EGU26-8733, updated on 13 Jun 2026
https://doi.org/10.5194/egusphere-egu26-8733
EGU General Assembly 2026

Development of AI-based precipitation forecasting at KIAPS

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This study outlines the development of an artificial intelligence (AI)-based precipitation forecasting system at the Korea Institute of Atmospheric Prediction Systems (KIAPS). The system is designed with three main components: an observation-based model for very short-term forecasting (nowcasting), a post-processing model to correct numerical weather prediction (NWP) fields for longer lead times, and a hybrid model to integrate these approaches which is to be built. The nowcasting model utilizes a U-Net architecture incorporating ConvLSTM at the bottleneck. It uses radar and satellite data sequences to produce 6-hour forecasts; the training strategy involves pretraining on radar/satellite data followed by fine-tuning with 1-hour accumulated rainfall gauge data from Automatic Weather Stations (AWS). The post-processing model employs a ConvNeXt v2 U-Net to correct Korea Integrated Model (KIM) NWP fields for forecasts up to 24 hours. Performance evaluations show that the observation-based model excels at shorter lead times with 34% improvement in the Critical Success Index (CSI) for precipitation exceeding 8 mm/hr, averaged over the 1–6 hour forecast period, compared to the baseline KIM forecast. Meanwhile, the post-processing model, which incorporates a differentiable CSI loss function for robust heavy precipitation forecasting, averaged over the 24 hour forecast period, achieves 31% CSI improvement relative to KIM with reduced performance degradation at longer lead times. Future work will focus on developing the hybrid model to merge these outputs for optimal accuracy across all forecast lead times.