Geophysical Research Abstracts
Vol. 16, EGU2014-10946, 2014
EGU General Assembly 2014

Retrieval of seasonally changing, bounded vegetation parameters through sequential assimilation of surface albedo observations

Gernot Geppert (1), Alexander Loew (1), and Felix Ament (2)

(1) Max Planck Institute for Meteorology, Hamburg, Germany (gernot.geppert@mpimet.mpg.de), (2) Meteorological Institute, University of Hamburg, Germany

Earth system models simulate land surface albedo in a simplified manner as the weighted average of background albedo and vegetation canopy albedo. Their weights are derived from the leaf area index and background albedo and canopy albedo are fixed parameters. Inversions of land surface albedo observations from the Moderate Resolution Imaging Spectroradiometer (MODIS), however, indicate a seasonal cycle of canopy albedo.

In order to estimate a time series of canopy albedo parameters and to judge their seasonal behaviour, we set up a sequential data assimilation framework based on the Data Assimilation Research Testbed (DART) and the land component of the MPI Earth System Model (MPI-ESM). We use the ensemble Kalman filter (EnKF) to update the parameter values every time a new (synthetic) observation is available. The EnKF relies on approximately Gaussian distributions of the assimilated quantities and does not constrain the estimates to the physical boundaries of albedo. Therefore we extended DART with a variable transformation technique (Gaussian anamorphosis) that transforms the states and the observations in conjunction with their error covariances from $(0,\ 1)$ to $(-\infty,\ \infty)$. This technique ensures appropriately bounded estimates and yields probability distributions in the transformed space which are closer to Gaussian distributions and thus improves the performance of the EnKF.

We performed assimilation experiments with synthetic observations of visible and near-infrared land surface albedo from a control run of MPI-ESM. We successfully tested the assimilation framework for consistency (perfect initial conditions are not deteriorated) and for the near to perfect retrieval of fixed and seasonal parameters from perfect observations without observation error. In these tests, we used two different assumed error levels to control the observational impact on the estimates. Using albedo observations with simulated errors of the order of 0.01 [-], we can retrieve fixed parameters with an absolute error below 0.005 and seasonal parameters with a root mean square error between 0.004 and 0.02 for 8 vegetation types. In the latter case, additive inflation in the untransformed space is necessary. For larger observation errors of the order of 0.04, an unwanted stronger weighting of observations closer to 0.5, which is caused by the non-linear transformation, leads to a bias between 0.03 and 0.05 in the retrieved parameters.