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Turbulence over Helsinki from sonic anemometer and scintillometer observations

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Given the lack of high-quality long-term observations from poleward cities, measurements were carried out as part of Helsinki UrBAN (Urban Boundary-layer Atmosphere Network, http://urban.fmi.fi): a dedicated research-grade observational network for the study of the physical processes in the atmosphere above the city.

In the present work we focus on observing turbulence properties. Two commercial large-aperture scintillometers, Scintec BLS900, have been installed path lengths of 1840 m and 4200 m at about 45–65 m above ground, in Helsinki, with sonic anemometers at each end of the longer path. From July 2011 to June 2012 we observed large variability in diurnal and annual cycles of both temperature structure parameter (CT2) and sensible heat flux (H). A robust method was developed for the calculation of CT2 from sonic-anemometer data. In contrast to many earlier studies, which solely present the values of H, a primary analysis here is on comparisons of CT2 itself. This has advantages, because optical-wavelength scintillometers measure CT2 with few assumptions, while the determination of H implies the applicability of Monin-Obukhov Similarity Theory that has several inherent limitations. The histograms of CT2 compare well between sonic and scintillometer. In-depth analysis is focused on one of the scintillometer paths: both CT2 and H comparisons gave similar and surprisingly high correlation coefficients (0.85 for CT2 and 0.84–0.95 for H in unstable conditions) given the differences between the two measurement techniques, substantial sensor separation, and different source areas.