

# Drought Analysis

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# Problem Statement

- Climate Change
- Drought impacts
- DateTime Series Model(neural Networks)
- USDM has no forecasting capability
- Temperature and precipitation allows for additional inference.

# Data Set Collection

- Drought data via United States Drought Monitor
- Temperature and precipitation data collected from the Institution of Carnegie Mellon University courtesy(Lai, Y).

# Climate Change

- The greatest threat to global public health.
- Rising global temperatures, shrinking ice sheets and glaciers, floods, wildfires, and **droughts**.
- Records that exceed over 1000 years indicate a sharp turn upwards in global temperatures.
- Increased frequency & severity.

# Droughts

- Abnormally dry weather with heavy impacts.
- They have worsened, with some severe examples coming into play recently.

# US Drought Monitor(USDM)

- What is the USDM?
- USDM is important to reduce dangerous and economic impacts.
- Various measures
- USDM labeling system
- USDM components

# The Drought Severity and Coverage Index

- DSCI methodology
- Ranges



# Temperature & Precipitation

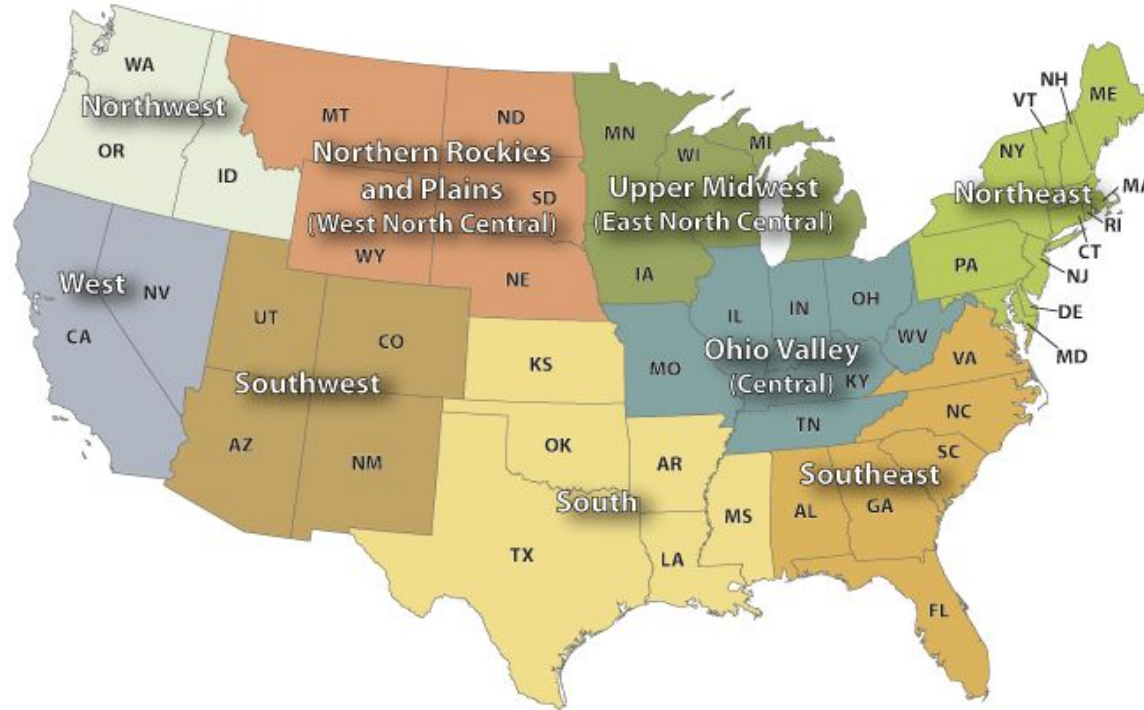
- Huge Precipitation variances across regions
- Troubling trends for temperature.





# U.S Climate Regions

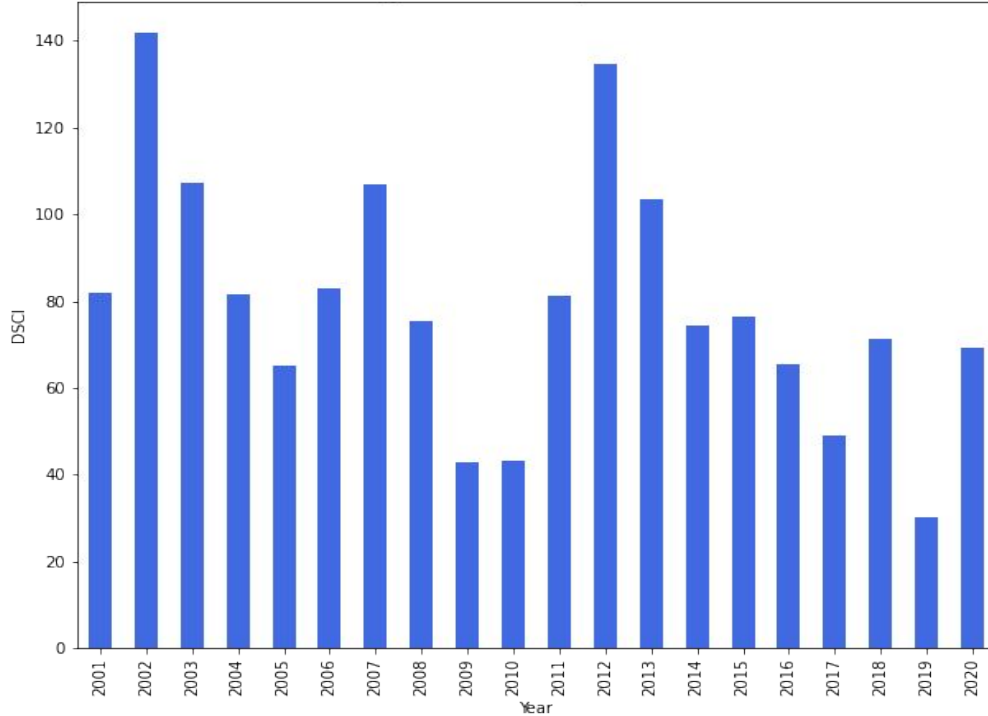
## U.S. Climate Regions



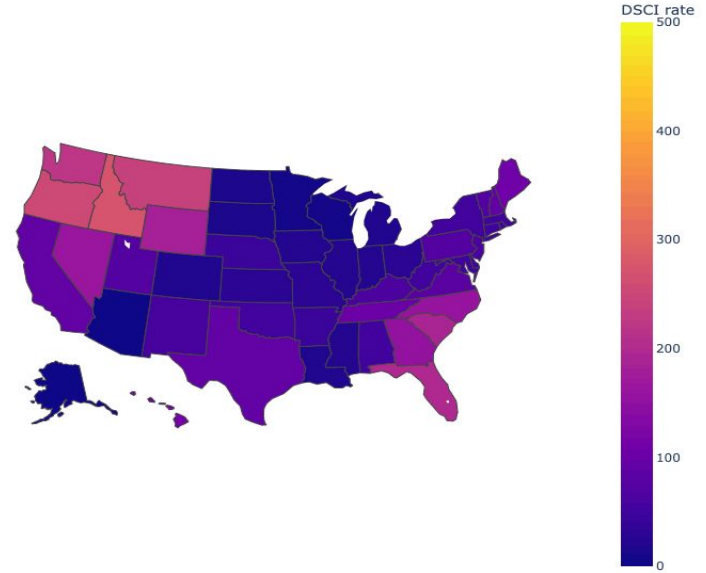
Through climate analysis, National Centers for Environmental Information scientists have identified nine climatically consistent regions within the contiguous United States which are useful for putting current climate anomalies into a historical perspective (Karl and Koss, 1984).

# Average Drought

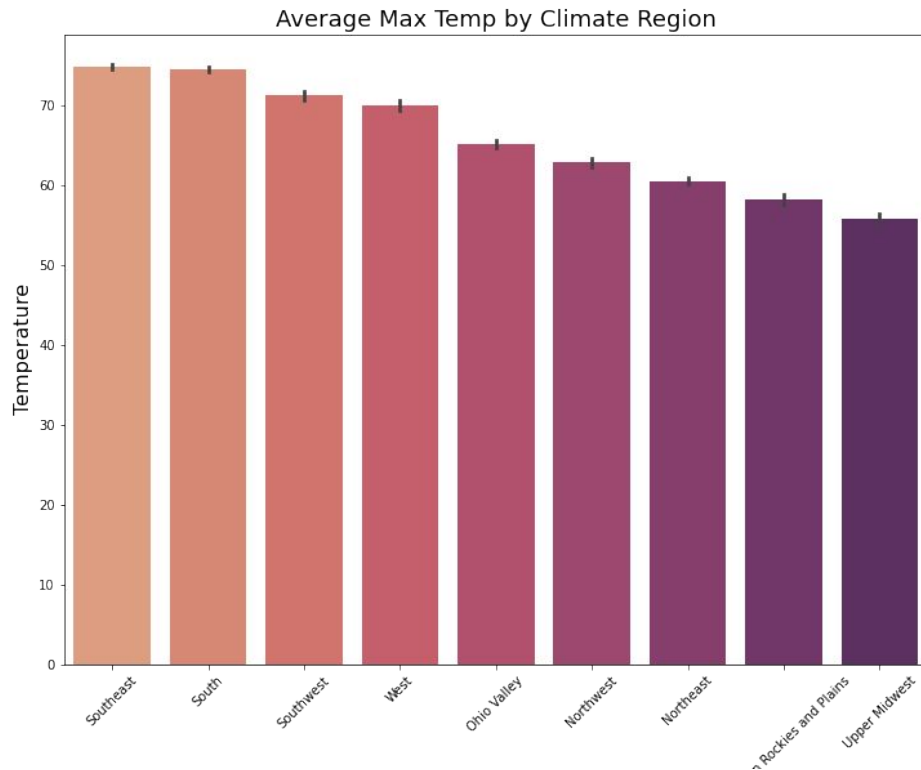
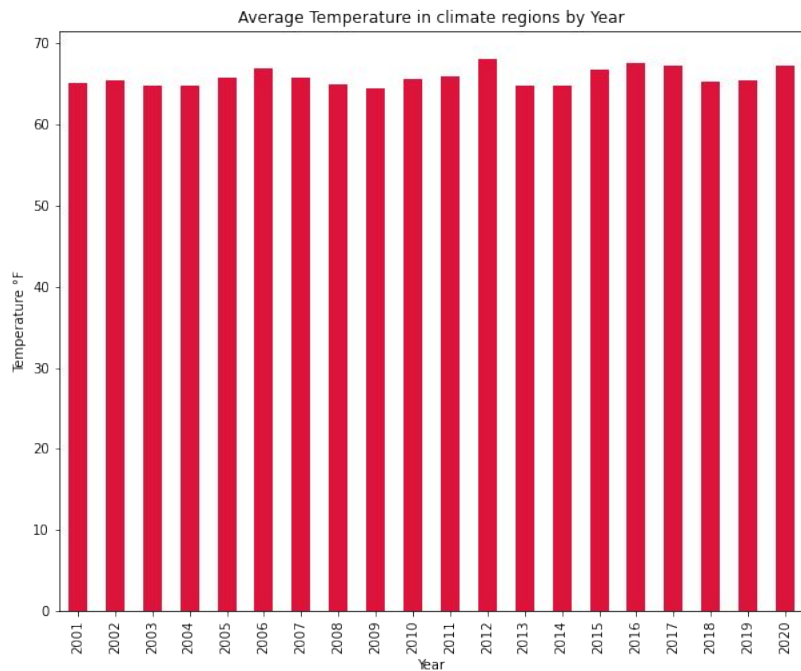
Average DSCI Climate Regions(2001-2020)



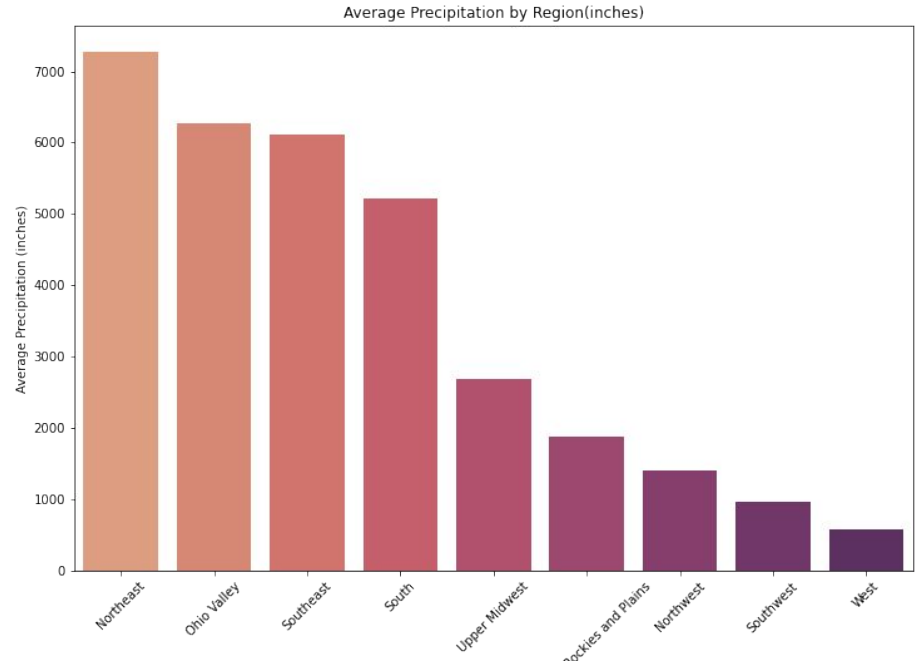
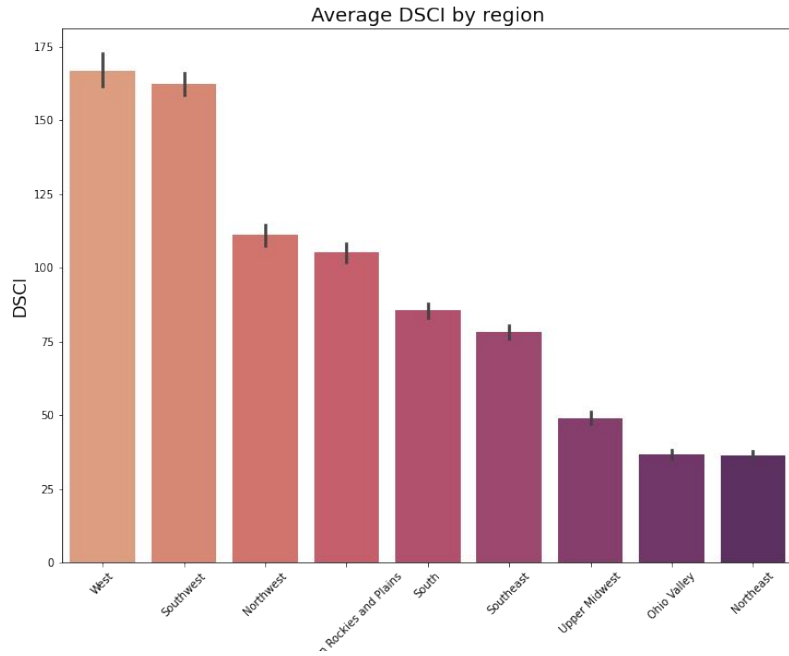
National drought average 2001



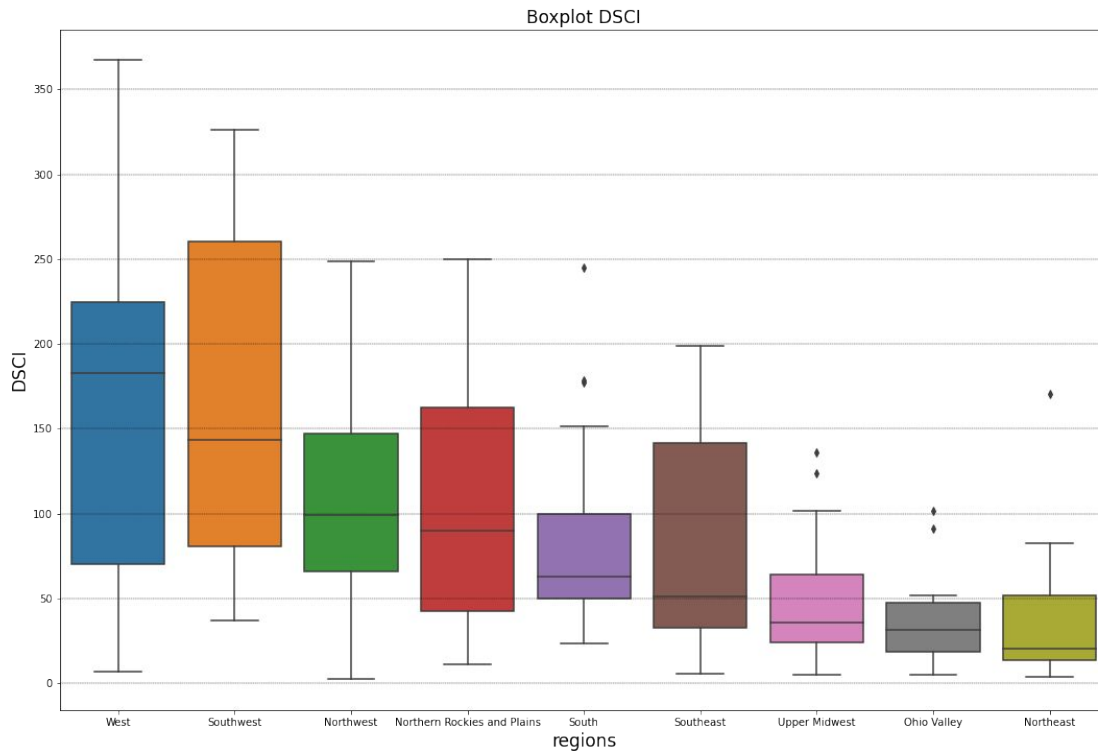
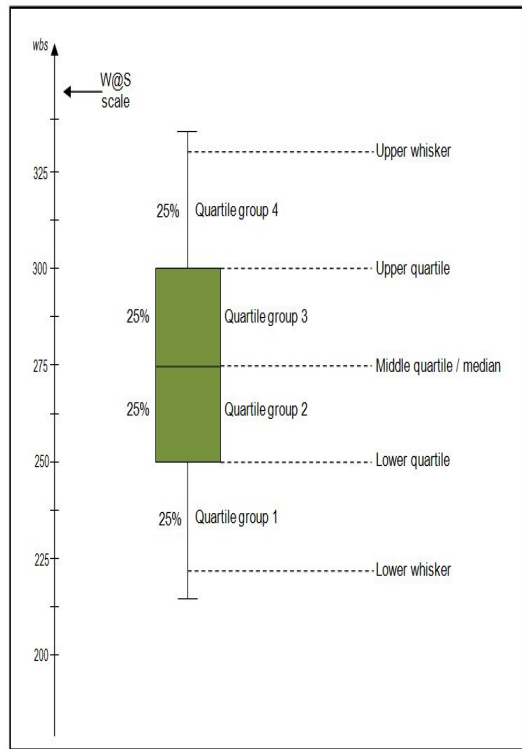
# Average Temperature



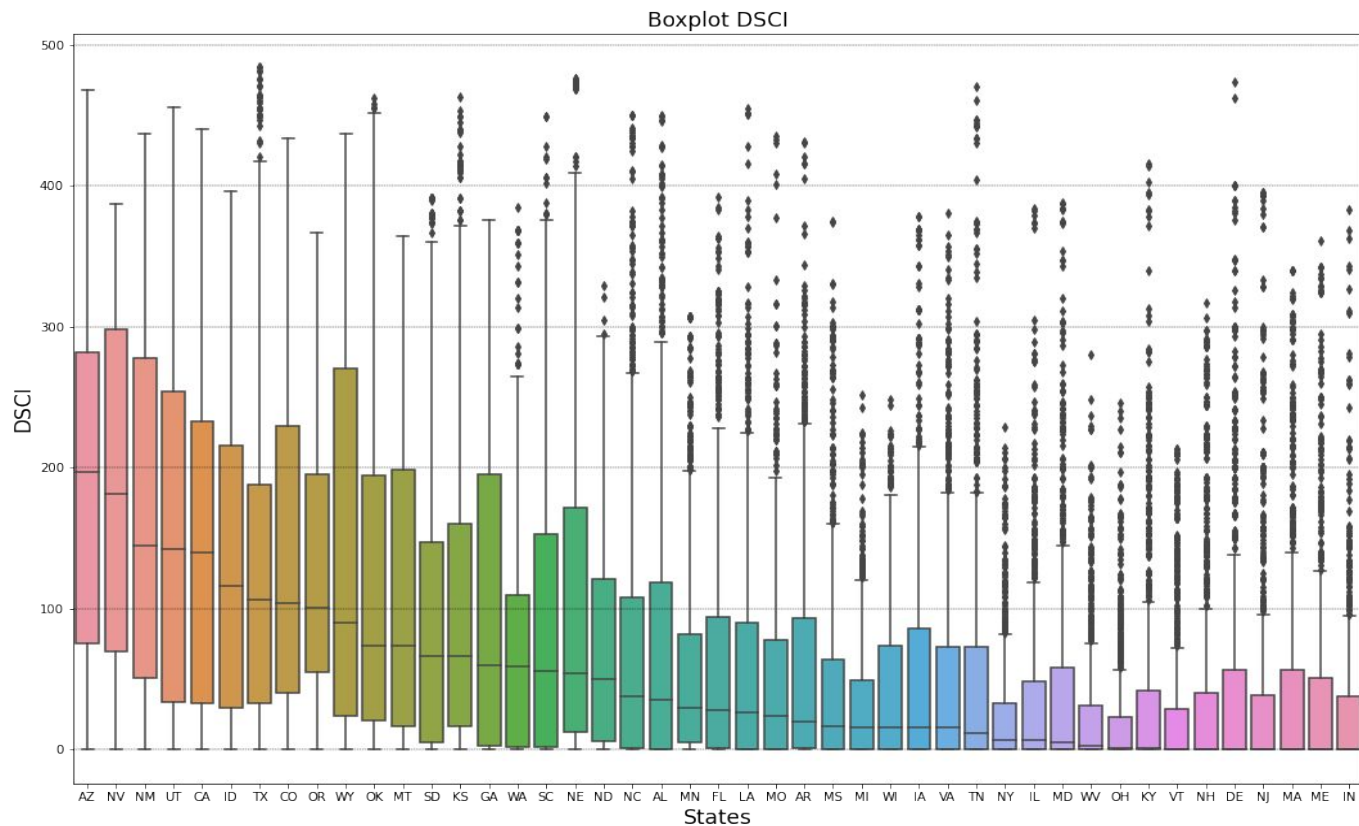
# Average Drought VS Precipitation

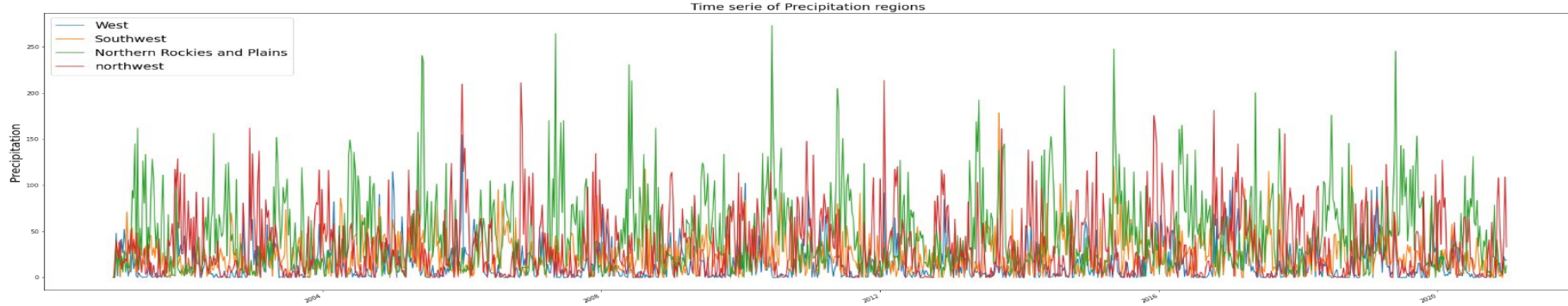
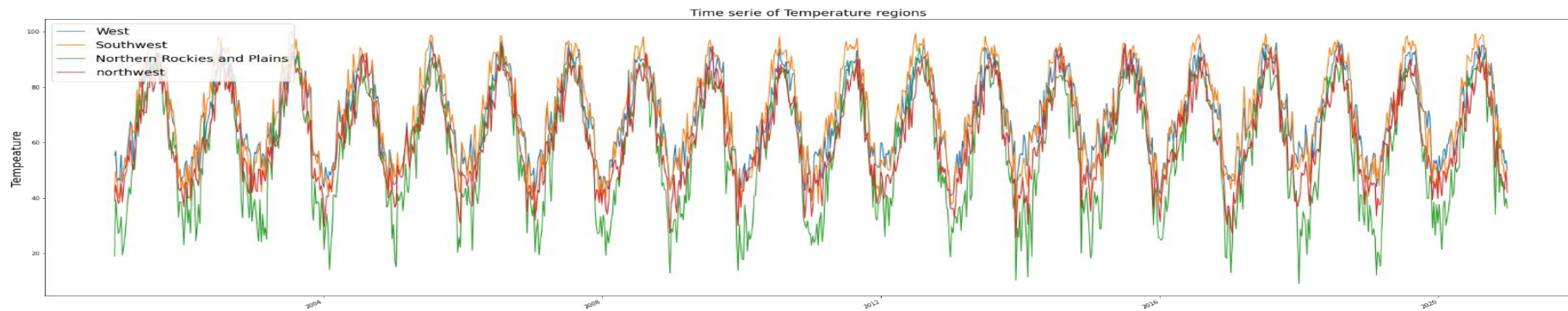
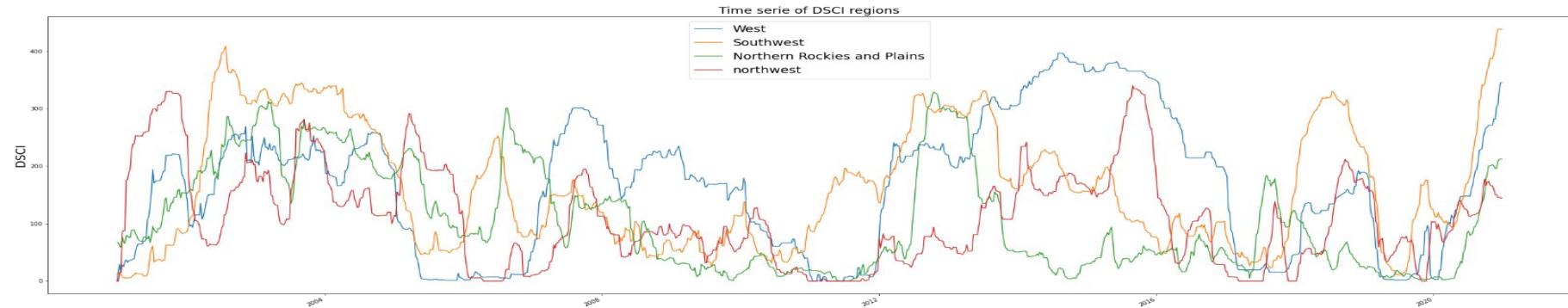


# Average Drought Regions

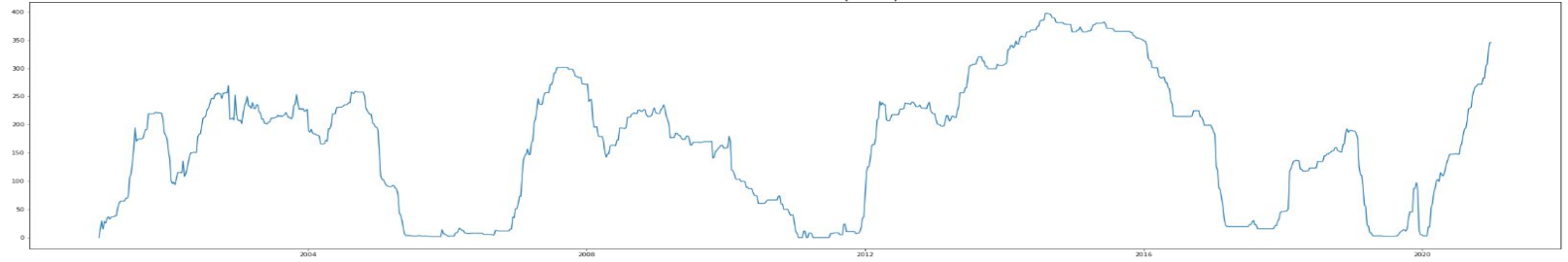


# Average Drought States

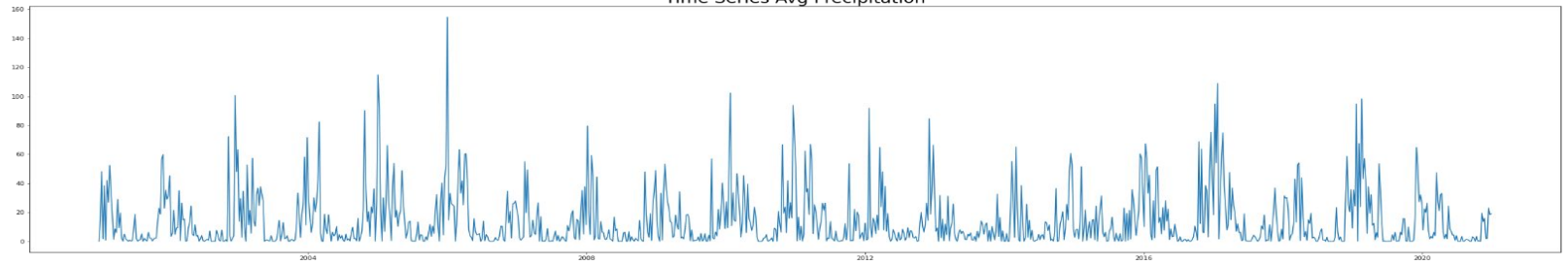




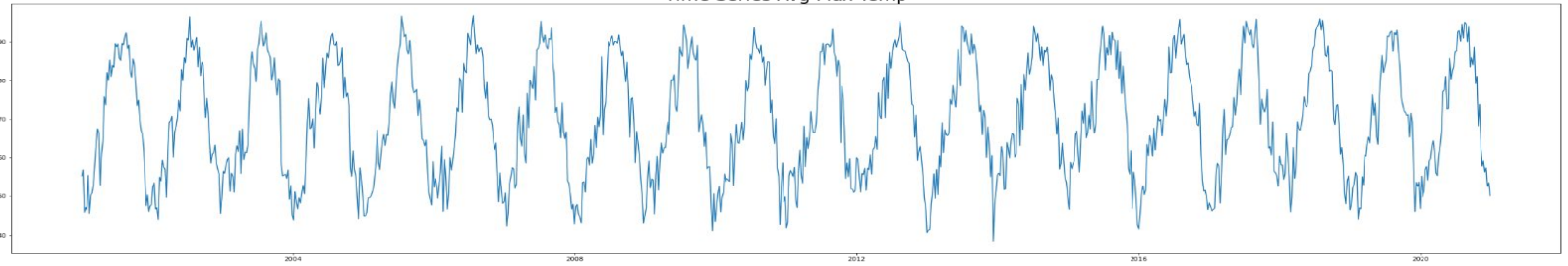
Time series DSCI(West)



Time Series Avg Precipitation

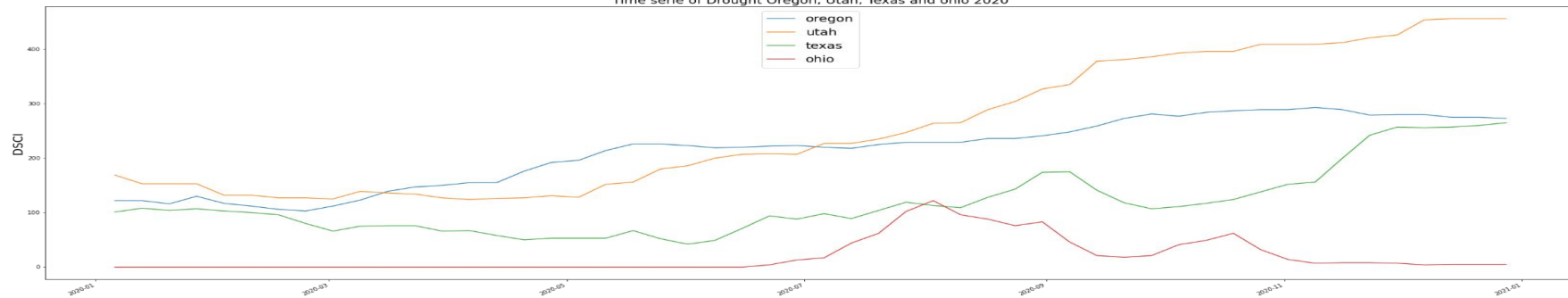


Time Series Avg Max Temp

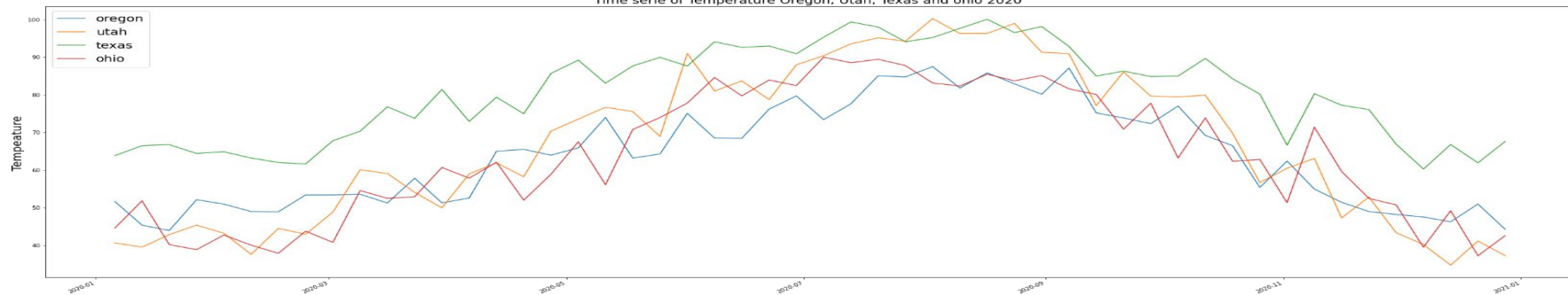




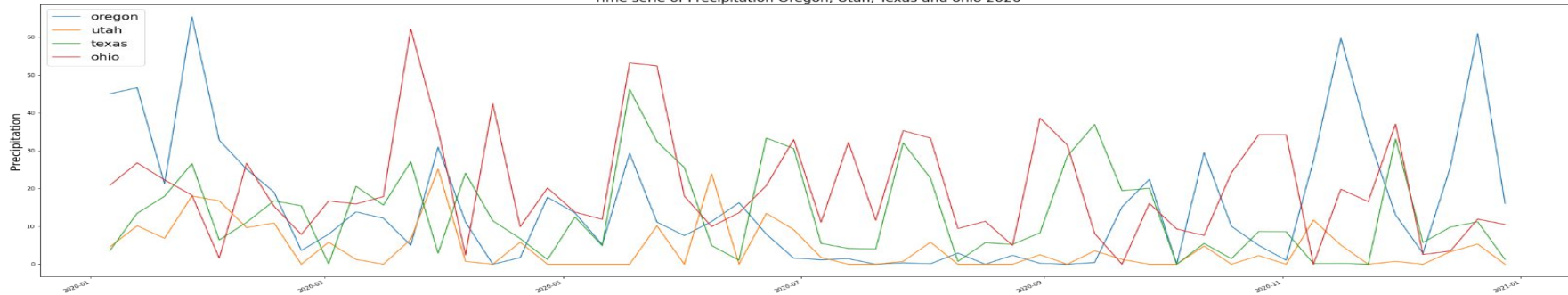
Time series of Drought Oregon, Utah, Texas and ohio 2020



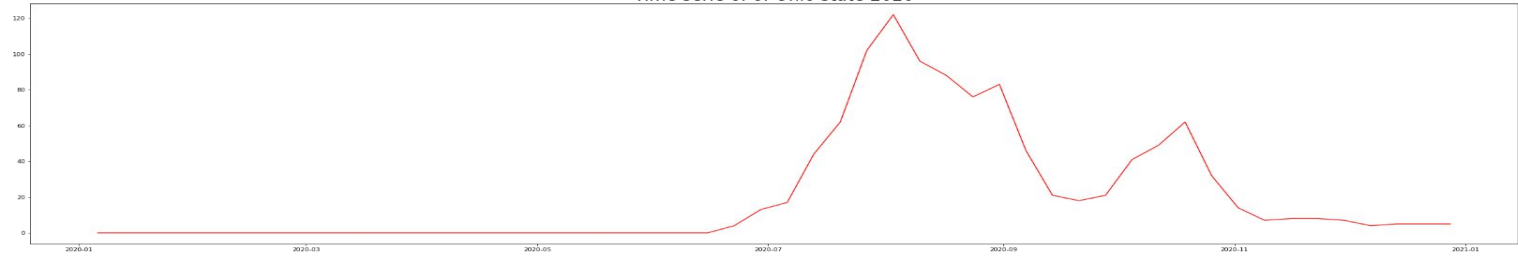
Time serie of Temperature Oregon, Utah, Texas and ohio 2020



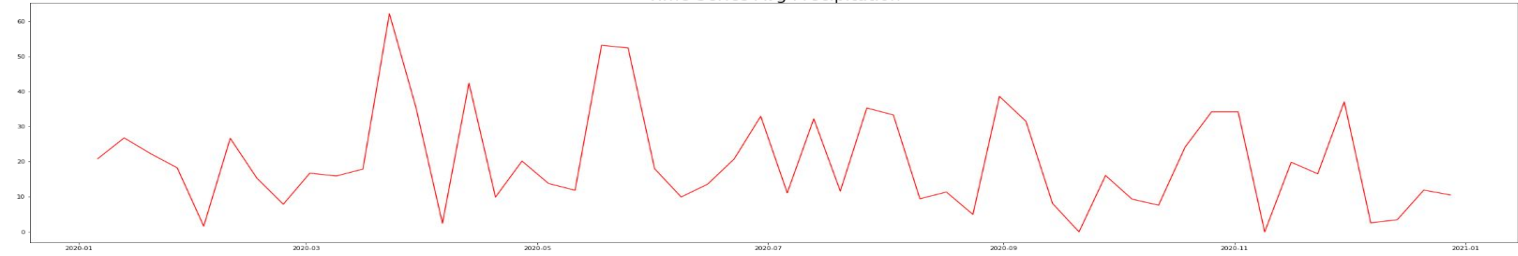
Time serie of Precipitation Oregon, Utah, Texas and ohio 2020



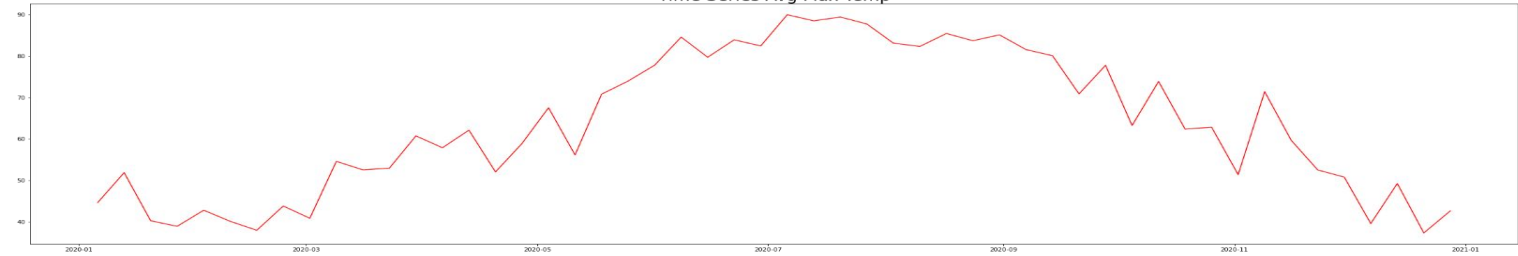
Time serie of of Ohio state 2020



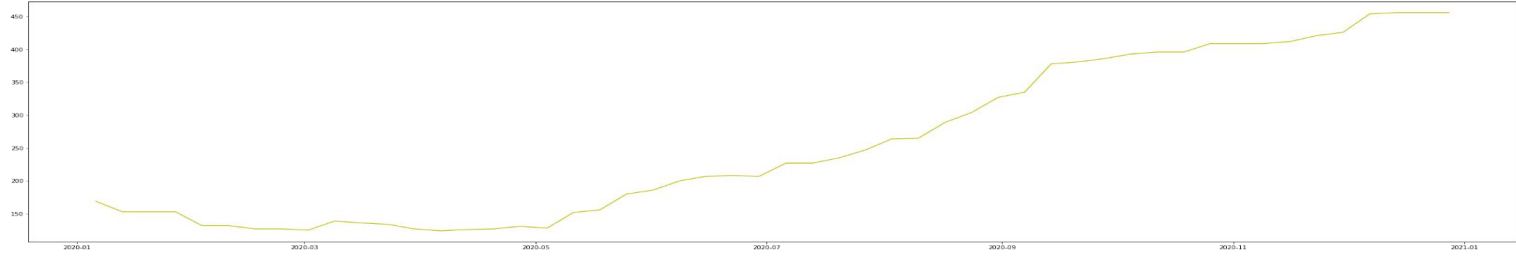
Time Series Avg Precipitation



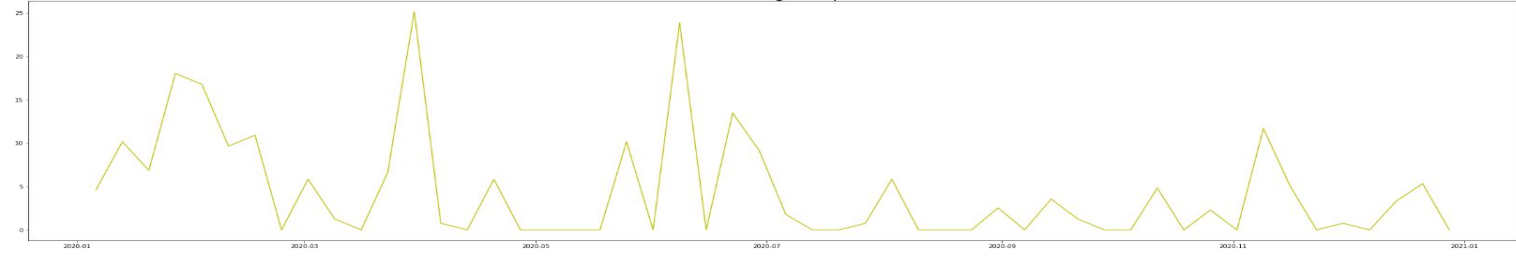
Time Series Avg Max Temp



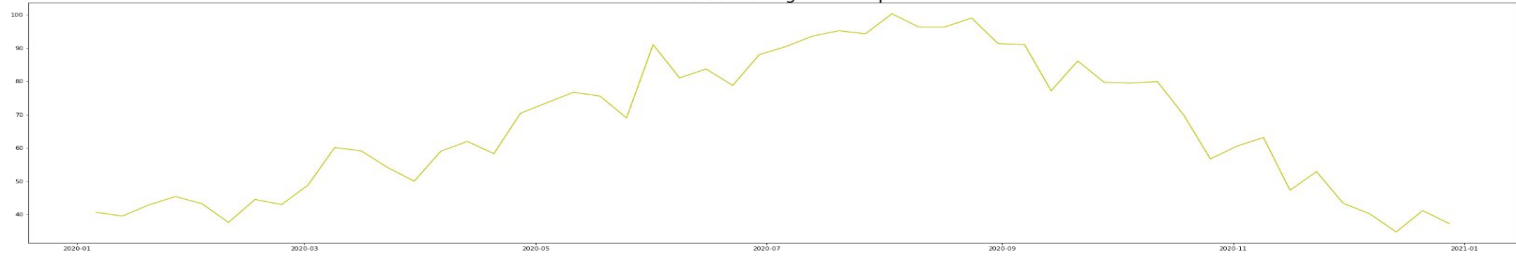
Time serie of of Utah state 2020



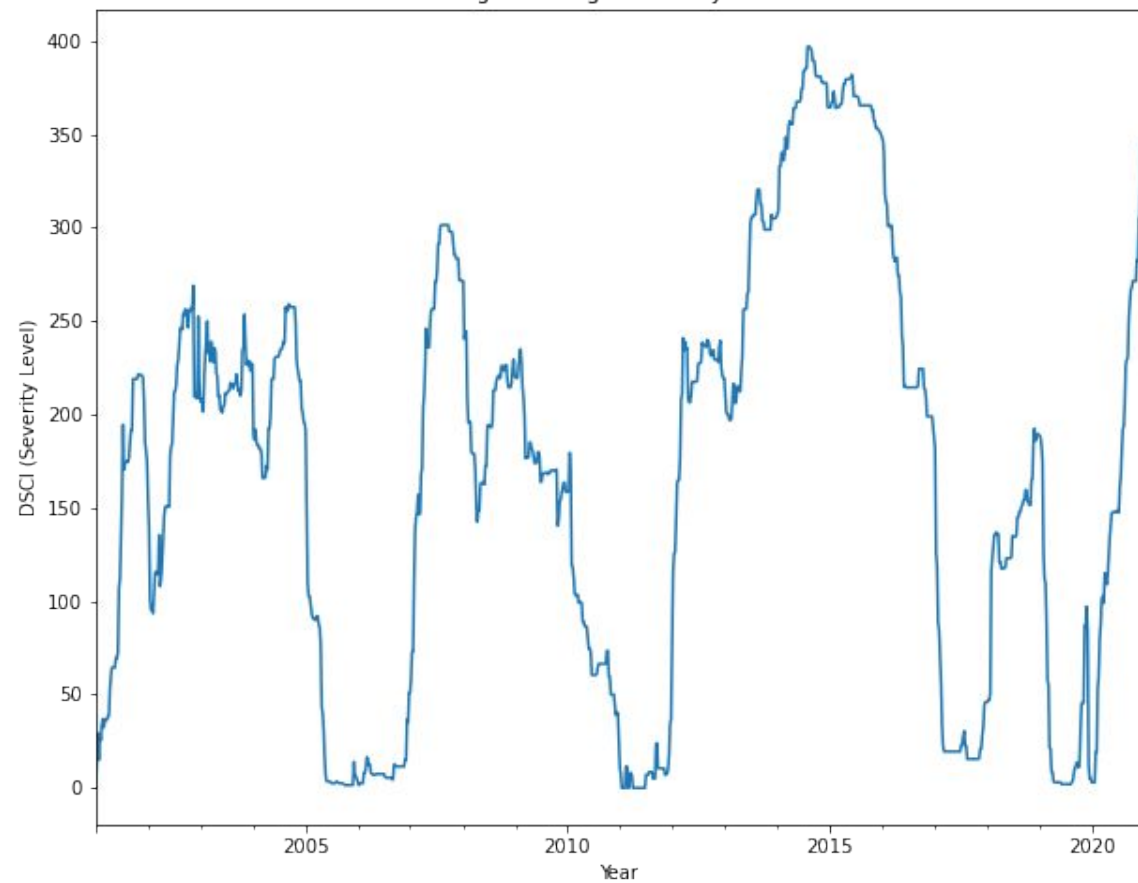
Time Series Avg Precipitation



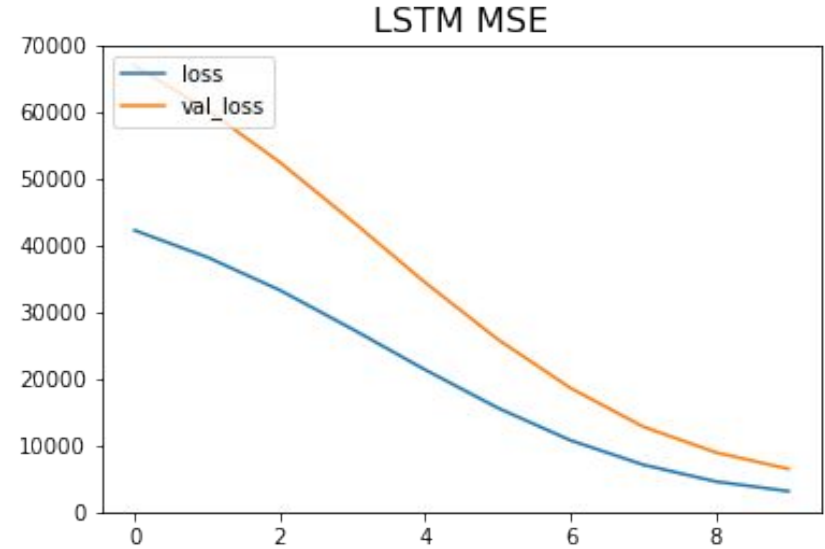
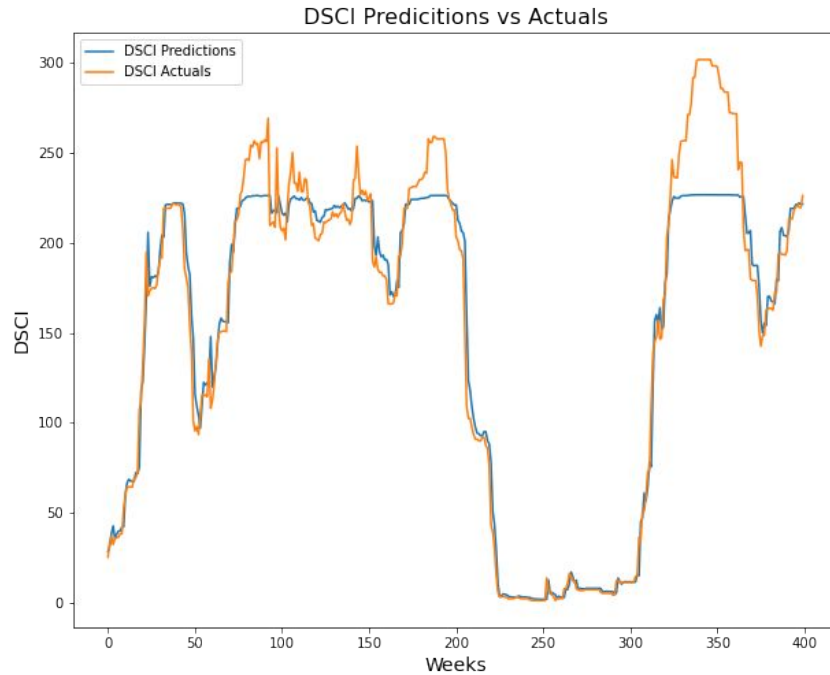
Time Series Avg Max Temp



West Region Drought Severity 2001-2020

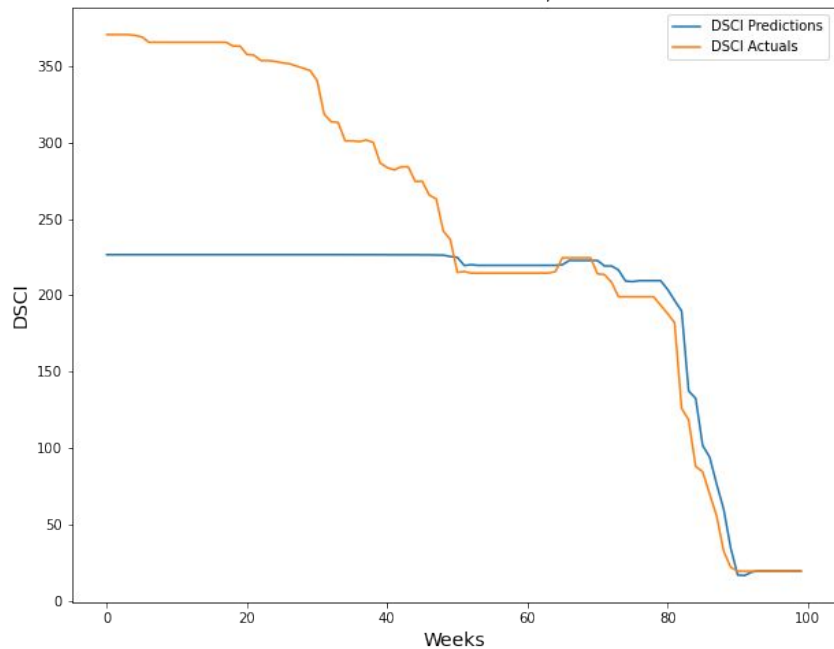


# LSTM Prediction Model

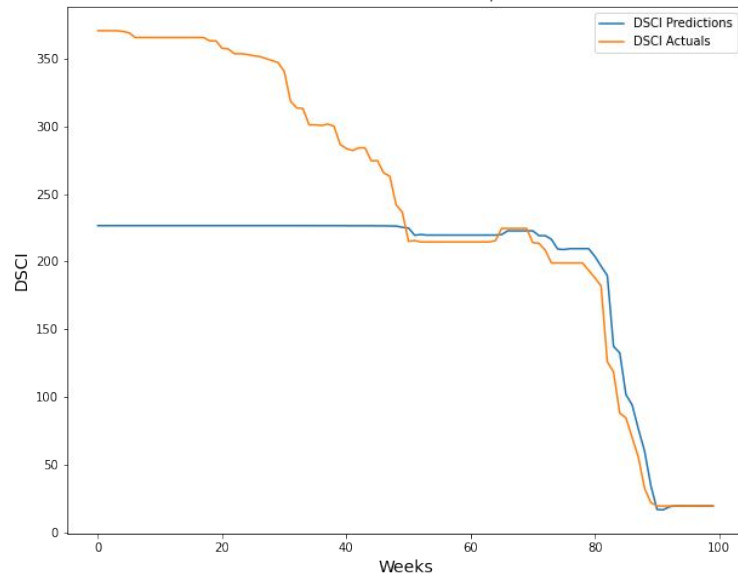


# LSTM Prediction Model

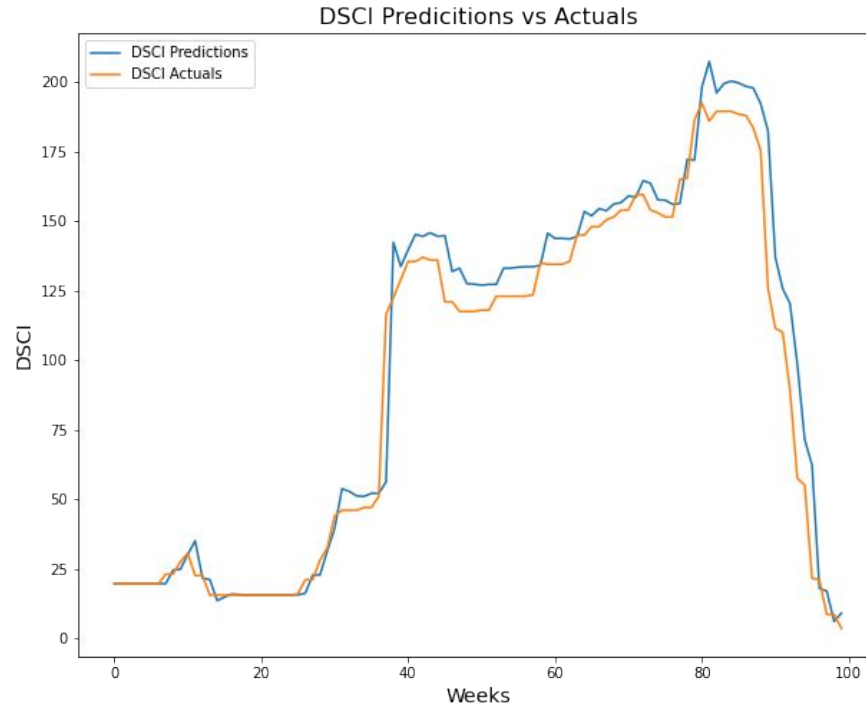
DSCI Predictions vs Actuals, Validation



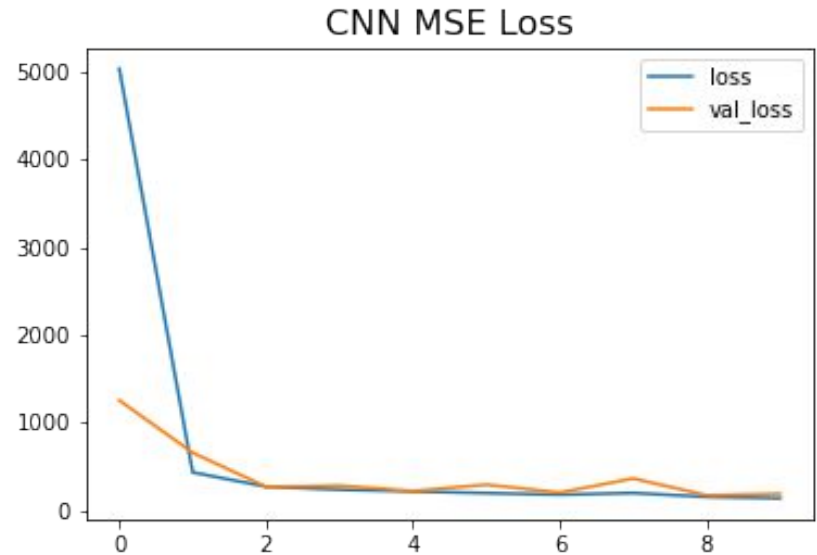
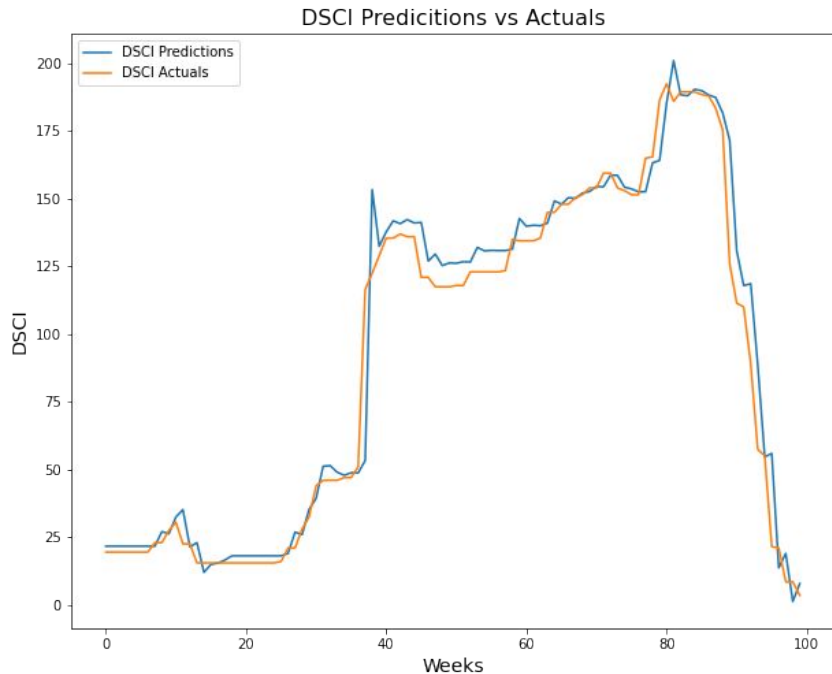
DSCI Predictions vs Actuals, Test Data



# LSTM Prediction Model

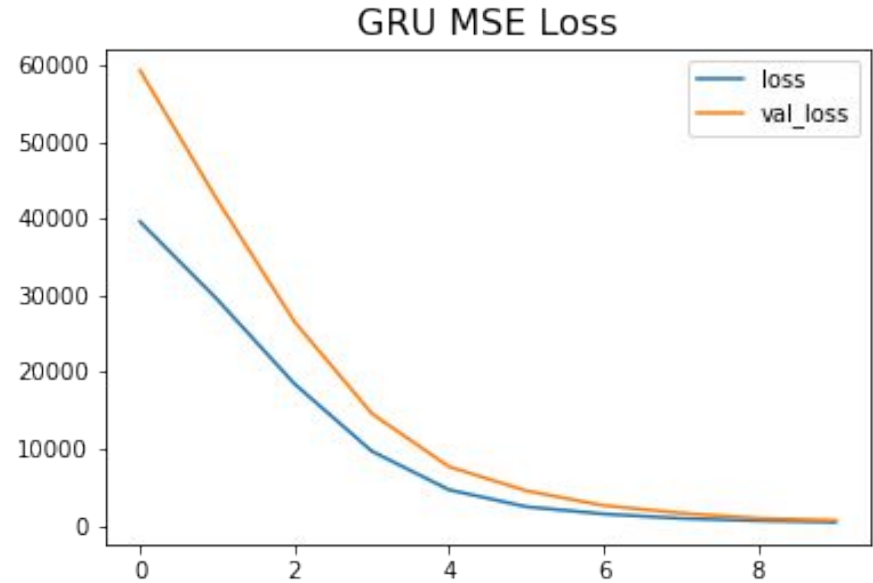
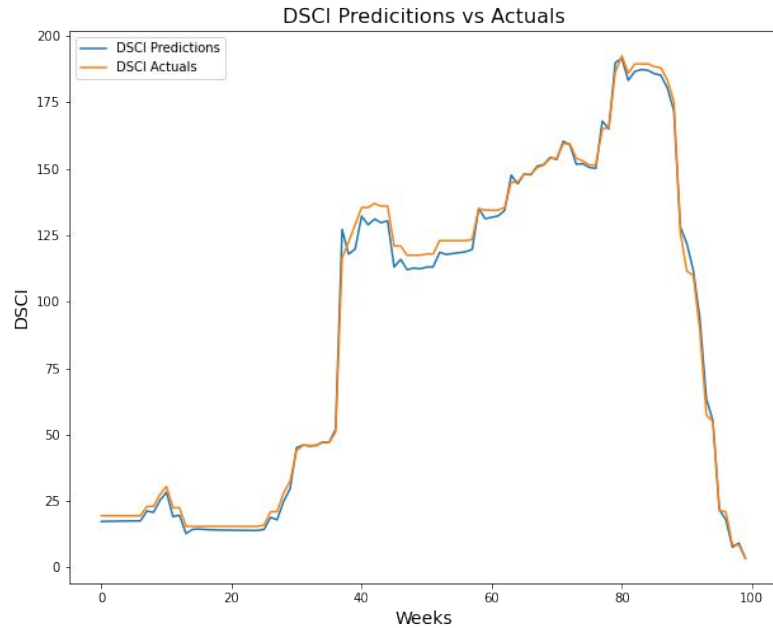


# CNN Prediction Model

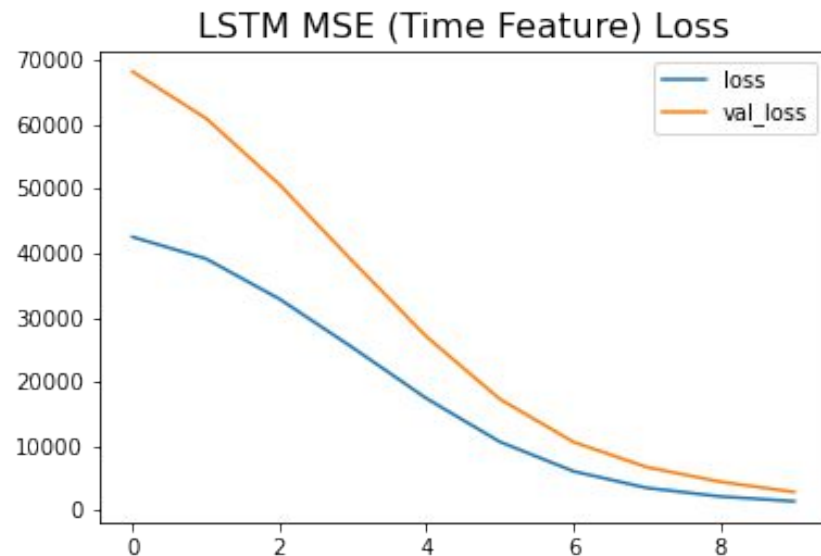
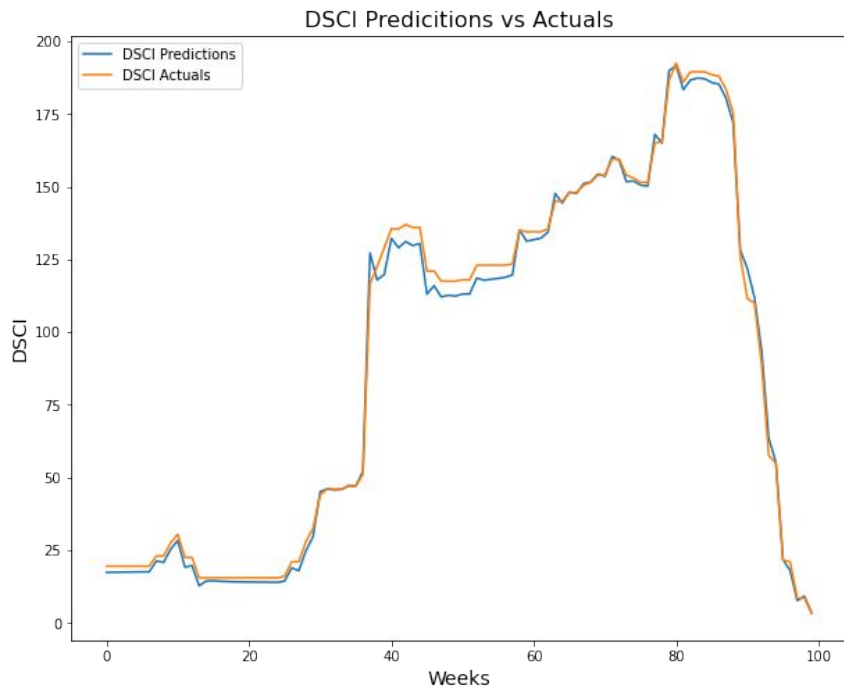




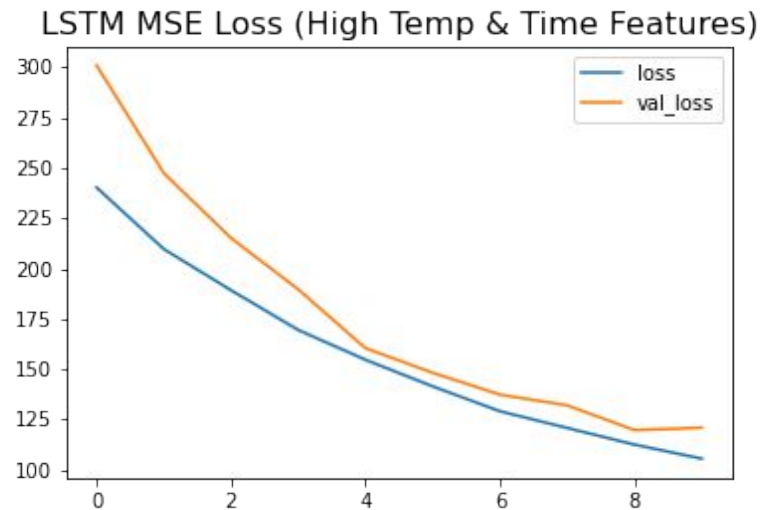
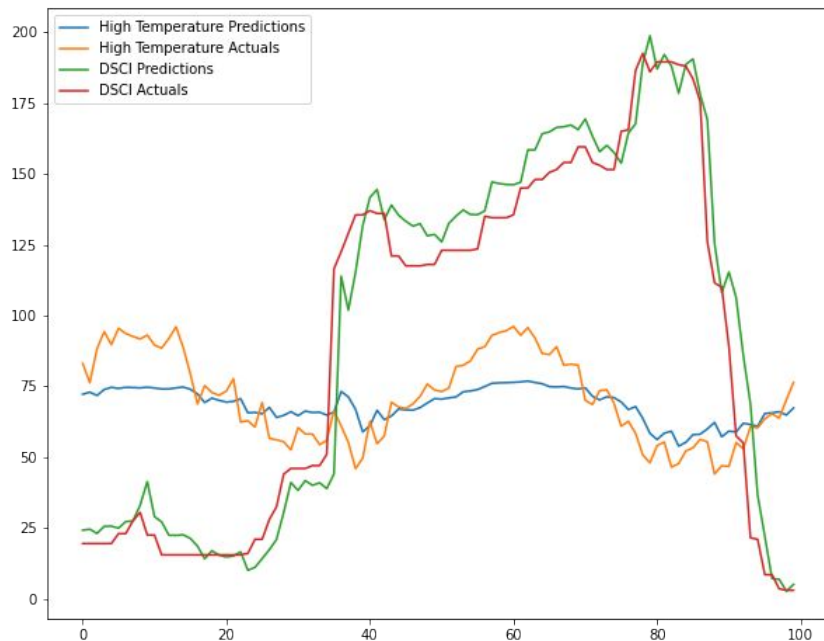
# GRU Prediction Model



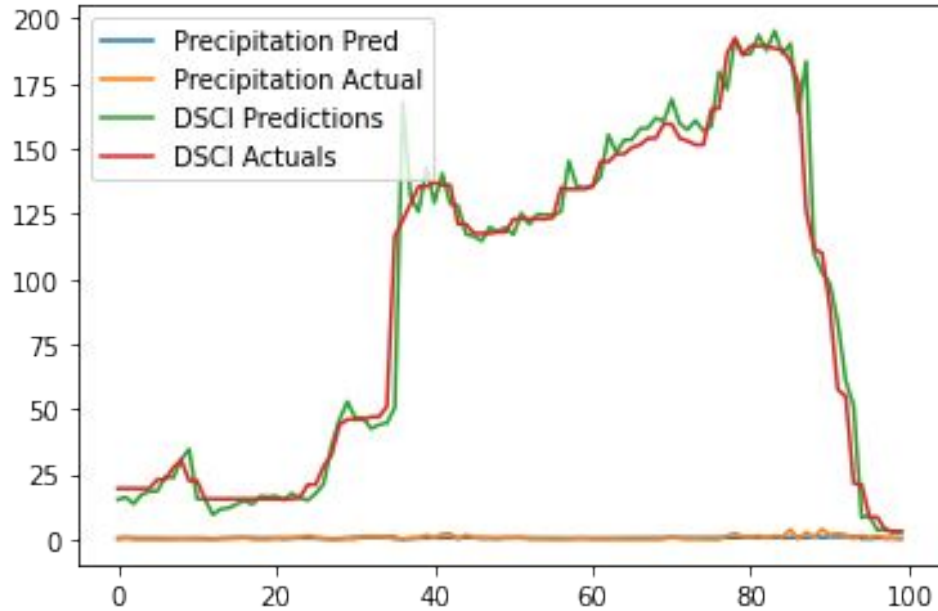
# LSTM Prediction Model (MV Time)



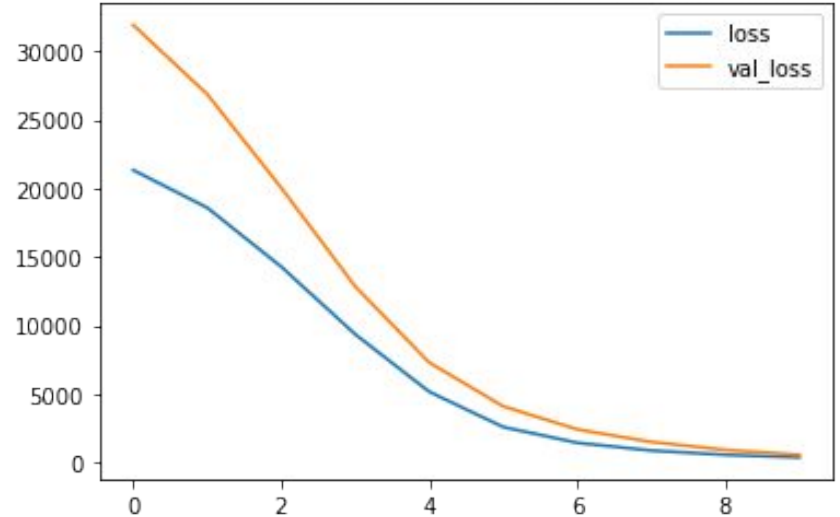
# LSTM Prediction Model (MV Time & High Temp)



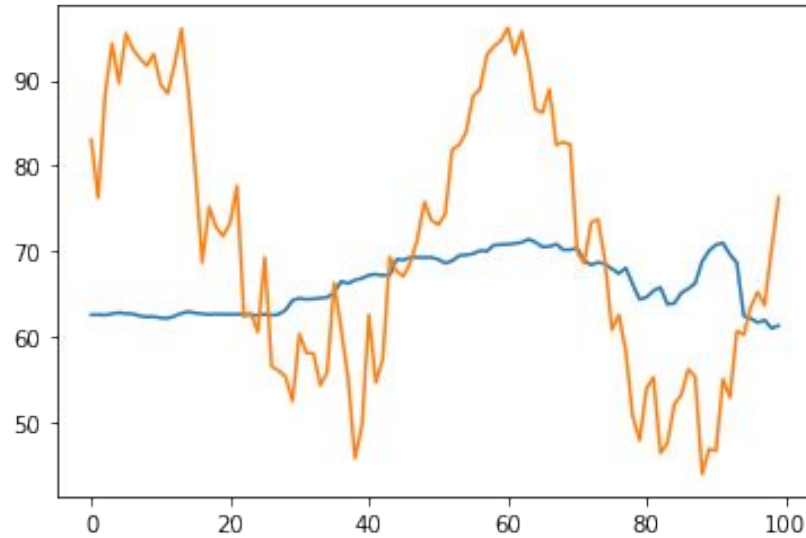
# LSTM Prediction Model (MV Time & Precipitation)



LSTM MSE Loss (Precipitation & Time Features)



# LSTM Prediction Model (MV Time & Precipitation)



# Model Metric Summary

Model	MSE	Val Loss	RMSE
LSTM	544.09	760.45	27.57
CNN	138.06	123.14	11.75
GRU	757.87	1187.01	44.91
LSTM M.V.	615.95	1142.63	33.8
LSTM Precip.	757.87	2000.4	44.7
LSTM Temp	4628.32	8033.28	89.62

# Drought Monitor Streamlit



# Conclusions

As we have been able to verify, temperature and precipitation are factors that significantly affect drought. We can also verify that drought and precipitation do not have a cycle or frequency like temperature.

After the analysis of the drought, we see that it varies depending on the region, for example the regions that are located in the south; We see that they have a higher degree of drought compared to the regions that are further north. If we analyze the states, we can see the same pattern of drought, with the exception of some cases where some states have a much higher peak than the average.

As far as modeling, CNN performed the best of all of our models. We will be able to use these techniques on other regions of the US.

We recommend that the drought monitor goes by daily DSCI measurements to get more accurate predictions and to test more multivariate models.

We need more data on the multivariate models.



# Next Steps

- Use modeling techniques at state levels.
- Add predictability function to streamlit app.
- Look for more robust temperature & precipitation dataset.

# References

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