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Atmospheric Chemistry and Physics Discussions

Interactive comment on "20-year LiDAR observations of stratospheric sudden warming over a mid-latitude site, Observatoire de Haute Provence (OHP; 44° N, 6° E): case study and statistical characteristics" *by* D. V. Charyulu et al.

Anonymous Referee #2

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20-year LiDAR observations of stratospheric sudden warming over a mid-latitude site, Observatoire de Haute Provence (44°N, 6°E): Case study and statistical characteristics

by Vidyaranya Charyulu et al

The paper presents a case study of the winter 1998/99 and a statistical analyses of SSW events from 1982 to 2001 reaching the NH mid-latitude station OHP.

Unfortunately, I can not recommend publishing this paper in its present form in ACP for the following reasons given below. As the lidar data record of OHP is of high quality

and of great interest for the scientific community and ACP reader ship I strongly recommend to rewrite this paper and to consider a new submission of it to ACPD. Taking into account the suggestions given below would create an interesting new paper and the scientific content would be of great benefit for the reader ship.

The following general points should be taken into account:

- A detailed statistical analysis of SSW events was already carried out by the new study from Charlton et al 2007 a/b (JoC) using reanalyses data to provide a NH statistics for over 40 years of observations. This observational based statistics is then used in a second paper to validate GCMs and CCMs with it. These two papers give a detailed overall analysis of major SSWs and should be taken into account in this ACPD study and can be used as guidance for this paper as well.

- In contrast to Charlton et al you are using a localized data set for only a mid-altitude station, but covering mid-stratospheric to the mesospheric levels. On the one hand you should relate your study to the already existing calendar of major and minor SSW events reported (e.g. Labitzke and Naujokat 2000 and following work see e.g. the FUB data CD and web side and Charlton et al 2007). And on the other hand you should distinguish or extend your work to the evolution of the stratopause warming phenomena before during and after the SSW event itself for what you have your lidar measurements. For example you could address the question: How strong is the stratopause affected by minor and major SSWs over NH mid-latitudes? There are two new papers out by Manney et al on this stratopause evolution issue, which again can help you as guidance for what your study can be used for (Manney et al 2007 ACPD and Manney et al JGR 2007 submitted; the papers are online on the MLS web side <submitted papers>). The Manney et al ACPD paper gives an overview of the stratopause evolution for the Eureka station (polar latitudes) for three NH winters during the 2000s. You could do something similar for your 20 years of OHP measurements concentrating on NH mid latitudes! If you do so, both scientific issues should be clearly related to the existing literature and concentrate on your mid-latitude station OHP! Then it would

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become a new, own standing research.

Right now it seems like that you are mixing up between SSW events at all and SSWs events over OHP without properly relating them with each other. Your paper should address the issue of how often/when/under which conditions SSWs events reach NH mid-latitudes (OHP)! Is this related to the fact that the SSW are wave 1 or wave 2 warmings? This would be a very helpful and interesting study and would be a perfect addition to already exiting literature. Right now the title and the paper reads like that polar SSWs and SSWs over OHP are two different phenomena, which is of course not true and I guess it was not meant to sound like that. Sometimes SSWs events reach OHP sometimes not, e.g. the second major SSW during Feb 1999 does not reach OHP but is very clearly visible in fig. 6.

Summarizing this all, the paper needs to be more focussed on your mid-latitude station OHP and your lidar measurements (vertical range) to improve and highlight the new scientific content.

In detail:

- The introduction is too long with too many repetitions but still important details are missing. E.g. the definition of a major and minor warming is not clearly given, see the first paper on this on which also the WMO definition of major and minor warmings is based (Labitzke 1977)! Be exact with the words and the definition! If you do need a different definition for a mid-latitude station because you are in mid-latitudes and the seasonal cycle is less pronounced you should say so. Labitzke (I think it was also 1977) also defines for the first time a Canadian Warming event. Don't cite all the others references who were not the first. Does the CW really play a role in your study? If not leave it out.

- In general too many references are given and are repeated. At the end of the introduction too many references are given only based on lidar measurements which are all cited in a general sector.

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- The case study: I would use your case study to demonstrate the different vertical structure during the developing phase of minor and major SSW events in the US/LM over OHP. The NH winter 1998/99 was already described by other authors in details e.g. Naujokat et al 2002. Don't repeat the same figures/content of them concentrate on something new see above.

- What is the point of showing the EPF and div F plots? What is really new what do you want to show with it?!

- The role of the QBO in your analyses is not clearly addressed and discussed. The original papers to cite are Holton and Tan (1982) and Charney and Drazin (1961), which explains the QBO, PW and SSW mechanism. Why do you find almost equal major SSW during QBOE and W phase over OHP? No discussion or interpretation is given, you just describe it. Here you should also take the solar cycle influence into account, which I assume could explain the equal numbers. The role of the sun plus the QBO is given by Labitzke and van Loon 1987 and following work!

- In the introduction you emphasize the role of planetary waves and gravity waves and you show lidar results from 30 to 70 km altitude where in the US/LM GW play a major role. However in your paper you don't show any results of GWs e.g. for the case study 1998/99. If you change your study to concentrate also on the US/LM and on the stratopause evolution you should also concentrate on GW analyses in your case study. For a new study on major SSW - stratopause evolution and the role of GWs see e.g. Siskind et al 2007 for the NH winter 2005/06.

Specific changes in the introduction:

- MA definition is not like in e.g. Andrews et al 1987.

- Statistical analyses of SSW influence on the troposphere (there are new papers on that!)

- Minor warmings can lead to a displacement of the polar vortex but not to easterly

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winds

- Matsuno et al 1971 first modelling study of SSW (role of PW) reference is missing!

- Daily stratospheric maps and the daily monitoring of weather services and e.g the FUB (Stratalert) described every NH winter (from 1957 to 2004) the spatial spread of SSW events even if it spreads to mid or low latitudes!

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 15739, 2007.