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Examination of Sun-induced Fluorescence (SIF) Signal on Heterogeneous Ecosystem Platforms using 'HyPlant'

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From the past decades, many satellite missions are continuously monitoring the global biospheric activity. Assessment and monitoring of terrestrial photosynthetic function on a global scale still remain uncertain after plenty of EO missions. It is difficult to quantify the actual photosynthetic rate on the basis of the simple greenness of vegetation using optical remote sensing technology. Measurement of Sun-induced chlorophyll Fluorescence (SIF) emitted by the terrestrial vegetation using airborne-based imaging spectroscopy, provide us a straight opportunity to track the variations of photosynthetic efficiency and monitor the plant health condition. Presently, chlorophyll SIF signal is a very timely topic and a subject of interest for the remote sensing scientific communities and space agencies, such as ESA (European Space Agency) and NASA (National Aeronautics and Space Administration).
Here we compute and analyze the SIF signals coming from different ecosystems i.e. grassland, harvested land, forest, young forest, deforestation area, aquatic region, and heterogeneous area of non-degraded peatland in Poland using new airborne-based imaging spectrometer 'HyPlant' (the airborne demonstrator for the FLEX mission) datasets. The FLuorescence EXplorer (FLEX) is the first satellite mission to be designed specifically for the measurement of passive sun-induced chlorophyll fluorescence in the terrestrial ecosystem. 'HyPlant' had been operated and captured data during SWAMP campaign on 11th of July 2015 supported by ESA within the FLEX-EU project, COST Action OPTIMISE, and EUFAR.
According to the existing literature on SIF measurement, till date, most of the studies are focusing on some specific ecosystems like cropland, grassland, or the forest area. In this study, we have emphasized on a comparative analysis of SIF signals obtained from different managed and natural ecosystems as well as different plant communities of peatland vegetation in a particular seasonal setting.
Spectral Fitting Method (SFM) retrieval algorithm which is based on two oxygen absorption bands, O_2A (740nm) and O_2B (690nm) was used to obtain the SIF maps of the different SWAMP area. The algorithm only used the high spectral resolution imagery detected by the HyPlant FLUO sensor (670-800 nm). Additionally, the different vegetation indices in relation to Photochemical quenching (PQ) process- NDVI, NDVIre, EVI, SR, MTCI, and Non-photochemical quenching (NPQ) process- PRI, cPRI has been calculated and analyzed. The outcome reviles a high to low SIF signal from grassland, young forest, forest and shallow aquatic ecosystems respectively, however, grassland was reflecting high MTCI, NDVI, NDVIre, EVI, and SR values. The high values of PRI and cPRI come from peatland domain. Aquatic and deforested regions showed low values for all indices. To bridge the gap in between in-situ measurements and classical remote sensing, we validate the SIF signals and vegetation indices calculated from 'HyPlant' data with the ground measurements during the same time frame.

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