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Improving the accuracy of temperature and humidity profiles retrieved from GK-2A/AMI Using post-processing method(technique)

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Vertical information of an atmosphere, including temperature and humidity profiles, total precipitation water(TPW), and instability indices, is essential to describe the thermal and dynamic states of atmosphere. The accuracy of those variables have great significance for improving accuracy of predicting weather information such as short-term precipitation and fog through the monitoring of dry/saturated air, ascent/descent, and atmospheric stability. Furthermore, differences between vertical information of an atmosphere derived from satellite observations and numerical weather prediction (NWP) fields allow for the diagnosis of forecast variability.

In this study, we applied 1D-VAR post-processing techniques to the temperature and humidity profiles retrieved by using GK2A/AMI AAP algorithm to enhance the accuracy of satellite-based atmospheric vertical information and improve its utility in operational forecasting. The post-processing method can be divided into two main steps: (1) error characteristic analysis and (2) real-time execution. First, the process of error characteristic analysis involves finding the optimal parameters (bias correction factor, the ratio of observation and background error covariance) that, minimize errors in the temperature and humidity profiles from the previous day while considering the uncorrelated errors. The input data used

ECMWF analysis fields as the reference data, and the observation and background data obtained from temperature and humidity profiles of GK-2A satellite derived from Korean Integrated Model (KIM) and Unified Model (UM) initial fields of global NWP model. The second step involves applying the parameters obtained from the error characteristic analysis of past data to the observation and background data. Subsequently, the values of real-time analytics are generated using the 1D-VAR optimal estimation method with a linear observation operator.

The post-processed results were validated for August 2022, comparing them against Wyoming radiosonde data and ECMWF analysis fields. The validation results show a significant improvement in temperature profiles, particularly in the mid-to-lower levels (the improvement of about 11% for temperature RMSE compared to GK2A AAP profiles), and there was also an improvement in humidity profiles across all levels. In the validation results of analysis fields, the rate of improvement was shown for all variables and levels (with an average improvement of about 18.7% in temperature and humidity RMSE). We plan to perform additional analyses based on seasonal variations, land/sea conditions, and other factors in the future work. Additionally, we intend to evaluate the operational utility of the post-processed outputs through various case studies. Lastly, we will enhance the post-processing technique through the optimization of the error characteristic analysis (period, domain, reference data, and input data).