



**Babeş-Bolyai University**

**Faculty of Environmental Sciences**

**Research Center for Disaster Management**



# COMPARATIVE STUDY OF REGIONAL AEROSOLS FROM COLUMNAR SUNPHOTOMETRIC DATA IN ROMANIA

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Cluj-Napoca  
OTEM 2010



# Outline

- ▣ Introduction to Sun photometry and AERONET
- ▣ Comparative analysis of Sun photometer data from 3 stations in Romania
- ▣ “mini” case-study
- ▣ Conclusions and future work

# Introduction to sunphotometry

- ▣ Sun photometry is a passive remote sensing technique which uses solar radiometers (calibrated to accuracies of one part in a thousand) to routinely assess atmospheric spectral optical depths to high accuracy.
- ▣ There is presently a global network of sun photometers (AERONET) providing information about the spectral variation of aerosol optical depth and information about atmospheric trace constituents.

# AERONET

## (Aerosol RObotic NETwork)

- ▣ AERONET is a network of ground-based sun photometers which measure atmospheric aerosol properties. The measurement system is a solar-powered CIMEL Electronique 318A spectral radiometer that measures Sun and sky radiances at a number of fixed wavelengths (340, 380, 440, 500, 675, 870, 1020) within the visible and near-infra red spectrum.

# Cimel CE 318

- ▣ The CE 318 automatic sun tracking photometer has been designed and realized to be a very accurate sun photometer with all the qualities of a field instrument : motorized, portable, autonomous (solar powered) and automatic.
- ▣ Its main purpose is to measure sun and sky radiance in order to derive total column water vapor, ozone and aerosols properties using a combination of spectral filters and azimuth/zenith viewing controlled by a microprocessor.



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# Sunphotometer stations in Romania

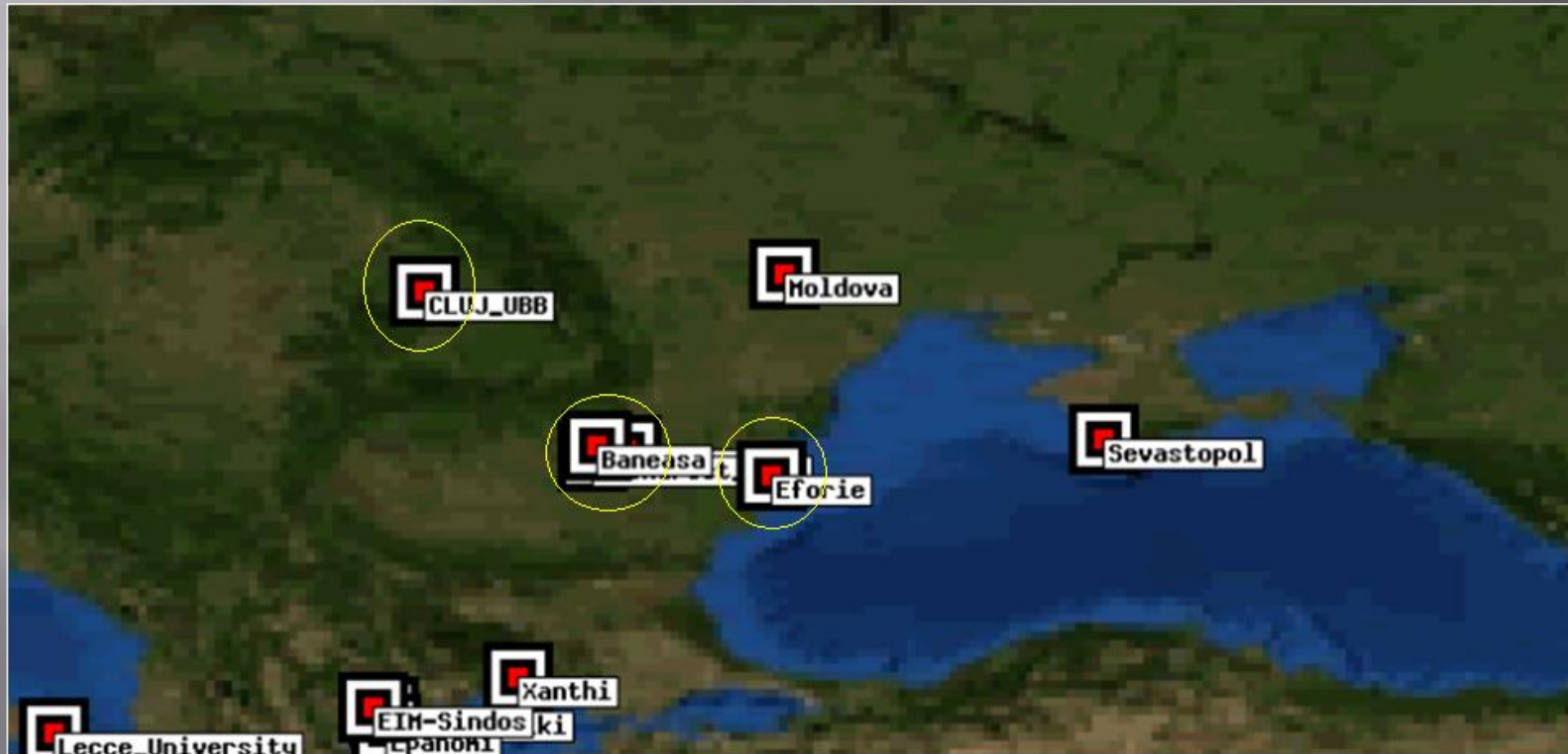
- ▣ Bucharest\_Inoe - lat:  $44.34806^{\circ}$  N, lon:  $26.02972^{\circ}$  E, Elevation: 93.0 m, data from 03.07.2007, near Bucharest, at Măgurele.
- ▣ Eforie - lat:  $44.07500^{\circ}$  N, Lon:  $28.63222^{\circ}$  E, Elevation: 40.0 m, data from 11.09.2009, near Black Sea, at Eforie.
- ▣ CLUJ\_UBB – lat:  $46.76833^{\circ}$  N, lon:  $23.55139^{\circ}$  E, Elevation: 405m, data from 05.07.2010 in Cluj-Napoca.

# Sunphotometer stations in Romania

- ▣ Main possible aerosol sources:
  - Bucharest\_Inoe: - urban pollution  
- dust intrusions
  - CLUJ\_UBB: - urban pollution  
- occasional dust intrusions
  - Eforie: - maritime aerosol  
- urban pollution from nearby Constanța city  
- dust intrusions



# Sunphotometer stations in Romania



Source: <http://aeronet.gsfc.nasa.gov>

# Data

- ▣ We analyzed data from 1st of July to 5th of October 2010, the period from which Cluj station was operational.
- ▣ Parameters analyzed:
  - AOT data:
    - **The Aerosols Optical Thickness** (AOT) is the degree to which aerosols prevent the transmission of light. The aerosol optical depth or optical thickness ( $\tau$ ) is defined as the integrated extinction coefficient over a vertical column of unit cross section
    - **The Angstrom exponent** describe the dependency of the aerosol optical thickness, or aerosol extinction coefficient on wavelength.

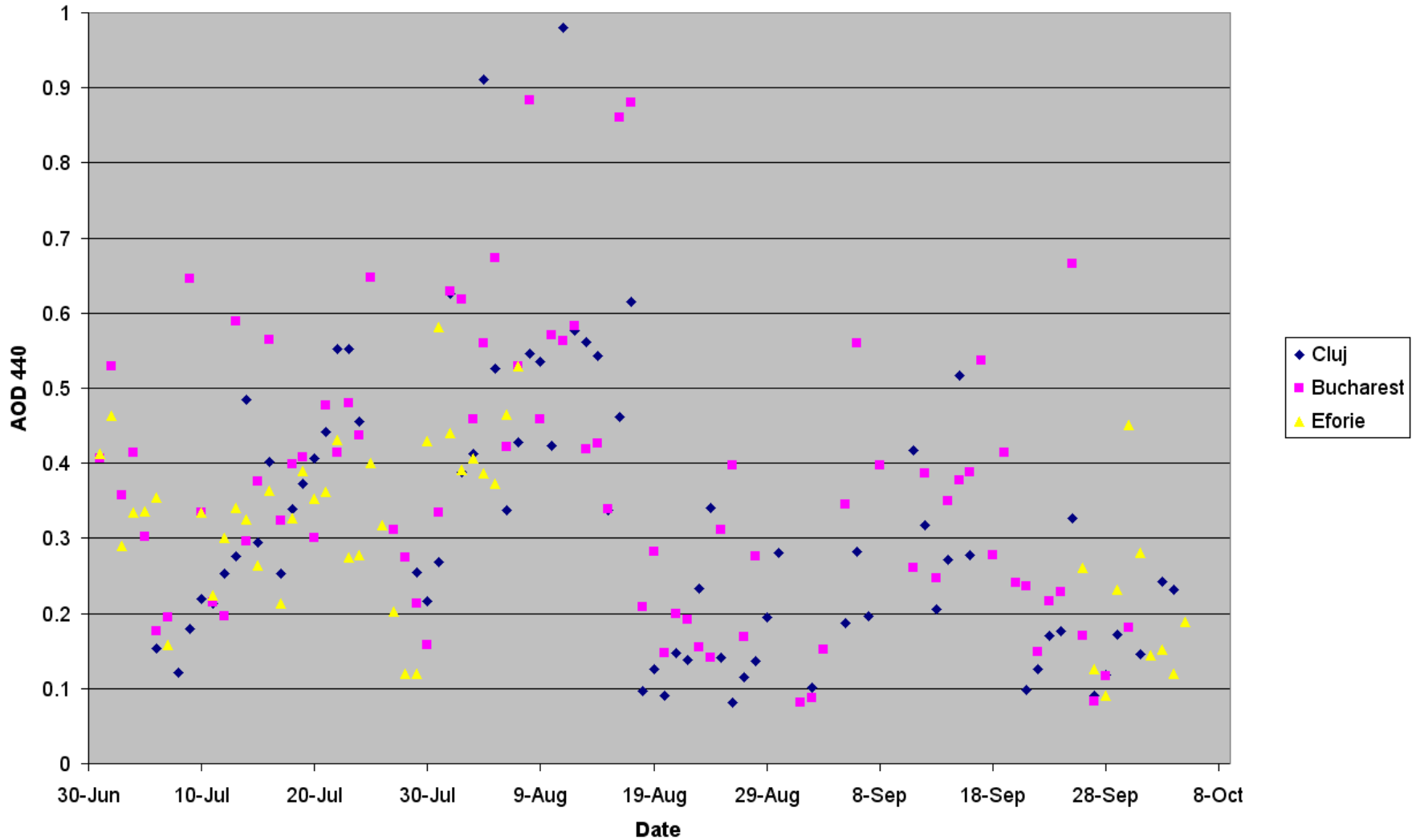
# Data

## Inversion data:

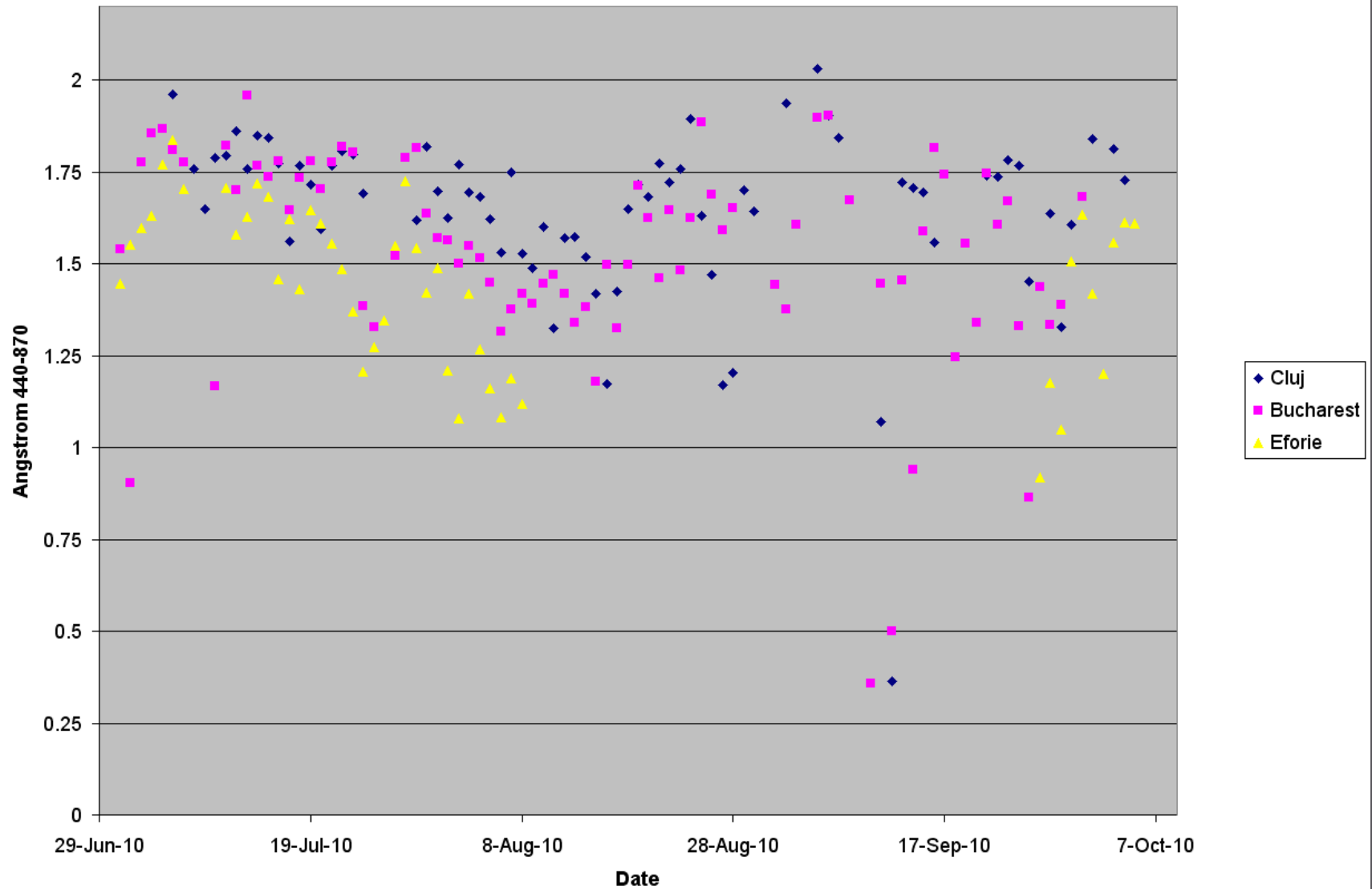
- **Single Scattering Albedo** represents the ratio of scattering efficiency to total extinction efficiency
- **Size Distribution:**  $dV(r)/d\ln r - (\mu\text{m}^3/\mu\text{m}^2)$   
volume particle size distribution in range of sizes:  $0.057 \mu\text{m} \leq r \leq 8.76 \mu\text{m}$

# AOT 440

AOD variation

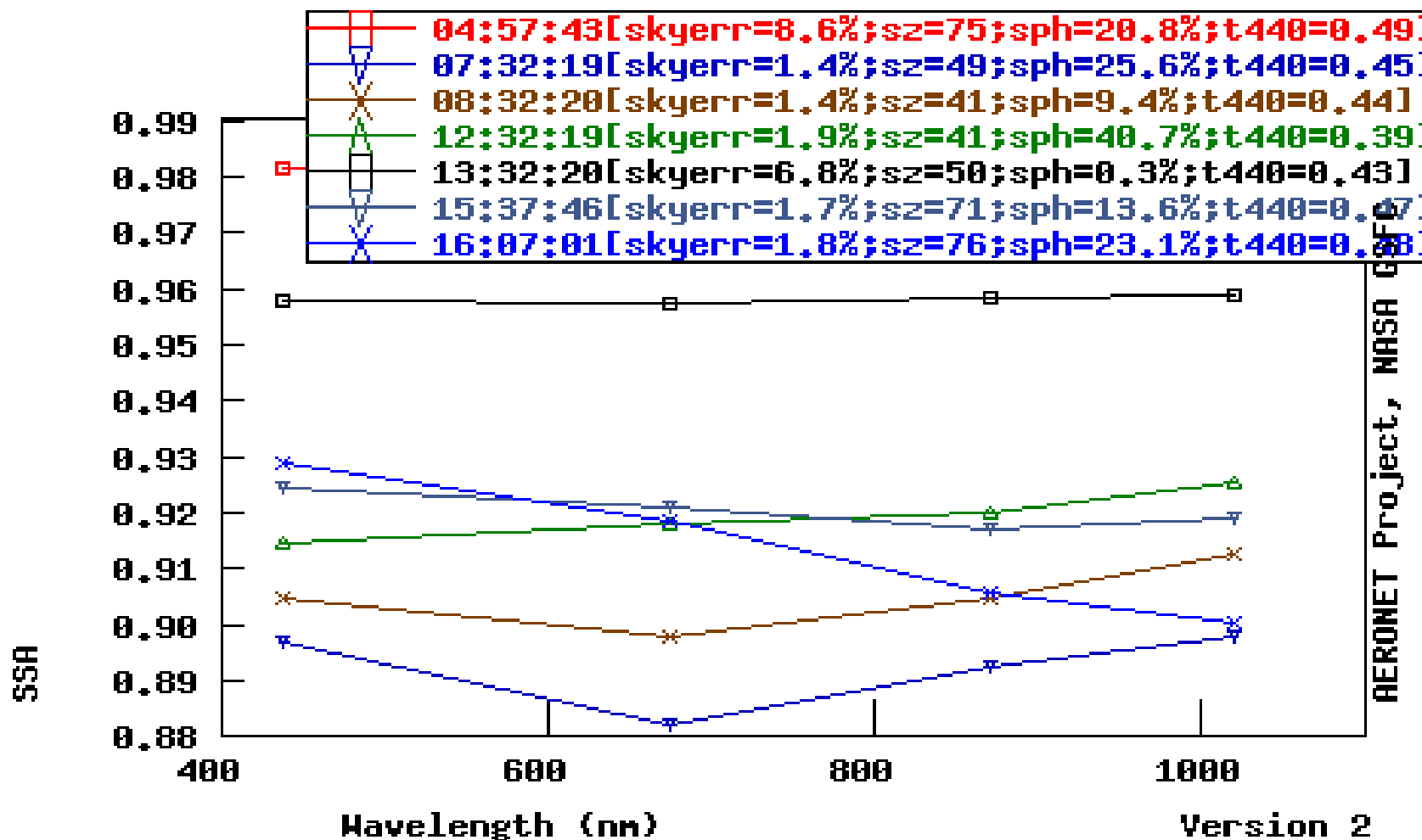


# Angstrom 440 - 870



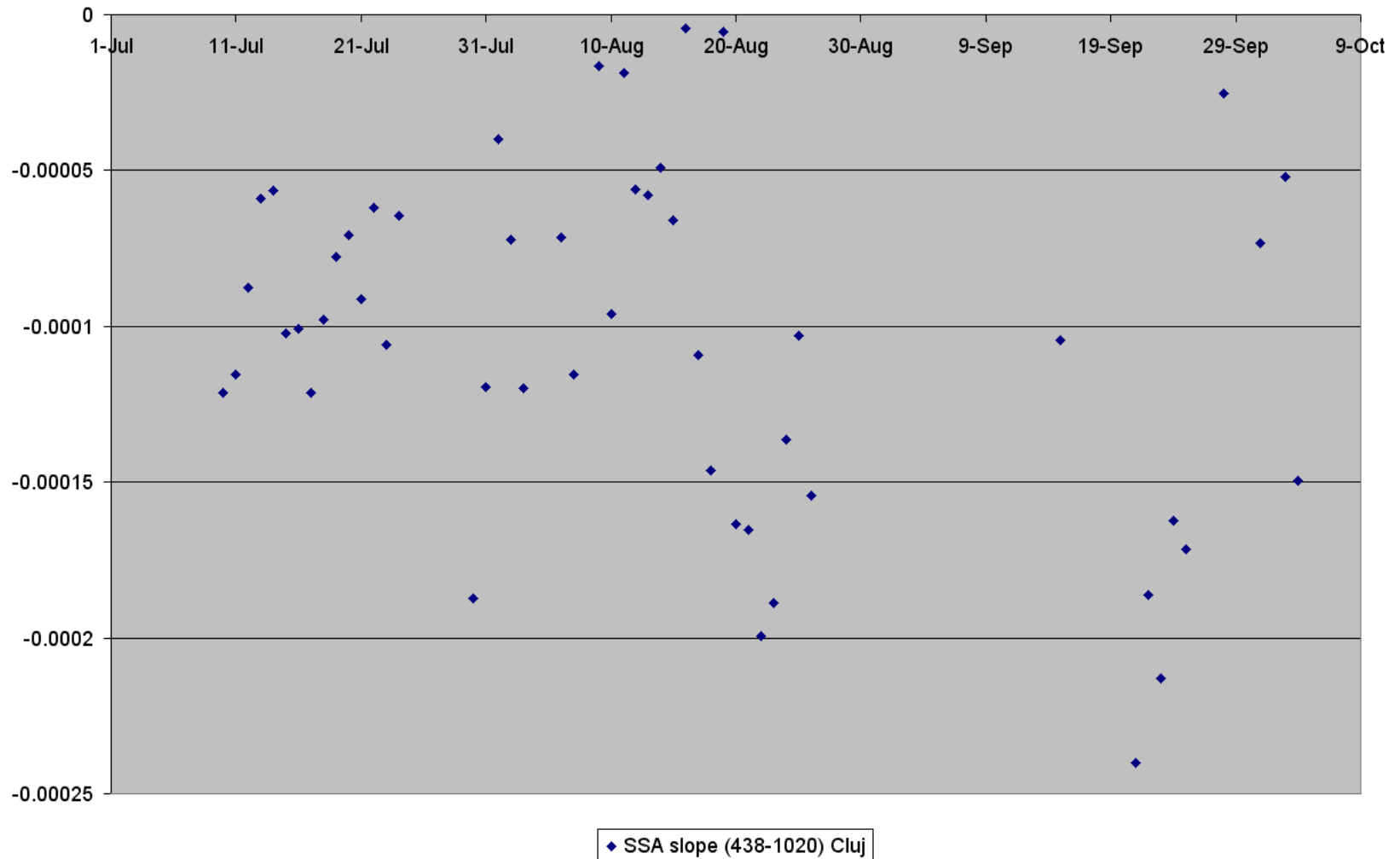
# Single Scattering Albedo slope Bucharest\_Inoe

CLUJ\_UBB , N 46°46'04", E 23°33'03", Alt 405 m,  
 PI : Nicolae\_Ajtai and Dan\_Costin, niky.ajtai@gmail.com  
 SSA Almuantar Level 1.5; 16 AUG 2010



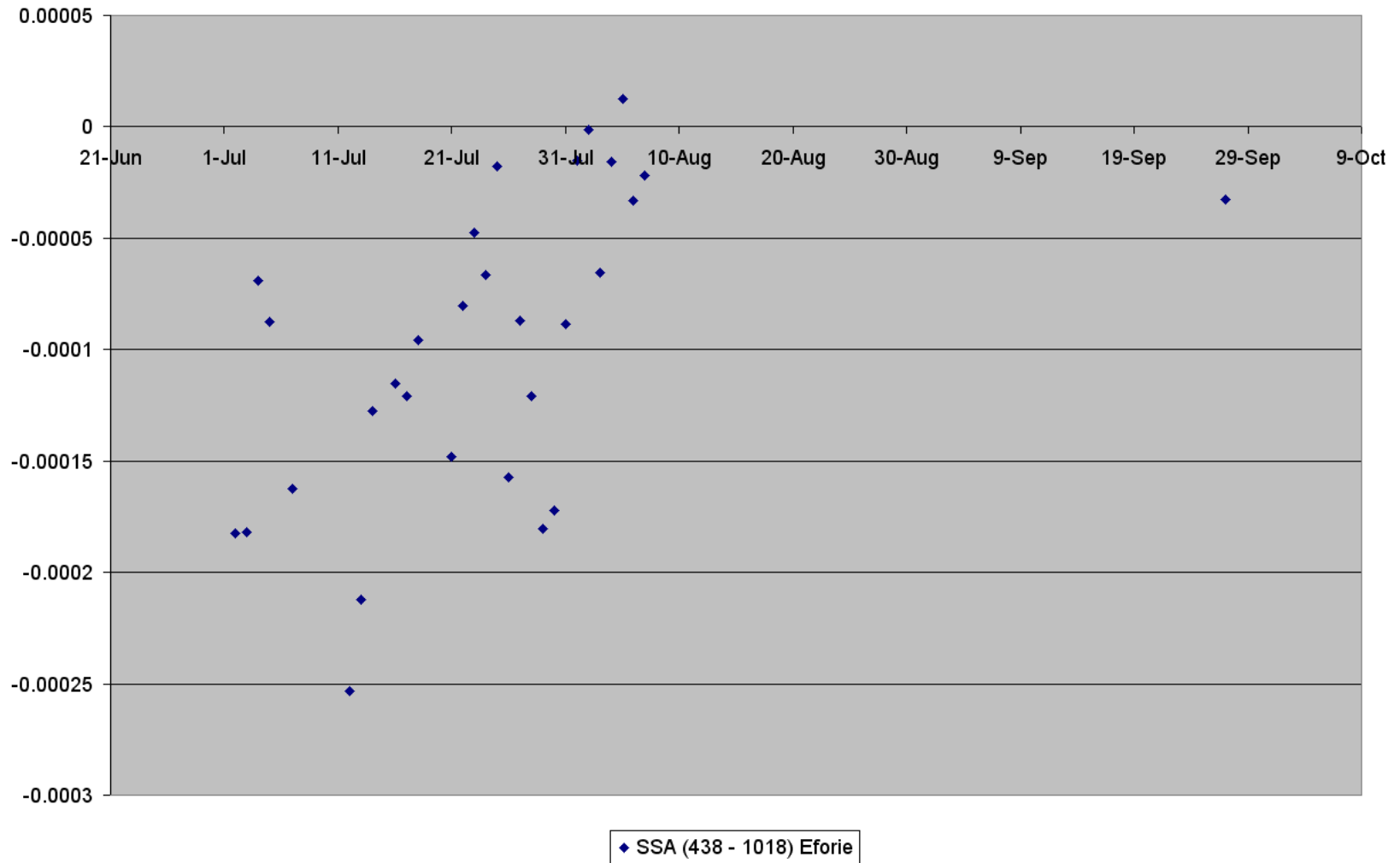
# Single Scattering Albedo slope CLUJ\_UBB

SSA slope (SSA 438 - SSA 1020)



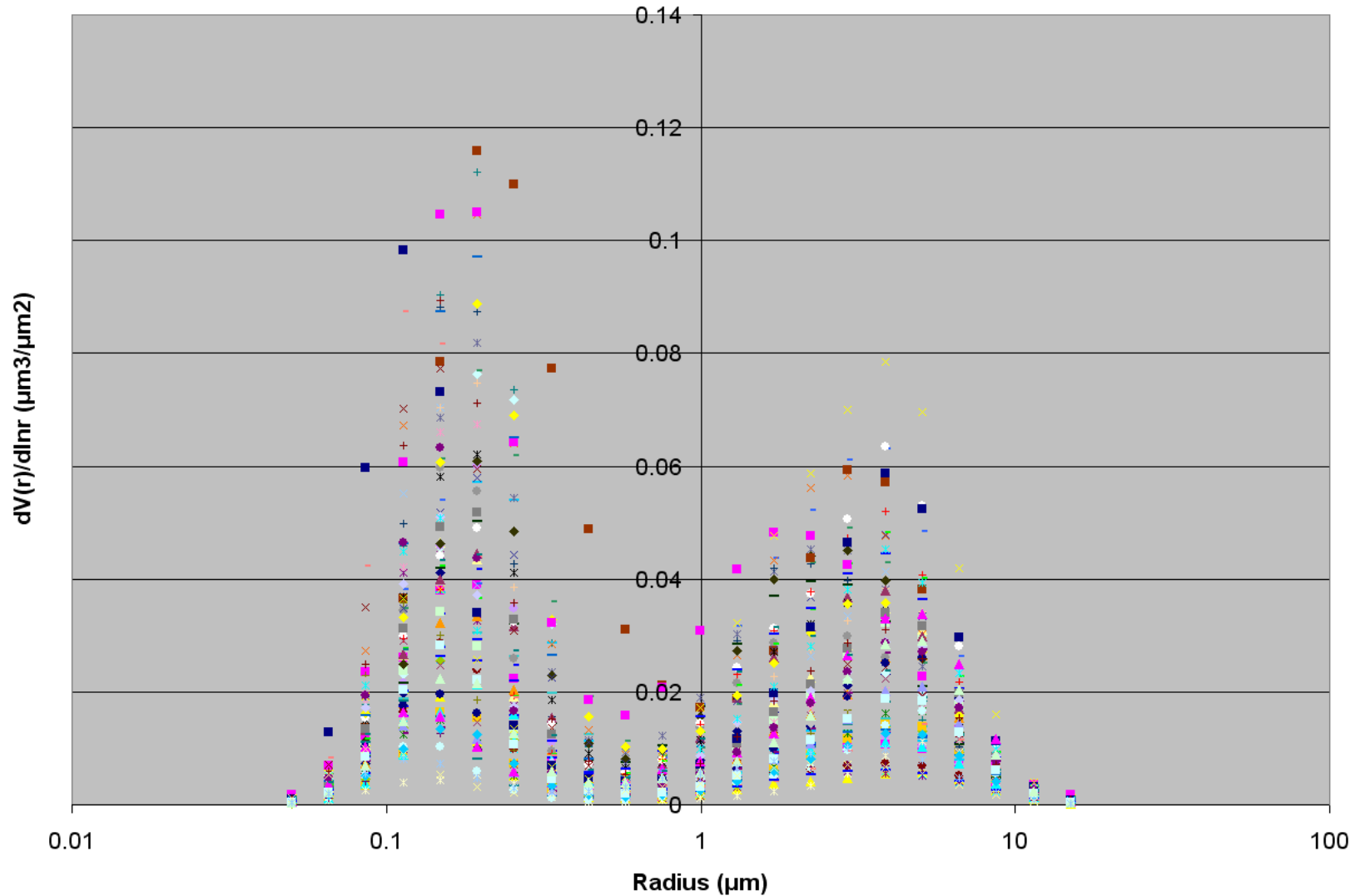
# Single Scattering Albedo Eforie

SSA (438 - 1018) Eforie

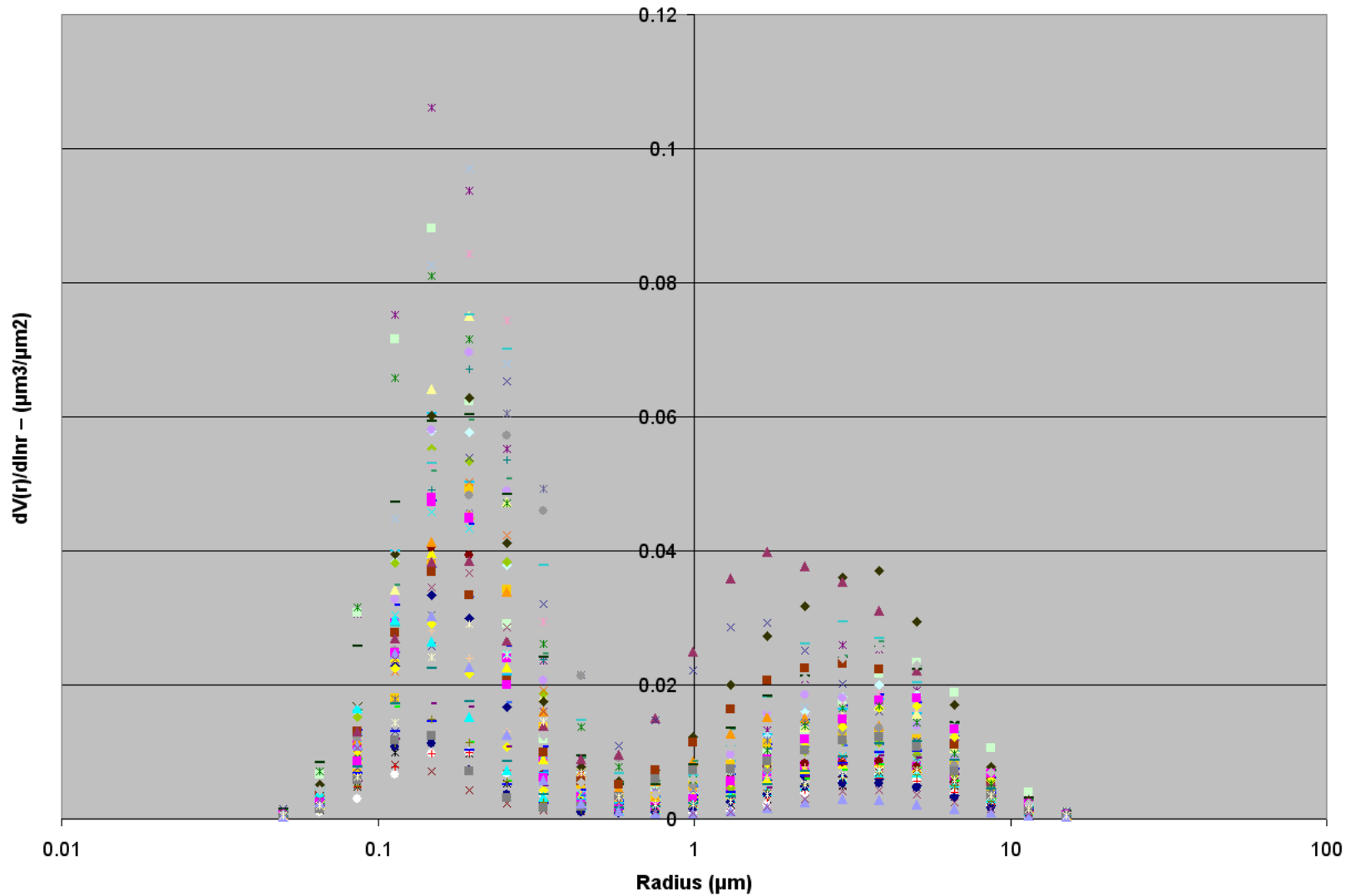




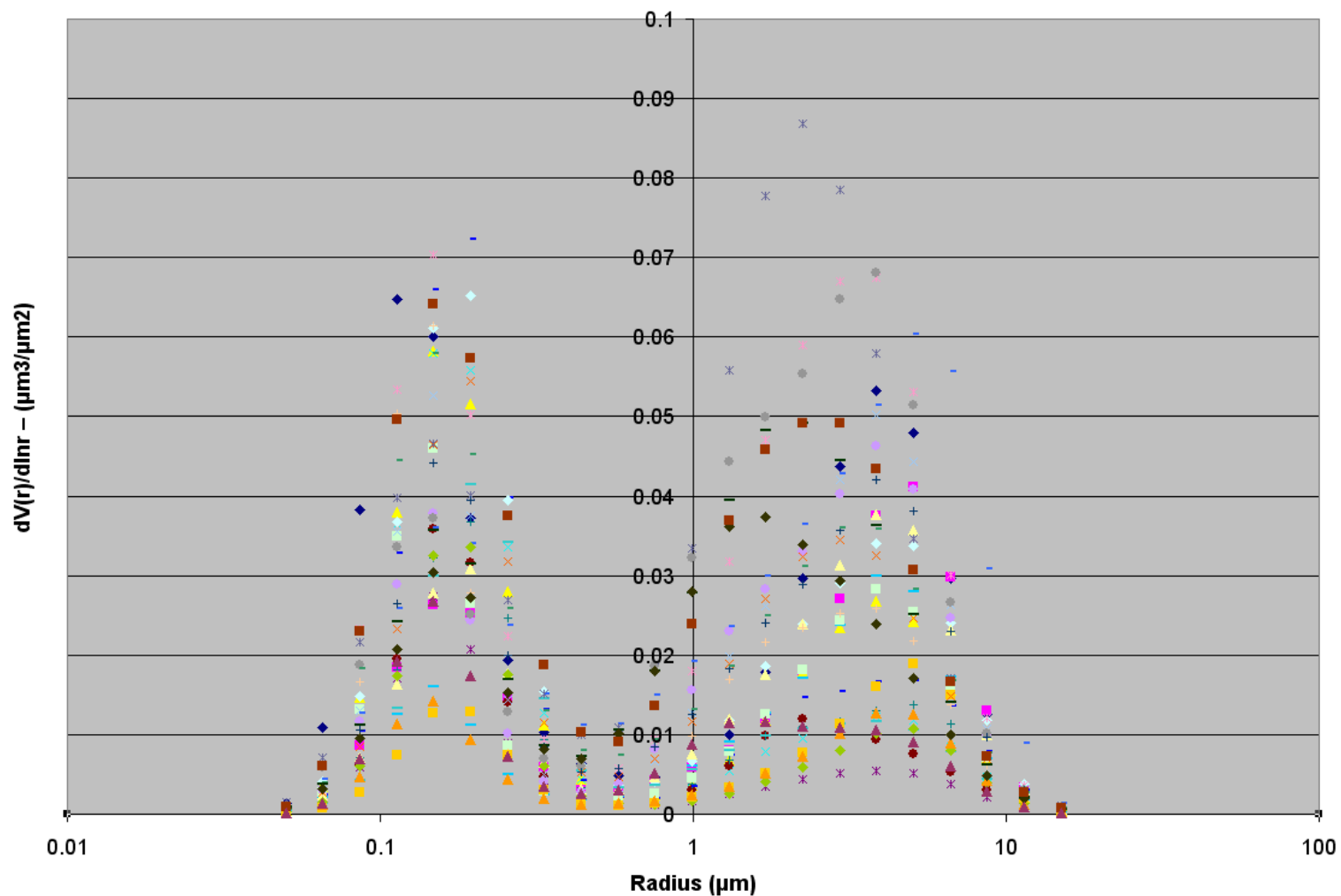
# Size Distribution Bucharest\_Inoe



# Size distribution CLUJ\_UBB



# Size distribution Eforie



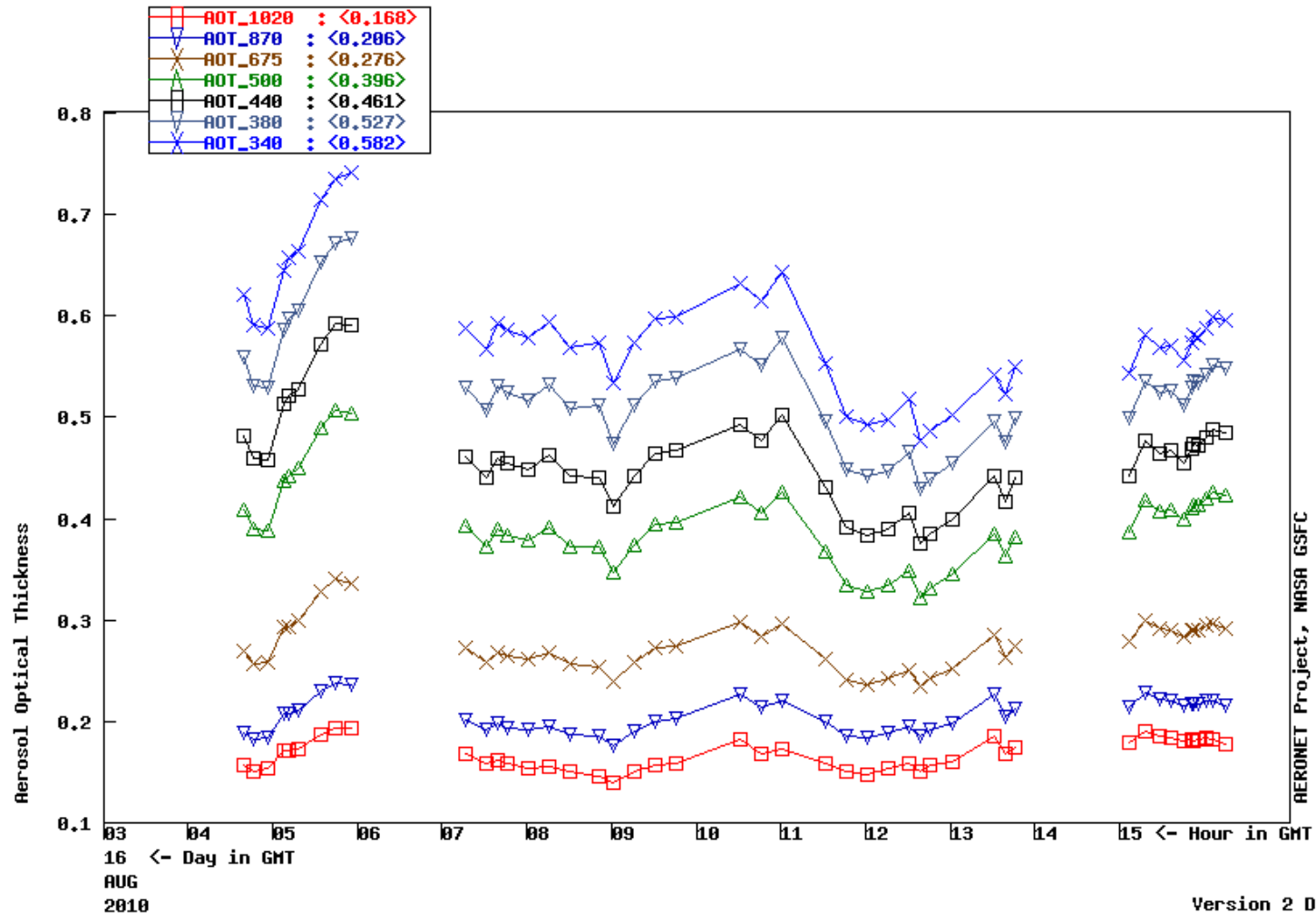
# Some aerosol optical properties

- ▣ Urban industrial aerosol:
  - high  $\alpha$  (Angstrom exponent)
  - variable SSA
  - high fine mode fraction
- ▣ Maritime aerosol:
  - lower optical thickness
  - pronounced coarse mode fraction
  - low  $\alpha$  (Angstrom exponent)
- ▣ Desert dust:
  - dominant coarse mode
  - positive SSA slope
  - low  $\alpha$

# Possible dust intrusion

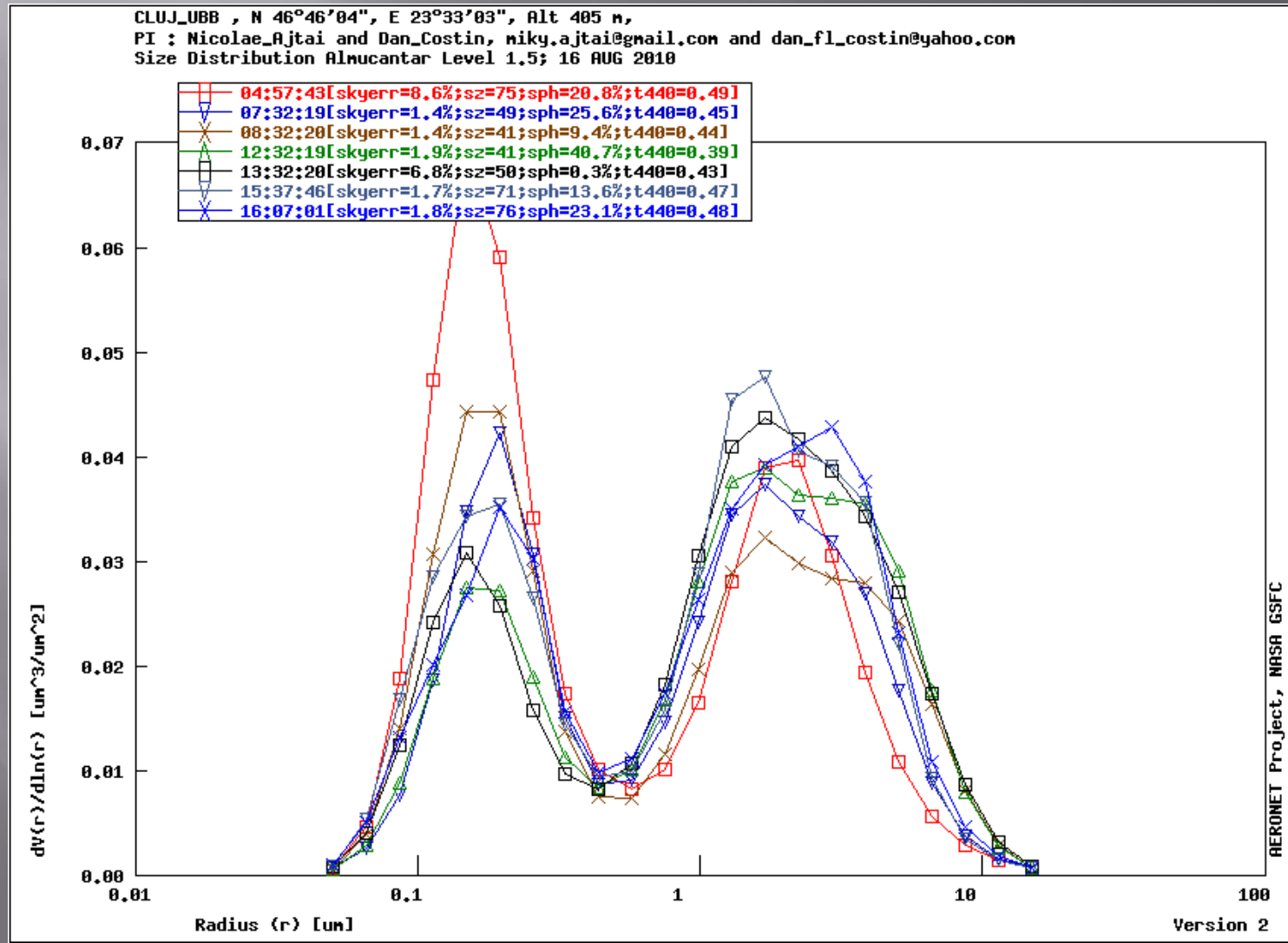
## ▣ Increase of AOT

CLUJ\_UBB , N 46°46'04" , E 23°33'03" , Alt 405 m,  
PI : Nicolae\_Ajtai and Dan\_Costin, miky.ajtai@gmail.com and dan\_fl\_costin@yahoo.com  
Level 1.5 AOT; Data from 16 AUG 2010



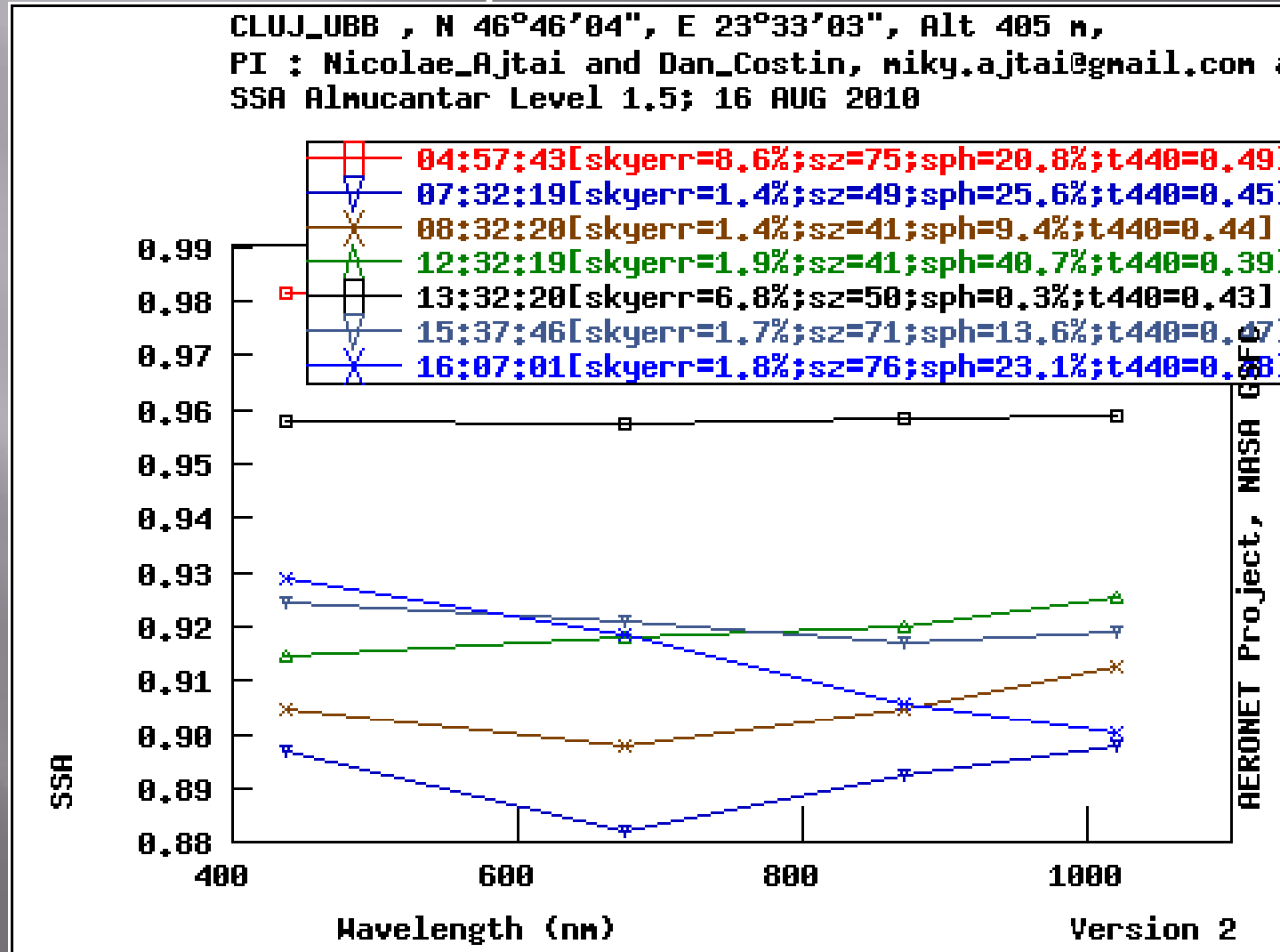
# Possible dust intrusion

## ▣ Increase of coarse mode



# Possible dust intrusion

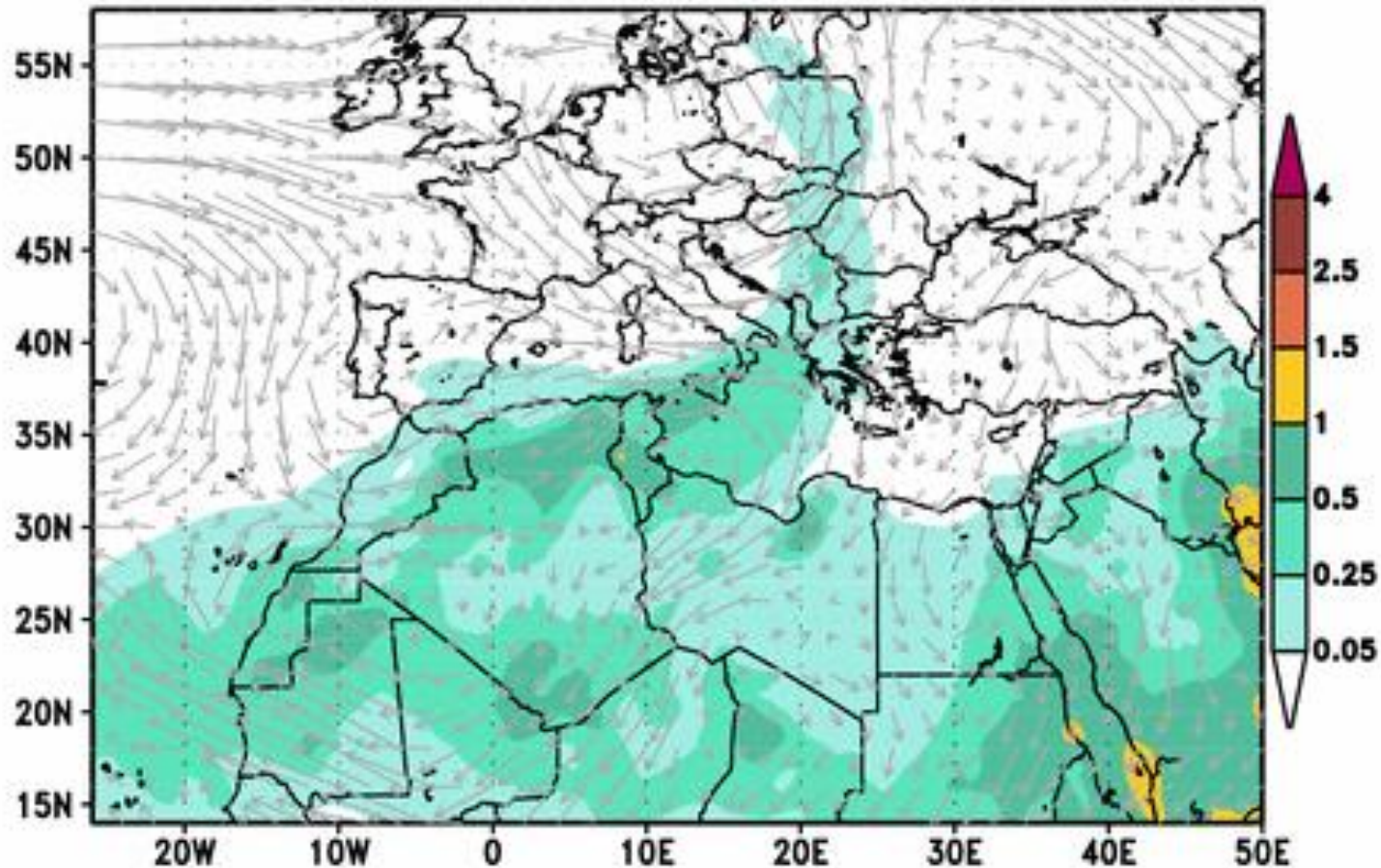
## Positive SSA slope



# Possible dust intrusion

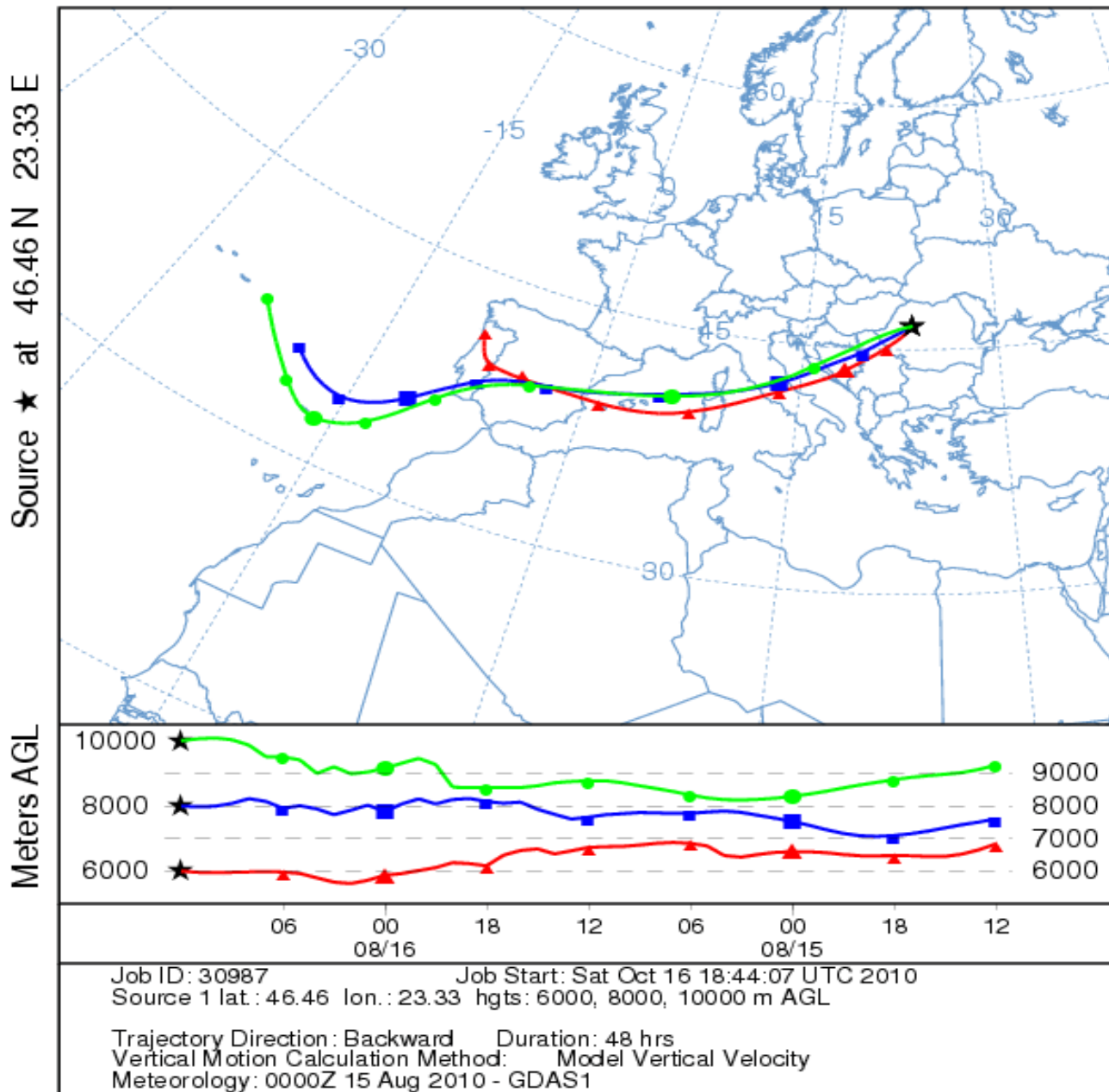
- Dust load – Barcelona Super Computer

BSC-DREAM8b Dust Loading ( $\text{g}/\text{m}^2$ ) and 3000m Wind  
6h forecast for 18z 16 AUG 10

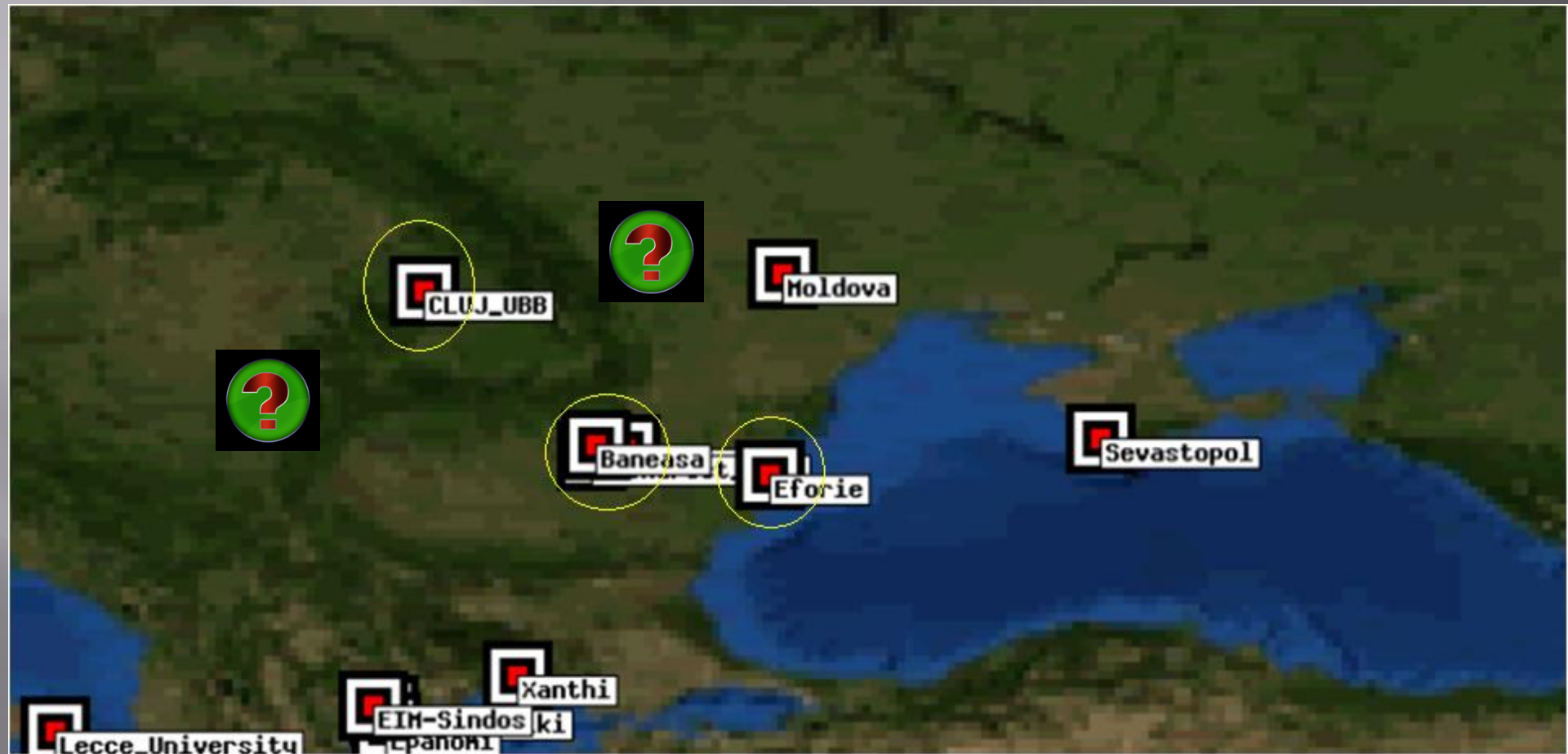




NOAA HYSPLIT MODEL  
 Backward trajectories ending at 1200 UTC 16 Aug 10  
 GDAS Meteorological Data



# What if ?



# Acknowledgements

- ▣ We thank: Prof. Sabina Ştefan, Dr. Phys.Doina Nicolae and their staff for establishing and maintaining the three sites used in this investigation.
- ▣ We thank Innovation Norway and the Romanian National Research Authority for funding the RADO STVES 115266 project.

# References

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- ▣ Dubovik O., Holben B., Eck T. F., Smirnov A., Kaufman Y. J., King M. D., Tanre D., Slutsker I., 2002 Variability of absorption and optical properties of key aerosol types observed in worldwide locations. *Journal of the Atmospheric Sciences* **59**:590-608.
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- ▣ \*\*\*, [http://ready.arl.noaa.gov/HYSPLIT\\_traj.php](http://ready.arl.noaa.gov/HYSPLIT_traj.php)
- ▣ \*\*\*, [http://www.bsc.es/plantillaH.php?cat\\_id=519](http://www.bsc.es/plantillaH.php?cat_id=519)

Thank you! 😊

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