Responses to Reviewer #2

We want to express our gratitude to the reviewer for the valuable and constructive comments. We have carefully considered each comment and greatly appreciate your input.

This study is an interesting study that revisits a set of regression methods that can be used to estimate long-term trends in sea surface temperature. Authors methodically investigate these regression methods and identify their pros and cons for estimating trends in sea surface temperature. Overall, this work is important and I find that the work deserves to be published in NHESS and falls within the scope of NHESS.

Thank you.

However, before publication, authors should consider multiple revisions that will improve the understanding of the manuscript and background knowledge of the work to readers. Therefore, I suggest the below revisions.
Decision – major revision

We've revised the manuscript accordingly. We have tried our best to introduce the background knowledge more concretely and clearly and added 16 papers as relevant references. Please see our illustrations in the following reply.

Major Comments
1. Literature Review
L29-31: Authors highlight some background knowledge on how global warming has led to increased warming in the ocean and how warmed oceans can change circulation patterns and provide energy for tropical storms. However, they only mention one reference for this sentence - Lin and Chan (2015) which explains a recent decrease in typhoon destructive potential. Authors need to revisit their literature review and provide a set of references to back their claim on how warming oceans can modify circulation patterns as well as how they can contribute to intense and tropical storms.

Thanks for the comments. As suggested, we've elaborated on the impacts of increased SST on typhoons and ocean circulation based on a series of papers cited in the revised manuscript. See L33-43.
"Rising sea temperatures have the potential to cause changes in ocean circulation

patterns. Research has shown that the Kuroshio and Gulf Stream, two important subtropical western boundary currents in the North Pacific and North Atlantic, can become stronger (Sakamoto et al., 2005; Cheon et al., 2012; Chen et al., 2019; Wang and Wu, 2019) and weaker (Levermann et al., 2005; Chen et al., 2019), respectively. This can ultimately impact the Atlantic meridional overturning circulation (AMOC), as the Gulf Stream is a key system component. The impact of SST warming on tropical cyclones has been a top concern in recent decades (Emanuel, 2005). As global warming continues, we see fewer cyclones overall, but those that do occur are more powerful, longer-lasting, larger, and more destructive (Emanuel, 2005; Maue et al., 2011; Lin et al., 2014; Sun et al., 2017). This increase in destructive potential is due to the combination of longer storm lifetimes and greater storm intensities resulting from warmer sea surface temperatures. However, the situation may be more nuanced, as other atmospheric conditions, such as increased wind shear, could counteract or even reverse this trend of heightened destruction (Lin and Chan, 2015).”

L32-33: Again, one reference is not enough to support the claim on how warming oceans can influence the marine environment. In both cases, there are many novel research has been conducted and they have to be credited properly when stating these claims.

Thanks. See L43-47.
“Coral reefs are facing an increasing threat due to rising ocean temperatures (Pandolfi et al., 2011). This has resulted in the unprecedented mass bleaching of corals, which has been triggered by rising sea surface temperatures (Frieler et al., 2013; Hughes et al., 2017; Hoegh-Guldberg et al., 2017; Sully et al., 2019). Although some mitigations have been observed through small-scale local upwelled or mixed cold water (Tkaachenko and Soong, 2017; Safaie et al., 2018; Davis et al., 2021), the overall situation remains concerning.”

2. Explanation of Buoy Data
The authors state that they have used SST data collected from three coastal buoys. They should provide locations of these buoys using geographical coordinates. I strongly recommend including a map to present the general location of these buoys.

Done. Please see figure 1 and L111-114.
“Three sets of SST data, collected from three coastal buoys located at Chenggong, Linshan Cape, and Magong stations (Fig. 1), all maintained by Taiwan's Central Weather Administration (CWA), were employed to assess the effectiveness of linear

regressions and the STL. The Chenggong, Linshan Cape, and Magong stations are located on the eastern coast of Taiwan, the northern coast of Taiwan, and the coast of Penghu Island, respectively."

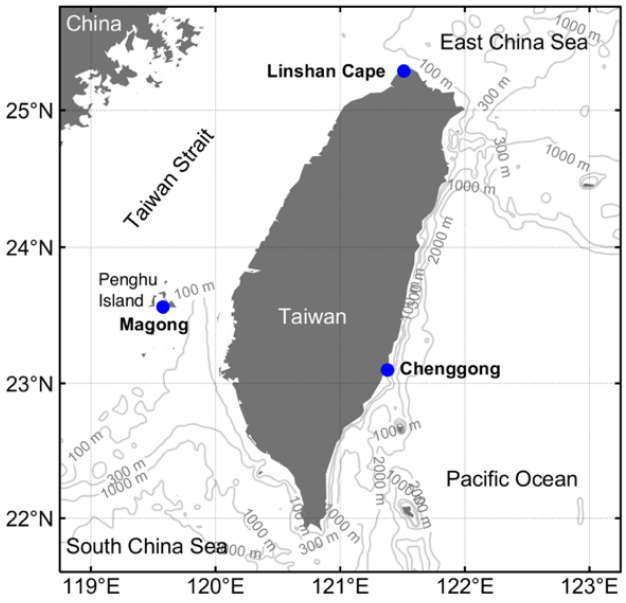

Figure 1: Topography and coastal line surrounding Taiwan. The blue dots denote three coastal buoys at Chenggong, Linshan Cape, and Magong stations, maintained by Taiwan's Central Weather Administration (CWA).

3. Figures

For figures 1(a) and 2 authors should indicate the numerical values of slopes for each regression method. Preferably using the same colors of regression lines. This will help the readers to compare the regression estimates by examining figures without going back and forth through text and figures. For Raw SST, please use a different color from OLSR1.

Revised as suggested. See Figures 2 and 3.

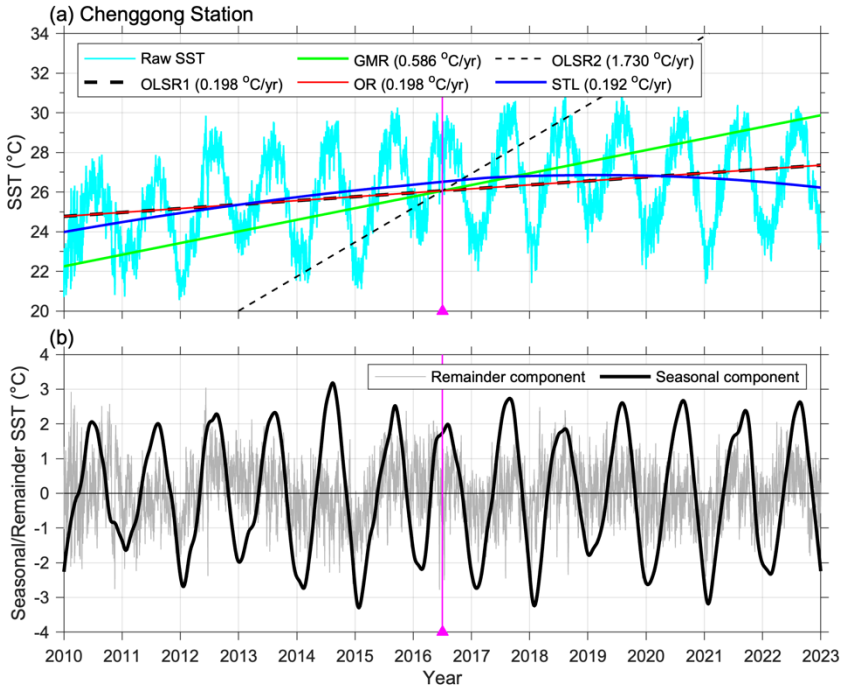

Figure 2: (a) Time series (2010-2023) of sea surface temperature from Chenggong coastal buoy stations and its long-term trend estimated using OLSR1, OLSR2, GMR, OR, and STL methods. (b) The seasonal and remainder components of the STL result. The vertical magenta lines and triangles denote the mean value of the time axis.

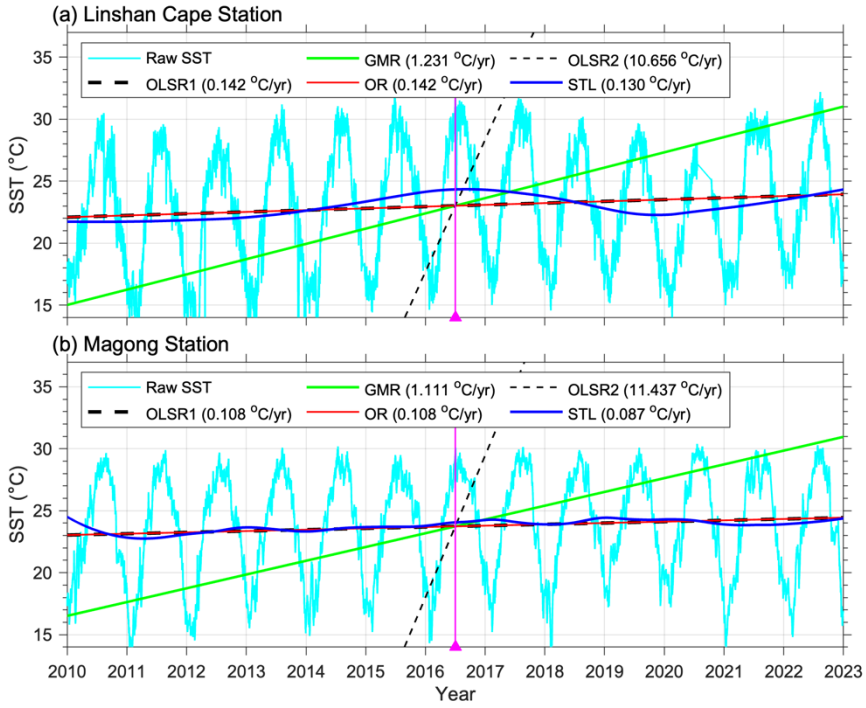

Figure 3: Time series (2010-2023) of sea surface temperature from (a) Linshan Cape Station and (b) Magong Station and their long-term trend estimated using OLSR1, OLSR2, GMR, OR, and STL methods. The vertical magenta lines and triangles

denote the mean value of the time axis.

4. Methods

In Figure 1(b), the authors plot the remainder components. However, it is unclear in the methods section how they obtain these remainder components. Please explain this in detail in the methods sections.

The conceptual description has been provided in L102-109. The methodology of STL involves numerous trivial and detailed operations, which are not suitably incorporated into the present manuscript. We've cited the paper of Cleveland et al. (1990) for readers interested in the details.

5. A summary table.

The authors do a good job of comparing the outcomes of different regression methods within the text of the manuscript. Since the comparison of these regression methods is the core objective of this paper, the authors should highlight their findings appropriately. For this, I suggest using a table to summarize and compare the findings. This will provide readers the opportunity to go through the findings of this important work at one stop rather than scouring through the text for each regression method.

Thanks. We have summarized the results of different methods in Table 1 of the manuscript.

Table 1: Summary of the $\widehat{b_1}$ (unit: °C/yr) estimated using general linear regression, STL, evenized SST, SST anomaly, and a combination of linear and sinusoidal fitting. The slope derived from linear fitting to the STL nonlinear curve (blue lines in Figures 2a, 3a, and 3b) represents the $\widehat{b_1}$ value of STL. As for the methods of evenized SST, SST anomaly, and combined linear and sinusoidal fitting, the representative $\widehat{b_1}$ is determined as the mean value during its stable period, marked by the black dashed lines in Figure 7 (6 months trimmed time).

	Methods of general linear regression				STL	Method of evenized SST	Method of SST anomaly	Method of linear and sinusoidal fitting
	OLSR2	GMR	OLSR1	OR				
Chenggong	1.730	0.586	0.198	0.198	0.192	0.193	0.189	0.180
Linshan Cape	10.656	1.231	0.142	0.142	0.13	0.124	0.109	0.109
Magong	11.437	1.111	0.108	0.108	0.087	0.09	0.080	0.082

Minor Comments

1. L59-61: I assume μ is mean. But it will be helpful to readers if you define it properly.

Corrected. See L79.

2. L105: (2) should be (b)

Corrected.

3. L162: Recheck figure reference (Fig 3 or 4?)

It is now Figure 5.

4. L259-261: It seems the letter “O” is used instead of the number zero (0).

We used degree (°).

5. L299: change “real-sea” to “observed”

Thanks. The associated sentence has been changed due to the other revision.