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Monitoring and Modeling Sediment Re-suspension in reservoirs

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Lakes and reservoirs are subject to sediment loads originated by hydrological processes in the catchment area. The sedimentation has been a matter of concern to the researchers for a long time, not only by volume losses and operational problems but also because of the retention of pollutants that are carried out and buried. As a result of different external driving forces such streams, waves and thermal behavior, sediment re-suspension can feedback the water column with nutrients triggering biological processes that can lead to algae blooms and compromise the water quality and its uses (Pollman at al, 2011). Modelling sediment re-suspension in shallow lakes has been done in a simplified way by the correlation with the shear stress acting at the button that can be obtained through hydraulic variables. In fact, the shear stresses in a lake generated by horizontal circulation are much smaller than the ones by vertical fluxes and involve reservoir morphology and a complex 3D hydrodynamics typically present in a low energy system (Skinner at al, 2014). In this work we use a continuous turbidity monitoring in a shallow lake in order to analyze its variation in function of the vertical velocities that are generated by meteorological, hydrological and thermal regime changes, such as wind, floods and the temperature mixing events. The site study is a shallow artificial reservoir located in the southeast of Brazil that was built in the beginning of the 19th century and covers an area of 0,5km^2 and a maximum depth of 5m. The hydrological contributing basin has predominant agricultural occupation. The deepest point of the lake was instrumented with continuous recording temperature gauges and a turbidimeter. The hydrological and atmospheric variables were also measured (wind, rain, radiation and flow) in high resolution time step. Initially, the events where we could identify an abrupt change in the thermal stratification condition were isolated, showing also a significant variation in turbidity. In parallel, a detailed quasi-3D model (Delft3D Flow) was setup and calibrated and verified for a grid with 30 vertical layers. The observed changes in turbidity were then correlated with the vertical velocities and the bottom shear stress computed by the model indicating that the power of the stratification can be related to the re-suspension. The obtained response is specific to the local sediment grain size and specific weight but allow us to go forward in the effort to predict sediment re-suspension in reservoirs.