Time Series Prediction of DC Precipitation Using LSTM

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Motivation And Objective

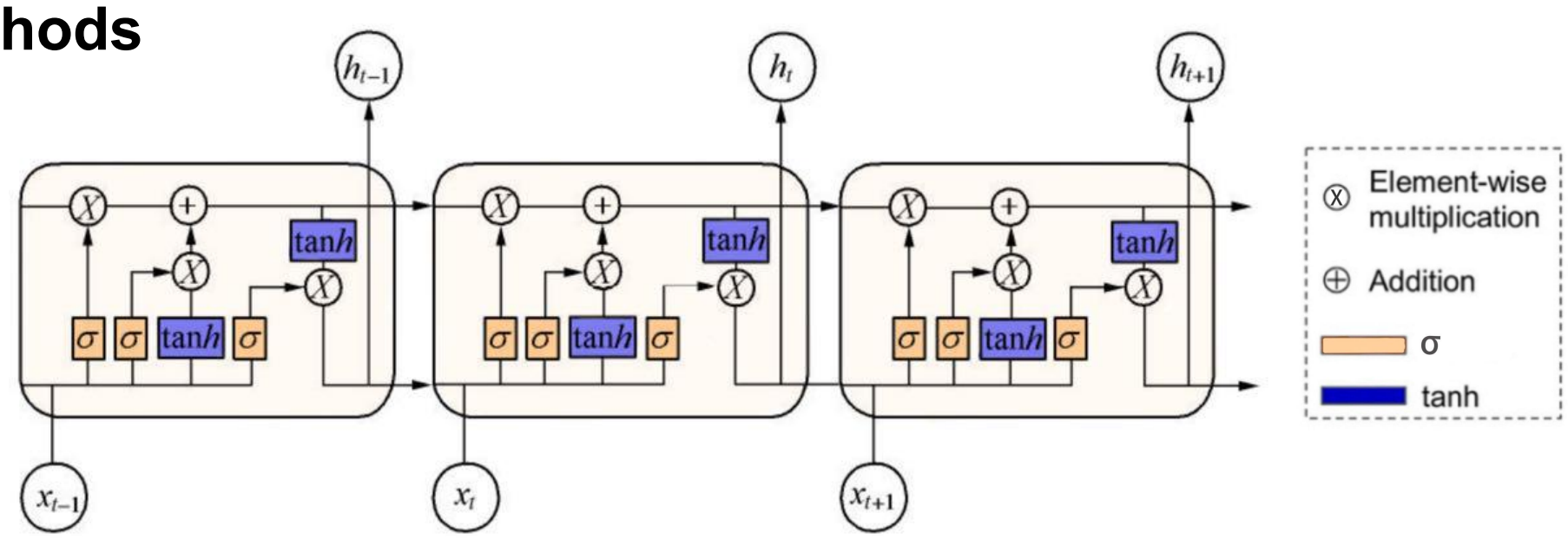
This project aims to predict future precipitation in DC using machine learning models to support water resource management and drought monitoring. ERA5 climate reanalysis data has been utilized and an LSTM model used for time-series forecasting while tracking carbon emissions to evaluate the environmental impact of the model.

Data Overview

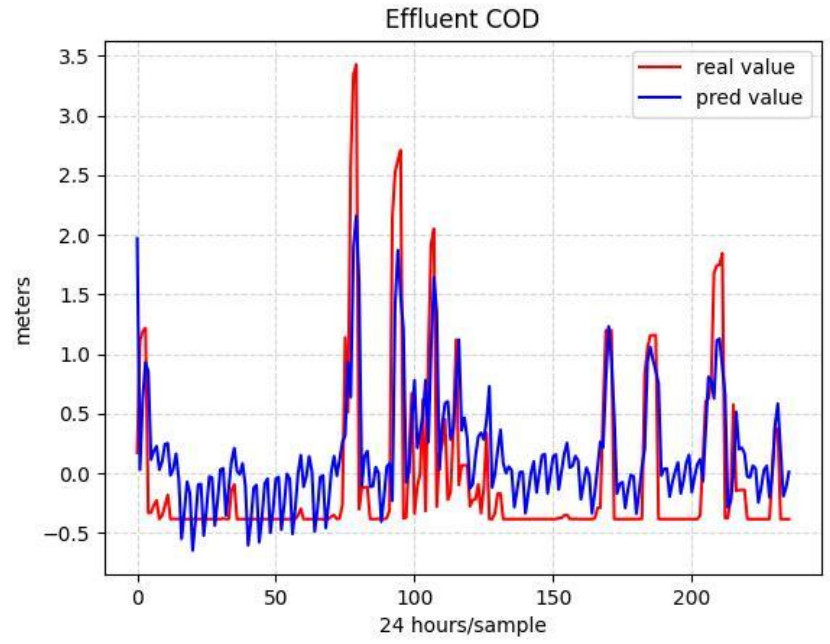
	Meteorological Variable	Level / Altitude
Input	Total Precipitation	Surface
	2m Temperature	2m
	Surface Solar Radiation Downwards	Surface
	Soil Temperature Level 1	Surface/Soil Level 1
Target	Precipitation	Surface

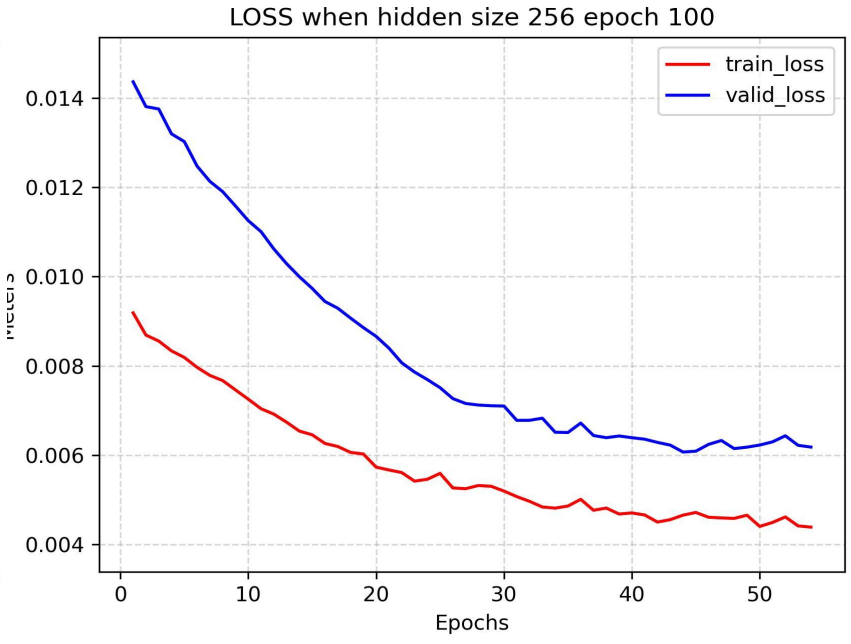
- 12-hourly reanalysis data from ERA5 covering North America.
- Includes variables such as total precipitation, 2m temperature, surface solar radiation, and soil temperature at level 1.

Methods



Evaluation metrics and Results





MAE	0.411598
RMSE	0.29304
MAPE	148.08%
R^2	0.423070

Time	4.38
CO_2 Emissions	2.04E-05
Energy Consumed	5.53E-05
cpu_power	42.5

Future Steps

- Error Analysis:Conduct detailed error analysis by segmenting predictions into low- and high-volatility regions to identify specific areas for improvement.
- Hyperparameter Tuning: Find the optimal hyperparameters.
- Alternative Architectures: Test sequential models like GRU or Transformers for better handling of long-term dependencies.

References

- Blasone, V., Coppola, E., Sanguinetti, G., Arora, V., Di Gioia, S., & Bortolussi, L. (2024). A deep learning framework to efficiently estimate precipitation at the convection permitting scale (Papers track). Workshop paper presented at Climate Change AI.
- Tang, Y., Zhou, J., Pan, X., Gong, Z., & Liang, J. (2024). POSTRAINBENCH: A comprehensive benchmark and a new model for precipitation forecasting. Workshop paper presented at *Tackling Climate Change with Machine Learning*, ICLR 2024.