Review of Paper ACPD 14 (2014), 1823-1859

Influence of airmass downward transport events on the variability of surface ozone at Xianggelila Regional Atmosphere Background Station, Southwest China,

by J. Ma, W. L. Lin, X. D. Zheng, X. B. Xu, Z. Li, and L. L. Yang

General Remarks

The manuscript describes results of atmospheric measurements obtained at a high-altitude station at the edge of the Tibetan Plateau. Observations in that region are highly relevant, but still sparse, which emphasizes the value of this manuscript. However, there are a few deficiencies the authors should consider addressing before publication in ACP. First of all, the investigations cited refer to work related to mid-latitudes. This is highly welcome, but downward transport in the subtropics is more controlled by the subtropical jet stream. Therefore, the relevant literature must be included. Also, the role of the monsoon in vertical exchange and the position of the jet stream require more details including literature.

Details

(1) Abstract: line 8: I think you mean "O_3 downward transport events". This is a deficiency throughout the paper: "transport event" is never clearly explained, but obviously preferentially assigned to STT events. Please, rephrase this expression clearer in the entire paper, also varying the wording (stratospheric intrusion, STT event, acronyms defined at the beginning, others).

(2) Abstract, lines 11-12: Is there a way to specify how significant this contribution is? Even a rough estimate ("of the order of ....") would be better than the phrase used.

(3) Abstract: The comparison with the jet-stream seasonality is missing.

(4) P. 1825, line 3: These stations are not necessarily remote, better remove "remote".

(5) P. 1825, following line 18: Here, an introduction to the importance of STT along the subtropical jet stream (STJ), its seasonality and the influence of the monsoon is expected. This cannot be omitted since the situation in the mid-latitudes cannot be fully transferred to Tibet. The importance of the STJ had been underestimated until the late 1990s. This is a time when case studies started (e.g., Cammas et al.). Sprenger et al., J. Geophys. Res., 108 (2003), 8518, doi: 10.1029/2002JD002587, found that the downward transfer along the STJ could be even more important than that STT in the mid-latitudes. This emphasizes the role of the high-lying stations in that area. There are indications of long-range transport of high-ozone air masses that emerged from shallow STT along the STJ (Langford et al., GRL 25 (1998), 2667-2670; Langford et al, GRL 26 (1999), 2449-2452; Trickl et al., ACP 11 (2011), 9343-9366). Koch et al., Int. J. Climatol., 26 (2006), 283-301, published some model-based climatology. Unfortunately, I am not familiar with the literature on the influence of the monsoon on the STJ, but something on this topic should be added.

(6) P. 1825, line 19: Better "The Tibetan Plateau and the surrounding mountain ranges".

(7) P. 1826, line 4: "and, on the south rim, the Nepal Climate Observatory .... in the Himalaya range (Cristofanelli....)"

(8) Sec. 2.2: Give uncertainties of the instruments.

(9) P. 1828, line 9: Add citation on HYSPLIT (see web site) and web site.

(10) P. 1828, line 21: "the case study" was (if I did not miss it) not yet introduced. If this is the case, please, write "in a case study described in Sect. 3.3".

(11) P. 1829, lines 1 and 2: Lower stratospheric CO is not immediately low above the tropopause. Above the transition zone values down to 20 ppb have been reported; at mid-latitude summit stations mostly values of 80-100 ppb arrive in STT air. If this is different in Tibet this could be discussed somewhere in the paper (see (23) further below).

(12) P. 1830, line 10: Better: "consistent with observations at background sites elsewhere in the Northern Hemisphere"

(13) P. 1830, line 11: Specify range of wintertime values for CO.

(14) P. 1830, line 18: ", where photochemically produced O_3 can accumulate starting in the late morning."

(15) P. 1830, lines 22-23: Better: "and then, until the beginning of the night, O_3 decreases with decreasing wind speed." Is there any idea about this behaviour? Does this mean that turbulent downward mixing from a reservoir diminishes and deposition becomes more important? Is the station located in flat terrain or elevated?

(16) P. 1831, line 1: An introductory sentence is missing, e.g., "The amplitude of the diurnal variation of O_3 varies as a function of the season." Then, I would continue "The maximal amplitude was found in spring, the minimal one in winter." This spring maximum is a remarkable result that could be emphasized on. Does this indicate an importance of the photochemical origin of the spring peak (see Monks)? What about CO?

(17) P. 1831, line 14: Describe how the clusters are defined (source region? Please, give some details!).

(18) P. 1831, line 23: The relative importance of types 1-4 is missing (see line 17); this is an important issue because of the discussion on p. 1832. I suggest adding a column with the relative contributions to Table 2 in addition to mentioning them in the text (or refer to the insert in Fig 4; is this what "ratios" mean in line 15? "Fractions" or "relative contributions" would be easier to understand.).

(19) P. 1832, lines 11-12: The situation in Central Europe is not relevant here. If you want to point out the similarity you could do this in a separate sentence. Sprenger et al. show the seasonality of STT (which is important to mention) not of the STJ. However, it is reasonable to assume that the band of STT events they show is related to the STJ. The seasonality of the STJ is described by Koch et al. as far as I remember (this should also be mentioned). The STJ is present during a major part of the year. Sprenger et al. distinguish between shallow, medium and deep folds. The definitions are unclear. In Tibet medium and deep folds could be the species of interest. The images for the medium folds (Figs. 3c and d by Sprenger et al.), indeed, indicate a seasonal pattern for the eastern rim of the highlands, but there is is not much as to deep folds. Thus, observational material is very important indeed.

(20) P. 1832, lines 15-17: do not mix heights and pressure levels. 200 to 400 hPa does not correspond to 1000 to 3000 m, otherwise you could put the altitude range in brackets. It is interesting to see a wintertime UTLS maximum in the pressure panel, but not in the height panel. Please, discuss this in the text!

(21) P. 1833, line 19: As said "transport event" is not sufficiently specific (see title of Sec. 3.4 and at many places)

(22) P. 1833, line 20: Replace "explain" by "demonstrate".

(23) P. 1834, line 3: What "higher layer"? Please, explain.

(24) P. 1833: The exceptionally low value of CO (I see 20 ppb not 50 ppb) asks for a few more words; 20 ppb is a value corresponding to the full stratosphere outside the UTLS transition layer (there are numerous papers on this, I suggest, e.g., Hegglin et al., J. Geophys. Res. 114 (2009), D00B11, doi: 10.1029/2008JD009984; other names to search for are Zahn, Pan, Hoor, Vogel, ...). I am not aware of any other example of this kind (see (Trickl et al., 2010), for a few examples). Is there evidence from more examples in your station record?

(25) P. 1835, line 21: "average maximal height" looks contradictory. What do you mean?

(26) P. 1838, lines 9-10: Why should be observations in China be consistent with findings for Europe? Better "and resembles that".

Figures:

(1) Fig. 1: Cite Google Maps?

(2) Fig. 6, line 5: "actually negative, but"; axis title "Y indicator" should be slighty separated from "Correlation coefficient".

(3) Figs. 8 and 9: The panels and the text is too small.

(4) Fig. 10: I do not see any red feature.

(5) Fig. 12: "above specific trajectory pressure" (levels?) is absolutely unclear.

Style

(1) P. 1824, line 26: Change to "from the stratosphere". Articles are missing at many places in the paper. Please, re-examine carefully. This review is not necessarily complete.

(2) P. 1825, line three: Same!

(3) P. 1825, line 15: Remove semicolon behind "2012".

(4) P. 1825, line 15: Replace "often" by "are often".

(5) P. 1825: line 21: Better: "have great impact on air circulation, climate change, on .... scales."

(6) P. 1825, line 23: "from the upper troposphere and the lower stratosphere"

(7) P. 1825, line 24: "natural input of"

(8) P. 1826, line 15: "which is located"

(9) P. 1826, line 20: "impact"

(10) P. 1827, line 7: "of the Yunan"

(11) P. 1827, line 11: Better: "for monitoring".

(12) P. 1828, line 16: "The height of the endpoint"

(13) P. 1829, lines 2-3: Replace "rich" and "poor" by "high" and "low".

(14) P. 1830, lines 20-21: "the O_3 mixing ratios increase sharply with increasing wind speed."

(15) P. 1831, line 2: "In the monsoon season"

(16) P. 1831, line 14: "grouped into 7 clusters"

(17) P. 1831, line 21: "abundant rain". I think "abundant precipitation" is more adequate in winter because of there is the possibility of snowing.

(18) P. 1831, line 26: "airmasses from the free troposphere to the surface"

(19) P. 1832, line 1: "level"

(20) P. 1832, line 5: "in fall, but the Y indicator"

(21) P. 1832, line 18: "large Y indicators" or "the occurrence of a large Y indicator"

(22) P. 1832, lines 16 and 23: Do you mean "possibility" or "probability"?

(23) P. 1832, line 22: "a tiny peak in the kernel probability density at pressures around 430 hPa"

(24) P. 1833, line 10: "from the upper"

(25) P. 1833, line 16: "rain"

(26) P. 1833, line 26: "detection limit of the CO analyzer"

(27) P. 1833, line 27: "7 day" or "7-day"; "trajectories initiated at 00:00 UTC"

(28) P. 1834, line 4: "in the higher layer"

(29) P. 1834, line 7: "origination" does not exist. You could use "origin" or "source region".

(30) P. 1834, line 11: Replace ", which" by "that".

(31) P. 1834, line 13: Remove "there was".

(32) P. 1835, line 4: "3.3, the Y indicator"

(33) P. 1835;: line 7: "there may be a high probability of an intrusion event."

(34) P. 1835, line 13: "To analyze further" (no split infinitive allowed in English grammar!)

(35) P. 1835, line 24: "The pressures covered by the trajectories in winter"

(36) P. 1836, line 12: "Because there is still monsoon influence in fall"

(37) P. 1837, lines 1 and 3: "the Y indicator"

(38) P. 1837, line 3: "there are still open questions such as"

(39) P. 1838, line 7: "pressure level"