Characterisation of Urban Heat Island Intensity and other urban climate influences using Radon-222

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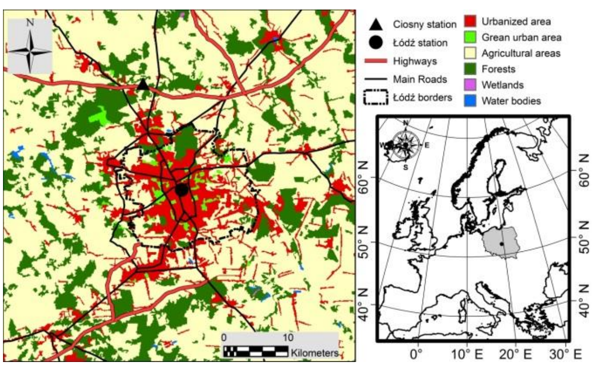
Background

More than half of the global population lives in urbanised areas. Improving our understanding of urban climate effects and accurately assessing the efficacy of mitigation measures necessitates an ability to separate effects resulting from factors that can be readily changed (e.g. urban planning and construction materials), from those that can't (e.g. prevailing meteorology).

Site and measurements

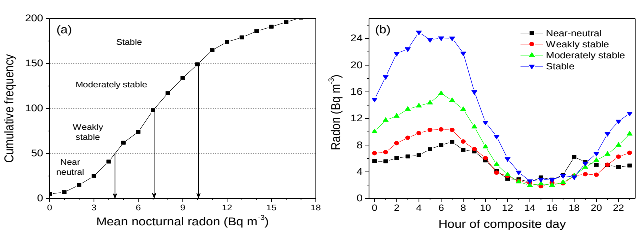
This poster summarises the key findings of Chambers et al. (2016), a study based on 4 years of paired urban/rural meteorological and atmospheric radon measurements in central Poland.



Location of study region in Europe and relative location of rural and urban measurement sites (Ciosny & Łódź) relative to the city centre.

Classifying nocturnal mixing state

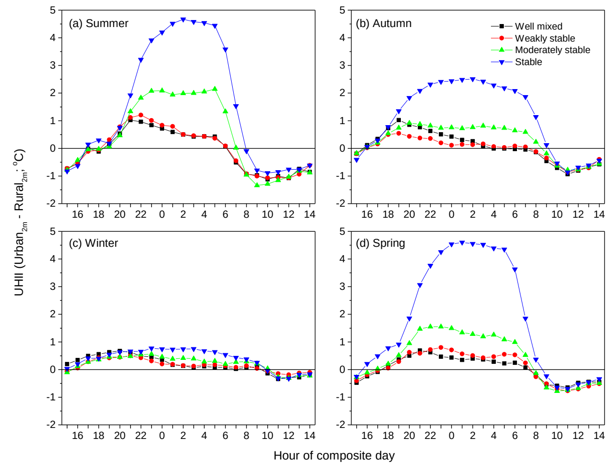
Urban climate influences are strongest at night, and their magnitude is directly related to the strength of nocturnal mixing. Near-surface radon observations provide a convenient means of estimating nocturnal mixing. Once fetch influences have been removed from a radon time series (see Chambers et al. 2015 for details) "stability" thresholds can be set based on mean nocturnal radon concentration. Diurnal composites of radon, meteorology or trace gases can then be made within each "stability" category.



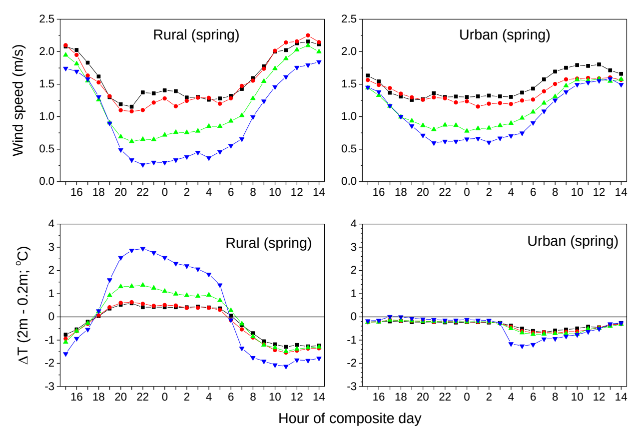
(a) Cumulative frequency plot from 4-years of nocturnal mean radon measurements separated into quartiles; (b) diurnal composite radon concentration within each of the resulting stability categories.

Urban climate influences

Urban heat island intensity (defined here as the 2m urban – rural temperature difference) was a strong function of the radon-based stability measure for all seasons except winter, when snow cover and frozen soils can inhibit the radon flux. Chambers et al. (2016) provide similar examples in the cases of relative and absolute humidity.



To demonstrate the close correspondence between nocturnal radon accumulation and factors affecting near-surface mechanical and thermodynamic stability, below we show examples in spring of diurnal composite wind speed and near-surface temperature gradient at the rural and urban sites for each of the radon-derived nocturnal stability categories.



References

Chambers SD, A Podstawczyńska, AG Williams and W Pawlak et. Characterising the influence of atmospheric mixing state on Urban Heat Island Intensity using Radon-222. Atmos. Environ., 147, 355-368, 2016.

Chambers, SD, AG Williams, J Crawford and AD Griffiths. On the use of radon for quantifying the effects of atmospheric stability on urban emissions. Atmos. Chem. Phys., 15, 1175–1190, 2015.

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