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Should precipitation influence dust emission in global dust models?

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Soil moisture modulates the threshold shear stress required to initiate aeolian transport and dust emission. Most of the theoretical and laboratory work that has confirmed the impact of soil moisture has appropriately acknowledged that it is the soil moisture of a surface layer a few grain diameters thick that truly controls threshold shear velocity. Global and regional models of dust emission include the effect of soil moisture on transport threshold, but most ignore the fact that only the moisture of the very topmost "active layer" matters. The soil moisture in the active layer can differ greatly from that integrated through the top 2, 5, 10, or 100 cm (surface layers used by various global models) because the top 2 mm of heavy texture soils dries within ∼1/2 day while sandy soils dry within less than 2 hours. Thus, in drylands where dust emission occurs, it is likely that this top layer is drier than the underlying soil in the days and weeks after rain. This paper explores, globally, the time between rain events in relation to the time for the active layer to dry and the timing of high wind events. This analysis is carried out using the same coarse reanalyses used in global dust models and is intended to inform the soil moisture controls in these models. The results of this analysis indicate that the timing between events is, in almost all dust-producing areas, significantly longer than the drying time of the active layer, even when considering soil texture differences. Further, the analysis shows that the probability of a high wind event during the period after a rain where the surface is wet is small. Therefore, in coarse global models, there is little reason to include rain-derived soil moisture in the modeling scheme.