Weather Data Analysis Report: Algiers (2002–2023)

1. Dataset Description & Statistics

This analysis covers 21 years of daily weather observations (Total count: **7,913 days**). The focus is on **Mean Temperature** (2m height) and **Reference Evapotranspiration (ET0)**, which are crucial for agricultural planning and water management.

Key Statistics

Feature	Mean	Std Dev	Min	25% (Q1)	50% (Median)	75% (Q3)	Max
Temp (°C)	**17.86**	6.08	2.0	12.70	17.20	23.30	**36.7**
ET0 (mm)	**3.72**	1.82	0.3	2.13	3.53	5.24	**9.58**

Observations:

- **Temperature:** The average daily mean temperature is approx **17.9°C**. The data shows that the climate is generally warm; looking at the 25th percentile (12.70°C), we can observe that **for 75% of the recorded days, the mean temperature was higher than 12.7°C.**
- **Evapotranspiration (ET0):** The average water demand is **3.72 mm/day**. Similarly to temperature, **for 75% of the days, the ET0 was higher than 2.13 mm**, indicating consistent evaporation levels throughout most of the year.

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2. Anomaly Detection

Anomalies were defined using a strict threshold of **2.5 Standard Deviations** from the mean.

Thresholds

- **Temperature Anomaly:** Values less than 2.66 °C or greater than 33.07 °C.
- **ET0 Anomaly:** Values greater than 8.27 mm. Lower bound is negative, which is physically impossible for ET0). **[Fig 1]**

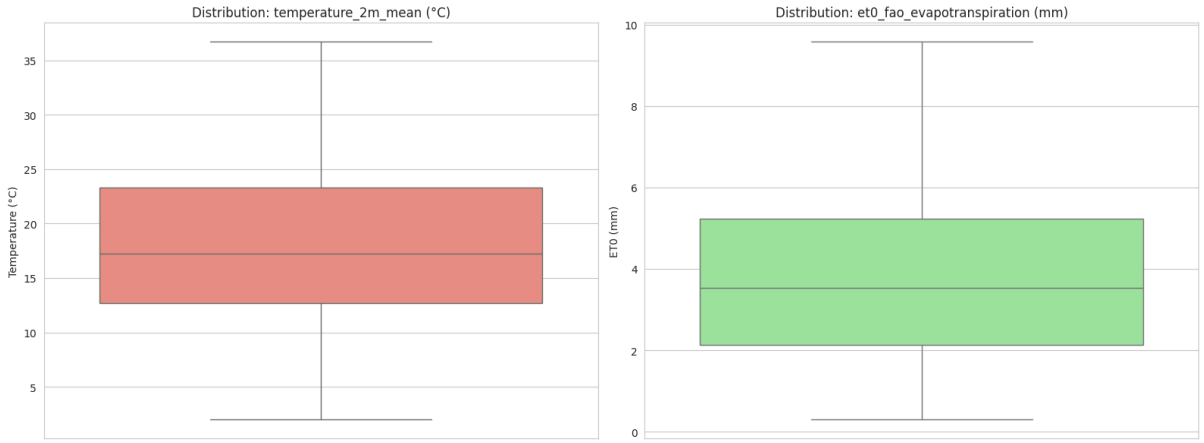

Fig 1 : Statistical Distribution & Outliers

Findings on Extremes

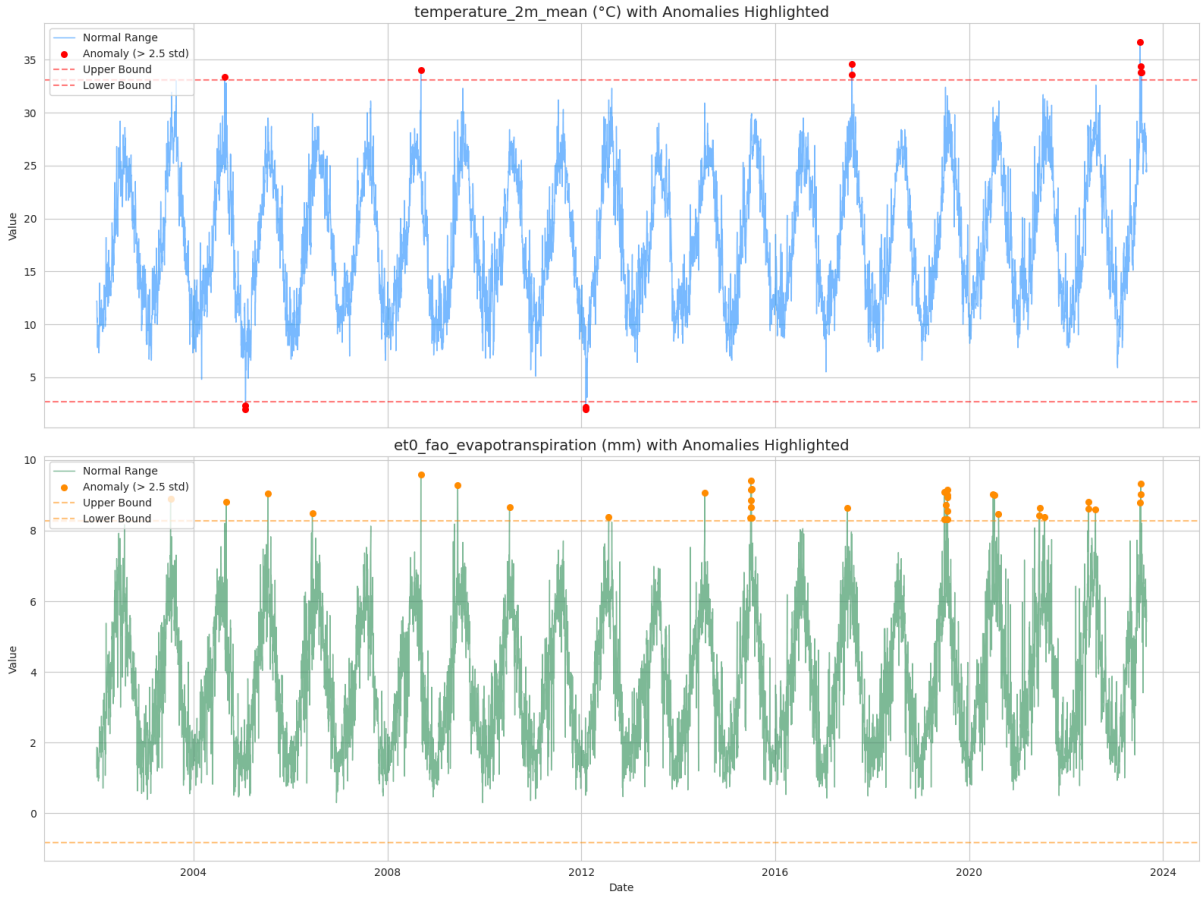

Fig 2 : Daily Time-Series with Anomalies

1. **Temperature Anomalies (High Heat Events):**
    - **12 anomalies** were detected.

- Crucially, **all major anomalies are on the high end** (extreme heat) **[Fig 2]**. There are almost no "extreme cold" anomalies detected visually, reinforcing the observation of a warming climate.
- **Recent Intensity:** The top 5 highest temperatures recorded are significant. Notably, **3 out of the top 5 hottest days occurred in the single year of 2023** (July), with the all-time peak of **36.7°C** on July 11, 2023. **[Fig 3]**

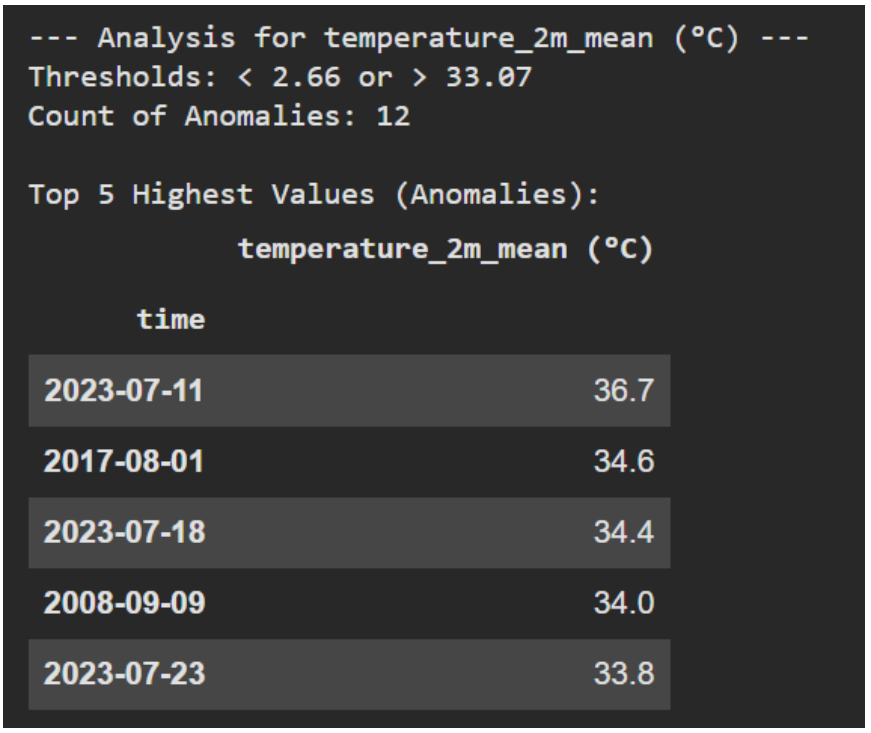

Fig 3 : Extreme Temperature Events

2. **ET0 Anomalies (High Water Stress):**
   - **37 anomalies** were detected.
   - These represent days of extreme dryness and wind significantly increasing water demand.
   - **2 out of the top 5** highest ET0 values occurred in **2015**, suggesting a particularly dry or windy period during that year. **[Fig 4]**

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--- Analysis for et0_fao_evapotranspiration (mm) ---
Thresholds: < -0.82 or > 8.27
Count of Anomalies: 37

Top 5 Highest Values (Anomalies):
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time	et0_fao_evapotranspiration (mm)
2008-09-09	9.58
2015-07-01	9.41
2023-07-17	9.33
2009-06-14	9.29
2015-07-06	9.19

Fig 4 : Peak Water Demand Events

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3. Trend Analysis

We analyzed the progression of weather patterns from 2002 to 2023.

General Trend (Annual Averages)

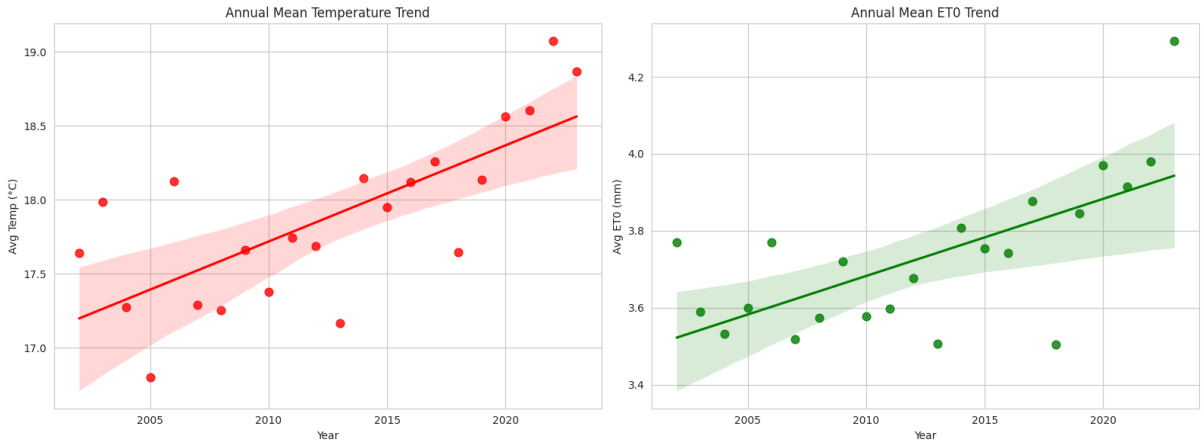

Fig 5 : Annual Climate Trends

- **Temperature:** There is a clear **upward trend**. As seen in the *Annual Mean Temperature Trend* graph (regression line) **[Fig 5]**, the yearly average temperature has steadily increased over the last two decades.
- **ET0:** Evapotranspiration follows a similar **upward trend**. As temperatures rise, the atmosphere's demand for water increases, leading to higher ET0 values. **[Fig 5]**

Visual Trend Observations

Fig 6 : Long-Term Climate Trends (365-Day Moving Average)

- **Moving Average (365-Day):** The red (Temp) and green (ET0) lines in the daily trend graphs **[Fig 6]** make seasonal changes less noticeable. Both lines slowly increase over time, especially from 2016 to 2023. During this period, winters seem less cold and summers seem hotter compared to the early 2000s.

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5. Conclusion

The dataset reveals a definitive shift in the local climate of Algiers.

1. **Warming is accelerating:** The concentration of record-breaking temperatures in **2023** signals that extreme heat events are becoming more frequent in recent years.
2. **Water demand is increasing:** The upward trend in ET0 means that crops will require more irrigation water to maintain the same yield compared to 20 years ago.
3. **Asymmetric Extremes:** The climate is shifting towards "hotter hots" rather than "colder colds," as evidenced by the lack of low-temperature anomalies.