GEDI data evaluation and canopy height change analysis--a case study in the Northeast of China

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Highlight:

In order to evaluate the effectiveness and accuracy of Global Ecosystem Dynamics Investigation (GEDI) in canopy height measurement, a set of rules was designed to filter the GEDI L2A version 2 data and compare the consistency with airborne observation data. Then, the airborne data of two periods were combined to evaluate canopy height growth.

Key words: *GEDI, canopy height, data filter, Change of tree growth*

1. Introduction

A new generation of satellite mission of LiDAR observations Global Ecosystem Dynamics Investigation (GEDI) has launched and a member of data has released publicly (Dubayah et al., 2020), in which the Relative Height(RH) energy metrics were used to calculate canopy height. We conducted experiments to evaluate the effectiveness of GEDI canopy height inversion in low slope topography in the northern forest region of China. The 99th quantile height (H99) of airborne laser scanning (ALS) data was used to evaluate the accuracy of RH, and the changes in canopy height of larch forest were evaluated based on RH index combined with ALS data of two periods.

2. Content

First, GEDI data was filtered based on the method of the latest research results (Dorado-Roda et al., 2021; Guerra-Hernández et al., 2021; Rishmawi et al., 2021; Potapov et al., 2021). In addition, under the premise of satisfying the filter rules, it should be synchronized with ALS observation time as much as possible.

The screening rules are as follows: (1) Footprints located in the forest area, no forest management activities; (2)Value of quality flag was 1, do not affected by clouds and rain; (3) Different types of beams effectively covered the ALS observation area; (4) GEDI RH99 was greater than 2 m; (5) The subcompartment was buffered inward by 25 m to reduce the impact of positioning errors and stand edge effects.

The distribution of footprints filtered is shown in Figure 1, and the data collection time of GEDI and ALS is shown in Table 1.

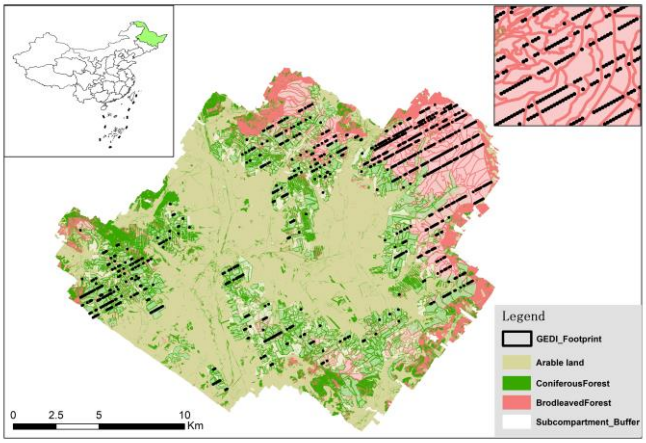

Figure 1: Distribution of filtered GEDI footprint for canopy height assessment

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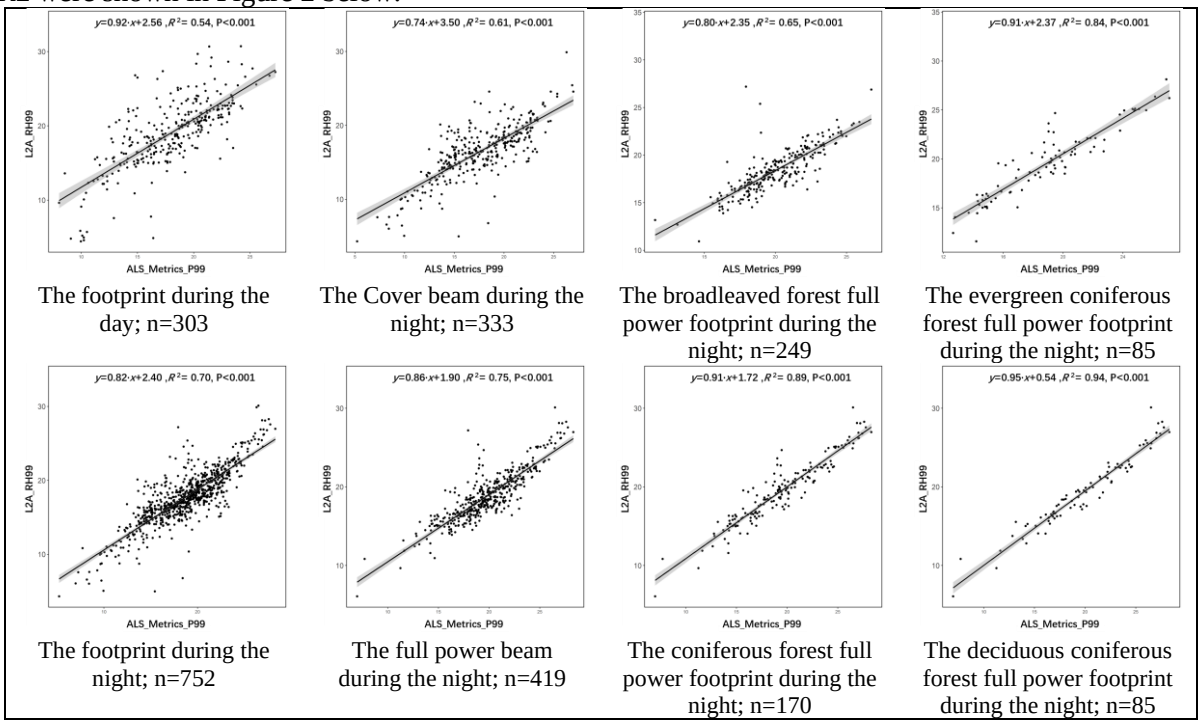
Table 1. Data acquisition description.

Data	Time(YYYY.M.D H)	Description
GEDI L2A	2020.5.2 2 2020.5.6 1 2020.7.26 17	Chinese time Used for canopy height assessment
	2019.7.4 2 2019.5.11 23	Used to assess canopy height changes
ALS data	2017.6	Used to assess canopy height changes
	2020.9	Used to evaluate the inversion and change of canopy height

Secondly, we used the method in the literature (Potapov et al., 2021) to calculate the H99 in the footprint level based on ALS data, and combined with the forest types in the footprint level covered area marked by hyperspectral image (HSI).

Then, we evaluated the GEDI canopy height based on the data of the filtered and marked. Based on the data usage instructions published by NASA LPDAAC (Dubayah et al., 2020), the difference of night and day acquisition time of GEDI L2A data on the data accuracy were analysed firstly. Then the full power beam and the "cover" beam were analysed. Secondly, based on the above analysis results, the inversion results were analysed by forest types. The analysis results based on determination coefficient R2 were shown in Figure 2 below.



The footprint during the day; n=303 | The Cover beam during the night; n=333 | The broadleaved forest full power footprint during the night; n=249 | The evergreen coniferous forest full power footprint during the night; n=85

The footprint during the night; n=752 | The full power beam during the night; n=419 | The coniferous forest full power footprint during the night; n=170 | The deciduous coniferous forest full power footprint during the night; n=85

Fig. 2. Effectiveness and accuracy evaluation of canopy height inversion using GEDI RH index

According to the analysis results above, the footprints of full power beam during the night have the best inversion capability for the canopy height of deciduous coniferous forest. In further study, the results showed that the R^2 of 75th percentile height (usually used to describe mean canopy height) between ALS and GEDI were 0.8196 and 0.8165 for evergreen and deciduous forests, respectively.

Finally, the GEDI data in 2019 were filtered based on the above filtered rules, and the canopy height change analysis was made by combining the ALS point cloud data in 2017 and 2020. As shown in Fig.3, the change value from 2017 ALS to 2019 GEDI was 2.394m, and 1.298m from 2017 ALS to 2020 ALS, among all selected larch forest canopy height changes at footprint level.

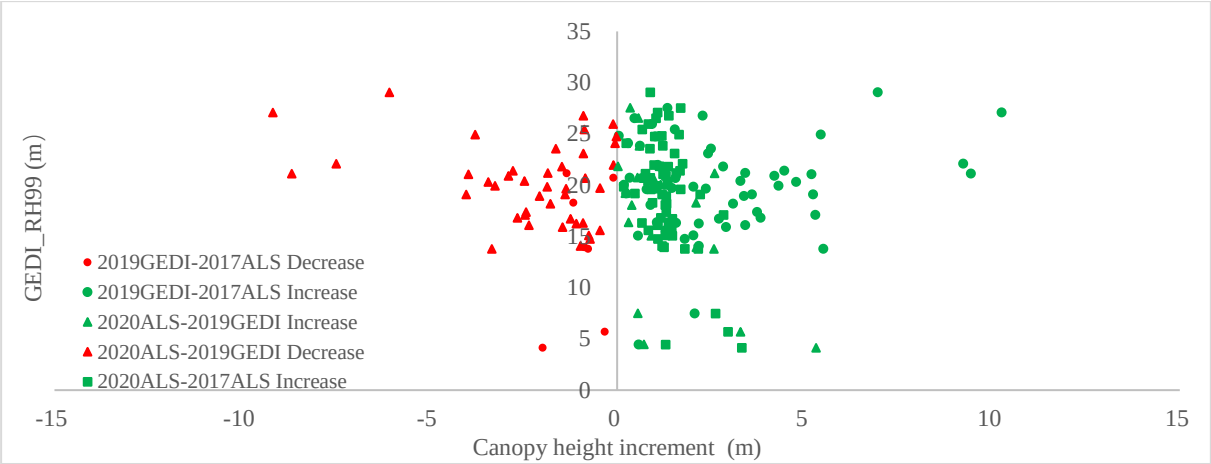


Fig. 3 Distribution of canopy height change in footprint level

As the results shown in Figure 3, GEDI overestimated coniferous forest change. However, the mean canopy height (calculated by H75 of ALS and RH75 of GEDI, respectively) was underestimated.

Acknowledgements

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