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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. You have raised some interesting questions, which we respond to below.

R#2: The manuscript entitled “Multiproxy reconstruction for Kuroshio responses to Northern Hemispheric oceanic climate and Asian Monsoon since marine isotope stage 5.1 (88 ka)” submitted by Shi et al. presents multi-proxies record of the region at northern part of the Okinawa Trough. In this manuscript, the authors state that the Kuroshio

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is the main governing factor on regulating regional hydrography for the last 88 ka. The data is plentiful and is sufficient to demonstrate the main points. However, there are some questions need to be clarify in the manuscript. Nevertheless, the manuscript is now in acceptable format for publishing on the journal of "Climate of the Past".

R#2:1. According to the record, sand depositions are high in interglacials. However, during interglacials, the sea-level are in high-stand periods. That means sources of riverine and costal sediments are far away from the coring site. Why coarse sediments are enriched during high-stand but low in glacial interval when coastline is close to coring area?

MC: Based on the results of major and minor elements (Fig. 1-1), we found there are lots of coarse volcanic detritus in sediments of MIS 1, while during MIS 5.1, there is no volcanic detritus. So we can observe the difference between MIS 1 and MIS 5.1. However, during these two periods, the sand contents obviously are higher than other periods. We attribute it to the sorting caused by intensified Kuroshio during interglacials. Previous research noted that the provenance was closely related to the Kuroshio marked by increasing coarse fractions since 7 ka during high-stand in the middle Okinawa Trough (Dou et al., 2010). It is reasonable to speculate the same mechanism for the increased sand contents because the Kuroshio flows through northern Okinawa Trough during MIS 5.1.

R#2: 2. In the manuscript, the reconstructed SSS are important indicator for monitoring past changes of hydrography of the OT. The calculated $d_{18}O_w$ is based on foraminiferal $d_{18}O$ and alkenone-derived SST. This kind of calculation might be biased by the different growing seasons and dwelling depths of forams and coccolithophores. As mentioned in the manuscript, alkenone-derived SST is representative to annual temperature. But planktonic foram is possibly indicate to summer conditions, denotes in page 1350, line 2-3. Is there evidence to prove that alkenoen-SSTs are usable in calculating $d_{18}O_w$ of this region?

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MC: For SSS estimate, it is better to use Mg/Ca derived SST because Mg/Ca is measured on the same organism and mineral phase that carries the $\delta^{18}\text{O}$ information. They are linked to the similar physical properties of surface ocean. In addition, alkenone derived temperature also has been successfully applied to SSS estimation, as detailed in Rostek et al. (1993) and Yu et al. (2009). However, such SSS estimation, as the reviewer pointed out, might be biased by the different growing seasons and dwelling depths of planktonic foraminifera and coccolithophores. In this study, the surface dwelling species *G. ruber* was used to determine the $\delta^{18}\text{O}$, which mainly lives in the upper mixed layer of the ocean (0–50 m) (Hemleben et al., 1989), therefore the data obtained from *G. ruber* are thought to largely reflect surface ocean conditions. On the other hand, both seasonal fluxes of *G. ruber* and coccolithophores in the middle depth from sediment trap located in the Okinawa Trough are high in spring and autumn (Tanaka, 2003; Yamasaki and Oda, 2003), when most surface water properties, including SST and SSS, approach annual average SST and SSS. Therefore, Uk^{37} -derived SST could be a good candidate to be used to obtain accurate average SSSs in the region. What's more, reconstructed average SSS for core CSH1 during MIS 1 matches very well with the instrumentally measured annual average SSS at the core site.

R#2: 3. The age model of this study is mainly built up with ^{14}C -datings and MIS events. However, when check in detail of planktonic foraminiferal oxygen isotope record, the picked MIS 5.1 is not so clear. The authors notice that there is a discrepancy of the age of ASO-4 event, and attribute to the uncertainty. I suggest to that volcanic events can be useful independently age control points to replace the MIS 5.1. The whole story may not change a lot, but the age can be more reliable.

MC: Thanks for your suggestions. According to the previous report (Machida, 1999), the Aso-4 event mainly occurred in MIS 5.1, but there was no accurate age point, just a range. According to our age model (AMS ^{14}C & $\delta^{18}\text{O}$), the third ash layer can be correlated to Aso-4. Because of the uncertainty of age point of Aso-4, it is risky to use Aso-4 as the age control point for core CSH1. Anyway, as the reviewer stated that, the

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change of last age control point does not affect the whole story.

R#2: 4. In this study, the authors compare their records to other records of ODP1144 and MD972142. realize that the authors try to compare their records to others for better addressing the AM topic. However, there are other published records that have similar age intervals based on cores retrieving from the ECS and SCS regions, why select ODP 1144 and MD972142? Is there any reason? In the manuscript, I didn't read any information for speculating this choice.

MC: We want to get some information about Asian Monsoon from such comparison, which is closely related to the regional hydrography. Insofar as it can be ascertained, the changes of hydrographic conditions in the South China Sea is highly investigated and both records show good results. That is why we choose ODP 1144 and MD972142 to do such comparison.

R#2: 5. In discussion, the authors attribute the foraminiferal d13C record to land vegetation changes. But, mostly the foraminifer d13C data reflect the DIC of sea water, which may imply to surface production change and upwelled subsurface water influence. Why varied land vegetation? Is there evidence can help to speculate the point?

MC: As mentioned by the referee, the $\delta^{13}\text{C}$ value mostly reflect the DIC of sea water, and the planktonic foraminiferal $\delta^{13}\text{C}$ can be affected by changes in sea surface productivity, upwelling subsurface water, inputs of river runoff, et al. The mean $\delta^{13}\text{C}$ values in global oceans decreased by 0.32‰ under glacial conditions (Duplessy et al., 1988). In this paper, he mentioned that Shackleton (1977) attributed such changes to the decreased forest cover during glacial periods.

R#2: 6. It's better to give detail information about the transfer function of DOT, such as modern analog database used in this study and estimated errors. It will be helpful to readers to judge the confidence of calculated DOT. Otherwise, what DOT means in this study? Generally, thermocline is a kind of depth range shows the mostly decreased trend of water temperature. So the value of calculated DOT in this study means the

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lowest reach of thermocline or mean depth of thermocline?

MC: Thanks for your suggestions. The DOT in the manuscript was calculated by using the thermocline depth transfer function of Andreasen and Ravelo (1997), which is based on the spatial distribution of 189 core top planktonic foraminifera in the tropical Pacific. The transfer function has a standard error of 22 m and additional 5 m of error due to insufficient counts in the core top database. In this paper, Andreasen and Ravelo (1997) noted that the mean annual thermocline (18°C isotherm) depth was defined in the transfer function (P3, right panel, the third line to the last) (Andreasen and Ravelo, 1997). So, in our manuscript, it indicates the mean DOT. Moreover, such method has been successfully used to estimate the DOT both in the South China Sea and the Okinawa Trough (Jian et al., 2000a; Jian et al., 2000b; Li and Jian, 2001; Wang et al., 2001).

R#2: 7. The results of factor analysis of foram census data show that *G. bulloides*, usually represent to upwelling and the high nutrient inputs, is the most important and speculative species. However, the factor score of factor 1 displays a generally smooth pattern except the MIS 3 event and varied between -1 and 1, lesser than factors. I will expect a more fluctuated pattern of Factor 1. How come of this pattern? Is there any special reason for speculating this kind of variation?

MC: *G. bulloides* is an indicator of upwelling. It is very interesting that the high abundance of *G. bulloides* mainly occurred in period of MIS 3 in core CSH1. During MIS 3, the sea level was 80 m lower than the present, and the winter AM intensified. It is speculated that the hydrographic conditions were helpful for the upwelling. However, until now we don't have more evidence to support this speculation. Further study needs to be conducted on this important issue in the future.

References Andreasen, D. J. and Ravelo, A. C.: Tropical Pacific Ocean thermocline depth reconstructions for the Last Glacial Maximum, *Paleoceanography*, 12, 395-413, 1997. Dou, Y., Yang, S., Liu, Z., Clift, P. D., Shi, X., Yu, H., and Berne, S.: Prove-

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nance discrimination of siliciclastic sediments in the middle Okinawa Trough since 30 ka: Constraints from rare earth element compositions, *Marine Geology*, 275, 212-220, 2010. Duplessy, J., Shackleton, N., Fairbanks, R., Labeyrie, L., Oppo, D., and Kallel, N.: Deepwater source variations during the last climatic cycle and their impact on the global deepwater circulation, *Paleoceanography*, 3, 343-360, 1988. Hemleben, C., Spindler, M., and Anderson, O. R.: *Modern planktonic foraminifera*, Springer, Berlin, 1989. Jian, Z., Wang, P., Chen, M. P., Li, B., Zhao, Q., Bühring, C., Laj, C., Lin, H. L., Pflaumann, U., and Bian, Y.: Foraminiferal responses to major Pleistocene paleoceanographic changes in the southern South China Sea, *Paleoceanography*, 15, 229-243, 2000a. Jian, Z., Wang, P., Saito, Y., Wang, J., Pflaumann, U., Oba, T., and Cheng, X.: Holocene variability of the Kuroshio current in the Okinawa Trough, north-western Pacific Ocean, *Earth and Planetary Science Letters*, 184, 305-319, 2000b. Li, B. and Jian, Z.: Evolution of planktonic foraminifera and thermocline in the southern South China Sea since 12 Ma (ODP-184, Site 1143), *Science in China Series D: Earth Sciences*, 44, 889-896, 2001. Machida, H.: The stratigraphy, chronology and distribution of distal marker-tephras in and around Japan, *Global and Planetary Change*, 21, 71-94, 1999. Rostek, F., Ruhlandt, G., Bassinot, F. C., Muller, P. J., Labeyrie, L. D., Lancelot, Y., and Bard, E.: Reconstructing sea surface temperature and salinity using delta18O and alkenone records, *Nature*, 364, 319-321, 1993. Shackleton, N. J.: Carbon-13 in *Uvigerina*: tropical rainforest history and the equatorial Pacific carbonate dissolution cycles, *Plenum*, New York, 1977. Tanaka, Y.: Coccolith fluxes and species assemblages at the shelf edge and in the Okinawa Trough of the East China Sea, *Deep Sea Research Part II: Topical Studies in Oceanography*, 50, 503-511, 2003. Wang, J., Saito, Y., Oba, T., Jian, Z., and Wang, P.: High-resolution records of thermocline in the Okinawa Trough since about 10000 aBP, *Science in China Series D: Earth Sciences*, 44, 193-200, 2001. Yamasaki, M. and Oda, M.: Sedimentation of planktonic foraminifera in the East China Sea: evidence from a sediment trap experiment, *Marine Micropaleontology*, 49, 3-20, 2003. Yu, H., Liu, Z. X., Berne, S., Jia, G. D., Xiong, Y. Q., Dickens, G. R., Wei, G. J., Shi, X. F., Liu, J. P., and Chen, F. J.: Variations in tem-

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perature and salinity of the surface water above the middle Okinawa Trough during the past 37 kyr, *Palaeogeography Palaeoclimatology Palaeoecology*, 281, 154-164, 2009.

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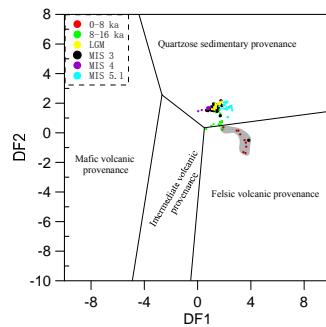
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Fig.1-1 Geochemical discrimination plot to obtain possible provenances of sediments in core CSH1.

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