Review of egusphere manuscript 2026-3261

Ozone Downward Flux Revealed by High-Resolution Differential Absorption Lidar over Tibet during Stratosphere-Troposphere Exchange

by Ruichun Dong, Xin Fang, Chengyun Yang and, Tao Li

July 29, 2026

General Remarks

The manuscript describes the observation and analysis of the short-term structures above a region with complex terrain. The description of the tropopause oscillations and the most likely underlying wave activity is neither really clear nor convincing. Models are used without demonstrating their capability of reproducing the observed tropopause structures. I cannot suggest publication in the current state.

Specific Comments

Introduction: In the Introduction also the international literature on a topic should be reviewed.

Lines 12-13: “It provides the first lidar-based detection of these rapid ozone descent events”: I do not believe that you mean world-wide! There is a host of literature on this issue. Also “the evidence linking them to temperature variability in the tropopause region” is not new. You find this even in many radiosonde ascents.

Line 27: STT has been studied since the 1950s. Why do you prefer to cite just Chen et al.? I would expect a citation of least the last review paper of Stohl et al. (JGR 2003) in addition.

Lines 30-34: You could add a few words about the role of the subtropical jet stream in this context. Sprenger et al. (JGR2003) found an STT maximum in that area.

Line 57: high resolution in time or in space?

Section 2: The lidar specifications are missing.

Lines 73-74: It is nice that you provide this capability. However, also lidar systems devoted to STT studies should be mentioned (e.g., Ancellet et al., Langford et al., Eisele et al., 1997, Kuang et al., Trickl et al., 2020).

Lines 78-81: Although lidar details are not ultimately essential for this study, a few more words could be added. For instance, it should be briefly explained why so many wavelengths are required and how they are generated (including citations).

Line 79: This wavelength pair does not allow for good vertical resolution unless there is a very strong ozone peak.

Line 83: Please, add a reference such as (McGee et al., 1993).

Line 88: Are the heights specified above the ground or above sea level?

Line 110: Please, cite the appropriate chapter in that book. This chapter, however, does not fully describe the state of the art of ozone lidar systems. What about aerosol and cloud interference? What about lidar calibration and uncertainty? References are needed.

Line 115: Please, add citations for the satellites.

Line 128: How fine?

Figure 3: An explanation of the inserts RAYLEIGH, RAMAN and MIE/RAYLEIGH is missing in the caption.

Lines 160-161: What justifies to name these ozone features as representing downward transport? With one exception I see just modulations of the tropopause. At this point I would just describe the observations and then relate them to the analysis if this really yields a proof of vertical transport and not just tropopause dynamics (which would be interesting as well).

Fig. 4: Please, explain the arrows.

Line 164: “Previous studies have given limited attention to such events.” This remark is important! It also would also be valid for features e.g. caused by tropopause oscillations.

Line 253: USSA1976 model

Figs. 9 and 10: What does the red asterisk mean? Please, add information on the method to the caption.

Lin e 209: How did you determine the temperature lapse rate for all times?

Line 220: PV is derived from model analyses. How can you expect that the models match your rather detailed observations? See line 248.

Fig. 7: Consider moving the data to line 1 of the caption since it seems to be representative for all panels.

Lines 242-243: How accurate is this theoretical wind field? Does it represent the observations?

Line 253: Please, specify USS1976 and add a reference.

Lines 278-279: Again: How accurate is the tropopause?

Line 286: I do not see the typical picture of a tropopause fold; please, explain.

Line 298 (and the following lines): I do not see “tropopause folding”, but an oscillating tropopause. In lines 307 and 308 a wave activity is mentioned!

Lines 328-331: Does this include the non-zero ozone-density gradients in the measured profiles?

Style

The manuscript is well written and just a few language corrections are suggested here:

Line 20: what does the tilde mean? Consider revising. See also Figs. 7, 9 and 10.

Line 75: Again: what does the tilde mean? It is the mathematical symbol for “proportional to” and should not used here.

Line 200: “Jacobian” is not precise. Please, extend.

Line 330: , thereby,

Lines 274, 298. 383: , therefore,

Line 393: ,but

References:

McGee, T. J., Gross, M., Ferrare, R., Heaps, R., and Singh, U.: Raman DIAL measurements of stratospheric ozone in the presence of volcanic aerosols, Geophys. Res. Lett., 20, 955–958 1993.

Sprenger, M., Croci Maspoli, M., and Wernli, H.: Tropopause folds and cross-tropopause exchange: A global investigation based upon ECMWF analyses for the time period March 2000 to February 2001, J. Geophys. Res., 108, 8518, https://doi.org/10.1029/2002JD002587, 2003.

Ancellet, G., Pelon, J., Beekmann, M., Papayannis, A., and Mégie, G.: Ground-Based Lidar Studies of Ozone Exchanges Between the Stratosphere and the Troposphere, J. Geophys. Res., 96, 22401–22421, 1991.

Langford, A. O., Masters, C. D., Proffitt, M. H., Hsie, E.-Y., and Tuck, A. F.: Ozone measurements in a tropopause fold associated with a cut-off low system, Geophys. Res. Lett., 23, 2501–2504, 1996.

Eisele, H., Scheel, H. E., Sladkovic, R., and Trickl, T.: High-Resolution Lidar Measurements of Stratosphere-Troposphere Exchange, J. Atmos. Sci., 56, 319–330, 1999.

Kuang, S., Newchurch, M. J., Burris, J., Wang, L., Knupp, K., and Huang, G.: Stratosphere-to-troposphere transport revealed by ground-based lidar and ozonesonde at a midlatitude site, J. Geophys. Res., 117, D18305, https://doi.org/10.1029/2012JD017695, 2012.

Trickl, T., Vogelmann, H., Ries, L., and Sprenger, M.: Very high stratospheric influence observed in the free troposphere over the northern Alps – just a local phenomenon?, Atmos. Chem. Phys., 20, 243–266, https://doi.org/10.5194/acp-20-243-2020, 2020.