Energy fluxes across an urban area – examples from the JU2003 case study

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Resumo

Este trabalho apresenta resultados do estudo de fluxos de energia, e sua variação espacial, obtidos no experimento JU2003. O padrão de histerese ($Q_* \times Y$) foi considerado de três formas: $Y = R$ (resíduo), $Y = Q_S$ (energia armazenada no solo) e $Y = Q_G$ (fluxo de calor para o solo, não mostrado no artigo).

1. Introduction

Data in use are from the Joint Urban 2003 Campaign (JU2003), carried out in the surroundings of Oklahoma City, OK, USA, from during July 2003. The JU2003 main goals were to grasp a better understanding of the dispersion processes in urban areas (Allwine and Flaherty 2006). Among other information available, JU2003 possesses a database of energy fluxes that has been partially analyzed by Grimmond et al. (2004), Holeman et al. (2004), and Hanna et al. (2011).

2. Variation across Oklahoma city

Maximum and minimum values of sensible heat flux and temperature were taken from the mean quantities for each site and plotted as function of 2D-distance from downtown. We found a slight systematic variation of fluxes or temperature across the NS direction.

3. Residual, ground heat flux, and torage

Figure 1 shows examples of the diurnal cycle of the residual and of

the stored energy in the soil. For GRS site, one-point temperature was used to estimate the energy stored in the ground, and for ASU site five-point were available. Thus, ASU estimation is expected to be more accurate.

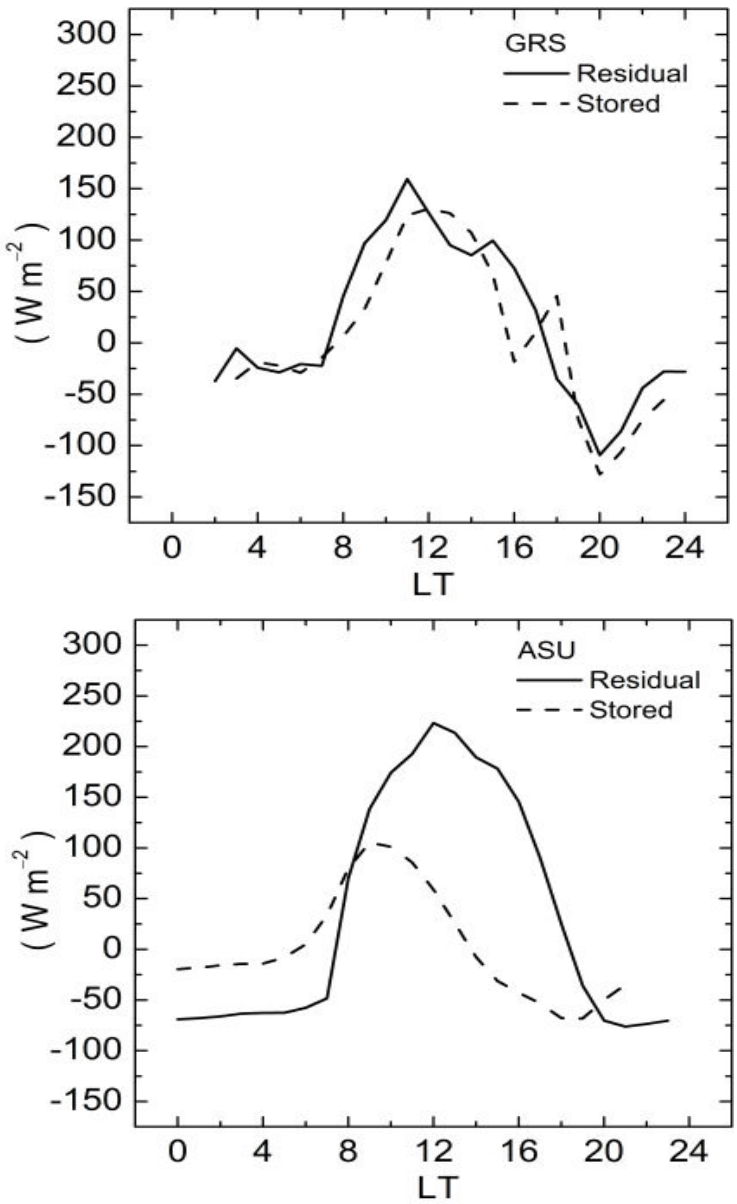

Figure 1. Diurnal cycle of the residual of the energy budget equation and of the stored energy in the soil.

$Q_* \times Y$ plots were obtained using Y equals residual (R), ground energy flux (Q_G), and stored energy in the soil (Q_S). Hysteresis patterns are well defined for urban and suburban areas when the input Y is R or Q_G. When Y is Q_S we did not find a clear relationship.

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References

Allwine, K.J., Flaherty J.E., 2006: Joint Urban 2003: Study Overview and Instrument Locations, Pacific Northwest Laboratory, (Report).

Grimmond C.S.B., Su H.B., Offerle B., Crawford B., et al., 2004: Variability of sensible heat fluxes in a suburban area of Oklahoma city. Proceedings of the 84th AMS Annual Meeting, Seattle, USA.

Hanna S., Marciotto E., Britter R., 2011: Urban Energy Fluxes in Built-Up Downtown Areas and Variations across the Urban Area, for Use in Dispersion Models, **J. Appl. Meteor. Climatol.**, **50**, 1341-1353.

Holeman, J.E., M. Princevac, S. Grossman-Clarke, et al., 2004: Joint Urban 2003 surface energy budget measurements and analysis. Proceedings ICTAM, Warsaw.