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A web application for Global Land Surface Temperature Estimation from Landsat

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The Land Surface Temperature (LST) is among the Essential Climatic Variables, defined by the World Meteorological Organization, as it enables monitoring the climate change. Moreover, LST can provide insights about causes and effects in both the natural and urban environments. The Landsat satellites monitor the LST from space for almost four decades with high spatial resolution. By taking advantage of the Landsat thermal measurements, starting from Landsat 4 up to the most recent Landsat 8, we make available LST maps on a global scale starting from 1982 to present.

A web application providing global LST data from Landsat on-the-fly has been developed by using the latest cloud infrastructure technologies. Google Earth Engine (GEE), an advanced Earth science data and analysis platform, allows the computation of LST maps for the globe, by providing all the necessary computing and storage resources. Thus, the application requires no computational power or input data from the users, making it lightweight and fast.

A single channel LST algorithm is used for consistency among the different Landsats 4, 5, 7 and 8. Single channel algorithms require emissivity information from external sources. The option to select the emissivity from different sources, i.e. MODIS (Moderate Resolution Imaging Spectroradiometer), ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) or NDVI-based (Normalized Difference Vegetation Index) is provided in the application. The user can select the desired emissivity source depending on the area of interest and the needs of the respective study, since different emissivity products provide more accurate results under different circumstances. Thus, the applications provides flexibility and better accuracy for the algorithm's implementation, depending on the user needs.

An evaluation process of the web application LST products was performed to observe and document the behavior of different emissivity products on LST. LST products from the web application were compared against two reference datasets: (a) high level ASTER LST products derived with temperature-emissivity separation approach; (b) Landsat LST products that have been independently produced, using different approaches. An overall RMSE (root mean square error) of 1.52 °C was observed for Landsat 5,7 and 8. No reference data were available for Landsat 4. Different emissivity sources provided different LST accuracies, depending on the surface cover of the area, its spatial homogeneity, as well as the effect of human interventions and their frequency.

The application can be accessed at: http://rslab.gr/downloads_LandsatLST.html