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28th Empa Science Apéro

What Will Happen When It Gets Warmer? Switzerland and the Changing Climate

Extreme bad weather, severe flooding and other catastrophic natural events have occurred more and more frequently over the past few years – with increasingly destructive power. Are these events the harbingers of changing climate? How do environmental changes affect our flora? Do we need to modify our patterns of energy usage with the changing climate? There are many different aspects to climate change, as the speakers at the 28th Empa Science Apéro emphatically demonstrated.

Are the severe storm “Lothar” in December 1999, the extremely hot, dry summer of 2003 and the damaging floods in Switzerland last year the first signs of a changing climate? “No,” explained Ulrike Lohmann, Professor of Experimental Atmospheric Physics at the ETH Zurich, “an individual extreme weather event does not indicate a changing climate; it merely represents a single occurrence of very bad weather.”

What is Climate Change?

Changes in climate can only be determined over the long term. For example the increase of the average global temperature by 0.8°C over the last century (of which in fact 0.6°C occurred during the last 30 years alone) is indeed an indication of changing climate. Scientists researching climate change were able to establish this trend through direct temperature measurements going back some 150 years as well as by using indirect temperature reconstruction methods based on natural “archives” such as ice cores obtained from bore sites.

But is humankind really responsible for the rapid temperature rise seen over the last 30 years? Computer models based on natural events alone (for example volcanic eruptions) cannot explain the observed increase. Only when the effects of greenhouse gases produced by man (such as carbon dioxide, CO_2) are taken into account do the models agree with the observed temperature trends.

“It is getting warmer very quickly,” maintained Ulrike Lohmann. Depending on which scenario is used, climate researchers calculate that by the end of this century temperatures will have risen by another

1.5°C to 6°C. How severe the increase will actually be depends on other factors including by how much greenhouse gas and also fine particulate emissions are reduced. Fine particles, so-called aerosols, counter the global warming effects of greenhouse gas because they reflect sunlight. Despite their positive influence on climate changes, aerosol emissions should be further reduced because of the damaging effects these fine particles have on human health. “Air pollution and climate change must be attacked together,” opined Ulrike Lohmann in conclusion.

Irrespective of how climate change is predicted to develop, one can expect in future that summers in Switzerland will get warmer and winters milder. The frequency, intensity and duration of extreme weather events are predicted to increase.

“Fertilizer from the air” – how do plants respond to CO_2?

Climatic warming is only one aspect of the phenomenon of global environmental change. Modifications to the chemistry of the atmosphere (such as the increased atmospheric concentration of the greenhouse gas CO_2), the associated climate change and the worldwide disruption to ecosystems all fall under the term “global change”. “The present concentration of CO_2 in the air, 380 ppm, represents a greater change than any other the atmosphere has ever undergone,” explained Christian Koerner, Professor of Botany at the University of Basel. The latest data from ice cores obtained by drilling in the Antarctic show that over the last 650,000 years the CO_2 concentration in the atmosphere ranged from 180 to 300 ppm. Professor Koerner and his research group are investigating the effects on plants of this elevated CO_2 concentration in the air.

Apart from its effect as a greenhouse gas, CO_2 has a direct influence on vegetation – it is one of the main nutrients for plants, being converted to sugar and organic matter during photosynthesis. “Carbon dioxide is often viewed as a poison,” said Koerner. “But CO_2 is the basic resource from which all life is derived!” The photosynthesis rate is still along way from its upper limit at the current atmospheric concentration of CO_2. Does this imply that more CO_2 means more plant growth? It is not quite so simple, according to the botanist from Basel University. Field experiments on alpine plants showed that additional CO_2 does not encourage increased growth. Under these conditions other plant nutrients become scarce and this hinders growth. Despite this, the increase level of CO_2 does leave its mark on plants. Koerner and his team observed that in a model forest of beech and spruce trees with artificially elevated levels of CO_2, the competitive relationships changed. While both varieties of tree profited from the additional CO_2 when grown on chalky soils, the beech trees reacted negatively on acid soils. On the other hand, there is evidence that – contrary to the effect seen in alpine plants – CO_2 strongly encourages growth in ivy and clematis, making these creepers more “aggressive”.

Climate change influences plants too. One frequently hears and reads about plants which, as a result of the greenhouse effect, begin to bloom earlier. It is not the temperature but the day to night relationship which wakes indigenous plants form their winter dormancy, explained Koerner. There are of course limits to this effect – plants cannot just flower earlier and earlier because of global warming!

There are however exceptions. “The chestnut tree in Geneva, which really does flower earlier every year, just doesn’t know about local customs!” joked Koerner. Chestnuts originate from the Mediterranean region and their “internal calendar” is slightly differently calibrated.

Energy consumption changing in step with the climate

Very few people think of buildings and the energy consumption associated with them when they hear the words “climate change”. In Switzerland, however, about half the annual energy consumed is used in and around buildings, so the consequences of global warming for energy policies are not to be underestimated.

Exactly how the warmer temperatures have affected energy consumption associated with buildings in this country is the subject of an investigation by researchers at the Empa. Their conclusion: in the course of the 20th century at the four locations evaluated in Switzerland the number of official heating days decreased by about 15%. Over the same period, on the other hand, the number of official cooling days increased from between 50 to 170%. Furthermore, predicted Thomas Frank of the Empa’s Building Technologies Laboratory, over the period 1975 to 2085 a 13 to 87% decrease in heating days (depending on the climate model used) will occur in Switzerland. For office buildings alone this means up to 300% higher energy requirements for air conditioning for cooling purposes. The bottom line is that in future electric power consumption is going to increase.

“The importance of techniques for keeping buildings cool in summer, and for the ventilation of inhabited dwellings at night will increase dramatically,” said Frank. Dark building facades can be protected from overheating by plants or by painting them in lighter colors. In houses and flats the internal temperature can be kept within the comfortable range in summer by good ventilation without the need for additional cooling – except during extremely hot years such as 2003, when ventilation at night alone could not cope.

Climate change and the increasing level of extreme weather events associated with it must also be taken into account when designing and constructing new buildings, said Frank. “Weather data models of extreme phenomena are necessary to allow the planning and implementation of suitable protective measures for buildings.”

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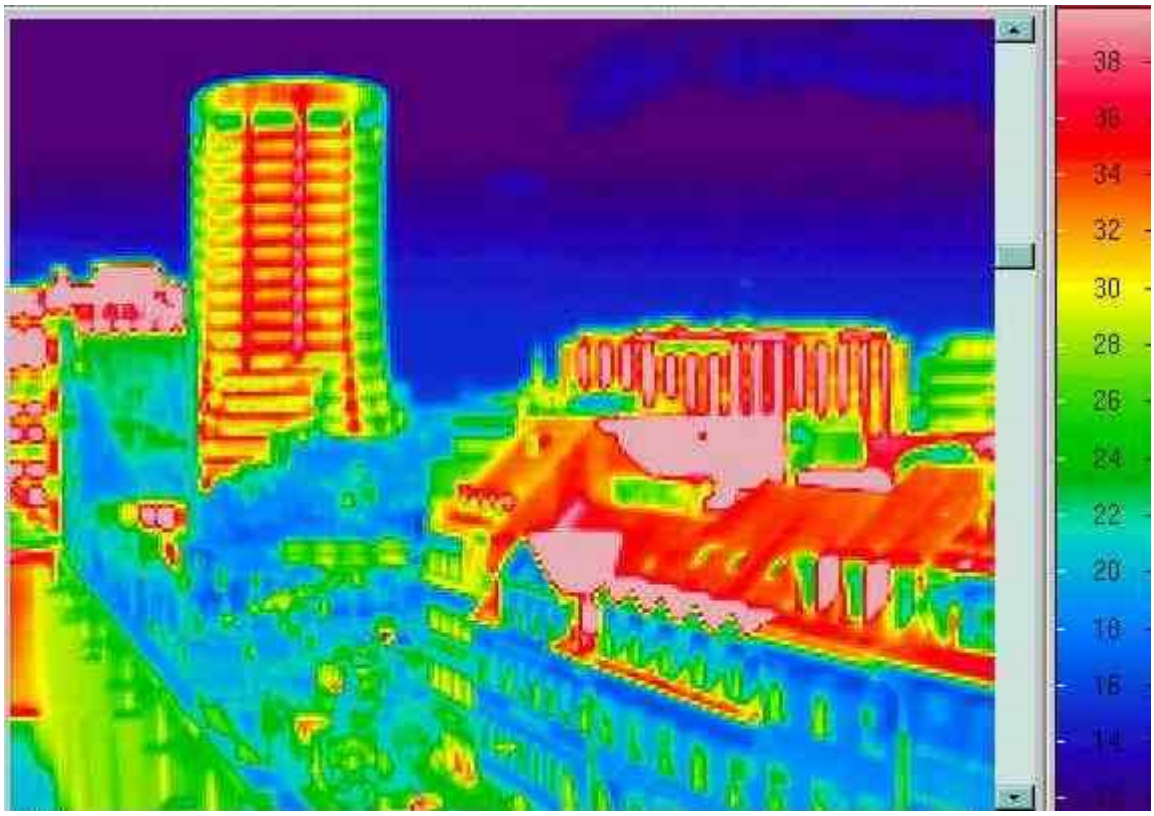

An image of Basel taken using an infra-red camera

This image is available from remigius.nideroest@empa.ch

What is an Empa Science Apéro?

The EMPA Academy provides a forum for debating current scientific and socially relevant issues through its Science Apéros. Held at regular intervals, these usually involve three or four speakers with backgrounds in research, politics and commerce, who present results and trends relevant to the selected topic seen from their particular point of view. After the round of presentations, a lively discussion ensues involving the audience. This continues during the aperitif after the formal proceedings come to a close.

Science Apéros are open to the public and expert alike; entrance is free of charge.

The next Science Apéro will take place on June 26th 2006, at 16:30 at the Empa Duebendorf. The theme is “Asbestos – a Recognized Danger?”

The current calendar of events can be viewed at: www.empa-akademie.ch/veranstaltungen