EGU2020-8932
https://doi.org/10.5194/egusphere-egu2020-8932
EGU General Assembly 2020

Towards deep learning based flood forecasting for ungauged basins

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Floods are among the most destructive natural hazards in the world. To reduce flood induced damages and casualties, streamflow forecasts should be as accurate as possible.

As of today, streamflow forecasts are usually made with either conceptual or process-based hydrological models. The problem these models usually have is that they perform best when calibrated for a specific basin, and performance degrades drastically if the models are used in places without historic streamflow measurements. To make things worse, some of the most devastating floods occur in developing and low-income countries, where historic records of streamflow measurements are scarce. Therefore, a central task for enhancing flood forecasts and helping local authorities to manage these areas is to provide high-quality streamflow forecasts in ungauged rivers. Although the IAHS dedicated an entire decade (2003-2012) to advance the problem of Prediction in Ungauged Basins the central goal remains largely a challenge.

In this talk, we will present a novel approach for tackling the problem of prediction in ungauged basins using a data-driven approach. More concretely, we show that the Long Short-Term Memory network (LSTM), which is a special type of a deep learning model, can serve as a generalizable rainfall-runoff simulation model. We will present recent results indicating that the LSTM gives on average better out-of-sample predictions (ungauged prediction) than e.g. the SAC-SMA in-sample (gauged) or the US National Water Model (Kratzert et al., 2019).

One place where these research results are already finding their way into operation is Google's Flood Forecasting Initiative. The goal of this initiative is to provide (enhanced) flood warnings, where needed, starting with a pilot project in India. And as mentioned above, historic streamflow records in those regions are scarce, which motivates new and innovative approaches for enhanced streamflow forecasting.

References:

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