

Interactive comment on “Evidences of thin cirrus clouds in the stratosphere at mid-latitudes” by P. Keckhut et al.

Anonymous Referee #1

Received and published: 13 July 2005

Keckhut et al. present lidar observations of thin cirrus in the lower stratosphere at a mid-latitude site. With the help of PV-advection techniques and trajectory calculations they show that the air mass wherein the cirrus formed is likely of recent tropical origin. The observation and subsequent analysis is of interest and relevance to ACP and the atmospheric science community. However, several aspects of the paper should be substantially improved. The section describing the lidar data and cloud detection should be improved to make a more convincing case that the observed signal is actually a cloud. Further, the central argument, that the cloud formed in air of recent tropical origin, is not well supported by the text and figures (I agree with the comment published by Martin Juckes). Finally, the authors may want to check their manuscript with a native

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

english speaker.

Specific comments:

Section 2

From Figure 2 I gather that the lidar operates at 532nm. This information should be given in the text as well, and 'powerful lidar' should be replaced by a better description of the lidar system. The authors mention the cloud threshold of 'three times the standard deviation of the scattering ratio at the cloud height'. Please show this threshold in Figure 2. Further, please also show the profile of the second case where clouds in the stratosphere were identified. Also, I would like to see a rough estimate of the mass of the condensed phase based on the lidar backscatter.

Why do you use ECMWF analyses for the PV advection, but ERA-40 for the trajectories? How well do the two ECMWF products agree with each other?

Sections 3 and 4

The authors mention that the lidar system has been running for two decades, quote a study (Goldfarb et al. 2001) that has analysed 3 years of data, but then use only data of three months in 2000. Moreover, of the two cases mentioned in the abstract, only one is discussed. Why? I do not require that the authors analyse more data, but obviously the reader wonders why, given the interesting data, the authors chose to miss the chance to present, for example, seasonal variability of cloud occurrence. However, I would like to see the lidar profile also of the second case mentioned by the authors. In the first paragraph of Section 4 I am at a loss as to why you identify the signal from 13.5-13.9km as cloud, but not, for example, at 12km or 14.6km. Perhaps adding the threshold value to Figure 2 (as said above) would help. In its current form Figure 2, and its description in the text, do not make a strong case that there is a cloud at all.

In the discussion of the PV anomaly, it is mentioned that it formed 'about a week before'.

Interactive
Comment

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

Clearly more information is needed here. One of the central points of the paper is that the observed cloud should come from the tropics, but none of the figures serves to support this statement.

Perhaps you could interpolate the PV field to the time of observation. It would be interesting to see where relative to the PV anomaly the cloud actually is observed.

Section 5

In the discussion of the air mass history it would be helpful if the authors would show the saturation mixing ratio in addition to the temperature history (Figure 6). Using simple assumptions for cirrus microphysics, would you say that the potentially available condensed mass is more or less in agreement with what you have estimated from the lidar backscatter (see my comment above)? I am somewhat worried by the fact that your cloud observation took place during a warming phase over the past 24 hours, as well as by the fact that temperatures about 6 days prior to observation were close, and even below, those at the observation site.

Does the last paragraph of section 5 imply that one would observe low ozone values and cirrus clouds even if there were no chemical ozone depletion (i.e. low ozone values cannot be taken as evidence of chemical depletion) ...?

Section 6

Again, in the first paragraph the reader is left wondering why the authors chose not to analyse more data, and why no explanation is provided why only 3 months of data were analysed.

The discussion in the second paragraph is vague. Arguably a question of definition, I would discuss this event rather in terms of rapid, quasi-isentropic transport rather than the wave-driven residual motion of the Brewer-Dobson circulation.

The last two paragraphs are vague and incoherent.

[Full Screen / Esc](#)[Print Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Technical corrections:

Fig.1.: Please change axis labels to english for consistency.

Fig.4.: Please indicate date/time also in the figure caption. Color scale is missing.

Fig.5.: Figure caption is confusing. Perhaps you could also show the locations where the trajectories actually crossed the thermal tropopause.

p4038/I21: Does that statement also refer to the WMO report? Decreased compared to what? Sentence should be reformulated.

I24: Instead of '... at polar latitudes ...' perhaps '... in the polar stratospheric vortex ...'.

I26: '... is directly related to the polar depletion (WMO, 1999).' Add 'ozone'.

p4039/I1: Perhaps adding a '/' to 'winter/spring' and 'summer/autumn' makes things clearer.

I3: 'In the recent years ...'. Sentence should be reformulated.

I9: 'It appears ...' Does that follow from the previous paragraph? That is, about 60% is not due to polar depletion?

I12: '... lead to heterogeneous chemistry similar ...' Try: '... heterogeneous chemical reactions similar to those taking place on ...'

I19: '... may contribute ozone ...' Add 'to'.

I26: '... in south ...' Add 'the'.

p4040/I18: '... half the time ...' of what?

p4041/I3: 'On a time scale ...' Reformulate sentence.

I5: Try '... suggest a threshold value of 3.5 PVU.'

I6: Add 'the' to '... considering tropopause ...'

[Full Screen / Esc](#)[Print Version](#)[Interactive Discussion](#)[Discussion Paper](#)

I12: Try 'PV is advected on isentropic surfaces and is relaxed'.

I25: '... reanalysis data with ...'

p4042/I1: Add 'the' to 'simulation', 'convective scheme', and later 'air masses of interest.'

I6: '... than the isentropic ...'

I18: '... horizontal gradients ...' add 'of PV'.

p4043/I14: 'themselves' is unnecessary.

I15: 'The cloud is located ...' or 'seems to be'.

p4044/I2: What is 'see level'?

I9: 'Their analysis ...'

p4044/I19: Reformulate sentence.

I23: 'The tropopause ...'

p4045/I5: '.. no longer than one or ...'

I6/7: Problem with singular/plural.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 4037, 2005.

[Full Screen / Esc](#)[Print Version](#)[Interactive Discussion](#)[Discussion Paper](#)