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Aeolian Sand Transport by Boundary Layer Turbulence

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Aeolian streamers and spatio-temporal transport intermittency and variability may be in large part responsible for the poor performance of our traditional aeolian transport models when applied to field measurements. This paper presents a collective overview of results from a number of investigations into the nature of spatio-temporal variability in general, and the formation and behaviour of aeolian streamers in particular. This includes three principal studies:

First, the results of field investigations into the formation and behaviour of aeolian streamers in coastal and desert environments, where spatio-temporal transport variability and associated turbulence characteristics were assessed with an extensive instrument array. Streamers were directly measured with a transverse array of Safires, while the wind field and associated turbulent structures were monitored with cup-anemometry and a rake of hot-film probes.

Second, field data were used to assess the statistical trends in transport variability as a function of spanwise scale of measurement and the temporal scale of time-averaging transport rates.

Third, wavelet analysis of high-frequency co-located wind speed (hot-film probes) and transport flux (Safires) time-series revealed different persistence characteristics at different temporal scales. The transition points between types of behaviour compare favourably with physically meaningful scales, such as the minimum temporal scale of saltation response to wind speed fluctuations, and the integral time-scale of the observed internal boundary layer turbulence dynamics.

The paper concludes with a tentative conceptual framework that integrates the results

and insights from these studies towards an improved understanding of aeolian sediment transport processes.