Calculating confidence intervals for reservoir volume estimated from remote sensing data

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Depth-volume curves of reservoirs in the Brazilian semiarid north-east are often severely out of date where reservoir volumes have been diminished by cumulative sediment deposition. This has been particularly worrying, given the dry period this region is experiencing in the last seven years. However, reservoir surface areas corresponding to different depths of water can be estimated from satellite imagery readily available on the internet, whereas in-situ water level measurements are usually available at a daily scale. Reservoir volume can be then estimated by numerical integration, albeit with some uncertainty. Thus, some metric of the associated uncertainty is a valuable information for decision makers in the field of water resources.

This paper describes two methods for estimating the uncertainty in estimated storage in terms of confidence intervals for the predicted volumes, one based on large-sample theory and the other based on a bootstrap procedure. When tested on two reservoirs in north-eastern Brazil, the two methods gave broadly similar results, albeit large-sample produced confidence intervals that were sensitive to the choice of water-level increments. When data from the new generation of satellite-mounted radar altimeters become available for widespread use, such computational procedures should find increasing application, particularly in developing regions where land use is changing and resources are limited.