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Repetitive Patterns of Snow Distribution and Ablation, and their applications

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Snow cover extent has long been identified as a sensitive indicator of climate change. Many researchers have recognized the fact that inter-annual melt patterns of snow across a watershed are similar from one year to the next because they are largely controlled by some inherent factors that are peculiar to each landscape such as topography, vegetation, and consistent synoptic weather patterns. However, almost no one has developed a method to characterize and quantify the inter-annually repeating component of this pattern. This development overcomes a number of ubiquitous and significant current problems in snowcover determination, including problems with cloud obscuration of the ground surface, the ability to do within-season snowmelt forecasting, generation of snow cover maps for times preceding the availability of satellite remote sensing instruments, and determination of the impact of a broad range of climate change scenarios on snowcover and melt. In this study we utilized a collection of snow cover maps produced from MODIS data across multiple years (2001 to 2012) coupled with the melt-out date of a collection of Snowpack Telemetry (SNOTEL) stations within a region of study to synthesize the regular pattern of snow depletion from the beginning to the end of melt seasons. The synthesized spatial time series are used as a template to determine the condition for cloud obscured areas and to generate snow cover maps for times predating the launch of the MODIS instrument. The accuracy of this method is evaluated over the headwaters of the Upper Snake River in Western Wyoming. The results indicate that this method, though simple, is tremendously efficient in cloud removal and generation of pre-MODIS snowmelt maps. Certainly, the snow modeling community as well as climate change experts will find the results very useful.