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A MULTIDIMENSIONAL MODELING APPROACH FOR COUPLED SHALLOW WATER + OVERLAND FLOW

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Recent storm events, for example Hurricane Sandy, which led to extensive flooding along much of the U.S. East Coast, have demonstrated the severe vulnerability of coastal lowlands and watersheds to storm surge combined with torrential rainfall. Accurate and efficient computational modeling of these types of flooding events, which can provide crucial data to assess flood risk and aid in emergency management planning, presents significant challenges. These challenges are primarily due to the complex topology of coastal watersheds and floodplains, which include features relevant to flooding such as small-scale drainage channels that receive stormwater from both the landfall of storm surge and runoff/overland flow due to rainfall.

The overall goal of the research presented in this talk is to improve the predictive capability of coastal hydrodynamic models for these types of scenarios. To this end, we present a multidimensional, multi-physics modeling framework for coupled shallow water + overland flow that employs two-/three-dimensional (triangular/triangular prism) elements for shallow water flow, one-dimensional line elements (element edges) for flow in small-scale channels/rivers that would be too computationally expensive to resolve in a full multidimensional setting, and the concept of so-called kinematic or run-off cascades for overland flow. We will discuss the formulation and implementation of the new modeling approach using discontinuous Galerkin methods and present results from example test cases.