

Dear editor, dear reviewers,
here are the replies to the comments.

Reviewer 1

- *The revisions to Section 1, particularly over lines 34–45, make the description of what Polar SWIFT does much clearer and helps set the stage for the rest of the paper. About the only confusion I had was the introduction of Equation 3, which, given how like it is to Equation 1, made me wonder if there was a repeated section of the text. Do you really need Equation 3? Or could you just say you are using Equation 1 with the temperature change from ERA5?*

While it may look superficially as if Equation 1 and Equation 3 are identical, they are actually not the same equation, and it would be both confusing and mathematically incorrect to refrain from including Equation 3. Equation 1 describes the application of the parameterization in the model. Equation 3 describes a linear fit model used to obtain some of the parameters in the equation. The variables have a different meaning, and they are described in the text following Equation 3. Therefore, we think the equation and the following text are necessary to be able to understand what we have done.

Reviewer 2 (this seems to be reviewer 3 from the first round of reviews?)

- *The information authors include in their reply about the types of GCM that benefit from this type of scheme is very clear. I do welcome the edits done to the abstract, but information on this should also be included in the main text, not only in the abstract. I suggest adding 1–2 sentences at the end of line 24 mentioning the potential benefits for these GCMs (as authors mention in their reply to my comment).*

Added a new paragraph based on the reply to the comment.

- *Similarly, the reasons for using the transport parameterization, given by the authors as answer to the second part of my same comment, provide useful information for readers, in particular the example with ECHAM6. At least part of it would need to be included into the main text. This could be merged to the additional sentence from previous point, for instance.*

Changed as suggested.

- *Number of vertical levels: I agree with the reasons authors give in their reply to my comment. I still think it is good to add information into the main text to justify this choice, for instance 1-2 sentences pointing to the reason and references given in the authors' reply to my related comment.*

Changed as suggested.

- *Line 20, this sentence is still ambiguous and leads to misunderstanding. It needs to be edited to make it as clear as the reply authors provide now to my related comment. I suggest they use the same wording as they do in their reply: "Polar SWIFT is intended as an extension that can be used in addition to an extrapolar scheme to add polar ozone chemistry to GCMs."*

We changed your suggestion slightly and changed the sentence in the manuscript at line 20 to: "Polar SWIFT is intended to add a more sophisticated polar ozone chemistry scheme to GCMs." The reason for changing your suggestion is that it is not necessary to run Polar SWIFT in combination with an extrapolar scheme. It is possible as well to use a climatology outside the polar vortex. Actually, this is the way that Polar SWIFT is implemented into ECHAM and AFES in the moment.

- *Initialization, Section 2.2. As authors state in their reply, previous publications don't include information on initialization choices, it'd be good to briefly add something here to justify choices for optimizing self-consistency in the initialization. I agree a full discussion is not appropriate for this paper, but it can be done briefly mentioning the compromise and choices adopted between model data and MLS observations. My suggestion: "As many species as possible have been initialized with MLS measurements, however ClONO₂ observations do not provide enough coverage. That is why we have decided to use only ATLAS values for chlorine species, since that helps guarantee consistency of HCl and ClONO₂ with Cly."*

Changed as suggested.

- *Line 325: "At the moment..."*

Changed as suggested.

- *Line 325-326. I welcome the edits done to the abstract in this respect, but some clarifying words should also be added in the conclusions. I suggest briefly adding to the end of this sentence "...as an alternative to the transport options in these models." In line with the end of your reply to my specific comment for the old version.*

Changed as suggested.