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A neural network method for land surface temperature retrieval from AMSR-E passive microwave data over the Tibetan Plateau

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The Tibetan Plateau is well known both for its high altitude and unique geographical features, and has been identified to be critical in regulating the Asia monsoon climate and hydrological cycle. The presence of permafrost and seasonal frozen ground play an important role in determining the nature of Tibetan land and atmosphere interactions. Land surface temperature (LST) is the link between soil-vegetation-atmosphere fluxes and soil water content through the energy water balance, and can be used as an indicator of soil moisture dynamics and for partitioning between sensible and latent heat. In this study, the LSTs over the Tibetan Plateau are retrieved from advanced microwave scanning radiometer-earth (AMSR-E) passive microwave data combined with infrared LST measurements (MODIS LST) onboard the same platform, Aqua satellite, using a generalized regression neural network method. Because of the difficulties in obtaining representative in-situ LST measurements at AMSR-E pixel scale, the MODIS LST is taken as actual ground measurements. To make the method suitable for more situations, clear-sky and cloudy brightness temperatures in AMSR-E channels are simulated under various atmospheric and surface conditions with the aid of the monochromatic radiative transfer model and the advances integral equation model, and are integrated with the measured AMSR-E brightness temperatures and MODIS LSTs to learn the neural network. The results show that the retrieved LST from AMSR-E data in channels 23.8V, 36.5H, 36.5V, 89.0V and 89.0H GHz (V: vertical polarization and H: horizontal polarization) gives the minimal root mean square error (RMSE), approximately 4.5 K, and that more than 73% of errors are within 4 K. In addition, a new group of LST (denoted as AMSR-E LST1) is derived with a single channel method from the same AMSR-E data in channel 37 GHz using a linear relation and is evaluated with MODIS LST. It is noted that there are significant differences between AMSR-E LST1 and MODIS LST with a RMSE of 7.15 K, which demonstrates that neural network method performs better than the single channel method.