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REGIONAL DISTRIBUTED HYDROLOGIC MODELING USING GPU

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ABSTRACT: Globally, water-related natural disasters (e.g., floods and droughts) are among the most frequent and costly natural calamities in terms of human hardship and economic loss. Understanding and estimating the spatiotemporal distribution of water at its intersection with mankind and the environment is critical for planning and management of a critical natural resource, especially under uncertain climate conditions. To this end, hydrologic models serve as valuable tools in urban planning and design in terms of flood planning and mitigation and water resource management. Recently, more distributed hydrologic models have emerged as computing resources become more efficient and available. Studies have shown that distributed hydrologic models fare well when compared to lumped models because of the improved ability to represent spatial nature of watershed characteristics. Additionally, distributed hydrologic models explicitly represent the physical processes of rainfall to runoff to help better understand the interaction of the environment and the surrounding ecosystem with fluid transport. This paper presents the development of a two-dimensional hydrologic model which solves the equations of conservation of mass and momentum. The distributed hydrologic model has been designed in graphics processing unit (GPU) framework using NVIDIA';s Compute Unified Development Architecture (CUDA) to leverage commodity high performance computing (HPC) power. This computational power allows the use of high fidelity distributed hydrologic models to evaluate hydrologic impacts at scales not previously feasible for planning and management studies. The development, validation, and use-cases of this model will be presented.

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