MARMARA ÜNİVERSİTESİ

Köklü geçmiş, güçlü gelecek...

Diurnal and seasonal variations of primary and secondary organic carbon at an urban traffic site in Istanbul

R.M. Flores[1], H. Ozdemir[2], B. Akkoyunlu[1], G. Demir[3], A. Unal[4], M. Tayanc[1]

[1] Marmara University, Göztepe Campus, 34722, Istanbul, TURKEY. [2] Istanbul Technical University, Istanbul, TURKEY
[3] Kirklareli University, TURKEY [4] Eurasia Institute of Earth Sciences, Istanbul Technical University, Istanbul, TURKEY

Acknowledgements
TUBITAK 115Y625
Env. Eng. Dept. Marmara University
BAPKO FEN-D-130319-0082
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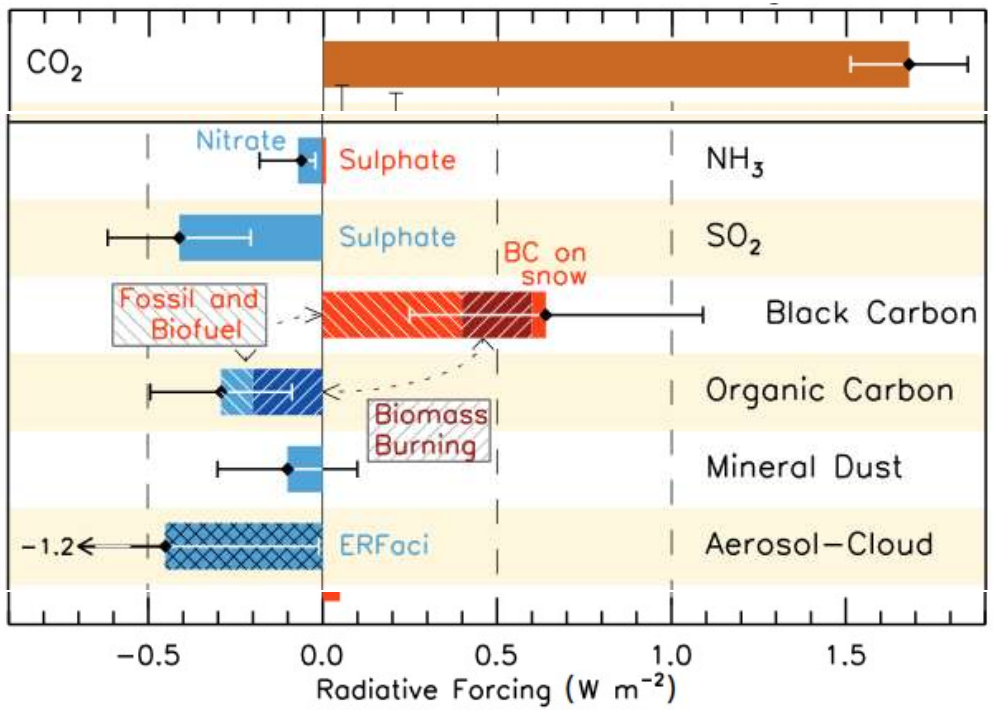
Background

- Particulate matter has harmful effects on human health, ecosystems, and climate change.
- Both positive and negative radiative forcing –large uncertainties.
- Reliable assessments depend on the development of global models of aerosols and clouds that are well constrained by observations.

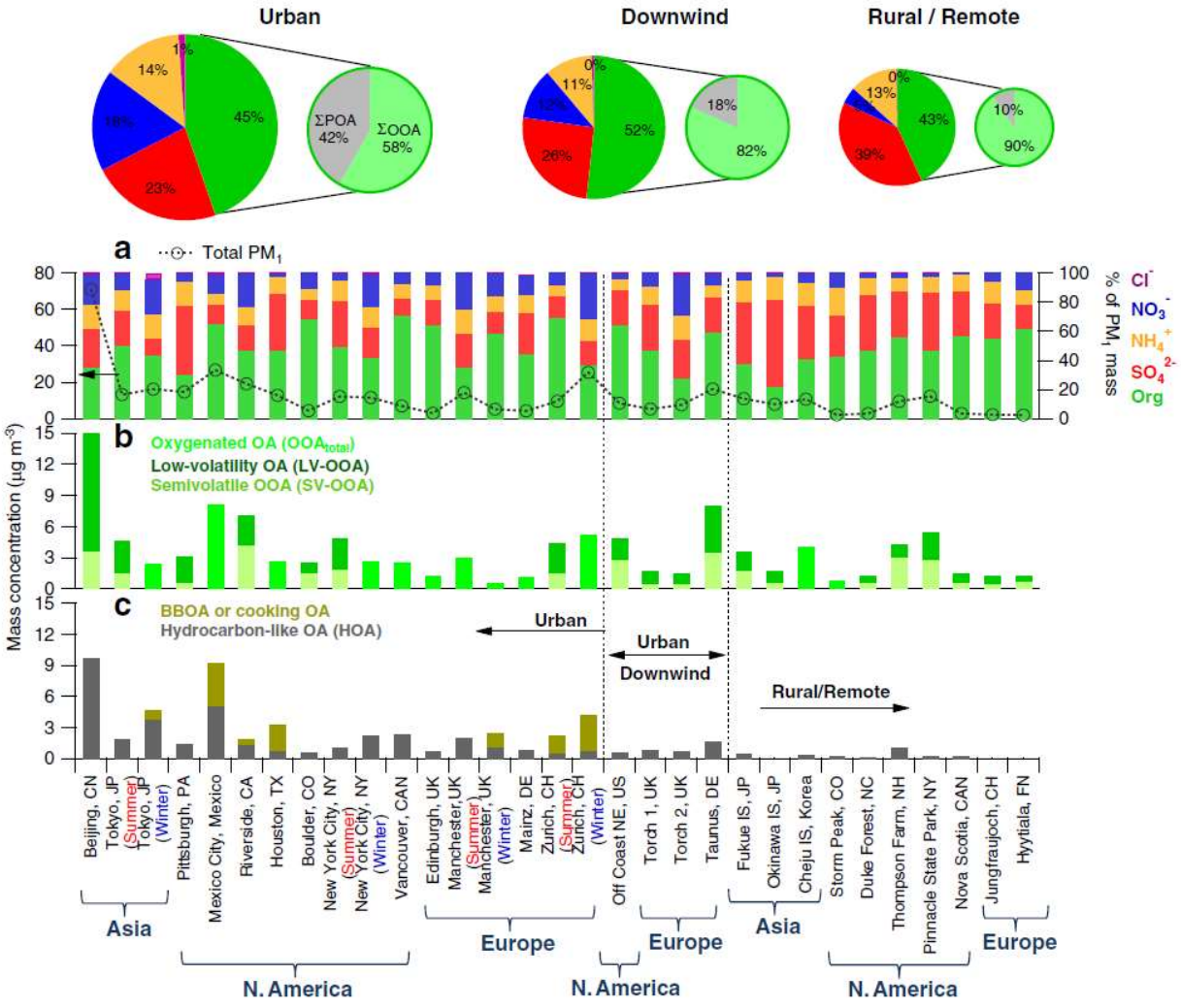


IPCC-WG1-AR5, 2014

Spatial variation of fine PM chemical components

- 18-70% organic
- 10-67% sulfate
- 1.2-28% nitrate
- 7-19% ammonium
- <4.8% chloride

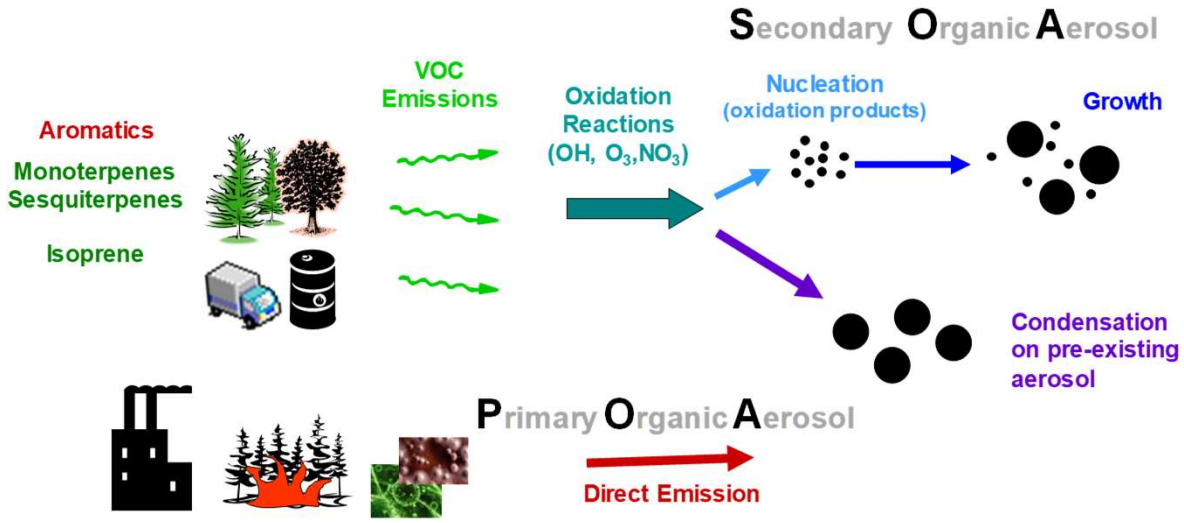
Zhang et al. 2007



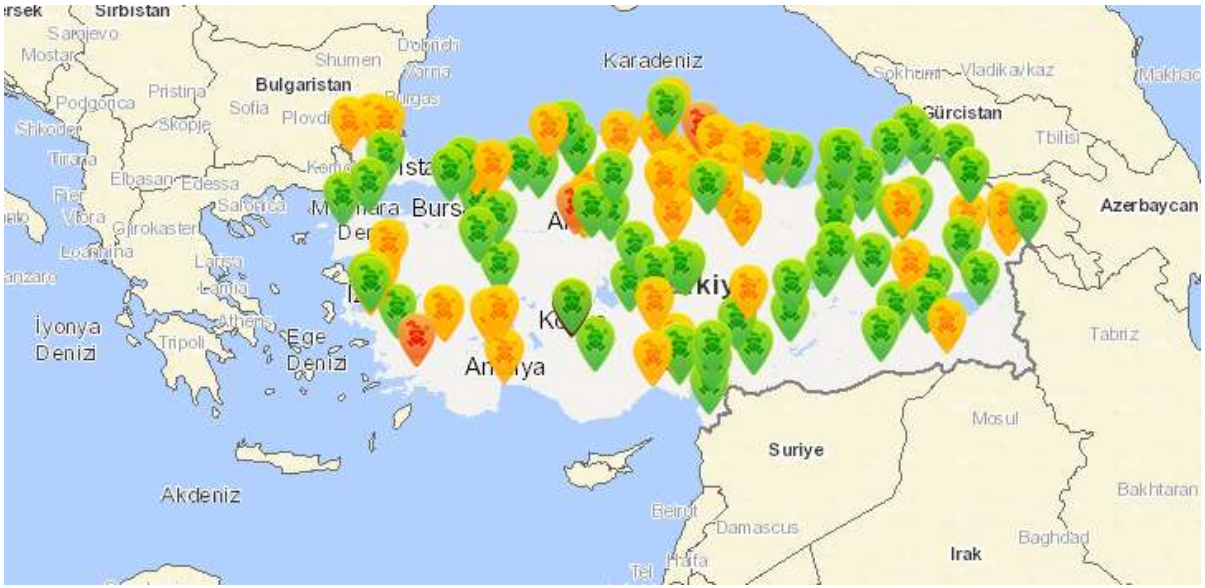
Zhang et al. 2011

Temporal variation of organic aerosol species

- Physicochemical properties
- Meteorology
- Oxidation, fragmentation, oligomerization, g/p partitioning, cloud processing



Air quality monitoring network in Turkey



Ministry of Environment and Urbanization

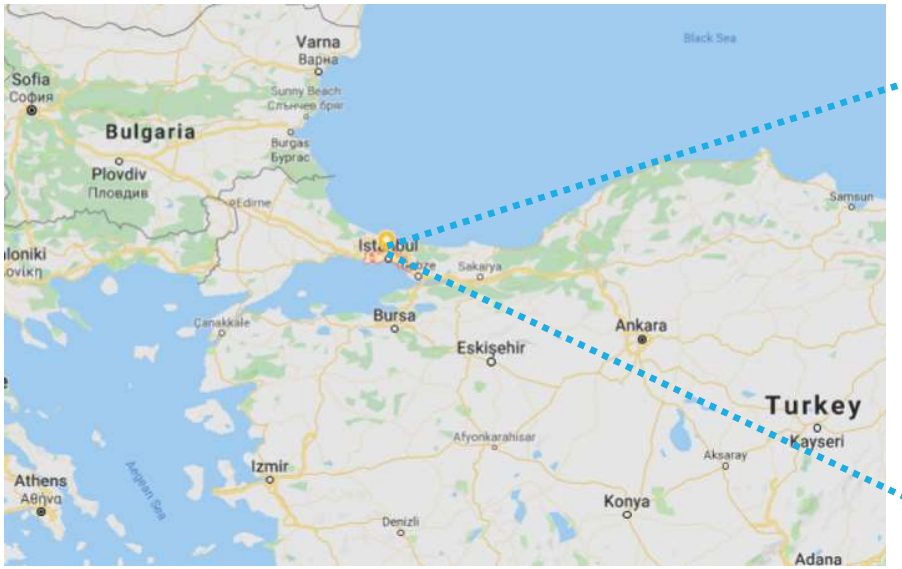
- SO2, CO, NO, NO2, NOx, O3
- PM10, PM2.5

- Istanbul 24 stations (only 4 have PM2.5)

Chemical characterization of PM in Istanbul

Ozdemir et al., 2014	BC	PM2.5	real time	Aug 2010 - Aug 2011
Szigeti et al, 2013	SO4, NO3, Cl, NH4	PM2.5	96h	Jun 2010 - May 2011
Kuzu et al., 2013	SO4, NO3, Cl, NH4	8 sizes	8h, night	Sep 2009 - Nov 2009
			4h, twice/day	Nov 2009 - Mar 2010
Theodosi et al, 2010	SO4, NO3, Cl, NH4	PM10	24h	Nov 2007 - Jun 2009
	OC/EC			Jul 2008 - Jun 2009

Methods



Sampling

- 300 High time resolved $PM_{2.5}$
- 2h - 7:00- 19:00h
- 12h – 19:00-07:00h

- 3 weeks winter, 1 week spring, summer, fall
- Jan 2017 - Jan 2018

- Real-time data $PM_{2.5}$

OC EC Analysis

- 300 high-time resolved PM2.5 samples
- Thermo-optical Sunset Laboratory
- NIOSH870 method

Fraction	Gas	Time (s)	Temperature (°C)
OC1	He	60	310
OC2	He	60	475
OC3	He	60	615
OC4	He	60	870
EC1	He+ O2 (2%)	45	550
EC2	He+ O2 (2%)	45	625
EC3	He+ O2 (2%)	45	700
EC4	He+ O2 (2%)	45	775
EC5	He+ O2 (2%)	45	850
EC6	He+ O2 (2%)	45	870

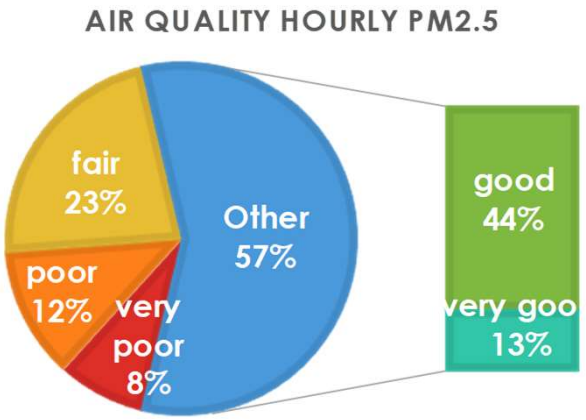
SOC estimation

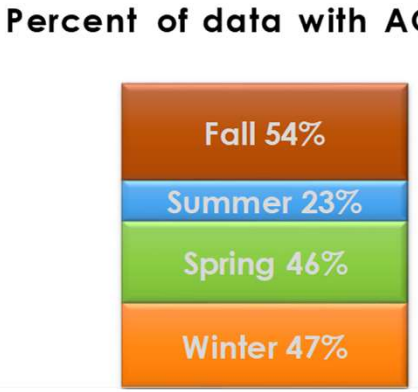
- EC tracer method (Turpin and Huntzicker, 1991)

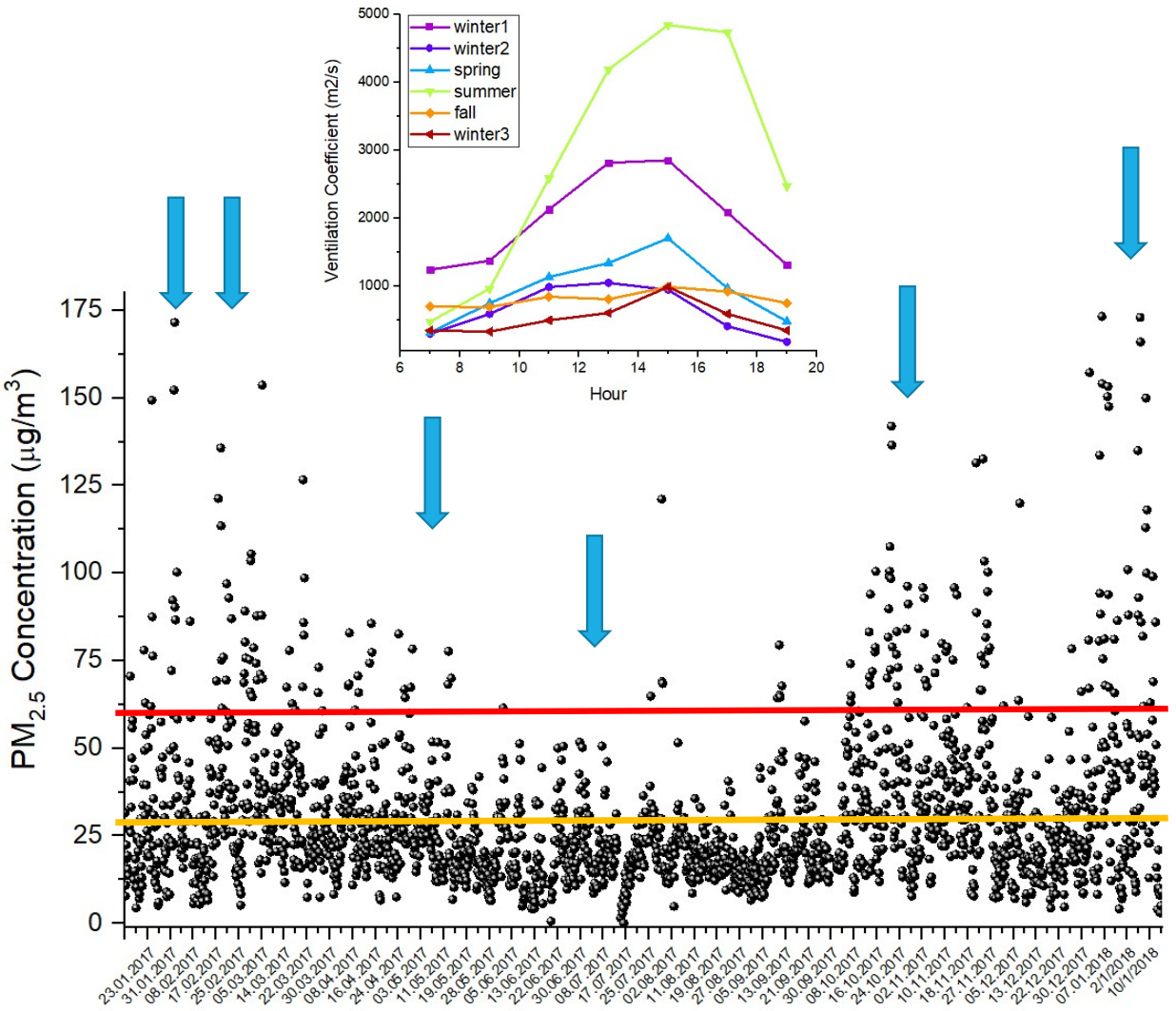
- $OC_{total} = SOC + POC$
- $POC = EC \times \left(\frac{OC}{EC}\right)_{pri}$
- $SOC = OC_{total} - POC$

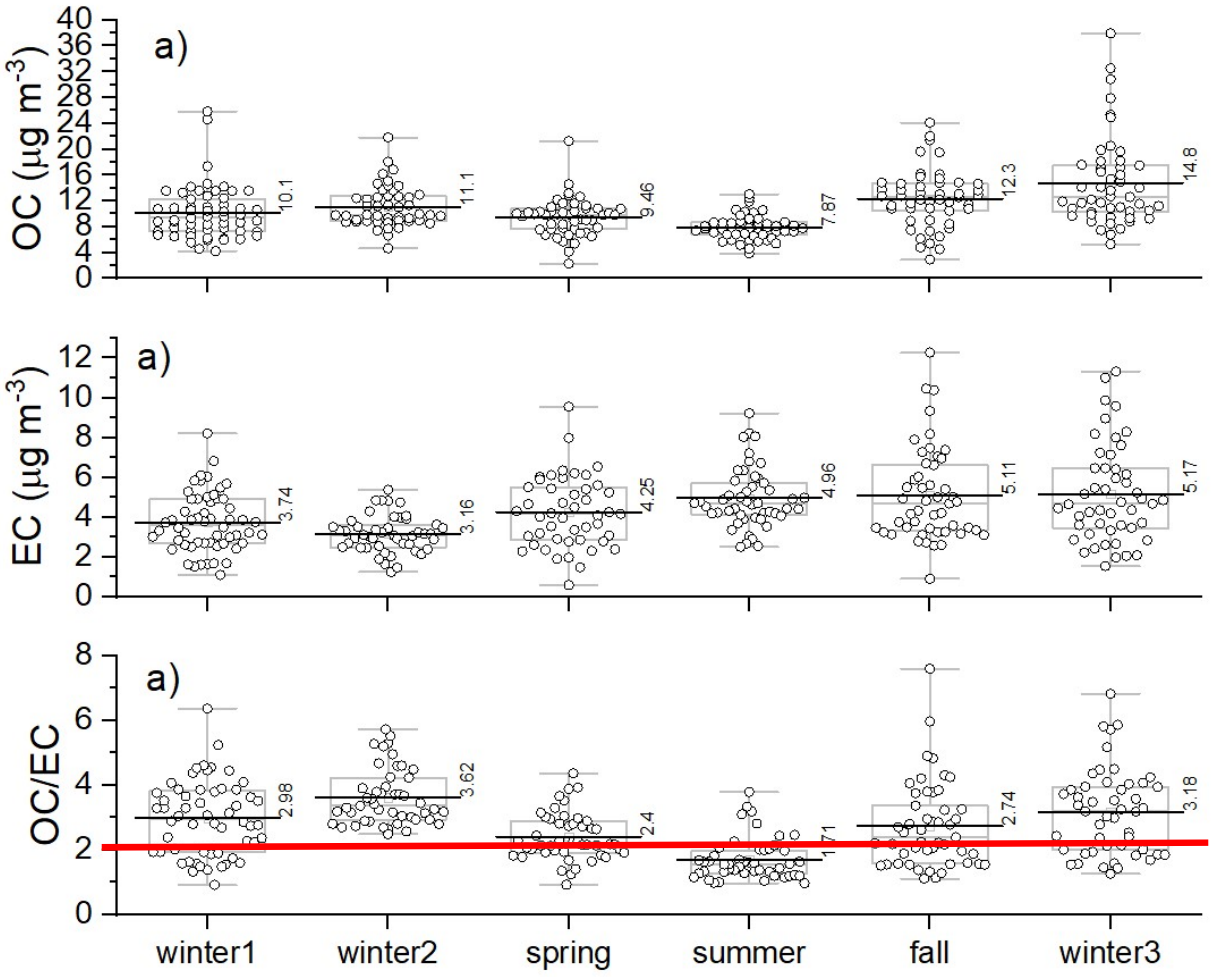
Birch and Cary, 1996

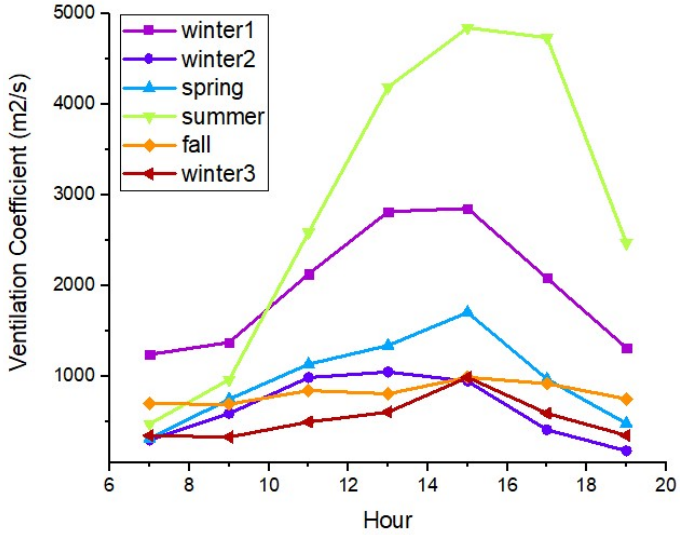
Results

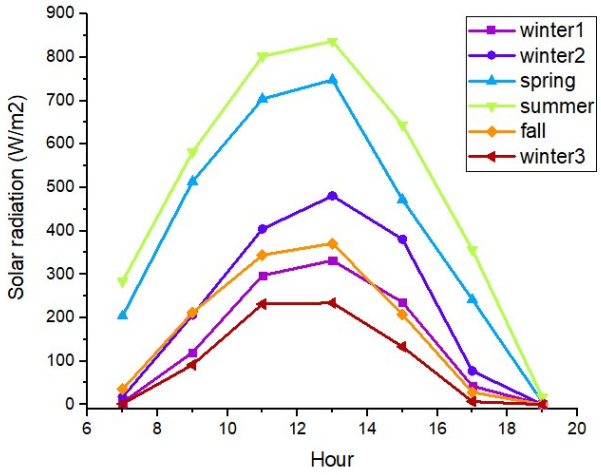

AIR QUALITY HOURLY PM2.5
fair 23%
Other 57%
poor 12%
very poor 8%
good 44%
very goo 13%

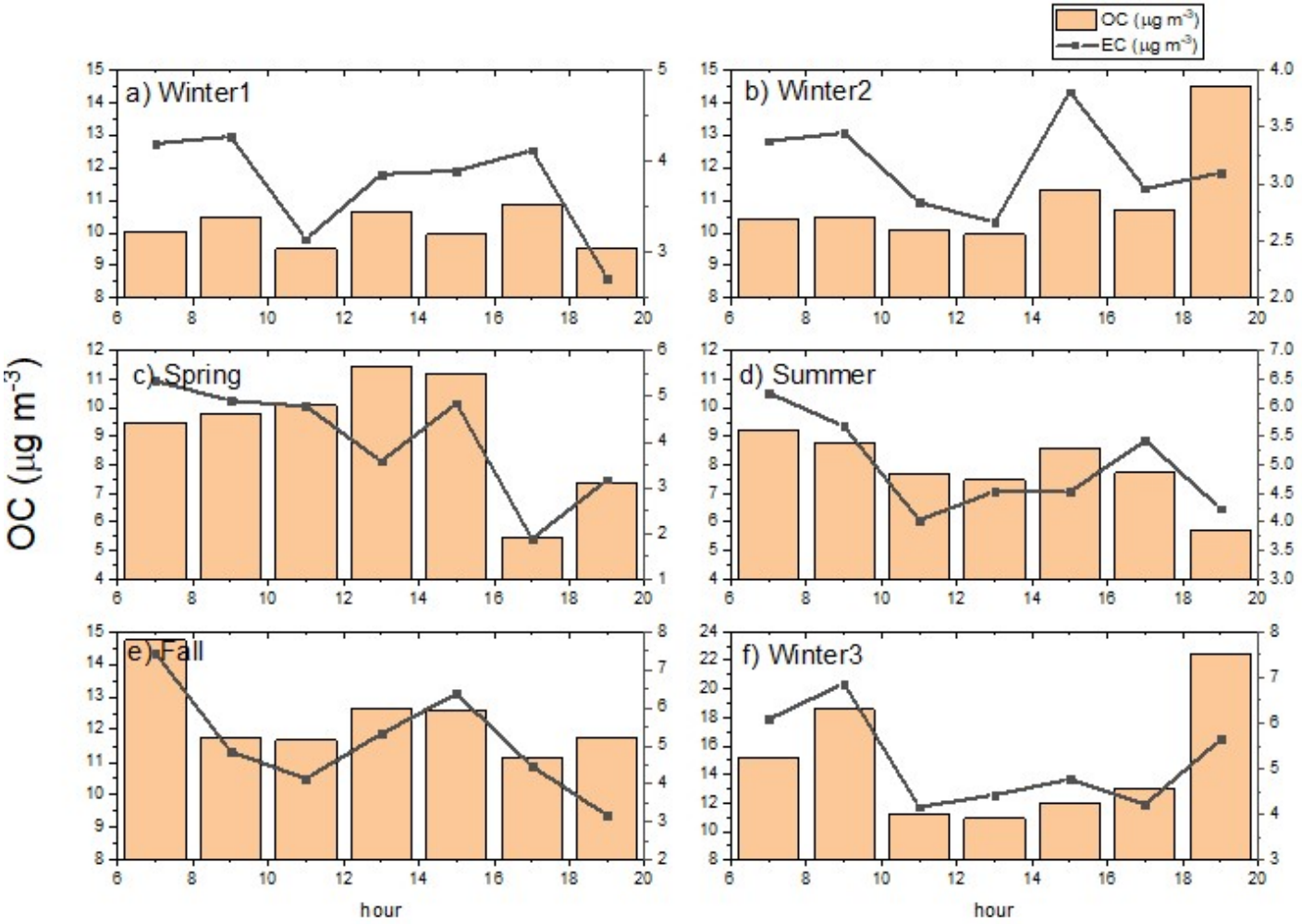

Percent of data with AQ>Fair
Fall 54%
Summer 23%
Spring 46%
Winter 47%

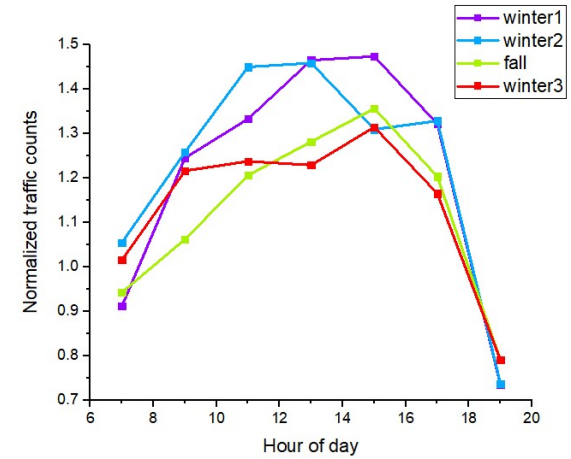

winter1
winter2
spring
summer
fall
winter3
Ventilation Coefficient (m2/s)
Hour
PM2.5 Concentration (μg/m3)

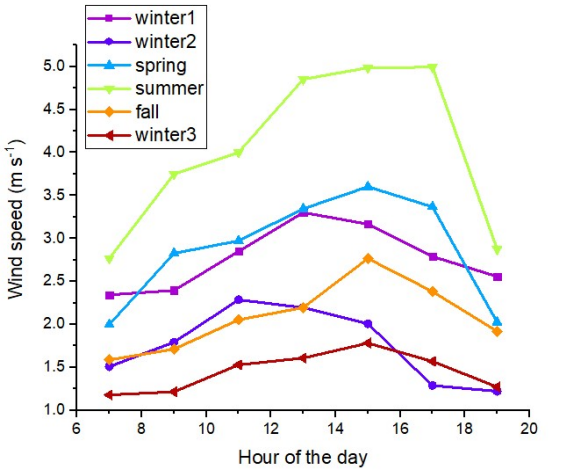

a)
OC (μg m-3)
10.1
11.1
9.46
7.87
12.3
14.8
a)
EC (μg m-3)
3.74
3.16
4.25
4.96
5.11
5.17
a)
OC/EC
2.98
3.62
2.4
1.71
2.74
3.18
winter1
winter2
spring
summer
fall
winter3


Ventilation Coefficient (m2/s)
Hour
winter1
winter2
spring
summer
fall
winter3

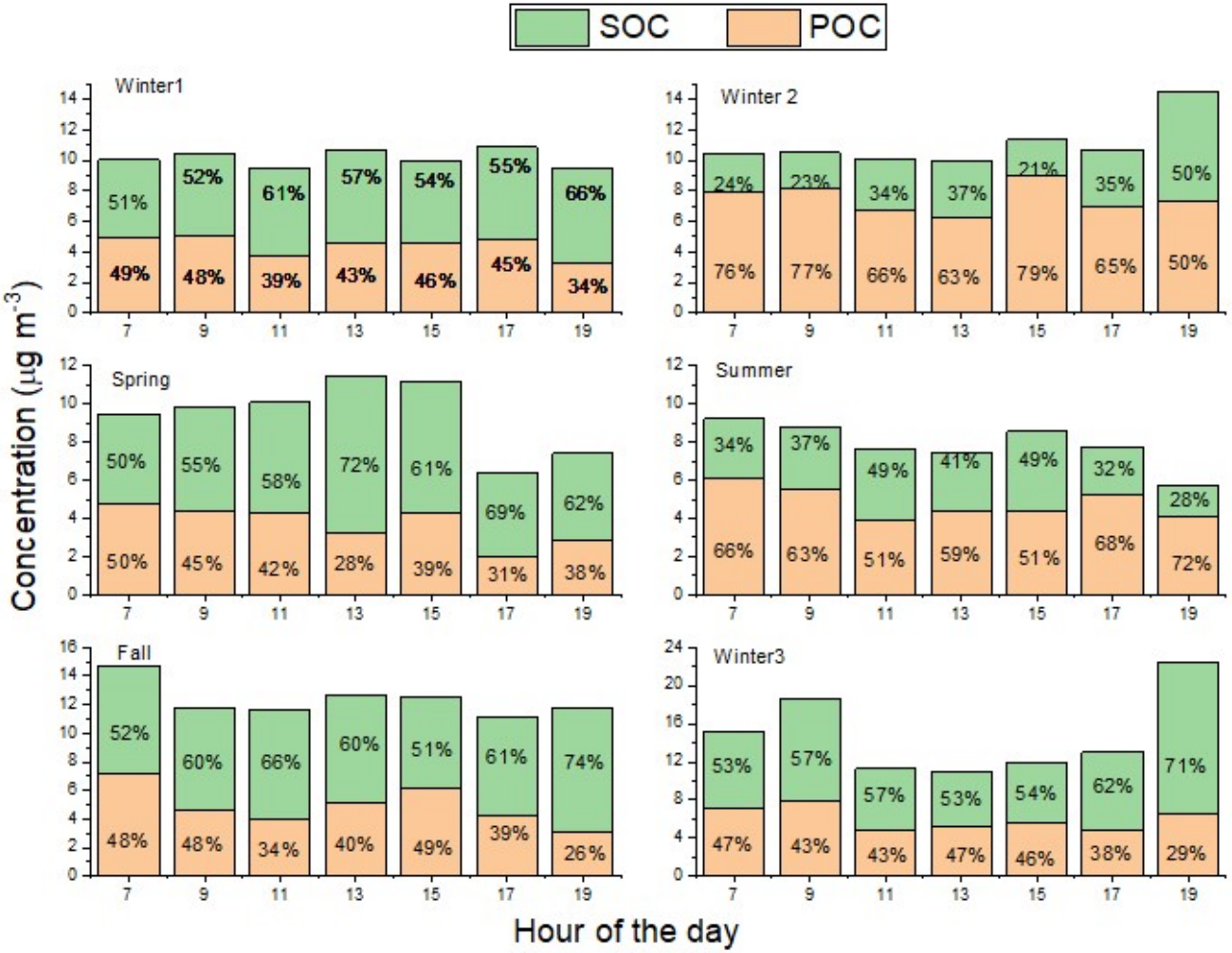

Solar radiation (W/m2)
Hour
winter1
winter2
spring
summer
fall
winter3

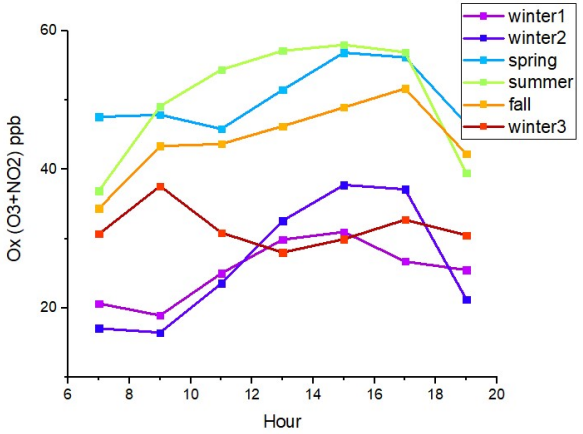

OC (μg m-3)
EC (μg m-3)
a) Winter1
b) Winter2
c) Spring
d) Summer
e) Fall
f) Winter3
hour
hour

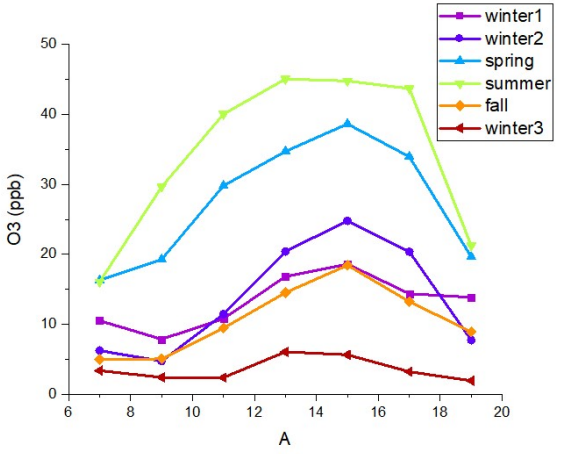

winter1
winter2
fall
winter3
Normalized traffic counts
Hour of day


winter1
winter2
spring
summer
fall
winter3
Wind speed (m s-1)
Hour of the day

EC (μg m-3)


SOC
POC
Winter1
Winter 2
Spring
Summer
Fall
Winter3
Concentration (μg m-3)
Hour of the day


winter1
winter2
spring
summer
fall
winter3
Ox (O3+NO2) ppb
Hour


winter1
winter2
spring
summer
fall
winter3
O3 (ppb)
A

Conclusions

- OC concentrations 2× higher during heating season
- Strong diurnal and seasonal variations of PM2.5, OC, and EC influenced by sources and horizontal surface wind speed
- Higher SOC concentrations during the winter due to increased OC emissions from residential heating
- SOC during spring possibly from biogenic origin.

Rosa M. Flores
rflores@marmara.edu.tr
rmflores@mtu.edu
http://mimoza.marmara.edu.tr/~rflores/

Thank you