Editor Comments on the revised manuscript by Kuilman et al.

Specific comments:

Title: Since CFRAM play a major role in your study it should also appear in the title.

Key points: Here you clearly summarize your study, however, as you write it here it does not appear in the abstracts. Since ACP does not use key points these will be simply lost after publication. Therefore, I would strongly suggest that you include these in your abstract.

Abstract: An abstract should be clearly written and summarize the idea and results of a study. Here are too many weird or complicated sentences that distract from the content of the study. Further, not all what you have done is summarized here. Therefore, the abstract should be revised.

The abbreviation "CO2" is used throughout the paper but has never been introduced.

P2, L51-52: Already the first sentence is rather weird formulated. I would never "increasingly realized". Please rephrase.

P2, L58-59: "We find the……" This sentence is also not clear. I would suggest to split it into two sentences.

P2, L72-73: Same here. It would be better to split this sentence.

General comment: Why do we consider doubled CO2 atmospheres? One sentence should be included to motivate why such scenarios are of interest.

P2, L89: "ozone is responsible for the existence of the stratosphere…….". This may be indirectly correct, but it sounds really weird and thus should be rephrased.

P2, L93-95: Also this is a really weird paragraph. This paragraph should be completely rewritten.

P3, L102: I am not aware of that. These are generally roughly parameterized. Which processes are you referring to? Please give some examples.

P3, L109ff: How is ozone represented in the climate models? This should be added.

P3, L116ff: How does CO2 affect the middle atmosphere? What role does ozone play in this context?

General comment on the introduction: The first part of the introduction (L84-L131) is really not well written. I do not see here the relation to your study. There is unfortunately no clear line. Therefore, I would suggest to completely revise this part.

P4, L176: Nothing mentioned here that the feedbacks are discussed separately.

P4, L184: What is the resolution in the boundary layer? As you write it sounds as they use a different resolution in the boundary layer then in the remainder of the atmosphere.

P5, L219: "……from a double CO2 equilibrium simulation by CESM." Why has this been done? From the description here I count three simulations, but in the table and later there are four simulations.

P5, L223: Add the years for which the simulation has been performed.

Table 1: What is "PI"? What SSTs have been used? Please add numbers in the table.

P7, L287: we can calculate as -> can be calculated since ……

General on this section: The description is much too long for the main part of the manuscript. You should shorten this Section and put the other parts to an Appendix.

General on Section 3: Also here I would suggest some restructuring. I would add subsections, on for the temperature responses and one for the feedbacks or directly use different Sections.

P10, L448: In section 2.2, it was….. -> As described in Section 2.2 four experiments…..

P10, L453: Are you using a 40 year mean? This should be clearly stated in the manuscript.

P10, L455: Add references to the earlier studies.

P11, L478-479: "all as compared the pre-industrial control simulation". That means the difference between these? Clearly state this. As it is written now it is rather confusing.

P11, L488: Why can only the radiative feedback been calculated?

P12, L498: It would be quite helpful if you would give your experiments names as it usually done in the modelling community and then use these names throughout the manuscript. It would make it much easier to follow which experiment you are actually discussing.

P12, L500-501: "the pressure level of which is an output of WACCM". What do you mean with that? The tropopause is an output level? But it is always at a different height.

P12, L501: Why 24 hPa?

P12, L505: Why do you not use temperature to derive the location of the tropopause?

P12, L506: Why is a mass weighting important? What is the error/uncertainty of not doing this?

General comment: How do your results agree with previous studies? Are your feedbacks higher or lower?

P13, L559: Something missing here after "radiative"?

General comment: Discuss a bit more in which altitude/latitude region the impact is highest/lowest and give numbers.

Figure 2: I see here the highest feedbacks for the mesosphere. This is not discussed like that in the main text. Further, you use different y-axis scale which masks a bit the differences between the atmospheric regions. At least you should mention the different y-scales in the figure caption.

Figure 3: Here, a strong cooling due to CO2 is visible while all others rather show a warming. This is not discussed like this in the text. At least it is not clearly stated.

P17, L606, Figure 4: Why has the upper stratosphere picked? Changes seem to be highest in the mesosphere. Why has the separation not been done there?

P17, L621: Thus, SSTs are important for the water vapour feedback on temperature, butt lower for the CO2 feedback on temperature. This could also be more clearly stated.

P17, L631: Temperature direct response -> Direct temperature response

P18, L669: Add also the paper by Brewer, 1949, QJRMS

P19, L681ff: Most of this paragraph rather belongs to the introduction.

P21, L757ff: Please quantify your results and give the percentages.

P21, L771: What symbol has been used for the statistical significance? Please add that to the figure caption.

P21, L780: Before you always wrote “ozone” but now you write “O3” without introducing the abbreviation.

P21, L787-789: Ozone is destroyed in polar winter in the lower stratosphere, not at 0.1 hPa.

P22, L804 and several other occasions: the 2 in CO2 should be written as subscript.

General comment: Discuss also the statistical significance. Which results do you derive with which significance?

Figure 10 caption: Add information what symbol has been used for the statistical significance.

P23, L853: Sentence with “This has been explained……..” is too complicated and should be rephrased, e.g. This can be explained by a ……leading to an …...

P24, L888: Discuss Figure 12 a bit more. The figures should be first described. What is shown, what do you see…….

P24, L893: Which cooling are you talking about? Up to date cooling for future cooling?

P26, L924: Add a number. How much stronger?

General comment: How do the results agree with previous studies? What is the importance of you results for future predictions or climate change etc.? This should also be discussed.

To summarize you results and for having it easier with the discussion you could make a table/matrix where you mark which feedbacks are important in which altitude/latitude region.

Technical corrections:

P2, 75: Add before after “in this way”.

P4, L164: are -> were

P4, L169: by -> with

P5, L207: earth -> Earth

P5, L218: SSTs forcing -> SST forcings

P7, L280: delete “to” before balance

P12, L505: don’t -> do not

P15, L577: leads to -> leads to a

P17, L619: One “the” obsolete.

P18, L681: synoptic -> synoptic scale

P21, L771: signifance -> significance

P21, determinged -> determined

P21, L776: CLOx -> ClOx

P23, L824: to lead a -> to lead to a

P23, L828: Delete “in WACCM”, you have already written it at the beginning of the sentence.

P23, L838: aren’t -> are not

P23, L841: “neither” obsolete? Or should it rather read “either”.

P23, L848: found by -> simulated by or simulated with

P25, L911: at a first -> as a first

P26, L939: leads to -> leads to a