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Deep Learning Approaches for Daily Climate Forecasting. Case Study: Malang Indonesia

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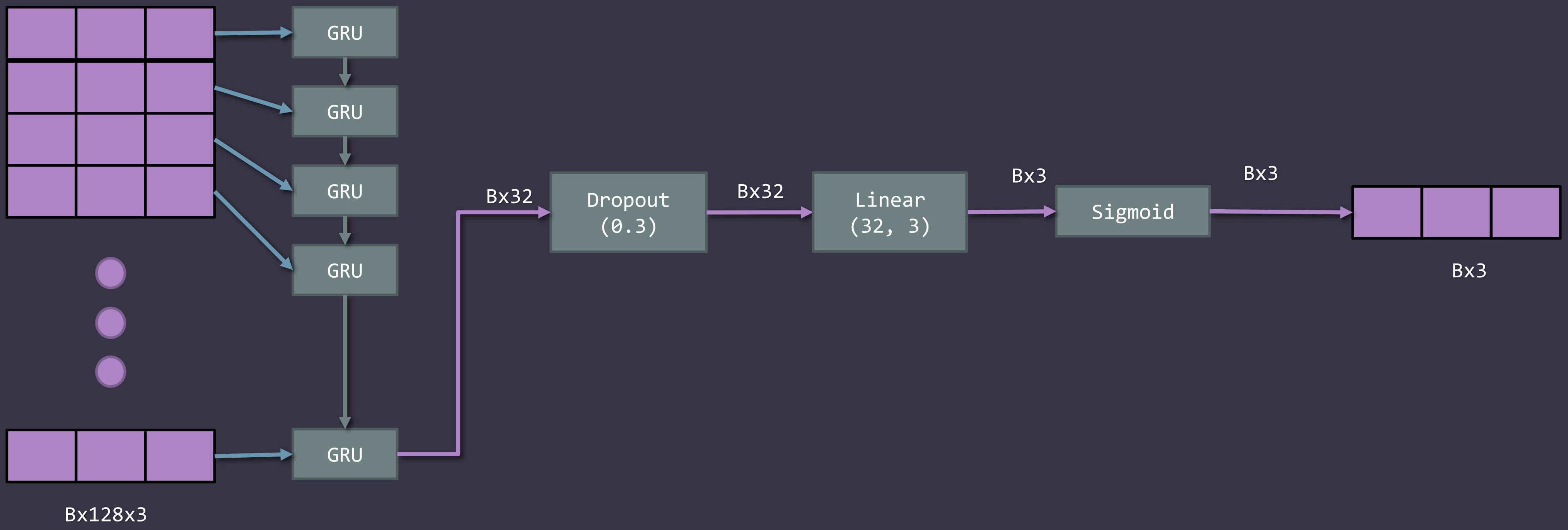
Introduction

- Climate and its elements often cause huge problems for humans and other living things. This influence applies to many sectors such as agriculture, livestock, transportation, health, and many others.

- Nowadays, Gate Recurrent Unit (GRU) is the latest approach which is the development of ANN has also started to be used for various purposes in several fields.

- This study tries to apply the GRU to forecast climate data consisting of temperature, rainfall, and humidity. Then, the GRU performances compare with LSTM, RNN, and MLP.

GRU - Network

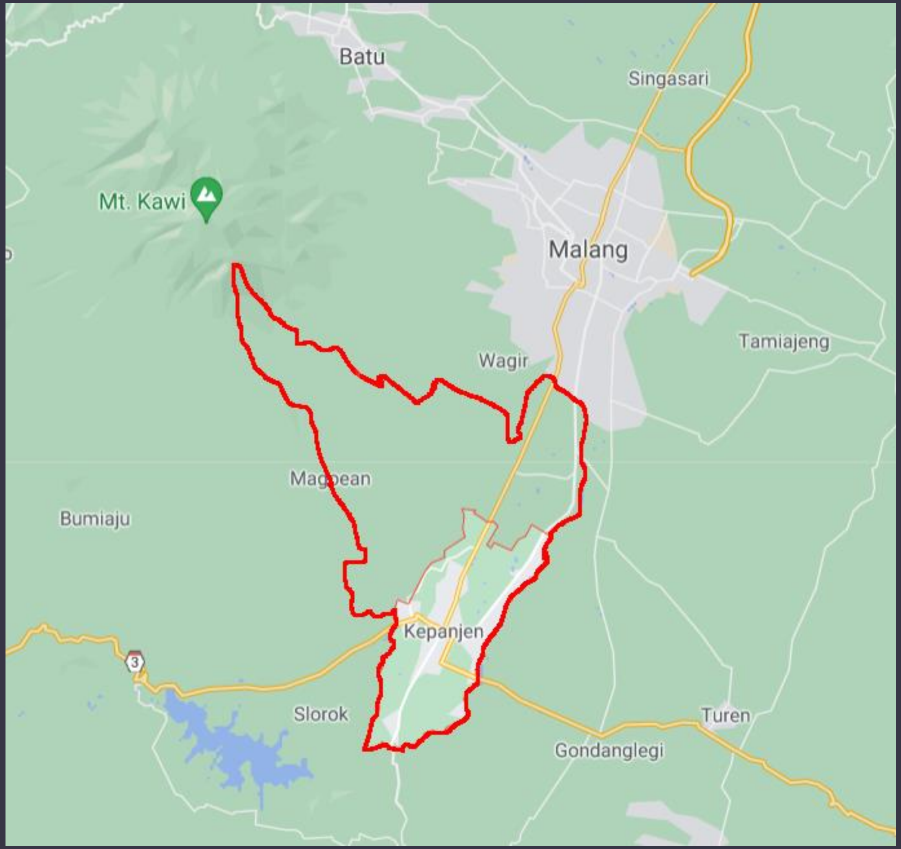

GRU
GRU
GRU
GRU
GRU
Bx128x3
Bx32
Dropout
(0.3)
Bx32
Linear
(32, 3)
Bx3
Sigmoid
Bx3
Bx3

Dataset

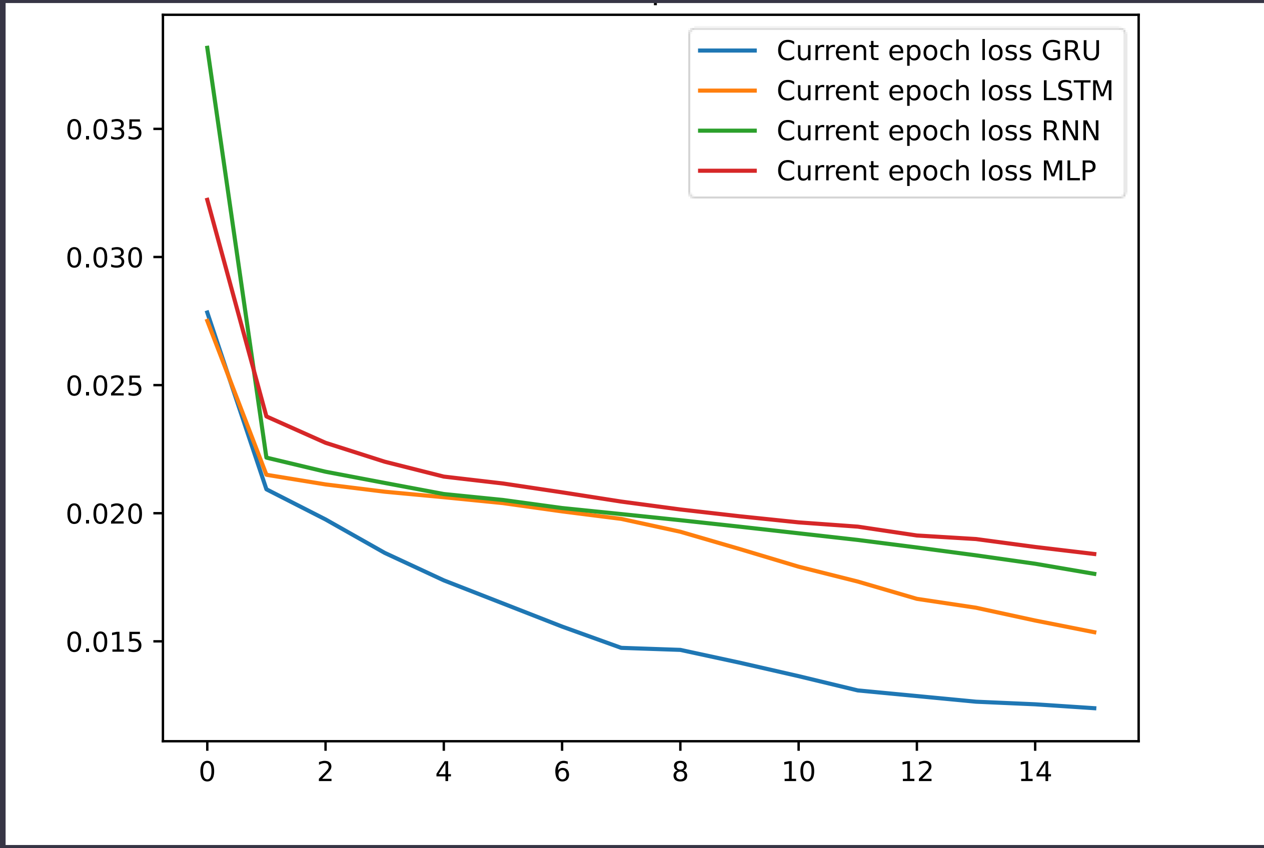
Our dataset is contains data from Malang, that is Kepajen, Ngajum, and Pakisaji.

We collected over 4 years worth of data, that is from 2016 to 2019 with a resolution of 1 day.

The model takes a sequence length of 128 days or around 4 months worth of daily weather data.



Loss Plot

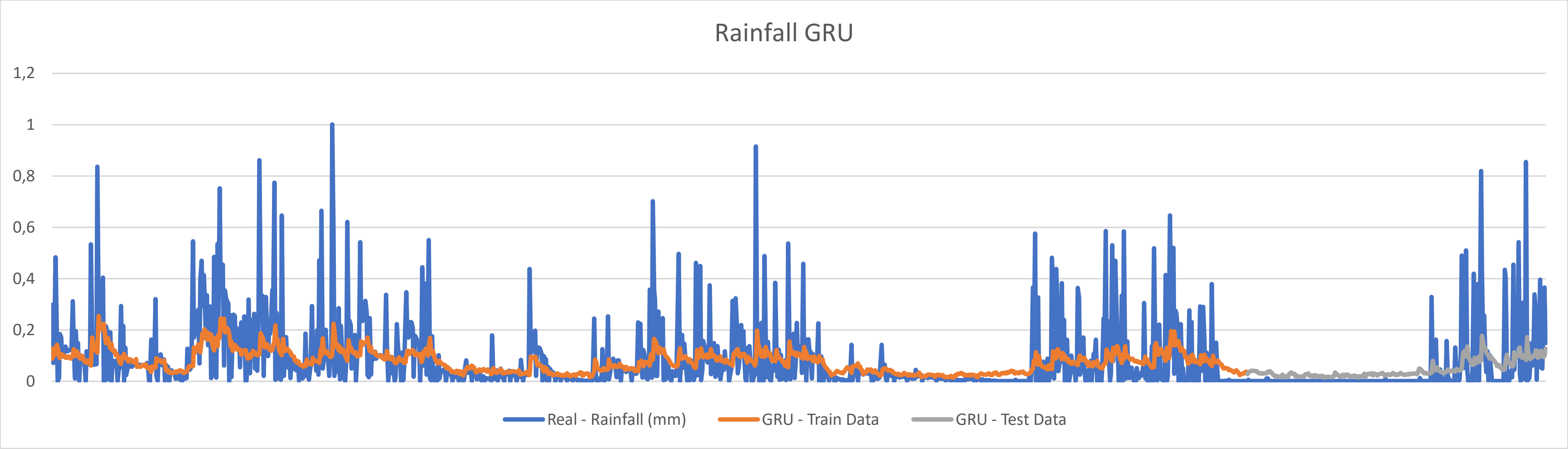


Current epoch loss GRU
Current epoch loss LSTM
Current epoch loss RNN
Current epoch loss MLP
0.035
0.030
0.025
0.020
0.015
0
2
4
6
8
10
12
14

Performance Comparation

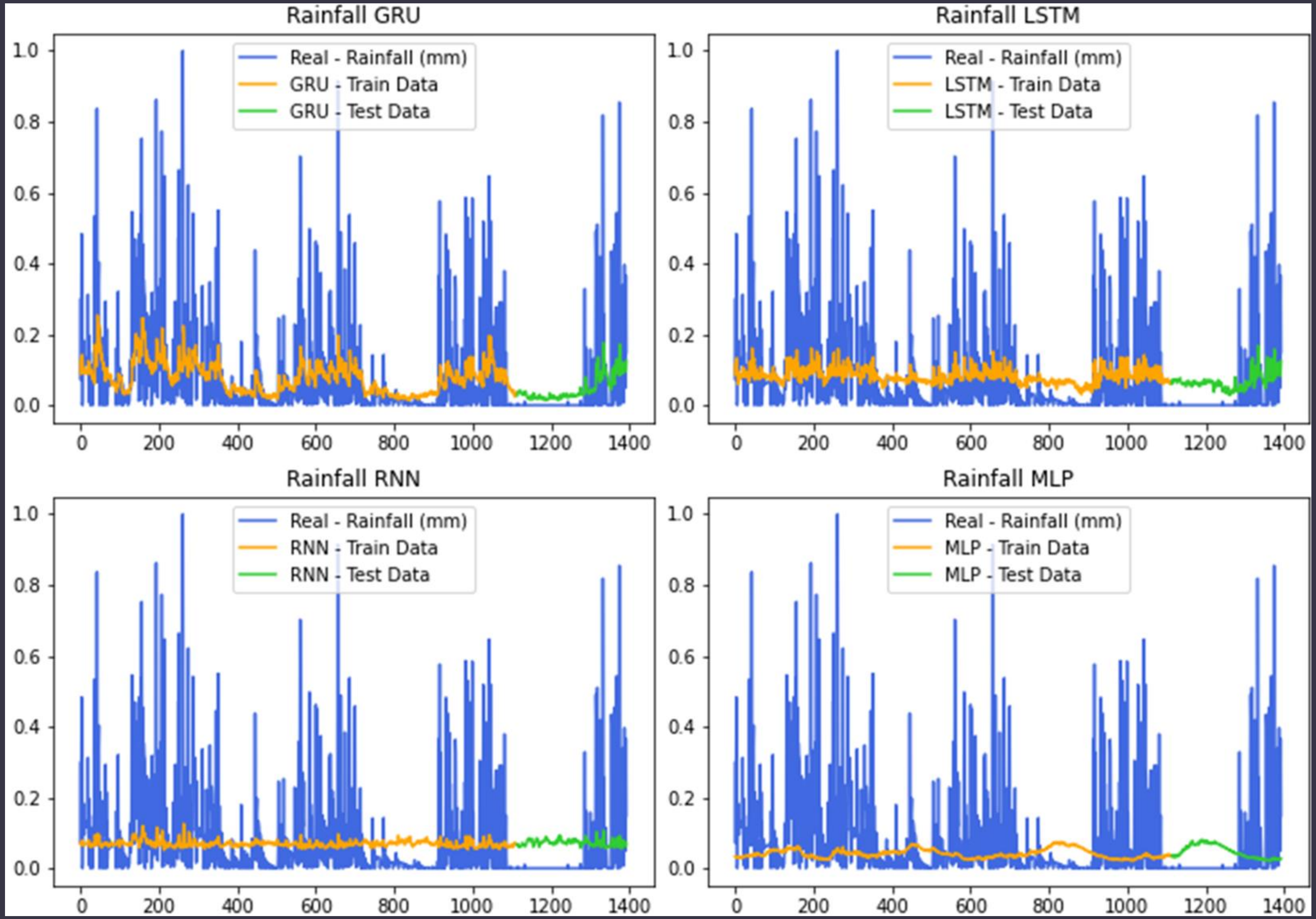
Error	LSTM		RNN		MLP	
	Cross Validation	80:20	Cross Validation	80:20	Cross Validation	80:20
MAE	0.109	**0.099**	0.128	**0.116**	0.121	**0.113**
RSME	0.142	**0.131**	0.159	**0.146**	0.157	**0.150**
SMAPE	73.288	**71.795**	75.682	**73.806**	76.192	**74.927**

Results – Rainfall

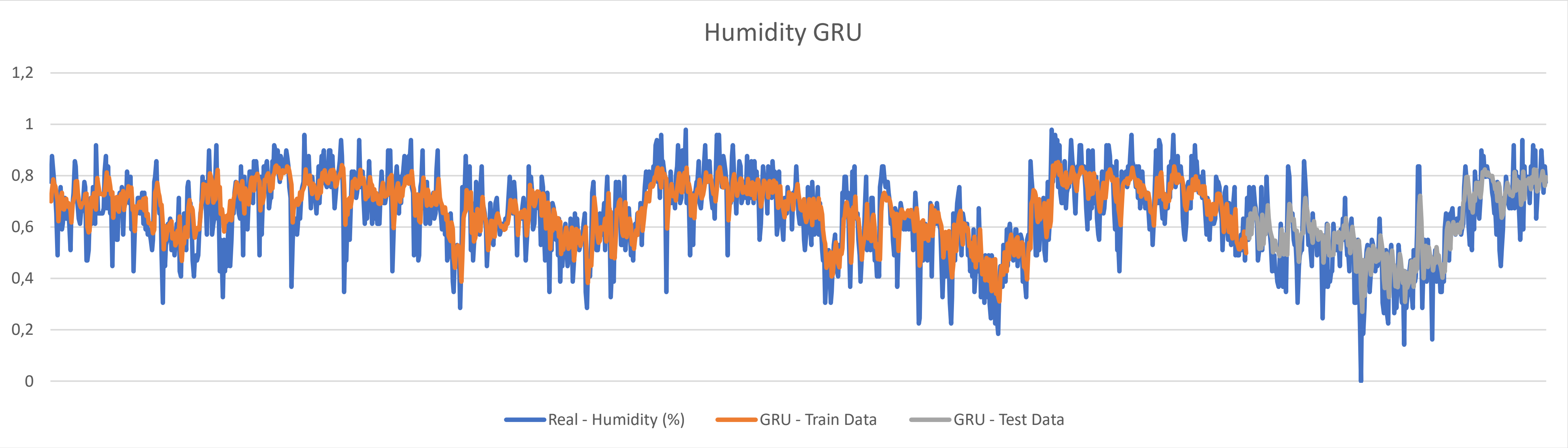


Results

Rainfall Comparation

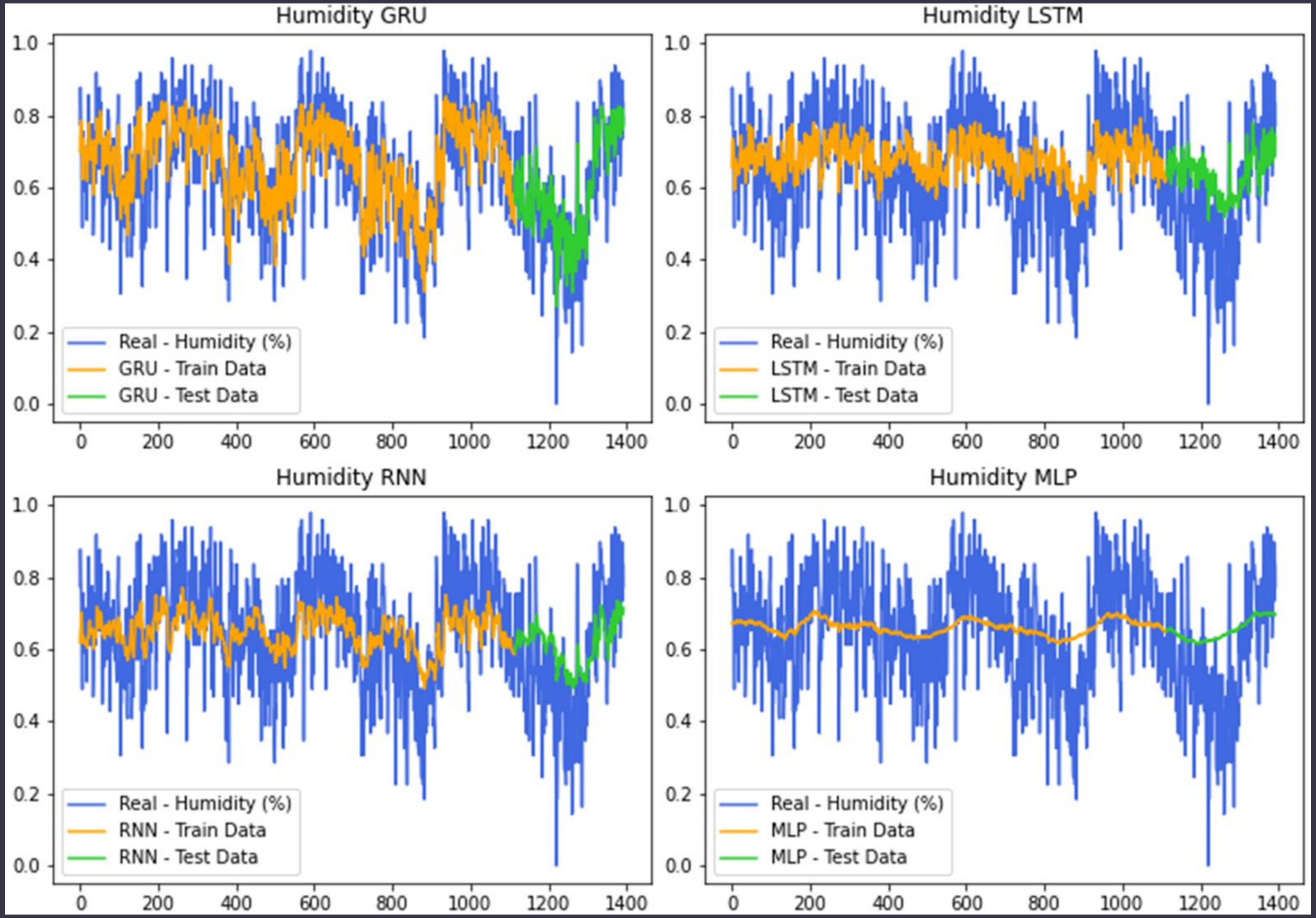


Results – Humidity

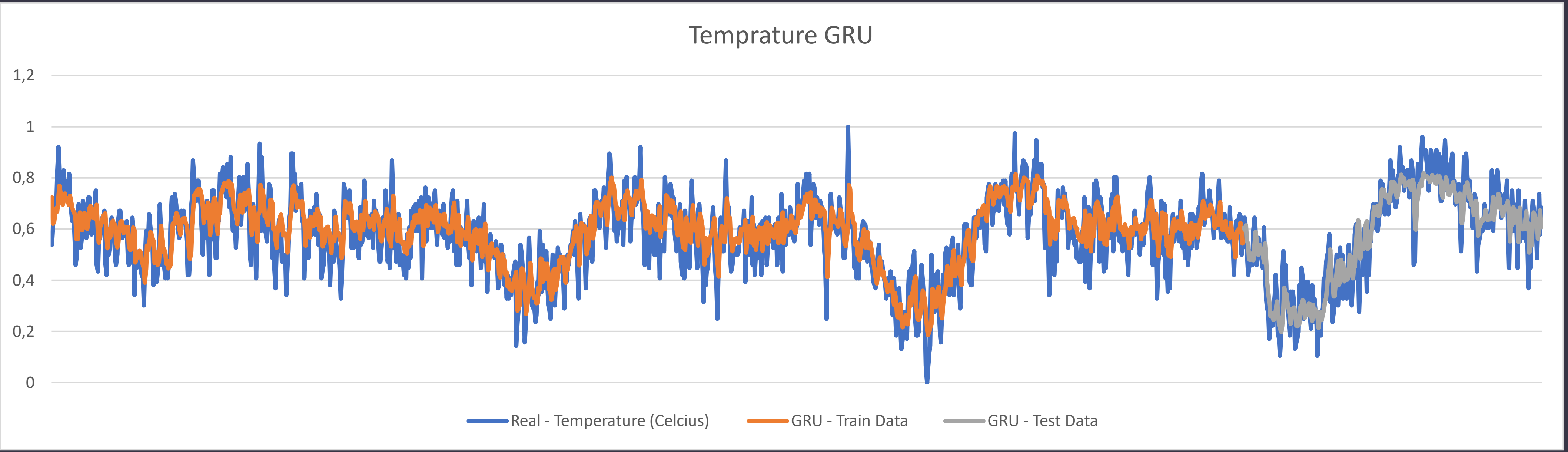


Results

Humidity Comparation

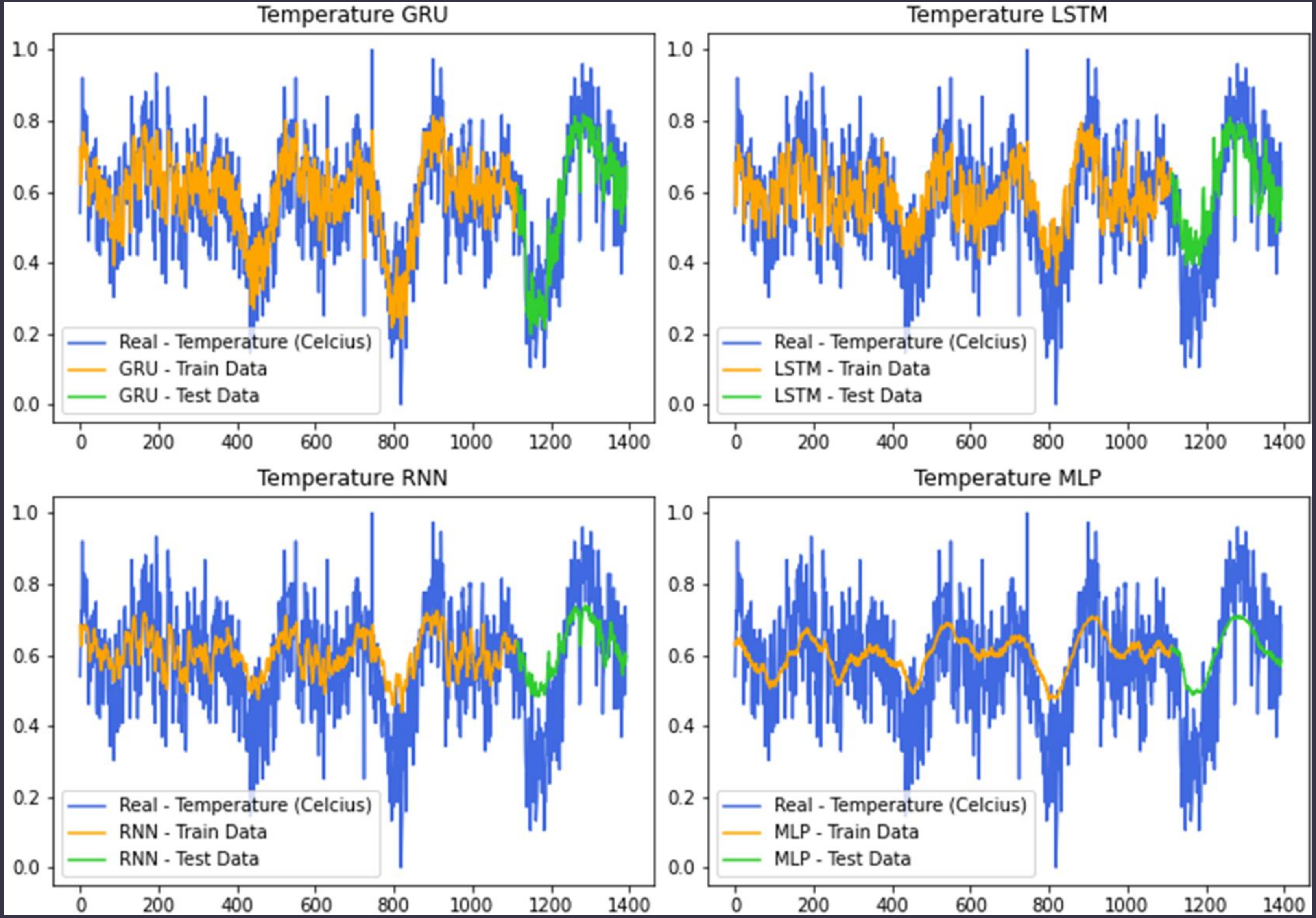


Results – Temperature



Results

Temperature Comparation



GRU Performance - Breakdown

	MAE	RMSE	SMAPE
Temperature	0.078	0.099	15.983
Humidity	0.093	0.119	18.148
Rainfall	0.062	0.110	171.887

Conclusion

1. As can be seen from the results, only GRU made forecasting close to the expected values with the real values. At the same time, other models such as LSTM and RNN managed to follow predictions close to the real expected pattern

2. Rainfall parameter where none of the models worked to make a good prediction, rainfall depends on many more factors than the regional temperature and humidity along with how the data is laid out

3. Temperature and humidity has a stable slope of change rainfall does not this spikiness does not help with the model generalizations

Future Work

1. Grouping of days, for Rainfall (reducing the spikiness)

2. Other Recurrent Models than GRU, LSTM, RNN

3. More Complex Model for LSTM ?

Thank You

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