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Simulation of aeolian dust emission over the Sahelian Belt in West Africa

Caroline Pierre (1,2), Eric Mougin (1), Béatrice Marticorena (2), and Gilles Bergametti (2)

(1) Geosciences Environnement Toulouse (GET), Toulouse, France (eric.mougin@lmtg.obs-mip.fr), (2) Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA), Creteil, France (gilles.bergametti@lisa.u-pec.fr, beatrice.marticorena@lisa.u-pec.fr)

Dust emitted from arid and semi-arid areas might have strong impacts on climate and ecosystems. These emissions depend on wind speed, soil characteristics and surface roughness. However, the amount of dust emitted by wind from semi-arid regions is estimated with a large degree of uncertainty, mainly due to the difficulty in accounting for the vegetation. As the example, in the Sahel, precipitation exhibits a well marked seasonal pattern and different annual rainfall rates from one year to another. This induces strong seasonal cycle and an important interannual variability of the vegetation cover and dust emissions. The temporal change of the vegetation and its impacts on dust emissions have been investigated over the Sahelian belt (12°N to 20°N ; 20°W to 35°E) from 2004 to 2007 on a daily basis. The seasonal vegetation was simulated using the STEP model (Sahelian Transpiration Evaporation and Productivity model; Mougin et al., 1995; Tracol et al., 2006) at a scale of 0.1° and 0.25° and the simulations have been compared to the MODIS Leaf Area Index (LAI) product. The agreement with satellite index is very satisfying during the active growth period (∼ July to September), both in terms of spatial distribution and amount of vegetation. The period of vegetation growth appears very sensitive to the initialization parameters of the STEP model, which therefore have been carefully constrained. Based on these vegetation fields, dust emissions are simulated using the explicit processes-based DPM model (Dust Production Model; Marticorena and Bergametti, 1995), taking into account vegetation characteristics and soil humidity. The impact of these factors are illustrated by computing dust emission in a specific fringe where dust emissions occur and seasonal vegetation develops. Over the 2004-2007 period, seasonal vegetation inhibits 8 to 28% of the annual emissions over this fringe, where simulated dust emissions vary from 1 to 30 Mt/year.