Author Comment to the revised version of the manuscript egusphere-2023-2140, (https://doi.org/10.5194/egusphere-2023-2140, in review, 2023): "Updating the radiation infrastructure in MESSy (based on MESSy version 2.55)"

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To the editor

Dear editor, thank you for accepting our manuscript subject to minor revisions based on the reviewer's comment. We would like to note that there was likely a misunderstanding regarding the orbital offset. We will try to clarify this by adjusting the manuscript and by providing a detailed response (blue) to the reviewer's comment (*black italics*) here. We will also provide a manuscript which will highlight the changes in comparison to the revised version. We thank the referee for taking the time to review the revised version of our paper and the editor for handling the manuscript.

Reply to reviewer

We thank the reviewer for agreeing to check the revised version of our manuscript. The reviewer raised one concern regarding the orbital offset used in the full calculation of the radiation. We think that there is still a misunderstanding which

we hope to address satisfactorily by replying to this comment and by adapting the text of our manuscript. The issue raised is as follows:

However, one minor, but important comment (from both reviewers) has been misunderstood. Section 2.6 (1): the original offset (opt0, old default) correctly uses the middle of the time interval for the calculation of the solar zenith angle. I believe the adoption of the new default (opt1) will introduce an error into the calculation. The radiation calculation needs to represent the movement of the sun over the whole period from the beginning to the end of the radiation timestep, not a discrete point in the interval. Therefore, opt0 (old default) is a better choice if you are going to select a representative time. (Even better would be to actually calculate the mean value of the solar zenith angle over the interval, but I appreciate this is beyond the scope of this paper.)

We are sorry that we misinterpreted the initial review comment regarding this issue and thank the reviewer for clarifying the disagreement, which we try to resolve now.

Maybe in our last reply we also did not make clear that the full radiation calculation is later on corrected with the exact orbital parameters of the model time steps associated with the full radiation call. To make this easier to follow we give the following example: Let's assume that the full radiation is performed every 30 minutes while the model time step is 10 minutes. At 10:00 a full radiation calculation is performed and the next one follows at 10:30. Previously, the offset was 15 minutes (30 minutes/2), hence the orbital parameters at 10:15 were used for the full radiation calculation. The results were then corrected using the orbital parameters at 10:00, 10:10 and 10:20 to provide the fluxes and heating rates for these time steps. Which we think is inconsistent as for the time step at 10:30 the results from the next full radiation with orbital parameters set to 10:45 were used. There are two ways of solving this inconsistency: (i) shifting the orbital parameters which are used to correct the full radiation calculation by half a model time step, which would lead to orbital parameters representative of 10:05, 10:15 and 10:25 (maybe this is what you had in mind) or (ii) shifting the initial orbital offset for the full radiation calculation to 10:10 which is (on average) closer to the orbital parameters at 10:00, 10:10 and 10:20 which are used to correct the fluxes and heating rates. I.e. the aim is to find the offset that produces the least error when the corrections with the orbital parameters

at the model time steps associated with the radiation call are used. This does not aim to provide the best offset representative of the orbital parameters for the time span from one full radiation call to the next.

We agree that overall option (i) could be even better. However, option (ii) is still an improvement regarding consistency and the shift of the orbital offset for the correction was never considered before. We also note that the difference in using the old and new default is rather small for the currently applied time step lengths and radiation call frequencies.

We have adjusted the respective parts in the manuscript to better motivate our choice and hope that this is also satisfactory for the reviewer.