RAPIDS: RAdar Pluvial flooding Identification for Drainage System

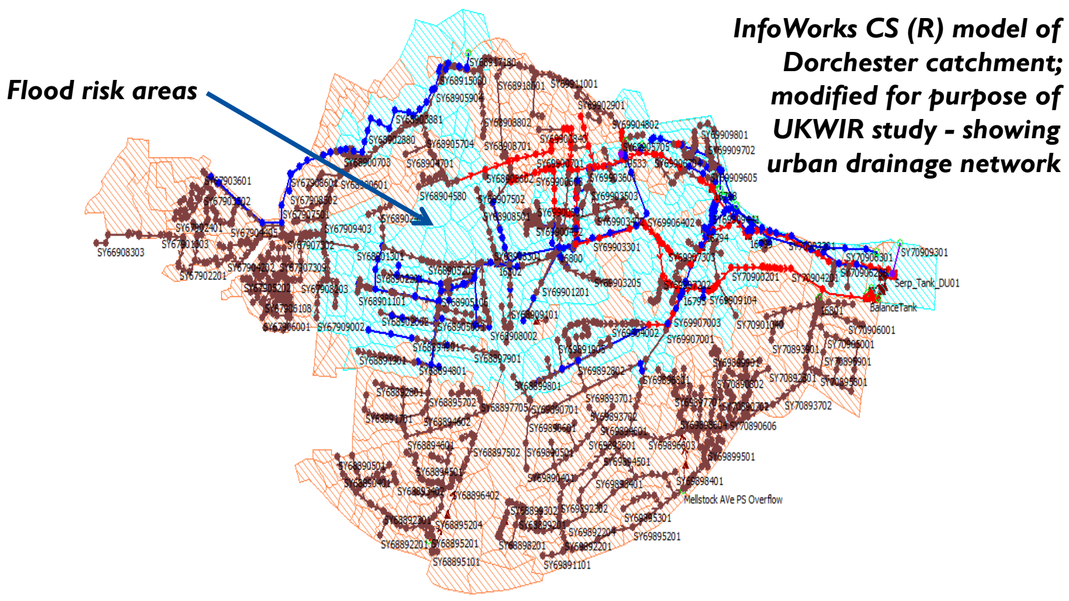
University of Exeter Centre for Water Systems

Andrew Duncan, Ed Keedwell, Slobodan Djordjević, Dragan Savić

UKWIR

Risks from urban flooding

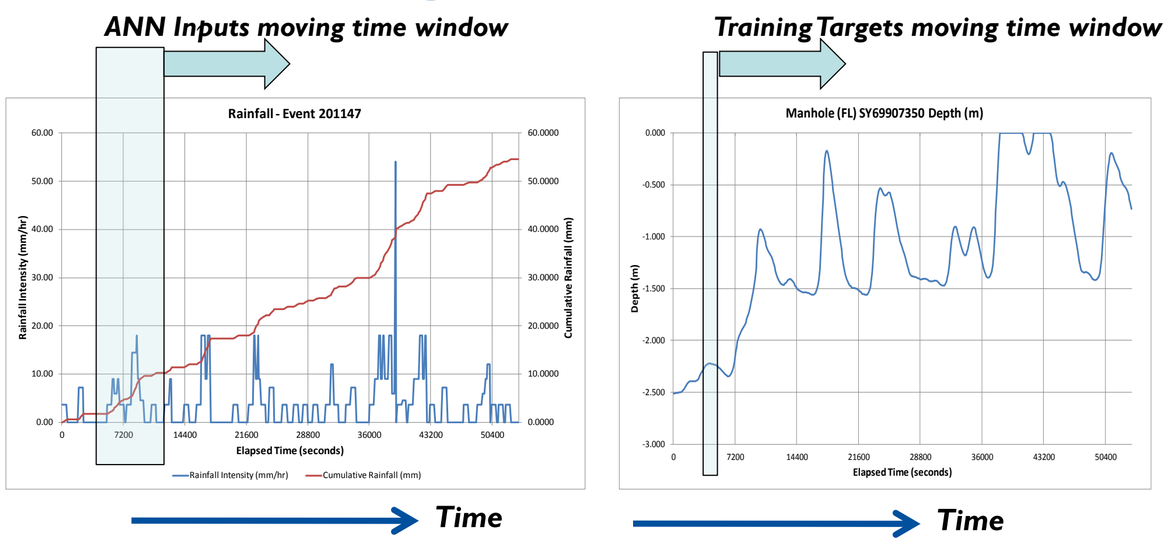
Increasing frequency and severity of extreme rainfall events means that people and property are being more frequently exposed to risks from urban flooding. These include damage to property, possible injury, exposure to disease vectors, and loss of life. The Environment Agency, water companies and local authorities thus require predictive models that work rapidly in real-time and provide temporally and geographically accurate assessments of likelihood and severity of flooding with, ideally, an operational minimum lead-time of 2 hours.



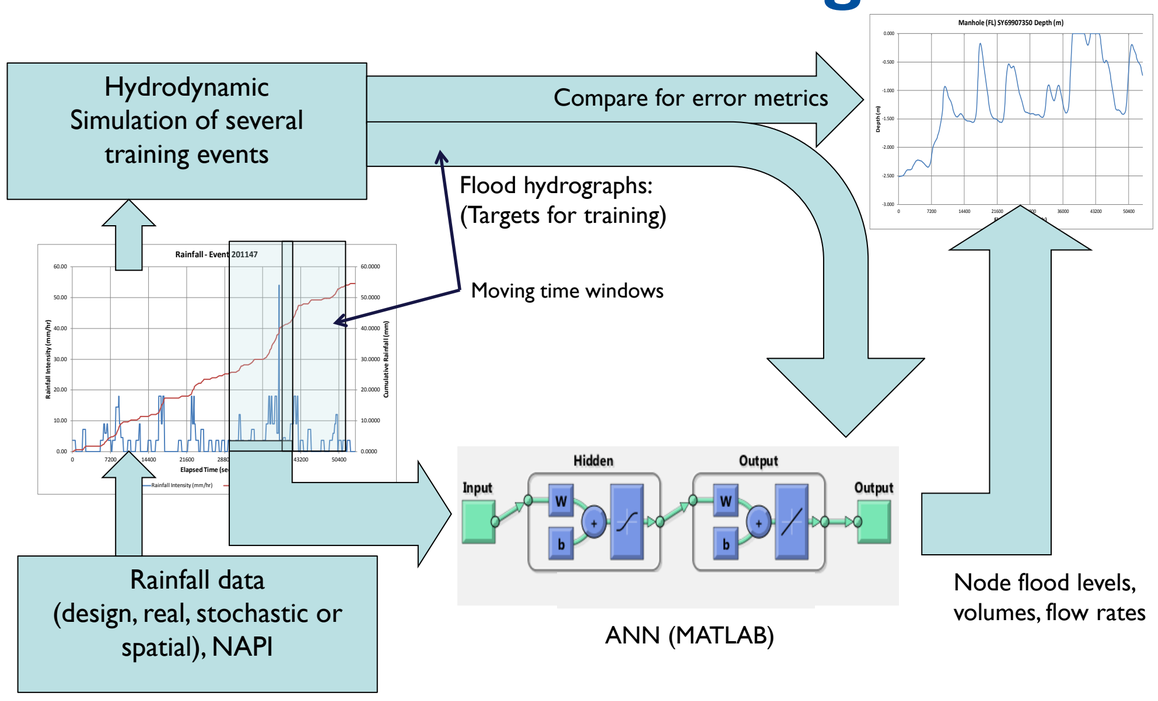
RAPIDS – ANN training schema

Inputs to the ANN include time-dependent signals such as rainfall intensity, cumulative rainfall depth and an estimate of soil moisture (NAPI). A moving time-window of the history of these signals is applied in parallel to the ANN inputs. Outputs are flood depths, flow rates or volumes from manholes, CSOs and outfalls. During training, the actual output of each node in the output layer is compared with the desired target flood hydrographs, produced either from observations or from the output of a hydrodynamic simulator. During training, several optimisation strategies are available to minimise the differences between ANN output and target signals over all the samples in the training dataset.

Moving time windows

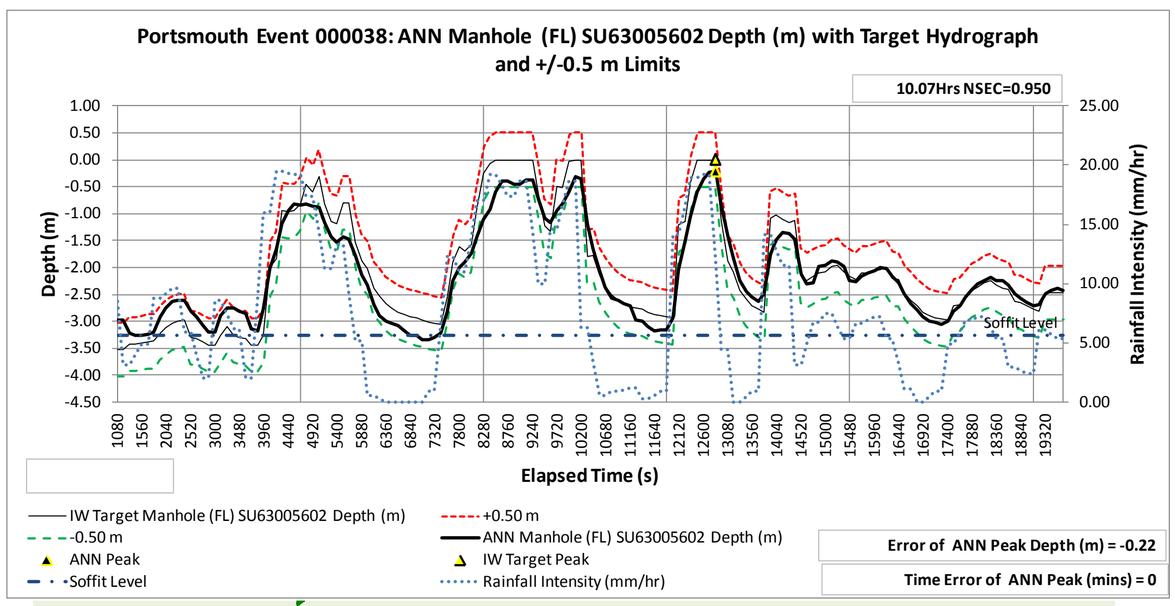


RAPIDS – ANN training schema



Test results (HydroMAT)

The Hydrographic Model Analysis Tool (HydroMAT) was developed to analyse results using 14 metrics. Here, results from 4 of them are shown for a RAPIDS model built for the Portsmouth urban catchment. ANN test output and original target hydrographs for a single manhole are presented. Depth and timing error of peak are also shown. Below that is a summary (Confusion Matrix) of peak flood depth categories for 20 manholes, comparing ANN output with target 'observations'. 19 nodes out of 20 are correctly classified.



Portsmouth Event 000038: Confusion Matrix for Flood Depth Categories

Depth Category of IW Target 'Observation'	Depth Category of ANN Prediction: A	B	C
A	0	0	0
B	0	5	0
C	0	1	14

Flood Depth Category Key

A = Below Soffit

B = Between Soffit and Basement Flood Level

C = Above Basement Flood Level

Published papers

Duncan, A., Chen, A.S., Keedwell, E., Djordjević, S., Savić, D.A., 2011. Urban flood prediction in real-time from weather radar and rainfall data using artificial neural networks, in: IAHS Red Book series no. 351, 58. Presented at the Weather Radar and Hydrology International Symposium, International Association of Hydrological Sciences, Exeter, UK.

Kellagher, R., 2012. The Use of Artificial Neural Networks (ANNs) in Modelling Sewerage Systems for Management in Real Time: Volume 1 - UKWIR Main Report (12/SW/01/2).

Schellart, A., Ochoa, S., Simões, N., Wang, L.P., Rico-Ramirez, M., Liguori, S., Duncan, A., Chen, A.S., Keedwell, E., Djordjević, S., others, 2011. Urban pluvial flood modelling with real time rainfall information–UK case studies.

www.floodrisk.org.uk

EPSRC Pioneering research and skills

Environment Agency

defra

RIVERS Agency

OPW

EPSRC Grant: EP/FP202511/1

HR Wallingford

raa

Halcrow

mouchel

FRMRC flood risk management research consortium

University of Exeter College of Engineering, Mathematics and Physical Sciences