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European heat stress to reach critical levels under climate change conditions

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Heatwaves are among the most dangerous natural hazards, being associated with considerable effects on the population. Under hot conditions the human body is able to regulate its core temperature via sweat evaporation, but this ability is reduced when the air humidity is very high. These conditions invoke heat stress which, in turn, may cause dehydration, hyperthermia and heat stroke. Heat stress is a major problem for vulnerable groups of the population and also constitutes an important threat for European workers with potential major impacts on workers' health and productivity. In this context, the H2020 project HEAT-SHIELD (<http://www.heat-shield.eu/>) aims at analyzing the impact of climate change on heat-related productivity in strategic industries in Europe within an inter-sectoral framework.

The present work provides the climatological basis for HEAT-SHIELD. We assess the future change in heat stress using a well-defined heat stress index (the Wet Bulb Globe Temperature) that is implemented by the International Standards Organization (ISO) as regulatory index to measure the heat stress of working people. The comprehensive and state-of-the-art regional climate model (RCM) ensemble of the EURO-CORDEX initiative is exploited and statistically adapted for more than thousand locations in Europe to derive potential climate change signals and various components of projection uncertainty (e.g. due to different RCMs, Global Circulation Models, Representative Concentration Pathways). Our results show that in large parts of Europe future heat stress will exceed critical levels for a physically-active human body. At the end of the 21st century, many European workers will very likely be affected by severe heat stress, not only due to the increase of the mean and maximum heat stress values, but also because heat stress situations will become more frequent. A direct consequence of heat stress is the loss in labour productivity especially for non-shaded conditions, which can result in a reduction of 15-60% working hours in the Mediterranean area under the strongest emission scenario for the end of the 21st century. Adapting European industries to these projected changes in addition to mitigation of climate change will likely be required in order to prevent major consequences for the health of workers and the economic productivity.