



Comparison of atmospheric and surface urban heat islands in terms of their diurnal variability – a summertime case study for Krakow, Poland

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Urban heat island (UHI) effect is nowadays considered in the context of synergistic interaction with heat waves, which are projected to increase their frequency. UHI phenomenon is primarily concerned with the atmosphere but it may also refer to the surfaces. Therefore, two main types of UHI may be distinguished: atmospheric UHI (AUHI) and surface UHI (SUHI). They are physically-related to each other according to thermal interactions between land (urban or rural) surface and near-surface atmospheric layer. AUHI is determined on the basis of air temperature (AT) measured in situ, whereas SUHI is assessed with the use of land surface temperature (LST) derived from remotely sensed thermal data. Obviously, AT is modulated by LST however their relationship is not constant during the day and depends on atmospheric mixing, advection from adjoining area with particular land use/land cover (LULC), and cloudiness. Comparisons of AT values from ground-based measurement and LST values estimated on the basis of satellite data are limited to cloudless conditions. Hence, in order to compare diurnal variability of AUHI and SUHI a 24-hour period of clear-sky weather over the study area is required, which is a rare situation at mid-latitudes. The aim of the study was to characterise the 24-hour patterns of the summertime atmospheric and surface UHIs in Kraków at cloudless conditions in the period 8th July 2013 18 UTC – 9th July 2013 18 UTC. AUHI was evaluated with the use of AT data measured at 21 urban and rural points located in the city of Kraków and its vicinities. SUHI was estimated on the basis of 8 day-time and night-time thermal infrared AVHRR images of the study area. The case study compared diurnal courses of AT and LST with respect to the measurement location, i.e. LULC type and vertical zone (since Kraków is located in diversified relief). Diurnal courses of AUHI and SUHI were comparatively analysed for each urban measurement point in relation to the rural point. The research included the identification of the specific differences and similarities between AUHI and SUHI diurnal changes taking into consideration the LULC types and the vertical zones. The possible causes of these differences and similarities were discussed.