# EUROPE
# CENTRAL EUROPE

INDEX TEMPERATURE
YEAR 2071-2100 RELATIVE TO 1961-1990 AND 2080-2099 RELATIVE TO 1961-1990
SCENARIO A2 AND OTHER SCENARIOS

Reference: WG1 2007, Schär et al. (2004), Meehl and Tebaldi (2004), Kjellström et al. (2007)

## 1 Extreme events

This fact sheet completes the main sheet on temperature in Europe for the A1B scenario, based on the PRUDENCE project results.[1] The ten regional climate models of the European PRUDENCE project show a certain consistency in the results for simulating extreme events for the A2 scenario (see FIGURE 1).

The 5th and 95th percentiles[2] represent on average the events corresponding to 4-5 days per season for the studied regions.

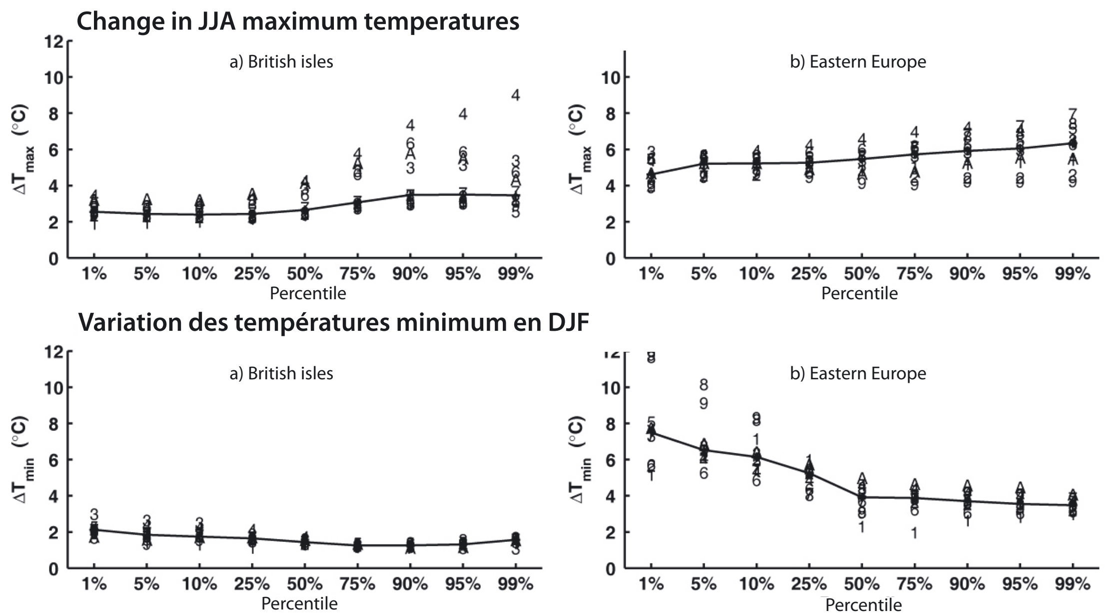
1. "Prediction of Regional Scenarios and Uncertainties for Defining European Climate Change Risks and Effects". The models used are finer scale than those applied in the IPCC report and use dynamic downscaling methods; they are called regional climate models.

2. See paragraphs 1.1 and 1.2 of the technical fact sheet for further information.

The mean temperature increases by 2 to 5°C depending on the region and the season; in particular in central Europe in winter and in the British Isles in summer, some models further modify the extremes of the distribution.

For maximum summer temperatures, there is less consistency between models above the 95th and 99th percentiles. According to current research, it is not easy to pinpoint the origin of this difference: does the interannual variability increase; does the diurnal variability increase; or a combination of the two? The dispersion between the models is larger for the highest distribution percentiles than for the lowest percentiles.

In winter, all the models show an increase in mean




SPRINGER AND THE CLIMATIC CHANGE, VOL. 81, 2007, P. 249-265, MODELLING DAILY TEMPERATURE EXTREMES: RECENT CLIMATE AND FUTURE CHANGES OVER EUROPE, KJELLSTRÖM, E., BÄRRING, L., JACOB, D., JONES, R., LENDERINK, G., SCHÄR, C., FIGURES 7A AND 7B, © SPRINGER SCIENCE + BUSINESS MEDIA BV; WITH KIND PERMISSION FROM SPRINGER SCIENCE AND BUSINESS MEDIA. FIGURE MODIFIED AND TAKEN FROM WORKING GROUP I CONTRIBUTION TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS. FIGURE S11.23. CAMBRIDGE UNIVERSITY PRESS.

FIGURE 1 Changes in the distribution of JJA daily maximum temperatures (top) and DJF daily minimum temperatures (bottom) in the British Isles (left) and in eastern Europe. These results come from the PRUDENCE project simulations (from 1961–1990 to 2071–2100 under the SRES A2 scenario). The horizontal axis gives the percentile of the distribution. The vertical axis gives the temperature changes each percentile separately for ten RCMs (1–9 and A). The beack line illustrates the median change of ten models. The percentiles represent the raw data and are not recalculated from a Gaussian ditribution curve (based on Kjellström et al., 2006).

minimum temperatures, above 4°C for central Europe and above 1.5°C for the British Isles. As in summer, the greatest temperature changes take place during extreme events.

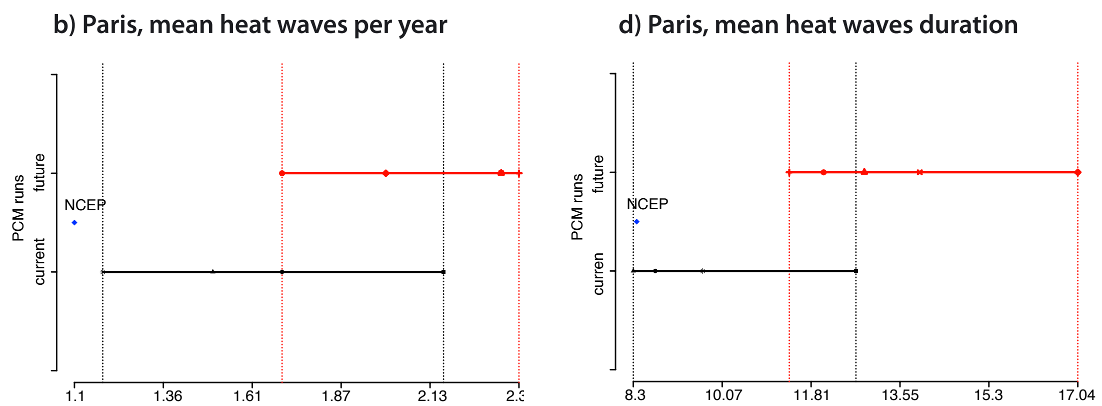
There is a link between the region most affected by climate change and the decrease in snow cover. This relationship reflects the importance of feedbacks between the temperature, the snow cover and the albedo on the temperature of the models. A decrease in snow cover leads to a lower albedo, meaning more solar radiation is absorbed by the surface. Furthermore, the reduction in snow cover facilitates heat transfer between the relatively warm ground and the atmosphere. These two effects lead to higher temperatures, which, in turn, further reduce snow cover. The importance of this feedback is illustrated below: in most of the models the regions with the greatest change in the 5th percentile of minimum winter temperatures correspond to the regions that are snow-covered for most of the year in the current climate. In the A2 scenario (see **FIGURE 3**), these regions are generally snow-covered ground for less than 25% of the time. Once again, the highest climate change signal and the greatest difference between the models are found in the lowest distribution percentiles.

## 2 Heat waves

As some studies only refer to a single climate model, it is best to be careful when interpreting – and validating – these results, precisely because they only cover one climate model. These very detailed studies merit nevertheless our attention.

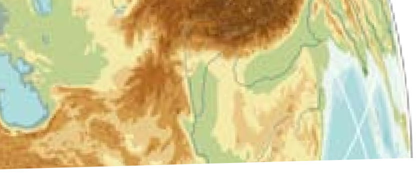
Thus, following the results of a specific climatic model, the number of heat waves should increase in Paris in the future (2080-2099), between 1.7 and 2.38 per year, and their duration should also increase, between 11 and 17 days, as the year 2003 showed us in Europe (see **FIGURE 2**).

According to another study, summer temperatures variability will be greater in the climate at the end of the century than in the current climate, especially in northern Switzerland (see **FIGURE 3**). Summer mean temperature will increase, more in central and eastern Europe than elsewhere, but the associated variations will be greater in southern than in the northern Europe. Indeed, in the future climate (2071-2100), the model simulates more summer drought episodes than in the current climate (1961-1990); this is the cause of the higher variability in these regions (see **FIGURE 3D**).




FROM MEEHL, G. A. AND TEBALDI, C., MORE INTENSE, MORE FREQUENT, AND LONGER LASTING HEAT WAVES IN THE 21TH CENTURY, SCIENCE 305, PP. 994-997 (2004); DOI: 10.1126/SCIENCE.1098704. REPRINTED WITH PERMISSION FROM AAAS.

**FIGURE 2** Based on the threshold definition of heat wave, the mean number of heat waves per year near Paris (B) and mean heat wave duration near Paris (D) are shown. In each graph, the blue diamond marked NCEP indicates the value computed from NCEP/NCAR reanalysis data. The black line shows the range of values obtained from four examples of the current climate (1961-1990), and the red line shows the range of values obtained from five examples of future climate (2080-2099). The dotted vertical lines facilitate comparisons of the simulated ranges/observed value.



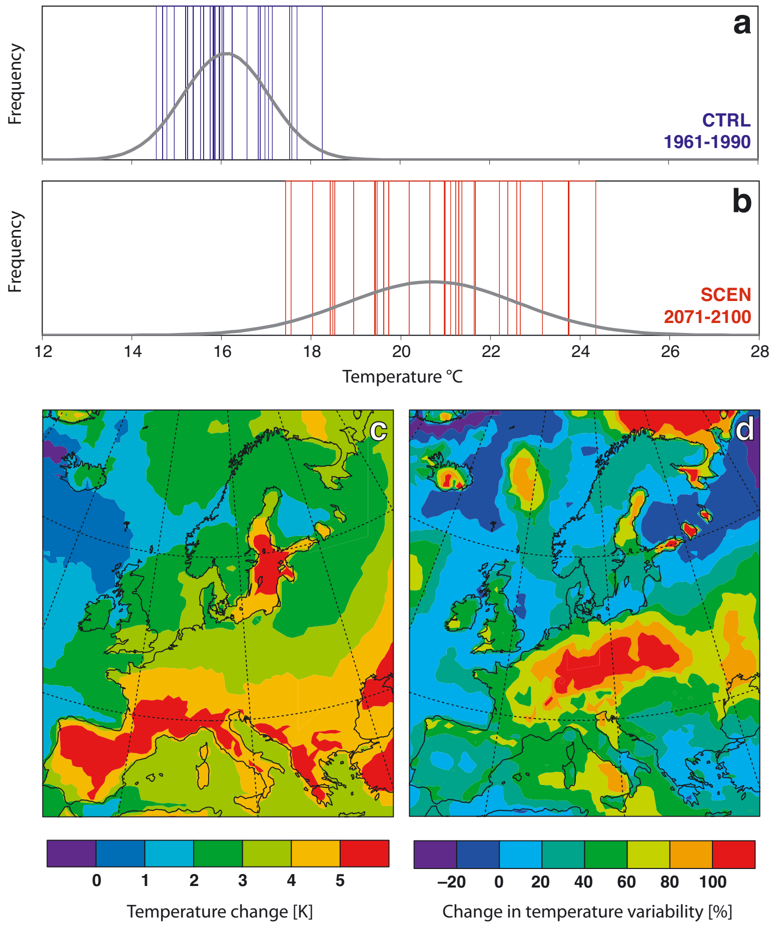





**FIGURE 3** Results from an RCM climate change scenario representing current (CTRL 1961–90) and future (SCEN 2071–2100) conditions. a, b, Statistical distribution of summer temperatures at a grid point in northern Switzerland for CTRL and SCEN, respectively. c, Associated temperature change (SCEN–CTRL, °C). d, Change in variability expressed as relative change in standard deviation of JJA means ((SCEN–CTRL)/CTRL, %).