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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Filamentary structure in chemical tracer distributions near the subtropical jet following a wave breaking event" *by* J. Ungermann et al.

Anonymous Referee #1

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Review of the manuscript "Filamentary structure in chemical tracer distributions near the subtropical jet following a wave breaking event" by J. Ungermann et al.

The manuscript reports on measurements taken by the CRISTA-NF instrument on-board the M55 Geophysicae high-altitude aircraft. The flight took place in July 2006 above the Mediterranean Sea and sounded a large trough in a region of the UTLS where Rossby wave breaking was taking place. The data collected by the instrument during the flight provides two-dimensional VMR distributions of the following chemical species in the UTLS region: ozone, nitric acid, PAN, water vapour and CFC-11. The manuscript discusses ozone, nitric acid and PAN. The resolution is comparatively high,

of the order of 0.5km in the vertical and 12.5km in the horizontal. The manuscript is well written and balanced. Its novel aspect is the 2d view it provides with a resolution higher than has been available to date on a few key chemicals in the UTLS. This is a very welcomed accomplishment. It allows to visualise the details of a type of dynamical structure that dominate the extra-tropical exchange between the stratosphere and the troposphere. The paper is appropriate for publication to ACP. I have only a few minor comments below that I suggest to address before publication.

1. A difficulty in the study is the heterogeneity of the data used in combination for the analysis (ECMWF, NCEP and aircraft measurement), even though the main results do not depend on the perfect match between these data. But the conclusion that filaments do not follow isentropes could be at least partly due to such a mismatch (see p.5048 l.25-28 and p.5060 l.4-5). In Fig. 3, the isentropes look as expected with respect to the PV contours: The vertical spacing between isentropes is small within the positive PV anomaly (in the northern part of the graphs) as vertical gradient of the potential temperature is enhanced; the vertical spacing then increases passed 2PVU towards the tropical troposphere; in the region of the jet, isentropes tend to be aligned with the PV gradients. But in Fig. 5, they look less natural with respect to the PV contours and they don't have the small scales that would be expected in such a region. The interpolation could well be responsible for errors on the location and tilt of isentropes in this region. Since this region is very dynamical and has lots of small scales, interpolation between two 6hourly data can be inaccurate. I recommend to add a sentence or two on this aspect in the article on p. 5048 l.25-28, and to recall it in the conclusion on p. 5060 l.4-5.

2. I was sad not to see the water vapour in 2d too! I understand that it is argued in the manuscript that this chemical does not bring enough to the main results and therefore is not included. But it's such a great tracer and it is so important radiatively. I would welcome it if you decided to include it.

3. In the explanation on the instrument and Fig 1 in Section 2, could you add a sentence

or two on the resolution of the measurements in the line-of-sight direction?

4. P. 5046 l. 5-8: Could you clarify please?

5. p. 5046, l. 23-24: This description is not accurate and its purpose is not clear at this stage. Rephrase please.

6. p. 5046 end of page: Can you say if there were any clouds in the region?

7. p. 5051, discussion on Fig. 9: Did you look at the PV and potential temperature values along the trajectories? Could that bring some additional information on the dynamics of mixing?

8. Section 3.5: You do not mention that HNO3 is also a stratospheric compound. Is the stratospheric source of nitric acid really negligible for your purpose? I recommend to add a comment on this aspect in this section.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 5039, 2013.