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Global compilation of coastline change at river mouths

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We are using Google Earth Engine to analyze Landsat images to create a global compilation of coastline change at river mouths in order to develop scaling relationships between catchment properties and shoreline behaviour. Our main motivation for doing this is to better understand the rates at which shallowing upward successions of deltaic successions are formed. We are also interested in getting an insight into the impact of climate change and human activity on modern shorelines.

Google Earth Engine is a platform that offers simple selection of relevant data from an extensive catalog of geospatial data and the tools to analyse it efficiently. We have used Google Earth Engine to select and analyze temporally and geographically bounded sets of Landsat images covering modern deltas included in the Milliman and Farnsworth 2010 database. The part of the shoreline sampled for each delta has been manually defined. The areas depicted in these image sets have been classified as land or water by thresholding a calibrated Modified Normalized Water Index. By representing land and water as 1.0 and 0 respectively and averaging image sets of sufficient size we have generated rasters quantifying the probability of an area being classified as land. The calculated probabilities reflect variation in the shoreline position; in particular, it minimizes the impact of short term-variations produced by tides. The net change in the land area of deltas can be estimated by comparing how the probability changes between image sets spanning different time periods.

We have estimated the land area change that occurred from 2000 to 2014 at more than 130 deltas with catchment areas ranging from 470 to 6300000 sqkm. Log-log plots of the land area change of these deltas against their respective catchment properties in the Milliman and Farnsworth 2010 database indicate that the rate of land area change correlates with catchment size and discharge.

Useful interpretation of the data requires that we filter out significant land change caused by earthworks at the coast. By assuming that changes in land area can be attributed to sedimentation driven by the fluvial system we can propose scaling relationships that can be used in stratigraphic analysis. The data could potentially be applied to develop models predicting shoreline behaviour of modern systems as a function of climate and catchment properties. This could be used to evaluate the shoreline response to damming of rivers and the impact of climate change.

Google Earth Engine is a user-friendly platform that facilitates generation of global compilations of landscape change. We are using it to investigate scaling relationships between the rate at which the shorelines build out and the catchment properties of its rivers, but we believe it could also be used to investigate scaling relationships and sediment budgets associated with other landforms.