Analysis of Extreme Temperatures in the Rio Grande Valley

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MARS4370: Introduction to Science Computing

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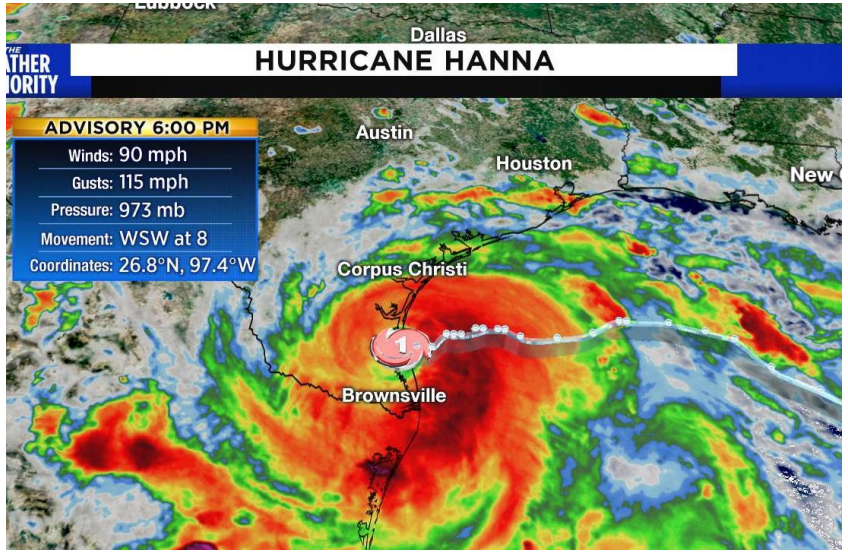
Introduction

- 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

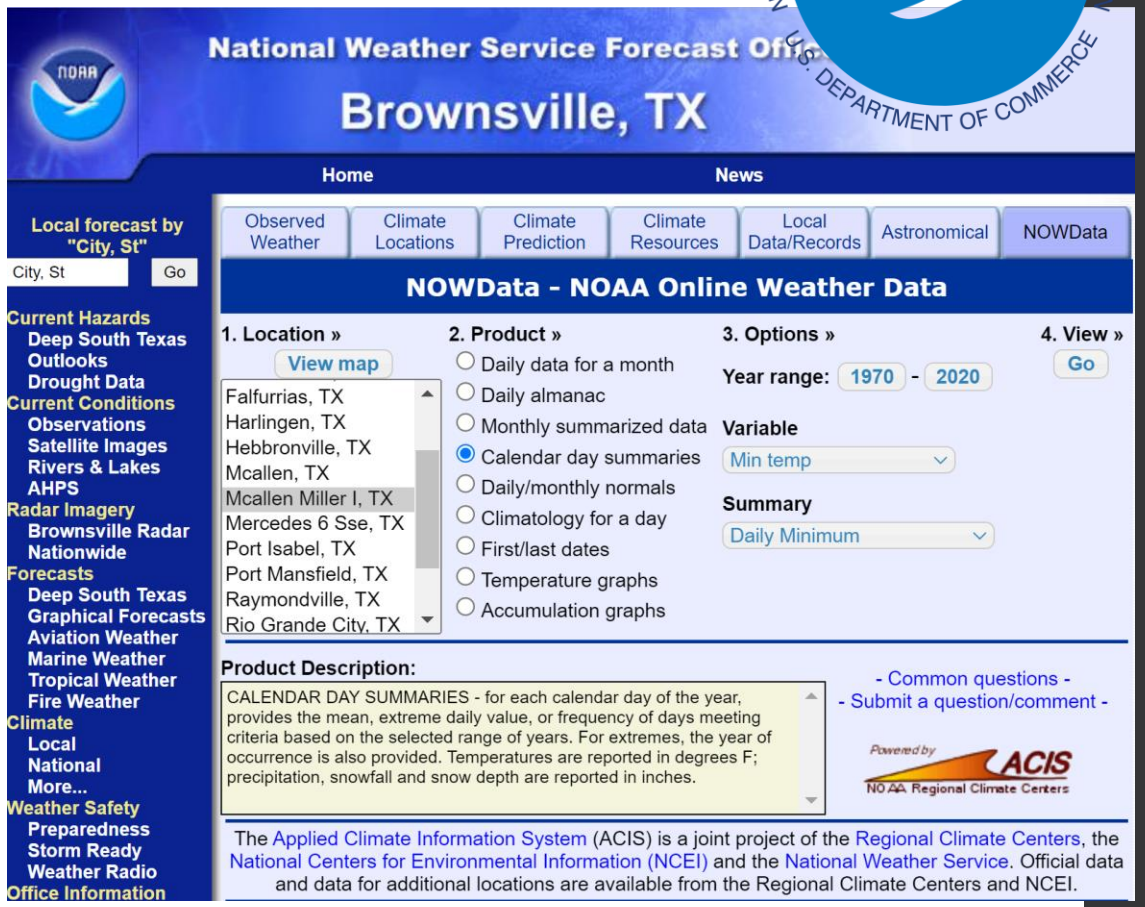
Have there been changes in local climate?

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



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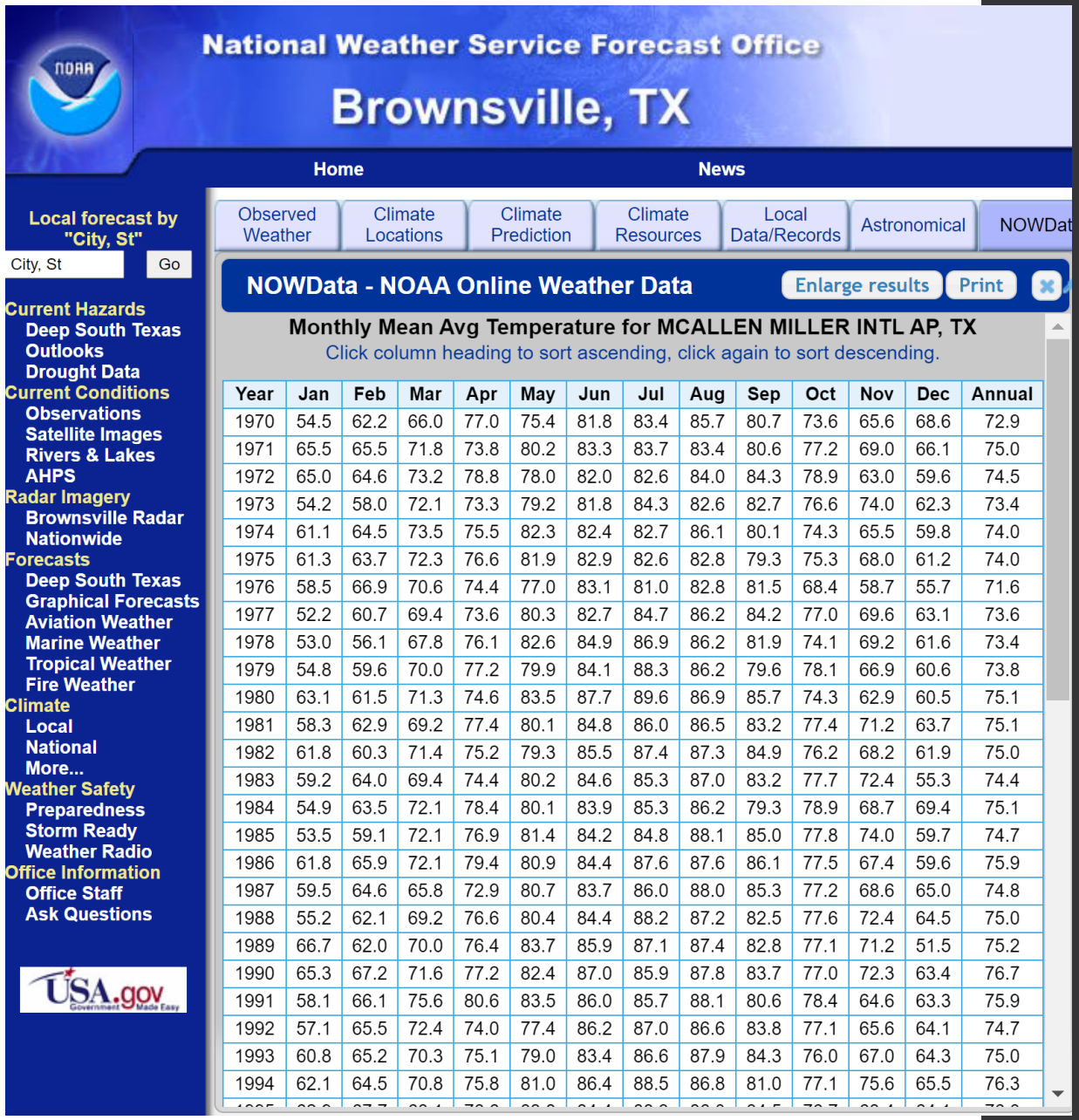

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1970	54.5	62.2	66.0	77.0	75.4	81.8	83.4	85.7	80.7	73.6	65.6	68.6	72.9
1971	65.5	65.5	71.8	73.8	80.2	83.3	83.7	83.4	80.6	77.2	69.0	66.1	75.0
1972	65.0	64.6	73.2	78.8	78.0	82.0	82.6	84.0	84.3	78.9	63.0	59.6	74.5
1973	54.2	58.0	72.1	73.3	79.2	81.8	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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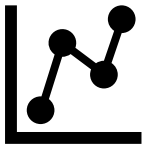
- Data manipulation using Pandas to make it into a timeseries

	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 × 4 columns

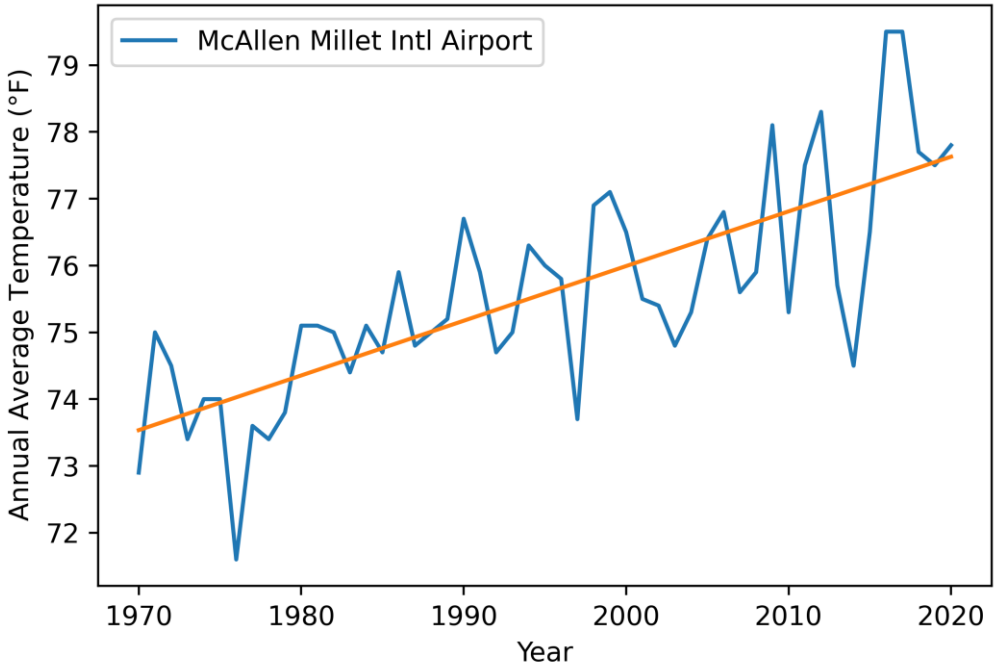
Methods



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

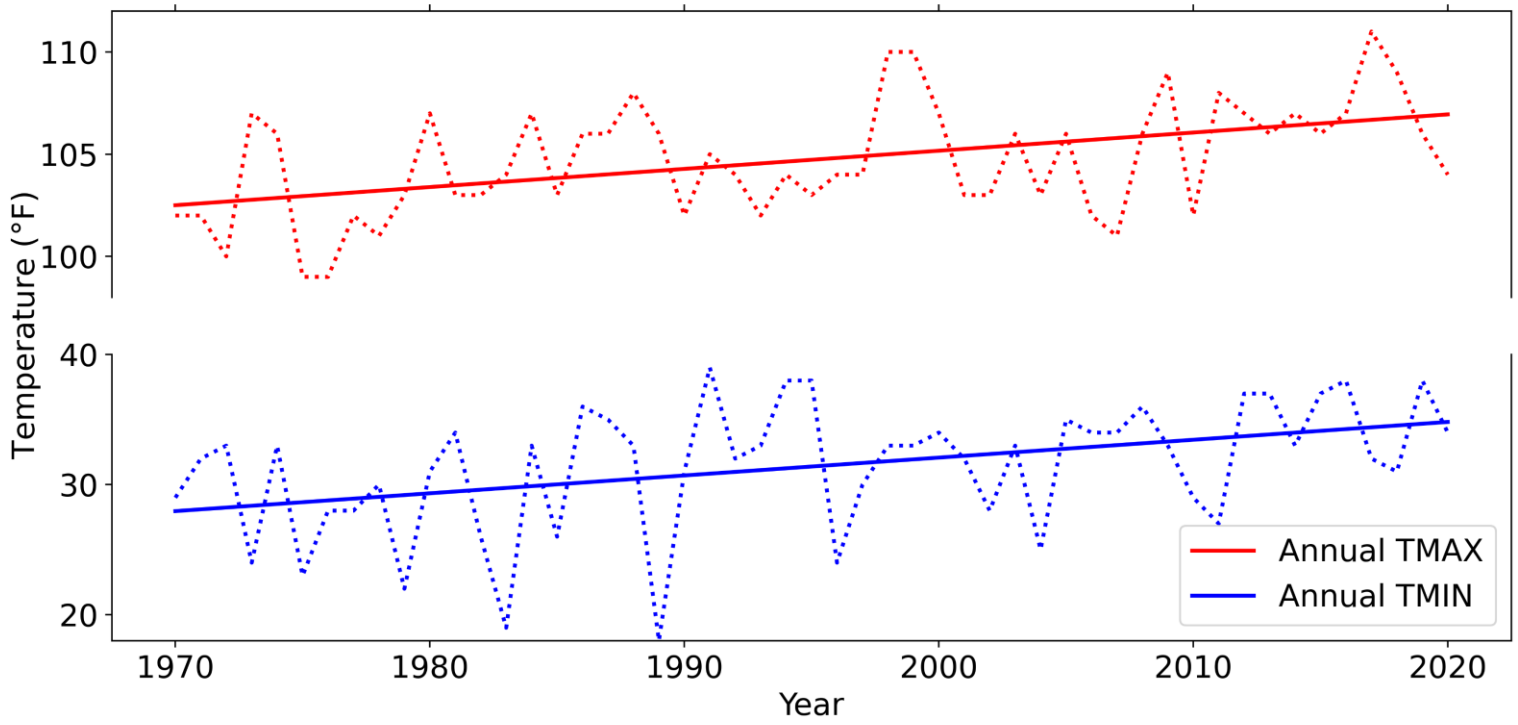
- Time series forecasting with ARIMA
  - Auto Regressive Integrated Moving Average
  - Source Code: towardsdatascience.com
  - Used to forecast future temperature trends
  - Monthly average temperature data was used to create a 12 month moving average

Results: Annual Average Temperature Trend

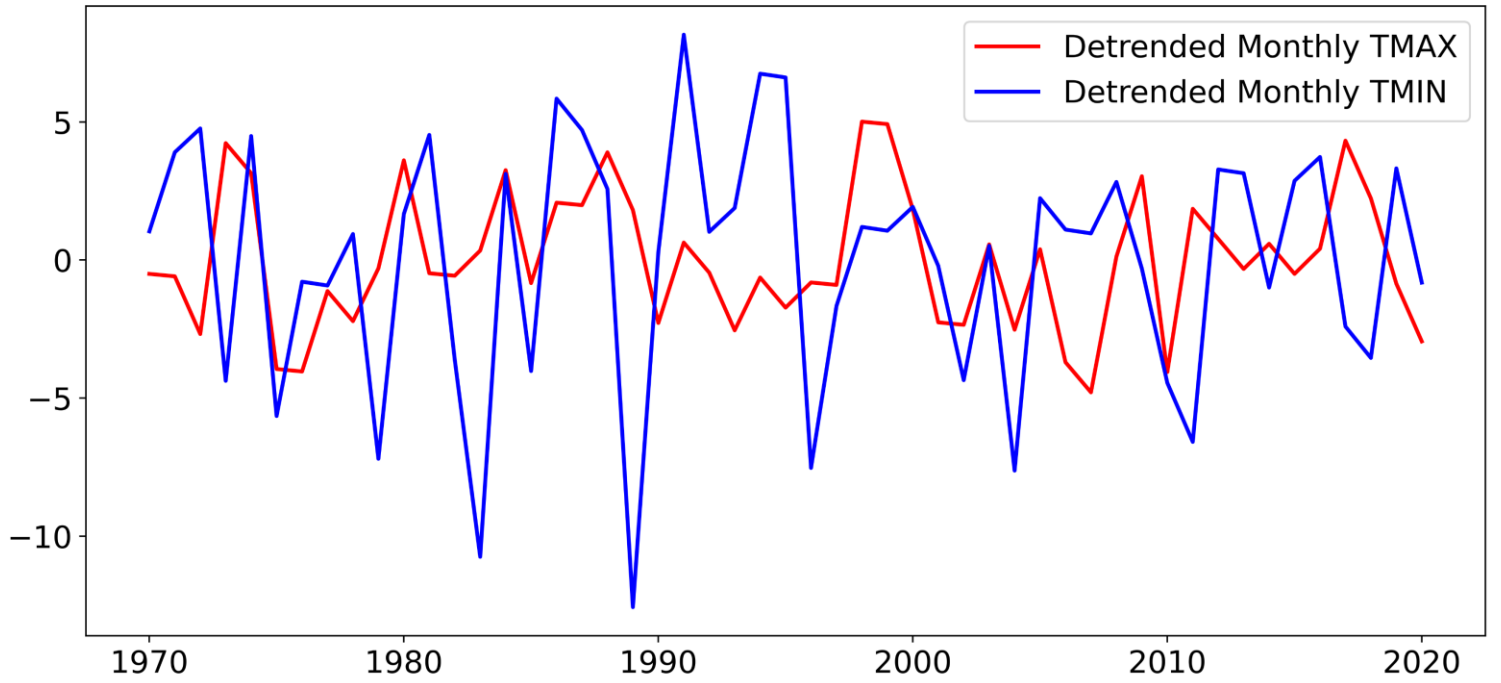


	Slope	Intercept	R-value
Annual Average Temperature	0.0818	-87.718	0.759

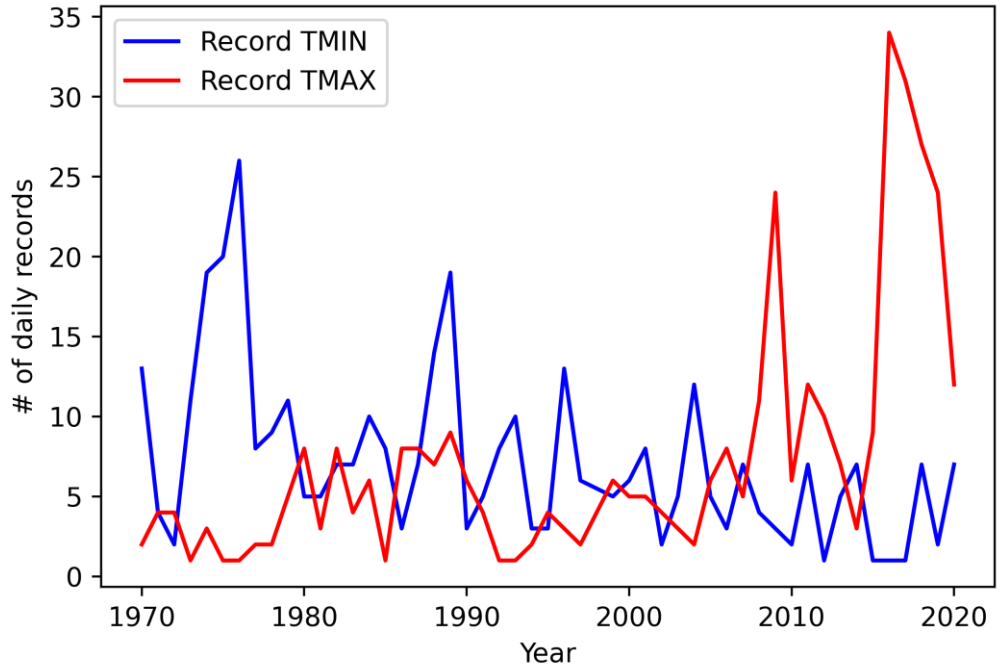
Results



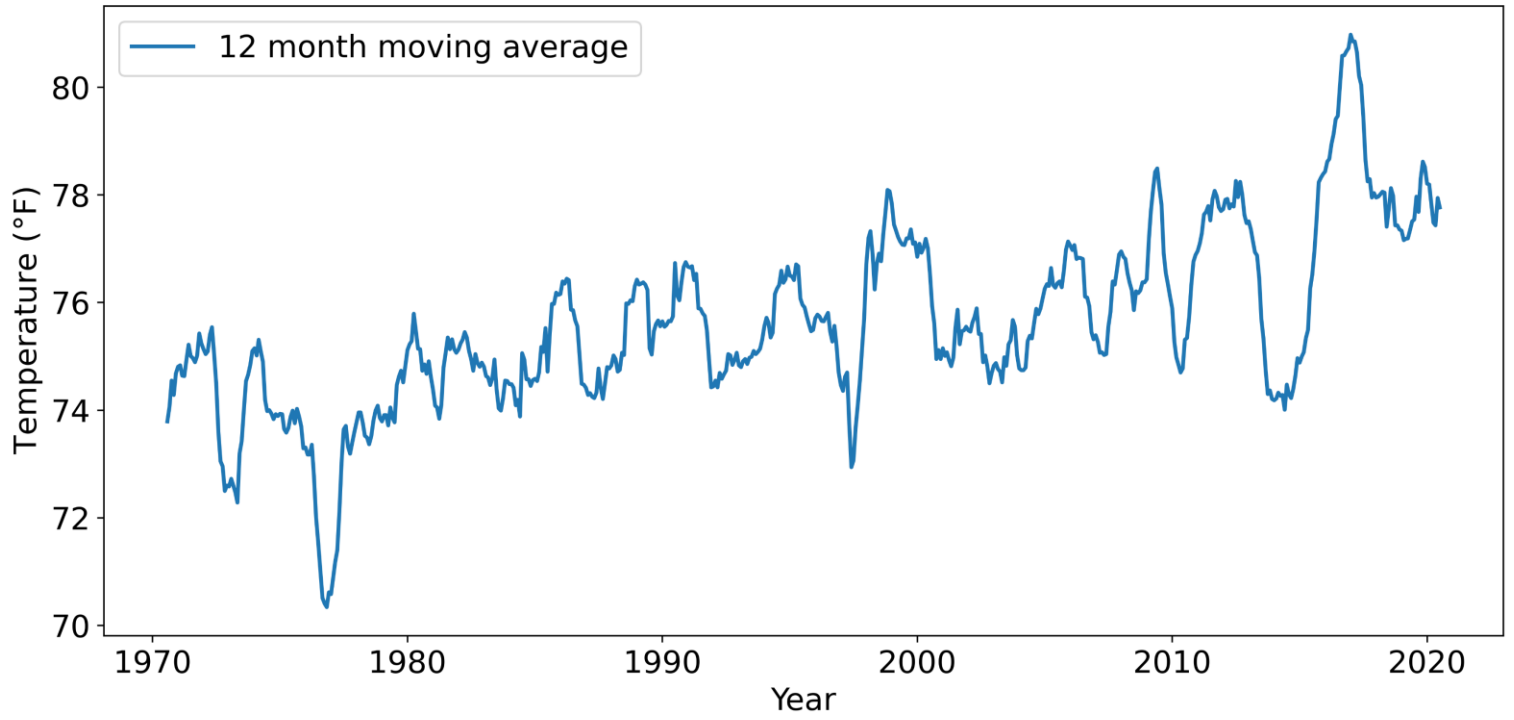
	Slope	Intercept	R-value
Annual TMAX	0.0888	-72.5677	0.467
Annual TMIN	0.137	-242.13	0.412


Detrended Monthly TMAX
Detrended Monthly TMIN
5
0
−5
−10
1970
1980
1990
2000
2010
2020

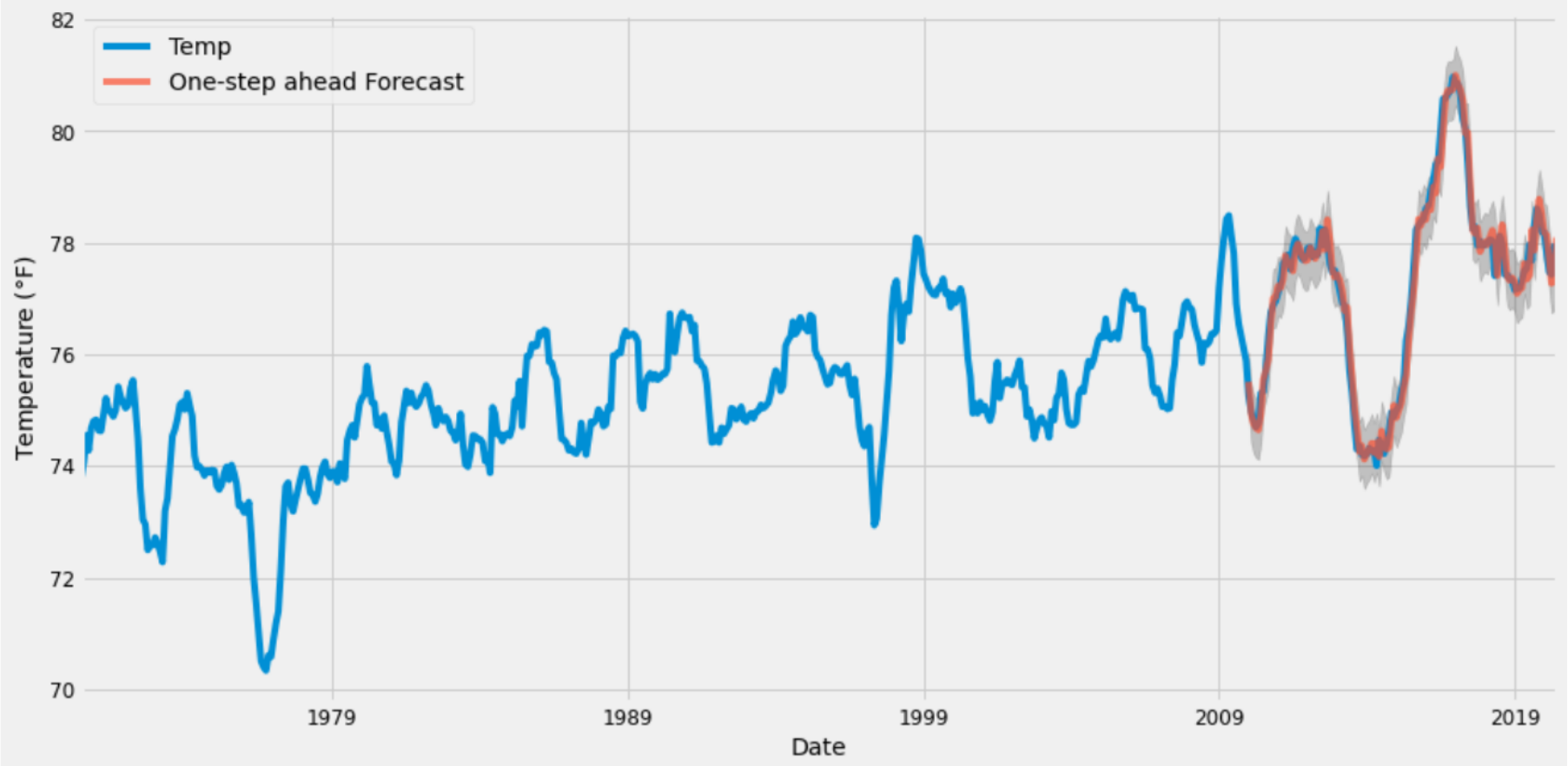
Tmin vs tmax


Record TMIN
Record TMAX
# of daily records
Year
0
5
10
15
20
25
30
35
1970
1980
1990
2000
2010
2020

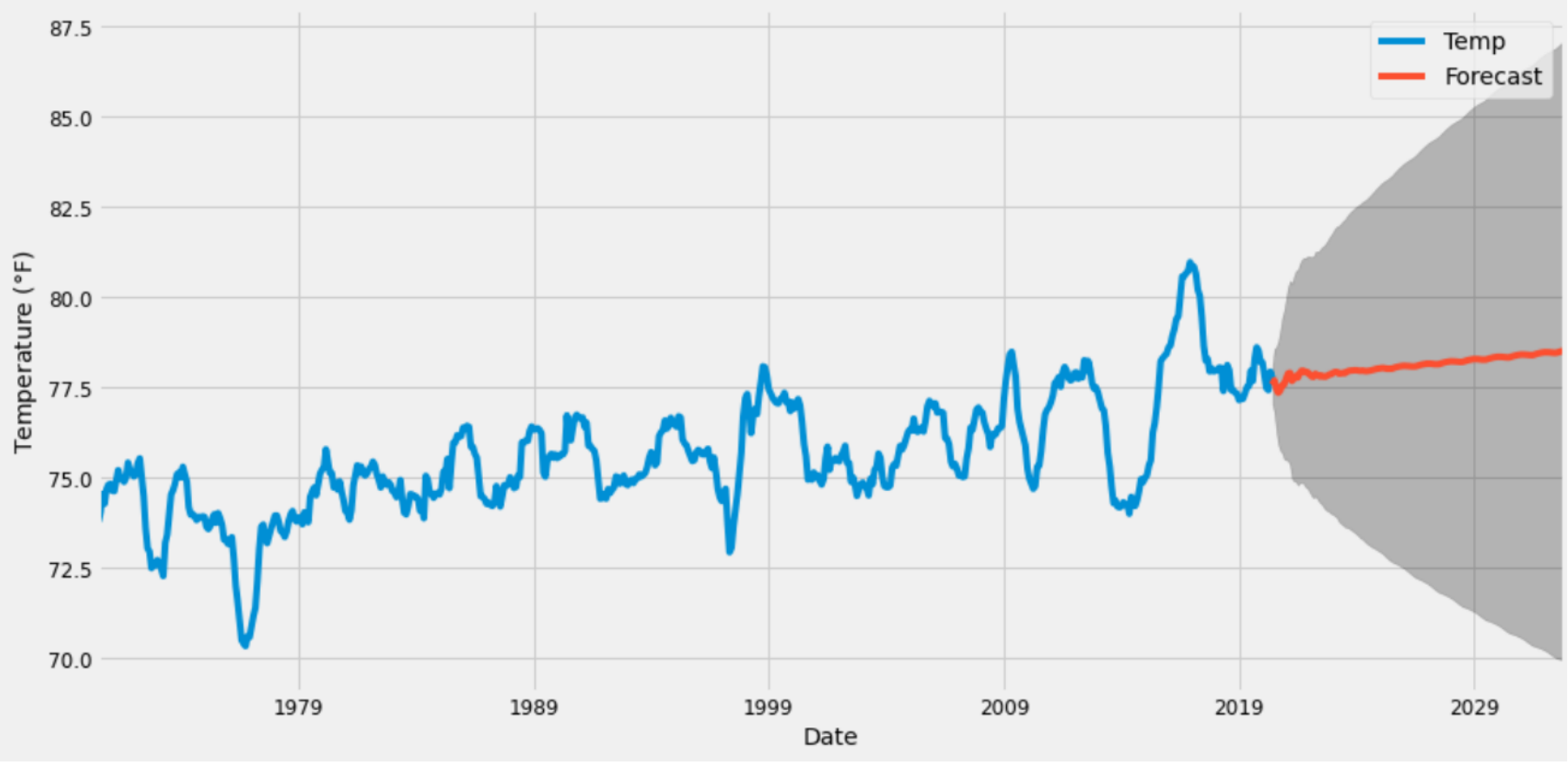
Results: Moving Average Using Monthly Average Temperatures



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