 61 07 96 55) ou J.L. Sportouch (05 61 07 93 63)
Centre National de Recherches Météorologiques
42, Avenue G. Coriolis - 31057 Toulouse Cedex