

## ***Interactive comment on “An unusual stratospheric ozone decrease linked to isentropic air-mass transport as observed over Irene (25.5° S, 28.1° E) in mid-May 2002” by N. Semane et al.***

**Anonymous Referee #2**

Received and published: 15 December 2005

An unusual stratospheric ozone decrease linked to isentropic air-mass transport as observed over Irene (25.5°S, 28.1°E) in mid-May 2002

by Semane, Bencherif, Morel, Hauchecorne, and Diab

The paper presents an unusual stratospheric ozone decrease over a subtropical station in the SH during May 2002. The study is of scientific interest as it highlights the early winter phase of the unusual SH winter 2002 in which the first sudden stratospheric warming with a split of the ozone hole was detected since observations began. The authors clearly indicate their own new/original contribution to this research field. The

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

diagnostics used to analyse this unusual event is appropriate and the figures presented are of high quality. However the paper needs more structure and clarification which is described in the detailed comments. The publication of the paper is recommended after improving the manuscript as described below.

The most important points are:

- The introduction needs some more structure and has to be tightened.
- A reference or proof is missing that the polar air tongue is of low ozone content in the mid stratosphere. To show an ozone map or cite a reference for May 2002 could clarify the statement. This is a very crucial point for the main statement of your paper!
- The input data are not described and the ozone measurements as well.
- Sometimes too many references are cited for one and the same argument which has to be tightened up.
- The use of abbreviations is sometimes misleading and they have to be written out once: e.g. TOMS, MIMOSA.

Detailed comments:

Title and Abstract:

To avoid irritations, it should be somehow clarified or strengthened in the title and in the abstract that this study focuses on SH only! During May, Arctic polar vortex remnants usually play a role in ozone depletion, but an inter-hemispheric exchange of air masses is not in the purpose of your paper.

- “strong planetary wave activity”: strong is relative? Just for this time of the season or?

Introduction:

The introduction needs to be clearer. In general, you should distinguish between tropospheric and stratospheric transport, spring summer and winter transport and between

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

SH and NH transport. Right now these subjects are all mixed up in the order.

- Diab et al (2004) investigated stratospheric features?

- “lateral privileged routes in the NH” are probably not valid for SH transport studies  
>shorten the text.

- The relation of the Logan citation to your study is missing > Cut off the reference.

There are some others references which are more valuable for your study, which investigated the simultaneously occurrence of polar vortex and tropical extrusions into the extratropics/subtropics e.g.: Calisei et al. 2001, Koch et al. 2002, Riese et al. 2002, Krüger et al. 2005 and references there in.

-“among the best”: why? Not obvious, too strong!

-Include: “Due to” “the sparseness”

-MIMOSA

-“starting in the early winter 2002 (Scaife et al)”: when? Early winter can be long.

-Add “: “This major warming, which has never been observed before over the SH since regular monitoring began (Naujokat and Roscoe, 2005)”.

-“over Irene a subtropical site “in the SH””: Add “

2.1) Ozone data:

-which instrument was used for the ozone measurements? Description is missing!

-TOMS

2.2.1)

The use of E<sub>pv</sub>, E-P, PV is misleading! Why not using the standard abbreviations? You mix up the usage of PV, E<sub>pv</sub> and APV in the whole manuscript.

- Nakamura etc (7 papers) too many references here shorten

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

- “powerful and elegant tool”: change to a more neutral description!

2.2.2)

-MIMOSA is now written out!

Are you using operational ECMWF analysis or the re-analysis of ECMWF officially named ERA40? There is a big difference between the two data sets? e.g. 4-D Var versus 3-D Var assimilation method.

-description of the input-data (ERA40?) is missing and a reference of the data as well!

4)

- The transition to the new section is not smooth.

-Fig.3 > Plate 3

-APV

-How about showing a vertical cross section over Irene with MIMOSA?

- In the lower and upper stratosphere: should be the lowermost and middle stratosphere > Upper stratospheric levels include pressure levels from 5 hPa upward.

-“As for the low concentrations of ozone in the upper part of the profile (above 625K), they can be attributed to air-mass advection from pole to tropics due to the fact that there is less ozone in the polar region”. This is not shown by your paper and is also not cited and proofed with others papers. For this time of the year the chemical ozone loss usually has not started. This point is very important for your main conclusions and has to be clarified either with maps or with references!!! See also in the abstract and in the discussion!

4.2) Wave activity:

-“The transport of polar air toward low latitudes can occur in the form of a polar filament”. There can be also other ways add

- Fig. 4 add: “and the contours represent  $\text{div}F$ ”
- change to: “(i.e. negative  $\hat{\text{values}}$  in Fig. 4)”
- Fig. 4a: You have not described the enhanced PW activity at the surface for May 3-8 which seems to be somehow connected to the increased PW activity later on in the upper stratosphere?
- “a large region of convergence”: Here it would be interesting to show or say something about the wave-mean flow interactions i.e. how does the zonal wind reacts on it!
- “an enhanced wave driving in the subtropical middle stratosphere where  $\tilde{E}$ ” where is the middle stratosphere for you? It is around 10hPa!
- “It shows upward and equatorward planetary-wave trajectories.” What are PW trajectories? I would not mix up trajectories and PWs nomenclature!
- “This gave rise to large-scale transport of polar air toward the subtropics and largely contributed to the development of the low ozone episode over Irene in mid-May 2002.” Mid-stratospheric ozone does not contribute much for chemical ozone loss or? Second, also for this time of the year, or?

#### 5) Discussion and conclusion

“From planetary wave trajectories illustrated by EP-flux in Fig. 4, the large-scale transport polar air-masses was driven by an unusual increase of planetary wave activity due to the early reversal of the zonal circulation followed by an increase of mixing near the subtropics (Fig. 5).”:

- 1) “the large-scale transport polar air-masses”: unclear
  - 2) “unusual increase”: not shown or proven that it was unusual!
  - 3) The early reversal of the zonal circulation: do you mean in the subtropics?
- => The reversal to westerlies in the subtropics allows the planetary waves to propagate

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

further to the equator, so that they can break at the subtropical barrier. The propagation of the PWs can be seen in PV maps in the middle stratosphere (polar tongue), whereas the breaking of the PWs (see div F) leads to tropical erosions. > Change the argumentation here!

- “To summarize ... can be attributed respectively to ozone-poor air originally from the polar vortex and to ozone poor air coming from tropics.” : distinguish between natural and chemical ozone losses. See also the general comment above.

- Add ^ ^: “This resulted in the lower ozone. 7-years period (1998-2005) ^over Irene, in the SH subtropics^.”

Figure 3 captions: Epv and APV used for the same field on one figure caption!

Figure 4c: “negative wave driving”: change to “negative values”

Figure 5: units of effective diffusivity?

---

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 12617, 2005.

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