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Improvement of satellite-based gross primary production through incorporation of high resolution input data over east asia

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Photosynthesis of plants is the main mechanism of carbon absorption from the atmosphere into the terrestrial ecosystem and it contributes to remove greenhouse gases such as carbon dioxide. Annually, 120 Gt of C is supposed to be assimilated through photosynthetic activity of plants as the gross primary production (GPP) over global land area. In terms of climate change, GPP modelling is essential to understand carbon cycle and the balance of carbon budget over various ecosystems. One of the GPP modelling approaches uses light use efficiency that each vegetation type has a specific efficiency for consuming solar radiation related with temperature and humidity. Satellite data can be used to measure various meteorological and biophysical factors over vast areas, which can be used to quantify GPP. NASA Earth Observing System (EOS) program provides Moderate Resolution Imaging Spectroradiometer (MODIS)-derived global GPP product, namely MOD17A2H, on a daily basis. However, significant underestimation of MOD17A2H has been reported in Eastern Asia due to its dense forest distribution and humid condition during monsoon rainy season in summer. The objective of this study was to improve underestimation of MODIS GPP (MOD17A2H) by incorporating meteorological data-temperature, relative humidity, and solar radiation-of higher spatial resolution than data used in MOD17A2H. Landsat-based land cover maps of finer resolution observation and monitoring – global land cover (FROM-GLC) at 30m resolution were used for selection of light use efficiency (LUE). GPP (eq1. GPP = APAR$\times$LUE) is computed by multiplication of APAR (IPAR$\times$fPAR) and LUE (ε= εmax$\times$T(°C)scalar$\times$VPD(Pa)scalar, where, T is temperature, VPD is vapour pressure deficit) in this study. Meteorological data of Japanese 55-year Reanalysis (JRA-55, 0.56° grid, 3hr) were used for calculation of GPP in East Asia, including Eastern part of China, Korean peninsula, and Japan. Results were validated using flux tower-observed GPP data of AsiaFlux. Results showed that about 40% of underestimation of monthly average of MOD17A2H is confirmed and underestimation of MOD17A2 was improved from 42.3% and 60.4% to 8.3% and -26.2% for two flux tower sites (API site in Japan and GCK site in Korea), respectively. These improvements suggest that correction of LUE by finer land cover classification and/or better frequency of solar radiation data is effective where MOD17A2H does not work well. Further research will include evaluation of the proposed approach over areas in different climate conditions and environments.