Forecasting Ambient Temperature with RNNs

- Forecasting Ambient Temperature with RNNs
- Linear vs Sequence Models

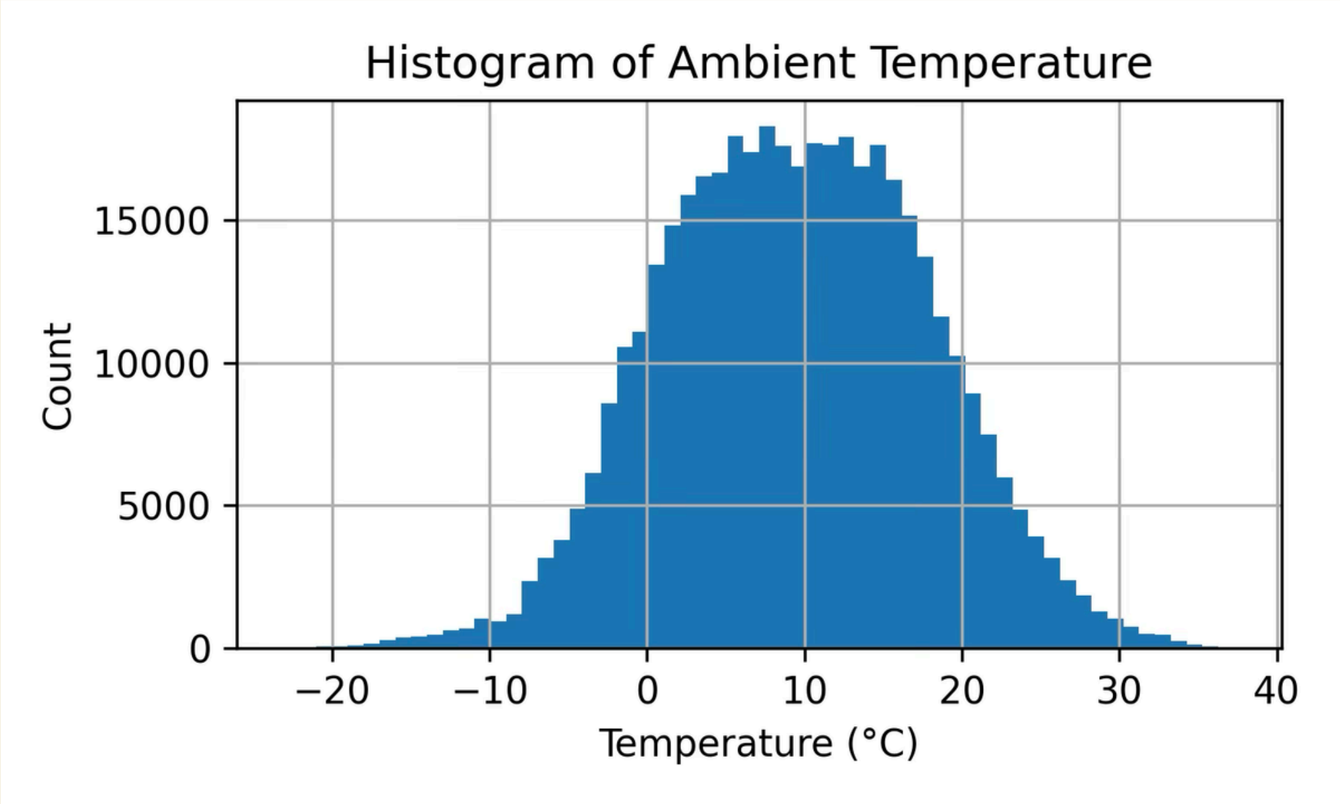
Mintesnot Kassa, Fordham University

Problem

- Need accurate short-horizon forecasts
- Applications: HVAC, energy, scheduling
- Temperature shows strong cycles

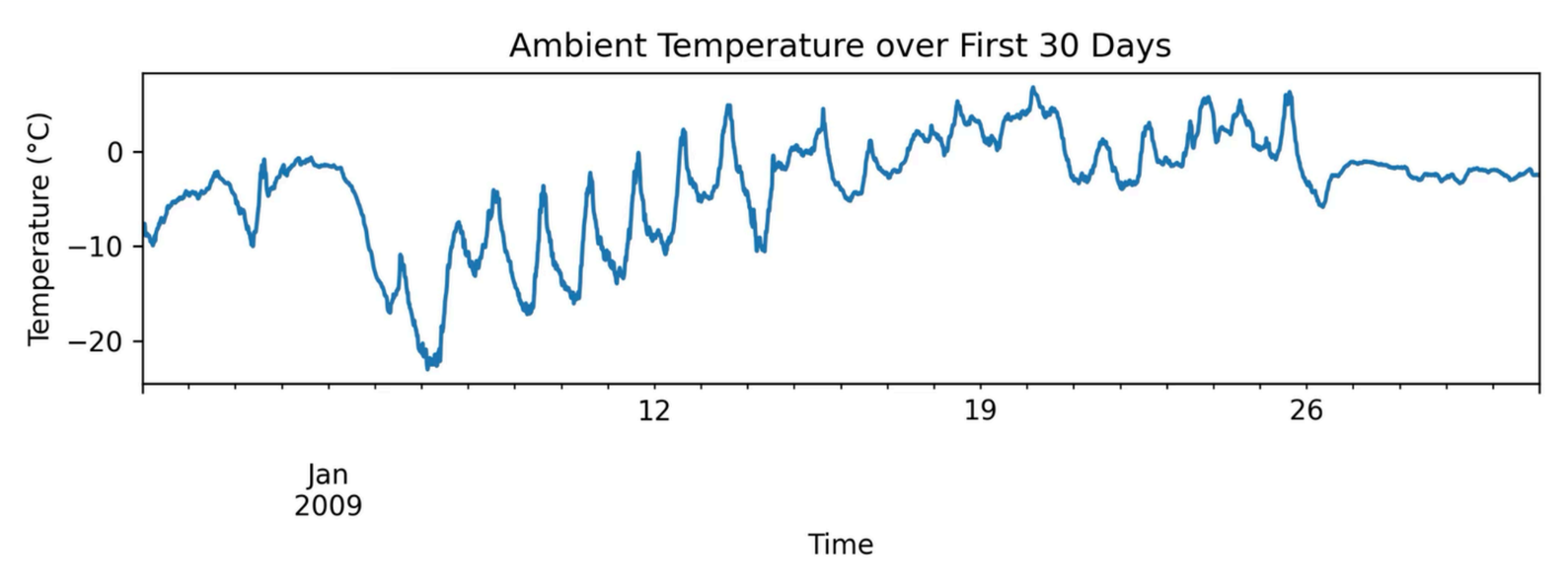
Dataset Overview

- Jena Climate Dataset (2009–2016)
- 10-minute resolution



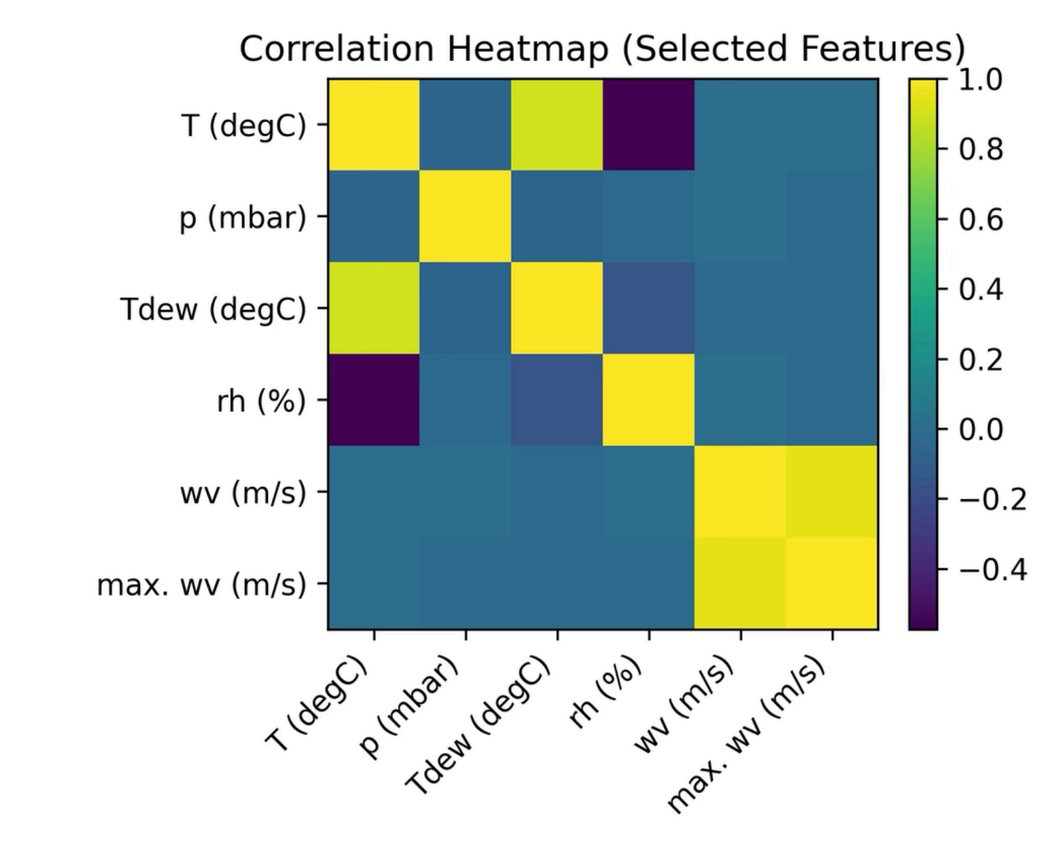
First 30 Days Visualization

- Strong diurnal structure and weather variability.



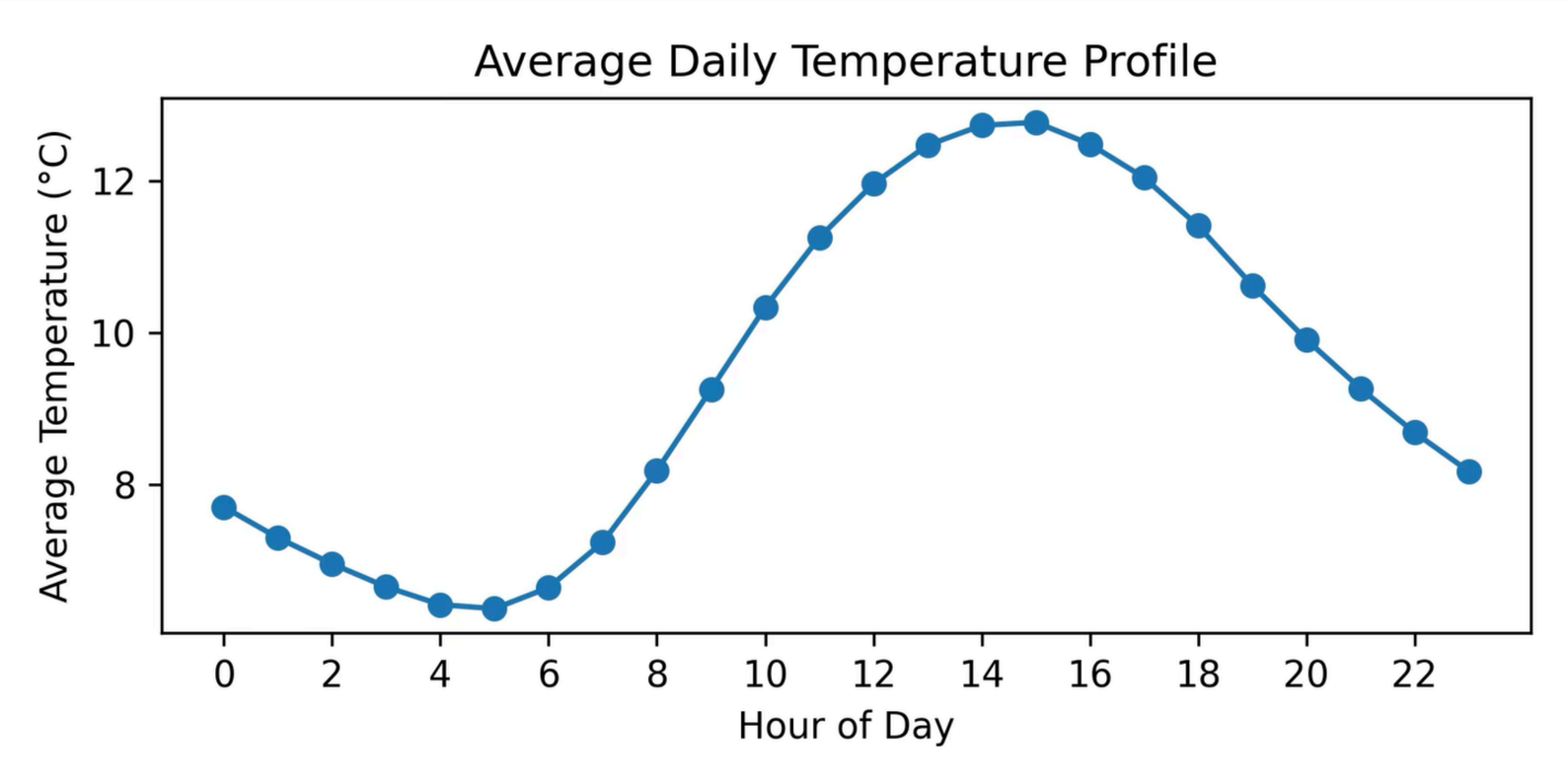
Correlation Analysis

- **Correlations among key meteorological features.**



Daily Temperature Profile

- Shows average diurnal cycle across dataset.



Windowing & Problem Setup

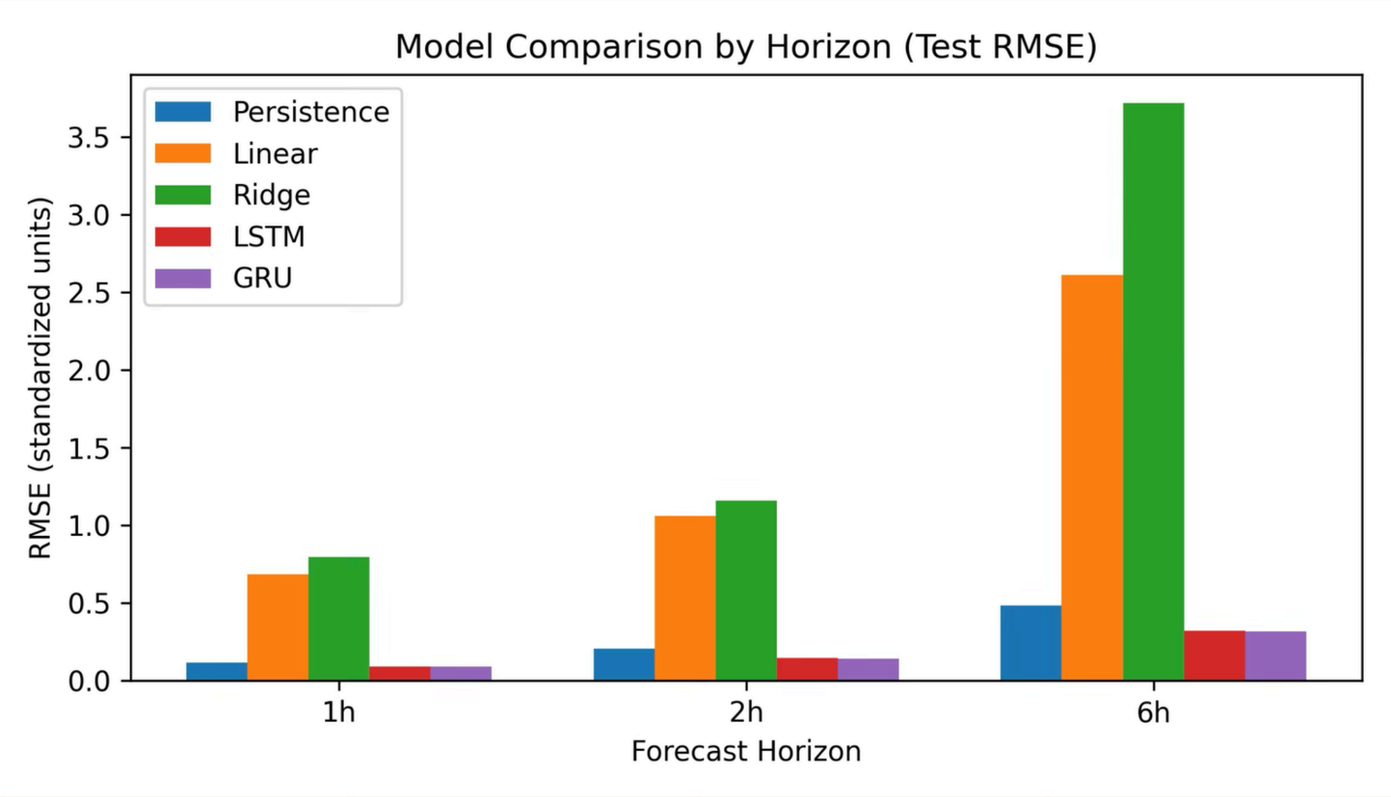
- History windows of 1,2,4,8 hours
- Forecast horizons: 1h, 2h, 6h
- Standardization applied

Models Compared

- Persistence, Linear, Ridge
- LSTM & GRU
- Adam optimizer, early stopping

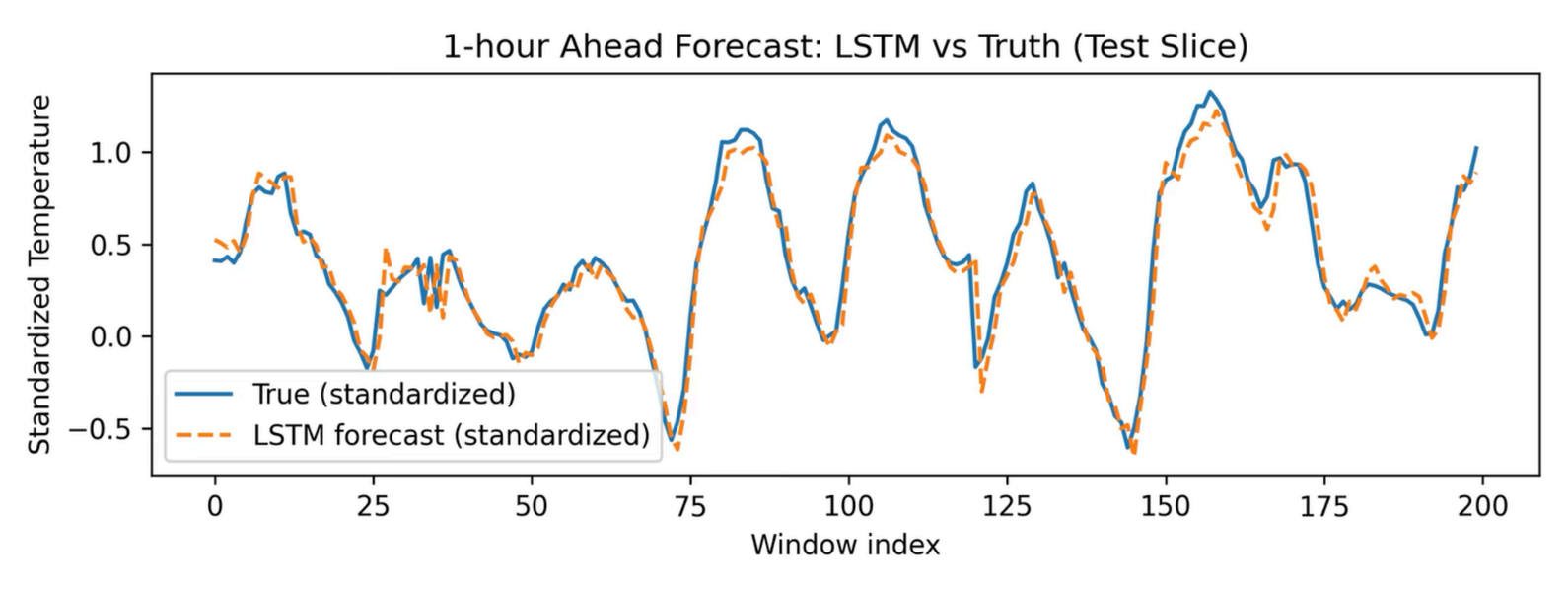
RMSE Comparison by Horizon

- **RNNs outperform at longer horizons, baselines strong at 1h.**



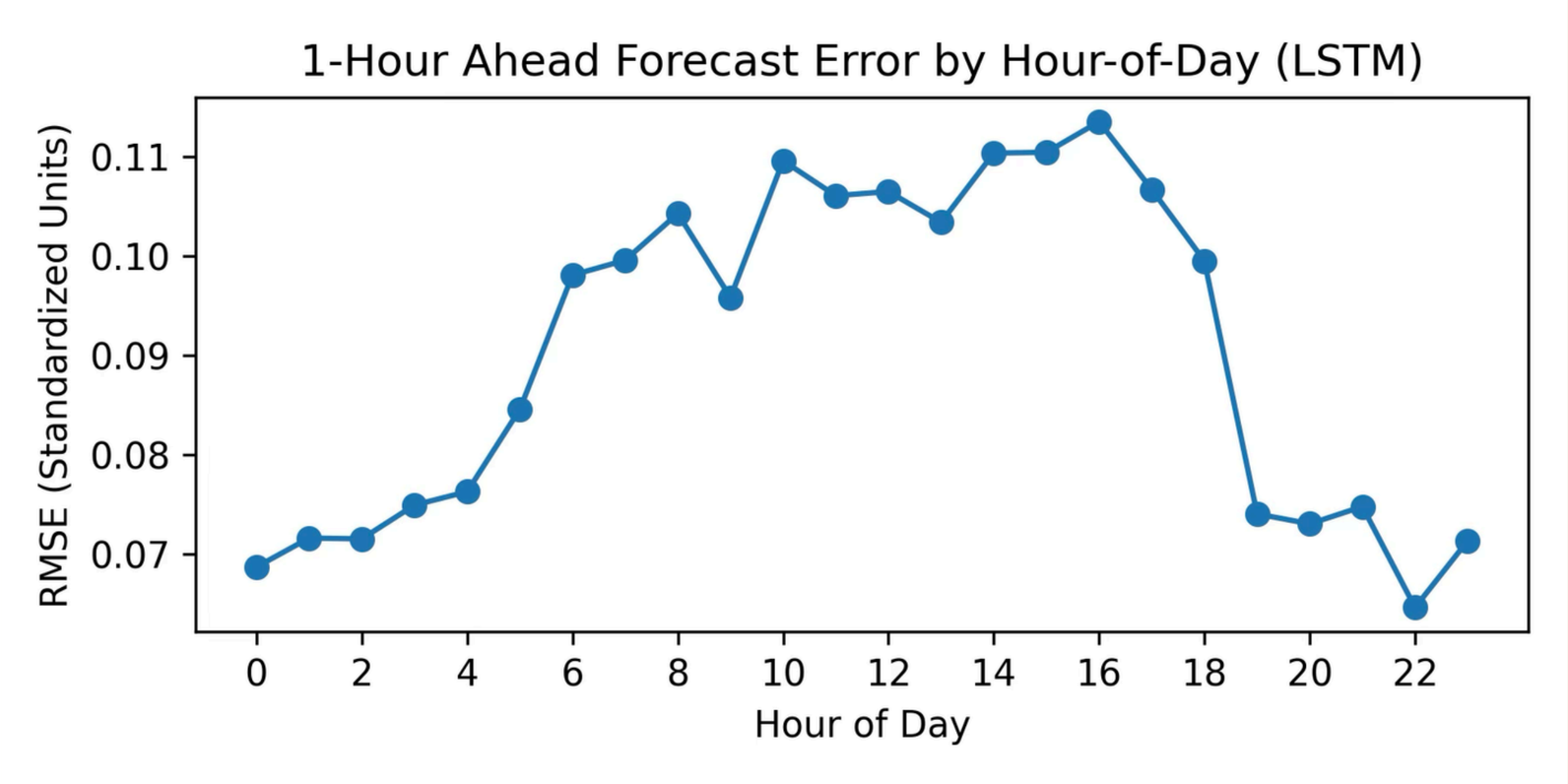
Forecast Example

- LSTM prediction vs true temperatures on test slice.



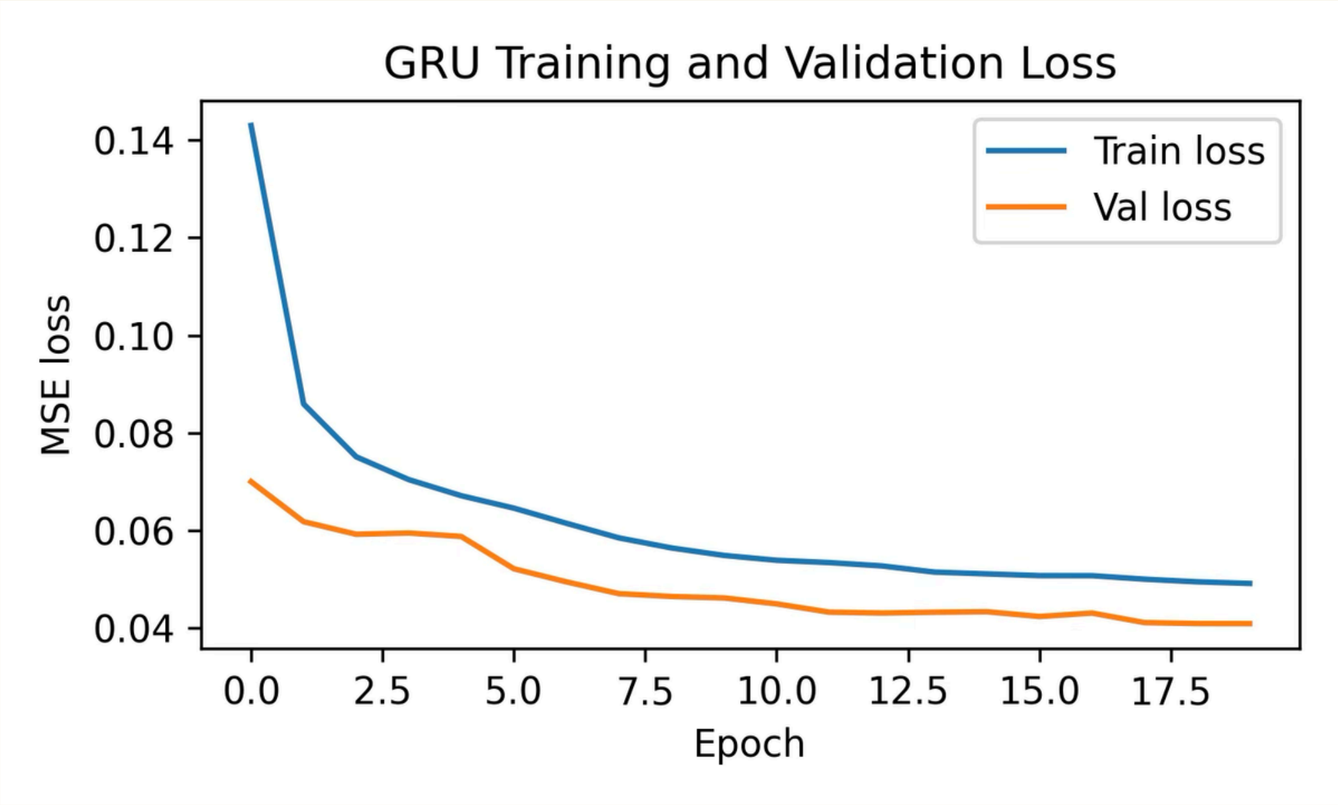
Error by Hour of Day

- **Higher error at dawn/dusk; smoother at midday.**



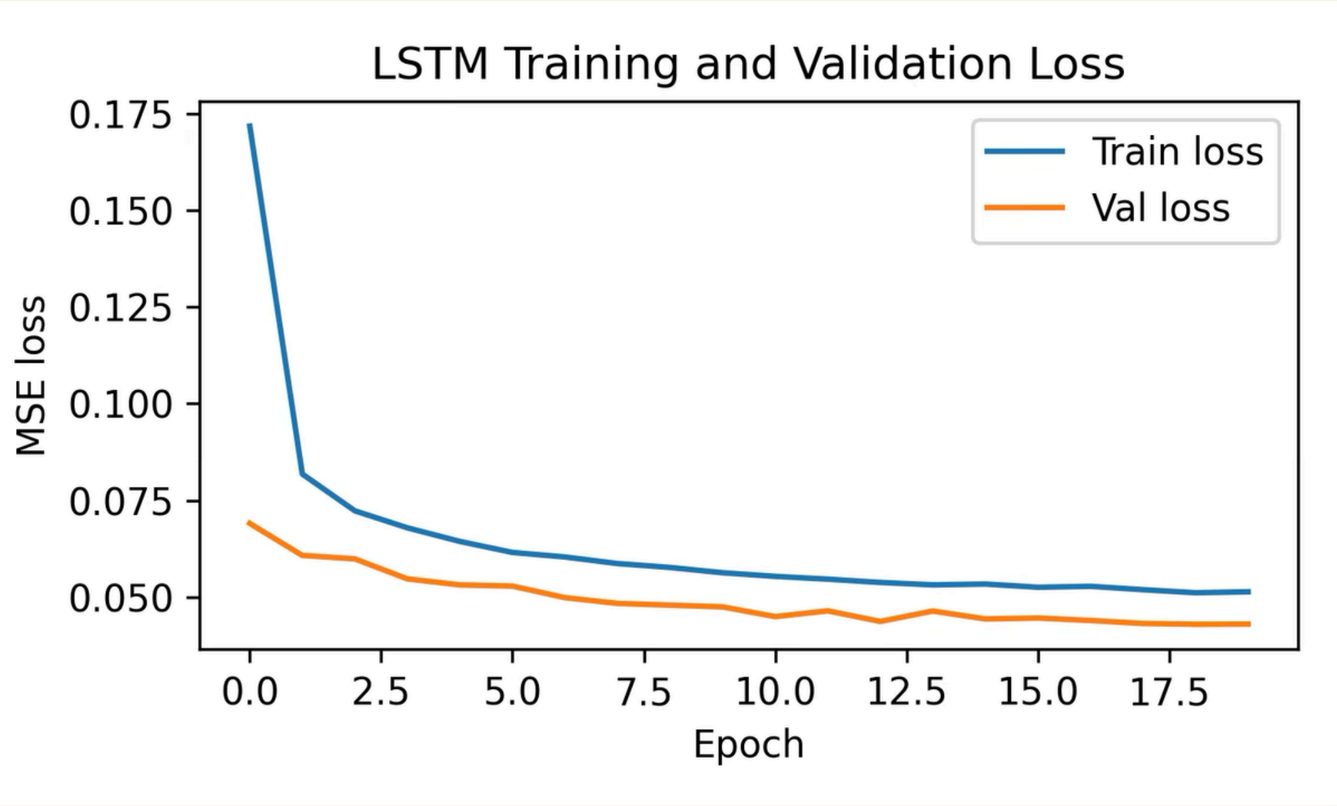
GRU Training Curve

- **Validation loss stabilizes after ~10 epochs.**



LSTM Training Curve

- **Shows similar convergence properties with slight variance.**



Key Observations

- 1h: persistence nearly optimal
- 6h: RNNs clearly better
- Ridge reduces overfitting

Conclusion & Future Work

- Extend to TCN/Transformers
- Add seasonal variables
- Probabilistic forecasting