Plinius Conference Abstracts,
Vol. 11, Plinius11-131, 2009
11th Plinius Conference on Mediterranean Storms

An early warning system for flash floods in Egypt

J. Cools (1), A. Abdelkhalek (2), M. El Sammany (3), A.H. Fahmi (3), W. Bauwens (2), and M. Huygens (1)

(1) Soresma, Gent, Belgium (jan.cools@soresma.be), (2) Vrije Universiteit Brussel (VUB), Department of Hydrology, Faculty of Engineering Sciences, Brussels, Belgium, (3) Water Resources Research Institute (WRRI), El Qanater, Cairo, Egypt

This paper describes the development of the Flash Flood Manager, abbreviated as FlaFloM. The Flash Flood Manager is an early warning system for flash floods which is developed under the EU LIFE project FlaFloM. It is applied to Wadi Watier located in the Sinai peninsula (Egypt) and discharges in the Red Sea at the local economic and tourist hub of Nuweiba city. FlaFloM consists of a chain of four modules: 1) Data gathering module, 2) Forecasting module, 3) Decision support module or DSS and 4) Warning module. Each module processes input data and consequently send the output to the following module. In case of a flash flood emergency, the final outcome of FlaFloM is a flood warning which is sent out to decision-makers.

The 'data gathering module' collects input data from different sources, validates the input, visualise data and exports it to other modules. Input data is provided ideally as water stage (h), discharge (Q) and rainfall (R) through real-time field measurements and external forecasts. This project, however, as occurs in many arid flash flood prone areas, was confronted with a scarcity of data, and insufficient insight in the characteristics that release a flash flood. Hence, discharge and water stage data were not available. Although rainfall measurements are available through classical off line rain gauges, the sparse rain gauges network couldn't catch the spatial and temporal characteristics of rainfall events. To overcome this bottleneck, we developed rainfall intensity raster maps (mm/hr) with an hourly time step and raster cell of 1*1km. These maps are derived through downscaling from two sources of global instruments: the weather research and forecasting model (WRF) and satellite estimates from the Tropical Rainfall Measuring Mission (TRMM).

The 'forecast module' comprises three numerical models that, using data from the gathering module performs simulations on command: a rainfall-runoff model, a river flow model, and a flood model. A rainfall-runoff model transforms the (forecasted) rainfall into a runoff volume (m^3) and consequently a time-dependent discharge (m^3/s) for each of the subwadis which is then routed through the main channel. The flood model then converts the discharges into water stages and generates a spatially-distributed flood map. The rainfall-runoff model is developed in Matlab-Simulink. The latter two models are implemented in Infoworks and Floodworks (both Wallingford Software), which allows an automatic feed into the warning module. The 'warning module' has two tasks: 1) to generate specific flags when modelling results exceed pre-established thresholds for rainfall, discharge, water stage, volumes, etc… 2) to communicate the given flags as warning signals to operators and/or stakeholders. The 'decision support module' or DSS finally gives to the user the capability of performing alternative analysis in order to have a better idea of the reliability of the forecasts by means of the comparison of already made forecasts with new data and a sensitivity analysis.

Although FlaFloM is now able to send out warnings, the forecasts of this first version are expected to be insufficiently accurate which may lead to false warnings and loss of trust with decision-makers if not communicated well. When new insights and data are available, the model will be updated which improves the forecast accuracy. At this moment, we see two major fields of improvement: 1) better rainfall forecasts and 2) better insights of the response of an arid area to storm events. Firstly, the rainfall maps provided better insights in the spatial and temporal extent of a rainfall event, though absolute rainfall values are not considered accurate. The major reason behind is the fact that both global systems are insufficiently parameterized for arid areas. New data from an improved rain gauge network is expected to add value. Secondly, better insights need to be gained on the response of the Wadi to rainfall. The calibration of the hydrological models is currently based on literature and a geological surface map from which we derived infiltration rates. Modelled discharges or flood volumes can only be assessed qualitatively based on the field knowledge of local Bedouins inhabitants. To reduce uncertainty on forecasts and to guide on new data to be collected, a sensitivity analysis with rainfall scenarios is performed.