Aeolian Landforms as Palaeo Wind Indicators - Application of Geoinformatics and Optically Stimulated Luminescence Methods to Analyse Dunefields in the Ili-Balkhash Region (Kazakhstan)

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Drylands currently cover almost half of the earth's land surface and are predicted to further expand due to human- and climate change-induced desertification. The uncertainty of future scenarios renders dryland research essential in order to inform policy decisions. In particular, the examination of geomorphological processes and palaeoclimatological reconstruction in desert systems are important for accurate modelling of future trajectories. This study investigates the relationship between wind dynamics and desert dune orientation using remote sensing and GIS (Geographic Information Systems). We present a semi-automated algorithm for dune mapping and quantify dune orientation based on optical satellite imagery and digital elevation data for dunefields in the Ili-Balkhash region of Kazakhstan in Central Asia. We predict modern dune orientations using the maximum gross bedform-normal transport rule (MGBNT) applied to reanalysed wind data and compare our results to observed dune orientations. We determine the timing of dune activity using quartz Optically Stimulated Luminescence (OSL) and examine the luminescence characteristics of dune sediments across the region as potential indicators of sediment history and provenance. Our predictions of bedform trend yield partial consensus with observed dune orientations; three sites yield mid-Holocene ages. We propose that modern wind regimes are not exclusively responsible for present dune morphologies, and that dune form may be inherited from earlier wind regimes. Given the small chronological dataset, however, we argue that further research into other potential influences on dune morphology, such as sediment supply, needs to be conducted to confirm this hypothesis.

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