

Responses

Adrienne Jeske and Holger Tost

September 5, 2025

Thank you for your reply. We will address the comments in the following. The referees' comments are blue. Our answers are displayed in black.

1 Answers to referee 1

Dear Adrienne Jeske and Holger Tost,
thanks for the clarifications regarding the CVTRANS routine. I welcome the move to present it in the supplement, as it had previously taken away the focus (at least in my case) too much from the actual aim of your manuscript which you clarified in the answer to the editor. That move also improved the story line significantly.
We are glad that we could improve the manuscript.

There are some point I have for further clarification, as stated below. Finally, I would suggest you to have a final re-read of the manuscript to remove those 'little' things that disturb the reading flow, like wrong line breaks, consecutive sentences that start the same, doubling of information within only a few lines, etc. (I haven't specifically mentioned all of them below).

Thanks for pointing that out. We went through the manuscript again.

Specific comments:

line 6/7: "The upward transport increased..." From the context (and reading twice, including the sentence before), I read that you mean the increase in regard with altitude, however, increase could also be in terms of mass. Thus, I'd suggest to make that more clear (especially in the abstract).

With the sentence "The increase in the vertical extent of convection is highly correlated with a rise in the tropopause height.", we are referring to the increase in depth. With "The upward transport increased on average to height levels of 130 hPa and above", we address the changes in mass (as can be seen in Fig.4). We changed the sentence to "The upward transport of air mass increased on average to height levels of 130 hPa and above".

line 50: I think, this sentence is a remnant of the old manuscript version? Please check!

You are right. We removed the sentence.

line 81 (and other places): "minor" adjustments:

I am not sure, if it really is a 'minor' adjustment – if it was, would it be necessary at all? I'd suggest to remove the word 'minor' in regards to the adjustments here and in the other places in the manuscript/supplement, where the adjustments are mentioned.

We removed "minor".

line 85: Maybe this is a bit 'personal taste' but I find this sentence makes a very abrupt start into this section. Maybe you can say something about where this mixing matrix was introduced (EMAC/MESSY/CVTRANS/other model), to soften the start and possibly link it to the models used in this study?

We reformulated the beginning of this subsection and start with CVTRANS to have a better connection with the subsection before.

line 87: "An important remark" I suggest removing this comment/sentence

We removed "An important remark", but keep the remark (the following sentence) itself.

line 88/89: remove line break

We removed the line break.

Figure 1a: On the y-axis, the word "surface" is split over two lines, please adjust to one line.

Done.

line 103/104: "The highest model level..." Either a) add something like "Again, the highest model level..." or b) consider even removing the statement here (this and the following sentence). It has (now) been nicely introduced in the description of Figure 1 in the paragraph above, and is actually not needed here.

We decided to go with your suggestion a) because this information is necessary to understand the whole manuscript. This repetition might assure that the reader can follow.

line 105: remove line break.

We removed it.

line 106/107: I think this is a repetition from lines 97f, and thus can be removed here.

We removed the two sentences about the main diagonal here.

line 111: "reach even" -> even reach

We switched these two words.

line 112: "starts also" -> also starts

We switched the word order.

line 126: "inside a whole mode grid cell" Do you mean one grid cell here, or rather the vertical column including the grid cell?

We mean a specific grid cell in the vertical column. We added "at a specific height." to make that more clear.

line 137: "An overview of the used submodels..." -> of all used submodels

We changed that.

l 148: "For the latter case" I assume, this is also a remnant of the previous manuscript version, there are no cases specified so far in this section.

We removed the sentence.

l 151: CVTRANS 3.0 -> CVTRANS v3.0 Please check for consistency throughout the manuscript/supplement.

We changed CVTRANS 3.0 to CVTRANS v3.0.

l 156: "Remark:" Maybe better something like: "We like to point out that ..."

We edit the sentence accordingly.

l 179/180: "transport has strengthened" Similar as in my remark to the abstract. From the description of the exchange matrix, I understand that you model the mass transport, thus, does strengthened transport refer to more mass being transported here (and in the abstract)? The abstract reads more like strengthened in terms of reaching higher altitudes.

As we discussed above, the abstract is referring to both: A strengthening in terms of the mass and the depth. We changed the abstract to make this point more obvious.

Figure 5: Is it possible to write the numbers on the (updraft mass flux) axis in an angle? I find them a little hard to read/connect this way.

Thank you for bringing this up. We hope that the readability improved with the changed angle.

line 221: "in average" -> on average

We changed that.

line 224: “mass fluxes tended to higher values” Not clear what you want to say here. Is it that the mass fluxes show higher values?

Yes, we want to say that.

line 230: remove “On the other hand” (following sentence starts the same) “impact of downdrafts” what do you mean with ‘impact’, in what regard?

We have rewritten the sentence in the following form: “The impact of downdrafts starting at the mid to upper troposphere (levels 15 to 13) has increased, i.e., more mass is transported downward from mid tropospheric levels”.

l 232: “in average” – > on average

We changed that.

Figure 6:

The legend covers some of the points in the plot, please move legend (maybe above the plot) or re-align such that all points are visible.

The legend is now above the plot.

Figure 7, caption: “30°S and 30°N” Do you mean ‘30°S to 30°N’

Yes, we do and we changed it.

l 250/251: “However,” I am not sure, ‘however’ is the word that you want to use here. What does it refer to? I cannot see a ‘contradiction’ to the statement in the sentence before.

We removed “however”.

l 255: “laxer” – > layer

We corrected the error.

l 256: remove line break

We did.

l 260: “boundary layer (BL) to the upper troposphere (UT)” Both terms have appeared in the manuscript before, so better introduce the abbreviations there.

We introduced them earlier.

l 265/266: “Different processes” examples?

Updraft, grid-scale subsidence, horizontal advection, (convective and non-convective) mixing and ... We reformulated the sentence. The new version is: “Transport by the updraft interplays with the grid-scale subsidence as well as grid-scale advection and other processes which lead to an combined impact on the transport of a tracer.”

l 272-274: Move this sentence to line 281 (following “...upward mass transport.”) Otherwise your reader immediately asks why you are not mentioning the Tibetan plateau.

We moved them.

l 272-273: Are you referring here to the ‘white areas’? Maybe add a range of latitudes, since ‘west of Africa/South America’ covers a large range of latitudes (including the ITCZ for example, which you already identified as a region with enhanced values).

Yes, we refer to the white areas. We make that clear with a reference to the Figure.

l 294: “less convection” This is confusing, the sentence before states that the transported portion increased?

As we repeated in the same paragraph, we performed the analysis for the UT ((a), tropopause pressure to tropopause pressure plus 150 hPa) and the region of the tropopause ((b), tropopause pressure to tropopause pressure plus 50 hPa).

We argue, that the results indicate that less convection reaches the upper troposphere in general (a), but that the convection that does reaches higher (reaches more often the region of the tropopause (b) itself).

l 297-299: I cannot follow where you are looking at, e.g. eastern Atlantic equatorial region": I mainly see blue areas here in Fig. 9, but you talk about an increase?

Thanks for pointing that out. Here we are still referring to the Pacific and not the Atlantic. This was a mistake which we corrected. Further, we provided more guidance for the reader here.

l 305/306: Any plans to use a "better" convective parameterisation in future studies?

Yes, please see the last sentence of the conclusions.

l 318: "A huge decrease can be observed..." Again, I am confused, I see a rather big increase? Or are you referring to further S/N, than better use latitudes to guide your reader!

We included the latitudes.

l 322: "... identify climate changes in convective activity" Climate changes (plural)? Do you mean 'climate change', 'climatic changes', or 'changes in convective activity due to climate change'?

We changed it to: "...changes in convective activity due to climate change".

l 347: "goes well" – > aligns

We changed that.

l 350: "but a partly" – > but partly

We removed "a".

l 367-369: These sentences seem to double information from lines 362-364. Can you combine these sentences?

We decided to remove two of the sentences and adapt one. No double information should be contained in this paragraph anymore.

l 370: "reaches higher" – > add 'altitudes' "tropopause altitude" – > 'tropopause height'

We changed that.

l 372: "similar to the tropics" – > similar to those in the tropics.

We added "those".

l374: "hypothesis" Is this really a hypothesis or rather a finding?

We reformulated the sentence.

Supplement:

"Minor modifications..." As mentioned before, I'd suggest removing 'minor'

We removed minor.

Section 2:

Why are you removing the comparison of old and new CVTRANS version (Fig. S1, that previously had 3 panels)? From the discussion in the review replies, I would understand removing the CVTRANSturb comparison, but would suggest to keep at least the old/new comparison.

We included all three panels of the Figure in the supplements.

Section 3

Please check for consistency, in the main manuscript you use at least some of the submodels with capital letters, here they are all in lower case. (E.g. CH4 vs ch4)

We wrote all submodel names with capital letters.

Section 4:

“In this table information,” remove the comma

We removed the comma.

Section 5/Figure S2 caption:

“compared form 1990...” – > from

We reformulated the sentence.

Section 6:

“La Niña event (Fig. S3)” check reference! Also in the following for Fig. S4.

We corrected the references.