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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Solar radiation trend across China in recent decades: a revisit with quality-controlled data" *by* W.-J. Tang et al.

Anonymous Referee #1

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Recommendation: Possibly acceptable after major revisions

The stated goal of this paper is a reexamination of surface solar radiation trends over China with quality controlled data. The authors report a much smaller "dimming" trend than was found by previous work. This is a potentially important result because the magnitude of historical aerosol radiative forcing is a critical unknown in our understanding of climate, but I find the conclusions to be unpersuasive and the authors' approach to contain fatal weaknesses. Were these weaknesses to be addressed, the manuscript could potentially be important.

The authors find that only six stations in China have solar measurements meeting their standards of quality (this may be true). Six stations, as the authors recognize, are not sufficiently geographically representative of the entire nation of China. They

therefore use data from these six stations to construct two empirical models for solar radiation based on various meteorological inputs, and then apply these models to the much larger network of meteorological stations to construct solar radiation time series covering all of China. The fatal weakness of this approach, however, is that the input parameters are very likely insufficient to capture the actual physical changes producing long-term trends in surface solar radiation. In this case, the fact that they find smaller trends than previous studies is not due to lack of a real trend but rather their model cannot sufficiently reproduce nature.

More specifically, two factors are the principal cause of interannual and decadal variability in surface solar radiation: clouds and aerosol. The input parameters to the neural network model are daily temperature range, daily mean temperature, relative humidity, sunshine duration, precipitation, and air pressure. Several of these are related to clouds, but it is known that clouds are not the cause of multidecadal solar radiation trends over China. There is no parameter that is clearly related to aerosol, which has likely experienced a large trend during this time period. Sunshine duration has partial correspondence, but it will not distinctly show how aerosol partially reduces radiation so long as it is still strong enough to affect the sunshine recorder. Temperature range is also related, but many factors beside aerosol can change temperature range. The hybrid model uses information from Global Aerosol Data Set, but so far as I can tell, this dataset is purely climatological and does not include how aerosol changes from year to year and decade to decade. If none of the input parameters properly represent how aerosol changes affected surface solar radiation, then there is no reason to expect that the constructed time series will show the full magnitude of the solar radiation trends that may have occurred.

The authors compare their constructed time series with observed series in Fig. 2, and I see substantial discrepancies. This leads me to believe that while the authors' empirical models can produce some resemblance to the actual solar radiation time series, I have some doubt about the ability of the models to reproduce long-term trends.

The most convincing plot is Fig. 3, which compares modeled and observed trends. I would prefer that this plot show trends for the pre-1990 and post-1990 period separately. What is most important is a demonstration of the models' ability to accurately reproduce trends during the "dimming" period.

Why start at 1979? Most of the reported dimming happened prior to that.

In generally, I think it is bad practice to show trends for the entire 1979-2006 time period since that encompasses both the dimming and post-dimming periods. Since this study is revisiting trends, why not focus on the separate periods when the long-term trends are downward and flat/upward?

Minor comments:

1) The term "weakening trend" is ambiguous. Does it mean that the trend magnitude is becoming weaker or that solar radiation is becoming weaker (i.e., a decreasing trend)?

2) Page 18399 lines 12-14: Wouldn't the recovery from the Pinatubo eruption have possibly produced and increase in solar radiation around 1993-1994?

3) Section 5.2: Norris and Wild (2007) show that satellite-based surface radiation records are not reliable for trends, both due to lack of time-varying aerosol and due to artifacts in the satellite cloud record.

4) It is extremely difficult to distinguish filled stars from filled circles in Fig. 1.

5) Fig. 2 is too small. I had to zoom in on the computer to examine it.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 18389, 2010.