



## Human influences and extreme weather events

Extreme weather events such as droughts and storms are the meteorological phenomena that attract attention. They are characterised by conditions that are well beyond the average weather we experience from day to day.

Extended heat waves and unusually heavy thunderstorms classify as extreme events.

Although they are rare - as the word suggests - it appears that their occurrence has increased in many regions, and especially in the Mediterranean area.



By **Andreas Pozzer**

Is there perhaps a connection between climate change and extreme events?

This question has no unique answer although some important conclusions were drawn by the Intergovernmental Panel on Climate Change (IPCC). The IPCC is part of the World Meteorological Organisation (WMO) and its main goal is to regularly provide assessments about the state of knowledge on climate change. The latest, fourth assessment report in 2007, discussed the relationship between extreme weather and human-induced climate change, expressing great concern about the developments ahead. In most cases extreme weather conditions result from a combination of factors, some influenced by human activities, some completely un-

related. In general, human-induced climate change can influence the occurrence of extreme events in two ways:

1. The average conditions may shift, so that previously rare conditions simply become more common.

2. The frequency of particular weather phenomena changes, so that episodes of extreme weather become more (or less) frequent.

Unfortunately, it is rather difficult to collect statistics on rare events and diagnose the exact causes of these complex phenomena. They are related to both local and global conditions of the atmosphere and oceans, including the Mediterranean Sea. Nonetheless, thanks to the usage of complex climate models, running on the largest computers, we can increasingly better determine if human influences change the likelihood of certain types of weather events.

An interesting example is shown in the figure below for central Europe. These results of scientific research are based on computer model projections for the 21st century that show climate change will strongly influence the occurrence of extreme temperatures in central Europe. This research shows that the likelihood of heat waves will increase strongly in this part of Europe. Following this study it has been estimated that human activities will almost double the risk of heat waves and that the unusually hot conditions that occurred in 2003 will become commonplace.

This topic is also part of the research at

the Cyprus Institute, where the computer modelling group at the Energy, Environment and Water Research Centre performs climate change studies. Special focus is dedicated to the eastern Mediterranean and Middle East, a region which is a "hot spot" of climate change. In this region the frequency of very hot days (and nights) is already high, and climate change will aggravate the situation.

Of additional great importance is the frequency and intensity of rain. Unfortunately, the first results of the research indicate that Cyprus and the surrounding region will be subject to further drying and warming. Scientists will work together with governments, policy makers and industry, to be prepared and develop the infrastructure needed to adapt to these changes.

Measured frequency of temperatures in central Europe during the period 1961-1990 (blue, measured) and 2071-2100 (red, modelled).

Courtesy of C. Schär, adopted from Nature Magazine. This figure shows that it is expected that the average temperature increases from 16°C to 21°C, and that the frequency distribution of events becomes "flatter". As a result, the warm events that were rare in the period 1961-1990 will become common in future and the number of very warm events increases very strongly.

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