

INTEGRASI DATA LIDAR GEDI DENGAN CITRA RADAR ALOS-2 DAN OPTIK SENTINEL-2 UNTUK PEMETAAN STOK KARBON ATAS PERMUKAAN VEGETASI TEGAKAN DI SEBAGIAN KABUPATEN MAGELANG

Yusri Khoirurrizqi
20/458652/GE/09335

INTISARI

Vegetasi berperan penting dalam penanganan perubahan iklim karena mampu menyerap dan menyimpan karbon. Pemetaan stok karbon vegetasi penting dilakukan untuk inventarisasi stok karbon dalam upaya mendukung mitigasi perubahan iklim. Secara efektif dan efisien, pemetaan stok karbon vegetasi dapat dilakukan dengan penginderaan jauh menggunakan interpolasi global melalui regresi berdasarkan hubungan antara data sampel dan nilai spektral/hamburan balik ke seluruh liputan citra. Penelitian ini bertujuan mengeksplorasi dan mengevaluasi integrasi data lidar GEDI dengan citra SAR ALOS-2 dan optik Sentinel-2 untuk memetakan stok karbon vegetasi tegakan. Pada penelitian ini, pemetaan stok karbon dilakukan dengan regresi *Random Forest* menggunakan citra SAR (ALOS-2) dan optik (Sentinel-2) sebagai variabel prediktor. Sampel referensi yang digunakan untuk pemodelan berasal dari pengukuran lapangan dan *footprint* GEDI—yang terlebih dahulu dikorelasikan dengan data lapangan—sehingga didapatkan dua hasil model. AGB pada *footprint* GEDI memiliki nilai korelasi = 0,5918 dan nRMSE = 24,39% terhadap sampel lapangan. Model stok karbon GEDI menghasilkan nilai rata-rata estimasi yang lebih tinggi (55,63 ton/ha) dibandingkan model stok karbon lapangan (46,61 ton/ha) karena nilai stok karbon maksimal pada sampel GEDI lebih tinggi. Berdasarkan hasil pengujian dengan sampel *testing* dari pengukuran lapangan, model stok karbon GEDI memiliki nilai MAE = 22,3166 ton/ha; RMSE = 26,2983 ton/ha; nRMSE = 28,0251%; R^2_{oos} = 0,3383 sedangkan model stok karbon lapangan memiliki nilai MAE = 21,2460 ton/ha; RMSE = 24,7336 ton/ha; nRMSE = 26,3577%; R^2_{oos} = 0,4147. Perbedaan hasil dan performa model disebabkan oleh perbedaan karakteristik sampel (jumlah dan sebaran) dan adanya perambatan kesalahan dari beberapa sumber (alometrik, data GEDI, pemodelan, *image-registration*, perbedaan waktu perekaman citra dengan pengambilan data lapangan). Penelitian lanjutan pada wilayah yang lebih heterogen serta eksplorasi berbagai metode regresi dan variabel turunan diperlukan untuk menguji efektivitas data GEDI dan mengembangkan model yang lebih akurat serta andal.

Kata Kunci: Stok Karbon, GEDI, ALOS-2, Sentinel-2, Magelang, Regresi *Random Forest*

INTEGRATION OF GEDI LIDAR DATA WITH ALOS-2 RADAR AND SENTINEL-2 OPTICAL IMAGERIES FOR MAPPING ABOVEGROUND CARBON STOCKS OF TREE VEGETATION IN PART OF MAGELANG DISTRICT

Yusri Khoirurrizqi

20/458652/GE/09335

ABSTRACT

Vegetation has an important role in addressing climate change because it can absorb and store carbon. Mapping of vegetation carbon stocks is important for carbon stock inventory to support climate change mitigation. Effectively and efficiently, vegetation carbon stock mapping can be done by remote sensing using global interpolation through regression, based on relationship between sample data and spectral/ backscatter values to the entire image coverage. This study aims to explore and evaluate the integration of GEDI lidar data with ALOS-2 SAR and Sentinel-2 optical imageries to map tree vegetation carbon stocks. In this study, carbon stock mapping was conducted with Random Forest regression using SAR (ALOS-2) and optical (Sentinel-2) imageries as predictor variables. The reference samples used for modelling came from field measurements and GEDI footprints, which were first correlated with field data, resulting in two models. The AGB in the GEDI footprint has a correlation value = 0.5918 and nRMSE = 24.39% against the field samples. The GEDI carbon stock model produced a higher average estimated value (55.63 tons/ha) than the field carbon stock model (46.61 tons/ha) because the maximum carbon stock value in the GEDI sample is higher. Based on the test results, with testing samples from field measurements, the GEDI carbon stock model has MAE = 22.3166 tons/ha; RMSE = 26.2983 tons/ha; nRMSE = 28.0251%; $R^2_{\text{oos}} = 0.3383$ while the field carbon stock model has MAE = 21.2460 tons/ha; RMSE = 24.7336 tons/ha; nRMSE = 26.3577%; $R^2_{\text{oos}} = 0.4147$. The differences in results and model performance are due to differences in sample characteristics (number and distribution) and the propagation of errors from several sources (allometrics, GEDI data, modeling, image-registration, differences in image recording time and field data collection). Further research in more heterogeneous areas and exploration of various regression methods and derived variables are needed to test the effectiveness of GEDI data and develop more accurate and reliable models.

Keywords: Carbon Stocks, GEDI, ALOS-2, Sentinel-2, Magelang, Random Forest Regression