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Airborne hyperspectral thermal data to characterize the thermal behavior of urban materials: preliminary results of the Potenza and Matera (Italy) TASI survey

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Analysis of the urban materials thermal behavior is challenging because it requires the use of high spatial and spectral resolution thermal data in order to detect impervious surfaces and urban vegetation, which can change significantly the local average surface temperature. Their distribution affects the urban surface heat island that is one of the most important matters in urban climatology studies [1].

To study and analyze the urban thermal behavior and material properties (i.e. land surface temperature, emissivity) in the study area, thermal infrared airborne remote hyperspectral data were used. The survey was carried out on December 12, 2015, using TASI-600 sensor [3, 4, 5], on two urban districts pertaining to the Basilicata Region in Italy. TASI-600 data were acquired with a spatial resolution of 1m/pixel and 32 channels from 8 to 11.5 μm with a spectral resolution of 100 nm. The airborne surveys interested two urban and one industrial districts: the city of Potenza (surveyed @ about 9:00 a.m. local time) with recently build urban functional areas and the city of Matera (surveyed @ about 1:00 p.m. local time) with its ancient historical centre much appreciated and renowned for its "Sassi" districts.

The advantage of the TASI airborne survey relies in the high spatial resolution that permits to clearly discriminate objects and single roof buildings, while the high spectral resolution assures the detection of the major atmospheric absorption bands required for an efficient atmospheric correction. Temperature emissivity separation (TES) procedure was efficiently applied to the TASI imagery to retrieve both temperature and spectral emissivity of the main urban surfaces [2].

Temperature emissivity separation (TES) was carried out by solving the following equation,

$$L_{\lambda,i} = [\varepsilon_{\lambda,i} B_\lambda(T_i) + (1 - \varepsilon_{\lambda,i}) L_{SKY_\lambda}]\tau_\lambda + L_{ATM_\lambda}$$

where L_{sky} is the measured radiance, the downwelling radiance, $B_{\lambda(Ti)}$the radiance from the surface, τ_λ is the atmospheric transmittance, and $L_{ATM\lambda}$is the radiance associated with TIR self-emission of all atmospheric components.

The obtained preliminary results are encouraging, as they show the benefits of the use of airborne TIR hyperspectral imaging for characterizing the main urban surfaces and understanding the urban temperature gradients which are the main factor affecting the Urban Heat Island Effect.

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