We would like to thank the reviewer for providing constructive comments and suggestions. Please find our responses below.

GENERAL COMMENT

It is very delighted to see these authors to describing the Exceptionally cold water days in the southern Taiwan Strait: their predictability and relation to La Niña. This manuscript tried to assess the predictability of exceptionally cold water and to develop a warning system in the Taiwan Strait (TS). It was clearly written, and already to develop one warning system using the Oceanic Niño Index and integrated wind speed. But it is still difficult to apprehend whether the authors were mainly concerned of "Exceptionally cold water days in the southern Taiwan Strait".

1. Firstly, the authors need to clearly define the cold waters days or the hotspot area (such as Penghu islands) as they demonstrate exceptionally cold water hit the marine natural resources around the Penghu Islands in the southwestern TS, causing considerable damage in marine aquaculture.

Reply:

As mentioned in the Sections 2 and 3 of manuscript, cold water days in this manuscript are defined as SSTAs < −2 °C, i.e. the temperature is lower than about 17°C (we will add a figure to further explain in the Supplementary). SSTA is a deviation from the daily climatological average. In a similar research work, McKinnon et al. (2016, Nature Geoscience) have used the same method to analyze SST and successfully predicted extremely hot days in summer in US.

The hot spot area has been re-defined as suggested by the reviewer. We will illustrate in the reply to the reviewer's second point. Please note that the threshold to define the cold water days SSTAs < −2 °C has been modified as SSTAs < −2.5 °C due to the change of targeting area as suggested in the review's second point.

2. Secondly, "cold damage" is still unclear. Based on the description in this submission, the "cold damage" should be a kind of biological or ecological response to low water temperature in the waters around Penghu islands. Therefore, the authors need to consider where is the optimum area for developing the warning system on "Cold damage". And, the analysis or observation on the impact of marine resource or aquaculture production of hotspot area (NOT equal to the blue dotted quadrilateral in Figure 1) may important in the session of result or discussion. For example, the author showed a moderate SST belt extending from southwest to northeast, and an isotherm of

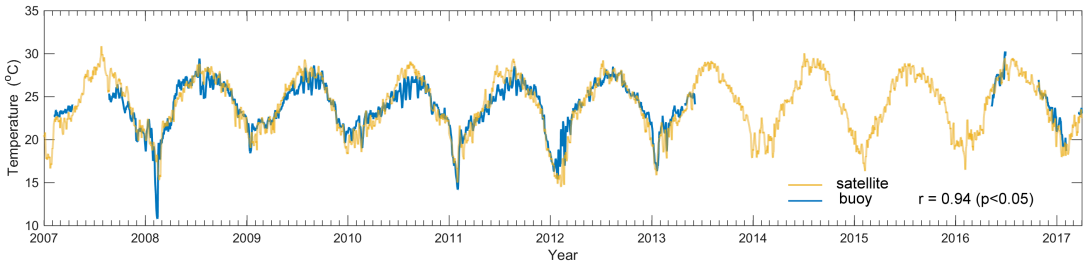
nearly 18 °C across the northern Penghu Islands in fig.3a. It might reveal to separate the colder water in the west from the warmer water in the waters of northern Penghu Islands (Not in the southeastern TS).

Reply:

Yes, the cold damage is biological or ecological response to low water temperature. To be specific, in the revised ms, we have defined "cold disaster" referring to the serious fish death induced by exceptionally cold water around the Penghu Island. In this ms, we aim to develop a warning system to predict the cold water days in the southern Taiwan Strait, as indicated in the title of our manuscript. It is expected that the presence of the cold water days points to the high possibility of the occurrence of cold disaster. Regarding that the long-term observations of water temperature around Penghu are absent (~20- year time series needed), the cold water days were characterized by remotely sensed SSTA lower than a threshold.

We agree with the reviewer that it is important to find the "optimum area" to calculate SSTA and evaluate its impact on biological environment for the development of the warning system. Unfortunately, we don't have data associated with marine resource or aquaculture production. The most relevant information is the date of occurrence of cold disaster in 2000, 2008 and 2011, indicating from the previous literature. The information should be sufficient for the present goal for this work, to predict the cold water days. But the sophisticated prediction for the cold disaster require the understanding of the detailed physical and biological processes and will need the information about marine resource. This is certainly our next goal.

As mentioned by the reviewer, the targeting area we selected covers a frontal area as shown in Figure 3a, which may not be suitable for the index of cold water days. We have re-selected the targeting area as a box in 23.5-24.5^{o}N and 119-120^{o}E, mainly off north coast of Penghu Island, covering the coolest SSTA feature in Figure 3c, and a high correlation ($r=0.94$, $p<0.05$) with observational water temperature (AC2-Figure 1). SST from buoy sited on the north of Penghu Islands (red star in Figure 10a) is the most suitable indicator monitoring the water temperature around Penghu Island, but unfortunately buoy SST is only available after January 2007 and lost efficacy in 2013-2016. As mentioned in the above reply, the long-term observations of water temperature around Penghu are absent. Although the satellite SST in the targeting area is overall higher than SST measured by the buoy (AC2-Figure 1), it has a high correlation with observational SST and should be sufficient for the present goal for this work. We will add the above results in the revised manuscript.



AC2-Figure 1. Time series of SST observed by satellite (yellow line) and buoy (blue line).

3. Thirdly, risk definition is also unclear. I did not know whether the risk include both of the vulnerability and impacts. I was also tried to search similar report for Coral Bleaching Products of NOAA (http://www.ospo.noaa.gov/Products/ocean/coral_bleaching.html) for high risk influenced by the vulnerability and impacts. They indicate the accumulation of thermal stress (i.e. Degree Heating Weeks, DHWs) that coral reefs have experienced over the past 12 weeks. At the same time, they also define the magnitude of impact levels as : the minor (<25% affected), moderate (26–50% affected), and severe (>50% affected) bleaching responses observed at the study sites. If possible, please try to explain the risk in this manuscript.

Reply:

Thanks for the suggestion. We can't define the magnitude of impact levels or impact area as done by NOAA because it requires large amount of biological and fishery data in the vast ocean. Three different risks in the manuscript mean three different probability of occurrence. The revised manuscript will try to estimate the occurrence probability within various degree of risk.

4. Fifthly, the warning system found the high risk (or hazards) happened in the years of 2000, 2008, 2011 and 2012. But the reference only indicates the "cold damage" happened in 2008 and 2011 (Chang et al., 2013), How about the condition in 2000 and 2012. I suppose there are weak cold damages in years of 2000 and 2012. If so, the authors should consider to explain or discuss about what's the difference of marine environment or wind condition between cold damage (2008 and 2011) and weak or non-cold damage (2000 and 2012) years. And if possible, please add one sub-figure for cold events in 2000 to compare the annual variations in figure 11, as the authors describe the cold damage around the Penghu Islands has occurred three times: 2000, 2008, and 2011 (line 30-31, page 2).

Reply:

As mentioned in Section1 & 6, cold disaster in historic records happened not only in 2008 and 2011 (Chang et al., 2013; Lu et al., 2012) but also in 2000 (Lu et al., 2012). The manuscript studies exceptionally cold water, which might potentially trigger disaster in the TS. A hindcast by the warning system showed high-risk warnings for the winters of 2000, 2008, 2011, and 2012, but it doesn't necessarily mean cold disaster must happen in these years. The results indicated that cold disaster likely happen in these four years. Actually, three of the high-risk years did indeed happen damage (2000, 2008, and 2011; Chang et al., 2013, Lu et al., 2012) in historic records, indicating occurrence probability of damage is about 75% within a high-risk warning.

Because the SST shown in Fig. 11 is observed by a buoy working after 2007, we don't have SST data in 2000 (AC2-Figure 1). However, we will add a sub-figure of SST observed by satellite in 2000 and do some discussions.

5. Otherwise, the Oceanic Niño Index (ONI), defined as a 3-month running mean of SST anomalies, is describe in the line 10, page 3. However, the ONI indexes in January, February and March 2012 are -0.8, -0.6 and -0.5, respectively. It seems that the 2012 winter did not match up with the first definition of <-0.9 C. Why? And whether the author is considered to describe or discuss about the long-term variation or trend in Taiwan Strait as the topic is focus on Exceptionally cold water days". If so, a new publish was suggested as your reference "Kuo et al., 2017 or 2018, Long-term observation on sea surface temperature variability in the Taiwan Strait during the northeast monsoon season, International Journal of Remote Sensing".

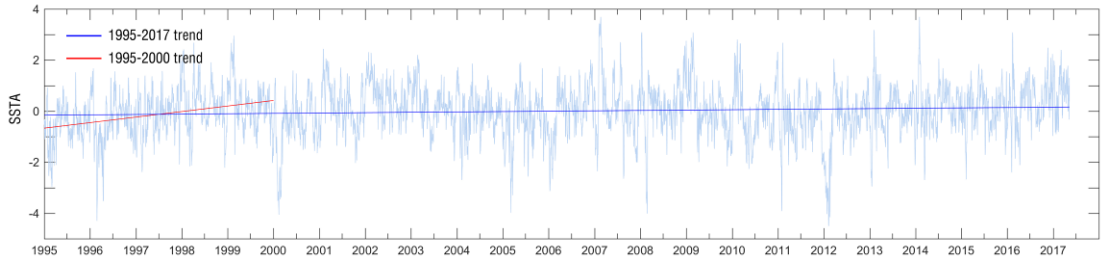
Reply:

Yes. As mentioned in Section 4.1 of the manuscript, ONI values used in this manuscript are downloaded from NOAA CPC. They are estimated according to the 3-month running mean of monthly SSTAs in the Nino3.4 region (https://goo.gl/XRFVM3). Because of the running mean needed, the ONI value has a delay time of two month; in other words, the latest ONI value obtainable in this month (April) is the value for February (as the AC2-Figure 2 screenshot shown). Actually, the ONI indexes used in January, February and March 2012 are -1.1(Nov.), -1.0(Dec.) and -0.8(Jan.), respectively.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2010	1.5	1.3	0.9	0.4	-0.1	-0.6	-1.0	-1.4	-1.6	-1.7	-1.7	-1.6
2011	-1.4	-1.1	-0.8	-0.6	-0.5	-0.4	-0.5	-0.7	-0.9	-1.1	-1.1	-1.0
2012	-0.8	-0.6	-0.5	-0.4	-0.2	0.1	0.3	0.3	0.3	0.2	0.0	-0.2
2013	-0.4	-0.3	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.3	-0.2	-0.2	-0.3
2014	-0.4	-0.4	-0.2	0.1	0.3	0.2	0.1	0.0	0.2	0.4	0.6	0.7
2015	0.6	0.6	0.6	0.8	1.0	1.2	1.5	1.8	2.1	2.4	2.5	2.6
2016	2.5	2.2	1.7	1.0	0.5	0.0	-0.3	-0.6	-0.7	-0.7	-0.7	-0.6
2017	-0.3	-0.1	0.1	0.3	0.4	0.4	0.2	-0.1	-0.4	-0.7	-0.9	-1.0
2018	-0.9	-0.8										

AC2-Figure 2. ONI values from https://goo.gl/XRFVM3

The trend in our studying region has a gentle slope (0.01°C/year), which is not significant, during the studying period of 1995-2017 (dark blue line in AC2-Figure 3). We will add the above results and Kuo et al. (2017) as reference.



AC2-Figure 3. time series of SSTA. Blue line is a trend from 1995 to 2017 (0.01°C/year); red line is a trend from 1995 to 2000 (0.21°C/year).

SPECIFIC COMMENT

1. There are too many errors of reference forms in the reference sections. For example, the format in line 17 and 25 of page 9 for references are different as following: Line 17: Kuo N-J, Ho C-R (2004). . .. Line 19: Lau N-C, Nath MJ (2006). . . Line 25: Lu Yi-Lin, Hsien I-L, Chung C-S, Lin, C-Y, Chen S-C, Tsai W-S (2012) Please check in detail by yourself.

Reply:

Thanks. We have modified that in the revised manuscript.

2. L19~20 of page 1, The authors may consider to modify the geographic term, for example, the average depth is 50 m, as they also use the description "approximately 30 m" for the Taiwan Bank.

Reply:

"The average depth is 50 m" give a description of the Taiwan Strait rather than of the

Taiwan Bank. We have clarified it in the revised manuscript.

3. Please try to explain the importance of this sentence "A lag-0- to lag-6-month correlation between rainfall anomalies in western Pacific and the peak La Niña was also observed by Wang et al. (2000)." (line 29-30, page). Did author try to say something using this sentence.

Reply:

We would like to mention a lag correlation is shown not only between cold event and La Niña but also between rainfall and La Niña. We have clarified it in the revised manuscript.

4. L8~L9 of page 3, the authors use "the 60 coldest days of winter based on the climatologically averaged SST (January 6–March 6 in non-leap years, and January 6–March 5 in leap years)" is not easy to understand the coldest days. The authors may consider to add one figure or supplement figure for this.

Reply:

Thanks. We will add a figure in the Supplementary. Please note that the 60 coldest days of winter has been modified as January 1–March 1 (regular years) and January 1–February 29 (leap years) due to the change of targeting area as suggested in the review's GENERAL COMMENT 2.

5. In addition, please confirm the definition of SSTA in line 17 of page 3. The sea surface temperature anomaly (SSTA) is the difference between the observed SST and the climatological SST. Did author use which the climatological daily SST is? In general, the SSTA is good indicator to see the long-term warming or cooling trend.

Reply:

Yes. SSTA is a deviation from the daily climatological average (we will add a figure to clarify in Supplementary) and the time series of SSTA can be an indicator to study long-term trend. However, the trend in our studying area has a gentle slope (0.01^{o}C/year) during the studying period of 1995-2017 (dark blue line in AC2-Figure 3). Actually, we can see a significant warming trend (0.21^{o}C/year) from 1995 to 2000 (red line), which is similar to the results of Kuo et al. (2017, Int. J. Remote. Sens.; 1980-2000 trend is about 0.15^{o}C/year) and Belkin et al. (2014, Clim. Change; 1978-1998 trend is about 0.07^{o}C/year). A trend has large variability depending on a sampling window, so you can't see an obvious long-term trend during the studying period. We will add a sentence for note in the revised manuscript.