Hydrology and Earth System Sciences Discussions

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Interactive comment on "Estimation of evapotranspiration in the Mu Us Sandland of China" *by* S. Liu et al.

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Dear Anonymous Referee#2: First of all, we greatly appreciate your careful work and very useful suggestions. We will try to take advantage of your advice for improving the manuscript. For an easier comprehension, your comments are also reported. We respond below to your comments item-by-item.

Major concerns: Referee #2: The major shortages of this manuscript are that the authors do not well address the results of the proposed methodology by using more ground observation data. At this stage, only one ground-measured monthly ET value had been used for validating authors' method or results.

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As we have known, ET measurement in sandland is scarce, so only one ground measured monthly ET value had been used. However, in the revised manuscript, we will use daily ET measurements (August 2004) to validate the method we used.

Referee #2: The authors used a fixed Priestley-Taylor coefficient for different land surface types. And they select a value of 1.26 from other persons' papers, but they do not explain whether this value was suitable for this study area.

As we cited in our manuscript, Liu et al.(2006) discussed the Priestley-Taylor coefficient(α) in the Yellow River basin where our study area lied in, they indicated an optimum value of α is in the range of 1.23 to 1.29 and adopted 1.26 in the end. Meanwhile, two typical days had been selected in different land surfaces respectively to validate the variation of α in the Mu Us Sandland (no listed in the manuscript), combined with measurements of eddy covariance system, 1.26 was finally thought as a better value in our study area.

The specific comments: -P5980 L17-20: As regard to the air temperature, the spatial variation in topography in Mu Us sand-land was not sharp. Therefore, the regional air temperature could be directly obtained using an interpolating method.

Though the spatial variation of topography in Mu Us sand-land was not sharp, the regional air temperature was interpolated from weather stations in and around Wushen County, as listed in Tab.1, the elevation of these stations have some difference, from 861.5m to 1460.4m, as a result, the elevation of each weather stations must be considered in the process of interpolating air temperature.

-P5982, L3-4: It could not add any new information by downscaling coarse resolution data to coarse resolution data, for example, from 8 km x 8 km to 1 km x 1 km. And you used AVHRR data from 1981-2000 and MODIS data from 2001 to 2003. Why did you not resample MODIS images from 1 km to 8 km?

As the DEM data we used in our analysis has a high spatial resolution of 1:250000

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and the total area of our study region lies in a limited area of 4*104Km2, so we used a relative higher spatial resolution (1Km) to analysis the distribution of ET.

-P5982, L9-10: How do you obtain the ratio? Please explain in detail.

In our study, s in Eq.(2) is deemed as an empirical value. In our revised manuscript the ratio will be determined by long term radiation measurements during different seasons.

-P5982, L16: What does NDVImax stand for? How do you obtain NDVImax? Please explain.

Annual NDVImax we used in our manuscript is the greatest vegetation index during a year of each pixel, which represents the level of vegetation coverage in the best growing season. In the process of obtaining NDVImax, we firstly selected the maximum NDVI of each pixel during the twelve months every year, so 23 images of annual NDVImax from 1981 to 2003 can be obtained. Then 23 values were averaged for each pixel, as a result, the spatial distribution of averaged NDVImax in study area can be obtained during 1981–2003.

-P5983, L10-12: The parameter "r" in Eq. 5 is diurnal mean albedo while "r" in Eq. 1 or Eq. 2 is monthly mean value of many days' instant albedo for satellite overpass times. There is some difference in the results of these two processing, which would cause a large accumulative Rn error at monthly scale.

The parameter "r" in Eq. 5 is a monthly value, which was obtained by averaging the three 10-d images of AVHRR products in a month from 1981 to 2001(Eq.1), and during 2001 and 2003, the monthly reflectance data is obtained by averaging the two 16-d images of MODIS products per month(Eq. 2).

-P5983, L21-23: As I know, Eq.7 is not put forward by Zeng. Please show the original literature. Have you compared monthly accumulative total Rn and Rnl from Eq.5 and Eq.7 with ground-measured data? Please explain.

In our revised manuscript, a new method to calculate net longwave radiation will be

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adopted as recommended by referee#1. Meanwhile, the corresponding validation of Rn will be added.

-P5984, L2-4: Please explain the relation between these 17 stations and your study area. Why did not you use the same data from Dongsheng Station and Ejinhollo Station as shown in table 2?

The data of 17 stations were used by Zeng(2004) to fit the coefficients of net longwave radiation model, which was applied in our manuscript; while Dongsheng and Ejinhollo stations as shown in Tab.2, which have the measurement of monthly total radiation were used to obtain the coefficients of total radiation model by us.

-P5984, L6: For the surface temperature, did you select from remotely sensed data or Weather Station data? Regional values or points' values. Please explain?

For the surface temperature, we used the regional values which were interpolated from weather station data in our manuscript. However, in our revised manuscript, an improved method of calculating net longwave radiation recommended by referee #1 will be adopted.

-P5984, L8: Have you validated this method by using ground observation data (as described at P5980, L29)?

As in our manuscript, monthly data are used to calculate ET in our study area, so monthly G, which is close to 0, has not validated using ground observation data. In the revised manuscript, daily ET will be calculated and validated, so the validation of daily soil heat flux will be added.

-P5984, L16: Which one do you use in this paper? (Tmax-Tmin le 12)? or (Tmin le 5)?

(Tmax-Tmin le 12) and (Tmin le 5) are used in our paper. When either of them is satisfied, the coefficient "C" can be considered as 0.54.

-P5984, L17: Tmax and Tmin are air temperatures? How do you obtain their regional

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distributions? Please explain in detail.

Tmax and Tmin are monthly maximum and minimum air temperature of each month respectively. For single weather stations, the monthly Tmax and Tmin can be averaged from daily maximum and minimum air temperature. For regional distributions, they were firstly converted to corresponding 'sea-level' values according to the altitude of each station. Then Kriging method was used in the interpolation of air temperature, in the end, the interpolated air temperatures were further converted to the actual air temperature using DEM data, thus the regional distributions can be obtained as we described on17-21 in page 5980.

-P5985, L4: Why do you set alpha=1.26? This is good for free water surface. But your study area is sand-land. Please explain.

Please see the answer to Major concern of referee#2 above.

-P5985, L12-17: Please show the original and corrected latent heat flux curves for this month.

In our manuscript, we used the monthly data to do validation, so we didn't show the latent heat flux before and after correction. However, this part will be shown in the revised manuscript as daily ET will be validated.

-P5985, L15-16: ... while the estimated ET of corresponding pixel was 80.8 mm. Please explain if your remote sensing images, for example, AVHRR's and MODIS's band reflectance images, have been geographically corrected? What tool or algorithm? Give the precision of your geographical correction. How do you select a proper pixel corresponding with ground observation site?

The remote sensing images we used, such as AVHRR's and MODIS's band reflectance images, are all products which have been geographically corrected. As the spatial resolution of our data is 1Km, so we just need to fix the pixel according to the latitude and longitude of our observation point.

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-P5985, L21-22: If you have only collected ET observation data from microlysimeter for one day, you can not obtain monthly total ET by multiplying it with 30. But if you have many days' ET data, you can use them for validating your model. Please show your validation results.

The ET observation data we used in our manuscript were referenced to the research of Masakazu(1992) over sand dune in 1988, which was gained based on several days selected in June, meanwhile, this result was in accordance with Li and Li's research(2000). In our revised manuscript, daily ET by eddy covariance system will be used to validate our models.

-P5985, L26 - P5986, L2: The validation in this paper is insufficient, please add more if possible.

Thank you for your suggestion, the daily validation results will be added in the revised manuscript.

-P5990, L15-16: Priestley Taylor coefficient, this is a key parameter for you model. But a fixed value is used for different land-surface types, for example, sand-land, grassland and forestland, which will make remarkable error in estimating regional ET.

Please see the answer to Major concern of referee#2 above.

-P6002, Fig.6: Here, ET stands for regional mean values or some points' values? How about precipitation?

In Fig.6, ET and precipitation are both stand for regional mean values.

-P6004, Fig.8: You need build such a relationship for all the pixels in Fig.2 and Fig.7

In Fig.8, ET and precipitation are both regional averaged values of all the pixels in our study area, so the relationship is based on all the pixels in Fig.2 and Fig.7.

-P6006, Fig.10: The relationship between ET and NDVImax. You need build such a relationship for all the pixels. Why there are only these points in Fig.10?

In Fig.10, the relationship between ET and NDVImax are based on these data of regional averaged values in our study area of each year, so there are totally 23 points in the plot, from 1981 to 2003.

Please also note the Supplement to this comment.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 5977, 2009.

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