Geophysical Research Abstracts
Vol. 20, EGU2018-2734, 2018
EGU General Assembly 2018

Down-scaling GOME-2 far-red solar-induced chlorophyll fluorescence from canopy to photosystem using a machine learning approach

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Solar-induced chlorophyll fluorescence (SIF) is a promising indicator for actual photosynthesis of terrestrial vegetation. SIF has become available from spaceborne observations in recent years and satellite SIF provides opportunities for direct estimation of global gross primary productivity (GPP). The radiative transfer processes of SIF from leaf to canopy, including multiple scattering and absorption, lead not only canopy-leaving SIF only a part of leaf-emitted SIF, but remotely sensed SIF sensitive to observation direction. Therefore, downscaling SIF from canopy to photosystem is essential for better understanding the relationship between remotely sensed SIF and photosynthesis (carbon assimilation or GPP). In this report, the relationship between directional canopy SIF and SIF at photosystem level was established based on a machine learning approach. We then applied the approach to GOME-2 satellite SIF product. We found that the downscaled SIF was independent of observation direction and the relationship between downscaled SIF and GPP was more independent on canopy structure. Our method provided opportunities for better using remotely sensed SIF as a proxy for GPP at global scale.