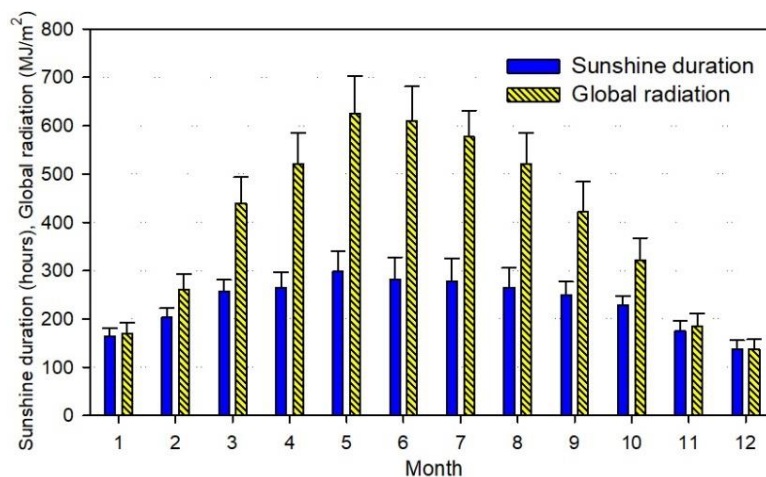


## Supplementary material

One of the main factors influencing the climate pattern around Ulaanbaatar is solar radiation indicating the atmospheric thermal regime. It is a pollution-free and clean natural resource for renewable energy production [54]. Moreover, solar radiation contributes to photochemical reactions polluting urban air [23]. The seasonal variations in the sunshine duration and global radiation from 1991 to 2020 are shown in Figure S1. The annual global radiation at the land surface was  $4788.3 \text{ MJ m}^{-2}$ , and monthly minimum values were measured from  $137.8$  to  $261.0 \text{ MJ m}^{-2}$  in the winter months when solar heights were low [37]. It reached the monthly peak value of  $624.6 \text{ MJ m}^{-2}$  in May and decreased until winter, depending on cloud cover and solar height. Total annual sunshine durations were 2804.3 hours, and the average diurnal duration was 8-9 hours. The monthly duration ranged from 169 to 227 hours in the cold season and 265 to 298 hours in the summer. The diurnal duration was 5-7 hours in winter and 9-12 hours in summer. Chong et al. [55] concluded that sunshine duration and solar radiation are the sources of air temperature regimes and an indicator of air pollution in urban areas.



**Figure S1.** Seasonal variations in sunshine duration and global radiation (1991-2020)