

Interactive comment on “A statistical model for sea surface diurnal warming driven by numerical weather prediction fluxes and winds” by M. J. Filipiak et al.

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Reply to comments of Anonymous Referee #1 Ocean Sci. Discuss., 7, C414–C415, 2010

> Authors attempted a new approach to develop a statistical model to predict diurnal warming of SST from the frequency matching method using the NWP model data. This new approach can be a meaningful contributor to the community. However, it is very difficult to grasp the author’s point with regard to the new model. There is either no explanation or no reference for the frequency matching method.

We have recently found that this method had already been developed to correlate rain
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gauge and rain radar measurements. We will include these references to this previous work.

Calheiros, R.V and Zawadzki, I.: Reflectivity-rain rate relationships for radar hydrology in Brazil, *Journal of Climate and Applied Meteorology*, 26, 118-132, 1987.

Rosenfeld D., Wolff, D.B., and Amitai E.: The window probability matching method for rainfall measurements with radar, *Journal of Applied Meteorology*, 33, 682-693, 1994.

Rosenfeld, D., Wolf, D.B., and Atlas, D.: General probability-matched relations between radar reflectivity and rain rate, *Journal of Applied Meteorology*, 32, 50-72, 1993.

Bringi, V.N. and Chandrasekar, V.: *Polarimetric Doppler weather radar: principles and applications* (pp. 557-559), Cambridge University Press, Cambridge, 2001.

Haddad, Z.S. and Rosenfeld, D.: Optimality of empirical Z-R relations, *Quarterly Journal of the Royal Meteorological Society*, 123, 1283-1293, 1997.

> It was argued that this method was used to avoid the NWP model error. The model error exists in the statistics too, so I cannot understand the argument.

It only avoids the error in the spatial location, which appears to be the NWP model error that most affects the derivation of a regression-based model, since the NWP model wind minima do not coincide with the diurnal warming maxima. The probability distribution of wind speed is derived from the frequency histogram over the whole spatial domain and the whole year (2007-2007), so this location error is effectively integrated out.

> It is not clear at all (p. 1502) why the use of the instantaneous wind field must be used instead of the daily mean values.

Variation in wind speed is the main cause of sub-daily variation in the warming, using the daily mean value will not capture this variation and is more suitable for estimating the peak warming (at approximately 1400 local time).

> More systematic analyses must be provided to ensure the improved predictability of SST for the frequency matching method, NWP model data, and the use of the instantaneous wind field.

We have compared the model results with AMSR-E and with SEVIRI for 2006-2007 (the model was derived using SEVIRI data from 2007-2008). This shows that the model produces reasonable estimates of diurnal warming on average. As noted by Referee #3, this is as far as the model can go, considering the wind location errors. Unfortunately, this work is no longer funded, so further work will only consist of editing this paper.

> The empirical formulae (1) and (2) were introduced arbitrarily without any physical interpretation. The formula (1) is even dimensionally inconsistent. It is important to argue the physical meaning of (1) and (2) before evaluating empirical constants.

The formulae were placed early in the paper to highlight the model formulation, with the detailed derivation left till later in the paper, and indeed, we do seem to have scattered the justification for these formulae to other places. This will be corrected. As Referee #3 notes, the functional form was based on as 'parameterless' physical arguments possible (low wind gives large warming for large heat flux) and the functional form chosen based on the actual data. The Q dependence was evidently linear, and the simplest W dependence was as shown in Equation (1).

> There is no reference to other statistical models (Webster et al. 1996, Kawai and Kawamura 2003).

We will change this section and simply refer to the recent review by Kawai and Wada (Kawai, Y. and Wada, A.: Diurnal sea surface temperature variation and its impact on the atmosphere and ocean: a review, *Journal of Oceanography*, 63,721-744, 2007.)

> Why is SEVIRI used for tuning, and AMSR-E for evaluation? What is the difference between these two satellite data?

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SEVIRI is used for tuning because it makes observations every hour over the Atlantic and Mediterranean (it is on the geostationary satellite Meteosat Second Generation). AMSR-E is used for evaluation because 1/ it is independent of SEVIRI 2/ it has global coverage, thus testing the model outside the 'tuning' geographical range (AMSR-E is on a polar orbiting satellite Aqua)—however, it observes any point on the globe only twice per day.

> Fig. 8 and 9 are interesting, but more detailed information must be provided how these results are obtained.

We will add more explanation in the text. Basically: The AMSR-E data is on a 0.25 deg grid, one observation at night and one at day at any one point of the globe. The day-night difference was calculated 1/ from the AMSR-E observations and 2/ from the statistical model driven by the NWP wind and heat flux. The average in each 0.25 deg box was calculated for 2006-2007 and mapped in Figure 8. 1515 ll. 6-27 describes Figure 9 but may need additional information provided.

> I suggest to include the formulae of other models shown in Fig. 9.

These are not simple models like the statistical model developed in the paper. The only adequate description would be to repeat the contents of the two papers referred to.

> Generally, the paper is poorly written. - English appears strange in many parts.

> The first (p. 1498, l. 20) last (p.1503, l. 12) in the introduction must be moved to the conclusion.

I don't understand this comment, but p.1503, l. 13-25 could indeed be re-phrased and moved to the conclusion.

> What is 'deceadance' and 'exceedance'?

It would be simpler to say 'small' and 'large'.

> The references for the importance of diurnal variation of SST on p. 1500 are mostly

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unpublished sources. There are many published papers on that (e.g., Dai and Trenberth 2004, Slinger 2003).

We will add further references as required

> p. 1501, l. 23; Who argued that the empirical model by Stuart-Menteth et al. (2003) gives unrealistic high amplitudes for low wind speeds.

We will check where this came from. Possibly it was meant to say that the Stuart-Menteth model can give large residual warming late in the day, which has been seen in some studies performed in the GHRSSST Diurnal Variability Working Group.

Interactive comment on Ocean Sci. Discuss., 7, 1497, 2010.