Report on the outcomes of a Short-Term Scientific Mission[1]

Action number: CA21119

Grantee name: Ancuta-Gabriela Ciocan

Details of the STSM

Title: Study of aerosol optical depth (AOD) using active remote sensing techniques from airborne instrumentation emphasizing accuracy, uncertainty, and spatiotemporal resolution in aerosol measurements

Start and end date: 20/07/2024 to 30/08/2024

Description of the work carried out during the STSM

Description of the activities carried out during the STSM. Any deviations from the initial working plan shall also be described in this section.

During my Short-Term Scientific Mission (STSM) at DLR, the work began with a five-day period of on-site training. During this time, I was introduced to the laboratories of the LiDAR Department at the Institute of Atmospheric Physics. This included visits to key facilities, such as the POLDIRAD system, a Polarization Density Doppler Radar that was part of the 2020 EUREC4A campaign. Additionally, I had the opportunity to see the WALES (combined airborne high spectral resolution and water vapor differential absorption LiDAR) system, which was being prepared for a new campaign, following its role in EUREC4A.

This initial training provided valuable insight into the measurement procedures used for airborne instrumentation, particularly LiDAR systems. I was also trained in the specific procedures involved in data collection and processing, essential for understanding the measurement process from a practical standpoint. The training laid a strong foundation for the subsequent remote work.

The data I worked with originated from the 2020 EUREC4A Campaign in Barbados, where the HALO aircraft completed 15 flights during January and February. Specifically, I focused on data from January 30th and 31st, and February 2nd, which were marked by strong Saharan Dust events.

After the on-site training, I conducted further research and analysis remotely. This involved two primary tasks: (1) a literature review to improve my understanding of the synergistic use of LiDAR and sun photometer data, and (2) the actual data analysis. Initially, I analyzed sun photometer data from the

[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.

Ragged_Point AERONET station in Barbados, focusing on Level 2 daily averages from January 1st to February 28th, 2020. This allowed me to observe the evolution of the Saharan Dust events and integrate this data with the LiDAR data.

For the airborne LiDAR data, I calculated Aerosol Optical Depth (AOD) from extinction data. The knowledge gained during the on-site training, combined with my literature review, was important in finalizing this analysis. In the end, I was able to compare results from both the LiDAR and sun photometer data, providing insights into the accuracy and spatiotemporal resolution of each measurement technique.

Overall, the work aligned closely with the initial plan. There were no deviations, and I successfully achieved the set objectives of improving my understanding of airborne aerosol measurement techniques and conducting comparative analysis with ground-based measurements.

(max. 500 words)

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Description of the STSM main achievements and planned follow-up activities

Description and assessment of whether the STSM achieved its planned goals and expected outcomes, including specific contribution to Action objective and deliverables, or publications resulting from the STSM. Agreed plans for future follow-up collaborations shall also be described in this section.

The STSM successfully met the planned goals and objectives outlined in the initial proposal. The hands-on training at the DLR, specifically within the LiDAR Department of the Institute of Atmospheric Physics, significantly enhanced my understanding of airborne remote sensing techniques. This training provided valuable insights into the use of LiDAR and sun photometer data, allowing me to complete the data analysis objectives set for this STSM. The focused work on aerosol optical depth (AOD) measurements, particularly in relation to the 2020 EUREC4A campaign, provided key practical knowledge and advanced my technical capabilities.

A major achievement of this STSM was the comparison of airborne LiDAR data with sun photometer measurements. I successfully computed Aerosol Optical Depth (AOD) from LiDAR extinction data and compared this with AOD values derived from sun photometer data collected at the Ragged_Point AERONET station. This comparison allowed for the assessment of the spatiotemporal resolution and accuracy of the airborne measurements, and also their capabilities of dealing with strong Saharan Dust events. These achievements directly support the Action's deliverables, particularly in relation to improving the accuracy of AOD retrievals and advancing synergistic approaches between airborne and ground-based measurement platforms.

The knowledge exchange that occurred during this STSM was another key achievement. My interaction with experts at DLR, combined with the literature review I undertook, has greatly enhanced my understanding of the calibration, maintenance, and operational aspects of airborne remote sensing instrumentation. These skills will not only benefit my current research but also contribute to my ongoing collaborations within the aerosol measurement community.

The extensive report of the results obtained through this STSM will contribute not only to Deliverable 2.1: "Report on synergistic approaches towards better quality products for aerosol optical depth.", but also to Deliverables 3.2 (Report on the requirements of different user communities on the accuracy, uncertainty and spatiotemporal resolution of aerosol measurements needed for their activities) and 3.3 (Publish a white paper on sun-photometric aerosol accuracy and uncertainty for different applications).

Regarding follow-up activities, the data and results are expected to be disseminated through oral or poster presentations at upcoming conferences, as well as a potential publication. This dissemination

aligns with the Action's objectives of promoting knowledge exchange and advancing aerosol measurement methodologies. In terms of future collaborations, there are agreed plans to continue working with DLR on further data analysis. These follow-up activities will create the possibility on integrating the results from this STSM with ongoing research efforts at DLR and potentially expanding the scope of the study to include other datasets from recent campaigns.

Overall, the STSM not only achieved its immediate goals but also laid the groundwork for continued research collaborations. This STSM contributes to the broader objectives of the Action, particularly in enhancing the accuracy, uncertainty, and spatiotemporal resolution of aerosol measurements, and supports the continued development of collaborative efforts within the research community.

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