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Monitoring meteorological variables in the mountainous region using multiple satellites remotely sensed data over the Korean Peninsula

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Mountain meteorology monitoring is important for forest research fields including the forest disaster and forest ecosystem management. The satellite observations provide an opportunity to monitor meteorological variables with high spatio-temporal resolutions in the mountainous region. Here, we propose the methodology to produce and monitor the mountain meteorology from multiple satellite data combination. In this study, satellite-based mountain meteorology were estimated for the last 15 years under both clear and cloudy sky conditions using the Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) and the Advanced Microwave Scanning Radiometer-EOS (AMSR-E), and GCOM-W1 AMSR2. The effect of cloud contamination that leads to the substantial retrieval error and signal loss was reduced by integrating the MODIS product and the brightness temperature (Tb) at 37 GHz frequency derived from microwave satellites. A pixel-wise regression method between MODIS atmospheric products and AMSR-E and AMSR2 Tb (hereafter AMSR Tb) was applied to estimate surface meteorological variables for all sky conditions. The ambient temperature lapse rate was applied to improve the retrieval accuracy from MODIS atmospheric products in complex terrain. Estimated results were evaluated using measurements observed from the Korea Forest Service (KFS) and Korea Meteorology Administration (KMA). KFS is operating the 150 meteorological stations, called the Automated Mountain Meteorology Stations (AMOS), over the mountain, and is observing the weather situation with 1 minute interval. Air and dew temperature (Tair and Tdew) retrievals from satellite dataset showed good agreements (RMSE < 4K) with measurements for clear sky conditions. Furthermore, the estimates accuracy was improved approximated 5% by applying the ambient temperature lapse rate. Substantial retrievals of meteorology were estimated for cloudy sky conditions in 2016 (n=2,657). The missing data due to cloud in the MODIS atmospheric products were successfully filled using the proposed pixel-wise regression method. The relative humidity calculated by using the Tair and Tdew retrievals showed a favorable agreement in comparison with AMOS measurements. The results presented in this study indicate that the multiple satellite data fusion can produce the surface meteorological variables with reasonable accuracy for all sky conditions over complex terrains such as the Korean Peninsula.