Hydrol. Earth Syst. Sci. Discuss., 3, S546–S549, 2006
www.hydrol-earth-syst-sci-discuss.net/3/S546/2006/

Hydrology and Earth System Sciences Discussions

HESSD

3, S546–S549, 2006

Interactive Comment

Interactive comment on “Satellite-based evapotranspiration and crop coefficient for irrigated sorghum in the Gezira scheme, Sudan” *by* M. A. Bashir et al.

M. A. Bashir et al.

Received and published: 25 July 2006

Reply to referee #1

I am grateful to Harald Kunstmann for his general and specific comments. All these remarks will be fully considered in the final version of this paper and will substantially improve its quality.

Reply to specific comments as numbered by the referee:

1) The article was already checked by a native speaker and two of our colleagues, thus it contains few mistakes which have been raised by the referee (P 794, line 20+23; P 798, line 17; P 798, line 25; P 799, line 4 and P 805, line 8) in his first comment, we

are going to correct it all before the next submission.

2) The reference Abdelhadi et al., 2006 is cited in the reference section; please refer to the reference list.

3) As mentioned by the referee the novelty of this paper is the application of the model to the area of Sudan which considered as the first attempt to apply energy balance model in an intensive cropping system in Central Sudan, area of weak infrastructure. In this area, traditional procedures have been adopted to calculate the evapotranspiration. These methods are costly, time consuming and point measurement techniques. The SEBAL model was also applied using NOAA imagery by Mohamed et al. (2004) in the southern part of the country. The study area contains three sub-basins stretch from the outfalls on the White Nile, it considered as the major wetland area in the Sudan where the climate and rainfall are quite different from the study area of our research. So it is difficult to compare the two studies as each of them proposed to achieve certain objectives.

4) Although the calculation of the instantaneous ET gives an idea of its spatial distribution, but is not of prime interest for the engineers and water managers due to its variation from day to day depending on meteorological conditions and variation in soil moisture. Thus for seasonal ET calculation daily values should be simulated and the missing days between the two consecutive images can be compensated by the daily calculation of crop reference evapotranspiration (ETo) using Penman Monteith approach. The method was used by many researchers (Tasumi and Allen 2000; Chemin and Alexandridis 2001). For our study the season extends from late July to mid November, so we believe that 4 instantaneous ET is quite suitable to simulate the seasonal ET (each represents a period of 30 days in average). Referring to other studies Chemin and Alexandridis (2001) used five image of NOAA to cover the rice-cropping season (May to September) with an average representation period of 32 days. Chemin, Y., and Alexandridis T.: Improving spatial resolution of ET seasonal for irrigated rice in Zhanghe, China, In: Proceedings 22nd Asian Conference on Remote Sensing, 5 - 9

HESSD

3, S546–S549, 2006

Interactive Comment

November, 2001.

5) It is known that the availability of the hydrological contrast in the image is very important to solve the energy balance on the surface using SEBAL model. In this study the sensible heat flux model was applied first to two pixels of the image: one pixel that is assumed to be completely wet where H = 0 holds (dT = 0) and another pixel that is associated with a complete dry down, so that LE = 0, or H = Rn - G. The sensible heat flux model was applied only to these two extremes because H is not known for all other pixels. The identification of the dry pixel negligible evaporation is based on measurements in the thermal infrared channel. First a group of pixels with maximum surface emittance were selected and visually inspected on the satellite image to identify at which locations in the landscape they occur. Morphological features on the image help to identify dry pixels where LE = 0 holds. The spatial interpolation of dT between its two extreme values for each image and at a certain time was realized by the radiometric surface temperature image. The assumption is that hot and intense thermally emitting surfaces create higher vertical differences in air temperature dT than do cold surfaces with minor thermal emittance. Field research has demonstrated that the relationship between dT(Ts) is indeed linear (dT = a+bTs). The coefficient a and b were different for each image. They were determined from the two (dT,Ts) pairs applicable to the dry and wet pixels. In the dry pixel, the sensible heat flux model was solved inversely and the spatial distribution of dT for all pixels was described by means of Ts image and linear relationship of dT. The albedo, emissivity, and roughness length are considered as one of the prerequisites of SEBAL model, these parameters was computed according Tasumi et al. (2000). We believe that SEBAL model should be validated to actual measurements to ensure its applicability, thus the SEBAL ET values were compared to actual field measurements using moisture depletion approach (the method that used to quantify water requirement for major crops in the Gezira scheme). As shown in this article close relationship were observed between daily, monthly and seasonal actual ET values derived from remote sensing data using SEBAL and the values calculated from soil moisture depletion method (MD).

HESSD

3, S546–S549, 2006

Interactive Comment

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 793, 2006.

HESSD

3, S546–S549, 2006

Interactive Comment