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Quality-assured long-term satellite-based leaf area index product

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Abstracts

Global long-term Satellite-based leaf area index (LAI) products have been generated and applied widely for understanding the feedbacks between climate and terrestrial vegetation. However, these long-term LAI products are not internally consistent over time and also not consistent with each other, which means they might be not suitable for serving as reference datasets in long-term global change research. Therefore, there is a strong need for a quality-assured long-term LAI product with reliable, traceable and understandable quality information. The Quality Assurance for Essential Climate Variables (QA4ECV) project is developing a quality assurance framework to provide understandable and traceable quality information for ECVs such as LAI. The LAI produced from this framework will add greater transparency and openness between ECV producers and end users, and facilitate the application of a long-term LAI product for global change research.

Numerous global satellite-based leaf area index (LAI) products have been generated and widely used for a number of applications such as crop assessment in agro-meteorology or to achieve a better understanding of soil-vegetation-atmosphere interactions and modeling BioGeochemical

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Cycles (e.g., Forzieri et al., 2017; Morton et al., 2014; Spracklen et al., 2012; Zeng et al., 2017). The theoretical and physical uncertainties of these products have been quantified for certain areas and temporal periods (e.g., Chen et al., 2002; Garrigues et al., 2008; Morisette et al., 2006). Furthermore, Jiang et al. (2017) comprehensively evaluated the consistency of the existing long-term (≥30 years) global satellite-based LAI products, in terms of uncertainty variations, trends and inter-annual variabilities. Their results indicate that these long-term LAI products are not internally consistent over time and also not consistent with each other. None of them are suitable for serving as a reference dataset in long-term global change research. These inconsistencies among these products are likely due to the different definitions of LAI (e.g. effective LAI vs green leaf LAI), spectral responsivity differences, satellite orbit drift, as well as the different methods of retrieval. Therefore, there is a strong need for a quality-assured long-term LAI product, which means reliable, traceable and understandable quality information is provided. These datasets need to refer to comprehensive details of the processing algorithm (e.g. in the form of an ATBD), undergo independent traceable ongoing and globally explicit validation, and contain estimates of uncertainties from the propagation through the processing algorithms.

The Quality Assurance for Essential Climate Variables (QA4ECV) project (funded by the European Union's Seventh Framework Programme (FP7/2007-2013) under QA4ECV grant agreement no. 607405) is developing a prototype international quality assurance framework between data producers, national metrology and standards organizations and data users to capture and provide understandable and traceable quality information for ECVs (http://www.qa4ecv.eu). This framework will be further developed for operational application within the European Copernicus Climate Change Service and will ensure that long-term ECV data products, such as LAI, are provided with full uncertainty metrics in a format that can be readily used by end-users (in netCDF4-CM format). One such product is the effective LAI that is produced using the Two-stream Inversion Package (Clerici et al., 2010; Voßbeck et al., 2010), based on the Two-Stream Model developed by Pinty et al. (2006), which implements the two-stream approximation of radiative transfer for a homogeneous canopy (1D-canopy). The 1D radiative transfer model is consistent with large-scale climate and Earth system models and does not require assumptions about other factors such as biome type. This LAI product will provide the uncertainties of LAI for each pixel, which have been propagated through the whole processing chain, also taking into account uncertainty correlations in an enhancement of the LAI product presented in Disney et al. (2016). This product will add greater transparency and openness between ECV producers and end users, and facilitate the application of a long-term LAI product for global change research.

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