Interactive comment on “1-D air-snowpack modeling of atmospheric nitrous acid at South Pole during ANTCI 2003” by Wei Liao and D. Tan

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I draw the attention to the subject of "model selection", with reference to Equation (3) and the comment at the bottom of the page on 9734: levels at 30 cm > levels at 10 cm, despite hardly any actinic flux.

Using the simplest diffusion model will explain this, assuming 1. local near equilibrium of chemistry and therefore C proportional upon actinic flux 2. steady state profiles 3. true diffusion term (term 1 on RHS eq 3)

d/dz(D.dC/dz) that is, the gradient in diffusivity, D, is included in the model. e.g. if actinic derived concentration is given as 

Aexp(k.z)
with \( k = 1/0.2 \) (typical from figure 3) z depth (negative) and diffusivity, \( D \) is given as
\[
D = 5 \times 10^{-4} \times \exp(k_D z)
\]
with \( k_D = 1/0.05 \) (which also looks reasonable, and describes the enhanced diffusivity near the surface due to ventilation), then solving
\[
\frac{dC}{dt} = A \exp(k z) + \frac{d}{dz}(D \frac{dC}{dz})
\]
with boundary conditions of \( C = 0 \) at \( z = 0 \) and \(-\infty\) produces a peak in \( C \) at a depth of 30 cm.

Parsimony would imply that the data presented cannot therefore discriminate between the chemistry and the diffusion.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 9731, 2008.