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Review of the manuscript “Atmospheric impacts of chlorinated very short-lived substances over the recent past. Part 1: the role of transport” by Bednarz et al., ACPD, 2022. (acp-2022-34)

Rafael Pedro Fernandez (Referee)

Referee comment on "Atmospheric impacts of chlorinated very short-lived substances over the recent past – Part 1: Stratospheric chlorine budget and the role of transport" by Ewa M. Bednarz et al., Atmos. Chem. Phys. Discuss.,
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Review of the manuscript “Atmospheric impacts of chlorinated very short-lived substances over the recent past. Part 1: the role of transport” by Bednarz et al., ACPD, 2022.

The paper presents a modeling study using a whole atmosphere CCM to evaluate how sensitive is the stratospheric loading of chlorinated very short-lived species (Cl-VSLS), including both Source Gas Injection (SGI) and Product Gas Injection (PGI), to different model configurations for the dynamical transport (i.e., considering free-running and nudged setups). The analysis focused on the Cl-VSLS evolution during the 2000-2019 period, where they found an overall SGI enhancement from 40 ppt to 80 ppt for the free-running simulation, and up to 10-20 ppt additional Cl-VSL when the model was nudged to ERA-Interim or ERA-5 reanalysis. The larger SGI for the nudged configurations resulted in an overall smaller SGI + PGI due to the faster transport. To evaluate the total inorganic chlorine evolution in the stratosphere, they present a comparison of HCl and COCl₂ trends in the stratosphere and upper troposphere with satellite observations (ACE-FTS). They show that regardless of the transport configuration, the inclusion of Cl-VSLS improves the model performance, although the hemispheric asymmetry observed in the lower stratosphere is only captured with the nudged simulations. The work is very well planned and provides a realistic and clear evaluation of the magnitude of the Cl-VSLS contribution to the total inorganic chlorine loading in the lower stratosphere. The methodology and results are generally well presented, although some clarification is required as described below. I suggest the paper is accepted for publication after the following issues highlighted in the attached file have been solved:

Please also note the supplement to this comment:

<https://acp.copernicus.org/preprints/acp-2022-34/acp-2022-34-RC1-supplement.pdf>