SIMULATING PARTICLE-LADEN TURBULENT FLOWS WITH PARAMETRIC UNCERTAINTIES

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RESUMO: Particle-laden flows are a very complex natural phenomenon and contribute for sediment transport and deposition that lead to the formation of basins hosting oil reservoirs. Those turbulent flows are triggered by small differences in the fluid density induced by the presence of sediment particles. A very important example of those flows are turbidity currents. A detailed modelling of this phenomenon may offer new insights to help geologists to understand the deposition mechanisms and the final stratigraphic form of the reservoirs. The increasing reliance on numerical simulation for the analysis of these complex physical systems has led in recent years to a strong development of knowledge in this area. In this sense, Uncertainty Quantification (UQ) provides a framework to enable robust computer simulations that take into account the unavoidable uncertainties present in input parameters and in the model structure (model discrepancy). The present work extends the efforts of the authors to build a reliable computational model for the prediction of deposition of sediments transported by particle laden-flows. It presents a UQ analysis, employing a probabilistic perspective, to consider the impact of using phenomenological models on quantities of interest such as bottom shear stresses and deposition maps. Those models combine experimental observations with physical intuition and try to capture the influence of the sediment concentration on the local flow viscosity and settling velocity. Both parameter uncertainties and different forms of model discrepancy (stochastic spatial fields) are considered in the simulations through non-intrusive stochastic collocation methods while a parallel Navier-Stokes solver handles the underlying deterministic model. A scientific workflow management engine tool designed for high-performance computers supports the whole procedure.

PALAVRAS-CHAVE: PARTICLE-LADEN FLOWS, TURBULENT FLOWS, PARAMETRIC UNCERTAINTIES