

How Climate Change Affects U.S. Corn and Wheat Yields

Yilong Xu

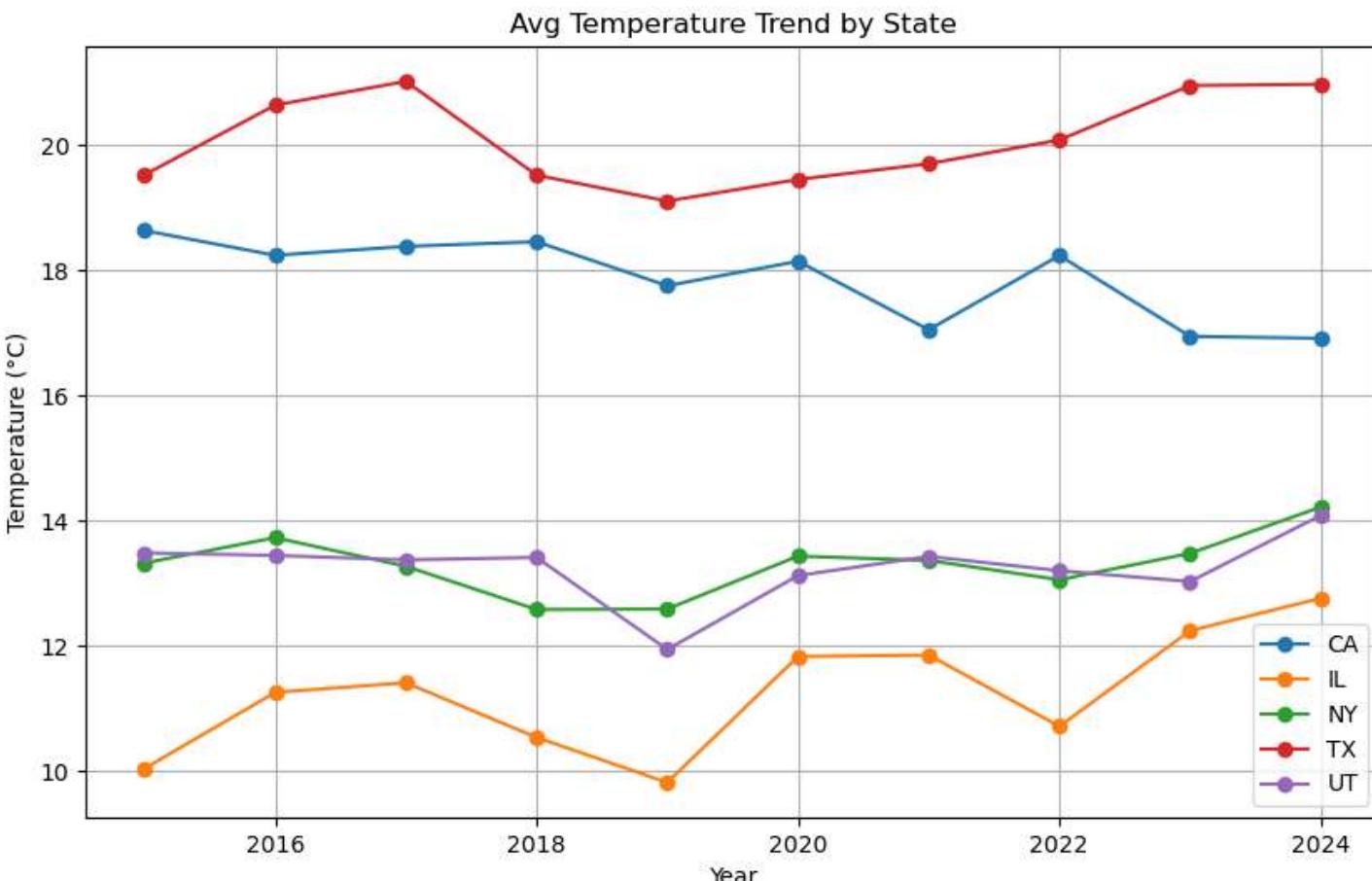
[https://github.com/yilongxu-
usc/dsci510_fall2025_final_project](https://github.com/yilongxu-usc/dsci510_fall2025_final_project)

Data Sources

Date Range: 2015/01/01 - 2024-12-31

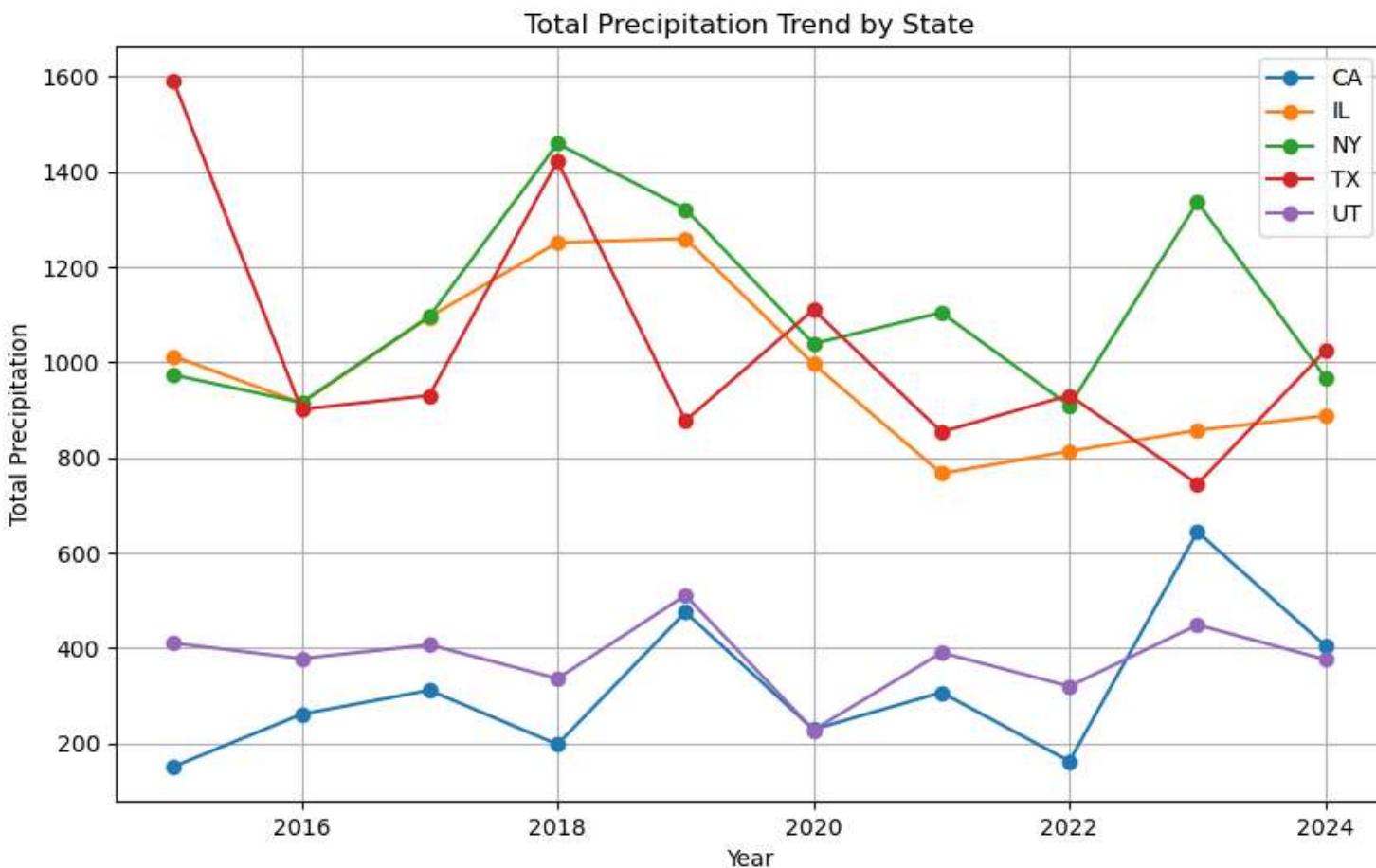
Dataset	Description	Type	Format	Data Size
Corn Yield Data, USDA NASS	<ul style="list-style-type: none">Provides annual corn yield (bushels per acre) for U.S. states.Shows how corn productivity varies geographically and how yields change over time	API Call	HTML response > json > CSV	2400 rows, 3 columns
Wheat Yield Data, USDA NASS	<ul style="list-style-type: none">Contains annual wheat yield statistics for U.S. statesWorks together with corn yield data to provide two independent agricultural indicators		HTML response > json > CSV	2600 rows, 3 columns
Monthly temperature and precipitation	<ul style="list-style-type: none">Provides monthly average temperature (TAVG) and total precipitation (PRCP) for multiple U.S. climate stationsUsed to compute annual climate metrics (mean temperature, accumulated precipitation)		HTML response > json > CSV	950 rows, 7 columns

Temperature Trends Across States (2015–2024)



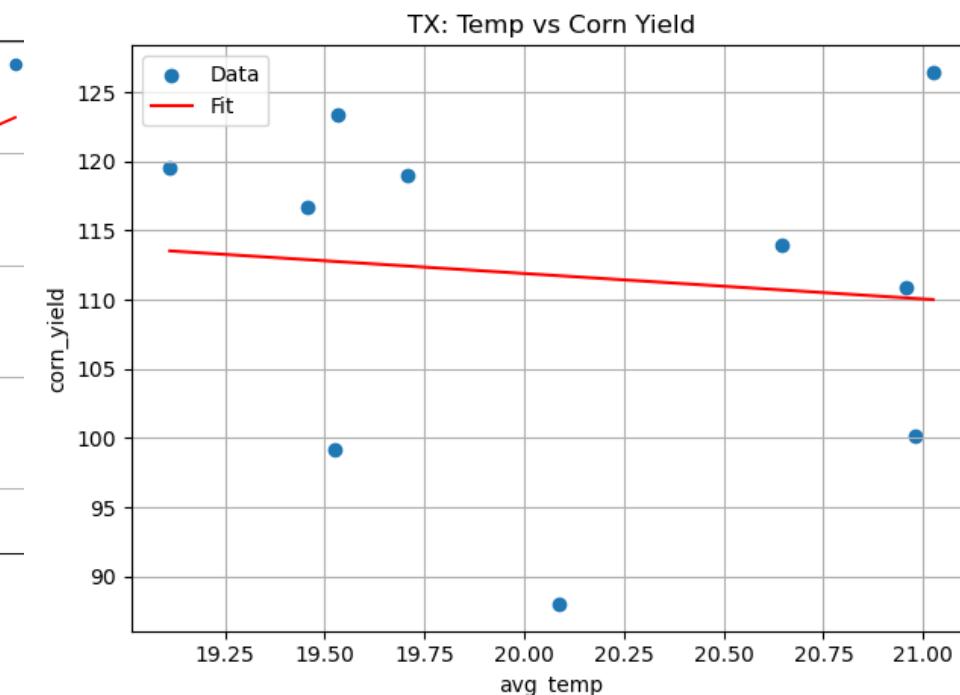
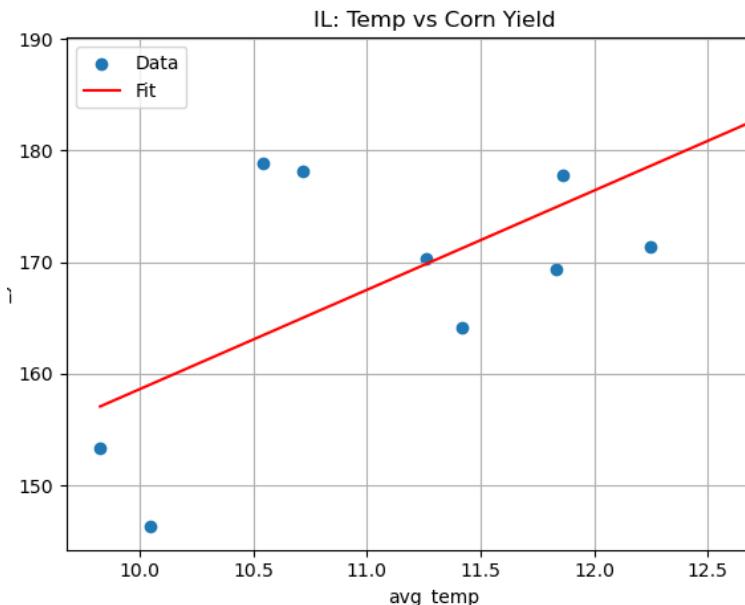
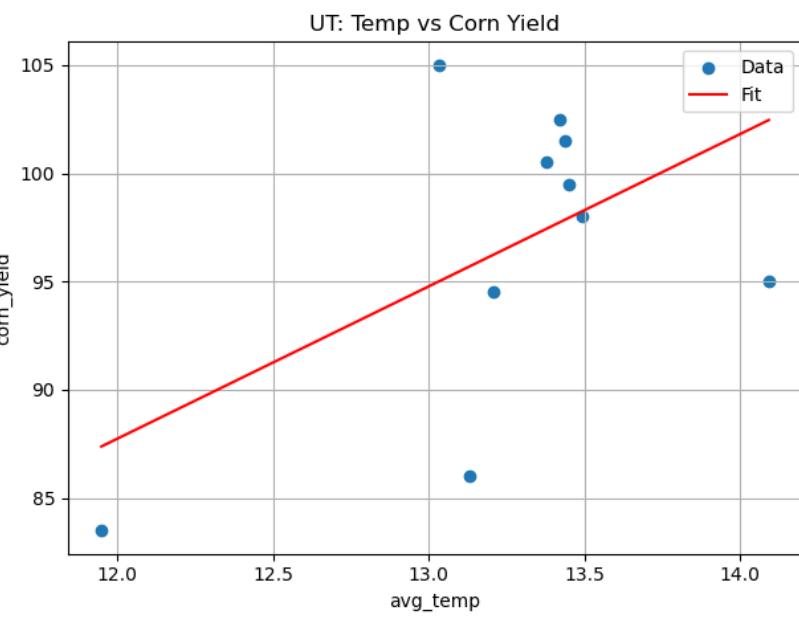
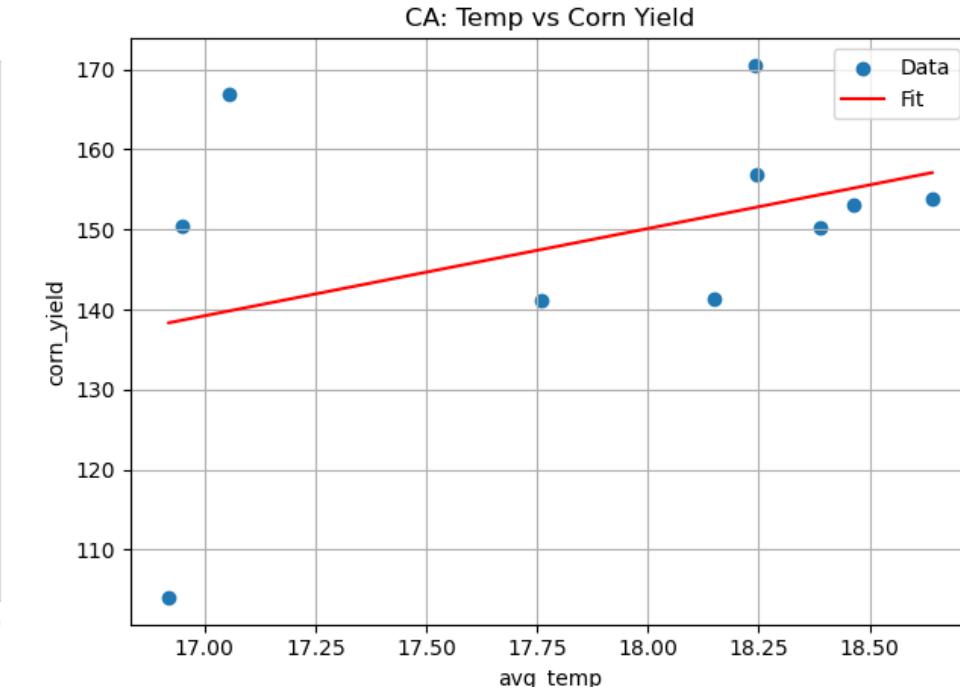
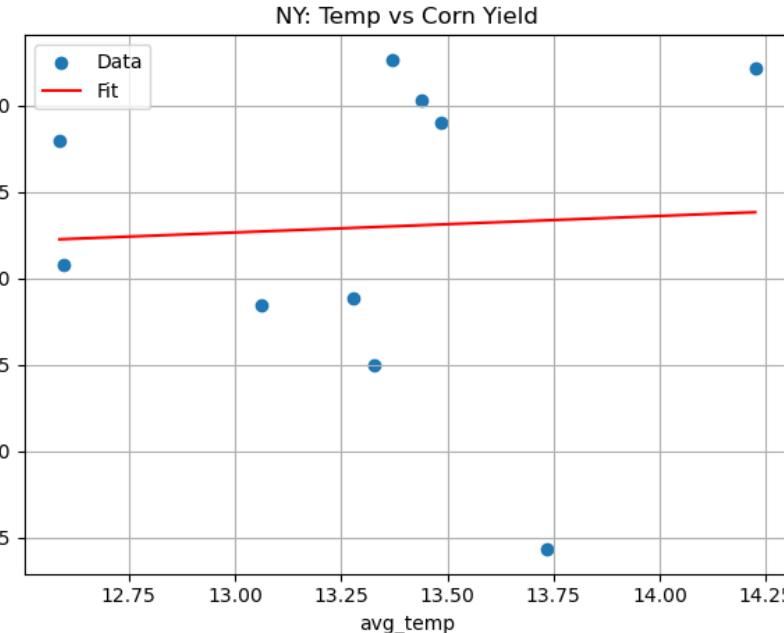
- All five states (CA, IL, NY, TX, UT) show mild warming trends, but not uniformly.
- California and Texas have the warmest average temperatures (17–20°C range)
- Illinois and New York stay cooler (9–14°C range)
- Utah shows the largest year-to-year fluctuation, indicating higher climate variability

Precipitation Trends (2015-2024)

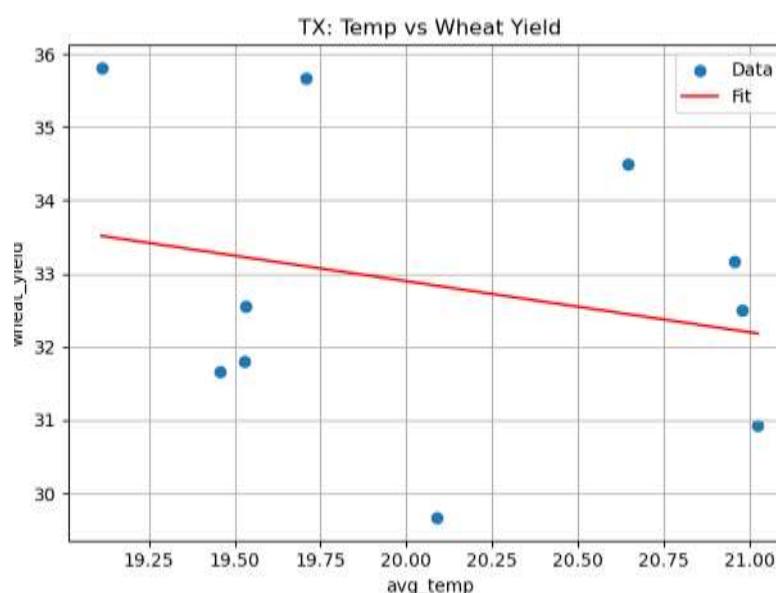
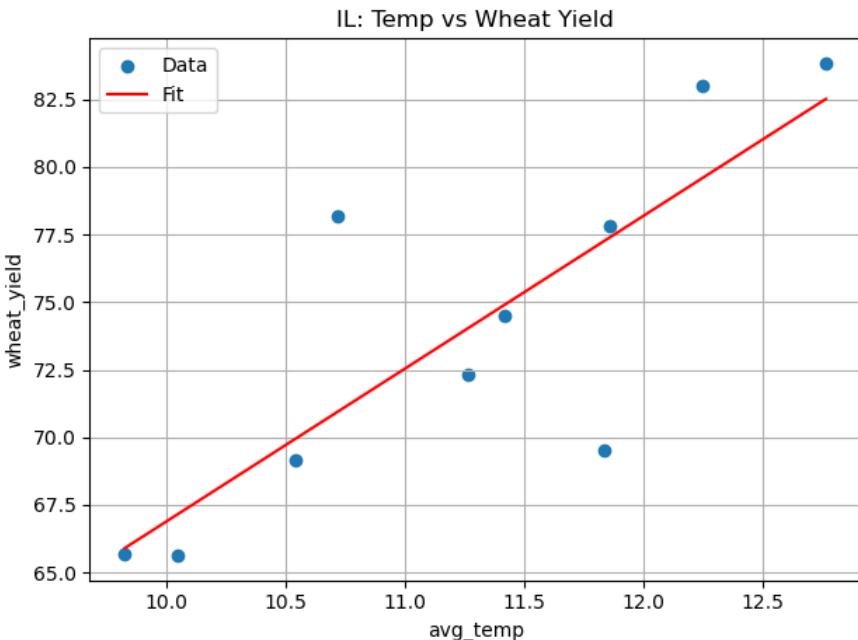
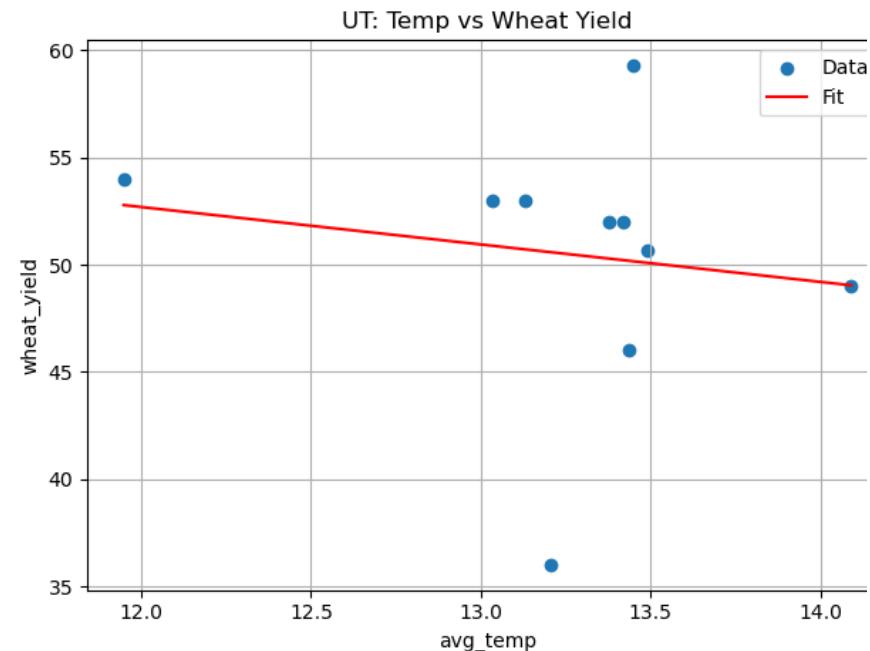
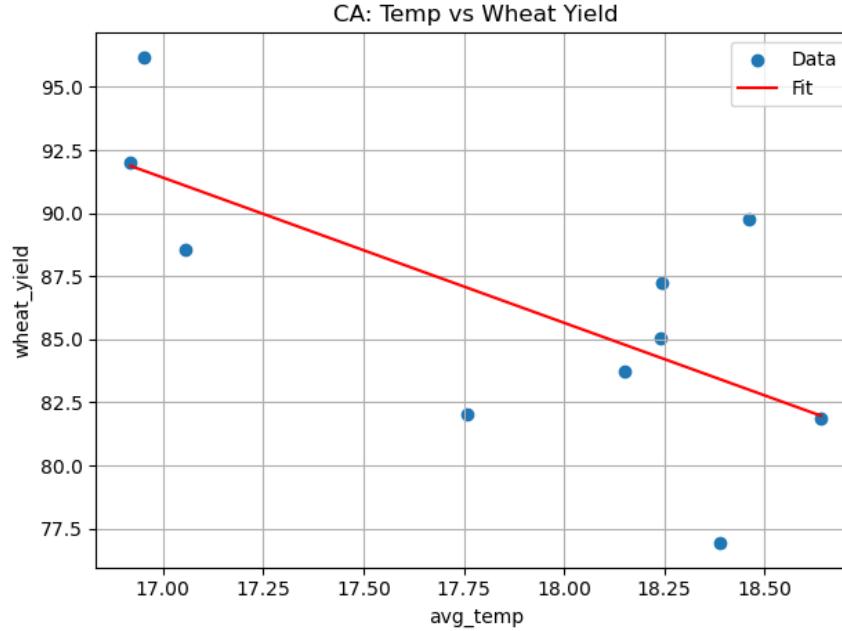
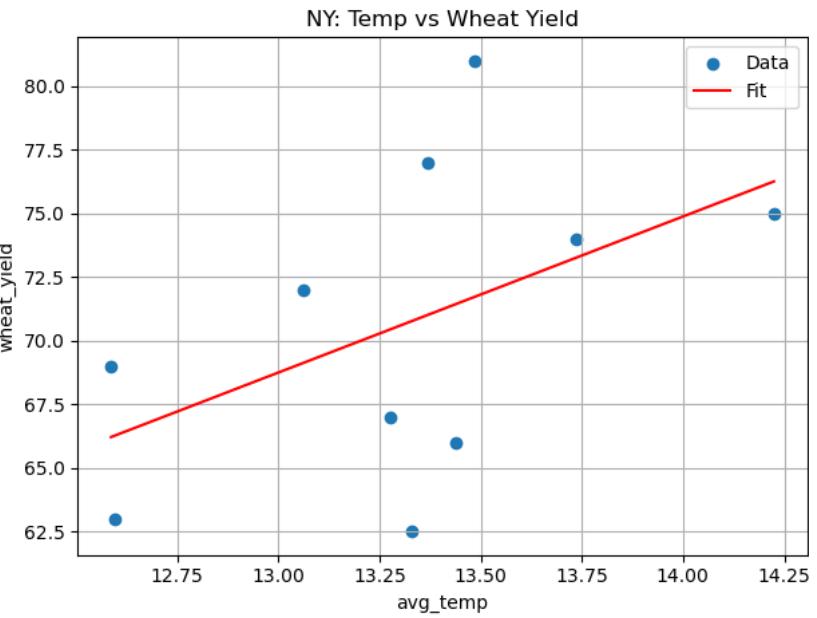


- Precipitation levels differ widely across states. Texas (TX) and New York (NY) have the highest rainfall, while California (CA) and Utah (UT) experience consistently dry conditions
- Texas shows the strongest volatility, swinging between very wet and very dry years, indicating strong influence from extremes such as droughts and heavy storms.
- New York also fluctuates, but the changes are less dramatic compared to Texas
- Illinois has moderate and relatively stable precipitation, without extreme annual swings
- California and Utah remain low-precipitation states, with smaller overall variations, reflecting their arid climates

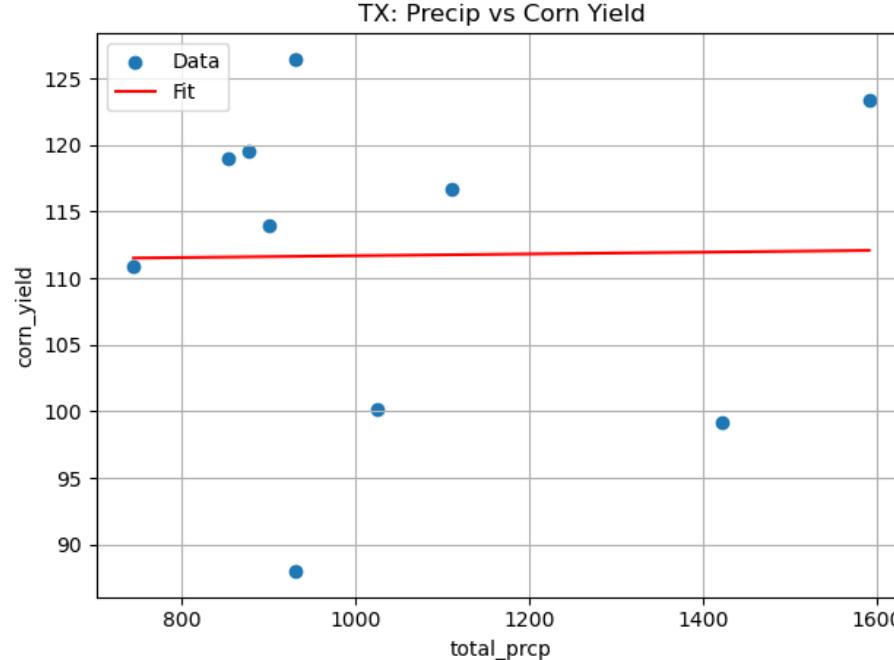
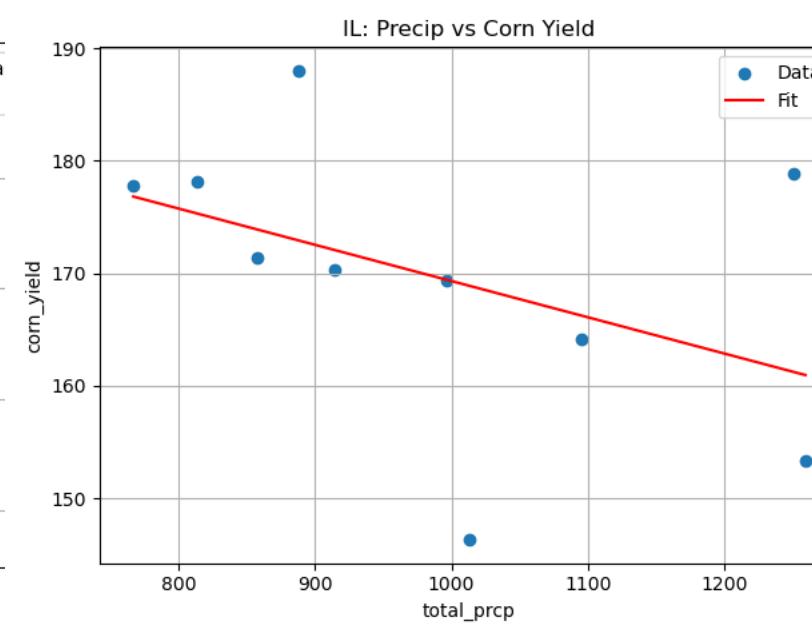
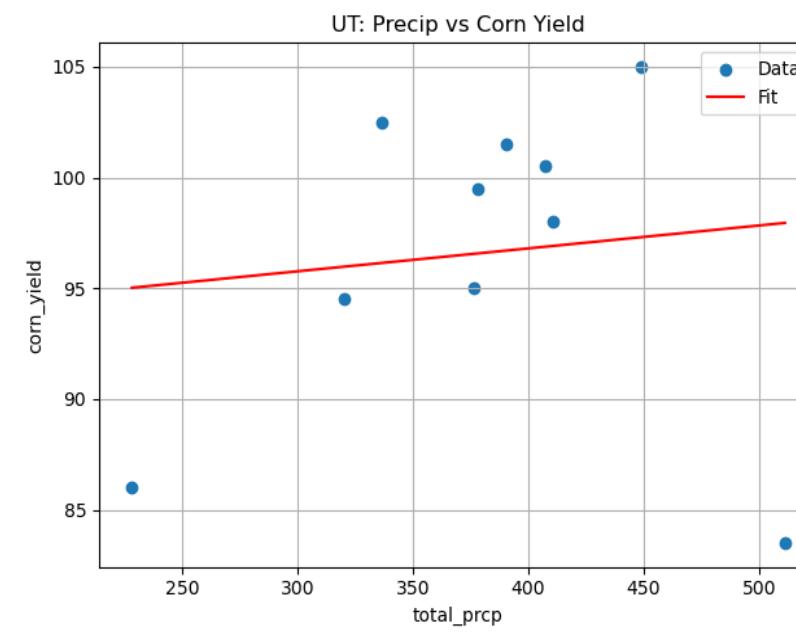
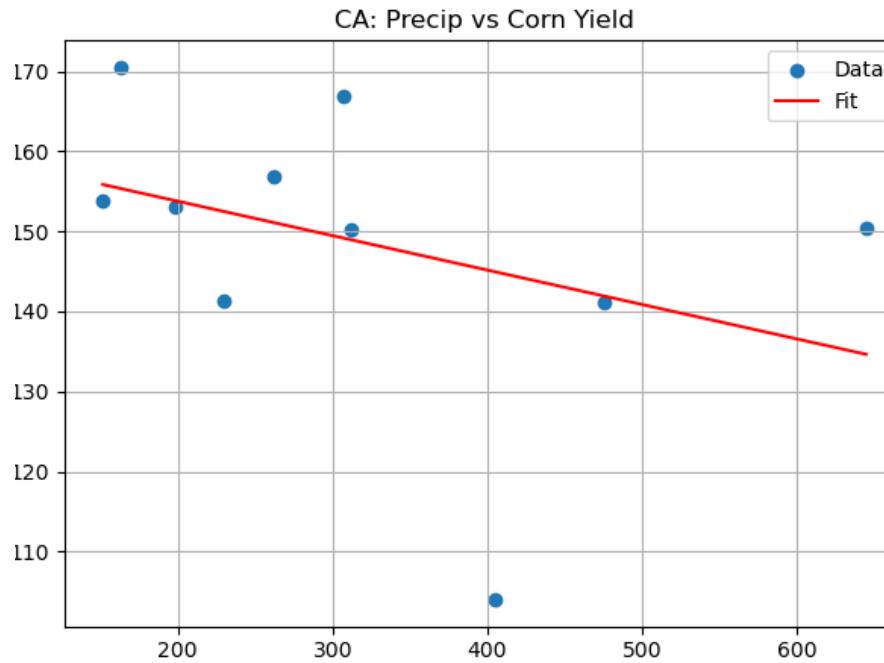
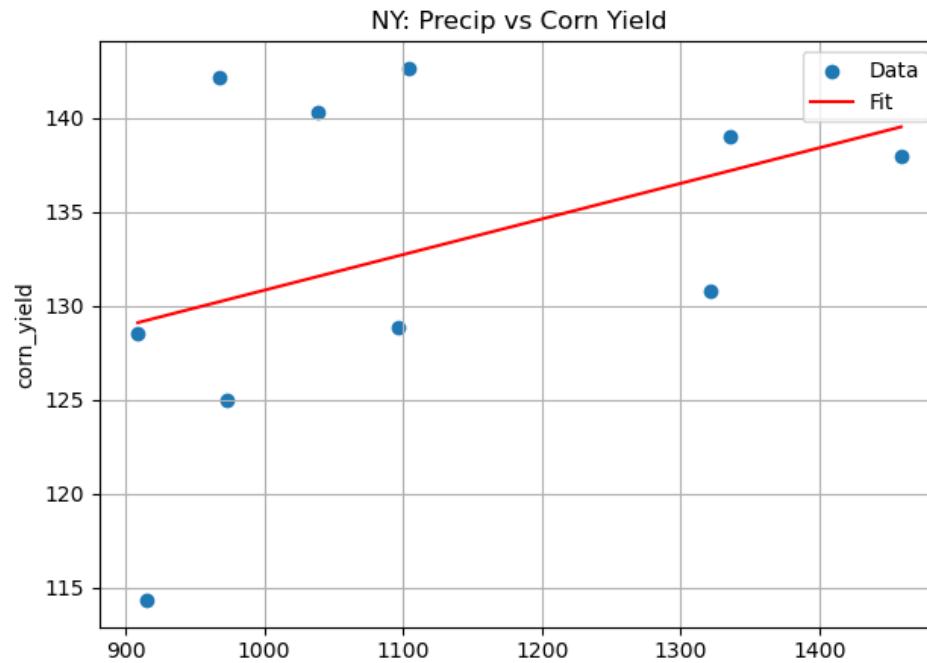
Effect of Temperature on Corn Yields (per state)



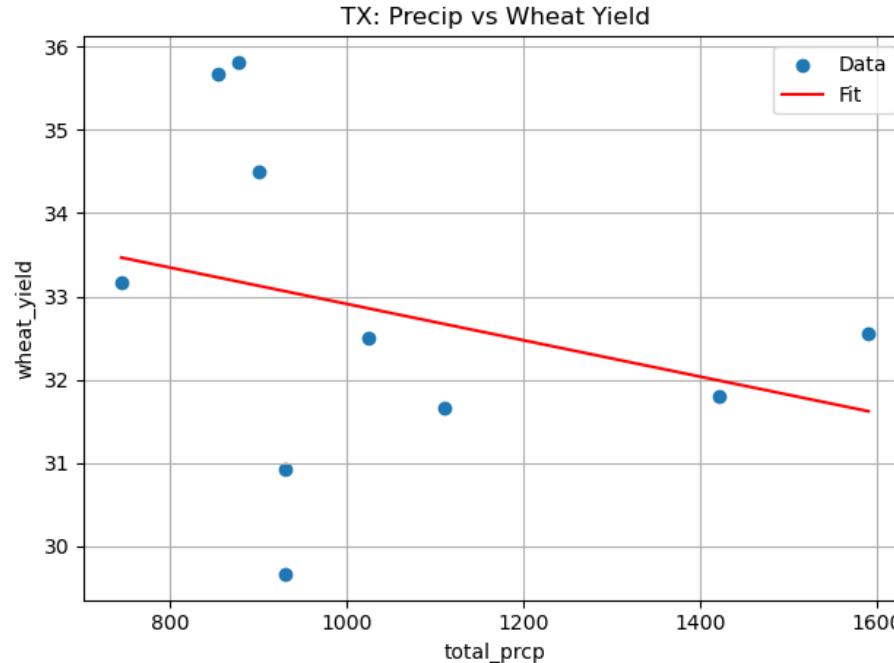
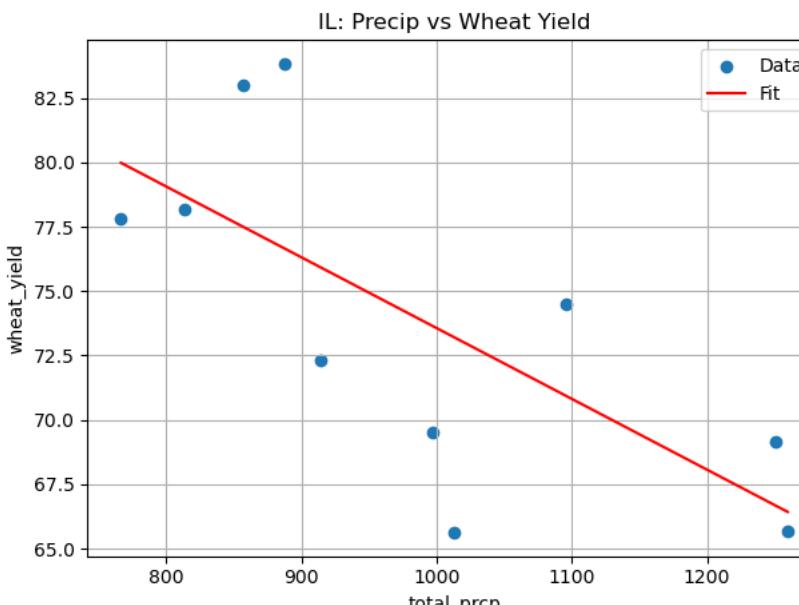
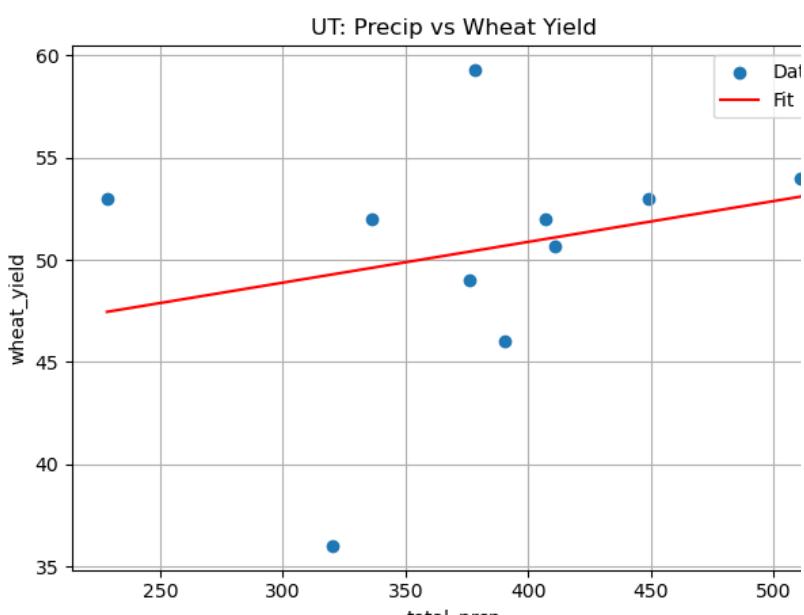
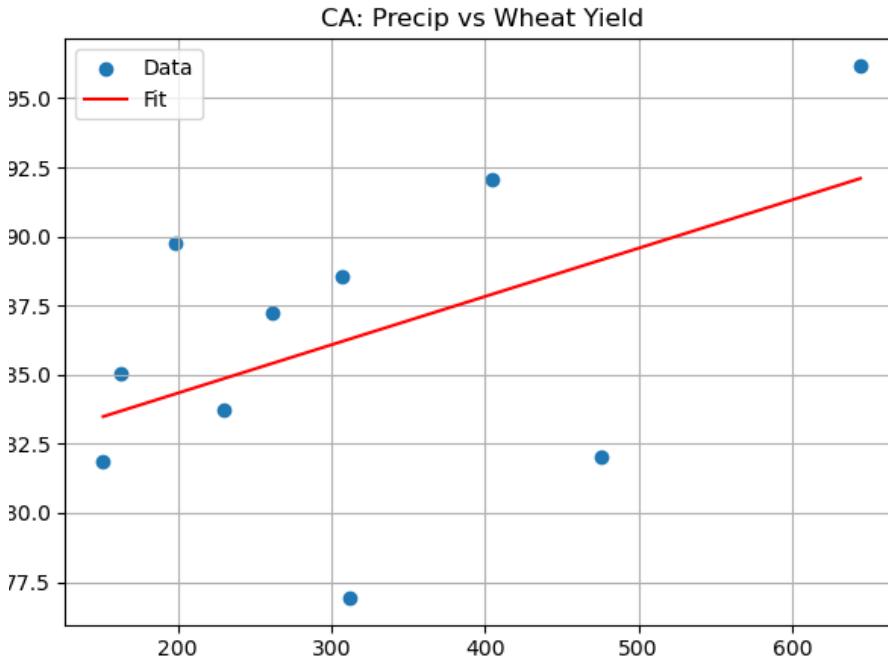
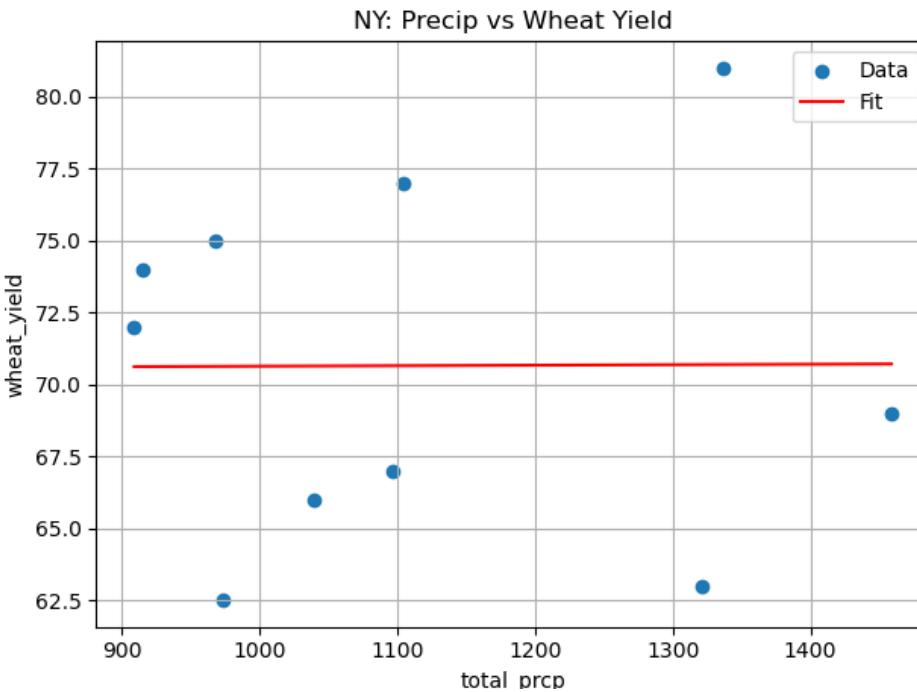
Effect of Temperature on Wheat Yields (per state)



Effect of Precipitation on Corn Yields (per state)

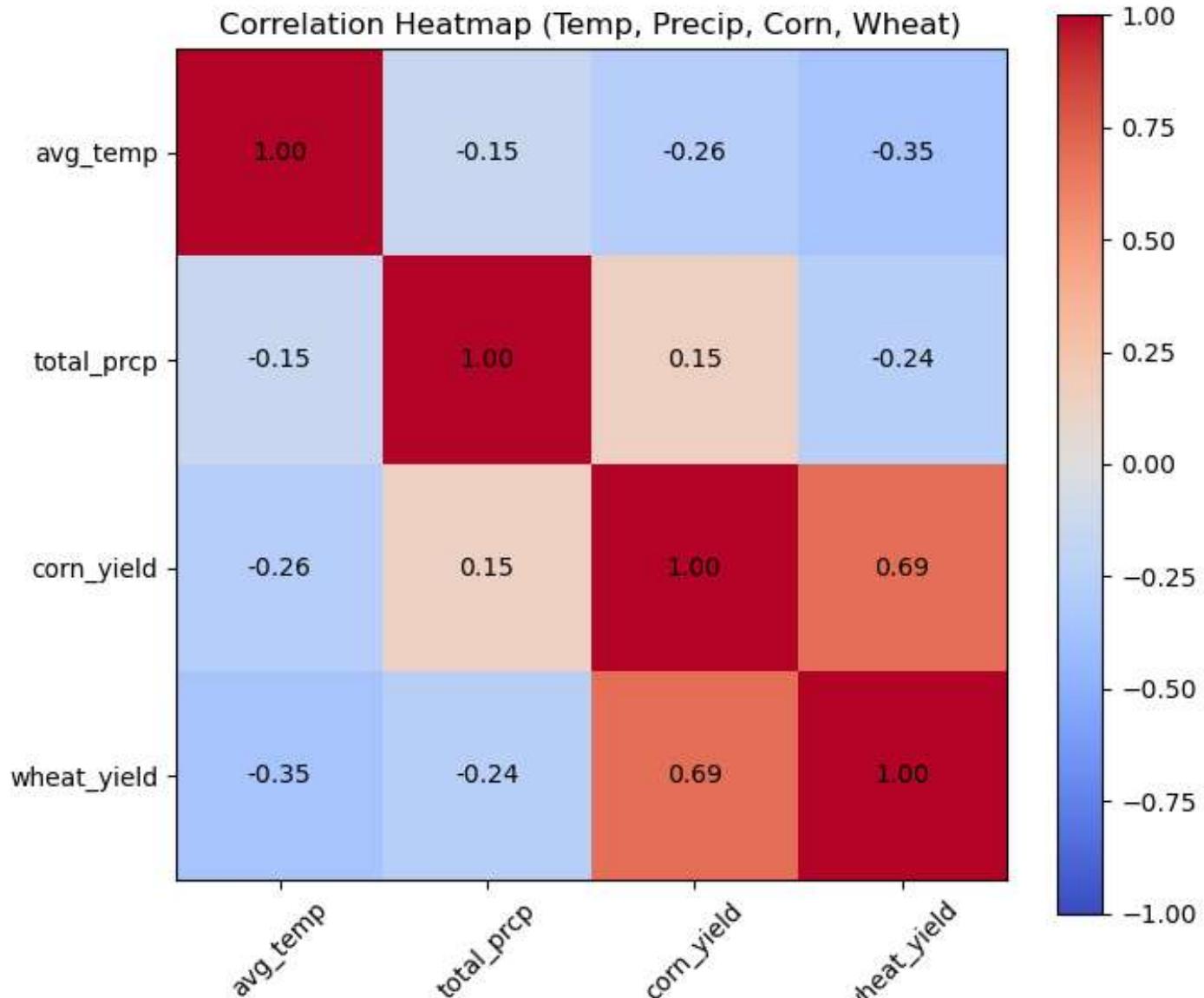


Effect of Precipitation on Wheat Yields (per state)



Heatmap

- Higher temperatures tend to be associated with slightly lower crop yields across states. This is consistent with heat-stress effects on both crops, especially wheat.
- Precipitation does not show a strong or consistent relationship with yields.
- States with good conditions for one crop tend to have good conditions for the other.
- Warmer years are slightly drier, but the relationship is weak and varies across states
- Temperature is a more influential factor than precipitation for both crops, but neither variable alone is a strong predictor of yield – indicating complex interactions behind crop performance



Challenges

- Getting reliable climate data from the NOAA API
- Frequent 400 (Bad Request) Errors
- NOAA API Limitations Not Documented Clearly
- Instead of trying to download all climate data at once, I rewrote the function, so it requests each station individually, catching failures without stopping the whole program

```
Traceback (most recent call last):
  File "c:\Users\yilon\dsci510_fall2025_final_project\src\main.py", line 7, in <module>
    temp_df = get_noaa_climate_data()
  File "c:\Users\yilon\dsci510_fall2025_final_project\src\data_retrieval.py", line 72, in get_noaa_climate_data
    response.raise_for_status()
    ~~~~~^~~~~~
  File "C:\Users\yilon\anaconda3\envs\SSCI586_Fall2025_v3137\lib\site-packages\requests\models.py", line 1026, in raise_for_status
    raise HTTPError(http_error_msg, response=self)
requests.exceptions.HTTPError: 400 Client Error: for url: https://www.ncdc.noaa.gov/cdo-web/api/v2/data?datasetid=GHND&datatypeid=123174&startdate=2010-01-01&enddate=2024-12-31&units=metric&limit=1000&offset=1
```

```
for name, (label, station_id) in stations.items():
    print(f"  Fetching station {station_id} ({name})...")

    params = {
        "datasetid": dataset,
        "datatypeid": datatype,
        "stationid": station_id,
        "startdate": start,
        "enddate": end,
        "limit": 1000
    }
```

**Thank you &
Questions**