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Adjustment of prior constraints for an improved crop monitoring with the Earth Observation Land Data Assimilation System (EO-LDAS)

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Throughout the past decades various satellite sensors have been launched that record reflectance in the optical domain and facilitate comprehensive monitoring of the vegetation-covered land surface from space. The interaction of photons with the canopy, leaves and soil that determines the spectrum of reflected sunlight can be simulated with radiative transfer models (RTMs). The inversion of RTMs permits the derivation of state variables such as leaf area index (LAI) and leaf chlorophyll content from top-of-canopy reflectance. Space-borne data are, however, insufficient for an unambiguous derivation of state variables and additional constraints are required to resolve this ill-posed problem. Data assimilation techniques permit the conflation of various information with due allowance for associated uncertainties. The Earth Observation Land Data Assimilation System (EO-LDAS) integrates RTMs into a dynamic process model that describes the temporal evolution of state variables. In addition, prior information is included to further constrain the inversion and enhance the state variable derivation. In previous studies on EO-LDAS, prior information was represented by temporally constant values for all investigated state variables, while information about their phenological evolution was neglected.

Here, we examine to what extent the implementation of prior information reflecting the phenological variability improves the performance of EO-LDAS with respect to the monitoring of crops on the agricultural Gebesee test site (Central Germany). Various routines for the generation of prior information are tested. This involves the usage of data on state variables that was acquired in previous years as well as the application of phenological models. The performance of EO-LDAS with the newly implemented prior information is tested based on medium resolution satellite imagery (e.g., RapidEye REIS, Sentinel-2 MSI, Landsat-7 ETM+ and Landsat-8 OLI). The predicted state variables are validated against in situ data from the Gebesee test site that were acquired with a weekly to fortnightly resolution throughout the growing seasons of 2010, 2013, 2014 and 2016. Furthermore, the results are compared with the outcome of using constant values as prior information. In this presentation, the EO-LDAS scheme and results obtained from different prior information are presented.