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Decadal changes in surface radiative fluxes

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Variations in solar radiation incident at the Earth's surface profoundly affect the human and terrestrial environment. Several studies suggested a general decrease of solar radiation over land surfaces on the order of 6-9 Wm-2 between 1960 and 1990, corresponding to 4%-6% over 30 years, a phenomenon now known as global dimming. Newly available surface observations from 1990 to present from the Global Energy Balance Archive and the Baseline Surface Radiation Network located at the authors' institute show that the decline in solar radiation at land surfaces seen in earlier data disappears in the 1990s. Instead, a brightening is observed since the late 1980s. This is found under both all sky and clear sky conditions, possibly pointing to an interplay of direct and indirect aerosol effects. The trend reversal is reconcilable with recently estimated trends in Earth reflectance, cloudiness, atmospheric transmission and daily temperature range and may substantially affect surface climate, hydrology and ecosystems. While the decline in solar energy could have partially counterbalanced the increase in downwelling longwave energy from the enhanced greenhouse effect prior to mid-1980s, this masking of the greenhouse effect may have no longer been effective thereafter. The estimated changes in downwelling longwave radiation are thereby based on GCM simulations and observations from the Baseline Surface Radiation Network. More radiative energy may have therefore been available at the surface compared to prior decades, in line with the significant temperature increase over the 1990s. The recent increase in surface radiative energy would favour higher evaporation in areas of unlimited water supply and thereby influence the hydrological cycle.