ESTIMATION OF TERRESTRIAL CARBON FLUXES OVER EAST ASIA THROUGH INTEGRATION OF SATELLITE REMOTE SENSING AND ASIAFLUX DATA

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The accurate estimation of carbon fluxes such as net primary production (NPP) and net ecosystem exchanges (NEE) over terrestrial ecosystems provides useful information to understand global carbon cycles. It is helpful to make use of satellite data from MODIS, TRMM, Landsat or COMS to facilitate to analyze the exchanges of terrestrial carbon dioxide. Although remote sensing has been used on estimating carbon fluxes over the world, studies that combine multiple satellite remote sensing, in situ flux data, and machine learning-based algorithm fusion have had minimum exploration especially for East Asia. This study quantified the carbon exchanges over East Asia and further improves our understanding of global carbon cycles.

The objectives of this study were to 1) develop a novel machine learning-based approach through algorithm fusion for carbon flux (NPP and NEE) estimation from multi-temporal multi-sensor data over East Asia and 2) examine the spatiotemporal patterns of the carbon fluxes. In situ data collected from the AsiaFlux network and multi-sensor data (MODIS, TRMM, and COMS) between 2004 and 2012 were used to develop a predictive model using machine learning-based algorithm fusion in this study. Data were randomly divided into two groups: 70% of the data were used for building predictive model(s) and the remaining 30% were used for validation of the model(s).

Machine learning approaches commonly used in the remote sensing field include artificial neural networks, decision/regression trees, support vector machines/regression, genetic algorithms and artificial immune systems, and these methods can be improved through algorithm fusion such as nested integration, serial integration, and parallel integration for quantifying carbon fluxes. The models proposed in this study were focused on combining regression trees and support vector regression through nested and parallel integrations.

The proposed models slightly over- and under-estimated NPP and NEE and possible reasons include that 1) satellite and flux tower footprints did not match exactly, 2) satellite data were less sensitive to the slight variations in lower canopies, and 3) training and validation data configurations might be biases. Spatiotemporal patterns of the carbon fluxes were examined by land use/land cover and topographic characteristics.

Keyword: NPP, NEE, Satellite remote sensing, Carbon flux, East Asia