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Changes in land-cover, land-use, and dust loadings in the Northern Eurasia drylands and implications for the surface energy balance and PAR

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The drylands of Northern Eurasia, including Central and East Asia, have undergone significant changes with adverse consequences for the regional climate, environment, and human well-being. Changes in vegetation types and their cover affected the surface albedo in the solar spectrum and the surface emissivity in the thermal IR, and hence altered the radiative components of the surface energy balance. On the other hand, land-cover and land-use changes affected the dust sources in the region by changing their extent and intensity. Resulting changes in the burden of atmospheric dust aerosol, in turn, contributed to changes in the surface energy balance by affecting both the solar and thermal IR radiation, as well as affecting the photosynthetically active radiation (PAR), with the impact on the ecosystem functioning.

Focusing on Central and East Asia, this study examines the coupling between the land cover changes and wind-blown atmospheric dust to assess its likely significance for the surface energy balance, overall land-atmosphere interactions, and climate. This is achieved by performing a series of modeling experiments using a one-dimensional radiative transfer code and a regional dust coupled modeling system WRF-DuMo constrained by satellite and ground-based data. We will present the results of extensive radiative transfer modeling in the presence of dust over the different types of land surfaces, considering the size distribution and composition representative of Asian dust. The surface albedo of common vegetation and ecosystem types was constrained by merging the USGS spectral library data with the MODIS albedo products. The satellite aerosol products from MODIS, MISR, and CALIPSO were used to constrain the dust loadings and properties. In addition, we performed a case study using WRF-DuMo to assess the changes in surface energy balance caused by coupled changes in land-cover and dust loadings. Formulation of the possible feedbacks in the coupled land-atmospheric dust system and implications for the integrated systems modeling will be addressed.

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