EGU24-698, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-698
EGU General Assembly 2024

Estimating air temperature based on satellite surface temperature in the Metropolitan Region of São Paulo

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Air and surface temperature are among the most important variables to study the urban climate and are closely linked with thermal comfort and human health. Despite their importance, for now only surface temperature can be estimated by remote sensing, which means that the spatial variability of urban air temperature data can only be studied with a dense set of weather stations, which are expensive and do not yet have a spatial resolution as good as remote sensing. Near-surface air exchanges heat mainly with the surface which suggests that their temperatures could be estimated by each other, but as air is a fluid and moves their relationship is complex, so this estimation cannot yet be done with enough precision. This study aims to help improve the estimation of air temperature with surface temperature using the concept of footprint/source areas, which are the average surface areas that air has most interacted with before reaching the sensor at a weather station. For that, footprint areas were approximated as circles around the weather station. Then, using Landsat 5 and 8 satellites data (which passes around 10 a.m. in local solar time), average surface temperatures at different radii around 51 weather stations at the Metropolitan Region of São Paulo, Brazil, were computed. Then, the Pearson Correlation Coefficient between air and surface temperature was computed for each radius, each weather station and different periods of the year, where the radius with maximum correlation would be an approximation of the true footprint area. The average surface temperature in this area is also a better value for estimating air temperature than the surface temperature in the original Landsat data (100 and 120 metters).