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Interactive comment on "A new radiation infrastructure for the Modular Earth Submodel System (MESSy, based on version 2.51)" *by* S. Dietmüller et al.

Anonymous Referee #2

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General comments

The paper presents a re-organized infrastructure of the radiation submodel within MESSy. So far the calculation of aerosol and cloud optical parameters as well as the radiative calculations themselves had been performed by one overall submodel, RAD4ALL. This submodel has now been split into 4 different and independent submodels, which are based on the existing parameterizations. The new infrastructure allows for additional diagnostics and an online radiative forcing calculation. Overall I recommend the paper for publication. However, there are some sections where the paper needs clarification.

I really have a hard time to understand the different shortwave radiation schemes and

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Discussion paper

how they interact with each other. First of all, it's not clear to me why there are two versions of the shortwave scheme by Fouquart and Bonnel (1980). The statement "the combination of optical properties of different species are inconsistent" sounds to me as if there is a bug in RAD_SHORT_v1, so I don't see a reason to keep this version. Furthermore, I do not understand how RAD_FUBRAD and RAD_SHORT_v1/2 interact with each other. In the introduction it is written that RAD_FUBRAD works only in the stratosphere and mesosphere, so I guess the troposphere is handled by RAD_SHORT_v1/2. How is this done technically? And why is RAD_SHORT_CMN needed in addition to RAD_FUBRAD? Figure 1 is also not very helpful in this respect. So I think Sect. 2.1 would benefit from some further explanations. My overall impression is that there is still some space for improving the code structure in the shortwave part of the radiation.

According to the paper and the supplement it is possible to call the submodels AEROPT and CLOUDOPT several times for diagnostic purposes, as far as I understand. Is it possible to combine the various set-ups of AEROPT and CLOUDOPT for diagnostic calls within one model simulation?

Sections 2.6, 3.2, 3.3 and 3.4 provide some nice examples how the various submodels and diagnostics can be applied. However, I think the interpretation of the results is sometimes a bit sloppy. I am aware that this is a technical description paper, but nevertheless it would be good to see some more discussion, e.g. on the differences between SW_v1 and SW_v2 in Sect. 2.6 (details below).

Specific comments

- Introduction: The introduction clearly states the motivation behind the re-organization. I think it would be very helpful to clearly list the modifications and new diagnostics as well. For example, it is not clear to me whether it was already with RAD4ALL possible to call the radiation n times or with different aerosol or cloud set-ups.

- P3, L19: "the combination of . . . is inconsistent. . ."

- Sect. 2.2: Spectral resolution of RAD_FUBRAD? On P4, L29 it is written that RAD_FUBRAD has 55 or 106 spectral bands in the UV-VIS band (250-690 nm). On P5, L8/9 it is written that the Chappuis band is resolved by either 1 band in the original version of the module or by 6 or 57 bands in the version of Kunze et al. (2014). So I assume that the overall 55 or 106 bands refer to the version of Kunze et al. (2014). How many bands in total does the original version then have? I am a bit confused about the various spectral resolutions. Please clarify.

- P5, L13: Shine and Rickaby (1989)

- P6, top: Please provide a reference for the CCMI stratospheric and volcanic aerosol data set.

- P7, L5: What is the purpose of several calls to the submodel AEROPT with different settings simultaneously?

- P8, L5: I have a general question on the spectral resolution of the shortwave scheme. Here you mention the 4 bands of the standard ECHAM5 shortwave radiation scheme. Cagnazzo et al. (2007) increased the number of shortwave bands from 4 to 6 for the middle atmosphere version of ECHAM5. Is this version of the shortwave scheme also available within the MESSy radiation code?

- P9, L15: It would be helpful to mention that the first call of the radiative calculation provides the temperature feedback. This information is only given in the supplement material, but I think it would be helpful to mention it in the main part of the paper as well.

- P9, L21: The statement that the calculated volcanic heating rates are comparable to Stenchikov et al. (1998) needs some more discussion. How comparable is the CCMI data set to Stenchikov et al. (1998) in terms of aerosol distribution and optical properties?

- P9, L23-25: Again I am a bit confused about the two versions of RAD_SHORT...

Which heating rates are more reliable, SW_v1 or SW_v2? Where do the differences between SW_v1 and SW_v2 come from and in which sense are they in agreement with Thomas (2008)?

- P11, L27: lead to -> led to ?

- P12, L11: For a better comparability - how large is the estimate by Stevenson et al. (2013)? Please provide the value.

- P13, L12: Could you provide the date of the next official MESSy release?

- Figure 1: What is the meaning of the different colors of the arrows? What does the dashed blue arrow to RAD_FUBRAF_E5 mean? The communication among the different shortwave routines is not absolutely clear to me (see major comment above).

- Table 1, caption: variated -> varied

- Table 2: net adjusted RF contrail: space missing -> 0.113 (0.113)

Specific comments on the supplement

- Is the description of the various namelists complete or is there only a subset of namelist parameters described?

- P4: “The namelist entry r_inp(m,n) then contains. . .”

- P4: “. . .decaying with elevation. . .” -> “. . .decaying with altitude. . .”

- P4: #vgrad: How do you specify the vertical gradient of the GHG VMR?

- P5: CTRL_FUBRAD, nbands=49: Why is this option still included if there are known bugs/shortcomings related to that specific spectral resolution?

- P5: Could you please briefly say what the acronym VISO means, for non-MESSy-experts?

- P8: CLOUDOPT, NCALL: Which call of CLOUDOPT is used for the radiative calcula-

tions, again the first call? Or can the n calls of CLOUDOPT be combined with n calls of the radiation scheme?

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