The 36th International Symposium on Remote Sensing of Environment,
11 – 15 May 2015, Berlin, Germany, ISRSE36-488

DOWNSCALING SUN-INDUCED CHLOROPHYLL FLUORESCENCE FROM 0.5 TO 0.05 DECIMAL DEGREES AT GLOBAL SCALE

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THEME: Forests, biodiversity and terrestrial ecosystems

KEY WORDS: Sun-induced chlorophyll fluorescence (SIF), spatial downscaling, light use efficiency (LUE), gross primary productivity (GPP), GOME-F, MODIS

ABSTRACT:

Sun-induced chlorophyll fluorescence (SIF) is known to relate directly to photosynthesis. Measuring it form space can thus provide a direct proxy of gross primary productivity (GPP), which in turn is of great value for the parameterisation and validation of land models, for monitoring the status of terrestrial ecosystems, detecting climate-induced anomalies and monitoring crop and forest productivity. Recent studies have generated SIF product at global scale from satellite remote sensing instruments such as GOME-2. However, the finest spatial resolution achieved by these products is 0.5°, which remains too coarse for many applications given the large heterogeneity in land cover at this spatial resolution. Adequate validation of SIF products with ground GPP estimations from flux-towers is also hampered because the observation footprint of in-situ measurements is too small compared to SIF pixels. To overcome these limitations we have downscaled the product from 0.5° to 0.05° by constraining a simple light-use efficiency (LUE) model with 3 other satellite products at 0.05°: NDVI, evapotranspiration (ET) and land surface temperature (LST), all derived from the MODIS instruments. The local relationship between SIF and the explanatory variables is first established at coarse resolution (0.5°) by exploring the spatial co-variation within a moving window of 11 by 11 pixels and finally applied at fine resolution (0.05°) within the target pixel. The method is applied globally to 7 years of monthly GOME-2 SIF data. The resulting 0.05° product displays a cleaner and more coherent signal when aggregated by land cover classes over different climatic zones. The 7-year climatology is validated with GPP derived from more than 50 flux towers, showing a noticeable improvement over the original coarse product. The resulting product opens new avenues for the calibration of land models at finer scale with in-situ flux-tower observations and for the global monitoring of primary productivity from space.

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