Godara, Nitesh; Bruland, Oddbjørn; Alfredsen, Knut

Flash flood simulations in a steep catchment using Telemac2D - hydrodynamic rainfall-runoff model

Flash flood simulations in a steep catchment using Telemac2D - hydrodynamic rainfall-runoff model

Nitesh Godara, Oddbjørn Bruland, Knut Alfredsen
nitesh.godara@ntnu.no, Trondheim, Norway
Department of Civil and Environmental Engineering, Norwegian University of science and Technology Trondheim, Norway

Abstract – **The frequency of extreme events is increasing as the consequences of climate change. According to the World Meteorological Organization (WMO, 2021), floods are the third largest hazard in terms of human losses (58 700 deaths) and second largest in terms of economic losses (US$115 billion). The extreme events are likely to increase in the future years because of the changing climate. Flash flood events also have large environmental and economic damage potential. Flash floods triggered by rain-on-snow events in small and steep catchments can lead to snow avalanches, landslides, debris flow, sedimentation and erosion of the riverbanks and bed. Hence, the analysis of such events is very important in terms of potential damage assessment and preparedness for such extreme events.**

In the present work, Telemac2D is used for flash flood calculations in a small and steep snow-covered Norwegian catchment using rain-on-grid technique. Telemac2D is originally a hydrodynamic model but has an option to include rainfall-runoff module making it a hydrodynamic rainfall-runoff model (HDRRM). Use of single model for both hydrological and hydraulic calculations save time for calibration and offline coupling of two different models. Also, it is possible to calculate high velocities, sheer stresses, water depths and extract flow hydrograph at any point in the catchment unlike a traditional hydrological approach where the flow hydrograph is generated usually only at the outlet of the catchment. At the moment, the hydrological module present in Telemac2D uses curve number method for hydrological calculations. The current study evaluates the model for flash floods calculation in small and steep catchments and suggests further improvements. Spatially distributed precipitation with hourly resolution was used.

The results show that this model can be used satisfactorily for short term events with peak flows but for longer events, the results indicate a need for time-varying curve number. Alternatively, implementation of another hydrological method can be done which includes time-varying infiltration abstractions and store the infiltrated water as subsurface flow which can further contribute to the recession part of the hydrograph. Furthermore, the study explores the benefits and limitations through a comprehensive description of model construction, calibration, and sensitivity analysis.

Keywords: Flash flood, Small and Steep catchments, rainfall-runoff modelling, rain-on-grid, Telemac2D.