

## ***Interactive comment on “Measurement and estimation of the aerodynamic resistance” by S. Liu et al.***

**S. Liu et al.**

Received and published: 13 June 2006

The authors thank Referee #1 for the detailed review and comments on this paper. Following is our response.

Major comments:

(1) With respect to that some data for nighttime were removed in Figure 1, which Referee #1 mentioned, the reason is that there were electric power failures on 6th, 19th, and 27th of June, which caused malfunctions for the eddy correlation system at nighttime and lasted for several hours. There have been no data missing for other days. As for the aerodynamic resistance measured by evaporation pan, because evaporation is very small at night and measurement error is large, we just used the daytime data from 7:00 to 17:00.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

(2) We agree with Referee #1 that evaporation from a smaller pan is usually larger than from a larger pan, so the resistance measured by a 15 cm diameter pan is smaller than that by an eddy covariance system. This explains the phenomenon in Fig. 3. We will add the explanation to the revised paper.

(3) Referee #1 thought that the aerodynamic models could be grouped in two types. We agree with it. There are a lot of Aerodynamic resistance models (Itier, 1980; Hall, 2002; et al) and different classification standards from different perspectives. Our purpose is to compare several popular models with field data so as to choose better ones in the calculation of aerodynamic resistance in remote sensing models.

(4) Referee #1 commented that the authors did not show any comparisons of heat fluxes. In previous papers, some researchers have had this kind of indirect comparisons (e.g. Xiexianqun (1991), Kalma(1990), Ham and Heilman (1991)). Now we have aerodynamic resistance data measured by two different methods and to compare them directly may avoid the effects of other parameters. This would be better than the indirect comparisons.

Specific comments:

(1) Referee #1 pointed out that it was better to use symbol “rah” instead of “ra” for heat transfer resistance because aerodynamic resistance could be either for momentum transfer or heat transfer. We agree with it and will use “rah” instead of “ra” in the revised paper.

(2) Referee #1 had a comment on the relationship between aerodynamic resistance and wind speed. Here, we just show the relationship between those two rather than to help in making a parameterization scheme.

(3) L in equations (7-12) is measured by the eddy correlation system.

(4) Referee #1 mentioned that the solution for stable case in the original Choudhury-1 model (Eqs. (27-31)) was not correct. We agree with it (Byun, 1990; Lee, 1997; Yang

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

et al., 2001). There is an error in Equation A (3) in Choudhury (1986). It needs a minus sign at left hand side. So we will use the model of Yang et al (2001) to replace Choudhury-1 model in the revised paper.

(5) For the 5th and 6th points in specific comments, one of the co-authors (L. Lu) has been calculating  $k_B-1$  and  $z_0m$  with field data. And we will determine the values of  $k_B-1$  and  $z_0m$  based on experimental data and put them into models in the revised paper.

(6) The surface emissivity is determined by an instrument for measuring directional emissivity, which consists of three parts: objects, the cavity and an infrared thermometer (IRT) (Xu et al (2004) and Huang et al (2005)). The instrument has been patented in China and is convenient and effective for measuring thermal infrared multi-reflection using the cold sky as radiation source.

(7) We thank Referee #1 for his suggestion in sensitivity study and we will take it into account in the revised paper.

Minor comments:

In this paper, we use “ $R_a$ ” to denote the aerodynamic resistance measured by the evaporation pan and eddy correlation system in equations (37-38). We will change to a better symbol in the revised paper.

References:

Byun, D. W.: On the analytical solution of flux-profile relationships for the atmospheric surface layer, *J. Appl. Meteor.*, 29, 652-657, 1990.

Choudhury, B.J., R.J. Reginato and S.B. Idso: An analysis of infrared temperature observations over wheat and calculation of latent heat flux. *Agricultural and Forest Meteorology*. 37, 75-88, 1986.

Hall, R. L.: Aerodynamic resistance of coppiced poplar, *Agriculture and Forest Meteo-*

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

rology, 114, 83-102, 2002.

Ham, J. M. and Heilman, J. L.: Aerodynamic and surface resistance affecting energy transport in a sparse crop, *Agriculture and Forest Meteorology*, 53, 267-284, 1991.

Huang M.F., S.M. Liu, S.H. Liu and Q. J. Zhu: A study of the difference between true surface temperature and radiometric surface temperature, *Advances in Earth Science*, 20(10), 25-32, 2005. (in Chinese)

Itier,B.: Une méthode simplifiée pour le mesure du flux de chaleur sensible, *J. Rech. Atmos.*, 14, 17-34, 1980.

Kalma,J.D. and Jupp,D.L.B.: Estimating evaporation from pasture using infrared thermometry: evaluation of a one-layer resistance model, *Agriculture and Forest Meteorology*, 51,223-246,1990.

Lee, H. N.: Improvement of surface flux calculation in the atmospheric surface layer, *J. Appl. Meteor.*, 36, 1416-1423, 1997.

Xie Xianqun: Comparison of some remotely sensed models for estimating evapotranspiration of the field, in: *Experimental study of the field evapotranspiration*, edited by: Zuo Dakang and Xie Xianqun, *Meteorology Press*, 128-138, 1991. (in Chinese)

Xu, J. P., X. M. Sun, R. H. Zhang: Measuring of thermal radiation multi-reflection information in soil-vegetation system, 2004 *IEEE International Geoscience and Remote Sensing Symposium Proceedings*, Anchorage, Alaska, USA, 2004.

Yang, K., Tamai, N., and Koike, T.: Analytical Solution of Surface Layer Similarity Equations, *J. Appl. Meteorol.* 40, 1647-1653, 2001.

---

Interactive comment on *Hydrol. Earth Syst. Sci. Discuss.*, 3, 681, 2006.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper