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Interactive comment on "Multiproxy reconstruction for Kuroshio responses to Northern Hemispheric oceanic climate and Asian Monsoon since marine isotope stage 5.1 (~ 88 ka)" *by* X. Shi et al.

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Dear reviewer, Thank you for the constructive comments on this manuscript that will bring substantial improvements of the present manuscript. We also apologize for the delay in this response to the comments. For the questions you raised, we respond to below.

R#1ïijŽ This study shows a long-term record of the ocean environmental changes in the Okinawa Trough by using quality data. I think the authors put a lot of effort into this study. Multiple proxies allow us to capture the paleoceanographic changes from several perspectives. However, I would like to recommend that the authors re-arrange the text and figures, because of the reasons mentioned below:

R#1ïijŽ(1) Any interpretations should be excluded in the results. In this part, the data from each proxy must be described clearly. Otherwise, it's not easy what the proxies indicate.

MC: Thanks for your comment. Some revisions have been made in the manuscript. Please check the revised version.

R#1ïijŽ(2) I found mismatches between the text and figures at many points. Some comparison data from the previous studies are lacked in the figures. In particular, it's not easy to compare the changes of different proxies shown in multiple panels. Even if the authors indicate the correlation between the proxies, I cannot recognize which changes or peaks are mentioned.

MC: We also noticed such mismatches between the text and figures and they mainly occurred in page 16, lines 6, 9 and 25 and page 17, lines 12, 15 and page 20, line 15. We have corrected these mistakes. Thank you very much. In order to present a clear comparison between SSS and G. quinqueloba, the depth of thermocline and G. inflata, the time series of G. quinqueloba and G. inflata were added in Figs.8 and 9 as shown below and included in the revised version.

R#1ïijŽ(3) Some interpretations in the discussion part are not understandable. I recommend that the authors carefully and logically explain their interpretations with additional references.

MC: Thanks for your comment. Some revisions have been made. Please check the revised version.

R#1ïijŽ(4) The title and abstract imply that the paper is going to focus on the change of the Kuroshio in the past 88 ka. However, this message is not fully displayed in the

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text. The authors need to show what are the proxies for the Kuroshio and how they have changed since MIS 5.1. When the authors modify the MS, I strongly believe that the MS will be accepted to the journal "Climate of the Past".

MC: Thanks for your comment. In this text, we use a suite of proxies, including sediment grain size, planktonic foraminiferal species, SST, SSS and DOT to reconstruct the hydrography in the northern Okinawa Trough, given that the change in hydrography in the northern Okinawa Trough is closely related to the strength of Kuroshio. Some proxies, such as the high abundance of P. obliquiloculata and higher SSS are directly caused by the Kuroshio, or other proxies such as grain size are more or less related to the Kuroshio.

[Specific comments] R#1ïijŽ4.1 Results Please explain the changes of indexes sequentially from the past to the present (or the present to past). It's not easy to understand their differences between the periods or ages.

R#1ïijŽ4.1. Grain size analysis: The amount of coarse grains increased during the MIS 1 and 5. It seems that these materials were supplied by the erosion or mixing of the Kuroshio Current. I would like to ask the opinions of the authors.

MC: The increasing coarse grains in MIS 1 and MIS 5 were caused by different reasons. Our bulk geochemical data (unpublished) shown in Fig.1-1 below suggest that there is abundant volcanic debris during the Holocene in core CSH1. However, we do not observe the contribution of volcanic debris in MIS 5.1. The volcanic debris may be delivered by the Kuroshio from the southern Okinawa Trough or the Philippine Sea during MIS 1 (strong Kuroshio). During MIS 5.1, the increasing grains, we also think it is related to the sorting caused by the intensified Kuroshio.

R#1ïijŽ4.2. Planktonic foraminiferal assemblages Please organize the information about species. A single species is sometime used as different water indexes. I cannot understand the relationships between species and water masses. MC: The abundances of planktonic foraminifera (PF) are closely related to their living conditions, such

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as temperature, salinity, nutrients, etc. The modern investigations of PF in surface sediments in the East China Sea and the northwestern Pacific show the distribution of PF is related to the different water masses, so the dominant species can be used as indicators of water masses. For example, in core CSH1, the species of N. pachyderma was used to indicate the subarctic water, and P. obliquiloba indicates the Kuroshio, and N. quinqueloba indicates the coastal water, etc.

R#1ïijŽ4.4. Alkenone SST I have a question about the description of the last paragraph. If 18Oruber indicates summer oceanic condition, we have another hypothesis: summer SST during MIS 5.1 was different from that of MIS 1?

MC: The average values of alkenone - SST show a little difference during MIS 1 and MIS 5.1. So the hypothesis, "summer SST during MIS 5.1 was different from that of MIS 1" was unreasonable. As previously reported, δ18O of calcite shells is controlled by both SST and SSS. It means much bigger difference of δ18Oruber between MIS 1 and MIS 5.1 must be caused by the SSS difference. The differences in salinity may indicate that the climate was different during MIS 1 and MIS 5.1.

R#1ïijŽ4.6. Depth of thermocline The same data (planktonic foraminiferal assemblage) were used for Figures 8c, d, and e. These changes could be associated each other, because they are from same data source. I don't understand what the authors want to discuss based on three nonindependent indicators. Moreover, the ratio of shallow/deep dwelling species shows the difference between MIS 1 and MIS 5.1. I would like to recommend that the authors give us more explanation and interpretation about this thing.

MCïijŽThe interpretation for depth of thermocline (DOT) is shown in Fig. 9, NOT in Fig. 8. In Figs. 9c, d, e, we use different data. Based on the abundances of G. truncatulinoides (dex.) and G. truncatulinoides (sin.), we obtain quantificational result of DOT using the planktonic foraminiferal transfer function (Andreasen and Ravelo, 1997). Meanwhile, we use the quantitative proxy, the ratio of shallow/deep species to

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indicate the DOT. Both quantificational and quantitative methods show similar trends of DOT. The reviewer pointed out that the ratios of shallow/deep dwelling species show great difference between MIS 1 and MIS 5.1. Such difference can also be observed in the quantificational DOT. At present, we think that the difference of DOT during MIS 1 and MIS 5.1 is closely related to the climate, although the SSTs are similar during these two ages. However, such presumption needs further evidence.

R#1ïijŽ5. Discussions I recommend that the authors re-arrange the figures, because it's not easy to compare the changes among the multiple proxies. I cannot follow the text, comparing the separately drawn graphs. For instance, the graphs of G. quinqueloba abundance and SSS were separately shown in Figs. 5 and 7 without any remarks.

MCïijŽThank you for the suggestion. Both down-core profiles for the abundances of G. quinqueloba and SSS were shown in Fig. 11. In order to make a clear comparison, we also presented the abundance profile of G. quinqueloba in Fig.8.

R#1ïijŽ5.1. Multiproxy hydrographic reconstructions I think the authors may misunderstand the meaning of factor analysis. (Page 13: lines 5 to 14) Each factor usually has a "single" meaning. Factor 2 may indicate "warm water" or "Kuroshio". If this factor means "dissolution", the scores of first two species (G. ruber and G. glutinata) and P. obliquiloculata must be opposite. In the list of planktonic foraminiferal fauna, these three species have positive scores for factor 2. Moreover, we can find other species, which could be susceptible or resistant to dissolution, though these others don't have any scores. (Pages 14: lines 5 to 6) If Factor 4 also shows "upwelling" condition, two factors (1 and 4) have same meaning. (Page 14: lines 13 to 15) The sea-level affects on geographic change, which probably blocked the Kuroshio flow and moved the river mouth close to the studies area. However, precipitation itself is not directly controlled by this geographic change. (Page 14: lines 11 to 30) I cannot completely agree the interpretation by the authors, because SSS seems to associate with the insolation at equator. Please see Fig. 10.

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MCïijŽThe results for factor analysis were presented in Page 12, Lines 14 to 20. The explanation for factor analysis was mainly listed in Pages 15, 16 and 17, not listed in Page 13. The reviewer thought we misunderstand the results of factor analysis for planktonic foraminifera. However, the results and interpretation agree well with modern investigations (Sun et al., 2003; Thompson, 1981; Ujiie and Ujiie, 2000; Xu and Oda, 1999). The reviewer said that "Factor 2 may indicate "warm water" or "Kuroshio". In Page 12, Lines 8 and 9, we showed that "The faunal Factor 2 represents warm water species G. ruber, G. glutinata, and P.obliquiloculata...", which is consistent with the reviewer's statement. In this text, we DON'T talk that factor 2 means dissolution. In this text (page 16, line 12- 14), we mentioned the result by Thompson (1981), that the foraminifera shells of G. ruber, G.glutinata, G. sacculifer and G. conglobatus are susceptible to carbonate dissolution, while P. obliquiloculata is resistant to dissolution. We want to clarify P. obliquiloculata is a more reliable proxy for the Kuroshio than others. As stated by the reviewer, precipitation itself is not directly controlled by the geographic change. We do agree this judgment. However, the SSS in the study area was obviously regulated by the runoff, which is closely related to the precipitation, and the Kuroshio. During the lower sea level, the estuary can move toward to the slope of the Okinawa Trough and block the Kuroshio flow. It is thus reasonable to speculate the geographic change exerts great influence on the hydrography change in the study area. According to the investigation of modern hydrography in the East China Sea (Lie et al., 2003), the SSS was mainly affected by runoff related to precipitation and the Kuroshio. Therefore, we think that our interpretation is suitable. The reviewer noticed the rough trends of SSS and insolation curves at equator, especially during MIS 2 to MIS 5.1. However, it is also very clear there is no similarity in SSS and insolation trends during MIS 1. Therefore, we think insolation is not a key factor controlling the SSS through evaporation and precipitation in the northern OT. Other revisions have been made in the revised version. Please check the supplementary.

References

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Lie, H. J., Cho, C. H., Lee, J. H., and Lee, S.: Structure and eastward extension of the Changjiang River plume in the East China Sea, Journal of Geophysical Research: Oceans, 108, doi:10.1029/2001JC001194, 2003. Sun, R., Li, T., Cao, Q., and Xiang, R.: Planktonic foraminifera distributions in surface sediments of the northern Okinawa Trough and their marine environment interpretation, Oceanologica et Limnologia Sinica, 34, 511-518(in Chinese with English Abstract), 2003. Thompson, P. R.: Planktonic foraminifera in the Western North Pacific during the past 150 000 years: Comparison of modern and fossil assemblages, Palaeogeography, Palaeoclimatology, Palaeoecology, 35, 241-279, 1981. Ujiie, Y. and Ujiie, H.: Distribution and oceanographic relationships of modern planktonic foraminifera in the Ryukyu arc region, northwest Pacific Ocean, The Journal of Foraminiferal Research, 30, 336-360, 2000. Xu, X. D. and Oda, M.: Surface-water evolution of the eastern East China Sea during the last 36,000 years, Marine Geology, 156, 285-304, 1999.

Please also note the supplement to this comment:
http://www.clim-past-discuss.net/10/C899/2014/cpd-10-C899-2014-supplement.pdf

Interactive comment on Clim. Past Discuss., 10, 1337, 2014.

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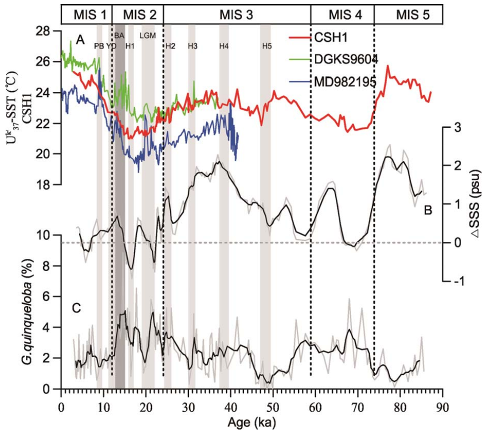

Fig.8 Time series plots of temperature, salinity and the abundance of *G. quinqueloba* in core CSH1 and compared to other records in cores MD982195 (Ijiri et al., 2005) and DGKS9604 (Yu et al., 2009). Gray bars are the same as those in Fig. 5. Salinity values are given as the difference from the present-day climate, ΔS. *G. quinqueloba* is an indicator of low saline coastal water in the East China Sea.

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Fig. 1. Fig.8 Time series plots of temperature, salinity and the abundance of G. quinqueloba in core CSH1 and compared to other records in cores MD982195 (Ijiri et al., 2005) and DGKS9604 (Yu et al., 2009). G

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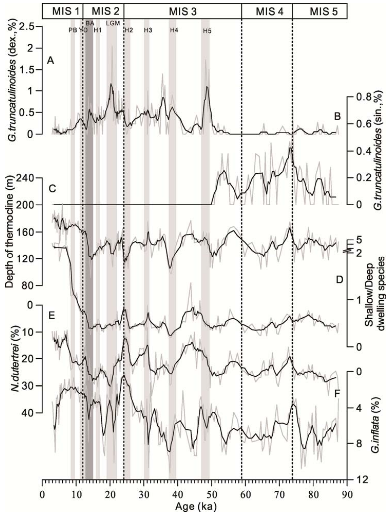

Fig. 9. Time series plots of abundance of *G. truncatulinoides*, depth of thermocline, the ratio of shallow/deep species, abundances of *N. dutertrei* and *G.inflata*. Both the distributions of *N. dutertrei* and *G.inflata* are related to DOT, but they show different down-core profiles in core CSH1. Gray bars are the same as those in Fig. 5.

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Fig. 2. Fig. 9. Time series plots of abundance of G. truncatulinoides, depth of thermocline, the ratio of shallow/deep species, abundances of N. dutertrei and G.inflata. Both the distributions of N. dutertrei

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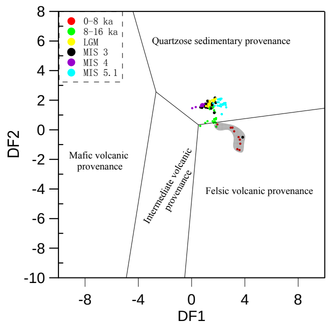

Fig.1-1 Geochemical discrimination plot to obtain possible provenances of sediments in core CSH1.

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Fig. 3. Fig.1-1 Geochemical discrimination plot to obtain possible provenances of sediments in core CSH1.

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