# COMPARISON BETWEEN AERONET AND LIDAR MEASUREMENTS DURING AN AEROSOL EVENT IN BUENOS AIRES, ARGENTINA


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## ABSTRACT

Aerosol characterization is a key parameter to understand its several effects on climate and pollutant transport. For this purpose we use a LIDAR system in combination with a co-located AERONET sunphotometer installed at CEILAP (CITEFA - CONICET) Buenos Aires, Argentina. The aerosol optical thickness retrieved with these instruments is compared in this work. Furthermore, we study this parameter in combination with the Ångström coefficient to estimate the type of aerosol load present in the atmosphere.


## 1. INTRODUCTION

A mixture of different transport scales are routinely detected at CEILAP (CITEFA – CONICET), (34.5 S, 58.5 W, 10 m ASL). For example, dust type aerosols are observed when the transport comes from the western region of our country. Biomass burning or/and VOC type are present when the advected air masses comes from northern region of the country and Brazil. Finally, urban/industrial aerosols are observed due to the small scale transport coming from Buenos Aires Megacity.

The present works study both tropospheric and boundary layer aerosols by combining a multiwavelength elastic LIDAR system and AERONET sunphotometer for a specific event. We have chosen measurements for September 24, 2004, spring time in Buenos Aires.

## 2. INSTRUMENTS

The LIDAR system and the sunphotometer are installed in the suburbs of Buenos Aires city at CEILAP. The tropospheric LIDAR system was conceived to monitor range-resolved aerosol optical properties. Its measuring range (from 300 m to 10 km ASL) allows studying the complete tropospheric aerosol column. The LIDAR emission system is a solid state Nd:YAG laser (Continuum Surelite III P-IV), with 650 mJ optical power at 1064 nm and 10 Hz repetition rate. Beam expanders are used to reduce the overall beam divergence. The backscattered radiation is collected by an f/2, 1 m focal length Newtonian telescope and focused into a 1 mm of diameter optical fiber. The laser beam is sent parallel to telescope field of view. The distance between optical axes is about 30 cm. Therefore the blind zone is approximately 300 m. A detailed system scheme is described in [1].

AERONET (NASA) is a federated international network of sun/sky photometers [2]. Data is available online in near real-time mode [3]. The measurements reported in this paper were acquired with the automatic scanning sunphotometer CIMEL described in [2].

## 3. RESULTS

We can see in Figs. 1 and 2 the normalized aerosol backscatter return obtained with the 1064 nm and 532 nm channels. Boundary layer temporal evolution is clearly seen over this period. We show in Figs. 3 and 4 two aerosol backscatter profiles obtained at 11 h and 14 h local time respectively. In order to validate our signals we have integrated the aerosol extinction [4] up to 10 km, considering a constant backscatter to extinction ratio ($k_p$) [5]. Two different lidar wavelengths are chosen: 1064 nm, (Fig. 5) and 532 nm (Fig. 6). Then we compare this result with sunphotometer aerosol optical thickness measurement by scaling the measured AOT (1020 nm), and AOT (500 nm) [6, 7] to the lidar wavelengths (AOT (1064 nm) and AOT (532 nm)) by means of the calculated Ångström coefficient.

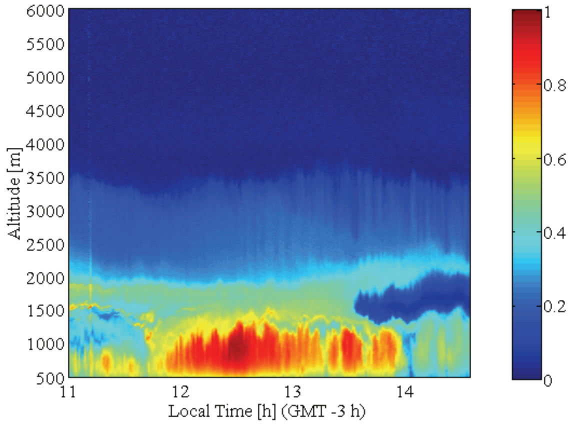


Fig. 1. Normalized aerosol backscatter at 1064 nm.

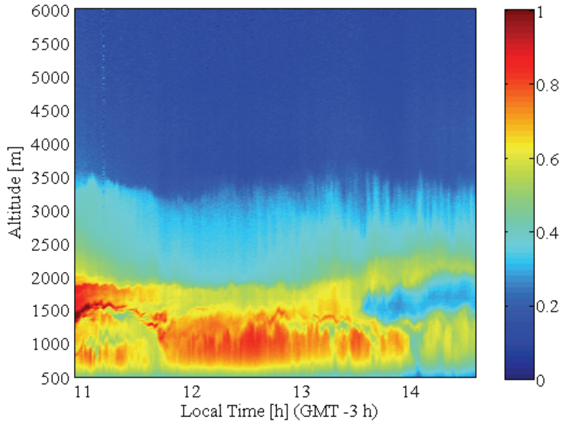


Fig. 2. Normalized aerosol backscatter at 532 nm.

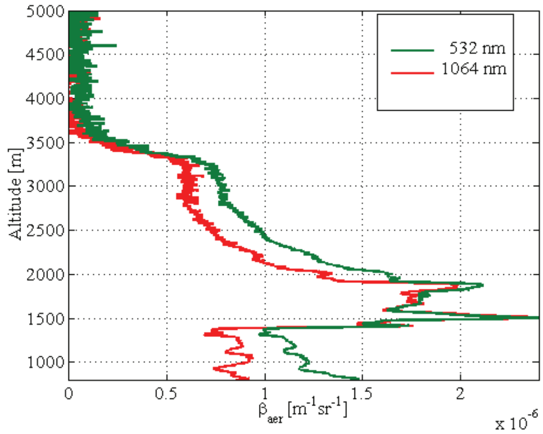


Fig. 3. Aerosol backscatter profiles at 11 h local time.

In order to classify the aerosol type we plot of the Ångström coefficient (α) versus (AOT (440 nm)). We present this scatter plot in Fig. 7. As a result three groups are formed representing three different aerosol types. The first one appears in the morning between 7 h and 14 h local time, and probably corresponds to Continental Polluted since it has 0.25<AOT<0.35 and 1<α<1.3. The second type is Urban/Industrial aerosols with 0.35<AOT<0.45 and 1.3<α<1.5. Continental Clean type is present during the afternoon. It has 0.1<AOT<0.2 and 0.7<α<1 [8, 9].

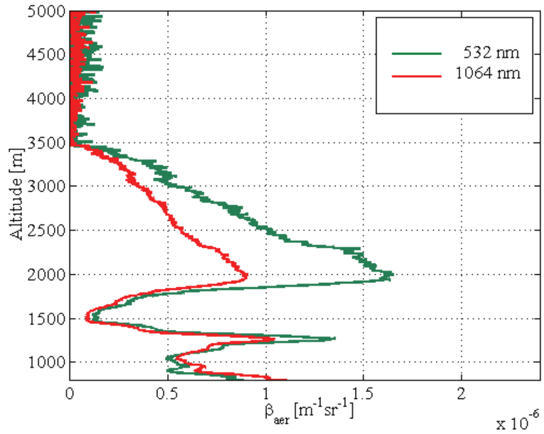


Fig. 4. Aerosol backscatter profiles at 14 h local time.

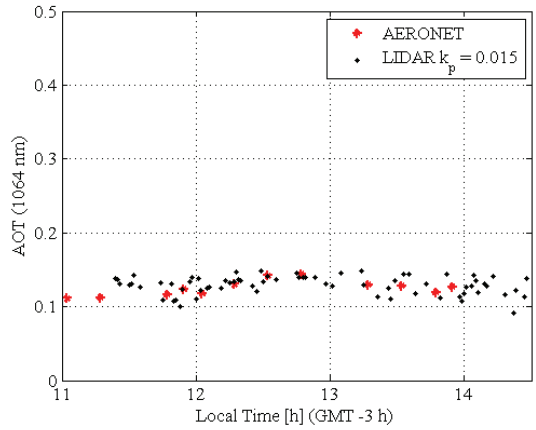


Fig. 5. AOT comparison between Lidar and Aeronet measurements al 1064 nm.

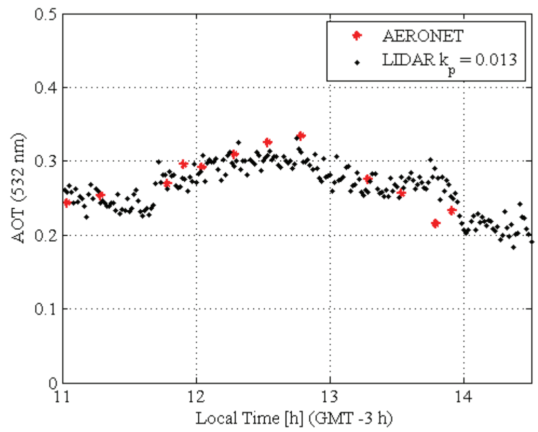


Fig. 6. AOT comparison between Lidar and Aeronet measurements at 532 nm.

A strong correlation can be observed in Fig. 8 between the time series corresponding to the sunphotometer derived water vapor content and the Ångström coefficient. Both signals decrease near 14 h local time.

Simultaneously we can observe in Fig. 9 a wind direction change from NNE – NE to NW – WNW and in the Fig. 10 the wind speed evolution. Finally, this same feature is also observed in the atmospheric pressure (Fig. 11).

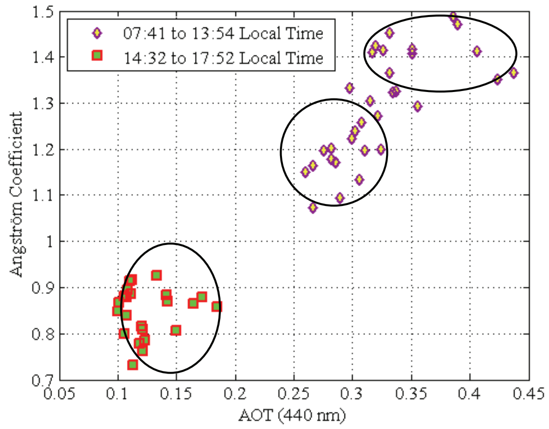


Fig. 7. Ångström coefficient versus aerosol optical thickness at 440 nm.

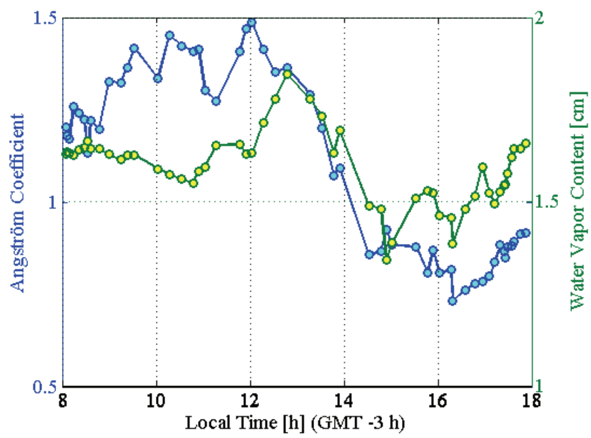


Fig. 8. Ångström coefficient and water vapor content temporal evolution.

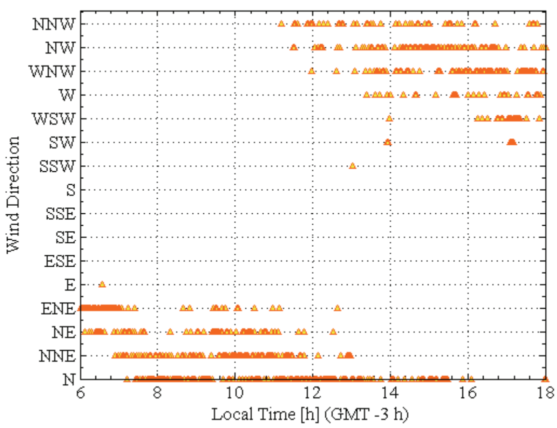


Fig. 9. Wind direction temporal evolution.

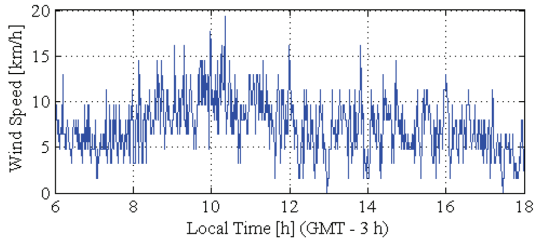


Fig. 10. Wind speed temporal evolution.

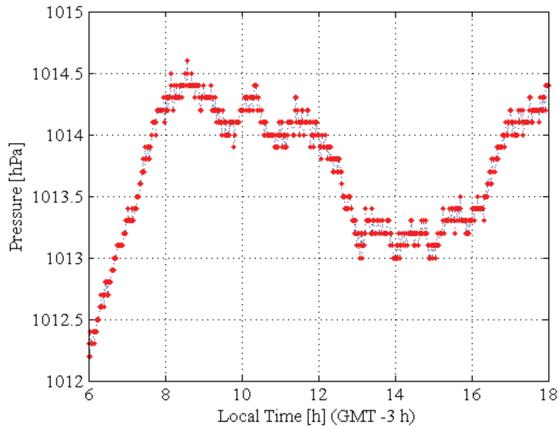


Fig. 11. Atmospheric pressure temporal evolution.

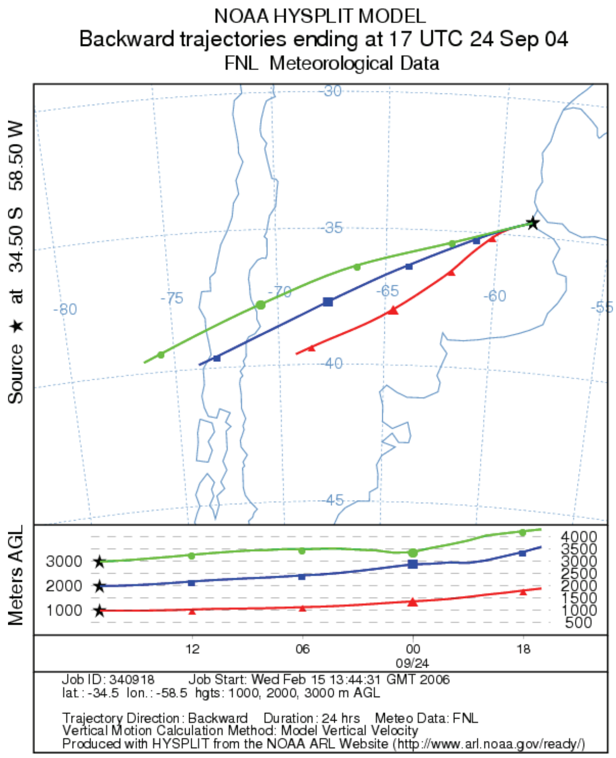


Fig. 12. HYSPLIT backward trajectory ending at 14 h local time.

HYSPLIT backward trajectory ending at 14 h and 17 h local time are presented on Figs. 12 and 13 respectively were used to retrieve the wind direction for higher atmospheric layers. It is possible observe dominant air masses coming from WSW. Fig. 14 illustrates the cyclonic condition over South America. This corresponds with the movement of air masses from WSW – SW.

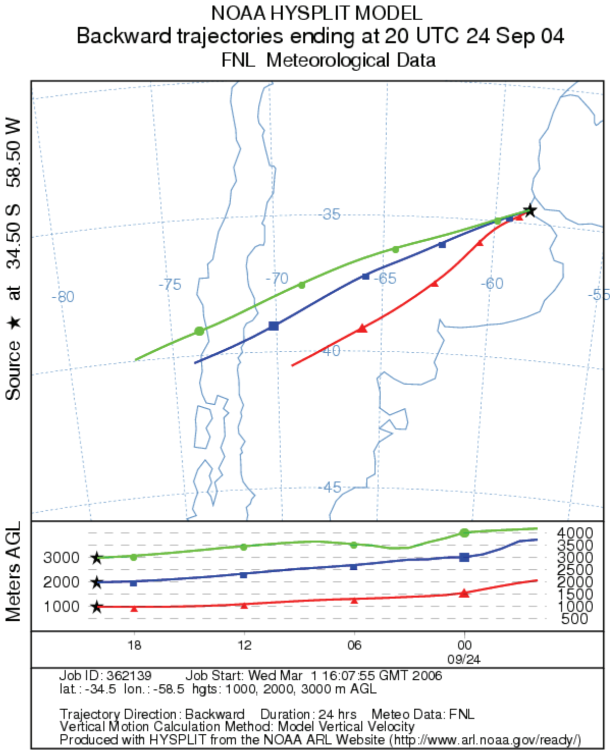


Fig. 13. HYSPLIT backward trajectory ending at 17 h local time.

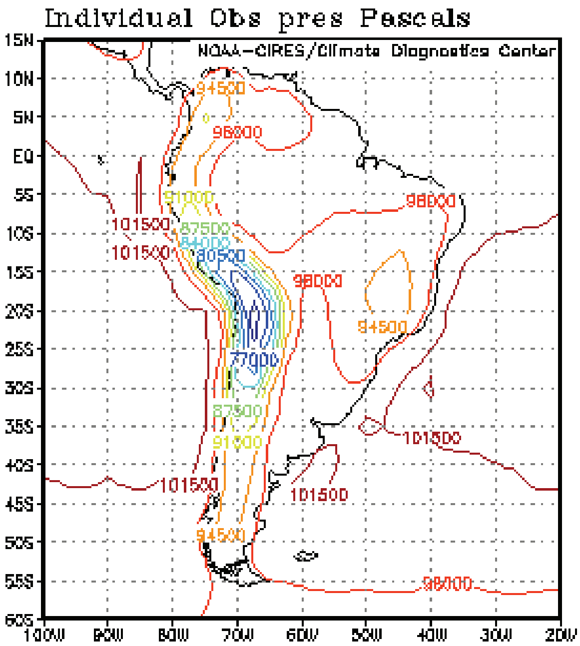


Fig. 14. Atmospheric pressure at South America.

## 4. CONCLUSIONS

We present an aerosol event where the wind carries out the polluted air masses over Buenos Aires through the Río de la Plata. This is a very normal condition in this region and it explains the low aerosol optical thickness values at Buenos Aires city.

## 5. ACKNOWLEDGMENTS

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