Atmos. Chem. Phys. Discuss., 13, C6285–C6287, 2013
www.atmos-chem-phys-discuss.net/13/C6285/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global and regional emissions estimates for N2O" *by* E. Saikawa et al.

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Received and published: 30 August 2013

(apologies for the kludgey formatting, but I can't prevent the PDF processor from wrapping lines with single linebreaks)

http://www.atmos-chem-phys-discuss.net/13/C5512/2013/acpd-13-C5512-2013.pdf

»> At 19483:23-4 you say "N2O regional emissions are approximately

»> mixed globally in two years[.]" This seems reasonable, but it *is*

»> a particular empirical claim which I have not previously

»> encountered (possibly due to my lack of experience and erudition)

»> [and] for which I'd like to know the source.

Eri Saikawa Wed, 28 Aug 2013 22:43:51 -0400

> regarding time scales for horizontal and vertical transport, you can

> for example take a look at Chapter 4 Atmospheric Transport in

> "Introduction to Atmospheric Chemistry by Daniel Jacob.

Dr Saikawa: IAC is indeed a wonderful introduction to atmospheric science in general, and it is good to see his "Figure 4-12 Typical time scales for global horizontal transport in the troposphere," and the quote that "It thus takes about 1 year for air to exchange between the northern and southern hemispheres." It does seem rather an off-hand approximation, and he offers no references, but when one is as eminent as Daniel Jacob, I guess one can do that :-)

http://www.atmos-chem-phys.net/11/12813/2011/acp-11-12813-2011.html

> An average [inter-hemispheric] exchange time of 1.39 $\pm$ 0.18 yr is derived from SF6 time series.

Dr Patra: Thanks for your much more precise approximation! SF6 mixing seems a good approximation for N2O mixing; although SF6 does not have a stratospheric sink (like N2O), it is also (indeed more) tropospherically inert. That being said, it seems to me that global mixing time and IH exchange time are equivalent–am I missing something? When I think of IHE, I think of a two-box problem like Jacob gives in

http://acmg.seas.harvard.edu/people/faculty/djj/book/bookhwk3.html#76878

Under that analysis, global mixing time for a regional signal would be a function of both intra-hemispheric exchange time (time to mix the regional emission into its hemispheric box) and inter-hemispheric exchange time (time to mix the region's hemisphere's box with the other hemisphere), no? But given your estimate of inter-hemispheric exchange, and that intra-hemispheric exchange is known to be substantially faster than inter-hemispheric exchange, to estimate that the time to mix a regional emission to

global background $\sim=$ 2 yr seems sound.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 19471, 2013.