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Biophysical and biogeochemical forcing and feedbacks to climate from land-use and land cover change

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Human land use and land cover change (LULCC) has been an important driver of recent climate change, due both to altered land-surface properties (biophysical effects) and to emissions of carbon dioxide and other greenhouse gases (biogeochemical effects). Additionally, LULCC has likely altered the magnitude of physical and biogeochemical feedbacks in the climate system. For example, albedo feedbacks due to changing snow, ice and vegetation distributions are sensitive to the area and extent of human land-use; similarly, terrestrial carbon cycle feedbacks are affected by changes in vegetation types and distributions that result from human LULCC. In this paper, I first review recent modelling studies of the effect of human LULCC on historical climate and discuss the range and types of forcings and feedbacks that are affected by LULCC. I then present a series of transient model simulations using an intermediate-complexity Earth-system model to: (1) compare the relative contribution of biophysical and biogeochemical effects to climate forcing from LULCC; and (2) compare the effect of these direct climate forcing effects to the indirect effects on climate which may have occurred as a result of LULCC-driven modification of physical and biogeochemical climate feedbacks.