Report on the outcomes of a Virtual Mobility[[1]](#footnote-1)

Action number: CA21119

Grantee name: Papachristopoulou Kyriakoula

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| **Virtual Mobility Details**  Title: Overview of the use of the ground-based sun photometric aerosol retrievals to radiative transfer-based applications  Start and end date: 01/04/2024 to 01/07/2024 |
| **Description of the work carried out during the VM**  Description of the virtual collaboration and activities carried out during the VM, with focus on the work carried out by the grantee. Any deviations from the initial working plan shall also be described in this section.  *(max. 500 words)*  Grantee enters max 500 word summary here.  This is the work carried out along with the virtual collaborations and activities carried out during the VM:  1) **Literature Review on using aerosol sun photometric retrievals in radiative transfer modelling applications.**  The main aim of this Virtual Mobility grant was to work on compiling an overview of the use of the aerosol sun photometric data in radiative transfer modelling studies towards specific scientific related goals and applications. For this goal online meetings were conducted with scientists from PMOD to collaborate with experts in sun photometer aerosol retrievals in order to finalize the literature that will be reviewed in the following three categories: constraining atmospheric and climate models, solar energy sector and satellite remote sensing.  **2) Sensitivity study for the aerosol direct radiative effects for all skies conditions.**  The second objective of this project was to perform a sensitivity study using radiative transfer modelling to assess the aerosol direct radiative effects under realistic 3D scenes with clouds using different vertical distributions of aerosols. These are the steps that were followed:   * As a test bed for this sensitivity study data from the EarthCARE simulated scenes (before launch available data) were employed. As a first step the necessary preprocessing (sub setting, change of units, file’s format, etc) of those datasets was performed in order to be able to be used an input to the radiative transfer model. A 3D computational and the corresponding assessment domain (the one characterized as 1st ranked, the 5201 pixel) was prepared from the Halifax scene. * Aerosol optical properties were calculated using the Mie tool of libRadtran package, for two aerosol components of EarthCARE aerosol model. * For the radiative transfer simulations, the libRadtran RT package (Mayer & Kylling, 2005; Emde et al., 2016) was used along with its MYSTIC solver for 3D RT simulations. For this goal online meetings were conducted with scientists from LMU to get the necessary transfer of knowledge from experts in radiative transfer modelling (the developers of libRadtran/MYSTIC RT package). The set up of the radiative transfer codes necessary for the simulations was conducted. * For the 3D domain from the Halifax scene, both clear-sky and all-sky aerosol direct radiative effects were calculated, vertically resolved for both downwelling solar fluxes (focusing on surface) and upwelling solar fluxes (focusing on top of the atmosphere - TOA). The simulations were performed for both 3D (mean of 5 x 21 assessment domain) and 1D (mean of independent 5 x 21 simulations). For the interpretation of the results online meetings were conducted with scientists from both LMU and PMOD. * All-skies aerosol direct radiative effects were also calculated for artificial aerosol layers below, inside and above clouds to investigate how the relative position of the aerosol layer compared to clouds affecting the results. |
| **Description of the VM main achievements and planned follow-up activities**  Description and assessment of whether the VM achieved its planned goals and expected outcomes, including specific contribution to Action objective and deliverables, or publications resulting from the VM. Agreed plans for future follow-up collaborations shall also be described in this section. |
| *(max. 500 words)*  Grantee enters max 500 word summary here.  Aerosol directs radiative effects are important for various scientific areas like atmospheric and climate modelling, the solar energy sector and satellite remote sensing. The main results of this VM grant are two: an overview of the ground-based sun photometric aerosol measurements for radiative transfer modelling studies and related applications, which is compiled in the Section 2 of the extended report of this VM. In addition, a sensitivity analysis of how aerosol distribution affects aerosol direct radiative effects estimates in realistic 3D atmospheric scenes with clouds was conducted and presented in Section 3 of the VM’s extended report. With the aerosols direct radiative effect subjected to high uncertainties, the effects of a more realistic representation of those in 3D cloudy scenes will be valuable for all the related applications.  The outcomes of this VM are related to HARMONIA’s objectives and deliverables: it could be part of the mid-term (24 month) scientific report of HARMONIA WG3. It could be included as a section describing the link of aerosol measurements with the modelling and satellite community for targeted applications. Finally, the outcomes of this VM could partially contribute to both D3.2 and D3.3 of WG3.  Finally, part of the results of this VM were presented at the International Radiation Symposium (IRS) 2024, which took place in Hangzhou, Chine in 17-21 June 2024:  **Papachristopoulou, K.**, Tsekeri, A., Kouklaki, D., Gialitaki, A., Emde, C., Mayer, B., Barker, H. W., Cole, J.N.S., Qu, Z., Kacimi, M., Amiridis, V., Kazadzis, S., Marinou, E., “Sensitivity Study of Aerosol Direct Radiative Effects on Cloudy EarthCARE Scenes Using 1D and 3D Radiative Transfer Simulations”, International Radiation Symposium 2024 (IRS2024), Hangzhou, China, 17–21 June 2024.  The presentation that was given in IRS2024 it is also attached. |

1. This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant. [↑](#footnote-ref-1)