Dear Editor, dear reviewer,

Thanks for the valuable comments, which help to improve the quality of the paper. The detailed replies are addressed below point by point in blue.

Best regards,

Linlu Mei on behalf of all co-authors

The paper describes the latest updates and additions to the already extensive suite of aerosol, cloud and surface reflectance databases implemented in SCIATRAN. The new databases are adopted from mostly recent work of, and published in the peer-reviewed literature by, a number of researchers. The paper is fairly well written and accessible. It should provide a useful reference to current and future users of SCIATRAN.

I understand the goal is to describe the updated databases, but I think a high-level description of the state of SCIATRAN would be useful in addition to the references that are already provided. This should include the radiative transfer solver(s) implemented, databases that existed before the recent update, as well as a reasoning for replacing them, if any.

Response: An extended description for the above-mentioned aspects is included in the revised version. For example, radiative transfer solvers (see lines 97-102 in the revised version); existing data and models (see Appendix B in the revised version). More information can also be found at lines 132 – 137 in the revised version.

It is not entirely clear to me whether the new aerosol databases are in addition to the "old" aerosol types or the they replace the "old" ones.

Response: The CAS databases and models from the previous version of SCIATRAN are still available in V4.6.

We have included additional clarification on this topic (see lines 132 – 137 in the revised version).

The databases implemented in SCITRAN is now quite extensive. While reading the manuscript I was hoping to find some sort of guidance or recommendation as to which database should be used under various situations. I don’t mean the trivial scenarios like land aerosol models over land and oceanic aerosol models over ocean, or water and ice clouds depending on what the user want to simulate. I am thinking of

especially of the bidirectional surface reflectance databases. Which one would be the most appropriate to use when all inputs required for the models are available?

Response: When all input parameters required for a selected surface type are available, we can give the following recommendations:

For an ocean surface, users have only one option to use

For a snow-free land surface, the following choices can be made:

1) For users preferring a simple globally applicable BRDF model, the XBAER BRDF model is recommended. In this model only one parameter (Soil-Adjusted Vegetation Index) is needed as the input.

2) For users interested is specific topics related to the vegetation properties, the PROSAIL is recommended.

3) For users working with multi-angle observations and only interested in a non-polarized modelling, the Ross-Li model is recommended

4) For users working with multi-angle observations and interested in a polarized modelling, a combination of the RPV and Facet models is recommended.

For a snow-covered land surface, FASMAR is recommended.

We have included the above information in the revised manuscript (see lines 585 – 598 in the revised version)

SPECIFIC COMMENTS:

Lines 113-14: Are the fluxes only for selected wavelengths, can the user request spectrally integrated quantities too?

Response: The calculation of spectrally integrated quantities is available. Different spectral response functions can be selected by user.

Lines: 126-128: I assume this means the gas absorption calculations use the HITRAN 2020 database. I understand the discussion of it is out of scope, but please at least provide a reference.

Response: The HITRAN 2020 reference is included in the revised manuscript.

Gordon, I. E., Rothman, L. S., Hargreaves, R. J., Hashemi, R., Karlovets, E. V., Skinner, F. M., Conway, E. K., Hill, C., Kochanov, R. V., Tan, Y., Wcisło, P., Finenko, A. A., Nelson, K., Bernath, P. F., Birk, M., Boudon, V., Campargue, A., Chance, K. V., Coustenis, A., Drouin, B. J., Flaud, J.-M., Gamache, R. R., Hodges, J. T., Jacquemart,

D., Mlawer, E. J., Nikitin, A. V., Perevalov, V. I., Rotger, M., Tennyson, J., Toon, G. C., Tran, H., Tyuterev, V. G., Adkins, E. M., Baker, A., Barbe, A., Canè, E., Császár, A. G., Dudaryonok, A., Egorov, O., Fleisher, A. J., Fleurbaey, H., Foltynowicz, A., Furtenbacher, T., Harrison, J. J., Hartmann, J.-M., Horneman, V.-M., Huang, X., Karman, T., Karns, J., Kassi, S., Kleiner, I., Kofman, V., Kwabia-Tchana, F., Lavrentieva, N. N., Lee, T. J., Long, D. A., Lukashevskaya, A. A., Lyulin, O. M., Makhnev, V. Yu., Matt, W., Massie, S. T., Melosso, M., Mikhailenko, S. N., Mondelain, D., Müller, H. S. P., Naumenko, O. V., Perrin, A., Polyansky, O. L., Raddaoui, E., Raston, P. L., Reed, Z. D., Rey, M., Richard, C., Tóbiás, R., Sadiek, I., Schwenke, D. W., Starikova, E., Sung, K., Tamassia, F., Tashkun, S. A., Vander Auwera, J., Vasilenko, I. A., Vigasin, A. A., Villanueva, G. L., Vispoel, B., Wagner, G., Yachmenev, A., and Yurchenko, S. N.: The HITRAN2020 molecular spectroscopic database, J. Quant. Spectrosc. Radiat. Transf., 277, 107949, https://doi.org/10.1016/j.jqsrt.2021.107949, 2022.

Lines 259-262: It is said that the continental aerosol type is not included in the SCIATRAN database because according to the authors' investigation it is not used in the XBAER algorithm for MERIS. It may be fine since the continental aerosol type is generally regarded "old" by some researchers but I'd think there should be a more substantial justification for excluding it beyond the fact that the XBAER algorithm does not use it for a specific instrument.

Response: Yes, the continental aerosol type is not included in SCIATRAN. One of the important reasons is, that the new implementations in SCIATRAN are driven mostly by the further development of the XBAER algorithm. In the XBAER algorithm, we are not using the continental aerosol type. Even in the NASA MODIS Dark-Target algorithm, continental aerosol type is only used as a back-up type when weakly-, moderately- and strongly absorbing aerosol types do not fit in the retrieval. Furthermore, as the reviewer mentioned, this continental aerosol type is not new.

We have extended the explanation in the revised manuscript (see lines 255 – 260 in the revised version).

Lines: 445-449: In the previous version, the effective radius of water droplets was between 4 and 20 microns. So, do you mean the database was extended to include the range 2 - 4 microns, or that the "old" database was replaced with a new one having effective radius between 2 and 40 microns?

Response: Database for water droplet sizes between 2 – 4 µm and 20 – 40 µm was calculated and added to the original 'old' database.

Table 3 caption: I think the correct URL is https://darktarget.gsfc.nasa.gov/atbd/ocean-algorithm

Response: Both the link above and in the paper contain the ocean aerosol models

Line 459: Is there a reference for the relationship between mode radius and effective radius?

Response: See, e.g., Kokhanovsky A.A. Cloud optics. Dordrecht: Springer; 2006.

At places where implementation of databases is discussed the choice of the specific way a particular database was implemented could be discussed. For example, re the ice particle habit (lines 520-525), has the linear interpolation been suggested by the database developer? I am not saying that a linear interpolation is not adequate; I am only suggesting that when it is appropriate the choice should be justified as much as possible, especially in those cases when multiple choices are possible.

Response: The linear interpolation with respect to the logarithm of maximal dimension of grain habits was implemented into the SCIATRAN software according to the suggestion of Saito et al., see

M. Saito, P. Yang, N. G. Loeb and S. Kato "A novel parameterization of snow albedo based on a two-layer snow model with a mixture of grain habits", J. Atmos. Sci. 2019, v76, 1419-1436.

Another interpolation type cannot be selected by user. We have included this information in the revised manuscript (see line 506 in the revised version).

Line 577: Are "typical values" of the mean chord length and optical thickness of snow provided in the code or database for a broad category of snow, say fresh and old snow? I assume users could read the Malinka (2014) paper, but still, having such values listed in the paper would be useful for casual users who just want to see the sensitivity to these parameters without prescribing unrealistic values.

Response: Typical values of chord length and optical thickness for different snow types are given in the revised version of manuscript (see Table 6 of the revised manuscript).

Line 808: The Dubovik and OPAC 4.0 dust models also have relatively large differences in the backward scattering direction (scattering angle 150-180 degrees).

Response: Corrected.

Lines 903-911: I am not sure I understand this part. What is being shown on the vertical axis in the lower panel of Fig. 5? Is it the reflectance from a single aerosol component divided by the reflectance from all 5 components, or the reflectance of 4

components (excluding one aerosol type) divided by the reflectance from all 5 aerosol types?

Response: We have updated Fig.5, especially the lower panel. In the revised version, the lower panel shows the TOA reflectance simulated considering individual aerosol components.

Line 2021: I assume the authors mean user-friendly interfaces. Is it really necessary to say it since it has not been shown in the paper?

Response: We believe users can get very quickly a feeling how to make correct settings once they start using SCIATRAN. Such a statement can also 'encourage' potential users (especially who are afraid of a complexity of the software) to use SCIATRAN. Thus, we would like to keep it in the revised manuscript.

TECHNICAL CORRECTIONS (could be more):

Line 145: "the explore of" should read " the exploration of".

Response: Done

Line 152: "of Young database" should read "**the** Young database".

Response: Done

Lines 191-192: "... optical properties those six components" should read "... optical properties **of** those six components".

Response: Done

Line 249: "Virible" should read "Visible".

Response: Done

Line 311: "wavelegths" should read "wavelengths".

Response: Done

Line 351: "Many investigations has …" should read "Many investigations have …"

Response: Done

Line 548: "Combing" should read "Combining".

Response: Done

Line 588: Perhaps “build-in” should read “built-in”?

Response: Done

Lines 773-774: Would read better “... the new aerosol types implemented in SCIATRAN” or “... the aerosol types newly implemented in SCIATRAN”.

Response: Done

Line 807: “paramterization” should read “parameterization”.

Response: Done

Figure 3 caption: See comment above for lines 773-774.

Response: Done

Line 824: “show layer” should read “snow layer”.

Response: Done

Lines 828-829: Instead of “the scattering processes plays very important role” the authors could write “the scattering process plays a very important role” or “scattering processes play a very important role”.

Response: Done

Lines 855-856: “responce” should read “response”; “instrument” should read “instrument”.

Response: Done

Line 859-860: “to the time of writing” should read “at the time of writing”.

Response: This sentence is deleted because the proposal has been accepted and this sentence is not needed any more.

Line 927: “chanels” should read “channels”.

Response: Done

Lines 983-984: “with the optical thickness of 20” should read “with an optical thickness of 20”; “the geometrical thickness” should read “a geometrical thickness”; “and the top height” should read “and a top height”.

Response: Done