Pre-processing of Rainfall Forecasts to Improve the Predictive Skill of the Real-time Flood Forecasting System for the Chao Phraya River Basin

Theerpol CHAROENSUK[1,2#+], Jakob LUCHNER[3], Nicola BALBARINI[3], Piyamarn SISOMPHON[4], Peter BAUER-GOTTWEIN [1]

[1]Technical University of Denmark, Denmark, [2]Hydro Informatics Institute, Thailand, [3]DHI A/S, Denmark, [4]Ministry of Higher Education, Science, Research and Innovation, Thailand

Currently, the effects of climate change are becoming more pronounced. To monitor and forecast floods, many nations and agencies have developed decision support (DSS) and flood forecasting systems. The Chao Phraya River basin, in particular, Thailand's most important river basin, is subject to frequent flooding because of the combined effects of precipitation, river floods and ocean storm surges. Thailand has established the operational Chao Phraya's flood forecasting model and DSS developed by Hydro-Informatics Institute (HII) in collaboration with DHI A/S for monitoring, warning, and assisting the Thai government in decision-making. The flood forecasting system consists of 3 components: 1) A numerical weather model (WRF-ROMS) coupling an atmospheric model, the Weather Research and Forecast (WRF) model with the Regional Oceanic Model System (ROMS) developed by HII 2) A hydrological model simulating runoff using real-time rainfall from situ stations and rainfall forecasts from WRF-ROMS 3) A 1D/2D hydrodynamic model that is forced with runoff produced by the rainfall-runoff model and includes real-time structure operation to simulate water level, discharge, and flood inundation. The quality of rainfall predictions, which have a tendency to underestimate rainfall peaks but overestimate total rainfall, most significantly limits system performance. For this reason, we explored pre-processing techniques applied to the rainfall forecast before ingestion into rainfall-runoff model. In this study, quantile mapping bias correction and random forest regression are used as pre-processing techniques to improve the accuracy of rainfall prediction. Forecast skill was assessed at key stations using RMSE and CSI, evaluated using re-forecasting experiments over a 6-year historical period with and without pre-processing techniques. The evaluation of flood forecast performance using pre-processing techniques shows a significant improvement in prediction skill compared the baseline scenario. Our study demonstrates that the pre-processing techniques can improve the accuracy of rainfall prediction and the skill of the operational system.