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Fast 2D flood modelling using GPU technology – recent applications and new developments

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In recent years there has been considerable interest amongst scientists and engineers in exploiting the potential of commodity graphics hardware for desktop parallel computing. The Graphics Processing Units (GPUs) that are used in PC graphics cards have now evolved into powerful parallel co-processors that can be used to accelerate the numerical codes used for floodplain inundation modelling. We report in this paper on experience over the past two years in developing and applying two dimensional (2D) flood inundation models using GPUs to achieve significant practical performance benefits. Starting with a solution scheme for the 2D diffusion wave approximation to the 2D Shallow Water Equations (SWEs), we have demonstrated the capability to reduce model run times in 'real-world' applications using GPU hardware and programming techniques.

We then present results from a GPU-based 2D finite volume SWE solver. A series of numerical test cases demonstrate that the model produces outputs that are accurate and consistent with reference results published elsewhere. In comparisons conducted for a real world test case, the GPU-based SWE model was over 100 times faster than the CPU version. We conclude with some discussion of practical experience in using the GPU technology for flood mapping applications, and for research projects investigating use of Monte Carlo simulation methods for the analysis of uncertainty in 2D flood modelling.