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The effect of atmospheric corrections on the estimation of snow water equivalent from AMSR-E measurements at 18.7 and 36.5 GHz

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Radiometric measurements near 19 and 37 GHz have been used for estimation of snow depth or snow water equivalent (SWE) for many years. Both of these snow parameters were shown to depend on the differences between the brightness temperatures (T_b's) at these frequencies, either at vertical or horizontal polarization [1]. The effect of atmospheric absorption is generally assumed to be insignificant, and thus not taken into account in such estimation. However, it was demonstrated [2] that the T_b differences between these frequencies when measured at surface differ from those measured at high altitudes (e.g., satellites). This effect of atmospheric absorption is found to be proportional to the T_b differences. Thus, the effect of atmospheric absorption on snow depth/SWE estimation may not be totally negligible, and requires a close examination.

In this paper, we examine the effect of atmospheric absorption on the estimation of snow depth/SWE over a region in the western USA, including Sierra Nevada. The region was bounded by 16˚-40˚ N latitudes and 115˚-120˚ W longitudes. Five months (between November 1, 2003 and March 31, 2004) of radiosonde data from the NWS (National Weather Service) stations (only two) in the region were used to derive the effective atmospheric temperature and absorption factor, the two key atmospheric parameters in the radiative transfer equation. These two parameters were found to depend mainly on elevation. The AMSR-E measurements at 18.7 and 36.5 GHz over the same region and time interval were used for demonstration of the effect. These AMSR-E measurements were first co-registered with 1-km digital elevation model of the region to account for the impact of elevation, and the effects of atmospheric absorption were analyzed for the two assumed surface temperatures of 250 K and 270 K.

Results showed that the atmospheric corrections could account for as much as ~ 25 % to the estimation of snow depth/SWE. The impact of surface temperature variations was found to be insignificant. There were some regional and seasonal variations of the effective atmospheric temperature and absorption factor from the two stations of five-month radiosonde data. Monthly averages of these atmospheric parameters were calculated and individually analyzed for corrections to the snow depth/SWE estimation. Results of these detailed analyses will be reported and discussed.

[1] J. E. Foster, A. T. C. Chang, and D. K. Hall, "Comparison of snow mass estimates from a prototype passive microwave snow algorithm: a revised algorithm and a snow depth climatology," Remote Sens. Environ., 62, 132-142, 1997.

[2] J. R. Wang, and W. Manning, "Near concurrent MIR, SSM/T-2, and SSM/I observations over snow-covered surfaces," Remote Sens. Environ., 84(3), 457-470, February, 2003.