

## Applications of ocean surface wind direction signals in microwave imager observation for atmospheric humidity analysis

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An empirical relative wind direction (RWD) model function was developed to represent azimuthal variations of oceanic microwave brightness temperatures of vertical and horizontal polarizations. The RWD model function was based on measurements of observed brightness temperature from the Advanced Microwave Scanning Radiometer and wind vector from SeaWinds, both on board the Advanced Earth Observing Satellite - II, and Special Sensor Microwave Imager Sounder (SSMIS) first guess departure and wind vector data in European Centre for Medium-Range Weather Forecasts (ECMWF) Integrated Forecasting System. The model function was introduced to a microwave ocean emissivity model; a FAST microwave Emissivity Model (FASTEM) in a radiative transfer model for satellite radiance assimilation. Performances of the RWD model function were much more realistic than present azimuthal model functions in FASTEM for low wind speed and high frequency channels.

An assimilation experiment using the RWD model function was performed in the ECMWF system. The experiment demonstrated reductions of first guess departure biases arising from modelling of the azimuthal variations in areas of high wind speed and low variability of wind direction. For example, bias reductions in ascending and descending SSMIS 19 GHz vertical polarized brightness temperature in Somali jet at the Arabian Sea were approximately 0.6 K and 0.7 K. The bias reductions were found for all assimilated microwave imager channels in a wide wind speed range. Moreover, analysis increments of specific humidity in the lower troposphere were reduced (e.g.,  $0.3 \text{ g kg}^{-1}$  reduction at 1000 hPa in the Somali jet). We found improvements of relative humidity and temperature in short-range forecasts in the lower troposphere. The experiment results clearly showed the importance of modelling the azimuthal variation of emissivity for assimilation of microwave imager observations. The RWD model function should be included in the radiative transfer model used in the microwave radiance assimilation observation operator.