Responses to Reference Report #2

This paper proposes a quantitative method for determining the four-color warning water level, and the results show that proposed method could be easily adopted in various coastal areas. Especially, the study provides an insight into the spatial distribution of the four-color warning water level and its correction value along the coastlines of China. It can be helpful for storm-surge forecasting and prewarning. The paper is well structured and mostly easy to follow. However, there are few critical points that should be addressed in the manuscript as follow:

Response: We greatly appreciate your kind help in reviewing the manuscript and all constructive comments. We substantially revised the paper based on these comments.

1. Figure 4 gives the distribution map of the shore section importance level. It is very necessary to further clarify the distribution characteristics, for example, what is the proportion of the 259 shore sections corresponding to the different importance levels?

Response: Thanks for your suggestion. We have carried out a statistical analysis on the proportion of the 259 shore sections corresponding to the different importance levels. Among the 259 shore sections, 49.1% are particularly important shore sections, 32.4% are important shore sections, 13.1% are relatively important shore sections, and 5.4% are normal shore sections. The particularly important shore section accounts for the largest proportion(49.1%). More detailed explanations about the distribution characteristics of the shore section importance level have been presented in the revised manuscript as follows:

Line 208-213:

The spatial distribution of shore section importance level were consistent with that of the warning water level. Among the 259 shore sections, the particularly important shore section accounted for the largest proportion(49.1%), while the other important grades shore sections accounted for 32.4%, 13.1% and 5.4% respectively. The shore section importance levels of Jiangsu, Zhejiang, Fujian, and Guangdong Provinces were higher than the other shore sections, and more than 90% of the particularly important shore sections were distributed in the coastal areas of the above provinces. This is because the coastal zones of these provinces with a high population density were the main areas of economic development on a country-wide scale, with this importance also being reflected in the high shore section importance level.

2. The paper points out that the four-color warning water level corresponding to the four levels of marine disaster emergency response is more helpful for the storm surge prewarning. It is better to explain what is the marine disaster emergency response level and how the four warning water levels improve the marine disaster prevention capabilities compared to the previous system.

Response: Thanks for your suggestion. More detailed explanations about the storm surge disaster emergency response level and the role of the four-color warning water levels in marine disaster prevention have been presented in the revised manuscript.

(1) Marine disaster emergency response is divided into four levels: Level I (particularly major disaster), Level II (major disaster), Level III (relatively major disaster), and Level IV (normal disaster). Marine disaster alerts are divided into four levels: red, orange, yellow, and blue,

corresponding to the highest to lowest warning levels, respectively. Correspondence between marine disaster emergency response and marine disaster alert level is shown in the table below.

Table Description of storm surge disaster emergency response level

Marine disaster emergency response level	Description
I	Affected by tropical cyclones or extratropical weather systems, it is expected that the high tide level of one or more representative tide gauge stations in the affected area will reach the red warning tide level in the future, a red storm surge warning should be issued, and level I marine disaster emergency response level should be launched.
II	Affected by tropical cyclones or extratropical weather systems, it is expected that the high tide level of one or more representative tide gauge stations in the affected area will reach the orange warning tide level in the future, an orange storm surge warning should be issued, and level II marine disaster emergency response level should be launched.
III	Affected by tropical cyclones or extratropical weather systems, it is expected that the high tide level of one or more representative tide gauge stations in the affected area will reach the yellow warning tide level in the future, a yellow storm surge warning should be issued, and level III marine disaster emergency response level should be launched.
IV	Affected by tropical cyclones or extratropical weather systems, it is expected that the high tide level of one or more representative tide gauge stations in the affected area will reach the blue warning tide level in the future, a blue storm surge warning should be issued, and level IV marine disaster emergency response level should be launched.

(2) Compared with the single value format that characterized the warning water level as determined in the mid-1990s(the previous system), the four-color warning water level, corresponding to the four levels of marine disaster emergency response levels are more helpful for the storm surge prewarning. The advantages are mainly manifested in several aspects:1)In the north area of the Yangtze River Estuary and the South China Sea, the newly approved blue warning water level has changed the situation that most shore sections can rarely reach the high tide level of the blue storm surge warning level once in 5 to 15 years according to the original standard. It is conducive to improving the the warning service capability of the above-mentioned shore section, and have also eliminated the paralyzing thinking caused by the absence of super-warning tide levels for many years;2)In the coastal areas of Fujian Provice, the frequent issuance of blue storm surge warnings has been effectively avoided, so that it can better play the role of alerting tide levels;3)The newly approved red alert tide level can more truly reflect the actual defense capability of the approved shore section.

3. The "Discussion" section should be further improved. For example, more detailed explanations of the advantage, limitation and future research could be presented.

Response: Thanks for your suggestion. According to your advice, the section of Discussion has been modified in the revised manuscript. More detailed explanations of the advantage, limitation and future research of this study have been presented in the section of Discussion.

(1) In the revised manuscript, the Discussion have been modified as below:

4. Discussion

The warning water level is mainly used for storm surge prewarning, and it is crucial to decision-making and mitigation measure design. This study proposed a newly approved quantitative method for determining the four-color warning water level, which includes the calculation formula of the HWL at the typical return period, the classification method of the shore section based on its importance and coastal county unit，and the quantitative calculation formula of the correction value of the warning tide level corresponding to wave exposure degree, surge protection facility construction standard and the shore section importance level. Compared with the method used for calculating the one-single-value warning water level in the mid-1990s, the method of calculating the four-color warning water level used in this study is more reasonable, mainly in the following aspects: (1) It proposed the description of the warning water level classification corresponding to the four levels of marine disaster emergency response levels, and the determination results of the four-color warning tide level are more helpful for the storm surge prewarning; (2) The calculation of correction values has been improved, by replacing qualitative calculation method with quantitative calculation method, especially proposing the method of calculating the wave run-up which is an important decisive element for the correction values; (3) In the process of calculating the four-color warning water level, the verification of the approved results are strengthened, to determine whether the approved warning water level is suitable based on the statistical analysis of historical storm surge disasters and the corresponding tidal heights. Our results about the spatial distribution of four-color warning water level, have been preliminarily applied to storm surge disaster prevention and mitigation in coastal areas of China. Several studies focused on the storm surge prewarning application methods for the newly approved four-color warning water level, corresponding to a refined shore section (Fu et al., 2017). However, limited by the data availability, it is not considered that the influence of storm surge disaster loss factors on the calculation of warning water level. The Correlation between storm surge disaster losses and the highest tide water exceeding the warning water level has not been established.

The precision of the warning water level directly affects the accuracy of the storm surge prewarning results, thereby affecting the objectivity of emergency strategies and decision-making for storm surge disaster mitigation. With the rapid development of China's coastal society and economy, storm surge protection facilities, population density, and coastal development conditions have also been changing. Therefore, the warning water level needs to be updated according to the actual conditions of the coastal areas in time, When it is not compatible with the storm surge prevention and mitigation. At the same time, in order to meet the needs of the increasingly refined storm surge disaster prevention and mitigation plans, the scale of warning water level assessment should be changed from coastal counties to coastal towns and communities.

Several studies highlighted that global sea-level rise would continue accelerating in the 21st century as a consequence of climate change (Church and White, 2011; Hay et al., 2015). In fact, coastal flooding hazard has been increasing on a global scale in recent decades, a trend expected to continue as a result of climate change(Maria et al., 2022). In the past 40 years, sea level in the coastal China seas has increased significantly, with the rate of 3.4 mm/a, higher than the global average from 1993-2018(3.25mm/a)（Ministry of Natural Resources of China, 2021; IPCC,2021）. In the IPCC Sixth Assessment Report, the latest monitoring and simulation results indicate that the current rate of Global mean sea level rise from 2006 to 2018 is accelerating (3.7mm/a) and will continue to rise in the future, showing an irreversible trend(Zhang et al., 2021; IPCC,2021).

Regional relative sea level rise is an important driving factor affecting extreme still water levels. The continuous rising sea level has led to an increase in extreme water levels in coastal areas of China(Qi et al., 2019), which can have an impact on the determination of warning water levels. Additionally, changes in storminess may have an important role in modifying the frequency and magnitude of water level extremes (Lowe et al., 2010; Woodworth et al., 2011). Future work about re-determining the warning water level should take these abovementioned issues into consideration.

(2)The references added in the revised manuscript are as below:

1) Maria, F.C., Marco, M.: Extreme-coastal-water-level estimation and projection: a comparison of statistical methods, Nat. Hazards Earth Syst. Sci., 22: 1109–1128, https://doi.org/10.5194/nhess-22-1109-2022, 2022.

2) Ministry of Natural Resources of China: 2021 China Sea Level Bulletin, Ministry of Natural Resources of China, Beijing, China, 2021. (in Chinese).

3) Zhang, T., Yu, Y.Q., Xiao, C.D.: Interpretation of IPCC AR6 report: monitoring and projections of global and regional sea level change, Climate Change Research, 17(6), 12–18, https://doi.org/10.12006/j.issn.1673-1719.2021.231, 2021.(in Chinese)

4) IPCC: Climate change 2021: The physical science basis. Contribution of working group I to the Sixth Assessment Report of the IPCC, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2021.

5)Qi, Q.H., Cai, R.S., Yan, X.H.: Discussion on climate change and marine disaster risk governance in the coastal China seas, Marine Science Bulletin, 38(4), 361–367, https://doi.org/10.11840/j.issn.1001-6392.2019.04.001, 2019.

4. U. S. or USA, China or PRC, please make it uniform in the entire manuscript.

Response: Thanks for your suggestion. We have checked the description of "USA" and "China", and make "USA" and "China" uniform in the entire manuscript.

5. Re-check the unit of Table 2 and 6. At the same time, it is recommended to move the unit "cm" of Table 6 from the table to the header position.

Response: Thanks for your suggestion. The unit of Table 2 and 6 have been changed to "a" in the revised manuscript. Based on your suggestion, we have also modified the positon of the unit "cm" in Table 5 as below:

Tab. 2 H_s value corresponding to return period (unit: a)

Corresponding water level return period of the actual defense capability of the shore section	Corresponding return period of H_s
(0,50)	2
(50,100)	3
(100,200)	4
≥200	5

Tab. 6 The high water levels (HWL) corresponding to return period at Zhifudao tide gauge station(unit: cm)

Return period	2a	5a	10a	20a	50a	100a

HWL corresponding to return period	184	209	225	240	260	275

6. Figure 5 shows the spatial distribution of H_s and H_d. Please re-check the name of Figure 5 and make sure the name corresponding to the content.

Response: Thanks for your suggestion. We have modified the name of Figure 5 in the revised manuscript as below:

Fig.5 Spatial distribution map of H_s and H_d: a) H_s; b) H_d