

Bulk vs. Skin Sea Surface Temperature

SST is an important parameter as it drives some climate processes and is fundamental in the calculation of the turbulent flux of heat in models and for the generation of data sets. At the surface, there is a *cool skin*, a layer a few millimeters thick that is due to the exchange of heat and moisture to the atmosphere as well as the emission of infrared radiation, the radiation just beyond red on the electromagnetic spectrum. Below that in the daytime is a *warm layer* a few centimeters thick that is caused by the absorption of sunlight (Fairall et al. 1996). Observations of SST made by ships and buoys are generally made a few centimeters to a few meters below the surface and below both the cool skin and warm layer (Makevich et al. 2004). These SSTs are called *bulk SSTs*. The SST directly at the surface is called *skin SST* and can be significantly different from the bulk SST especially under weak winds and high amounts of incoming sunlight (Fairall et al. 1996, Wick et al. 1996, Zeng et al. 1999). Several groups have developed methods to adjust bulk SSTs to skin SSTs (Fairall et al. 1996, Zeng et al. 1999).

Satellite instruments that observe in the infrared part of the spectrum in principle measure skin SST. One such instrument is the Advanced Very-High Resolution Radiometer (AVHRR, Schluessel et al. 1987) used on satellites operated by the [National Oceanic and Atmospheric Administration \(NOAA\)](#). In practice, AVHRR measurements have been tuned to bulk SST measurements made by buoys (May et al. 1998). We have worked to retune the AVHRR observations to skin SSTs that have been adjusted from bulk measurements from buoys across the globe. The new AVHRR skin SSTs have a nearly zero bias compared with buoy skin SSTs and standard deviations less than 0.5 Kelvin under daytime and nighttime conditions.

We have also developed an algorithm to obtain the skin SST in GCMs and NWP models from bulk SST (Zeng and Beljaars 2005). In ocean GCMs, bulk SST is generally taken to be the temperature of the uppermost model layer tens of meters below the surface. In atmospheric GCMs uncoupled to an ocean GCM or NWP models, bulk SST is provided from a data set. My latest work has been to implement this scheme into the atmospheric component of the NCAR CCSM coupled with its land component using climatological SSTs, that is, the same seasonal cycle of SST averaged over several decades every year. The new scheme is able to create a diurnal cycle in SST in summer of greater than three Kelvin in some areas of the western Pacific warm pool (Brunke et al. 2008).

For more information on this research, check out:

Brunke, M. A., X. Zeng, V. Misra, and A. Beljaars, 2008: Integration of a prognostic skin sea surface temperature scheme into climate and weather models. *Journal of Geophysical Research*, **113**, D21117, doi:10.1029/2008JD010607.