



## **New methods for reducing cloud obscuration based on combination products of MODIS and AMSR2**

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As one of the main sources for water availability in semi-arid mountain regions, snow melt provides runoff and water supply for the downstream population and is of great importance for both human and environmental systems. For this reason, snow data such as snow cover (SCA) and snow depth (SD) is especially important. Snow cover has been mapped using many remote sensors in the visible, near-infrared, thermal, and microwave wavelengths. Since 1966, optical remote sensors such as AVHRR, Landsat and MODIS have obtained critically important data for observing the earth's snow cover. The Moderate Resolution Imaging Spectroradiometer (MODIS) employed by Terra and Aqua satellites provides spatially snow covered data with 500 m and daily temporal resolution. However the utility of the MODIS snow-cover products is limited by cloud cover which causes gaps in the daily snow-cover map products. In this paper, we developed a new method in order to reduce cloud obscuration. This method includes four parts: A) Combining various MODIS Terra and Aqua products; B) Temporal and spatial filtering; C) Zonal snowline approach and D) Combining the product deriving from the above three parts and the AMSR2 passive microwave snow depth product (with a spatial resolution of 10 km). In part D, the consistency of two different data (optical remote sensing data with spatial resolution of 500 m and passive microwave remote sensing data with a spatial resolution of 10 km) was evaluated. This study was carried out for Qinghai Province located in northwestern part of China during 1<sup>st</sup>, October, 2013 to 31<sup>st</sup>, March, 2015. In order to evaluate the performance of the proposed methodology, 14 MODIS snow cover product tiles (with cloud coverage less than 10%) were selected as possible "ground truth" data and cloud mask was generated for each tile randomly. The results show successful performances arising from the methods applied, which resulted in all cloud coverage being removed. The overall accuracy of the new TAA2C (Terra-Aqua-AMSR2 Combined) product is 93.4% as compared with 30 ground stations in all-sky conditions. Without the AMSR2, the daily combination of MODIS Terra-Aqua can only remove limited cloud contamination: 35.8% of the annual mean cloud coverage compared with 44.7% (MODIS Terra) and 53.6% (MODIS Aqua).