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Non-radiative processes drive surface temperature dynamics during land cover changes in the Horn of Africa

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Climate can be perturbed by land cover change through its influence on the exchange of water, energy, and gases between the land surface and atmosphere. However, in the areas of considerable land cover changes, such as the Horn of Africa, estimating the relative contribution of the associated biophysical changes to the climate through their impact on net land surface temperature dynamics requires further study. Here we used an empirical model driven by time series data (2001 – 2013) from meteorological and moderate-resolution satellite observation, and quantified the relative contribution of radiative (albedo) and non-radiative (evapotranspiration and surface roughness) changes to surface temperature dynamics in the region. In our analysis, the impact of background climate variability signal was removed from every pixel. We find that the conversion of forest to cropland generated maximum net warming (1.3 K) compared with other conversion classes (savanna, shrubland, grassland, and cropland). The warming from the reduction of evapotranspiration and surface roughness process were up to 10-times stronger than the cooling effect from albedo increase (–0.12 K). This result indicates that albedo effect weakly counterbalances the warming from the non-radiative processes, and the climatic impacts of land cover changes were mainly driven by the non-radiative processes in the region.