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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Stratosphere-troposphere exchange in the vicinity of a tropopause fold" *by* Christiane Hofmann et al.

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We thank Andreas Stohl for his report which contains many helpful comments and suggestions for improvements. We will revise our article with respect to his points and answer open questions soon. However, we would like to comment on his main point of criticism in advance:

- *However, my main point of criticism is that it simply does not add much to our general understanding of stratospheric intrusions. Similar studies of similar events have been published in great number and I* ***can't find any novel results***

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Discussion paper

of this study in particular.
Reply:
Indeed, there are many relevant studies of stratospheric intrusions available. However, all of them show that models are still not able to reproduce observed ozone enhancements at the surface caused by stratospheric intrusions correctly in time, location and amount, which shows that there is further need for improvements.
Furthermore, as far as we know, this is the first time the efficiency of mixing along a tropopause fold has been analysed. To our knowledge there is no other study, which addresses the question of irreversibility and transience of exchange associated with a fold. We quantified the fraction of air masses, which are indeed transported into the troposphere as well as the composition of the air masses inside the tropopause fold.

- ***Neither are the methods applied particularly novel*** *(certainly good tools have been used) nor are the results showing something that has not been shown before.*
Reply:
We present the results of a newly developed model system, which allows for consistent simulations on different scales. Therefore, this is the first time chemical tracers on global and regional scale can be directly compared, i.e. using the same model parametrisations, chemistry calculations, initialisation criteria, etc. for the global and the regional model.
Since in earlier studies the impact of stratospheric intrusions on surface ozone concentrations has been analysed either from Eulerian or from Lagragian point of view, the combination of both techniques might also be seen as a novel applied method.
Furthermore, the initialisation of artificial tracers directly inside the tropopause

fold and subsequent analyses mentioned above have never been performed before.

- *Partly this is also related to the fact that this is a **pure modeling study that does not involve any in-depth analysis of measurement data** (the passing mentioning and use of ozone time series of surface stations does not really provide much extra insight). Often it is the combined use of models and measurement data that can reveal interesting aspects, whereas it is difficult to show something definitive if only a model is used.*
  Reply:
  The study was intended as a chemical process study to investigate the efficiency of mixing associated with the fold and its effect on surface ozone. For a full 3d-process study it is surprisingly difficult to find an appropriate data set including turbulence and wind measurements with high resolution tracer measurements of the required precision. This is of course the next step to go to investigate the physical processes and the relevant time scales which lead to the erosion of the fold. In the current manuscript we wanted to show the potential consequences of the different model resolutions for the correct simulation of the surface ozone fields.
  With this study the potential of the model system MECO(n) has been demonstrated. It can now be applied to analyse e.g. aircarft measurement data in future studies.

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