Second review of "Impact of aerosols and clouds on decadal trends in all-sky solar radiation over the Netherlands (1966-2015)," by R. Boers, T, Brandsma, and A. P. Siebesma

General comments:

This paper shows an innovative approach to isolate the sources of dimming and brightening for the Netherlands over a 50-year period. It is of high scientific significance because the trends of dimming then brightening over the period of study are well known global phenomena, but their causes are not universally consonant. Problems in documenting dimming, especially, in the early part of the period of study are hampered by a lack of appropriate data that have been generally available during the recent brightening period. In my opinion, the authors have ably used available sources of data to create credible proxies and correct data appropriately (e.g., cloud fraction over the transition from human observers to ceilometers) to study dimming and brightening over the Netherlands and impressively determined the relative contributions of aerosols and clouds to those phenomena. The mathematics used is impressive but cumbersome and could be simplified for the reader by including only the final equations in the main text of the paper, with complete descriptions of their components and the details of the derivations placed in an appendix. That is only a suggestion. In addition, more frequent reminders to the reader of the time periods that terms discussed represent would be useful.

One major concern is that the primary results presented in Table 2, and summarized in the abstract, are not intuitive and require more explanation. That is, the 50-year trends in clear-sky and cloud-base radiation are both greater than the 50-year trend in all-sky radiation. Intuitively, the former two trends should add to the all-sky trend. However, when examining sub-trends during the periods of dimming and brightening separately, which can be done from the results presented in Table 2, the component trends (i.e, clear-sky and cloud-base) do sum better to the reported all-sky trends for those sub-periods, within the margins of error presented. One potential problem I see in your analysis is in your interpretation of eq. 21. As stated on lines 256-257, the over-bars in the equation represent 50-year means and the primed quantities represent yearly deviations from decadal averages. This inconsistency may lead to problems. Another potential problem I see is that the weights applied to the clear-sky term (.32) and the cloud fraction term (.68) represent the fractional periods of clear and cloudy conditions over the entire 50-year period. Since those fractions likely change through the 50-year period, I believe it would be beneficial to analyze eq. 21 over decadal periods, using decadal means, yearly deviations from decadal means, and decadal weights of fractional clear-sky and cloudy periods to compute $S'(y_k)$. Then, the means and deviations used would be internally consistent and the fractional mean periods of clear and cloudy skies would be appropriate to the decade being analyzed.

Specific comments:

Abstract: As detailed in the general comments, the differences among the three trends listed needs more explanation.

l. 28-30 Brightening in the U.S. from the mid 1990s to ~2011 is attributed primarily to a reduction in cloud cover in Long et al. (2009), Augustine and Dutton (2013), and their results are based on data alone.

Why mention that climate models are not capable of reproducing these trends. Are climate models even capable of resolving the cloud physics necessary to resolve the various cloud types and cloud cover responsible for dimming and brightening? I doubt it.

l. 36-42 Wang et al. (2013) has clearly shown that errors associated with single black detector pyranometer measurements adversely affect trends in solar radiation. In this respect, GEBA data are not of unmistakable quality.

l. 73-73 Does your statement that cloud cover data are collected simultaneously with radiation data apply to the Netherlands? That may not be true for most of the radiation stations over the globe.

l. 105 Define acronyms

l. 132-133 How is a representative cosine of the solar zenith angle (SZA) determined for a particular hour? Do you use the cos(SZA) at the midpoint of the hour or do you average the SZAs within the hour period? Averaging SZAs at low sun does not provide a good "representative" SZA for the hour.

l. 199 Change "to suggesting that" to "that suggests"

l. 220-221 To get proxy data for $S_{cj}(y_k)$ I assume that you plot the data corresponding to the variables in eq. 15 in a way analogous to Langley plots, and then use the resulting relationship to generate the proxy data per okta. Correct? If so, I assume that the scatter, and thus uncertainty, of those plots would be small for clear-sky data and larger for oktas 1 through 8. Those uncertainties would define the error in the various terms of eq. 21. Were those uncertainties incorporated into your analysis? They should at least be presented in some form—if possible. If my interpretation of your proxy data generation is wrong, please better explain your method in the paper.

l. 249 This sentence needs to be reworded.

l. 270 The 4^{th} term is shown.

l. 321 "is" should be changed to "in"

l. 355 Since you are discussing aerosol optical depth and cloud optical depth in the same sentence, references to each should be specific. In this case, insert "cloud" in front of "optical depth" on this line.

l. 366-368 By "cloud fractional coverage at specific cloud cover," do you mean the transformation of okta observations to fractional cloud cover? If so, please state this more clearly.

l. 414 The sentence beginning with "The SNHT was applied …" is difficult to understand. What do you mean by "reduced with?" and how does that apply to the a) and b) permutations?

l. 516 What is ERA?

l. 537 "b)" should be changed to "2)"

l. 555 The sentence beginning with "Cloud amount is increasing…" is counterintuitive. It would benefit by inserting "in solar radiation at the surface" after "overall trend."

l. 560 The large tick marks represent 10 Wm^{-2}.

Wang, K., R. E. Dickinson, Q. Ma, J. A. Augustine, and M. Wild (2013), Measurement methods affect the observed global dimming and brightening, *J. Climate*, 26, 4112-4120, doi:10.1175/JCLI-D-12-00482.1

Augustine, J. A., and E. G. Dutton (2013), Variability of the surface radiation budget over the United States from 1996 through 2011 from high-quality measurements, *J. Geophys. Res.,118,* doi:10.1029/2012JD018551.

Long, C. N., E. G. Dutton, J. A. Augustine, W. Wiscombe, M. Wild, S. A. McFarlane, and C. J. Flynn (2009), Significant decadal brightening of downwelling shortwave in the continental United States, *J. Geophys. Res.,* 114, D00D06, doi:10.1029/2008JD011263.