

## ***Interactive comment on “Detection of dimming/brightening in Italy from homogenized all-sky and clear-sky surface solar radiation records and underlying causes (1959–2013)” by Veronica Manara et al.***

**Anonymous Referee #1**

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Review of ACPD manuscript entitled “Detection of dimming/brightening in Italy from homogenized all-sky and clear-sky surface solar radiation records and underlying causes (1959-2013) authored by V. Manara et al.

General remarks: Using surface observation of surface solar radiation in Italy during 1959-2013, long-term trend of surface solar radiation and its potential causes were studied. The current study has scientific solid approaches for providing data quality control, filling time gaps in the time series and homogenization of the data. The time series used cover an adequate time span for such studies and the spatial distribution

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of the stations is good enough. I suggest accept it after following issues are addressed. 1. One of most interesting features of this research is that the authors evaluated SSR trend under clear and cloudy skies to discuss aerosol and cloud effect separately. Clear sky is defined using cloud threshold of 1 okta, which is said to allow to select more samples of clear sky condition, however, there is no indication that how many samples each month are selected on average. Additionally, when we use clear sky SSR measurements or departure to study long-term trend of SSR, we should keep it in mind that SSR varies to some extent with solar zenith angle that varies gradually. Suppose an extreme case, there are only two days selected at first two days in one January and last two days in another January, when we compare SSR values directly, variation of solar zenith angle on SSR may exert potential effect on SSR, so I suggest to use the ratio of SSR measurement to SSR at the top of the atmosphere in order to minimize solar zenith angle effect. 2. Data homogeneity is a big issue for the evaluation of long-term trend, therefore, it is valuable for careful evaluation of this issue, however, when we detect abrupt jump in the raw time series using some homogeneity analysis methods, it is very important to determine whether the jump is true or not based on metadata, so the authors should say some words on this issue. 3. The corresponding author published results on sunshine duration in JGR, I'd wonder whether sunshine duration and SSR are consistency in interannual and decadal variations. 4. It was suggested that mineral dust variations on SSR variability may be used to support that the dimming showed regional dependence, however, there is no indication whether long-term trend in the long-range transport of mineral dust from outside agrees with the observed dimming.

Minor comments: 1. L66-76, there are a few other publications showing significant contribution of cloud to the interannual variation of SSR, for example, in China (Xia X., Spatiotemporal changes in sunshine duration and cloud amount as well as their relationship in China during 1954-2005, JGR, 2010, 115, D00K06, doi:10.1029/2009JD012879; Xia X., A closer looking at dimming and brightening in China during 1961-2005, Ann. Geophys., 2011, 28, 1121-1132). Furthermore, in pol-

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luted region such as in Beijing metropolitan area, interannual variation of SSR may be also related to that of air pollution, which was supported by the fact that the correlation coefficient between interannual variation of SSR and AOD may range from -0.44 to -0.81 (Zhang et al., On the drivers of variability and trend of surface solar radiation in Beijing metropolitan area, *International J. Climato.*, 2015, 35, 452-461). This is not surprising since annual mean aerosol direct effect on SSR ( $24 \text{ Wm}^{-2}$ ) is comparable to that of cloud effect ( $-42 \text{ Wm}^{-2}$ ) in this polluted region (Li et al., Aerosol optical properties and their radiative effects in northern China, *JGR*, 2007, 112, D22S01, doi:10.1029/2006JD007382). Therefore, aerosol and cloud effects on interannual and decadal variation of SSR may depend on aerosol loading level that should be noticed.

2. L89-90, Since aerosol loading is highly variable from year to year, interannual variation of clear sky SSR may be related to aerosol direct effect.

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