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Interactive comment on "Characterisation and quantification of regional diurnal SST cycles from SEVIRI" *by* I. Karagali and J. L. Høyer

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GENERAL COMMENTS:

- *The daily cycle of sea surface temperature is driven by daily solar heating and nighttime cooling of the ocean. It is important for a number of reasons, including the fact that phytoplankton growth can be stimulated by the stability created by the diurnal thermocline. This paper provides a thorough investigation of the statistics of the diurnal cycle of sea surface temperature (SST) using data from two different satellites (SEVERI and ENVISAT) and from an array of instrumented buoys. It assumes that the reader knows a bit about these satellites. An important thing to know (not stated, but I guess this is correct) is that SEVERI is a geostationary*

satellite, fixed above a chosen point on the earth's surface, and so is able to provide hourly sea surface temperature maps of the bit of the ocean it can see, clouds permitting. The paper first makes a comparison of SST measured by the two satellites. This examination involves analysis of large data sets (over 50 million values of SST) and is rather technical, involving various levels of quality control. To a non-specialist, it seems that the two satellites are closely matched in their estimates of SST. The main differences occur in places where atmospheric effects are important. This makes me wonder why the processing of the satellite data to derive SST from the two sensors doesn't use the same physics in making the atmospheric correction.

It is not clear what the reviewer means by "This makes me wonder why the processing of the satellite data to derive SST from the two sensors doesn't use the same physics in making the atmospheric correction." but it should be noted that the 2 datasets are derived from different instruments. The AATSR observes the same position twice, with different atmospheric path lengths, in contrast to the SEVIRI. The satellite platforms that carry the instruments are also operating at different altitudes above the surface (AATSR was on a polar orbiting platform at approximately 700 km above the surface, SEVIRI is at 36000 km). Therefore, different algorithms are applied to the retrieved brightness temperatures to convert them into SST and these algorithms depend on the number of channels on the infra-red radiometer.

- *I also wonder about the effects of cloud cover. Presumably, no estimate of SST is available if the ocean is covered by cloud. Are there diurnal variations in cloud cover (perhaps driven by the SST) and does this have any effect on the statistical analysis? It would be good to know how the number of clear sightings varies during the day.*

Diurnal variations in the cloud cover can be driven by the diurnal variations of SST, especially in the form of afternoon convection due to warming and evapo-

ration. This can be a small scale effect, within a SEVIRI grid cell and may be undetectable by the cloud flagging scheme. For details on the cloud cover percentage from SEVIRI, see Figure 8d in Karagali et al, SST diurnal variability in the North Sea and the Baltic Sea, Remote Sens. Environ., 112, 159–170, 2012.

- *The amplitude and phase of the diurnal cycle of SST are presented as maps of the area covered by the SEVERI satellite and as plots of temperature against time of day in 8 selected areas. I suspect that the last figure (figure 8) will be most referred to by physical oceanographers. This shows the daily cycle of sea surface temperature in different months in the 8 selected regions. The range of the cycle is quite large - over a degree in some places and the maximum temperature occurs at between 2 and 3 o'clock in the afternoon, local time. Minimum temperatures occur at about 4am local time, so the daily cycle is a little asymmetric. This information will be useful to people who model the thermal structure of the ocean. There is no attempt in the discussion of this paper to place the results in the context of the important physics driving the daily cycle.*

  Judging by the last sentence, it is not clear what the reviewer would wish to read. Nonetheless, we would kindly highlight that the important physics driving the daily cycle have already been presented as part of the results and these are the coincident low winds and solar heating. In addition the potential impact of the water turbidity into trapping/scattering light at the upper few meters of the water column is discussed. For further comments on the physics, one can refer to Karagali and Høyer, Observations and modelling of the diurnal SST cycle in the North and Baltic Seas, J. Geophys. Res.-Oceans 118, 1–16, 2013.

DETAILED POINTS:

- *The presentation of the satellite data (sections 2.1 and 2.2) contains details which are based on current conventions and so will mean nothing in the future when*

these conventions have changed. Better to stick with statements that have a meaning in plain language if you can. An example is the statement that "we use measurements that have an uncertainty lower than 0.8". This means nothing to people who don't use this data.

A label (K) was missing on the uncertainty thresholds, this has been added and the manuscript is now more SI compliant as requested by the reviewer. In addition, the authors would kindly like to note that the satellite data description details are specific to the versions of the data used and thus they can be considered relevant.

- *The meaning of the last paragraph on page 1098 is not clear to me. I can see how the dawn skin temperature can be taken as the "foundation" temperature to relate diurnal changes to. Why is it necessary to have refinements on this?*

  If we rely only on the last pre-dawn SST value to construct single-sensor SST_{found} fields, there will practically be no foundation fields due to lack of data at the specific time. In addition, an instantaneous skin value can be biased high/low, therefore it may not always be representative of the well-mixed conditions across the upper ocean layer. This is why such "refinements" are required, especially when performing a long-term quantification and characterisation of the diurnal signal based on 1 satellite sensor.

- *I notice on page 1099 that you ignore data if the satellites differ in their temperature measurements by more than 4 standard deviations. I'm sure this isn't really a big issue, but does leaving out the bad data not make your results look better than they actually are? Line 15 on this page, the sentence beginning "The last row.." should begin "The last 3 rows..", I think.*

  It is not clear what the reviewer means in this comment. Both the unfiltered and filtered results are presented in the manuscript (1st and 2nd row of Table 2), thus the reader can assess the impact directly. Line 15 of that page reads "Note that

the last row is different from rows 1 to 5 in that the number of match-ups is limited by the availability of drifting buoy measurements.". Looking at the labels of the Table, it can be concluded that only the bottom row of the last 3 rows shows SEVIRI–AATSR match-up statistics. Nonetheless we have reformulated the sentence to "Note that the last row is different from rows 1 to 5 in that the SEVIRI–AATSR match-ups have been calculated only where drifting buoy measurements are available, for comparison."

- *Page 1101 second line textminus? You are a bit sloppy about describing some of your results. For example, line 13 on this page "SEVIRI before adjustment had a mu of -0.08..". You are talking about a difference, so you mean "SEVIRI – AATSR..." I think.*

  "Textminus" has now been corrected, it was a leftover of the Latex code. The sentence reads "SEVIRI before adjustment had a μ of -0.08, σ = 0.57 K against AATSR" and that indicates a difference which is another way of stating SEVIRI–AATSR.

- *5 lines down "statistics are slightly larger" doesn't mean anything.*

  This has now been modified to "mean bias and standard deviation".

- *Page 1102. The start of section 4.2 gave me a headache: "The averaged statistics for all the TFFs against VF and DTFF, are shown in Table 3". I had to look back to see what these acronyms meant. Be worth reminding your reader what these values are.*

  The values are mentioned in the text already, for example in the 2nd line of the paragraph "The mean bias (μ) for all the TFFs-VF is almost zero and standard deviation (σ) values are mostly less than 0.3 K, while very subtle differences between the TFF are identified." If the reviewer happens to refer to the acronyms rather than the values, these are defined in the Methods section and one can

seek them there, whenever required. Nonetheless, we have spelled them out once again in the 1st sentence of section 4.2.

- *Page 1104 Are the numbers shown in figure 4a the total hours (when temperature is above foundation) over 6 years? Be more physically meaningful to give the average number of hours in a day when the temperature is above the dawn value.*

  The numbers on 4a are the total hours when temperature is above foundation by more than 1 degree over 6 years. It is also mentioned in the caption and the text. The reasons that it be more physically meaningful to give the average number of hours in a day when the temperature is above the dawn value, are not clear to the authors. Also what does the reviewer mean by "dawn value" is not clear to the authors. If he refers to the foundation temperature value, It should be made clear that the it is not the same as the "dawn value", whatever that is.

- *On page 1105, I'm not sure what figure 4c shows. Is a zero occurrence when delta-T> 1 every day?*

  Figure 4c, as mentioned in the text and the caption, shows the number of occurrences over 6 years when the day-time SST is lower than the foundation value by at least 1 degree and is a measure of variability. A zero occurrence is any day-time minus foundation > -1 degree.

- *On line 17 what do you mean by "insolation>= 400 Wm^{-2}"? Is this daily mean insolation?*

  As the insolation is derived from the 3-hourly ECMWF fields, it is the 3-hourly "instantaneous" insolation coincident with the 3-hourly instantaneous low wind speed.

- *You introduce SST subscript found at the bottom of page 1105 and I'm not sure you've defined this, although I can guess what it is.*

It is not clear exactly what the reviewer means here but the subscript has been previously introduced, see page 1098, section 3.2 SST foundation fields.

- *Page 1106 first paragraph. Why does the time zone matter (in producing vertical stripes on your map) ? The map shows a difference in temperature. I don't see quite why this should jump when you cross a time zone.*

  The map shows the maximum of the monthly mean difference between day-time and foundation SST. The time zone matters in the sense that, for a given time zone, the eastern part will have received more heating compared to the west part and thus it will have warmed more.

- *page 1128 caption to figure 8 should start "Average daily cycles.." I think.*

  Indeed. Corrected to "monthly averaged daily cycles".