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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Changes in Surface Broadband Shortwave Radiation Budget during the 2017 Eclipse" *by* Guoyong Wen et al.

Anonymous Referee #3

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The authors conducted a ground-based experiment to observe broadband shortwave irradiance at Casper, Wyoming and Columbia, Missouri, located in the totality path of the August 2017 solar eclipse but separated by 1200 km. Surface shortwave flux measurements with simultaneous atmospheric observations allow the investigation of the impact of the solar eclipse on the surface shortwave radiative budget under different atmospheric conditions. Radiative transfer calculations show that the non-eclipse-to-eclipse surface SW flux ratio primarily depends on the obscuration of the solar disk during eclipse and slightly depends on cloud optical depth. The noneclipse surface SW flux can then be derived by multiplying the observed SW flux with the modelled surface SW flux ratio. It was found that at the Casper site, the eclipse led to a decrease of 379 W m-2 (50%) in averaged local surface SW flux, and the Moon's shadow caused

about a 8% reduction in global average surface SW radiation budget when the totality was at Casper; at the Columbia site, the eclipse led to a decrease of 329 W m-2 (46%) in averaged local surface SW flux, and the Moon's shadow caused about a 7% reduction in global average surface SW radiation budget when the totality was at Columbia. The paper is well written and adds useful information to the existing literature on the impact of the eclipse on the surface broadband shortwave radiation budget. I recommend the paper be accepted by the ACP after addressing the following comments and suggestions (which follow the order of the presentation instead of the importance).

1. 80: Some information on the spectral resolution of the PSI and PSI-ER would be useful.

2. 90: The TDE correction is 18 W/m2 at Casper but only 2 W/m2 at Columbia at the totality. Any explanation about such difference?

3. 105: What is the wavelength for the aerosol optical depth listed in Table 2?

4. Clarify that in Eq. (1) the "I" is the solar monochromatic direct irradiance.

5. 179: What are the wavelengths here? Is the gaseous absorption negligible?

6. 205: Consider to add the subscript "o" for "I" in Eqs. (4) and (5) to be separated from the "I" at the surface in Eq. (1).

7. Equation (6.1) makes an important assumption that the non-eclipse-to-eclipse surface SW flux ratio for realistic 3D cloudy atmospheric conditions is approximately equal to the 1D model computed flux ratio for clear atmospheric conditions. Some discussions on the potential impact of this assumption are necessary.

8. Consider to use "RDF" or "RD" instead of "deltaF" in Eqs. (8.1), (8.2), and 8.3) for the relative differences.

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