

# Analysis of Extreme Temperatures in the Rio Grande Valley

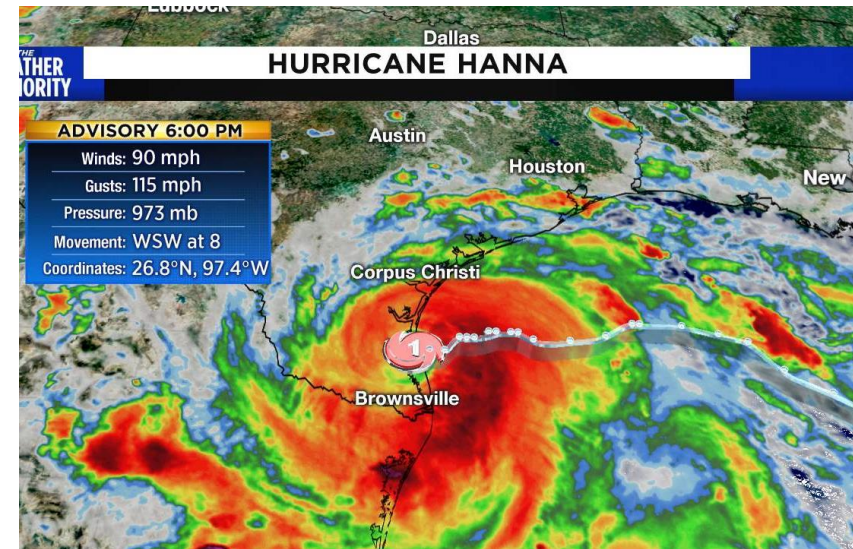
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MARS4370: Introduction to Science Computing

May 3, 2021

# Introduction

- Climate change models focus on global models; uncertainty on how it will affect on the local scale
- On a study of southeastern US states, Texas was projected to have the greatest decrease in precipitation trends (Liu et al., 2012)
- Increase in extreme weather events



# Purpose



Have there been changes  
in local climate?




Has there been an increase  
in extreme events?

Changes in local climate and extreme events will be studied through the analysis of **extreme temperatures**.

# Methods: Data Aquisition

- Data obtained from NOAA's NOWData Portal
  - McAllen-Miller Int'l Airport
  - Monthly Average Temperatures
  - Monthly record high and low temperatures
  - Daily Record Highs and Lows
  - 2017 - 2020



**National Weather Service Forecast Office**  
**Brownsville, TX**

Home News

Local forecast by "City, St"  City, St

Observed Weather Climate Locations Climate Prediction Climate Resources Local Data/Records Astronomical NOWData

**NOWData - NOAA Online Weather Data**

1. Location »   
Falfurrias, TX  
Harlingen, TX  
Hebbronville, TX  
McAllen, TX  
McAllen Miller I, TX  
Mercedes 6 Sse, TX  
Port Isabel, TX  
Port Mansfield, TX  
Raymondville, TX  
Rio Grande City, TX

2. Product »  
☐ Daily data for a month  
☐ Daily almanac  
☐ Monthly summarized data  
☒ Calendar day summaries  
☐ Daily/monthly normals  
☐ Climatology for a day  
☐ First/last dates  
☐ Temperature graphs  
☐ Accumulation graphs

3. Options »  
Year range: 1970 - 2020  
Variable:   
Summary:

4. View »

**Product Description:**  
CALENDAR DAY SUMMARIES - for each calendar day of the year, provides the mean, extreme daily value, or frequency of days meeting criteria based on the selected range of years. For extremes, the year of occurrence is also provided. Temperatures are reported in degrees F; precipitation, snowfall and snow depth are reported in inches.

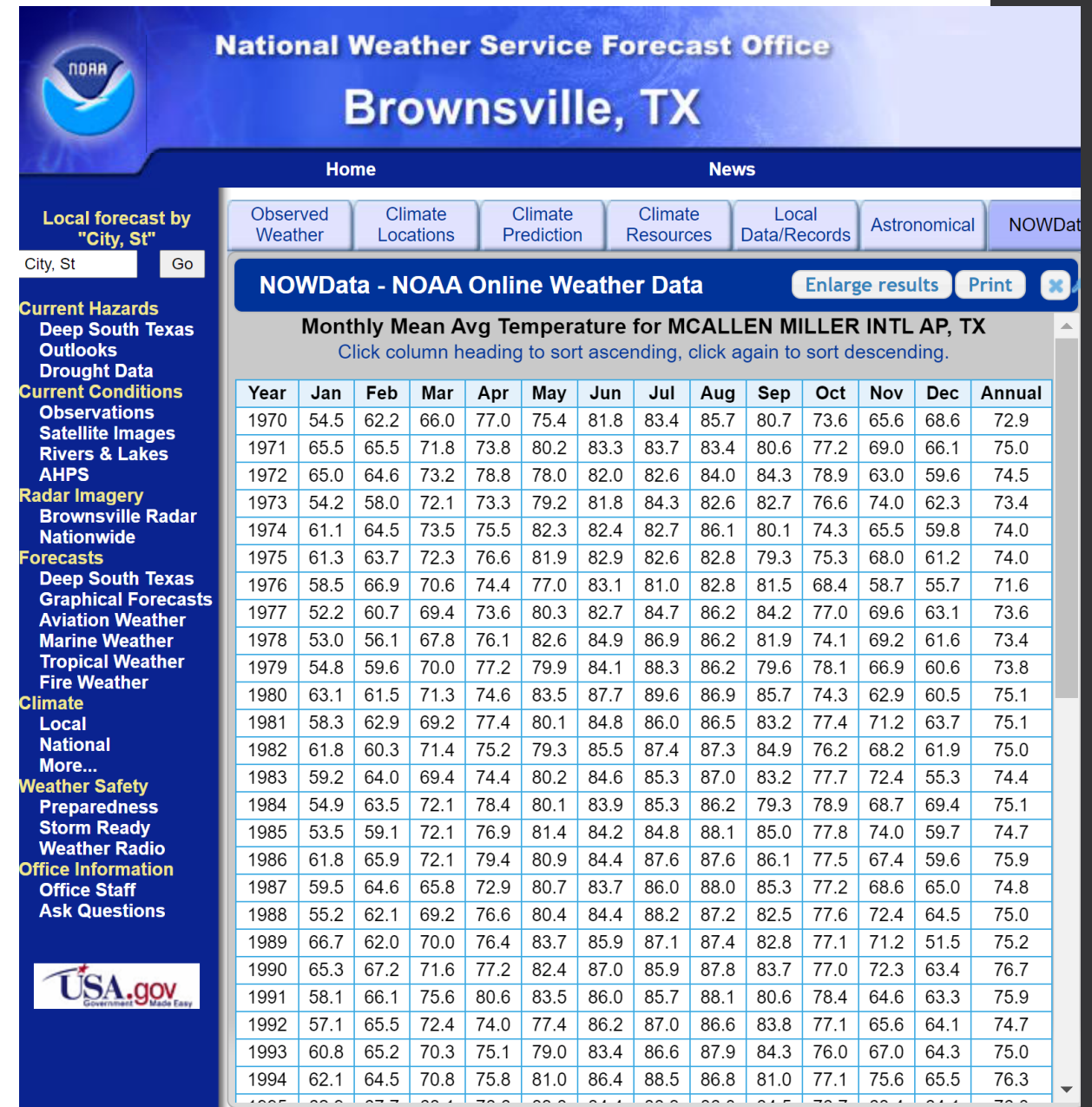
- Common questions -  
- Submit a question/comment -

Powered by **ACIS**  
NOAA Regional Climate Centers

The Applied Climate Information System (ACIS) is a joint project of the Regional Climate Centers, the National Centers for Environmental Information (NCEI) and the National Weather Service. Official data and data for additional locations are available from the Regional Climate Centers and NCEI.

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Current Hazards  
Deep South Texas Outlooks  
Drought Data

Current Conditions  
Observations  
Satellite Images  
Rivers & Lakes  
AHPS

Radar Imagery  
Brownsville Radar  
Nationwide

Forecasts  
Deep South Texas  
Graphical Forecasts  
Aviation Weather  
Marine Weather  
Tropical Weather  
Fire Weather

Climate  
Local  
National  
More...

Weather Safety  
Preparedness  
Storm Ready  
Weather Radio

Office Information  
Office Staff  
Ask Questions

USA.gov  
Government Made Easy

Observed Weather Climate Locations Climate Prediction Climate Resources Local Data/Records Astronomical NOWData

NOWData - NOAA Online Weather Data [Enlarge results](#) [Print](#)

Monthly Mean Avg Temperature for MCALLEN MILLER INTL AP, TX  
Click column heading to sort ascending, click again to sort descending.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1970	54.5	62.2	66.0	77.0	75.4	81.8	83.4	85.7	80.7	73.6	65.6	68.6	72.9
1971	65.5	65.5	71.8	73.8	80.2	83.3	83.7	83.4	80.6	77.2	69.0	66.1	75.0
1972	65.0	64.6	73.2	78.8	78.0	82.0	82.6	84.0	84.3	78.9	63.0	59.6	74.5
1973	54.2	58.0	72.1	73.3	79.2	81.8	84.3	82.6	82.7	76.6	74.0	62.3	73.4
1974	61.1	64.5	73.5	75.5	82.3	82.4	82.7	86.1	80.1	74.3	65.5	59.8	74.0
1975	61.3	63.7	72.3	76.6	81.9	82.9	82.6	82.8	79.3	75.3	68.0	61.2	74.0
1976	58.5	66.9	70.6	74.4	77.0	83.1	81.0	82.8	81.5	68.4	58.7	55.7	71.6
1977	52.2	60.7	69.4	73.6	80.3	82.7	84.7	86.2	84.2	77.0	69.6	63.1	73.6
1978	53.0	56.1	67.8	76.1	82.6	84.9	86.9	86.2	81.9	74.1	69.2	61.6	73.4
1979	54.8	59.6	70.0	77.2	79.9	84.1	88.3	86.2	79.6	78.1	66.9	60.6	73.8
1980	63.1	61.5	71.3	74.6	83.5	87.7	89.6	86.9	85.7	74.3	62.9	60.5	75.1
1981	58.3	62.9	69.2	77.4	80.1	84.8	86.0	86.5	83.2	77.4	71.2	63.7	75.1
1982	61.8	60.3	71.4	75.2	79.3	85.5	87.4	87.3	84.9	76.2	68.2	61.9	75.0
1983	59.2	64.0	69.4	74.4	80.2	84.6	85.3	87.0	83.2	77.7	72.4	55.3	74.4
1984	54.9	63.5	72.1	78.4	80.1	83.9	85.3	86.2	79.3	78.9	68.7	69.4	75.1
1985	53.5	59.1	72.1	76.9	81.4	84.2	84.8	88.1	85.0	77.8	74.0	59.7	74.7
1986	61.8	65.9	72.1	79.4	80.9	84.4	87.6	87.6	86.1	77.5	67.4	59.6	75.9
1987	59.5	64.6	65.8	72.9	80.7	83.7	86.0	88.0	85.3	77.2	68.6	65.0	74.8
1988	55.2	62.1	69.2	76.6	80.4	84.4	88.2	87.2	82.5	77.6	72.4	64.5	75.0
1989	66.7	62.0	70.0	76.4	83.7	85.9	87.1	87.4	82.8	77.1	71.2	51.5	75.2
1990	65.3	67.2	71.6	77.2	82.4	87.0	85.9	87.8	83.7	77.0	72.3	63.4	76.7
1991	58.1	66.1	75.6	80.6	83.5	86.0	85.7	88.1	80.6	78.4	64.6	63.3	75.9
1992	57.1	65.5	72.4	74.0	77.4	86.2	87.0	86.6	83.8	77.1	65.6	64.1	74.7
1993	60.8	65.2	70.3	75.1	79.0	83.4	86.6	87.9	84.3	76.0	67.0	64.3	75.0
1994	62.1	64.5	70.8	75.8	81.0	86.4	88.5	86.8	81.0	77.1	75.6	65.5	76.3



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- Data obtained from NOAA's NOWData Portal
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  - 2017 – 2020
- Data manipulation using Pandas to make it into a timeseries

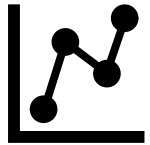


The screenshot shows the NOAA National Weather Service Forecast Office website for Brownsville, TX. Below the website header, a Jupyter Notebook interface is visible. The input cell 'In [36]:' contains the command 'McMill'. The output cell 'Out[36]:' displays a table of temperature data. The table has five columns: an index, 'Year', 'Month', 'Temp', and 'date'. The data spans from 1970 to 2020, with rows 1 through 5 showing data for 1970 and rows 708 through 712 showing data for 2020. The table is truncated in the middle with ellipses. Below the table, it indicates '612 rows x 4 columns'.

	Year	Month	Temp	date
1	1970	Jan	54.5	1970-01-31
2	1970	Feb	62.2	1970-02-28
3	1970	Mar	66	1970-03-31
4	1970	Apr	77	1970-04-30
5	1970	May	75.4	1970-05-31
...	...	...	...	...
708	2020	Aug	87.3	2020-08-31
709	2020	Sep	82.8	2020-09-30
710	2020	Oct	78.6	2020-10-31
711	2020	Nov	74.1	2020-11-30
712	2020	Dec	63	2020-12-31

612 rows x 4 columns

# Methods

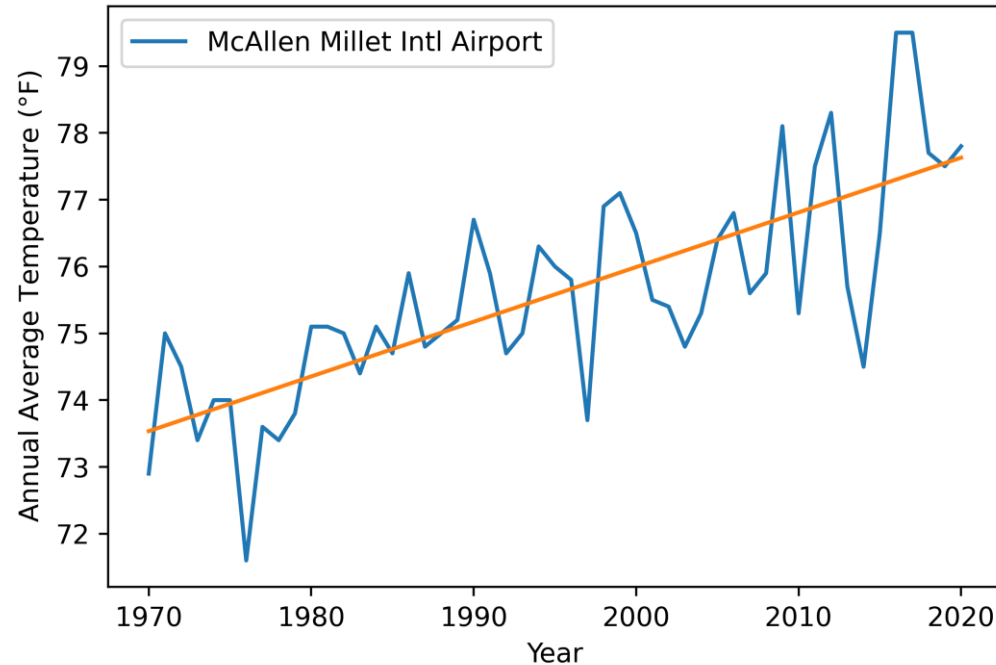


- Linear Regression
  - Find linear relationship between Annual Temperatures and Time
  - Scipy -> stats



- Time series forecasting with ARIMA
  - Auto Regressive Integrated Moving Average
  - Source Code: [towardsdatascience.com](https://towardsdatascience.com)
  - Used to forecast future temperature trends
  - Monthly average temperature data was used to create a 12 month moving average

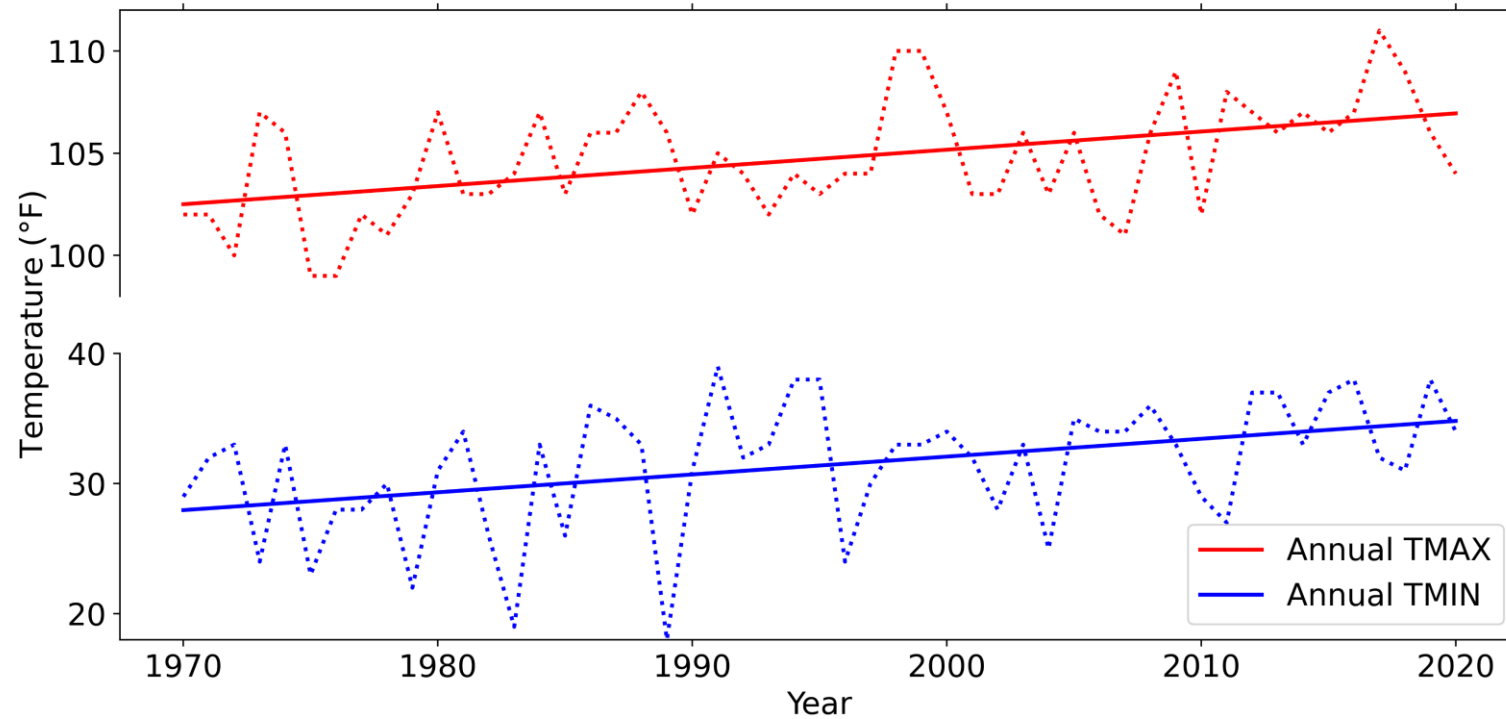
# Results: Annual Average Temperature Trend



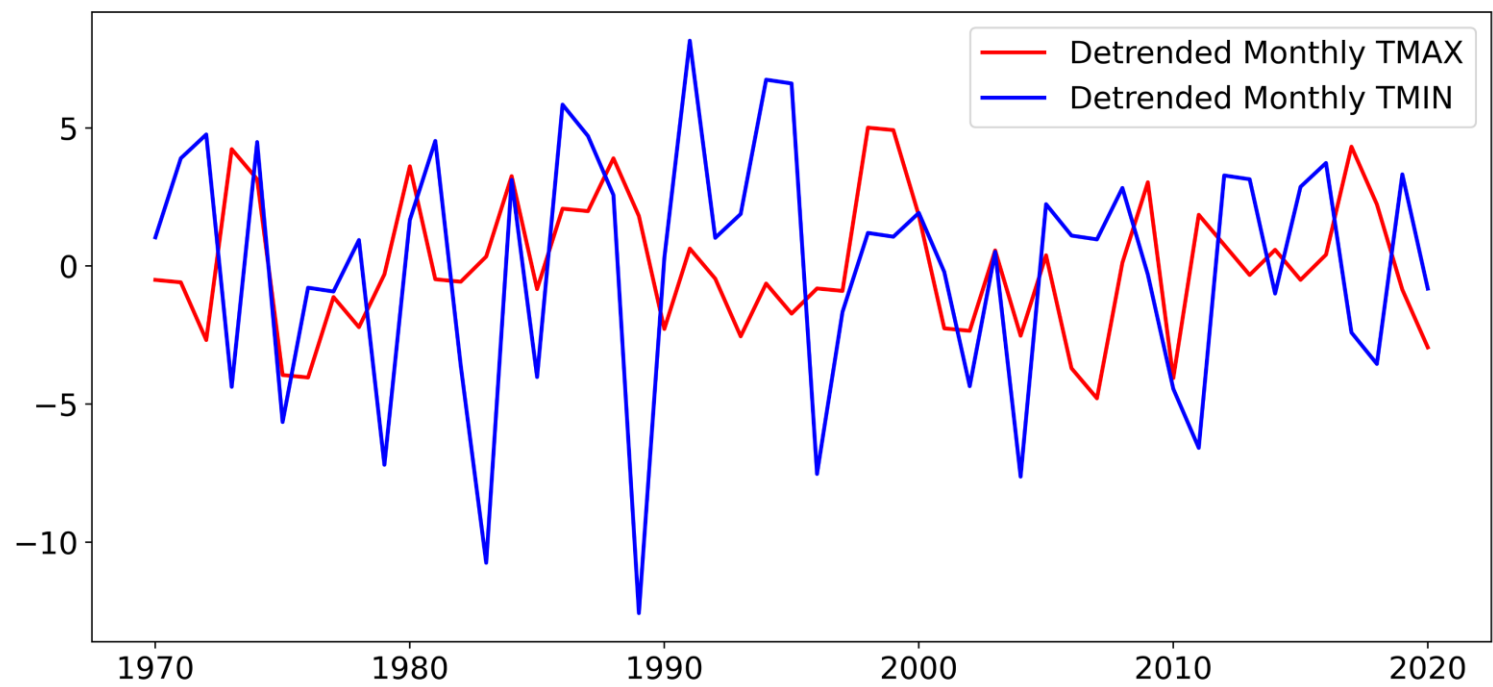
	Slope	Intercept	R-value
Annual Average Temperature	0.0818	-87.718	0.759



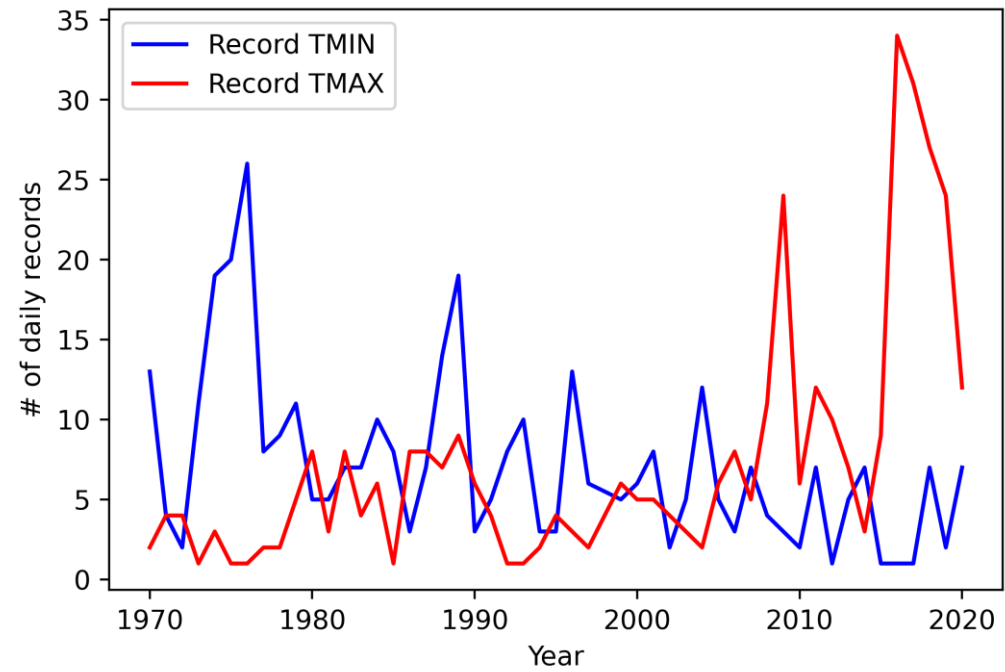
# Results



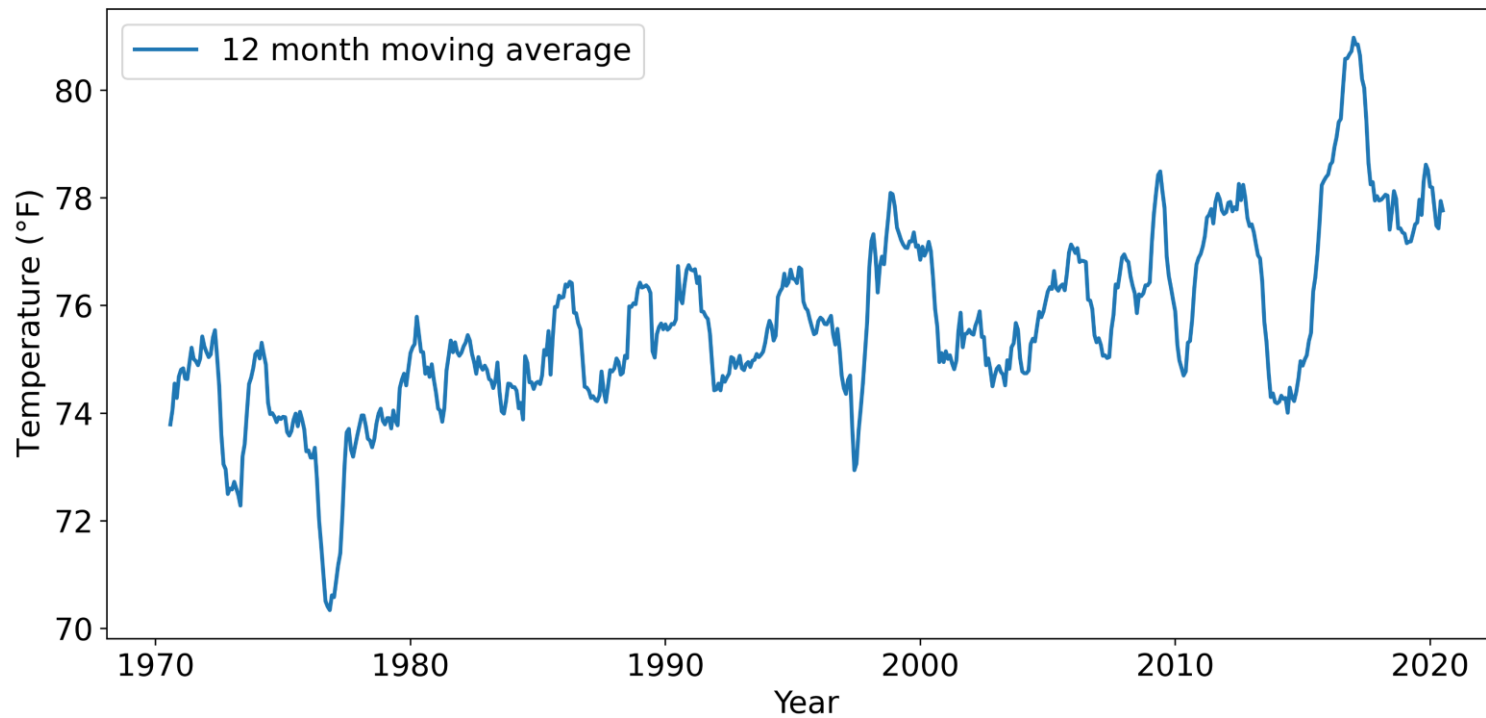
	Slope	Intercept	R-value
Annual TMAX	0.0888	-72.5677	0.467
Annual TMIN	0.137	-242.13	0.412



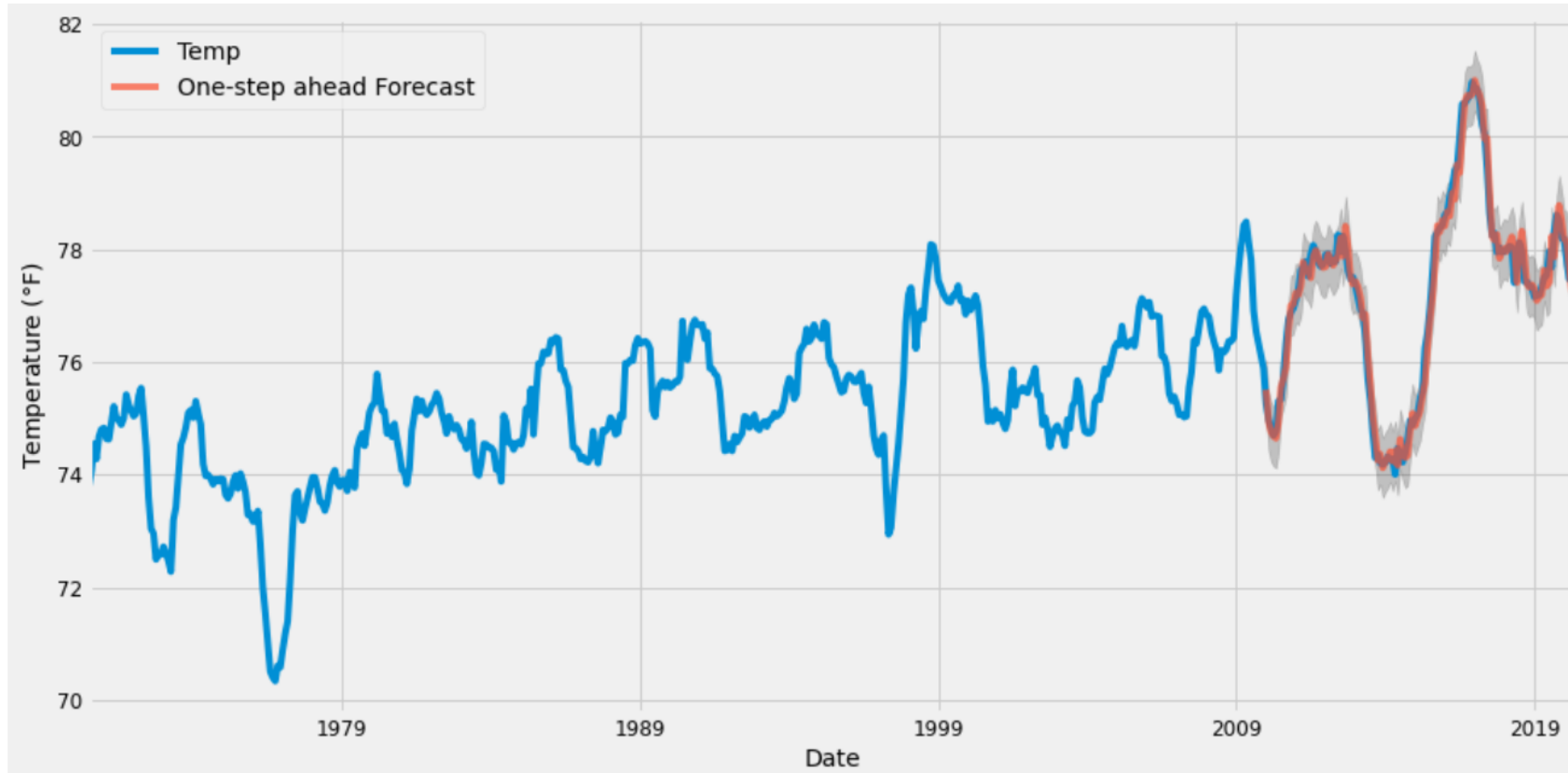
# Tmin vs tmax



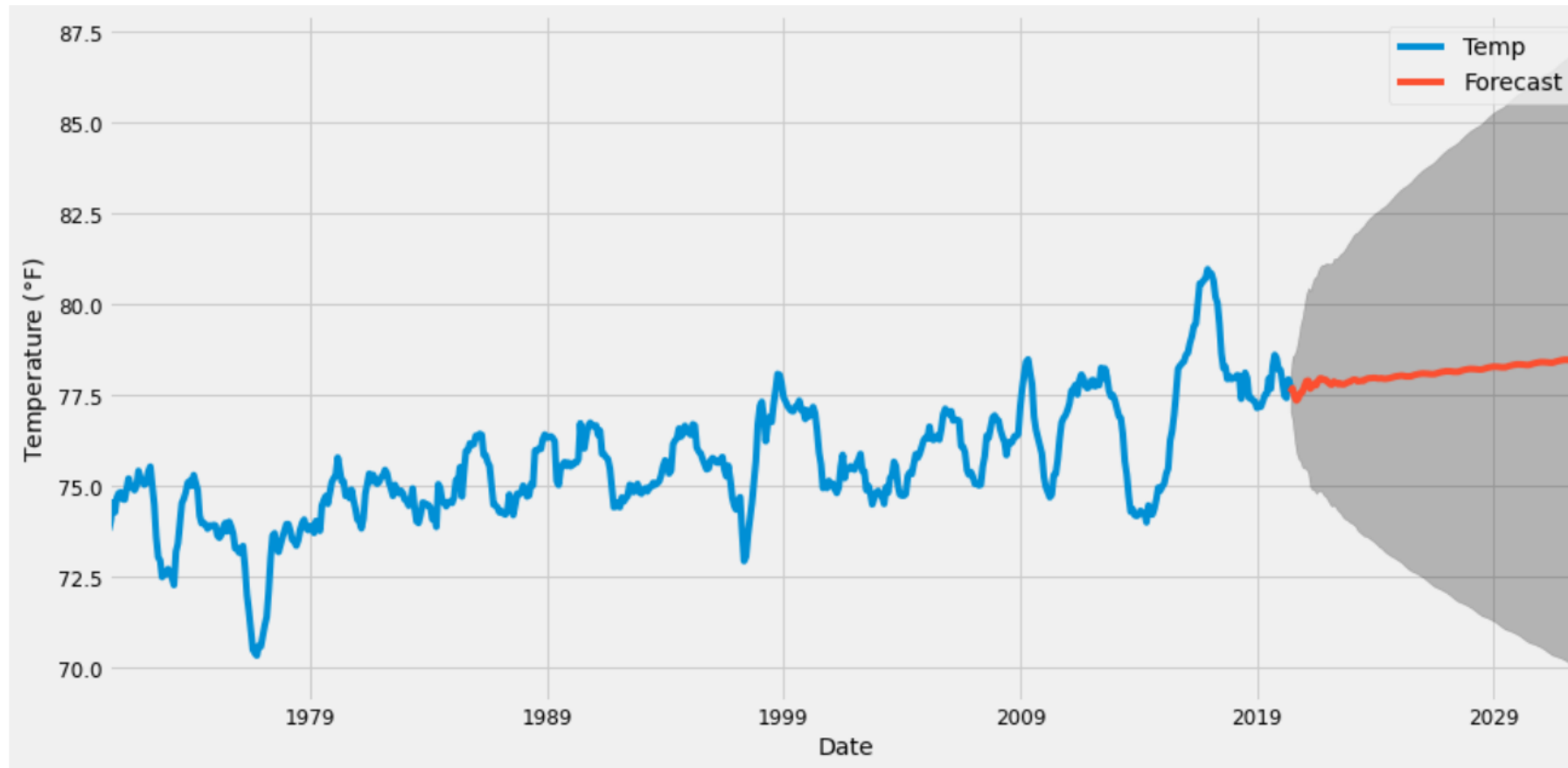
# Results: Moving Average Using Monthly Average Temperatures



# Results: ARISMA Model



# Results: Timeseries Forecast





# Discussion

- Current temperature trends indicate that temperatures are increasing
- Average Annual Temperatures, Annual Maximum and Minimum temperatures increasing at similar rates
- Daily Maximum records are increasing