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GPU Accelerated Numerical Simulation of Viscous Flow Down a Slope

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Numerical simulations are an effective tool in natural risk analysis. They are useful to determine the propagation and the runout distance of gravity driven movements such as debris flows or landslides. To evaluate these processes an approach on analogue laboratory experiments and a GPU accelerated numerical simulation of the flow of a viscous liquid down an inclined slope is considered.

The physical processes underlying large gravity driven flows share certain aspects with the propagation of debris mass in a rockslide and the spreading of water waves. Several studies have shown that the numerical implementation of the physical processes of viscous flow produce a good fit with the observation of experiments in laboratory in both a quantitative and a qualitative way. When considering a process that is this far explored we can concentrate on its numerical transcription and the application of the code in a GPU accelerated environment to obtain a 3D simulation.

The objective of providing a numerical solution in high resolution by NVIDIA-CUDA GPU parallel processing is to increase the speed of the simulation and the accuracy on the prediction. The main goal is to write an easily adaptable and as short as possible code on the widely used platform MATLAB, which will be translated to C-CUDA to achieve higher resolution and processing speed while running on a NVIDIA graphics card cluster. The numerical model, based on the finite difference scheme, is compared to analogue laboratory experiments. This way our numerical model parameters are adjusted to reproduce the effective movements observed by high-speed camera acquisitions during the laboratory experiments.