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Nonlinear Processes in Geophysics Discussions
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Interactive comment

Interactive comment on "Residence Time of Energy in the Atmosphere" *by* Carlos Osácar et al.

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i) Carbon dioxide is the most important anthropogenically produced greenhouse gas, and its significant growth in the atmosphere is primarily due to the combustion of fossil fuels, as coal, oil and natural gas. These combustions on surface constitute an additional energy inflow to the atmosphere not considered in Section 2. Its magnitude can be estimated from public data. In recent years, the consumption of fossil fuels has been about 10 Gtoe per year; this implies an energy flux of 0.08 W/m**2 which is small compared with the natural energy fluxes mentioned in Section 2. The data comes from J. Houghton, "Global Warming. The complete briefing". 4th. edition. Cambridge University Press.

ii)We agree with your point and in the new version of the paper all data will come from the reference of Peixoto and Oort.

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Discussion paper

iii) In the paper, our purpose for introducing the Sun in the discussion was, in part, to gain perspective for the meaning of the residence time of energy in the atmosphere. The fact that the K-H time scale (10**7 yr) was formally like our eqs. (1) and (10), and the fact that the K-H scale is roughly the time needed by the star to settle to equilibrium after a global thermal perturbation was a well known fact in solar physics. See, for example: H. Spruit, Space Science Reviews, 94, 113-126 (2000). Besides, Stix (2002) carried out a numerical experiment using a stellar evolution code. He produced a perturbation in the centre of the Sun that consisted in an increase of the nuclear energy release. The time taken for the adjustement to a new thermal equilibrium ocurred in roughly 10**7 yr. This confirmed the interpretation of the K-H time scale as the time needed by the star to settle to equilibrium after a global perturbation. Stix(2002) also argued why the photon-diffusion time scale in the Sun, in other words, the time scale of energy transport, was coincident with the K-H scale. Our interpretation of your (iii) point is why we have not carried out a calculation of the residence time of energy using the diffusion of photons in the atmosphere. Our purpose is to consider this calculation in a near future using a simple model for the atmosphere and, perhaps, a Monte Carlo method. Anyway, this does not look a simple enterprise and would constitute the subject of another paper.

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