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Dune formation on the Cooper Creek floodplain, Strzelecki Desert, Australia - first results of morphodynamic simulations

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Linear Dunes, which align longitudinally to the resultant wind vector, are the prevailing type of the south-north trending and partially vegetated dunes in the Strzelecki Desert, Australia. However, particularly on the Cooper Creek floodplain near Innamincka, striking complex dune features consisting of transversely oriented east-west trending dunes occur. These transverse dunes extend over several kilometers and are superimposed by linear dunes that elongate northwards and are separated by sandy swales.

The aeolian features in the Strzelecki Desert are the result of interrelated late quaternary aeolian and fluvial activity and serve, thus, as archives providing information about variations in palaeoclimate and potential changes in fluvial sediment supply and wind strength and directionality. However, since the dunes are currently mostly stabilized by vegetation, it is uncertain whether their formation can be explained by the contemporary wind systems. To understand the dynamic processes underlying the genesis of the dune field in the Strzelecki Desert, the role of vegetation and the wind regimes leading to the observed dune patterns must be elucidated.

Here we investigate the formative processes of the dune features occurring on the Cooper Creek floodplain by means of morphodynamic modeling of aeolian sand transport and dune formation in presence of vegetation growth. Our simulations show that a source-bordering dune can be formed out of the sediments of seasonally exposed sandbars of the palaeo-Cooper system by a unidirectional wind, which explains the emergence of the transverse dunes in the field. Moreover, a shift in the wind regime to obtuse bidirectional wind flows combined with a rapid decrease in the vegetation cover leads to the formation of linear dunes on the surface and in the lee of the transverse dunes. These linear dunes elongate over several kilometers downwind as a result of the seasonal wind changes. The dune shapes obtained in our simulations agree well with the real dune morphologies when a low vegetation growth rate is applied in the model.

Although geochronological investigations, reported in the literature, on the Cooper Creek floodplain did not show the linear dunes declining in age downwind (which suggests the adjacent swales or the transverse dune to be the sediment source), our simulations show that strikingly similar linear dune morphologies can be obtained by sediment influx due to saltation alone. In this case, the bars of the palaeo-Cooper system might as well have served as the sediment source for the formation of the linear dunes. Therefore, our results suggest that a long-distance transport extension model could also explain the linear dune formation, while previous geochronological investigations supported the wind-rift vertical extension and wind-rift vertical accretion models.

The morphodynamic simulations may thus not only help to reconstruct the palaeoenvironment of the northern Strzelecki Desert, but also provide insights for the interpretation of the sediment archives located on the Cooper Creek alluvial fan.