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Optimal bands pair combination for LST retrievals from TASI-600 airborne data

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Thermal Airborne Spectrographic imager (TASI) has been widely used for different research purposes and applications, but only few works have been carried out on Land Surface Temperature (LST) retrievals exploiting the instrument data. LST is a significant parameter in a wide range of scientific disciplines, such as studies regarding evapo-transpiration, global change, and monitoring of water plants stress and drought. In order to solve the inversion problem for LST estimation by remote sensed data, a great variety of algorithms has been published and successfully applied on most popular satellite and airborne data. In this context, we aim to select the best wavelengths combination for TASI channels in order to retrieve LST by its data applying the split window (SW) algorithm suggested by Sobrino and Raissouni (2000)
TASI-600 is a thermal sensor with 32 channels covering the spectral range between 8 and 11.5 μm (LWIR) and a spectral resolution of 109.5 nm. With the purpose of selecting the optimal bands combination, numerical analysis has been performed on TASI channels located in the range between 10 and 11.5 μm, which corresponds to the typical SW wavelengths (10 – 12 μm). A radiative transfer experiment has been carried out by using Moderate Resolution Atmospheric Radiance and Transmittance Model (MODTRAN) code. An observer altitude of 1 km, consistent with aerial acquisitions, and profiles and surface characteristics of a training dataset gathered from the database compiled by Borbas et al. have been considered. The SeeBor V5.0 database consists of 15,704 clear-sky profiles of temperature, ozone, total precipitable water (TPW); and other ancillary data such as ground latitude, longitude and elevation, surface pressure, skin temperature, spectral emissivities and the relative International Geosphere-Biosphere Programme (IGBP) classification.
As preliminary outcomes, we have obtained that best TASI channels combinations suitable for LST estimation result in channel 18 (10.034 μm) combined with channel 28 (11.024 μm), and channel 29 (11.134 μm) combined with channel 30 (11.354 μm). Simulations of LST retrievals reveal an R2 of 0.999 for both bands combinations and a Root Mean Square Error (RMSE) of 0.485 K for the pair of bands 18 and 28, and a RMSE of 0.521 K for the pair of channels 29 and 30. Nevertheless, TASI channels located after 11 μm present a larger Noise Equivalent Delta Temperature (NEΔT) which increases with wavelength; thus, the involvement of these bands would have negative impact on the outcomes. On the other hand, the spectral variability in the emissivity of the different IGBP classes becomes larger for the bands combination 18 and 28, especially for barren areas (bare soil class), resulting on greater errors on the LST estimation. Hence, a sensitivity analysis has been accomplished evaluating the contribution to the total theoretical error on LST retrieval on the two channels pairs for the different terms involved in the SW algorithm, in particular those concerning the NEΔT and emissivity uncertainty.

Sobrino, J. A., & Raissouni, N. (2000). Toward remote sensing methods for land cover dynamic monitoring: Application to Morocco. IJRS, 21(2), 353-366.