Response to minor revisions from Anonymous Referee #1

Authors appreciate reviewer's thoughtful comments and suggestions. The manuscript has been revised to accommodate the reviewer's comments.

General Comments:

I thank the authors for their responses to my comments. However, some issues remain. I have limited myself to issues which came up during my own prior review. I believe that this manuscript can in principle be published, but that some claims made in the paper still need to be moderated, and some additional details provided.

Comment) While I agree that C-TRAIL seems like a useful tool and look forward to seeing it applied more broadly, there does not seem to be sufficient quantitative evidence for claims in the abstract and elsewhere that the model can be called "reliable" and "comprehensive". A true assessment of reliability would require comparison of C-TRAIL to results from other models for many different scenarios, rather than a single campaign. Furthermore, C-TRAIL has its own issues, including mass conservation errors and the (ubiquitous) uncertainty in meteorology and emissions inventories. I would recommend that the authors remove words like "reliable", and "comprehensive" from the abstract, as these claims are not meaningfully quantified in the paper.

Response) Thanks for your comments. We removed "reliable" and "comprehensive" as the reviewer suggested. The reason why we called our model "reliable" was that for this case study (KORUS-AQ), it showed somehow similar conclusions to previous studies. However, in case of being reliable as it can be applied for many different campagins and/or scenarios, your statement is right. Also, the claim of "comprehensive" was due to model's capability in seeing different aspects in a source-receptor problem, which as you mentioned may not be the perfect adjective to use here. Again, we removed "reliable" and "comprehensive" and added "novel" to represent the novelty of the output.

Comment) On a similar note, it seems too strong to claim that any model is "ideal" (line 342).

Response) Thanks. We replaced "ideal" with "practical".

Comments) The conclusions still state that C-TRAIL is highly computationally efficient (line 348), but this is not quantified in the manuscript. Either this claim should be removed or a quantitative assessment of computational overhead due to C-TRAIL should be included.

Response) As the reviewer suggested, we removed our claim.

Comment) The authors have added a description of air "packets", which helps considerably. However, it would be useful to clarify that the packets are massless (if they are, as I assume). If they are not massless, then the question remains of how they can be pruned and spawned without incurring additional errors in mass conservation, beyond the "interpolation" errors already discussed by the authors. If they are indeed massless, then they also presumably have no size, rather than being simply small (lines 80-82).

Response) Thanks for the comment. As the reviewer addressed, packets don't have any mass. So, we modified the sentence into:

"we will refer to these points as "air packets" for two reasons: (1) Their nature is similar to that of air parcels, but they are massless, and (2) they behave much like particles, but they carry information about several species."

Comment) I appreciated the authors' response regarding issues modeling cloud convection. However, this hinges on the approach taken by WRF and CMAQ for simulating convection, as well as the resolution of the original WRF simulation. It would be helpful to the reader if the authors included a technical description of how each of the three components (WRF, CMAQ, and C-TRAIL) attempts to account for convection. This would help both in understanding limitations of the approach and in ensuring that readers can reproduce the results.

Response) Thanks for the suggestion. We added a table in a supplementary document and the below paragraph into the revised manuscript:

"In addition, the C-TRAIL model considers convective transport only for resolved clouds (when clouds cover an entire grid). The WRF model implements the cloud model to obtain cloud properties on a sub-grid scale and addresses vertical transport on a resolved scale (Kain, 2004). Outputs from the WRF model are used in the CMAQ's cloud model to account for convective transport in two separate modules: sub-grid scale clouds and resolved clouds (Byun and Schere, 2006). In this version of C-TRAIL for convection, we only use vertical winds determined from resolved clouds (see Table S1)."

Table S1: Convective transport treatment in WRF, CMAQ, and C-TRAIL

Models	**WRF v3.8**		**CMAQ v5.2**		**C-TRAIL v1.0**	
Convection Scheme	Kain-Fritch (2004)		ACM		ACM modified	
Scales	Resolved	Sub-grid	Resolved	Sub-grid	Resolved	Sub-grid
Availabilty	✓	✓	✓	✓	✓	×

Comment) There remain some grammatical errors, which unfortunately harm the readability of the paper. For example, line 125 reads "it incurs mass conservation by adding minor interpolation errors", but this doesn't make sense (I assume this was meant to be "it violates mass conservation" or "it incurs mass conservation errors"?). I recommend that authors perform an additional sweep for such issues, as well as fixing some of the figure references which appeared as "Error! Reference source not found".

Response) Thanks for the suggestion. In addition to a professional editor, we proofread the paper and revised for grammatical and reference-related errors.