Predicting Heavy Localized Rainfall using Supervised Machine Learning

Motivation:

When stakes are high and the unexpected occurs, it's tempting to throw the baby out with the bathwater and blame the forecasters for their inability to predict the future. At some point, skepticism is likely to become built in: maybe weather is just too random to predict, simply beyond the reach of technology? Actually, neither is true. Thanks to increased computing power and better measurements, the future of weather prediction has never looked brighter.

Automatation is the future of weather prediction:

Weather forecasting in the 21st century will inevitably move towards big data, computer vision, and artificial intelligence. Computer-aided analyses already provide a third eye to the meteorologists, helping them look at things humans don't have the time or energy to do. From drawing weather charts to detecting tornados, tracking hurricanes or analyzing the onset of heavy rain, everything will eventually become automated.

Detecting hazards right when they form:

Early detection of risks can save lives and valuable resources. Consequently, there is a strong interest in developing automated detection algorithms for hazardous weather phenomena. By drawing on the vast historical data collected, non-linear statistical models like artificial neural networks can be trained to identify dangerous situations the instant they begin to form. Some events like the onset of hail or heavy rainfall are harder to predict than others. But the limits of predictability are still vastly unexplored. Knowing what features to look for is key to a successful prediction. This is still a relatively new line of research with many new exciting practical applications..

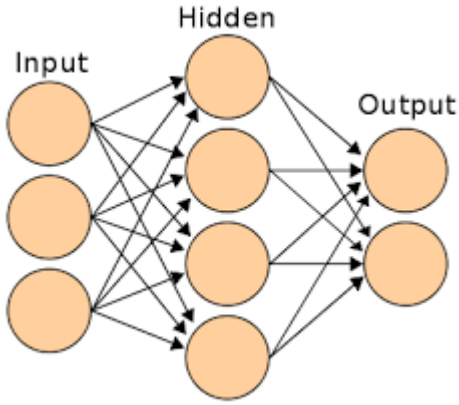

Fig 1: Artificial neural network with one hidden layer.

Objectives:

The goal of the proposed thesis is to apply supervised machine learning techniques to predict the onset of heavy localized rain a few minutes up to a few hours ahead of time. The candidate will:

(1) Train an artificial neural network in R or Python to predict the onset of heavy rainfall based on inputs from a large number of in-situ and remote-sensing data.

(2) Run a case study for the city of Rotterdam, assessing the performance of the developed model(s) as a function of data availability and forecast lead time.

(3) Determine the most informative features, analyze the cost of type I and type II errors and propose ideas for future improvements.

Keywords: machine learning, heavy rainfall, early warning, statistics

TU Delft

For more information:
Dr. Marc Schleiss
Assistant Professor
Room 2.18, GRS
m.a.schleiss@tudelft.nl