How much is the accuracy of land emissivity representation necessary for adequate cloud water content estimation over land using satellite-based passive microwave remote sensing?

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The utilization of satellite-based passive microwave remote sensing (PMW) is an essential technique to grasp the long-term and extensive distribution of cloud water content (CWC). However, in particular, over highly heterogeneous land, detailed MW radiative transfer characteristics between land and atmosphere including clouds are not adequately elucidated. Therefore, most of CWC estimation methods are not implemented over land. This study aims to elucidate these characteristics and to reveal for adequate estimation of CWC over land using satellite-based PMW, how much accuracy of representation of land emissivity is needed. For this purpose, at first, the important parameters related to MW radiative transfer at CWC-sensitive frequencies (89 and 36 GHz) between land and atmosphere under the existence of clouds are clarified based on the radiative transfer equations. Also, the relationship between errors in representation of these parameters and brightness temperatures used for CWC estimation is specified through theoretical consideration. Then, ground-based passive MW radiometer observations and numerical simulations are utilized to reveal real features of these important parameters, physical variables of land which have large radiative impacts, and their relationships. Finally, it is found that there are threshold values of liquid water path with which we can reasonably neglect the heterogeneity of emissivity and radiation of land surface in CWC estimation over land. Furthermore, for the case of LWP less than the thresholds, we show the desirable accuracy in representation of land emissivity and volumetric soil moisture content for both frequencies.

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