Geophysical Research Abstracts
Vol. 20, EGU2018-1974, 2018
EGU General Assembly 2018

Wetropolis' flood demonstrator: mathematical design & drowning by numbers

Onno Bokhove, Tom Kent, and Thomas Goodfellow
Leeds, School of Mathematics, Applied Mathematics, United Kingdom (o.bokhove@leeds.ac.uk)

The Wetropolis Flood Demonstrator will be introduced and analysed. Wetropolis commenced as outreach model for the public to let them experience rainfall events causing river flooding [1,2]. Wetropolis is a table-top model with a conceptual river, flood plain, city, porous moor representing the upper catchment and groundwater flow, and an upland reservoir. Key is the rainfall, in terms of rain amount per Wetopolis day (a day is WD=10s), it rains either 1s, 2s, 4s or an extreme 9s in a WD, and rainfall location, either in the moor, in both reservoir and moor, in the reservoir or not. These 4x4=16 rain amount times rain location combinations are visually drawn daily (so every 10s) from two skewed Galton boards (as two steel balls fall down), with the most extreme rainfall event: 90% rainfall in both moor and reservoir with a probability of 7/256$\sim$3%, causing floods in the city every 5 minutes on average, by mathematical design.

Although it started as outreach tool, Wetropolis has also triggered the thinking about flood mitigation amongst flood practitioners. Wetropolis was inspired by the extreme 2015 Boxing Day Aire River floods in and around Leeds, UK. Straightforward and more advanced analysis of extreme floods peaks of several rivers in Yorkshire shows that it is useful to introduce the excess flood volume, the volume of water above a certain river level threshold that caused the flooding. Given these excess volumes, I will show which flood mitigation measures are expected to be useful.

Flood storage via controlled and enhanced flooding of certain sections of flood plains and reservoir storage seems hitherto the only mechanisms to create the required volumes or "space for water". Natural flood management solutions, whilst seemingly appealing, generally contribute (far too) little to flood mitigation, as simple estimates can illustrate. To wit, the Boxing Day floods in Leeds, taking a flooding threshold of 3.9m at the Armley river level gauge in Leeds, lea to a flood excess volume/lake of 2.1k by 2.1km and 2m depth. When one is able to partition this lake in parts on upstream flood plains, then the flood damage can possibly be minimised or prevented.

Time permitting, we may showcase Wetropolis life at the EGU General Assembly [3].

[1] https://blogs.reading.ac.uk/dare/2017/07/25/wetropolis-flood-demonstrator/
[2] Outreach project of EPSRC Living with Environmental Change Network Maths Foresees: www1.maths.leeds.ac.uk/mathsforesees/projects.html
Further funding from EPSRC Fluid Dynamics Centre for Doctoral Training, University of Leeds, Leeds and the School of Mathematics, University of Leeds, Leeds, UK.
[3] Convenors, please respond as to whether life showcasing is possible and for how long –to make the long car trip worthwhile. See [1] for the size of the set-up, circa 1.4mx1.4m.