**Ocean Science
Discussions**

# *Interactive comment on* "Spatio-temporal complexity analysis of the sea surface temperature in the Philippines" *by* Z. T. Botin et al.

**Anonymous Referee #2**

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General comments:

This paper aims to extend an interesting measure of spatio-temporal complexity (STC) to the domain of SST analysis. It is fairly well written, the methods described well, and the English is good and readable. Unfortunately I have several fundamental concerns regarding the way the technique has been applied to SST data; and for this reason I cannot recommend publication. It would need to be reviewed again after a major revision.

Specific comments:

These are my major concerns, most important first:

1. STC is supposed to be measuring patterns of anomalies and structures in the

SST space-time field. Unfortunately the fixed threshold (25.2'C) of the SST matrix into binary (p2835 L5-15) ensures that the dominant 'pattern' will be the seasonal SST cycle (even in the tropics), causing larger blobs when the region is warmer and smaller blobs when cooler. It is explained (p2836 L13-24) that many smaller blobs will generate a higher STC value, and larger blobs a lower STC. There is only one small section at the end of the discussion (p2845 L15-20) which recognises the possibility that higher overall temperatures may influence the STC; but otherwise throughout the paper there is an implicit assumption that the STC is indicating the complexity of the SST field.

Figures 3 and 4 provide evidence for this problem, in that the STC values are often truncated at a low value (<0.2). I believe this indicates the weeks when the majority of the region was either above or below the threshold, and hence the method could not measure the complexity/heterogeneity. The authors have not considered this possibility. The peaks between the truncated troughs are probably when the average SST of the region was closer to the threshold value.

A revised paper would need to explicitly consider the background SST signal, using (a) a scatterplot of STC vs mean SST; (b) mean SST vs time on the same axes as STC. I predict that the scatterplot would show clear structure, perhaps with a peak STC around the SST threshold value and lower STC when the mean SST is high or low.

The method may possibly work by using an adaptive rather than fixed threshold, for instance the mean or median SST for each weekly time slice. The median would ensure that there are equal numbers of pixels above and below the threshold, and hence STC would measure the complexity of SST structures.

This issue invalidates all the results and interpretation. (Including EOF: I expect the dominant modes are related to the duration of the too-low/too-high SST periods.) I wonder whether graphs of mean SST vs time would show clearer distinction between El Nino/La Nina/Normal years than STC? If so it is difficult to justify the value of STC

for this application.

2. There are no statistics to prove any connection between the STC or EOF metrics and the ENSO, only qualitative observations. The paper would need standard time-series comparison statistics with significance testing. p2843 L4 chooses an ad hoc definition of 'significant', but this should always be 'less than 5% probability that this result could happen by chance'.

3. The SST data matrix is divided into time slices to allow analysis of STC vs time (p2836 L4-12). I am concerned that the choice of 3, 4, 5 weeks is much too short to represent the spatio-temporal complexity, so only the spatial complexity will be measured. Indeed with a time slice of 3 weeks there will only be one time position for the 3x3x3 kernel cube. This concern is borne out in Figure 3, where there is negligible difference between the 3 slice durations.

4. Section 2.3 identifies 6 sub-regions with distinct thermal properties for detailed study (p2837 L14-21). I am concerned that the clustering based on the SST trend per pixel may actually conflict with the STC method. If the result is to identify regions each with similar SST trends, then won't these be less temporally complex than typical?

As Issue 1 is so fundamental, I believe the paper would need substantial rewriting before resubmission.

Technical corrections:

In the PDF I received the tables were repeated and only tables 4, 5, 6 were referred to.

Figure 1(a) appears to have the wrong ordering of SST maps.

Additional comments after reading other reviews:

The editor also noticed that 'Figure 3 has a really clear (seasonal) signal...'. I believe the reason it was not possible to distinguish the seasonal and interannual variability, relate to ENSO, or infer any 'cause and effect' on the SST structure is due to the decision to

apply the fixed threshold.

The first reviewer was also concerned about the non-stationary SST data, and suggested moving thresholds (main comment 6).

Interactive comment on Ocean Sci. Discuss., 6, 2831, 2009.