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Long-term stability of the SE Australian escarpment inferred from cosmogenic-nuclides and high-resolution topography analysis

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Passive margin escarpments are major features of continental relief and long-standing remnants of rifting episodes. Despite their presence along many continental borders, their mode of evolution is highly debated and various types of scenarios are proposed, such as parallel retreat or down-wearing of the escarpment. Reported rates of evolution also vary over several orders of magnitudes, from a few meters to a few kilometers per million years. For these reasons additional geomorphological data that allow to constrain their history are highly needed.
We quantified landscape dynamics across the SE Australian Escarpment (Bega Valley), in order to assess its stability over the Late Cenozoic to Holocene timescales through the determination of CRN basin-averaged denudation rates of 20 catchments. The calculated landscape denudation rates are 10-20 mm/ka in lowland and upland catchments for both sides of the escarpment while catchments draining across the escarpment display denudation rates up to 60 mm/ka. Geomorphic parameters extracted from a high-resolution Digital Elevation Model derived from stereo-pairs of Pléiades images show that hilltop curvature is constant in the lowland part, up to the very edge of the escarpment. We estimate an apparent hillslope diffusion coefficient from CRN-derived denudation rates and Pléaides DEM-derived hilltop curvature. When confronted with measured hillslope lengths in the lowland part, it leads to a hillslope relaxation time lower bound on the order of several Ma, and suggests that the landscape is stable over such a timescale. This argues against significant recent evolution of the escarpment, and, in particular, against rapid retreat rates.
Our study also demonstrates the potential of high-resolution Digital Elevation Models derived from Pléiades images pairs in quantitative geomorphology studies. Such technique provides a suitable and cost-effective alternative to airborne LiDAR, and allows to extract fine-scale morphometric parameters over large areas in low-vegetation settings.