Where in High Mountain Pastures does Snow Seasonality Link Most Closely with Subsequent Land Surface Phenology?

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Within the context of a NASA LCLUC project, we have been working to detect significant changes in metrics of snow seasonality in high mountain pastures across Kyrgyzstan and to associate them, with metrics of land surface phenology in the subsequent growing season, as modulated by terrain features. There are multiple challenges to address including reconciling spatial and temporal scales of observation, topographic normalization of reflectance, seeking ecological signal amidst a welter of variation across multinomial stratifications, and limitations on statistical tests due to autocorrelation, very large sample sizes, and inappropriate neutral model expectations. Working in mountainous landscapes can pose special challenges because terrain features—elevation, slope, aspect, and landform—as well as geographic context can interact to change the ecological expectations of their interactions. We use two types of MODIS products—land surface temperature (MOD11A2, MYD11A2) and snow cover (MOD10A2)—to track the seasonal progression of thermal time and the seasonality of snow cover. We model land surface phenology using NDVI data from Landsat TM/ETM+/OLI sensors as a quadratic function of accumulated growing degree-day calculated from MODIS LST products. Phenological metrics derived from the fitted parameter coefficients include Peak Height (PH) of NDVI and the Thermal Time to Peak (TTP) NDVI. Snow cover seasonality metrics include First Date of Snow (FDoS), Last Date of Snow (LDoS), and Duration of Snow Season (DoSS). We explore how the phenological metrics (PH, TTP) are linked to the seasonality metrics (FDoS, LDoS, DoSS) and how these relationships change as a function of terrain, particularly in contrasting aspects on moderate to steep slopes. The analyses reveal those parts of the landscape where pasture productivity is more vulnerable to changing snow seasonality.

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