Responses to RC2:

As one of the key tracers of hydroclimate change, precipitation isotopes have very important research significance. According to the current situation of less observational data, the authors used iGCMs to obtain high-resolution precipitation isotope data over the past 148 years, which will provide important data support for the study of precipitation isotopes and hydroclimate change. I think this research is meaningful, but there are still some problems in the article, I think it needs to be further elaborated before accepting publication.

Re: We would like to thank the reviewer for the comments and suggestions, which helped us improve the quality of our work. We have carefully revised the manuscript, especially for the validation of the dataset's quality, adding more details and enriching the results. Please find a detailed point-by-point response to each comment.

1. There is a problem with regional division. For example, Yunnan Province is a typical southwestern region of China, and its climate is dominantly influenced by the Indian summer monsoon, which is different from the region of southeastern China where is mainly influenced the East Asian summer monsoon. How can it be divided into southeastern regions? Generally, the Indian summer monsoon precipitation oxygen isotope values during JJAS are lower than the East Asian summer monsoon rainfall. I don't think current regional division is scientific.

Re: Thanks for the valuable comments. We agree with the reviewer that some current sub-region division is not fully appropriate, because we have tried to include as many stations as possible within a sub-region to train the data fusion and bias correction methods. According to the reviewer's suggestions, we have re-divided the sub-regions according to review's suggestions (Fig. 1) by taking terrain and climatic conditions into account, as well as ensuring sufficient number of stations and data volumes in a sub-region.

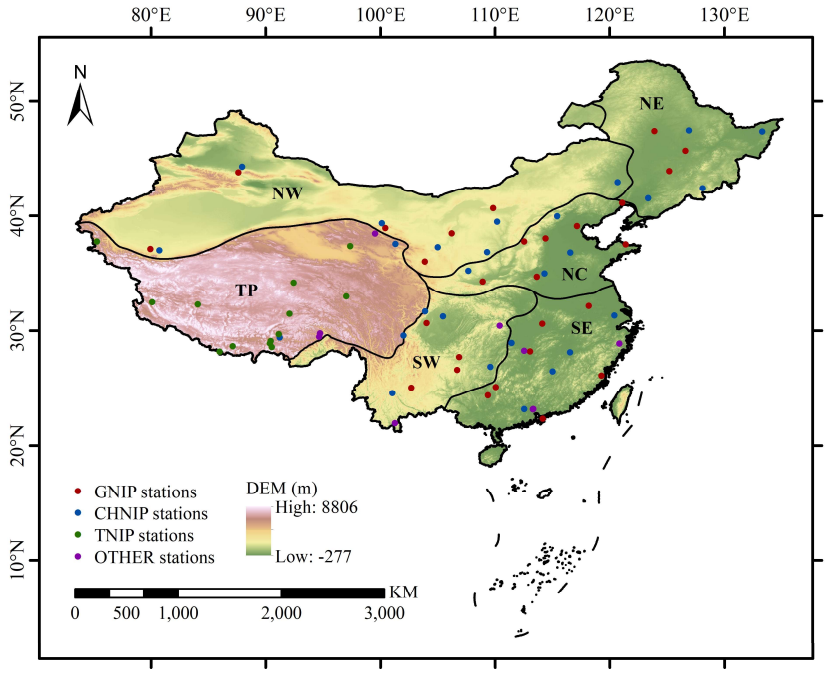

Figure 1. New sub-region division (NE – Northeast China, NC – North China, SE – Southeast China, SW – Southwest China, TP – Tibetan Plateau, NW – Northwest China).

2. There are some GNIP stations with long-term precipitation isotope monitoring data, which can be used to compare long-term changes with the simulation results, such as the Hong Kong station. I suggest that the authors can compare the Hong Kong station and other stations with 8-10 years of monitoring data with the simulated isotope records. This comparison can be used to verify the reliability of the simulation.

Re: Thanks for the suggestion. Two stations with appropriate length of observation were randomly selected for each sub-region. Totally, 12 stations were selected. The time series of $\delta^{18}O_p$ were plotted for observations, iGCM simulations, and the generated isoscape (Fig. 2). As can be seen from Fig. 2, the variations of $\delta^{18}O_p$ are very consistent between the generated isoscape and observations, and the isoscape performs much better than raw iGCM simulations. In particular for the period before 2007, the CNN model integrates the advantages of various simulations and captures most features of the observed data. These results generally prove that the generated isoscape is reliable.

3. At present, the altitudes of each monitoring site vary greatly. When the author uses the monitoring data of each site for spatial analysis and compares them with the simulation results, did the author consider the effect of altitude on precipitation isotopes to calibrate? For example, according to the relationship between altitude and precipitation isotopes at each site or the large region scale, first calibrate the precipitation isotope data of all stations to the same altitude, and then compare it with the simulated data. Because the simulation precipitation isotope results are at the same altitude, if no calibration is performed, the spatial comparison of the simulated and monitored precipitation isotope data will inevitably not be the real results. In the current manuscript, it seems that the author has not calibrated, and it is suggested that the author add relevant correction processes or solutions.

Re: We agree with the reviewer that altitude is an important factor to be considered in the study. However, we do not think that iGCMs as GCMs are simulated at the same altitude. The sigma vertical coordinate is commonly used in climate models (Schmidt et al., 2006; Hourdin et al., 2006; Collins et al., 2004), in which the lowest coordinate surface follows the model terrain, and pressure at other layers are scaled with the surface pressure. The precipitation isotope data from the surface layer were used in our study. Moreover, we are afraid the use of the direct relationship between altitude and precipitation isotopes for calibration may introduce uncertainty or bias to dataset, because the precipitation isotopes in a region are affected by latitude, land and sea location, temperature, precipitation and many other factors. However, in the revised manuscript, we will introduce the physical-based ancillary data such as elevation and meteorological data in the fusion processes. The details of the introduced data are Shuttle Radar Topography Mission digital elevation data (SRTM DEM) with the spatial resolution of 90m, and dataset of gridded monthly precipitation and temperature in China with spatial resolution of the 0.5 degree.

References:

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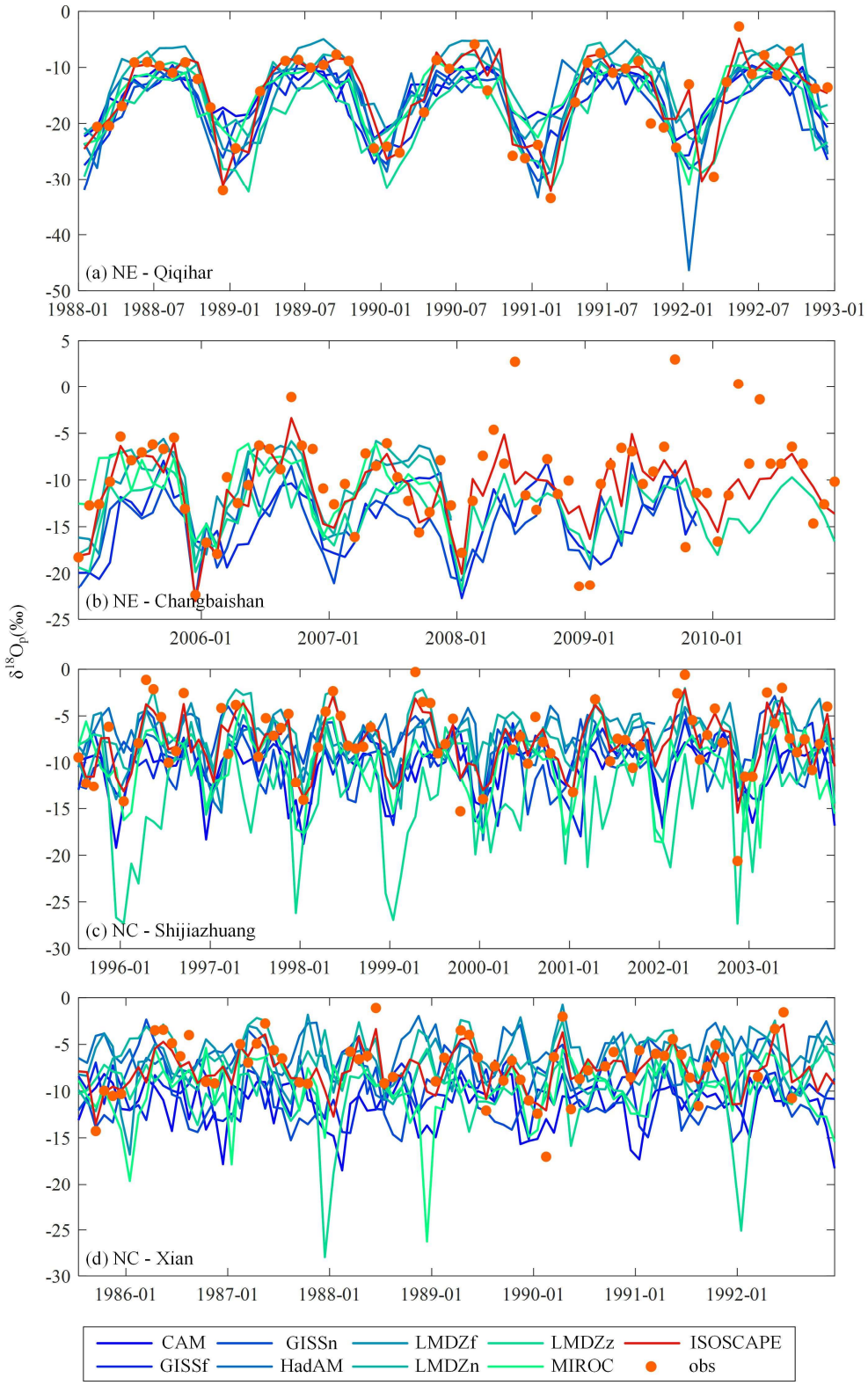
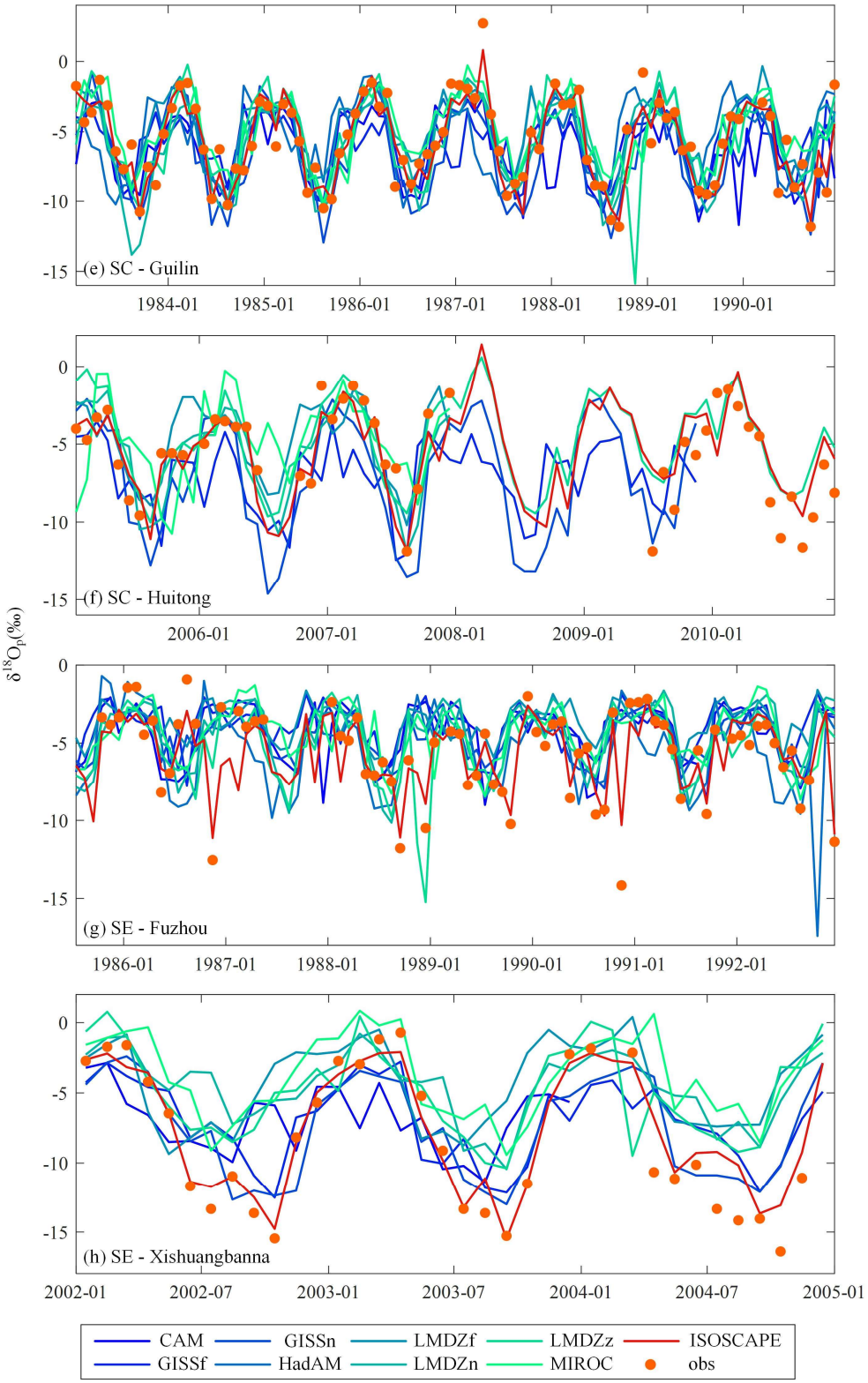


Figure 2. Time-series comparisons of $\delta^{18}O_p$ among the built isoscape, iGCM simulations, and in-situ observations at selected stations in each sub-region.



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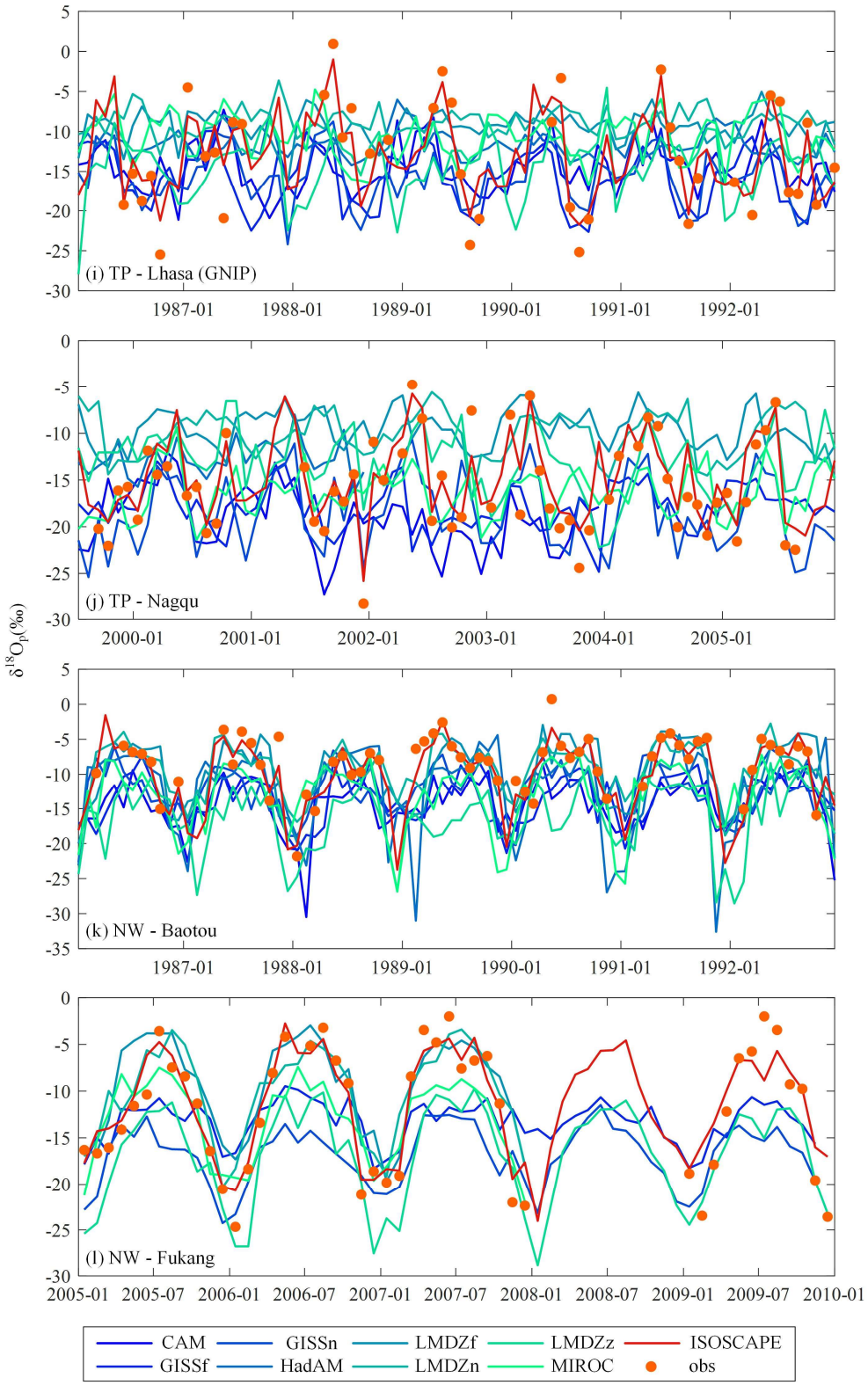

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