

Interactive comment on “Estimation of evapotranspiration through an improved daily global solar radiation in SEBAL model: a case study of the middle Heihe River Basin” by Jingqiu Yin et al.

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Dear Nadja den Besten, Thank you for all your feedbacks and comments about our work. All the questions you mentioned have been answered and the thesis has been revised. In addition, Dr. Liu's thesis can be downloaded from CNKI. You may not be able to download it, but I can upload it. At the same time, I checked the literature related to him and added it to the article.

Kind regards,

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The answers to your questions are as follows:

1. L. 11 Response: I have deleted it.
2. L. 41-45 Response: The “arid and semi-arid areas” has been revised to “arid and semi-arid regions.”
3. L. 42-43 be specific and name them Response: The L.42-43 has been revised to “The research on the evapotranspiration process of desert oasis is an important link in the study of its hydrological and ecological interaction, hydrological cycle and oasis ecosystem management.”
4. L. 45 The “especially” has been revised to “Especially” Response: I have revised.
5. L. 76 100m resolution Response: The “100m” has been revised to “100m×100m”
6. L.99 The “comes” has been revised to “was adopted” Response: I have revised.
7. L.99 So you also downscaled this to 100m? how ? Response: Positioning spatio-temporal precision on more practical scales, weighing the spatial heterogeneity of the underlying surface of the study area and the limitations of remote sensing observations, so that the regional ET model can be directly driven by remote sensing parameters that satisfy the regional spatial heterogeneity scale which not only satisfies the application requirements (i.e. agriculture activities) but also does not lose its maneuverability (Liu, 2008). DEM with spatial resolution of 100m×100m is used. The retrieved parameters of TM are resampled 100m×100m to meet the application needs. Based on the neighborhood similarity of surface spatial attributes, the thermal enhancement method proposed by Kustas et al., (2003) is improved, and the MODIS 250m vegetation index is used to improve the resolution of 1KM's LST and surface albedo products to 250m (Liu, 2008). Furthermore, the TM 100m vegetation index is used to improve the

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resolution of the product from 250 to 100 m

8.L.101 added "Landsat". Response: I have added "Landsat".

9. L.101 "The heights of vegetation", how was done? Stop sentence to explain this. Than to meteo data. Response: the heights of vegetation, which are actually measured, in order to calculate the roughness length.

10. .L.104 two ET measurement Response: In addition, an eddy covariance instrument in oasis farmland is used to obtain ET and other water and heat flux hourly, and a small lysimeter is used to measure ET in wetland to obtain ET daily

11.L.110-111 I am not sure how this is done? It is not retrieved form the website? You did it yourself ? Response: I have revised, and added the new website. We got the data from the old website, but they've changed now. The land cover data on the internet can't meet our requirements. It was made by Dr. Li, one of the authors, who also used it in his article.

12.L.144 shouldn't this be "d b" instead of "b"? Response: No. b is right.

13.L.193 It is a pity I can not find this source on line. Surface albedo is of huge influence to the evaporation flux. I am wondering why the sensitivity analysis turns out differently and also where the study of Liu was performed. Response: Yes, surface albedo is moderate sensitive to ET, but the LST and daily GSR are more sensitive than it(Liu ,2008, Zheng et al.,2016, Xia,et al.,2013, Chen,2007). Liu's research was carried out in Shandong Province, China. The experimental station is Yucheng comprehensive experimental station of Chinese Academy of Sciences. Dr. Liu's thesis can be downloaded from CNKI freely. You may not be able to download it, but I can upload it. And Chen (2007) made a similar study on sensitivity analysis, and reached the same conclusion as Liu in Zuomaoxikong watershed in the source region of Yangtze river.(Chen's thesis canalso be downloaded from CNKI freely.) In our study period, except for the amount of cloud, other weather conditions are the same, and there is no

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rainfall. We also find that the surface albedo and NDVI are almost unchanged, in several consecutive days. we also find that the surface albedo of MODIS from 21 to 24 is almost unchanged. If the study period is discontinuous and the interval is long, the surface albedo can not be used. The third strategy is suitable for continuous multi day period

143.L.210 So do you interpolate between TM observation dates? Or do you downscale MODIS with TM? Please explain. Response: Please look at the answer of the sixth question.

15.L.231 Response: I have revised, and the ambiguous part is removed.

16.L.249-250 this seems a conclusion. Response: I have deleted it.

17.L.255 Response: I have revised, and the ambiguous part is removed.

18.L.272 And is that expected? Please interpret these results and discuss. Response: Yes, the simulated ET of the improved scheme is what we expect. I have revised, and added the tables. results and discuss:In wetland, the mean measured ET for 4 days was 2.1 mm. The MABE of the improved scheme-simulated ET is 0.6 mm, and the MARBE is 28%. For the original scheme ET, the MABE is 1.4 mm, and the MARBE is 64%. The simulated ET changes from 3.4 mm (original scheme) to 2.1 mm (improved scheme).

19.L.282 This is new. Should be mentioned in area description. Response: Heihe River is an inland river in arid and semi-arid region. In the middle reaches, all farmland irrigation water comes from of Heihe River, which is agricultural production water mentioned in the introduction of the article.

20.L.283-285 Response: I have revised: Fig. 6 and 7 illustrate that, for all land cover types, except for water bodies, the highest ET value is found over the farmland given the presence of irrigation water, followed by forest, wetland, and residential areas, the lowest values appeared over bare rock land. And the ambiguous part is removed.

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21.L.305 And maybe mention again how novel this is. Response: I have revised: Considering astronomical, atmospheric (i.e., air molecules, water vapor, and cloud), and surface factors (i.e., slope, aspect, terrain shading, and surface coverage), the new daily GSR model is proposed, based on Iqbal model C. By using DEM data and remote sensing data, surface factors are extracted, and by using meteorological station data and remote sensing data, atmospheric factors, including sunshine duration, are calculated. The new model has been coupled with SEBAL to better estimate ET. The daily surface ET of June 21–24, 2009 in Heihe River Basin of Gansu Province is simulated. The results can be summarized as follows:

22.L.288-289 don't use the word vicinity(is it about distance),but approximately for instance. Response: The “vicinity” has been revised to “approximately”

23.L.337 What do you mean? Irrigated farmland show high ET rates? Response: Yes, in this region, the water source of crop growth in the middle reaches of Heihe River is irrigated by Heihe River. So irrigated farmland show high ET rates.

24.349-453 Response: I have deleted it.

25. Maybe a flowchart will help to describe the methodology. Response: I have added it. Please look at Fig.1.

References Xia T, Wang Z: Sensitivity re-analysis of SEBAL to input data[J]. J Tsinghua Univ(Sci&Techn01). 2013,53(9):1241-1248 Zheng CL, Wang Q, Li PH. Coupling SEBAL with a new radiation module and MODIS products for better estimation of evapotranspiration[J]. Hydrolog SCI J.2016.61(8): 1535–1547.doi: http://dx.doi.org/10.1080/02626667.2015.1031762 Chen Ling, 2007. Estimation of Regional Evapotranspiration Using Advanced SEBAL. M.S. thesis, Lanzhou University. 56pp

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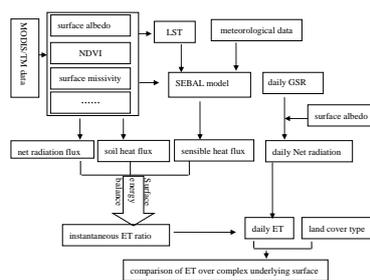


Fig.1. Flow chart of this study

Fig. 1.

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Table 2
ET of three combination schemes on 24 June, 2009(Unit: mm)

Classification	farmland			wetland		
	measured ET	original scheme	improved scheme	measured ET	original scheme	improved scheme
TM strategy	4.8	6.3	5.0	2.2	4.7	3.5
MODIS strategy	4.8	6.3	4.2	2.2	4	2.6
TMMODIS Hybrid strategy	4.8	7.0	4.8	2.2	4.7	3.1

Fig. 2.

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Table 3
Errors of ETs of three combination strategies on 24 June, 2009(Unit: mm)

simulation strategy	simulation scheme	farmland		wetland	
		MABE (%)	MABRE (%)	MABE (%)	MABRE (%)
TM strategy	original scheme	1.5	31	2.5	114
	improved scheme	0.2	4	1.3	59
MODIS strategy	original scheme	1.5	31	1.8	82
	improved scheme	0.6	13	0.4	18
TMMODIS strategy	original scheme	2.2	46	2.5	114
	improved scheme	0	0	0.9	41

Fig. 3.

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Table 4

a. Daily ET of middle Heihe River Basin on June 21–24, 2009 (farmland) (Unit: mm)							
Date	Measure ET	simulated ET		MABE		MARBE (%)	
		improved	original	improved	original	improved	original
6.21	4.9	3.8	6.6	1.1	1.7	22	35
6.22	5.1	3.9	6.5	1.2	1.4	24	27
6.23	4.5	4.4	6.6	0.1	2.1	2	47
6.24	4.8	4.8	7	0	2.2	0	46
Mean	4.8	4.2	6.7	0.6	1.85	12	39

b. Daily ET of middle Heihe River Basin on June 21–24, 2009 (wetland) (Unit: mm)							
Date	Measure ET	simulated ET		MABE		MARBE (%)	
		improved	original	improved	original	improved	original
6.21	2.1	2.4	4.1	0.3	2	14	95
6.22	1.9	1.2	2.2	0.7	0.3	37	16
6.23	2.1	1.7	2.7	0.4	0.6	19	29
6.24	2.2	3.1	4.7	0.9	2.5	41	114
Mean	2.1	2.1	3.4	0.6	1.4	28	64

Fig. 4.