



Quantification of the effect of urbanization on solar dimming

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- From the 1960s to the late 1980s, a noticeable decline in surface solar radiation, termed global dimming, was observed at different locations throughout the world. From the late 1980s, a reversal in solar radiation trends, termed global brightening, has been detected. This study is based on the analysis of year-to-year variations of annual radiation fluxes by using worldwide pyranometer network measurements (GEBA) during the 25-year period, from 1964 to 1989. The quantitative characteristics of the effect of urbanization on solar dimming have been obtained by using gridded population density data (GPWv3). Here we show that, during the 25-year period (1964 – 1989), solar dimming over worldwide sites was essentially a local phenomenon associated with human activity as expressed by the sites' population density. Specifically, our findings indicate that solar dimming was observed only over a limited part ($\sim 30\%$) of the total land area, restricted to highly-populated sites with population density less than 10 person/km^2 . Dimming was dominated by anthropogenic aerosol emissions: the decline in surface solar radiation intensified from $-0.05 \text{ W/m}^2/\text{yr}$ to $-0.32 \text{ W/m}^2/\text{yr}$, with population density increasing from 10 to 200 person/km^2 . At sites with population density $> 200 \text{ person/km}^2$, a saturation effect was observed: declining trends were much less pronounced than those over sites with a lower population density. Overall, it is demonstrated for the first time that urban areas obtained less solar radiation, compared to rural areas, in the amount of $\sim 12 \text{ W/m}^2$ which is equivalent to about 8%.