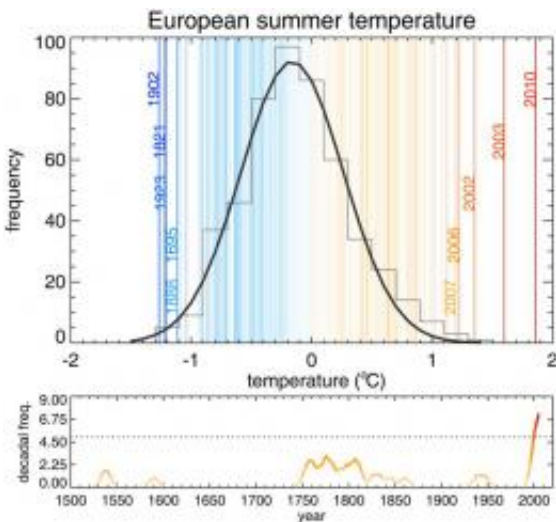


Scientists study record-breaking 2010 heatwave

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The 2010 heatwave (see at the right side of this picture) shattered all the records in terms of the deviation from the average temperatures. Credit: ETH Zürich

An international research team has compared the hot summers of 2003 and 2010 in detail for the first time. Last year's heatwave across Eastern Europe and Russia was unprecedented in every respect: Europe has never experienced so large summer temperature anomalies in the last 500 years.

The summer of 2010 was extreme. Russia was especially hard hit by the extraordinary heat: in Moscow, daytime temperatures of 38.2°C were recorded and it didn't get much cooler at night. Devastating fires caused

by the dry conditions covered an area of 1 million hectares, causing crop failures of around 25%; the total damage ran to about USD 15 billion. Even though passengers were also collapsing on trains in Germany in 2010 because the air-con units had failed in the heat, the general perception is still that the summer of 2003 was the most extreme – among Western Europeans at least. An international research team involving ETH Zurich has now compared the two heatwaves and just published their findings in *Science*.

Area fifty times bigger than Switzerland

The 2010 heatwave shattered all the records both in terms of the deviation from the average temperatures and its spatial extent. The temperatures – depending on the time period considered – were between 6.7°C and 13.3°C above the average. The heatwave covered around 2 million km² – an area fifty times the size of Switzerland. On average, the summer of 2010 was 0.2°C warmer in the whole of Europe than in 2003. Although it might not sound like much, it's actually a lot when calculated over the vast area and the whole season. “The reason we felt 2003 was more extreme is that Western Europe was more affected by the 2003 heatwave and it stayed warm for a long period of time,” explains Erich Fischer, a postdoc at the Institute for Atmospheric and Climate Science at ETH Zurich.

The reason for the heatwaves in both 2003 and 2010 was a large, persistent high-pressure system associated by areas of low pressure in the east and west. In 2010 the heart of this high-pressure anomaly, often referred to as blocking, was above Russia. The low pressure system to the east was partly responsible for the floods in Pakistan. But the blocking was not the only reason for the extraordinary heat between July and mid-August; on top of that, there was little rainfall and an early snow melt, which dried out the soil and aggravated the situation. “Such prolonged blockings in the summertime are rare, but they may occur

through natural variability. Therefore, it's interesting for us to put the two heatwaves in a wider temporal perspective," explains Fischer.

500-year-old temperature record broken

With this in mind, the researchers compared the latest heatwaves with data from previous centuries. Average daily temperatures are available back as far as 1871. For any earlier than that, the researchers used seasonal reconstructions derived from tree rings, ice cores and historical documents from archives. The summers of 2003 and 2010 broke 500-year-old records across half of Europe. Fischer stresses: "You can't attribute isolated events like the heatwaves of 2003 or 2010 to climate change. That said, it's remarkable that these two record summers and three more very hot ones all happened in the last decade. The clustering of record heatwaves within a single decade does make you stop and think."

More frequent and intense heatwaves

In order to find out whether such extreme weather conditions could become more common in future, the researchers analysed regional scenarios for the periods 2020-2049 and 2070-2099 based on eleven high-resolution climate models and came up with two projections: the 2010 heatwave was so extreme that analogues will remain unusual within the next few decades. At the end of the century, however, the models project a 2010-type [heatwave](#) every eight years on average. According to the researchers, by the end of the century heatwaves like 2003 will virtually have become the norm, meaning they could occur every two years. While the exact changes in frequency depend strongly on the model, all the simulations show that the heat waves will become more frequent, more intense and longer lasting in future.

More information: D. Barriopedro, et al., The hot summer of 2010: redrawing the temperature record map of Europe, *Science*, [doi:10.1126/science.1201224](https://doi.org/10.1126/science.1201224) (2011)

Provided by ETH Zurich

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