Polarimetry and spectroscopy to reveal the intrinsic depolarization of dust aerosol in laboratory

12 months' position available at the Institute of Light and Matter (iLM), Lyon University, France.
ATMOS research group
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Scientific context and motivations

As underscored by the latest IPCC report (IPCC, 2013), atmospheric aerosols are complex physical objects that may somewhat counterbalance the warming effect of most greenhouse gases. However, to draw such a conclusion, the interaction of light with such complex systems should be first quantified. The dust aerosol is indeed a complex physical object, presenting a wide range of sizes, a highly irregular shape, sometimes with sharp edges and surface roughness, which prevents from analytical solutions to the Maxwell's equations (Mishchenko et al., 2002), thus limiting our ability to quantify the interaction of such complex systems with the electromagnetic field. Quantifying light backscattering by the mineral dust aerosol is then challenging. Light scattering numerical simulations exist but rely on assumptions that should be carefully checked. Hence, while light backscattering is of prime importance as involved in future satellite lidar missions (MESCAL, EarthCare or ACCP) as underscored by CNES in France, it is only recently that light backscattering has been observed in laboratory for particles embedded in ambient air (Miffre et al., 2016) to quantify the ability of the mineral dust aerosol to backscatter laser light. This Pi-polarimeter quantifies the particles deviation from isotropy through accurate particle depolarization ratio (PDR)-measurements. Not only polarimetry is involved but also spectroscopy as PDR-measurements are currently performed at several wavelengths, covering the UV and VIS spectral ranges (Miffre et al., 2016).

Work plan

The present call, funded by CNES, is aimed at extending this unique laboratory Pi-polarimeter to the IR spectral range to quantify the PDR-spectral dependence, which is key for aerosol identification (Burton et al., 2016). More precisely, fundamental laboratory intensive work is required to address the dust aerosol PDR at exact backscattering angle. Starting from the existing laboratory Pi-polarimeter (Miffre et al., 2016), the candidate will contribute to develop a Pi-polarimeter in the IR-spectral range. Likewise, backscattering measurements are planned for each definite property (size, origin) of the dust aerosol to face its complexity. Such unique laboratory measurements of the intrinsic dust PDR will be made available to a broad scientific community, in France and abroad through publications and conferences.

Candidate profile

To carry out this research project, candidates must hold a PhD in optics (polarimetry, spectroscopy, laser physics) and/or atmospheric physics (atmospheric aerosols, satellite remote sensing). Above all, precision is required to reveal the intrinsic ability of this complex aerosol to depolarize laser light. This 12 months' position will be located at the Institute of Light and Matter (iLM) under the supervision of A. Miffre from the ATMOS research group (Prof. Rairoux group leader). The position is funded by CNES as part of the EECLAT proposition.

Contact information

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