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Projected changes in frequency and duration of heat wave hazards in Central/Eastern Europe using regional climate model experiments

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Human health is very likely affected by regional consequences of global warming. One of the most severe impacts is probably associated to temperature-related climatological extremes such as heat waves. In the coming decades hot conditions in most regions of the world are very likely to occur more frequently, more permanently, and more intensely than in the recent decades. In order to develop adaptation and mitigation strategies on local scale, it is essential to analyze the projected changes related to warming climatic conditions including heat waves.
In 2004, a Heat Health Watch Warning System was developed in Hungary on the basis of a retrospective analysis of mortality and meteorological data to anticipate heat waves that may result in a large excess of mortality. In the frame of this recently introduced Health Watch System, three levels of heat wave warning are applied. They are associated to the daily mean temperature values, and defined as follows: (i) Warning level 1 (advisory for internal use) is issued when the daily mean temperature exceeds 25 °C. (ii) Warning level 2 (heat wave watch) is issued when the daily mean temperature for at least 3 consecutive days exceeds 25 °C. (iii) Warning level 3 (heat wave alert) is issued when the daily mean temperature for at least 3 consecutive days exceeds 27 °C.
In the present study, frequency and length of the above climatic conditions are analyzed using PRECIS regional climate model experiments with 25 km horizontal resolution for the recent past and the coming decades (1961-2100) for Central/Eastern Europe. In order to assess different future conditions, three different emission scenarios (B2, A1B, and A2) were considered, in which the future CO_2 level is estimated 621 ppm, 717 ppm, and 856 ppm, respectively. The climatic conditions of 1961-1990 (as a reference), and 2021-2050, 2071-2100 future periods are evaluated on the basis of daily mean temperature values, after applying bias correction to the raw outputs, for which the monthly empirical distribution functions are considered. The results clearly suggest more and longer heat wave occurrences in the region. The larger the estimated CO_2 concentration level by 2100, the larger the projected increase. Moreover, by the end of the 21st century the average first occurrence of the heat warning days is simulated to shift earlier, and the average last occurrence later, than in the reference period – thus the length of the heat wave season is projected to become significantly larger.