Geophysical Research Abstracts
Vol. 18, EGU2016-4686, 2016
EGU General Assembly 2016

Comparative assessment of mid-latitude land-cover change effects on temperature in historical LUCID and CMIP5 simulations

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During the industrial period, large areas of North America and Eurasia experienced a reduction in forest cover and an expansion of agricultural areas. Here we compare results from the LUCID and CMIP5 model intercomparison projects in order to investigate how these land-cover changes (LCC) have locally impacted the biophysical land surface properties, like albedo and evapotranspiration, and how this has affected seasonal mean temperature as well as its diurnal cycle. We use a method adapted from Kumar et al. (2013) to extract the impact of LCC in climate simulations including all historical forcings. We show that in most cases, this method captures well the sign and the seasonal cycle of the impacts diagnosed from single-forcing experiments, even if it tends to underestimate them.

Our analysis reveals that both the LUCID and CMIP5 models agree on the albedo-induced cooling of mean winter temperatures. In contrast, there is more disagreement about the response of the latent heat flux and therefore about changes in mean summer temperature, when evaporative cooling plays a more important role. Overall, a majority of models exhibits a local warming effect of LCC during this season, contrasting with LUCID results (de Noblet-Ducoudré et al., 2012), but also with present-day observations of the impact of deforestation on mean temperature (Lee et al, 2011). We also find that none of the analyzed models reproduce well the changes in the diurnal cycle from observations. However, overall the CMIP5 models agree better with observations than the LUCID models regarding the warming effect of deforestation on daytime temperatures during summer, and its cooling effect on nighttime temperatures during winter.

References:
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