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Observed long-term variations of solar irradiance at the Earth's surface

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For a long time scientific communities assumed that the heat balance components were rather stable. During the last twenty years or so, however, this assumption was challenged by observational evidences. The variability of short-wave radiation became a starting point for questioning the stability of fluxes. In this contribution the variation of global radiation (sum of direct solar and diffuse sky radiation) at the earth's surface is examined based on pyranometer measurements at about 400 sites. The period of the study covers in general the last 50 years. For Europe the study is extended to the beginning of observations in the 1920s and 1930s. Global radiation generally increased in Europe from the 1920s to the 1950s. After the late 1950s and early 1960s global radiation began to decrease in most areas of the world at a mean rate of 0.7 Wm-2a-1 until 1980s, thereafter 75% of the stations showed a recovery at a mean rate of 0.7 Wm-2a-1. All stations in the Polar region, which are far from aerosol sources, also show this pattern of change. At the remaining 25%of the stations the decrease has continued to present. These regions are a part of China, most of India, and Central Africa. Both during the declining and recovering phases global radiation observed under the cloudless condition also followed the same tendency, indicating the simultaneous and parallel changes of aerosol and cloud conditions. Long-term observations of total zenith transmittance of the atmosphere indicate a decrease in transmittance to the mid-1980s and an increase after this period. Since the brighter and darker periods correspond to relatively warmer and colder periods, the present study offers the possibility to quantitatively evaluate the mutual relationships between the solar irradiance, atmospheric transmittance, cloud conditions and air temperature.