Geophysical Research Abstracts
Vol. 21, EGU2019-4017-2, 2019
EGU General Assembly 2019

Predicting surface uplift and erosion in the Chilean Coastal Ranges using mechanically controlled modelling

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Understanding feedbacks between biological and geological processes forms a topical debate in the Earth sciences that currently supersedes the discussion of climatic vs. tectonic control of the last decades. One of the best regions in the world to study such feedback processes are the 3000 km long Chilean Coastal Ranges in South America. These mountain ranges are the product of very similar geological and plate tectonic boundary conditions. However, they feature a pronounced biological gradient from north to south, which spans some 20° in latitude from biota-free, desert-like environments in the Atacama region to heavily vegetated areas in the humid-temperate zone. Recognizing this ideal setting a German priority programme (called: Earthshape) is under way to investigate feedback processes between biology and geology in particular the erosion and landscape evolution and erosion as a function of vegetation. As a contribution this programme, we currently use numerical modelling techniques to predict rock uplift processes in the Chilean Coastal Ranges, subject to mechanically controlled boundary conditions as known from local geology. Our project attempts to explain a startling observation: The topography of the Coastal Ranges features a systematic change of the relationship between slope and elevation, from biota-free (in the north) to heavily vegetated regions in the south. These latitudinal morphological changes are consistent with today's topography being a function of the observed vegetation gradient and may hence potentially be interpreted as biota-controlled. We aim at producing a quantitative tool (a biota-modulated erosion law), that describes the relative importance of biota and tectonics on erosion processes in surface process models.