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Implications of sediment redistribution on modeled sea-level changes over millennial timescales

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Sea level is a critical link in feedbacks among topography, tectonics, and climate. Over millennial timescales, changes in sea level reshape river networks, regulate organic carbon burial, influence sediment deposition, and set moving boundary conditions for landscape evolution. Sea-level changes influence tectonics by regulating rates and patterns of erosion and deposition, which perturb the surface loads that drive geodynamic processes at depth. These interactions are complex because sea-level changes are influenced by the geomorphic processes that they themselves modify, since sediment redistribution deforms the gravitational and crustal elevation fields that define sea level.

A recent advance in understanding the coupling between sea level, tectonics, and topography was the incorporation of sediment redistribution into a gravitationally self-consistent sea-level model, which permits the computation of sea-level responses to erosion and deposition (Dalca et al., 2013, Geophysical Journal International). Here I use this model to quantify changes in sea level resulting from the erosion of some of the most rapidly eroding sites on Earth and the deposition of sediment offshore. These model results show that the sea-level fingerprints of sediment redistribution are strongly variable in space, and that they can represent a significant component of the total sea level change since the last interglacial. This work provides a basis for understanding a fundamental driver of landscape evolution at some of Earth's most geomorphically dynamic sites, and thus aids investigation of the couplings among tectonics, climate, and topography.

References

Dalca A.V., Ferrier K.L., Mitrovica J.X., Perron J.T., Milne G.A., Creveling J.R., 2013. On postglacial sea level – III. Incorporating sediment redistribution. Geophysical Journal International, doi: 10.1093/gji/ggt089.