Snow probability for snow covered area detection

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EXTENDED ABSTRACT

Snow covered area is an important component in hydrological cycle and its importance increases as the snow melt runoff percentage in the annual river discharge increases. Thus, monitoring the snow cover extent and its variability are important in terms of water resources management and climate change studies (Brubaker et al., 2005; Cohen and Entekhabi, 2001).

Due to the highly dynamic nature of snow, conventional methodologies cannot keep up with monitoring the rapid change in snow characteristics and are mentioned as inadequate (Mognard, 2003; Rees, 2006; Tekeli and Tekeli, 2012; Sönmez et al., 2014). Remote sensing (RS) provides convenient solutions to track the rapid changes in snow parameters. Among the various RS techniques, satellite imagery with its wide area coverage and frequent, repeated cycles provides the most cost effective solutions and many successful applications of satellite imagery in snow monitoring have been performed since 1960s (Tekeli, 2007). Due to its high albedo, snow covered area detection has been the mostly provided by RS products obtained by using satellite data.

Snowmelt Runoff Model (SRM) and Hydrologiska Byråns Vattenbalansavdelning (HBV) models have been very often used in operational runoff forecasting (Udnaes et al., 2007). SRM is among the few models that directly uses the snow covered area (SCA) as an input parameter. As SCA is one of the input variables, accuracy of the SCA will directly affect the SRM simulations/forecasts results.

Interactive Multisensor Snow and Ice Mapping System (IMS) provided by National Oceanic and Atmospheric Administration’s National Environmental Satellite Data and Information Service (NOAA/NESDIS) is used as SCA data in this study. The main motivation for IMS use is; (1) IMS provides the longest satellite-derived environmental data for hemispheric snow cover monitoring; (2) erroneous snow detections which can arise from differentiating between clouds, fog with ice and snow, bright surface features, boundaries between water bodies are eliminated as much as possible by the interactive techniques (Chen et al. 2012). Figure 1 represents clipped IMS data over Turkey for 30 April 2007.

Although SCA can be derived from satellites in a real time manner, SCA images may not be readily available as an input into the model at the hand when they are needed for forecasting the snowmelt runoff. In this case, the long term SCA monitoring enables a solution as it helps to determine the spatial and temporal distribution of snow cover within the study area.

Having the long term IMS SCA images at hand, probability of snow (PS) similar to Richer (2009) is defined for each pixel over Turkey region using Equation 1. The difference of Equation 1 from that of Richer’s is that since IMS is free of cloud blockage all available data can be used enabling the removal the subtraction of cloud covered images from the analysis.

References:

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2 Department of Meteorology, Ondokuz Mayis University, Samsun, Turkey.
3 Remote Sensing Division, Turkish State Meteorological Service, Ankara, Turkey.
Figure 1: Sample IMS data for 30 April 2007.

\[ PS = \frac{(Number \ of \ days \ pixel = Snow)}{(Total \ number \ of \ images)} \]  

(1)

PS image calculated using Equation 1 for Julian day (JD) 60 is presented in Figure 2. White pixels have a value of 1 and indicate that these pixels are always snow covered in all the available images. Black pixels have a value of 0 and indicate that these pixels never indicated snow in any of the available images.

Figure 2: Probability of snow for Julian day 60.
REFERENCES


Rees WG. 2006 *Remote sensing of snow and ice* Taylor & Francis, Cambridge University, England


