

## ***Interactive comment on “Trace gas transport in the 1999/2000 Arctic winter: comparison of nudged GCM runs with observations” by M. K. van Aalst et al.***

### **Anonymous Referee #2**

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This is an interesting paper comparing a nudging-GCM to observations for the 1999/2000 Arctic winter. It shows an interesting approach that has some potential and would should be evaluated in detail. The paper is well-written and concise. However, some modifications to the text are required before the paper should be accepted to show the value of the nudged-GCM for tracer simulations.

The approach of using nudged GCM fields does allow for the representation of specific events, which is a nice feature. However, the authors may be underestimating how important the nudging is to the final vertical velocities. The problem of insufficient decent in the polar vortex, for example, could be due to inconsistencies between the model physics and real physics. Since there are actually two models that are assimilating the

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data in effect, this means also, that discrepancies between the ECMWF and ECHAM model physics, ECMWF and real physics and/or ECHAM and real physics could be causing vertical velocities which are slightly off. The authors argue in the discussion (line 15) that the temperature in the ECMWF is correct, and therefore the radiation should be correct, but this is not true—the temperature is assimilated and should be correct, and discrepancies between the model and real atmosphere could be hidden in the radiation and/or vertical velocities and be caused by the assimilation of the temperature to be correct. Again this same process can be true when we move to the nudged-ECHAM model.

A more detailed analysis of the tendencies in the polar vortex would address this issue—in this paper the authors indicate that the tendencies of the assimilation are small compared to the other tendencies: showing this is true in the polar vortex would be illuminate this important issue. In addition, is it possible to get the increment from ECMWF (or the forecast and then the analysis)? This would allow the authors to access whether the discrepancies between the ECMWF model and real atmosphere are forcing vertical velocities which may cause problems for the model simulation (perhaps this is not relevant depending on which variables are nudged, but it is something to think about).

The authors indicate that the MA-ECHAM has been used for similar studies in a non-nudged methodology and that this does better than in the nudged methodology (or did I misunderstand?). This would provide important information for the ability of nudged models to work in the middle atmosphere compared with standard GCMs, and this comparison should be highlighted (it would be easier to understand the nudging if the authors had done a non-nudged simulation of the same tracers at the same time).

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Interactive comment on Atmos. Chem. Phys. Discuss., 3, 2465, 2003.

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