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Global gross primary production estimation based on satellite-derived canopy conductance

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Satellite remote sensing provides temporally and spatially continuous information on biophysical land surface properties related to gross primary productivity (GPP) and evapotranspiration (ET), such as leaf area index, and the fraction of radiation absorbed by the green vegetation (APAR). If water and carbon fluxes are to be interpreted jointly (e.g., to analyse water use effiency), they should be estimated in conceptually coupled approach that recognised the physiological role of stomatal control. In previous research using 16 flux towers world-wide (Yebra et al., 2013) we demonstrated that dry canopy canopy conductance (Gc) can be estimated from optical remote sensing and provides better ET estimates than alternative, more empirical approaches. Here we present a GPP estimation method that is explicitly coupled to ET by using the same satellite-based estimates of Gc and does not require vegetation class mapping. As well as the control of water availability on GPP (expressed in Gc), the algorithm considers radiation and temperature limitations. In addition to Gc the light use effiency (LUE) and APAR are also derived from MODIS reflectance data. We tested two alternative temperature functions, two approaches to estimate LUE and two satellite APAR algorithms. Preliminary results show that the optimal combination is to use the Enhanced Vegetation Index (EVI) to estimate LUE and the Donohue et al (2008) algorithm to estimate APAR. The Raich et al (1991) and MODIS GPP product ramp functions perform similarly well, but on conceptual grounds the former may be preferred. The best algorithm configuration performs very well compare to existing approaches, explaining 61% of the variance in observed 8-day GPP, with an RMSE of 4.8 μmol m-2 s-1.