Geophysical Research Abstracts
Vol. 14, EGU2012-10736, 2012
EGU General Assembly 2012

Detection of surface heterogeneity in eddy covariance data

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Upwind-surface heterogeneity can induce instationarity into ground-based eddy covariance (EC) measurements, complicating the interpretation of vertical turbulent flux in terms of surface exchange. A heterogeneity-detection scheme is presented and tested for the case of an abrupt spacial change in land use; a paved surface, rectangular and large, embedded into green grassland. The measuring mast stands at the downwind shorter edge of the rectangular, making an ultrasonic anemometer and a Krypton hygrometer subject to fetch fluctuations from deviations in wind direction. The EC method requires a high-frequency time series of usually half an hour length to produce a single estimate of vertical turbulent flux. The detection scheme is based on binning an individual time series according to instantaneous wind direction, that is, fetch length; one bin tending to be more strongly affected by the grassland than the other. Taking into account autocorrelation, a resampling method establishes a suitable p-value for testing the bin difference. The results are in accordance with both appropriate statistical analyses of the 40 pooled times series and the physical setting of paved surface versus grassland.