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Sediment connectivity at source-bordering aeolian dunefields along the Colorado River in the Grand Canyon, USA

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Aeolian dunefields that are primarily built and maintained with river-derived sediment are found in many river valleys throughout the world and are impacted by changes in climate, land use, and river regulation. Quantifying the dynamic response of these aeolian dunefields to alterations in river flow is especially difficult given the highly correlated nature of the interacting geomorphic and sediment transport processes that drive their formation and maintenance. We characterize the effects of controlled river floods on changes in sediment connectivity at source-bordering aeolian dunefields in the Grand Canyon, USA. Controlled floods from the Glen Canyon Dam are used to build sandbars along the Colorado River in Grand Canyon which provide the main sediment source for aeolian dunefields. Aeolian dunefields are a primary resource of concern for land managers in the Grand Canyon because they often contain buried archaeological features. To characterize dunefield response to controlled floods, we use a novel, automated approach for the mechanistic segregation of geomorphic change to discern the geomorphic processes responsible for driving topographic change in very high resolution digital elevation models-of-difference (DODs) that span multiple, consecutive controlled river floods at source-bordering dunefields. We subsequently compare the results of mechanistic segregation with modelled estimates of aeolian dunefield evolution in order to understand how dunefields respond to contemporary, anthropogenically-driven variability in sediment supply and connectivity. These methods provide a rapid technique for sediment budgeting and enable the inference of spatial and temporal patterns in sediment flux between the fluvial and aeolian domains. We anticipate that this approach will be adaptable to other river valleys where the interactions of aeolian, fluvial, and hillslope processes drive sediment connectivity for the maintenance of source-bordering aeolian dunefields.