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Discussions

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

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(Apologies for the kludgey formatting, but I can't prevent the Copernicus PDF processor from wrapping lines with single linebreaks, or turning 2*'>' into a guillemet. Guess I should be doing this in LaTeX.)

http://www.atmos-chem-phys-discuss.net/13/C6285/2013/acpd-13-C6285-2013.pdf

|| 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 [inter-hemispheric] exchange [IHE] time are equivalent

Apologies for the typo: I meant to say "global mixing time and IHE time are *not*



equivalent"

|| –am I missing something? When I think of IHE, I think of a two-box problem like [Daniel] 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?

Prabir Patra Fri, 30 Aug 2013 09:24:29 +0900 (JST)

|| Yes, the IHET is a rough estimation of mixing of mass between two hemisphere[s],

|| and the two box model is most simplified representation of that.

|| Please see one of my recent ideas about the inter and intra-hemispheric mixing in the PDF file attached.

Thanks for that page, which is quite interesting. Is it publicly available? It would be useful to link to. Meanwhile, just to quote the part of the PDF I found most interesting:

| Meridional distributions of SF6 and CH3CCl3 along the HIPPO flight tracks suggest that

| the meridional transport occurs between 4 distinct subregions of the troposphere,

| not two well-mixed hemispheric areas as traditionally considered.

This makes sense, since the transport we're discussing is advective and the meteorology is obviously not uniform.

|| The theoretical framework for treating the intra-hemispheric transport needs to develop.

Perhaps this is a model-worthy problem? Models being often used for source attribution, I'm guessing (but I Could Be Wrong) that information about the spatial sensitivity of decay of emissions would be useful. If so, something I could see doing (once I finish my masters thesis :-) would be a (seemingly) straightforward model intercomparison project regarding this (alleged) spatial sensitivity. (Indeed, this seems so straightforward that I suspect it may already have been done. OTOH, our community is funding-constrained, and something like this may just have low priority.) What I mean:

This discussion started with the claim (by Saikawa et al. in the paper under review) that "N2O regional emissions are approximately mixed globally in two years[.]" Unless I'm missing something, this claim presumes

1. one can measure or model the ambient concentration C(r,t) for N2O (or indeed for any emittant–e.g., SF6) for every spatial region r of interest at any given time t of interest.

2. one can measure or model a "global background" concentration C'(t) over all r at t (e.g., a mean).

3. one can quantify a "global mixing criterion." E.g., one might define this "GMC" as met when, over all or some substantial fraction of regions, |C(r,t) - C'(t)| < $\delta$_gmc, where $\delta$_gmc is (e.g.) a constant or a function of a standard deviation.

4. upon an emittant pulse (of sufficient S/N, i.e., with size sufficiently greater than normal variation) at some time t_p in any single region r (perhaps constraining emissions in all other regions), the GMC will be met by some time t_gmc < t_p + 2 yr)

The hypothesis (item 4) seems testable, or at least modelable. Consider the following pseudocode (again, formatted to defeat the PDF processor):

| for each model M in a set of models



| | for each time period T in a set of time periods (presumably each ∼2 yr duration)

| | | for each timestep t in T (i.e., over the temporal domain of the run of M)

| | | | for each gridcell r_p in the grid of M (i.e., over the spatial domain of the run of M)

| | | | | if (t==t_0) induce an emission pulse in r_p (only)

| | | | | for every r in the grid of M (including r_p)

| | | | | | compute C(r,t)

| | | | | | if (C(r,t) partially satisfies GMC) record {t, r, C(r,t)}

| | | | if GMC is fully satisfied (over the grid of M)

| | | | | record success

| | | | | break current run, continue to next run (e.g., next time period with same model, or next model)

| | | | else if (GMC not fully satisfied) && (t is final timestep of T)

| | | | | record failure

| | | | | break current run, continue to next run

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