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Sediment supply adjusts channel sinuosity across the Amazon Basin

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Sediment supply is a fundamental component of alluvial river systems and forms a significant proportion of the material used to construct channel bedforms. As meandering rivers migrate, they increase their sinuosity and overall occupation within the floodplain. Here we investigate how sediment supply affects meander deformation and channel growth using a suite of satellite imagery from the Amazon Basin. The Amazon is comprised of regions supplying vastly differing sediment loads (over several orders of magnitude) and freely meandering river systems uninfluenced by human modification making it an ideal study site for examining the influence of sediment supply on meandering dynamics.

Measurements of the channel migration rate and fractional rate of change in channel length (sinuosity) were made and compared to the total suspended sediment flux for each reach. We established the meander symmetry index (σ) to quantify the predominant style of meander deformation for each reach: extensional meanders were considered to be bends with indices approximating 1.0, while downstream rotational meanders were those that exceeded 1.05, and upstream rotational meanders had indices of less than 0.90. Downstream rotating meanders were found to be most common on all rivers. However, up to 50% of meanders on some reaches were classified as upstream rotating. Extensional meanders were rare along all reaches. Reaches characterised as downstream rotating, on average, were observed to increase their sinuosity more rapidly than the others. We suggest that rivers carrying larger sediment loads are more capable of sequestering sediment on their point bars facilitating bar growth and bend curvature, which enhances river bank erosion and channel expansion. Upstream rotating meanders were observed to develop in response to the deposition of sediment lobes at the point bar head or through compound bend development. We suggest that reaches with low sediment supplies are less capable of constructing point bars, reducing their capacity to increase bend curvature and channel sinuosity.