

Four Cities, Four Climates

A Comparative Analysis of Weather Patterns Across the United States

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STA 199

Research Question & Motivation

RESEARCH QUESTION

How have temperature patterns, weather variability, and precipitation characteristics differed across four geographically distinct U.S. cities?

KEY FOCUS AREAS

Seasonal Patterns Seasonal temperature trends

Daily Variability High/low ranges & historical extremes

Precipitation Frequency and intensity dynamics

Longitudinal Trends Location, direction, and strength

MOTIVATION

Understanding Regional Climate Impact

01 Our Connection

02 Four Contrasting Climates

03 Changing Weather & Climate

04 Choosing Where to Live

Data & Methodology

4
Airport stations

2017–24
Study period

Daily
Observation unit

Dataset Overview

Data source
NOAA weather records

Locations
RDU (Raleigh–Durham), **DTW** (Detroit), **LAX** (Los Angeles), **IAD** (Washington Dulles)

Study period & unit
2017–2024 (Daily observations)

Data Preparation

01 Filtered to daily summary (SOD) observations

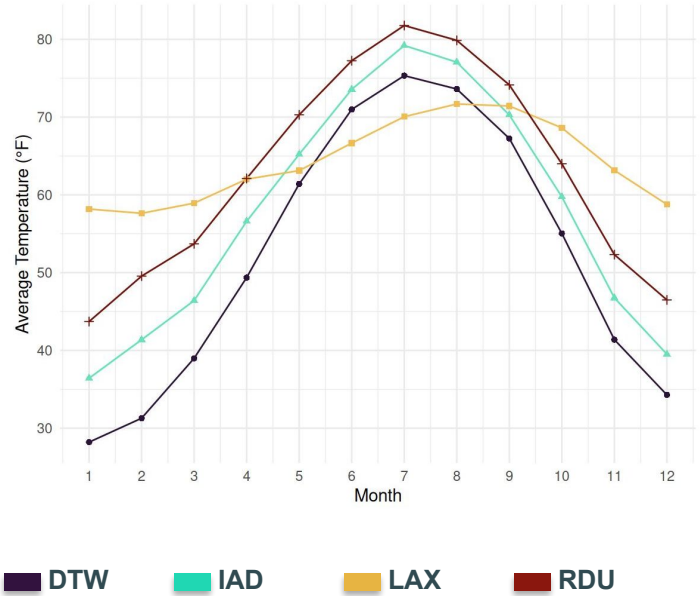
02 Selected relevant weather variables and combined datasets

03 Converted measurements to numeric values and handled missing/trace values

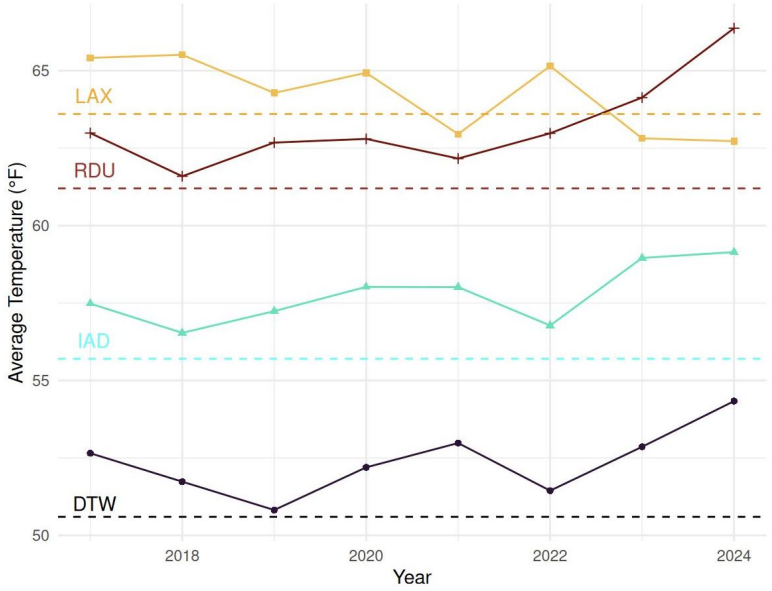
04 Restricted comparisons to 2017–2024

Average Temperatures

Seasonal pattern by month



Average temperature by year



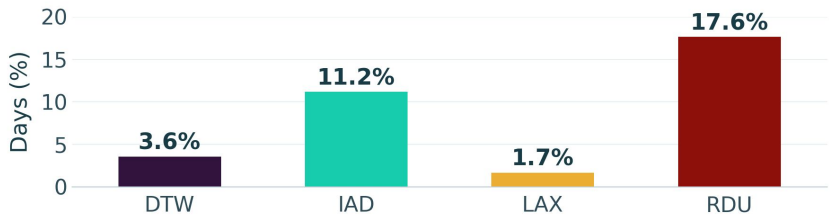
Trend fit · 2017–24

Annual temperature

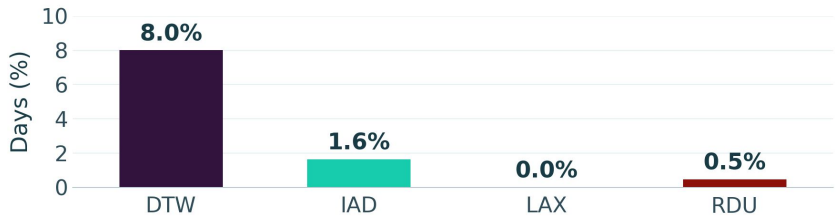
City	Slope	r
RDU	+0.203	+0.558
DTW	+0.239	+0.539
IAD	+0.266	+0.687
LAX	-0.377	-0.782

Hot and Cold Days

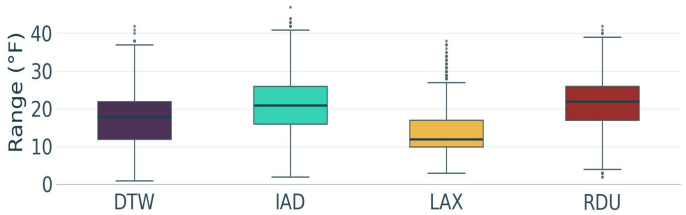
HOT DAYS · Daily high ≥ 90°F



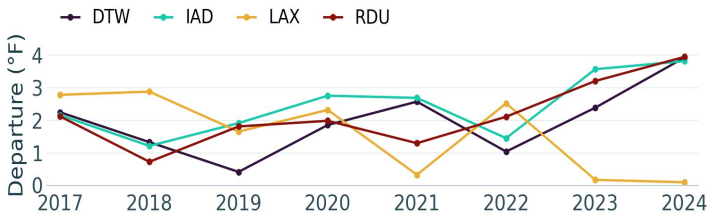
COLD DAYS · Daily high ≤ 32°F



DAILY HIGH–LOW TEMPERATURE RANGE



ANNUAL DEPARTURES FROM NORMAL



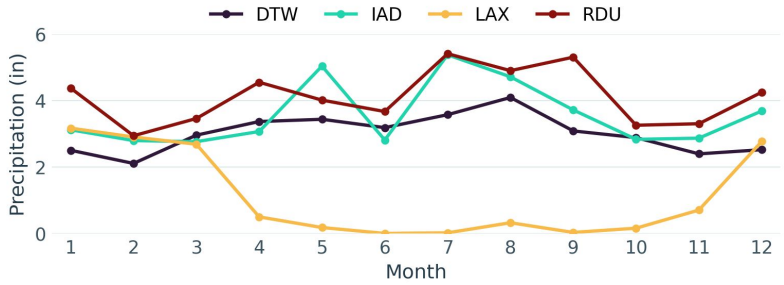
Trend fit · 2017–24

Annual temperature departure

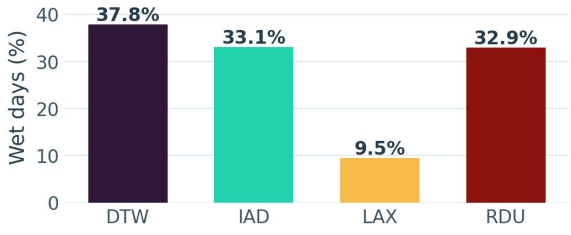
City	Slope	r
RDU	+0.300	+0.724
DTW	+0.234	+0.531
IAD	+0.262	+0.681
LAX	-0.378	-0.762

Precipitation and Snowfall

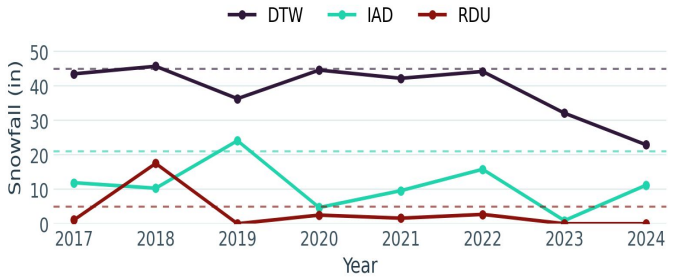
Average Monthly Precipitation



How Often Does It Rain?



Yearly Snowfall Across Cities



Trend fit · 2017–24

Annual snowfall

City	Slope	r
RDU	-1.07	-0.436
DTW	-2.24	-0.677
IAD	-0.944	-0.324
LAX	NA	NA

Precipitation per Wet Day



Conclusions & Limitations

DTW · Detroit
Continental Extreme

★ **Coldest & Most Wet Days**
Extreme winter freeze & heavy snowfall

IAD · Dulles
Mid-Atlantic Balanced

★ **Balanced Seasonality**
Steady summer heat & year-round rain

LAX · Los Angeles
Coastal Mediterranean

★ **Mildest Year-Round**
Zero freezing highs & lowest seasonal swings

RDU · Raleigh
Humid Subtropical

★ **Hottest & Wettest Storms**
Highest extreme heat & storm intensity

CLIMATE PATTERNS

01 Temperature Trends
Eastern stations (RDU, IAD, DTW) show warming & higher departure trends, while LAX exhibits cooling.

02 Snowfall Trajectories
Annual snowfall demonstrates a downward trend across all applicable stations.

03 Observed vs. Expected Climate
Findings matched existing climate classifications for each location

RESEARCH LIMITATIONS

01 Correlation vs. Causation
Data are purely observational, & correlations are mostly weak

02 Single-Station Bias
Station Data vs. Overall City/Area

03 Short Time Window (8 Years)
Sensitive to annual/monthly changes
Minimum of 30 years to make Climate Change related conclusions