

What do we mean by climate change?

Climate Science Communications Group Committee

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What do we mean by climate change?

Climate change is frequently in the news these days, but what does it mean?

To address this question we need to understand what climate is. Briefly climate is a short hand way of summarizing the weather observed over a particular period of time at a particular location. Mostly we are familiar with climate averages such as average temperature or rainfall experienced at a location. But other weather factors are also part of climate such as wind, sunshine, and cloud. Furthermore although averages are useful they don't tell the whole story. We also need to summarise how much these elements might vary during the same period. This might include their range and information about the size of extreme events and how often they occur. Internationally local climate standards are assessed over thirty year periods though for some applications shorter or longer periods are useful.

Averages and ranges may also be assessed for larger areas and indeed for the world as a whole. The climate of the Earth is largely determined by astronomical factors (the strength of the Sun and distance from it, the speed of rotation of the Earth and the tilt of the Earth's axis), atmospheric constituents (gases, aerosols, dust and clouds) and the configuration of the Earth's surface (land, ocean or ice). Locally and regionally the climate is also affected by latitude, altitude, local and regional geography and time of year.

Recent climate over land and the oceans can be computed from weather records, e.g. collected by weather stations or ships, ocean buoys and increasingly satellites. For periods going back further in time we use records of factors that affected by the climate – such as tree rings, ice cores from ice sheets, climate sensitive species over land and in the oceans, and deposits of mud and rock.

What do we mean by climate change? In general terms climate change relates to shifts in climate between different periods of time, long enough to minimize the effects of short terms variations, both locally and globally. However current interest has focused on an observed warming of the global climate over the past 150 years. In fact 2016 was the warmest year on record at over 0.8°C above the 1961-1990 average [Ref 1] and more than 1°C above the 1850-1900 average. It was the third year in a row to set a record. Sixteen of the seventeen warmest years have occurred since 2001 [Ref 2] up to 2016. The scientific community and policymakers are interested in understanding the reasons for this warming and what may happen in the future, as it has considerable implications for human society.

There is a lot of evidence that the global climate has changed in the past on many timescales and for many reasons. Over the last two and a half million years the Earth has been in a relatively cool phase during which large polar ice sheets have grown (ice ages) and then receded (interglacial periods) several times, in a quasi cyclical manner, related to changes in astronomical factors. Further back in time much warmer episodes have been related to higher levels of atmospheric carbon dioxide (e.g. about 3MY and 55MY ago [Ref 3].) Since the end of the last ice age, 10,000 years ago, the world's climate has been relatively stable, but regionally there have been important natural fluctuations.

So the question is whether the climate change we have observed over the past 150 years is part of a longer term climate cycle, natural variability or a long term change related to some specific factor. The evidence we have is that it is overwhelmingly the result of changes to the composition of the atmosphere – the growth in so called greenhouse gases, such as carbon dioxide, methane and nitrous oxide, which trap heat in the atmosphere and lead to changes in global, regional and local climates. The scientific challenge in understanding climate change is to separate out the effect of greenhouse gases from other potential factors, which may vary regionally. We also need to be able to predict the future course of climate change whilst greenhouse gas levels continue to grow due to human activities.

Two separate briefing documents will address in more detail what causes climate change and how we can predict its future course.

Notes, further reading and references:

Ref 1 : WMO Statement on the Status of the Global Climate in 2016, WMO, 2017.

Ref 2 : <https://www.nasa.gov/press-release/nasa-noaa-data-show-2016-warmest-year-on-record-globally>

Ref 3 : IPCC 5th Assessment Report, Chapter 5.