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Satellite-based Monotoring of mitiple natural disasters in Mongolian socio-ecological system

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In this presentation, a conceptual mechanisms how multiple natural hazards (i.e. drought, dust storm, land degradation, and Dzud) in Mongolia are linked with each other and how satellite earth observation (EO) data can be utilized to analyze cause-and results relations and to predict the natural hazards. Massive loss of livestock and wildlife animal during winter seasons (dzud) is an endemic climatic disaster in the Central Asia grasslands but the mechanisms are not well understood yet. Recent national-wide sever Dzud occurred during 2009-2010 winter in Mongolia. Whereas, high stocking rate of livestock may give negative effects on sustainable use of pastureland. Dzud is a natural mechanism reducing grazing pressure when stocking rate is high enough to cause the negative effect. Both Dzud and land degradation were directly linked with drought phenomena, which is associated with dust storm occurrence because those conditions can cause sparse vegetation and increase of sensible heat generating strong vertical wind. At a lower level of administration (i.e. soum), stepwise multiple regression analysis was conducted to find significant factors of inter-annual livestock change. For a period from 2003 to 2010, various datasets were prepared from national census and satellite data (summer and winter temperature and precipitation, and summer dryness and vegetation index, NDVI). As results, linear regression models were successfully produced at 70% of soums studied. Summer and winter variables appeared equally important in controlling livestock dynamics. Single-factor models were predominant. The primary factor of each soum showed certain regional patterns incident well with climate severity and foraging resource availability (e.g. temperature in north, dryness in south, and NDVI in middle). Our results indicate that Mongolian pastoral livelihood is highly vulnerable to extreme variability of endemic regional climate factors and hence, there are still rooms for enhancing socio-ecological adaptive capacity such as herder's preparedness and governance. We illustrate the seasonal climate-vegetation-livestock interactions with a simplified schematic mechanism model. Our schematic model refined it to give better process-oriented relationships among key variables. Seasonal temperature and precipitation are the primary forcing variables to determine vegetation growth and livestock accessibility to food resources and dryness. Summer standing biomass and winter dry biomass (i.e. residue) were separated and associated with seasonal livestock foraging, respectively. By its mechanistic nature, the schematic model can be applied to test statistical significance of factors associated with annual livestock change or to provide logical grounds on developing a dynamic numerical model in future.