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Monitoring of IR Clear-Sky Radiances over Oceans for SST (MICROS)

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The rapid advancement of fast radiative transfer models (e.g., the Community Radiative Transfer Model, CRTM) and first guess upper air (e.g., the National Centers for Environmental Prediction Global Forecast System, NCEP/GFS) and sea surface temperature analysis (e.g., daily Reynolds) fields have made it possible to simulate top-of-atmosphere brightness temperatures (BT), in real-time. In the Advanced Clear-Sky Processor for Oceans (ACSPO) developed at NESDIS, simulated BTs are used for improved cloud screening and SST retrievals.

Clear-sky radiances over oceans in all AVHRR bands is the major ACSPO product, from which SST and Aerosol Optical Depth (AOD) products are derived in the Earth emission and solar reflectance bands, respectively. All products require monitoring and validation. A near-real time web-based system, Monitoring of IR Clear-Sky Radiances over Oceans for SST (MICROS; http://www.star.nesdis.noaa.gov/sod/sst/micros/) was established to evaluate the sensor clear-sky BTs ("observations", O) against CRTM simulations ("model", M). M-O biases in AVHRR BTs in bands centered at 3.7, 11, and 12 μm onboard NOAA-16, -17, 18, -19 and MetOp-A, and retrieved SSTs, are trended. Initially, MICROS was used internally within the NESDIS SST team for testing and improving ACSPO products. Subsequently, CRTM scientists have made a number of critical improvements to CRTM using MICROS results. They now routinely use MICROS to continuously monitor M-O biases to validate and improve CRTM performance. Furthermore, MICROS proved instrumental in evaluating the accuracy of the global first-guess SST and upper-air fields used as input to CRTM, NCEP/GFS and Reynolds SST. Also, inclusion of double differences in MICROS has contributed to sensor-to-sensor monitoring within the Global Space-Based Inter-Calibration System (GSICS).

MICROS is an end-to-end system that processes satellite level 1B data using ACSPO, performs statistical analyses of the BT and SST biases, and publishes their summaries on the web. Both nighttime and daytime data are processed, but only nighttime data are currently employed for sensor cross-comparisons because they are not contaminated by solar reflectance and least affected by the diurnal cycle in SST. Positive M-O biases persist in all AVHRR bands during the full monitoring period from July 2008-present, due to a combined effect of missing aerosol in CRTM; the use of daily-average bulk Reynolds SST not corrected for the effect of the diurnal cycle and skin effect in the model; and residual cloud. MICROS objective is to fully understand and reconcile the measured and simulated BTs, and minimize cross-platform biases based on first-principles, through the improvements to ACSPO algorithms, CRTM and its inputs, satellite radiances, and skin-bulk and diurnal SST modeling.

Work is underway to improve CRTM daytime performance, and optimize first-guess SST and upper air fields. Adding global model aerosol fields [Goddard Chemistry Aerosol Radiation and Transport (GOCART) and Navy Aerosol Analysis and Prediction System (NAAPS)] in CRTM are expected to improve M-O biases. Also, MICROS functionality is being extended to additionally monitor two MODIS instruments onboard Terra and Aqua, VIIRS onboard NPP and AVHRR onboard Metop-B.