An evaluation of errors of Himalayan glacier outlines

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Digital outlines of glaciers, useful for a variety of glaciological and hydrological purposes, are now widely available for most of the world's glaciers, primarily through the Global Land Ice Measurements from Space (GLIMS) initiative and the Randolph Glacier Inventory. The quality of these outlines varies with region and data source. This work, carried out within the Contribution to High Asia Runoff from Ice and Snow (CHARIS) project, has three goals. First, we discuss the various sources of error in the creation of glacier outlines. Second, we evaluate the data quality for a select set of glacier outlines in the great Himalayan region. We estimate the positional uncertainty of vertices in the glacier outline polygons by comparing the outlines to high-resolution satellite imagery, and propagate these errors through the polygon area formula to arrive at error estimates for glacier area. The theory behind this error propagation is presented and its ramifications discussed. The third goal is to compile statistics on glacier parameters by combining the outlines with digital elevation models to determine for each glacier: elevation range, area, elevation distribution (hypsometry). Each of these quantities is reported with error estimates, and is summarized by country and region. These data will be used in various ways by us at NSIDC and by our CHARIS project partners, and it is hoped that these methods will be useful in other contexts.