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# Bar dimensions and bar shapes in estuaries

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Estuaries cause fascinating patterns of dynamic channels and shoals. Intertidal sandbars are valuable habitats, whilst channels provide access to harbors. We still lack a full explanation and classification scheme for the shapes and dimensions of bar patterns in natural estuaries, in contrast with bars in rivers. Analytical physics-based models suggest that bar length in estuaries increases with flow velocity, tidal excursion length or estuary width, depending on which model. However, these hypotheses were never validated for lack of data and experiments. We present a large dataset and determine the controls on bar shape and dimensions in estuaries, spanning bar lengths from centimeters (experiments) to 10s of kilometers length. First, we visually identified and classified 190 bars, measured their dimensions (width, length, height) and local braiding index. Data on estuarine geometry and tidal characteristics were obtained from governmental databases and literature on case studies. We found that many complex bars can be seen as simple elongated bars partly cut by mutually evasive ebb- and flood-dominated channels. Data analysis shows that bar dimensions scale with estuary dimensions, in particular estuary width. Breaking up the complex bars in simple bars greatly reduced scatter. Analytical bar theory overpredicts bar dimensions by an order of magnitude in case of small estuarine systems. Likewise, braiding index depends on local width-to-depth ratio, as was previously found for river systems. Our results suggest that estuary dimensions determine the order of magnitude of bar dimensions, while tidal characteristics modify this. We will continue to model bars numerically and experimentally. Our dataset on tidal bars enables future studies on the sedimentary architecture of geologically complex tidal deposits and enables studying effects of man-induced perturbations such as dredging and dumping on bar and channel patterns and habitats.