Orientation of Australian linear dunes

Dominik Patrick Nommensen[1], Andrew Lewis Gunn[1]

[1]School of Earth, Atmosphere & Environment, Monash University, Clayton

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ABSTRACT

Sand dune morphology and type result from the accumulation of wind-blown sand particles shaped by specific wind regimes. Covering one third of Australia, linear dunes are the most abundant dune type in the interior of the continent (Wasson et al., 1988), forming an anti-clockwise dune whorl. These dune fields extend from modern arid areas to patches of sub-humid climate, believed to reflect expanded arid climates over past glacial cycles (Hesse, 2010). However, it remains uncertain whether these dunes formed during distinct periods of glacial-interglacial aridity cycles or during heterogeneous growth periods (Hesse, 2016).

Since linear (longitudinal) dune crests tend to align parallel to the net-sand transport, they can be used to infer paleoclimates. More specifically, their orientation provides information about the paleo-wind regime that formed them (Ewing et al., 2006). Comparing dune orientation with modern wind regimes will help us identify potential areas of active dune formation and regions where dunes formed under different climate conditions.

While some studies focused on dune orientation and wind direction (net-sand transport) alignment in Australia (Brookfield, 1970; Nanson et al., 1995; Hope, 2005), their results are somewhat inconsistent. Direct dating of dune activity, on the other hand, requires sparse and expensive point-measurements of paleoclimate proxies and sediment (Fitzsimmons et al., 2013; Hesse, 2016). Therefore, we aim to provide an easily reproducible, low-cost, unbiased, and, most importantly, consistent way of comparing modern wind regimes and dune orientation. We do so by using freely available gridded ERA5-Land climate reanalysis and AW3D30 digital surface model data suitable for a continental scale comparison between wind regime and dune topography.

Ultimately, this comparison will not only shed more light on the Quaternary and modern Australian dune genesis but also help to better our understanding of future climate-landscape interaction with respect to climate change in Australia and globally.

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