Dust emissions from the externalized surface

Alf Grini, CNRM/GMEI

1. General theory

Dust is mobilized from dry desert surfaces when the wind friction speed reaches a threshold wind friction speed of approximately 0.2 m/s. Dust is an important aerosol with annual global emissions ranging from 1000 to 3000 $Tg\ yr^{-1}$ and average global load around 10-30 Tg.

Dust is mobilized by two related processes called saltation and sandblasting. Saltation is the horizonal movement of soil grains in a turbulent near surface layer. Sandblasting is the release of fine dust when the saltating grains hit the surface. Several papers document these two processes. *Marticorena and Bergametti* [1995] and references therein describe the physics of saltations, and *Shao and Raupach* [1993] describe the physics of sandblasting.

2. Implementation in the Externalized surface

The dust fluxes are calculated using the Dust Entrainment And Deposition (DEAD) model [*Zender et al.*, 2003]. This model is based on *Marticorena and Bergametti* [1995]. The dust fluxes are calculated consistently with the ISBA soil surface scheme. Table 1 gives an overview of the main input to the dust production model. **Table 1.**

3. Features of the model

3.1. Drag partitioning

As shown in Table 1, the emissions are sensitive to the surface roughness. Large surface roughness, will on one hand increase the momentum flux towards the surface (and therefore increase the dust flux). On the other hand, the momentum will be absorbed by the roughness elements themselves, and therefore the moment will not be available

for erosion of the bare soil. This process is called *drag partitioning* and is disussed in detail in *Marticorena and Bergametti* [1995]. The roughness lengths used by ISBA for non-vegetated surfaces are so large that they give no dust emission using the equations in DEAD. This problem is currently solved by re-calculating the drag on bare soil and on rock assuming that the dust emission takes place at bare soil with roughness length of 30 μm and that rock has a roughness length of 200 μm.

3.2. Saltation/Sandblasting

DEAD calculates the saltation fluxes according to *Marticorena and Bergametti* [1995]. However, this paper does not give a

References

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Alf Grini, Pierre Tulet, Laurent Gomes Meteo-France, CNRM-GMEI 42 Gaspard Coriolis 31057 Toulouse, FRANCE (e-mail: alf.grini@cnrm.meteo.fr)

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Tables

Table 1. ISBA variables used by the dust module

PARAMETER	EFFECT ON DUST EMISSION	REFERENCE
wind friction speed	Increase emissions	*Marticorena and Bergametti* [1995]
Soil moisture	Inhibit emissions	*Fecan et al.* [1999]
Vegetation fraction	Inhibit emissions	*Marticorena and Bergametti* [1995]
Surface roughness	Inhibit emissions	*Laurent et al.*
Surface texture	Soil sizes $> 50\mu m$ increase saltation flux	**?**