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COMPUTER PREDICTIVE MODELS FOR PARTICLE LADEN FLOWS : PARAMETRIC AND STRUCTURAL UNCERTAINTIES

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Abstract. The increasing reliance on numerical simulation for the design, analysis and optimization of complex physical systems has lead to pushing forward the development of knowledge in this area. Uncertainty Quantification (UQ) provides a framework to enable robust computer simulations that take into account the unavoidable uncertainties present in parameters (input data) and in the model structure (model discrepancy). Particle-laden flows are considered to be responsible for sediment transport and deposition that lead to the formation of basins hosting oil reservoirs. Generally speaking, those turbulent flows are triggered by small differences in the fluid density induced by the presence of sediment particles. A detailed modeling of this phenomenon may offer new insights to help geologists to understand the deposition mechanisms and the final stratigraphic form of the reservoirs. 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 viscosity 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. Both parameter uncertainties and different forms of model discrepancy (stochastic spatial fields) are considered in the simulations through non-intrusive stochastic collocation methods while the underlying deterministic model is handled by a fully parallel Navier-Stokes solver. The whole procedure is supported by a scientific workflow management engine tool designed for high-performance computers.