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Estimation of Land Surface Temperature from GCOM-W1 AMSR2 Data over the Chinese Landmass

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As one of the most important parameter at the interface between the earth's surface and atmosphere, land surface temperature (LST) plays a crucial role in many fields, such as climate change monitoring and hydrological modeling. Satellite remote sensing provides the unique possibility to observe LST of large regions at diverse spatial and temporal scales. Compared with thermal infrared (TIR) remote sensing, passive microwave (PW) remote sensing has a better ability in overcoming the influences of clouds; thus, it can be used to improve the temporal resolution of current satellite TIR LST. However, most of current methods for estimation LST from PW remote sensing are empirical and have unsatisfied generalization. In this study, a semi-empirical method is proposed to estimate LST from the observation of the Advanced Microwave Scanning Radiometer 2 (AMSR2) on board the Global Change Observation Mission 1st-WATER "SHIZUKU" satellite (GCOM-W1). The method is based on the PW radiation transfer equation, which is simplified based on (1) the linear relationship between the emissivities of horizontal and vertical polarization channels at the same frequency and (2) the significant relationship between atmospheric parameters and the atmospheric water vapor content. An iteration approach is used to best fit the pixel-based coefficients in the simplified radiation transfer equation of the horizontal and vertical polarization channels at each frequency. Then an integration approach is proposed to generate the ensemble estimation from estimations of multiple frequencies for different land cover types. This method is trained with the AMSR2 brightness temperature and MODIS LST in 2013 over the entire Chinese landmass and then it is tested with the data in 2014. Validation based on in situ LSTs measured in northwestern China demonstrates that the proposed method has a better accuracy than the polarization radiation method, with a root-mean squared error of 3 K. Although the proposal method is applied to AMSR2 data, it has good ability to extend to other satellite PW sensors, such as the Advanced Microwave Scanning Radiometer for EOS (AMSR-E) on board the Aqua satellite and the Special Sensor Microwave/Imager (SSM/I) on board the Defense Meteorological Satellite Program (DMSP) satellite. It would be beneficial in providing LST to applications at continental and global scales.