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Influence of dynamic topography on the evolution of the eastern Australian landscape since the Upper Jurassic Epoch

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Australia is an outstanding natural laboratory to study the influence of dynamic topography on landscape evolution, having been largely unaffected by tectonic deformation since the Jurassic. Recent studies of the past eastern Australian landscape from present-day longitudinal river profiles and from mantle flow models suggest that the interaction of plate motion with mantle convection accounts for the two phases of large-scale uplift of the region since 120 Ma.
We coupled the dynamic topography predicted by one of these mantle flow models (using the finite element code for thermochemical mantle convection *CitcomS*) to a surface process model (using the finite volume code for geomorphological and stratigraphic evolution *Badlands*) to quantify the feedbacks between mantle flow, landscape dynamics and sediment transport at continental scale. Here we apply the approach to the evolution of the Australian landscape over the last 150 Myr.
The mantle flow model predicts that Australia was dynamically tilted down to the east 150 Myr ago due to long-lived subduction along the eastern border of the continent. Subduction rolled back 100 Myr ago and the eastward migration of eastern Australia over sinking ancient Gondwanaland slabs caused it to rebound from being drawn down. Following a period of absolute plate motion stagnation, renewed uplift of the eastern highlands occurred during the Cenozoic, as the Australian plate migrated over the Pacific Superswell.
We forced *Badlands* models with this predicted evolution of dynamic topography, varying rainfall regime, erodibility, long-term sea level variations, dynamic topography magnitude and elastic thickness across a series of experiments. The *Badlands* models quantify the time dependence of erosion and deposition, as well as the evolution of catchment dynamics, drainage capture and drainage network reorganisation. The predicted temporal and spatial changes in longitudinal river profiles as well as erosion and deposition maps show that the motion of the Australian plate over the convecting mantle resulted in significant reorganization of the eastern Australian drainage, continental-scale erosion and sedimentation. The model predicts that the Murray River drained eastward between 150 and $\sim$120 Ma, and switched to westward draining due to the tilting of the Australian plate from $\sim$120 Ma. First order comparisons of eight modelled river profiles and of the catchment shape of modelled Murray-Darling Basin are in agreement with present-day observations. The predicted denudation of the eastern highlands is compatible with thermochronology data and sedimentation rates along the southern Australian margin are consistent with cumulative sediment thickness. Despite the relative simplicity of our coupling approach, these promising results reflect the fundamental links between continental-scale dynamic uplift, and continental-scale drainage evolution and deposition.