

Analogue Forecast System for Daily Precipitation Prediction Using Autoencoder Feature Extraction: Application in Hong Kong

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Abstract

In the Hong Kong Observatory, the Analogue Forecast System (AFS) for precipitation has been providing useful reference in predicting possible daily rainfall scenarios for the next 9 days, by identifying historical cases with similar weather patterns to the latest outputs from the deterministic model of the European Centre for Medium-Range Weather Forecasts (ECMWF). Recent advances in machine learning allow more sophisticated models to be trained using historical data to represent patterns of high-impact weather events more effectively. As such, an enhanced AFS has been developed using the deep learning technique autoencoder. The datasets of the fifth generation of the ECMWF Reanalysis (ERA5) are utilised in which more meteorological elements in higher horizontal, vertical and temporal resolutions are made available as compared to the previous ECMWF reanalysis products used in the existing AFS.

The enhanced AFS features four major steps in generating the daily rain class forecasts: (1) preprocessing of gridded ERA5 and ECMWF model forecast, (2) feature extraction by the pre-trained autoencoder, (3) application of optimised feature weightings based on historical cases, and (4) calculation of the final rain class from a weighted ensemble of top analogues. The enhanced AFS demonstrates superior performance over the existing AFS consistently, especially in capturing heavy rain cases, during the verification period from 2019 to 2022. This paper presents the detailed formulation of the enhanced AFS and discusses its advantages and limitations in supporting precipitation forecasting in Hong Kong.

(Full paper to be updated soon.)