Aerosol properties over the Paris megacity monitored using a multi-wavelength Raman Lidar

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The Site Instrumental de Recherche par Telédétection Atmosphérique (SIRTA) is an atmospheric observatory, located 20 km south of Paris, based on a growing ensemble of state-of-the-art active and passive remote sensing instruments (Haeffelin et al., 2005). More than 150 different instruments or sensors are deployed and continuously monitor the atmosphere for more than 10 years. SIRTA database collection is daily enhanced by more than 5000 files, making three gigabyte of records. On June 2015, the CNRS-IPSL Hi-Performance multi-wavelengths Raman Lidar, called IPRAL, has been deployed at SITA observatory for improving the capabilities of the station on multiple research targets (e.g., clouds characterization, aerosol typing, and aerosol-cloud interaction, among others).

This is the first time that a high-performance multi-wavelengths Raman Lidar is permanently deployed nearby the megacity of Paris allowing a preliminary tropospheric aerosol typing (e.g., anthropogenic, dust, and biomass-burning plumes). Three intensive aerosol properties were then derived from IPRAL's measurements: the backscatter-related Angström exponent between 355 and 532 nm (β-AE), the lidar ratio at 355 and 532 nm and the particle linear depolarization ratio (δ^P) at 355 nm.

A new methodology was used for estimating the depolarization errors such as the systematic error of the volume linear depolarization ratio (δ) (minimum and maximum of the δ histogram, Figure 1, provided by the Polarimetric Lidar Simulator developed by Bravo-Aranda et al., 2016). The simulator is based on the Stokes-Müller theoretical basis presented by Freudenthaler, 2016 and the Monte Carlo technique.

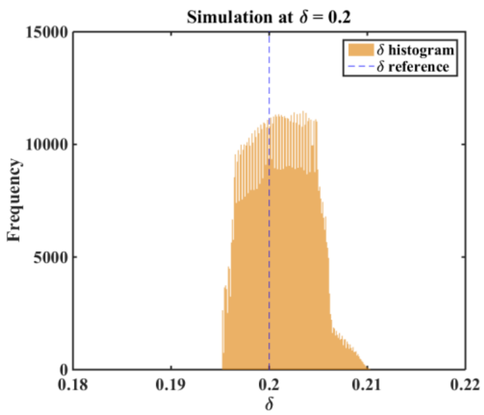

Figure 1. δ histogram of IPRAL provided by Polarimetric Lidar Simulator using a δ reference of 0.2.

The high standard performance of IPRAL Raman lidar were evaluated and evidenced by very good agreements found between the AOD derived from IPRAL and Cimel sun-photometer measurements as well as β-AE and extinction-related (α-AE) Cimel Angström Exponent (Table 1), pointing to a fine-mode aerosol-particle predominance.

Table 1. IPRAL and Cimel sun-photometer Aerosol Optical Depth (AOD) comparison at two different wavelengths on July 2, 2015.

	IPRAL		Cimel Sun-photometer	
AOD	355nm	532nm	340nm	500nm
	0.78	0.43	0.77	0.45
β-AE	1.5±0.3		-	
α-AE	-		1.3±0.1	

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