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**A Pre-processing Method for Assimilation of Microwave Sounder
Observations over Winter Sea Ice for Numerical Weather Prediction**

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Assimilation of microwave sounder observations over sea ice into numerical weather prediction systems has been challenging due to difficulties in surface radiation estimation. This study presents a preprocessing method for better utilization of near-surface microwave sounder observations (e.g. 53.6, 54 GHz) over winter sea ice. The method involves an estimation of apparent sea ice emissivity and a bias correction approach. The apparent emissivity was calculated using 50.3 GHz microwave observation and the auxiliary data from a Korean Integrated Model (KIM). The observation counterparts simulated using the apparent emissivity exhibit a high correlation with the observations. However, observation departures at 53.6 GHz show a positive bias of 0.65-1.12 K in winter sea ice. Based on the sensitivity test of microwave radiance to the uncertainties in contributing variables, the bias predictors were selected considering the uncertainties in surface emissivity, skin temperature, and atmospheric upwelling radiance. As a result, the bias was effectively removed by subtracting the estimated bias from the observation. Further, an experiment assimilating bias-corrected observations over winter sea ice was executed. The additional information from the microwave observations over sea ice has amplified the temperature analysis increment, resulting in a decrease of temperature analysis errors by 0.5% from near-surface to 500 hPa.