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Forecasting Reservoir Inflows Using Regionally Trained and Finetuned LSTM Models: A Case Study with CAMELS-DE

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The increasing frequency of extreme hydrological events, such as floods and droughts, poses significant challenges for operators of drinking water reservoirs in maintaining a balance between water supply and demand. While the security of supply typically requires high water levels to meet consumer demands throughout the year, ensuring flood protection, on the contrary, necessitates that reservoir storage is kept partially free to accommodate high inflows. Accurate inflow forecasting is essential for making risk-based operational decisions, including the timely release of water from drinking water reservoirs to mitigate flood risks. While deep learning approaches, particularly Long Short-Term Memory (LSTM) networks, have become prevalent in rainfall-runoff modeling, most existing studies focus on small, homogeneous datasets limited to single hydrological basins. This study leverages the newly published CAMELS-DE dataset to develop a regionally trained and finetuned LSTM model encompassing 1,582 catchments across Germany. We apply this regional model to five small catchments upstream of drinking water reservoirs and compare its performance against basin-specific LSTM models. Our findings demonstrate that the regionally trained LSTM model significantly improves the accuracy of inflow estimates, especially when finetuned to our target catchments. This is highlighting its potential for enhancing reservoir management strategies in the face of climate change.