Journal of Agrometeorology

ISSN : 0972-1665 (print), 2583-2980 (online)
Vol. No. 26 (1) : 124 - 127 (March - 2024)
https://doi.org/10.54386/jam.v26i1.2279
https://journal.agrimetassociation.org/index.php/jam

Short Communication

Extraction of MODIS land surface temperature and its validation over Samastipur district of Bihar

RAJESH G. M.[1]* and SUDARSHAN PRASAD[2]

[1]Department of Soil and Water Conservation Engineering, Kerala Agricultural University, Thrissur-680656, Kerala.
[2]Department of Soil and Water Engineering, Dr. Rajendra Prasad Central Agricultural University, Pusa-848125, Samastipur, Bihar.
**Corresponding Author email: rajeshgm7991@gmail.com*

Land surface temperature (LST) is an important variable for the assessment of the surface energy budget. LST controls the surface emitted long-wave radiation, being also important for the estimation of the sensible and latent heat fluxes between the surface and the atmosphere (Sun and Pinker, 2003). Remotely sensed thermal data constitute the best source of information for LST estimation over large areas, and within these, data obtained from geostationary satellites are the only capable of fully characterizing the daily cycle of LST. LST has found wide applications in climate change assessments, agricultural drought monitoring, urban heat analysis, and land surface modelling Moreover, the Global Climate Observing System (GCOS) recognizes LST as an essential climate variable due to its significant influence on Earth's climate characterization. To acquire accurate LST data across different spatial scales, remote sensing techniques offer a valuable solution. They provide extensive spatial coverage, frequent data acquisition, long-term observations, and superior performance compared to ground-based measurements (Chung *et al*., 2020).

MODIS Land Surface Temperature (LST) product is extensively used in agricultural studies like crop health assessment, soil moisture estimation, irrigation management, land use land cover change, air-temperature retrieval and crop water stress detection (Shah *et al.,* 2012; Dadhwal and Bhat, 2023). Several algorithms have been developed to obtain LST from space, most of them making use of data from sensors onboard polar-orbiters (Liang, 2001; Dave *et al.,* 2023). Similar methodologies (Li and Wang, 2019) have also been applied to data from geostationary satellites, with lower spatial resolution but higher temporal samplings.

The present study was undertaken to develop a relationship between the LST generated by the Satellite Application Facility on Land Surface Analysis and in situ measurements collected at meteorological station, Pusa, Samastipur district of Bihar. The study region, Samastipur district of Bihar, was divided into 67 numbers of square grids of 8 km × 8 km spatial resolution using the Geographic Information System (ArcGIS) software version 10.7.1 (Fig. 1). Global Land Data Assimilation System (GLDAS) Noah land surface temperature data product Noah 0.25° × **0.25**° monthly dataset was downloaded (https://daac.gsfc.nasa.gov/) from the years 2000 to 2020 and processed in ArcGIS for land surface temperature extraction over the study area. The air temperature (maximum and minimum) data were collected from the meteorological station situated in the campus of Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur for the 21 years from 2000 to 2021. These daily data were processed and converted into monthly scale for validating the satellite based LST extracted from GLDAS.

The mean monthly land surface temperature over the study area was extracted from GLDAS LST products for each grid points created in the region using the algorithm as mentioned in Fig. 2 and compared with air temperature recorded at meteorological station (MS), Pusa. Following the suggestion of Subramanya, (2006) the observed air temperature over the selected 14 grid points like GP-44, GP-45, GP 46, GP-47, GP-53, GP-54, GP-55, GP-56, GP-60, GP-61, GP-62, GP-63, GP-65 and GP-66 which are under the circumferential coverage of 3000 km^2 in flat area from MS, Pusa considering as center for comparison and validation.

Table 1 shows the extracted and bias corrected GLDAS LST over the selected region having 14 grid points. All the extracted data of 21 years were bias corrected and related with the observed values. Fig.3 clearly depicts the close relationship between the near

Article info - DOI: *https://doi.org/10.54386/jam.v26i1.2279*
Received:21 July 2023; Accepted: 1 February 2024; Published online : 1 March 2024

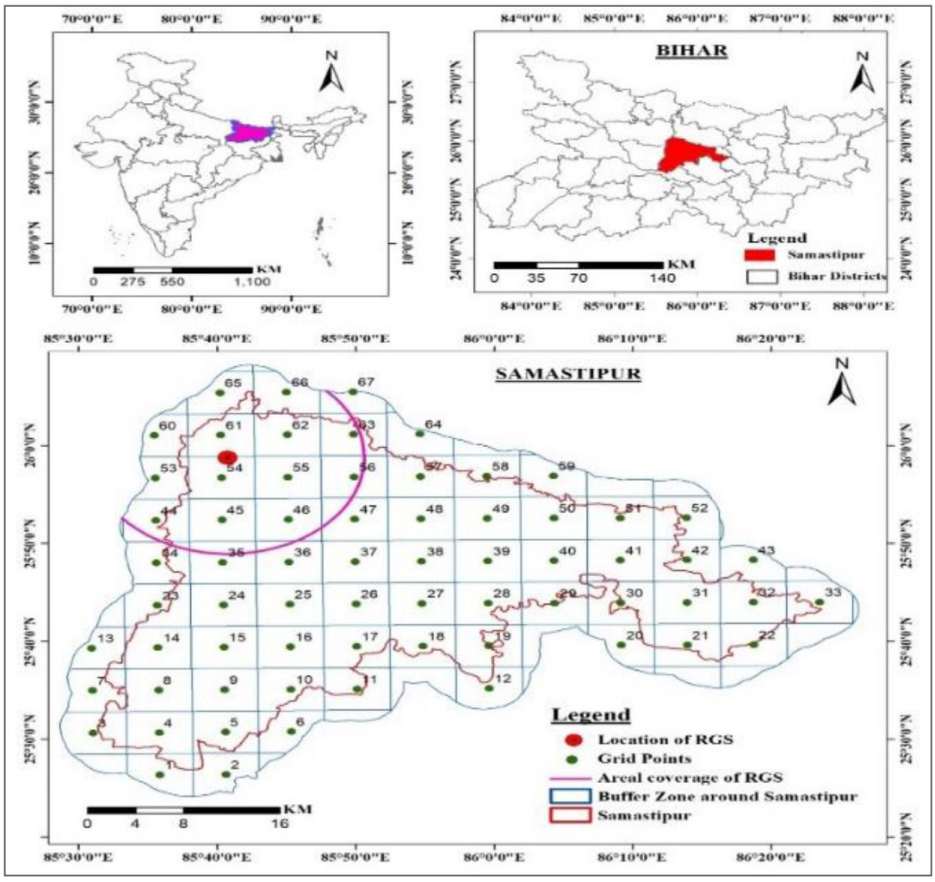

Fig.1: Location of study area

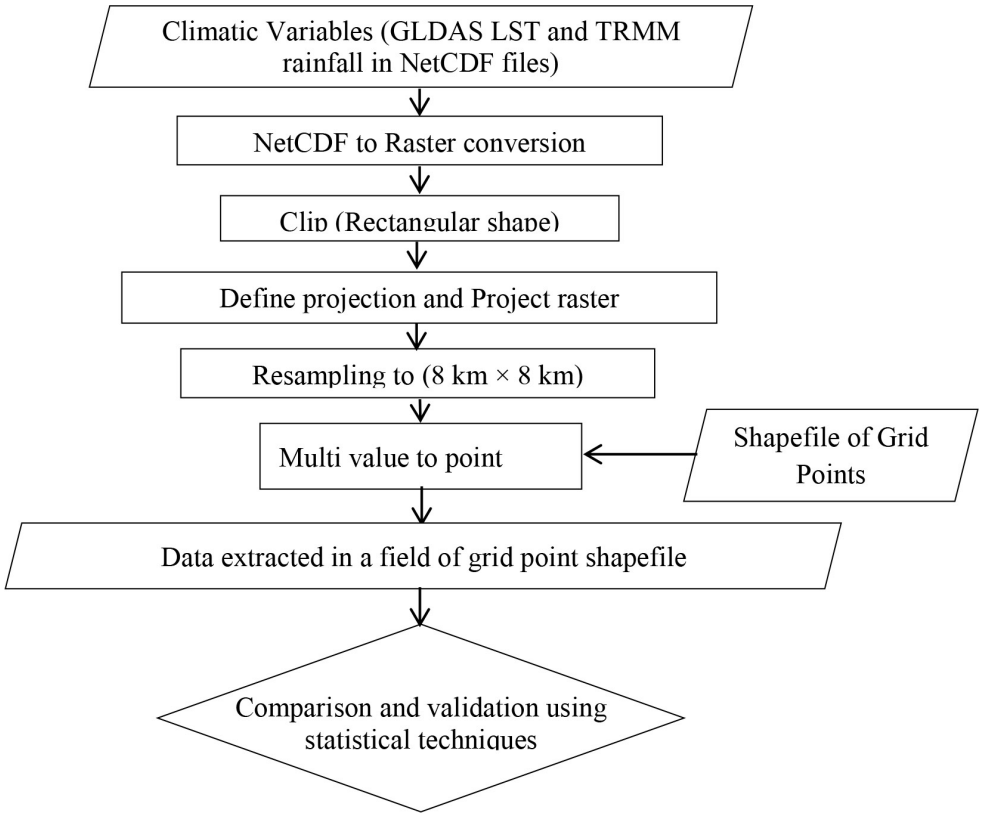

Fig.2: Flow chart for extraction of climatic variables from satellite over the study area

Table 1: Basic statistics of observed air temperature, extracted and bias free GLDAS land surface temperature over Samastipur district of Bihar

Grid Points	Observed air temperature			Extracted GLDAS LST			Bias Corrected GLDAS LST		
	Mean (ºC)	SD (ºC)	CV	Mean (ºC)	SD (ºC)	CV	Mean (ºC)	SD (ºC)	CV
GP-44	24.95	5.63	0.23	25.94	7.03	0.27	24.95	5.68	0.23
GP-45	24.95	5.63	0.23	25.90	7.01	0.27	24.95	5.68	0.23
GP-46	24.95	5.63	0.23	25.86	6.97	0.27	24.95	5.68	0.23
GP-47	24.95	5.63	0.23	25.82	6.94	0.27	24.95	5.68	0.23
GP-53	24.95	5.63	0.23	25.83	7.00	0.27	24.95	5.68	0.23
GP-54	24.95	5.63	0.23	25.80	6.97	0.27	24.95	5.68	0.23
GP-55	24.95	5.63	0.23	25.76	6.94	0.27	24.95	5.68	0.23
GP-56	24.95	5.63	0.23	25.73	6.90	0.27	24.95	5.68	0.23
GP-60	24.95	5.63	0.23	25.67	7.00	0.27	24.95	5.68	0.23
GP-61	24.95	5.63	0.23	25.64	6.98	0.27	24.95	5.68	0.23
GP-62	24.95	5.63	0.23	25.61	6.94	0.27	24.95	5.68	0.23
GP-63	24.95	5.63	0.23	25.59	6.89	0.27	24.95	5.68	0.23
GP-65	24.95	5.63	0.23	25.48	6.98	0.27	24.95	5.68	0.23
GP-66	24.95	5.63	0.23	25.46	6.94	0.27	24.95	5.68	0.23

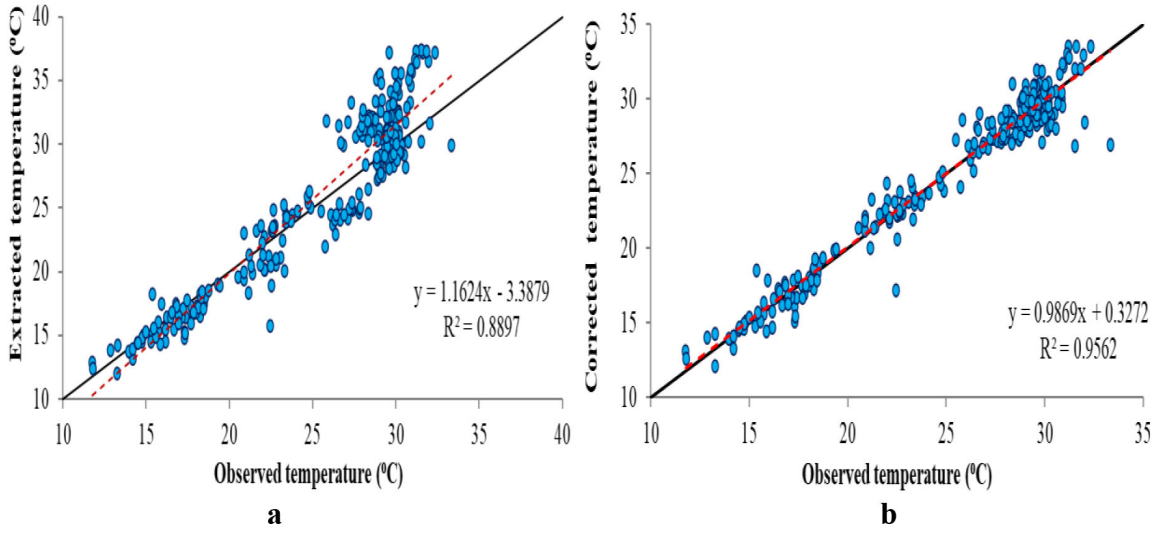

Fig. 3: Scatter plot between monthly observed mean temperature and (a) monthly extracted mean LST and (b) monthly corrected mean LST

surface air temperature observed and the bias free (corrected) land surface temperature extracted. The graphs show that the mean air temperature observed and the bias free land surface temperature extracted (Fig.3b) were greatly improved over non corrected data (Fig 3a).

The statistical analysis advocates the use of satellites based GLDAS LST product for air temperature over the district however, application of some statistical correction method like Linear-Scaling method of bias correction which has been found to be extremely suitable and reliable.

ACKNOWLEDGEMENT

The authors thank the Department of Soil and Water Engineering, RPCAU, Pusa for extending the facilities, guidance and technical assistance in conducting this research work.

***Funding*:** RPCAU, Pusa

***Conflict of interests*:** The authors declare that there is no conflict of interest related to this article.

Data availability: Data available in public domain

***Author's contribution*: Rajesh G M:** M. Tech Research Work**; S. Prasad:** Major Advisor

Disclaimer: The contents, opinions, and views expressed in the research communication published in the Journal of Agrometeorology are the views of the authors and do not necessarily reflect the views of the organizations they belong to.

Publisher's Note: The periodical remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

REFERENCES

Chung, J., Lee, Y., Jang, W., Lee, S. and Kim, S. (2020). Correlation analysis between air temperature and MODIS land surface temperature and prediction of air temperature using TensorFlow long short-term memory for the period of occurrence of cold and heat waves. *Remote Sens.*, *12*(19): 3231. https://doi.org/10.3390/rs12193231

Dadhwal, V. K. and Yamini Bhat. (2023). Revisiting statistical spectral-agrometeorological wheat yield models for Punjab using MODIS EVI and NCMRWF re-analysis temperature data. *J. Agrometeorol.*, *25*(1): 10–17. https://doi.org/10.54386/jam.v25i1.2067

Dave, J. A., Pandya, M. R., Shah, D. B., Varchand, H. K., Parmar, P. N., Trivedi, H. J., Pathak, V. N., Singh, M. and Kardani, D. B. (2023). Comparative analysis of two parameter-dependent split window algorithms for the land surface temperature retrieval using MODIS TIR observations. *J. Agrometeorol.*, *25*(4): 510–516. https://doi.org/10.54386/jam.v25i4.2286

Liang, S. (2001). An optimization algorithm for separating land surface temperature and emissivity from multispectral thermal infrared imagery. *IEEE Trans. Geosci. Remote Sens.*, *39*(2): 264-274.

Li, D. and Wang, L. (2019). Sensitivity of surface temperature to land use and land cover change-induced biophysical changes: the scale issue. *Geophy. Res. Lett.*, *46*(16): 9678-9689. https://doi.org/10.1029/2019GL084861

Shah, D. B., M. R. Pandya, H. J. Trivedi, and A. R. Jani. (2012). Estimation of minimum and maximum air temperature using MODIS data over Gujarat. *J. Agrometeorol.*, *14*(2): 111–118. https://doi.org/10.54386/jam.v14i2.1403

Subramanya, (2006). Engineering Hydrology. Tata McGraw Hill, Publishing Company Ltd., New Delhi, pp- 127.

Sun, D. and R. T. Pinker, (2003). Estimation of land surface temperature from a Geostationary Operational Environmental Satellite (GOES-8), *J. Geophys. Res.: Atmos.*, 108(D11): 4326. doi:10.1029/2002JD002422.