Atmos. Chem. Phys. Discuss., 3, S808–S810, 2003
www.atmos-chem-phys.org/acpd/3/S808/


Atmospheric Chemistry and Physics Discussions



# *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.

**D. Shindell (Referee)**

dshindell@giss.nasa.gov

Received and published: 13 June 2003

This is generally a well-written, thorough paper describing the results of nudged GCM runs for the 1999/2000 winter. There is unfortunately a paucity of data from within the vortex, but the authors do a good job of utilizing what little is available and do not overstate their conclusions. They are upfront about both the successes and flaws of the model. They make a strong case that at least for areas outside the polar vortex, the nudging procedure can be used successfully for comparisons with observations from a particular year. Though the nudging procedure has a time lag of up to a few days, the authors make comparisons over the course of a winter, which is reasonable. It would be worth pointing out that the results would not necessarily be meaningful



Full Screen / Esc
Print Version
Interactive Discussion
Discussion Paper

for an individual day, but the seasonal results are convincing. I find the paper largely acceptable, and recommend that it be published following minor revisions to improve the clarity and readability as suggested below.

Specific comments:

Section 3.1, line 21: Earlier in the paper, the importance of how the vertical coordinate is chosen is stressed. You should therefore describe the vertical coordinate structure here rather than only giving the model top. I believe it's a hybrid-pressure coordinate system?

Section 4, line 11: It would be useful to clarify if the 0.02 ppmv sine function is 20 ppbv peak-to-peak, or 40 ppbv peak-to-peak. Either way, however, why is the value so small? The observed interhemispheric gradient in methane in the troposphere is more like 100 ppbv.

Section 7, page 2482, line 15: The authors suggest that the problems with their semi-Langrangian scheme (e.g. high numerical diffusion) are similar to those found using the first order slopes scheme of Russell and Lerner, 1993. I do not find this line of argument very compelling, as it is well-known that first-order slopes are insufficient to preserve strong gradients such as those present across the vortex boundary, which requires second-order slopes (e.g. Prather, JGR, 1986). The numerical diffusion in their model could indeed be the authors problem, and I would remove the first-order slopes comment, which suggests otherwise.

Section 8, line 5: In their conclusions, the authors describe the underestimation of subsidence or spurious mixing within or across the vortex. It is worth noting here that one of the main impacts of either problem will be a tendency to overestimate temperatures within the Arctic vortex. This is a topic of great interest, given the sensitivity of ozone chemistry to these temperatures.

Technical comments:



**ACPD**

3, S808–S810, 2003

Abstract, line 12: It's misleading to say that "the model represents the Arctic vortex well". It would be better to revise this to read "the model represents some aspects of the Arctic vortex well".

Abstract, line 14: It would be clearer to add the word 'observations', saying "profiles outside the vortex match observations well".

Abstract, line 17: The end of the sentence should just say "from MA-ECHAM4 and various observations", i.e. remove the comma after ECHAM and the word respectively.

Section 2.1, line 8: Replace "as well as" with "and".

Section 2.2, line 19: You've already defined the acronyms for THESEO and SOLVE, so there's no need to write these out here.

Section 3.2, line 2: It would be better to end the sentence with "... tendencies in both the lower and middle atmosphere".

Section 6, page 2479, line 7: This sentence is confusing. It would be better to say "... good fit below 70 hPa, a substantial model underestimate above this level that increases with altitude to about 0.4 ppbv at 20 hPa, ...".

Section 6, page 2479, line 21: The end of this sentence should be rewritten to say something like "... plays a role in the discrepancies between the model and observations."

---

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