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# A Useful Tool for Atmospheric Correction and Surface Temperature Estimation of Landsat Infrared Thermal Data

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Land Surface temperature (LST) is a critical variable for studying the energy and water budgets at the Earth surface, and is a key component of many aspects of climate research and services. The Landsat program jointly carried out by NASA and USGS has been providing thermal infrared data for 40 years, but no associated LST product has been yet routinely proposed to community.

To derive LST values, radiances measured at sensor-level need to be corrected for the atmospheric absorption, the atmospheric emission and the surface emissivity effect.

Until now, existing LST products have been generated with multi channel methods such as the Temperature/Emissivity Separation (TES) adapted to ASTER data or the generalized split-window algorithm adapted to MODIS multispectral data. Those approaches are ill-adapted to the Landsat mono-window data specificity. The atmospheric correction methodology usually used for Landsat data requires detailed information about the state of the atmosphere. This information may be obtained from radio-sounding or model atmospheric reanalysis and is supplied to a radiative transfer model in order to estimate atmospheric parameters for a given coordinate.

In this work, we present a new automatic tool dedicated to Landsat thermal data correction which improves the common atmospheric correction methodology by introducing the spatial dimension in the process. The python tool developed during this study, named LANDARTs for LANDsat Automatic Retrieval of surface Temperature, is fully automatic and provides atmospheric corrections for a whole Landsat tile. Vertical atmospheric conditions are downloaded from the ERA Interim dataset from ECMWF meteorological organization which provides them at 0.125 degrees resolution, at a global scale and with a 6-hour-time step. The atmospheric correction parameters are estimated on the atmospheric grid using the commercial software MODTRAN, then interpolated to 30m resolution.

We detail the processing steps implemented in LANDARTs and propose a local and spatial validation of the LST products from Landsat dataset archive over two climatically contrasted zones: south-west France and centre of Tunisia. In both sites, long term datasets of in-situ surface temperature measurements have been compared to LST obtained for Landsat data processed by LANDARTs and filtered from clouds. This temporal comparison presents RMSE between 1.84K and 2.55K. Then, Landsat LST products are compared to ASTER kinetic surface temperature products on two synchronous dates from both zones. This comparison presents satisfactory RMSE about 2.55K with a good correlation coefficient of 0.9. Finally, a sensibility analysis to the spatial variation of parameters presents a variability reaching 2K at the Landsat image scale and confirms the improved accuracy in Landsat LST estimation linked to our spatial approach.