

DAFTAR PUSTAKA

- Asner, G. P., & Mascaro, J. (2014). Mapping tropical forest carbon: Calibrating plot estimates to a simple LiDAR metric. *Remote Sensing of Environment*, 140, 614–624. <https://doi.org/10.1016/j.rse.2013.09.023>
- Badan Pusat Statistik. (2025). Statistik tanaman perkebunan tahunan Indonesia 2024 (Vol. 1). Badan Pusat Statistik.
- Basyuni, M., Tanjung, I. L., Slamet, B., Ritonga, F. N., Al Mustaniroh, S. S., Larekekng, S. H., Arifanti, V. B., Iryanthony, S. B., Sumarga, E., Baba, S., Salmo Iii, S. G., Ginting, E., Kusumawardani, N., & Omoto, R. (2026). UAV-based mangrove biomass estimation and carbon potential valuation in North Sumatra, Indonesia. *Carbon Balance and Management*, 21(1), 71. <https://doi.org/10.1186/s13021-026-00440-6>
- Belgiu, M., & Drăguț, L. (2016). Random forest in remote sensing: A review of applications and future directions. *ISPRS Journal of Photogrammetry and Remote Sensing*, 114, 24–31. <https://doi.org/10.1016/j.isprsjprs.2016.01.011>
- Brown, S. (1997). Estimating biomass and biomass change of tropical forests: A primer (FAO Forestry Paper No. 134). Rome: Food and Agriculture Organization of the United Nations
- Chave, J., Réjou-Méchain, M., Búrquez, A., Chidumayo, E., Colgan, M. S., Delitti, W. B. C., ... & Vieilledent, G. (2014). Improved allometric models to estimate the aboveground biomass of tropical trees. *Global Change Biology*, 20(10), 3177–3190. <https://doi.org/10.1111/gcb.12629>
- Chen, Z., Yang, X., Pan, X., Wu, T., Lei, J., Chen, X., Li, Y., & Chen, Y. (2025). Estimating Forest Aboveground Biomass in Tropical Zones by Integrating LiDAR and Sentinel-2B Data. *Sustainability*, 17(8), 3631. <https://doi.org/10.3390/su17083631>
- Cui, L., Xu, X., & Chen, S. (2025). Estimating biomass consumption and carbon emissions by integrating GEDI, Sentinel-1, and Sentinel-2 data. *Ecological Indicators*, 178, 113889. <https://doi.org/10.1016/j.ecolind.2025.113889>
- Da Costa, M. B. T., Silva, C. A., Broadbent, E. N., Leite, R. V., Mohan, M., Liesenberg, V., Stoddart, J., Do Amaral, C. H., De Almeida, D. R. A., Da Silva, A. L., Ré Y. Goya, L. R., Cordeiro, V. A., Rex, F., Hirsch, A., Marcatti, G. E., Cardil, A., De Mendonça, B. A. F., Hamamura, C., Corte, A. P. D., ... Klauberg, C. (2021). Beyond trees: Mapping total aboveground biomass density in the Brazilian savanna using high-density UAV-lidar data. *Forest Ecology and Management*, 491, 119155. <https://doi.org/10.1016/j.foreco.2021.119155>
- Delegido, J., Verrelst, J., Alonso, L., & Moreno, J. (2011). Evaluation of Sentinel-2 red-edge bands for empirical estimation of green LAI and chlorophyll content. *Sensors*, 11(7), 7063–7081. <https://doi.org/10.3390/s110707063>
- Draper, N. R., & Smith, H. (1998). *Applied regression analysis* (3rd ed.). John Wiley & Sons.
- Dubayah, R., Blair, J. B., Goetz, S., Fatoyinbo, L., Hansen, M., Healey, S., Hofton, M., Hurtt, G., Kellner, J., Luthcke, S., Armston, J., Tang, H., Duncanson, L., Hancock, S., Jantz, P., Marselis, S., Patterson, P. L., Qi, W., & Silva, C. (2020). The Global Ecosystem Dynamics Investigation: High-resolution laser ranging of the Earth's forests and topography. *Science of Remote Sensing*, 1, 100002. <https://doi.org/10.1016/j.srs.2020.100002>

- Dubayah, R.O., J. Armston, J.R. Kellner, L. Duncanson, S.P. Healey, P.L. Patterson, S. Hancock, H. Tang, M.A. Hofton, J.B. Blair, and S.B. Luthcke. 2021. GEDI L4A *Footprint* Level Aboveground Biomass Density, Version 1. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAAC/1907>
- Duncanson, L., Kellner, J. R., Armston, J., Dubayah, R., Minor, D. M., Hancock, S., Healey, S. P., Patterson, P. L., Saarela, S., Marselis, S., Silva, C. E., Bruening, J., Goetz, S. J., Tang, H., Hofton, M., Blair, B., Luthcke, S., Fatoyinbo, L., Abernethy, K., ... Zraggen, C. (2022). Aboveground biomass density models for NASA's Global Ecosystem Dynamics Investigation (GEDI) lidar mission. *Remote Sensing of Environment*, 270, 112845. <https://doi.org/10.1016/j.rse.2021.112845>
- European Space Agency (ESA). (2015). Sentinel-2: ESA's optical high-resolution mission for operational services. ESA Communications.
- Food and Agriculture Organization. (2003). *Forests, the global carbon cycle and climate change* (Technical Report MS14). <https://www.fao.org/4/xii/ms14-e.htm>
- Frampton, W. J., Dash, J., Watmough, G., & Milton, E. J. (2013). Evaluating the capabilities of Sentinel-2 for quantitative estimation of biophysical variables in vegetation. *ISPRS Journal of Photogrammetry and Remote Sensing*, 82, 83–92. <https://doi.org/10.1016/j.isprsjprs.2013.04.007>
- Gibbs, H. K., Brown, S., Niles, J. O., & Foley, J. A. (2007). Monitoring and estimating tropical forest carbon stocks: Making REDD a reality. *Environmental Research Letters*, 2(4), 045023. <https://doi.org/10.1088/1748-9326/2/4/045023>
- Global Forest Watch. (2025). Indonesia dashboard. Retrieved March 20, 2026, from <https://www.globalforestwatch.org/dashboards/country/IDN/>
- Hairiah, K., Ekadinata, A., Sari, R. R., & Rahayu, S. (2011). *Pengukuran Cadangan Karbon: dari tingkat lahan ke bentang lahan* (Petunjuk Praktis, Edisi kedua). Bogor, Indonesia. World Agroforestry Centre - ICRAF, SEA Regional Office.
- Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The elements of statistical learning: Data mining, inference, and prediction* (2nd ed.). Springer.
- Intergovernmental Panel on Climate Change (IPCC). (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Prepared by the National Greenhouse Gas Inventories Programme (H. S. Eggleston, L. Buendia, K. Miwa, T. Ngara, & K. Tanabe, Eds.). IGES.
- Intergovernmental Panel on Climate Change (IPCC). (2023). Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (A. Revi, R. Slade, J. Skea, P. Shukla, & J. Malley, Eds.). IPCC. <https://doi.org/10.59327/IPCC/AR6-9789291691647>
- Jensen, J. R. (2014). *Remote sensing of the environment: An earth resource perspective* (2nd ed.). Pearson.
- Jian, K., Lu, D., & Li, G. (2025). Modeling Forest Carbon Stock Based on Sample Plots and UAV Lidar Data from Multiple Sites and Examining Its Vertical Characteristics in Wuyishan National Park. *Remote Sensing*, 17(3), 377. <https://doi.org/10.3390/rs17030377>
- Kellner, J. R., Armston, J., & Duncanson, L. (2023). Algorithm Theoretical Basis Document for GEDI *Footprint* Aboveground Biomass Density. *Earth and Space Science*, 10(4), e2022EA002516.

<https://doi.org/10.1029/2022EA002516>

- Khasanah, N., van Noordwijk, M., Ekadinata, A., Dewi, S., Rahayu, S., Ningsih, H., Setiawan, A., Dwiyanti, E., & Octaviani, R. (2012). *The carbon footprint of Indonesian palm oil production* (Technical Brief No. 25: Palm Oil Series). World Agroforestry Centre - ICRAF, SEA Regional Office. (p. 10)
- Lee, H., Yuan, T., Yu, H., & Jung, H. C. (2020). Interferometric SAR for Wetland Hydrology: An Overview of Methods, Challenges, and Trends. *IEEE Geoscience and Remote Sensing Magazine*, 8(1), 120–135. <https://doi.org/10.1109/MGRS.2019.2958653>
- Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2015). Remote sensing and image interpretation (7th ed.). John Wiley & Sons.
- Maxwell, A. E., Warner, T. A., & Fang, F. (2018). Implementation of machine-learning classification in remote sensing: An applied review. *International Journal of Remote Sensing*, 39(9), 2784–2817. <https://doi.org/10.1080/01431161.2018.1433343>
- Ngadi, N., & Nagata, J. (2022). Oil Palm Land Use Change and Rice Sustainability in South Sumatra, Indonesia. *Land*, 11(5), 669. <https://doi.org/10.3390/land11050669>
- Nunes, M., Ewers, R., Turner, E., & Coomes, D. (2017). Mapping Aboveground Carbon in Oil Palm Plantations Using LiDAR: A Comparison of *Tree-centric* versus *Area-based* Approaches. *Remote Sensing*, 9(8), 816. <https://doi.org/10.3390/rs9080816>
- Nuthammachot, N., Askar, A., Stratoulis, D., & Wicaksono, P. (2022). Combined use of Sentinel-1 and Sentinel-2 data for improving above-ground biomass estimation. *Geocarto International*, 37(2), 366–376. <https://doi.org/10.1080/10106049.2020.1726507>
- Opreanu, C. H., & Lăzărescu, V.-A. (Eds.). (2016). *Landscape archaeology on the northern frontier of the Roman Empire at Porolissum: An interdisciplinary research project*. Mega Publishing House.
- Pan, Y., Birdsey, R. A., Fang, J., Houghton, R., Kauppi, P. E., Kurz, W. A., Phillips, O. L., Shvidenko, A., Lewis, S. L., Canadell, J. G., Ciais, P., Jackson, R. B., Pacala, S. W., McGuire, A. D., Piao, S., Rautiainen, A., Sitch, S., & Hayes, D. (2011). A large and persistent carbon sink in the world's forests. *Science*, 333(6045), 988–993. <https://doi.org/10.1126/science.1201609>
- Phua, M.-H., Hue, S. W., Ioki, K., Hashim, M., Bidin, K., Musta, B., Suleiman, M., Yap, S. W., & Maycock, C. R. (2016). Estimating Logged-Over Lowland Rainforest Aboveground Biomass in Sabah, Malaysia Using Airborne LiDAR Data. *Terrestrial, Atmospheric and Oceanic Sciences*, 27(4), 481. [https://doi.org/10.3319/TAO.2016.01.06.02\(ISRS\)](https://doi.org/10.3319/TAO.2016.01.06.02(ISRS))
- Rijal, S. S., Pham, T. D., Noer'Aulia, S., Putera, M. I., & Saintilan, N. (2023). Mapping Mangrove Above-Ground Carbon Using Multi-Source Remote Sensing Data and Machine Learning Approach in Loh Buaya, Komodo National Park, Indonesia. *Forests*, 14(1), 94. <https://doi.org/10.3390/f14010094>
- Saatchi, S. S., Harris, N. L., Brown, S., Lefsky, M., Mitchard, E. T. A., Salas, W., Zutta, B. R., Buermann, W., Lewis, S. L., Hagen, S., Petrova, S., White, L., Silman, M., & Morel, A. (2011). Benchmark map of forest carbon stocks in tropical regions across three continents. *Proceedings of the National Academy of Sciences*, 108(24), 9899–9904. <https://doi.org/10.1073/pnas.1019576108>
- Salazar Villegas, M. H., Qasim, M., Csaplovics, E., González-Martínez, R.,

- Rodriguez-Buritica, S., Ramos Abril, L. N., & Salazar Villegas, B. (2023). Examining the Potential of Sentinel Imagery and Ensemble Algorithms for Estimating Aboveground Biomass in a Tropical Dry Forest. *Remote Sensing*, 15(21), 5086. <https://doi.org/10.3390/rs15215086>
- Sandamali, J., & Narine, L. L. (2025). A data-driven, cloud-based approach for forest aboveground biomass mapping using GEDI and other earth observation data: An ecoregion-specific Investigation across the state of Alabama, USA. *Geocarto International*, 40(1), 2465446. <https://doi.org/10.1080/10106049.2025.2465446>
- Shendryk, Y. (2022). Fusing GEDI with earth observation data for large area aboveground biomass mapping. *International Journal of Applied Earth Observation and Geoinformation*, 115, 103108. <https://doi.org/10.1016/j.jag.2022.103108>
- Sullivan, M. J. P., Lewis, S. L., Affum-Baffoe, K., Castilho, C., Costa, F., Sanchez, A. C., Ewango, C. E. N., Hubau, W., Marimon, B., Monteagudo-Mendoza, A., Qie, L., Sonké, B., Martinez, R. V., Baker, T. R., Brien, R. J. W., Feldpausch, T. R., Galbraith, D., Gloor, M., Malhi, Y., ... Phillips, O. L. (2020). Long-term thermal sensitivity of Earth's tropical forests. *Science*, 368(6493), 869–874. <https://doi.org/10.1126/science.aaw7578>
- Torres, R., Snoeij, P., Geudtner, D., Bibby, D., Davidson, M., Attema, E., Potin, P., Rommen, B., Floury, N., Brown, M., Traver, I. N., Deghay, P., Duesmann, B., Rosich, B., Miranda, N., Bruno, C., L'Abbate, M., Croci, R., Pietropaolo, A., ... Rostan, F. (2012). GMES Sentinel-1 mission. *Remote Sensing of Environment*, 120, 9–24. <https://doi.org/10.1016/j.rse.2011.05.028>
- Wang, J., Xiang, C., & Liang, A. (2025). Estimation of Forest Aboveground Biomass in China Based on GEDI and Sentinel-2 Data: Quantitative Analysis of Optical Remote Sensing Saturation Effect and Terrain Compensation Mechanisms. *Remote Sensing*, 17(20), 3437. <https://doi.org/10.3390/rs17203437>
- Wilks, D. S. (2011). *Statistical methods in the atmospheric sciences* (3rd ed.). Academic Press.
- Xu, X., Yang, J., Qi, S., Ma, Y., Liu, W., Li, L., Lu, X., & Liu, Y. (2025). Estimation of Forest Aboveground Biomass Using Sentinel-1/2 Synergized with Extrapolated Parameters from LiDAR Data and Analysis of Its Ecological Driving Factors. *Remote Sensing*, 17(14), 2358. <https://doi.org/10.3390/rs17142358>
- Yan, Y., Lei, J., & Huang, Y. (2024). Forest Aboveground Biomass Estimation Based on Unmanned Aerial Vehicle–Light Detection and Ranging and Machine Learning. *Sensors*, 24(21), 7071. <https://doi.org/10.3390/s24217071>
- Zhang, L., Zhang, X., Shao, Z., Jiang, W., & Gao, H. (2023). Integrating Sentinel-1 and 2 with LiDAR data to estimate aboveground biomass of subtropical forests in northeast Guangdong, China. *International Journal of Digital Earth*, 16(1), 158–182. <https://doi.org/10.1080/17538947.2023.2165180>