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Influence of orographic precipitation on the co-evolution of landforms and vegetation

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Topography plays an important role in controlling the amount and the spatial distribution of precipitation due to orographic lift mechanisms. Thus, it affects the existing climate and vegetation distribution. Recent landscape modelling efforts show how the orographic effects on precipitation result in the development of asymmetric topography. However, these modelling efforts do not include vegetation dynamics that inhibits sediment transport. Here, we use the CHILD landscape evolution model (LEM) coupled with a vegetation dynamics component that explicitly tracks above- and below-ground biomass. We ran the model under three scenarios. A spatially uniform precipitation scenario, a scenario with increasing rainfall as a function of elevation, and another one that includes rain shadow effects in which leeward hillslopes receive less rainfall than windward ones. Preliminary results of the model show that competition between increased shear stress due to increased runoff and vegetation protection affects the shape of the catchment. Hillslope asymmetry between polar- and equator-facing hillslopes is enhanced (diminished) when rainfall coincides with a windward (leeward) side of the mountain range. It acts to push the divide (i.e., the boundary between leeward and windward flanks) and leads to basin reorganization through reach capture. Our findings suggest that there exists a strong coupling between climate and landform evolution processes, and that orographic precipitation can imprint its influence on landforms in semi-arid ecosystems.