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城市复杂环境下涡度相关通量观测的适用性分析

Applicability of eddy covariance technique to the measurement of turbulent fluxes in complex urban context

关键词：城市 涡度相关 通量 坐标旋转 湍流 平流

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作 者 单位

宋 涛 中国科学院大气物理研究所/大气边界层物理与大气化学国家重点实验室, 北京 100029

修天阳 中国气象局, 北京 100081

孙 扬 中国科学院大气物理研究所/大气边界层物理与大气化学国家重点实验室, 北京 100029

王跃思 中国科学院大气物理研究所/大气边界层物理与大气化学国家重点实验室, 北京 100029

摘要：利用涡度相关技术，于2008—2009年对北京325 m铁塔47 m、140 m和280 m高度处CO_2和能量通量进行了观测.研究了涡度相关技术应用于城市环境通量长期观测中的理论问题和方法适用性.结果表明，平面拟合方法受地面建筑物的影响明显，不同的坐标旋转方法所计算CO_2通量差异在15%以内，这种差异随着观测高度的增加而减小.稳态检验表明，城市环境下低质量的数据分布没有明显的日变化趋势.CO_2通量在各自通量贡献区内明显受到平流输送的影响，47~140 m之间的平流约占140 m日累计CO_2通量的33%.白天对流混合，污染物浓度梯度很小，垂直平流不大，水平平流占据了平流输送的绝大多数，夜间水平平流和垂直平流则具有相同量级.

Abstract：The applicability of eddy covariance (EC) technique in the urban context is discussed by analyzing the fluxes data of carbon dioxide and energy measured at three levels, 47, 140 and 280 m, over an urban landscape in Beijing. The results show that the effect of buildings on planar fitting method is significant. The different rotation methods lead to differences in fluxes of the order of 15%, and the differences decrease with increasing of measurement heights. As methods of quality control, the application of stationary test indicates that the variation of temporal distributions of low quality data is not significant. However, integral turbulence test show that low quality data are usually found in the early morning and later afternoon hours. The difference of flux measured at three levels indicates that the contribution of advection on measured CO_2 fluxes is not negligible. In August 2008, the total advection between 47 and 140 m is 34% of the diurnal integrated fluxes at 140 m. During the daytime, the advection of vertical as a component of total advection is lower than that of horizontal, which is another component of total advection, due to the small vertical gradients caused by sufficient turbulent mixes. During the nighttime, the magnitudes of both vertical and horizontal are comparable.

Key words：eddy covariance fluxes coordinate rotation turbulence advection

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