Linkages between Snow Cover Seasonality, Terrain, and Land Surface Phenology in the Highland Pastures of Kyrgyzstan

Geoffrey Henebry, Monika Tomaszewska, and Kamilya Kelgenbaeva

South Dakota State University, Geospatial Sciences Center of Excellence, Brookings, United States
(geoffrey.henebry@sdstate.edu)

In the highlands of Kyrgyzstan, vertical transhumance is the foundation of montane agropastoralism. Terrain attributes, such as elevation, slope, and aspect, affect snow cover seasonality, which is a key influence on the timing of plant growth and forage availability. Our study areas include the highland pastures in Central Tien Shan mountains, specifically in the rayons of Naryn and At-Bashy in Naryn oblast, and Alay and Chong-Alay rayons in Osh oblast. To explore the linkages between snow cover seasonality and land surface phenology as modulated by terrain and variations in thermal time, we use 16 years (2001-2016) of Landsat surface reflectance data at 30 m resolution with MODIS land surface temperature and snow cover products at 1 km and 500 m resolution, respectively, and two digital elevation models, SRTM and ASTER GDEM. We model snow cover seasonality using frost degree-days and land surface phenology using growing degree-days as quadratic functions of thermal time: a convex quadratic (CxQ) model for land surface phenology and a concave quadratic (CvQ) model for snow cover seasonality. From the fitted parameter coefficients, we calculated phenometrics, including "peak height" and "thermal time to peak" for the CxQ models and "trough depth" and "thermal time to trough" for the CvQ models. We explore how these phenometrics change as a function of elevation and slope-aspect interactions and due to interannual variability. Further, we examine how snow cover duration and timing affects the subsequent peak height and thermal time to peak in wetter, drier, and normal years.