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Comparative analysis of hydroacoustic lakebed classification in three different Brazilian reservoirs

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Until today, the surface of artificial water bodies around the world reached an area of around 500,000 km^2 equaling one third of the surface of natural water bodies. Most of the constructed waster bodies are reservoirs with a variety of usage purposes, reaching from drinking water supply, electricity production, flood protection to recreation. All reservoirs have in common, that they disrupt riverine systems and their biochemical cycles and promote the accumulation of sediments upstream of the dam. The accumulated sediments contain organic matter, nutrients and/or pollutants which have a direct influence on the water quality within the impoundment. Consequently, detailed knowledge about the amount and the quality of accumulated sediments is an essential information for reservoir management. In many cases the extensive areas covered by the impoundments make it difficult and expensive to assess sediment characteristics with a high spatial resolution. Spatial extrapolations and mass balances based on point information may suffer from strong deviations.
We combined sediment point measurements (core and grab sampling) with hydroacoustic sediment classification in order to precisely map sediment parameters. Three different reservoirs (Vossoroca, Capivari, Passauna) in the south-east of Brazil were investigated between 2011 and 2015. A single beam echosounder (EA 400, Kongsberg) with two frequencies (200 & 38 kHz) was used for the hydroacoustic classification. Over 50 core samples and 30 grab samples were taken for physical and chemical analysis to serve as ground truthing of the hydroacoustic measurements. All three reservoirs were covered with dense measurement transects allowing for a lakebed classification of the entire sediment surface.
Significant correlations of physical parameters like grain size distribution and density as well chemical parameters like organic carbon content and total phosphorous with a selection of hydroacoustic parameters were obtained. They enabled the derivation of empiric models used for the extrapolation of the sediment point information to the entire reservoir surface. With the obtained spatial information carbon and phosphorous budgets were calculated. Former stock calculations, which were based solely on point sampling, could be improved The results show that the method is transferable to different reservoirs with varying characteristics in regard of their catchments, morphology and trophic state.