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The Origin of Aeolian Dunes – TOAD

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Sand dunes originate from complex interactions between fluid flow, bed morphology and sediment transport. The coupling between flow and sediment transport controls the bed morphology, and through feedback, the ground surface strongly modify the dynamic of airflow. It is therefore necessary to quantify the relations between these three parameters to understand the mechanisms of dune nucleation and growth.
While the conditions that control the shape and dynamic of mature dunes have been extensively studied, the initiation and early stages of aeolian dune development remain poorly understood. The development of a dune pattern involves localized deposition inducing bedform formation, which will then, under favourable conditions, produce dunes. Some environmental factors are already recognized as critical ingredients to generate sand deposition: changes in surface roughness, surface moisture and bed instability. However, until now, we have lacked the capacity to measure the necessary variables, at the ultra-high spatial and temporal resolutions required to detect small-scale variations in surface conditions and wind-blown sand transport.
The aim of the TOAD project is to use a multidisciplinary approach to highlight the conditions that enable dune initiation. We propose to combine field measurements (including TLS, and 3D sonic anemometers), physical (using the Refractive Index Matching flume) and numerical modelling (CFD and CA models) to quantify feedbacks between fluid flow, sediment transport and surface morphology.