A trial of elucidation for dust emission conditions in East Asia by synoptic data analyses and a field observation

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Mineral dust particles are blown up into the free atmosphere by sand-dust storm (SDS) in drylands, and they are broadly distributed by wind in the upper atmosphere. SDS is a type of disaster in drylands, which sometimes kills people and animal, destroys infrastructure, reduces merchandise value of livestock etc. In downwind regions like Japan, there is reports on its health effect. In the global scale, there are many reports about their effects on climate via direct and indirect effects of radiation. Many researchers have developed numerical dust model to avoid such damages, but their accuracy is still low, especially in its emission phase (Uno et al. 2006; Carmichael et al. 2008).

We can divide causes of dust emission (in other words, wind erosion) into erosivity (i.e., ability of wind to cause erosion) and erodibility (i.e., susceptibility of soil and land surface to wind erosion represented by the threshold wind speed for dust emission). Erosivity can be expressed by one parameter, which is wind speed and accuracy for its observation and its forecast is relatively reliable. On the other hand, erodibility has many parameters relating with soil and land surface such as soil particle size, soil wetness, crust, soil freeze, snow cover, vegetation cover, and we have a very big hurdles for monitoring all with high accuracy. This can be a big reason of low accuracy of dust emission modeling.

Tottori University set up a dust monitoring system at Tsogt-Ovoo, Mongolia, which is located in a northern part of the Gobi Desert. We have clarified that effects of soil crust (Ishizuka et al. 2012 SOLA), vegetation cover in topographic depression (Gantsetseg et al. 2017 J. of Arid Land), stone (Buyantogtokh et al. 2019 in preparation), dead leaves on erodibility. We also have conducted analyses of wind and present weather data included in synoptic report to elucidate dust emission conditions, which differs place by place. Kurosaki et al. (2011 GRL) clarified that dust emission frequencies increased at many synoptic meteorological observatories in East Asia from 1990s to 2000s and the major causes are in increased erodibility, which can be shown by reductions of threshold wind speed. Wu et al. (2016 SOLA) clarified that the major causes for dust emission are different station by station in East Asia. Wu et al. (2019 in preparation) clarified that effect of livestock number at Abaga Qi, which is located at Xilingol Grassland, China.

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