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Assessing urban heat island conditions in Pärnu (Estonia) via a network of 50 weather sensors

Andreas Hoy
Stockholm Environment Institute (Tallinn Centre), Climate, Energy and Atmosphere Programme, Tallinn, Estonia (andreas.hoy@sei.org)

Weather observations are traditionally conducted at the edge of urban settlements, to obtain data representative of a larger territory. Yet, inherent micro-climatic diversities are considerable, and this range increases in urban areas – the space where most people live, work, and sleep. Here, grey infrastructures like buildings, roads, parking lots, and railway tracks lead to a combination of surface sealing, lack of ventilation, and anthropogenic heat. While a lot of data indeed exist within urban spaces already – e.g., from satellites, radar stations and climate models – they all need calibration from measurements, in the city itself. More granular observations are hence required to quantify and verify the effect city space has on weather parameters.

Pärnu is located in southwestern Estonia at the Baltic Sea coastline. A shallow long-stretched bay near the town`s centre leads to among the highest sea water temperatures in northern Europe during summer, already creating a natural heat island effect. This effect is further enhanced by urban structures, leading to a high probability of elevated minimum temperatures during heat waves, especially in Pärnu`s town centre. To investigate shape, intensity and location of Pärnu`s heat island (and its dependency on certain weather situations) we establish a network of about 50 temperature and relative humidity sensors (around 80% new sensors, 20% from existing networks) during spring 2023, data collection will start during May/June 2023. Data will be open access, and live measurements publicly accessible.

The distribution of sensor units is based on Local Climate Zones and sufficiently covers the micro-climatic diversity of Pärnu. It also allows the calibration of a city climate model, which will be used to support subsequent modelling of Pärnu`s urban heat island. Sensor units will be installed at (mostly lamp) posts in and around Pärnu, with a higher density of sensors in highly frequented, touristic, and socio-economically vulnerable districts. The network will provide in Estonia (and much of northern Europe) unprecedented insights into local temperature characteristics of a small-sized urban area, and may feed into a range of future applications useful for decision-making activities related to e.g., city planning, climate risk reduction, adaptation planning as well as weather and climate communication. It also provides prospects for e.g., highly localised weather forecasts and even future projections of heat stress and vulnerability.

Within this contribution, we outline the concept of the network and present results of the first

summer of measurements, with a special focus on heat events.