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Analyzing topography effects for l-band radiometry using an improved model approach

X. Li (1,2,3), L. Weihermüller (3), L.X. Zhang (1,2), L.M. Jiang (1,2), and H. Vereecken (3)

(1) Beijing Normal University, School of Geography and Remote Sensing Science, Beijing, China (lixx213@mail.bnu.edu.cn), (2) State Key Laboratory of Remote Sensing Science, Jointly Sponsored by Beijing Normal University and Institute of Remote Sensing Applications, Beijing, China (lixx213@mail.bnu.edu.cn), (3) Forschungszentrum Jülich GmbH, IBG-3 Agrosphere, 52425 Jülich, Germany (lixx213@mail.bnu.edu.cn)

Global measurements of soil moisture, the key variables in the water cycle, are provided by spaceborne radiometer based on the long wavelength detection. As one potentially critical factor, topography will induce soil moisture retrieval error over mountain areas from space. Therefore, it is imperative to develop microwave radiative transfer models for L-band over mountain areas characterized by low complexity, and therefore, practical use. To address this issue, we pay close attention to the interactive mechanism between topography and microwave radiation by describing microwave radiation characteristics of terrain scenes.

To explore the mechanism of relief effects on L-band, landscape scenes are generated based on Gaussian surfaces ranging from flat terrain to multiple hills within a 35 x 35 km scene. The scattering radiation, one of contributions to the L-band microwave signal, had undergone the fairly reasonable modification that we recalculated the mutual diffuse reflection of adjacent hills instead of the maximal unidirectional diffuse reflection. Therefore, an improved microwave radiative transfer model to simulate relief effects was proposed. Based on the model, the significance of soil moisture and land surface temperature to relief effects in these terrain scenes are analyzed respectively. When the soil becomes wetter the deviation of TB between flat and mountainous terrain is enhanced. In contrast to water content, land surface temperature has a negligible effect with less than 1 K for both polarizations. Besides, the impact of topography on brightness temperature and soil moisture retrieval is predicted. It is shown that the soil moisture retrieval error at L band arisen by topography is more than 4%, the maximum permissible error, and the maximum fractional error of soil moisture retrieval compared to soil moisture in the flat terrain is 77.6%. The results presented indicate the necessity of eliminating relief effects at L-band and our approach provides a potential methodology for topography correction.