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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Uncertainties of parameterized near-surface downward longwave and clear-sky direct radiation" *by* S. Gubler et al.

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We thank the referee for his or her detailed, dedicated and construtive comments. Based on this we have been able to substanstially improve the study.. Please refer to the first paragraph of the answer to referee 2 for a short introduction concerning the main issues changed in the manuscript.

1. Title. "direct radiation" is not a proper term. You can use shortwave direct radiation or broadband direct solar radiation. In the title, it is better to use "clear-sky shortwave radiation". I would write the shortwave radiation first, then longwave radiation in the title. In the paper you also present the results of the shortwave radiation first, then the longwave radiation. Is it important to use "near-surface"

instead of "surface" in the title?

The title was changed to "Uncertainties of parameterized surface downward clear-sky shortwave and all-sky longwave radiation."

2. Page 3359, line 9-10 Are the parameterizations used in this paper take into account the surface elevation?

   No, they don't. Topographic variability and small scale changes are not a primary focus of this investigation, however shading from surrounding terrain is taken into account. In this study, we want to estimate the uncertainties of the radiative fluxes at the measurement stations (without extrapolation).

3. Page 3359, line 19-20 How accurate is the Iqbal model in W/m2? Can you give some numbers according to the literature? *According to Gueymard (2003b), the Iqbal (1983) model is accurate to 1.8 % (MBD) and 3.3 % (RMSD), similar as we have seen for Payerne.*

4. Page 3361,line 18 How many clear-sky hours are there in the 113976 data points?

   In dependence of the location and the clear-sky detection algorithm, the number of clear-sky hours varies strongly. We included: "The number of clear-sky hours varies between 25000 and 38000."

5. Page 3362, line 12 The visibility at Jungfraujoch could be different from other stations at lower altitude. Are there other aerosol measurements available? Have you checked the AERONET data and aerosol products from satellites, for example MODIS?

   Yes, we checked with Aeronet data from Davos (the Aeronet data at Jungfraujoch has not enough measurements), and measurement obtained at Payerne (from MeteoSwiss for precipitable water and aerosol). The parameterization for

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absorption by aerosols by Maechler (including visibility) was changed to a parameterization based on the Ångström parameters from Iqbal (1983), model A.

6. Page 3363, line 4 Is the screen-level temperature the same as the 2m temperature? Some readers might not know the term "screen-level".

   We put "...as screen-level temperature (i.e. the temperature at the height of the measurement device, which is usually 2m above the ground)".

7. Page 3363, line 17 There are ozone data from satellite measurements, for example on the TEMIS website (www.temis.nl).

   We made a test based on the TEMIS measurements, however SDR is insensitivity to ozone (see also Gueymard (2003b)). Therefore, and since we do think that the measurements we used represent a reasonable range of ozone for Switzerland, we do not include the TEMIS measurements for this study (see also comment 16 of the other referee).

8. Page 3364 3.1.1 How accurate is the clear-sky SDR calculation if the input data are perfect?

   They are very accurate (Fig. 4 in the attached manuscript, upper figures).

9. Page 3365, line 12 "...at screen-level height temperature T" Should T be T* ?

   True. Thank you.

10. Page 3365, line 14-19 Could you give more information about the parameterizations in Table 3? Are they applicable for any clear-sky situations? What are the advantage and limit of these parameterizations?

11. Page 3365, Eq.(4) What is "e" in Eq.(4)? It is not explained.

    Sorry, "e" should be "p_v".

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12. Page 3367, line 10 Why do you select the path length of 4.3 for the sensitivity study? Is the path length calculated using A5 or A6? The solar zenith angle for this path length is about 75 degree. Is the mean path length so large at Jungfraujoch?

    The was due to an error when estimating the mean path length, where we should have estimated the mean solar zenith angle (around 60ï£¡), and then calculate the path length ($m_r = 2$). The analysis is now made for path length 2.

13. Page 3370, line 4-5 There are cloud mask data from SEVIRI/MSG or Meteosat for day and night. Is it possible to use night time cloud fraction and cloud optical thickness to derive night time cloud transmissivity or cloud factor instead of the interpolation of the day time values?

    The focus of this study mainly lies in the behaviour of simple downward radiation models, which are often used in models concerning processes at the Earth's surface or subsurface. Model inputs are often limited to few quantities measured at a meteo stations or provided by general circulation models. We therefore explicitely have chosen this simple approach of cloud estimation and interpolation, since they can be easily applied in any impact model.

14. Page 3371, line 17-20 It seems that the parameterization for the diffuse SDR behaves differently to the measurements. What is the reason for that? Are there any physics missing in the parameterization?

    Please consult point 20, Referee 2.

15. Page 3372, line 12-15 Is it possible that in Fig. 2 the points at the upper left corner are influenced by clouds?

    Yes, you are right. We included this by writing: "One restriction already mentioned above must be kept in mind: clear-sky hours are based on the cloud estimation of Dürr and Philipona (2004) and thus error-prone. This might be a cause for

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some of the scatter in Fig. 3 at Jungfraujoch, for example. To analyze the effect of the clear-sky estimation, the validation measures were additional estimated for clear-sky hours using the synoptic cloud observations at the three stations Jungfraujoch, Payerne and Locarno-Monti.” “

16. Page 3373, line 9-10 "... a clear positive correlation of uncertainty with the path length" Do you mean path length or surface elevation (surface height)? What are the differences in path length between the 7 stations? I think you use local path length (Eq. A6) in the calculations, the main difference may be the surface elevation.

    We mean the path length through the atmosphere.

17. Page 3374, line 12 "For global radiation, a clear distinction is observed for the high and the low elevation sites ..." Could you give an explanation for it?

    We took this validation measure out, since we believe that it does not give that much information (or would include much more work, and the manuscript is already quite long). The explanation to your question would be that the modeled uncertainties for the high elevation sites are smaller than the low elevation sites, and thus we reach less hits at high elevation site.

18. Page 3375, line 10 "... only uses one parameter estimate ..." Could you clarify this sentence?

    We mean that instead of implementing another parameterization to model the elevation dependence of the parameter one would use a fixed parameter value. The sentence was changed to ”For many applications, a modeler would apply the published parameterization as it is and use only one parameter value instead of modeling the elevation dependence of the parameter additionally. To get the best parameter estimate for all stations, the parameterizations were also fitted to the measurements of all stations simultaneously“.

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19. Page 3377, section 4.2.2 Are the same data set of T* and Pv are used to derive the parameters in Table 3 and used in the calculation of LDR in the validation? Will it cause any compensation error?

    No, the data sets are independent, otherwise we would make circular arguments. For fitting of the LDR parameterizations, we used the ASRB data (measured LDR and Temperature), but the model is then run with data from the ANETZ network. Validation is performed with ASRB, but the runs are independent.

20. Page 3381, line 24-25 "In general, the global Iqbal radiation perform satisfyingly" I think that the uncertainties of the parameterizations are rather large. What is the requirement for the accuracy of the shortwave and longwave radiation simulations in climate or agriculture related models? Where do you use the parameterizations?

    Using measurements from Payerne, we could show that the Iqbal (1983) model performs satisfactorily according to Gueymard and Myers (2008); Badescu (2012) for SDR. Even when not using high quality measurements, we were able to show that the modeled global SDR meets the quality criteria. For LDR, we did not find a similar criteria, but assuming that the LDR should more or less not have larger errors than SDR, our models fit the measurements well. All LDR parameterizations we used have been studied in many other publications, and proved to work well. We additionally showed that fitting them to local conditions improves their behaviour strongly.

Technical comments

1. Is Fig. 6 referred to in this paper?
2. Page 3373, line 3 Change "ozon" to "ozone"

   Done.

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Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/12/C2263/2012/acpd-12-C2263-2012-supplement.pdf

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 3357, 2012.