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Landscape morphology is often the result of many complex interacting processes operating over a range of scales, and characterizing patterns on relevant scale intervals can help link form with process. Due to the interplay of dynamic factors shaping them, coastal environments represent a typical example of such landscapes. Multiscale analysis methods are successfully applied for the quantitative characterization of the spatially variability of coastlines. Numerous studies focus on lines resulting from the intersection of a plane at a certain elevation with the three-dimensional landscape. However, in most cases, the reason for the choice of the actual elevation is not mentioned, and sometimes not even the value of the selected elevation is specified. Such an approach relies on the assumption that one studies a self-affine pattern for which the irregularity is independent from elevation.
The present study questions this assumption by applying fractal analysis not to one, but rather to a series of different elevations. The application area, the Avon Estuary, is a part of the Bay of Fundy in Nova Scotia, Canada, which is renowned for its semi-diurnal tides that can exceed a tidal range of 12 m. The topography of Avon Estuary is influenced by complex interacting factors, including hydrodynamic processes, sedimentary processes, vegetation, and ice formations, as well as by anhropogenic structures.
The area-perimeter analysis method was applied to a digital elevation model (DEM) of the study area. The DEM was based on Light Detection and Ranging Data (LiDAR) data, which can achieve high positional accuracy within tidal wetlands. The survey was conducted during low tide to maximize the exposure of mud flats. It used a 20 degree scan angle, a scan frequency of 70 kHz and a 50% overlap in swath width of adjacent flight lines, resulting in a data resolution of 0.5m. GPS points were collected throughout the study area covering each flight line and were used to verify the accuracy of the data set. The resulting DEM of the Avon Estuary was used to produce contours at 0.5 m intervals ranging from -4.5 to 7.5m. The area-perimeter method was then applied to data at each elevation. The results show a pronounced and coherent elevation dependence of the fractal dimension on elevation. We discuss the reasons for the elevation – fractal dimension relationship and show that this approach supports a better understanding of the interacting processes that dominate the area on different ranges of scale.