EMS Annual Meeting Abstracts
Vol. 13, EMS2016-189-3, 2016
16th EMS / 11th ECAC

Synthetic weather files for dynamic simulations of future building energy demand in Finland

Kirsti Jylhä (1), Kimmo Ruosteenoja (1), Juha Jokisalo (2), Targo Kalamees (3), Hanna Mäkelä (1), and Reijo Hyvönen (1)

(1) Finnish Meteorological Institute, Helsinki, Finland (kirsti.jylha@fmi.fi), (2) Aalto University School of Engineering, Espoo, Finland, (3) Tallinn University of Technology, Tallinn, Estonia

The influences of air temperature, solar radiation, wind speed and air humidity on heating and cooling energy demand of buildings can be assessed by dynamic simulation programs that use hourly weather data as input. Hourly temporal resolution is likewise required for weather files used in simulations of future energy demand. In order to estimate the impacts of climate change on energy demand, present-day Test Reference Year (TRY) hourly weather files were constructed first. These files consist of observed data in twelve months that originate from different calendar years and have weather conditions close to the long-term climatological averages. Synthetic future weather files were then developed by combining the present-day TRY weather data with climate change projections for the 21st century. This was conducted using delta-change methods tailored for the various climatic variables. The observed partition between the global, direct and diffuse radiation components was also utilized.

The present-day and future hourly weather files were used in the IDA Indoor Climate and Energy simulation program in order to simulate time-varying energy demand of a typical detached house in southern Finland in the current climate conditions and around the years 2030, 2050 and 2100. For assessing changes in delivered energy consumption of the example house due to climate change, three alternative heating systems and two different cooling systems were examined. Finally, the simulated decreases in heating energy demand and increases in cooling energy demand were compared to estimates that were based on the use of traditional heating and cooling degree-day sums. It appeared that the dynamic building energy simulation algorithm and the degree-day sum method gave almost equal percentage changes in heating energy demand. In contrast, the cooling degree-day sum method was not able to adequately assess the cooling energy demand of the example house considered here. This demonstrates the added value of dynamic building energy simulations compared to the use of cooling degree-days.