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A modified equation to calculate the potential future shoreline position using transects

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Coastal erosion plays a vital role in shoreline assessment and the rate of erosion (or accretion) is a crucial variable for it. Significant number of studies have been conducted to determine erosion rates using a variety of methods, out of which transect-based implementations are quite popular. In such methods, a suitable baseline is selected onshore or offshore and line segments, called transects, are drawn from it usually perpendicular to either the baseline or the actual shoreline at regular intervals. The transects intersect the shorelines from the different years under observation at various point. The general approach is to observe the points where the shorelines intersect with these transects for each year and calculate a rate of erosion from it. Dedicated utilities, such as the Digital Shoreline Analysis System (DSAS) developed by United States Geological Survey (USGS), exist which performs these steps automatically. This rate can be used to build a simplified model to project the expected future position of the shoreline under a number of assumptions which can be removed subsequently by including various other parameters influencing coastal dynamics in the model. However, when calculating the potential shoreline position even using the simplified model, previous literature does not mention the need to take into account the orientation of the transects with respect to the parallels and meridians in Mercator projections, such as Universal Transverse Mercator (UTM), which is often used in such analyses, including those performed using DSAS. We propose a modified equation with an additional term to incorporate this change. Since the rate (of erosion) itself is calculated along the transect, the potential future position of the shoreline when calculated as described above must necessarily lie on the transect. Two separate collaborative case studies incorporating this modification were done on a part of the coast in eastern India and on the island of St. Kitts in Saint Kitts and Nevis. A significant reduction in the root-mean-square (RMS) error in the estimated shoreline positions were observed during the studies. We discuss the rationale and the need for this modification as well as the implementation. Additionally, the applicability and assumptions under which the equation can be used to give fruitful results from the perspective of spatial reference systems are pointed out.