



A case of self-perturbation: channel responses to meander cutoffs in the Ucayali River, Peru

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In 1997, the most drastic change in the course of the Ucayali River in over 200 years took place with the cutoff of a human-induced, 72 km triple-lobed meander bend near Pucallpa, Peru. The cutoff's anthropogenic origins are attributed to local ribereños, who decades earlier in an effort to reduce canoe travel time carved a meter deep by 2 m wide shortcut channel across the neck of the bend. The river responded dramatically in the following years, undergoing accelerated migration and channel widening both up- and downstream of the cutoff that led to the eventual cutoff of four additional cutoffs (three downstream and one upstream).

In this study, we quantify Ucayali's response to this major cutoff event as well as twelve additional cutoffs occurring since 1992 through the analysis of annual, bankfull-resolving, Landsat-derived channel masks. Cutoff-induced accelerated morphodynamics occurred downstream of all 13 cutoffs, with 11/13 cutoffs spurring accelerated migration and 8/13 causing channel widening. We attempt to understand the mechanisms driving the observed nonlocal accelerated morphodynamics by computing the change in length of the river due to cutoff, which is approximately proportional to the slope perturbation, and the volumes of sediment released to the downstream reaches through the excavation of chute channels. By tracking planform changes of individual meander bends near cutoffs, we find that the downstream distance of cutoff influence scales linearly with the length of the removed reach. Our findings highlight the understated role of cutoff perturbations as drivers of nonlocal morphologic change and provide insight toward improved predictions of channel responses.