Geophysical Research Abstracts
Vol. 14, EGU2012-796, 2012
EGU General Assembly 2012
© Author(s) 2011

Investigating boundary layer turbulence for aeolian sand transport

Z. S. Lee and A.C.W Baas
King's College London, United Kingdom (zoe.lee@kcl.ac.uk)

Recent and ongoing studies into the mechanisms of aeolian sand transport have found that turbulence parameters, rather than mean velocities, are fundamental for understanding the dynamics of moving sand. A more comprehensive understanding of turbulent motions in the atmospheric boundary layer and how this turbulence interacts with sediment has been permitted thanks to technological improvements in sensor technology, to record sand transport and three-dimensional wind velocities at high spatio-temporal resolutions.

This paper presents results from novel fieldwork conducted to investigate the role of turbulence in aeolian sand transport by measuring wind velocities in a tight vertical array. Co-located saltation impact sensors (Safires) and sand traps were used to simultaneously monitor the resulting transport. Measuring wind velocities in three dimensions at a series of different heights above the surface allows a unique opportunity to explore atmospheric turbulence, to try and ascertain how and where turbulent motions are generated within the flow and to see how these motions change with respect to height above the surface. Furthermore, the co-located transport sensors allow the sand transport response to these turbulent motions to be realized.

Turbulence is quantified through the calculation of the stress tensor, shear velocity, turbulence kinetic energy and turbulent structures from quadrant analysis. These parameters are visualized spatially and temporally using vertical correlations and contour plots. The results show that shear stress is not a consistent parameter throughout the flow, rather it is changeable with height above the surface, and furthermore, there is no consistent pattern with height above the surface. Over relatively short timescales shear stress is shown to evolve in patterns which appear to demonstrate the presence large eddies within the flow.

With the experimental design presented here, it is possible to track these eddies down towards the surface and observe the sand transport response at the co-located safires and traps. Sand transport events are found to relate to peaks in resultant shear stress at a number of timescales. From these analyses it is clear that the mechanisms of aeolian sand transport cannot be fully understood from recording wind velocities at 0.5 m above the surface, or higher, it is important to monitor turbulent parameters as close to the surface as possible.