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A deep learning multimodal method for precipitation estimation: case study of the extreme rainfall from July 2021

Arthur Moraux[1,2], Steven Dewitte[3], and Adrian Munteanu[2]
[1]Royal Meteorological Institute of Belgium, Brussels, Belgium
[2]Vrije Universiteit Brussel, Brussels, Belgium
[3]Royal Observatory of Belgium, Brussels, Belgium

In July 2021, western Europe has been subject to extreme rainfall that lead to severe flooding, incurring heavy property losses and claiming dozens of people's lives in both Germany and Belgium. This unfortunate disaster is a reminder that carrying out studies about extreme event forecasting is a matter of prime importance in the field of meteorology. The extreme rainfall from July 2021 invites us to study the performance of our deep learning method for precipitation estimation in case of extreme events.

The main novelty of our method resides in its ability to merge different physical measurement modalities in order to improve precipitation estimation accuracy. In specific, the proposed method merges rain gauge measurements with a ground-based radar composite and thermal infrared satellite imagery. The proposed convolutional neural network design, composed of an encoder–decoder architecture, performs multiscale analysis of the three input modalities to simultaneously estimate the rainfall probability and the precipitation rate with a spatial resolution of 2 km. The training of our model and its performance evaluation are carried out on a dataset spanning 5 years from 2015 to 2019 and covering Belgium, the Netherlands, Germany and the North Sea. Once trained, we evaluate the performance of our model to estimate the extreme precipitation that happened in Belgium and Germany in July 2021 by comparing our results with the measurements from rain gauges and radar estimation.