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The potential of Earth-Observation for assessing personal exposures to heat

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Abstract
The increasing frequency and intensity of excessive heat events (EHE) due to climate change propel the demand of sophisticated data and methods to assess heat exposures of humankind. To assess heat exposure across a population and its relation to health outcomes, it is preferable to estimate personal exposures for each individual in the target population. The importance of acquiring personal heat exposure patterns is echoed in the UN Sustainable Development Goals (SDG) indicators 11.b and 13.1.1 as to obtain information about the number of impacted people in climate-related hazards and the focus areas for mitigating and adapting to climate change. Assessment of personal exposures to heat requires space-time mapping of near surface air temperature at a high resolution. Earth observation (EO) based measurement of land surface temperature (LST) potentially provides high resolution and continuous coverage (gap free) information for estimating personal human heat exposures. However, the relation between LST and near surface air temperature remains uncertain. Thus, its potential in support of assessing personal exposures to heat has not been sufficiently explored. This study follows a 3-step workflow to identify the scope and limitations of applying LST to heat exposure analysis. First, a multi-resolution diurnal LST dataset is derived over a period of 3 months (containing an EHE) of the province of Utrecht (∼1000 km2), the Netherlands, by applying state-of-art unmixing-based downscaling techniques. The multi-resolution dataset contains original and downscaled LST data at high temporal resolution. Then, relations between LST and observed near surface air temperature were drawn for multiple resolutions of LST, in order to identify the optimal LST resolution for estimating near surface air temperature. Finally, the transferability of LST-based heat exposure to the air temperature-based one is examined given the distribution pattern of home locations in Utrecht. This was achieved by aggregating temperature over the EHE at the home locations of individuals. The downscaled LST properly captured the air temperature variations around urban areas, which guaranteed the reliability of heat exposure assessment around home locations. This study pioneers research in the applicability of downscaled LST to personal heat exposure assessment. It relies on downscaling as the technical backbone of this research to explore the potential of using the LST as an alternative heat data, where air temperature measurements are sparse or absent.