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**Geoscientific
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Interactive comment on "A new dust cycle model with dynamic vegetation: LPJ-dust version 1.0" *by* S. Shannon and D. J. Lunt

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Review of paper "A new dust cycle model with dynamic vegetation: LPJ-dust version 1.0" by S. Shannon and D. J. Lunt

This paper presents the development of a new dust aerosols emissions fluxes, taking into account vegetation cover, soil moisture, snow depth and threshold friction velocity. Several sub-clouds scavenging schemes are tested. The emissions are transported using the TOMCAT chemistry-transport model and all added parameters effects are tuned by comparisons to dust deposition data and surface concentrations measurements.

The specific development is a coupling between the dust production model and the Lund-Potsdam-Jena vegetation model. The methodology used follows several steps: (1) results are very sensitive to tuned paramaters such as the threshold friction veloc-

ity; (2) it is necessary to optimize the tuning, (3) the best way is to make ensemble simulations and to select the best first guess.

This approach is really questionable because: the physics may be more precisely and explicitely described. The best way is not always to use simple schemes, with many parameters and to adapt these parameters. In the case of friction velocity threshold, explicit schemes exist and are already implemented into dust emissions and transport models (see Iversen and Shao for example). The tuning may be efficient for some regions or some parameters. But this is not really robust and mainly depends on the multi equilibrium of the physics in the model. This is completely model-dependent. Not universal. The 'best' parameters are valid for specific locations and periods, preferentially when the physics is quasi-linear and relatively 'smooth'. This is not the case of dust emissions fluxes, by definition a sporadic process. It seems difficult to apply ensemble methods on a process mainly based on extreme responses. If ensemble modeling showed improvements in the forecasted results for temperature (for exemple, a process with a diurnal cycle and rarely extreme values), this approach is difficult to adapt to physical phenomenon based on multi threshold values.

More specifically:

The whole sections 2.3.1 and 2.3.2, about the dry and wet depositions are completely already writen in [Seinfeld and Pandis, 1998] without any new material. The authors should removed these sections and just cite the book. Idem for 2.6 about sub-cloud scavenging.

The terminology "new dust cycle model" is completely overestimated. There is nothing "physically" new in this paper. Just statistical adjustement of well-known (and sometimes 'old') schemes.

The dust model is constituted of the scheme of [Marticorena et al., 1995]. With this scheme, the vertical flux is simply diagnosed using an alpha factor linking the vertical to the horizontal flux. This approach is robust, widely used, but a lot a schemes were

developed in the last ten years. For example, the schemes of [Shao et al., 2000] and [Alfaro and Gomes, 2001] are much more physical. By using this type of schemes, the authors would have more realistic and “state-of-the-art” results.

The “conclusions” section includes all results. This is shortly presented and a lot of questions remain open. For example: what about the relative uncertainties of the dust emissions model and the chemistry-transport model? What about the meteorology uncertainties? The scores are built using ’monthly’ dust fluxes and the ’primary’ fluxes are calculated using 6-hours ERAinterim meteorological data. This seems now relatively crude when a large part of all dust models used in the world are using, at least, hourly meteorological data, knowing that the dust emissions are sporadic and may occur during very short periods of one to two hour.

Finally: to tune a model containing many parameters and by using results averaged over several months (results are presented as annual mean surface concentrations) in Fig.9 is not a step forward for dust emissions modelers and chemistry-transport model applications.

Interactive comment on Geosci. Model Dev. Discuss., 3, 473, 2010.