World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:11, No:05, 2017

Spatio-Temporal Dynamics of Snow Cover and Melt/Freeze Conditions in Indian Himalayas

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Abstract : Indian Himalayas also known as third pole with 0.9 Million SQ km area, contain the largest reserve of ice and snow outside poles and affect global climate and water availability in the perennial rivers. The variations in the extent of snow are indicative of climate change. The snow melt is sensitive to climate change (warming) and also an influencing factor to the climate change. A study of the spatio-temporal dynamics of snow cover and melt/freeze conditions is carried out using space based observations in visible and microwave bands. An analysis period of 2003 to 2015 is selected to identify and map the changes and trend in snow cover using Indian Remote Sensing (IRS) Advanced Wide Field Sensor (AWiFS) and Moderate Resolution Imaging Spectroradiometer(MODIS) data. For mapping of wet snow, microwave data is used, which is sensitive to the presence of liquid water in the snow. The present study uses Ku-band scatterometer data from QuikSCAT and Oceansat satellites. The enhanced resolution images at 2.25 km from the 13.6GHz sensor are used to analyze the backscatter response to dry and wet snow for the period of 2000-2013 using threshold method. The study area is divided into three major river basins namely Brahmaputra, Ganges and Indus which also represent the diversification in Himalayas as the Eastern Himalayas, Central Himalayas and Western Himalayas. Topographic variations across different zones show that a majority of the study area lies in 4000–5500 m elevation range and the maximum percent of high elevated areas (>5500 m) lies in Western Himalayas. The effect of climate change could be seen in the extent of snow cover and also on the melt/freeze status in different parts of Himalayas. Melt onset day increases from east (March11+11) to west (May12+15) with large variation in number of melt days. Western Himalayas has shorter melt duration (120+15) in comparison to Eastern Himalayas (150+16) providing lesser time for melt. Eastern Himalaya glaciers are prone for enhanced melt due to large melt duration. The extent of snow cover coupled with the status of melt/freeze indicating solar radiation can be used as precursor for monsoon prediction.

Keywords : Indian Himalaya, Scatterometer, Snow Melt/Freeze, AWiFS, Cryosphere
Conference Title : ICCGW 2017 : International Conference on Cryosphere and Global Warming
Conference Location : Paris, France
Conference Dates : May 18-19, 2017