Morphodynamics of sinuous rivers in poorly vegetated landscapes: An integration of remote sensing and river-discharge records

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Modern unvegetated sinuous rivers have potential to be used as analogues for extraterrestrial planets with active hydrological cycles, as well as pre-Silurian rivers originally devoid of vegetation. The main objective of this research is to understand the relative controls of vegetation (or lack thereof) on fluvial sinuosity, though the analysis of three modern, sinuous unvegetated rivers, namely: the Río La Leona in Patagonia (Argentina), which is subject to temperate-oceanic climate conditions; Río Santa Cruz in Patagonia (Argentina), which transect areas located within both cold, semi-arid desert and cold desert climate zones; and the Uzboy Channel in the Karakum desert of Turkmenistan, which is representative of a cold desert climate. The primary method employed in this study is remote sensing of fluvial forms through both low- and high-resolution satellite imagery. Results include the implementation of a database of sinuous channel-reach geometry, including index of channel sinuosity, bar shape, coverage, morphodynamic behavior, and gradients Visual-enhancement software is also used to highlight the relative coverage of vegetation alongside active channels. An unvegetated terrain has been defined in previous literature as having less than 0.5% vegetation coverage and a ratio between the diameter of vascular-plants axis (if any) and channel width of 10^{-4} or less. Río La Leona shows 2.44% vegetation coverage along its entire channel belt, Santa Cruz 1.25% coverage, and the Uzboy channel only 0.58% vegetation coverage. Information derived from remote sensing on the three considered rivers will be compared with their discharge record. The three analyzed case studies represent contrasting basin and climate settings, and the analysis of their dynamics will ultimately provide a wide perspective on how sinuous-channel reaches originate and evolve in the absence of widespread vegetation.