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Understanding the impact of changes in land-use/land-cover and atmospheric dust loading and their coupling upon climate change in the NEESPI study domain drylands

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The Northern Eurasia Earth Science Partnership Initiative (NEESPI) Science Plan identifies atmospheric aerosols and pollutions and their impacts on and interactions with the Earth systems (and terrestrial ecosystem dynamics in particular) as a cross-cutting topic of special interest. Wind-blown mineral dust, being an important atmospheric constituent in the NEESPI drylands, can exert strong radiative forcing upon the regional climate and cause adverse impacts on human and ecosystems health. The impacts of dust storms are not only regional, but may affect areas thousands of kilometers from their source, making interactions between climate change, land use and dust aerosols globally relevant. Given the intimate coupling between the land processes and wind-blown atmospheric dust and their importance in the climate system, an improved understanding of how land-use/land-cover changes affect Asian dust and associated feedbacks is needed to make assessments of climate change more realistic.

To improve the ability to predict impacts of dust on the climate and environment, we have been developing a coupled regional dust modeling system for Central and East Asia. This includes implementation of a new dust module DuMo into the NCAR Weather Research and Forecasting (WRF) model as well as a coupled treatment of dust aerosol interactions with atmospheric radiation. The dust module DuMo includes two different state-of-the art schemes that explicitly account for land properties (including vegetation and soil geomorphology and moisture) and meteorology, and, thus, improves modeling capability.

The focus of this talk will be on the impact of atmospheric dust on the surface energy balance and photosynthetically active radiation (PAR). Both processes play a key role in the ecosystem functioning as well as overall in land-atmosphere interactions, but they are rarely considered in an integrated fashion.