Geophysical Research Abstracts
Vol. 14, EGU2012-13522, 2012
EGU General Assembly 2012

Mitigation of turbidity currents in reservoirs with passive retention systems: validation of CFD modeling

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Sediment deposition by continuous turbidity currents may affect eco-environmental river dynamics in natural reservoirs and hinder the maneuverability of bottom discharge gates in dam reservoirs. In recent years, innovative techniques have been proposed to enforce the deposition of turbidity further upstream in the reservoir (and away from the dam), namely, the use of solid and permeable obstacles such as water jet screens , geotextile screens, etc..

The main objective of this study is to validate a computational fluid dynamics (CFD) code applied to the simulation of the interaction between a turbidity current and a passive retention system, designed to induce sediment deposition.

To accomplish the proposed objective, laboratory tests were conducted where a simple obstacle configuration was subjected to the passage of currents with different initial sediment concentrations.

The experimental data was used to build benchmark cases to validate the 3D CFD software ANSYS-CFX. Sensitivity tests of mesh design, turbulence models and discretization requirements were performed.

The validation consisted in comparing experimental and numerical results, involving instantaneous and time-averaged sediment concentrations and velocities. In general, a good agreement between the numerical and the experimental values is achieved when: i) realistic outlet conditions are specified, ii) channel roughness is properly calibrated, iii) two equation $k - \varepsilon$ models are employed iv) a fine mesh is employed near the bottom boundary.

Acknowledgements

This study was funded by the Portuguese Foundation for Science and Technology through the project PTDC/ECM/099485/2008. The first author thanks the assistance of Professor Moitinho de Almeida from ICIST and to all members of the project and of the Fluvial Hydraulics group of CEHIDRO.