My understanding of "Size-resolved aerosol composition at an urban and a rural site in the Po Valley in summertime: implications for secondary aerosol formation"

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Figure 1. sampling sites

Introduction

The aerosols affect the atmospheric radiation budget, cloud formation and human health.

Knowledge about the concentrations of aerosol organic and inorganic compounds in size-segregated aerosol samples provides information on the nature of secondary formation processes.

Background

TC: total carbon

WSOC: water-soluble organic carbon

WINC: water-insoluble carbon

WINC = TC − WSOC

TOC: total organic carbon

IC: inorganic carbon

OC: organic carbon

EC: elemental carbon

ALWM: aerosol liquid water content

SIA: secondary inorganic aerosol

SOA: secondary organic aerosol

quasi-ultrafine fraction

(size range 0.05–0.14 μm)

the small accumulation mode of particles

(0.14–0.42 μm)

the large accumulation mode

(0.42–1.2 μm).

Methods

Sampling:fivestage (0.14, 0.42, 1.2, 3.5 and 10 μm) Berner impactors (flow rate 80 L min−1)

Analysis: ion chromatography(Tedlar foils，water-soluble inorganic species and organic acids) and evolved gas analysis（ aluminium foils， total carbon/TC）

Backtrajectory calculation

Principal component analysis

Results

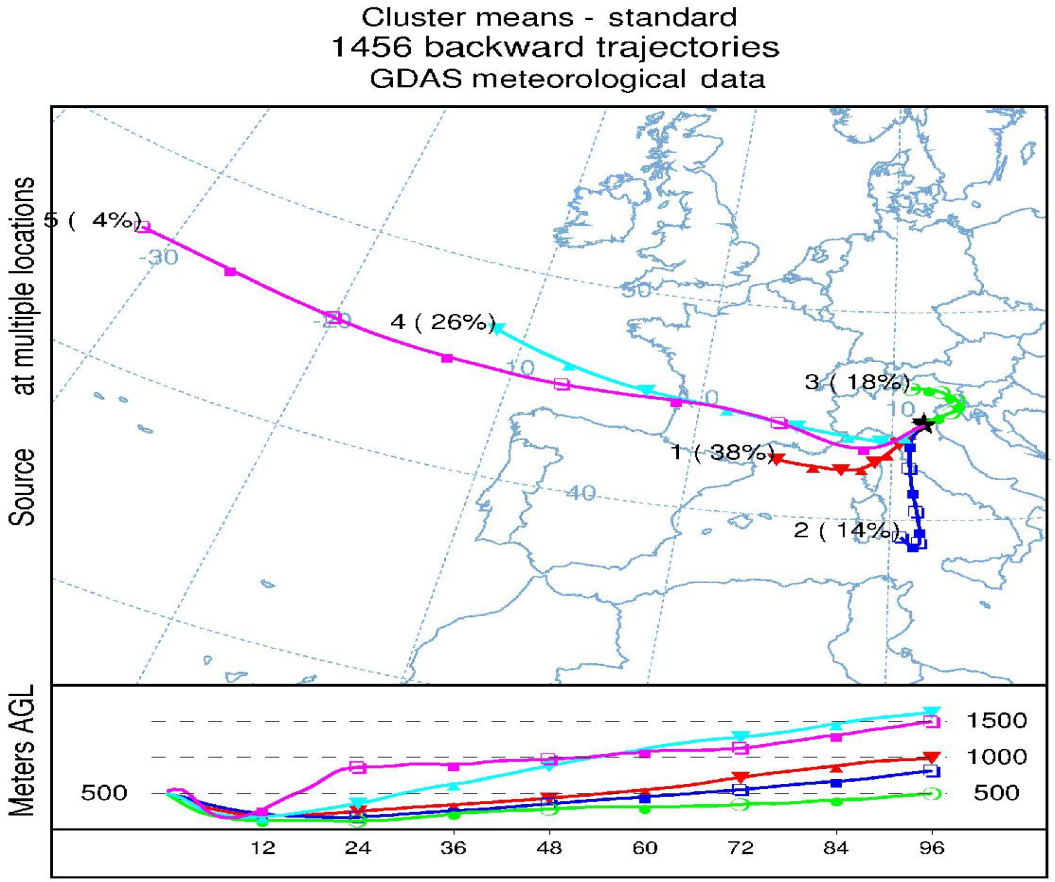


Figure 2. Map with average trajectories for each obtained cluster

Clusters 1 and 3,were characterized by short trajectory lengths and corresponded to a higher residence time of air masses in the basin.

Cluster 1 had the highest occurrence and accounted for 38 % of the total trajectories.

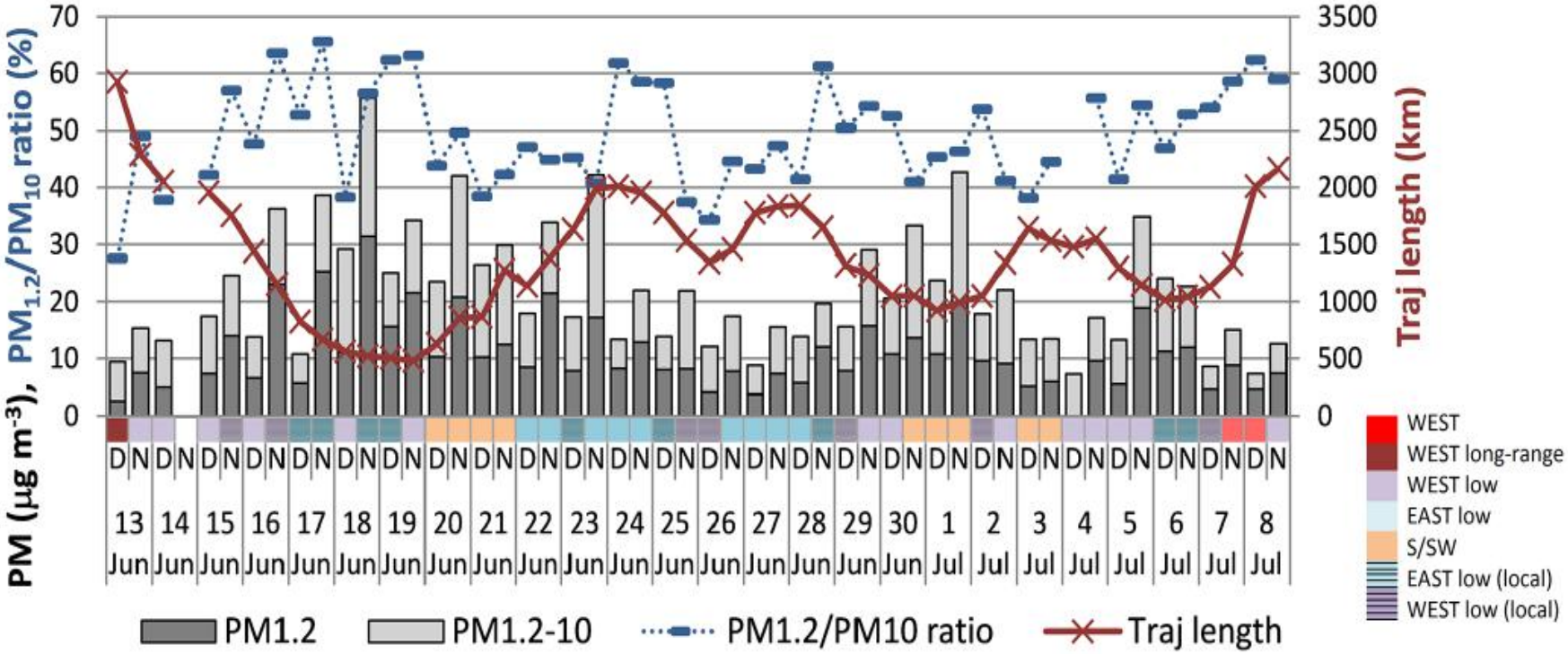


Figure 3. Time series of PM1.2 and PM10 mass concentrations (in µg/ m3) and of the PM1.2 to PM10 ratio (%) for SPC.

（1）The highest contributions of PM1.2 to PM10 were observed most of the times when 4-day trajectories were very short (< 1500 km).

（2）The PM1.2 contribution to PM10 was the highest, with maxima during the night, peaking at 67 % of total PM10 mass on 17 June.

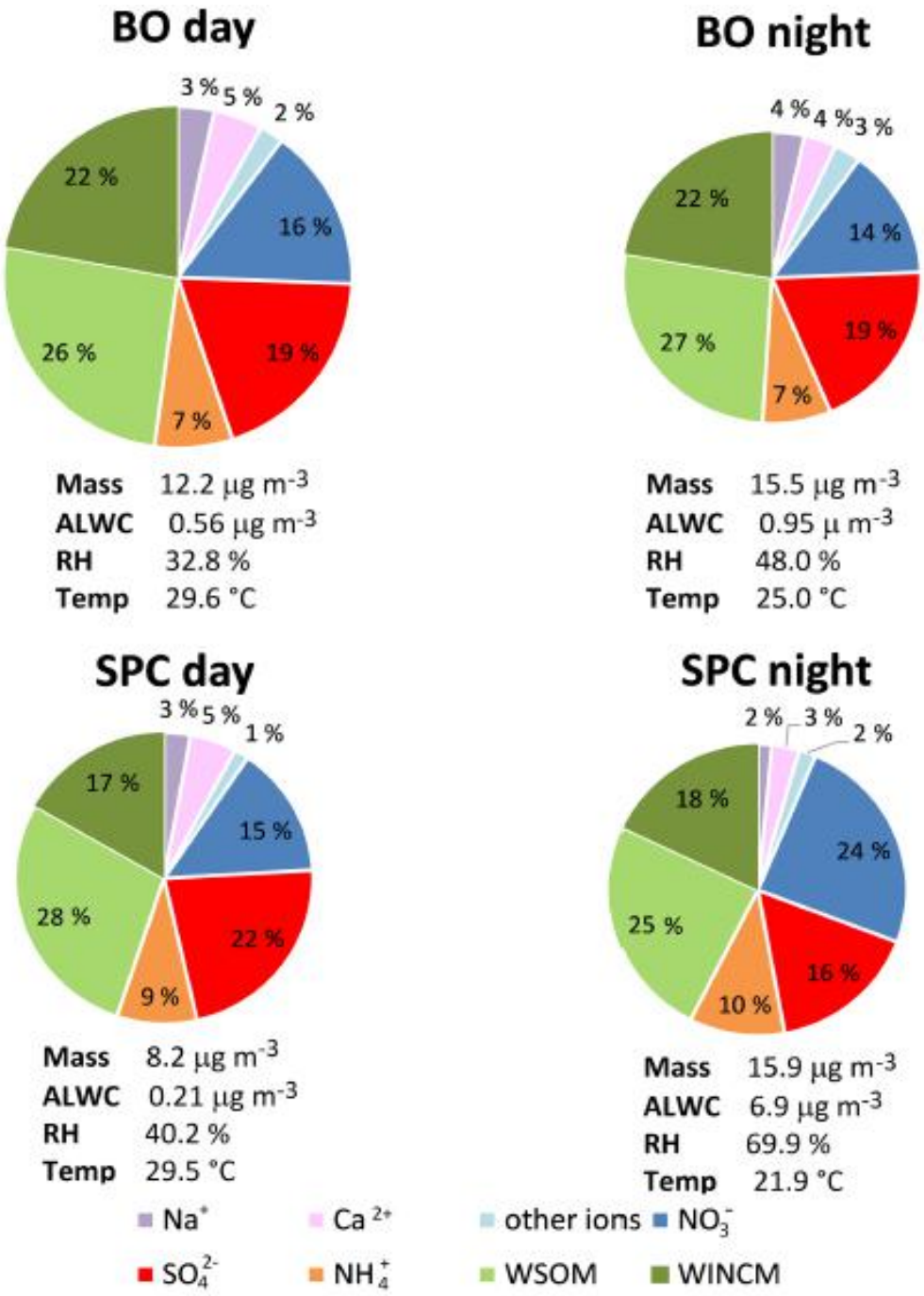
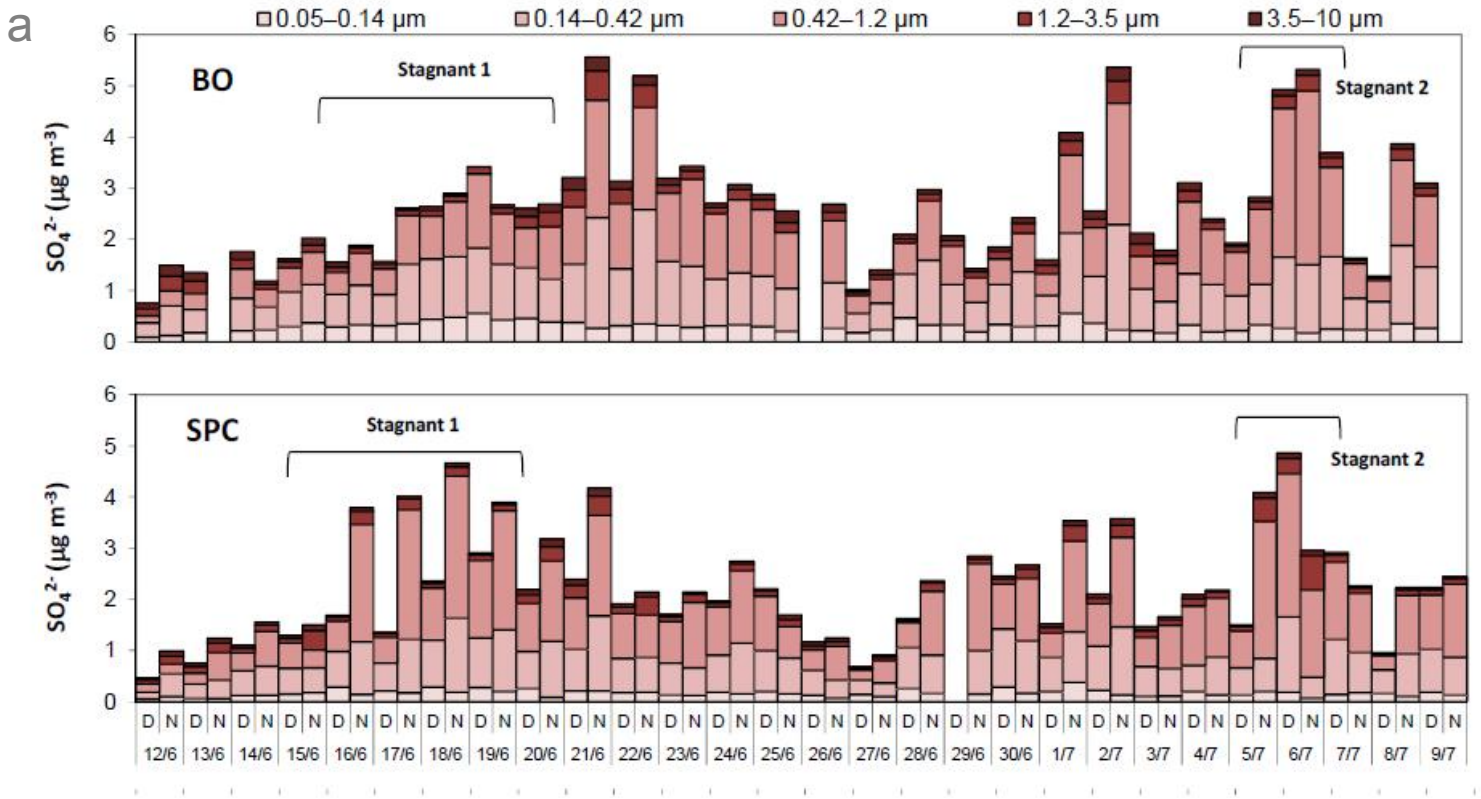
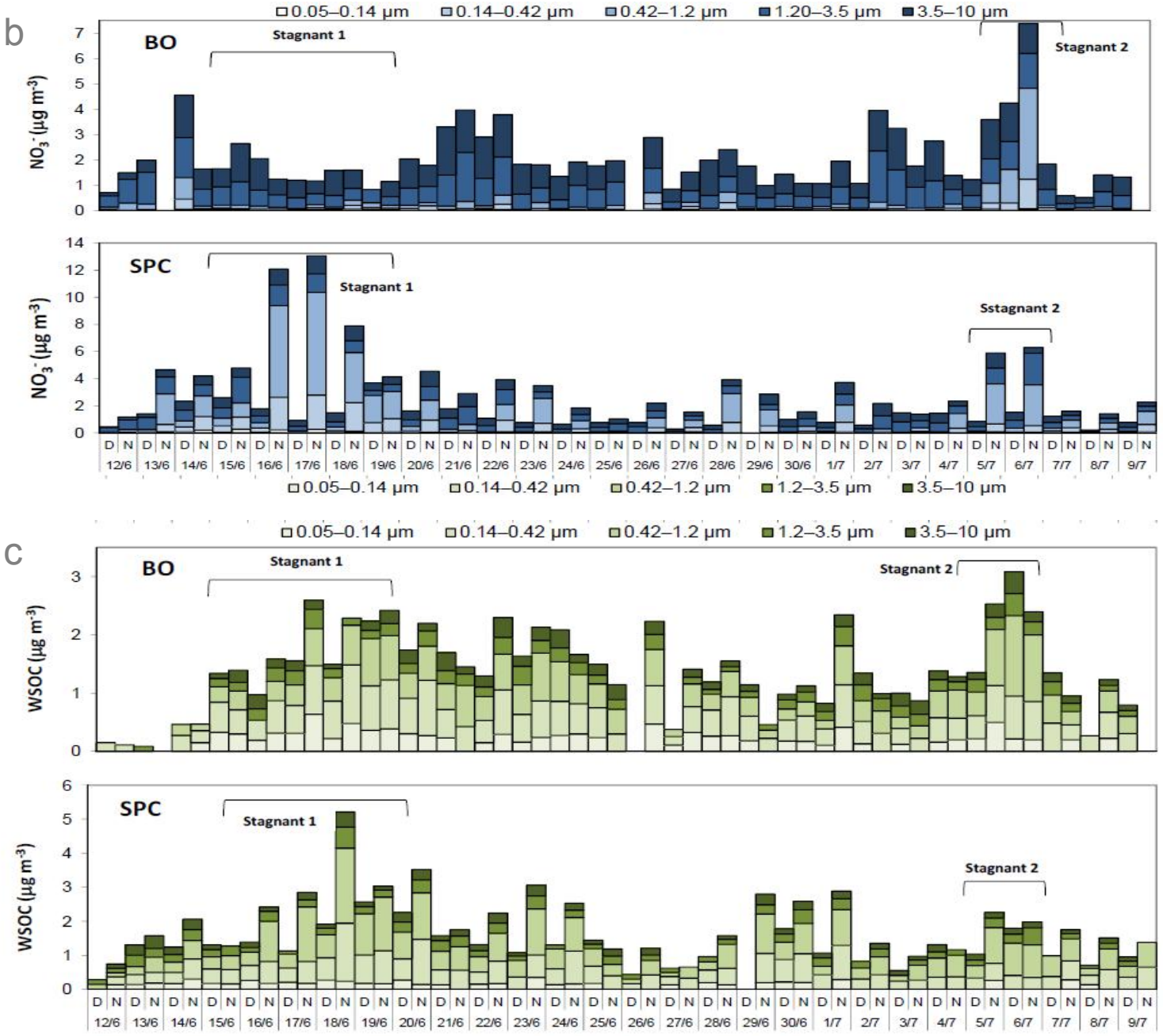


Figure 4. Average day and night PM10 composition at BO and SPC during the campaign.

Figure 5. Time series of sulfate, nitrate and WSOC size-segregated concentrations in BO and SPC. Please note the different scale for nitrate and WSOC in BO.



During the first of such events,the sulfate concentrations increased in BO and SPC to a similar extent in daytime, while higher concentrations were measured in SPC at night.


b
0.05–0.14 µm
0.14–0.42 µm
0.42–1.2 µm
1.20–3.5 µm
3.5–10 µm
BO
Stagnant 1
Stagnant 2
SPC
Stagnant 1
Sstagnant 2
NO3- (µg m-3)
c
WSOC (µg m-3)
12/6
13/6
14/6
15/6
16/6
17/6
18/6
19/6
20/6
21/6
22/6
23/6
24/6
25/6
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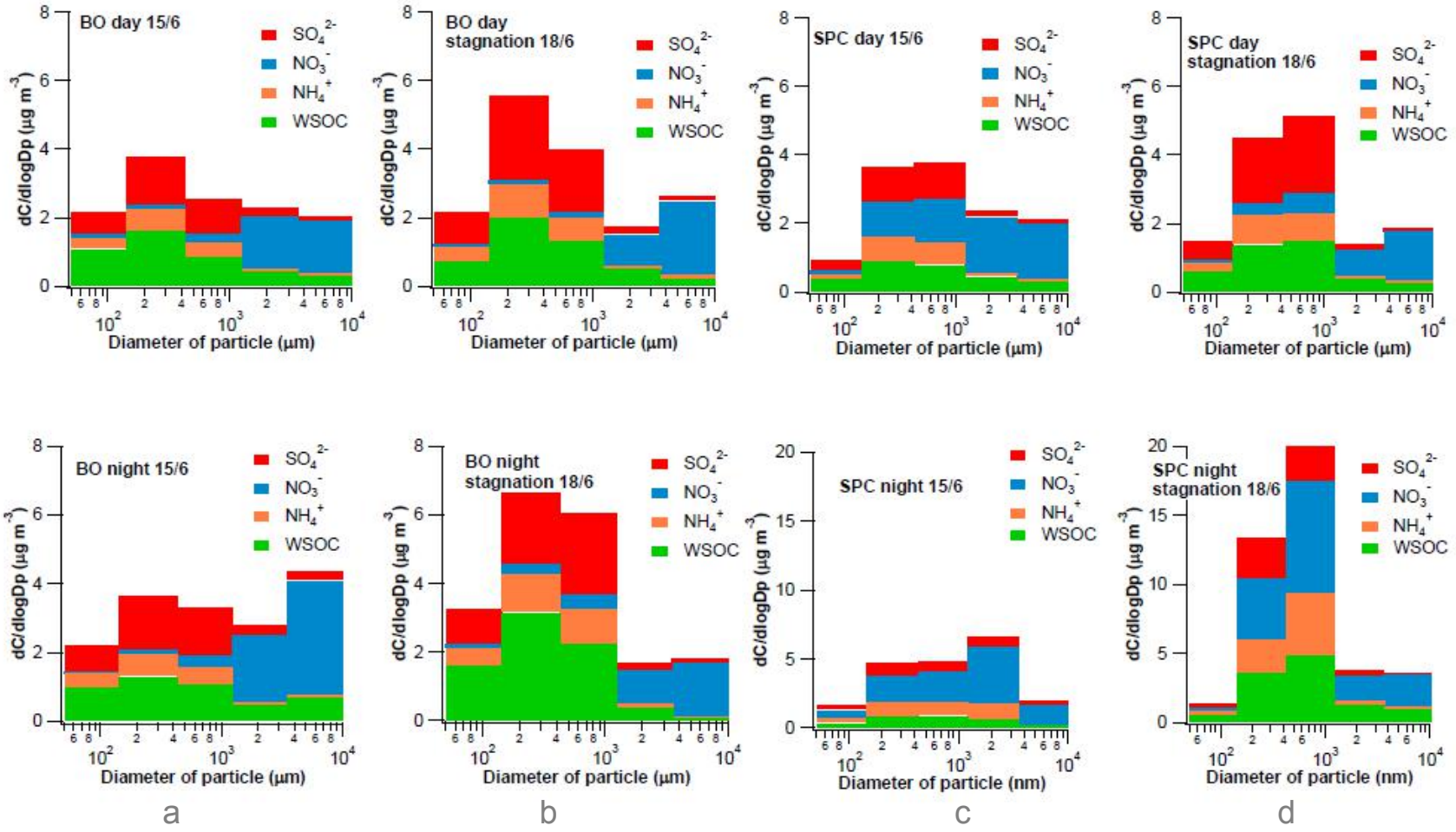


Figure 6. Size-resolved aerosol composition for BO and SPC during day (top) and night (bottom), respectively, during one day characterized by background conditions (15/6) and during one day under stagnant conditions (18/6).

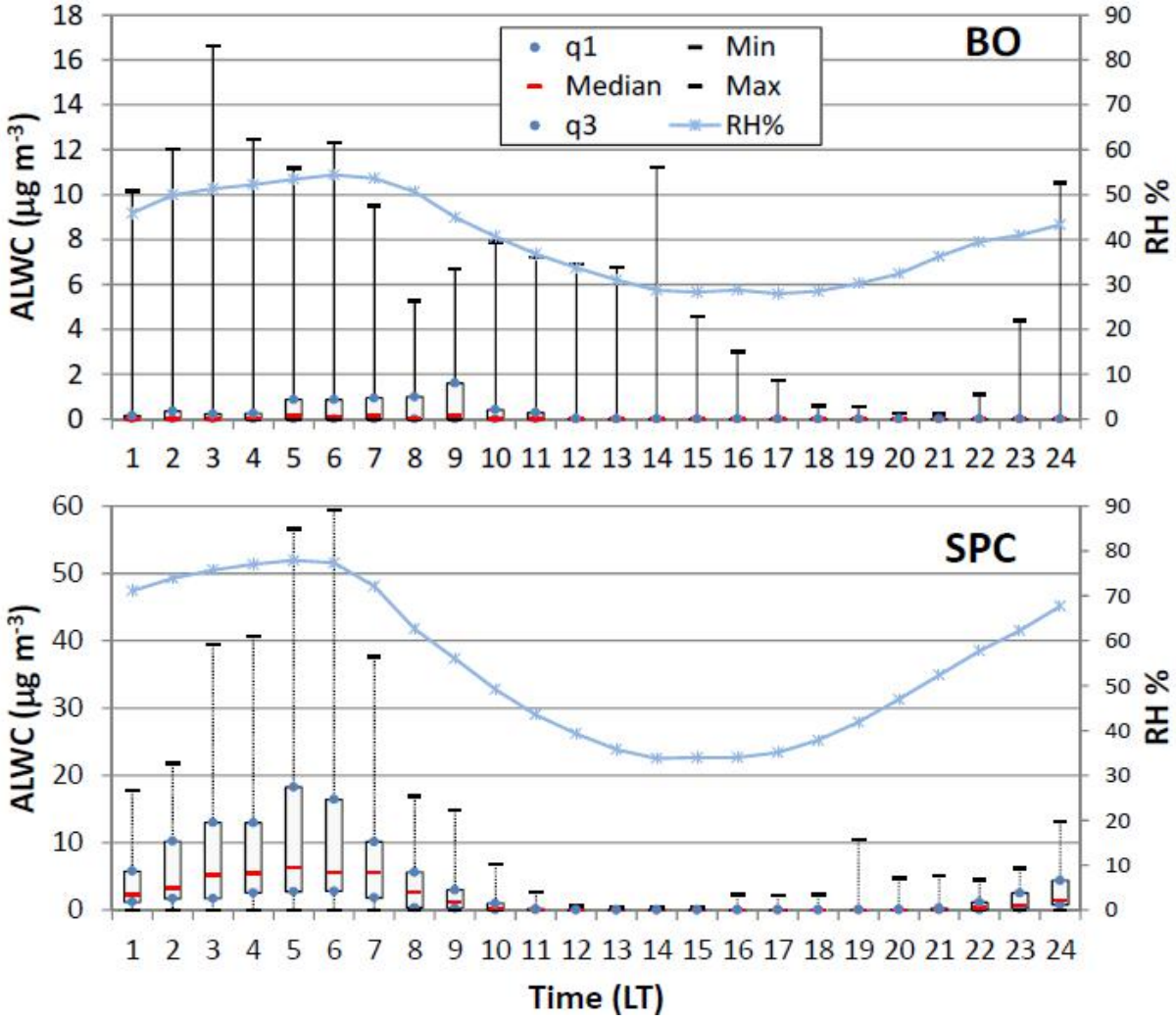


Figure 7. Box plot of average diurnal variation of aerosol liquid water content (ALWC) with superimposed diurnal variation of relative humidity (RH) during the campaign.

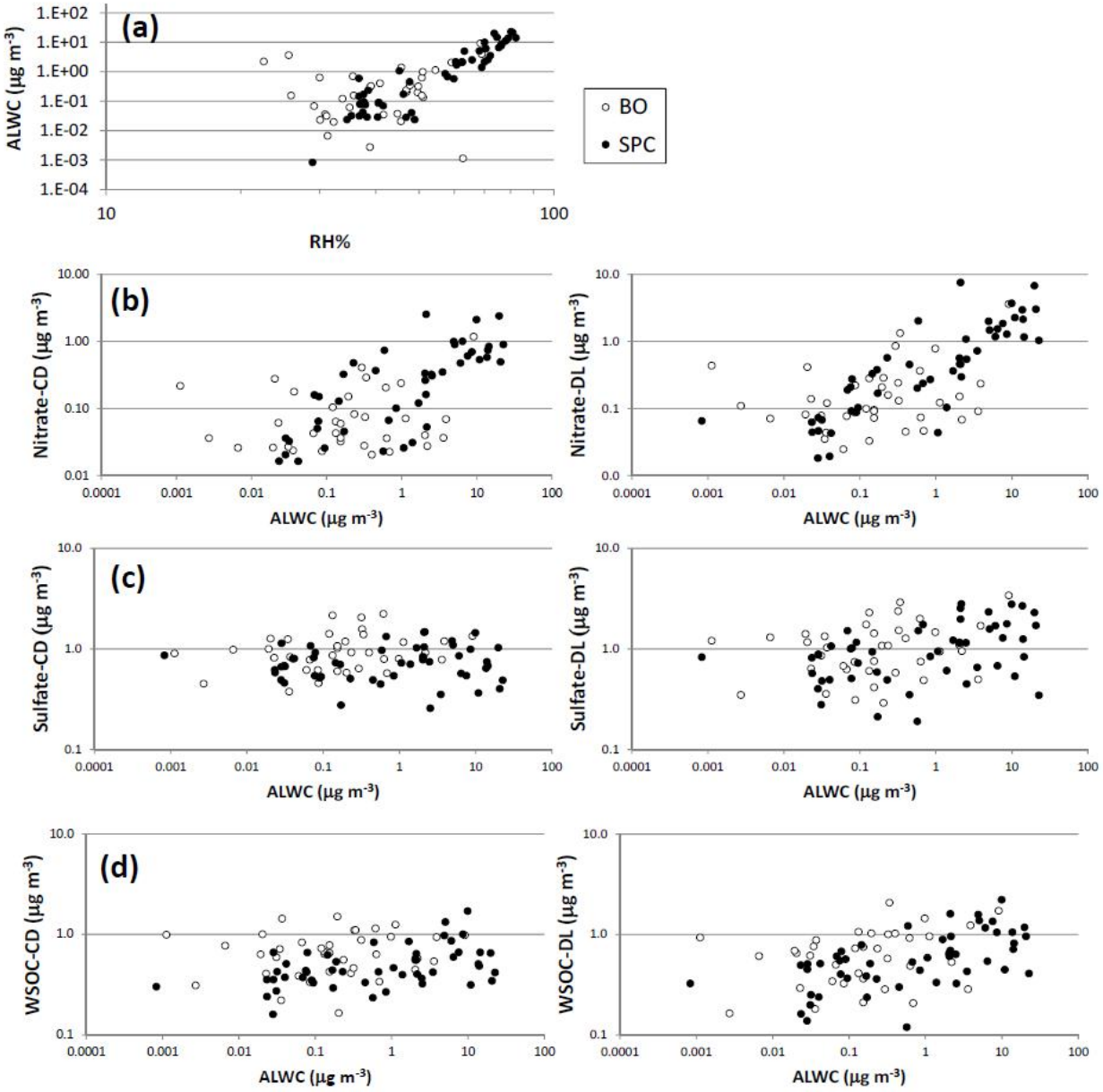
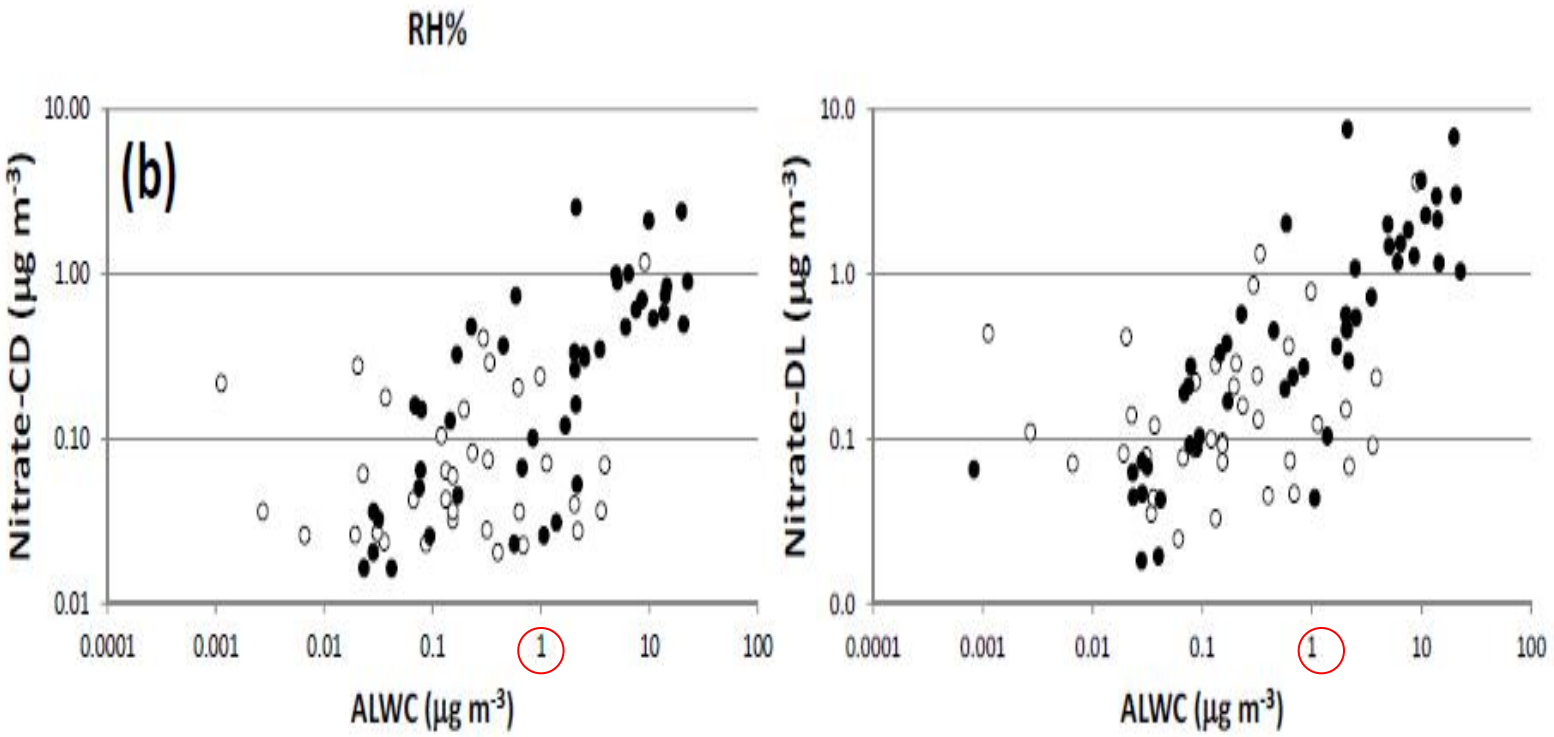


Figure 8. Relationship between ALWC and RH% (a); relationship between nitrate (b), sulfate (c) and WSOC (d) in the condensation (CD,left panel) and in the droplet (DL, right panel) mode of particles .



Panel b of figure 8 shows that the correlation between particulate nitrate and ALWCwas strong for both modes in SPC where ALWC levels above 1 µ g/m3.

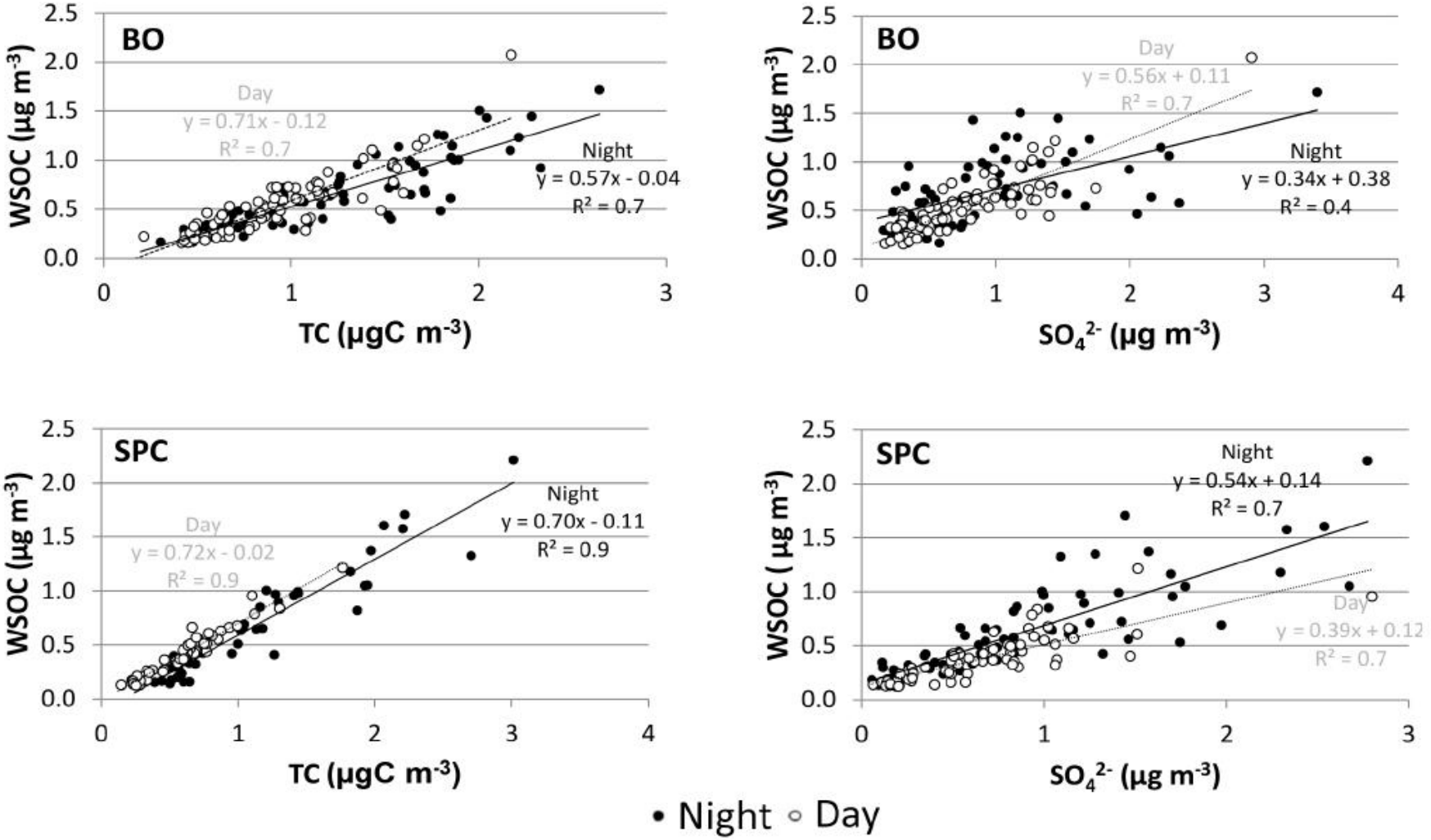


Figure 9. Linear regressions between WSOC and TC (left) and WSOC and SO2− 4 (right) in the size intervals: (1) 0.05–0.14 µm, (2) 0.14–0.42 µm and (3) 0.42–1.2 µm in daytime and at night for BO (top) and SPC (bottom).

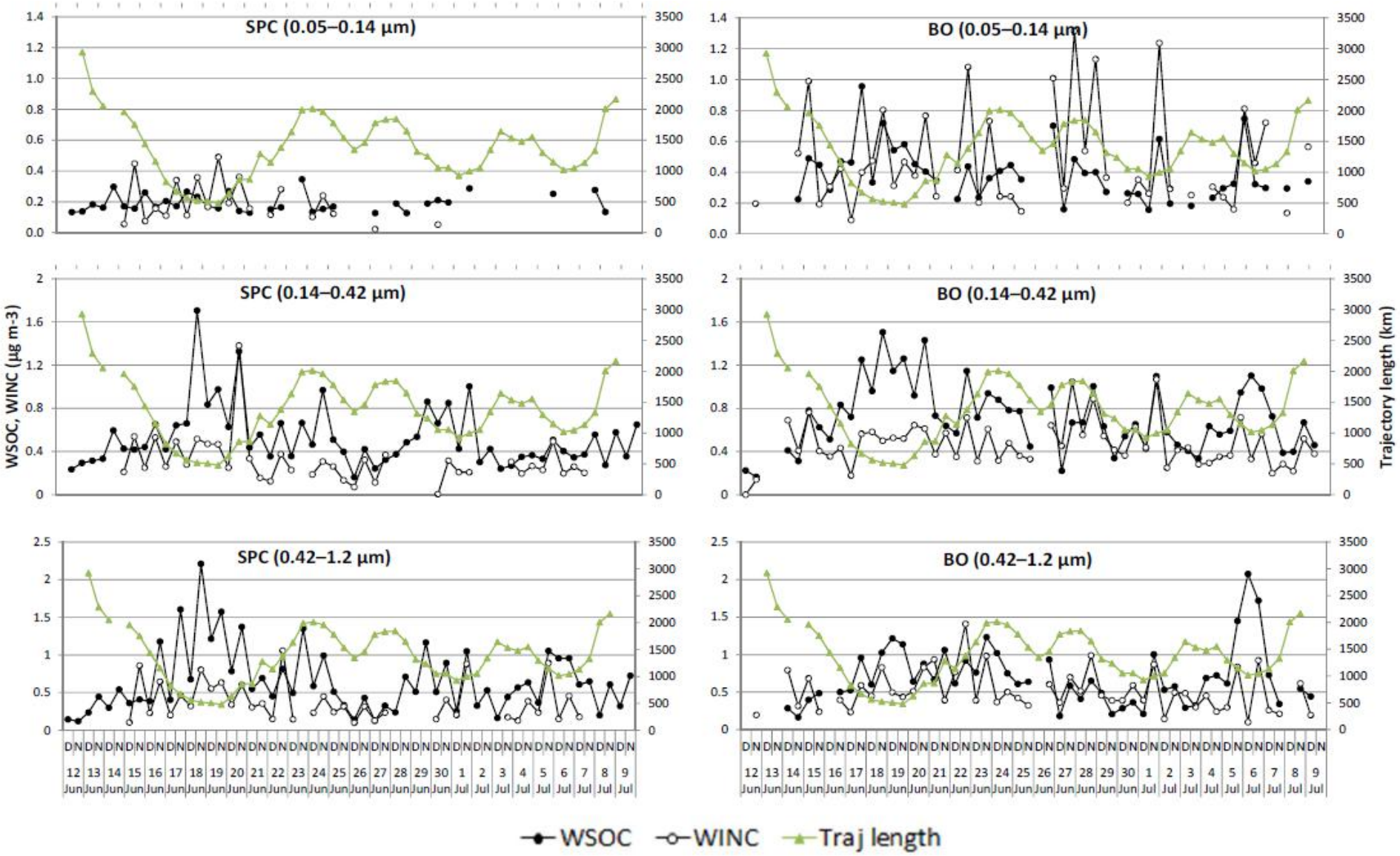


Figure 10. Time series of WSOC and WINC (DTC—WSOC) concentrations in the size intervals.

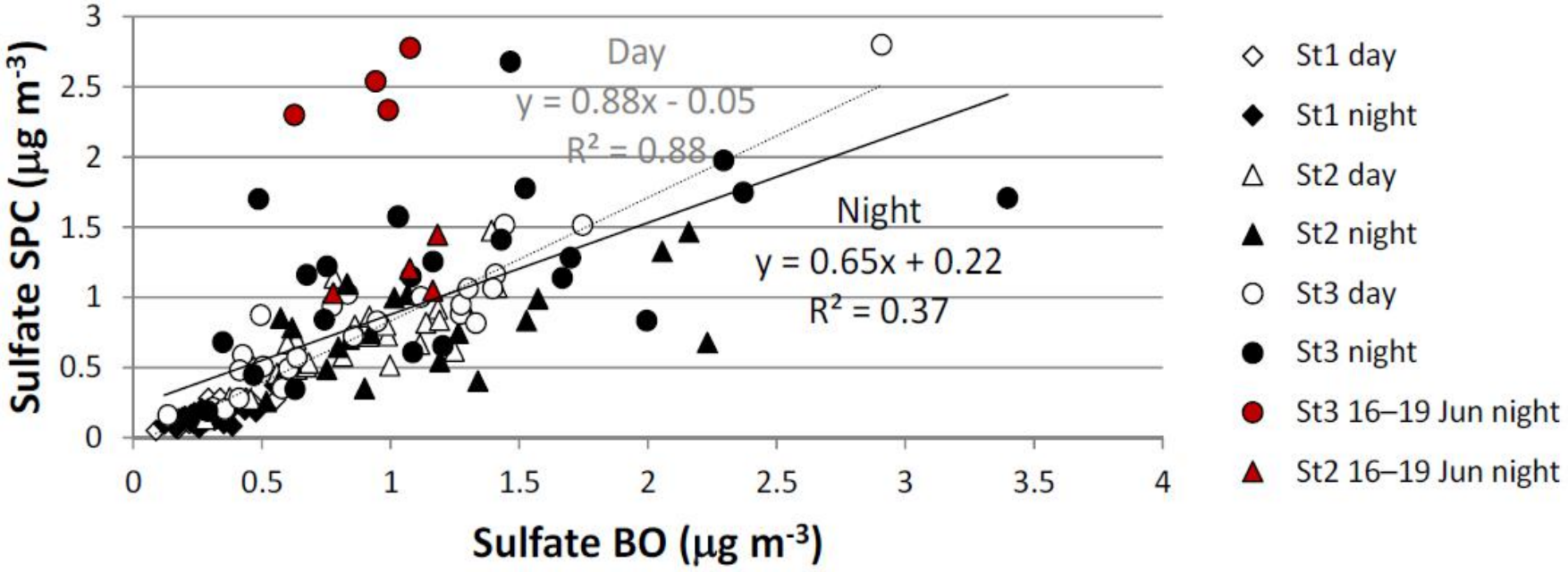


Figure 11. Scatterplot of sulfate concentration at SPC vs. BO during day and night for the impactor stages 1 (0.05–0.14 µm), 2 (0.14– 0.42 µm) and 3 (0.42–1.2 µm). The regression lines are referred to the diurnal and nocturnal concentrations in the three stages as a whole.
Condensation and droplet-mode samples for the stagnant nights during 16–19 June are filled in red.

Conclusions

the characteristics of the size-segregated aerosol composi - tion and its variability at a rural and an urban background site in the Po Valley could be explained by a limited number of factors reflecting main physicochemical processes and/ or transport patterns in the atmosphere.

(1)The first is the photochemical production of SIA and SOA.

(2)The second is nocturnal SIA and SOA formation, enhanced in the shallow, cool and humid boundary layer and favored by the presence of aerosol liquid water.

Thank you