



Sol-air temperature and daylight illuminance profiles for the UKCP09 data sets

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ABSTRACT

To provide information on climate change, the UK Climate Impacts Programme (UKCIP) provided the latest UKCP09 data to a resolution of 5 km square grids for the UK. Those data sets were used in this study along with the historical measured data for two locations—Bracknell (London) and Edinburgh—to critically analyse the likely changes that may occur in the sol-air temperature and daylight illuminance profiles. These parameters have an important bearing on the design and function of buildings and building services.

Drastic increment of sol-air temperature was found for the projected data sets. An increase of as much as 20.1 °C of sol-air temperature for dark-coloured surface was found for Edinburgh and 13.3 °C for Bracknell. These increments may be due to the compound effect of change in the constituent variables that are used to calculate sol-air temperature, i.e. solar radiation, wind speed and dry bulb temperature. A sensitivity test was carried out to see the effect of each variable on sol-air temperature.

An increasing trend of daylight was also found in the data sets. This is attributed to the changing clarity of the sky condition. The predictions indicate a radical change in the characteristics of solar climate, i.e. from the present diffuse fraction of total irradiation of 0.37 which indicates mild turbidity to a drop of 0.13 indicating clear skies with exceptionally low turbidity.

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1. Introduction

Climate is changing and in this instance significant financial and technical resources to adaptation is gaining ground [1,2]. In the United Kingdom, the United Kingdom Climate Impact Programme (UKCIP) was set up in 1997 to co-ordinate scientific research into the impacts of climate change, and to help organisations adapt to those unavoidable impacts.

The recently released United Kingdom Climate Projections (UKCP09) provides projections of future climate conditions according to different carbon emission scenarios. Data sets from these projections are used in sectors such as transport, building services, healthcare, water resources and coastal defences, to ensure that the UK is adapting well to the likely changes of the climate.

Data sets from the UKCP09 were used in this study along with historical measured data for two locations to critically analyse the likely changes that may occur in the sol-air temperature and daylight illuminance profiles. These two parameters are important with respect to building design, i.e. the sol-air temperature is used to determine the building cooling load and the daylight illuminance affects window design. Building dwellers require natural lighting

and also a view of the outside world [3–5]. In a fully air-conditioned office building, 20–30% of total electricity is used for electric lighting [6,7] and it accounts for 10% of the energy consumption for residential buildings [8]. Proper lighting control linked to daylight can reduce building's electricity consumption [9–11].

This study provides altered profiles of sol-air temperature and daylight illuminance for the UKCP09 data for future years and for different emission scenarios.

2. UKCP09

UKCP09 is the most comprehensive package produced to date and it is the fifth generation of UK climate projection. Probabilistic projections of climate change are provided based on quantification of the known sources of uncertainty. A User Interface (UI) is provided to facilitate access to the projections and a User Guidance is available to support decisions related to using UKCP09. An analytical tool which is the Weather Generator (WG) together with the Threshold Detector is offered to support users in exploring potential impacts, vulnerabilities and adaptation options.

Three types of climate information available from the UKCP09 are:

- Probabilistic projections
- Marine and coastal projections
- Observed climate and climate trends

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