26th International Congress on Modelling and Simulation, Adelaide, SA, Australia, 30 Nov–4 Dec 2025
mssanz.org.au/modsim2025

# A novel deep learning model for post-processing of short- and medium-term daily precipitation forecasts

**Chenguang Zhao** [a]

[a] *State Key Laboratory of Earth Surface Processes and Disaster Risk Reduction, Faculty of Geographical Science, Beijing Normal University, Beijing 100875, China*
*Email: zhaochenguang0413@163.com*

**Abstract:** Accurate precipitation forecasts are crucial for societal development and safety, particularly during extreme precipitation events. Current Numerical Weather Prediction (NWP) models have been widely used and play a key role in precipitation forecasts, however, systematic biases persist. Consequently, statistical methods and deep learning models have been proposed for the post-processing of precipitation forecasts, which improve the original forecasts to a certain degree. However, owing to the highly nonlinear and nonstationary nature of precipitation, these methods fail to perform adequately for extreme precipitation.

Thus, in this study, we first proposed a novel deep learning model, coupling the Long Short-Term Memory and Nonstationary Transformer (LNT), to capture nonstationary precipitation features. Second, we designed a novel loss function, called the generalized exponential likelihood (GEL) loss function to capture extreme precipitation by balancing clustering and outlier features. Furthermore, we proposed a dual-layer dynamic learning rate adjustment strategy (A) for handling dynamic learning demands to get the global optimal solution and the higher precision of post-processing. The dataset from the European Centre for Medium-Range Weather Forecasts (ECMWF) was used as inputs for the models in the experimental post-processing of daily precipitation forecasts.

The results show that precipitation post-processed by the LNT_GEL_A outperformed the original ECMWF forecasts and the other models. Particularly, at the lead time of 240h, when the precipitation was above 50.0mm/d, LNT_GEL_A could better balance the precipitation intensity and reliability, with a CORR of 0.66, the lowest RMSE (14.95mm/d), and a probability of detection (POD) of 0.8. Additionally, the LNT_GEL_A model demonstrated superior performance in capturing high precipitation areas during the spatial distribution analysis of typical extreme precipitation events. Overall, the proposed LNT_GEL_A model offers an innovative approach, enhancing the precision of original precipitation forecasts and providing valuable insights for post-processing short- and medium-term daily precipitation forecasts.

***Keywords:*** *Post-processing, Short- to medium-term daily precipitation forecasts, Deep learning, Loss function, Learning rate*