

The satellite-based remote sensing of particulate matter (PM) in support to urban air quality: PM variability and hot spots within the Córdoba city (Argentina) as revealed by the high-resolution MAIAC-algorithm retrievals applied to a ten-years dataset



Lara Sofia Della Ceca¹, Hebe A. Carreras², Alexei I. Lyapustin³, and Francesca Barnaba⁴

e-mail address: dellaceca.lara@gmail.com (L.S. Della Ceca)

¹Institute of Space Studies Mario Gulich, National Commission of Space Activities-National University, Argentina

²Multidisciplinary Institute of Plant Biology, CONICET and FCEfYN (UNC), Argentina

³GEST/UMBC, NASA Goddard Space Flight Center, Baltimore, MD, USA

⁴Institute of Atmospheric Science and Climate, National Research Council of Italy (ISAC-CNR), Rome, Italy



National Research Council of Italy

INTRODUCTION. Particulate matter (PM) is one of the major harmful pollutants to public health and the environment [1]. In less developed countries air quality monitoring networks are still lacking and satellite-based datasets could represent a valid alternative to fill observational gaps. The main PM (or aerosol) parameter retrieved from satellite is the 'aerosol optical depth' (AOD), an optical parameter quantifying the aerosol load in the whole atmospheric column. Datasets from the MODIS sensors on board the NASA spacecrafts TERRA and AQUA are among the longest records of AOD from space. Recently, a new algorithm called Multi-Angle Implementation of Atmospheric Correction (MAIAC) was developed for MODIS, providing AOD at 1 km resolution [2], a more suitable resolution at the urban scale than the standard 10 km-resolution MODIS AOD product.

STUDY AREA and DATASET.

MAIAC AOD retrievals over the decade 2003-13 were employed to investigate the spatial and temporal variations of atmospheric aerosols over Córdoba city (Argentina) (Figure 1).

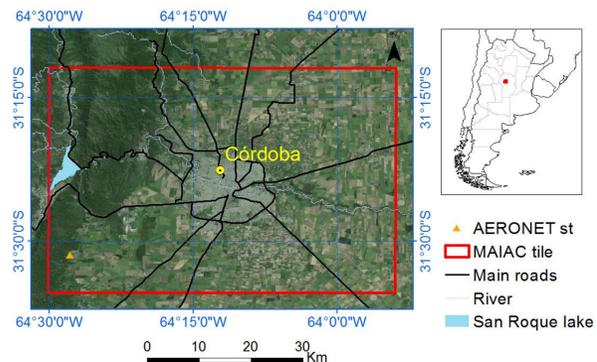
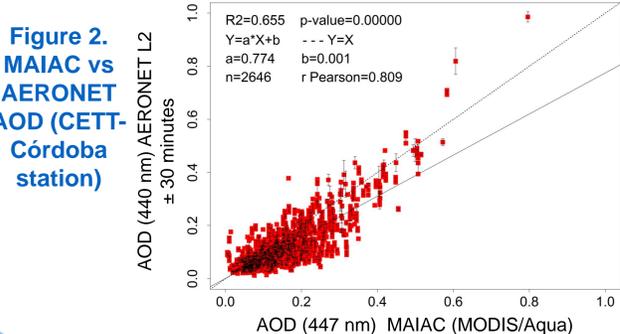


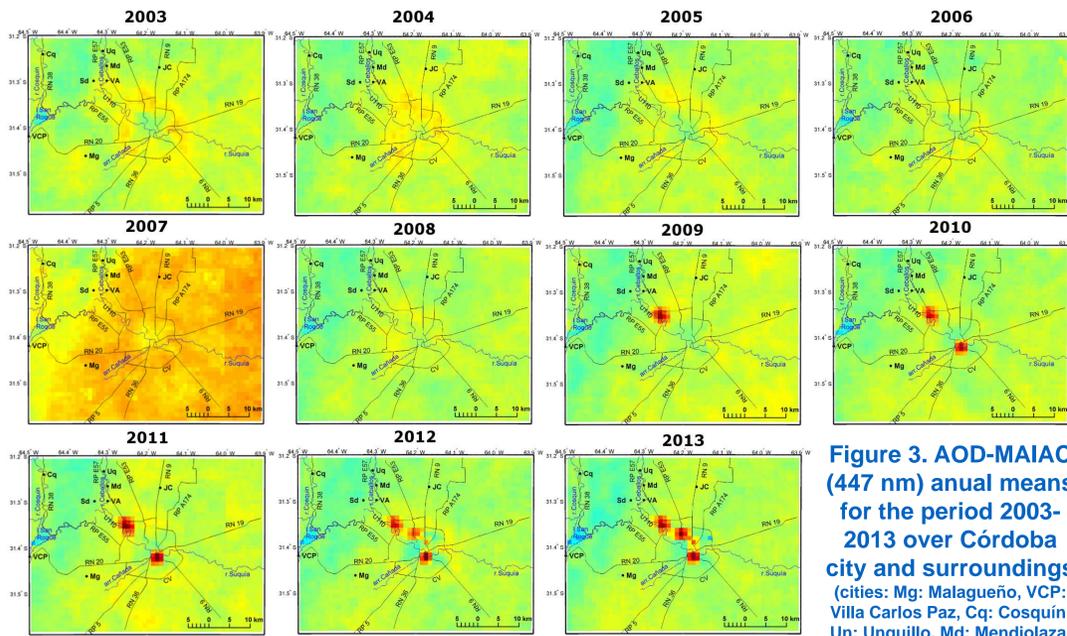
Figure 1. Location of Córdoba city in Argentina and zoom over the city area and its surroundings.

The MAIAC retrievals over the city were validated using AOD data from the Córdoba sunphotometer operating within AERONET [3]. This showed a rather good performance of MAIAC in the area (Figure 2).



CONCLUSIONS. MAIAC AOD retrievals have been shown to represent a good alternative to study the aerosols distribution over Córdoba, where ground-based PM monitoring is poor. Some specific areas in the city showed a marked increase of AOD over the time, probably due to changes in vehicular traffic flows. In addition, a seasonal cycle of AOD was observed related to meteorological conditions and to local and remote season-dependent particulate matter sources (tourism, agricultural activity, biomass burning).

RESULTS. The satellite MAIAC AOD dataset was employed to investigate the 10-years trend (Figure 3) as well as monthly patterns (Figure 4) of PM in Córdoba. A marked increase of AOD over time was observed, particularly evident in some areas of the city (hot spots, Figure 3). These hot spots are likely related to changes in vehicular traffic flows after the construction of new roads in the city urban area.



The monthly-resolved analysis (Figure 4) showed a marked seasonal cycle, evidencing the influence on AOD of both meteorological conditions and season-dependent sources. For instance, in the Córdoba rural area an increase of AOD is observed during March-April, which is the soybean harvesting period, the main agricultural activity in the region. Furthermore, higher AOD signals were observed in the vicinity of main roads during summer months (Dec. to Feb.), likely related to the increase in vehicular traffic flow due to tourism.

Long-range transport is also shown to play a role at the city scale, as high AODs throughout the study area are observed between August and October. In fact, this is the biomass-burning season over the Amazon region and over most of South America, with huge amounts of fire-related particles injected into the atmosphere and transported across the continent [4] (Figure 5).

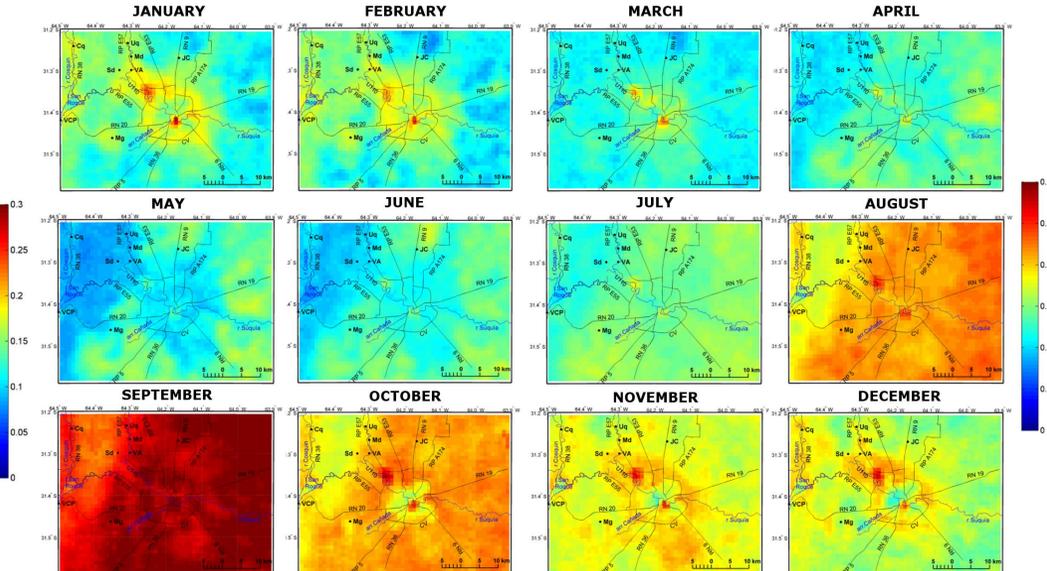


Figure 4. AOD-MAIAC (447 nm) monthly means for the period 2003-2013 over Córdoba city and surroundings (cities: Mg: Malagueño, VCP: Villa Carlos Paz, Cq: Cosquín, Un: Unquillo, Md: Mendiolaza, VA: Villa Allende, JC: Juárez Celman, Sd: Saldán).

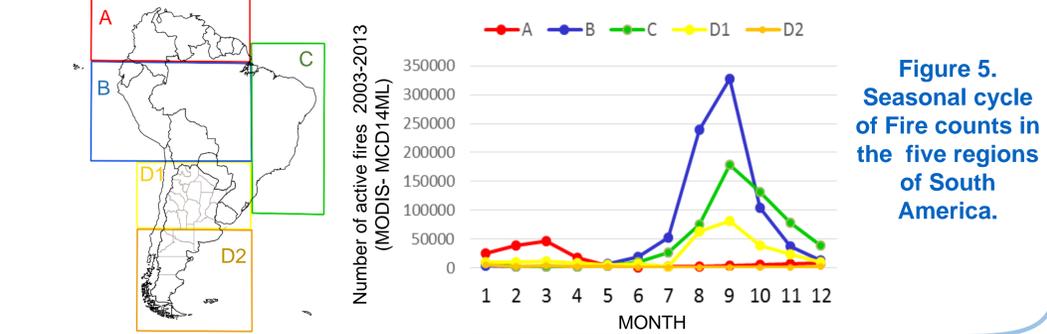


Figure 5. Seasonal cycle of Fire counts in the five regions of South America.

