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Application and validation of an artificial neural network approach for the fast estimation of the Total Precipitable Water (TPW) from AHI data

Yeonjin Lee, M. H. Ahn, Su Jeong Lee

Ewha Womans University, South Korea

The next generation geostationary satellite of Korea equipped with a high performance imaging instrument, Advanced Meteorological Imager (AMI) which has the pseudo-sounding channels, is under development to be launched in 2018. For the retrieval of total precipitable water (TPW) from the AMI data, a statistical approach, Artificial Neural Network (ANN) based on the multi-layer perceptron model with the feed-forward and back-propagation training, has been developed. To prepare the training dataset consisting of the input data (brightness temperatres, observation geometry, spatio-temporal information of measurement, etc.) and the output data (the corresponding TPW) are prepared using a set of atmospheric profiles of temperature (T) and humidity (q). For a comprehensive representation of the TPW within the interested area, the vertical profiles of T & q retrieved from the hyperspectral Infrared Atmospheric Sounding Interferometer (IASI) onboard the Metop satellite for two years are used. With the T & q profiles, the theoretical radiances are prepared using MODTRAN 5.2.2 with the spectral response function of the Advanced Himawari Imager (AHI), quite a similar instrument to AMI, onboard Himawari-8 for the band-averaged radiance.

For the algorithm training, the whole dataset is resampled to include similar number of training data based on the different values of TPW (0-10, 10-20, 20-30, 30-40, 40-50, 50-60, 60 and higher). The used dependent variables are day, hour, satellite zenith angle, latitude, longitude and the 9 simulated brightness temperatures (6.2, 6.9, 7.3, 8.6, 9.6, 10.4, difference(11.2-12.4), 12.4 and 13.3 μm) and the corresponding TPW values obtained from the T & q profile. An extensive performance tests for different sets of the ANN parameters including number of epochs, learning rate, and number of hidden neurons has been conducted to find the best combination of the parameters (hidden neuron: 11, epoch: 1400 and learning rate: 0.45). The algorithm performance has been assessed using the actual AHI observation data and the preliminarly results are going to be introduced during the conference.