ARISTOTLE UNIVERSITY OF THESSALONIKI - AUTH
LABORATORY OF ATMOSPHERIC PHYSICS - LAP

Seven years of Raman/backscatter lidar observations of free tropospheric aerosols over Thessaloniki: Geometrical and Optical properties

Elina Giannakaki, Dimitris Balis and Vassilis Amiridis

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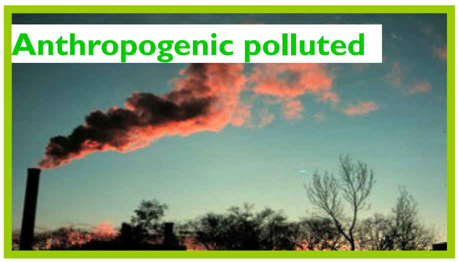
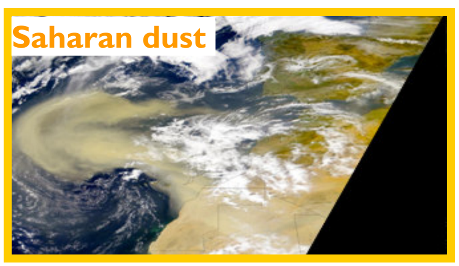
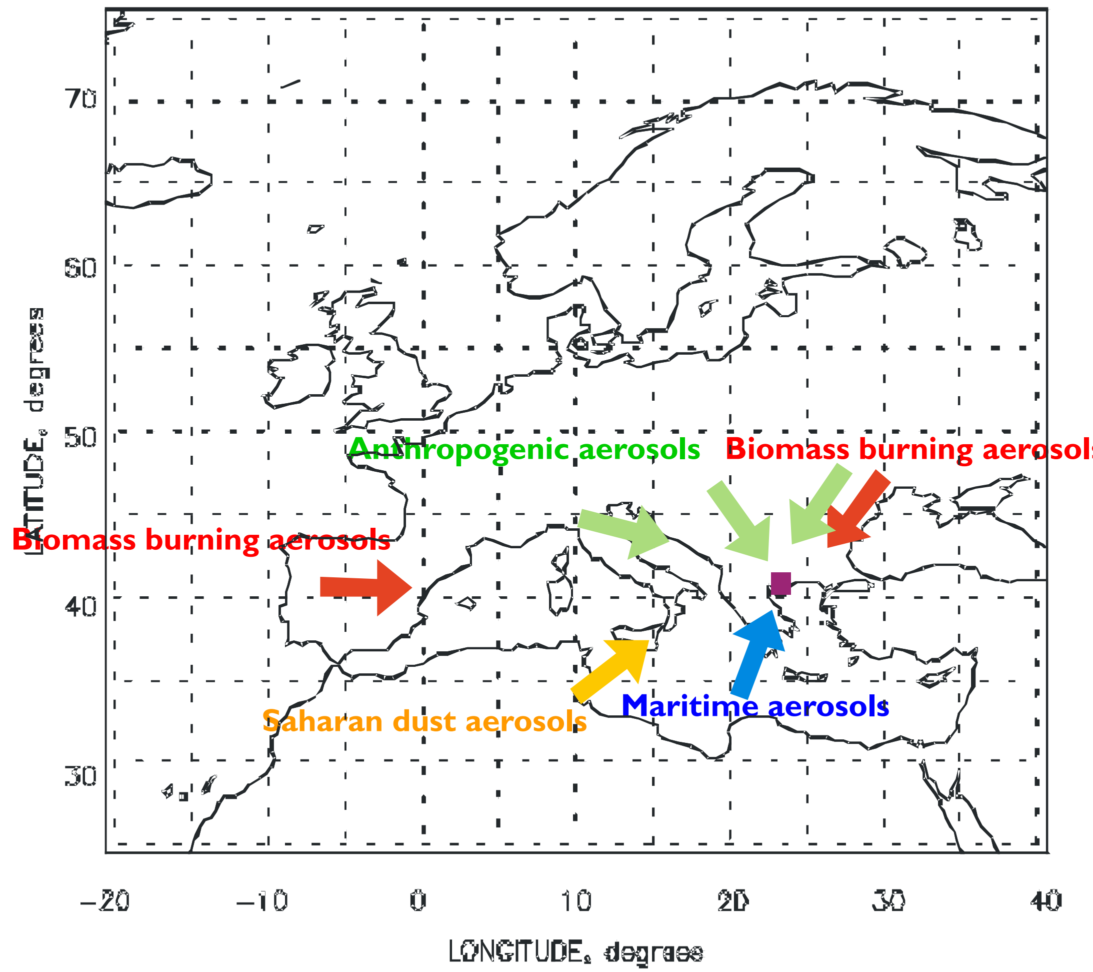
Outline

- Introduce our place
- Describe lidar system
- Seasonality of optical properties
- Cluster analysis and aerosol sources
- Characteristic «signatures» of aerosol «types»
- Geometrical properties
- Conclusions and next steps

Thessaloniki in a «key» position







Backscatter – Raman Lidar

From January 2001:

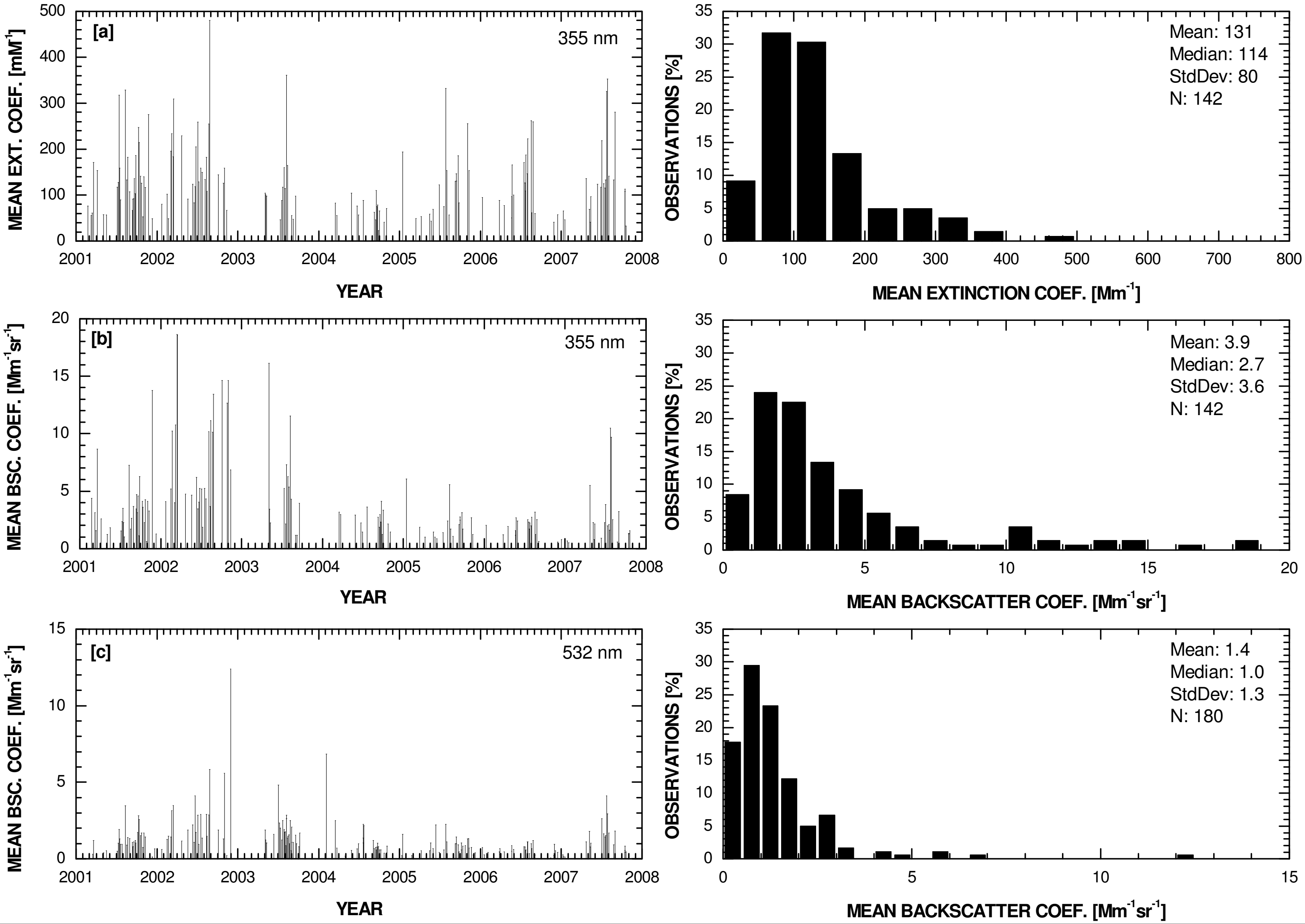
Backscatter coefficient at **355** and **532** nm
Extinction coefficient at **355** nm

Lidar ratio at **355** and **532** nm
Ångström exponent, related to
backscatter and related to **extinction**

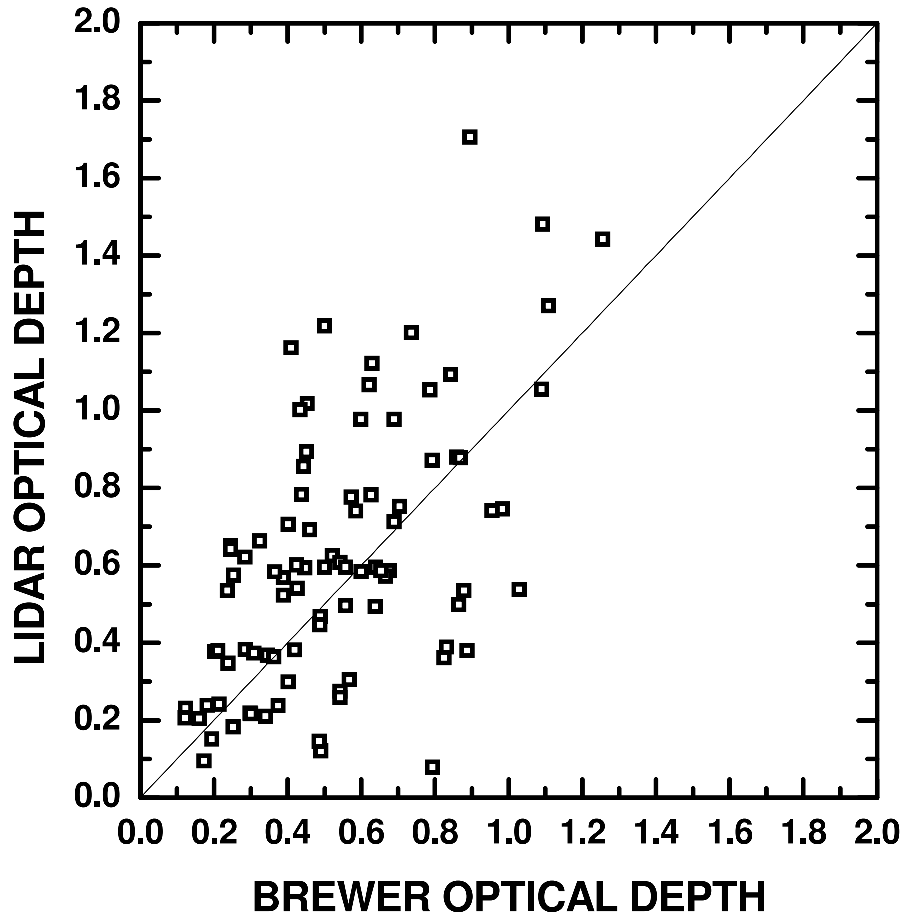
From April 2008:

Backscatter coefficient at **355** and **532** nm
Extinction coefficient at **355** and **532** nm

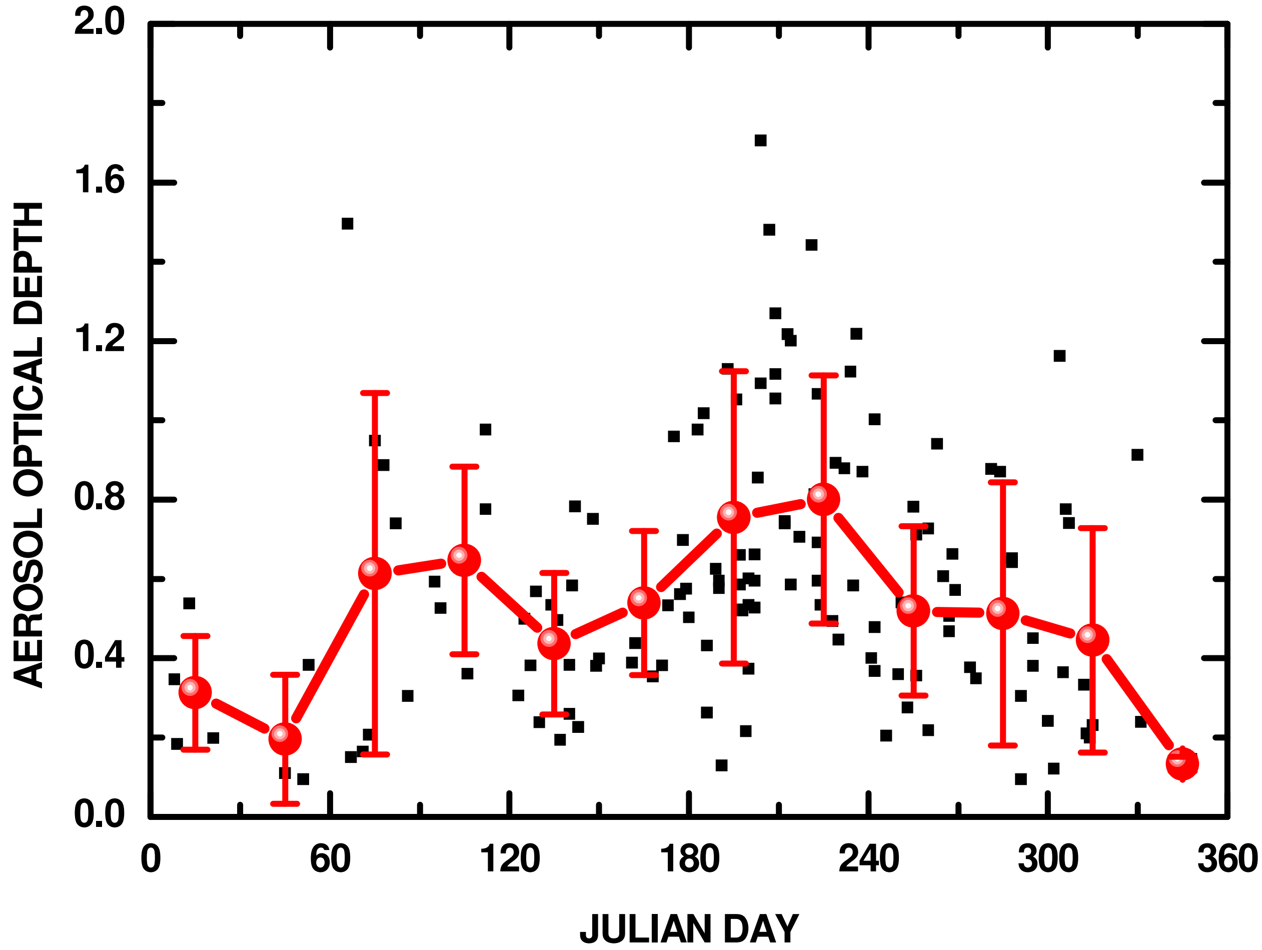
The measurements from 2001 to 2007:



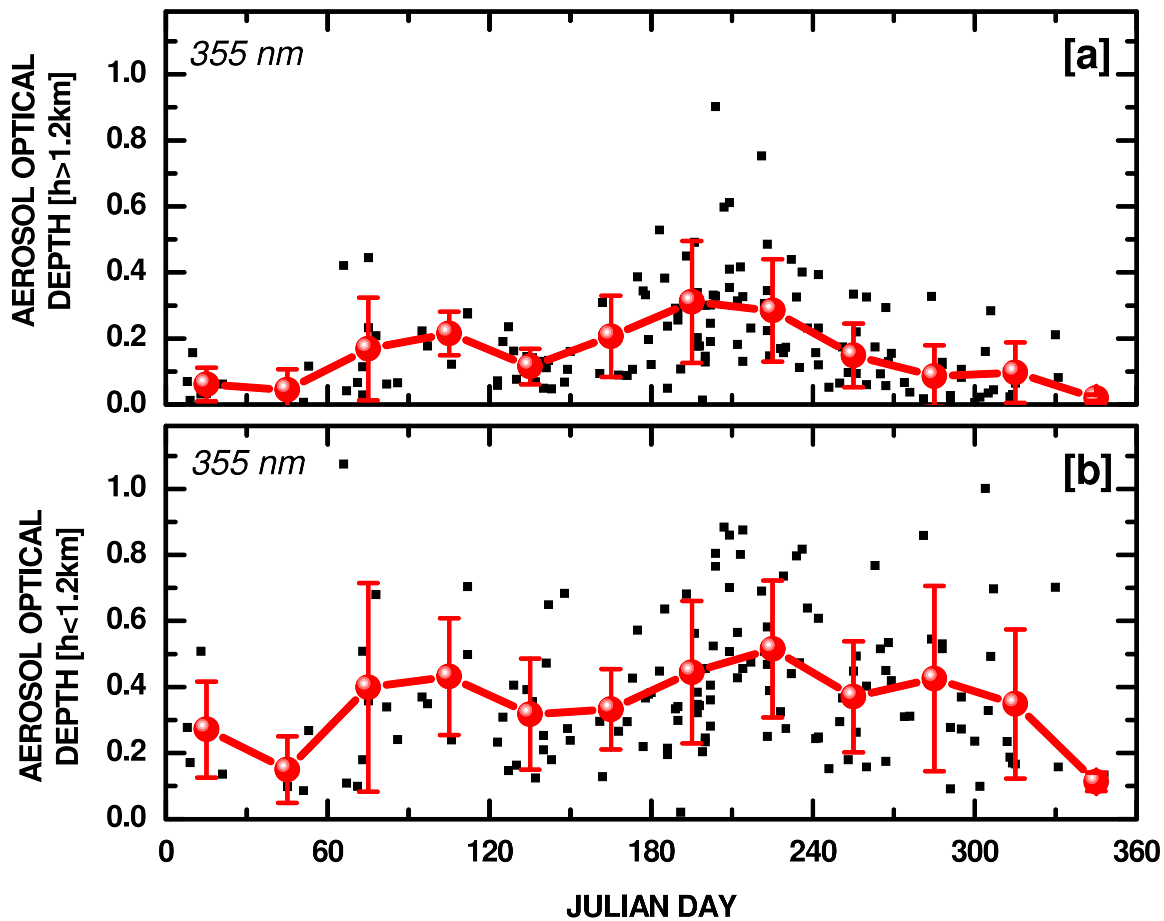
Independently datasets of AOD



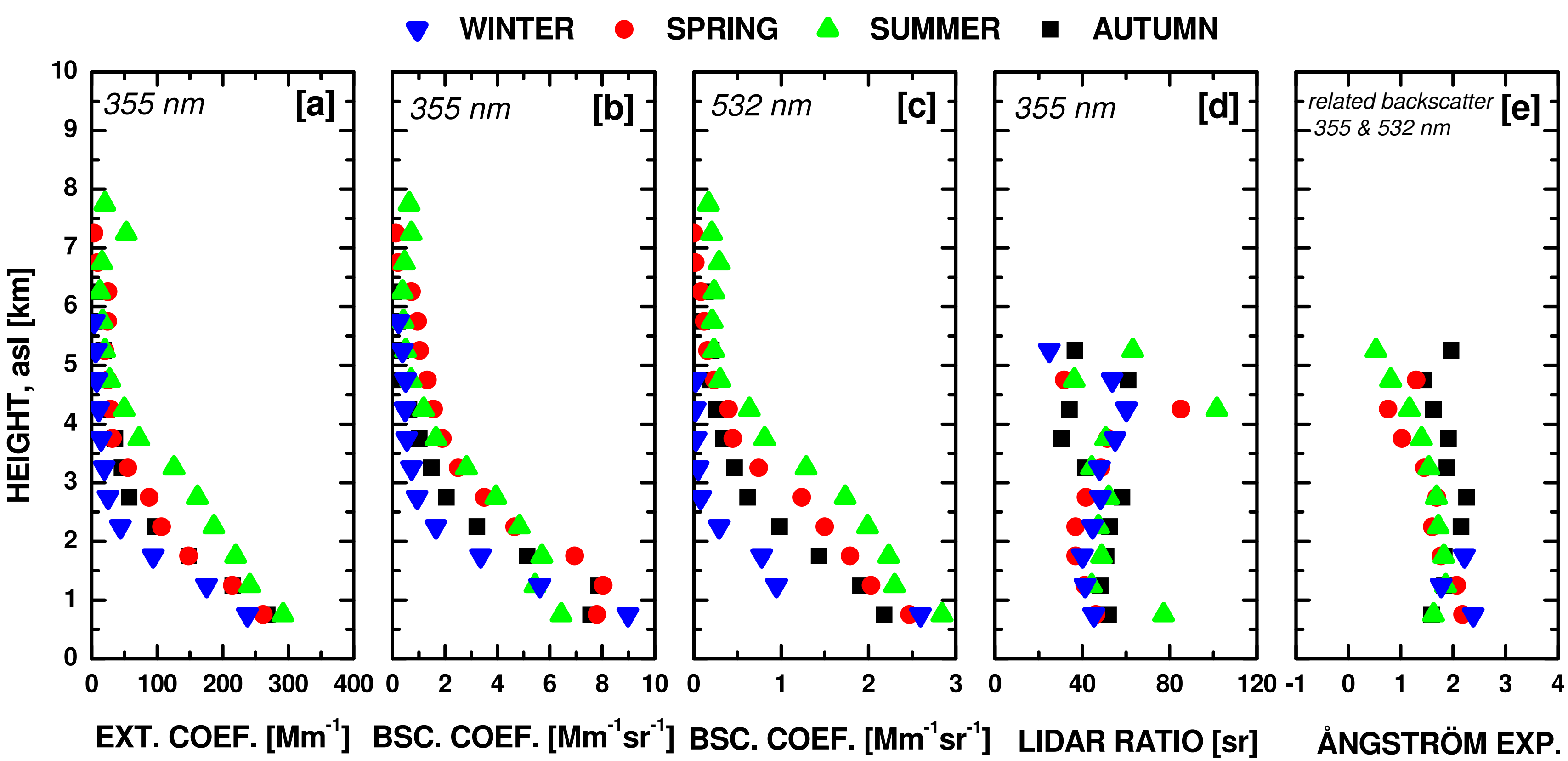
Seasonal variability of AOD



Free tropospheric AOD contribution

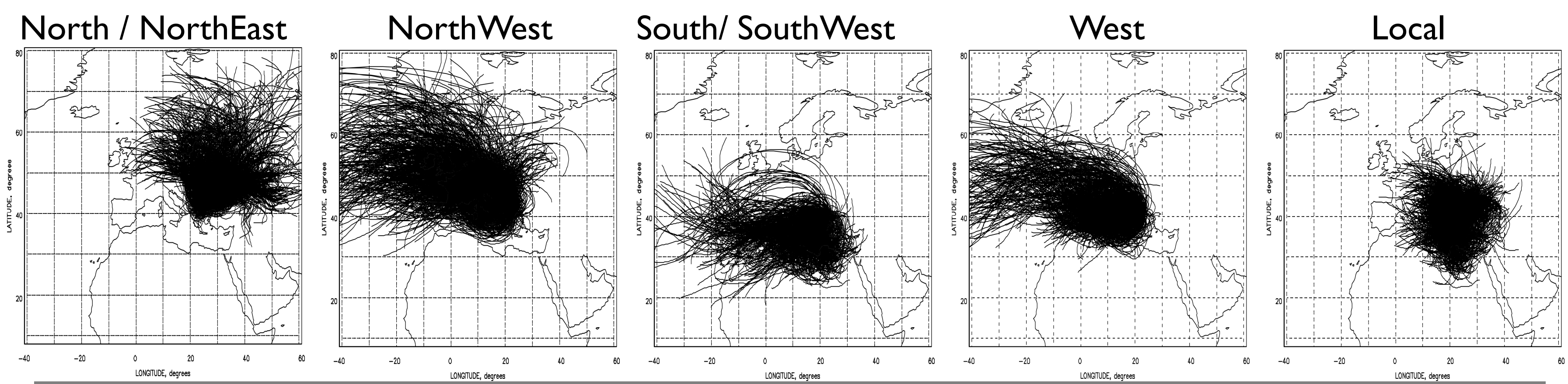


Seasonally mean vertical profiles

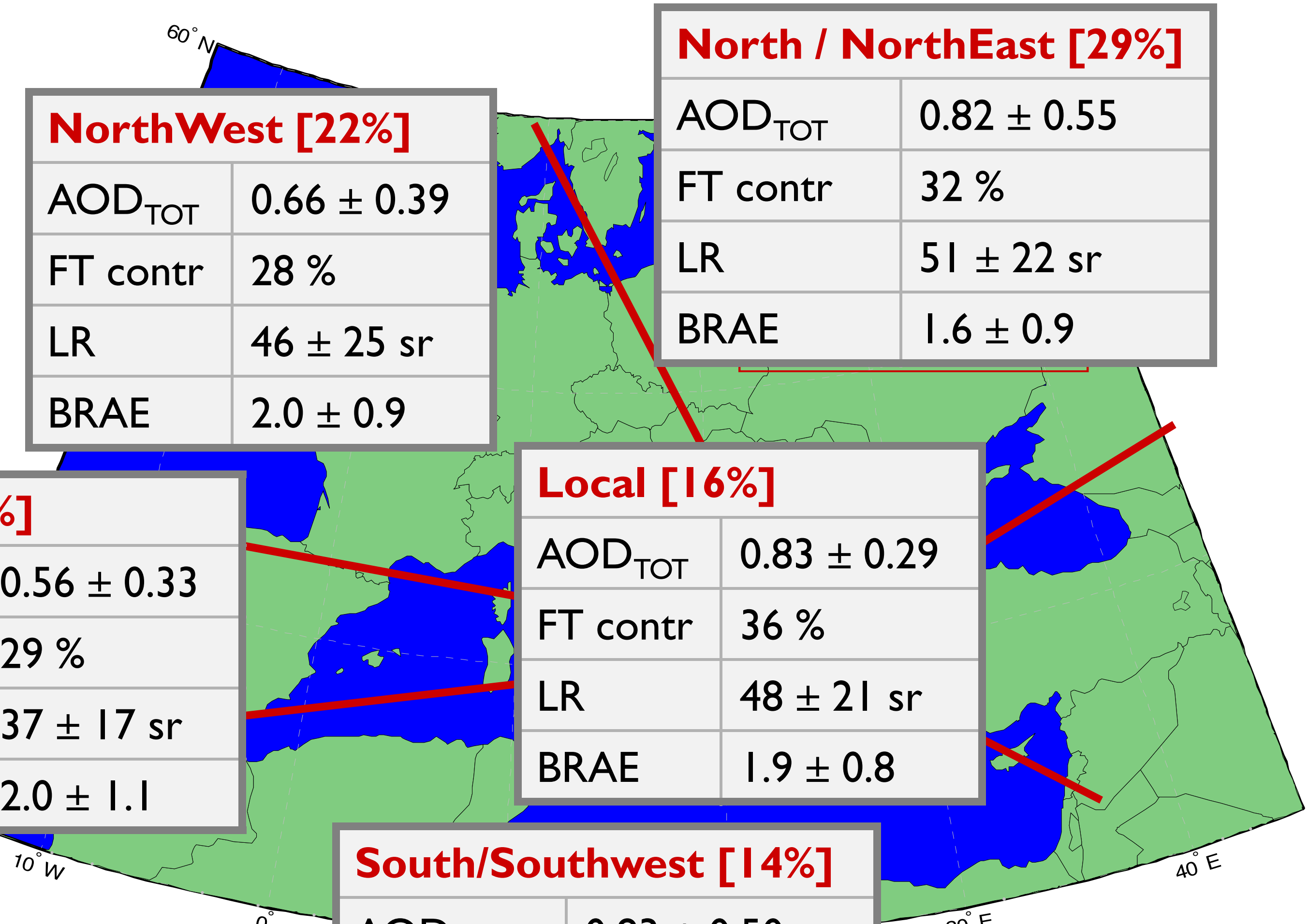


Cluster analysis

Cluster	**Possible Sources of Aerosols**
North / NorthEast	Balkans, Eastern Europe, Biomass Burning
NorthWest	Central Europe, Maritime from Atlantic Ocean
South / SouthWest	Saharan, Italy, Maritime from Mediterranean
West	West Europe, Maritime from Atlantic Ocean, Biomass Burning
Local	Central Europe, Maritime from Mediterranean



Optical properties for each cluster



NorthWest [22%]	
AOD_{TOT}	0.66 ± 0.39
FT contr	28 %
LR	46 ± 25 sr
BRAE	2.0 ± 0.9

North / NorthEast [29%]	
AOD_{TOT}	0.82 ± 0.55
FT contr	32 %
LR	51 ± 22 sr
BRAE	1.6 ± 0.9

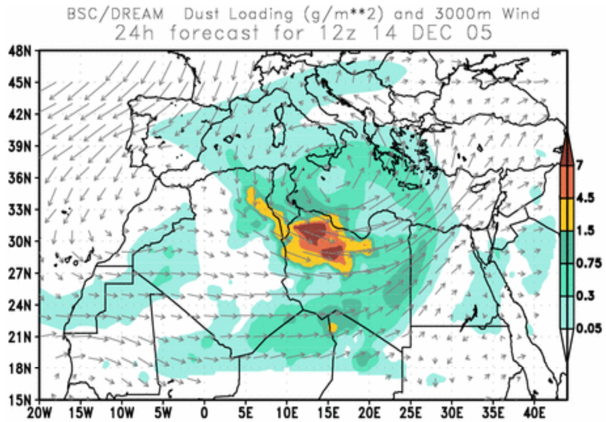
West [19%]	
AOD_{TOT}	0.56 ± 0.33
FT contr	29 %
LR	37 ± 17 sr
BRAE	2.0 ± 1.1

Local [16%]	
AOD_{TOT}	0.83 ± 0.29
FT contr	36 %
LR	48 ± 21 sr
BRAE	1.9 ± 0.8

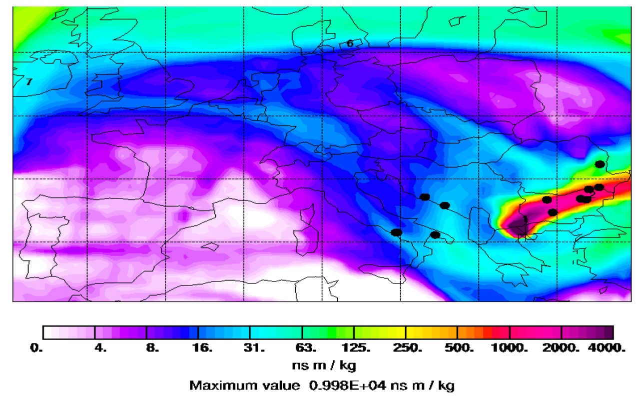
South/Southwest [14%]	
AOD_{TOT}	0.83 ± 0.50
FT contr	37 %
LR	42 ± 21 sr
BRAE	1.3 ± 1.1

Synergetic data to characterize the source region of aerosol particles

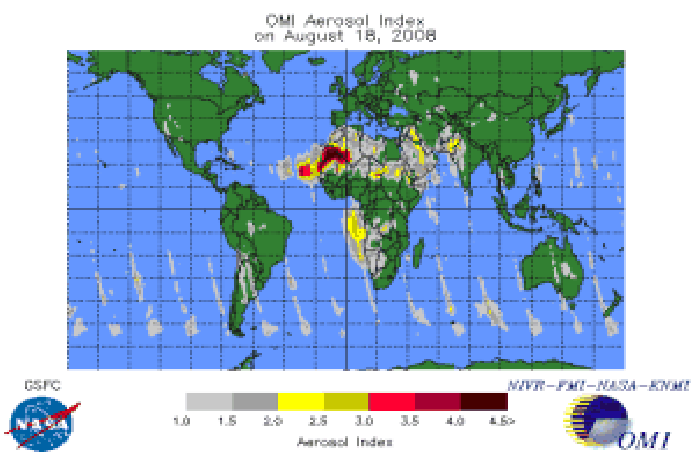
Aerosol dust load DREAM model



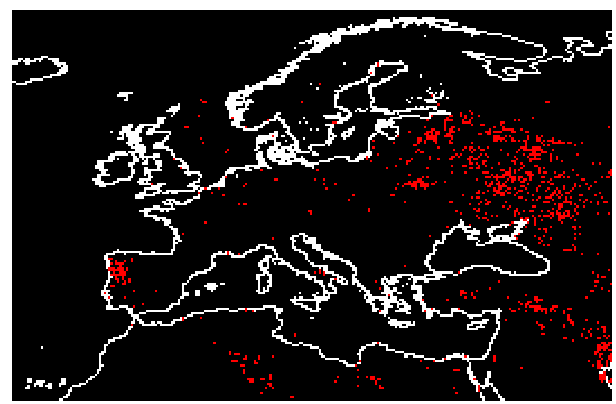
FLEXPART model



Aerosol Index from OMI & TOMS



Hot Spots from ATSR



Optical properties for each aerosol «type»

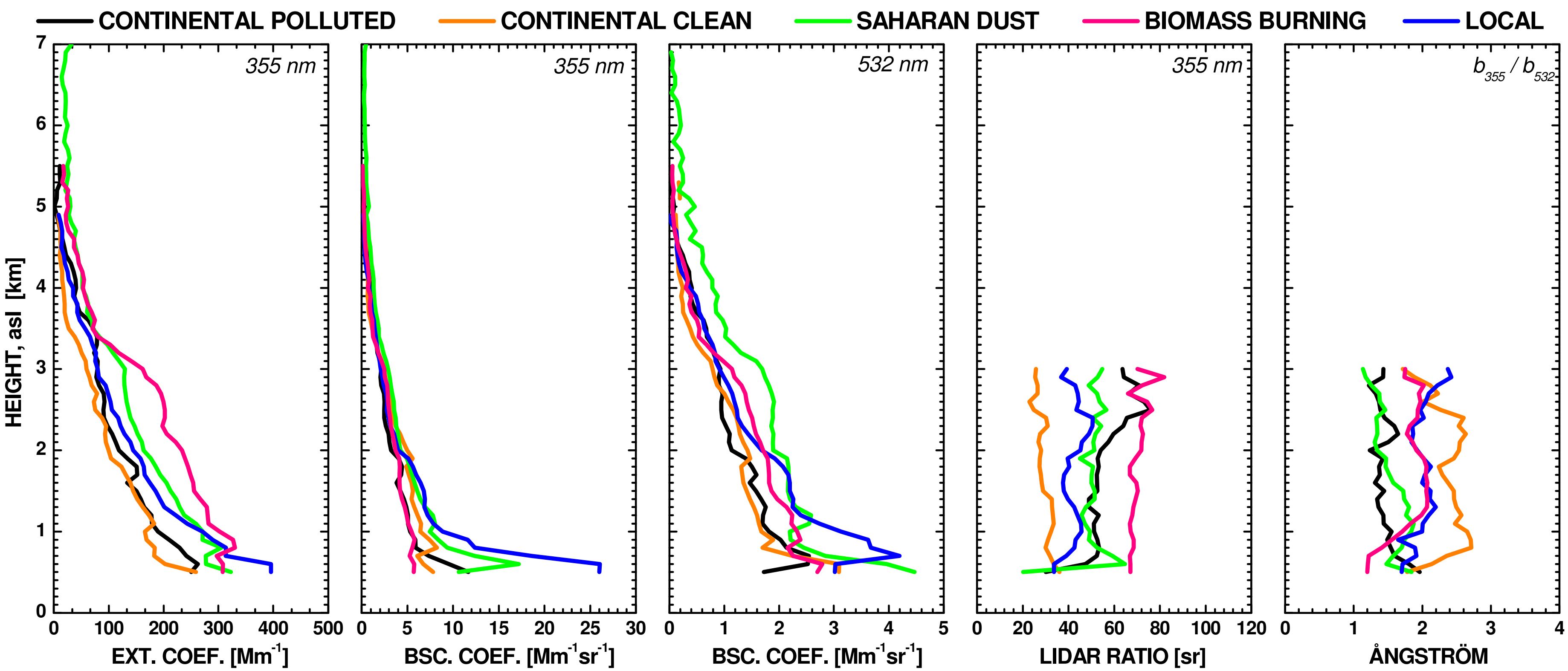
5 Aerosol Types	Saharan Dust	Biomass burning	Local	Continental Polluted	Continental Clean

Optical properties for each aerosol «type»

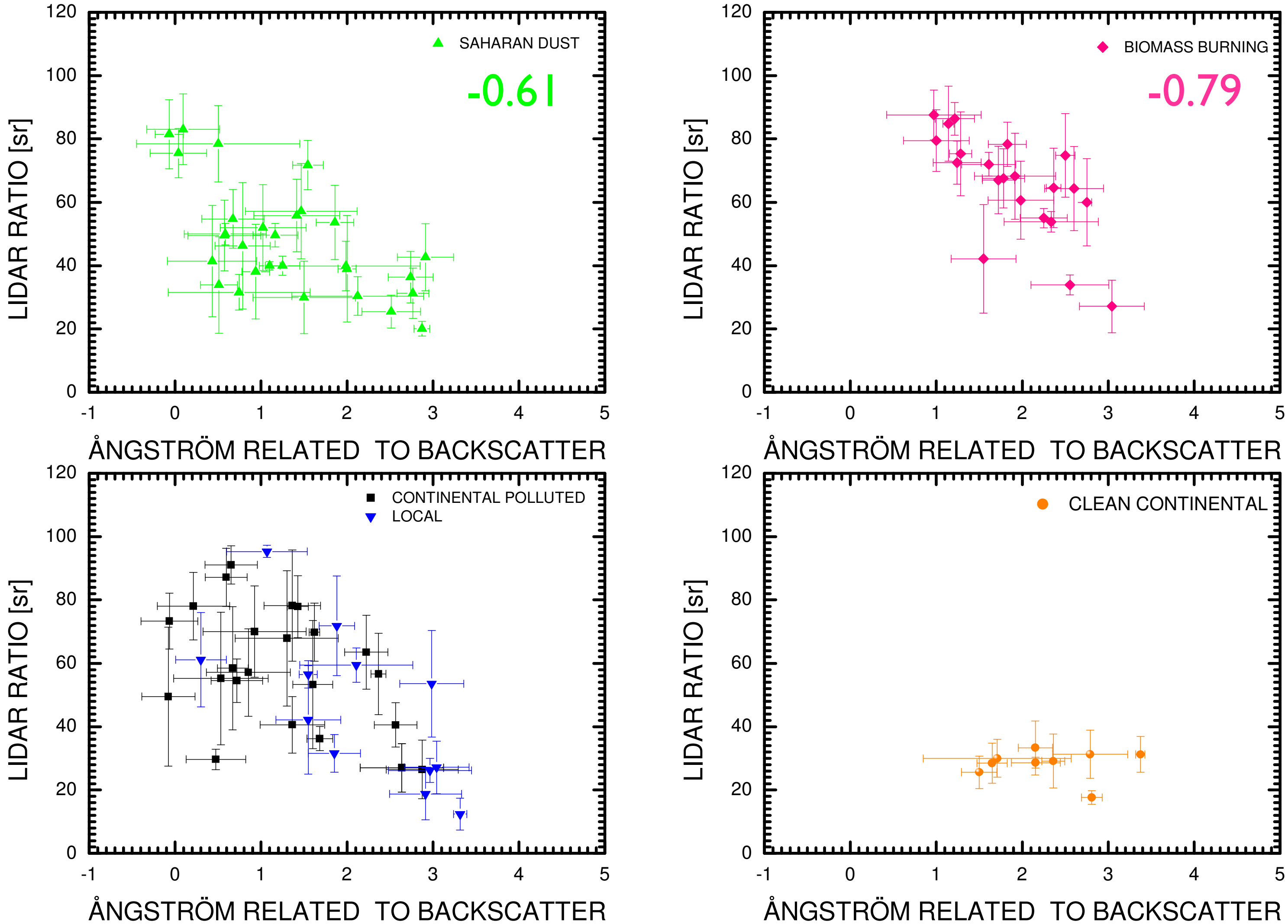
Parameter	Saharan Dust	Biomass burning	Local	Continental Polluted	Continental Clean
AOD, column	0.88 ± 0.42	0.95 ± 0.34	0.75 ± 0.18	0.60 ± 0.54	0.52 ± 0.19
AOD, FT	0.46 ± 0.28	0.5 ± 0.22	0.28 ± 0.09	0.28 ± 0.17	0.21 ± 0.12
LR_{355}, sr	52 ± 18	69 ± 17	53 ± 19	56 ± 23	29 ± 7
$Å_{b355/b532}$	1.47 ± 1.0	1.71 ± 0.7	2.0 ± 0.9	1.42 ± 1.0	2.31 ± 0.5
N_{obs}, %	30	15	12	33	10

maximum middle minimum

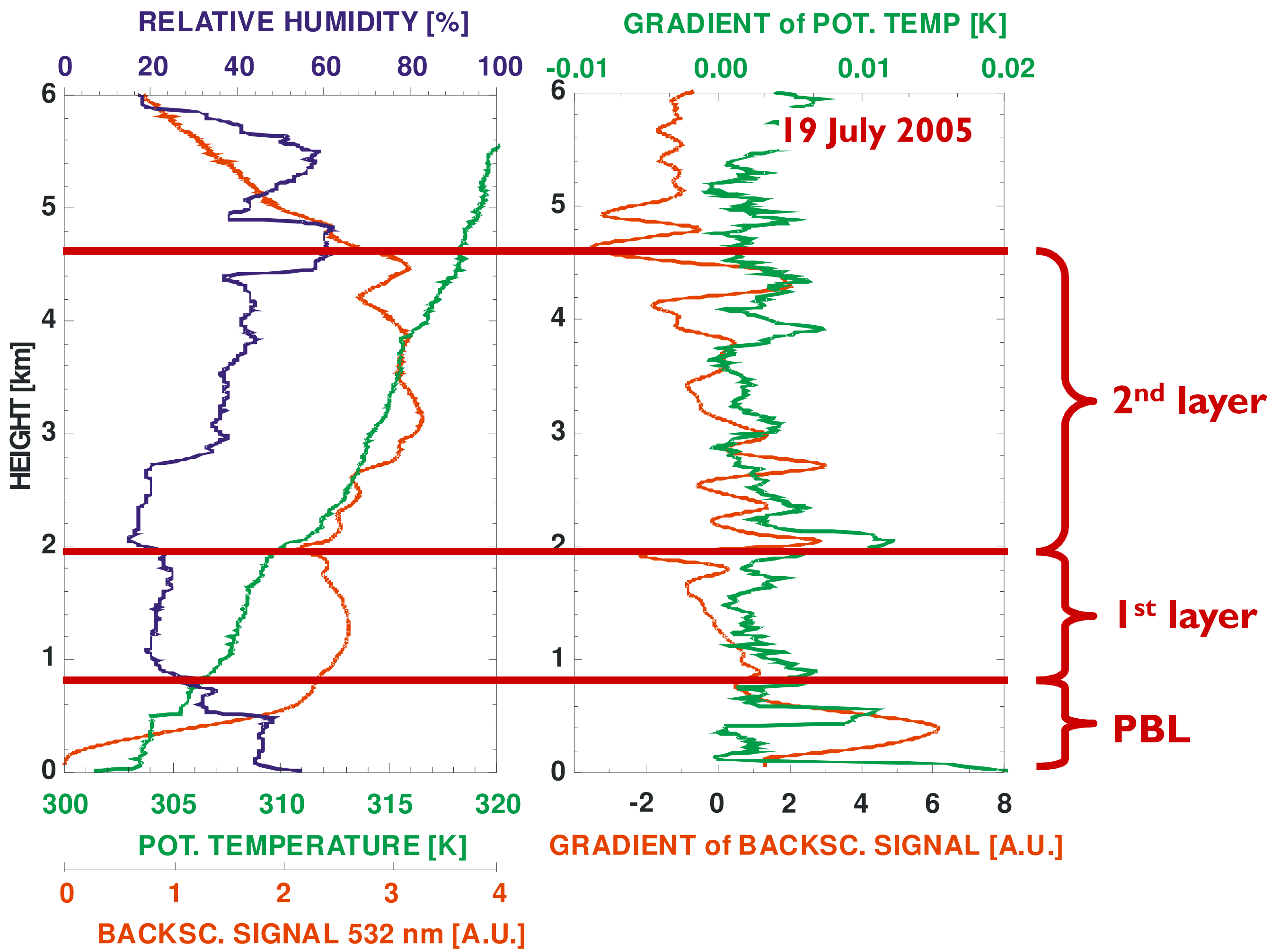
Vertical profiles for each aerosol «type»



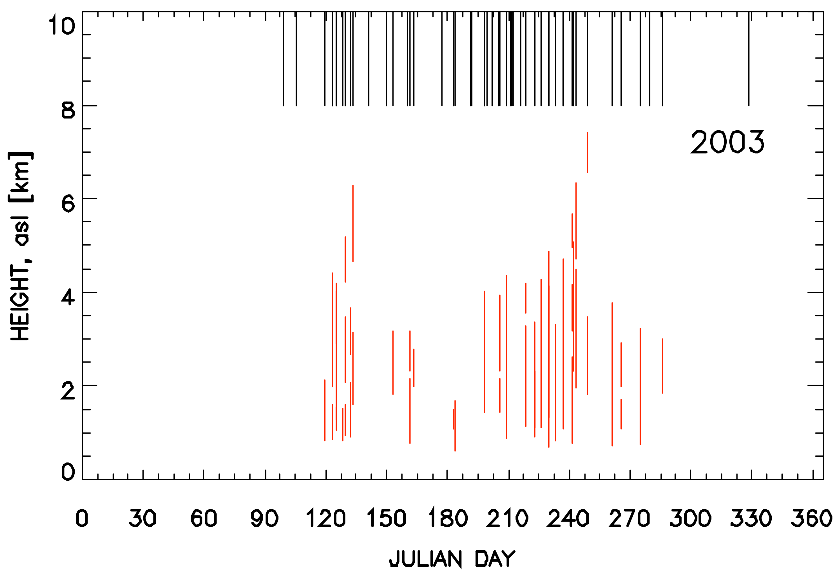
Characteristics «signatures» of aerosols

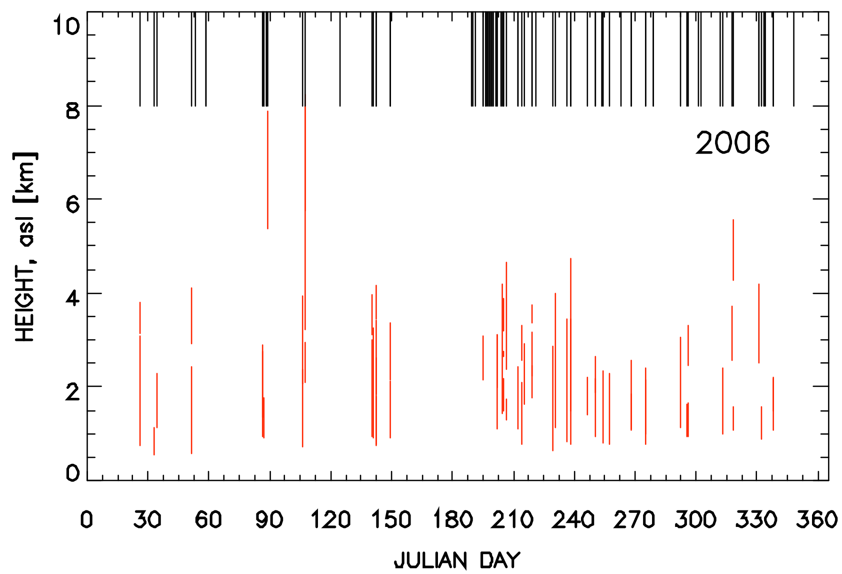


Identify Geometrical Properties

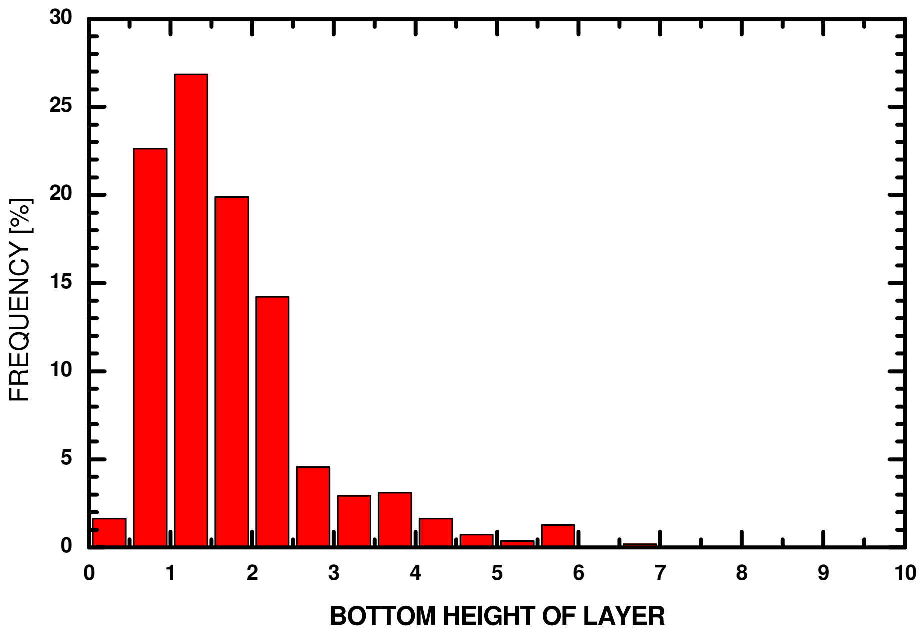


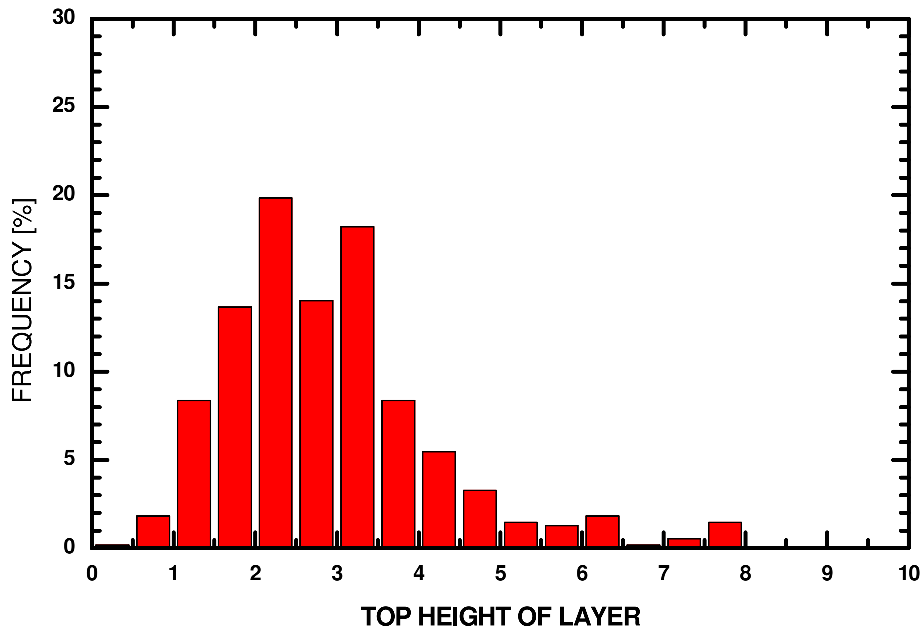
Geometrical layers for 2003 and 2006





Histograms of Geometrical Properties





Conclusions

- A seasonal pattern was found in the column AOD, with values up to 1.8. The pattern was attributed to the enhanced contribution of the FT aerosol component to the total AOD (reaching 40%) in cases of Saharan dust and biomass burning aerosols

- A classification of optical aerosol properties was applied using a cluster analysis algorithm. Five main aerosol transport pathways were found for Thessaloniki. Additional synergetic tools were used to identify from these clusters aerosol sources and better characterize optical properties

- Characteristics optical «signatures» for each «aerosol type» were found, that can be used for reliable backscatter retrievals by space-borne instruments like CALIPSO

- The geometrical properties of elevated and distinct aerosol layers should be identified in order to better characterize each «aerosol type»

Acknowledgments

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