First Year of Sunphotometer Measurements in Romania

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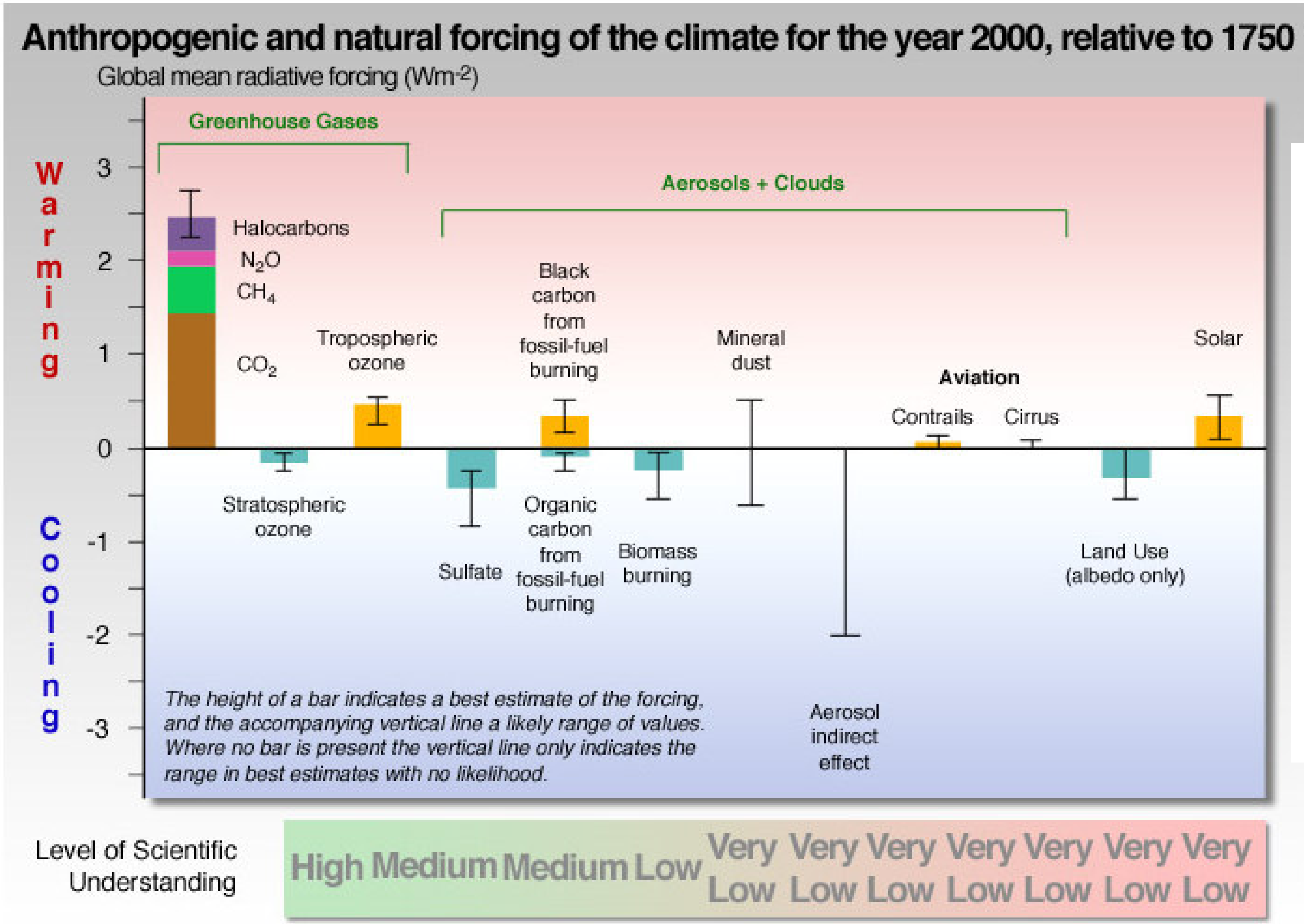
Outline

- Motivation
- AERONET
- Technique
- Results
- Conclusions

Objectives and motivation

- Goal: **study of the aerosol properties from continuous measurements of sun and sky radiances at a number of fixed wavelengths**
- **'Ultimate' goal -to achieve a coherent understanding of aerosol behavior near Bucharest**
- Motivation : **aerosols are important factors into the radiative balance due to their direct and indirect effect**



Adapted from: **IPCC**, 2001: *Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change* [Watson, R.T. and the Core Writing Team (eds.)]. Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA, 398 pp.

Aerosols have large influence on radiation budget as both "cooling" effect and "warming" effect

Low level of knowledge today high uncertainties

HOW?

CIMEL- CE318 automated sunphotometer
λ=340, 380,440,500, 675, 870,1020 nm

- A solar radiometer

-passive remote sensing instrument

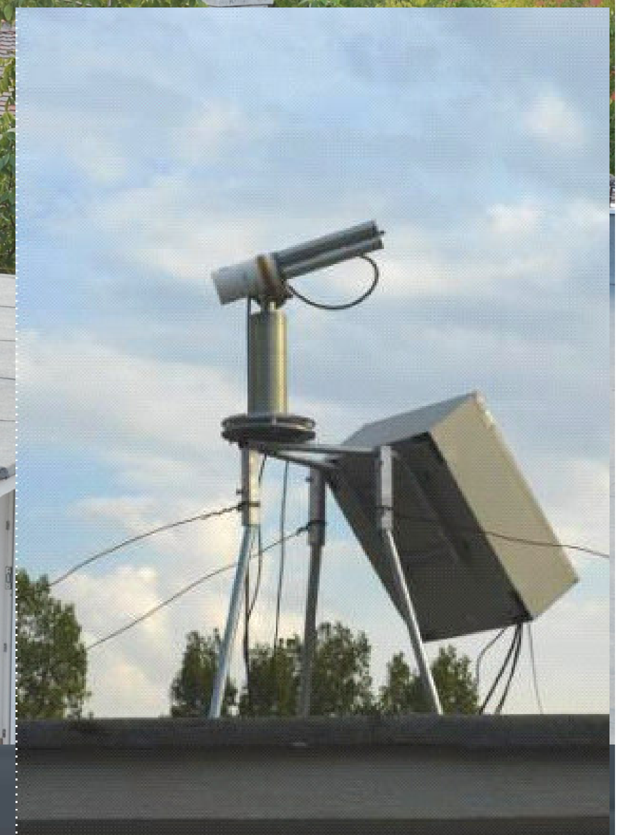
-pointed directly at the Sun to measure atmospheric extinction (absorption + scattering).

-sky radiance measurements

almucantar and principal plane

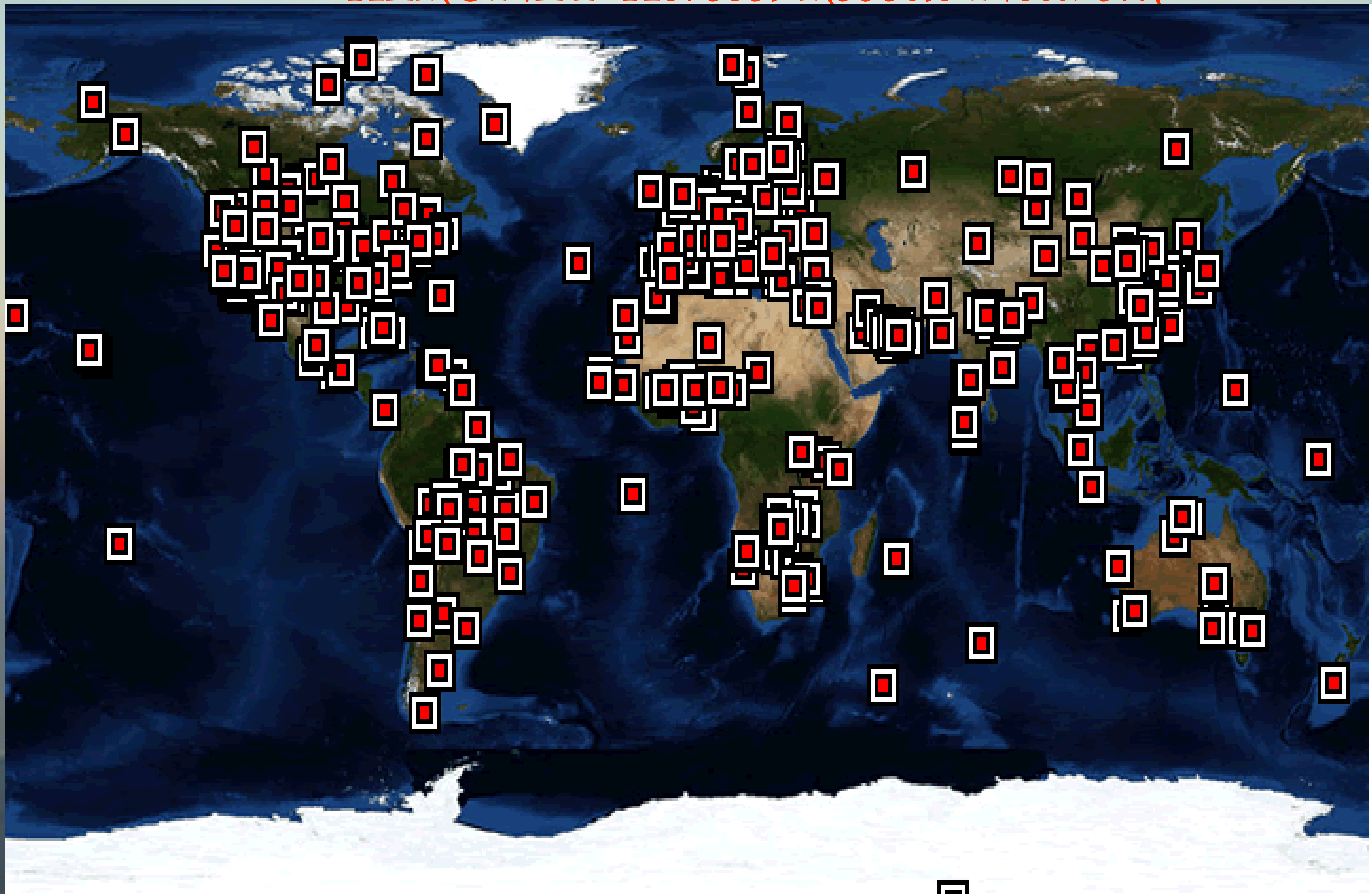
⇩

provide information on the vertically integrated volume during daytime



- July 2007 –June 2008 Magurele-Bucharest site

AERONET-Aerosol Robotic Network



Standard instruments, calibration procedures, data handling → Annual and global studies

Sunphotometer data

- Aerosol optical depth (AOD)
- AOD fine/coarse modes
- 440-870 Angstrom exponent

Inversion products- Dubovik method

- Volume particle size distribution
- refractive index
- single scattering albedo

Errors

- **Our instrument is calibrated every year using PHOTONS calibration facilities in Lille (LOA/USTL, France)**

- **This procedure yields to**

-an estimated accuracy of 0.01-0.02 for the absolute AOD error (wavelength dependent) and

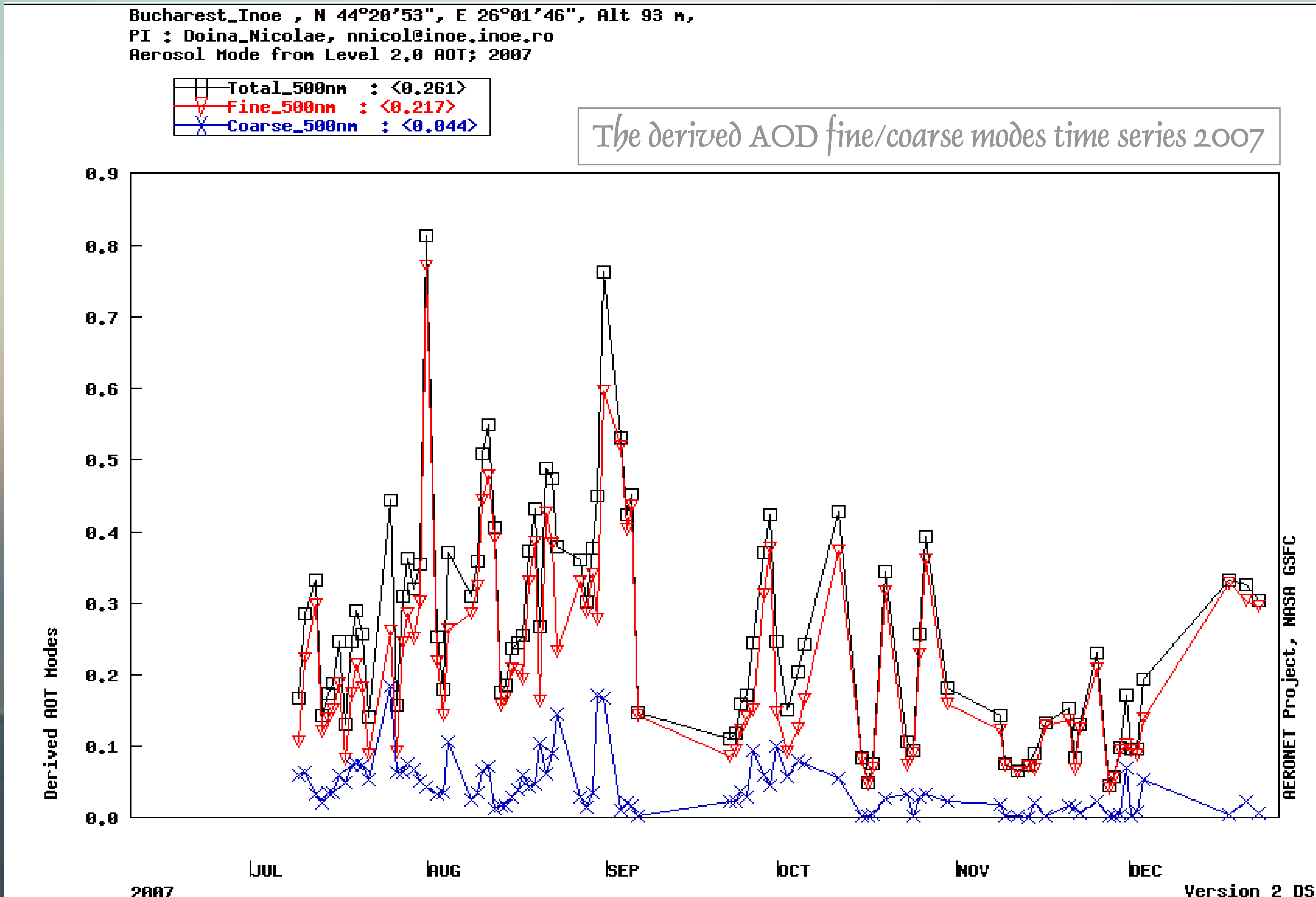
- 5% relative error for the radiance in the sky channels

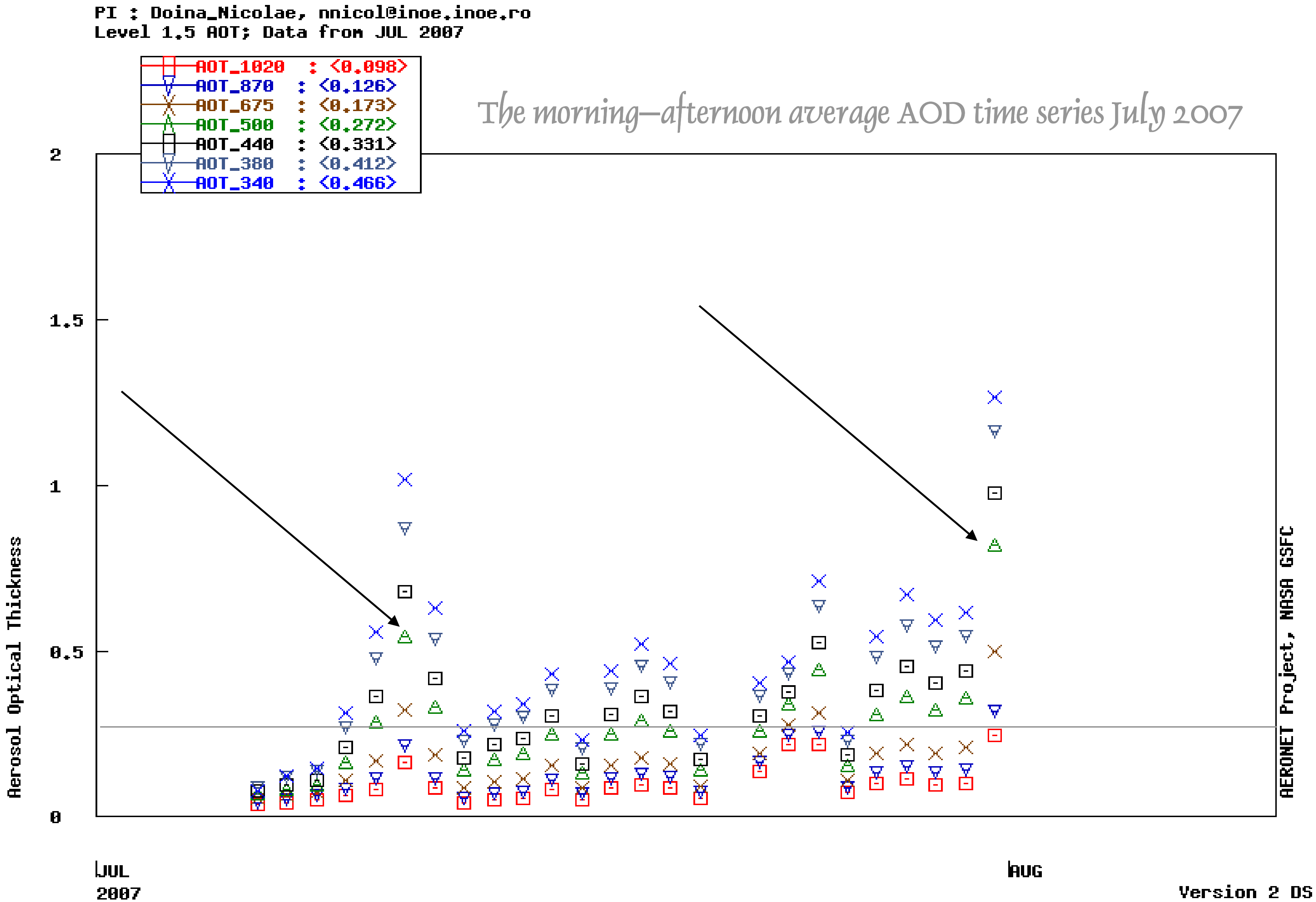
Results

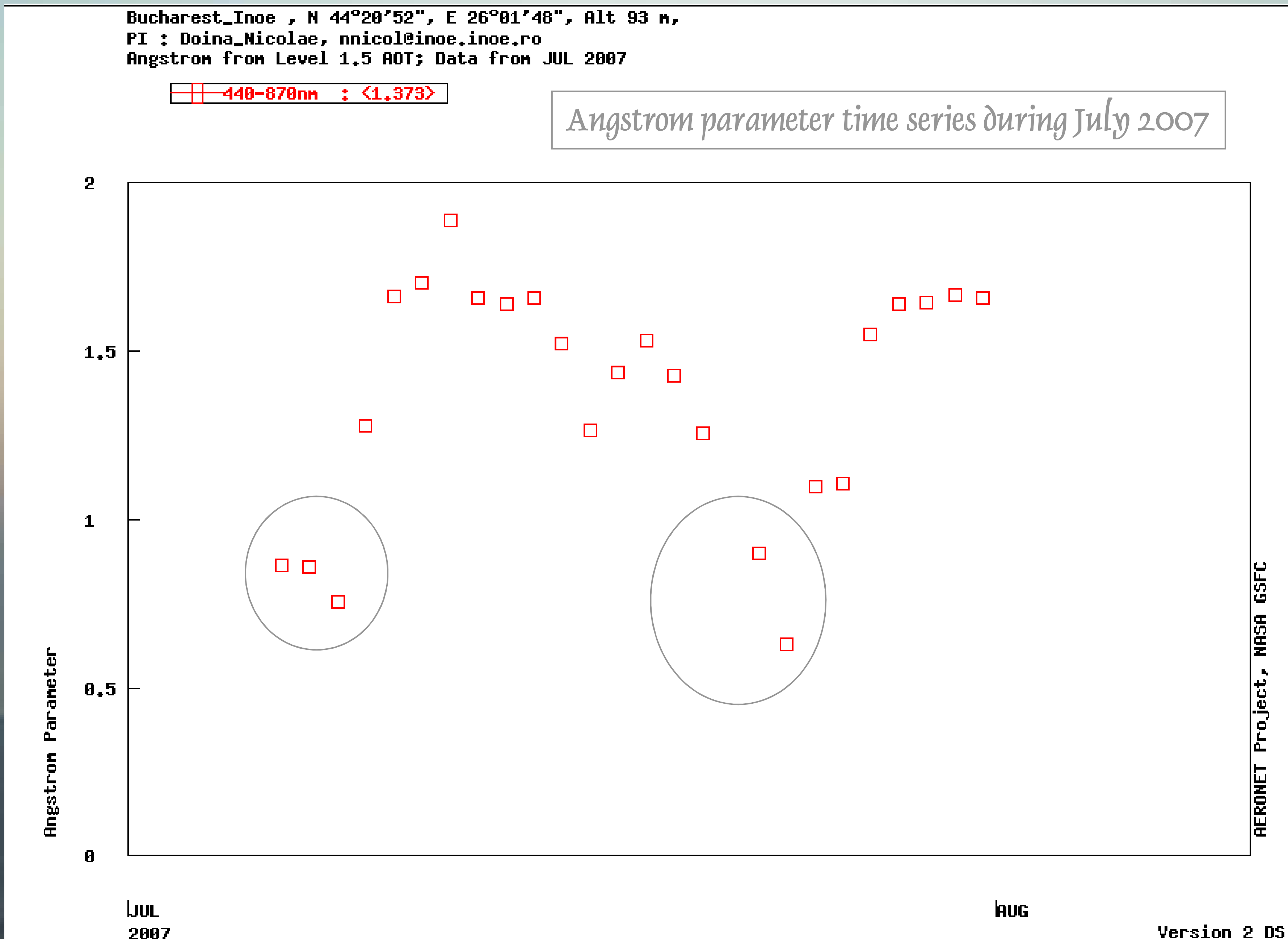
	Jul 2007	Aug 2007	Sept 2007	Oct 2007	Nov 2007	Dec 2007	Jan 2008	Feb 2008	Mar 2008	Apr 2008	May 2008	Jun 2008
AOD	0.272	0.356	0.289	0.297	0.115	0.307	0.144	0.333	0.145	0.220	0.305	0.414
no.of days	24	24	13	15	14	5	9	4	13	16	25	26
å	1.359	1.501	1.427	1.362	1.659	1.527	1.527	1.630	1.458	1.163	1.235	1.545

The monthly average time series of AOD at 500nm wavelength
and 440-870 angstrom parameter-*å* measured
at Magurele during July 2007-June 2008

The derived AOD fine/coarse modes time series 2007

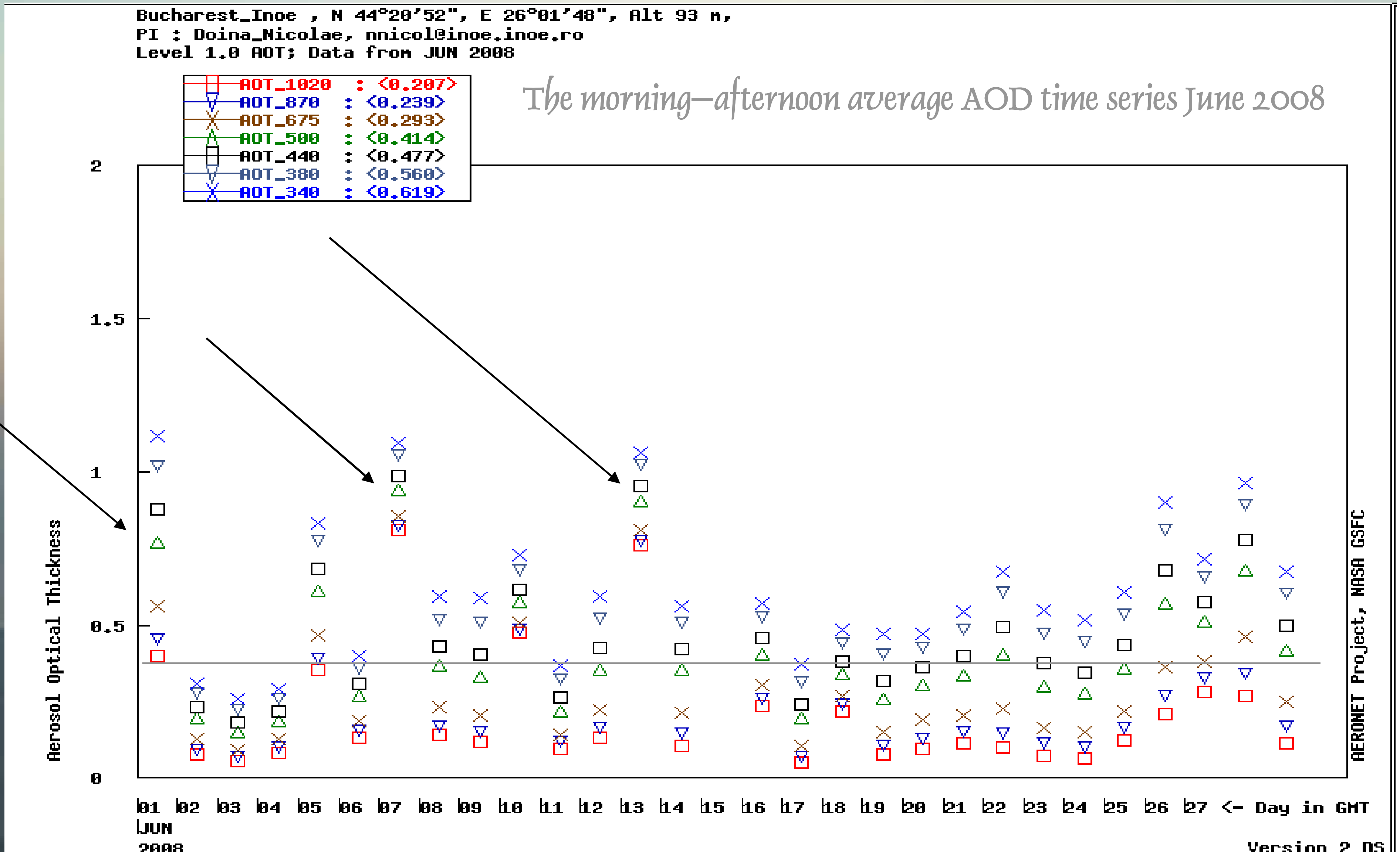



PI : Doina_Nicolae, nnicol@inoe.inoe.ro
Level 1.5 AOT; Data from JUL 2007
AOT_1020 : <0.098>
AOT_870 : <0.126>
AOT_675 : <0.173>
AOT_500 : <0.272>
AOT_440 : <0.331>
AOT_380 : <0.412>
AOT_340 : <0.466>
The morning–afternoon average AOD time series July 2007
2
1.5
1
0.5
0
Aerosol Optical Thickness
JUL
2007
AUG
AERONET Project, NASA GSFC
Version 2 DS



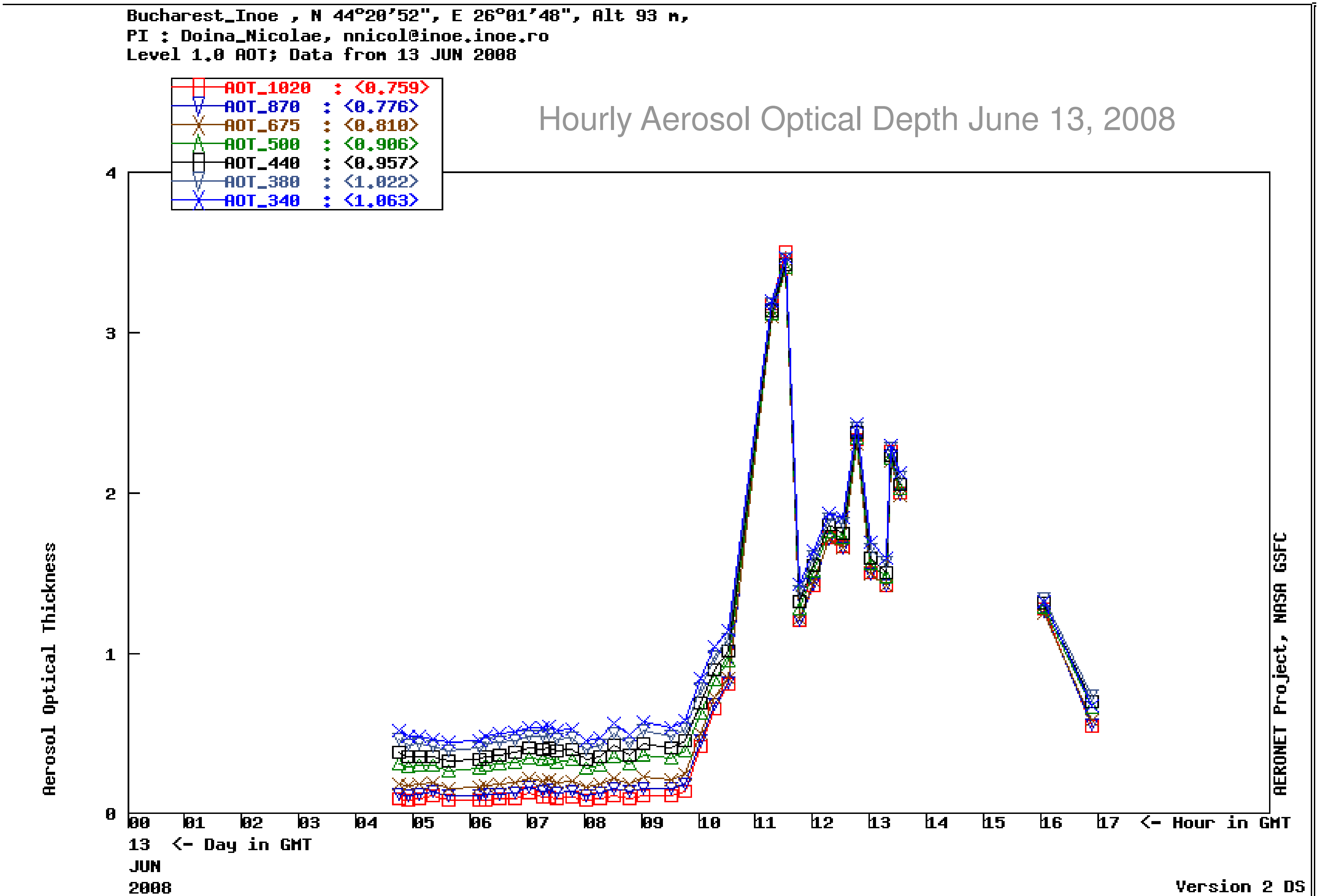
Bucharest_Inoe , N 44°20'52", E 26°01'48", Alt 93 m,
PI : Doina_Nicolae, nnicol@inoe.inoe.ro
Angstrom from Level 1.5 AOT; Data from JUL 2007
440-870nm : <1.373>
Angstrom parameter time series during July 2007
2
1.5
1
0.5
0
Angstrom Parameter
JUL
2007
AUG
AERONET Project, NASA GSFC
Version 2 DS

Results

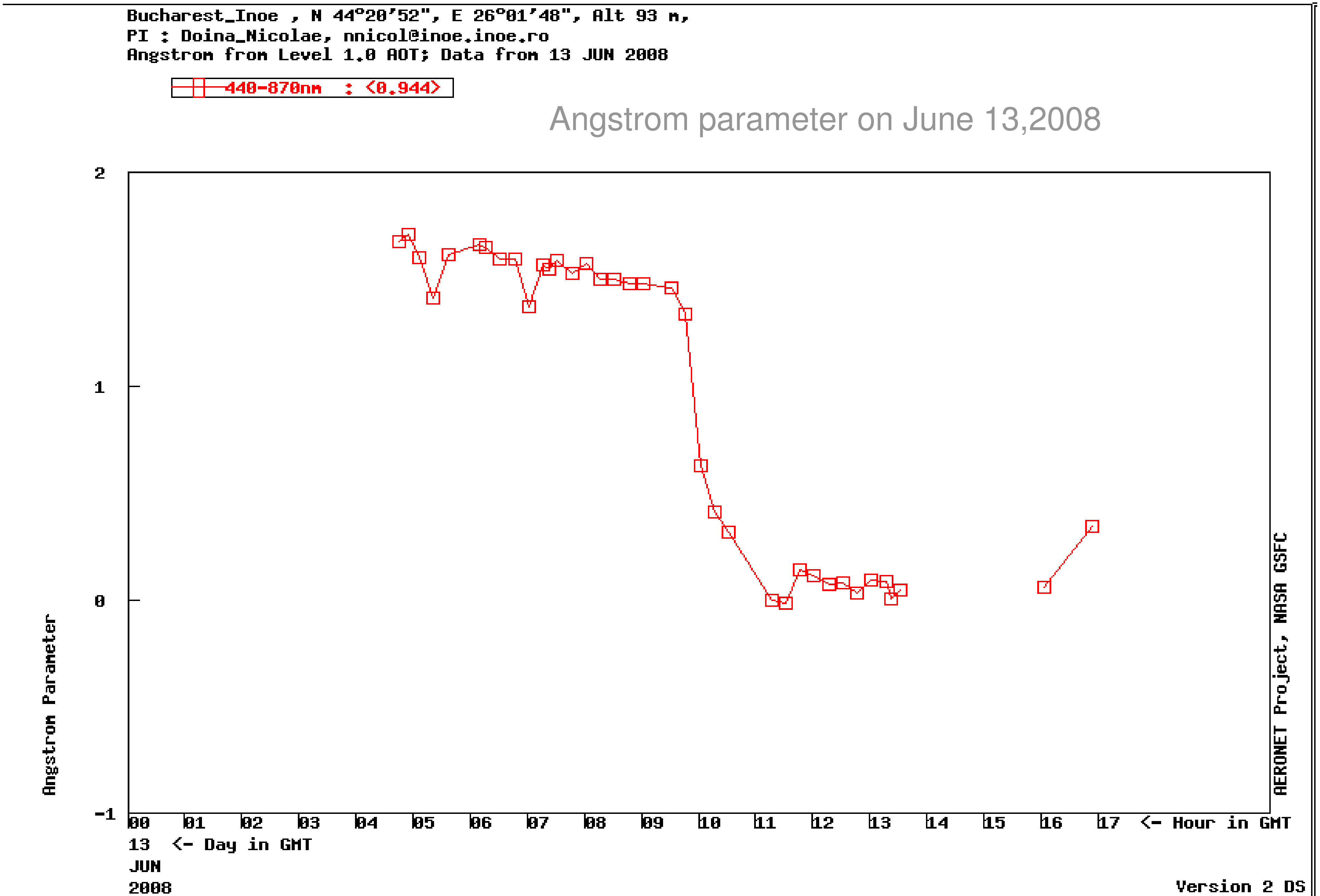


Bucharest_Inoe , N 44°20'52", E 26°01'48", Alt 93 m,
PI : Doina_Nicolae, nnicol@inoe.inoe.ro
Level 1.0 AOT; Data from JUN 2008
AOT_1020 : <0.207>
AOT_870 : <0.239>
AOT_675 : <0.293>
AOT_500 : <0.414>
AOT_440 : <0.477>
AOT_380 : <0.560>
AOT_340 : <0.619>
The morning–afternoon average AOD time series June 2008
Aerosol Optical Thickness
2
1.5
1
0.5
0
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 <- Day in GMT
JUN
2008
AERONET Project, NASA GSFC
Version 2 DS

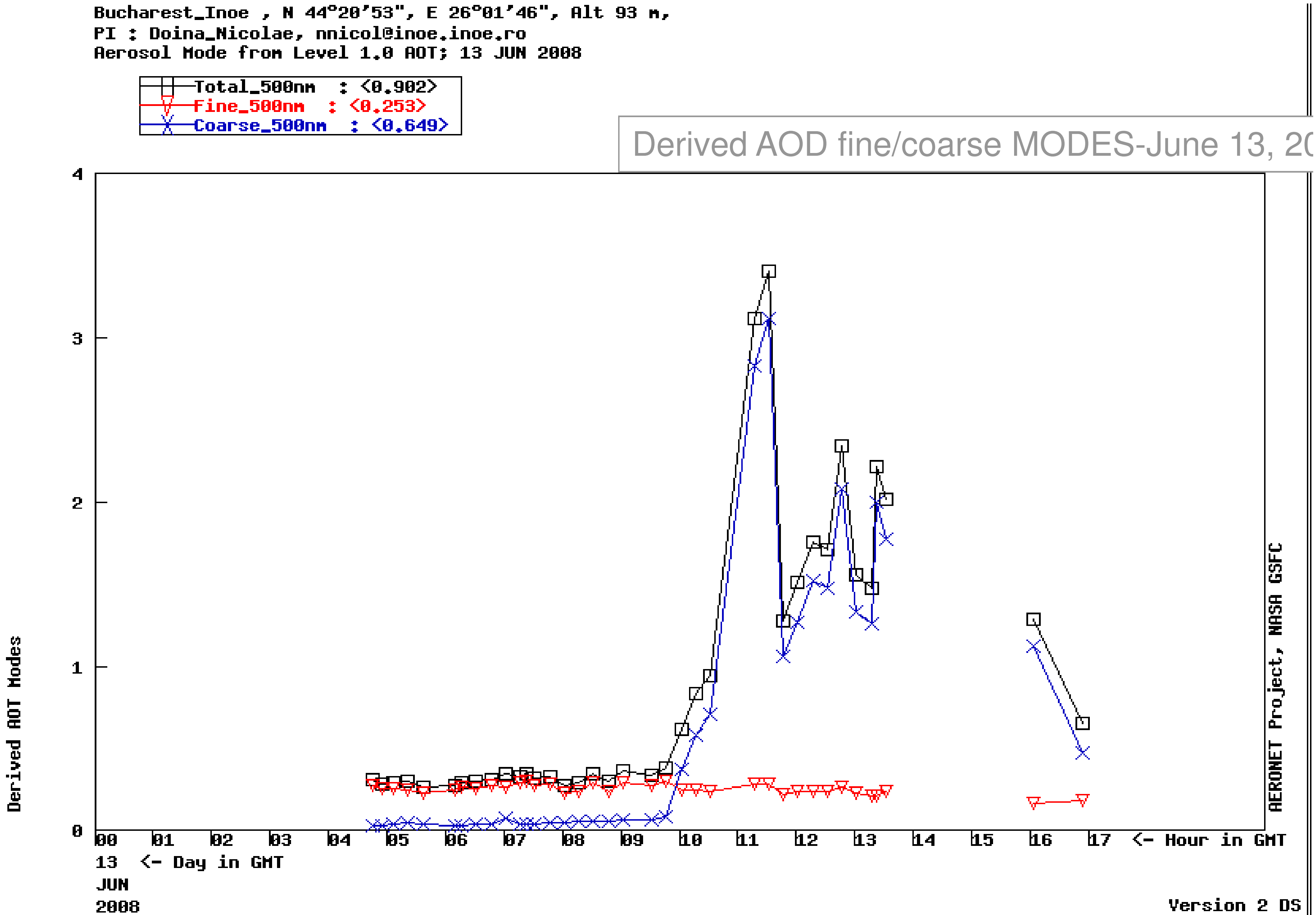
Hourly Aerosol Optical Depth June 13, 2008



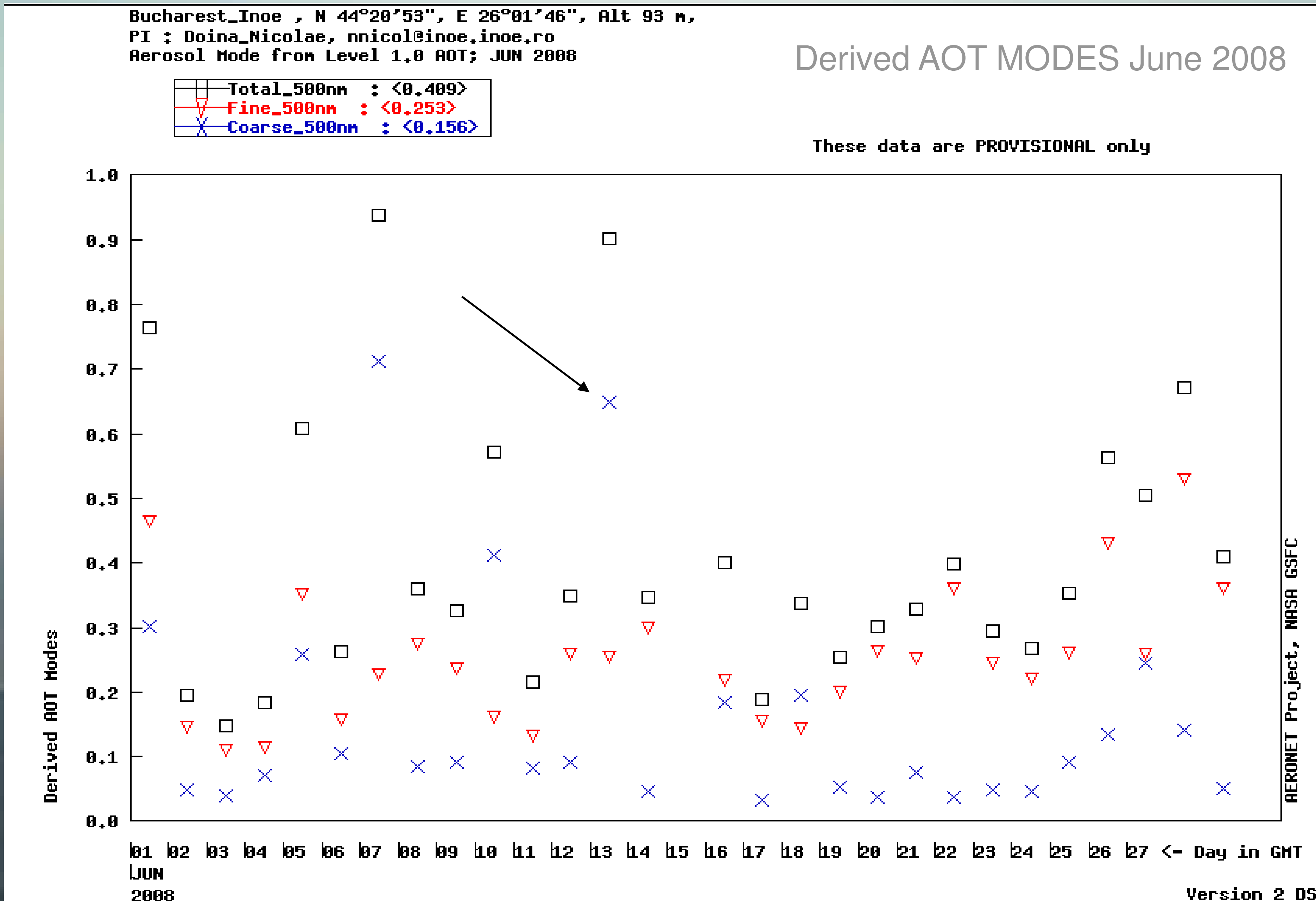
Angstrom parameter on June 13,2008



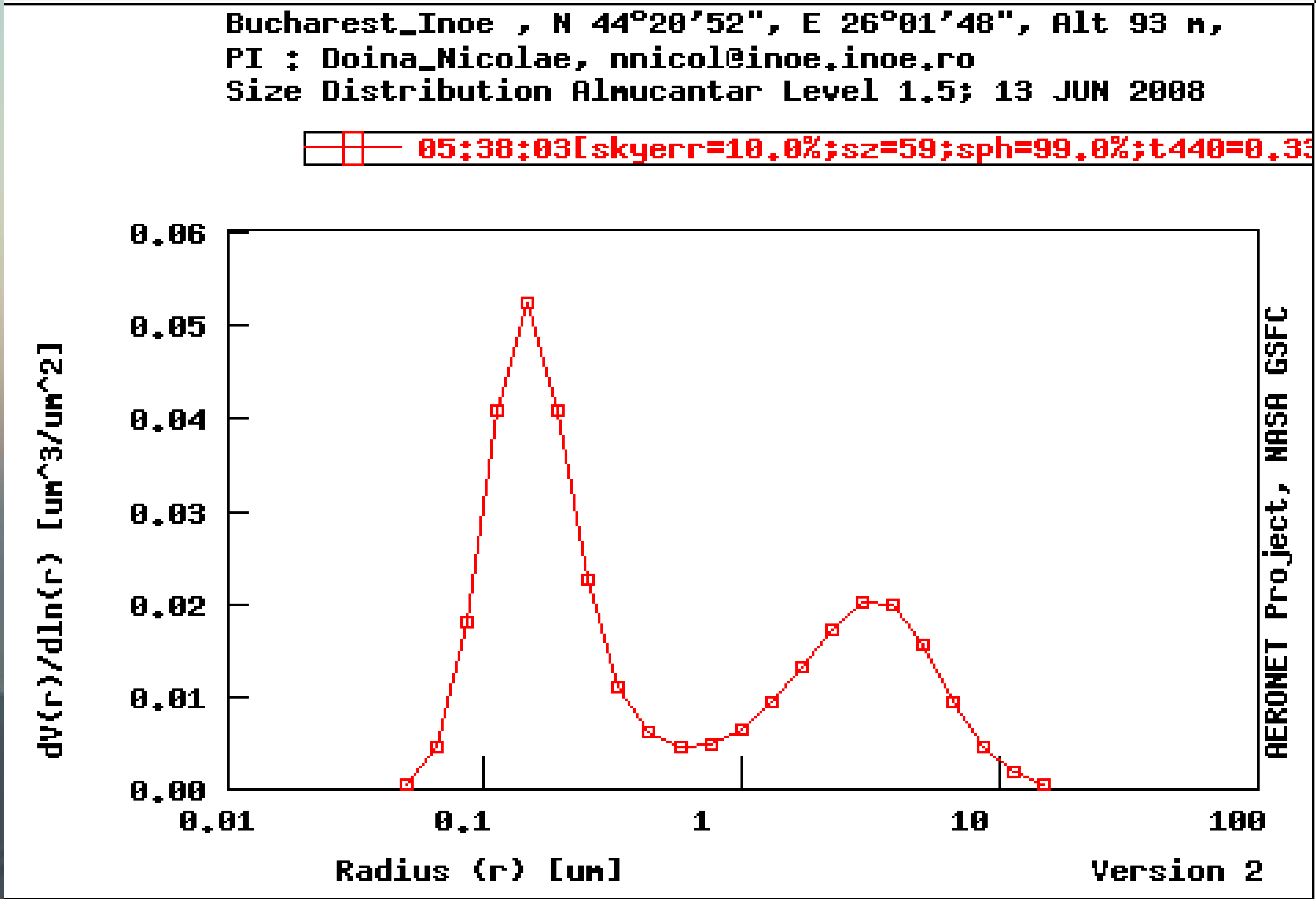
Derived AOD fine/coarse MODES-June 13, 20



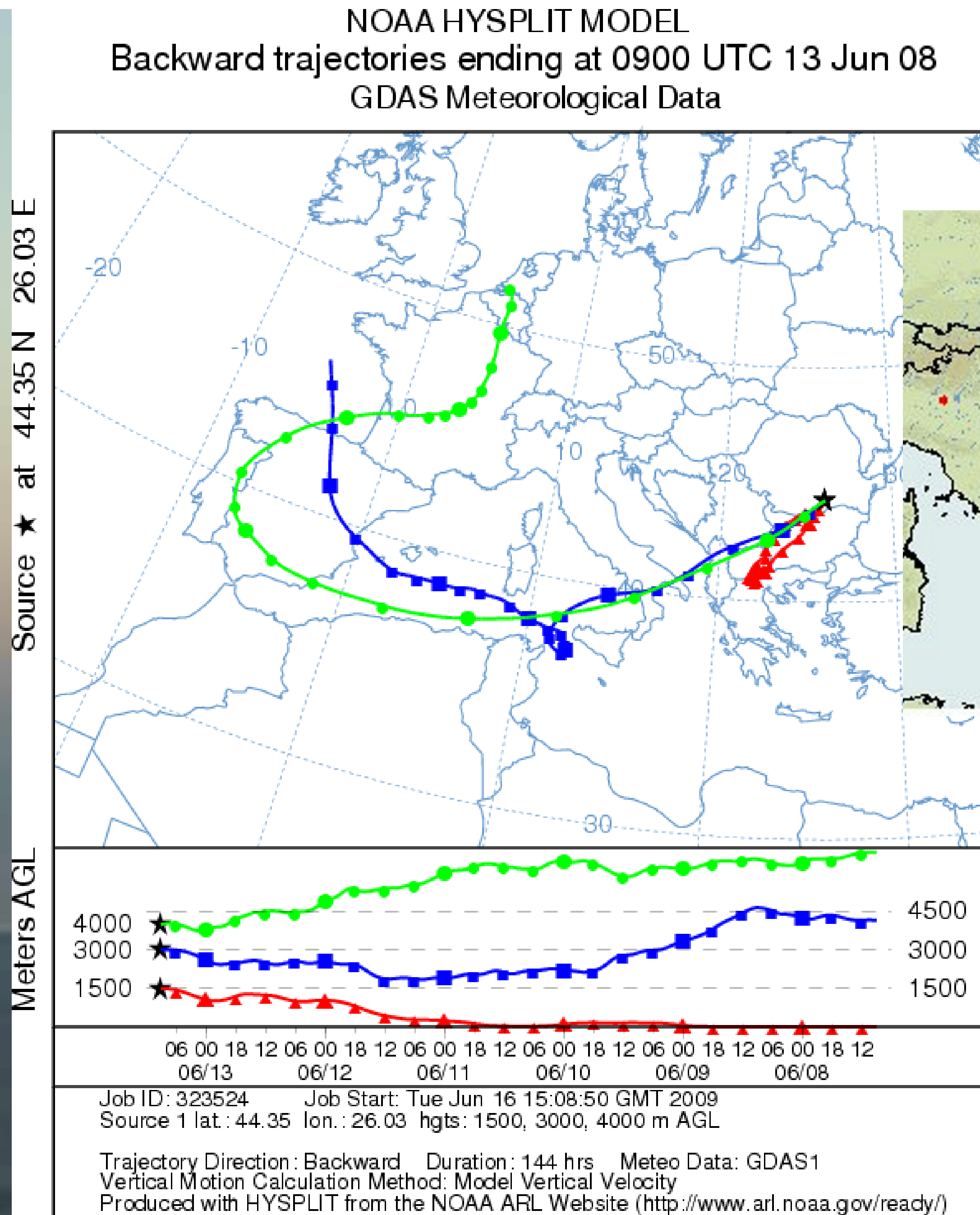
Derived AOT MODES June 2008

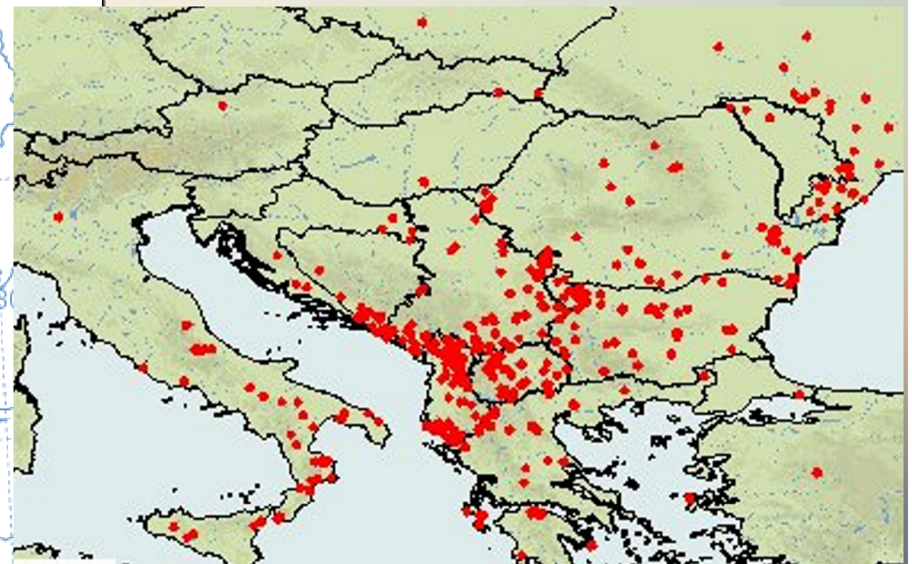


Size distribution June 13, 2008

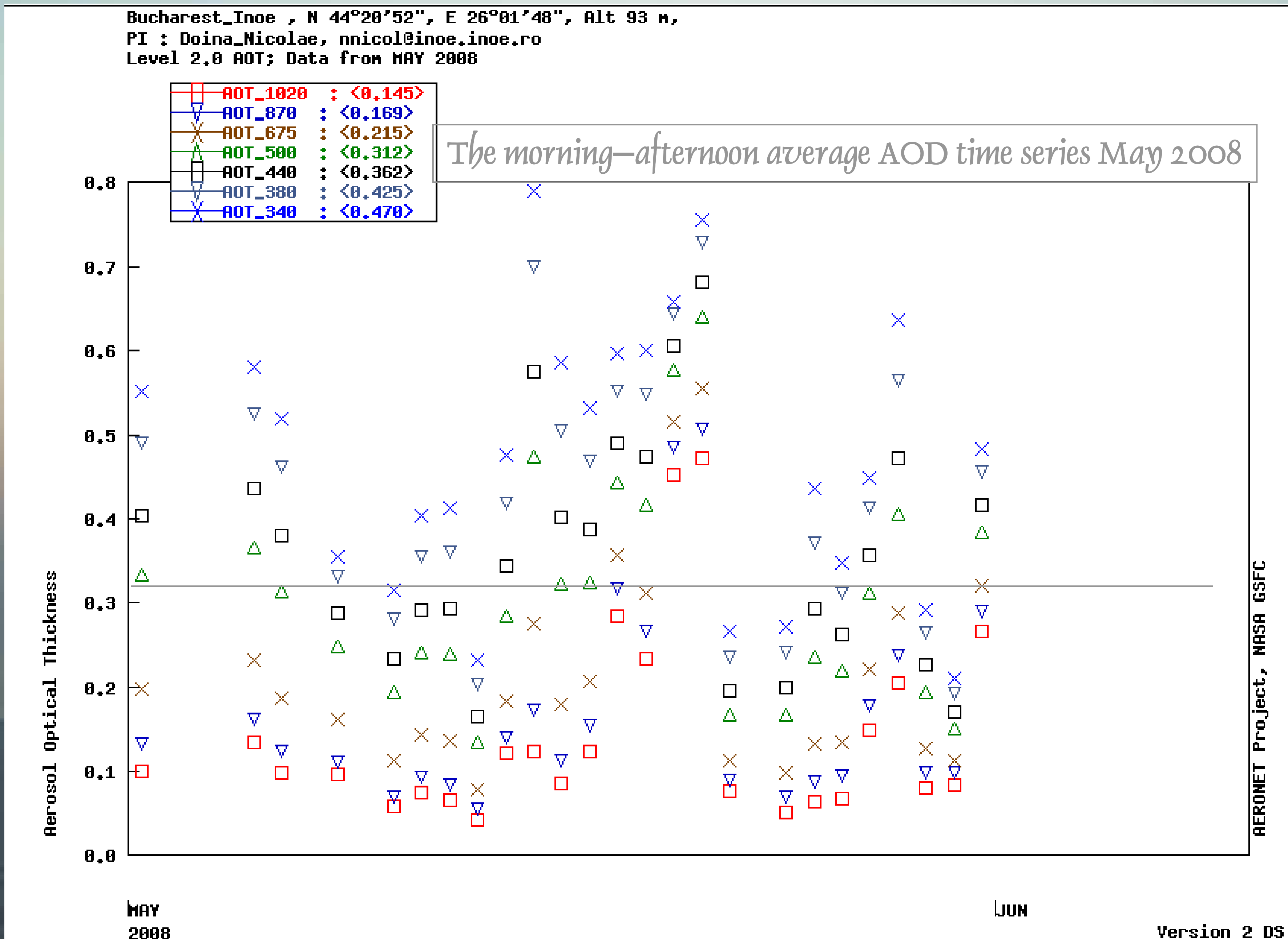


Aerosol source June 13, 2008

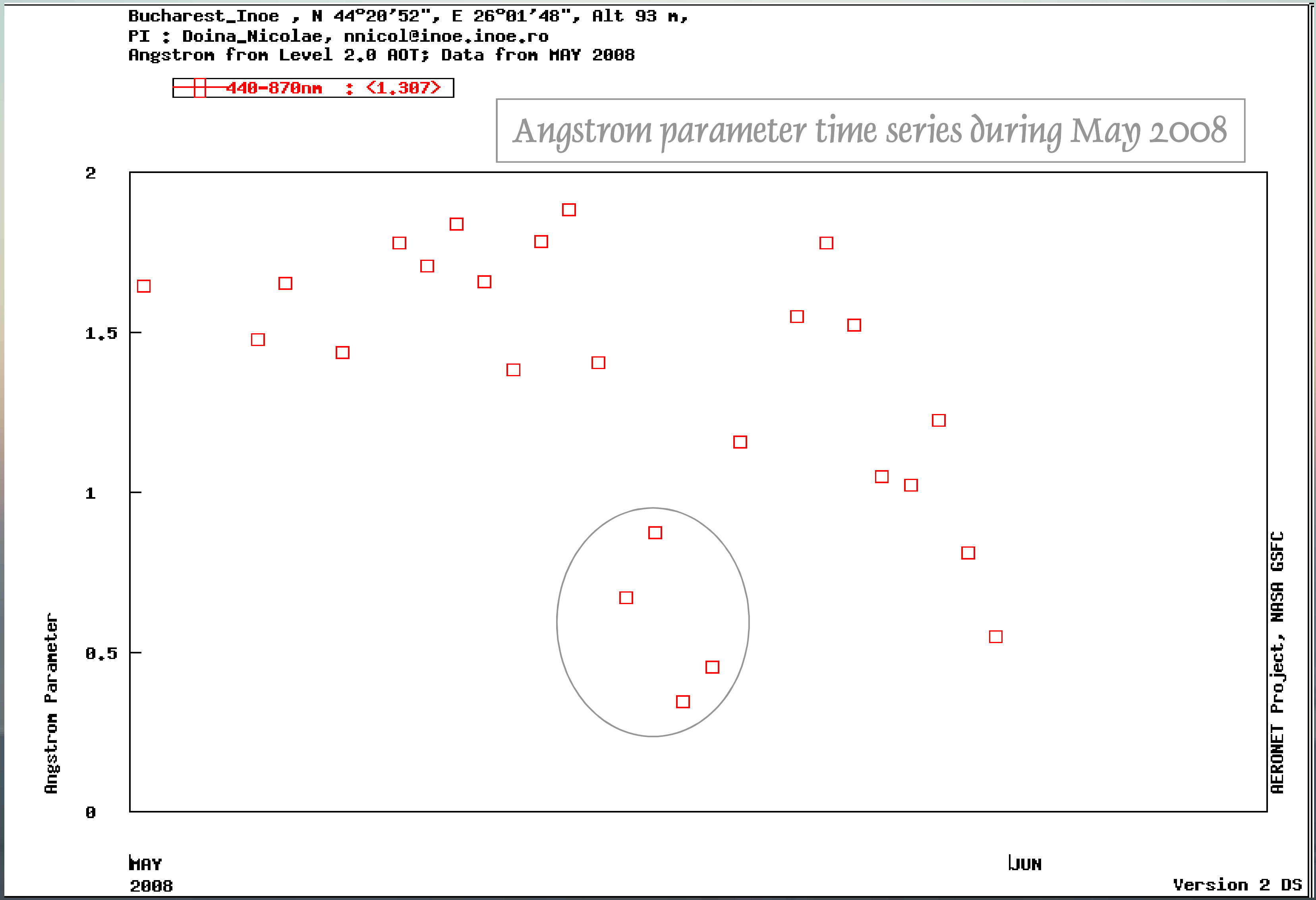


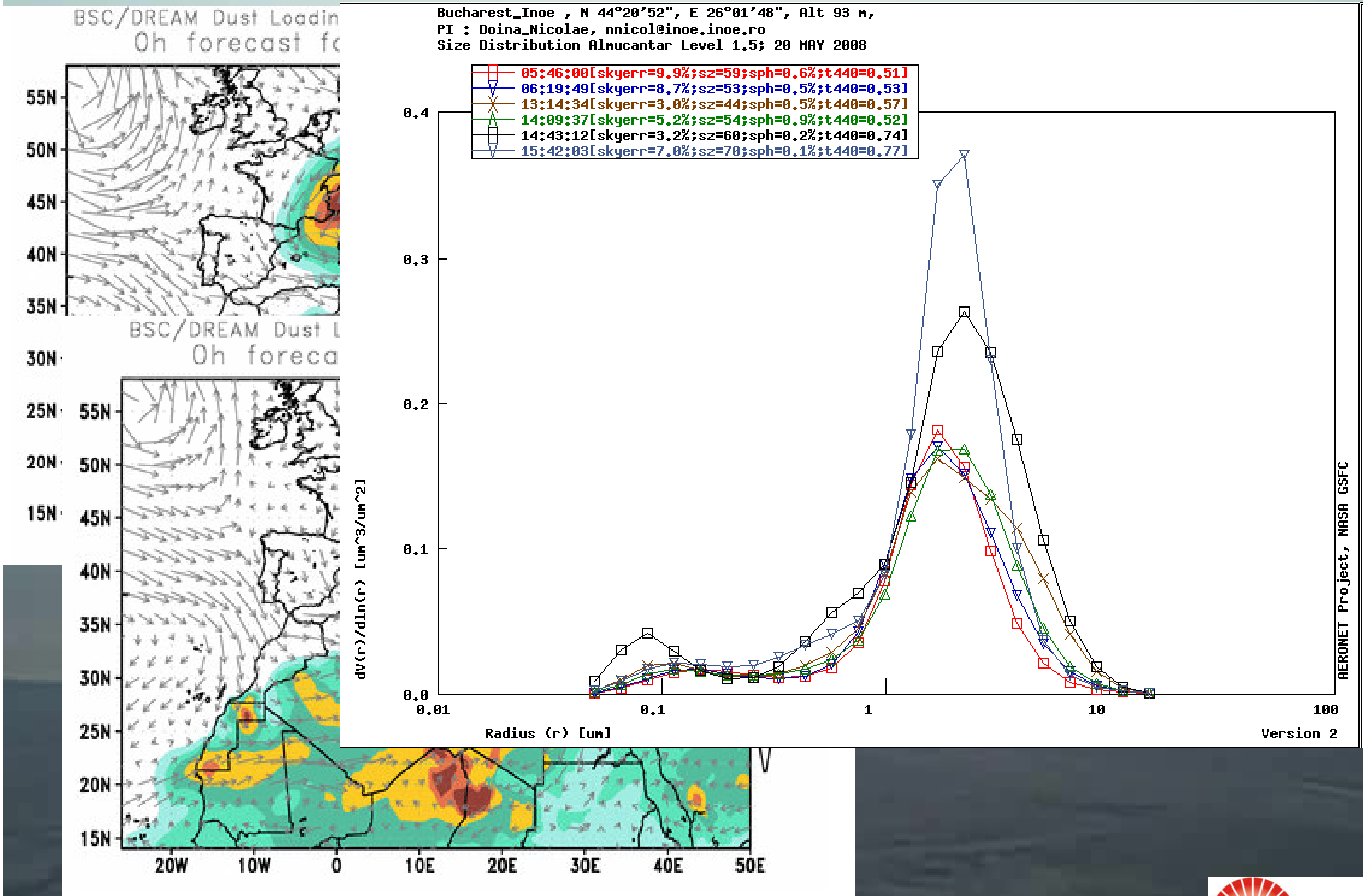


Composite TERRA-MODIS Image June 10-13, 2008 -fire alerts

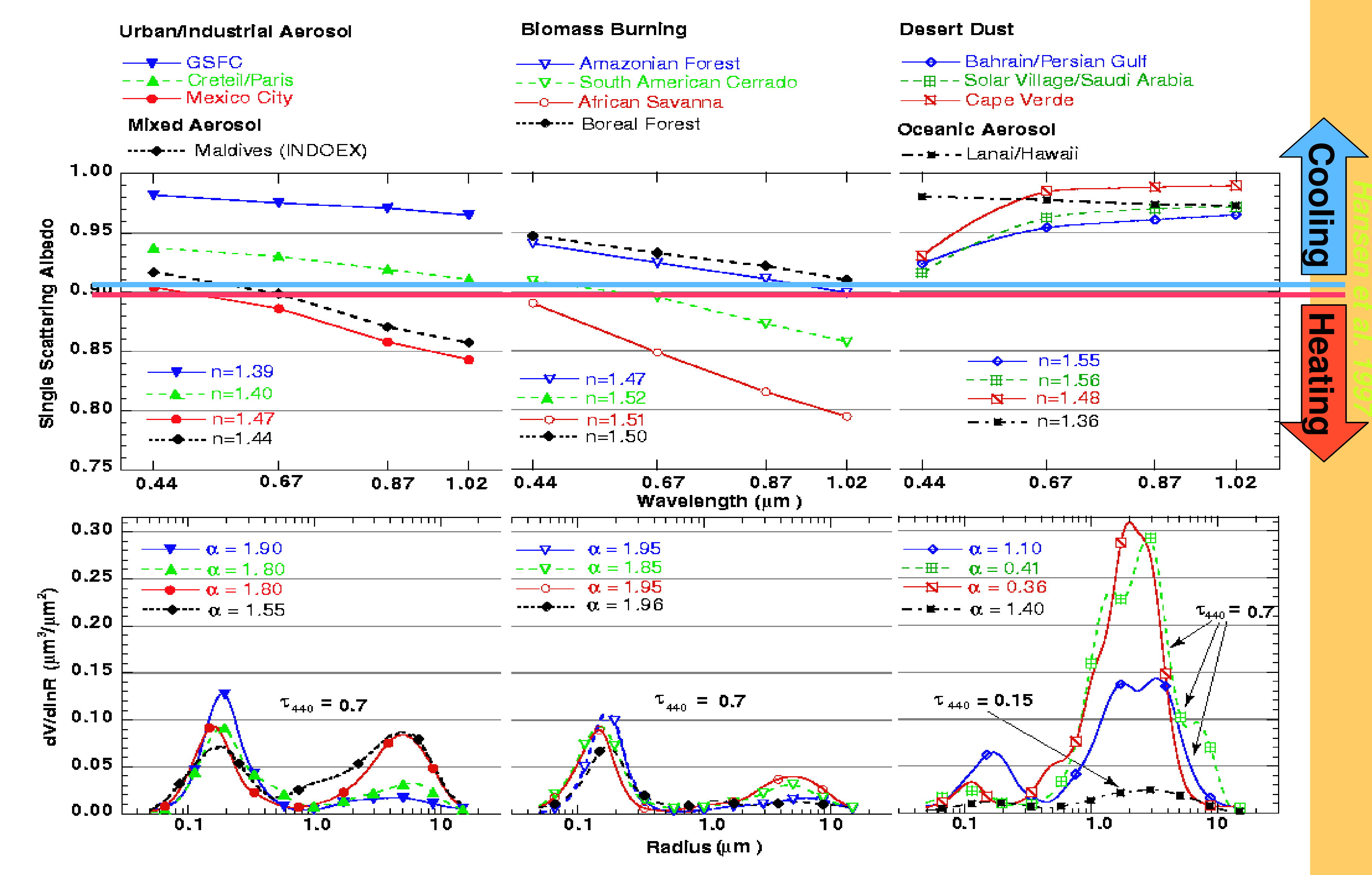


Bucharest_Inoe , N 44°20'52", E 26°01'48", Alt 93 m,
PI : Doina_Nicolae, nnicol@inoe.inoe.ro
Level 2.0 AOT; Data from MAY 2008
AOT_1020 : <0.145>
AOT_870 : <0.169>
AOT_675 : <0.215>
AOT_500 : <0.312>
AOT_440 : <0.362>
AOT_380 : <0.425>
AOT_340 : <0.470>
The morning–afternoon average AOD time series May 2008
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Aerosol Optical Thickness
AERONET Project, NASA GSFC
MAY
2008
JUN
Version 2 DS


Bucharest_Inoe , N 44°20'52", E 26°01'48", Alt 93 m,
PI : Doina_Nicolae, nnicol@inoe.inoe.ro
Angstrom from Level 2.0 AOT; Data from MAY 2008
440-870nm : <1.307>
Angstrom parameter time series during May 2008
2
1.5
1
0.5
0
Angstrom Parameter
MAY
2008
JUN
AERONET Project, NASA GSFC
Version 2 DS


BSC/DREAM Dust Loadin
0h forecast fo
BSC/DREAM Dust L
0h foreca
55N
50N
45N
40N
35N
30N
25N
20N
15N
20W
10W
0
10E
20E
30E
40E
50E
Bucharest_Inoe , N 44°20'52", E 26°01'48", Alt 93 m,
PI : Doina_Nicolae, nnicol@inoe.inoe.ro
Size Distribution Almucantar Level 1.5; 20 MAY 2008
05:46:00[skyerr=9.9%;sz=59;sph=0.6%;t440=0.51]
06:19:49[skyerr=8.7%;sz=53;sph=0.5%;t440=0.53]
13:14:34[skyerr=3.0%;sz=44;sph=0.5%;t440=0.57]
14:09:37[skyerr=5.2%;sz=54;sph=0.9%;t440=0.52]
14:43:12[skyerr=3.2%;sz=60;sph=0.2%;t440=0.74]
15:42:03[skyerr=7.0%;sz=70;sph=0.1%;t440=0.77]
dV(r)/dln(r) [um^3/um^2]
0.4
0.3
0.2
0.1
0.0
0.01
0.1
1
10
100
Radius (r) [um]
Version 2
AERONET Project, NASA GSFC

AERONET *global comparison: Properties from four Generic types*



Holben et al. 2003, NASA/GSFC

Hansen et al. 1997

Conclusions

- Preliminary data suggest that during July 2007-June 2008 the aerosol is not strongly absorbing as in other Aeronet urban sites
- Aerosol size distributions are dominated by fine mode particles (radius < 0.6 micron) with high values when biomass burning strongly influences
- Data suggest a dynamic aerosol pattern highly influenced by long range transport
- the dust intrusions episodes examined by our team were associated with marked increases in aerosol optical depth at all wavelengths
- values during dust events agree well with those obtained under the same kind of events in AERONET sites

Acknowledgements

The authors wish to acknowledge DELICE grant contract FP7 REGPOT-2008-1 Contract no. 229907.

This work was supported by a grant from Norway through the Norwegian Co-operation Programme for Economic Growth and Sustainable Development in Romania.

The AERONET database is maintained and made publicly available by B.N. Holben (NASA′s Goddard Space Flight Center, Greenbelt, MA).

Active fire maps are produced by the European Space Agency, ESA/ESRIN ATSR.

Air mass back trajectories were produced by the Hybrid Single Particle Lagrangian Integrated Trajectory-HYSPLIT 4.6 Model of NOAA

DREAM MODEL- BSC Barcelona

Thank you for your attention!

Optical depth = $\tau = \int_0^{\infty} \sigma(z) N(z) dz$

[ ] [m^2] [m^{-3}] [m]

σ = absorption, scattering, or extinction cross section [m^2]

N = gas molecule or particle number density [m^{-3}]

z = range (distance) along optical path [m]

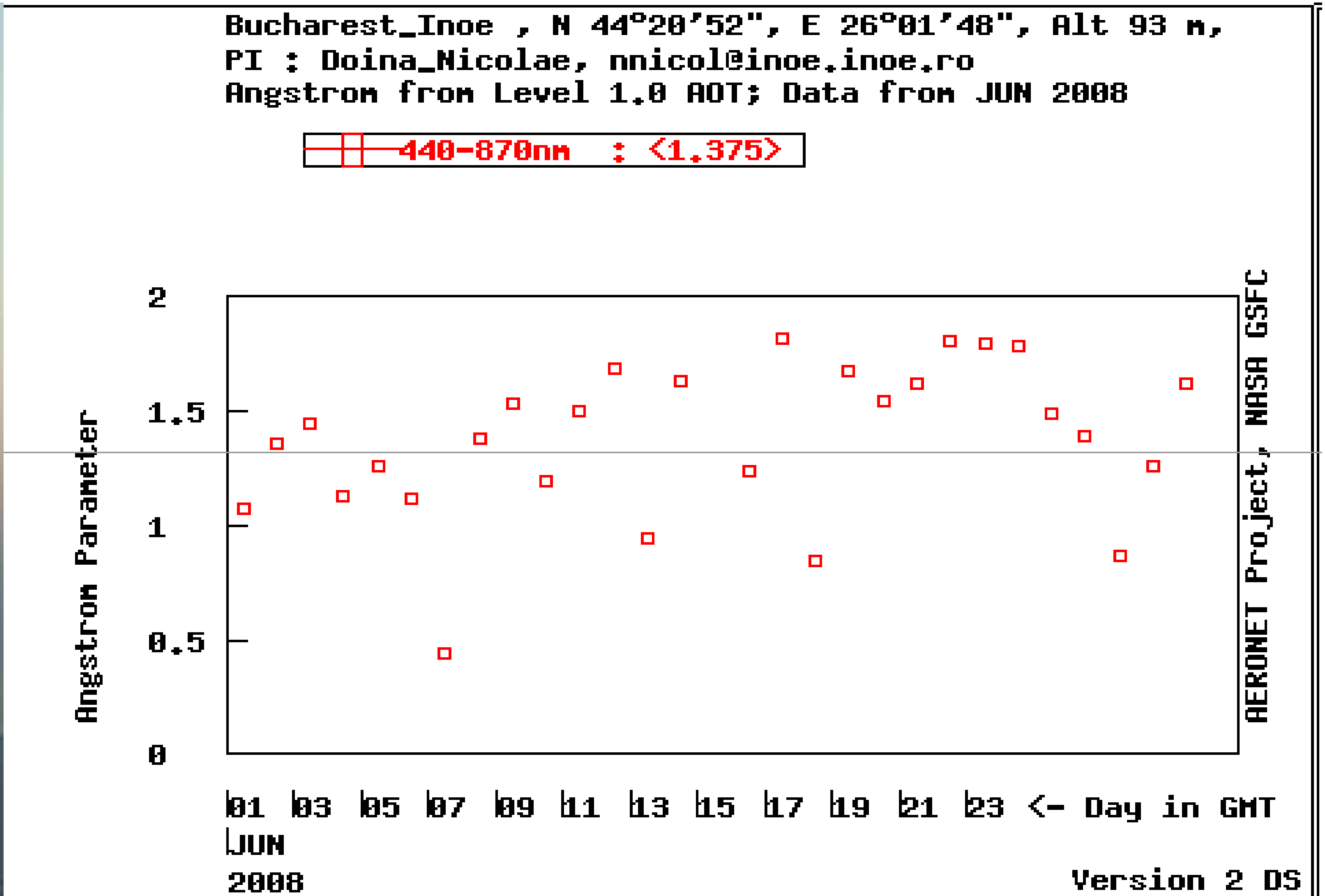
Optical depth decreases at longer wavelengths. Depending on the details of the particle-size distribution, the wavelength variation can be estimated with Angstrom's turbidity formula:

$$\tau_\lambda = \tau_0 \left(\frac{\lambda}{\lambda_0} \right)^{-\alpha}$$

with τ_λ = optical depth at wavelength λ
τ_0 = optical depth at wavelength λ_0
α = the Angstrom exponent

You can use optical depth measurements at two wavelengths to estimate the Angstrom exponent:

$$\alpha = -\frac{\ln\left(\frac{\tau_1}{\tau_2}\right)}{\ln\left(\frac{\lambda_1}{\lambda_2}\right)}$$


Bucharest_Inoe , N 44°20'52", E 26°01'48", Alt 93 m,
PI : Doina_Nicolae, nnicol@inoe.inoe.ro
Angstrom from Level 1.0 AOT; Data from JUN 2008
440-870nm : <1.375>
Angstrom Parameter
2
1.5
1
0.5
0
01 03 05 07 09 11 13 15 17 19 21 23 <- Day in GMT
JUN
2008
AERONET Project, NASA GSFC
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