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Landscape response to changes in dynamic topography

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Dynamic topography is characterized by broad wavelength, low amplitude undulations of the Earth's surface maintained by stresses arising from mantle convection. Earth's topography is thus an aggregate of both dynamic and isostatic topography that is modulated by surface processes and changes in topography and/or the climate can be recorded in the offshore sedimentary record. However, it is generally difficult to deconvolve this record into contributions from changes in climate, isostatic topography, and dynamic topography. Herein, we use a landscape evolution model that is capable of producing simulations at the necessary scale and resolution for quantifying landscape response to moderate changes in dynamic topography in the presence of flexural unloading and loading due to erosion and deposition. We demonstrate that moderate changes in dynamic topography coupled with flexural response imposed on a landscape with pre-existing relief and drainage divide, disequilibrates the landscape resulting in a measurable increase in erosion rates and corresponding sedimentary flux to the margin. The magnitude and timing of this erosional response to dynamic topography is dependent on several key landscape evolution parameters, most notably the erosion (advection) coefficient and effective elastic thickness. Moreover, to maximize this response, we find that changes in dynamic topography must be slow enough and long-lived for given rates of erosion otherwise the landscape will not have sufficient time to generate a response. Lastly, this anomalous flux can persist for a significant amount of time beyond the influence of dynamic topography change as the landscape strives to re-equilibrate.