Geophysical Research Abstracts
Vol. 20, EGU2018-11878, 2018
EGU General Assembly 2018

Heat Stress Mitigation of Urban Trees – Fine Scale Assessment Based on Terrestrial LiDAR Data

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Heat stress on summer days has been increasing due to urbanization and climate change (Konarsk et al., 2014). To reduce the heat stress, outdoor thermal comfort regulation effect of urban trees, air temperature reduction and solar radiation decrease, has been researched. Trees in urban area strongly reduce pedestrian level heat stress by absorbing and reflecting solar irradiance although air temperature reduction effect is weak.
Studies on solar radiation transmissivity have been conducted by applying photogrammetry and measuring solar radiation under trees. 2-dimensional techniques, photogrammetry, has been replacing by 3-dimensional (3D) technique using light detection and ranging (LiDAR). LiDAR data can build 3D canopy models that calculate solar radiation transmissivity, reflectivity, and absorptivity. With 3D data, it is possible to calculate solar radiation in 3D space and terrestrial LiDAR facilitates modelling fine scale results.
However, little attention has been paid to pedestrian level solar radiation. With the solar radiation in 3D space, studies in urban area mainly focused on energy costs of buildings. In this study, we focused on the pedestrian level solar radiation mitigation effect of urban trees by measuring transmissivity based on the terrestrial LiDAR data. To assess transmissivity, we voxelized the LiDAR data and applied ray-tracing technique to calculate sky view factor which affects diffuse solar radiation transmissivity and the shadow effect of direct solar radiation. Modeled results are verified by measuring shortwave radiation under trees and roof of the adjacent building.