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Attribution of surface temperature response to land use change in arid ecosystems

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The arid and semiarid region in north China has experienced substantial land cover changes since the early 1980s partly due to the implementation of large-scale afforestation programs and efforts to combat desertification. In this study, micrometeorological observations in a crop land ecosystem (Daman), a mixing forest ecosystem (Hunhelin), a shrub ecosystem (Sidaoqiao) and their adjacent bare land are used to evaluate the surface temperature response to land use change in Heihe River basin. Results indicate that, comparing to bare land, the crop land has a cooling effect about $0.5 \sim 2.2$ K, the mixing forest has a cooling effect in the daytime ($0.6 \sim 2.3$ K) and a warming effect in the nighttime ($0.9 \sim 2.3$ K) and the shrub land has a cooling effect in the growing season ($0.2 \sim 1.2$ K) and warming effect in the non-growing season ($0.4 \sim 1.7$ K). These temperature changes are decomposed into contributions from changes in radiative forcing, heat resistance (Rt), Bowen ratio (or surface resistance), ground heat flux and air temperature change according to the intrinsic biophysical mechanism (IBPM) and the two-resistance mechanism (TRM). Independence between the biophysical forcings is the prerequisite for both methods. The statistic results show that independence between Rt and the Bowen ratio is similar to the independence between the Rt and surface resistance (Rs). Results also show that Bowen ratio change and heat resistance change (ΔRt) are the dominant biophysical forcings, and the nighttime ΔRt is largely up to the radiometric resistance change (ΔRr).