Geophysical Research Abstracts
Vol. 21, EGU2019-6010, 2019
EGU General Assembly 2019


# Using microwave vegetation optical depth for estimating gross primary production

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Microwave satellite observations are increasingly being used for describing large-scale vegetation properties. Due to its all-weather capabilities, microwave vegetation optical depth (VOD) represents an alternative data source of vegetation information upon traditional optical-based retrievals. A recent study by Teubner et al. (2018, http://dx.doi.org/10.1016/j.jag.2017.10.006) has indicated that VOD can be linked to gross primary production (GPP) by a combination of the original VOD values and temporal changes therein. Building upon this concept, here we present a model for estimating GPP from microwave VOD.

The model was applied at local to global scale using active (Advanced Scatterometer – ASCAT) and passive (Advanced Microwave Scanning Radiometer for Earth Observation – AMSR-E) microwave VOD observations from C-, X- and Ku-band. We assessed the model's ability to extrapolate temporally and spatially in situ measurements of GPP from FLUXNET, which we compared with GPP from FLUXCOM and the Moderate-resolution Imaging Spectroradiometer (MODIS).

The model performs well at extrapolating GPP temporally based on VOD information, while it requires additional information related to vegetation type for performing accurate spatial extrapolation of in situ GPP observations. The VOD-based upscaling of GPP tends to overestimate mean annual GPP compared to FLUXCOM and MODIS but exhibits similar latitudinal patterns.

Overall, our findings underpin the potential of VOD as an alternative to diagnose GPP globally from space. Since the approach provides additional information about GPP independent of optical data, our approach may create the basis for analysing ecosystem properties such as carbon allocation and may further contribute to improved GPP estimations especially in cloud-prone regions.