

The Retrieval of Microphysical Aerosol and Cloud Properties Combining Aerosol Measurements from Multi Angle polarization data from Ground, Aircraft and Satellite

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The inversion of multi-angle, and multi-spectral polarization data is a great tool for the retrieval of microphysical properties of aerosol cloud particles. The measurement of polarized intensities as function of the scattering angle at multiple wavelengths can be applied to ground based and airborne in situ measurements as well as to airborne or satellite remote sensing observations.

Our team has developed multiple measurement concepts and instruments that uses mathematical inversion techniques as a primary tool to retrieve aerosol microphysical properties from a variety of in situ and remote sensing sensors that measure light scattering at multiple scattering angle combinations. Our multiwavelength in-situ sensors include imaging nephelometers from the ground and from aircraft with hyper-angular and high angular resolution, discrete polar nephelometers with a more limited angular distribution, and integrating nephelometers measuring the scattering coefficients in the backscattering and forward scattering regions. On the remote sensing side, we have used the airborne AirHARP polarimeter on the NASA ER2 and UC12 aircrafts, and from space we had the Hyper-Angular Rainbow Polarimeter (HARP) CubeSat collecting data for 2 years, and we are currently working on the GAPMAP mission (recently launched and currently in a commissioning phase) and in the HARP2 polarimeter that will be launched to space on the NASA PACE mission in the spring of 2024.

In this talk we will show the application of the Generalized Retrieval of Aerosol and Surface Properties (GRASP) inversion algorithm to a multitude of measurements from the platforms described above, demonstrating their synergy and applicability to laboratory measurements, field campaigns, ground networks, aircraft and satellite.

Specific results include laboratory measurements with different aerosols types, results from past field campaigns, remote sensing results from HARP CubeSat, and discussion on future measurements to be performed with the GAPMAP polarimeter in the ADLER-2 mission, and with the HARP2 sensor on the NASA PACE platform. In particular, we will show results from two years of HARP CubeSat data collected around the globe, including aerosol retrievals over dust and biomass burning smoke. Saharan dust has been measured with HARP near the source and arriving in the Americas after long range transport. In situ results will include aerosols from multiple sources including urban pollution, biogenic and biomass burning aerosols. In all cases, GRASP retrievals provided results on aerosol optical depth, particle size, non-sphericity, and aerosol refractive indices.