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| **Exploring Queensland's Woody Landscape: Structural insights from GEDI LiDAR** |
| **Introduction/Aim:** There is significant public, state, national and international interest in deforestation to inform climate and emission policy and reporting, biodiversity conservation, nature-positive outcomes, and supply chain policies related to environmental, social and governance (ESG). Mapping deforestation remains a challenge – all current forest definitions incorporate a height threshold that is not easy to measure and monitor on-ground or from passive remote sensing optical data. The Queensland State Government has a robust and spatially-comprehensive woody vegetation mapping and monitoring program in the Statewide Land and Trees Study (SLATS). However, SLATS is deliberately agnostic to forest definitions, mainly because it does not presently quantify height. New active remote sensing technologies, such as spaceborne LiDAR, have the potential to inform monitoring and reporting of deforestation against national and international definitions within Queensland. This study aims to place the SLATS woody extent data product in the context of national and international definitions of forest through the integration of the Global Ecosystem Dynamics Investigation (GEDI) spaceborne LiDAR data. Furthermore, by characterising the SLATS woody extent product according to forest definitions, this study provides a nuanced breakdown of annual clearing statistics based on structural criteria. **Methods / Results:** This study first explored the relationship between the SLATS woody extent product and top-of-canopy GEDI height retrievals by analysing over 26 million level 2B GEDI footprints for the year 2022. The area under the receiver operator characteristic curve was calculated using a binary classification of footprints within SLATS-defined woody areas to evaluate the spatial distribution of performance. Results overall show strong agreement between GEDI height retrievals and the SLATS woody extent across Queensland (mean AUC = 0.85). Tall and dense regional ecosystems such as wet eucalypt (mean AUC = 0.909) and rainforest (mean AUC = 0.889) performed the best, whereas low and sparse vegetation such as woodlands within hummock grasslands (mean AUC = 0.782) and eucalypt low open woodlands (mean AUC = 0.771) did not perform as well but demonstrated acceptable performance. GEDI height data were then calibrated and validated using extensive airborne laser scanner (ALS) mosaics spanning from 1999-2023 at 10cm, 50cm and 100cm resolution and a generalised additive model (GAM) was used to fit the data. All GEDI data for 2022 were then calibrated and intersected with Foliage Projective Cover (FPC) data. The probability that a given a point within the SLATS woody extent will meet a given definition of forest height (m) and crown cover (CC). Three international definitions of “forest height” were considered: the Food and Agriculture Organisation of the United Nations (FAO) (>=5m, >=10% CC); the National Greenhouse Gas Inventories (NGGI) (>=2m, >=20% CC); and the United Nations Framework Convention on Climate Change (UNFCCC) (>=2-5m, >=10-30% CC). Findings showed 60% of cleared vegetation met FAO, 65% met NGGI, and between 29% (high range) and 94% (low range) met UNFCCC definitions of forest. Results therefore show that a large proportion of the SLATS woody extent product has significant height and crown cover based on the proportion of the extent meeting NGGI, FAO and UNFCCC definitions. Furthermore, the majority of clearing involved the removal of vegetation with lower height and density.**Conclusion:** This study highlights that GEDI data can be used successfully to infer forest characteristics within the SLATS woody extent product, as well as provide insights into forest clearing - which is essential for informing land management strategies aimed at biodiversity and carbon storage. Future work is aimed at exploring future SLATS report data and comparing results with other state-level SLATS programs such as those undertaken by the New South Wales state government. Finally, investigation into a more comprehensive and spatially-dense dataset by incorporating ICESat-GLAS data or the proposed Earth Dynamics Geodetic Explorer (EDGE) should be explored. |