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# River morphodynamics from space: the Landsat frontier

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NASA's Landsat family of satellites have been observing the entire globe since 1984, providing over 30 years of snapshots with an 18 day frequency and 30 meter resolution. These publicly-available Landsat data are particularly exciting to researchers interested in river morphodynamics, who are often limited to use of historical maps, aerial photography, and field surveys with poor and irregular time resolutions and limited spatial extents. Landsat archives show potential for overcoming these limitations, but techniques and tools for accurately and efficiently mining the vault of scenes must first be developed.

In this PICO presentation, we detail the problems we encountered while mapping and quantifying planform dynamics of over 1,300 km of the actively-migrating, meandering Ucayali River in Peru from Landsat imagery. We also present methods to overcome these obstacles and introduce the Matlab-based RivMAP (River Morphodynamics from Analysis of Planforms) toolbox that we developed to extract banklines and centerlines, compute widths, curvatures, and angles, identify cutoffs, and quantify planform changes via centerline migration and erosion/accretion over large spatial domains with high temporal resolution. Measurement uncertainties were estimated by analyzing immobile, abandoned oxbow lakes. Our results identify hotspots of planform changes, and combined with limited precipitation, stage, and topography data, we parse three simultaneous controls on river migration: climate, sediment, and meander cutoff. Overall, this study demonstrates the vast potential locked within Landsat archives to identify multi-scale controls on river migration, observe the co-evolution of width, curvature, discharge, and migration, and discover and develop new geomorphic insights.