Reply

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1. Introduction

Deschamps and Dedieu (1985; hereafter referred to as DD) claim that the surface albedos given in Pinty et al. (1985) are in excess by a large factor as compared to their own results. They attribute the source of this excess to the procedure we used to correct for atmospheric effects.

Before starting the discussion, some preliminary remarks must be made about DD's comment.

2. Preliminary remarks

It must be pointed out that Eqs. (2) and (3) reported by DD are not correct and are not those given by Pinty et al. (please see the original paper for the correct equations). Note also that the intrinsic atmospheric contribution is surprisingly lacking in Eq. (4).

DD compare the transmission factors for atmospheric gases within the METEOSAT VIS-channel and over the whole spectrum, respectively. First, it must be noted that the quantity E_g^2/E_s is not a transmission factor. Second, DD state that the aerosols would produce the same effect on the transmission factor in the two cases. This statement is not correct when absorbing aerosols are considered; indeed, aerosols mostly absorb in the infrared region and, consequently, the transmission factors would be different in the two cases studied by DD. Third, as DD compute the transmission factors for two spectral ranges, we do not understand why, when reporting their results, DD refer to the method by Pinty et al. (1985). In order to avoid any possible confusion, it is recalled that the method by Pinty et al. is not based on the computation of transmission factors, but uses in situ measurements of the surface global radiation.

3. Atmospheric correction

DD state that we used values of surface global radiation over the whole spectrum together with METEOSAT data measured over the VIS-channel that is only sensitive between 0.4 and 1.1 μm, which is mostly outside the spectral region where water vapor absorption occurs. Quite logically, DD conclude that the atmospheric correction is overestimated in the method we used.

Such a criticism may not, however, be relevant since, prior to the application of our method, we were careful to perform the conversion of METEOSAT radiances into broadband radiances. The conversion procedure we applied is fully described in section 3b of the original paper. Obviously, the goal of the conversion is to derive satellite radiances over the same spectral range as the one concerning the surface global radiation measurements. The conversion is made with the help of conversion factors defined as the ratio of the broadband radiances to the METEOSAT radiances. These factors are intended to account for the contributions of all the optically acting parameters (the colors of the underlying surfaces, the atmospheric composition, the angular conditions) which lead to spectral changes of the radiances within the overall solar spectral range. So, as METEOSAT radiances have been converted into broadband radiances, the procedure we used is spectrally consistent. It remains that the albedo values we computed (Pinty et al., 1985) might be erroneous but, in such a case, the eventual sources of error shouldn't lie where DD claim.

4. Discussion of the albedo values

Without any information about the method used by DD to compute their own surface albedos (there is no reference to a published work), we find it difficult to start a detailed and fruitful comparative discussion.

Although the sensitivity study (§4, Pinty et al., 1985) already gives keys to an estimate of the error on the computed albedo values, we take the opportunity of this reply to emphasize some points. These points concern the application of the method with METEOSAT data over some Sahelian sites.

1) In the absence of a complete and widely admitted solution to the problem of conversion of METEOSAT radiances into broadband radiances, we are led to use an approximate value for the conversion factor. The value of 2.57 we used is within the range of the results reported by Koepke (1983): 2.4 ± 1 and 2.8 ± 1 for bare and vegetated surfaces, respectively. Moreover,

this value agrees with that derived by using the parameterization of the conversion factor recently developed by Stum et al. (1985). However, without any additional measurements, it is not possible to ascertain that the 2.57 value is right and a deviation of about 10% from the true value may be expected. Figs. 1d and 3 in Pinty et al. show that such an uncertainty can lead to a relative overestimate of 10 to 15% in surface albedo.

2) The intrinsic atmospheric contribution has been estimated using an aerosol optical depth deduced from the horizontal visibility. This indirect estimate does not ensure that the optical depth taken for the computation is consistent with the optical depth implicitly, but actually, involved in the measured value of the surface global radiation. That means that, in our method, an underestimate of the atmospheric reflectance may not be compensated by the value of the surface global radiation. As shown in Fig. 1b of the original paper, a relative overestimate of 10% in surface albedo may result from an underestimate of 18% in the atmospheric reflectance.

3) As shown in our paper, an error of 5% in surface global radiation is likely to yield an error of 10% in surface albedo. It must be kept in mind that a 5% accuracy in surface global radiation is the accuracy currently accepted for a well-maintained routine network (Hay and Wardle, 1982). One may expect that under African conditions where the experimental difficulties increase, the attainable accuracy is worse than 5%.

4) The last point which must be discussed is one which has undoubtedly led to a systematic overestimate in the albedo values reported by Pinty et al. In our case study, only the mean daily value of the surface global radiation was available; as described in section 3a of our paper, we assumed that the atmospheric transmission function was independent of the solar zenith angle in order to estimate the surface global radiation as a function of local time. Proceeding in this way, we derived a mean daily value of the transmission factor which is systematically lower than the actual value at low solar angles. Using the model developed by Justus and Paris (1985) we have compared the mean daily value of the transmission factor with the transmission factor at low solar angles. With clear-air atmospheres, including rural aerosols, we have found that the mean daily value of the transmission factor leads to an underestimate of less than 3% in the derived surface global radiation at low solar angles. This, in turn, corresponds to a relative overestimate of less than 6% in the surface albedo values reported in Pinty et al. (1985). This systematic error which might be taken into account remains, however, less than the erratic errors previously discussed.

5. Conclusion

In conclusion, we welcome the comment by DD since they give us the opportunity to make some of our points clearer. Their conflicting results demonstrate the need for further extensive studies in this interesting topic.

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