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Comment on acp-2022-794

Anonymous Referee #2

Referee comment on "Parameterization of downward long-wave radiation based on long-term baseline surface radiation measurements in China" by Junli Yang et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-794-RC2>, 2023

Title: Parameterization of downward longwave radiation based on long-term baseline surface radiation measurements in China

Author(s): Junli Yang et al.

MS No.: acp-2022-794

MS type: Research article

Scientific aspect:

The search for empirical expressions for longwave downwelling irradiance for China is a welcome contribution. The measurement of longwave down welling irradiance has been rare worldwide, and especially in China. In this sense, this reviewer does not demand the expansion of the scope to larger regions. To build an empirical relationship between the longwave down welling irradiance with widely available climatic elements requires accurate irradiance measurement. The required accuracy is made not only of an instrumental accuracy, but also of the traceability to the international standard. This latter point is very important for any long-term observations, and is the basis for the Baseline Surface Radiation Network. This development comes from a bitter experience to realize serious differences among the longwave calibration methods practiced by many countries. It has become necessary to establish the global standard in longwave calibration, which is

materialized as the World Standard Group of pyrgeometers at the World Radiation Centre in Davos. Within the BSRN, there was only one Chinese station, Xianghe, which joined the BSRN, more than 10 years later than other sites, and ceased to operate already in 2015. The continued functioning of this site was an international wish. It is not a constructive direction for each country to establish own baseline radiation network. If this is done, however, like Chinese Baseline Radiation Network (CBSRN), its traceability to the World Standard must be established. This point is missing in the presented paper, reducing the trustworthiness of the accuracy of the proposed equations. The current status of the BSRN is summarized in Driemel et al. 2018, *Earth Syst. Sci. Data*, 10, 1491-1501. Li et al., 2013 may present the information on the CBSRN, but this literature is not accessible for most readers. Its main content can be introduced in the paper.

The empirical relationships under the cloudless sky are quite straightforward, as the depth of the atmospheric emission effectively reaching the surface is quite thin as the authors pointed out. The mathematical shapes adopted in this sort of calculation are usually grey body emission. There are, however, at least two original proposals, which are independent of the graybody preoccupation. These original proposals are made by Swinbank's 1963 QJRM and Ruckstuhl's 2007 JGR papers. Swinbank is quoted in the manuscript but his originality is not appreciated.

The attempt to expand the empirical relationships to all sky conditions causes a problem, mainly owing to the diversity of the clouds and the limit in our observational documentation. Nevertheless, one of the earliest proposals was attempted by H.M. Bolz (1949) in *Zeitschr. Meteorol.* This is a systematic introduction of the effect of clouds. Relating to this matter, the description from Line 182 to Line 192 must be reformulated. It is necessary to present how the authors consider the shapes of Equations (5), (6) and (7) are justified, and how each independent variables offer the targeted results. There seem to be a slight confusion in expressing Greek variables also.

Formalities:

- Generally, quoting earlier works for substantiating the point in the papers must be done carefully. Just quoting many papers does not support the point authors wish to make. As an example, let's take the first two sentences in the introduction, Line 28 to 32. The importance of the longwave downwelling radiation was not realized only in 1994 or 2020. These papers are rather recent papers in this subject. This reviewer suggests the authors to quote the first and most original paper on the subject and then several recent and best papers. Not all papers quoted in these lines do not necessarily represent the best knowledge of the present time.
- Introduction can be shorter. Numerical details can be summarily presented in Conclusions.
- Line 44 to 49: in this discussion, Bolz's and Ruckstuhl's works can make a constructive contribution.

- Line 180, Table 2: Under Column Network/Site, Line Swinbank (1963), H.M.A.S. Diamantina in the Indian Ocean should be added to Aspendale and Kerang. The observation on board Diamantina over the Indian Ocean provided the measurement in very high humidity, and played an important role in generalizing Swinbank equation.
- Line 185-191: There are confusions in Greek letters.
- The analyses in Line 193 Section 4.3, and Line 236 Section 4.4. are well done and very useful.
- Line 273-275: The seven CBSRN sites are all confined in the continental interior regions and do not represent the climate of the maritime regions. This bias should be considered.
- Line 373-379: The order of references, Liu, M.Q., et al. and Li, M.Y., et al. should be reversed. Likewise, Line 381-384: Niemelä et al., and Monteith can be reversed.