A Deep Learning Approach to Short-Term Quantitative Precipitation Forecasting

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ABSTRACT

Short-term, spatially distributed quantitative precipitation forecasting (SD-QPF), or 'precipitation nowcasting', is important for hydrological and water resources applications, such as flash flood warning systems and operations of dams and reservoirs. The state-of-the-art methods in SD-QPF include radar extrapolations, numerical weather prediction (NWP) models, and hybrid methods that combine the two. Despite the diversity of methods that have been used, SD-QPF remains difficult: even sophisticated methods may not be able to consistently outperform relatively simple baselines such as Persistence. Methods in Deep Learning (DL) have demonstrated significant and often unexpected improvements across a wide variety of domains ranging from image and video processing to machine translation and speech recognition. Emerging research has suggested that that DL may improve point predictions in the context of very short-term - 0-2 hours - distributed QPF (VSD-QPF) by taking advantage of growing data from in-situ weather sensors as well as remote sensors such as radar and satellites, along with advances in computing. Here we examine the hypothesis that DL can improve VSD-QPF, specifically point predictions, based on observed hourly precipitation data over the contiguous United States, by leveraging a Convolutional Long Short-Term Memory (LSTM) recurrent neural network for 1-hour precipitation nowcasting. We find the DL approach performs better than the baseline method of Persistence and a state-of-the-art method using Optical Flow.

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