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Interactive Comment

Interactive comment on "How stratospheric are deep stratospheric intrusions?" *by* T. Trickl et al.

Anonymous Referee #1

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General comments:

In this article, Trickl et al. present simultaneous ozone lidar and water vapor lidar measurements, model simulation of some STE cases, and investigation of the mixing process for stratosphere-to-troposphere transport by using tracers such as water vapor and ozone. This article presents a lot of detailed analysis of both measurements and modeling. This paper also gives an excellent review on the previous work in the introduction section. Overall, this manuscript is well written and original. I recommend this article to be published on ACP with some minor revisions.

Specific comments:

P15465, L7, 'the' references.

P15470, L17, I don't think 'cut' is appropriately used here. Your point is that two receivers extend the detection dynamic range to about 8 orders.

P15470, L25, can you give the major reason(s) for the uncertainty improvement of the 2012 upgrade, maybe by adding 'due to . . .'?

P15471, L22, maybe it would be better to change unit of density to molecules/mˆ3. Same for other places.

P15476, L15, 'the two layers . . ..', which two layers?

P15476, L21-23, I can't understand the logic here. How can we tell this air mass came from upper troposphere? This depends on the mixing process. The SI air mixed with moister air results in higher water vapor.

Figure 4, P15507,Unit of VMR is used in Figure 1 for water vapor, but unit of RH is used in Figure 4. So, it's hard to compare them. Can you provide an approximate conversion between these two units, maybe in title of Figure 4?

Figure 5, P15508, it's hard for me to tell dark blue and black dots. Also, add an 'approximately' in the last sentence of the title.

P15477, L17-21, are the t-zero dots in Figure 5 are initialized at the same pressure level?

P15478, why would the model underestimate the fraction of stratospheric ozone because of its lower resolution than DIAL?

P15479, L4, add 'Vaisala' ahead of 'RS-92'.

P15478, L19-24, I'm curious why the fraction of stratospheric ozone has a large increase at 'Time 30' in the FLEXPART simulation in Figure 7?

P15479, L24, may add 'at a single station' after 'be identified'.

P15502, Table 1, what's the physical meaning of negative water vapor mixing ratio and negative RH?

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P15487, L10-12, '. . .very little mixing occurs within most of the troposphere. . .'. This conclusion is questionable. The ozone concentration of the air mass with stratospheric source decreases from hundreds of ppbv to less than 100 ppbv within time duration from hours to three days, as the DIAL measurements shown in this manuscript, suggesting considerable or significant mixing within troposphere.

P15487, L21-22, 'free tropospheric mixing is extremely slow' without 'strong wind shear or convective processes'. This statement is related to the above 'little mixing' statement. I think this statement is not precise. For example, Figure 11 shows the ozone concentration of the SI air quickly decreases by irreversibly mixing with the tropospheric air. How can we conclude the mixing is 'extremely slow'? Slow is a relative word. The similar conclusion also appears in the abstract, P15464, L20.

P15490, L0-17, I'm not familiar with the uncertainty in the in-situ water vapor measurements. It's ok to present the discrepancy between two instruments. But I would be more careful to draw a conclusion without solid evidence, such as the dew-point-mirror instrument has systematic bias.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 15463, 2014.

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