Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2020-360-AC1, 2020

Hydrology and Earth System Sciences
Open Access
Discussions

Interactive comment on "Variations of surface roughness on inhomogeneous underlying surface at Nagqu Area over the Tibetan Plateau" *by* Maoshan Li et al.

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Received and published: 1 November 2020

Title: The variation of numerically simulated turbulent fluxes on the Tibetan Plateau and in its surrounding areas ——————————————————————- We are thankful to the reviewers for their valuable comments on the paper. Below we provide the responses to the comments and questions raised. Modifications and improvements are incorporated in the revised manuscript as mentioned below for each of the comments. For easy visualization, the responses to the reviewers' comments in bold are provided below and changes in manuscript are also highlighted in RED color (Track Change). ——————————————

———————————————- The manuscript presents a study on estimating surface roughness length from remote sensing data which is tested with calculated roughness length from field observation data. It appears to be converted from a thesis chapter, premature for journal submission. The list of references does not follow an order. The authors should have spent more time in making the manuscript ready. In addition to this formatting and writing problem, I have more concern on the science aspect of the manuscript. The list of references has been adjusted in order.

(1)The assumption of this study is that the roughness length varies with time when surface vegetation cover is changing. For the same reason, would zero-plane displacement be varying too? Why is it taken as a constant value 0.03 m ? (L180). ResponseeïijŇThe magnitude of the zero plane displacement d is related to many factors, first of all it is related to the canopy height. In 1969, G. Stanhill had empirically obtained the relationship between the height of the high-stalk crop h and the height of zero-plane displacement d as: d=0.979h-0.154 As a rough approximation, d can be derived from: d=0.64h In this study, we use the measured values of average wind speed and turbulent flux of a single height ultrasonic anemometer, the calculation scheme of surface roughness proposed by Chen et al. (Chen et al., 1993) to obtain the dynamic variation of the surface roughness in single observation point. Because the average height of canopy is 0.05 m in observational sites, it is taken as a constant value 0.03 m.

Stanhill G (1969) A simple instrument for the field measurement of turbulent diffusion flux. J Appl Meteorol 8:509–513

(2) Please provide a reference for the von Karman constant (0.35). Hogstrom (1985 and 1996) suggests a value of 0.40.

Response, Thank you for your careful correction. After discussing with the co-authors of the paper, the length of Mönen Obukhov is calculated using the TK3 software of Bayreuth University in Germany. In this software, k is 0.4, so k is also 0.4 in this paper, already revised.

Foken, T: Micrometeorology, (Springer Heidelberg), XX, 113 illus., 308 p., Softcover (2008), doi:ISBN: 978-3-540-74665-2

(3) Please provide an equation showing how u* us calculated. It is certainly not a directly measurable variable.

Response, u* is calculated from the wind speed observed by the eddy covariance observation system, the formula is as followsïijŽ

(4) About the Massman model, I could not find exact equations in wither Massman 1997 or 1999. However, I see you 2.6 is somewhat close to Massman 1999 Eq. 5. The relationship in Massman Eq. 5 C1- C2*. . . while yours is C1 + C2*. . . Something looks inconsistent.

Response: Formula 6 is wrong due to carelessness. should be 'γ=C_1-C_2âŃĚexpâĄą(-C_3âŃĚC_dâŃĚLAI)'

(5) About acf, it is not clear to me why this correction factor is applied to the vegetation height calculated from 2.10? How is it relevant? If Sun 2016 use acf due to the use of ASTER DEM. This is not used in your study, what is the reason to apply such a correction factor?

Response, acf is the altitude correction factor, which is used to characterize the influence of altitude on vegetation height in northern Tibet. Because the altitude calculation is consistent with Chen's method (Chen, et al., 2013), it is obtained from ASTER's DEM products in this study.

Chen, X.L., et al., An improvement of roughness height parameterization of the Surface Energy Balance System (SEBS) over the Tibetan Plateau. Journal of Applied Meteorology and Climatology, 2013. 52(3): p. 607-622.

(6) You cannot present an equation without telling the source or showing how the equa-

tion is derived. Please include a reference to, for example, 2.13. Response, The LAI used in this thesis is calculated by the NDVI of MODIS (Su,1996). The calculation formula is: (13)

Su, Z.B., 1996. Remote Sensing Applied to Hydrology: The Sauer River Basin Study. RuhrUniversität Bochum, Lehrstuhl für Hydrologie, Wasserwirtschaft und Umwelttechnik.

(7) Values of hmax and hmin are required to estimate Zom. Are the hmax and hmin values estimated based on the three observation stations representative to the whole area where you produce maps of roughness length?

ResponseïijŇDue to the limitation of observation conditions (high altitude, high cold, and harsh natural conditions), observation sites are relatively rare. The vegetation of the three selected sites, Nagqu StationïijĹAlpine meadowïijĽ, NPAM Station and Namco Station, is the vegetation condition of the typical vegetation underlying surface on the northern Tibetan Plateau. A large number of vegetation conditions need to be observed in the next step

(8) There are empirical equations for estimation of roughness lengths and zero plane displacement based on vegetation height. It would be good to test how the empirical relationships compare to equation 2.8 and 2.9.

Response, In Section 3.3, the surface roughness calculated by observations was used to evaluate the results of satellite retrieved (9), showing that the correlation between the two is up to 0.83.

3.3 Evaluation of satellite data retrieved results The Z0m scatter plot is shown in Figure 7. It can be seen that there is a significant positive correlation between the satellite data and the surface roughness calculated from the site data. The correlation coefficient between the observation result and the retrieved result is different from that of the NAMCO station in 2010 in Fig. 7(g), and the others are large. It shows that the average result of the underlying surface smoothed the same underlying surface results in different regions, further indicating that the satellite retrieved results are more similar to the site calculation results. However, the results of the NAMCO site are different from those of other sites. The correlation coefficient with the average results of the underlying surface is 0.83, and the correlation coefficient with the satellite retrieved results is 0.62. Or because the Namco Observation Station is closer to the lake (1km), it is more affected by local microclimate such as lake and land winds. The results in Figure 7 all passed the F test of P = 0.05. It indicates that there is no significant difference between the site data calculation results and the satellite data retrieved results.

Fig. 7 Scatter plots of the retrieved and calculated surface roughness length on four sites (a-d: scatter plot of the observation results and the average result of the underlying surface; e-hïijŽscatter plot of the observation and retrieved results; a,e: BJ station in 2008; b,f: BJ station in 2012; c,g: NAMC station in 2010; d,h: NPAM station in 2012)

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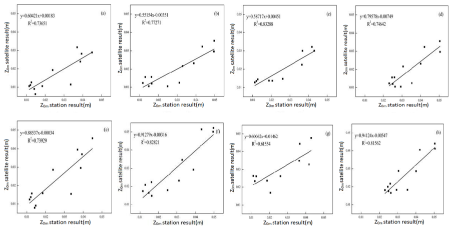

Fig. 1. Fig. 7 Scatter plots of the retrieved and calculated surface roughness length on four sites (a-d: scatter plot of the observation results and the average result of the underlying surface; e-hïijŽscatter