Questioning the Relevance of the Radiative Forcing Concept for Anthropogenic Land-Cover Change Issues

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We perform five climate simulations using the IPSL coupled atmosphere-ocean-vegetation climate model (IPSLCM4) to investigate *the links* between radiative forcing and surface climate change resulting from Anthropogenic Land Cover Change (ALCC). We address past (from pre-industrial to present-day) as well as future (from present-day to the end of the 21st century) changes to better assess the robustness of our results.

We show that mid-latitude as well as tropical deforestation lead to a global cooling of the surface climate that varies between 0.05K for past to 0.14K for future ALCC. In all simulations, less than 30% of this cooling results from the increase in surface albedo, while the remaining part is due to the reduced evapotranspiration and thereby atmospheric water vapour. Both changes lead to a reduction of the global mean radiative forcing at the tropopause but in all cases the resulting annual temperature change of the surface is less than the one we would have obtained if this radiative forcing was induced by a change in CO_2. This implies that *ALCC are less efficient in cooling down the planet than a radiatively equivalent greenhouse gas*. Moreover, the change in surface albedo alone, although leading to the larger change in radiative forcing at the tropopause, is less efficient than the changes in other land-surface characteristics when translated in terms of global mean annual change in surface temperature. *It therefore limits the relevance of using the concept of radiative forcing to compare ALCC to other forcings* as suggested in the IPCC assessment.

The equilibrium climate sensitivity of the IPSL-CM4 model is slightly above 1K/(Wm^{-2}) when computed from changes in CO_2, while it goes down to about 0.3K/(Wm^{-2}) if CO_2 remains constant but land-cover is modified. This value is relatively insensitive to the latitude at which the deforestation takes place (mid-latitudes or tropics).