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Seasonal Variations of the Surface Fluxes and Surface Parameters over the Loess Plateau in China

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ABSTRACT

Turbulent fluxes were measured by an eddy covariance system at three levels over an intricate land surface on the southern part of the Loess Plateau, consisting of heterogeneous flat terrain and a large valley 500 m away from the observation site to the southeast. The surface roughness length, the seasonal variation of bulk transfer coefficient for sensible heat (C_H), and the seasonal variation of surface moisture availability (β) were also analyzed based on the observation. The flux footprint was carefully considered in this study. A relatively dry period of the experimental area existed from June to the first week of July 2004 when the land surface offered turbulent energy to the atmospheric surface layer mainly by sensible heat flux with a maximum value of around 230 Wm^{-2} . A wet duration lasted from the second week of July to the end of September 2004 with very frequent rainfall events in conditions when the winds were mainly from the southeast; latent heat flux was dominant during the wet season and reached a peak value of around 280 Wm^{-2} . The surface parameters of C_H and β were calculated when the mean winds coming from the flat terrain, i.e., from the northwest direction. The values of C_H ranged between 0.004 and 0.006 during the observational year of June 2004 to June 2005. The surface moisture availability β changed with seasons as anticipated with high values during June and July 2004 and lowest values around 0.03 in February 2005. Its peak value of 0.91 occurred in July; the mean value of β during the wet season was 0.29. Furthermore, the relationship between the surface soil water content and β indicated that changes in soil water content contributed much to variations of surface moisture availability β .

KEYWORDS

Loess Plateau; Surface Fluxes; Bulk Transfer Coefficient; Soil Moisture Availability

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References

- [1] J. C. Wyngaard, "Scalar Fluxes in the Planetary Boundary Layer—Theory, Modeling, and Measurement," *Boundary-Layer Meteorology*, Vol. 50, No. 1-4, 1990, pp. 49-75. doi: 10.1007/BF00120518
- [2] T. Hiyama, A. Takahashi, A. Higuchi, M. Nishikawa, W. Li, W. Liu and Y. Fukushima, "Atmospheric Boundary Layer Observations on the Changwu Agro-Ecological Experimental Station over the Loess Plateau, China," *AsiaFlux Newsletter*, No. 16, 2005, pp. 5-9.
- [3] R. Kimura, N. Takayama, M. Kamichika and N. Matsuoka, "Soil Water Content and Heat Balance in the Loess Plateau—Determination of Parameters in the Three-Layered Soil Model and Experimental Result of Model Calculation," *Journal of Agricultural Meteorology*, Vol. 60, No. 1, 2004, pp. 55-65. doi: 10.2480/agrmet.60.55
- [4] R. Kimura, M. Kamichika, N. Takayama, N. Matsuoka and X. C. Zhang, "Heat Balance and Soil Moisture in the Loess Plateau, China," *Journal of Agricultural Meteorology*, Vol. 60, No. 2, 2004, pp. 103-113. doi: 10.2480/agrmet.60.103

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- [5] S. Liu, R. Sun, Z. Sun, X. Li and C. Liu, " Evaluation of Three Complementary Relationship Approaches for Evapotranspiration over the Yellow River Basin," *Hydrological Processes*, Vol. 20, No. 11, 2006, pp. 2347-2361. doi:10.1002/hyp.6048
- [6] I. Tamagawa, " Turbulent Characteristics and Bulk Transfer Coefficients over the Desert in the HEIFE Area," *Boundary-Layer Meteorology*, Vol. 77, No. 1, 1996, pp. 1-20. doi:10.1007/BF00121856
- [7] J. Kondo and T. Watanabe, " Studies on the Bulk Transfer Coefficients over a Vegetated Surface with a Multilayer Energy Budget Model," *Journal of the Atmospheric Sciences*, Vol. 49, No. 23, 1992, pp. 2183-2199. doi:10.1175/1520-0469(1992)049<2183:SOTBTC>2.0.CO;2
- [8] H. K. Kafle and Y. Yamaguchi, " Effects of Topography on the Spatial Distribution of Evapotranspiration over a Complex Terrain Using Two-Source Energy Balance Model with ASTER Data," *Hydrological Processes*, Vol. 23, No. 16, 2009, pp. 2295-2306. doi:10.1002/hyp.7336
- [9] W. P. Kustas, F. Li, T. J. Jackson, J. H. Prueger, J. I. MacPherson and M. Wolde, " Effects of Remote Sensing Pixel Resolution on Modeled Energy Flux Variability of Croplands in Iowa," *Remote Sensing of Environment*, Vol. 92, No. 4, 2004, pp. 535-547. doi:10.1016/j.rse.2004.02.020
- [10] W. Li, T. Hiyama and N. Kobayashi, " Turbulence Spectra in the Near-Neutral Surface Layer over the Loess Plateau in China," *Boundary-Layer Meteorology*, Vol. 124, No. 3, 2007, pp. 449-463. doi:10.1007/s10546-007-9180-y
- [11] M. Nishikawa, T. Hiyama, K. Tsuboki and Y. Fukushima, " Numerical Simulations of Local Circulation and Cumulus Generation over the Loess Plateau, China," *Journal of Applied Meteorology and Climatology*, Vol. 48, No. 4, 2009, pp. 849-862. doi:10.1175/2008JAMC2041.1
- [12] A. Takahashi, T. Hiyama, M. Nishikawa, H. Fujinami, A. Higuchi, W. Li, W. Liu and Y. Fukushima, " Diurnal Variation of Water Vapor Mixing between the Atmospheric Boundary Layer and Free Atmosphere over Changwu, the Loess Plateau in China," *SOLA*, Vol. 4, No. , 2008, pp. 33-36. doi:10.2151/sola.2008-009
- [13] N. Takayama, R. Kimura, M. Kamichika, N. Matsuoka and X. C. Zhang, " Climatic Features of Rainfall in the Loess Plateau in China," *Journal of Agricultural Meteorology*, Vol. 60, No. 3, 2004, pp. 173-189. doi:10.2480/agrmet.60.173
- [14] D. Matsushima and J. Kondo, " A Proper Method for Estimating Sensible Heat Flux above a Horizontal-Homogeneous Vegetation Canopy Using Radiometric Surface Observations," *Journal of Applied Meteorology*, Vol. 36, No. 12, 1997, pp. 1696-1711. doi:10.1175/1520-0450(1997)036<1696:APMFES>2.0.CO;2
- [15] K. Shimoyama, T. Hiyama, Y. Fukushima and G. Inoue, " Seasonal and Inter Annual Variation in Water Vapor and Heat Fluxes in a West Siberian Continental Bog," *Journal of Geophysical Research*, Vol. 108, No. D20, 2003, p. 4648. doi:10.1029/2003JD003485
- [16] J. C. Kaimal and J. E. Gaynor, " Another Look at Sonic Thermometry," *Boundary-Layer Meteorology*, Vol. 56, No. 4, 1991, pp. 401-410. doi:10.1007/BF00119215
- [17] J. C. Kaimal and J. J. Finnigan, " *Atmospheric Boundary Layer Flows*," Oxford University Press, New York, 1994.
- [18] E. K. Webb, G. I. Pearman and R. Leuning, " Correction of Flux Measurements for Density Effects Due to Heat and Water Vapour Transfer," *Quarterly Journal of the Royal Meteorological Society*, Vol. 106, No. 447, 1980, pp. 85-100. doi:10.1002/qj.49710644707
- [19] R. Leuning and J. Moncrieff, " Eddy-Covariance CO₂ Flux Measurements using Open-and Closed-Path CO₂ Analyzers: Corrections for Analyzer Water Vapor Sensitivity and Damping of Fluctuations in Air Sampling Tubes," *Boundary-Layer Meteorology*, Vol. 53, No. 1-2, 1990, pp. 63-76. doi:10.1007/BF00122463
- [20] W. Brutsaert, " *Evaporation into the Atmosphere: Theory, History, and Applications*," Kluwer Academic Publishers, Boston, 1982.
- [21] J. C. Wyngaard and O. R. Cote, " The Budgets of Turbulent Kinetic Energy and Temperature Variance in the Atmospheric Surface Layer," *Journal of Atmospheric Sciences*, Vol. 28, No. 2, 1971, pp. 190-201. doi:10.1175/1520-0469(1971)028<0190:TBOTKE>2.0.CO;2
- [22] J. C. Wyngaard, " On Surface-Layer Turbulence," In: D. A. Haugen, Ed., *Workshop on Micrometeorology*, American Meteorological Society, Boston, 1973, pp. 101-149.

- [23] E. L. Andreas, " Two-Wavelength Method of Measuring Path-Averaged Turbulent Surface Heat Fluxes," *Journal of Atmospheric and Oceanic Technology*, Vol. 6, No. 2, 1989, pp. 280-292. doi:10.1175/1520-0426(1989)006<0280:TWMOMP>2.0.CO;2
- [24] R. J. Hill, " Review of Optical Scintillation Methods of Measuring the Refraction-Index Spectrum, Inner Scale and the Surface Fluxes," *Wave Random Media*, Vol. 2, No. 3, 1992, pp. 179-201. doi:10.1088/0959-7174/2/3/001
- [25] W. Brutsaert, " Stability Correction Functions for the Mean Wind Speed and Temperature in the Unstable Surface Layer," *Geophysical Research Letters*, Vol. 19, No. 5, 1992, pp. 469-472. doi:10.1029/92GL00084
- [26] W. Brutsaert, " Aspects of Bulk Atmospheric Boundary Layer Similarity under Free-Convective Conditions," *Reviews of Geophysics*, Vol. 37, No. 4, 1999, pp. 439-451. doi:10.1029/1999RG900013