The developing and evaluation on the machine learning-based approach of the mini-radiosonde- “Storm Tracker” data calibration

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The mini-radiosonde Storm Tracker (ST) was devised as an alternative for the high spatiotemporal resolution observations of the lower atmospheric vertical profile. Several field campaigns at various locations were conducted with ST co-launching with Vaisala RS-41 (VS) for calibration. There were significant warm biases in the temperature (T) and dry biases in the relative humidity (RH) in ST daytime observations. In this study, we proposed a machine-learning-based two-step bias correction model.

The input datasets are the co-launches of Taipei Summer Storm Experiments (TASSE), Yilan Experiment of Severe Rainfall (YESR) and other field campaigns in 2018-2021. The co-launches are interpolated to 1 hPa in pre-processing. Both linear regression and gradient boost regression are tested. In step-1, the temperature bias between ST and VS is predicted with ST pressure (P), T, RH, horizontal wind, and clear-sky solar radiation (R). In step-2, the object is the specific humidity (Q) bias. The results show both the corrected T and Q are highly correlated with VS, and the root-mean-squared errors decreases. The feature importance analysis shows P and R are crucial. The robustness test suggested that the vertical resolution of the input affects the model skills. Coarse-resolution input leads to higher biases, however, the effect is limited as the resolution finer than 1 hPa.

The sensor bias correction process is essential since ST uses a general PTU sensor with high precision and low accuracy. The sensor bias correction process uses linear regression to estimate the sensor biases. Through this process, it not only reduces the sensor bias within ST but also boosts the model skills.

Keywords:Machine-learning, Storm Tracker, Bias correction