Tailored climate information for assessing energy demand and physical functioning of buildings

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Weather and climate information tailored to support decision-making in the built-up environment is becoming increasingly important. Energy-efficiency and climate resilience of buildings constitute a key subject in climate change mitigation and adaptation. Increasing outdoor air temperatures influence the heating and cooling energy demand of buildings and may increase the overheating risk of indoor conditions. Besides, more frequent rainfall events at the expense of snowfall in winter may intensify mold growth and moisture condensation in structures and slow down the drying of structures. Therefore, because buildings are designed to last for several decades, the planning, construction and maintenance of buildings need to be prepared for the changing weather conditions.

The National Building Code of Finland demands that new buildings have to pass the nearly zero-energy requirements for energy performance and conformity, and this needs to be verified by calculations which use so-called test reference year (TRY) hourly weather data as input. TRY data sets describe typical present-day weather conditions during twelve months that usually originate from different years. Following the related standard (ISO 15927-4:2005) with a few modifications, the TRY data files have been constructed for Finland twice: in 2012 and 2020. While the former (TRY2012) is officially still in use, the latter (TRY2020) was recently developed with the aid of a newer set of weather observations, covering the period 1989-2018 and containing the following variables at hourly resolution: temperature, relative humidity, wind speed and direction, global, diffuse and direct solar radiation, and precipitation.

An important part of work was to assess what kinds of weather conditions the built environment should be prepared for, depending on the forthcoming greenhouse gas emissions. Therefore, the tridecadal (1989-2018) weather datasets were transformed to represent future climate by modifying the hourly values of the weather variables in accordance with multi-model mean projections derived from an ensemble of 28 CMIP5 climate models. The transformations were performed using delta-change methods tailored for the various climatic variables. The observed partition of the global radiation between direct and diffuse components was also utilized in the transformation algorithm.

The new climate information supports the design of healthy, safe and energy-efficient buildings in the changing climate of Finland. The work was part of a chain of multi-year ongoing research activities funded by the Ministry of the Environment and Healthy Premises 2028 program set by Prime Ministers’s Office. The materials produced in the project can also be utilized in education and scientific research. Previously, based on future scenarios linked to TRY2012, the annual energy demand was simulated to decrease by 20-40 % for heating and increase by 40-80 % for cooling in Finland by 2100.