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Towards a parameterization of convective wind gusts in Sahel

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West Africa is responsible for between 25 and 50 % of the global emissions of mineral dust (cf [Engelstaedter et al., 2006]) and these dust emissions have a huge impact on climate (cf [Carslaw et al., 2010]) and soil erosion. Numerous studies have focused on the quantification of the dust emission fluxes from knowledges of the soil surface characteristics, leading to the formulation of a threshold wind friction velocity (cf [Marticorena and Bergametti, 1995]) above which the dust can be uplifted. That flux varies with the cube of the surface wind speed above the threshold and is therefore particularly sensitive to the way the wind speed is modeled (cf [Menut, 2008]). Moreover, in the Sahelian belt, about half of the dust uplift happens during isolated events which generate violent cold pool outflows from moist deep convection, and associated high surface wind speeds. Therefore, the representation of convectively generated winds appears critical (cf [Marsham et al., 2011], [Knippertz and Todd, 2012]).

The present study is motivated by these issues, and is carried out within the CAVIARS French Research National Agency (ANR) project. First, we examine the ERA interim reanalysis of the ECMWF, frequently used as an input wind field for off-line dust emission models (cf [Pierre et al., 2012]). The comparison with high-frequency local measurements shows that, not unexpectedly, the increase of the surface wind speed from deep convection is not represented in large-scale reanalysis. Therefore, following [Redelsperger et al., 2000], we propose a statistical approach to introduce a formulation of the surface wind gusts during deep convection, based on the analysis of convection-permitting high resolution simulations made with the UKMO atmospheric model (CASCADE project), the AROME operational model from Meteo-France, and the MesoNH Large Eddy Simulations model. High-frequency observations are also used to complement the analysis. However, unlike [Redelsperger et al., 2000] who focused on the wet tropical Pacific region, and linked wind gusts to convective precipitation rates alone, here, we also analyse the subgrid wind distribution during convective events, and quantify the statistical moments (variance, skewness and kurtosis) in terms of mean wind speed and convective indexes such as DCAPE. Next step of the work will be to formulate a parameterization of the cold pool convective gust from those probability density functions and analytical formulaes obtained from basic energy budget models.

References :

[Carslaw et al., 2010] A review of natural aerosol interactions and feedbacks within the earth system. Atmospheric Chemistry and Physics, 10(4):1701{1737.
[Engelstaedter et al., 2006] North african dust emissions and transport. Earth-Science Reviews, 79(1):73{100.
[Knippertz and Todd, 2012] Mineral dust aerosols over the sahara: Meteorological controls on emission and transport and implications for modeling. Reviews of Geophysics, 50(1).
[Marsham et al., 2011] The importance of the representation of deep convection for modeled dust-generating winds over west africa during summer.Geophysical Research Letters, 38(16).
[Marticorena and Bergametti, 1995] Modeling the atmospheric dust cycle: 1. design of a soil-derived dust emission scheme. Journal of Geophysical Research, 100(D8):16415{16.
[Menut, 2008] Sensitivity of hourly saharan dust emissions to ncep and ecmwf modeled wind speed. Journal of Geophysical Research: Atmospheres (1984{2012), 113(D16).
[Pierre et al., 2012] Impact of vegetation and soil moisture seasonal dynamics on dust emissions over the sahel. Journal of Geophysical Research: Atmospheres (1984{2012), 117(D6).
[Redelsperger et al., 2000] A parameterization of mesoscale enhancement of surface fluxes for large-scale models. Journal of climate, 13(2):402{421.