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Interaction between sand dunes and rivers, and the impact on geomorphology

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The interaction between aeolian and fluvial processes can significantly change surface morphology. When sand dunes and rivers coincide with each other, the interaction of sediment transport fluxes between the two systems may lead to change in either or both systems. However, these two systems are usually studied independently which leaves many questions unresolved in terms of how they interact. This study examines the factors (temporal/spatial scale, climatic condition, wind/water speed, wind/water sediment supply) that lead to one process dominating the other and investigates the triggers that may switch the dominance between processes and the consequent changes in morphology that may occur.

Results are presented from 184 globally distributed study sites from locations where fluvial and aeolian systems interact with each other. At each location key attributes, e.g. wind/river direction, dune morphology, river channel pattern, river course change history and vegetation were identified from satellite images using Google maps and other published data. From these data, 10 different types of interaction were classified and the results have been analysed to understand the most frequent modes of interaction. River channels most frequently flow parallel to the local wind direction (60% of all examples) and braided rivers are the dominant channel pattern (37%). Longitudinal dunes rather than transverse dunes are most frequently associated with these braided channel patterns, possibly due to transverse dunes being associated with low sediment availability and therefore the Aeolian sediment flux is insufficient to change the river channel type. In contrast meandering rivers occur more frequently when sand sheets dominate the aeolian system. Overall, cresentic dunes are the most common dune type (55%) where fluvial and aeolian systems interact.

The results demonstrate that when the fluvial system is the dominant process (greatest sediment flux), the river channel disrupts the aeolian system and modifies the dune morphology; otherwise, the sand dunes divert the river channel course and change the channel morphology and flow direction. However, in some situations these two mechanisms alternate due to seasonal changes in aeolian or fluvial sediment flux.