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Monsoon speeds up Indian plate motion

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Short-term plate motion variations on the order of a few Myrs are a powerful probe into the nature of plate boundary forces, as mantle-related buoyancies evolve on longer time-scales. New reconstructions of the ocean-floor spreading record reveal an increasing number of such variations, but the dynamic mechanisms producing them are still unclear. Here we show that climate changes may impact the short-term evolution of plate motion by linking the observed counter-clockwise rotation of the Indian plate since 10 Ma explicitly to increased erosion and reduced elevation along the eastern Himalayas, due to temporal variations in monsoon intensity. By assimilating observations into empirical relations for the competing contributions of erosion and mountain building, we estimate the first-order decrease in elevation along the eastern Himalayas since initial strenghtening of the monsoon. We show moreover with global geodynamic models of the coupled mantle/lithosphere system that the inferred reduction in elevation is consistent with the Indian plate motion record over the same period of time, and that lowered gravitational potential energy in the eastern Himalayas following stronger erosion is a key factor to foster plate convergence in this region. Our study implicates lateral variations in plate coupling and their temporal changes as an efficient source to induce an unusual form of plate motion where the Euler pole falls close to its associated plate. Importantly, we find less agreement between modelled and observed plate motions if we assume a larger Indo-Australian plate, supporting the notion that India and Australia were separate tectonic units prior to monsoon intensification.