Evaluating Snow Depth in Western China Based on Passive Microwave Remote Sensing

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Abstract: Snow cover estimation is important for climate change studies and successful water resource management. It has been shown that snow cover can affect directly climate dynamics, and so our ability to estimate global snow coverage and volumetric storage of water in seasonal and permanent snowpacks impacts on our ability to monitor climate and climate change and to test climate model simulations. Furthermore, successful estimation of volumetric storage of snow water at a basin scale should improve the management of water supply. Remote sensing has been used to monitor continental scale seasonal snow covers for 25 years with much of this effort focused on the use of remote sensing of snow cover area using visible and infrared sensors. While this effort is starting to mature, the successful estimation of global snow volume [snow depth or snow water equivalent (SWE)] is still at a developmental stage.

Progress in retrieving snow depth or SWE has been made through the available “instruments of opportunity” such as the Scanning Multichannel Microwave Radiometer (SMMR) and the Special Sensor Microwave Imager (SSM/I). Neither instruments were designed explicitly for snow applications but have been found to be effective for this application. For snow detection, passive microwave instruments tend to underestimate the snow area compared with estimates from visible-infrared snow-mapping methods. Additionally, the errors of estimates of snow volume tend to be large with standard errors of 20 mm SWE and greater not uncommon (e.g., see). The perceived need by water resource managers and land surface and climate modelers is for high accuracy, local scale estimates of snow volume on a daily basis. Fortunately, the spatial resolution of the SMMR and SSM/I instruments tends to restrict their effective use to regional-scale studies. Furthermore, currently available SSM/I data is acquired twice daily only at high latitudes with coverage more restrictive at lower latitudes. The Advanced Microwave Scanning Radiometer—Earth Observing System (AMSR-E) aboard Aqua, which was launched in 2002, helps to overcome some of these drawbacks.

This paper describes the development and testing of an algorithm to estimate global snow cover volume from spaceborne passive microwave remote sensing observations. Our aim is to estimate the snow depth for the snow area. In order to evaluate the snow water equivalent (SWE) inversion algorithm for passive microwave sensor AMSR-E in Western china, both snow cover fraction the brightness temperate of AMSR-E were considered. The data demonstrator that the snow depth have very close relationship with snow fraction in pixels and the ratio of different frequency brightness. A methodologically simple approach to estimate snow depth from spaceborne microwave instruments is described, compared SWE got from AMSR-E daily SWE product with the ground measurements from 15 meteorological stations in Tibetan plateau in 2003 and 35 meteorological stations in Xinjiang in January 2004. The results show AMSR-E overestimate SWE both in these two regions, and RMSE is 21mm and 31.8 mm in Tibetan plateau and Xinjiang, respectively. Through incorporating snow fraction factor, a new empirical algorithm estimate snow depth and SWE have been developed in Xinjiang. This new algorithm appeared higher accuracy than AMSR-E does in Xinjiang. Due to complex topography, shallow patchy snow and

frozen grounds covered at the Tibetan Plateau, this technique didn’t show good results. In future we will focus on how to evaluate and eliminate the effects of these factors quantitatively on SWE retrieval.