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Influence of meteorological patterns on global dimming and brightening in Europe

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Observational studies have found interdecadal variability in incoming solar radition at the Earth's surface, known as global dimming and brightening. In Europe, the reported trends are around -3Wm^{-2}/decade for 1950-1980, and +2Wm^{-2}/decade for 1980-2000, though the representativeness of these numbers is an open issue. Global dimming and brightening has been linked to changes in aerosol and clouds.

On short time scales, at mid latitudes, clouds related to synoptic weather strongly influence atmospheric transmittance of solar radiation. In this work, we investigate if changes in synoptic weather patterns can influence dimming and brightening. Normalized observations of surface solar radiation are fitted against the monthly frequency of occurrence of 29 daily weather patterns (Grosswetterlagen, GWL). A trend difference index, B_w, is developed to compare the decadal scale variability of modeled and observed insolation. Trend analysis of surface insolation data from the Global Energy Balance Archive (GEBA) shows that there are regional differences in global dimming and brightening. In many of the European GEBA sites, a large part of the monthly solar radiation variability can be explained by a linear combination of GWL patterns. In some locations, the long term trends can also be partly explained by changes in weather patterns. It is likely that in parts of Europe, some of the global dimming and brightening signal is a consequence of fluctuations in meteorological patterns, rather than due to changing aerosol loadings.