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Regional trends in surface solar radiation derived from satellite-based data sets

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The monitoring of the surface solar radiation and the detection of its variability and possible changes is highly relevant for our understanding of the climate system. Clouds and aerosols are the main contributors to the observed changes in the solar energy reaching the surface. Clouds are well observed from satellites, especially during daytime, making satellite-derived data sets of the surface radiation a potentially powerful source of information to assess the spatial structure of surface solar radiation. Surface-based observations, e.g., from the BSRN and GEBA networks, have been used to assess the temporal variability and trend of the surface radiation. Due to the limited spatial distribution of the surface stations, a generalization of the trends derived from measurements at individual stations is difficult. Satellite-derived data of the surface radiation, providing up to global coverage, are available since the 1980s allowing an analysis of the regional variability of temporal changes of the surface radiation.

Here, we use surface solar radiation data generated and provided by the EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF, www.cmsaf.eu) based on geostationary and polar-orbiting satellites. The ability of the satellite-derived data sets to detect trends is tested and assessed by comparison with surface reference observations in Europe. It is shown that, at least for part of the available time series, the satellite data is stable and can be used to derive trend estimates. Substantial regional differences in the trend of the surface solar radiation are detected across Europe between 1994 and 2005, with strong positive trends over Central Europe (brightening) and negative trends over the Mediterranean Sea (dimming).