Fixed-term position

Title: Evaluating the potential of several empirical methods for the disaggregation of LST MODIS products

Duration: 12 months
Starting date: by October 2021
Location: Strasbourg / ICube laboratory

Topic description

This research work is financed by the French space agency (CNES).

To efficiently study physical processes related to LST (Land Surface Temperature) such as water stress or urban heat islands, a high temporal resolution as well as a sufficiently high spatial resolution (especially in heterogeneous environments where the size of the observed objects is often smaller than the pixel size) are necessary. However, the technical specificities of current sensors do not generally allow the estimation of the LST at a satisfactory spatial resolution for local scale applications. Indeed, products with a spatial resolution of a hundred meters or less are available at best every 16 days (ASTER and Landsat), and those available on a daily basis have kilometric resolution (MODIS). These resolutions are a strong limitation for many applications such as LST monitoring in urban areas. Several studies have shown that by exploiting information from an image acquired in the reflective domain it is possible to estimate the LST at a better spatial resolution than the native image (Granero-Belinchon et al., 2019a[1] , 2019b[2]). Based on these results, the idea is to test the applicability of existing empirical disaggregation methods to the MODIS 1 km data to produce daily LST, in the absence of cloud cover, at 500 m and 250 m resolution. After validation of the results (with ASTER, Landsat and airborne images), the best method will be used to produce a full year national disaggregated LST dataset, which would represent a significant contribution to the panel of available LST datasets.

The objective of this work is therefore to test several empirical disaggregation methods on MODIS 1 km LST products to determine the most suitable method and produce a 1-year disaggregated daily LST time series at the national scale.

The proposed work is divided into 4 steps:

(1) Identification of study areas to test the disaggregation methods
The aim is to select areas for which validation data are available (ground data and/or Landsat and ASTER acquisition). These areas will be representative of different landscapes: forest, agricultural, peri-urban, urban, with two to three zones per landscape type, for a total of 8 to 12 study areas.

(2) Application of disaggregation methods on MODIS images for the identified areas
For disaggregation, the study will focus on the empirical methods presented in Granero-Belinchon et al. (2019a). These methods combine low-resolution IRT data with high-resolution visible or near-infrared (VNIR) data based on the assumption that the relationships established between a

[1] Granero-Belinchon, C., Michel, A., Lagouarde, J-P., Sobrino, J., Briottet, X (2019a). Multi-Resolution Study of Thermal Unmixing Techniques over Madrid Urban Area: Case Studyof TRISHNA Mission. Remote Sensing, 11 (10), pp.1251.
[2] Granero-Belinchon, C., Michel, A., Lagouarde, J-P., Sobrino, J., Briottet, X. (2019b). Night thermal unmixing for the study of microscale Surface Urban Heat Islands with TRISHNA. Remote Sensing, 11 (12), pp.1449.

temperature and a spectral index at a coarser resolution are preserved at a finer scale. The work presented in this paper is carried out in an urban environment on thermal images simulated at different spatial resolutions ranging between 20 and 100 m. The aim here is to go further by extending the evaluation to other environments and other spatial resolutions. We will thus evaluate 7 empirical methods for disaggregating MODIS LST data over the study areas selected in step 1.

(3) Validation
The validation of the data produced in step 2 and the identification of the most suitable disaggregation method for MODIS LST products will be done in two steps. First, a visual inspection will allow the elimination of wrong maps presenting possible artefacts generated during the disaggregation. Second, the remaining maps will be compared to concomitant Landsat or ASTER LST products or to LST maps estimated from airborne acquisitions.

(4) Production of LST disaggregated dataset with the selected method
The method identified during the validation as being the most suitable for the disaggregation of the MODIS LST products will be applied to a one-year time series (2019) over the entire French territory. The observations made during the validation may lead to restrictions and recommendations concerning the quality of disaggregated data in certain areas.

This work will take place in the framework of the activities of the Centre d'Expertise Scientifique (CES) dedicated to the estimation of LST and emissivity, supported by the CNES, in close collaboration between the ICube laboratory and ONERA.

Net salary: between 1600 à 2000€ according to the experience

Candidate profile

Education: Engineer/Master or PhD in remote sensing or signal processing
Knowledge in radiation and optical remote sensing and programming skills in Python would be a plus

Contact information

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