# Using the DRCOG 2018 pilot land use land cover data to predict urban air temperature in the Denver metro area

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Exposure to extreme heat can drastically increase health risks for urban residents, including increasing mortality rates during heat waves and even exacerbating serious mental health conditions (see footnotes 1 and 2). This heat risk is generally not equally distributed. Furthermore, regional climate shifts may increase urban heat as well as the inequities of heat risk, implying the need to develop city-specific resilience strategies (see Footnote 3).

Addressing the inequity of urban heat can start with understanding how microscale urban land uses modify daytime and nighttime air temperature. During the day, radiative heat is captured, stored and reradiated by urban land covers. Heat transfer properties, however, differ among land covers.

Using a network of air temperature sensors, deployed over Denver's urban core across a gradient of urban land covers (see Footnote 4) (Figure 1A on the next page), and regional air temperature and relative humidity at Denver International Airport as a reference, we can estimate the relative influences of land cover on air temperature with the high-resolution data. Previously, most available land cover data are available at a resolution of 30 square meters. At that scale, measuring the influence of tree canopy, turf or impervious surface on microclimate is not possible. However, with DRCOG's 1-square-meter 2018 pilot land use data, in addition to identifying the influence of land cover types on microclimate, we can also use computational models to predict microclimate air temperature over the entire Denver metro area for any given regional-scale air temperature and humidity (Figure 1B on the next page).

We are fine-tuning our models to provide data that can inform urban planners on the effect of specific land covers on urban heat. With citywide microclimate air temperature, city managers can have a better understanding of exactly where the urban heat is the biggest issue, while also quantifying how much urban tree cover, turf and green space contribute to mitigating those temperatures.

## Footnotes

1. Mullins, J. T. & White, C. Temperature and mental health: Evidence from the spectrum of mental health outcomes. J. Health Econ. 68, 102240 (2019).
2. Hondula, D. M., Balling, R. C., Vanos, J. K. & Georgescu, M. Rising temperatures, human health, and the role of adaptation. Curr. Clim. Chang. Reports 1, 144–154 (2015).
3. Ossola, A. & Lin, B. B. Making nature-based solutions climate-ready for the 50 °C world. Environ. Sci. Policy 123, 151–159 (2021).
4. Ibsen, P. C. et al. Greater aridity increases the magnitude of urban nighttime vegetation-derived air cooling. Environ. Res. Lett. 16, 034011 (2021).

Figure 1:

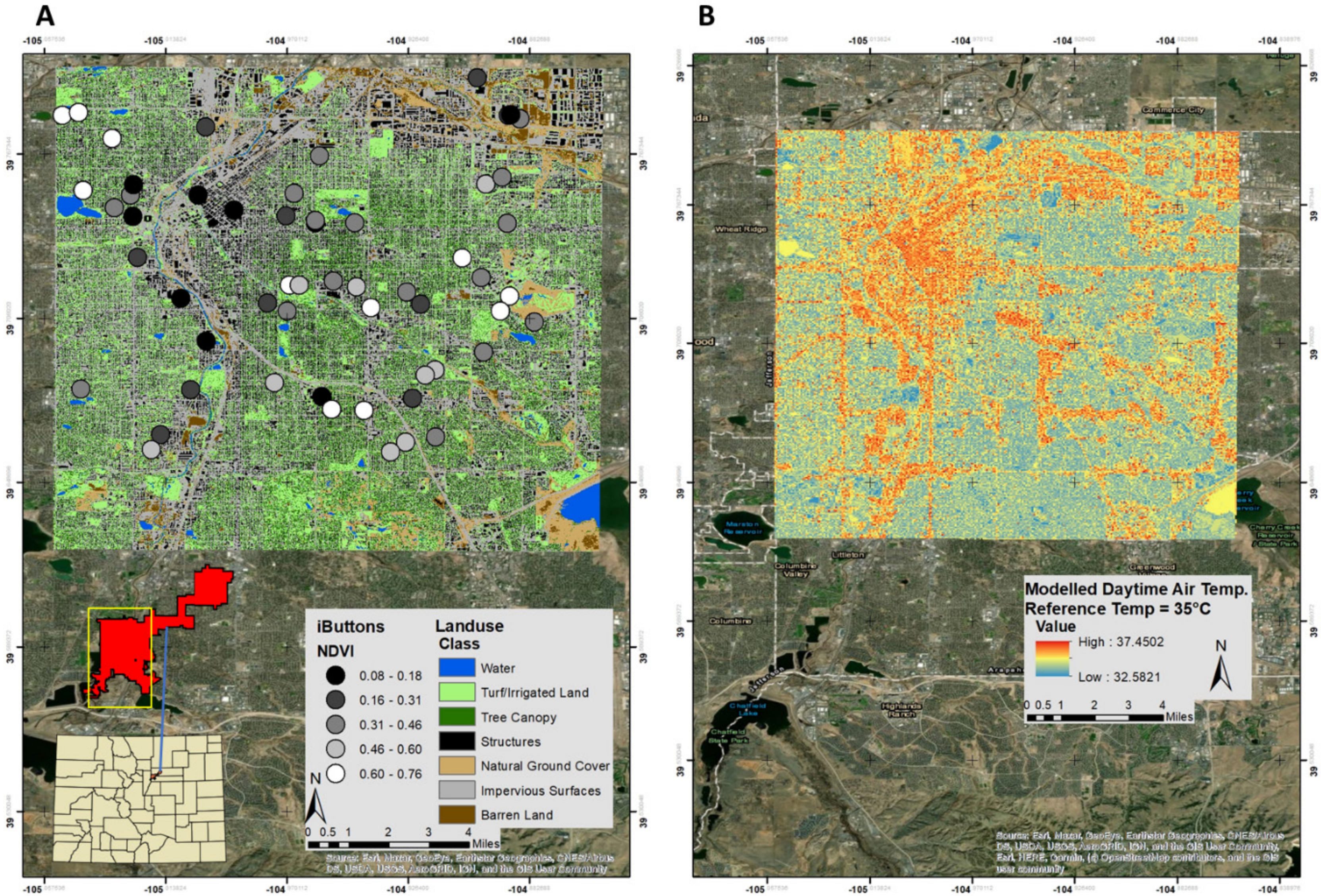


Figure 1A: DRCOG land use land cover imagery (section 12), overlaid with the microclimate sensor locations, stratified against urban greenness. 1B: Modeled daytime air temperature over the DRCOG land use land cover section 12 extent. The random forest model used Denver International Airport temperature at 30 degrees Celsius as a reference.