

OBIA4RTM: Object-based plant parameter retrieval using radiative transfer modelling of vegetation

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Abstract

OBIA4RTM is an open-source Python tool (<https://github.com/lukasValentin/OBIA4RTM>) that attempts to combine object-based image analysis (OBIA) methods with radiative transfer models (RTM) of vegetation to retrieve plant parameters from optical remotely sensed imagery (i.e. Sentinel 2) for different agricultural crop types. Currently, plant parameters such as the leaf area index (LAI) are retrieved operationally on a per-pixel base. Pixel-based approaches, however, neglect spatial autocorrelation. Moreover, the current usage of RTM is hampered by the ill-posed nature of radiative transfer theory as the inversion of the equations required to derive plant parameters cannot be done analytically and no unique solution to the inverse problem exists. The introduction of spatial constraints is therefore considered a way to reduce the ill-posedness of plant parameter retrieval and enhance the retrieval accuracy.

The proposed approach will deliver more meaningful and stable results about plant-parameters than pixel-based ones as the usage of spatial information is assumed to suppress noise inherent in satellite imagery. The end user – mainly individual farmers – will consequently benefit from more accurate and robust results. This is considered particularly important as shareholders and decision makers in agriculture demand up-to-date and reliable information about crop growing conditions to adjust farming practices accordingly.

To demonstrate and validate the OBIA4RTM tool an agricultural region in Southern Germany with in-situ measurements of plant-parameters over longer time periods available (collected by LMU Munich) will be used as test site. In addition, scaling up the approach will be demonstrate on the catchment scale located in a similar climatic regime to demonstrate the capacity of the tool to deal with larger amounts of data.

Once the plant parameter data is retrieved from optical imagery, delivery of the results to the individual farmers is planned to be accomplished via OGC-compliant web-services and portals such as the Web-Feature-Service (WFS) hosted e.g. on a GeoServer. Due to the early phase of development the results will be publicly available.

OBIA4RTM is hypothesized to overcome the current disadvantages of pixel-based approaches. Moreover, it could further foster the usage of OBIA methods in the field of agriculture and contribute to the scientific corpus of the emerging OBIA paradigm. As the tool is not assumed to tackle any privacy or ethical issues, no such conflicts can be identified.

Keywords

OBIA, Radiative Transfer Modelling, Plant Parameters, Optical Remote Sensing