

S3-06

Concerns in the diurnal variations of ECMWF ERA5 SST

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Sea surface temperature (SST) is an essential parameter in climate, weather, and ocean sciences because it plays a decisive role in ocean-atmosphere interactions, especially in understanding heat budgets and related phenomena. Recently, ECMWF ERA5 reanalysis data of the high-resolution hourly SST at the ocean-atmosphere boundary (called the ocean-atmosphere interface temperature, SST_{int}) are available, expecting extensive applications in diverse atmospheric and ocean sciences fields. Here we examined ERA5 skin temperature and we raise concerns about the reliability of the ERA5 SST_{int} data: Sudden alternating spatial transition repeats periodically between localized and large-scale distributions with a 12-hour interval, at 10 UTC and at 22 UTC; hourly variations show little correlation with the solar radiation in spite of the expected strong correlation because of the solar radiation being a major driving force for SST's diurnal variation. Understanding such unrealistic features, we revisited the model and identified typographical but serious errors in the formulations describing the OBL model, that might cause, in part, current unreliable features in the ERA5 SST_{int} diurnal variation. The diurnal variations of SST_{int} are simulated using the revised the OBL model and are against long-term buoy-observed SSTs at 1m-depth. Results revealed an excellent agreement, with an average absolute deviation smaller than 0.07 K and a standard deviation below 0.5K. Also much agreed with are the diurnal variation patterns of the solar radiation. The revised model appears to have a potential to significantly improve the diurnal variation of SST_{int} and thus lead to the better weather forecasting and climate simulations.