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Absorption of Photosynthetically Active Radiation by a Tropical Rainforest in Indonesia, Measurements and Modelling

PAVEL PROPASTIN¹, OLEG PANFEROV²

¹*Georg-August-Universität Göttingen, Institute of Geography, Cartography, GIS and Remote Sensing Sect., Germany*

²*Georg-August-Universität-Göttingen, Buesgen-Institute: Bioclimatology, Germany*

Abstract

The plant ecosystem ability to absorb photosynthetically active radiation (PAR) is one of the most important research issues with respect to the modelling carbon assimilation by vegetation. In ecosystem research and especially those using remote sensing data this ability is characterised by the fraction of absorbed PAR (FAPAR) — which is specific for individual vegetation types. However, estimates of FAPAR for the tropical rainforest are rare. The presented study investigates FAPAR in a tropical rainforest stand located in the central part of Sulawesi (Indonesia). FAPAR is estimated based on field measurements, modelling (using a 3-D radiative transfer model, SPM3D), and the FAPAR product of Moderate Resolution Imaging Spectroradiometer (MODIS). FAPAR based on field observations is calculated from hemispherical photography and measurements of incoming PAR taken above and below the canopy. The estimated mean value is 0.88. FAPAR of the study stand shows pronounced seasonal dynamics, which are captured by both the SPM3D and MODIS data: generally, the value of FAPAR is lower during wet seasons and higher during dry seasons. The comparison of modelling and remote sensing results revealed general underestimation of FAPAR by the MODIS product especially under overcast sky conditions (wet seasons). At annual scale the FAPAR simulated by the SPM3D shows the mean of 0.84, and estimated by MODIS - of 0.79. These inconsistencies could not be ascribed to contamination of the MODIS FAPAR product by clouds (the MODIS data were extensively corrected before the use), but are caused by too large seasonal amplitudes in MODIS FAPAR.

Keywords: Indonesia, radiation absorption, radiation modelling, rainforest