The aerosol in Cairo (Egypt) as seen by AERONET and MODIS

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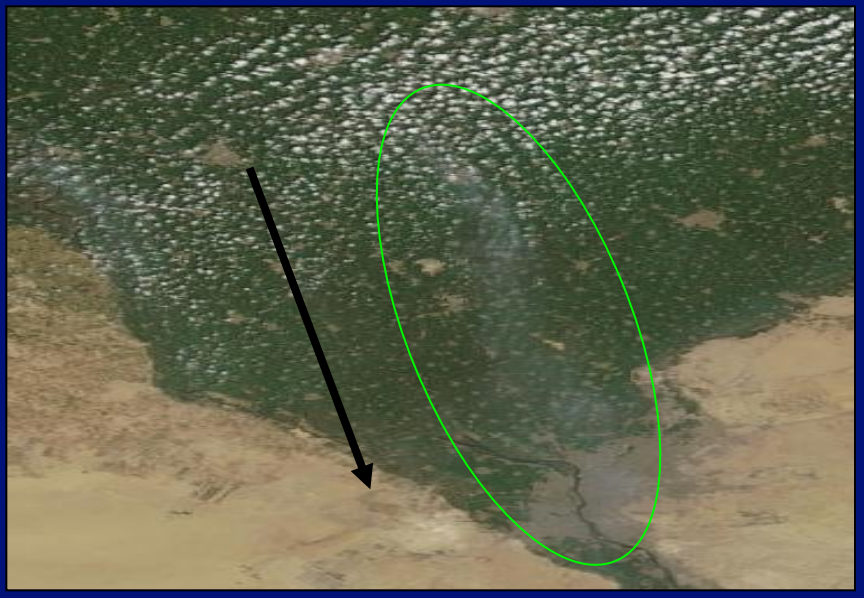
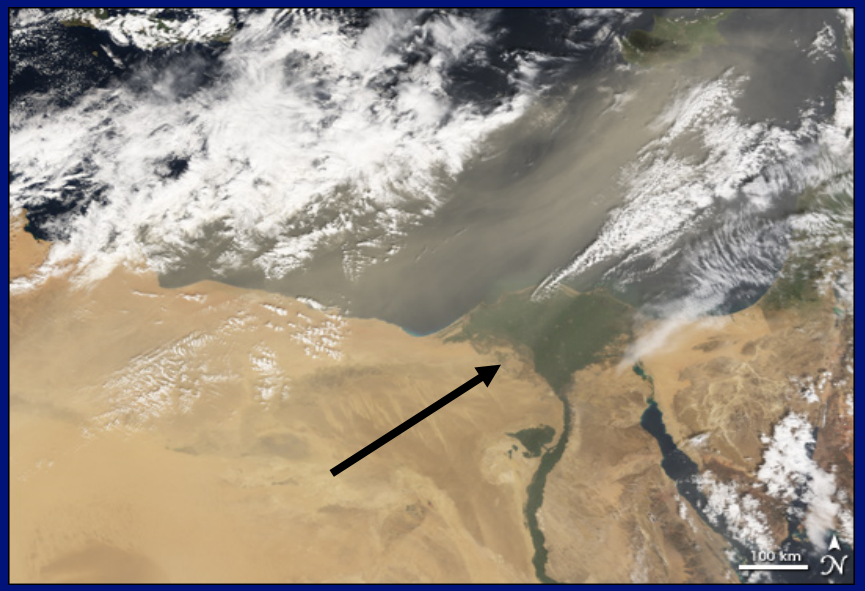
Pop: >16 millions





‘Black Cloud’

Desert Dust

Cairo Aerosol CHaracterization Experiment (CACHE)

Oct. 2004 – Mar. 2006

***QUESTIONS*:**

IMPACTS…

1) ON RADIATIVE TRANSFER?

- **Integrated content (AOD)**
- **Radiative forcing (TOA and BOA)**
- **Role of the various aerosol components**
- **Seasonality**
- **…**

2) ON HEALTH? **(ground level)**

- **Concentration (PM10, PM1)**
- **Composition**
- **Size distribution**
- **Source apportioning**
- **…**

Remote sensing

Surface measurements

a

b

c

Vertically integrated measurements

CIMEL sun-tracking photometer (AERONET)

+

MODIS (AQUA & TERRA)

Sun-tracking photometer (AERONET)

14 months of continuous measurements, more than 750 quality assured (level 2) point data

DIRECT MEASUREMENTS:

- AOD @ 440,675, 870, 940 and 1022nm
- Angström exponent
- Diffuse sky radiance in the solar almucantar (4λ)

INVERSION PRODUCTS (level 2 quality assured):

- size-resolved concentration
- refractive index
- optical properties (SSA, g)
- radiative forcing (F_{TOA} and F_{BOA})

MODIS

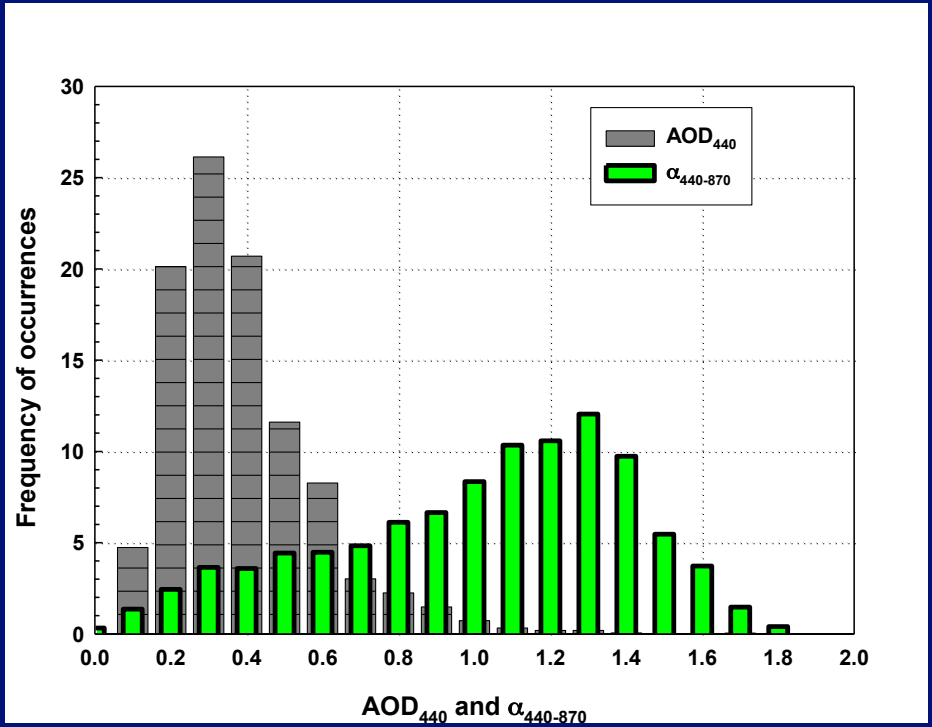
2000-2008 (2946 point data for Cairo) (C005-Level 2 data)

Reflectance measurements

AEROSOLS INVERSION PRODUCTS:

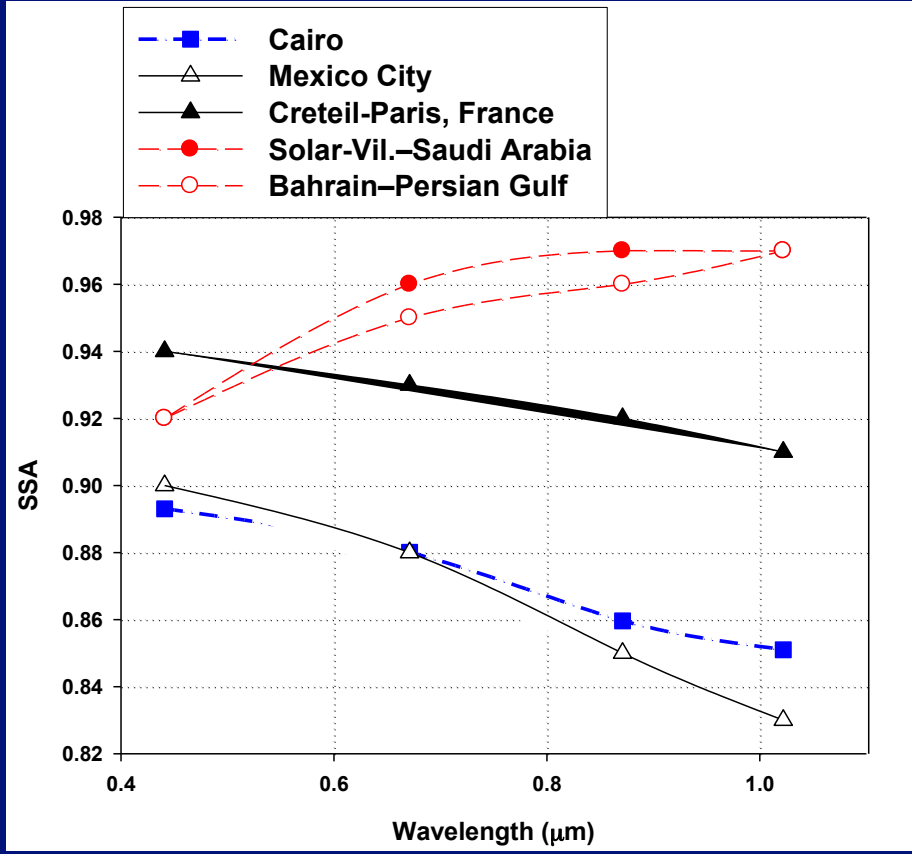
- AOD @ 470, 550, 660, 940 and 1022nm
- Angström exponent (470/660nm)

AOD, Angström exponent, SSA

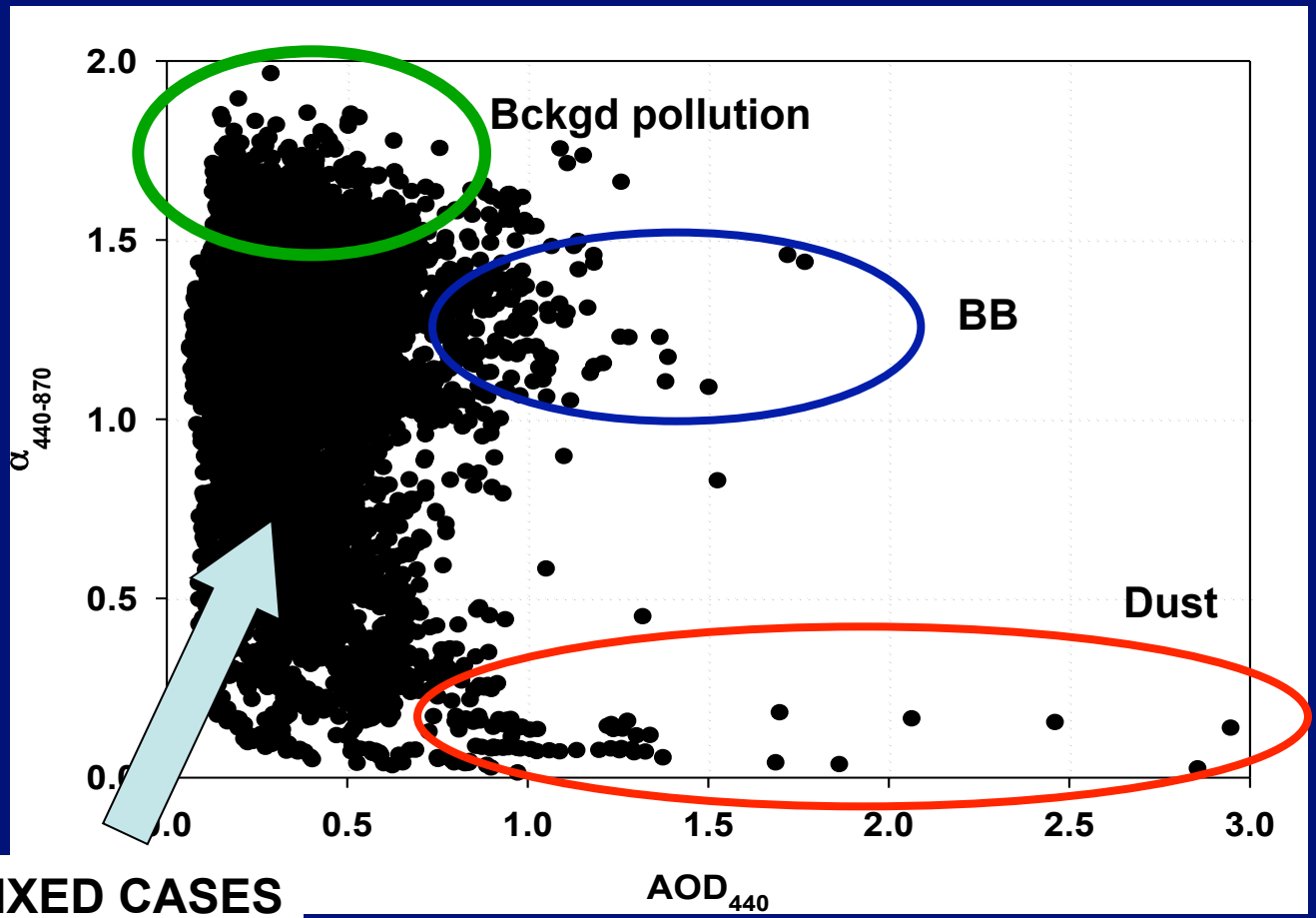


Statistical distribution

Yearly averaged SSA: Comparison with the data of Dubovik et al. (2002).

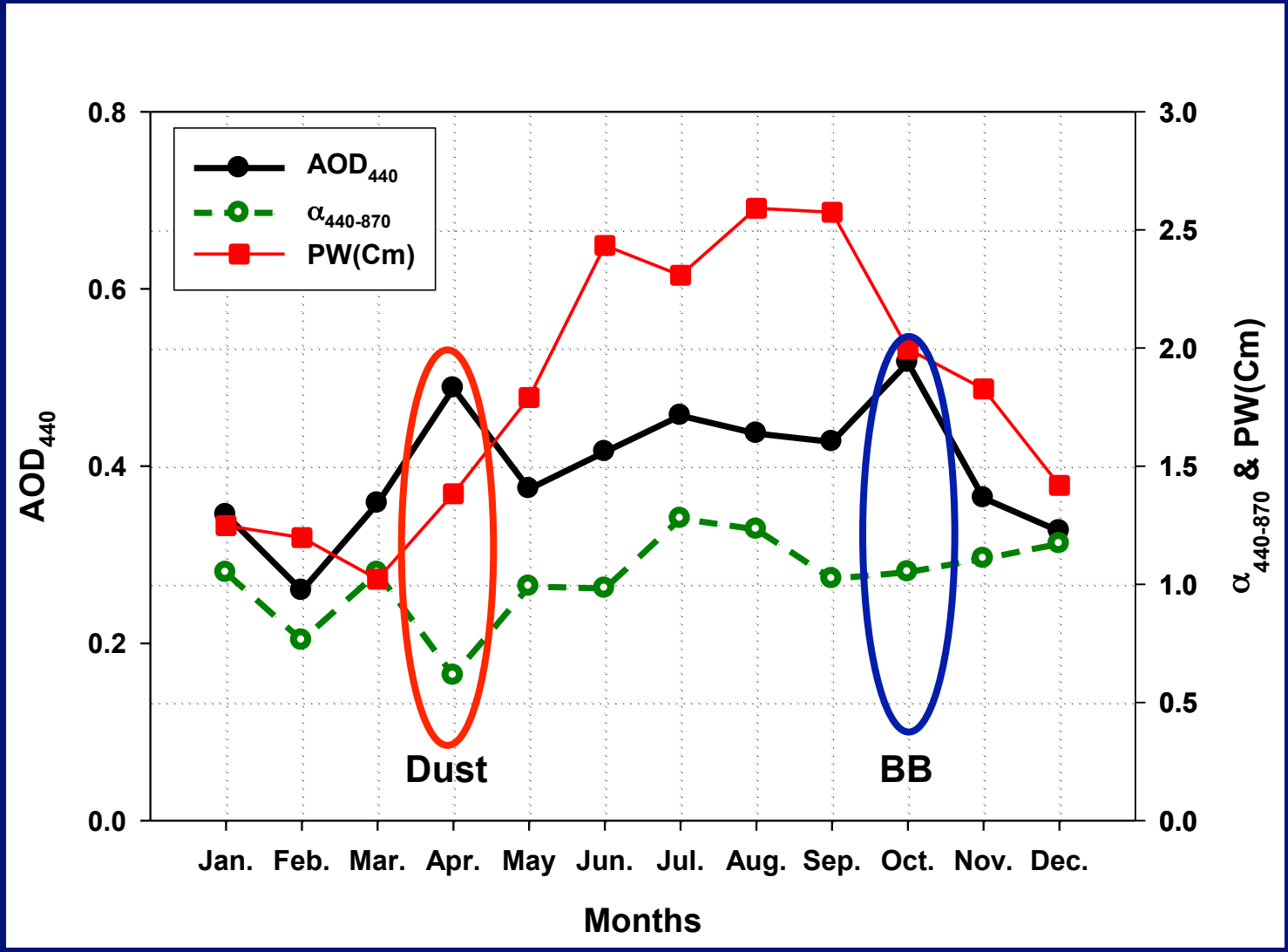


Correlation between α and AOD



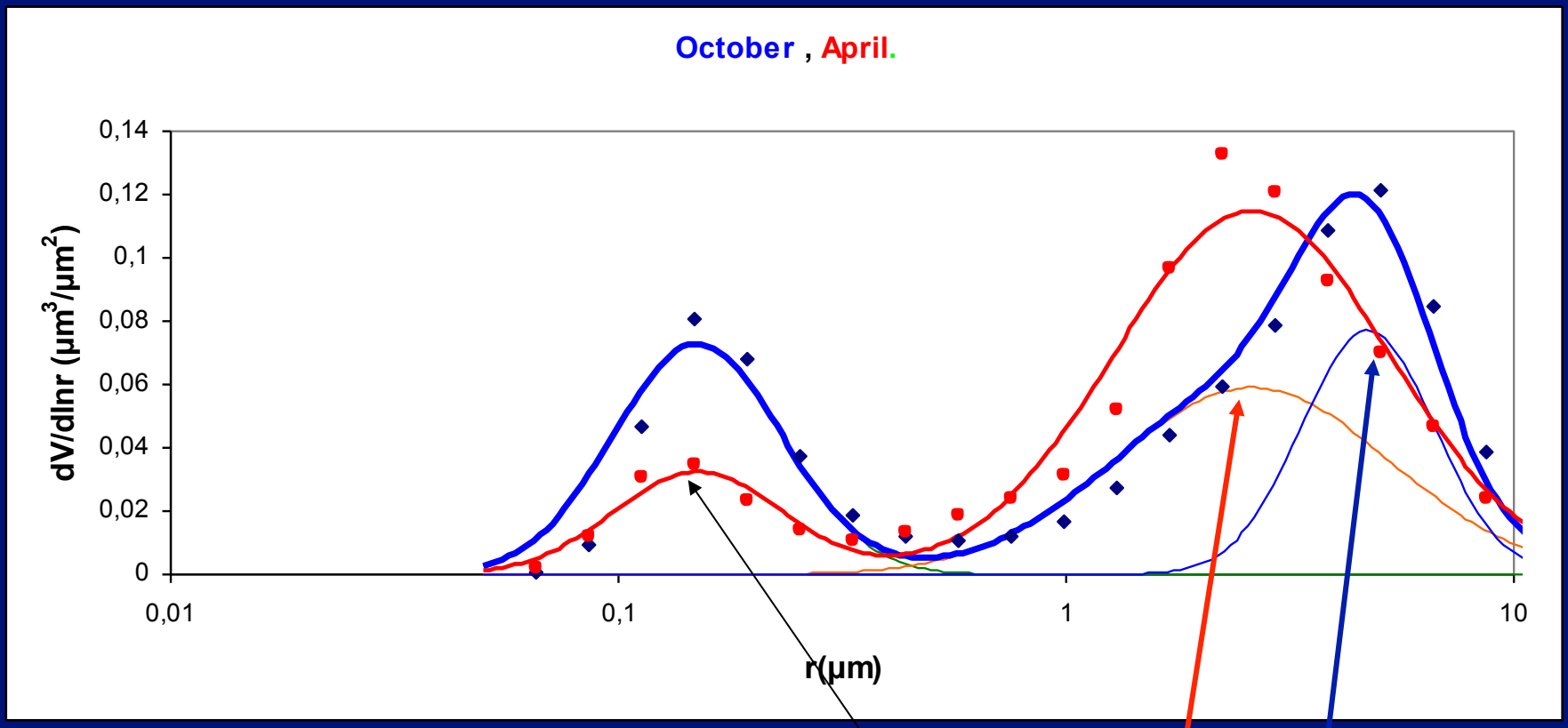
(El Metwally,et al., 2008)

Seasonal variations



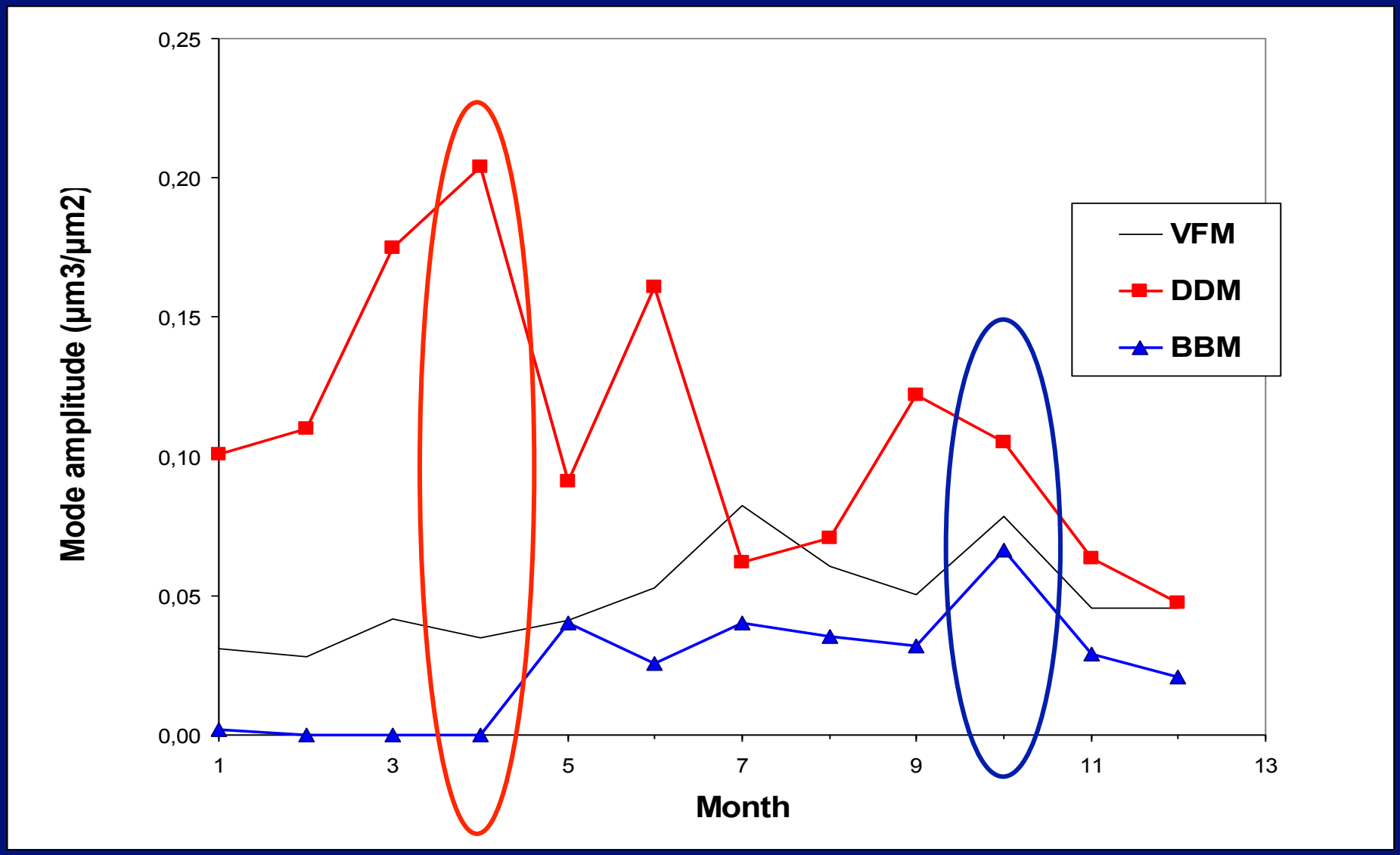
Month averages

(El Metwally,et al., 2008)

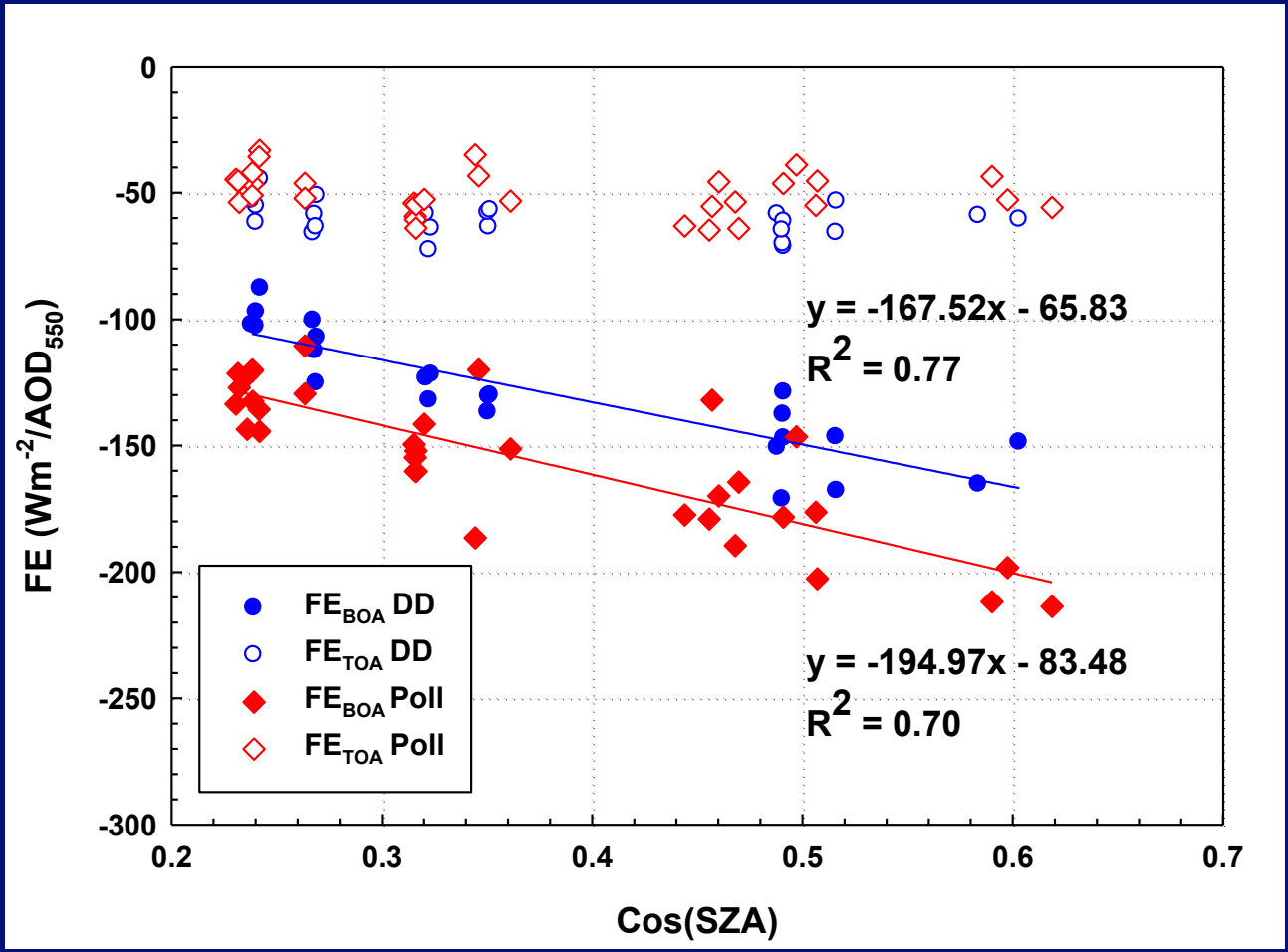


	VF	DD	BB
gmr (µm)	0,15	2,6	4,7
gsd	1.5	2.0	1.4

Month averages



Influence of the aerosol composition on the radiative Forcing Efficency (@TOA and BOA)



Contribution of the Desert dust and Biomass burning components to the month averages of the BOA radiative forcing (El Metwally et al., 2010)

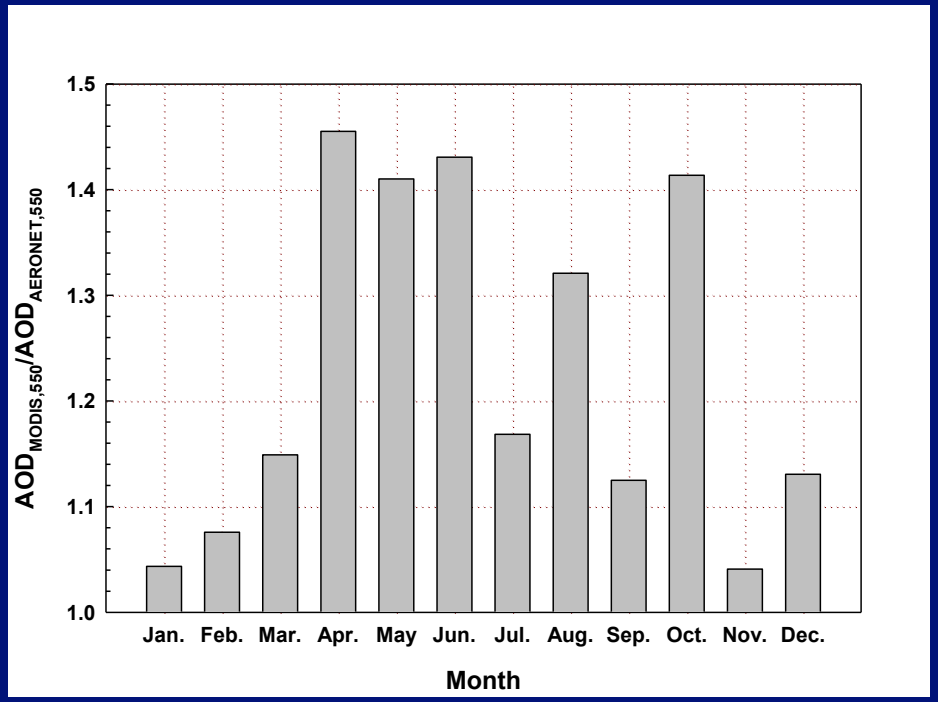
Month	RF_{others}	RF_{DDM}	RF_{BBM}
Jan	63%	35%	1%
Feb	62%	38%	0%
Mar	51%	49%	0%
Apr	47%	53%	0%
May	51%	26%	24%
June	45%	41%	14%
Jul	55%	19%	26%
Aug	55%	22%	23%
Sept	49%	33%	18%
Oct	42%	25%	33%
Nov	59%	21%	20%
Dec	66%	17%	16%
	54±8%	*32±12%*	*15±12%*

(El Metwally et al., 2010)

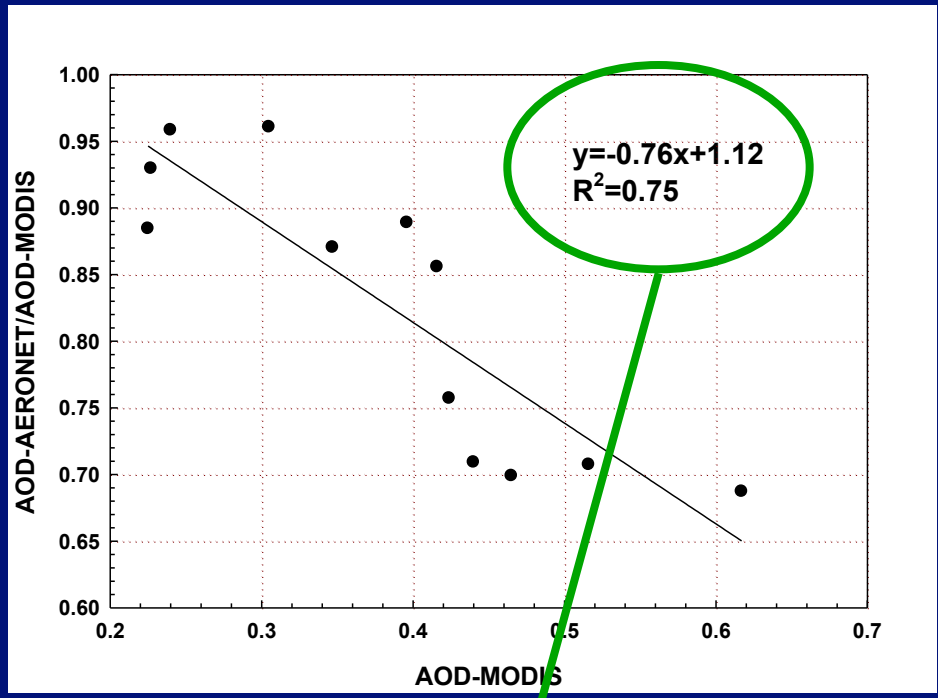
All-year round, Desert Dust is a significant component of the aerosol in Cairo

Biomass burning is more seasonal

Comparison with MODIS
(and correcting MODIS for Cairo conditions)



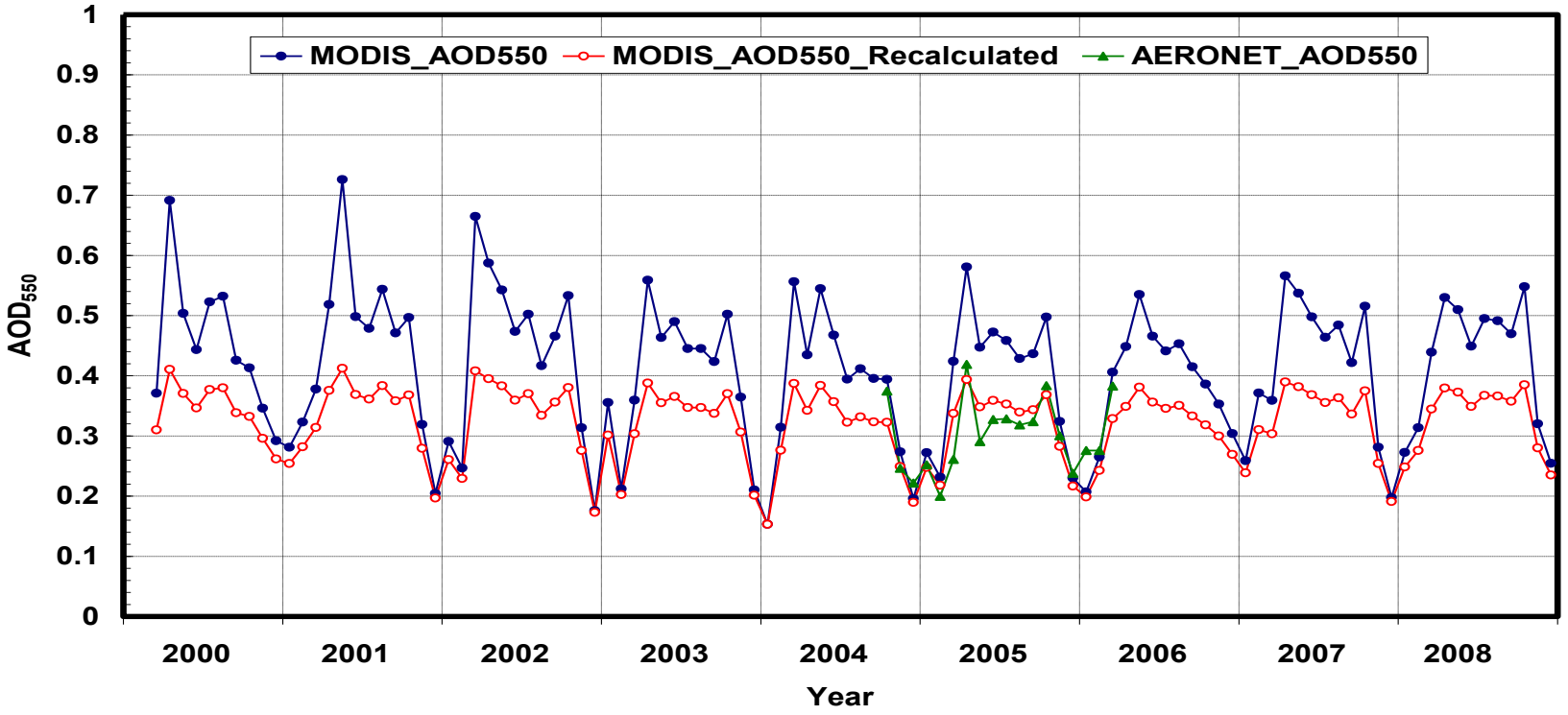
Ratio of the month averages of the AOD at 550nm derived from MODIS to the one measured with the AERONET sunphotometer during CACHE



Correlation between the AOD ratio of and the MODIS-derived AOD550 values

Correcting the MODIS-derived AOD550

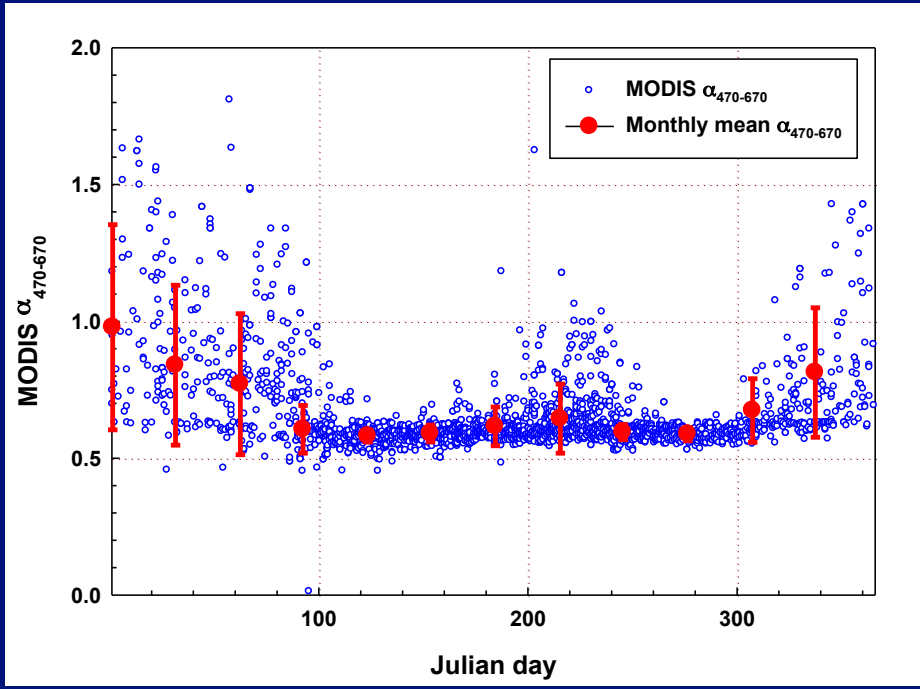
Results of the correction



(El Metwally,et al., 2010)

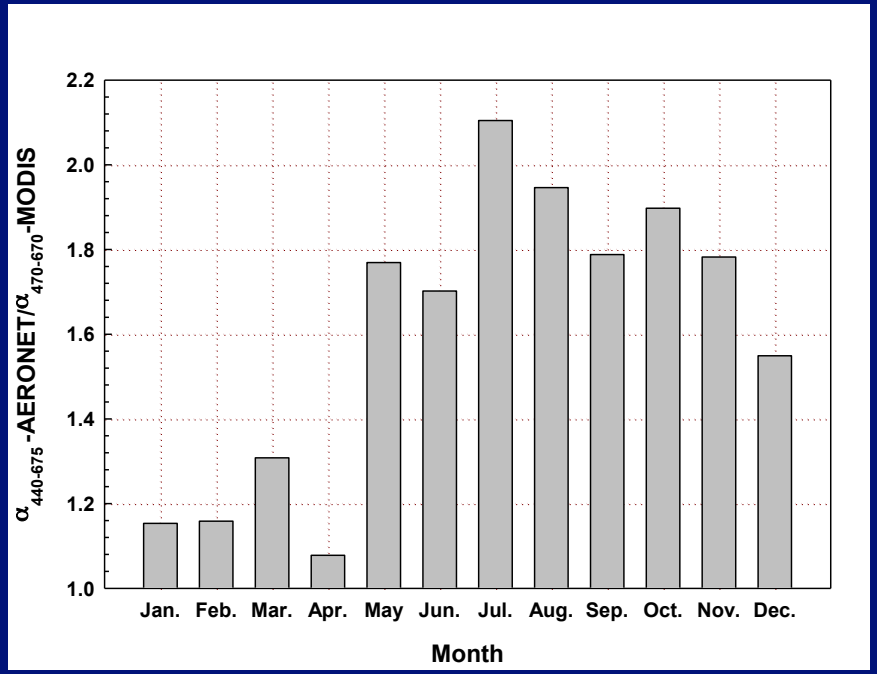
Spectral dependence of the AOD (Angström exponent)

MODIS



Daily and monthly averaged values of the Ångström exponent derived from the MODIS radiances measurements performed at 470 and 670nm between 2000 and 2008.

AERONET/MODIS



Comparison of the monthly averages of the AERONET and MODIS Angstrom exponents

Conclusions

The aerosol in Cairo is a mixture of 3 main components:

- Background pollution
- Desert Dust
- Biomass burning

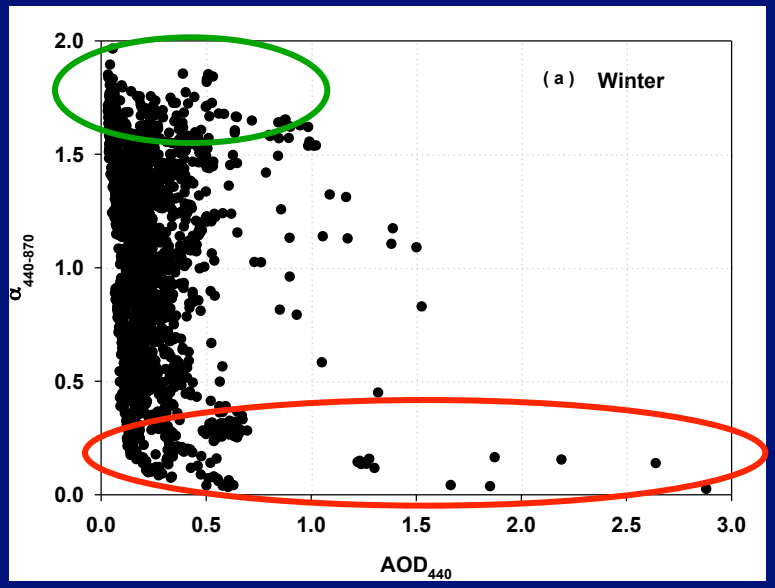
A strong aerosol variability, which is due to:

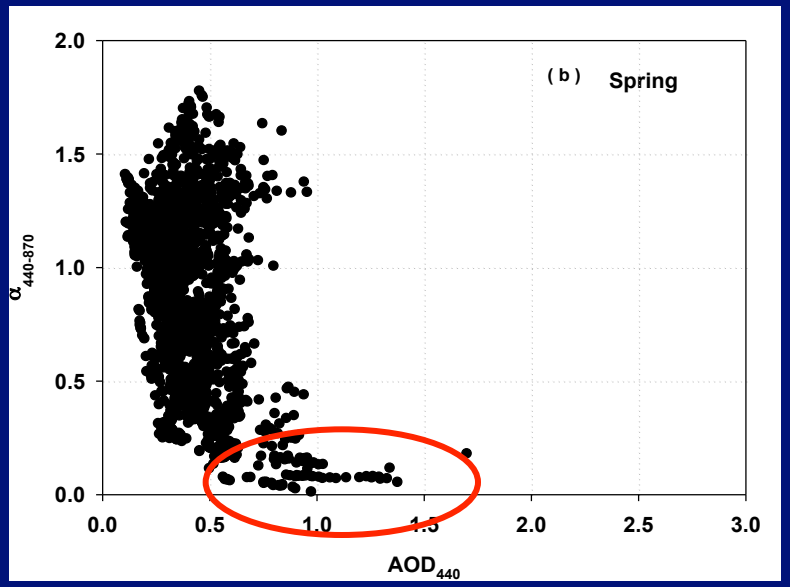
- meteorological factors (rain, insolation)
- the activation of sources external to the city
  - natural (Desert Dust)
  - anthropic (Biomass Burning)

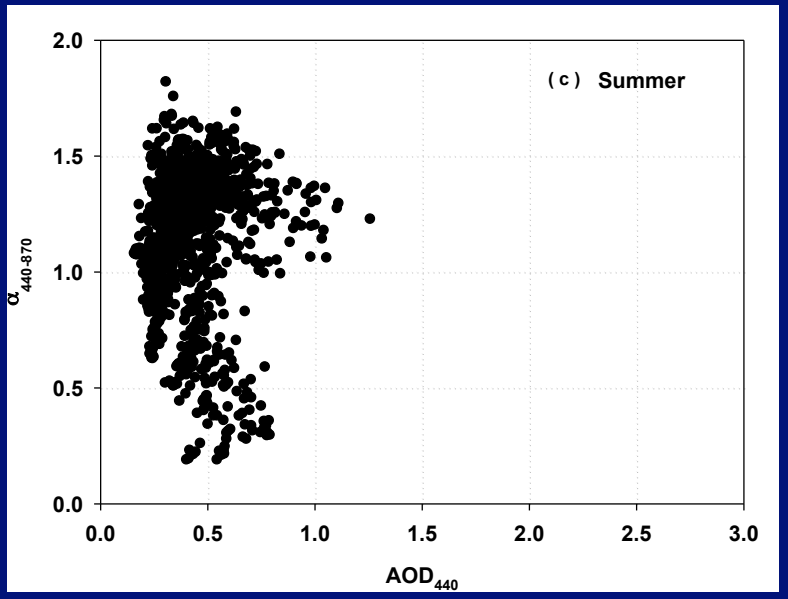
MODIS AODs can be corrected for achieving long time series, but there seems to be a problem with the aerosol models

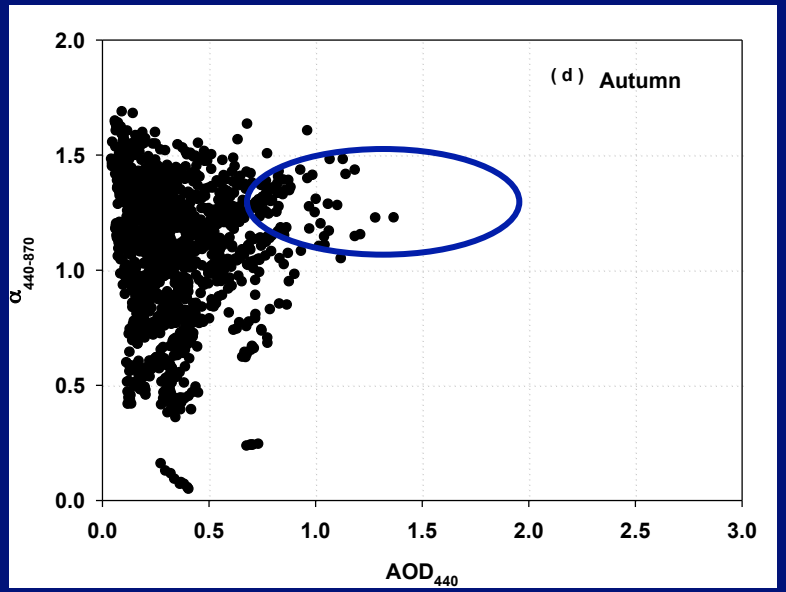
THANK YOU…..

Seasonal variations

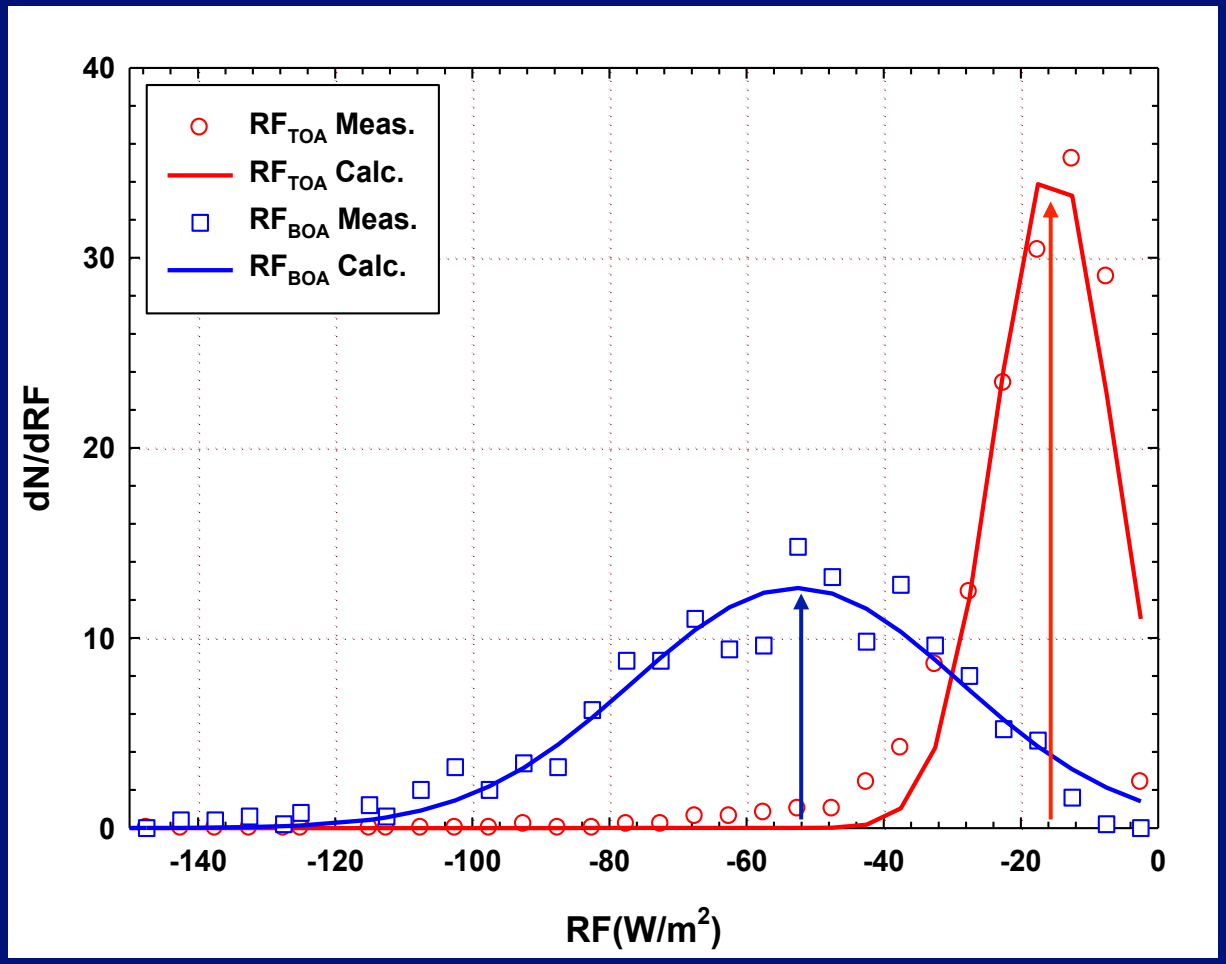








Statistical distribution of the Radiative Forcing (all data)



Cooling at TOA and at BOA, but Heating of the column