Extreme Flood Events Prediction and Classification Using Deep-Learning-based approaches: A Case Study in the Seine River Basin, France

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Résumé

This study focuses on improving flood event prediction accuracy for the Seine River through feature selection, customized loss functions, and comparative analysis of deep learning models. This study considers a comprehensive set of variables, including downstream and upstream weather and hydrological conditions, sub-rivers, and piezo data, to assess their impact on forecasting extreme events. Results showed that including hydrological conditions from the upstream region and sub-rivers significantly enhanced the accuracy of flood event predictions. Customized loss functions, particularly the MSE-based Quantile Tail Huber Loss, improved the models' ability to detect and predict extreme flood events. A comparative analysis of deep learning models, such as GRU, Bi_GRU, Bi_GRU_Attention, and CNN_Bi_GRU_Attention, revealed that the Bi-GRU_Attention model performed the best when combined with the customized loss functions and feature selection scenarios. Forecasting metrics and classification metrics were used to evaluate the accuracy and classification abilities of the models. The study highlights the robustness of customized loss functions and the importance of selecting relevant variables for accurate flood event prediction across different deep-learning models. The research provides valuable insights for flood management authorities and decision-makers, aiding in proactive flood mitigation and disaster response strategies along the Seine River. It also paves the way for future comparisons between data-driven and physically based flood prediction approaches, bridging the gap in flood prediction methods.

Mots-Clés: Deep Learning, Flood Forecasting, Extreme Events, Seine River

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