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A Cloud-based Framework for Coupling the National Water Model with a 2D Hydrodynamic Model for Improved Flood Forecasting in Low Relief Coastal Terrains

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Abstract: Coastal areas face significant challenges due to climate change. One of the primary challenges is the increasing risk of flooding that can cause severe damage and threaten lives. As such, the ability to accurately forecast flooding events and disseminate alerts is increasingly important. The National Water Model (NWM) has made large strides in providing flood forecasting information on a large scale. However, the coarse resolution of the NWM may not be sufficient for low relief coastal terrains. Rather, 2D hydrodynamic models are often more suitable for flood forecasting in coastal areas where low relief terrain is common. However, the computational expense of these models can pose a barrier to their implementation. This work focuses on the design of a cloud-based, real-time modeling system for a 2D hydrodynamic model coupled with the NWM to support decision makers in assessing flood risk in coastal areas. A prototype has been created using Google Cloud Platform (GCP) including cloud-based execution for the 2D hydrodynamic model with high spatial resolution input data, utilization of GPUs for model execution speed-up, a relational database for storing the model output, and a web front-end for dissemination of results and model initiation. The system is designed to run automatically if an extreme weather event is forecasted and produce near real-time results using boundary conditions automatically obtained and prepared from the NWM.

Keywords*: Flood warning applications; cloud computing; 2D hydrodynamic model; GPUs; Google Cloud Platform*