Geophysical Research Abstracts
Vol. 20, EGU2018-14095, 2018
EGU General Assembly 2018

Systematically evaluating the albedo of various land-cover types and albedo changes associated to land-cover transitions in Earth System Models

Quentin Lejeune (1,2), Edouard Davin (1), Grégory Duveiller (3), Alessandro Cescatti (3), and Sonia Seneviratne (1)

(1) Institute for Atmospheric and Climate Science, ETH Zürich, 8092 Zürich, Switzerland, (2) Climate Analytics, 10969 Berlin, Germany, (3) European Commission Joint Research Centre, Via E. Fermi, 2749, I-21027 Ispra (VA), Italy

Many studies have demonstrated the impacts of albedo changes on climate conditions across space and time. However, land surface models (LSMs) exhibit substantial differences in their simulated impacts of land-cover changes on albedo, therefore calling for a thorough evaluation of this aspect in Earth System Models (ESMs). Such systematic evaluation efforts have so far been impeded by the structure of land surface models, which by default do not provide information on the albedo of the various land-cover types that they can represent, and have thus required designing dedicated model experiments for comparison with the relevant observational data.

We have circumvented this problem by developing a tool that extracts land cover-specific albedo values from default ESM or LSM global simulations, and compares them to the results from the most recent satellite-derived global observations. We evaluate the performance of this extraction methodology by using a simulation conducted with the Community Land Model 4.5, which also provides the albedo of various land cover types at the sub-gridcell level. We show that the extraction method is well able to retrieve the albedo of forests and crops/grasses where these land cover types are at least moderately abundant (>20%), introducing an error of $\sim$0.01 (0.02 in the presence of snow). Retrieving the albedo from shrubs was hampered by their limited spatial coverage.

We then reconstruct the albedo of both forests and crops/grasses in historical simulations conducted with CMIP5 models for which land cover and albedo information is only provided at the grid cell level, and compare these results with observational findings derived from combinations of either the GlobAlbedo and GlobCover datasets, or the ESA CCI land cover and MODIS albedo products. We identify substantial variations between models, and also systematic differences with observations. The MPI models indeed exhibit higher albedo than observations for mid-latitude crops/grasses, a finding that must however be interpreted in the view of previous results that have highlighted the lower satellite-derived albedo of short vegetation types compared to in situ observations. We also find that mid-latitude forest albedo is almost systematically underestimated in CMIP5 models compared to observations. As a result, all models simulate higher albedo increases associated to deforestation compared to satellite-derived evidence. This tool will be available in the next release of the ESMValTool, and will therefore also be usable to evaluate the next round of CMIP6 simulations.