Geophysical Research Abstracts
Vol. 21, EGU2019-7357, 2019
EGU General Assembly 2019

Investigating the urban thermal behavior using UAV imaging and in-situ micrometeorological observations: the case of Heraklion, Greece

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Cities form a complex arrangement of multiple microclimates, driven mainly by the urban heterogeneity in terms of land cover types, building materials and structure. These attributes affect the surface energy balance, causing the Urban Heat Island (UHI) phenomenon, which undermines the thermal comfort and the quality of life in cities, posing serious risks during extreme events (e.g. heat waves). A major driver of the urban climate is the thermal attributes of the urban cover and building materials that modulates the temperature of the atmospheric surface layer. In order to investigate the spatiotemporal variability of the above phenomena in the appropriate scale, an extended UAV campaign, incorporating RGB, NIR and IR cameras, covering the historic city center of Heraklion, Greece has been performed during two consecutive days in July 2018. Heraklion city center is also equipped with a permanent micrometeorological tower measuring net radiation and turbulent heat and CO_2 fluxes, as well as with a dense urban meteorological station network. UAV imagery is used to produce calibrated and orthorectified RGB/NIR image mosaics and analytic digital surface model (DSM) of the area (5 cm). An optimized Support Vector Machines (SVM) algorithm is applied for the classification of the urban surface materials, whose emissivity is obtained by available urban spectral libraries. Material emissivity is used to calibrate the thermal maps (10 cm) by the IR camera. Available in-situ surface and radiative temperature measurements are used for the evaluation and validation of the produced thermal imagery and associated material emissivity. The spatiotemporal variability of surface temperature is investigated according to the interconnections between incoming radiation, city morphology and land cover types. The relationship between surface and air temperature and the potentiality to estimate sensible heat flux maps using VHR thermal imagery is examined. The first results show the extreme spatiotemporal variability of surface temperature in the urban environment and the pronounced effects of urban canyon orientation, building density and materials to the observed temperatures.