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Interactive comment on "Impacts of Tibetan Plateau uplift on atmospheric dynamics and associated precipitation δ^{18}O" *by* S. Botsyun et al.

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We thank the Anonymous Referee #2 for this constructive review. We will provide the editor and reviewers with a corrected manuscript, meanwhile here is a point-by-point response:
(a) Model validation is obviously very important. First of all, we want to stress that LMDZ has been used for numerous present-day climate and paleoclimate studies (Kageyama et al., 2005; Ladant et al., 2014; Sepulchre et al., 2006), including studies of monsoon region (eg. Lee et al., 2012; Licht et al., 2014) also showed that LMDZ-iso has the best representation of the altitudinal effect compared to other GCM and RCM isotope-equipped models. These authors also have provided a detailed description of rainfall patterns over the Tibetan Plateau, and showed LMDZ-iso ability to simulate atmospheric dynamics and reproduce rainfall and δ^{18}O patterns consistent with

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data over this region. For the purpose of our experiments validation, in the current manuscript version we compare MOD run outputs with rainfall data from the Climate Research Unit (CRU) (New et al., 2002). Corresponding figure is in the supplementary materials (Fig. S1). When compared to CRU dataset, MOD annual rainfalls depict an overestimation over the high topography of the Himalayas and the southern edge of the Plateau, with a rainy season, which starts too early and ends too late in the year. Over central Tibet (30-35°N), the seasonal cycle is well captured by LMDz-iso, although monthly rainfall is always slightly overestimated (+0.5 mm/day). CRU data shows that the northern TP (35-40°N) is dryer with no marked rainfall season and a mean rainfall rate of 0.5 mm/day. In MOD experiment, this rate is overestimated (1.5 mm/day on annual average). In addition, we suggest to provide a comparison of humidity transport between LMDZ-iso MOD simulation outputs and ERA-40 re-analysis data (Uppala et al., 2005). This comparison depicts reasonable representation of both directions and magnitudes of moisture transport patterns by LMDZ-iso model. Model slightly overestimates the moisture transport magnitude to the west and north of the TP. Despite some model-data mismatches, the ability of LMDZ-iso to represent the seasonal cycle in the south and the rainfall latitudinal gradient over the TP as well as reasonable humidity transport allows its use for the purpose of this study. To make this comparison clearer, we will add these explanations in the corrected manuscript text and add an extra figure with model-data (with CRU precipitation) comparison to the main text and add and additions panel to the Fig. 4 with humidity transport from the ERA-40 re-analysis data.

(b) The reviewer raises a very important point. First of all, for each modelling study there are limitations associated with experimental design. In this study the topography uplift scenarios are clearly idealized, as our purpose is to test the sensitivity of δ18O to the climatic changes associated with the topography uplift. For a purpose of using GCM simulations as "forward proxy modelling" (Sturm et al., 2010), realistic experiments should be designed, including accurate paleo pCO2, land-sea distribution and latitudinal positions of continents. On the other hand, as it was noted by Anonymous

Referee #2, δ^{18}O distribution is highly dependant of hydrological cycle representation in GCM simulations. Comparing the simulated and observed precipitation and humidity transport in the new figures, some model-data mismatches are identified. Model-data comparison show that mean annual precipitation amount is slightly overestimated by the model for the northern TP, thus could result in underestimation of the amount effect contribution for the northern TP. On the contrary precipitation model overestimates the precipitation over the southern edge of Himalayas. If it was more realistic, the contribution of the amount effect estimated by the decomposing method would be less important. We will add a paragraph discussing these uncertainties in the conclusion section of the corrected manuscript.

(c) The difference between δ^{18}Ovapour and δ^{18}Oprecipitation is linked to the post-condensation effects, mainly associated with raindrop reevaporation that can occur after initial condensation. Because lighter isotopes evaporate more easily, rain reevaporation leads to an isotopic enrichment of precipitation. Therefore, the more reevaporation, the greater the difference between δ^{18}Oprecipitation and δ^{18}Ovapour. We will explain this better in the paper. We refer to the study of (Lee and Fung, 2008), where post-condensation effects are explained in details. The contribution of such processes increases dramatically for very dry areas, where the relative humidity is less than 40%. In the absence of the TP (LOW experiment), large-scale subsidence superimposed to the sea surface pressure low anomaly ("Thermal Low") induces very dry condition over Asia (Fig. S2) which are favourable for high rate of post-condensational effects (Fig. 8). In contrast, the HTP uplift even to the INT height cancels the Thermal Low structure and creates relatively wet conditions (the relative humidity > 40%) over HTP with raindrop reevaporation playing a secondary role. Aridification of the Tarim Basin and creation of Taklimakan desert that is simulated for the MOD case makes post-condensational effects important over this region for the second uplift stage (Fig. 9). We agree that it is necessary to make this point clearly in the corrected manuscript.

(d) , (e) Thank you that you noticed this issue, we will change the order of figures and do necessary corrections.

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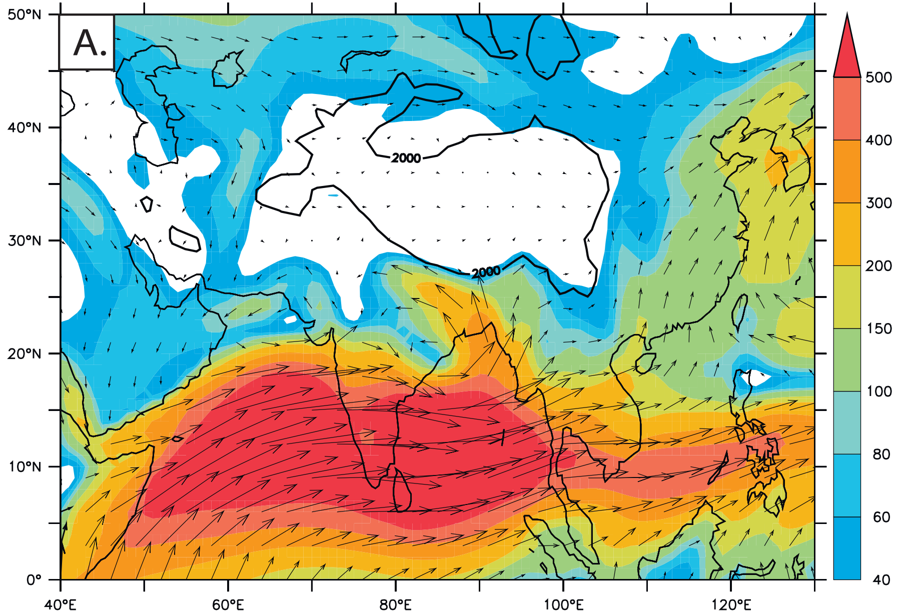

Fig. 1. Directions and intensity of JJA vertically-integrated humidity transport averaged from ERA-40 re-analysis

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