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Comment on acp-2021-924

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Community comment on "Observation Based Budget and Lifetime of Excess Atmospheric Carbon Dioxide" by Stephen E. Schwartz, Atmos. Chem. Phys. Discuss.,
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The manuscript models the response of CO₂ concentrations to cessations of emissions. That issue has been discussed by Archer and responded to by Schwartz. I presume other referees will concentrate on that issue. I believe there is another issue that needs to be dealt with.

In discussing the importance of the atmospheric CO₂ concentration adjustment time, Schwartz (pg 3 line 82-7 pg 55 line 1570-6, pg 59 line 1688-1705) states that the global mean surface temperature (GMST) will respond rapidly to the decline in CO₂ atmospheric concentration within a decade. If this is so, then, as he has stated in other venues, ceasing emission is not as pressing although moral hazard remains [Schwartz, 2019].

However, there is considerable and accepted work showing that this is not the case. For example, Solomon, (2009) and Joos, (2013). Current discussion of this issue revolves around whether surface temperature will increase after emissions cease, under the rubric of Zero Emissions Commitment (ZEC). (Ehlert 2017, MacDougall, 2020) While there is considerable controversy about whether that will happen, there is good agreement that surface temperatures will remain roughly constant, or at best considerably elevated above pre-industrial for long times, certainly one to two hundred years, and probably for a thousand or more.

This, perhaps counterintuitive, result, arises from the balancing of the decrease in CO₂ forcing by a decrease in cooling via heat loss to the ocean. Also, the ESMs indicate that sea level rise will continue long after CO₂ emissions have stopped. Finally, if the CO₂ concentration decreases so rapidly, this implies that most will go into the upper ocean. Since mixing between the upper ocean and the abyss is slow this would imply a rapid decrease in pH not the increase stated in line 1695.

Schwartz should take this into account.

In passing, it seems that if one is going to model a relaxation process such as the adjustment of atmospheric CO₂ concentration after cessation of emissions with a long tail, a stretched exponential would be better than a single exponential.

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