'Old' information theory makes it easier to predict flooding

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Many different aspects are involved in predicting high water and floods, such as the type of precipitation, wind, buildings and vegetation. The greater the number of variables included in predictive models, the better the prediction will be. However, the models will inevitably become increasingly more complex. PhD student from Delft University of Technology (TU Delft, The Netherlands) Steven Weijs uses basic insight from the information theory (Shannon's Information Theory) to demonstrate the cohesion between this added complexity, the information from observational data and the uncertainty of predictions.

He will continue his research at the École Polytechnique Fédérale de Lausanne in Switzerland thanks to funding from the prestigious AXA Research Fund Postdoctoral Fellowship.

In his research, the Delft PhD student Steven Weijs shows how Shannon's Information Theory can also be applied to studying high water and flooding. Information theory, first devised in 1948 by Claude Shannon, sees information and uncertainty as numerical quantities, measured in 'bits', that correspond with the extent to which the recipient of a message is surprised by that message ('surprisal'). The level of surprisal depends on how likely the recipient considered the event to be: rain in the Netherlands, for example, is hardly a surprise, but seeing rain in the desert is highly unlikely and surprising and therefore provides more information.

Steven Weijs analysed the way information flows through models used to make certain decisions about 'water' (switching pumping engines on and off, for example). The golden rule was: the greater the amount of information, the better the decision. In fact not only the flow of water, but also the flow of information from measurements, via models and predictions, to the final decision should be optimised. This would be achievable by assessing the models according to the amount of information comprised in their predictions.

Acquiring the AXA Research Fund Postdoctoral Fellowship means that after obtaining his PhD in Delft later this year, Weijs will be able to continue his research at the École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland.

TU Delft Works closely with the EPFL in the area of innovative measuring technology. The EPFL is currently focusing on collecting vast amounts of information about the weather and hydrology in the Val Ferret area. This is a pilot district where a lot of high-tech measuring equipment and sensor networks have been set up. The researchers hope that the information can be used to make more accurate predictions about flooding and enable better management of reservoirs to cope with high water levels.

In his follow-up research, Weijs will be applying the information theory to determine the best locations for setting up measuring equipment (and the best type of measuring equipment) in order to collect as much information as possible about possible flooding. The detailed measurements obtained from Val Ferret can also be used to design cheaper, less intensive sensor networks, which can be deployed on a larger scale in similar, larger areas and ultimately be used to make more accurate predictions of flooding in the Netherlands.

Provided by Delft University of Technology