EGU22-2807
https://doi.org/10.5194/egusphere-egu22-2807
EGU General Assembly 2022


# Source-to-sink aeolian landscape dynamics in the Lut Desert (Iran)

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Over the last two decades, source-to-sink studies have provided a wealth of information on fluvial-dominated landscapes and their response to tectonic, climatic and biologic forcings. This approach is now expanding for a variety of morpho-sedimentary systems in glacial, submarine and aeolian environments, not only on Earth but also on other planetary bodies. However, works dedicated to aeolian-dominated landscapes often remain qualitative or limited to a single component of the sediment budget such as erosion or accumulation, dust or sand. Hence, the potential of source-to-sink methods is still to be exploited to bring new quantitative information on aeolian sediment-routing systems and associated landforms. The Lut Desert in Iran is nested in an endorheic basin which provides an appropriate context to develop such an aeolian source-to-sink approach. Thanks to remote sensing data and new cosmogenic dating, together with higher resolution wind data and a modern understanding of dune dynamics, we analyze the aeolian transport properties from closed depressions and mega-yardangs upwind to dune fields downwind over decades to millions of years. These erosional and depositional Quaternary landforms cover areas that geographically coincide perfectly with the present-day geometry of the aeolian sediment-routing system. Sandflows derived from modern wind data are sufficient to explain the exchange of mass from the aeolian depressions to the dune fields, providing a coherent scenario for the long-term spatial organization and temporal evolution of these features. In addition, bedform alignments predicted from the wind data are in agreement with the observed dune orientations, which suggests a stability of wind regimes and transport properties over the intermediate time scales from centuries to millennia associated with dune growth and migration. Estimates of the sand discharges associated with the developments of the erosional and depositional landforms show that only a fraction of the wind-blown sediments has accumulated in dune fields since the onset of

aeolian erosion. As there is no evidence of sand evacuation through the mountain ranges surrounding the desert, the difference likely corresponds to the emission of dust into the atmosphere. Accordingly, the Lut Desert is not only an internal aeolian routing system for sand, it is also a major source of atmospheric dust leading to an overall loss of mass at the scale of the endorheic basin. Performed at the scale of a whole desert, this sediment budget reveals the full potential of source-to-sink methods to document how aeolian processes drive landscape dynamics and closely link the evolution of continental surfaces to atmospheric circulations.