

The Math

1 Period Averages

For each reference period, the average temperature anomaly is calculated as the mean of the temperature anomalies in that period.

$$\text{avg}_{\text{preindustrial}} = \frac{1}{n_{\text{preindustrial}}} \sum_{i=1}^{n_{\text{preindustrial}}} \text{Anomaly}_i$$

$$\text{avg}_{\text{midcentury}} = \frac{1}{n_{\text{midcentury}}} \sum_{i=1}^{n_{\text{midcentury}}} \text{Anomaly}_i$$

$$\text{avg}_{\text{recent}} = \frac{1}{n_{\text{recent}}} \sum_{i=1}^{n_{\text{recent}}} \text{Anomaly}_i$$

where n denotes the number of years in each period, and Anomaly_i is the temperature anomaly for year i .

2 Warming Since Pre-Industrial

The warming relative to the pre-industrial baseline is computed by subtracting the pre-industrial average from the observed anomaly:

$$\text{Warming}_t = \text{Anomaly}_t - \text{avg}_{\text{preindustrial}}$$

3 Trend Analysis

The trend in temperature anomalies over a selected time period is modeled using linear regression:

$$\text{Anomaly}_t = \beta_0 + \beta_1 \cdot t$$

where β_0 is the intercept, β_1 is the slope, and t is the year. The slope β_1 represents the rate of change of temperature anomalies over time in units of °C per year.

The rate of change per decade is:

$$\text{Rate per Decade} = \beta_1 \times 10$$

The total change in temperature over a selected period from year t_1 to year t_2 is given by:

$$\text{Total Change} = \text{Rate per Decade} \times \frac{t_2 - t_1}{10}$$

4 Acceleration of Warming

To assess the acceleration of warming, the selected period is divided into two halves. The rate of warming for each half is calculated as follows:

For the first half of the period $[t_1, t_2]$:

$$\text{Rate}_1 = \beta_{1_1} \times 10$$

For the second half of the period $[t_2, t_3]$:

$$\text{Rate}_2 = \beta_{1_2} \times 10$$

The acceleration of warming is computed as:

$$\text{Acceleration} = \text{Rate}_2 - \text{Rate}_1$$

where a positive acceleration indicates an increase in the rate of warming in the second half of the period.

5 Warming Thresholds

The temperature anomaly surpasses key thresholds as follows:

- The 1.5°C threshold:

$$\text{Warming} \geq 1.5^\circ C$$

- The 2.0°C threshold:

$$\text{Warming} \geq 2.0^\circ C$$

These thresholds are important for tracking climate change impacts and progress toward international climate targets such as the Paris Agreement.