

# Prediction for Drought Relief Projection

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## Objectives

- Utilize machine learning techniques to predict drought towards more effective water resource management and disaster mitigation

## Methodology

- The Standardized Precipitation Evapotranspiration Index (SPEI) is used as an indicator for water balance.
- SPEI is defined by precipitation and potential evapotranspiration (PET).
- Precipitation prediction: Telnet
- PET prediction: ResConv LSTM w/ Attn
- Area of testing: India due to high drought frequency
- Data: ERA5 data from 1941 to 2024 (0.25 degree spatial resolution)

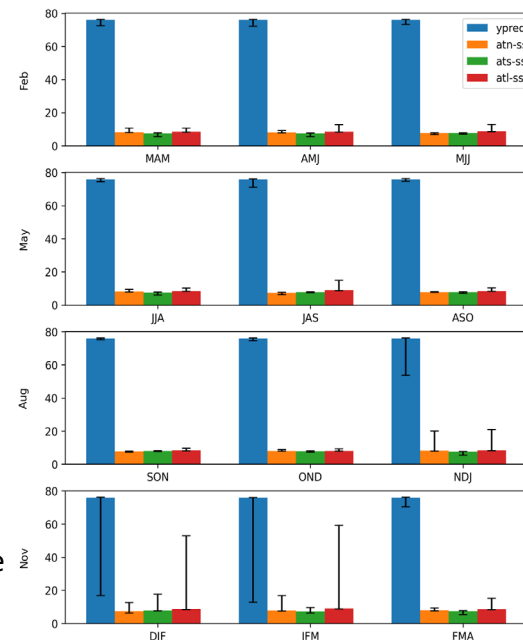
## Features

### Telnet features

- Precipitation
- Atlantic SST
- Ats - sst
- Atlantic Nino - sst
- Time index
- SST: sea surface temp

### ResConv LSTM w/ Attention

- Variables for Penman-Monteith Method
- T2m (Air Temperature)
- D2m (Dew point Temp)
- Wind speed
- Net radiation
- Saturation vapor pressure
- Actual vapor pressure
- Delta
- Gamma



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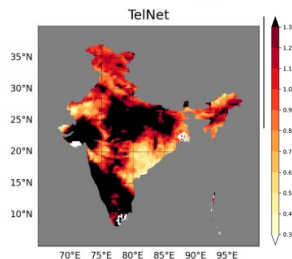
## Precip & PET Results

- Fine tuned hyperparameters, selected features using PMI, and selected most optimal starting weights to optimize performance
- Precipitation predictions were quite overall but accumulated error near mountain range bordering northeast side
- PET predictions were less accurate and had gridding artifacts due to batching for memory conservation

## Performance Metrics

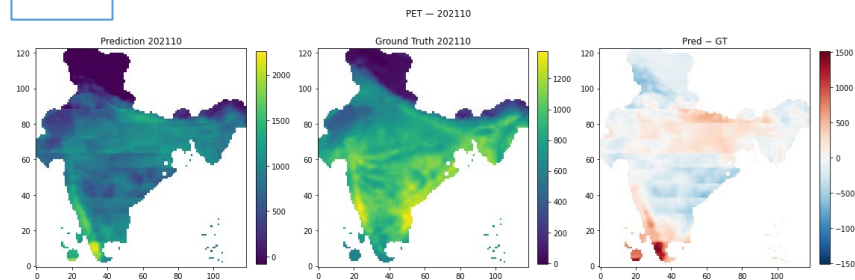
ResConv LSTM Attn:  
MSE=0.0241,  
RMSE=0.1439,  
R2=-0.9099

Precip: RMSE distributed as map

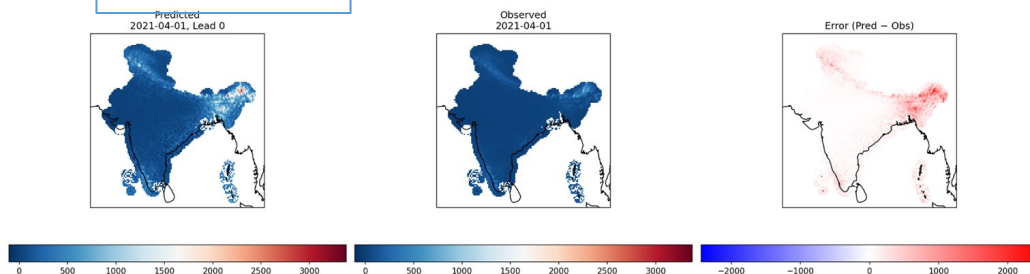


## Train and test performance

### PET



### Precipitation



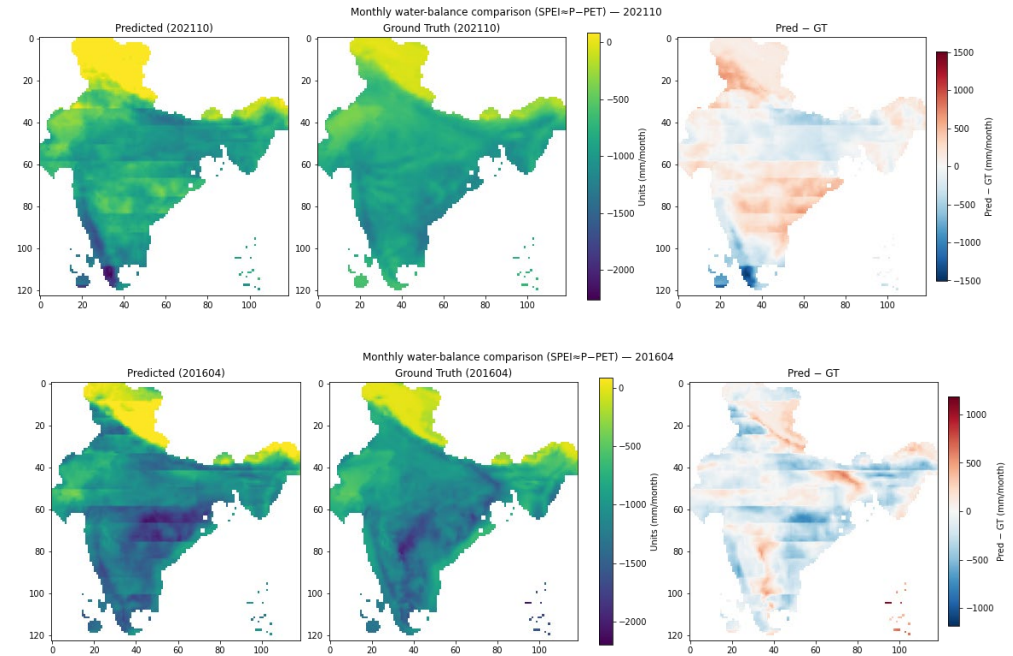
## Future Directions

- More comprehensive evaluation/validation
- Improve the PET model
- Implement autoregressive prediction for prediction for several months into the future
- Predict for more countries / global prediction

## References

- ResConv LSTM Attn model
- <https://www.sciencedirect.com/science/article/pii/S1364815224003219>
- Telnet model
- <https://www.nature.com/articles/s43247-025-02207-2>
- SPEI
- <https://open.canada.ca/data/en/dataset/d765c41-8ee0-4aca-be4b-084448e52a58>

## SPEI Predictions



Sample SPEI predictions