



Food and Agriculture Organization
of the United Nations

ISSN 2709-006X [Print]
ISSN 2709-0078 [Online]



FAOSTAT ANALYTICAL BRIEF 39

Temperature change statistics 1961–2021

Global, regional and country trends

HIGHLIGHTS

- The FAOSTAT Temperature change dataset, produced in collaboration with NASA, covers the period 1961–2021 for 197 countries and 41 territories.
- The 2021 global mean annual temperature change over land was 1.4 °C, joining 2019 as the third warmest year on record since 1961. This value represented statistically significant warming compared to the reference climatology of the period 1951–1980.
- The last ten years (2012–2021) were on average 1.3 °C warmer than 1951–1980; this represented a warming of 0.3 °C over the previous decade (2002–2011), and a 0.7 °C warming compared to 1992–2001.
- Northern America registered the largest mean annual temperature change (1.9 °C), followed by Europe (1.6 °C), Asia (1.5 °C) and Africa (1.4 °C). Warming in South America and Oceania was 1.0 °C and 0.6 °C, respectively.
- In 2021, mean annual temperatures were warmer than normal in more than 170 countries and territories. Of these, temperatures in 125 countries and territories were much warmer than normal.

FAOSTAT TEMPERATURE CHANGE

INTRODUCTION

Increases in land surface air temperature associated with rising greenhouse gas concentrations threaten the livelihoods of farmers and communities throughout the world. The [FAOSTAT Temperature Change](#) statistics provide country-level information on observed warming trends on land, as a basis to help identify risk and design the responses necessary to safeguard the agriculture, forestry and fisheries sectors.

The FAOSTAT Temperature Change statistics are disseminated for the period 1961–2021 for 197 countries and 41 territories. They are produced in collaboration with the [NASA Goddard Institute for Space Studies](#) (NASA–GISS) and are based on regularly updated time series of temperature readings from a vast array of meteorological stations around the world forming a well-established international network. Temperature change data in FAOSTAT are disseminated as monthly, annual and seasonal (winter, spring, summer and autumn) means. The data provide information on mean temperature changes, characterizing them as (statistically significant) “warmer,” “much warmer” or “colder” anomalies with respect to the climatology of the period 1961–1980, taken to represent the climatic normal.

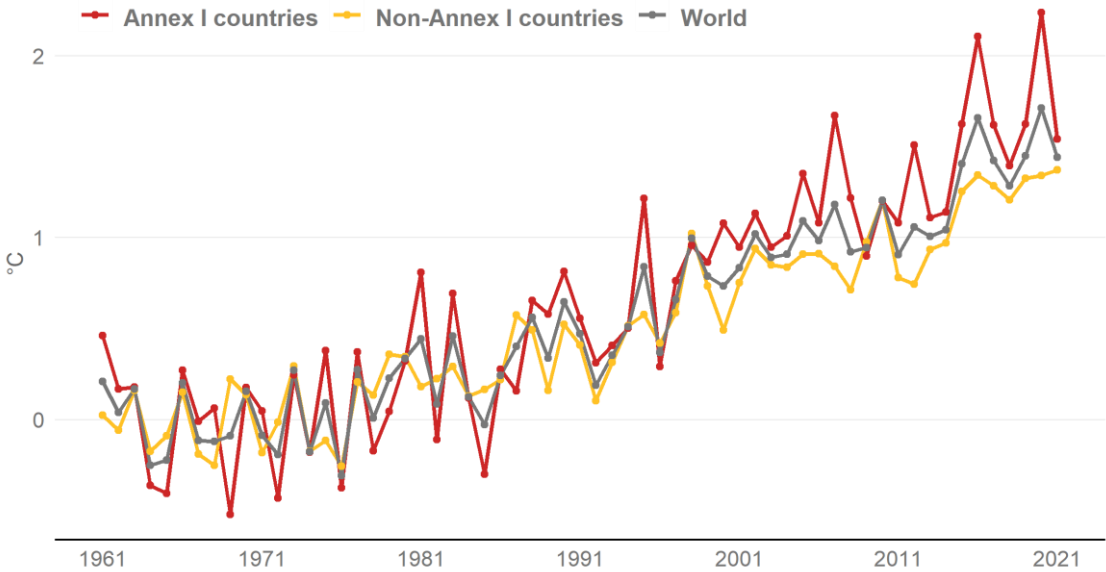
More specifically, warmer (or colder) temperatures are defined as anomalies exceeding the 95 percent confidence interval (CI) of the reference climatology, while much warmer (or much colder) temperatures

are anomalies exceeding the 99 percent CI. Conversely, normal temperatures correspond to anomalies within the 95 percent CI, representing the range of expected interannual variability. For instance, the interannual variability of the mean global annual temperature change on land, which is also disseminated in the database for each country and territory alongside mean values, was computed from all available data to be ± 0.4 °C.

GLOBAL

In 2021, the global mean annual temperature anomaly was 1.4 °C. 2021 tied with 2019 as the third warmest year over the period 1961–2021 (Figure 1), following 2016 (1.6 °C) in second position and 2020 (1.7 °C) as the warmest year on record. Furthermore, the last ten years (2012–2021) were on average 1.3 °C warmer than 1951–1980; this represented a warming of 0.3 °C over the previous decade (2002–2011), and a 0.7 °C warming compared to 1992–2001. Figure 1 illustrates trends in temperature change globally as well as for the Annex I and Non-Annex I groups of parties¹ reporting to the United Nations Framework Convention on Climate Change (UNFCCC) due to the relevance of this indicator of climate change. The two groups differ in their commitments for reporting and action under the Convention. Annex I countries usually have a more affluent economy and stricter requirements for reporting. These countries, which are often located at higher latitudes, recorded relatively more warming compared to tropical and subtropical countries.

Figure 1: Mean annual temperature anomalies over land

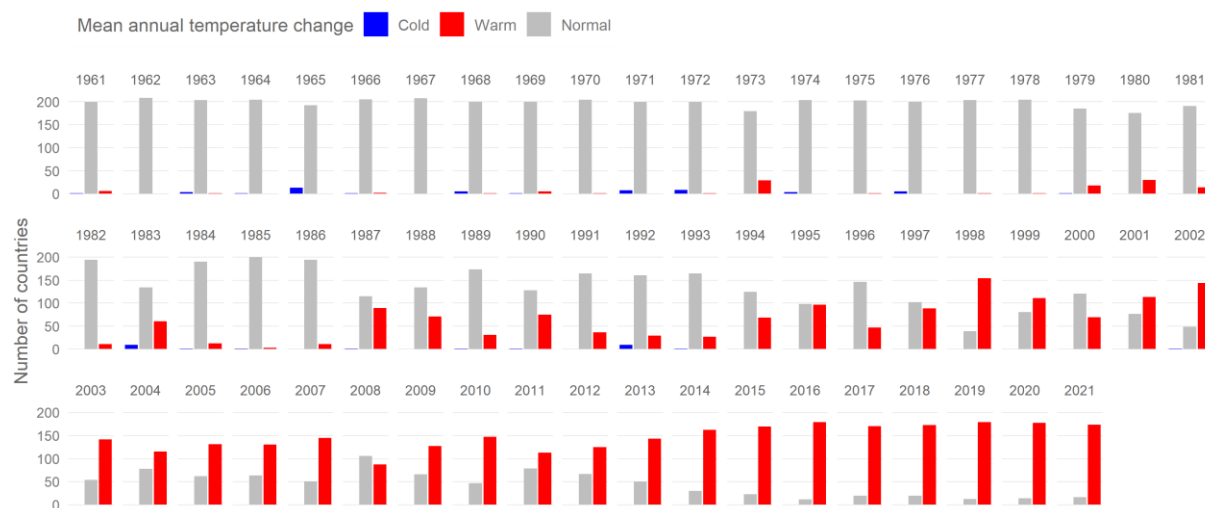


Source: FAO. 2022. FAOSTAT: Temperature Change. In: FAO. Rome. Cited March 2022. <http://www.fao.org/faostat/en/#data/ET>

¹The list of the type of parties to the UN Climate Convention is reported in the Annex and is drawn from <https://unfccc.int/process/parties-non-party-stakeholders/parties-convention-and-observer-states>. For corresponding FAOSTAT area codes, please also see the tab 'Country Group' in FAOSTAT Definitions and Standards <http://www.fao.org/faostat/en/#definitions>.

In order to further qualify the statistical significance of the global temperature signal, the collective statistics of the 197 countries and 41 territories in the database were also analysed. In 2021, the mean annual temperatures were warmer than normal in 171 countries and territories (Figure 2). In fact, in 125 of these (that is, in almost three-quarters of all countries and territories in the database), the mean annual temperatures were much warmer than normal. Additionally, since 2002, no country or territory had colder temperatures than normal.

Figure 2: Mean annual temperature change over land expressed as anomalies by country



Source: FAO. 2022. FAOSTAT: Temperature Change. In: FAO. Rome. Cited March 2022. <http://www.fao.org/faostat/en/#data/ET>

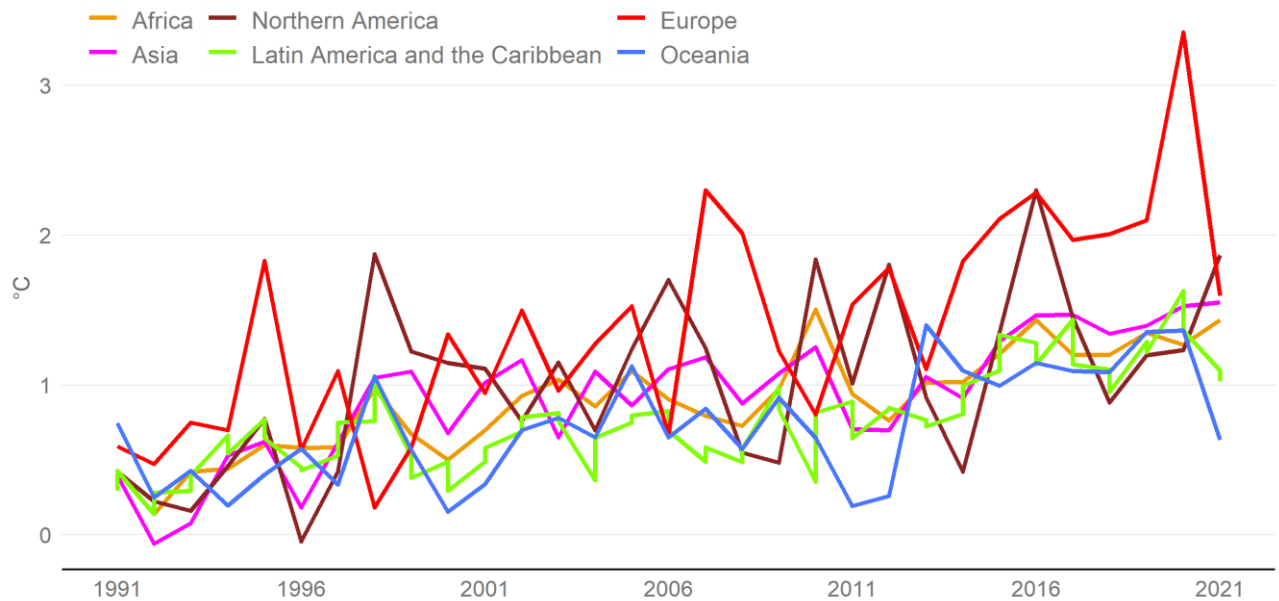
Annual bars in Figure 2 represent the number of FAOSTAT countries and territories in the three temperature anomalies categories of normal (within 95 percent CI), warm (positive anomalies outside of the 95 percent CI) or cold (negative anomalies outside of the 95 percent CI).

REGIONAL

In 2021, land in the northern hemisphere saw larger warming than in the southern hemisphere. Northern America registered the largest mean annual temperature change (1.9 °C), followed by Europe (1.6 °C) that in FAOSTAT aggregates includes the Russian Federation, then Asia (1.5 °C) and Africa (1.4 °C). Warming in Latin America and the Caribbean (composed of the South and Central America FAOSTAT regions) and Oceania was 1.0 °C and 0.6 °C, respectively. The observed temperature anomalies were statistically significant in all regions except for Oceania, where the observed annual warming was just below the 95 percent CI of the reference climatology (± 0.62 °C). All regions recorded an upward trend in the past three decades (Figure 3).

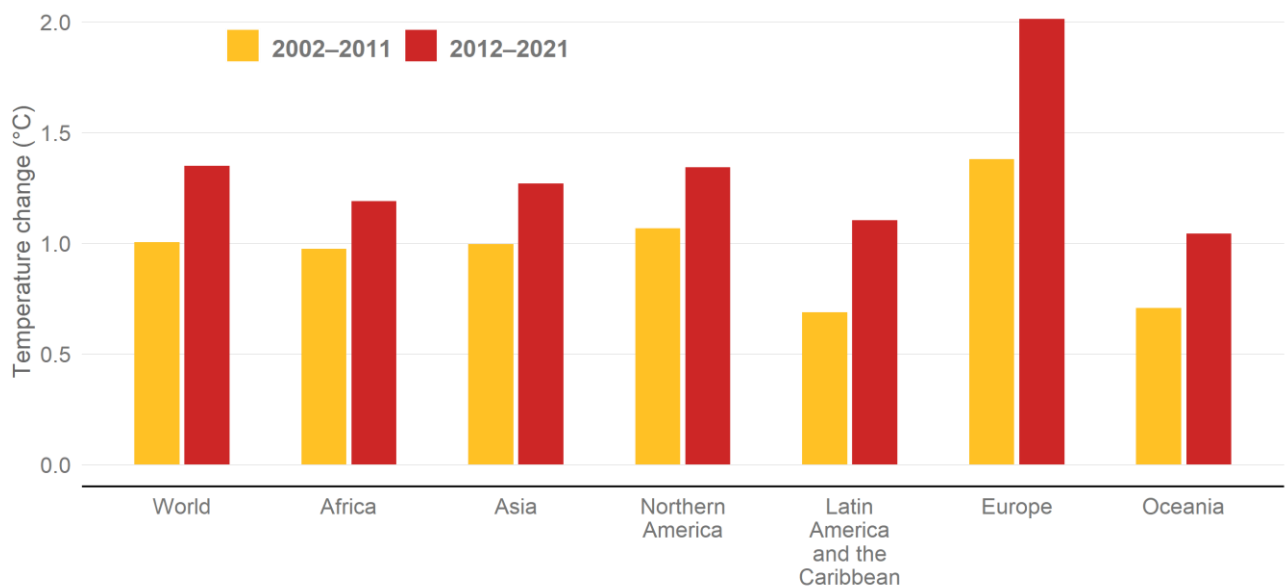
In all regions, the decadal mean warming was greater in the last decade (2012–2021) compared to the previous one (2002–2011) (Figure 4). The largest absolute increase was recorded in Europe, where the more recent decade was about 0.6 °C warmer than previous one. The smallest absolute increase was in Africa, where the 2012–2021 decade was 0.2 °C warmer than 2002–2011. Nonetheless, the comparison of regional trends (and country trends, relevant to the next section) may be biased due to uneven coverage and time evolution of meteorological stations in the different regions (see also the Explanatory Notes).

Figure 3: Regional trends in mean annual temperature changes measured over land



Source: FAO. 2022. FAOSTAT: Temperature Change. In: FAO. Rome. Cited March 2022. <http://www.fao.org/faostat/en/#data/ET>

Figure 4: Mean annual temperature changes measured over the land, global and regional trends by recent decades



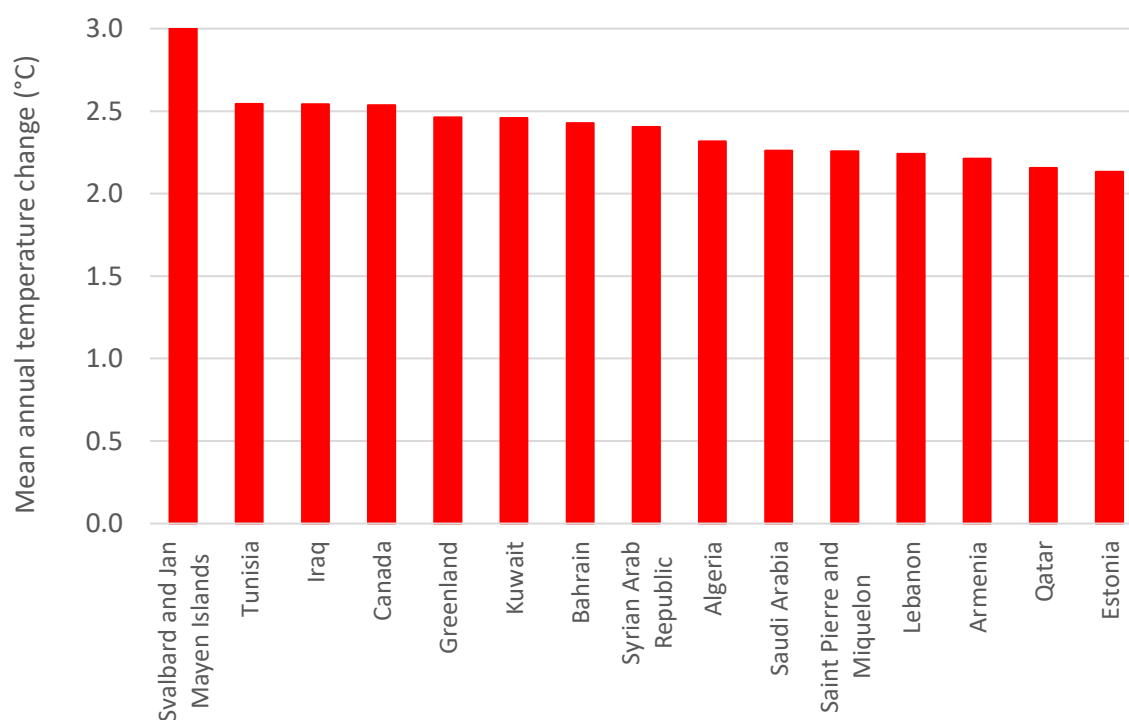
Source: FAO. 2022. FAOSTAT: Temperature Change. In: FAO. Rome. Cited March 2022. <http://www.fao.org/faostat/en/#data/ET>

COUNTRY

In 2021, 162 countries and territories – more than 70 percent of the total – experienced annual mean warming above 1.0 °C. Nearly half of these warmed by more than 1.5 °C and 20 by over 2.0 °C.

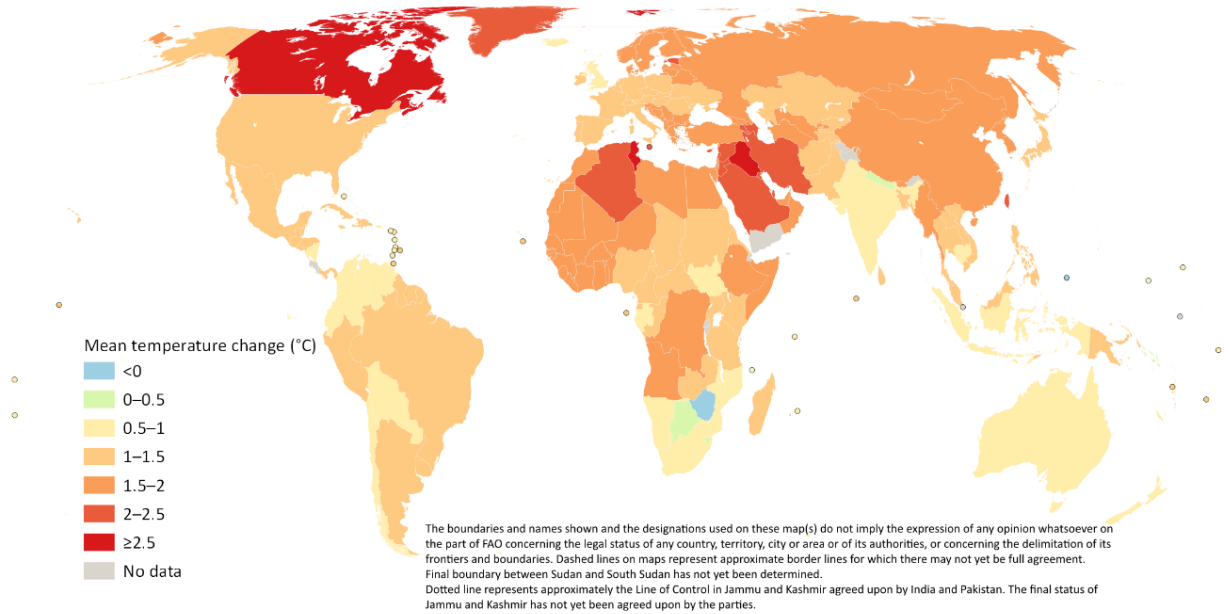
In 2021, the 15 countries or territories with the larger warming (all above 2.2 °C; see Figure 5) were recorded in northern latitudes such as the Svalbard Islands (Norway), Canada, Greenland (Denmark), Saint Pierre and Miquelon (France), and Estonia as well as in arid and semi-arid regions of the northern hemisphere, specifically Northern Africa and West Asia (Tunisia, Iraq, Kuwait, Bahrain, the Syrian Arab Republic, Algeria, Saudi Arabia, Lebanon and Qatar). In 2021, the country or territory with the greatest warming on land was the Svalbard Islands (3.0 °C), followed by Tunisia, Iraq and Canada, all with warming above 2.5°C. Conversely, only three of the 238 country and territories covered in the database experienced virtually no warming in 2021 (Palau, Zimbabwe and Botswana; see Figure 6).

Figure 5: Countries and territories with largest mean annual temperature change over land for the year 2021



Source: FAO. 2022. FAOSTAT: Temperature Change. In: FAO. Rome. Cited March 2022.
<http://www.fao.org/faostat/en/#data/ET>

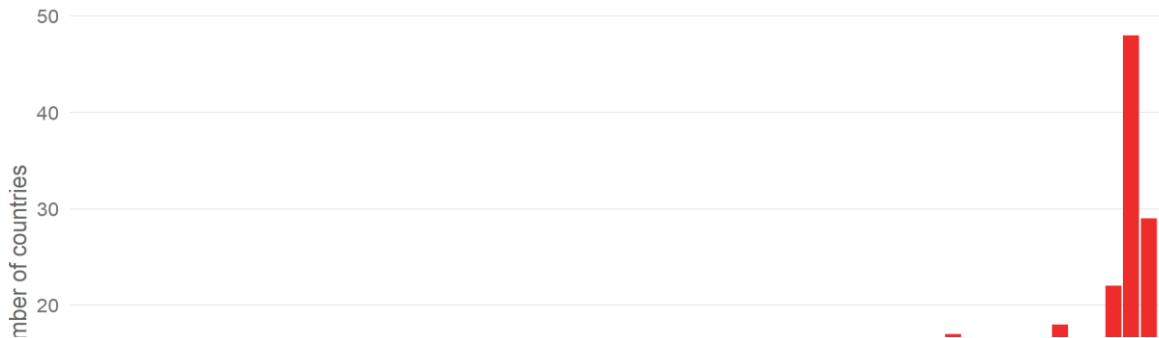
Figure 6: Global map of temperature changes, 2021



Source: FAO. 2022. FAOSTAT: Temperature Change. In: FAO. Rome. Cited March 2022. <http://www.fao.org/faostat/en/#data/ET> based on UN Geospatial, 2020.

29 countries or territories broke their warming record in 2021, compared to the time series 1961–2021. This record-setting in 2021 was second only to the year 2020, when 48 countries had broken their warming record (Figure 7).

Figure 7: Number of countries and territories with record warming



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