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Photosynthetically Active Radiation estimated from satellite imagery: quality assessment of several methods against the measurements at several locations in Europe

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This communication is a step further in the comparison of several methods to assess Photosynthetically Active Radiation (PAR) from satellite images. Six different methods are applied onto Meteosat images over Europe and their results are compared to PAR measurements performed at terrestrial stations.
An accurate knowledge of PAR radiation is necessary as it represents the portion of the solar spectrum responsible for the growth of plants, algae, and certain microorganisms. Climate change is slowly but surely changing the rules by providing a new distribution map of cultures; for instance French Champagne and vineyard owners are currently widely investing in southern United-Kingdom to ensure the sustainability of their business model. A better knowledge of PAR is crucial to detect trends of changing and provides key assets to farmers to get prepared to the future.
The scarcity of ground PAR measurements motivated scientists to find alternatives. As measurements of the total or broadband irradiation are collected at more terrestrial sites for a long time, several researchers developed empirical models to derive PAR from the broadband irradiation. The main advantage of such models is their ability to provide long-term archives of PAR measurements everywhere in the world, as soon as ground-measured or satellite-derived broadband irradiations are available. These methods bear the underlying assumption that the ratio between PAR and broadband is constant. Three methods have been considered in this validation activity; they are part of group #1.
Sophisticated radiative transfer models (RTM) in the atmosphere may give accurate estimates of PAR provided accurate description of the atmosphere is available as input, such as the CAMS data set. As RTMs are computationally expensive, recent methods have been built to reduce the amount of calculations by working on a reduced number of spectral bands in cloud-free conditions. An all-sky version of these data is obtained by extracting a clear-sky index in the broadband or the PAR range. Three such methods have been selected and form the group #2.
Validations of these methods are presented in photosynthetic photon flux density (expressed in μmol.m-2.s-1) at 3 sites in the United-Kingdom, 1 in north of France and 1 in south east of Spain. Ground measurements have been carefully quality-checked. Preliminary results show a relative bias in percent that ranges between -5 to 15 %, a relative mean square error of 28 to 35 %, and correlation coefficients comprised between 0.945 and 0.960 for all methods. In most cases, methods of the group #2 outperform the others. Nevertheless, with a posteriori adjustment of bias, methods of group 1 turn out to be a good compromise, in particular when real time is at stake.