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Optimization of vegetation parameters through sequential assimilation of surface albedo observations

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The dynamic global vegetation model JSBACH, which is the land surface model of the MPI Earth System Model, uses cover fractions of 21 plant functional types (PFT) to represent the vegetation in a grid box. Each PFT is described by a set of parameters and the global distribution of PFTs allows for a spatially differentiated description of the land surface. However, the PFT parameters are constant over time and thus neglect seasonal changes of the described properties.

A comparison of land surface albedo estimated by JSBACH and observed land surface albedo from the Moderate Resolution Imaging Spectroradiometer (MODIS) shows a lack of seasonal variability within the model results. Additionally, an analysis of leaf reflectance and leaf transmittance in the products of the Joint Research Center Two-stream Inversion Package indicates a seasonal cycle of these quantities which is not reflected by the constant canopy albedo parameters of JSBACH.

To derive an appropriate set of seasonally varying canopy albedo parameters, we have set up a flexible, sequential data assimilation framework that allows us to estimate a time series of parameter values.

A standalone version of JSBACH including a phenology model (spatial resolution T63, $\sim 1.9°$; time step 30 minutes) is forced with ERA-Interim reanalysis data. The visible and near-infrared canopy albedo parameters are perturbed to generate an ensemble that represents their uncertainty. The Ensemble Kalman Filter is then used to update the combined state and parameter vector according to observations every time a new observation is available.

To configure the assimilation system and evaluate its performance, we use synthetic observations from a control run of JSBACH with seasonally varying canopy albedo parameters. The simulated land surface albedo of the control run is perturbed and subsets of the data are used for the assimilation. Different subsets are generated to represent global remote sensing and local station measurements and the results of the assimilation are compared with respect to reproducing the parameters of the control run.