Potential impact of snow darkening effect by light-absorbing aerosols on the hydrological cycle over Eurasia

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In this study, we present the possible impact of snow darkening effect (SDE) on the hydrological cycle over Eurasia by light-absorbing aerosols using the NASA GEOS-5 Model experiments with aerosol tracers and a state-of-the-art snow darkening module, Goddard SnoW Impurity Module (GOSWIM) for the land surface. Results show that SDE can have a significant regional dependency in partitioning the role of evaporative and advective components on the hydrological cycle, especially during spring and summer season. Over the western Eurasia (40-60˚N, 20-60˚E), SDE-induced rainfall increase during early spring can be largely explained by the increased evaporation from snowmelt. Rainfall, however, decreases in early summer due to the reduced evaporation as well as moisture divergence associated with the development of anticyclonic circulation. On the other hand, in the East Asian region, the moisture advection from adjacent ocean is a main contributor to rainfall increase in the melting season. Warmer land-surface due to earlier snowmelt further increases moisture convergence and significantly increases rainfall over the region. This finding suggests that the SDE may play an important role in advancing and strengthening monsoonal circulation in East Asia, while it may lead to dry and hot summer by intensifying blocking high over the mid-western Eurasia

Keywords: Snow darkening effect, Light-absorbing aerosol, Hydrological cycle, Asian summer monsoon, Heat wave

