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Nowcasting heavy precipitation over the Netherlands using a 13-year radar archive: a machine learning approach

Eva van der Kooij[1], Marc Schleiss[1], Riccardo Taormina[1], Francesco Fioranelli[1], Dorien Lugt[2], Mattijn van Hoek[2], Hidde Leijnse[3], and Aart Overeem[3]

[1]Delft University of Technology, Delft, the Netherlands
[2]HKV Lijn in Water, Lelystad, the Netherlands
[3]Royal Netherlands Meteorological Institute, de Bilt, the Netherlands

Accurate short-term forecasts, also known as nowcasts, of heavy precipitation are desirable for creating early warning systems for extreme weather and its consequences, e.g. urban flooding. In this research, we explore the use of machine learning for short-term prediction of heavy rainfall showers in the Netherlands.

We assess the performance of a recurrent, convolutional neural network (TrajGRU) with lead times of 0 to 2 hours. The network is trained on a 13-year archive of radar images with 5-min temporal and 1-km spatial resolution from the precipitation radars of the Royal Netherlands Meteorological Institute (KNMI). We aim to train the model to predict the formation and dissipation of dynamic, heavy, localized rain events, a task for which traditional Lagrangian nowcasting methods still come up short.

We report on different ways to optimize predictive performance for heavy rainfall intensities through several experiments. The large dataset available provides many possible configurations for training. To focus on heavy rainfall intensities, we use different subsets of this dataset through using different conditions for event selection and varying the ratio of light and heavy precipitation events present in the training data set and change the loss function used to train the model.

To assess the performance of the model, we compare our method to current state-of-the-art Lagrangian nowcasting system from the pySTEPS library, like S-PROG, a deterministic approximation of an ensemble mean forecast. The results of the experiments are used to discuss the pros and cons of machine-learning based methods for precipitation nowcasting and possible ways to further increase performance.