





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



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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 Cordoba city (Argentina) (Figure 1).

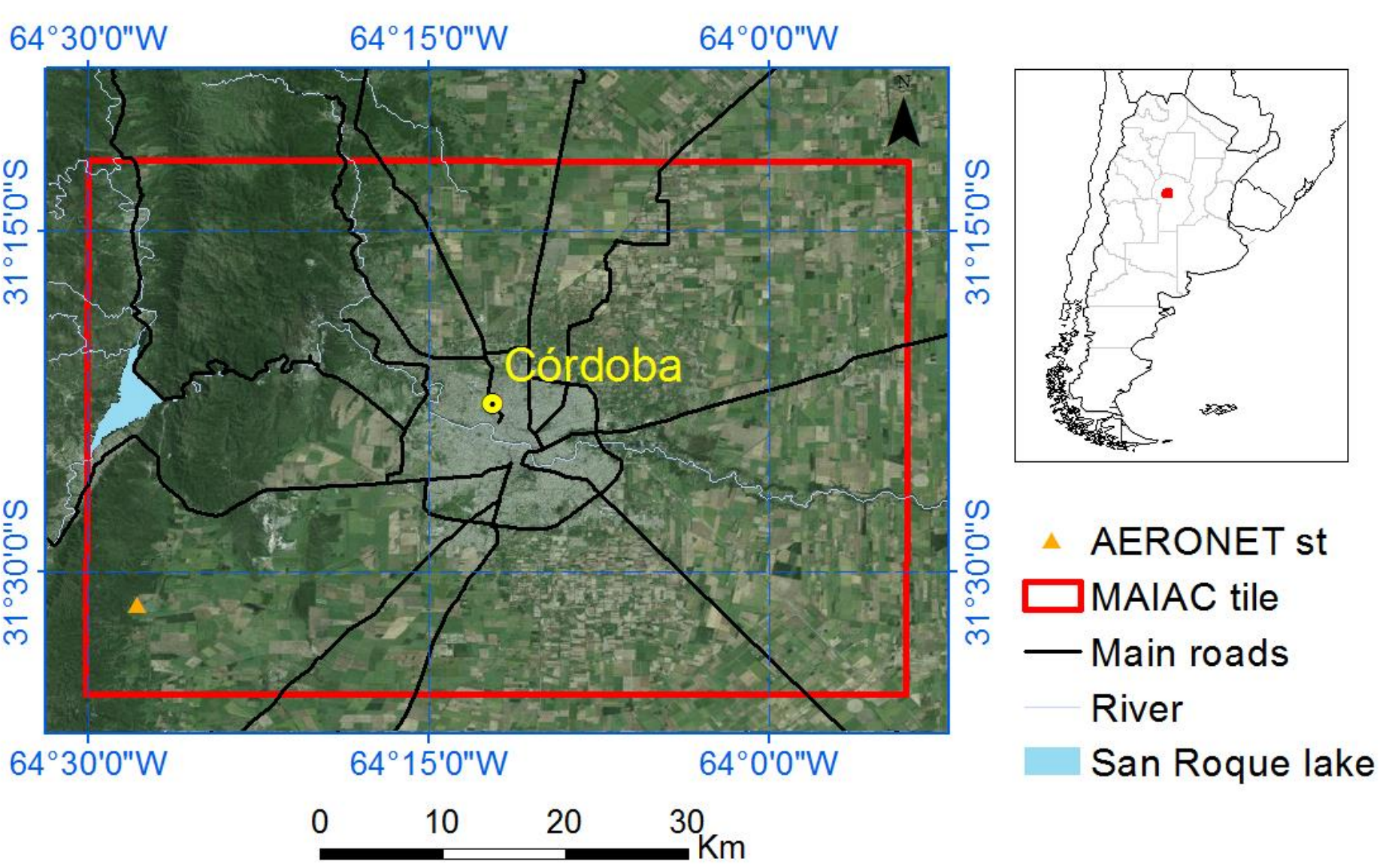


Figure 1. Location of Córdoba city in Argentina and zoom over the city area and its surroundings .

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

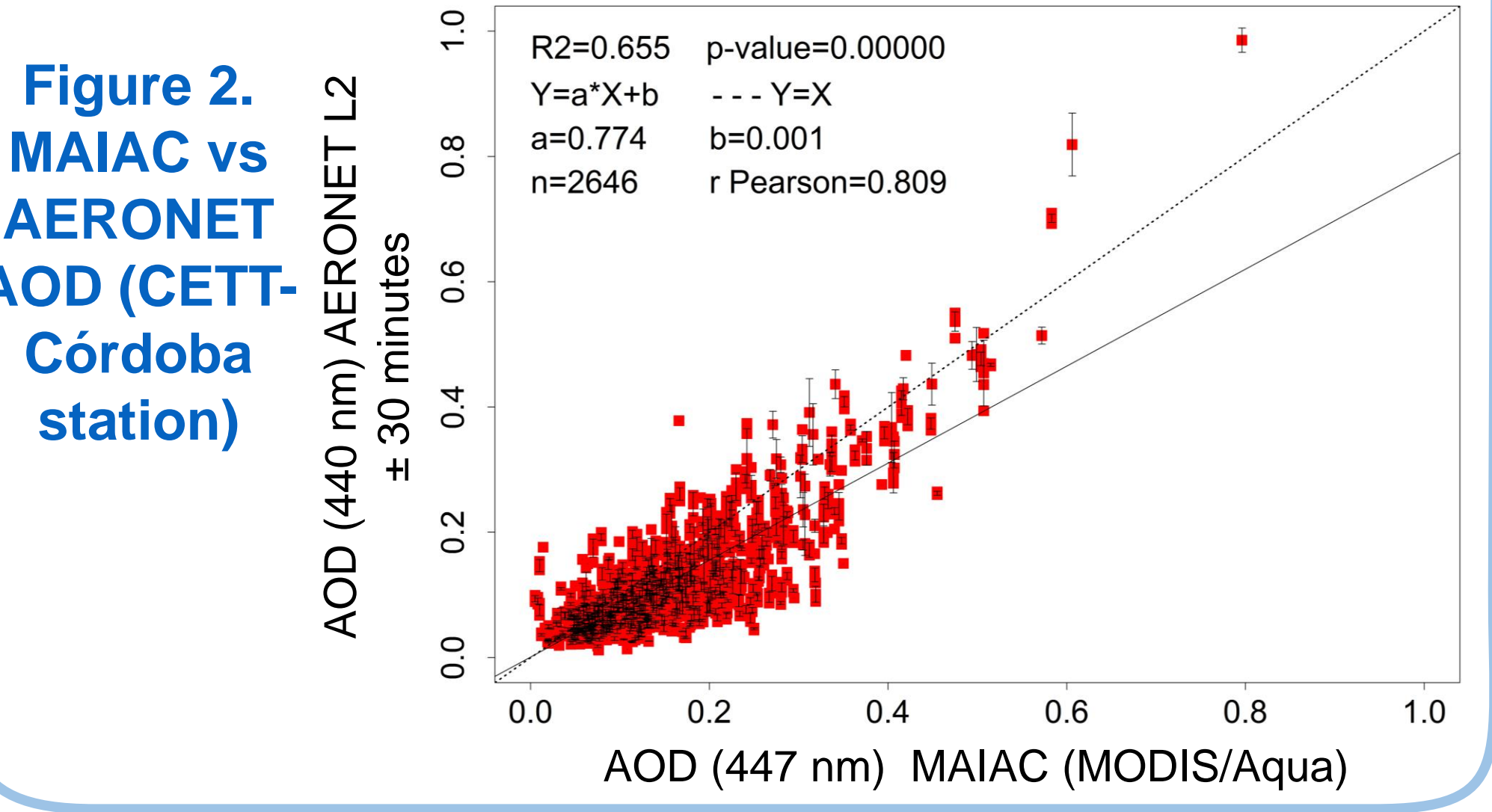


Figure 2. MAIAC vs AERONET AOD (CETT-Córdoba station)

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 Cordoba. 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.

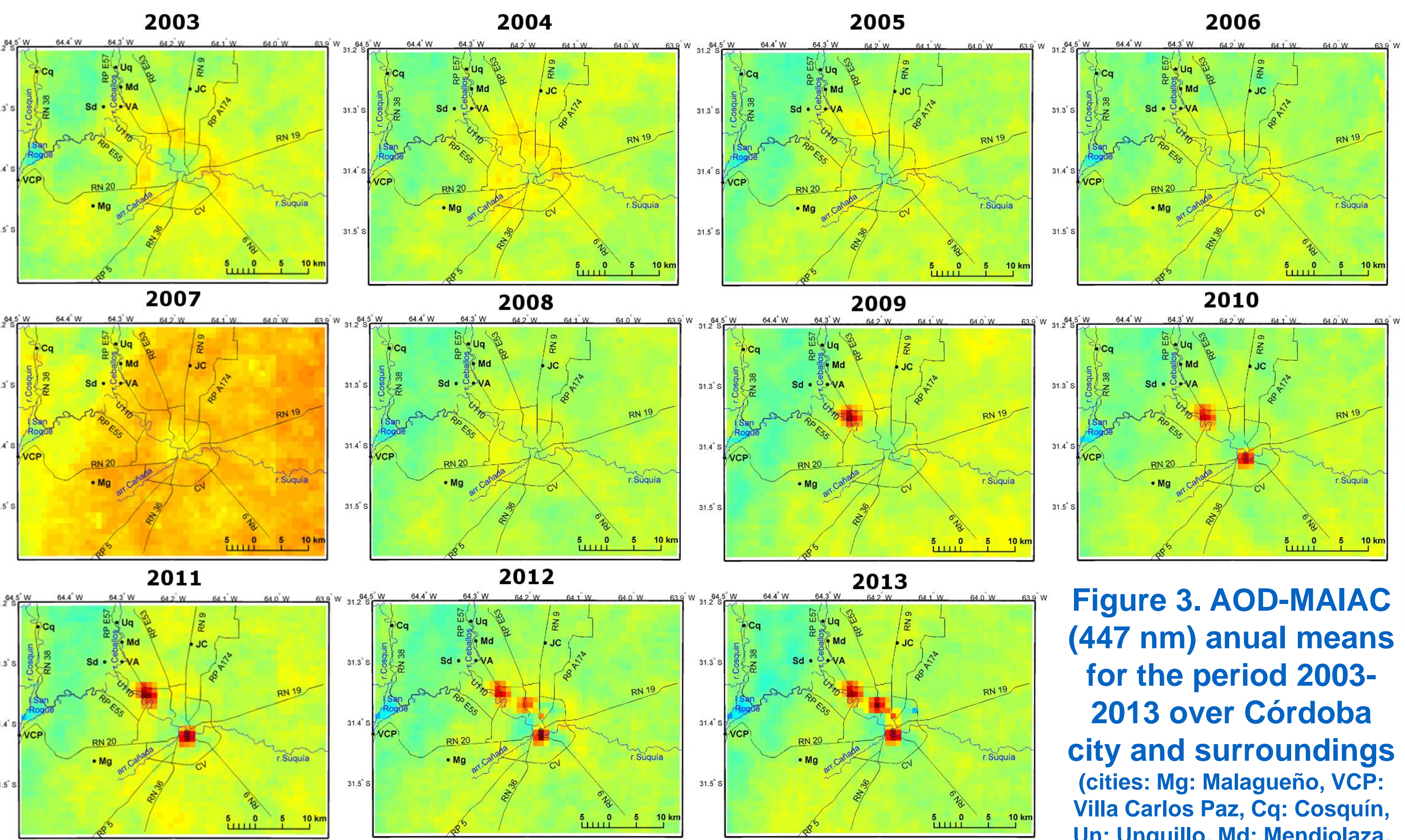


Figure 3. AOD-MAIAC (447 nm) annual means for the period 2003-2013 over Córdoba city and surroundings (cities: Mg: Malagueño, VCP: Villa Carlos Paz, Cq: Cosquín, Un: Unquillo, Md: Mendiola, VA: Villa Allende, JC: Juárez Celman, Sd: Saldán).

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 Cordoba 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).

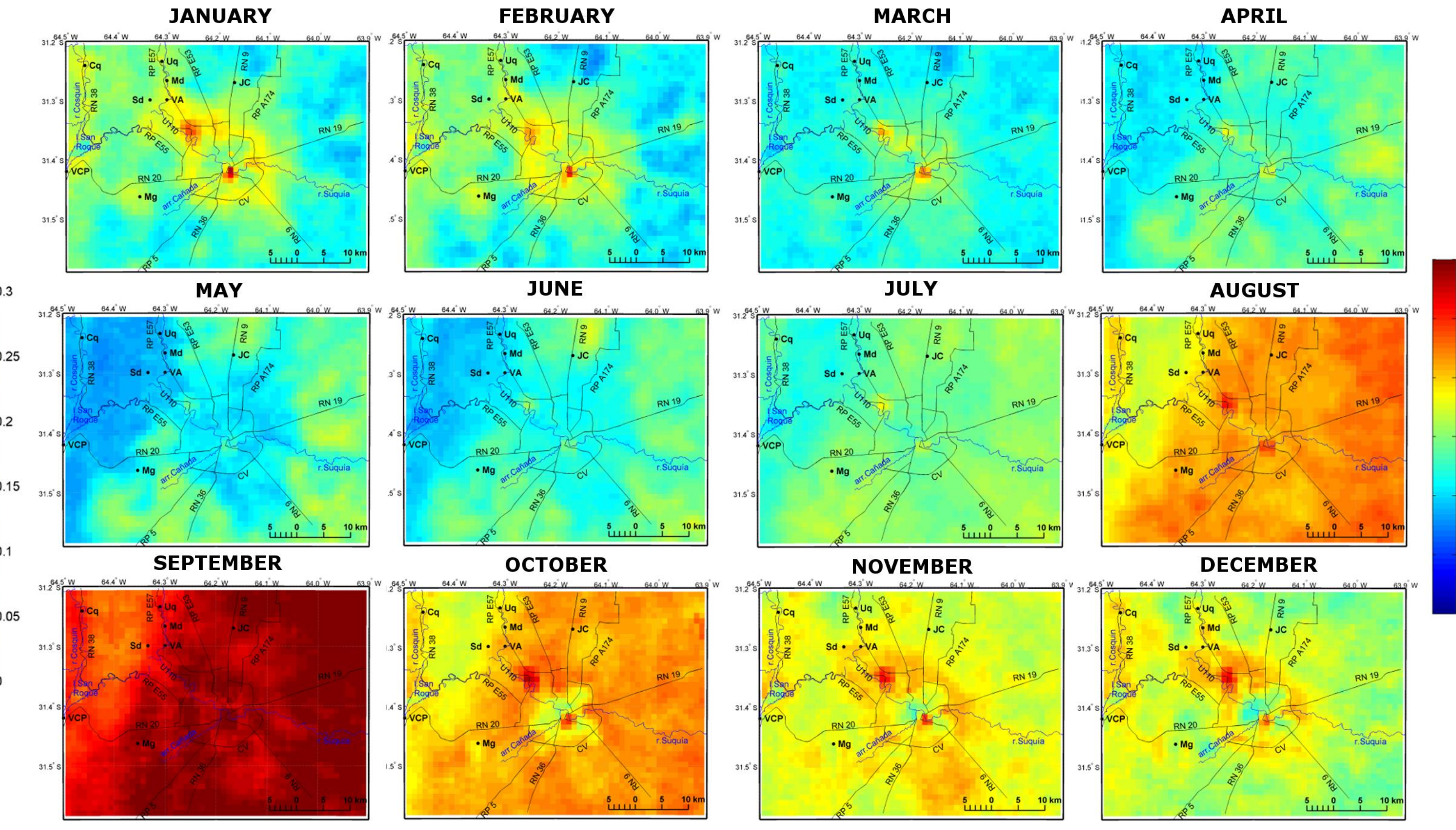


Figure 4. AOD-MAIAC (447 nm) monthly means for the period 2003-2013 over Córdoba city and surroundings (cities: Mg: Malagueño, VCP: Villa Carlos Paz, Cq: Cosquín, Un: Unquillo, Md: Mendiola, VA: Villa Allende, JC: Juárez Celman, Sd: Saldán).

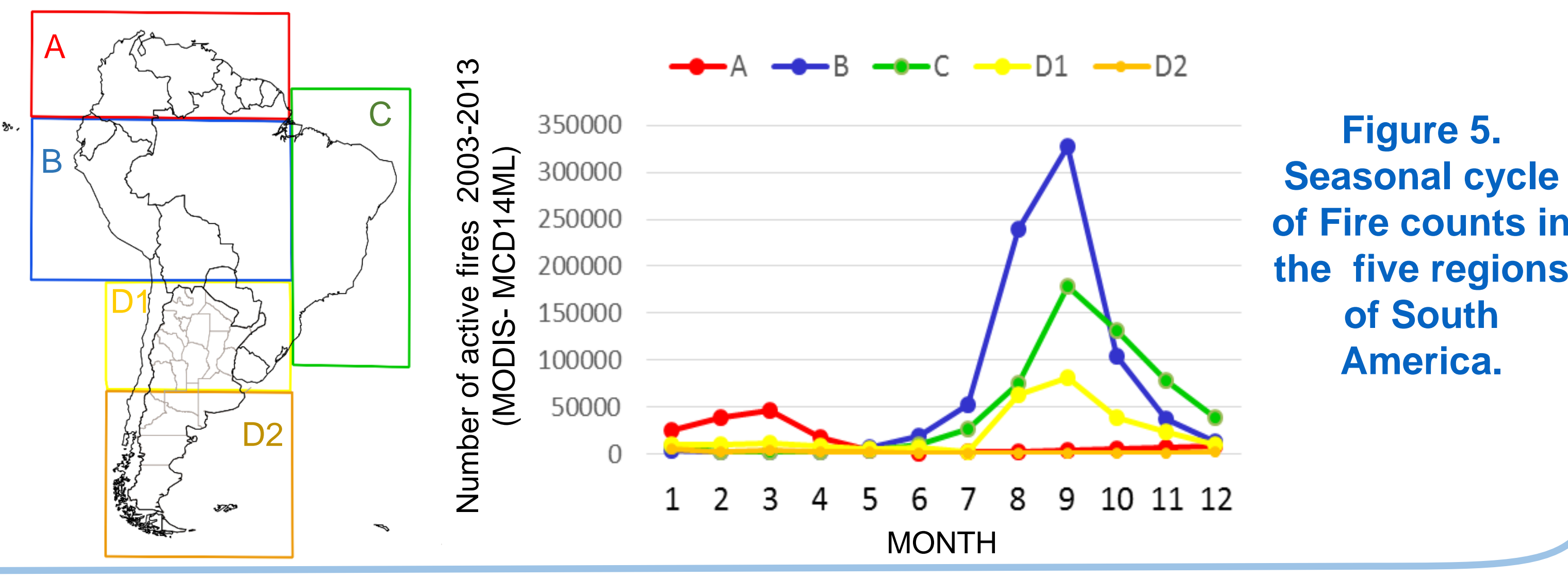


Figure 5. Seasonal cycle of Fire counts in the five regions of South America.