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# Using the satellite-derived Photochemical Reflectance Index to estimate photosynthetic Light Use Efficiency in semi-arid ecosystems

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Primary productivity, being one of the largest components in the global carbon cycle interacts with environmental factors in many complex ways. It is important to achieve the best possible estimates for the components of the carbon cycle since relatively small changes in climate could alter the direction of the net carbon flux. Current diagnostic models are based on Monteith's light use efficiency approach where primary productivity is the product of absorbed photosynthetic active radiation and a light use efficiency (LUE) term. Often, the LUE is assumed to be biome-specific and within biomes to be constrained by climatic variables, which are extracted from global circulation models. The inaccuracies attributed to this way of determining LUE could be reduced by directly estimating LUE from remote sensing data, through a better capturing of the temporal and spatial variability within a region.

In many ground-based studies the Photochemical Reflectance Index (PRI), a normalized ratio of two narrow spectral bands, has been established as a single, direct indicator of light use efficiency. The few existing studies show that a PRI based on satellite data has also great potential to track seasonally changing light use efficiency and primary productivity in the boreal and temperate terrestrial ecosystems investigated so far. In this presentation we examine the applicability of the PRI to estimate primary productivity in semi-arid ecosystems. The study is based on 1 km resolution reflectance data from the satellite based MODIS-sensor and relies on measurements taken at Mediterranean FLUXNET-sites for validation. In particular we focus on

- How the choice of the reference band and the mode of atmospheric correction performed on the spectral data influence the performance of the Photochemical Reflection Index as a proxy of light use efficiency. The PRI with reference bands 12 (564-556 nm) or 1 (620-670 nm) exceeds a PRI with reference bands 13 (662-672 nm) or 4 (545-565 nm) in relevance. The variance in LUE explained by the PRI increases further when only backscatter regimes are considered. Atmospheric correction with the 6S-Model does not improve the performance of the PRI.
- The temporal aspect in the correlation between the spaceborne PRI and the eco-physiological processes estimated by local measurements of gas fluxes and radiation absorption. Averaging the half-hourly flux- and radiation-data over several hours prior to the acquisition times of the satellite scenes improves the correlation between on-site LUE and PRI. Is this purely statistical or process-driven?
- How well the satellite-based PRI is able to capture stress events reducing primary productivity, in particular summer droughts.