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Comparing forward and inverse models to estimate the seasonal variation of hemisphere-integrated fluxes of carbonyl sulfide

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Abstract. A simple inverse model is proposed to deduce hemisphere-integrated COS flux based on published time series of total column COS. The global atmosphere is divided into two boxes representing the Northern and Southern Hemispheres, and the total column COS data from several stations are used to calculate hemispheric COS loadings. The integrated flux within each hemisphere is calculated as a linear combination of a steady-state solution and time-varying perturbation. The nature of the time-varying perturbation is deduced using two different approaches: an analytic solution based on a cosine function that was fitted to the original total column COS measurement time series and a Simplex optimization with no underlying assumption about the functional form of the total column time series. The results suggest that there is a steady-state COS flux from the Northern to the Southern Hemisphere. There is a seasonal variation superimposed on this flux that in the Southern Hemisphere has a maximum rate of COS input into the atmosphere around January and a maximum rate of COS removal from the atmosphere around August--September. In the Northern Hemisphere, the maximum rate of COS input into the atmosphere is around May--June, and the maximum rate of COS removal is either August or January, depending on which station in the Northern Hemisphere is considered. The results of the inverse model are compared with the outcome of a forward approach on the temporal and spatial variation of the dominant global sources and sinks published earlier. In general, the deduced hemisphere-integrated flux estimates showed good agreement with the database estimates, though it remains uncertain whether COS removal from the atmosphere in the Northern Hemisphere is dominated by plant and soil uptake in the boreal summer or by oceanic uptake in boreal winter.

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