Thank you for your attention to the manuscript.

First, the analytical method is not fully described, and some of the results are very hard to understand if all the analyses are accurate.

Reply：

The measurement methods of these data used in the manuscript were described in section 2.2. According to this comment we will describe more analytical method in the revised manuscript for better understanding.

Second, the paper deduces correlations between various climate records, but does not validate these correlations statistically.

Reply：

Through our research, we found the relationship between the $\delta^{18}O_{bub}$ and the variation of the alpine glacier Tanggula. This feature might help us to reconstruct the glacier variation trend over the past, although the statistically analysis were not made. We think it should be of great significance to carry out digital analysis between sequences based on more accurate chronological data in the further work.

Third, some basic physics is invoked but not described. For example, there is no explanation for how water and O2 can exchange isotopes fast enough to influence the isotopic composition of O2 in trapped gases.

Reply：

The main purpose of this manuscript is to present the relationship between the $\delta^{18}O_{bub}$ and the variation of the alpine glacier Tanggula. This conclusion was confirmed after comprehensive analysis and comparison with regional glacier changes, although we do not understand the exact exchange progress right now.

Specific concerns include:
Total air content was determined by an indirect qualitative method and was apparently not checked against robust observations. (Section 2.2)

Reply：

The air content in the Tanggula ice core was determined by describing the characteristics of how much bubbles in a restricted area in the computer. This method maybe not that accurate, but it is the real character of how much bubbles in the ice. We think the result should be used to deduce the variation trend of the air content in the ice core.

In Figure 2, the data does not constrain annual layer thicknesses well. Bomb radioisotopes are invoked but the data are not included.

Reply：

The radionuclide β activation in the ice core was detected using a low-concentration α-β activation counting instrument at the SKLCS for absolute age control of the ice. It shows the maximum at the 9.6m of the ice core. So we put it in Fig.2. The detail message will be added in the revised manuscript.

The analytical method for measuring and standardizing d18O of O2 was not fully described.

Reply：

More information about the measuring and standardizing d^{18}O of O2 will be added in the revised manuscript.

Figure 3: The relation between TSI and air content is not validated by a simple x-y plot showing the relationship between the 2 properties, or other approaches. The high value for air content comes around 1640, but there is no TSI maximum at this time.

Reply：

The comparison between the TSI and air content was used for age control of the age-depth relationship calculated by the Bolzan flow model. As the air content was not the exact value. There could be some deviations between these two variables. But the overall trends and characteristics should be consistent.

Table 1: the authors do not explain how they measured d15N, which is needed to calculate d18Oatm. I could not find information about the reference gas.

Reply：

The $\delta^{15}N$ wan not measured in this study. The reference gas was the compressed ambient air which was mentioned in the section 2.2.

Figure 4: there is no statistical documentation for a relationship between climate and d18Obub. Also in Fig. 4: d18Obub reaches +2 per mil, which would require a firn column thickness of about 200 meters thick at certain times. This seems unlikely to say the least.

Reply：

Yes, the $\delta^{18}O_{bub}$ was relatively high compared to the that in the atmosphere. As the δ15N wan not measured in this study, we could not calculated how deep is the firn layer.

Fig. 5. There is no statistical evidence showing coherency between Tangguula and other records.

Reply：

This figure showed that the variation of the glacier in the central Tibetan Plateau was not quite the same with those in the other region. But it indicated a close relationship of the late Holocene glacier variations in the central TP to the variations of the NAO.

Lines 220-225: There is no evidence that water and O2 exchange isotopes fast enough to impact the isotopic composition of O2 in ice cores. At least the authors do not make a case that extensive exchange is plausible.

Reply：

In this manuscript discussion part, we analysis the physical and chemical influence to the variation of the $\delta^{18}O_{bub}$. But we did no further research. In the next work we will focus on the progress and mechanism of the isotopic exchange during or after the storage of the air into the ice.