AN OPTIMIZED METHOD TO VALIDATE HIGH RESOLUTION GROSS PRIMARY PRODUCTION BASED ON FLUX TOWER MEASUREMENT

Tao Yu, Yong Pang*, Xiaodong Niu, Zengyuan Li

Institute of Forest Resource Information Techniques, Chinese Academy of Forestry, Beijing, China
Key Laboratory of Forestry Remote Sensing and Information System of National Forestry and Grassland Administration, Beijing, China

* Corresponding author: Yong Pang, pangy@ifrit.ac.cn

Abstract

High spatial-temporal resolution of satellite imagery provides a good data source for monitoring regional carbon fluxes and carbon cycle. However, a mismatch of temporal and spatial scale exists between the remote sensing data and ground measurement data when validating the remote sensed products. To optimize the strategy to match the Sentinel-2 derived gross primary productivity (GPP) and ground GPP, we analyzed the accuracy of Sentinel-2 GPP when validating at several temporal and spatial scales at Baotianman station in the Henan province and Pu'er station in China. Results of this study indicated that the best match existed when validating the Sentinel-2 GPP at footprint spatial scale at the time about 30~60 minutes on the passing time of Sentinel-2 images.

1. Introduction

Multiple kinds of satellite images, especially the high spatial and temporal earth observations in recent years, such as Landsat and Sentinel series, have increased the potential to accurately estimate gross primary productivity (GPP) and describe the detailed vegetation photosynthesis. Some questions still worth investigating when validating high resolution GPP.

- What impacts does the mismatch between flux footprint and satellite pixels have on the validation accuracy?
- How to match the high resolution satellite data and flux tower observations, and to improve their agreement in photosynthesis estimates?

2. Data and Methods

Carbon flux data were obtained from the flux tower measurement from Baotianman site (111°56′10″ E, 33°29′59″ N) in Henan Province and Pu'er site (101°5′24″E, 22°24′59″N) in Yunnan Province in China in the Sentinel-2 overpassing time in 2019 and 2020. Steps to validate the high resolution GPP were as follows:

- Real time Sentinel-2 GPP were obtained through Carnegie, Ames, Stanford Approach (CASA).
- The observed GPP were derived from carbon flux data.
- Footprint of the observed GPP was obtained by using the flux source area model (FSAM).
- Sentinel-2 GPP were validated at different temporal and spatial scales.

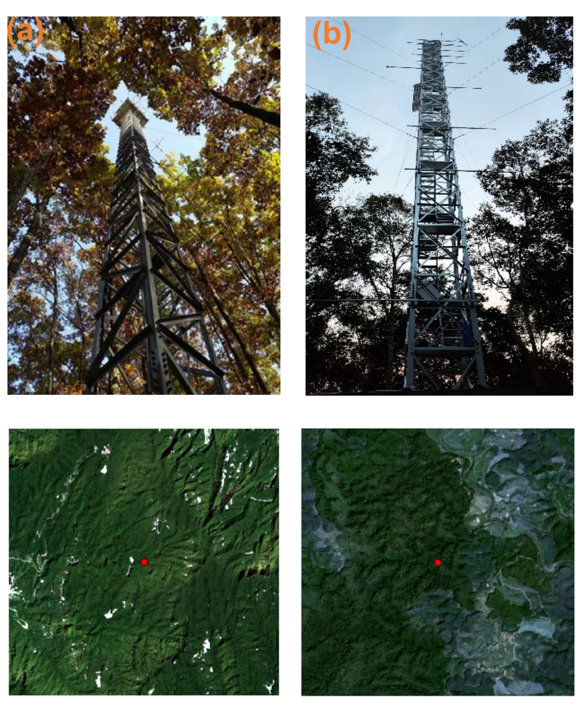

Figure1 Flux tower and the digital orthophoto map at Baotianman site (a) and Pu'er site (b)

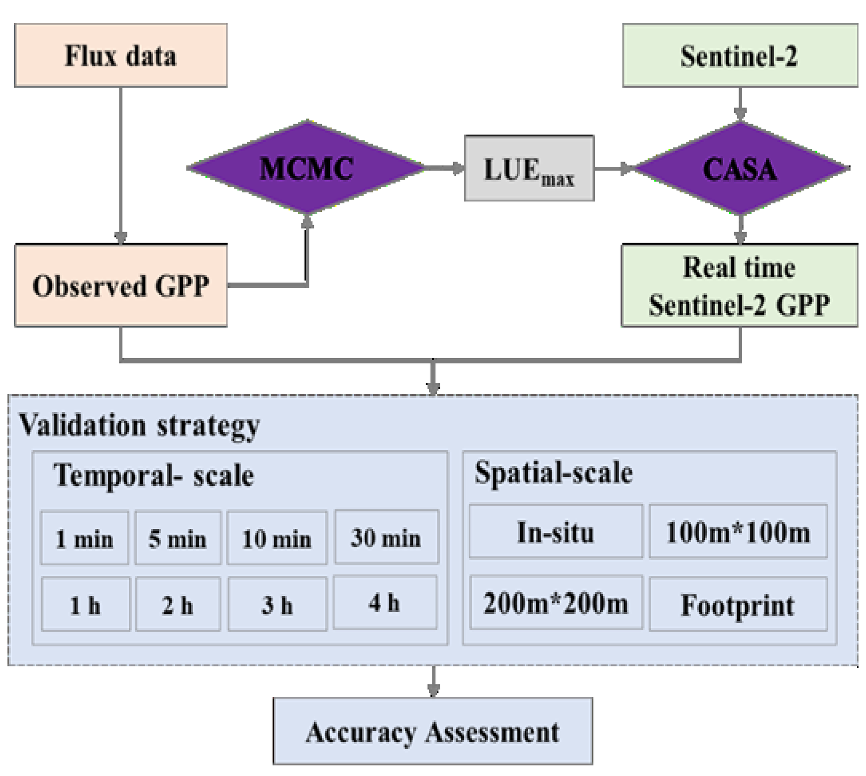

Figure 2 Flowchart of real time GPP validation

3. Results

From Figure 3 and Figure 4, we could find that GPP at the passing time of Sentinel-2 is in a sharp changing trend. The hourly changes in GPP within a day are significant, and the average value cannot reflect the variation of GPP.

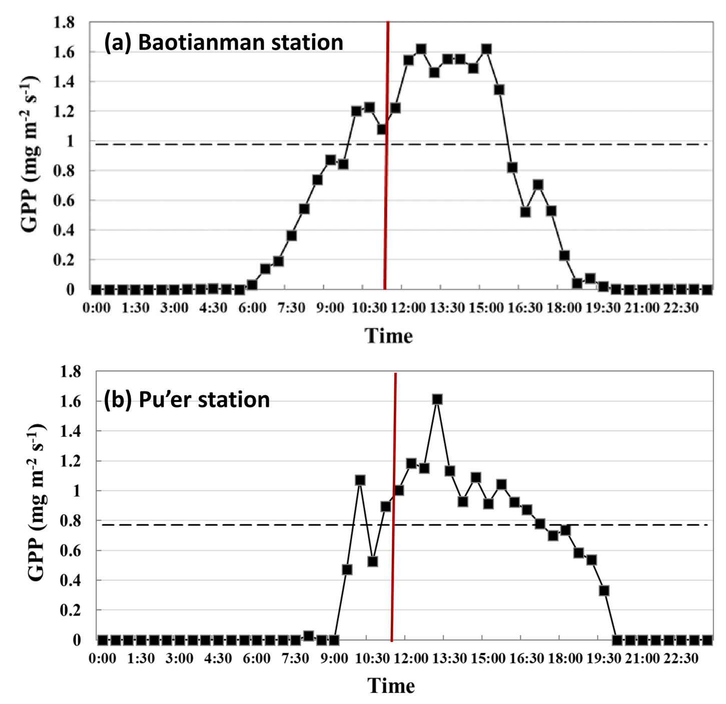

Figure 3 Variation of GPP in one day

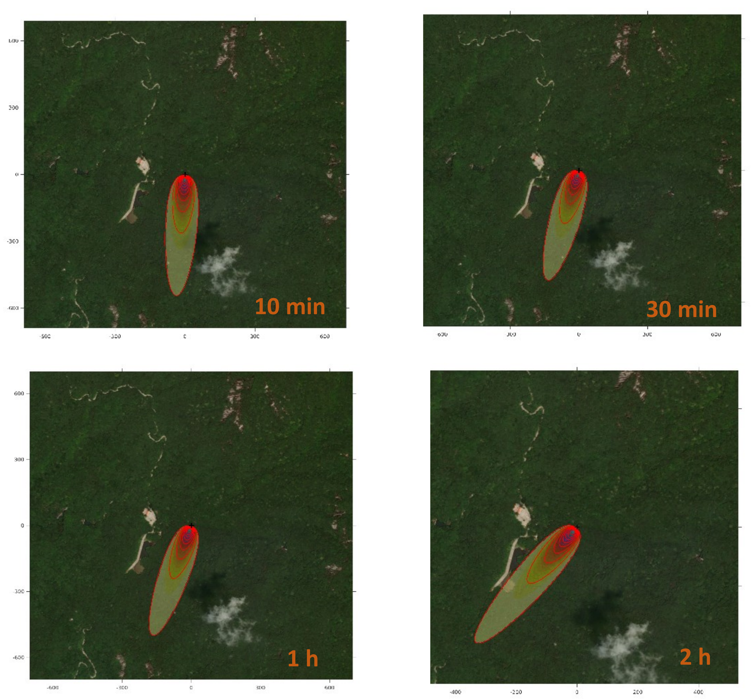

Figure 4 Variation of GPP footprint

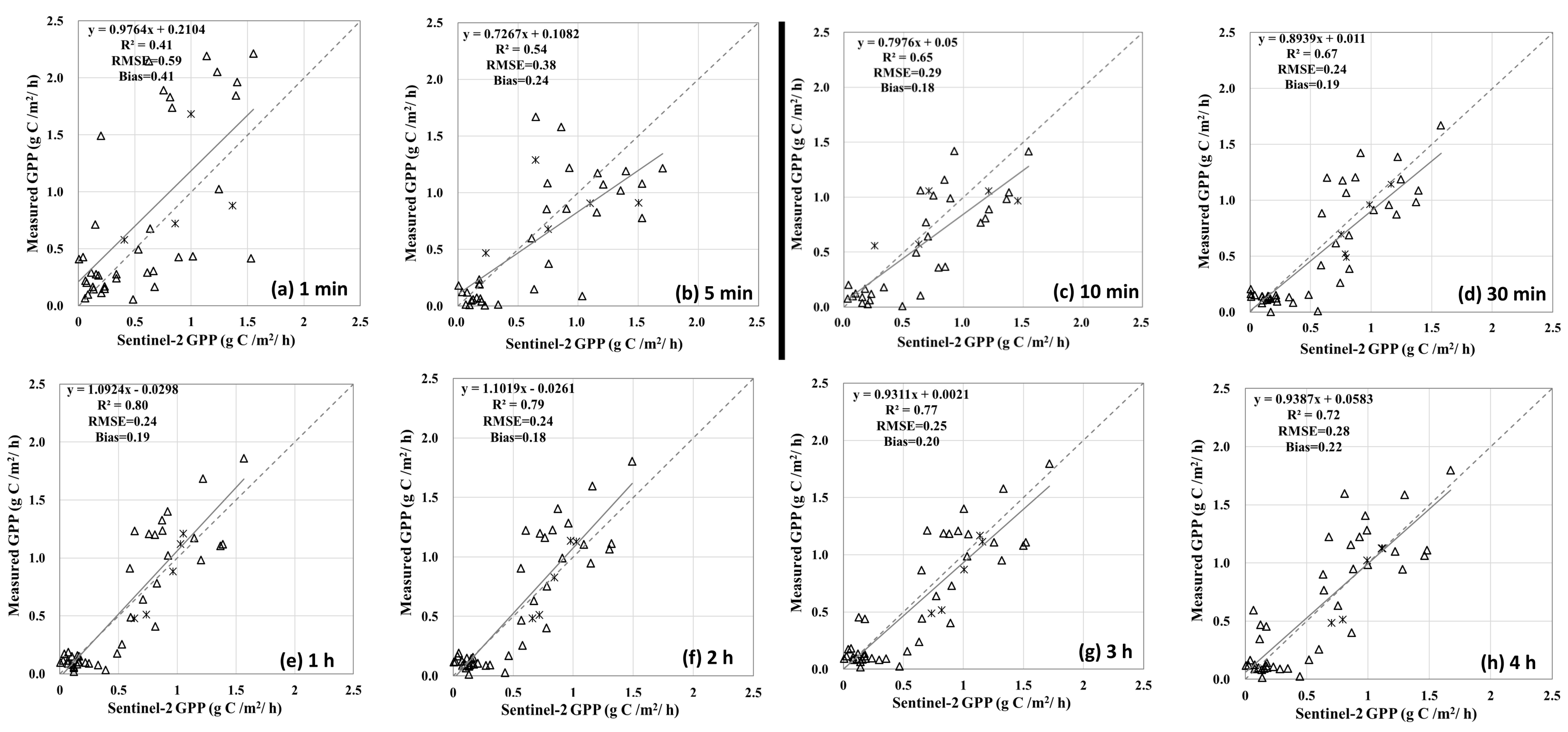

Figure 5 Validation of Sentinel-2 GPP at footprint sale

R^2 shows a trend of increasing first and then decreasing, and the trend change occurs between 30 minutes and 2 hours. RMSE generally show a trend of decreasing first and then increasing, reaching the lowest value around 30 minutes to 2 hours (Figure 5, Figure 6).

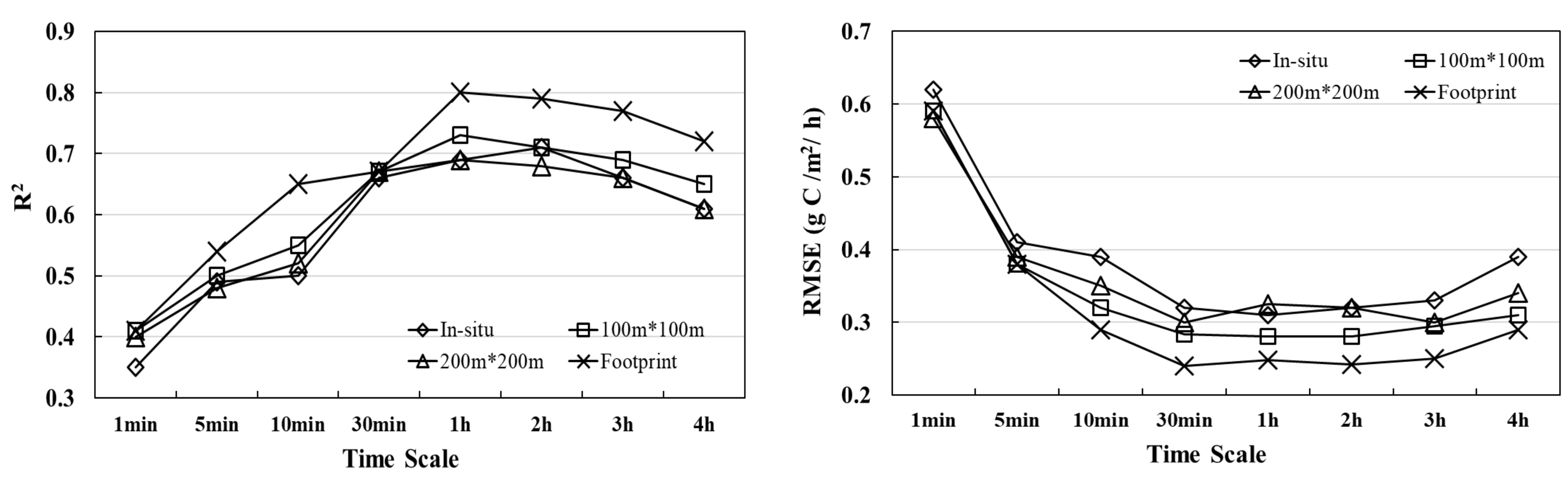

Figure 6 Accuracy of Sentinel-2 GPP when validating at different spatial an temporal scales

4. Conclusions

- At the temporal scale, the correlation between flux tower observed GPP about 30 min-2 h on the passing time of satellite and Sentinel-2 GPP is the best.
- At the spatial scale, the correlation between weighted GPP in the footprints and high-resolution GPP is the best.

Major Reference

Kong, J., Ryu, Y., Liu, J.,et al. 2022. Matching high resolution satellite data and flux tower footprints improves their agreement in photosynthesis estimates. Agricultural and Forest Meteorology, 316, 108878.