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# Wetropolis: models for education and water-management of floods and droughts

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The Wetropolis flood demonstrator was constructed based on a mathematical design by Bokhove and built in 2016 by Zweers. It visualises how extreme rainfall events can cause extreme river flood events in a dynamic, conceptual and scaled table-top set-up. It contains a 1:100-sloped meandering river with flood plain, fixed upstream inflow, a city plain downstream, a moor with visible groundwater flow and a reservoir and, rainfall. Extreme events are often classified in return periods, e.g. the Leeds Boxing Day flood in 2015 was an event with a magnitude which occurs, on average, only once in 200 (or more) years; it is a so-called 1:200+ return period event. Return periods may be difficult to comprehend: people often think that the next Boxing Day event will happen in 2215. Wetropolis provides us a visualised sense of return periods. Rather than 24hrs, a Wetropolis day is scaled down to 10s (i.e. one wd), and rather than 1:200yrs extreme river floods in Wetropolis return on average every 36.5wd's, so on average every 365s. Rainfall varies in both location and duration: either in the reservoir, reservoir and moor, in the moor or nowhere, which four outcomes are determined by a steel ball falling down every 10s through a skew-symmetric Galton board with probabilities: 3/16, 7/16, 5/16 and 1/16. Likewise, rain duration is 1s, 2s, 4s or 9s during a 10s day with the same probabilities. It follows that maximum rainfall occurs when it rains 9s (or 90%) in both moor and reservoir with a probability of (1/16)x7/16 =7/256. Correspondingly, the city only floods when this rare rainfall event happens, so every (256/7)x10s=365s, on average. During the Boxing Day flood it rained 48hrs consecutively and indeed a Wetropolis' Boxing Day event with two consecutive wd's of extreme 90% rainfall in both locations is extremely rare.

In our EU project (https://www.wetropolis.nl/), Wetropolis will be modified to address educational and water management aspects based on the local hydrology in the Dutch province of Overijssel. First, we will present how we also aim to visualise droughts in Wetropolis, by modifying the Galton board, given that extremes in both drought and flooding are expected under climate change, cf. extreme droughts in the summers of 1976 and 2018. Second, to accommodate flexibility, the Wetropolis design will become modular so that it can be adapted to local situations. Given that Wetropolis concerns conceptual extreme-event modelling and visualisation, since it is not meant to be a scale model, it is key to identify the central concepts of flooding and drought in a particular region before adapting the design. Third, the modular design allows us to promote active thinking about different scenarios of flood and drought mitigation. Hence, Wetropolis is a useful precursor in the creation of water-management solutions by decision makers, and also enhances citizens' participation. We will present concrete examples of the above three innovations.