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Advancing Spatiotemporal Rainfall Nowcasting through Deep Learning Techniques

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For weather forecasters and hydrologists, predicting rainfall in the short term – minutes to a few hours – is crucial for a range of applications. While traditional nowcasting methods excel in operational settings, they face limitations in predicting convective storm formation and high-intensity events. Enter deep learning, a powerful tool transforming numerous fields. Convolutional neural networks, in particular, have shown promise in improving nowcasting accuracy. These networks can learn complex patterns and relationships within data, like the intricate tapestry of rainfall variations observed in historical radar sequences. However, capturing long-term dependencies in this data remains a challenge, resulting in fuzzy nowcasts and underestimating high-intensity events. This study proposes a novel deep learning model that goes beyond simple extrapolation, effectively capturing both the spatial correlations and temporal dependencies within rainfall data. Our hybrid convolutional neural network architecture tackles this challenge through three key components: Decoder & Encoder: These modules focus on unraveling the intricate spatial patterns of rainfall and a temporal Module to learn the subtle long-term evolutions and interactions between rain cells over time. By capturing these temporal dependencies, the model can produce more accurate forecasts. To evaluate the model performance, it is compared against both deep learning and optical flow baselines. This presentation will introduce the model and provide a summary of its performance in spatiotemporal rainfall nowcasting.

Keywords: deep learning; spatiotemporal encoding, rainfall nowcasting; radar; optical flow