Ground-Based Observations for Validation of Copernicus Global Land Products: Land Surface Temperature

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1. Introduction

Copernicus Global Land Products (CGLPs) are satellite-derived bio-geophysical land surface products provided by the Copernicus Global Land Service[1]. In order to ensure these datasets are of high quality and consistency they must be validated using independent data sources.

The Ground-Based Observations for Validation of CGLPs (GBOV) project aims to develop and distribute robust in situ datasets which can provide a systematic and quantitative validation of CGLPs. In situ observations from a number of permanent ground-based monitoring sites (covering 10 m^2), are upscaled in order to be more representative of the equivalent CGLP pixel (5 km^2). Here we present the methods to upscale in situ Land Surface Temperatures (LSTs) from 13 in situ sites for validation of the CGLP LST product.

2. Reference Measurements (RMs)

- Thermal Infrared Radiances (RM-2)
  - Derived from thermal radiation data measured by radiometers or pyrgeometers at each site (Fig. 1).
- Land Surface Emissivity (LSE, RM-8)
  - Monthly emissivity is derived for each site from the CIMMS Baseline Fit Emissivity Database[2].
- Land Surface Temperature (RM-9)
  - Derived using in situ observations of thermal infrared radiances (RM-2) and LSE (RM-8) at each site.

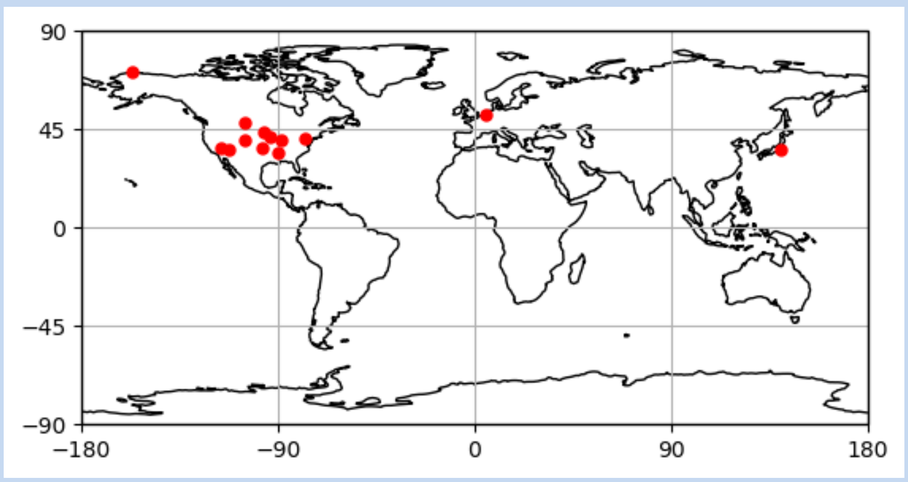

Fig. 1: Location of the 13 GBOV LST in situ sites.

3. Upscaled LST (LP-7)

- Upscaling coefficients describing the relationship between in situ LSTs (RM-9) and LSTs at CGLP pixel resolution were derived from satellite data of higher resolution than CGLP data.
  - 1 km GlobTemperature[3] Moderate Resolution Imaging Spectroradiometer (MODIS) Terra LSTs were used to derive the coefficients for each in situ station, calendar month and for two satellite overpass times approximately corresponding to daytime and nighttime.
- In situ LSTs (RM-9) at stated validation times are upscaled using a linear function and the upscaling coefficients to provide an estimate of the equivalent LST of the CGLP satellite footprint around each in situ site.

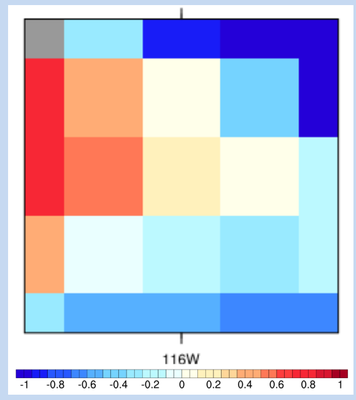

Fig. 2: Daytime median difference (K) between LSTs at the MODIS pixel observing the site (grey) and surrounding MODIS pixels in the 5 km^2 CGLP pixel corresponding to the Surfrad Desert Rock, Nevada site.

4. Results

- Upscaled LSTs (LP-7) for 2013-2016 generally have a smaller median difference compared to CGLP LST data than seen for in situ LSTs (RM-9).
- This suggests that the upscaled LSTs are more comparable to the CGLP data, as shown in Fig. 3 and Fig. 4 for two example sites.

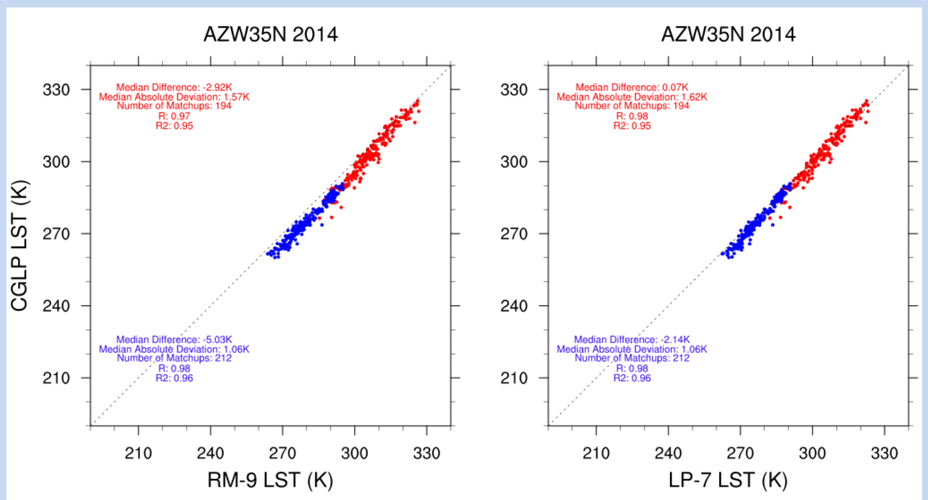

Fig. 3: In situ LST (RM-9) and upscaled LST (LP-7) compared to CGLP data for the USCRN Williams, Arizona site in 2014. Daytime data is in red and nighttime data is in blue.

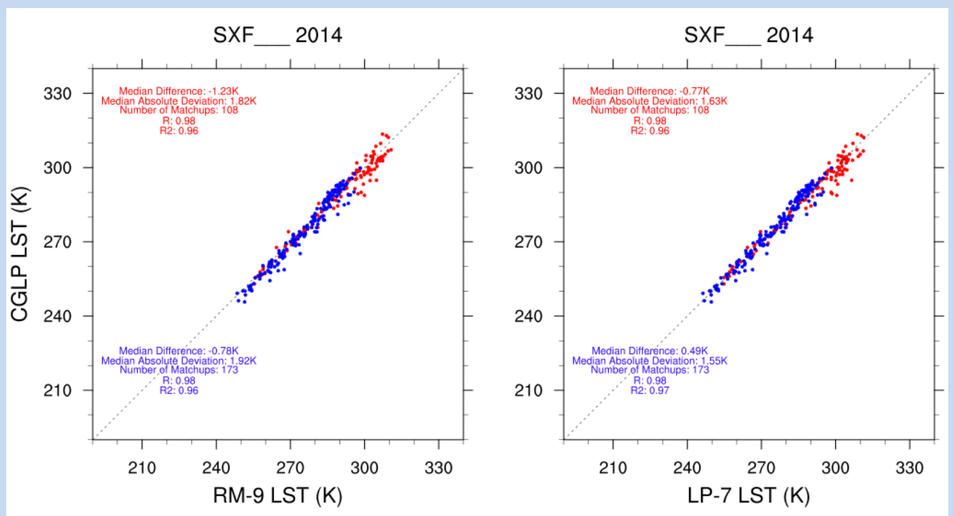

Fig. 4: In situ LST (RM-9) and upscaled LST (LP-7) compared to CGLP data for the Surfrad Sioux Falls, South Dakota site in 2014. Daytime data is in red and nighttime data is in blue.

5. Summary, Data Access and Future Work

- A method for upscaling in situ LSTs to LSTs at CGLP pixel resolution (5 km^2) has been developed.
- Results suggest that the upscaled LSTs are generally more comparable to the CGLP data than in situ LSTs which were not upscaled. Data for the 13 sites is available for 2013-2016 on the GBOV website (http://gbov.copernicus.acri.fr/).
- Future work will apply this method to further years of data, extend this method to more sites with existing thermal radiation instrumentation and set up new instrumentation at existing in situ sites.

6. References and Acknowledgements

1. Copernicus Global Land Service: https://land.copernicus.eu/global/index.html
2. Seemann, S.W., Borbas, E.E., Knuteson, R.O., Stephenson, G.R., & Huang, H.-L. (2008). Development of a global infrared land surface emissivity database for application to clear sky sounding retrievals from multispectral satellite radiance measurements. Journal of Applied Meteorology and Climatology, 47, 108-123
3. ESA DUE GlobTemperature Project. http://www.globtemperature.info/

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