

Runoff prediction and flood warning for a small river catchment supported by a web interface in Berlin



S.Bandermann¹, S.Gilli¹, K. Draht², L. Goll³, B. Stremmel⁴, D. Gierse⁵, B. Creutzfeldt³

¹ Ingenieurgesellschaft Prof. Dr. Sieker mbH (IPS), Rennbahnallee 109A 15366 Hoppegarten (E-mail: info@sieker.de); ² Berliner Wasserbetriebe, 10179 Berlin;

³ Berliner Senatsverwaltung für Stadtentwicklung und Umwelt, 10179 Berlin;

⁴ 3S Sensor Systems Solutions, 12677 Berlin; ⁵ HydroSystemTechnik, 59872 Meschede

Introduction

The Panke (Fig 1), a 27 km long river with a catchment area of 200 km², is prone to flash floods that can cause severe damage in the urban area of Berlin. The main reason for this is the storm-water sewer system draining into the river. The peak run-off therefore occurs shortly after it rains.

To protect the city from sudden and fast flash floods a gauge based warning system was not found to be helpful because its warning time-frame was not advanced enough to allow realistic precautionary measures to be carried out.



Fig 1: River Panke in Berlin

In response to this threat, the city of Berlin and the Berliner Wasserbetriebe (BWB, company responsible for the urban drainage system) promoted a new flood prevention strategy: a radar based precipitation forecast system combined with a river runoff model that predicts the runoff 2 hours in advance. This time-window is sufficient for the emergency services to take action and apply suitable protection measures. The predicted runoffs are available online (live web interface) for different locations. When certain thresholds are reached, automatic alerts are triggered.

Rainfall-Runoff

The hydrological modeling of the river Panke and its catchment is performed by the software STORM (IPS). It takes into account the distributed rainfall, soil-water balance, evaporation, runoff concentration with time-area-functions and the urban drainage systems. The results are transferred to a hydraulic river model (HEC-RAS), which calculates, in combination with GIS tools, water levels, floodplains inundations and damage potential.



Fig 2: System sketch of the river Panke

Flood Forecast

Runoff and flood forecasting are performed by linking the hydrological model STORM with a radar-based precipitation forecast. We use the data of the private weather service HST, which are simultaneously calibrated using rain-gauges. The forecast is available with a resolution of 5 minutes for the first 2 hours (Fig 4). It then covers the next 3 days in steps of 1 hour. The STORM® simulation runs in a loop using continuously updated data from 5 virtual rain gauges. The results are made available on the fly in a web-based database.

Web-Interface and Flood Warning

The runoff predictions are visualized with the web-interface HydroWebView, developed in cooperation with 3s sensors systems solutions (Fig 3). The service is already in use in a way that, if thresholds are exceeded, a warning will be generated and passed on by SMS and e-mails. The BWB then activates a diversion gate (Fig 2). Registered users (for now only project-partners) can access simulation forecasts as well as results for historical events at various locations along the Panke. The service can be made available to a broader public in the future.

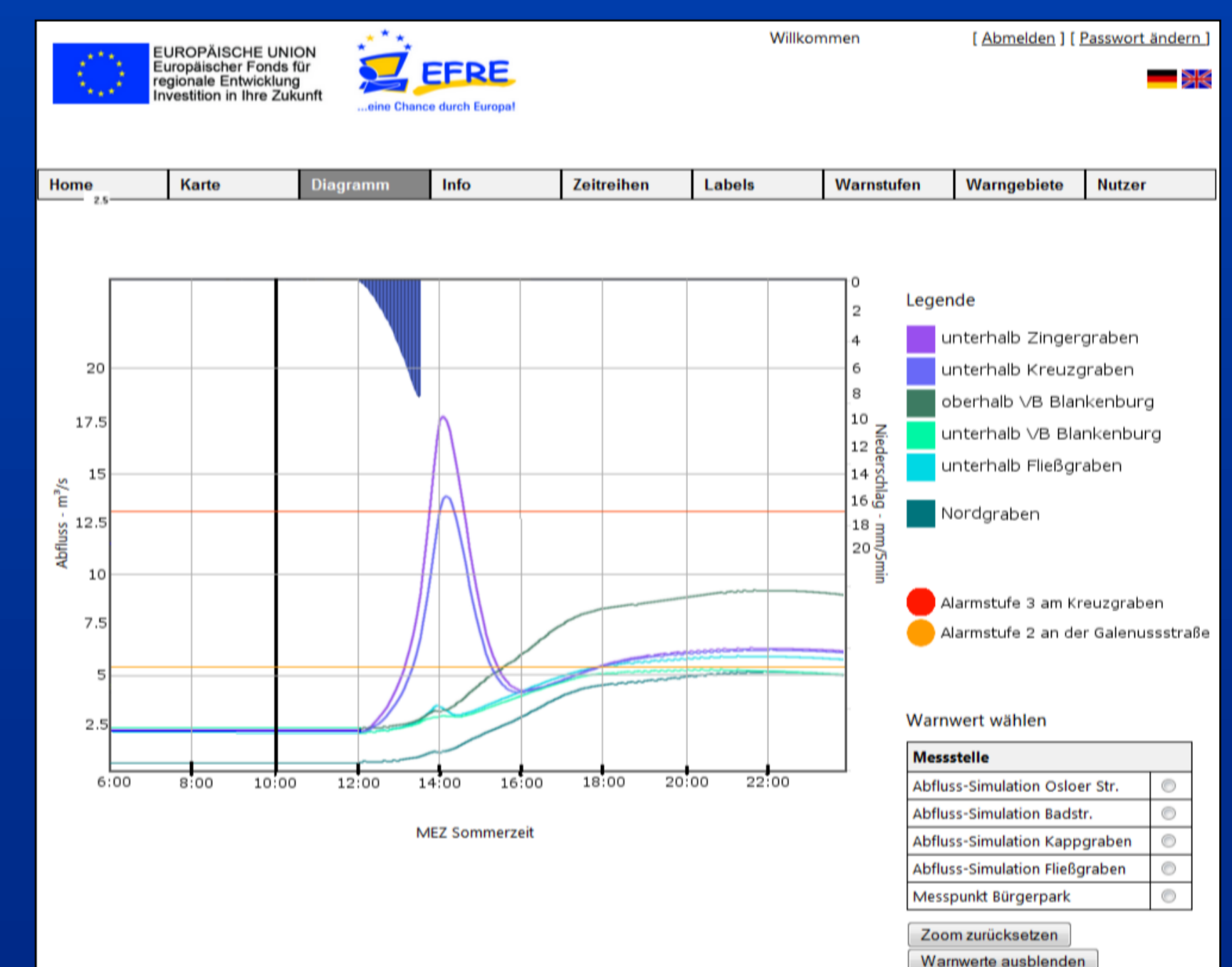


Fig 3: WEB Interface HydroWebView

Outlook

An extension of the model, which is currently in the test phase, consists of the automated coupling of the rainfall-runoff model with an hydraulic model (HEC-RAS). Using an API, the inflows calculated in STORM are passed on as boundary conditions in HEC-RAS.

The coupled hydrological-hydraulic model thus allows a live forecast of the water level in the Panke for the next 72 hours. The results are posted on the same web-interface (Fig 3).

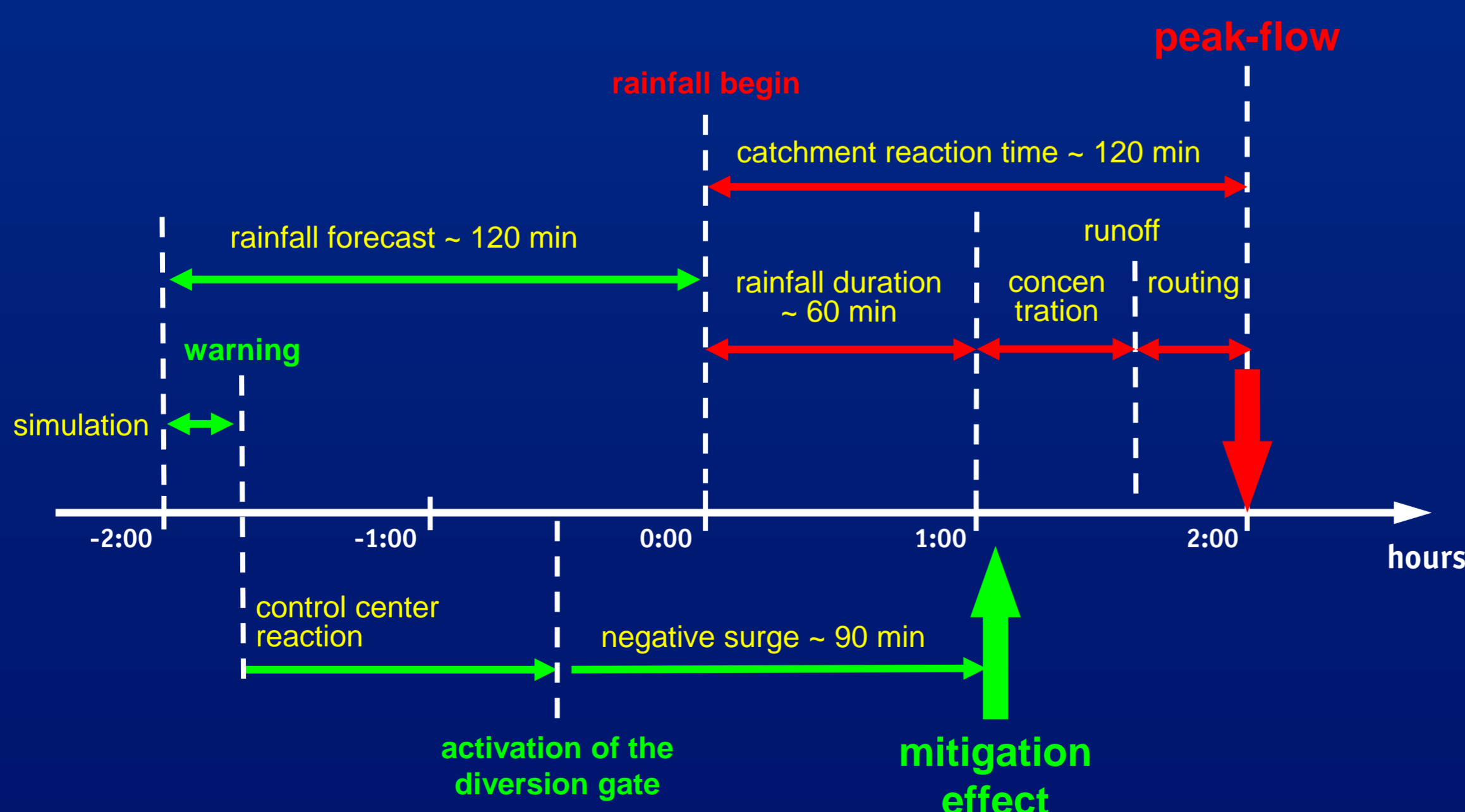


Fig 4: Time line

Conclusions

An effective flood alert warning tool for urban areas has been set up. By using accurate forecast rainfall data in the rainfall-runoff model STORM, it is possible not only to simulate historical events, but principally to alert authorities to implement timely flood protection measures. The model has been working in real time since July 2015. A 3-day forecast of the flow of the river Panke is displayed on diagrams on a dedicated website. A tool extension is currently being tested with the coupling of a hydraulic model (HEC-RAS) for also forecasting water levels.