

Bologna

Air Quality Observatory

Urban background

(44°31' N 11°20' E, 39 m asl)



The air quality monitoring station is located inside the research area of CNR in Bologna, via Gobetti. The site is classified as urban background station. The activity of the measurement station began in November 2011, in the framework of the Supersite project of Regione Emilia Romagna.

Mt. Cimone

Italian Climate Observatory "Ottavio Vittori"

Mountain remote background

(44°12' N, 10°42' E, 2165 m asl)



The Italian Climate Observatory "O. Vittori" (ICO-OV) GAW-WMO Global Station, is located on the top of Mt. Cimone (2165 m a.s.l.), the highest peak of the northern Italian Apennines and it is the only high mountain station for atmospheric research located both South of the Alps and the Po basin.

San Pietro Capofiume

Atmospheric Composition Observatory

Rural background

(44°39' N, 11° 37' E, 11 m asl)



The meteorological station "Giorgio Fea", located at the rural site of St. Pietro Capofiume (BO), it is owned by ARPA Emilia Romagna and CNR collaborates and implements continuous measurements and performs field experiments for over thirty years.

ANGELA MARINONI, ANGELO LUPI, STEFANIA GILARDONI, DOUGLAS ORSINI, FRANCESCOPIERO CALZOLARI, PAOLO BONASONI, SILVIA BUCCI, PAOLO CRISTOFANELLI, PAOLA DE NUNTIIS, OXANA DROFA, FEDERICO FIERLI, TONY LANDI, MAURO MAZZOLA, MARCO PAGLIONE, MATTEO RINALDI, FABIAZIO ROCCATO, LEONE TAROZZI, FEDERICO ZARDI, MARIA GKINI, KOSTAS ELEFThERIADIS, FEFATZIS PRODROMOS, ROBIN LEWIS MODINI, MARTIN GYSEL, ROSARIA ERIKA PILECI, MICHELE BERTO', GUNTHER WEHRLE, JEAN PHILIPPE PUTAUD, GRISA MOKNICK, PAOLO LAJ, AURELA MINNA, CLAUDIO MAZZOLENI, TYLER CAPEC, LYNN MAZZOLENI, ULEVICIUS VIDAMANTAS, PAOLA MASSOLI, ROBERTA VECCHI, GIANLUIGI VALLI, NICOLA SPINELLI, ANTONELLA BOSELLI, LUCA FERRERO, ANDREA D'ANNA, SILVANA DEIULIIS, FRANCESCA MIGLIORINI, VANES POLUZZI

3-28 July 2017: MONTE CIMONE ACTRIS-2 campaign – WP11

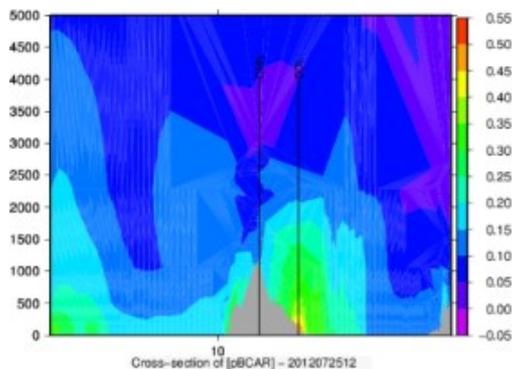
Absorbing aerosol studies in the Po Basin and its export to the free troposphere

The three sites were equipped with a variety of instrumentation for optical characterization including:

MAAP, Aethalometer, Nephelometer, CAPS, Laser-Induced Incandescence, SP2, PAS, LiDAR, Sunphotometers.

Moreover sampling for chemistry and morphology have been performed as well as the physical characterization.

The Bologna/Monte Cimone field campaign took place **from 3 to 28 July 2017**, during the summer period when the vertical export of pollutants is particularly active. Simultaneous measurements of elemental and brown carbon, absorption - scattering - extinction coefficients have been performed together with chemical (on line and offline) as well as morphological characterization of aerosol particles. The campaign was organized as part of ACTRIS-2 WP 11 “*Improving the accuracy of aerosol light absorption determinations*”, with the main goal of assessing the processes affecting the variability of the MAC value. The vertical “profile” of pollution was studied through the columnar sunphotometric measurements and the vertical distribution of the measurement sites.



Moreover a comprehensive measurements interpretation has been carried out by using an air quality modelling chain implemented over Po Basin with high horizontal and vertical resolution. A cross section, intercepting the three sampling sites will be generated for investigating the fate of absorbing aerosol as well as of other anthropogenic and natural species.

3 measurement sites:



17 INSTITUTIONS INVOLVED

5 TNA applications

CNR-ISAC

ARPAE

TNA

PSI

JRC – Ispra

Aerosol d.o.o

IGE

TNA

UNIMI

DISAT

CeSMA

ALA

CNR-ICMATE

CNR - IMAA

Institute of Atmospheric Sciences and Climate

Environmental Agency EMILIA ROMAGNA

NATIONAL CENTER FOR SCIENTIFIC RESEARCH
"DEMOKRITOS"

Paul Sherer Institute

Joint Research Center

Aerosol d.o.o.

Institut de Géosciences de l'Environnement

Finnish Meteorological Institute

Michigan Technological University

Center for Physical Sciences and Technology
Vilnius

Aerodyne Research

Milano University, Physics Department

Milano Bicocca University, Environmental
Science Department

Università degli Studi di Napoli Federico II,
Centro di Servizi Metrologici Avanzati

ALA Advanced LIDAR Applications S.r.l.

Institute of Condensed Matter Chemistry and
Technologies for Energy

Institute of Methodologies for Environmental
Analysis

<http://www.isac.cnr.it/en>

<https://arpae.it/>

<http://www.demokritos.gr/?lang=en>

<http://www.psi.ch>

<https://ec.europa.eu/jrc/en>

<http://www.aerosol.si/>

<http://www.ige-grenoble.fr/?lang=fr>

<http://en.ilmatieteenlaitos.fi/>

<http://www.mtu.edu/>

<http://www.ftmc.lt/en>

<http://www.aerodyne.com/index.phpa>>

<http://ambiente.fisica.unimi.it/>

<http://www.disat.unimib.it/>

<https://www.unina.it/-/768495-centro-di-servizi-metrologici-avanzati-cesma->

<http://www.alasystems.it/home-it/>

<http://www.icmate.cnr.it/en/>

<http://www.imaa.cnr.it/en>

MEASUREMENTS CARRIED OUT

Monte Cimone (mountain site, 2165):

Absorption coefficient: MAAP, AE31, AE33

Photoacoustic,

Black carbon: Single Particle Soot Photometer

Scattering coefficient: NEPH TSI 3 λ

Extinction coefficient: CAPSs PM_{ss}a (450, 780 nm),

Chemistry: filters 24h EC/OC/BrC

ACSM

Columnar measurement: Sunphotometer PFR



San Pietro Capofiume (rural site in Po Valley):

Absorption coefficient: MAAP, AE31, AE33

Scattering coefficient: NEPH TSI 3 λ

Extinction coefficient: CAPS (630 nm)

Chemistry: filters 24h EC/OC/BrC

ACSM

Columnar measurement:

Sunphotometer CIMEL (CE-318, Lunar)

LiDAR ALA

WindLiDAR (windcube)



Bologna (urban site, Po valley):

Absorption coefficient: MAAP, AE31

Black carbon: Artium LII-300

Scattering coefficient: NEPH TSI 3 λ

Extinction coefficient: CAPS SSA (630 nm)

Chemistry: filters 24h EC/OC/BrC

online WSBroc (abs 370nm coupled with PILS)

Nighttime AMS

Columnar measurement:

Sunphotometer (MFR7)

PSI MOSQUITA VAN

Profiles and transects mainly from San Pietro to Pian Cavallaro (1878 m asl) and from Bologna to Milan

**Absorption coefficient: MAAP
AE33 (7w)**

Photoacoustic Extinction meter (PAX, 870 nm)

Black carbon: Single Particle Soot Photometer

Scattering coefficient: NEPH TSI 3 λ

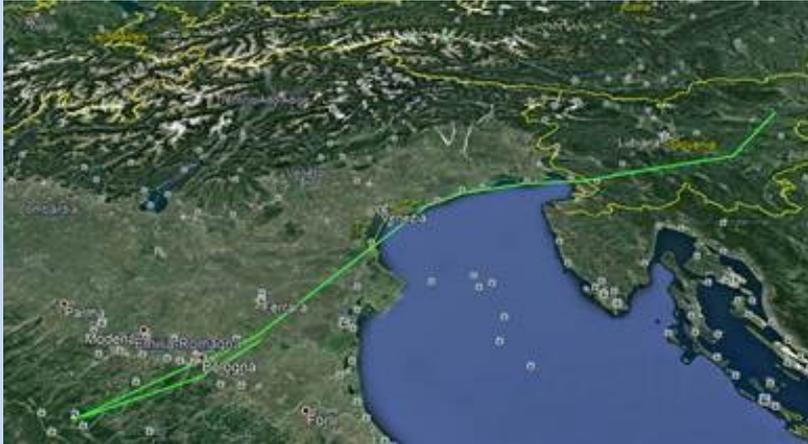
Extinction coefficient: CAPS PMssa (780 nm)

Chemistry: AMS



July, 20 2017

Two aircraft measurements



The ultra-light aircraft from GreenLight (<http://www.worldgreenflight.com/>) have flew over Po Valley, equipped with instrument for

equivalent black carbon (AE33) and carbon dioxide concentration, completing three vertical profiles over the three sites of the campaign: S. Pietro Capofiume, Bologna and Mt. Cimone.

Synergy with EMERGe project (Effect of Megacities on the transport and transformation of pollutants on the Regional and Global scales)

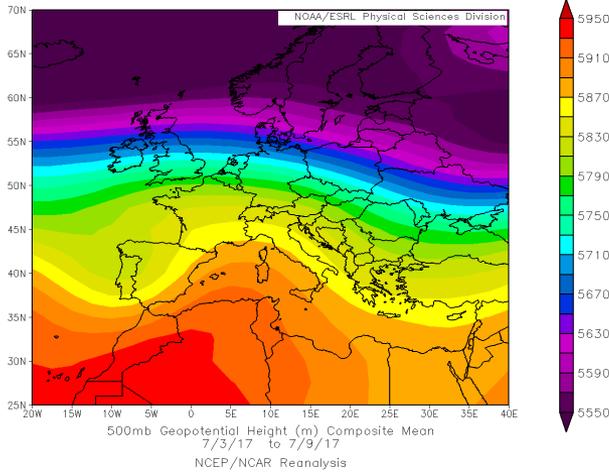
The second HALO aircraft flight over Italy took off at 9UTC from Germany to enable flight downwind of the Po Valley in the late morning and in the afternoon over Rome. The flight measurements are focused on catching the outflow of pollution from the polluted areas of Po Valley and Rome.



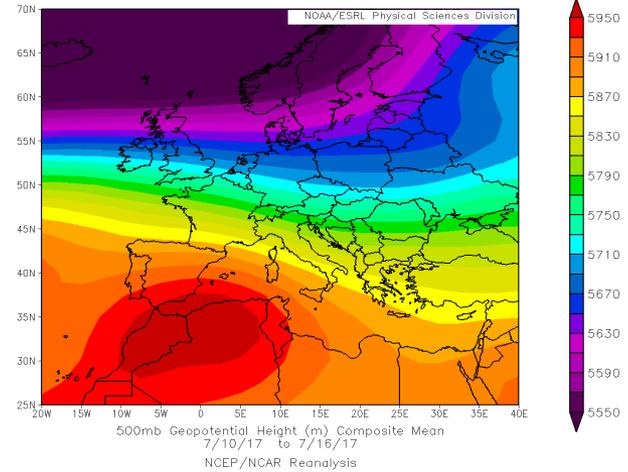
METEOROLOGICAL OVERVIEW: 500-hPa geopotential height

Summer 2017 was the 2nd warmest summer in Italy since records began on 1800 with +2.48°C anomaly relative to 1971-2000 mean.

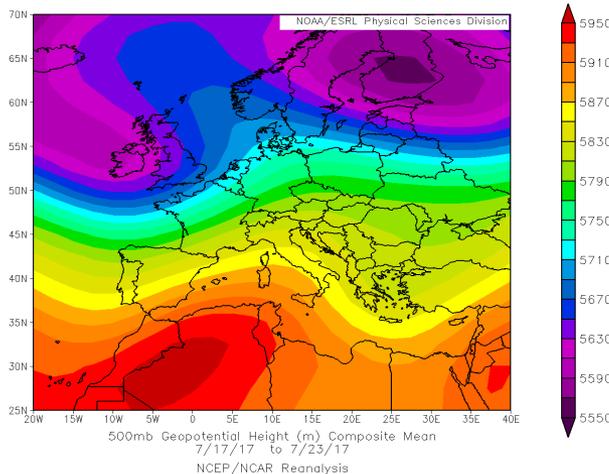
w 1



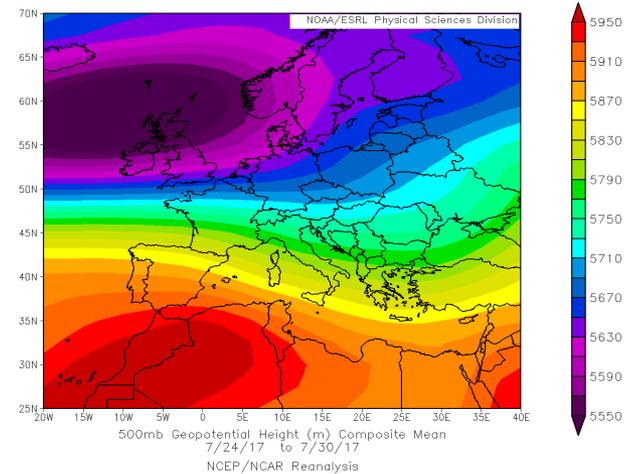
w 2



w 3



w 4

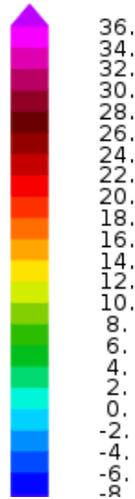
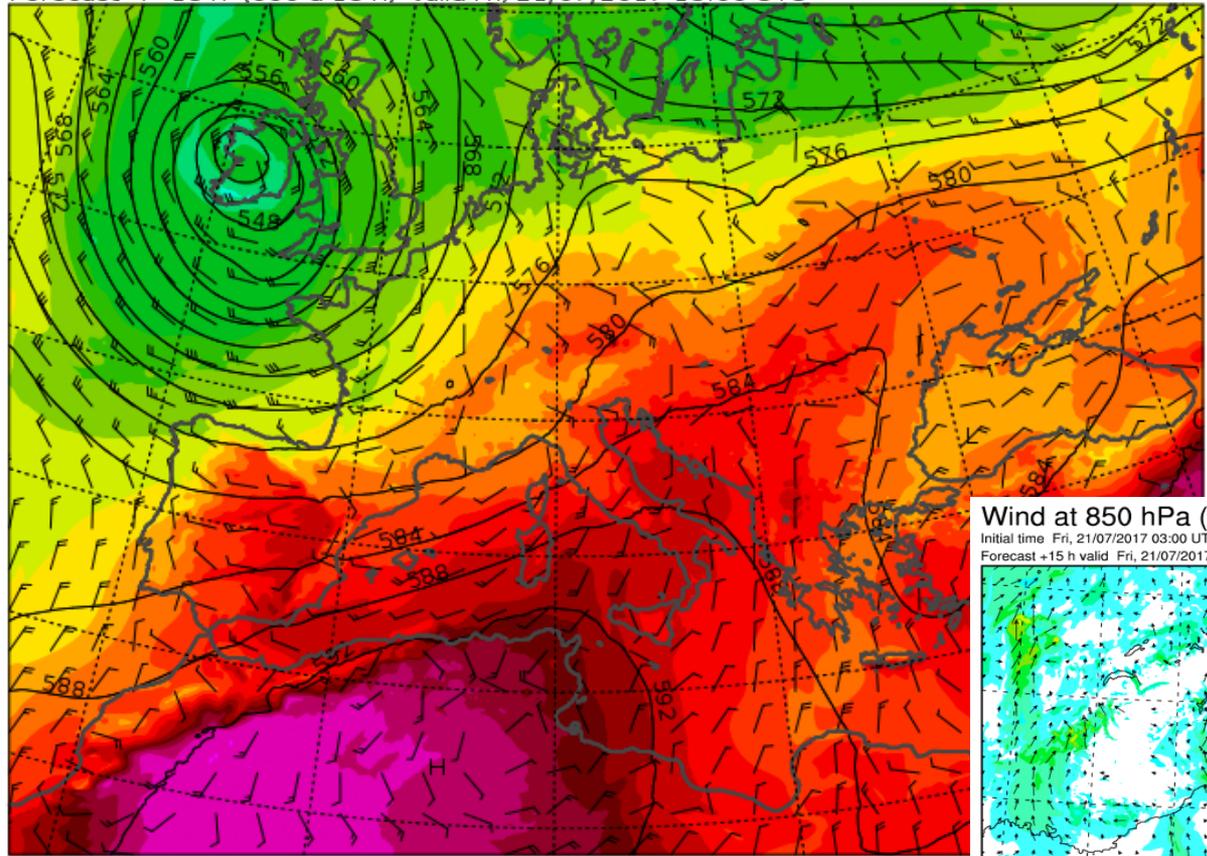


Temperature (C) Wind at 850 Isobaric surface (hPa) Geopotential height (dam) at 500 Isc

Initial time Fri, 21/07/2017 00:00 UTC

Forecast + 18 h (000 d 18 h) valid Fri, 21/07/2017 18:00 UTC

18 UTC 21 Jul 2017
BOLAM, +18h forecast

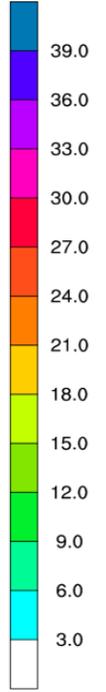
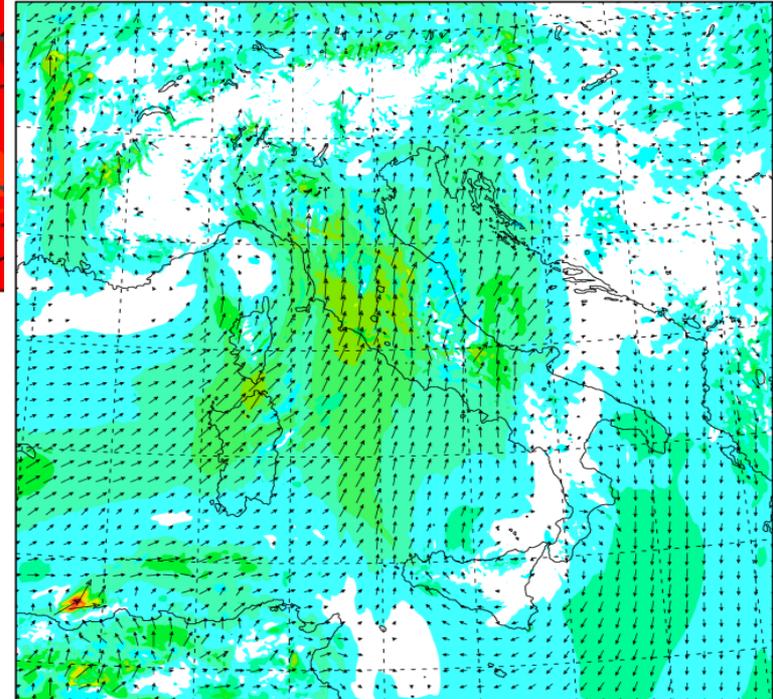


Bolam Model, CNR-ISAC, Italy

Wind at 850 hPa (m/s)

Initial time Fri, 21/07/2017 03:00 UTC

Forecast +15 h valid Fri, 21/07/2017 18:00 UTC

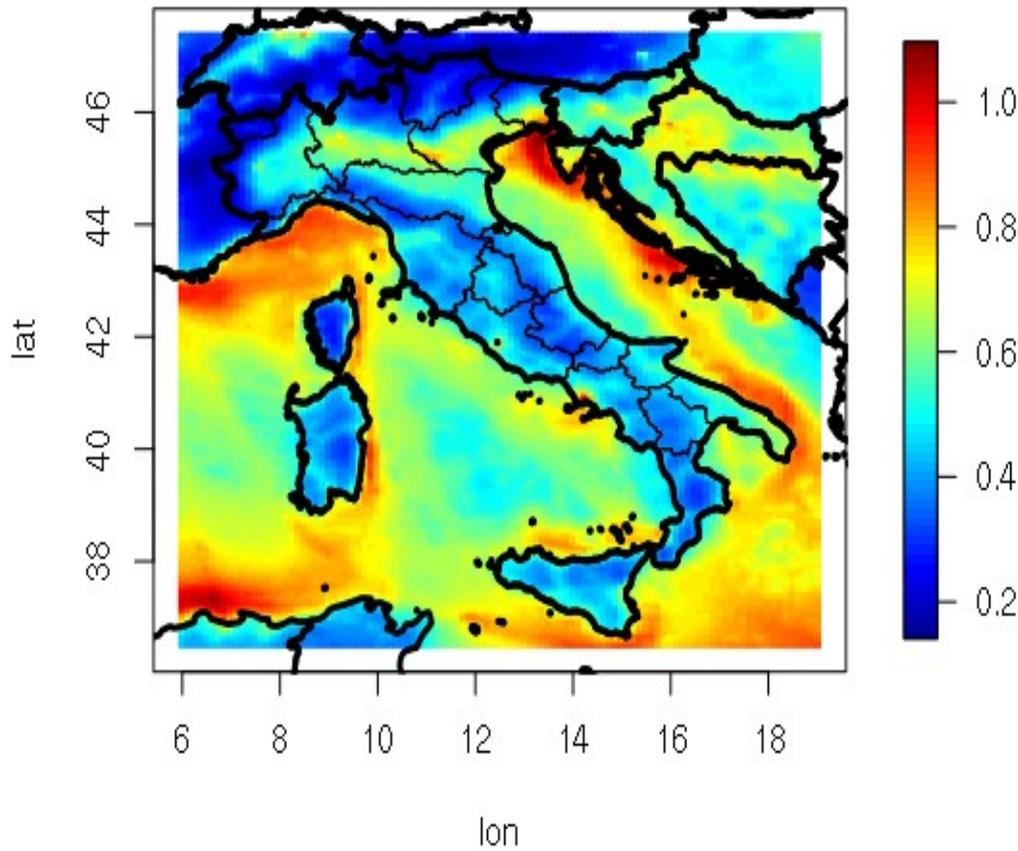


Moloch model, CNR-ISAC, Bologna, Italy

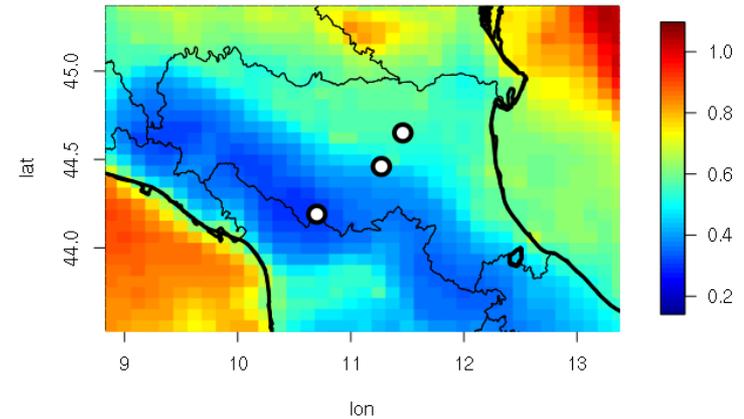
18 UTC 21 Jul 2017
MOLOCH, +15h forecast

PRELIMINARY RESULTS: Black carbon concentration forecast

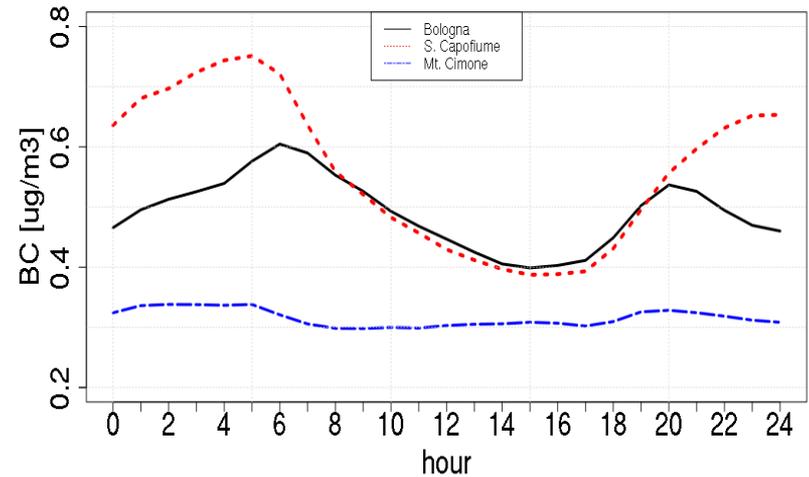
Monthly Mean (July 2017) Black Carbon [$\mu\text{g}/\text{m}^3$]



Monthly Mean (July 2017) Black Carbon [$\mu\text{g}/\text{m}^3$]

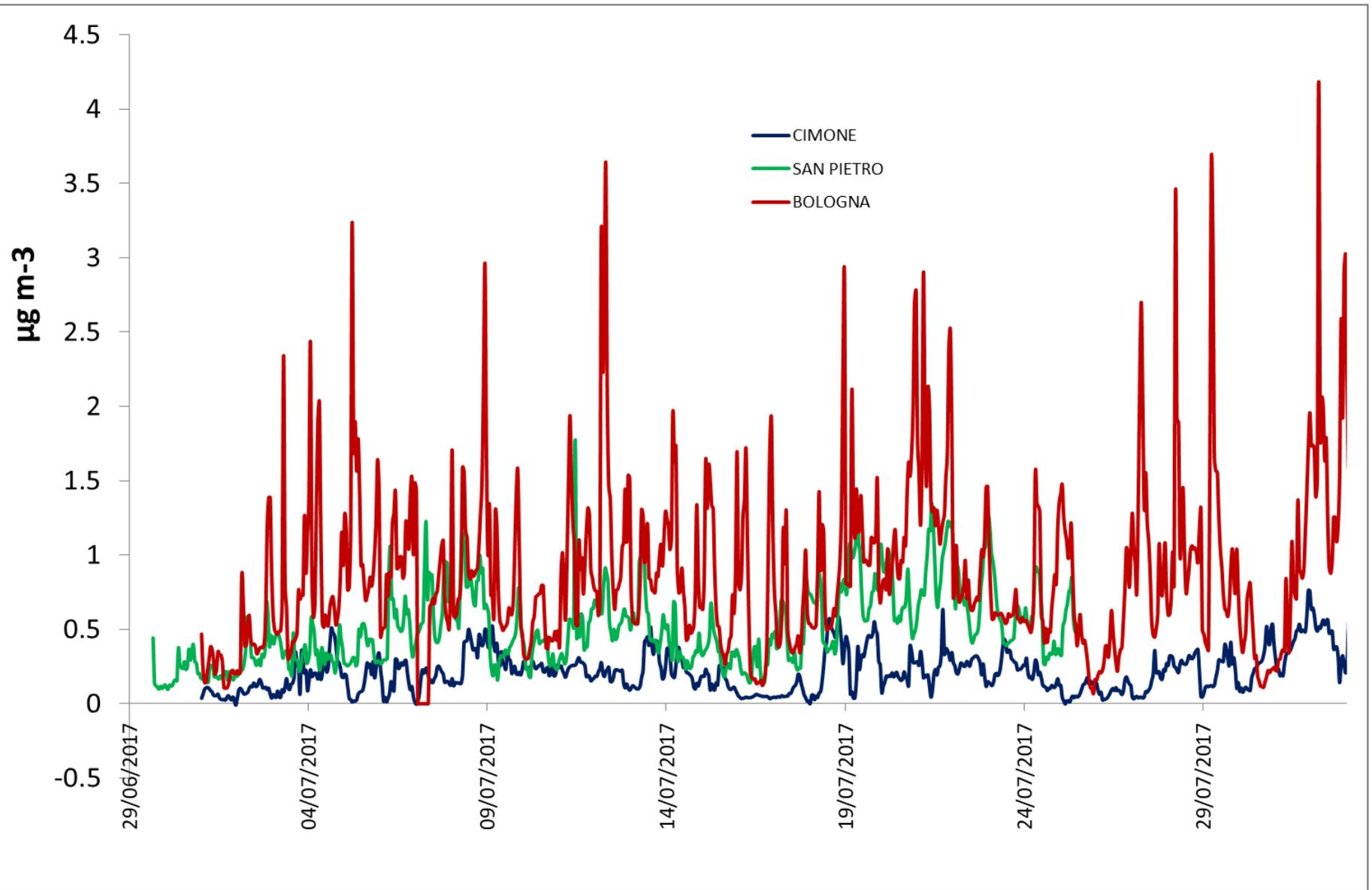


BC Daily cycle (July 2017)



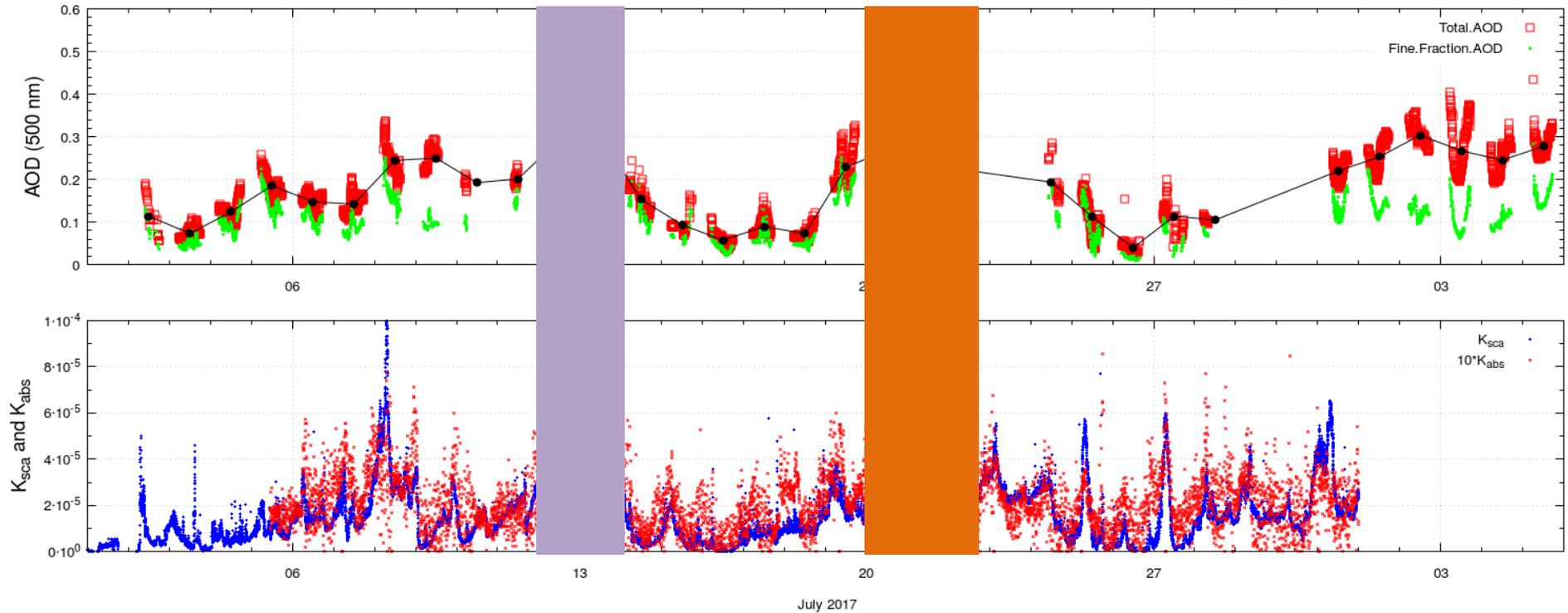
<http://actris-cimone.isac.cnr.it/airquality>

PRELIMINARY RESULTS: eqBC from MAAP measurements over 3 sites



PRELIMINARY RESULTS:

AOD and absorption/scattering near surface in San Pietro Capofiume



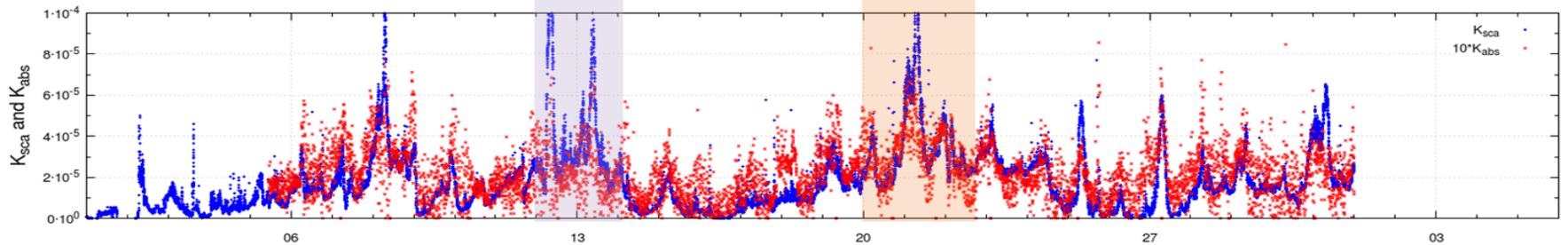
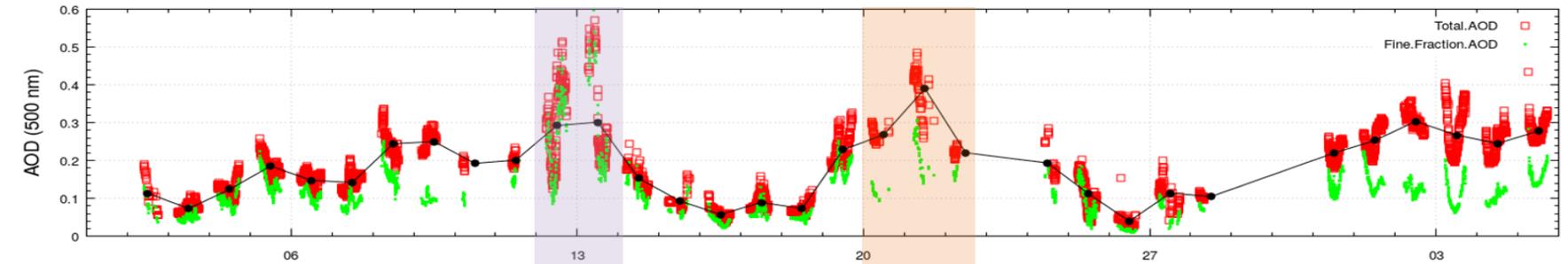
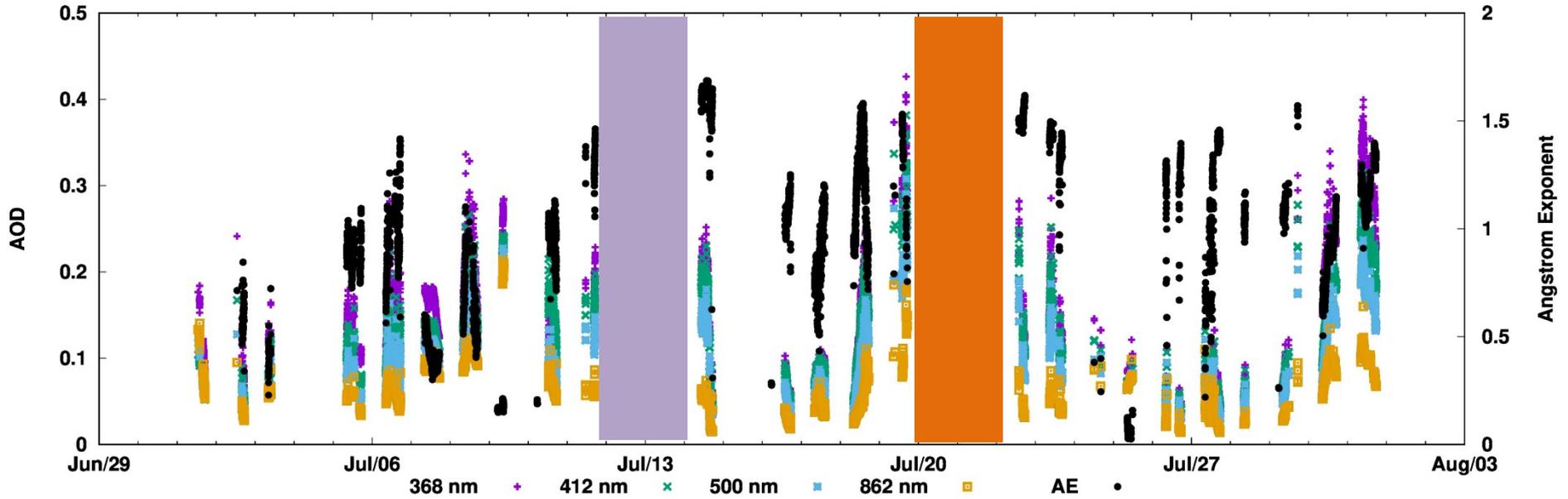
Pollution/biomass burning?



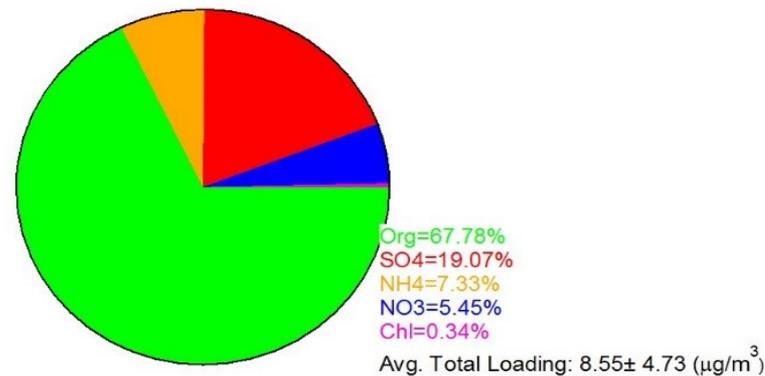
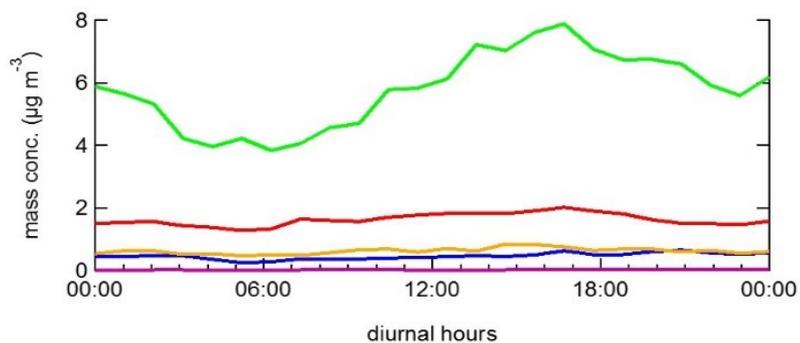
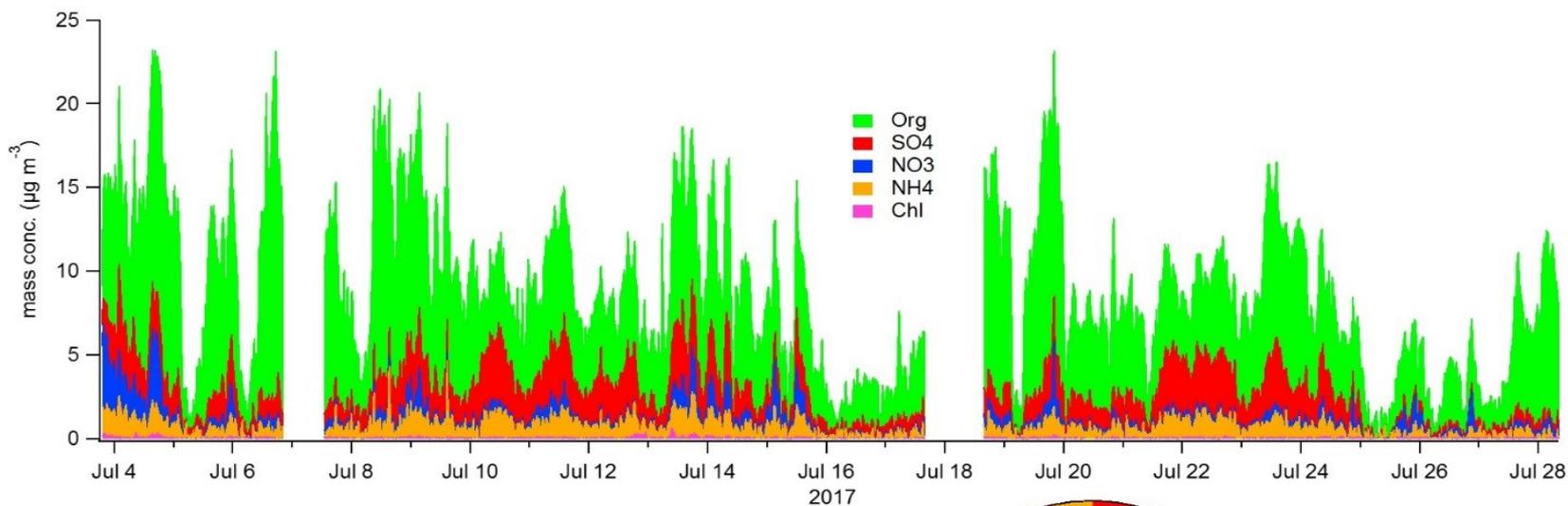
Dust transport

PRELIMINARY RESULTS: AOD at Monte Cimone

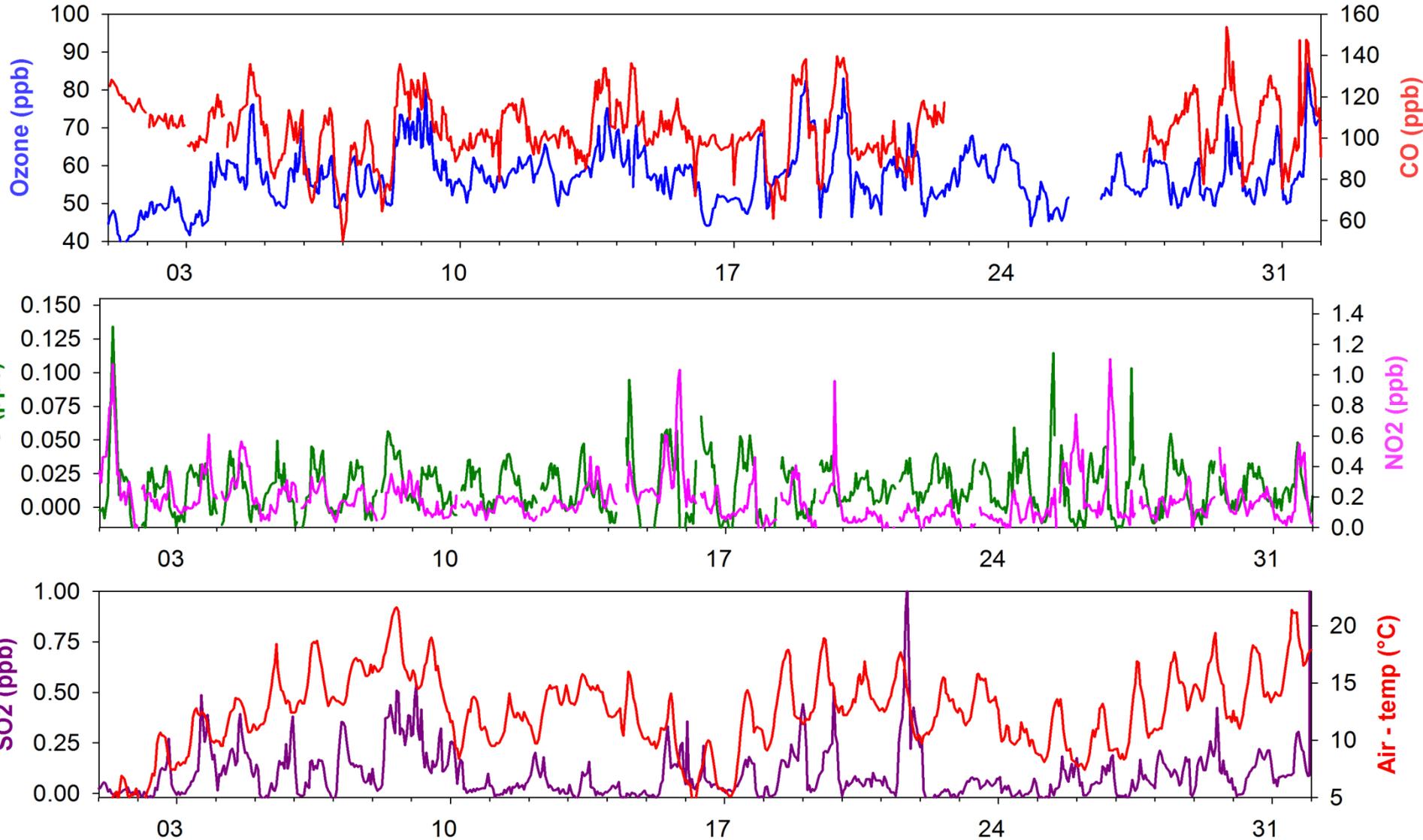
PFR at Mt Cimone - raw data



PRELIMINARY RESULTS: Online Aerosol Chemistry at Monte Cimone



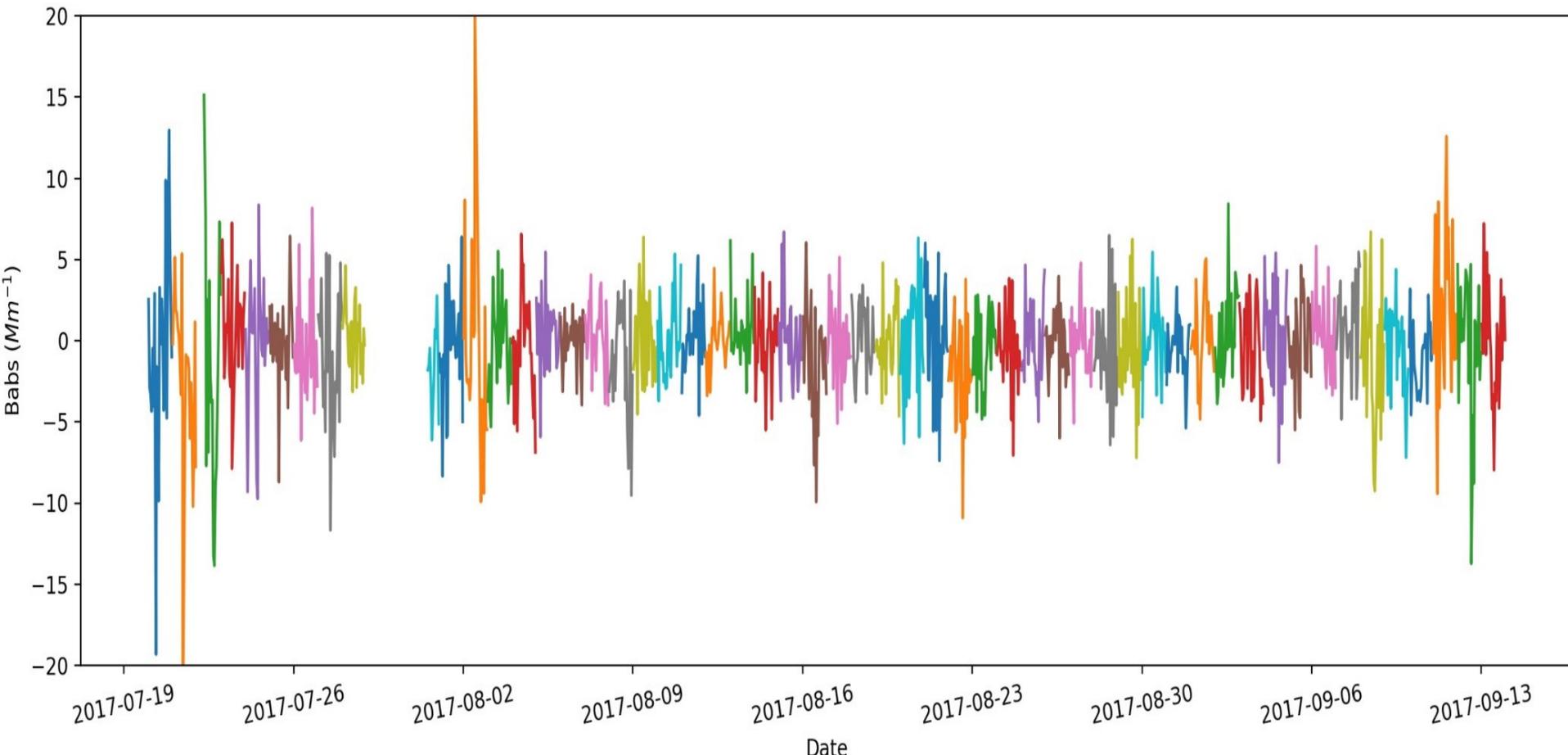
PRELIMINARY RESULTS: Gas Chemistry at Monte Cimone



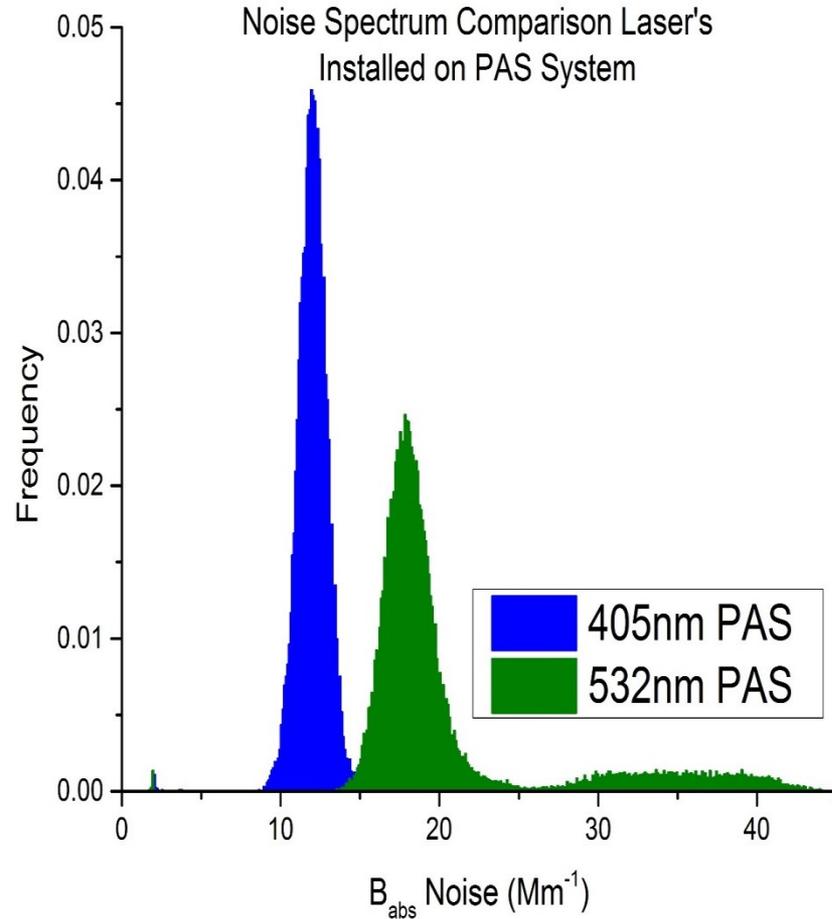
PRELIMINARY RESULTS: Photoacoustic at Monte Cimone

B_{abs} Full Time Series: 1 Hour Average

60 Minute Average of Absorption Coefficient (Bkgnd Corrected)
from 07/20/2017 to 09/13/2017

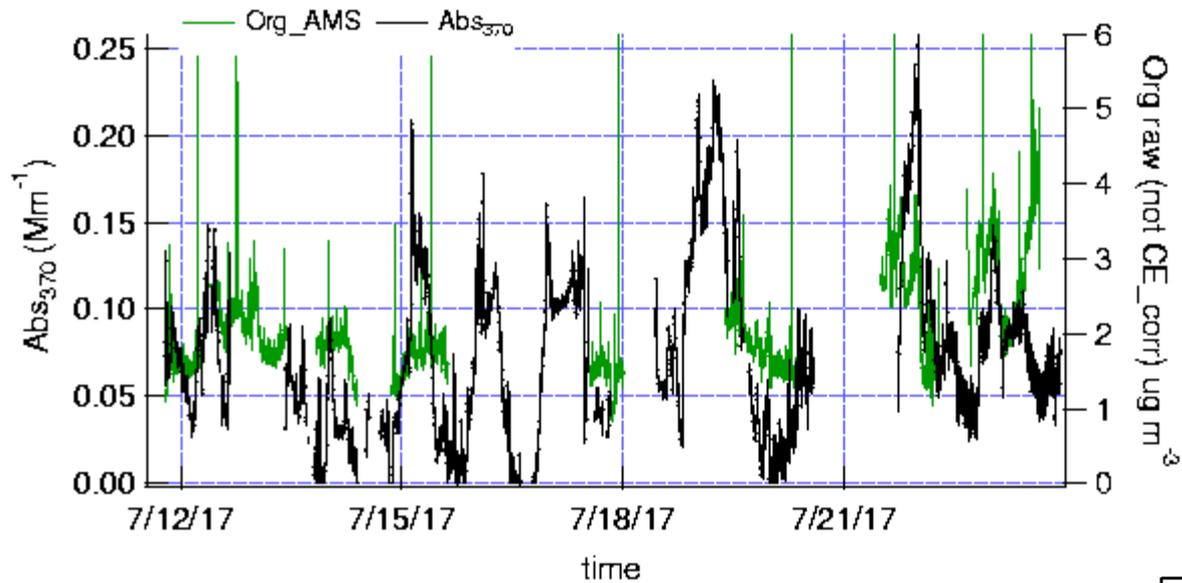


Comparison of Noise Spectra

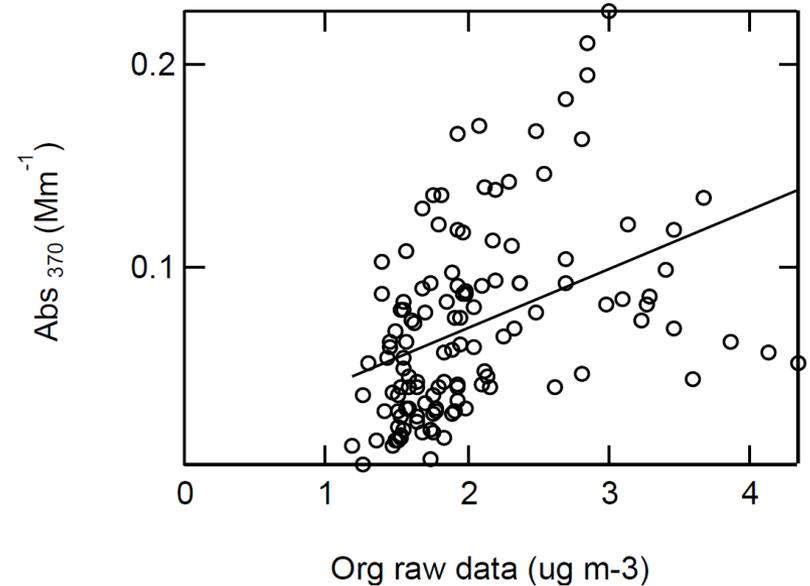


- 405nm laser died
 - 750mW of power
- Replaced by 532nm laser
 - 200mW of power
- Lower power led to more noise

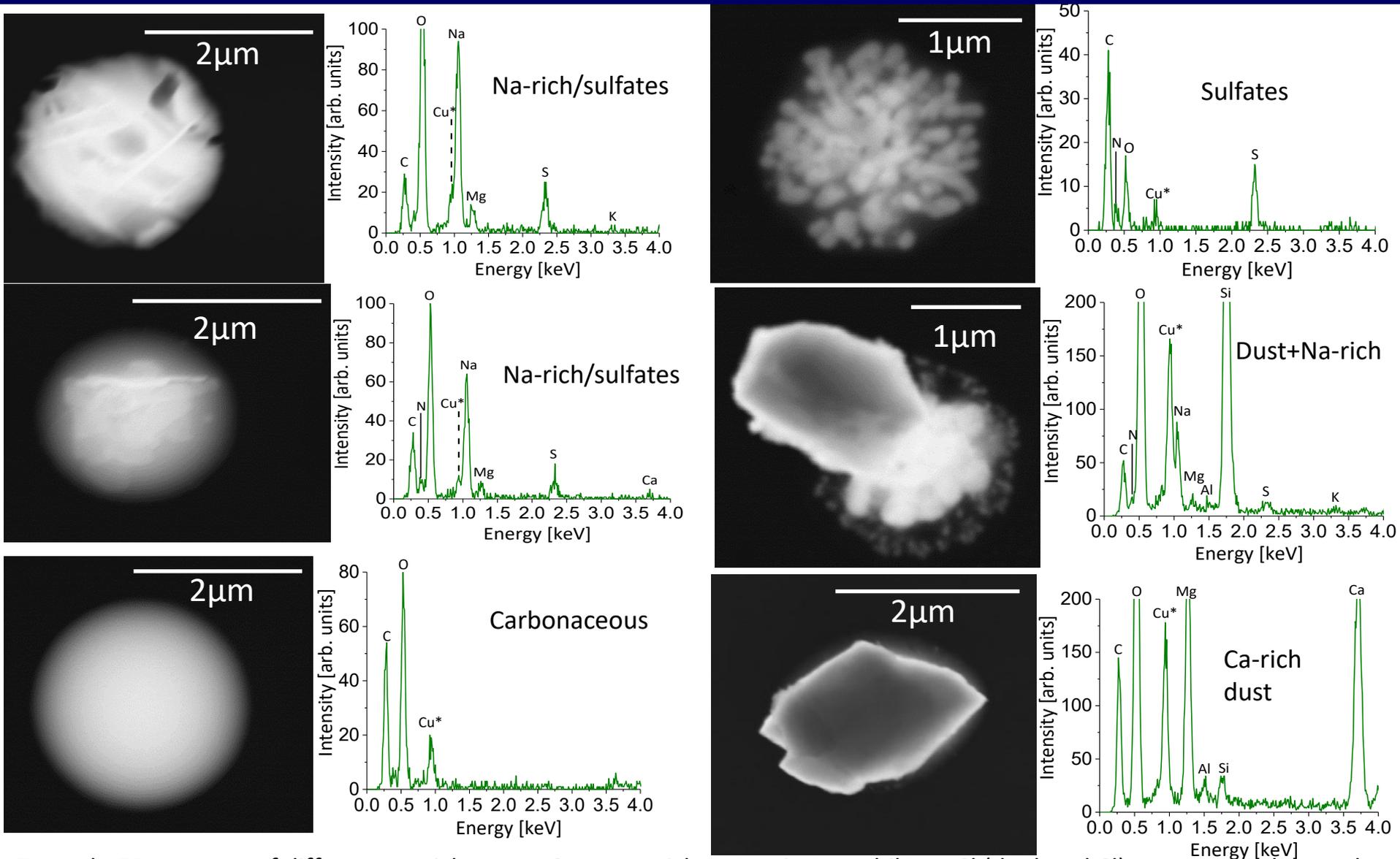
PRELIMINARY RESULTS: WSBrC at Bologna



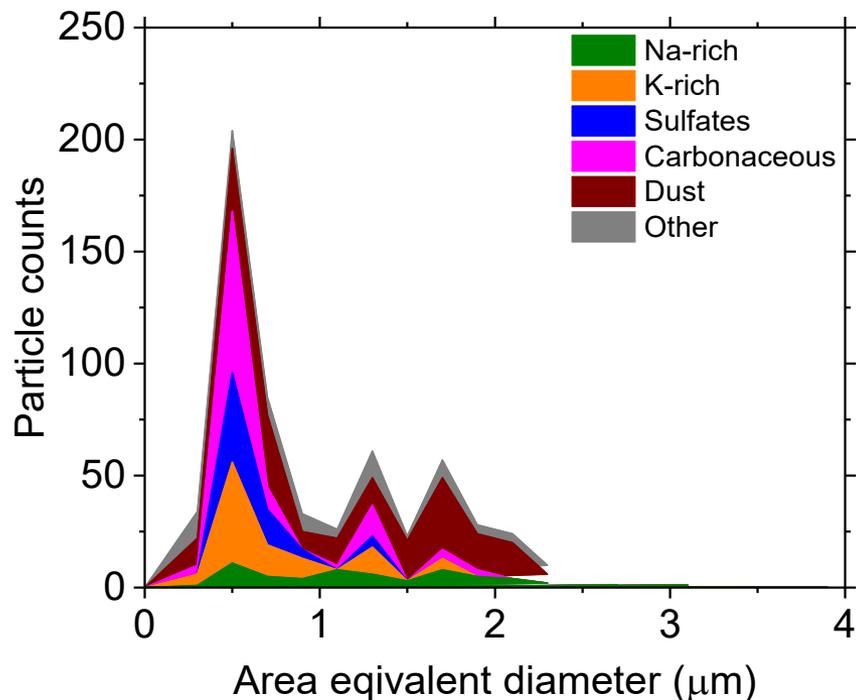
Weak correlation between Organics (AMS) and 370 nm absorption can be due to different optical properties of BrC.



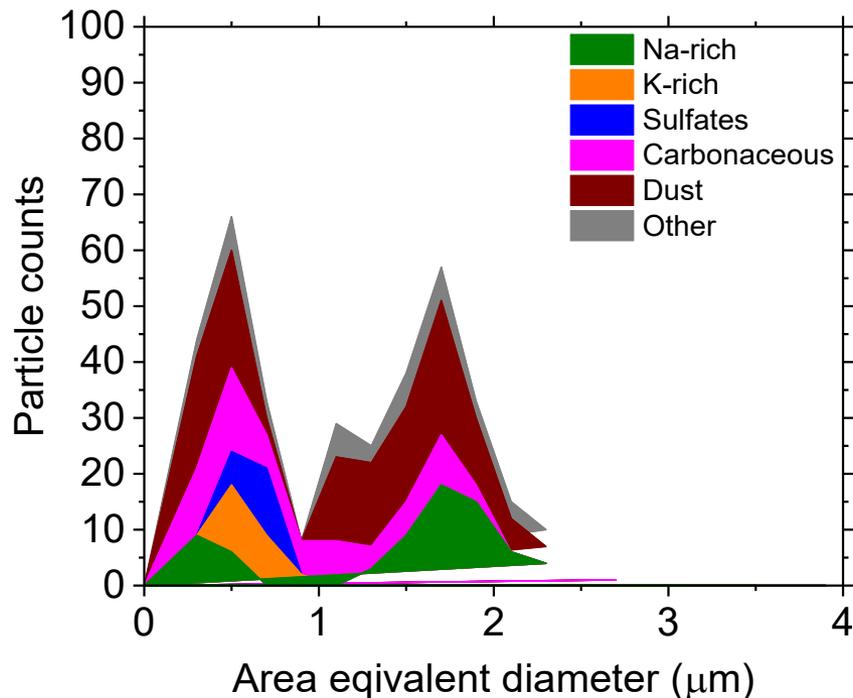
PRELIMINARY RESULTS: EDX on filters from Monte Cimone



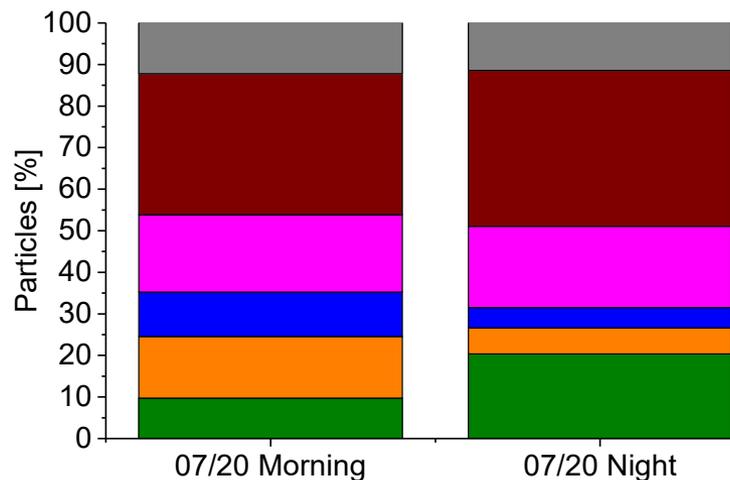
Example EDX spectra of different particle types. Some particles contain Na, while no Cl (depleted Cl) suggest aged sea-salt particles. Samples from morning/afternoon and night of 07/19/2017.



07/20/2017, Morning (8:33-8:53 AM)



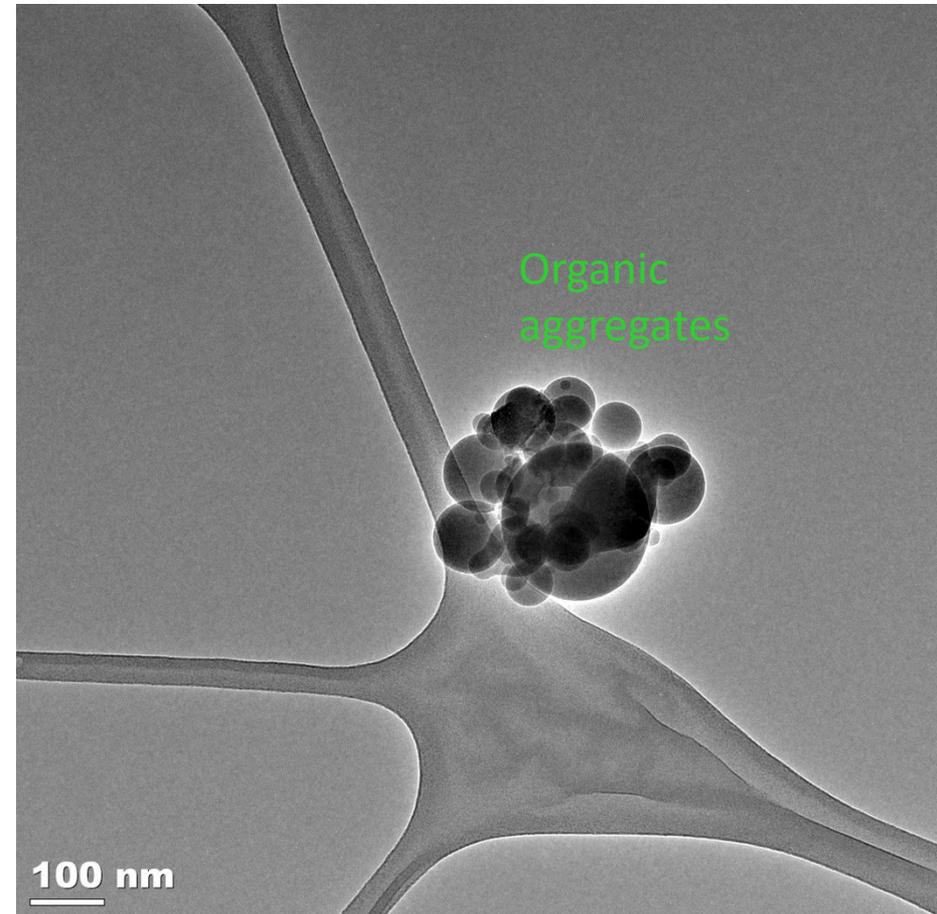
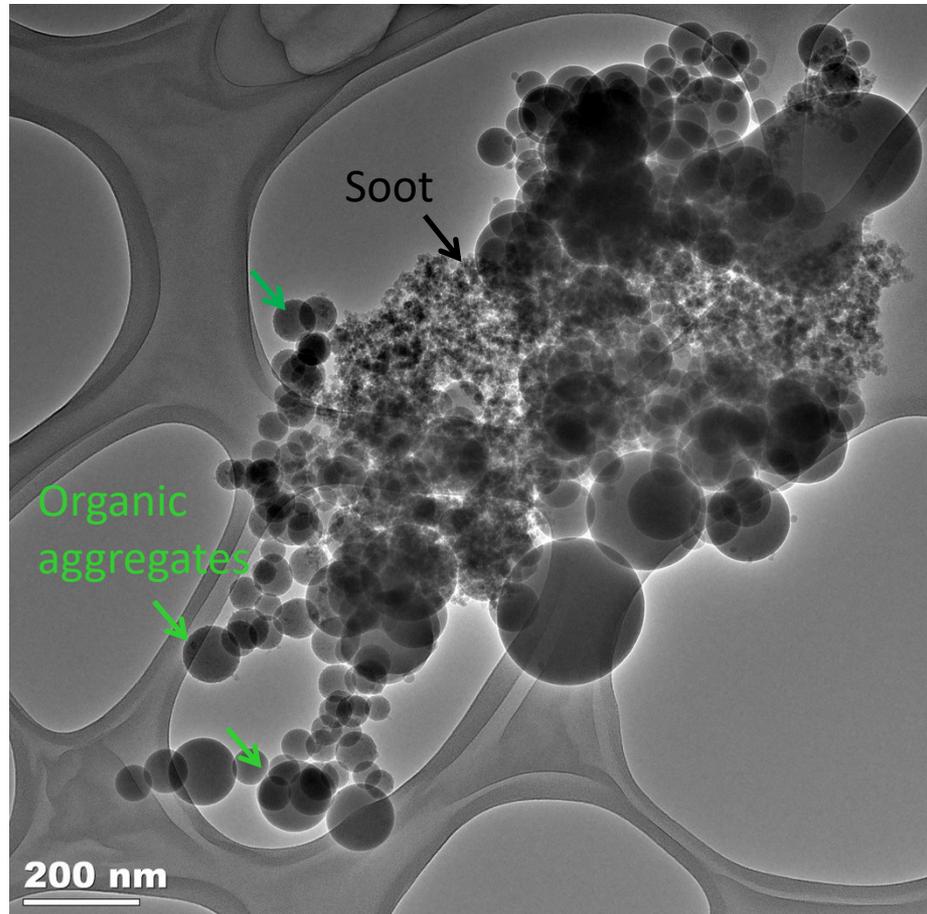
07/20/2017, Night (9:20-9:39 PM)



Focused on 07/20/2017 sample because relatively better particle loading on the substrate.

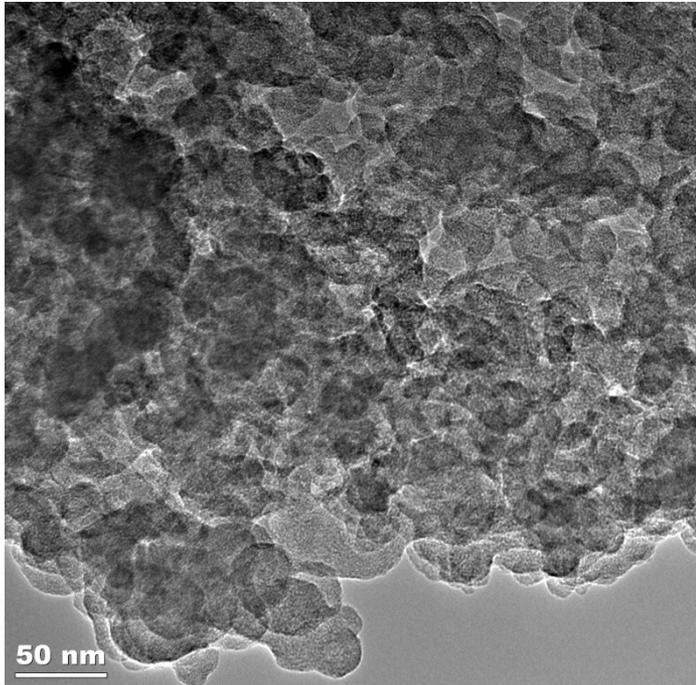
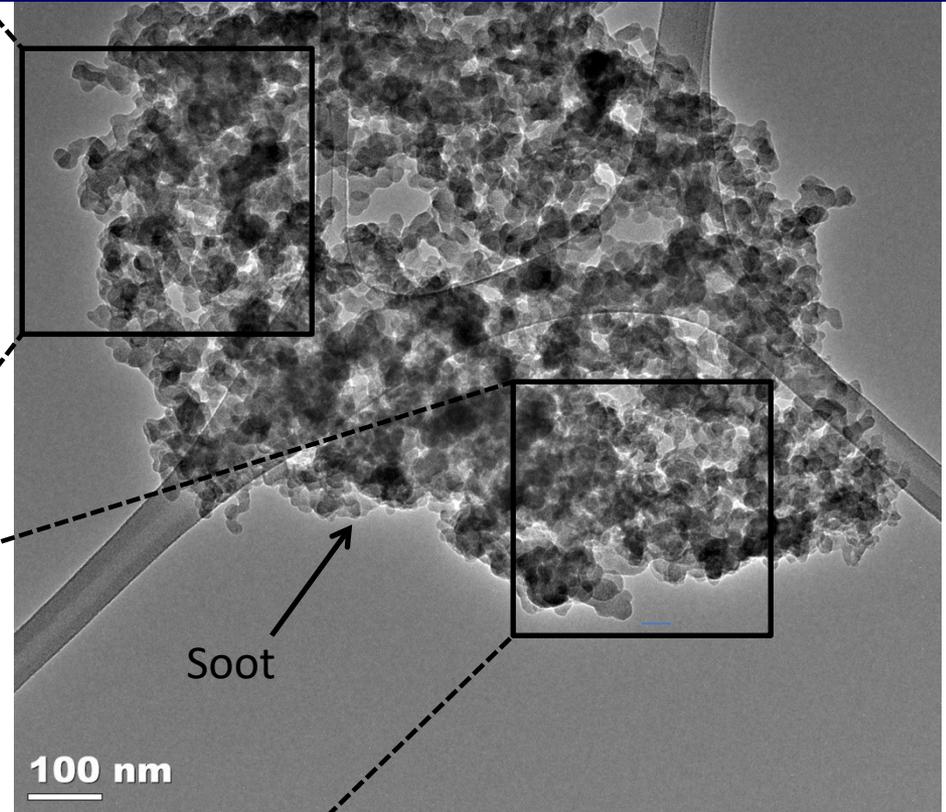
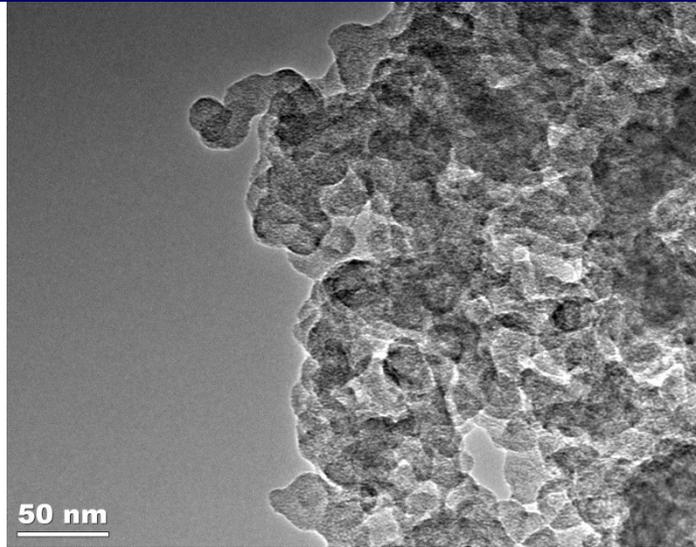
Note that these are preliminary analysis. currently analysis is based on stage C sample. Need to combine both stage C (1-0.5 μm) and D (0.5-0.25 μm) to get enough particle statistics.

PRELIMINARY RESULTS: TEM on filters from Monte Cimone

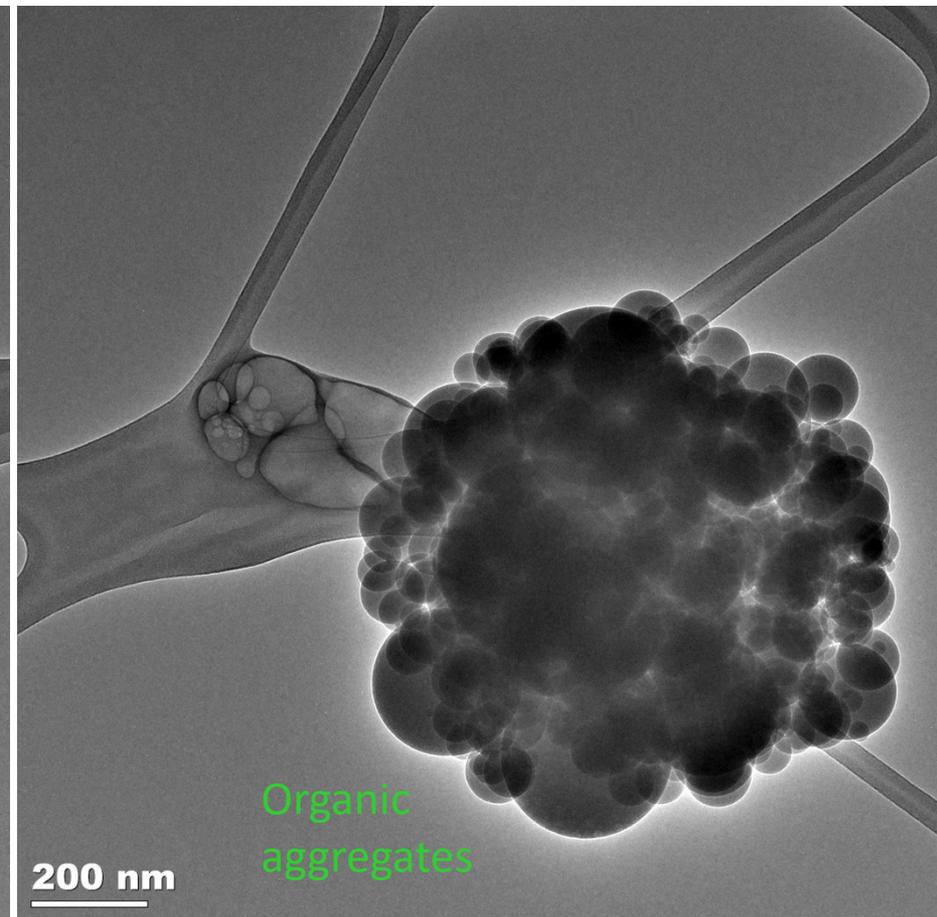
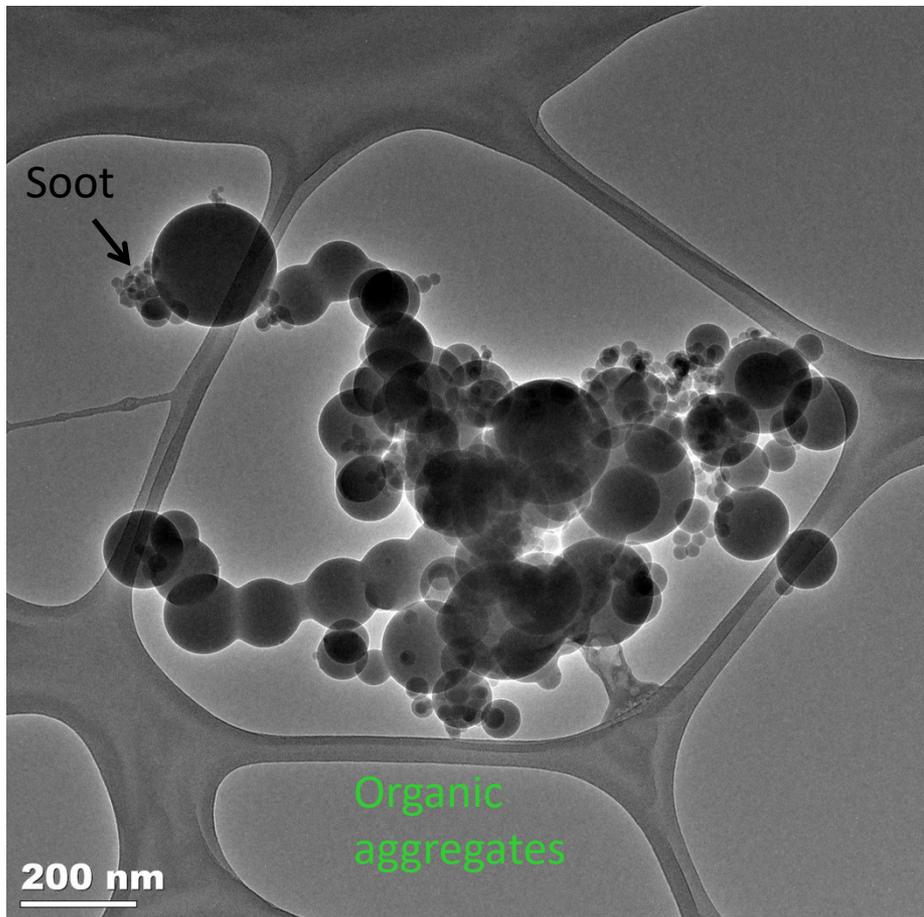


07/19/2017, 8:25-8:45 AM

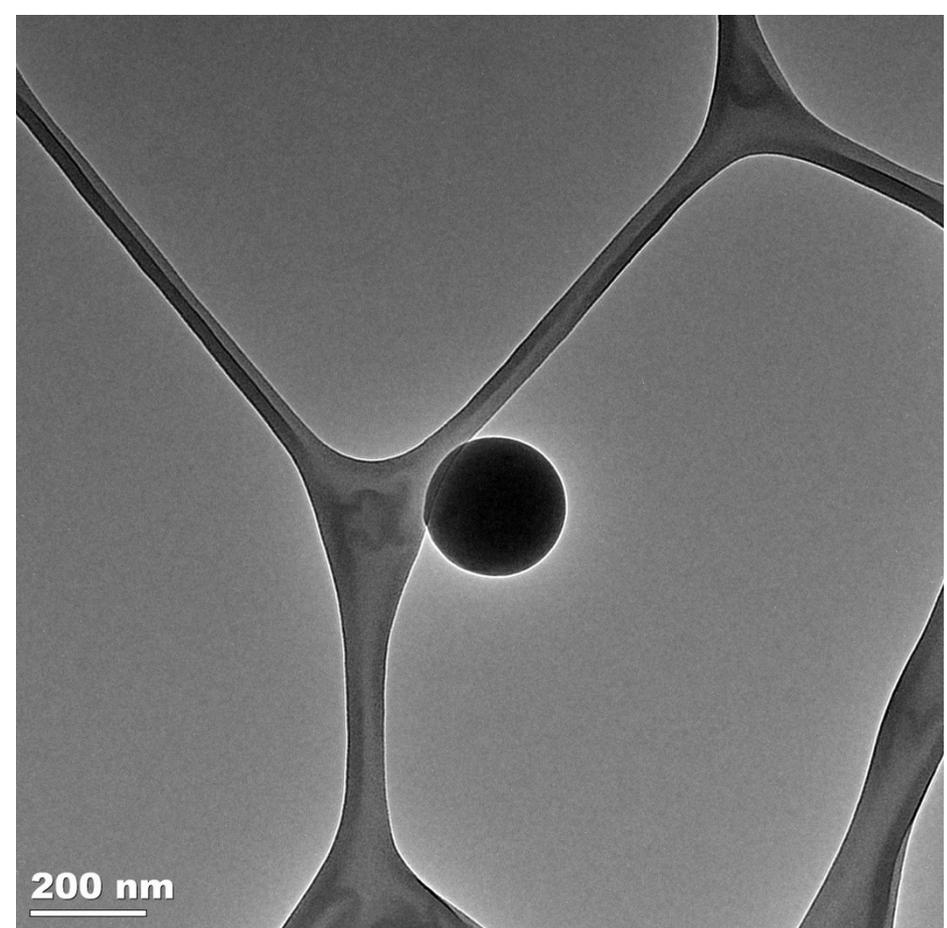
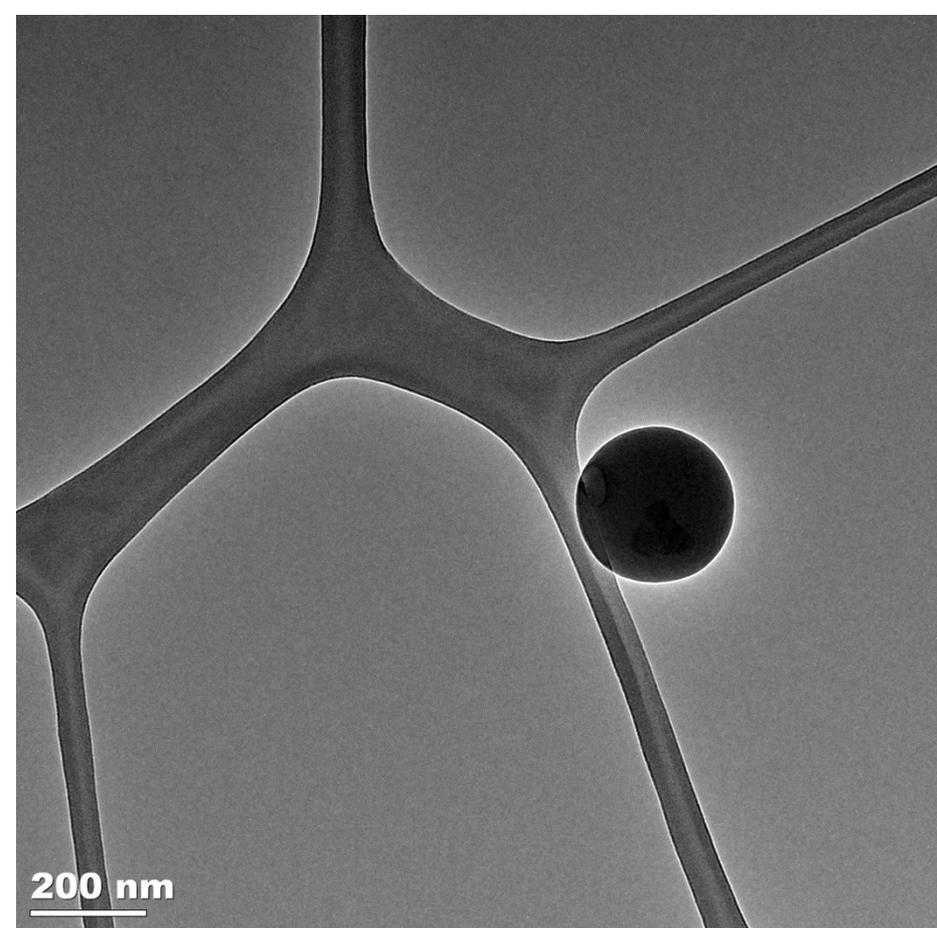
PRELIMINARY RESULTS: TEM on filters from Monte Cimone



07/19/2017, 8:25-8:45 AM

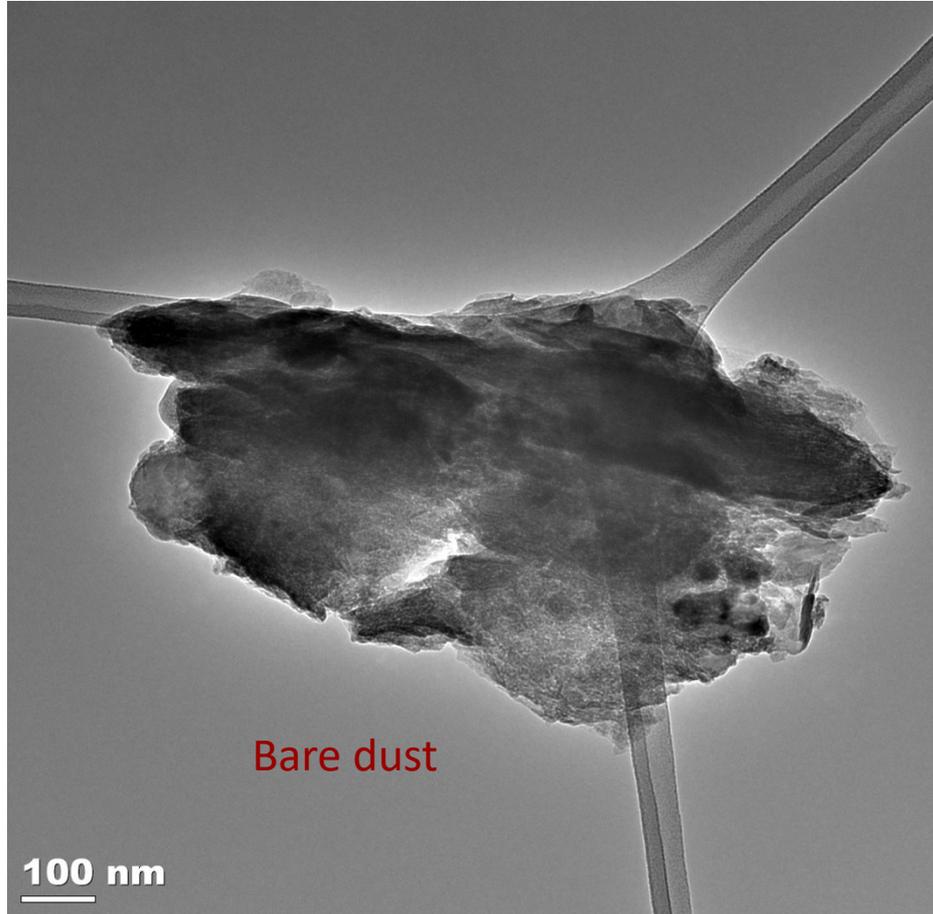
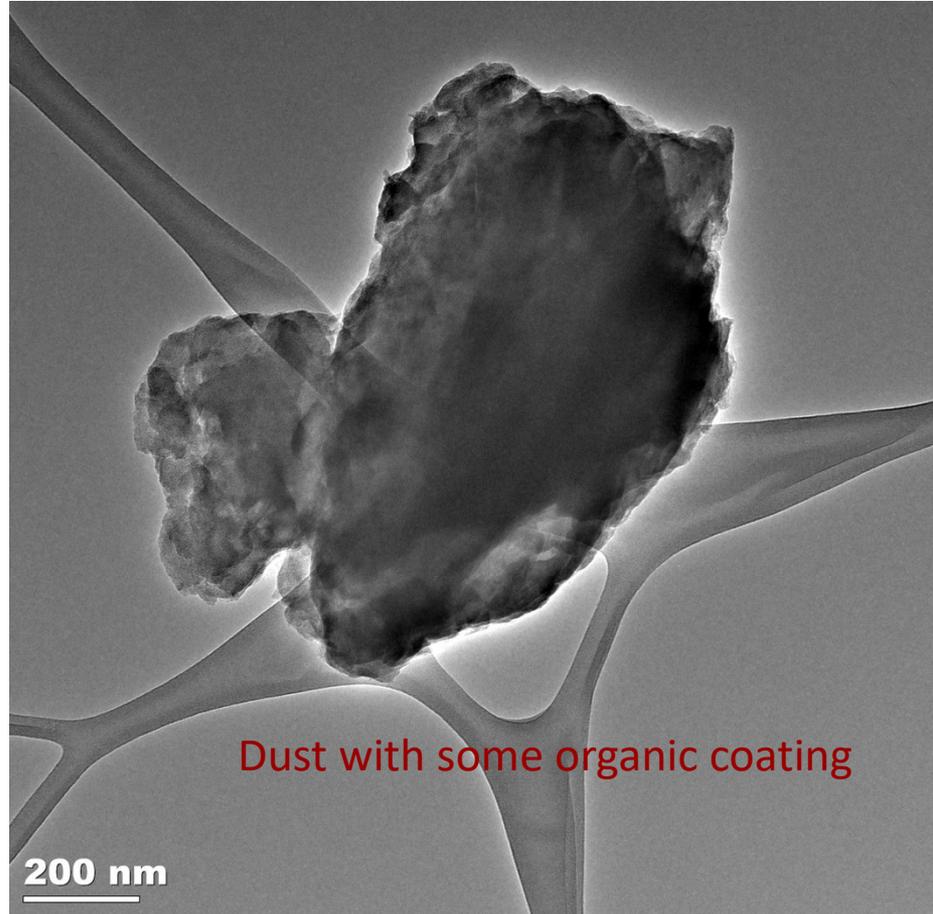


These aggregates of organic particles and sometime mixed with soot are quite common in this sample.



Tar balls like particles (resistant to electron beam, didn't damage after 1 min exposure to electron beam; elemental composition of C and O).

07/19/2017, 8:25-8:45 AM



07/19/2017, 10:38-10:57 AM