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# Comment on acp-2021-749

Zhipeng Qu (Referee)

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Referee comment on "A case study on the impact of severe convective storms on the water vapor mixing ratio in the lower mid-latitude stratosphere observed in 2019 over Europe" by Dina Khordakova et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-749-RC1, 2021

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## General comments

The authors of this manuscript present a detailed study of mid-latitude stratospheric moistening events linked to the deep convection. The method and results are well presented and convincing. It is a good contribution for understanding the UTLS moistening mechanism in mid-latitudes, in addition to the previous studies focusing on Indian monsoon and North America region. I recommend the publication of the manuscript after minor revision.

## Specific comments

L194-196: To make this phrase easier to understand, I suggest to mention first the enhanced ozone and point to the subsequent section 3.3. Otherwise, the description here appears to me difficult to understand. I see directly the high ozone content rather than the diluted ozone due to the mixing with tropospheric air. The question also rises here why the ozone content is high.

L201-202: I'm wondering what is the cause of the zigzag form of the T profiles between 160 and 140 hPa. Is this due to the instrument artifacts or any other reasons?

L202-203: I have doubt about the use of overshooting top in this statement. The overshooting tops are usually of small dimension (several km in D). The ice water content is always very high inside and the temperature are usually much lower than the ambient lower stratospheric air (much larger than 2 K). In addition, within the overshooting top it is usually very dry due to the low temperature. I guess what you talk about here is either

the mixing area near the overshooting tops due to the breaking of gravity waves (jumping cirrus, ice plume and eventually plume with higher humidify, etc.). I do see in the simulation that these areas can be a little bit cooler than the ambient temperature due to the mixing with lower troposphere air and the sublimation of mixed ice just after the convection. Same for another statement in L424.

Figure 3 & 4: is there any ice observed in these two cases? If there is any in the lower stratosphere, maybe it is worth adding them into the plots with some discussions.

L327: I suggest emphasizing here that the thickness of the humid layer from the observation (vertical dimension in m or km?) is much thinner than the resolution of the MLS data in the lower stratosphere which is in the scale of kilometers.

L485-486: I suggest also to point out the need in the future satellite mission that high resolution in vertical dimension is crucial for understanding the water vapor distribution in UTLS.

**Technical corrections**

L81: is there any altitude dependency of the humidity sensor?

Figure 2: I suggest to write $H_2O$ instead of H2O in the x and y labels. Same for the other figures (and O3 as well).

L178-180: Please verify the numbers used in this phrase.

L181: In figure 3, I see the values are mostly around 4 ppmv instead of 5.

Figure 3: repeating phrase in the caption: "The gray region marks the level between 365K and 370K in which the water vapor enhancement is observed"