

**WORKSHOP "OSSERVATORIO CLIMATICO-AMBIENTALE DI LECCE:
ATTIVITA', POTENZIALITA' e PROSPETTIVE FUTURE"
CNR-ISAC Lecce , 23 Aprile 2015**

**I-AMICA ed il potenziamento a Lecce della
strumentazione per il monitoraggio in remoto
dell'aerosol atmosferico:
effetti sugli studi relativi all'ambiente ed al clima**

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P. Burlizzi, S. Romano**

**Laboratorio di Aerosol &Clima
Dipartimento di Matematica e Fisica
Universita' del Salento**

Sommario

- **Obiettivi di ricerca del Laboratorio Aerosol & Clima**
- **Overview della strumentazione esistente**
- **Potenziamento nell' ambito di I-AMICA**
- **Risultati sulle misure effettuate il 2 Aprile 2015**

Laboratorio di Aerosol &Clima

Obiettivi:

Studiare gli effetti dell' aerosol sul Clima attraverso

- la caratterizzazione delle proprietà dell'aerosol atmosferico al suolo ed in quota,
- misure di irradianza della radiazione solare e terrestre al suolo e da satellite e
- con l'ausilio di modelli di trasferimento radiativo e modelli climatici regionali integrati da dati sperimentali.

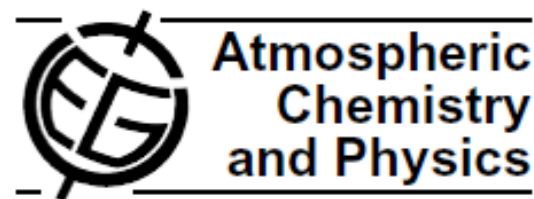
Le misure vengono effettuate con dispositivi di campionamento in situ e dispositivi di monitoraggio in remoto attivo (LIDAR) e passivo (radiometri) localizzati al suolo o su satelliti

Queste attività sono state effettuate dal 2000 a tutt'oggi nell' ambito della rete Europea EARLINET e della rete mondiale AERONET gestita dalla NASA

Attualmente sono finanziate in parte da

EU Project ACTRIS II (2015-2019, www.actris.net/).

Atmos. Chem. Phys., 8, 6995–7014, 2008
www.atmos-chem-phys.net/8/6995/2008/
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Monthly-averaged anthropogenic aerosol direct radiative forcing over the Mediterranean based on AERONET aerosol properties

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Monitoraggio degli AEROSOL

◆ **Campionamenti in situ (campionatori di PM, spettrometro dimensionale, nefelometro)**

◆ **Monitoraggio remoto ATTIVO**

- dal suolo (lidar UNILE)
- da satellite (CALIOP)

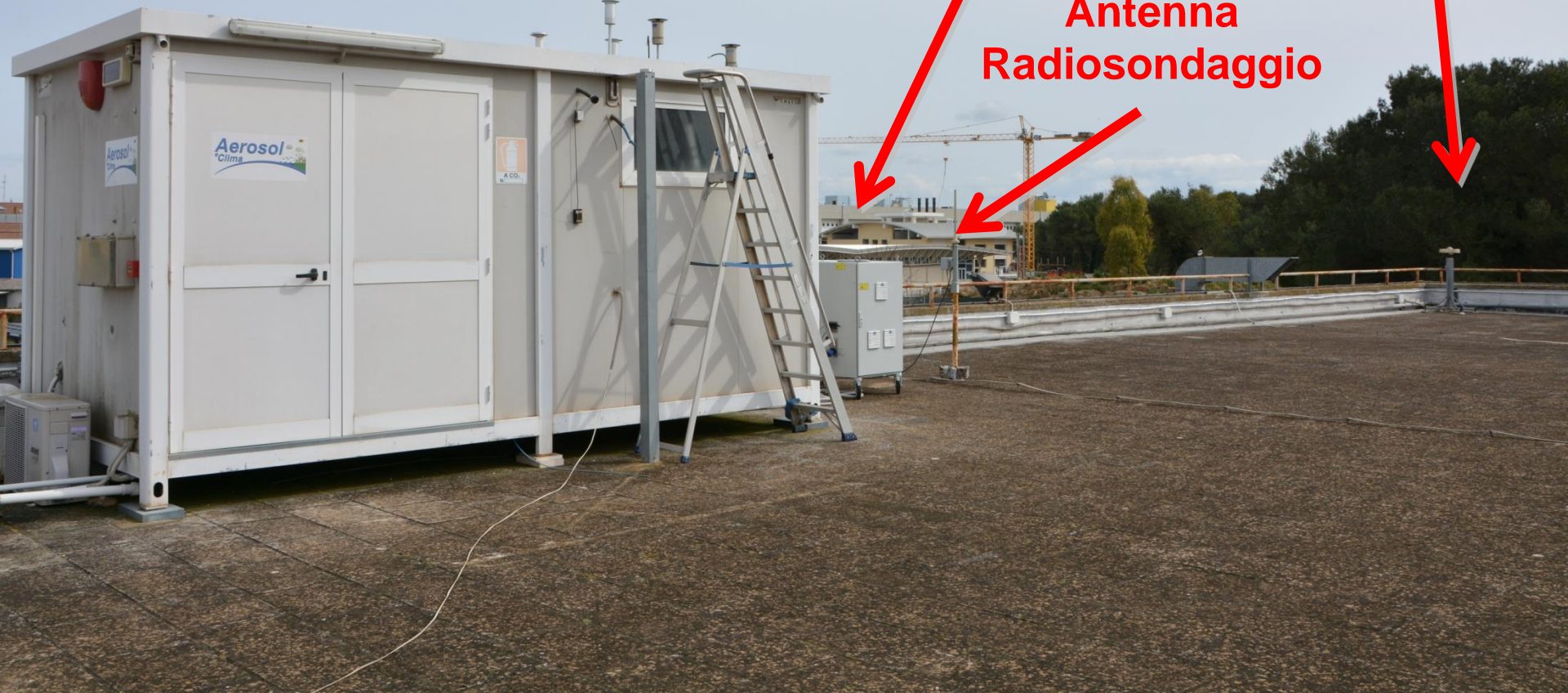
◆ **Monitoraggio remoto PASSIVO**

- dal suolo (radiometro solare, AERONET)
- da satellite (radiometro spettrale, MODIS)

**LIDAR CNR
(IMAA, ISAC)**

**ANTENNA
GPS EURF**

**Antenna
Radiosondaggio**



Costo Strumentazione Container ~ 400 kEURO

**Campionatore PM
bicanale**

nefelometro





Impattore a 7 stadi

**APS-Spettmetro
dimensionale**

CARATTERIZZAZIONE DEL PARTICOLATO CAMPIONATO

Tecnica Termo-Ottica (TOT): Analizzatore SUNSET

Determinazione della concentrazione del carbonio organico ed elementare



**Caratterizzazione
Morfologica e Chimica delle particelle :
SEM/EDAX (JEOL, Model JSM-6480 LV),**



Spettrofotometro Perkin Elmer Spectrum 2000 FT-IR

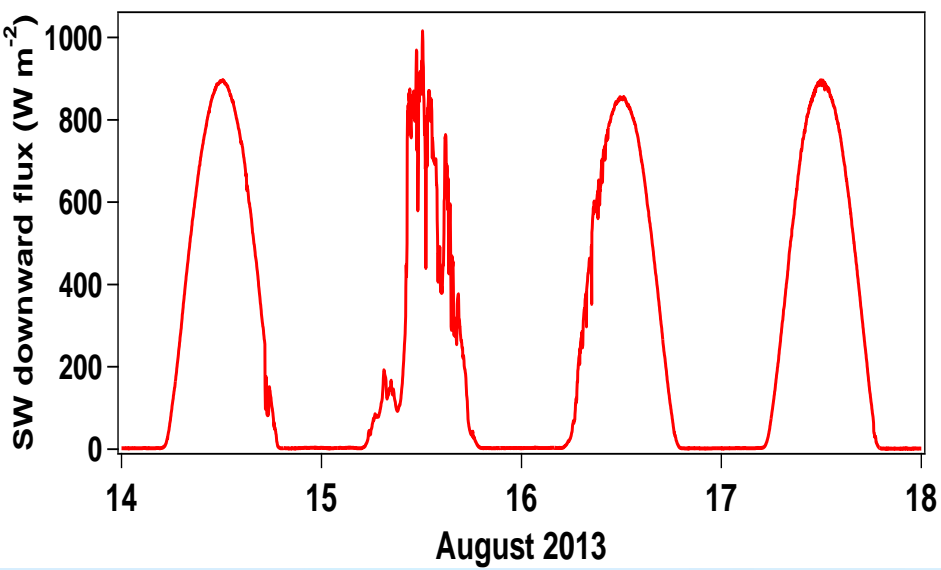
(15000 a 30 cm^{-1})



IRRADIANCE MEASUREMENTS

Upward and Downward
Kipp&Zonen
pyranometer (CMP 21
model) [0.3-2.8 μm]

AT THE
SURFACE



AT THE TOP OF THE
ATMOSPHERE

<http://ceres.larc.nasa.gov/>

Upward and
Downward
Kipp&Zonen
pyrgeometer (CGR 3
model) [4.5-42 μm]



CERES
radiometer
sensors on
TERRA and
AQUA satellites
SW (0.3-5 μm)
WN (8-12 μm)
Total (0.3-100 μm)

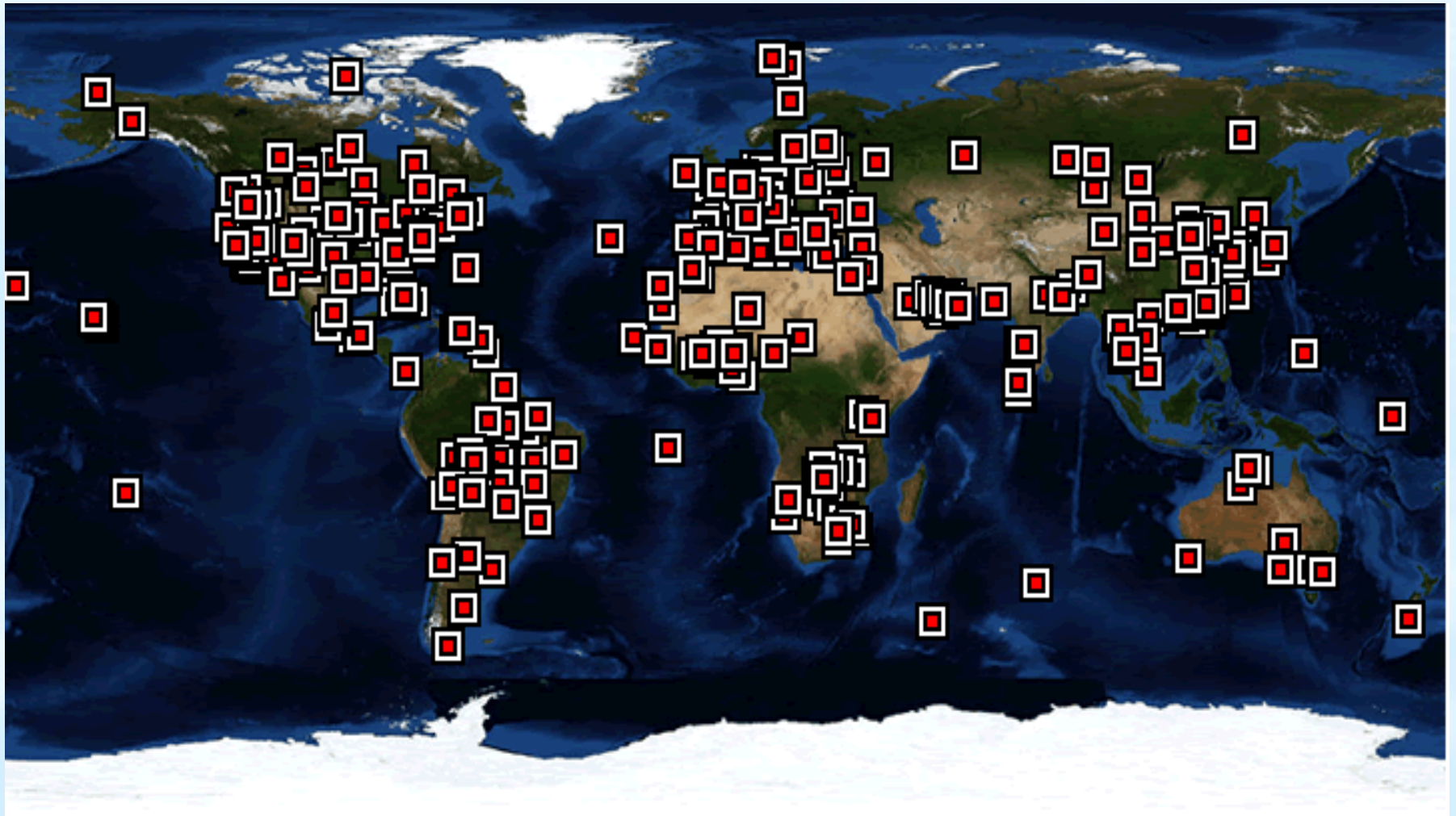
Sun-Sky Photometer

I-AMICA Lunar Photometer



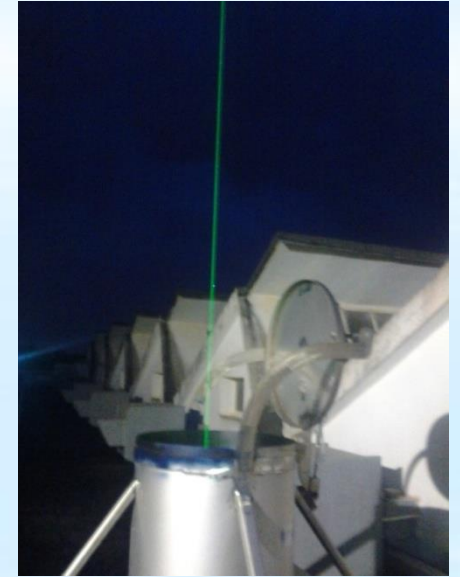
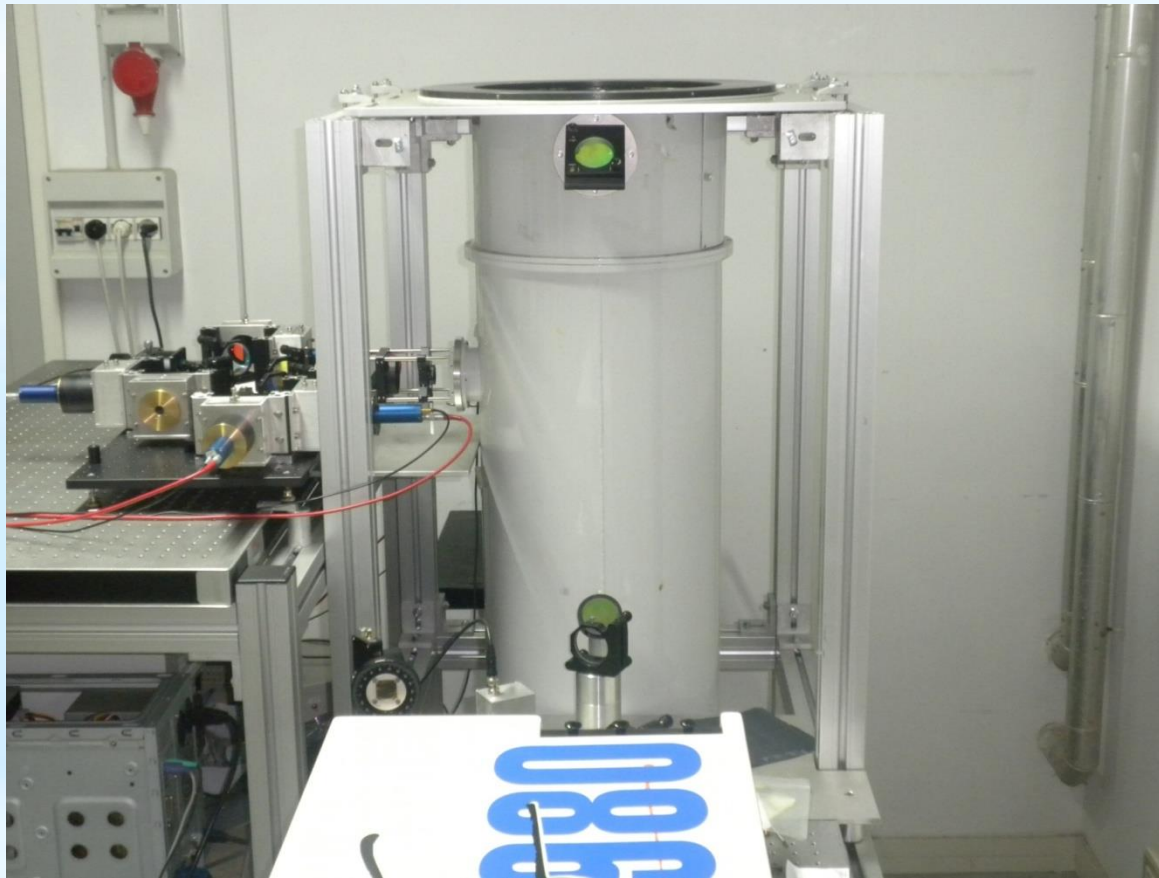
Rete AERONET

(<http://aeronet.gsfc.nasa.gov/>)



~400 fotometri

SISTEMA LIDAR (UNILE)

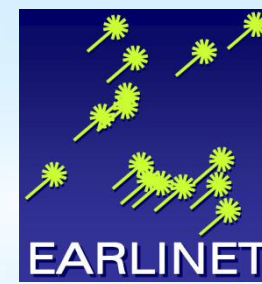


3 lunghezze d'onda 355, 532 e 1064 nm

EARLINET 2000-2003

EARLINET - ASOS (2006-2011)

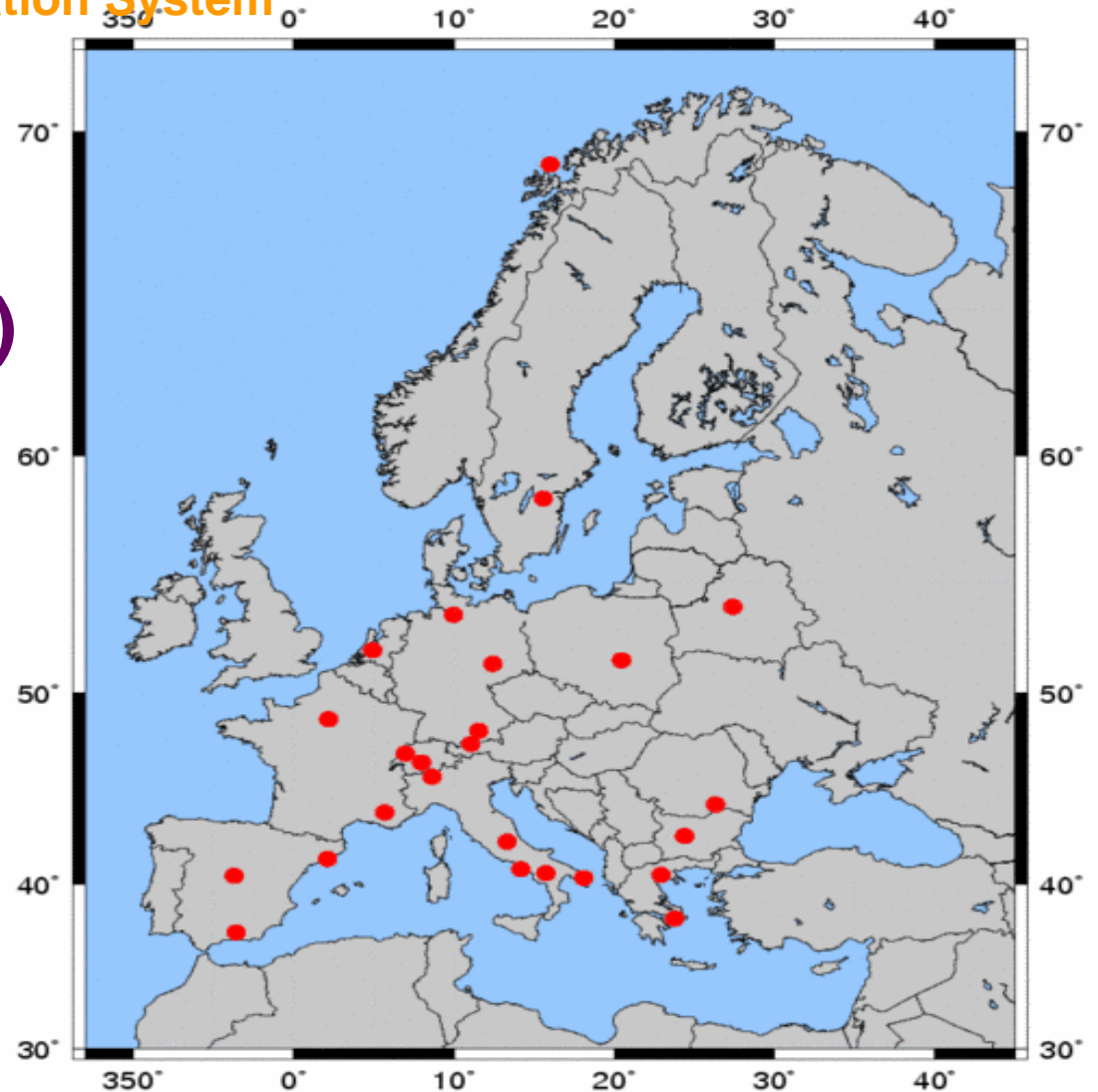
European Aerosol Research Lidar Network
Advanced Sustainable Observation System

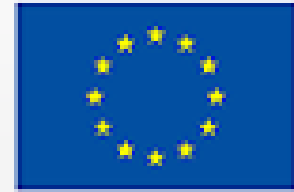


ACTRIS (2012-2015)

ACTRIS II (2015-2019)

~35 stazioni



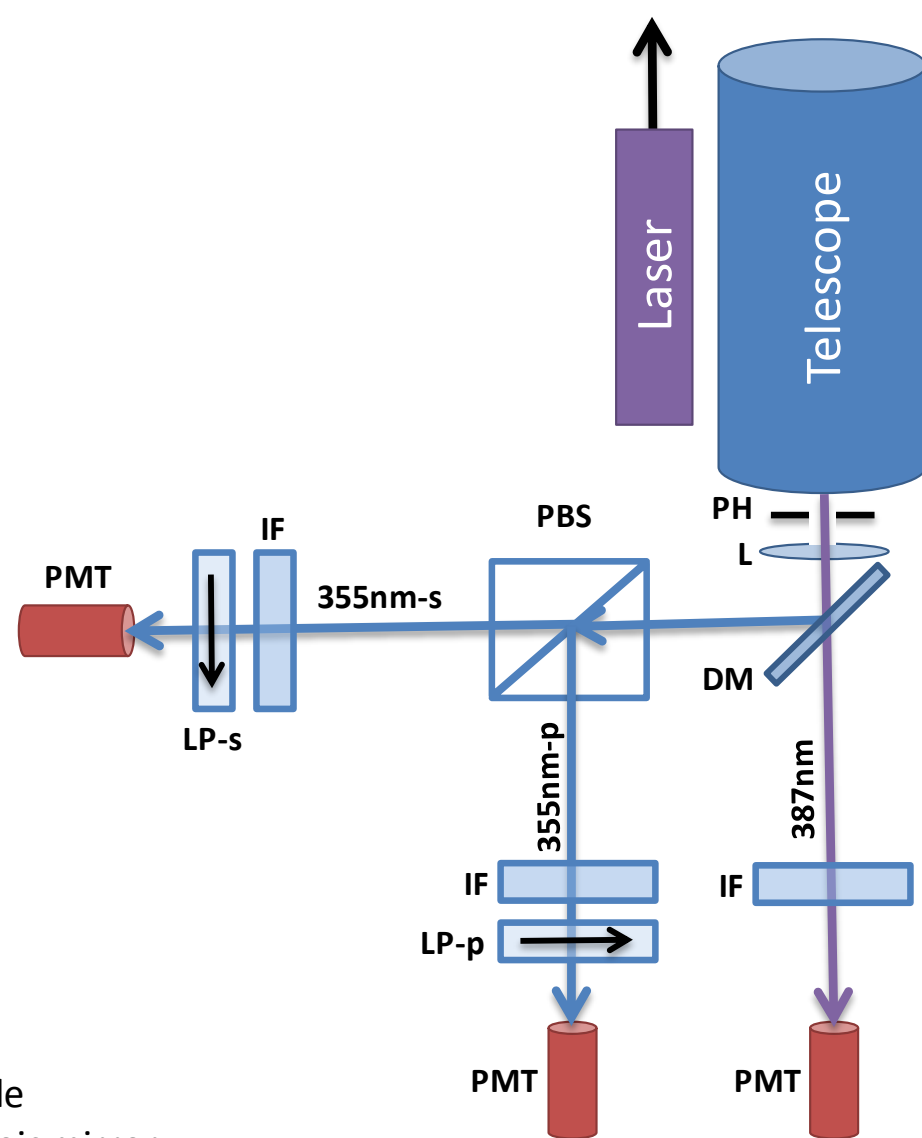


UNIONE EUROPEA
Fondo europeo di sviluppo regionale



**Raman
Depolarization
Lidar
– Raymetrics
LR111-UV-D2**

Raymetrics LR111-UV-D2



PH: Pin hole

DM: Dichroic mirror

IF: Interferential filter

LP-s: Linear polarizer: cross component

LP-p: Linear polarizer: parallel component

PBS: Polarizing beamsplitter

PMT: photomultiplier

Raman Depolarization Lidar - Raymetrics LR111-UV-D2



Transmitter	
Pulse laser source	Nd:YAG
Wavelengths emitted	355nm
Total Energy per pulse	30mJ @ 355nm
Pulse duration	5.5ns
Repetition rate	20Hz
Laser beam diameter	4mm (before beam expansion)
Laser beam divergence	<1.5mrad (before laser beam expansion) <0.1 mrad (after laser beam expansion)
Energy Stability	<2%
Receiver	
Telescope (Diameter)	Cassegrainian (20 cm primary mirror)
Field-of-view	1 mrad (user selectable)
Elastic wavelengths detected	355 nm
Depolarization channel	YES
Raman wavelengths detected	387nm

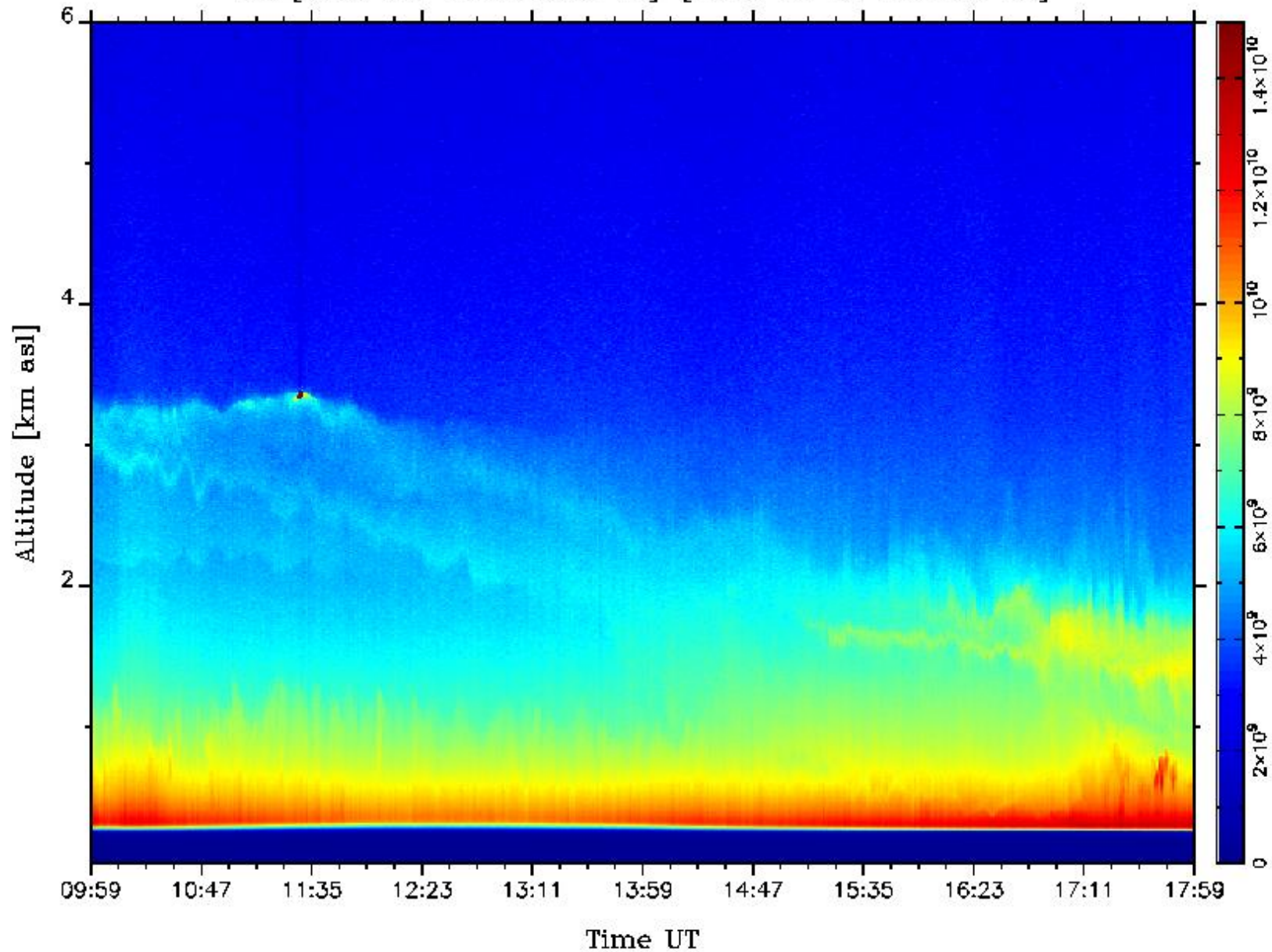
Detection unit

Transient recorder	A/D converter (12-16 bit at 20 MHz)	
	250 MHz fast photon counting system	
	Raw Spatial Resolution	7.5 m
	Raw Signal Range	up to 120 km
	Min RAW Temporal Time Res.	Down to 10 secs for multiple acquisition mode Down to 1 second for single shot measurement
	Operational Mode	PC Controlled via Ethernet Interface
	Minimum Effective range (overlap)	150 – 300 meters (without software correction)
Detection channels	FWHM detection Bandwidth:	~0.4 nm @ 355 nm (p & s)
	Detector	PMT
	Mode	Simultaneous Analog + Photon Counting (For both P and S)
	Aerosol Profiling: Range Corrected Signal: From almost ground (overlap)* up to 15 km (minimum temporal resolution down to 10 min)	
Detection channels	FWHM detection Bandwidth:	~0.45 nm @ 387 nm
	Detector	PMT
	Mode	Simultaneous Analog + Photon Counting
	Aerosol Profiling (387nm): Range Corrected Signal: From almost ground (overlap)* up to 14 km – night-time, 4 km daytime (Exceptional minimum temporal resolution down to 10 min)	

RC Signal

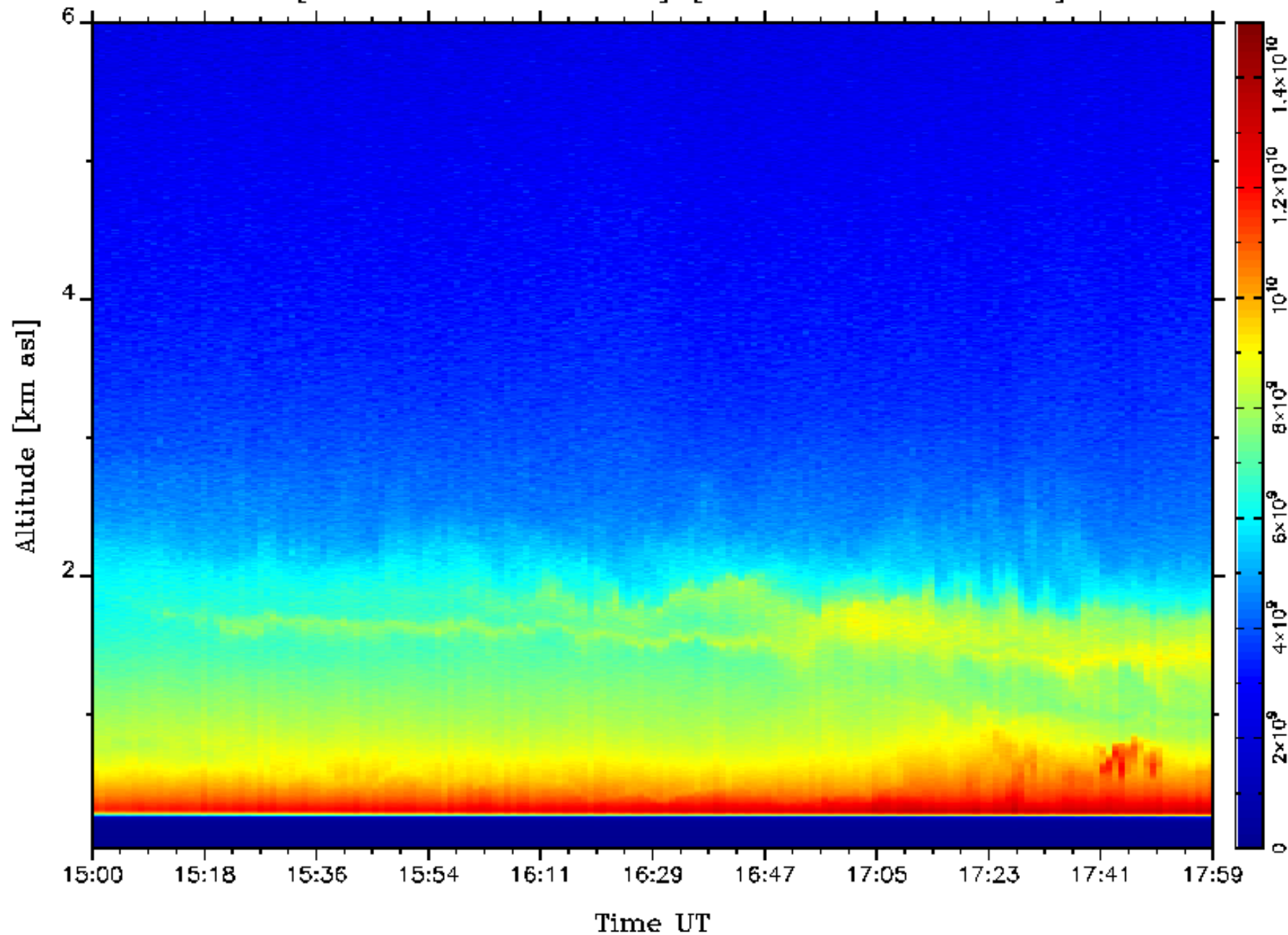
Lecce - UNILE (40.30N, 18.10E, 30.0m asl) RM_200-02-14 355nm

rcs [2015-04-02 10:00:15 UT] - [2015-04-02 17:59:09 UT]



Lecce - UNILE (40.30N, 18.10E, 30.0m asl) RM_200-02-14 355nm

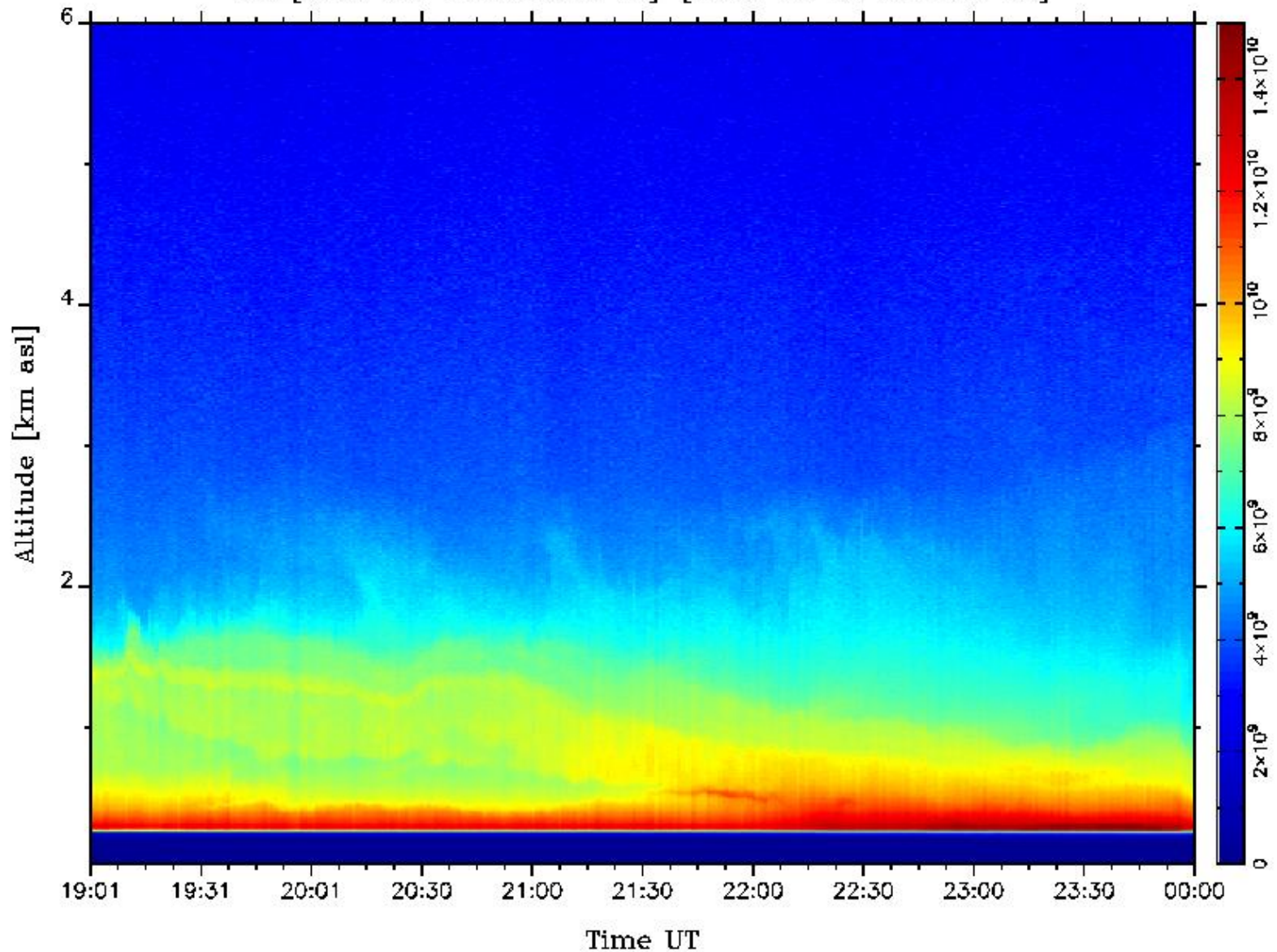
rsc [2015-04-02 15:00:00 UT]-[2015-04-02 17:59:09 UT]



RCS Signal

Lecce - UNILE (40.30N, 18.10E, 30.0m asl) RM_200-02-14 355nm

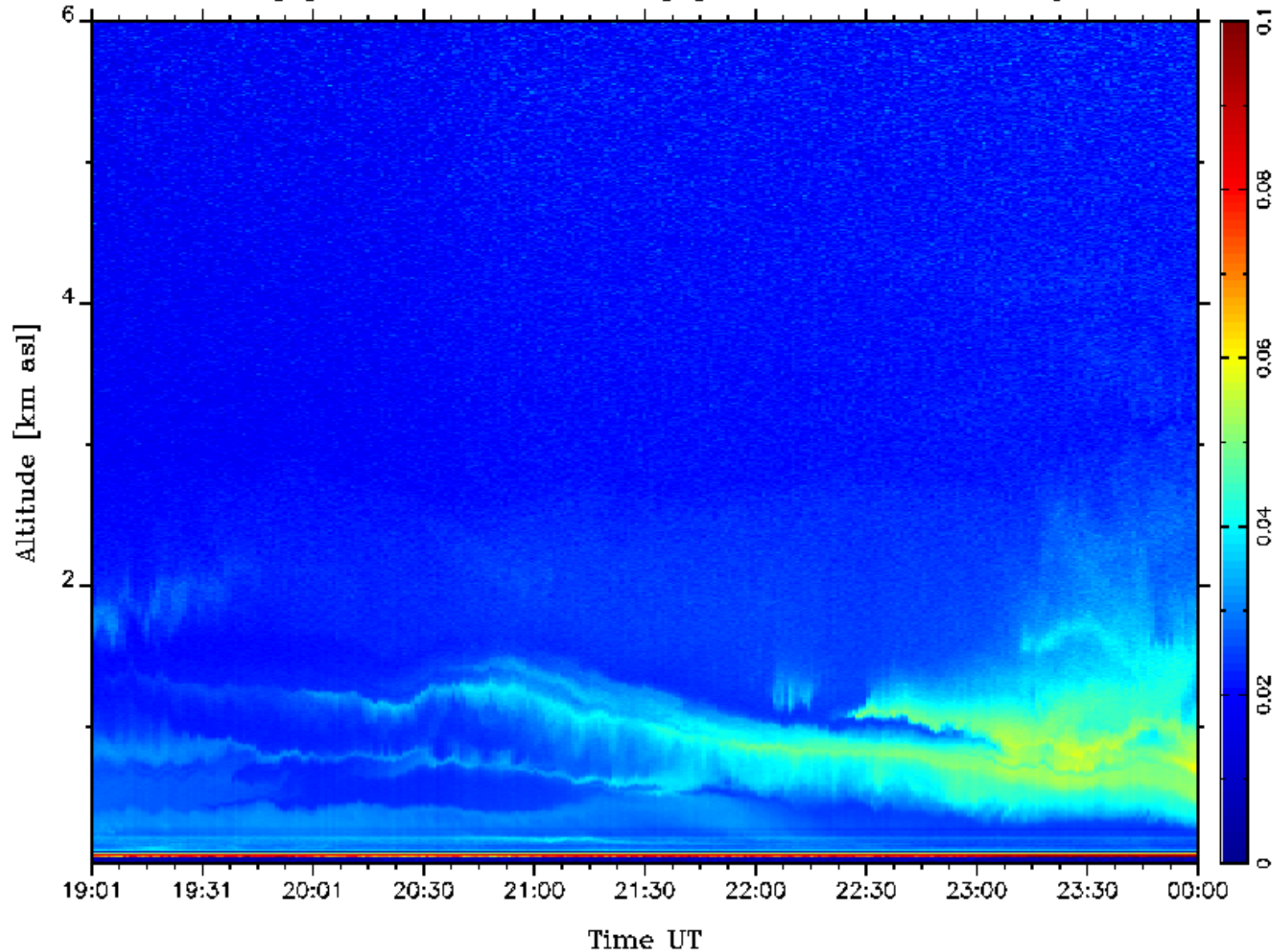
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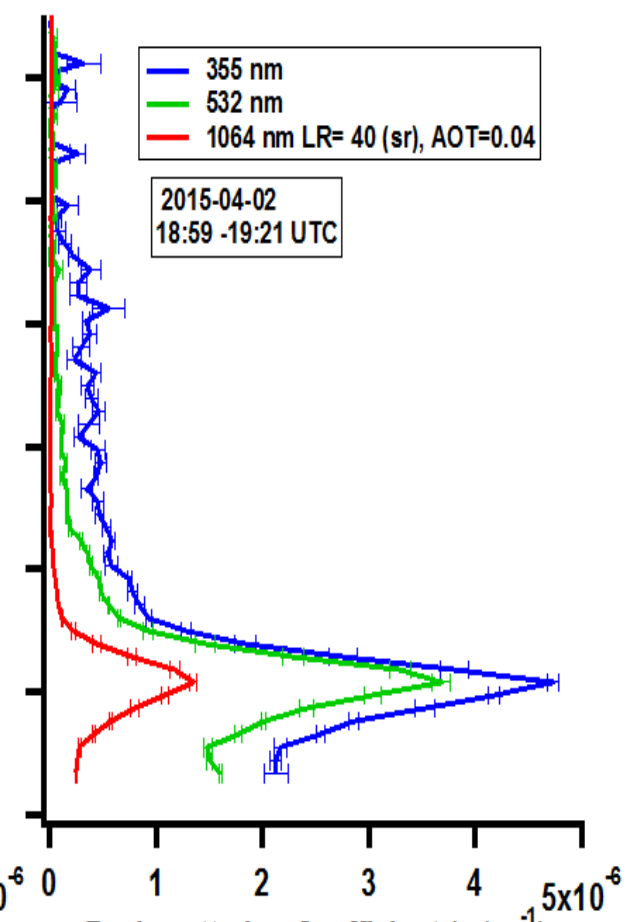
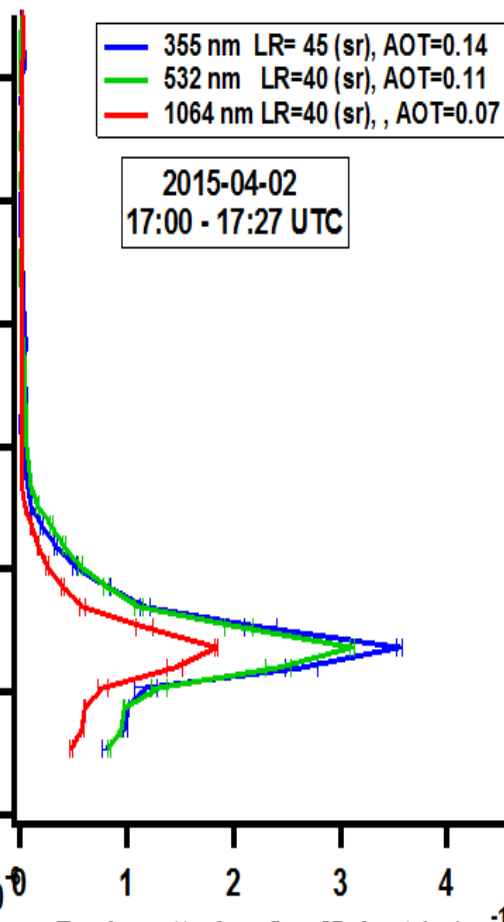
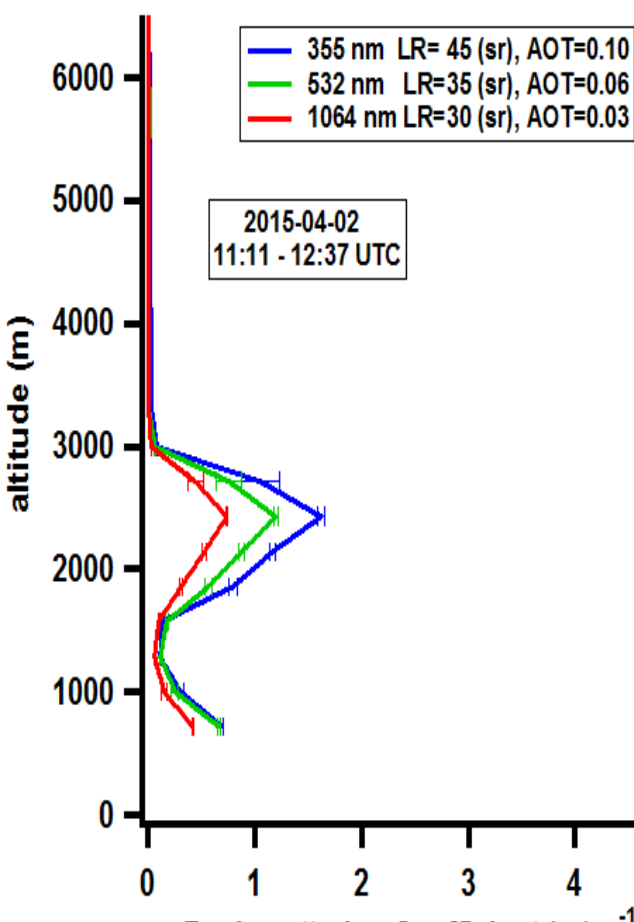
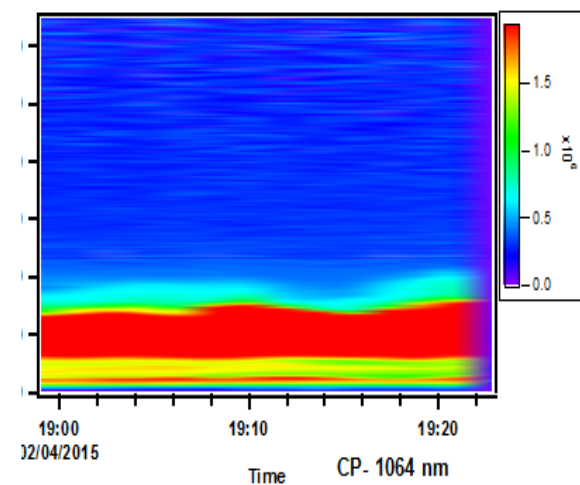
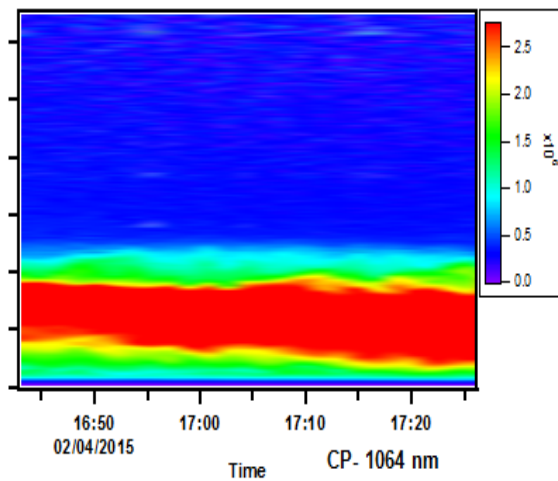
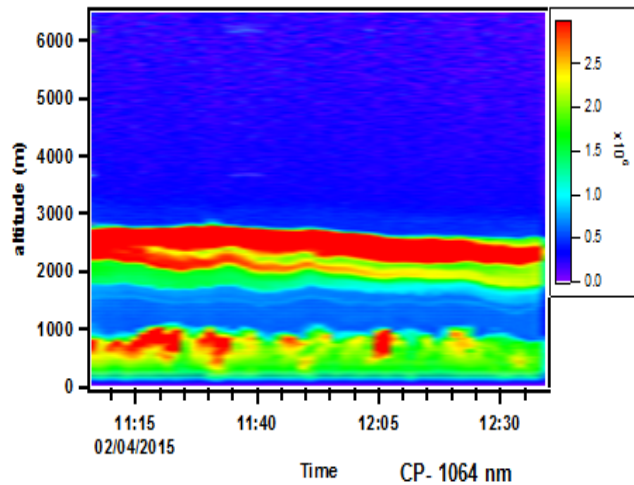


Segnale di depolarizzazione

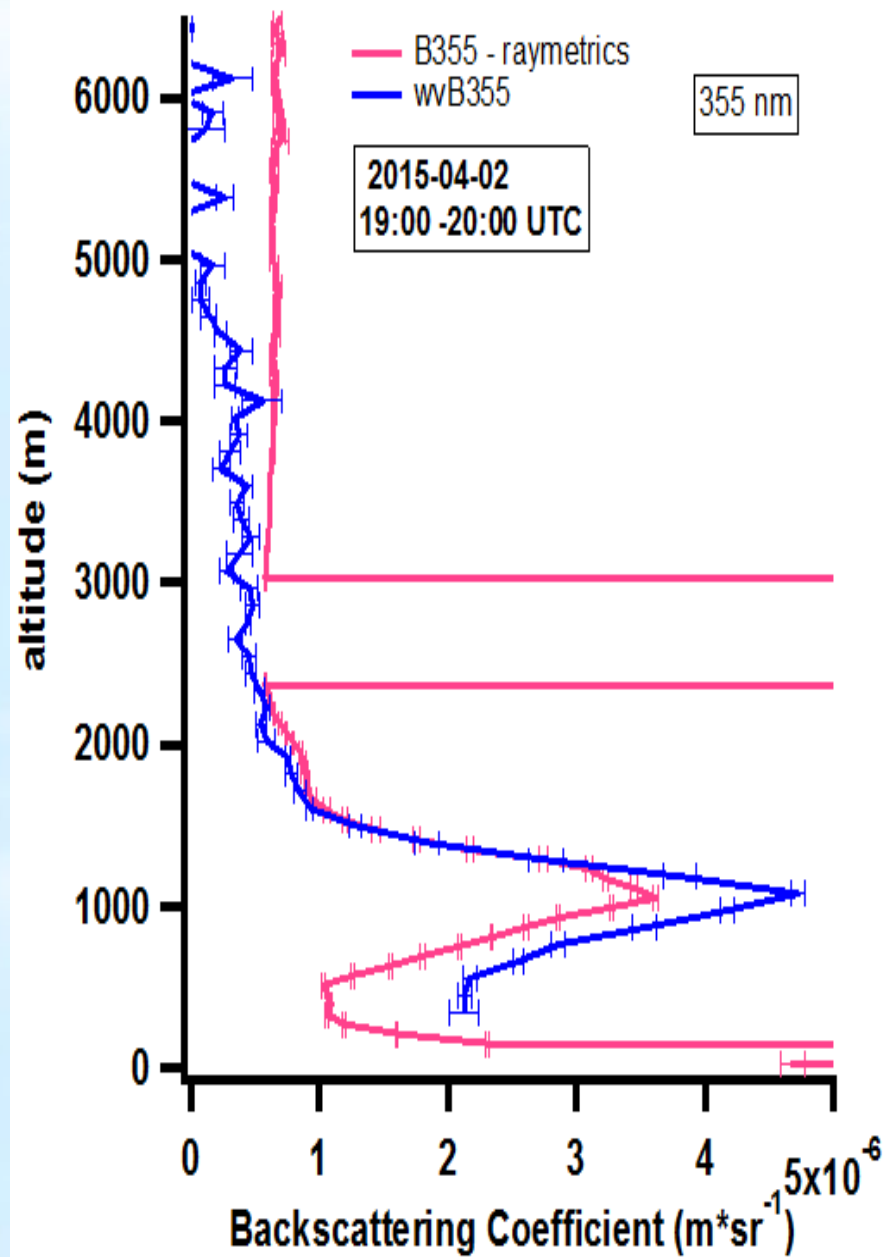
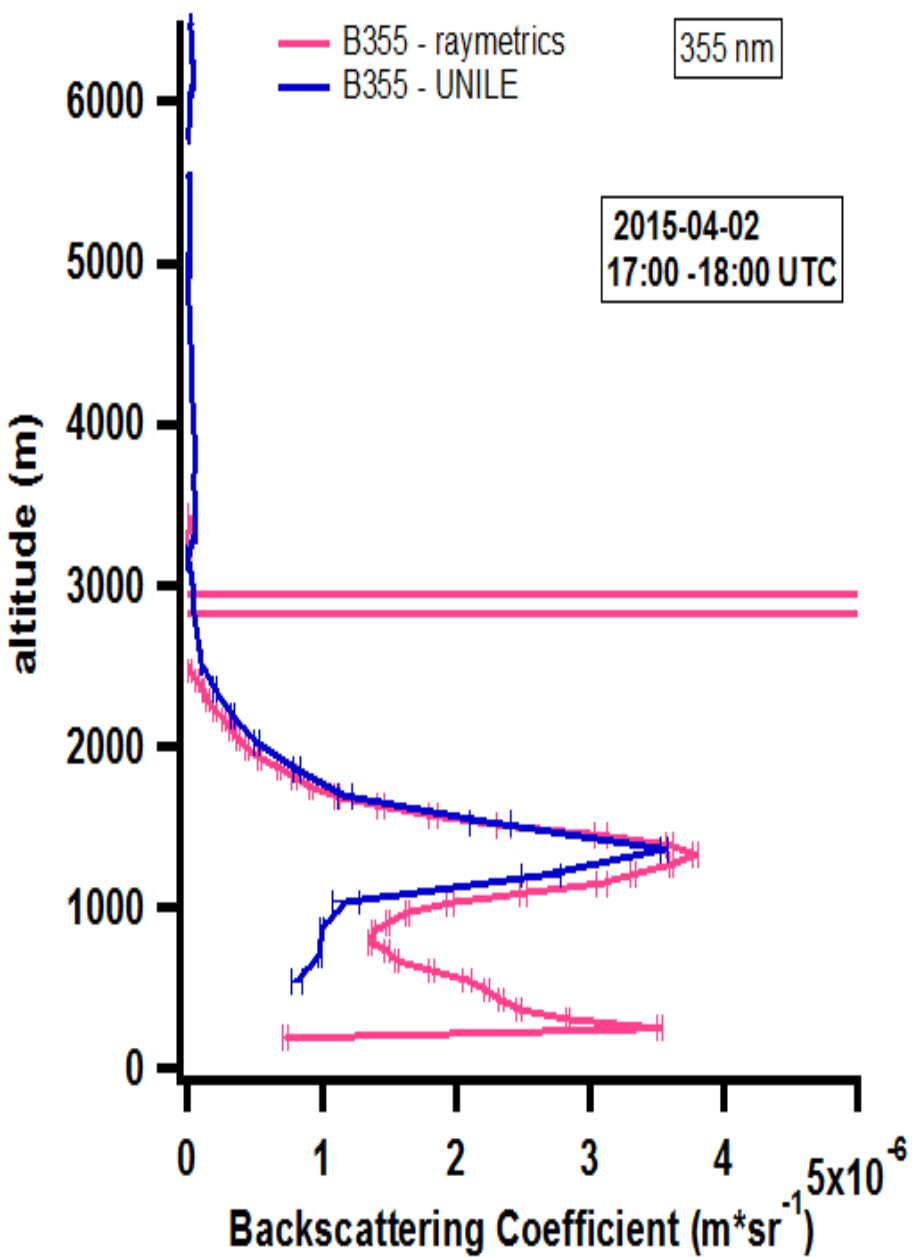
Lecce - UNILE (40.30N, 18.10E, 30.0m asl) RM_200-02-14 355nm

vdep [2015-04-02 19:00:31 UT] - [2015-04-02 23:59:29 UT]

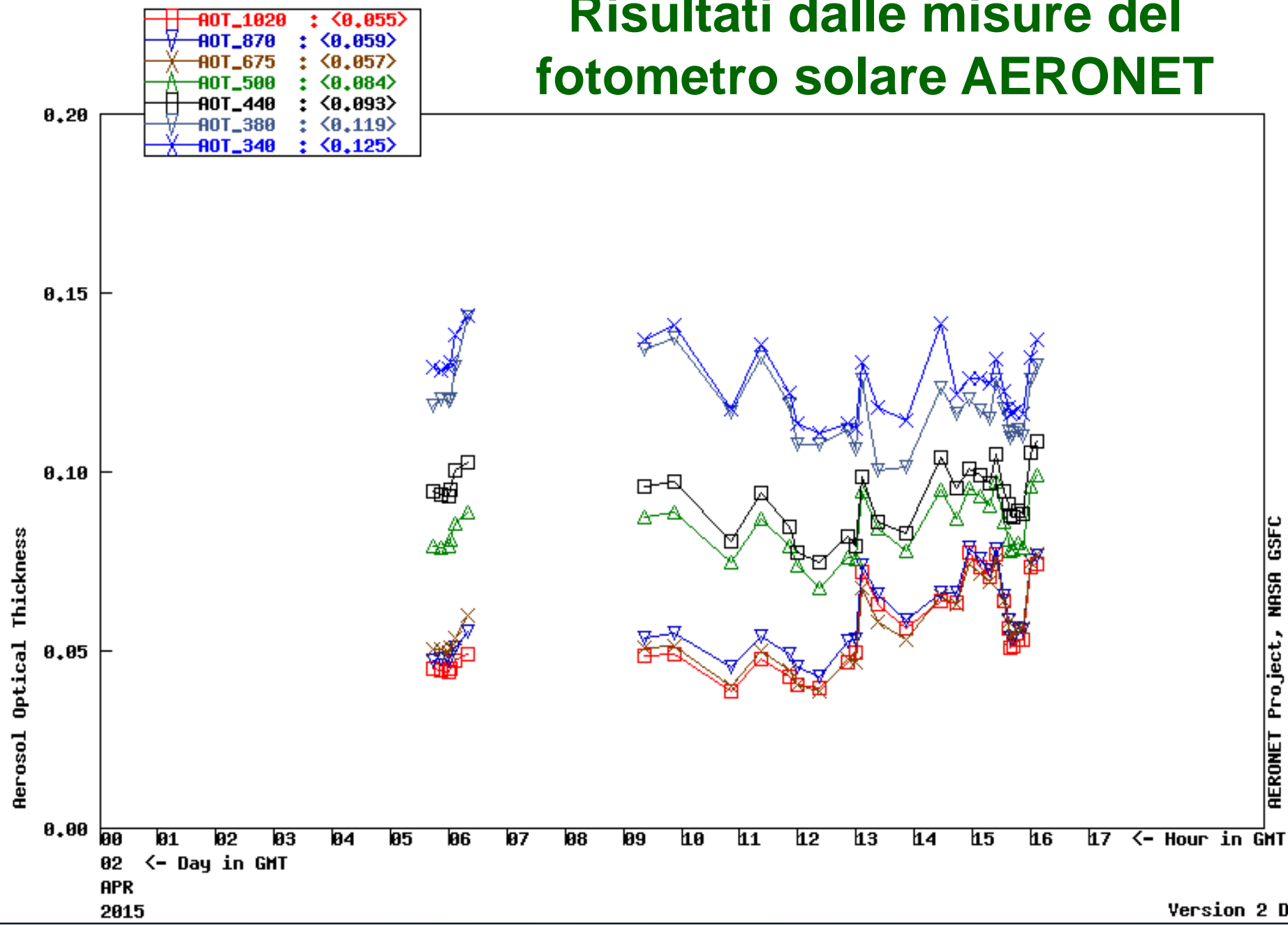




Confronto UNILE-Raymetrics a 355 nm

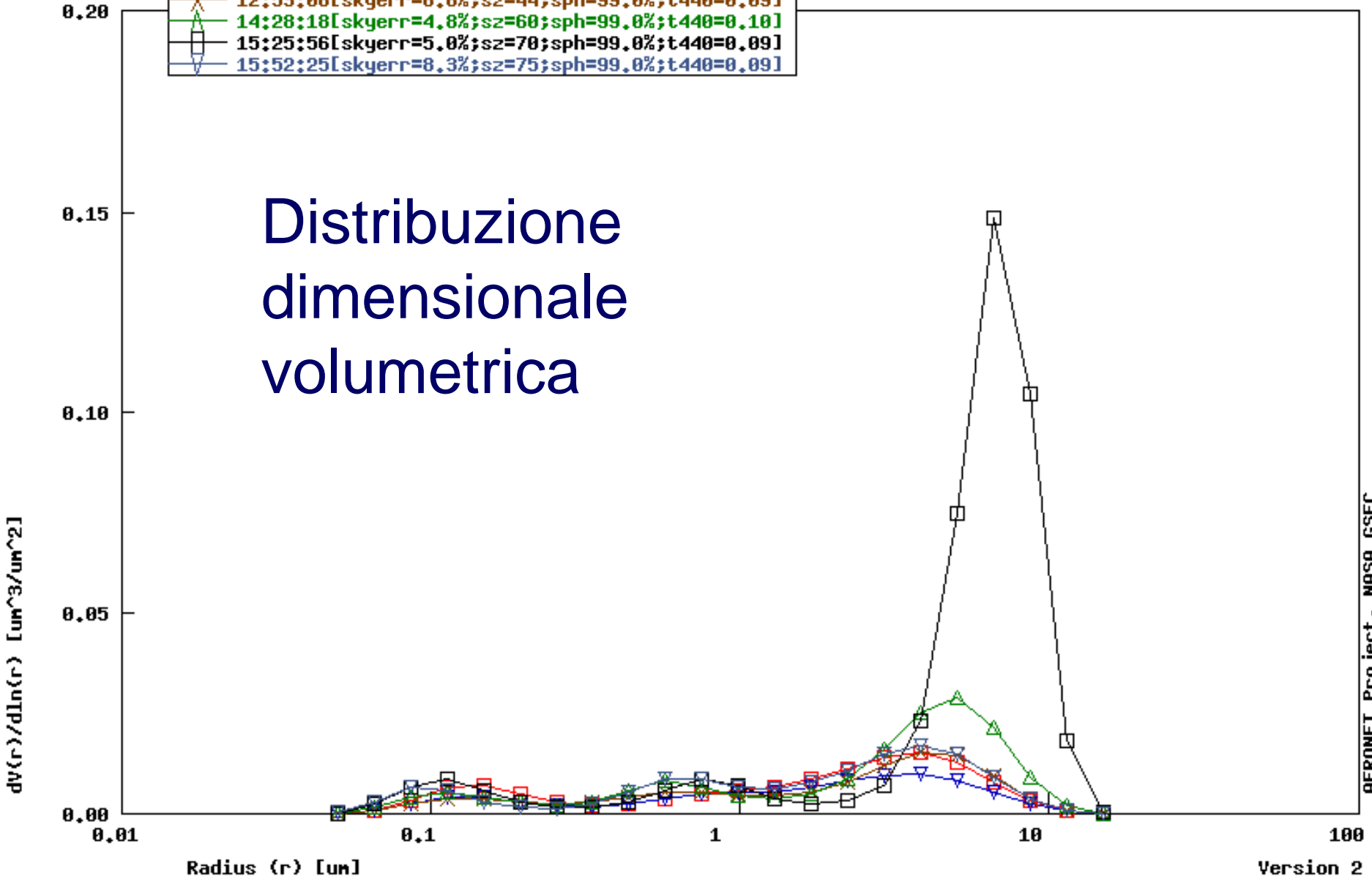


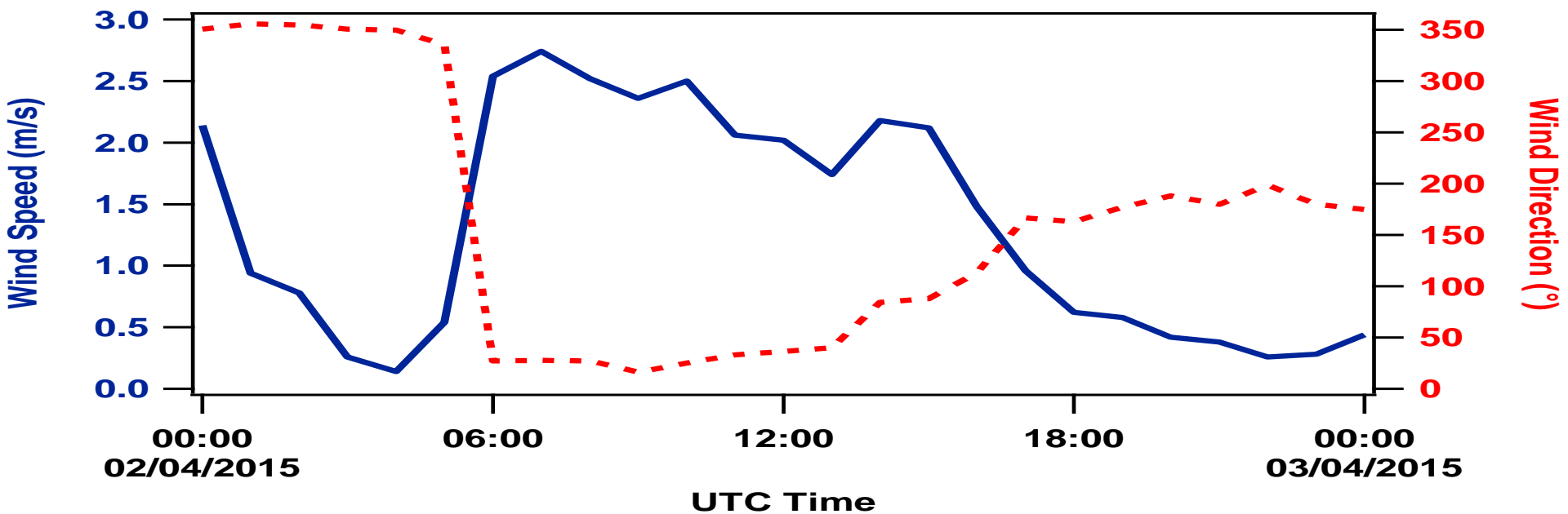
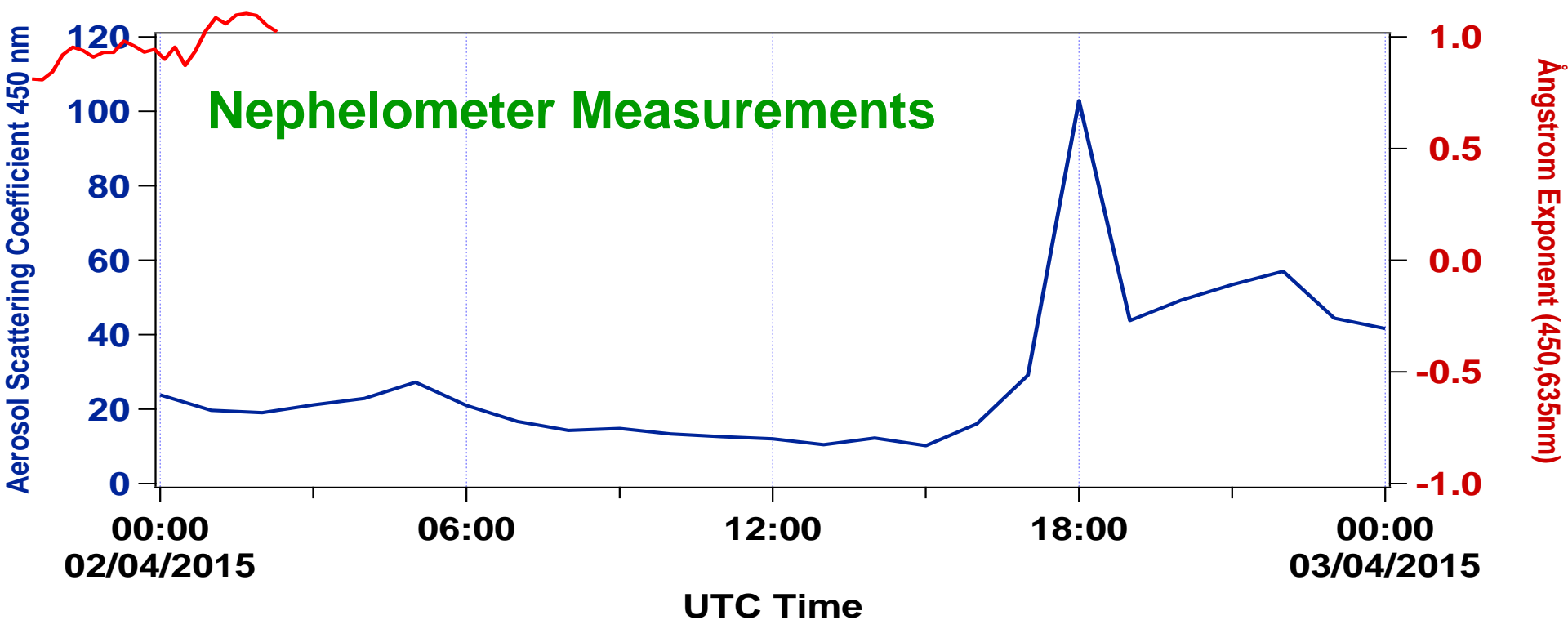
Risultati dalle misure del fotometro solare AERONET

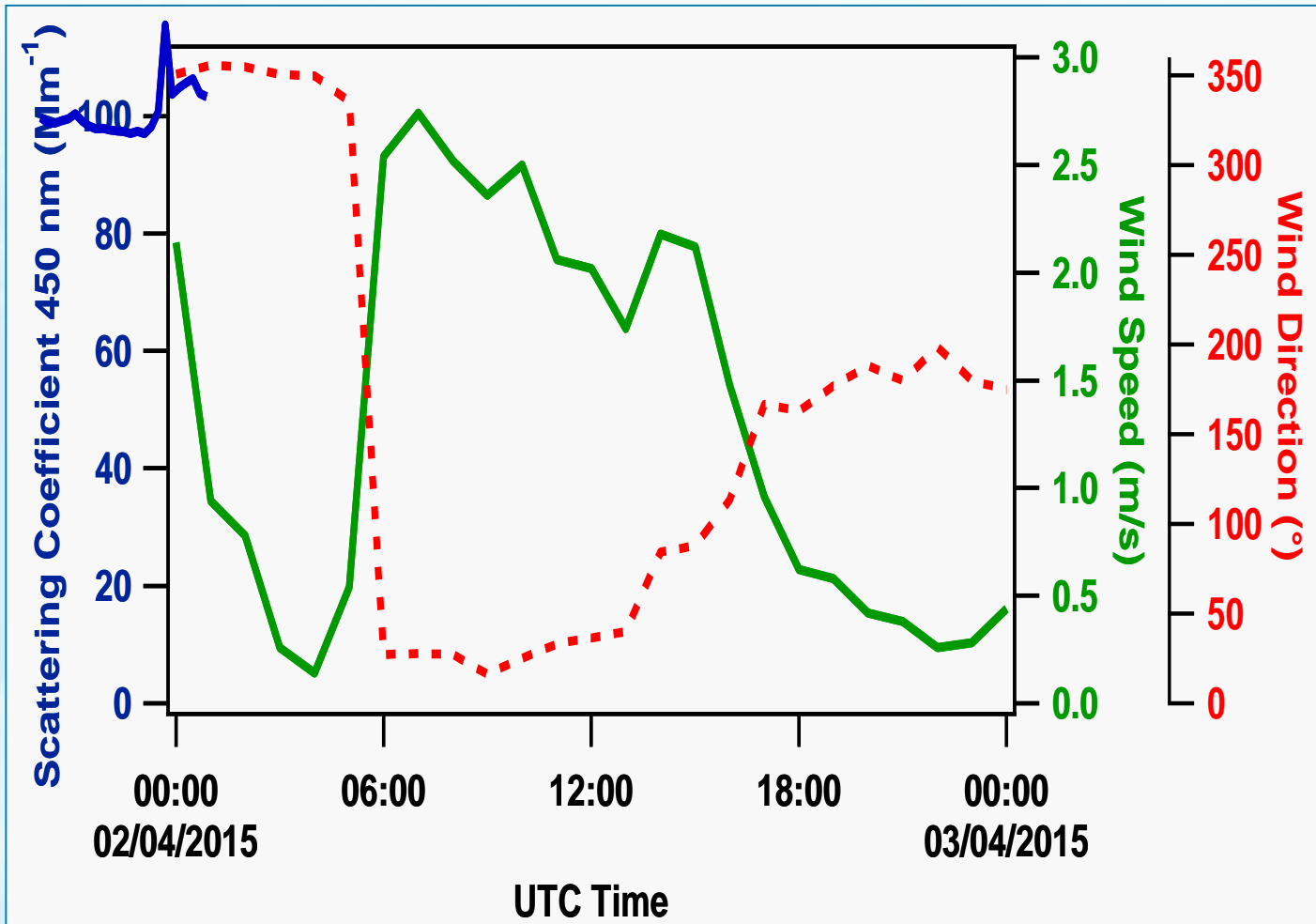


- 05:53:20[skyerr=3.5%;sz=75;sph=99.0%;t440=0.10]
- 11:53:07[skyerr=3.4%;sz=38;sph=40.3%;t440=0.08]
- 12:53:06[skyerr=6.6%;sz=44;sph=99.0%;t440=0.09]
- 14:28:18[skyerr=4.8%;sz=60;sph=99.0%;t440=0.10]
- 15:25:56[skyerr=5.0%;sz=70;sph=99.0%;t440=0.09]
- 15:52:25[skyerr=8.3%;sz=75;sph=99.0%;t440=0.09]

Distribuzione dimensionale volumetrica

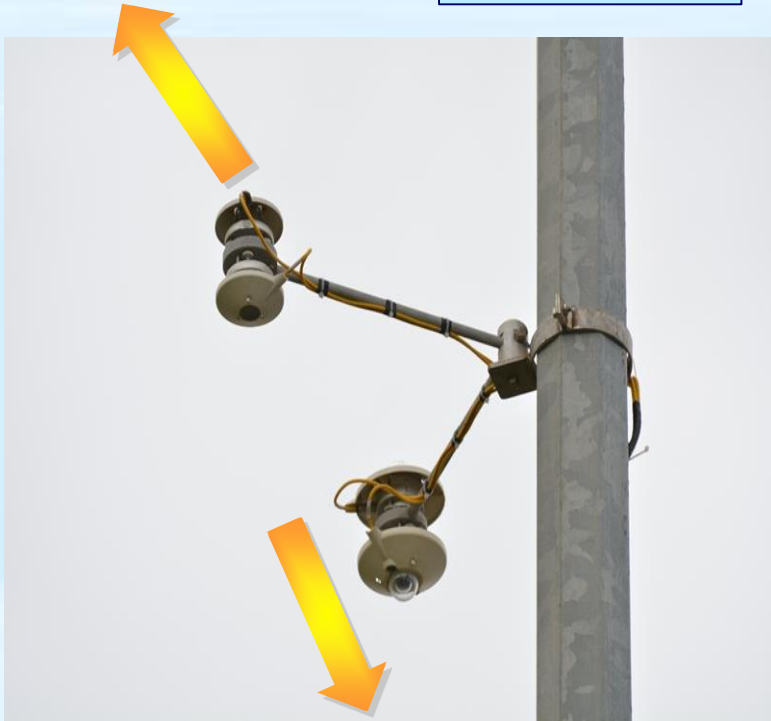






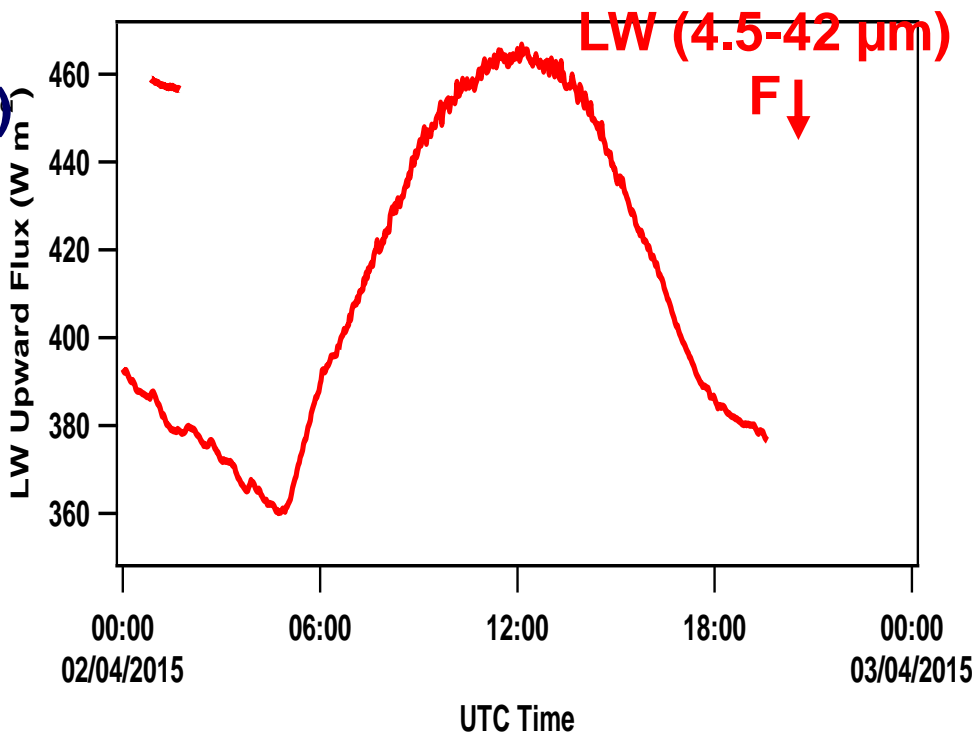
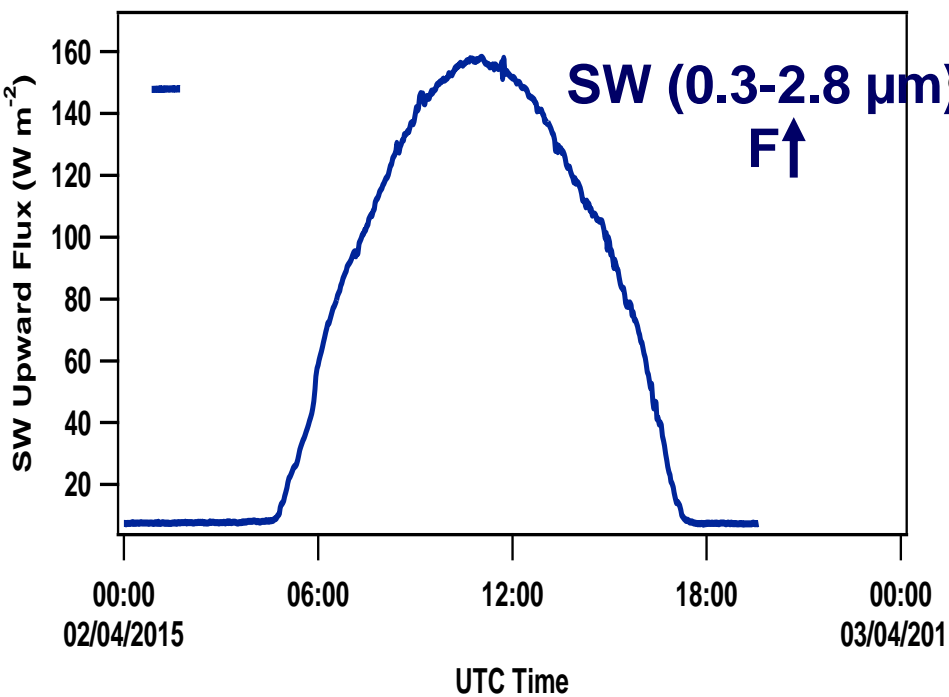
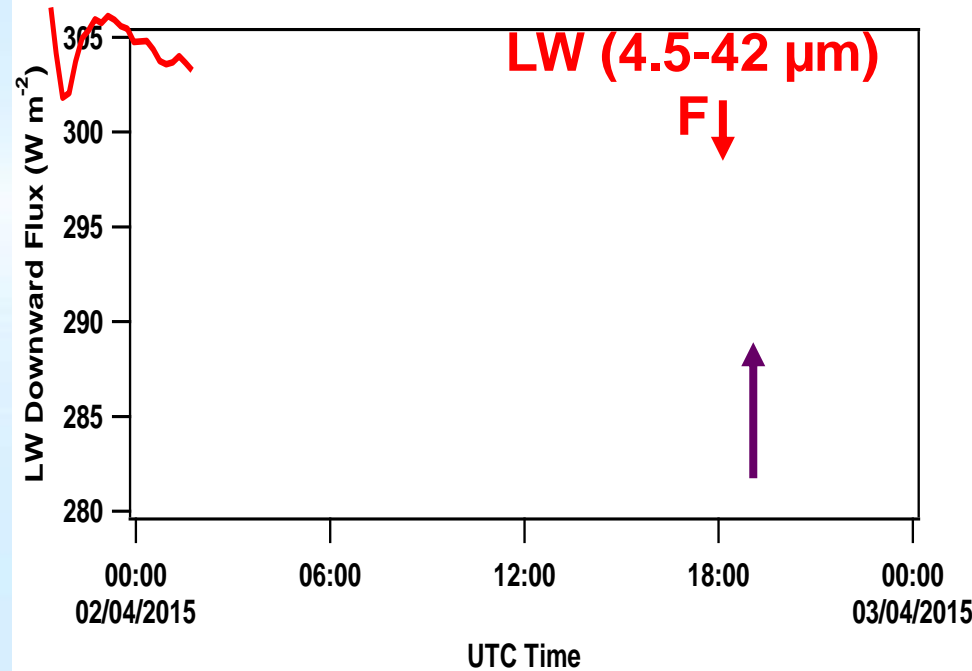
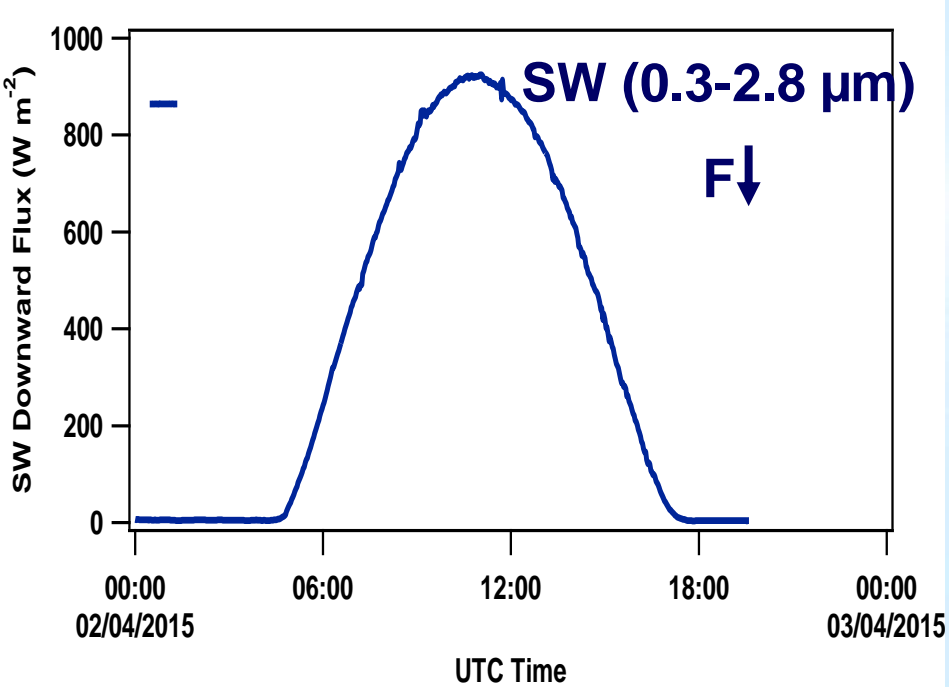
IRRADIANCE MEASUREMENTS

**AT THE
SURFACE**

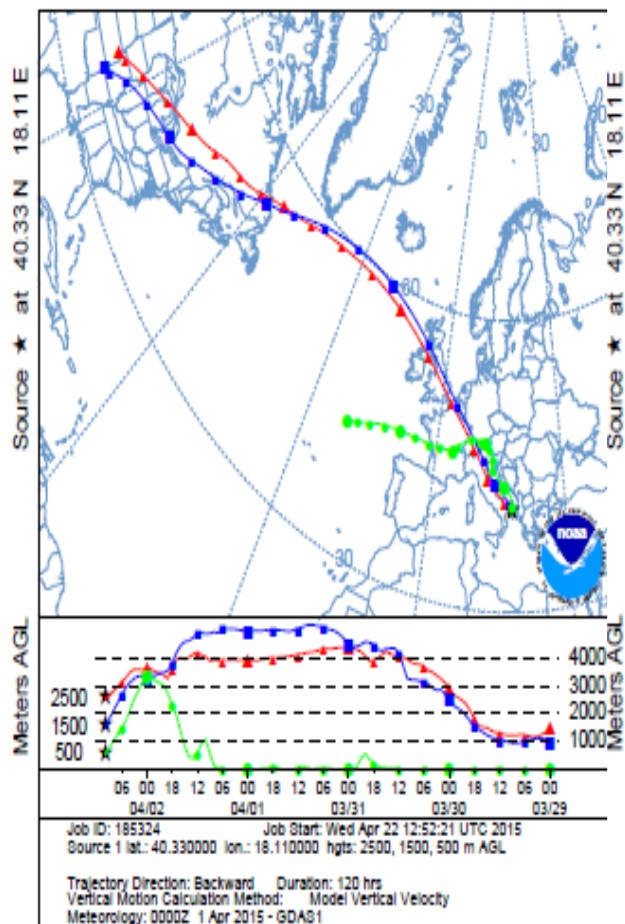


**Upward and Downward
Kipp&Zonen
pyranometer (CMP 21
model) [0.3-2.8 μm]**

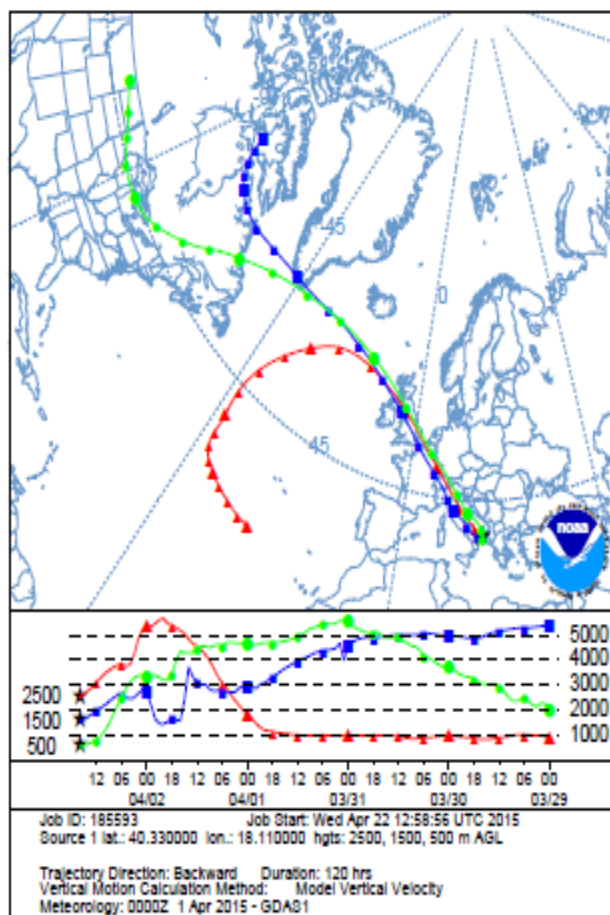
**Upward and
Downward
Kipp&Zonen
pyrgeometer (CGR 3
model) [4.5-42 μm]**



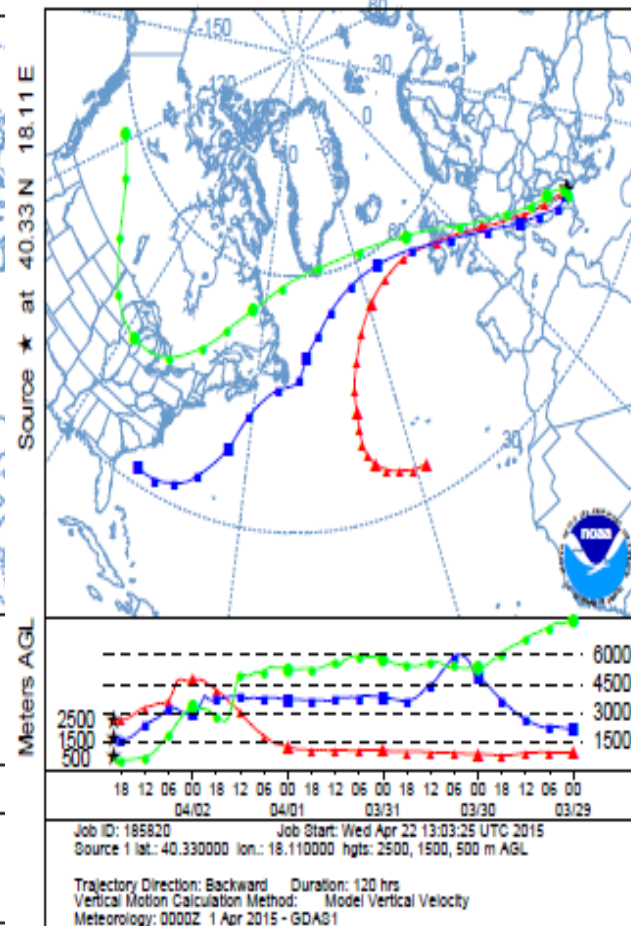
NOAA HYSPLIT MODEL
 Backward trajectories ending at 1000 UTC 02 Apr 15
 GDAS Meteorological Data



NOAA HYSPLIT MODEL
 Backward trajectories ending at 1600 UTC 02 Apr 15
 GDAS Meteorological Data

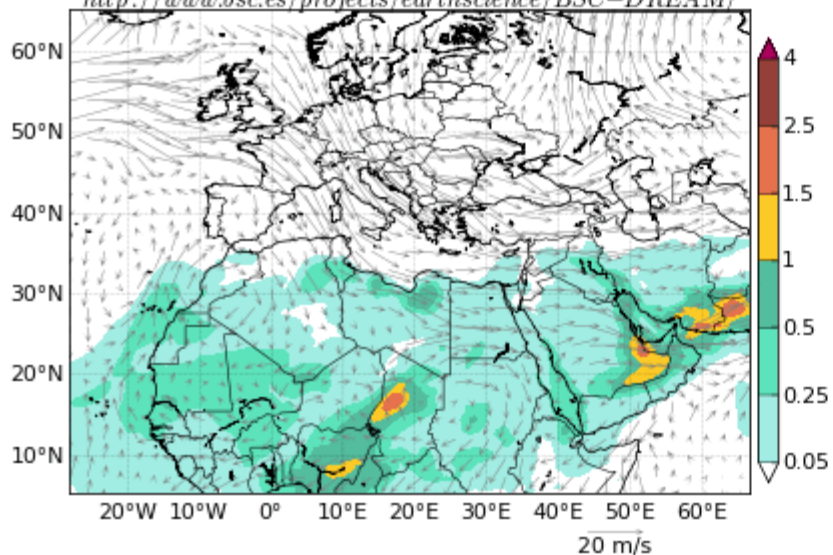


NOAA HYSPLIT MODEL
 Backward trajectories ending at 2000 UTC 02 Apr 15
 GDAS Meteorological Data



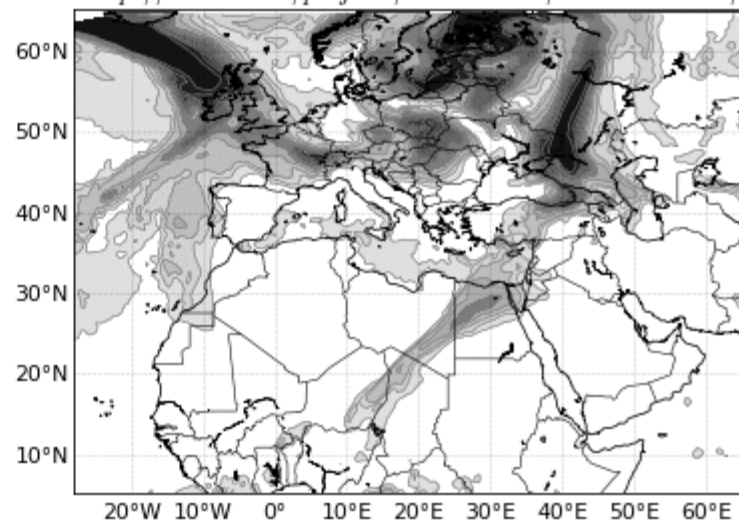
BSC-DREAM8b v2.0 Dust Load (g/m^2) and 3000m Wind
06h forecast for 18UTC 02 Apr 2015

<http://www.bsc.es/projects/earthscience/BSC-DREAM/>



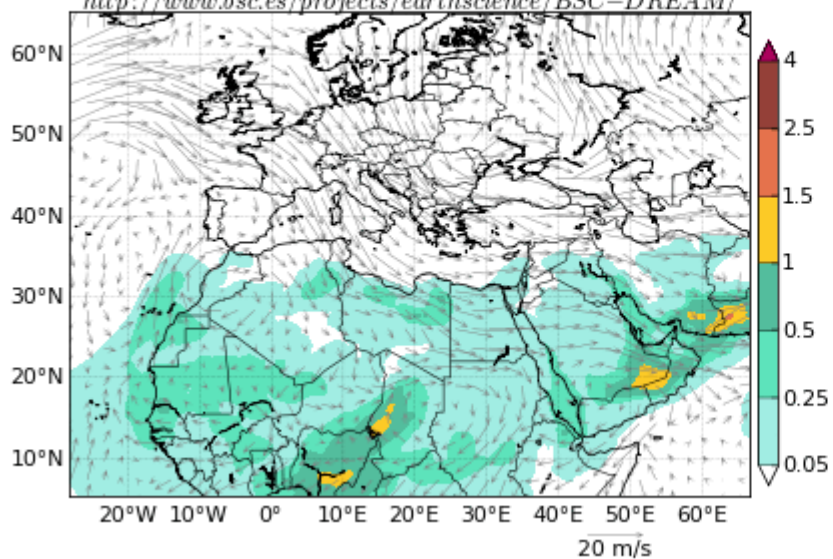
BSC-DREAM8b v2.0 Total Cloud Cover
06h forecast for 18UTC 02 Apr 2015

<http://www.bsc.es/projects/earthscience/BSC-DREAM/>



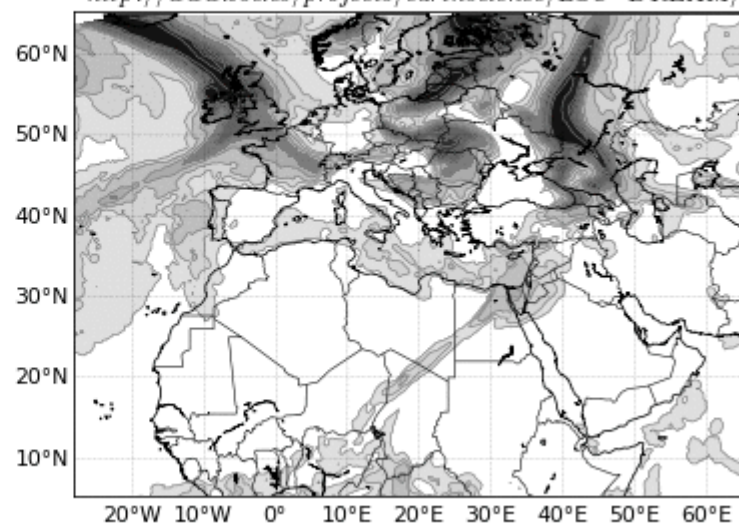
BSC-DREAM8b v2.0 Dust Load (g/m^2) and 3000m Wind
12h forecast for 00UTC 03 Apr 2015

<http://www.bsc.es/projects/earthscience/BSC-DREAM/>



BSC-DREAM8b v2.0 Total Cloud Cover
12h forecast for 00UTC 03 Apr 2015

<http://www.bsc.es/projects/earthscience/BSC-DREAM/>





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Atmospheric Environment

journal homepage: www.elsevier.com/locate/atmosenv

The impact of long-range-transport on PM₁ and PM_{2.5} at a Central Mediterranean site

M.R. Perrone^{a,*}, S. Becagli^b, J.A. Garcia Orza^c, R. Vecchi^d, A. Dinoi^a, R. Udisti^b, M. Cabello^c

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^d *Physics Department, Università di Milano, 20133 Milan, Italy*

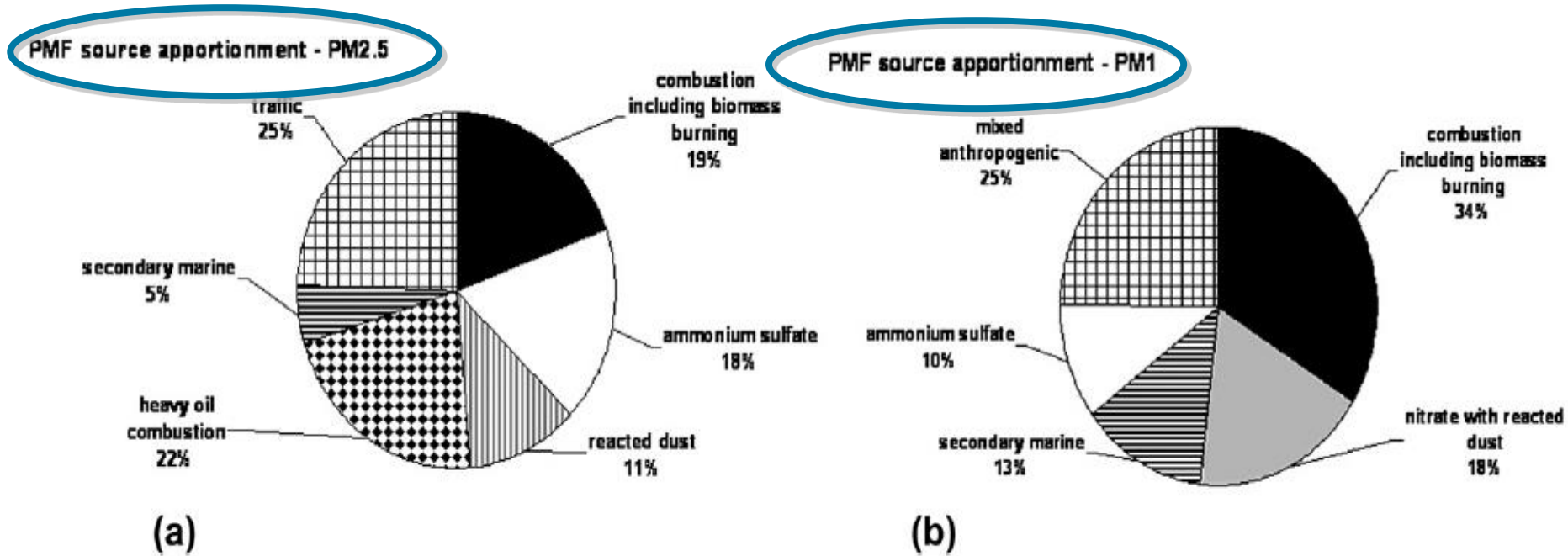
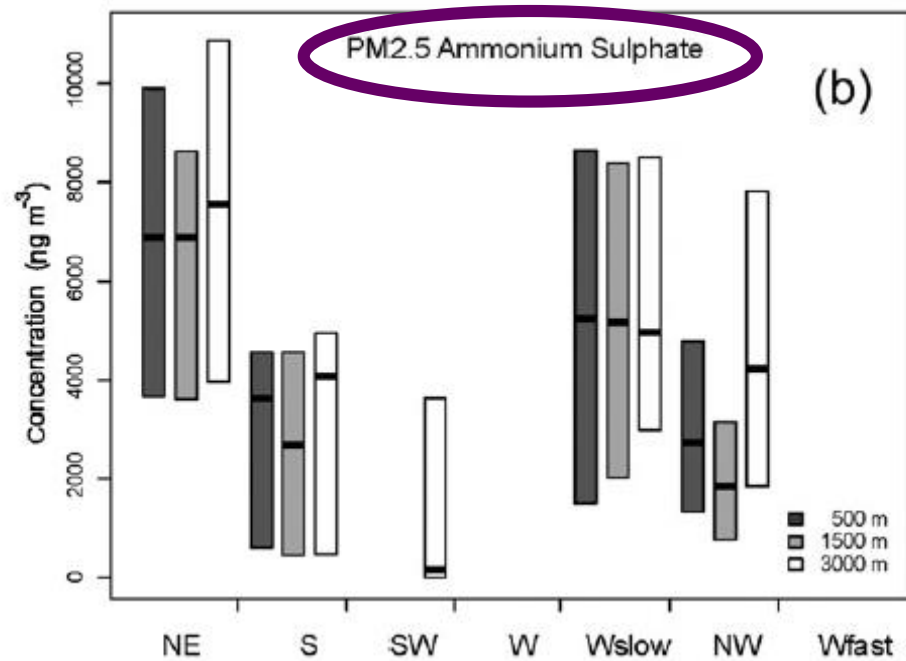
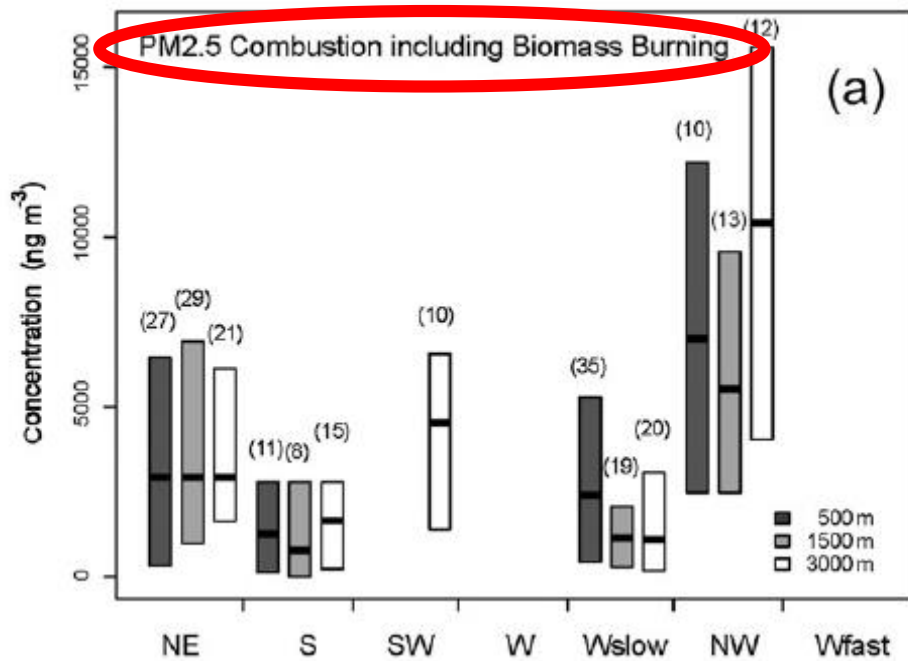
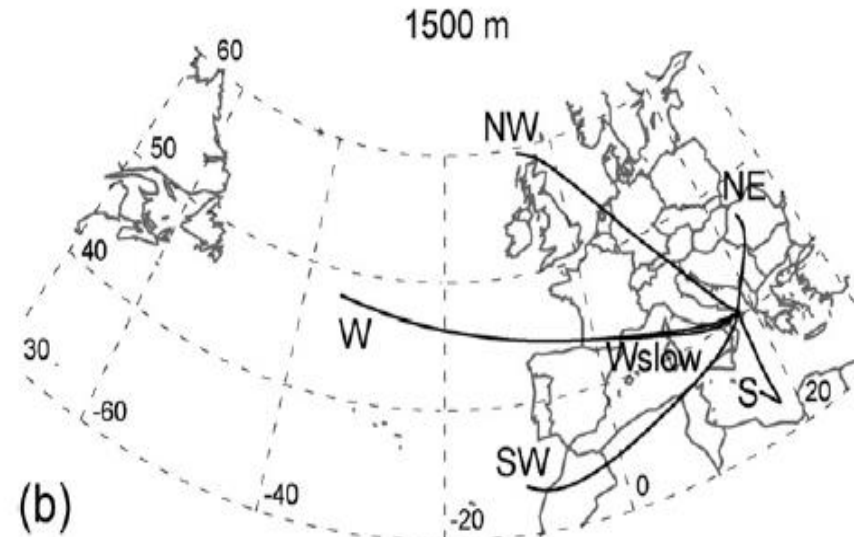
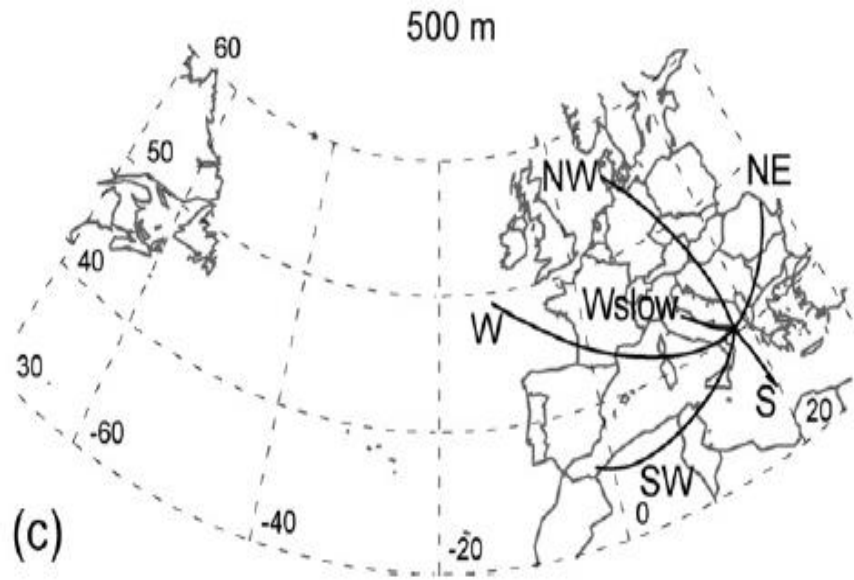
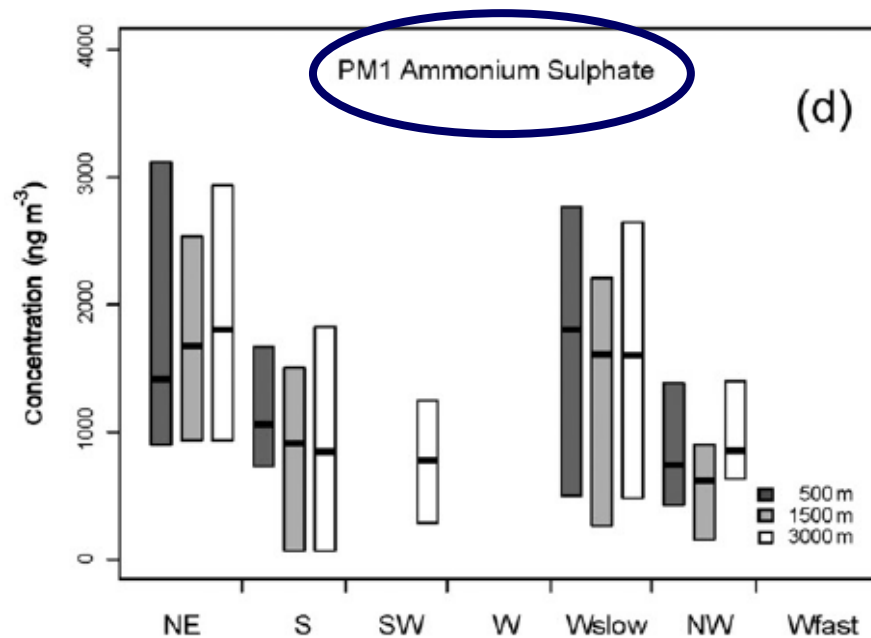
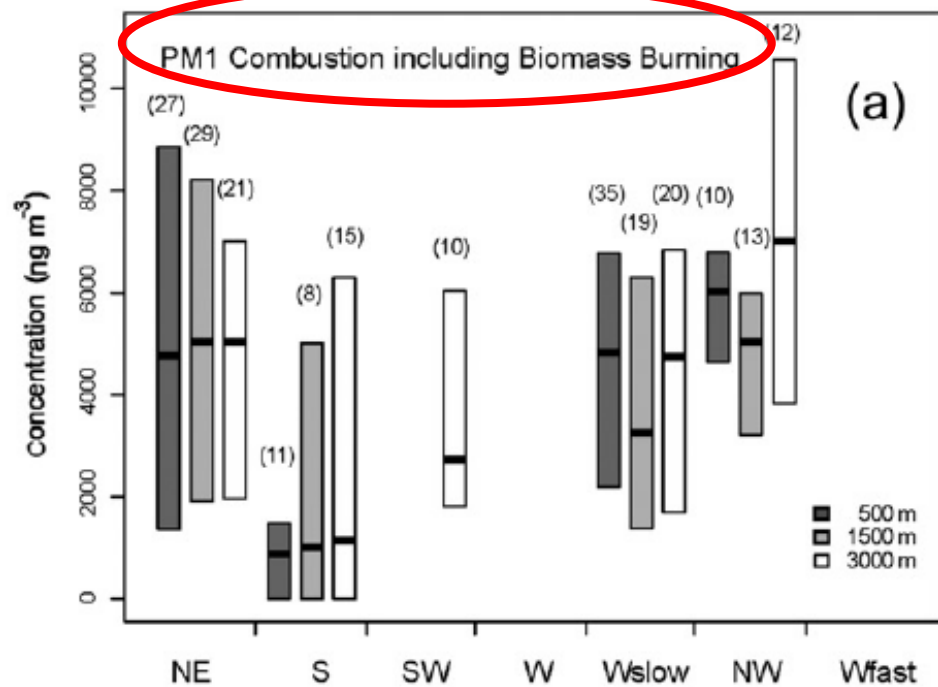
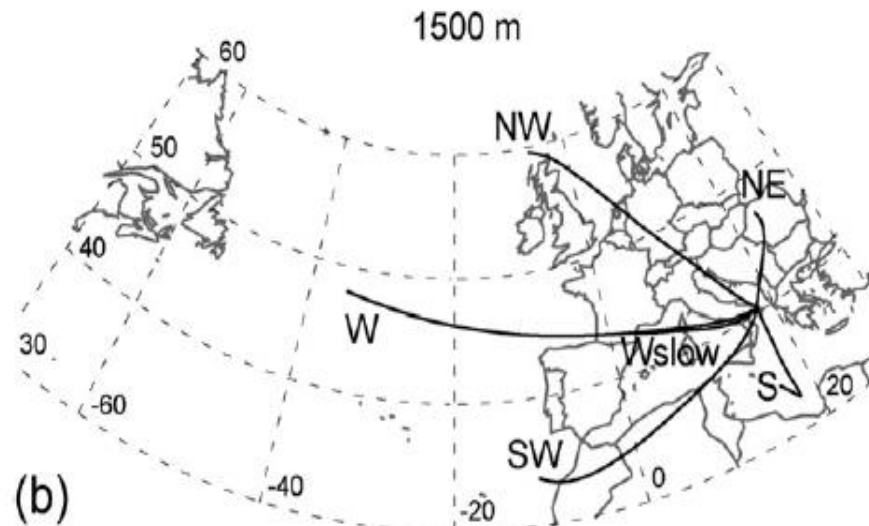
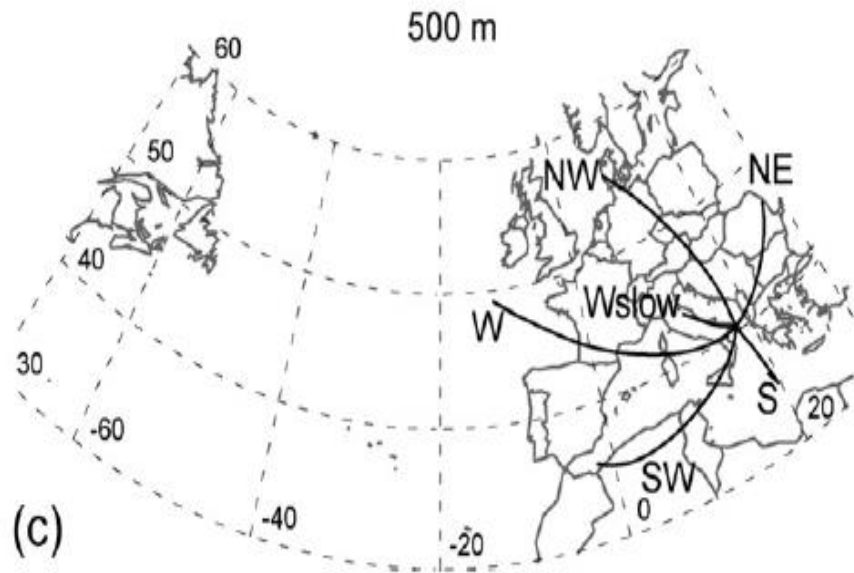
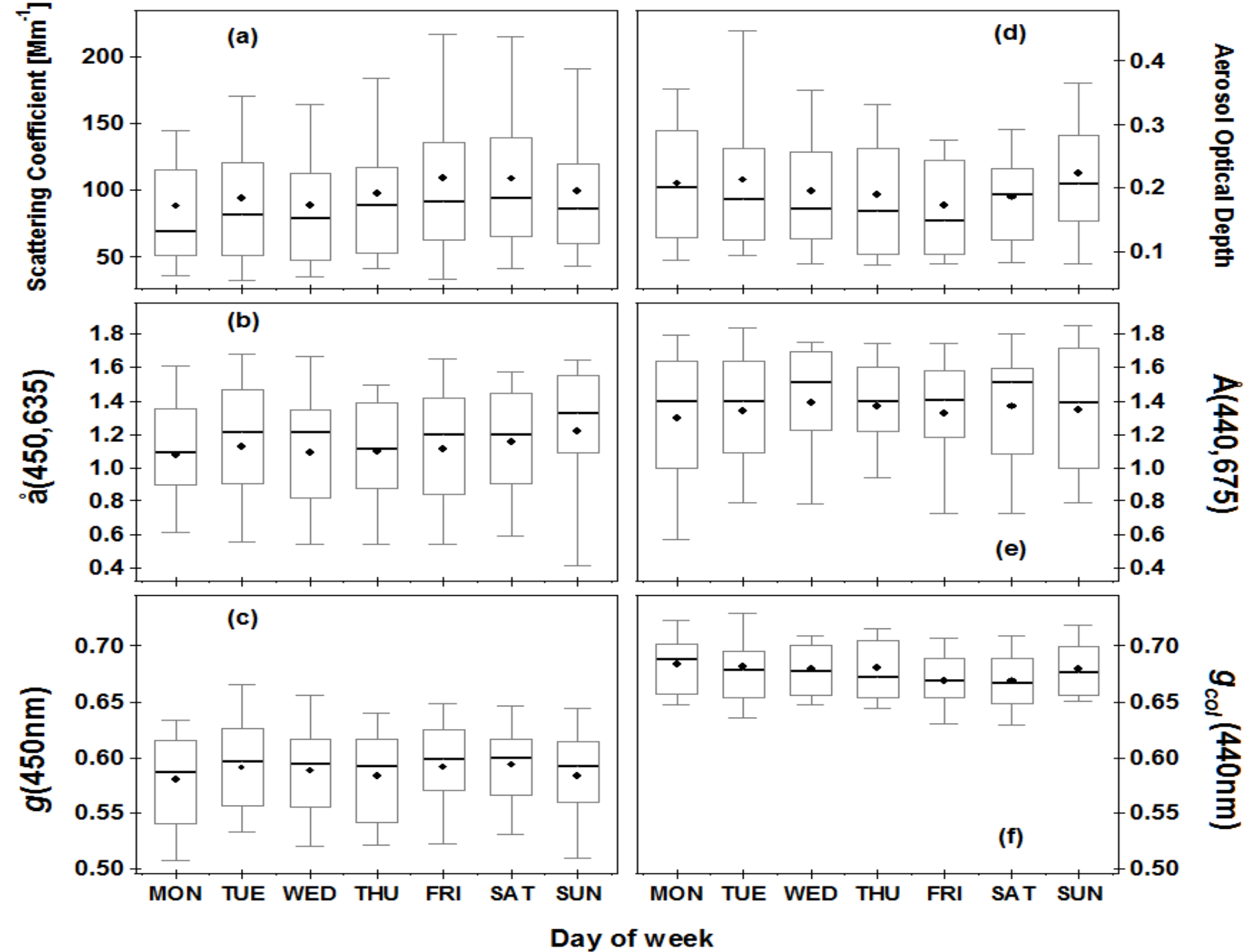


Fig. 1. Source apportionment from PMF for (a) PM2.5 and (b) PM1, respectively.





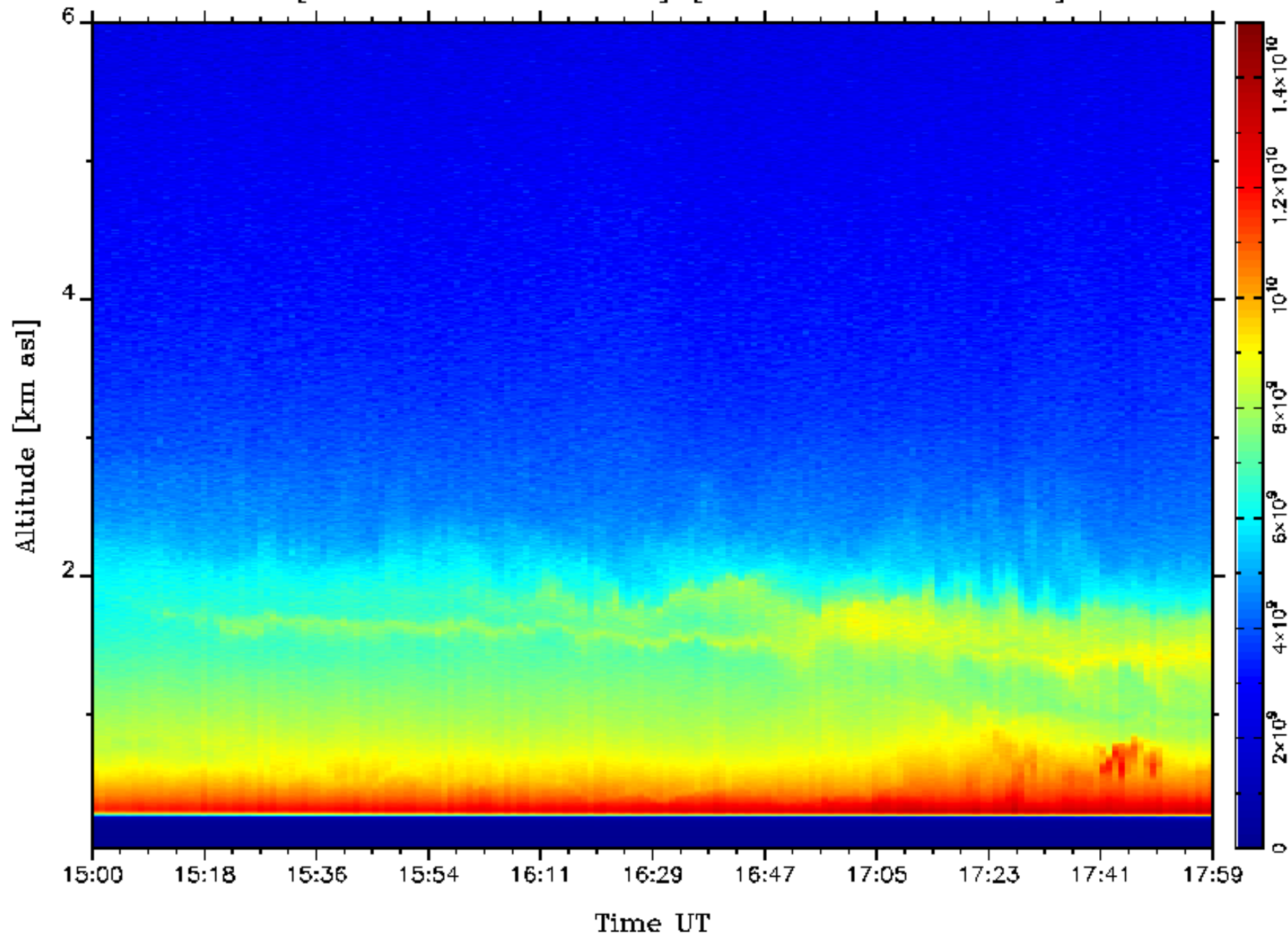


Conclusioni

- Un LIDAR che funziona 24 ore su 24 (e.g. Raymetrics) e' lo strumento ideale per identificare le “intrusioni” transfrontaliere di particolato atmosferico
- La caratterizzazione del PM o aerosol dal suolo in quota richiede l'uso integrato di diversa strumentazione

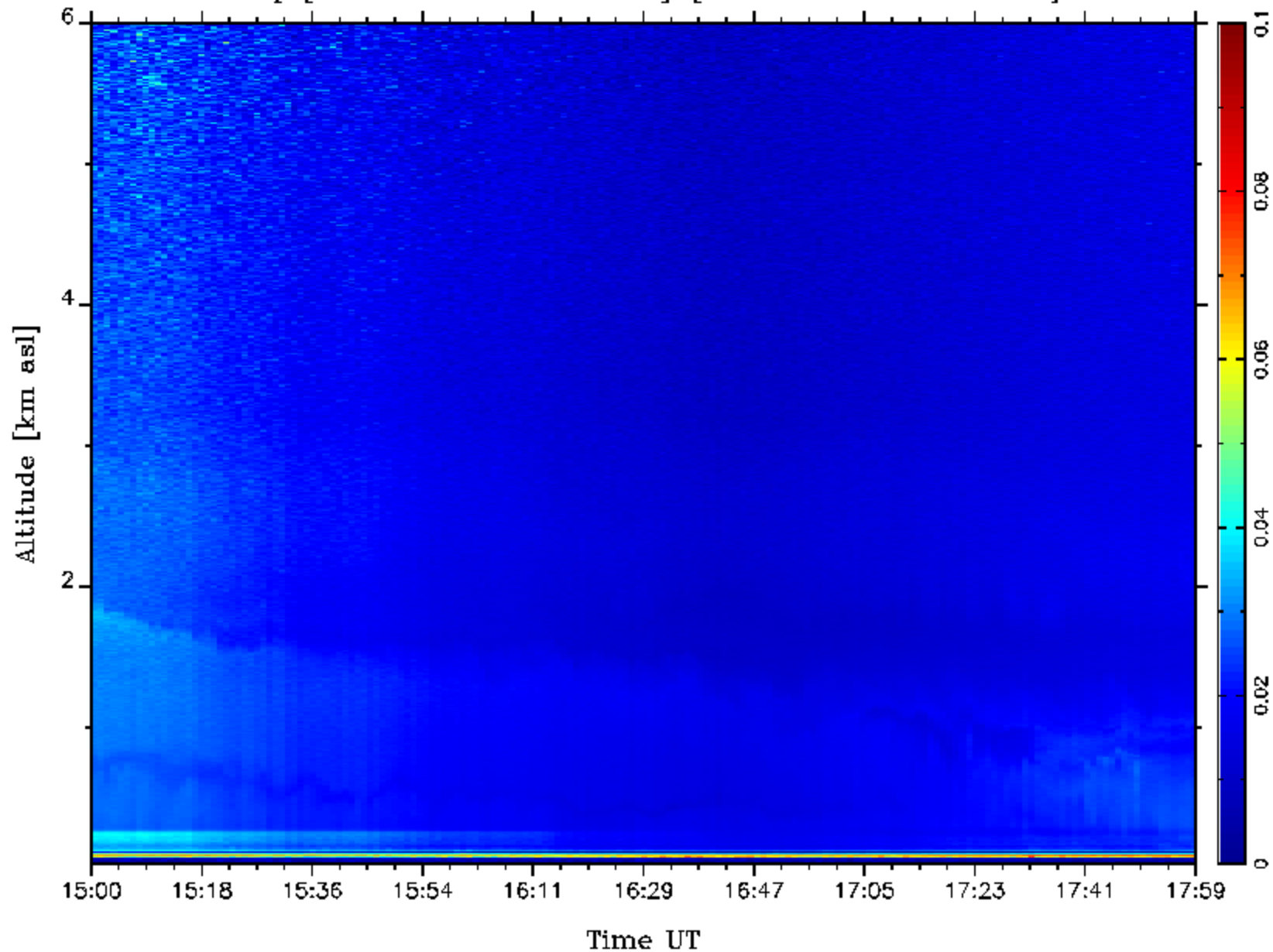
Lecce - UNILE (40.30N, 18.10E, 30.0m asl) RM_200-02-14 355nm

rsc [2015-04-02 15:00:00 UT]-[2015-04-02 17:59:09 UT]



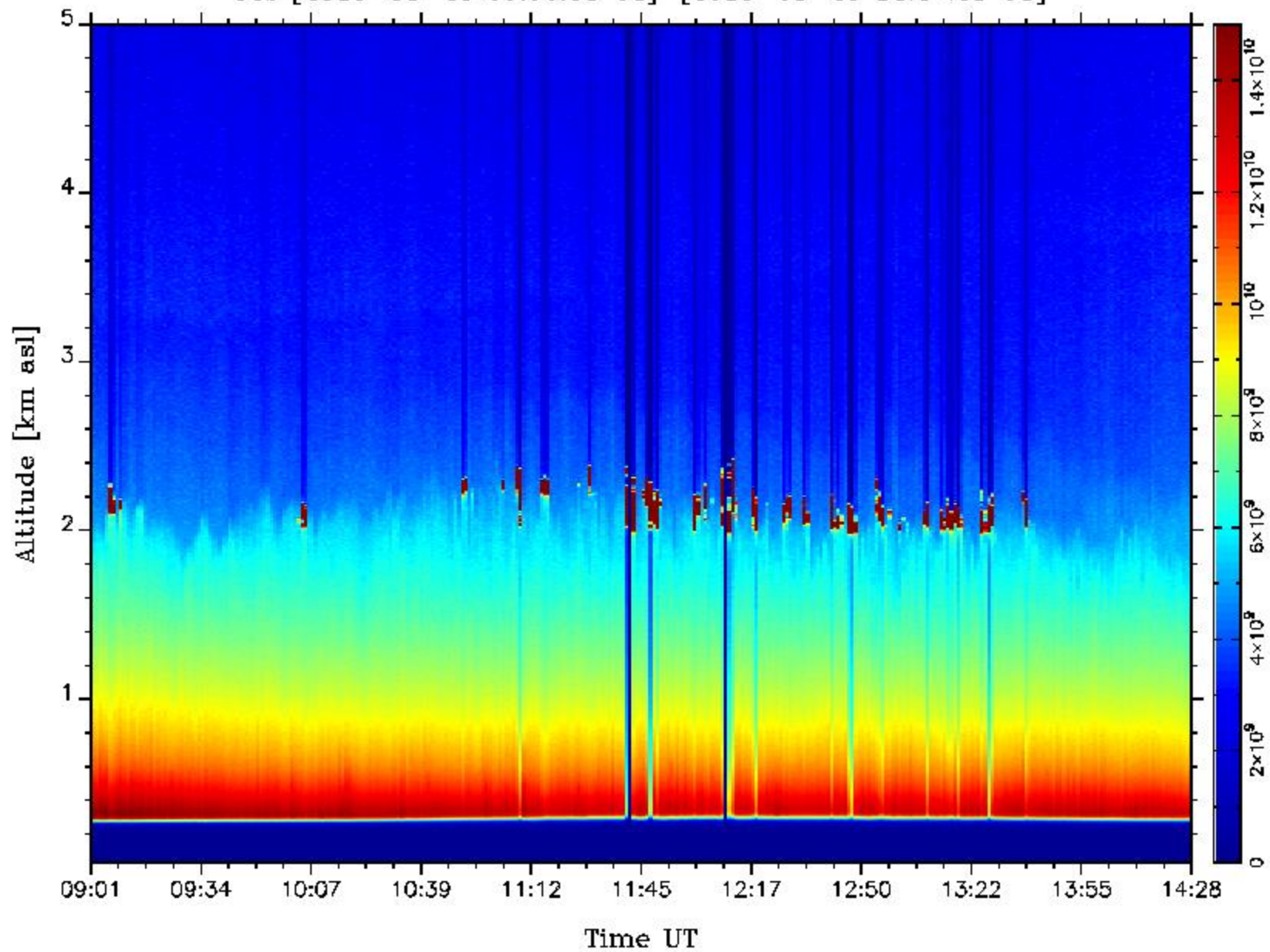
Lecce - UNILE (40.30N, 18.10E, 30.0m asl) RM_200-02-14 355nm

vdep [2015-04-02 15:00:00 UT]-[2015-04-02 17:59:09 UT]



Lecce - UNILE (40.30N, 18.10E, 30.0m asl) RM_200-02-14 355nm

rcs [2015-03-20 09:00:53 UT]-[2015-03-20 14:27:28 UT]



Il LIDAR (Light Detection And Ranging)

Il sistema LIDAR operante presso il Dipartimento di Fisica dell' Università del Salento (**LIDAR UNILE**) è stato ottimizzato per la misura dei profili verticali del coefficiente di retrodiffusione ed estinzione dell'aerosol, del rapporto di depolarizzazione totale e del rapporto di mescolamento del vapor acqueo. UNILE è costituito da:

- un laser Nd:YAG triplicato in frequenza (A) che genera impulsi a 355 nm di durata temporale di circa 10 ns, energia massima di 360 mJ e frequenza di massima di ripetizione di 30 Hz.
- un telescopio di tipo Newtoniano (B) con uno specchio di 33 cm di diametro e lunghezza focale 120 cm
- un sistema ottico per la selezione spettrale del segnale retrodiffuso (C),
- un sistema di rivelazione e acquisizione del segnale analogico digitale (D).

