Google Earth Engine derived areal extents to infer elevation variation of lakes and reservoirs

Anthony Nguy-Robertson (1), Jack May (2), Sebastien Dartevelle (1), Sean Griffin (3), Justin Miller (4), Robert Tetrault (5), Charon Birkett (6), Eileen Lucero (7,8), Tess Russo (7), and Matthew Zentner (2)

(1) Office of Geomatics, National Geospatial-Intelligence Agency, United States (anthony.l.nguyrobertson@nga.mil), (2) Operational Environment Analysis, Defense Intelligence Agency, United States , (3) Geospatial Research Lab, Engineering Research and Development Center, US Army Corps of Engineers, United States , (4) Office of Sciences and Methodologies, National Geospatial-Intelligence Agency, United States , (5) Foreign Agriculture Service, United States Department of Agriculture, United States , (6) Earth System Science Interdisciplinary Center, University of Maryland at College Park, United States , (7) Department of Geosciences, Pennsylvania State University, United States , (8) Office of Targeting and Transnational Issues, National Geospatial-Intelligence Agency, United States

Monitoring water supplies is important for identifying potential national security issues before they begin. As a means to estimate lake and reservoir storage for sites without reliable water stage data, this study defines correlations between water body levels from hypsometry curves based on in situ gauge station and altimeter data (i.e. TOPEX/Poseidon, Jason series) and sensor areal extents observed in historic multispectral (i.e. MODIS and Landsat TM/ETM+/OLI) imagery. Water levels measured using in situ observations and altimeters, when in situ data were unavailable, were used to estimate the relationship between water elevation and surface area for 18 sites globally. Altimeters were generally more accurate (RMSE: 0.40 – 0.49 m) for estimating in situ lake elevations from Iraq and Afghanistan than the modeled elevation data using multispectral sensor areal extents: Landsat (RMSE: 0.25 – 1.5 m) and MODIS (RMSE 0.53 – 3.0 m). Correlations between altimeter data and Landsat imagery processed with Google Earth Engine confirmed similar relationships exists for a broader range of lakes without reported in situ data across the globe (RMSE: 0.24 – 1.6 m). Thus, while altimetry is still preferred to an areal extent model, lake surface area derived with Google Earth Engine can be used as a reasonable proxy for lake storage, expanding the number of observable lakes beyond the current constellation of altimeters and in situ gauges.