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Modelling Deforestation Uncertainty due to Albedo Variability

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The conversion of forested areas into croplands is the result of the expansion of agriculture and industry. Deforestation is associated with increased atmospheric CO_2 and alterations to the surface energy and mass balances that can lead to local and global climate changes. An important component of these deforestation effects on climate are radiative changes due the difference in albedo between forest and croplands/pastures. While observations clearly show albedo variability within similar vegetation classes, most GCMs make use of only one snow-free albedo value for each vegetation class. Here we use the University of Victoria Earth System Climate Model to estimate the sensitivity of deforestation simulations to observed albedo variability based on experiments that simulate 50% deforestation over high, mid and low latitudes. The magnitude of the uncertainty in the modelled global surface air temperature (SAT) response due to albedo variability represents 0.30, 1.60 and 1.80 of the deforestation signal for the high- mid- and low-latitude experiments respectively. The uncertainty associated with the local (over deforested area only) soil carbon ranges from 0.043 in high-, 0.21 in mid-, to 5.50 in low-latitudes. High forest density appears to cause large uncertainties within the low latitudes, along with increased exposure to radiation from the sun. The albedo sensitivity of the modelled climate response to deforestation indicates that caution should be taken when using GCMs to predict deforestation effects.