

DD3318

Variability of trends observed in Atmospheric Aerosol optical properties over Pune, India

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15MS031



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Data use Validation

Linear correlation tables (regression analysis)

AERONET: (Between all wavelengths)

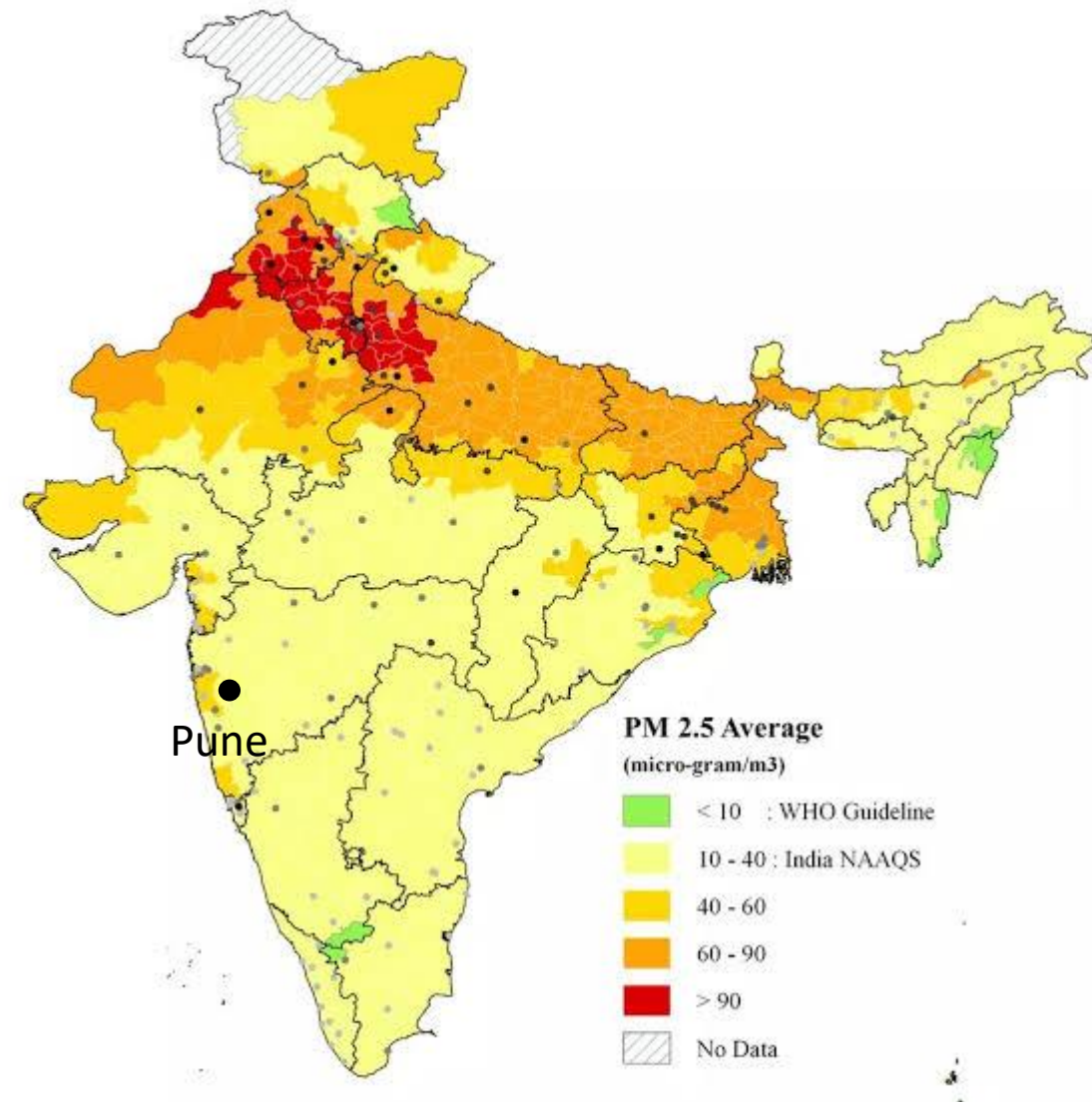
	440 nm	675 nm	870 nm	1020 nm
440 nm	1	0.999999002	0.99986068	0.999999064
675 nm	0.999999002	1	0.999837763	0.999999927
870 nm	0.99986068	0.999837763	1	0.999841493
1020 nm	0.999999064	0.999999927	0.999841493	1

Between all sensors

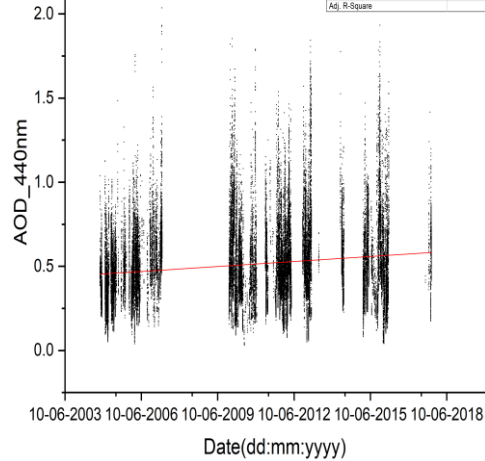
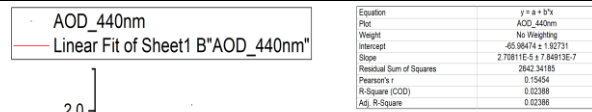
	AERONET	AQUA	TERRA	MISR	MERRA
AERONET	1	0.68485732	0.731497	0.605072	0.666724
AQUA	0.684857323	1	0.888874	0.5394242	0.414804
TERRA	0.731497301	0.88887398	1	0.5388499	0.459666
MISR	0.605072006	0.53942416	0.53885	1	0.643513
MERRA	0.666723739	0.41480428	0.459666	0.6435134	1

Pune meteorology

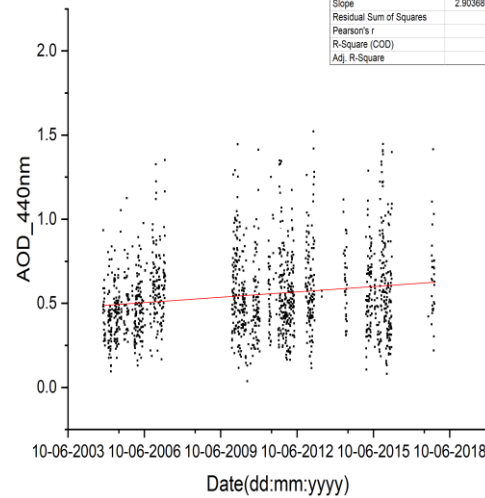
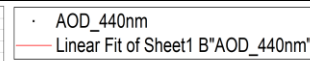
- Ninth most populous city in the country with an estimated population of 3.13 million
- Lies on the western margin of the Deccan plateau (leeward side), at an altitude of 560 m (1,840 ft) above sea level.
- Hot semi-arid to tropical wet and dry
- Maximum temperatures sometimes reaching 42 °C in summer
- Heavy dusty winds in May, with humidity remaining high
- Moderate rainfall averaging 722 mm.
- Winter mean temperatures of 20 °C dropping at night up to 6 °C.



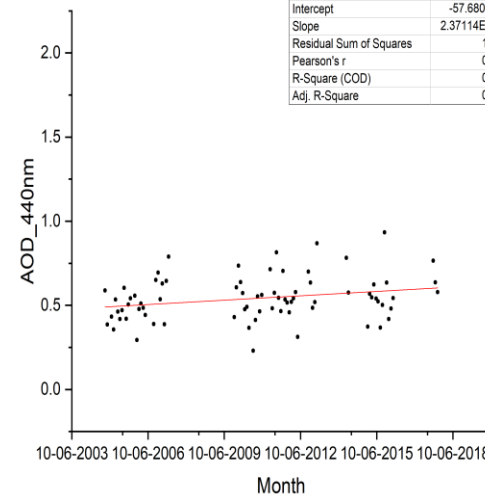
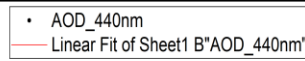
Aerosol Optical Depth (AOD) interannual variations: AERONET



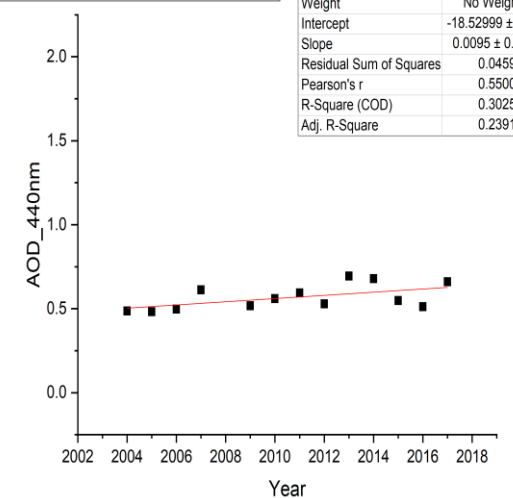
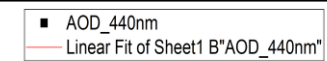
All Data ($m=0.0098 \text{ yr}^{-1}$)



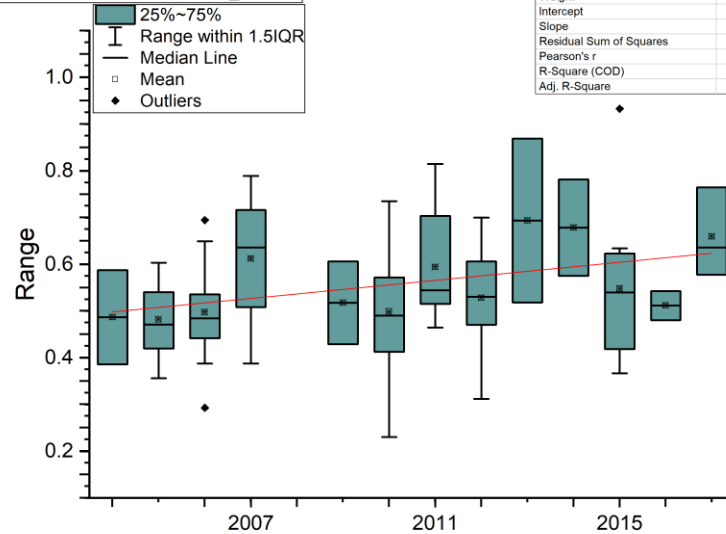
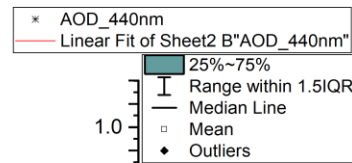
Daily average Data ($m=0.0106 \text{ yr}^{-1}$)



Monthly average Data ($m=0.00865 \text{ yr}^{-1}$)

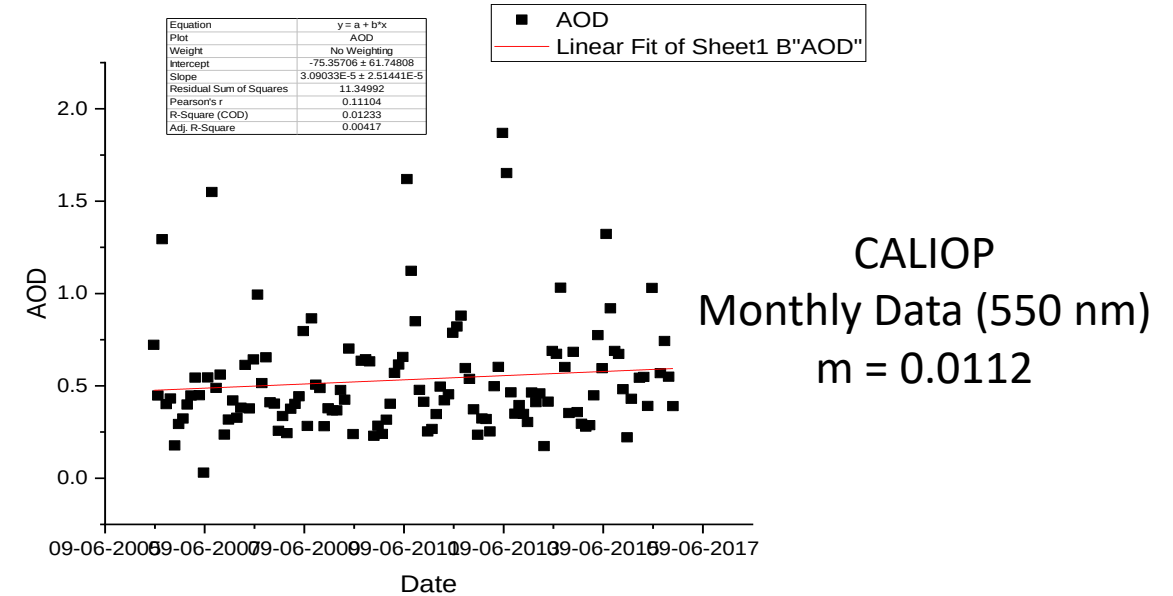
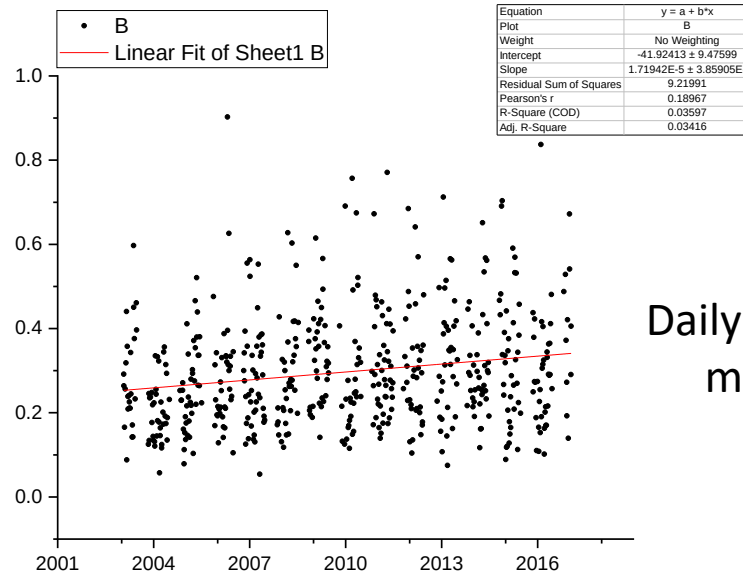
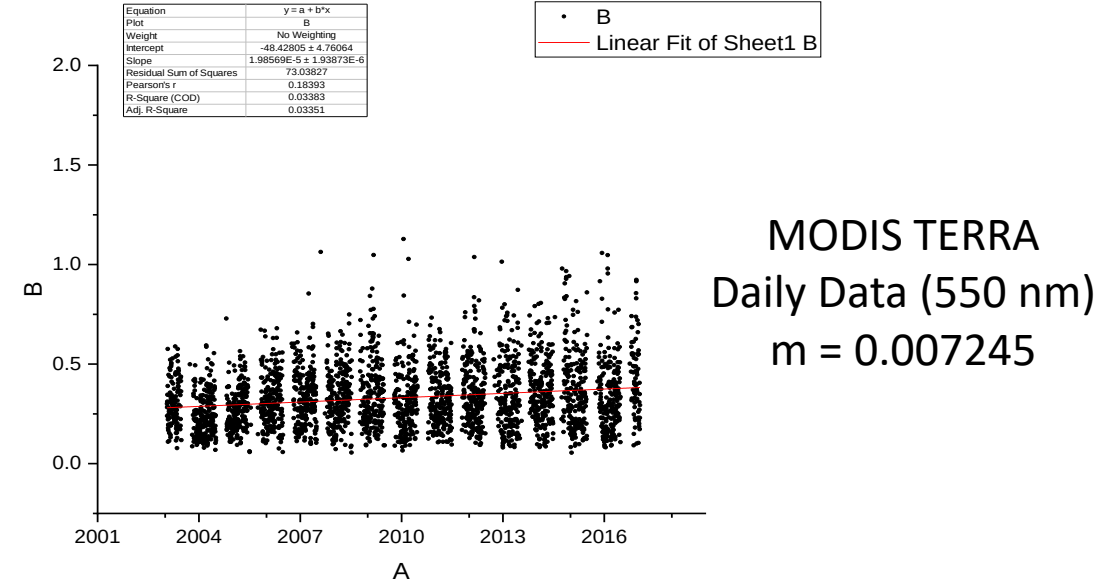
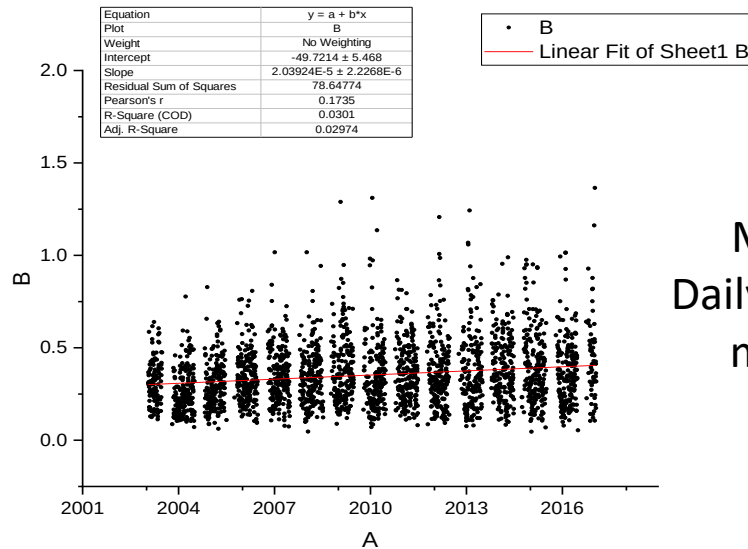


Annual average Data ($m=0.0095 \text{ yr}^{-1}$)

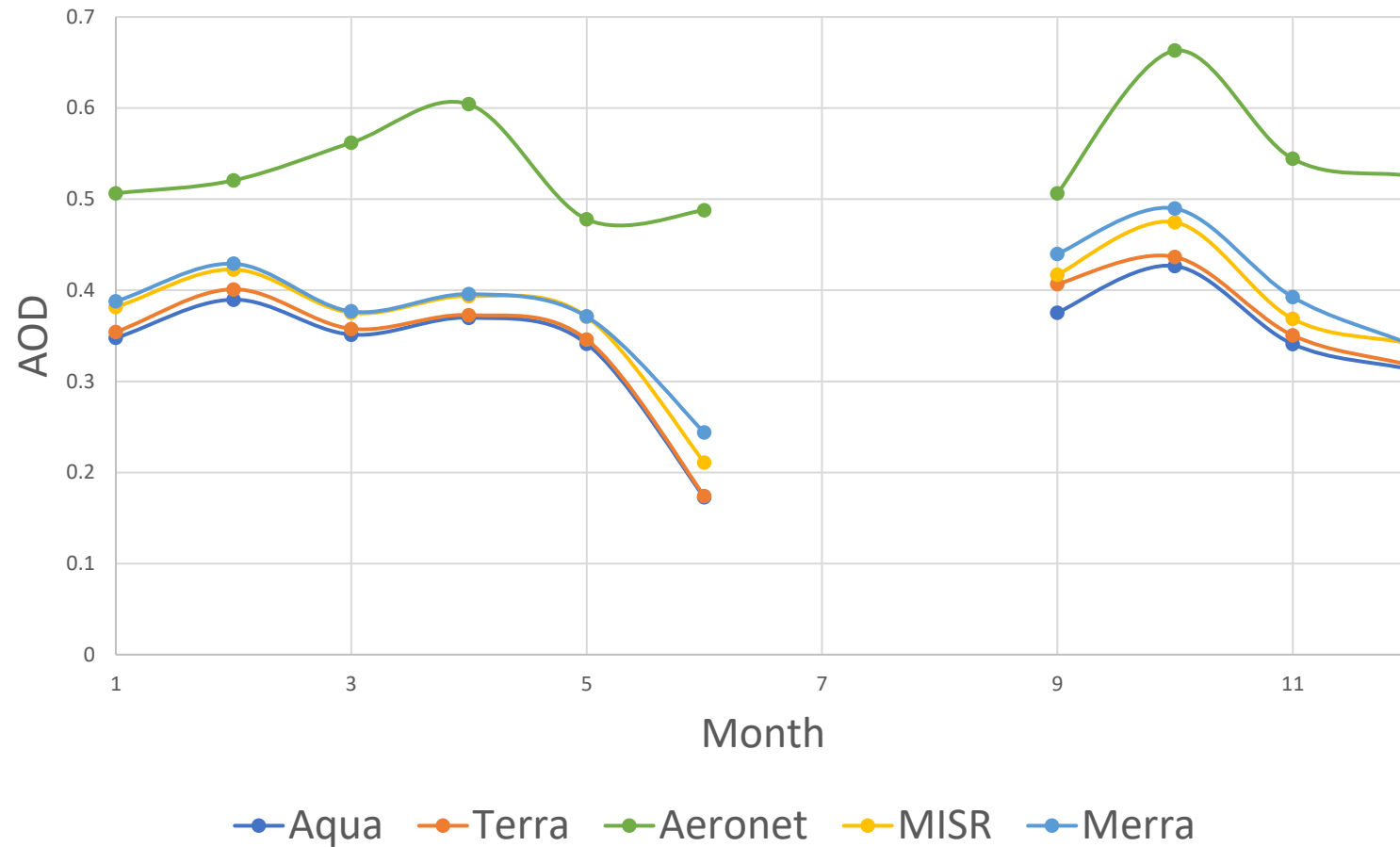


Box and whisker plot of Monthly averaged Data into Years ($m=0.00969 \text{ yr}^{-1}$)

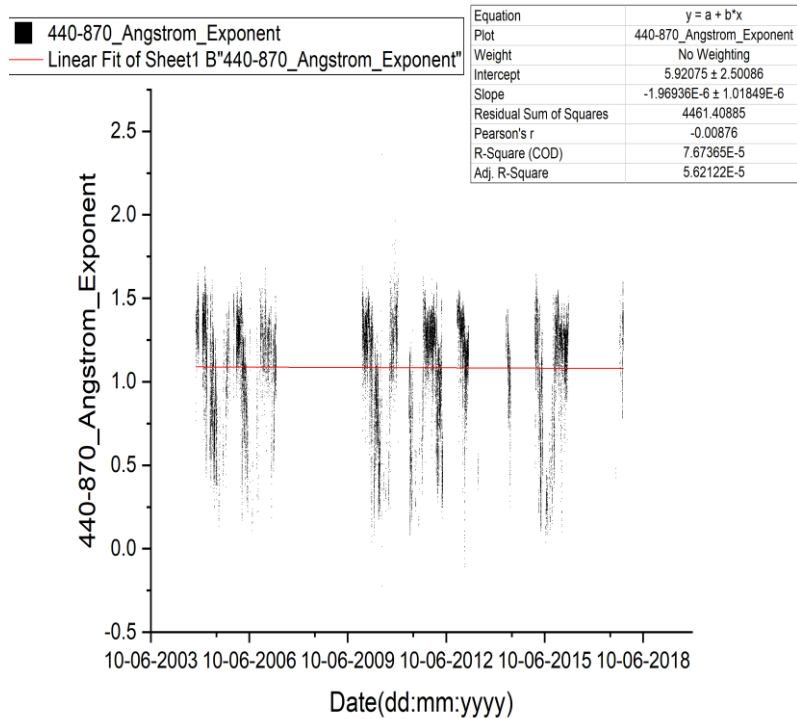
Aerosol Optical Depth (AOD) interannual variations: Satellites



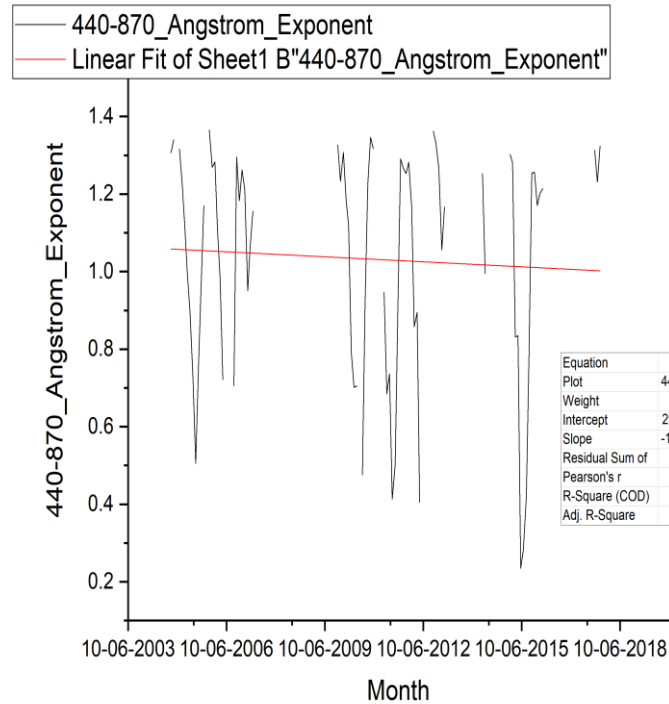
Aerosol Optical Depth (AOD) intra annual variations



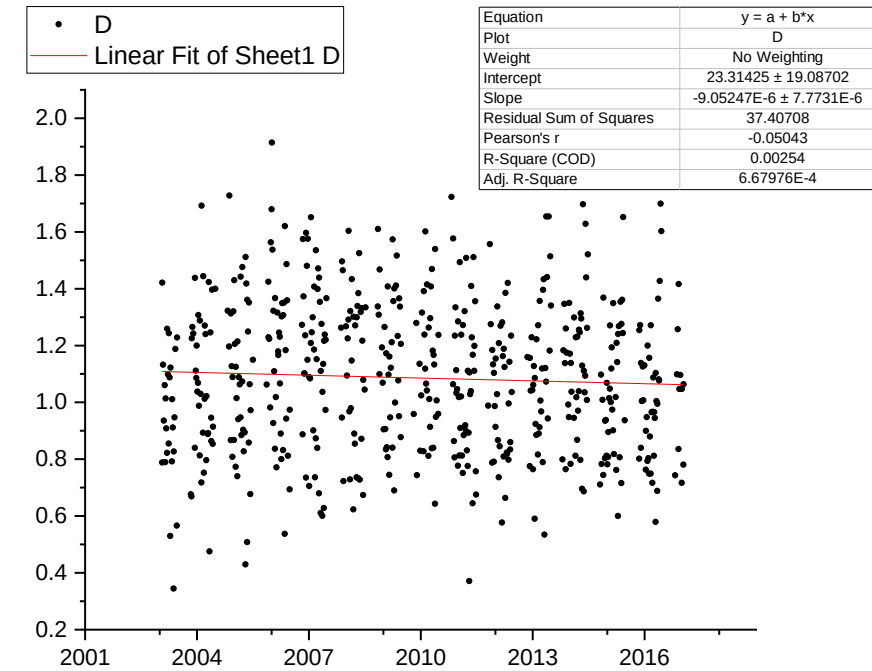
Angstrom Exponent variations



AERONET
All Data (440-870 nm)
 $m = -0.007188$

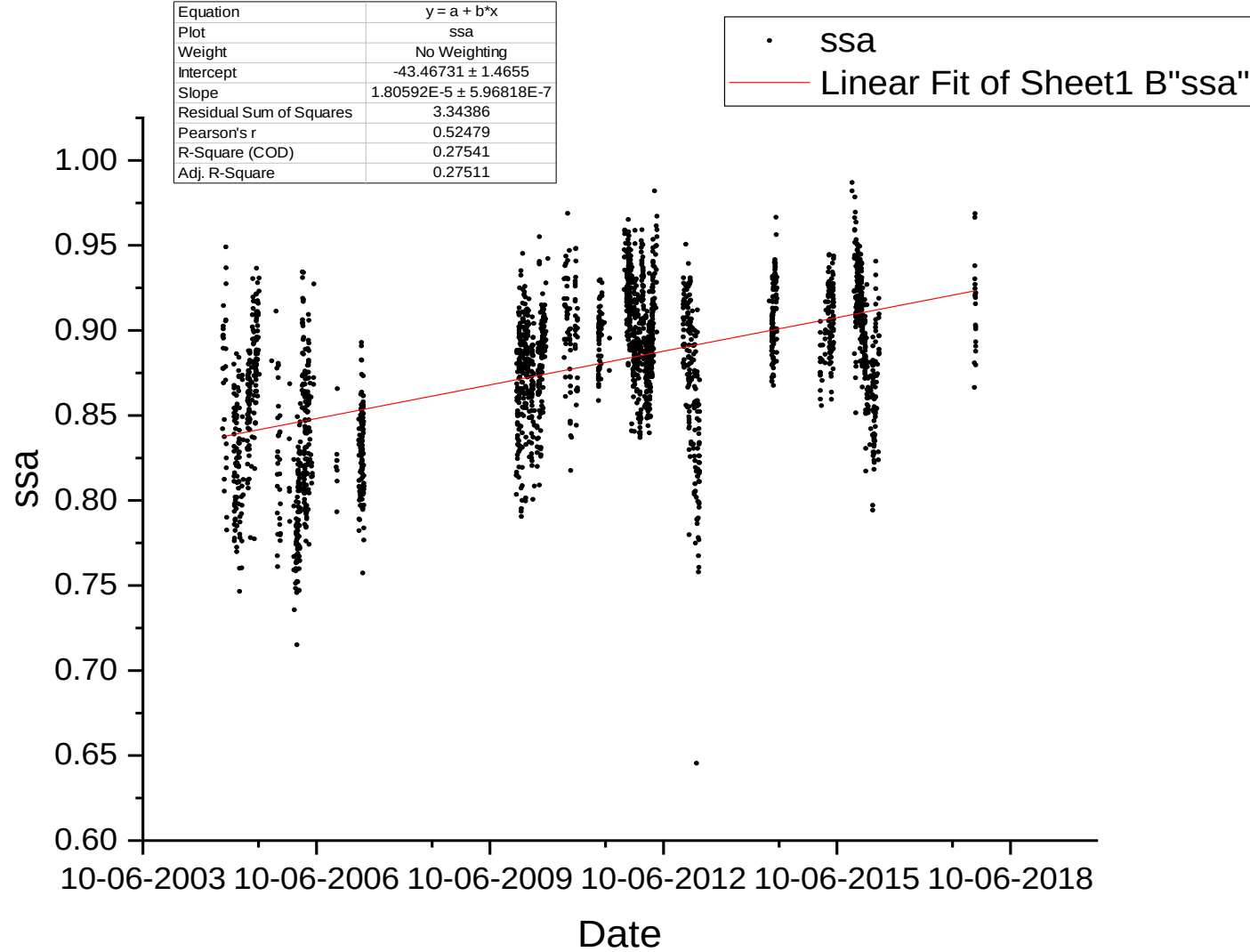


AERONET
Monthly averaged Data (440-870 nm)
 $m = -0.004270$



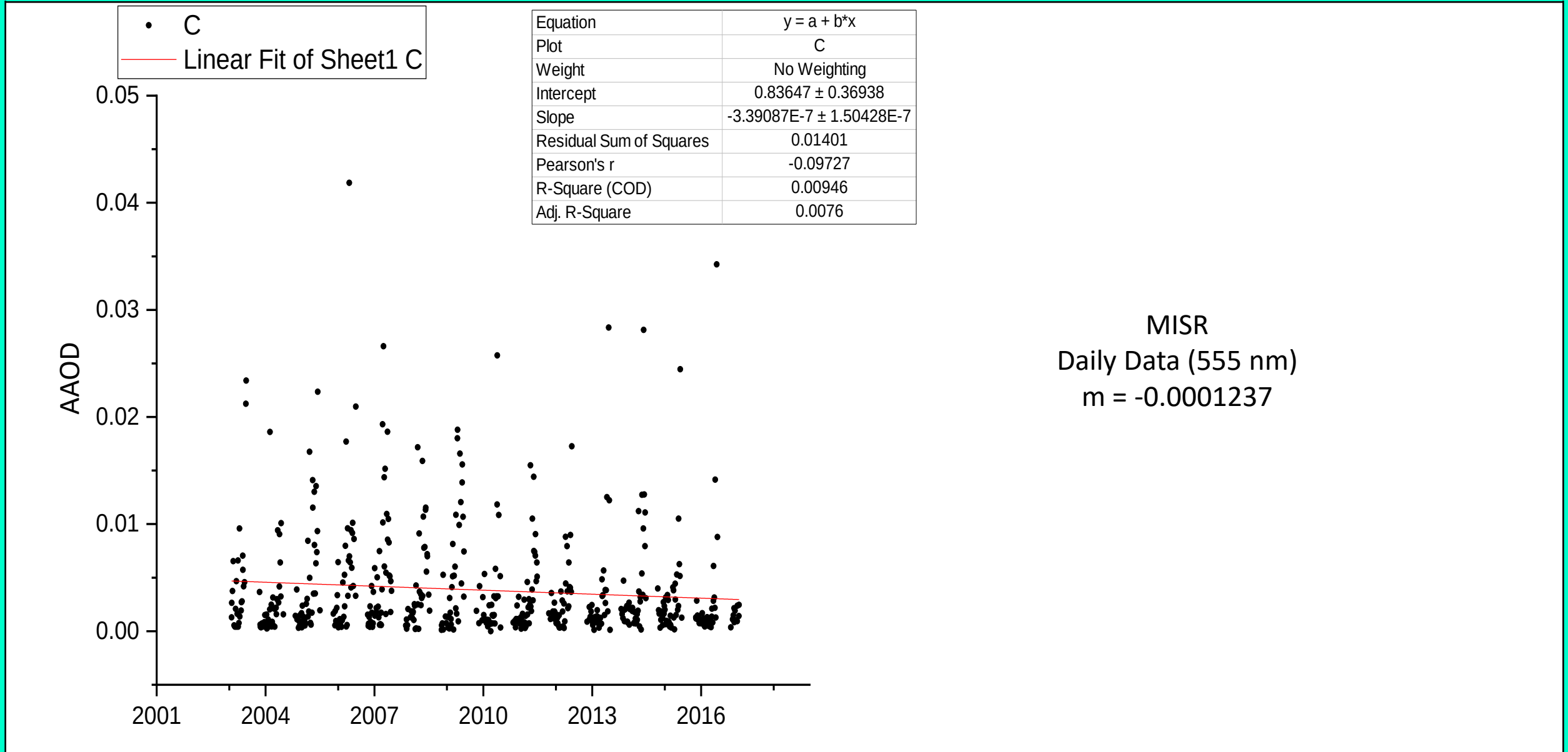
MISR
Daily Data (555 nm)
 $m = -0.003304$

Single Scattering Albedo (SSA) variations



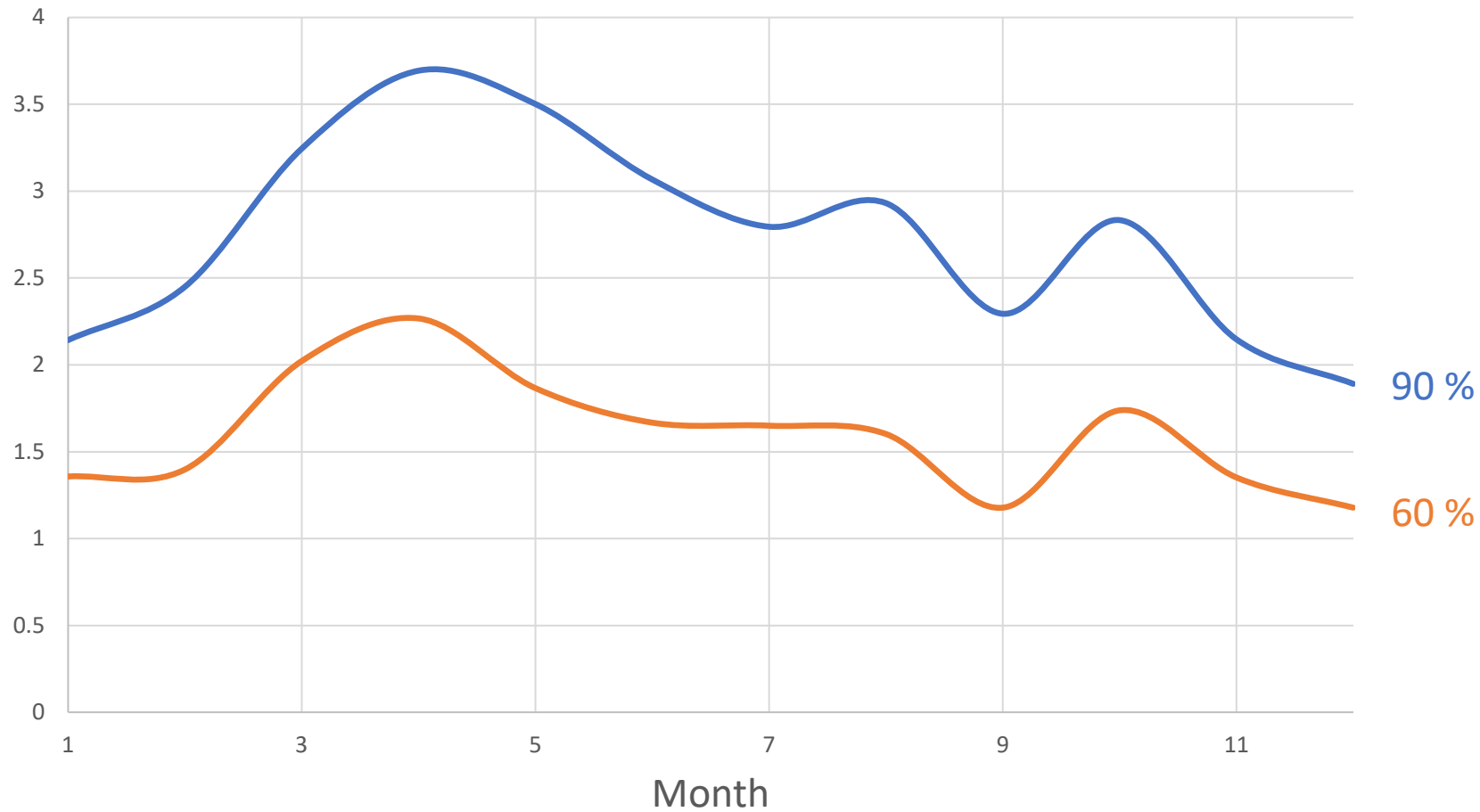
AERONET
All Data (440 nm)
 $m = 0.00657$

Absorbing AOD variations

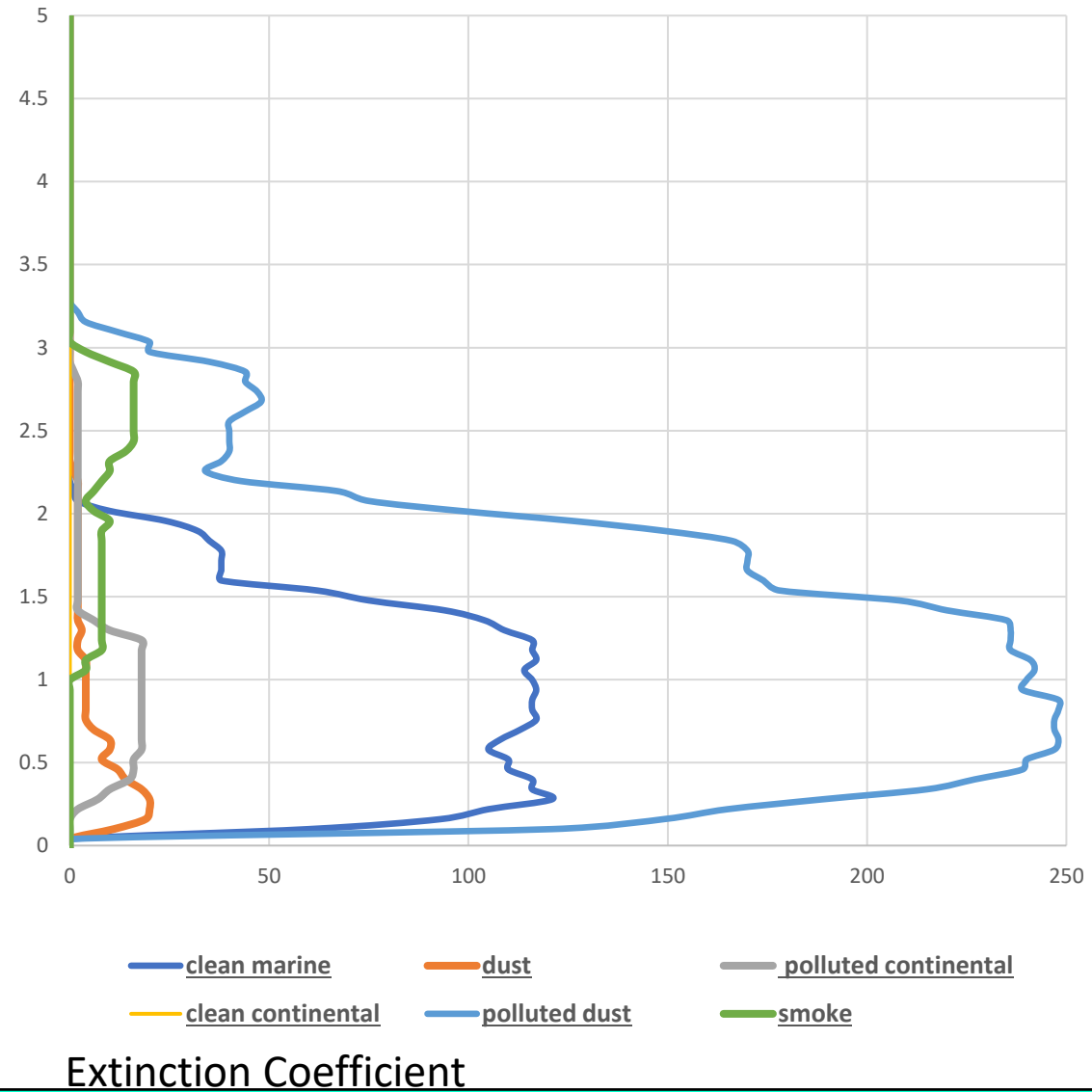
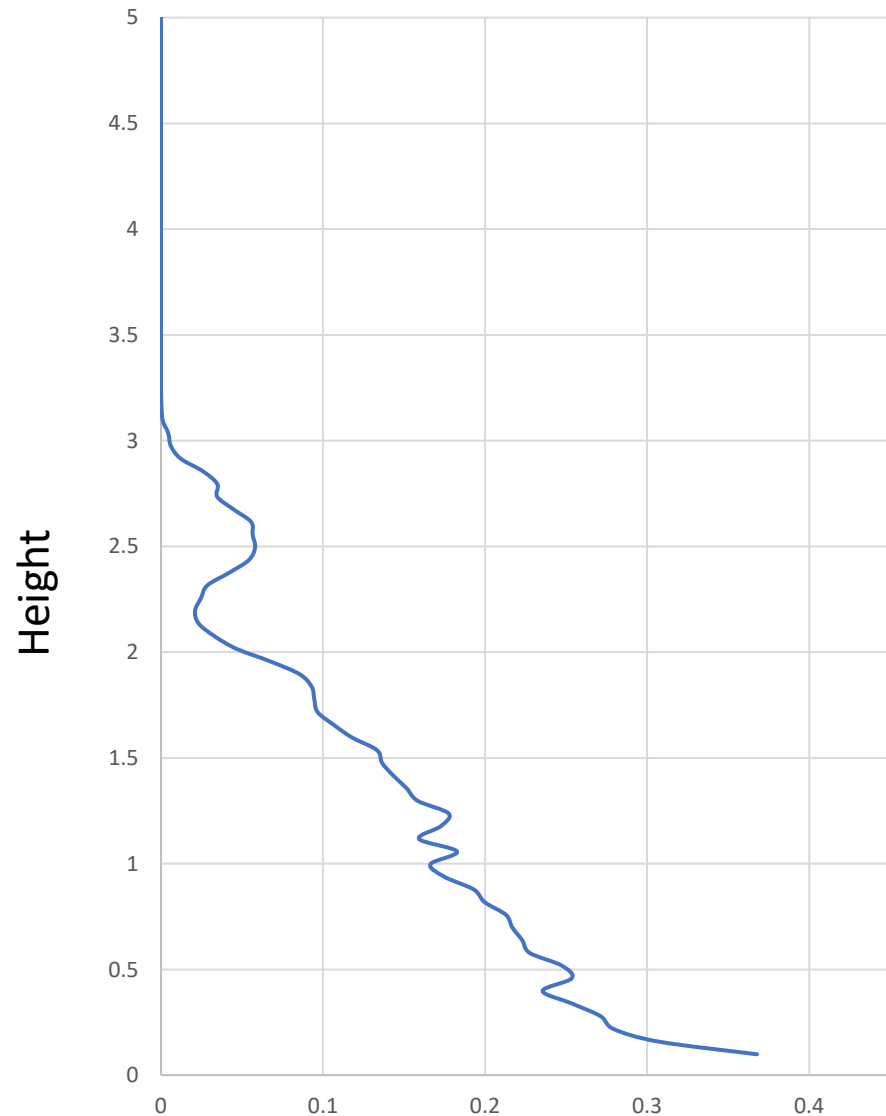


Aerosol Vertical profile

Average height below which 63% and 90 % of aerosols are: (2016)

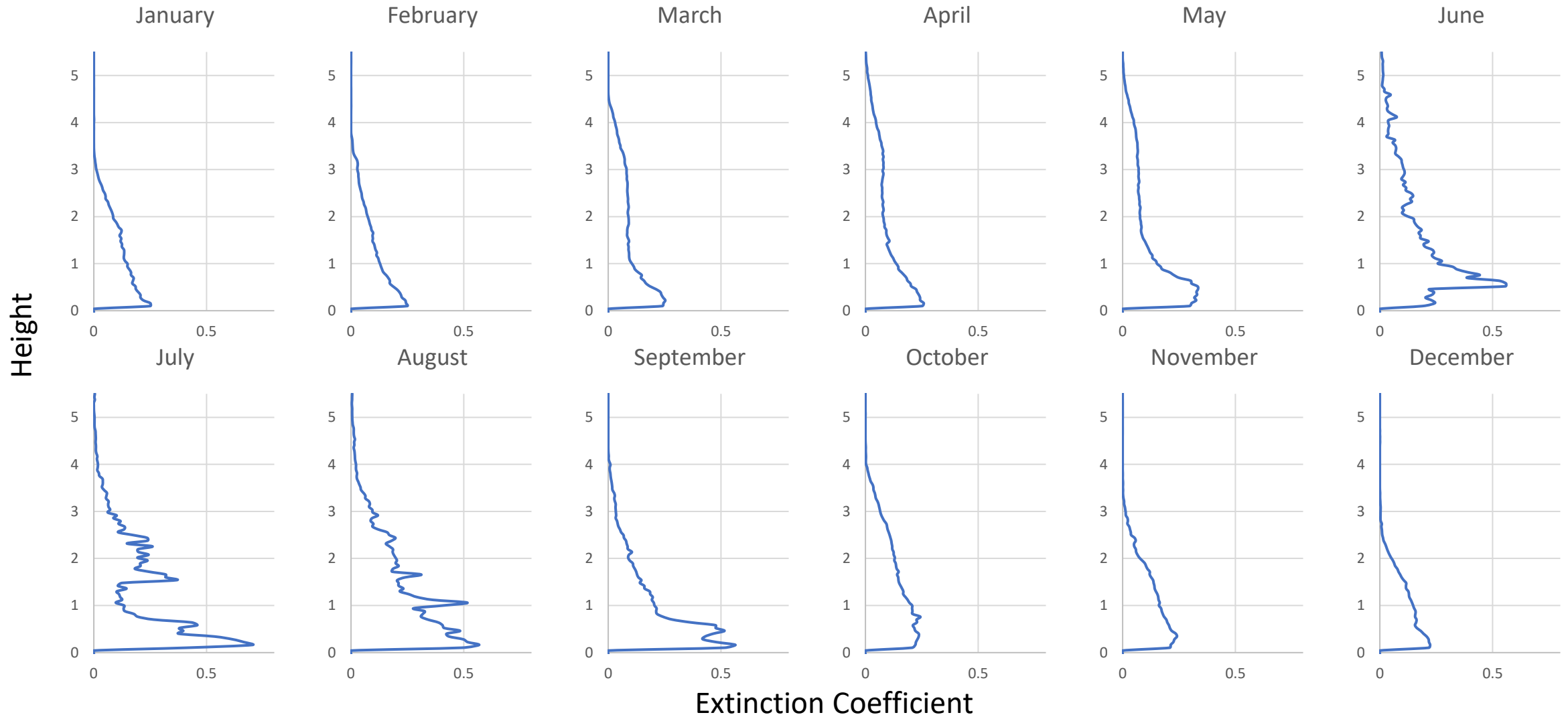


Aerosol Vertical profile



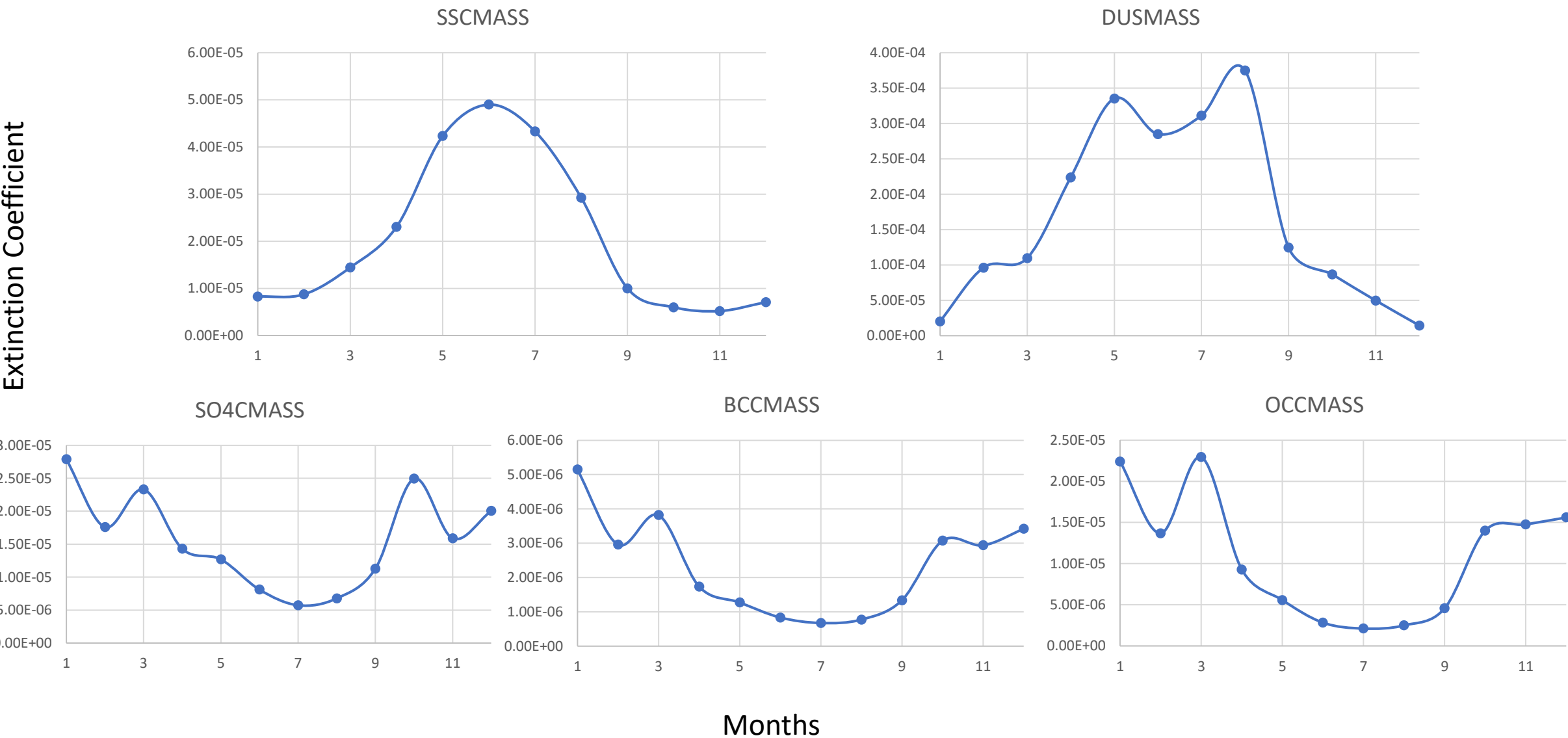
Aerosol Vertical profile

Month wise extinction coefficient along height (averaged)



Aerosol Characterisation

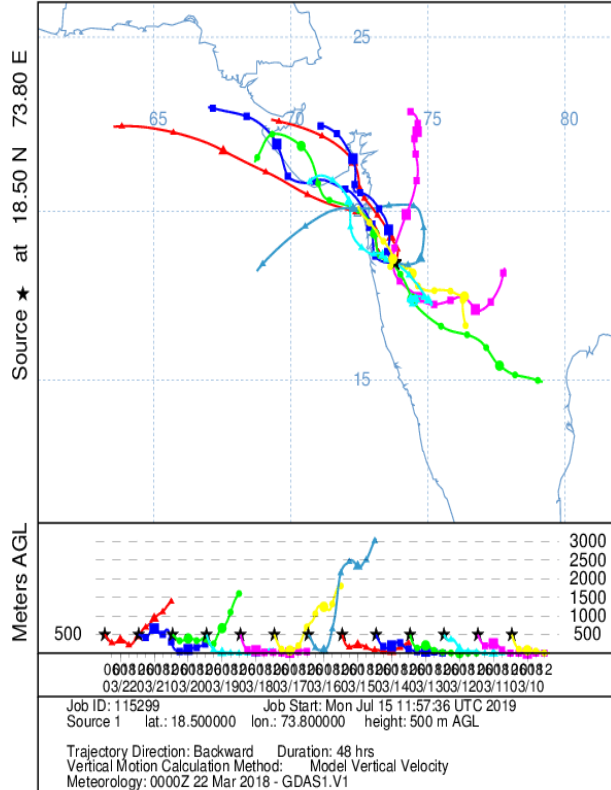
Extinction Coefficient



Months

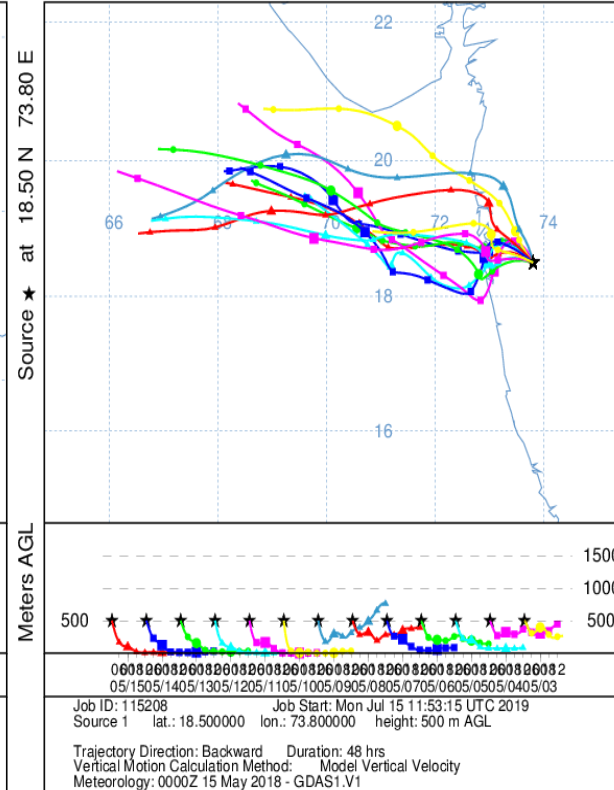
Aerosol Source

NOAA HYSPLIT MODEL
Backward trajectories ending at 1100 UTC 22 Mar 18
GDAS Meteorological Data



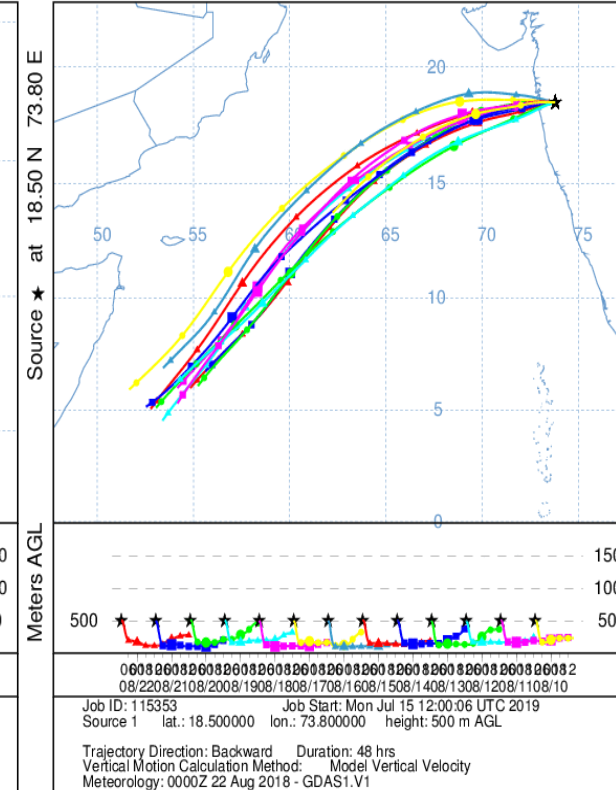
March

NOAA HYSPLIT MODEL
Backward trajectories ending at 1100 UTC 15 May 18
GDAS Meteorological Data



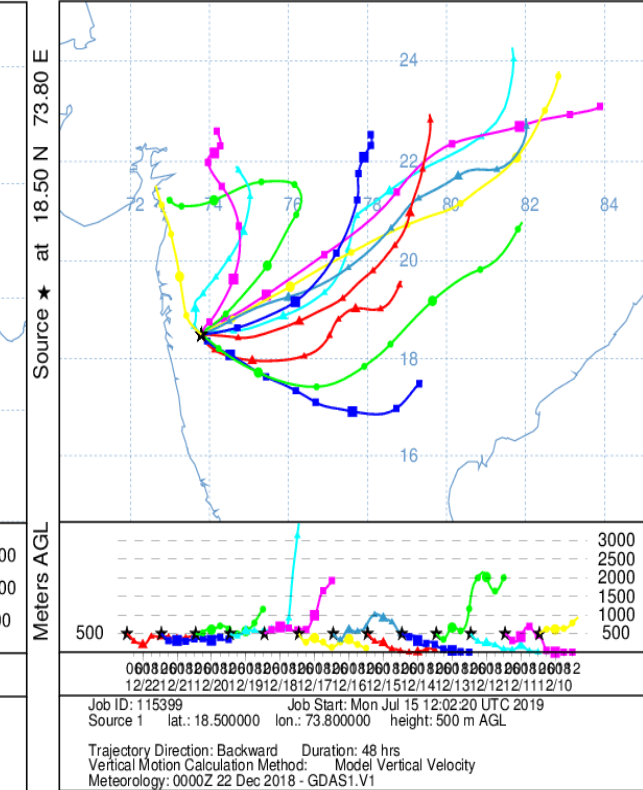
May

NOAA HYSPLIT MODEL
Backward trajectories ending at 1100 UTC 22 Aug 18
GDAS Meteorological Data



August

NOAA HYSPLIT MODEL
Backward trajectories ending at 1100 UTC 22 Dec 18
GDAS Meteorological Data



December

5 day HYSPLIT back trajectory

Observation

Year 2008 in Pune:

- 2008 Commonwealth Youth Games in Pune with a “green” theme.
- CNG introduced and MNGL (Maharashtra Natural Gas Limited) started supply to Pune.
- Euro 3 / Bharat Stage III started to be applied on vehicles.

Table-7.1
Emission Benefits of CNG Buses Compared to
Conventional Diesel Buses

FUEL	CO	NO3	PM
Diesel	2.4g/km	21g/km	0.38g/km
CNG	0.4g/km	8.9g/km	0.012g/km
% reduction	84	58	97

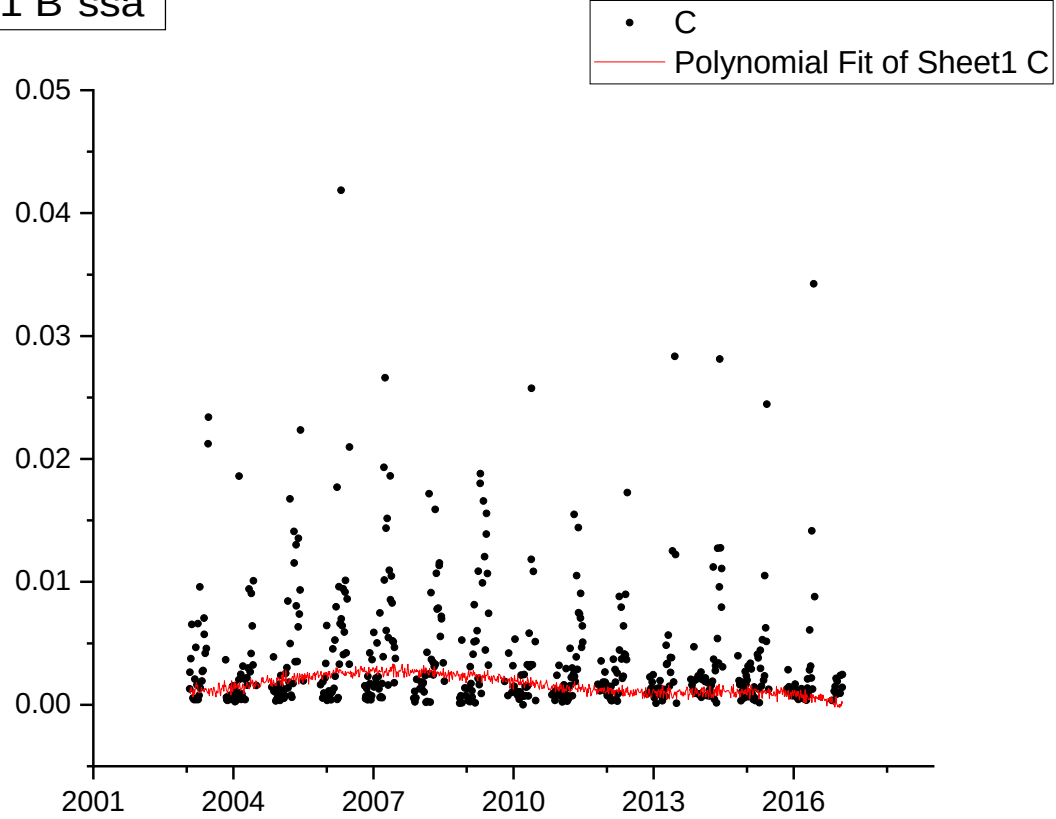
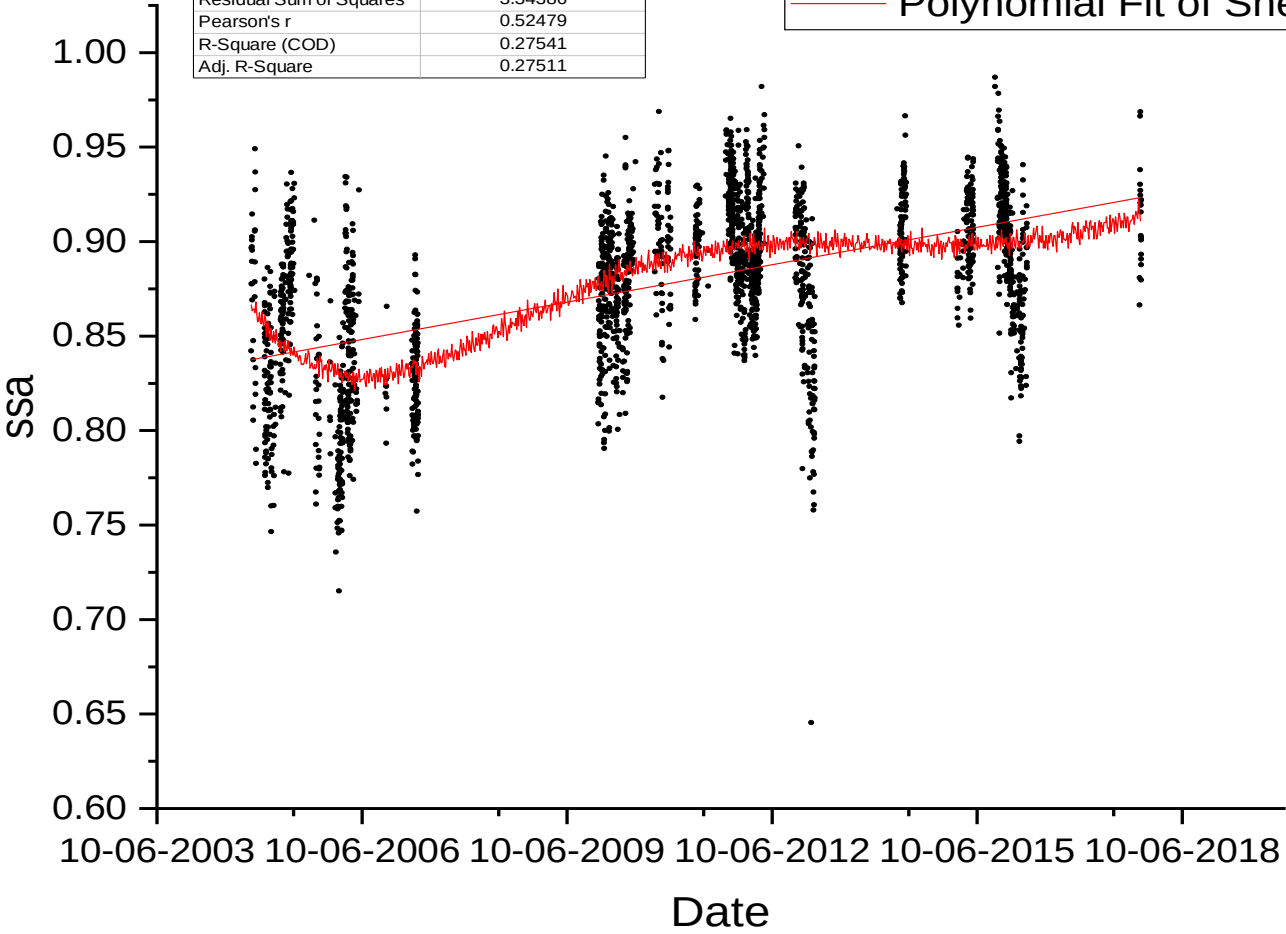
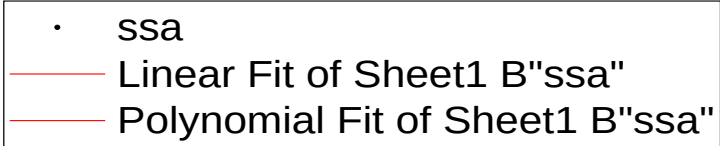
Observation

Difference between slopes before and after 2008

Sl No.	Sensor	Wavelength(nm ⁻¹)	Temporal Range	2004-2008 (yr ⁻¹) Before Control	2009-2017 (yr ⁻¹) After Control	2004-2017 (yr ⁻¹) Overall
1	AERONET (All Data)	440	3-4 minutes	0.0098	0.00422	0.009855
2	AERONET (Monthly average data)	440	Monthly	0.0657	0.01	0.00865
3	MODIS Terra	550	Daily	0.0144	0.00402	0.007245
4	MODIS Aqua	550	Daily	0.0160	0.00291	0.007442
5	CALIPSO	532	Monthly	0.0413	0.017	0.01126
6	MISR	555	Daily (Fortnight)	0.00439	-0.00219	0.00419
7	MERRA	550	Monthly	0.0178	0.00242	0.0055

Observation

Equation	$y = a + b \cdot x$
Plot	ssa
Weight	No Weighting
Intercept	-43.46731 ± 1.4655
Slope	$1.80592E-5 \pm 5.96818E-7$
Residual Sum of Squares	3.34386
Pearson's r	0.52479
R-Square (COD)	0.27541
Adj. R-Square	0.27511



Selected References

Books:

- Atmospheric Science - *Wallace, Hobbs*
- Introduction to Atmospheric Chemistry - *Daniel J Jacob*
- Aerosol Optics - *Alexander A Kokhanovsky*

Journals:

- Validation of satellite and model aerosol optical depth and precipitable water vapour observations with AERONET data over Pune, India - *Vijayakumar et al 2018*
- Regional sulfate drives long-term rise in AOD over megacity Kolkata, India - *Prashant Rawat, Sayantan Sarkar et al 2019*
- Aerosol radiative forcing over a tropical urban site in India – *Pandithurai et al 2004*
- Sun-sky radiometer–derived column-integrated aerosol optical and physical properties over a tropical urban station during 2004–2009 – *Sumit Kumar et al 2011*

THANK YOU