

## Global temperature for 2021 to be the 6th highest since 1891 (Preliminary)

The annual anomaly\* of the global average surface temperature for the year 2021 (i.e., the combined average of the near-surface air temperature over land and the sea surface temperature) is estimated at +0.22°C\*\* above the 1991 – 2020 average, likely to be the 6th warmest on record. The past eight years (2014 to 2021) are likely to be the eight warmest years for the 131-year period since 1891 (Figure 1).

The monthly average air temperatures for July in 2021 were the highest recorded since 1891 and May to November were ranked within the fifth warmest or higher for each month. The seasonal average air temperature for the boreal summer (June to August) and Autumn (September to November) were also within the third highest or higher recorded since 1891 for the season.

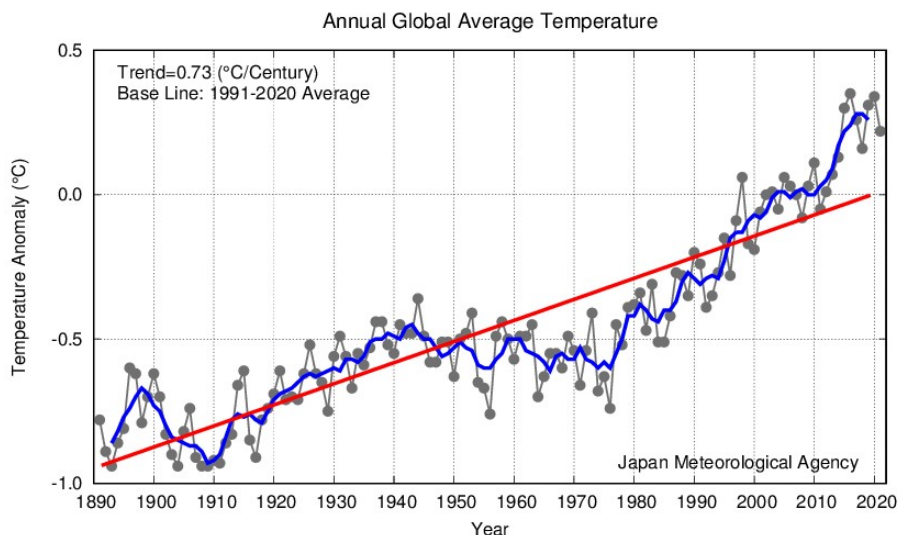
On a longer time scale, the annual global average surface temperature has been rising at a rate of about 0.73°C per century, which is thought to be attributed to global warming due to increase in anthropogenic greenhouse gas concentrations including carbon dioxide. In addition the global averaged surface temperature is affected by inter-annual to decadal natural fluctuations intrinsic to the earth's climate. It is known that the global mean surface temperature tends to decrease after a La Niña event occurs and vice versa. For this year, the La Niña event that started in the boreal summer of 2020 ended in the boreal spring of 2021, and a La Niña event emerged in the boreal autumn of 2021.

Warm temperature deviations are especially seen over wide areas of southern Europe and Northern Africa to Middle East and East Asia, and the central part of North America over the land, and over the North Pacific and the Atlantic Ocean (Figure 2).

The final report on the global temperature for 2021 is scheduled to be published early in February 2022.

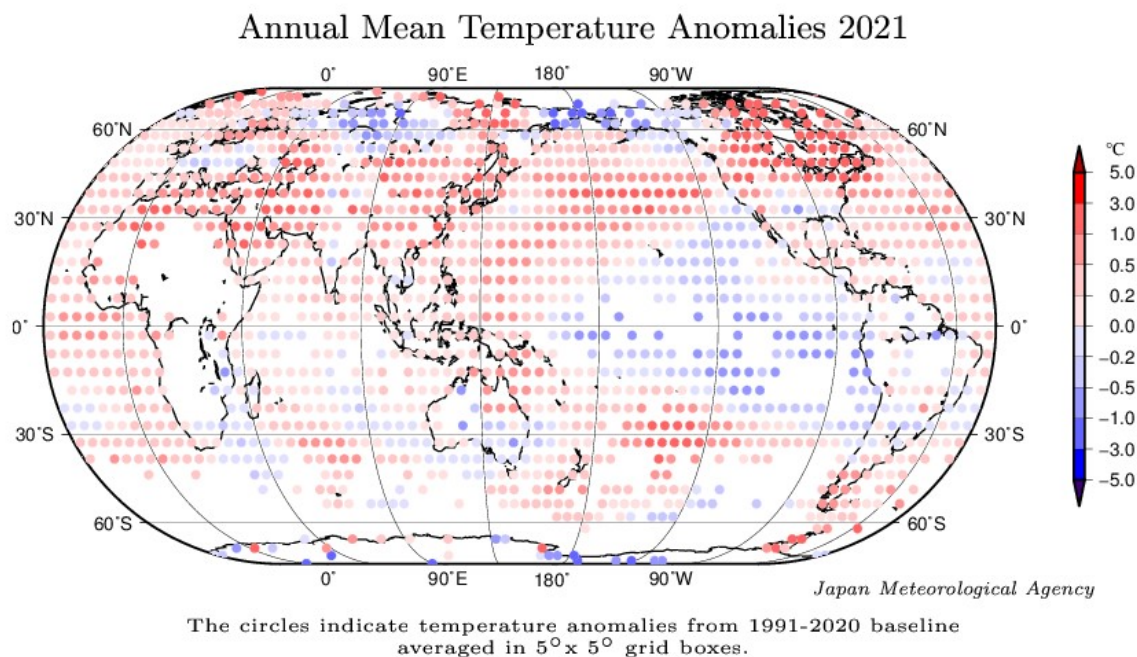
\* In May 2021, the JMA replaced the 1981 – 2010 baseline period for global monitoring with that of 1991 – 2020 (See TCC News No. 65) .

\*\* Note that this figure (hence its rank in the record, either) is still subject to change, because at the moment of this announcement it is only a preliminary result that was calculated based on temperature observations for the period of January to November in 2021.



**Figure 1 Long-term change in annual mean surface temperature anomalies over the globe (Preliminary value)**

Anomalies are derived from the 1991 – 2020 average baseline. The thin black line indicates surface temperature anomalies for each year, while the blue and red lines indicate the related five-year running mean and the long-term linear trend, respectively.



**Figure 2 Annual mean temperature anomalies in 2021 (Preliminary value)**

The circles indicate anomalies of surface temperature averaged in 5° x 5° grid boxes. The annual mean global temperature anomaly is determined by averaging the anomalies, derived from the 1991 – 2020 average baseline, of all grid boxes weighted with the grid box area.

### Ranking of annual global average temperatures

Rank	Year	Temperature Anomaly w.r.t. 1991 – 2020 average
1	2016	+0.35
2	2020	+0.34
3	2019	+0.31
4	2015	+0.30
5	2017	+0.26
6	<b>2021</b>	<b>+0.22*</b>
7	2018	+0.16
8	2014	+0.13
9	2010	+0.11
10	2013	+0.07

\* 2021 is preliminary value