SHORT-TERM INDOOR PARTICULATE MATTER *vs.* OUTDOOR ATMOSPHERIC CONDITIONS

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3rd International Conference on
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June 24-26, 2014 Valencia Conference Centre, Spain

OUTLINE

- WHAT IS ATMOSPHERIC PM AND WHY IT IS IMPORTANT?
- SOURCES OF PM
- INDOOR PM EXPERIMENT
- CONCLUSIONS

WHAT IS PM?

Airborne particulate matter (PM) – dust, dirt, soot, smoke, and liquid droplets suspended in the atmosphere

Formation processes
&
Subsequent reactions in the atmosphere

Particles

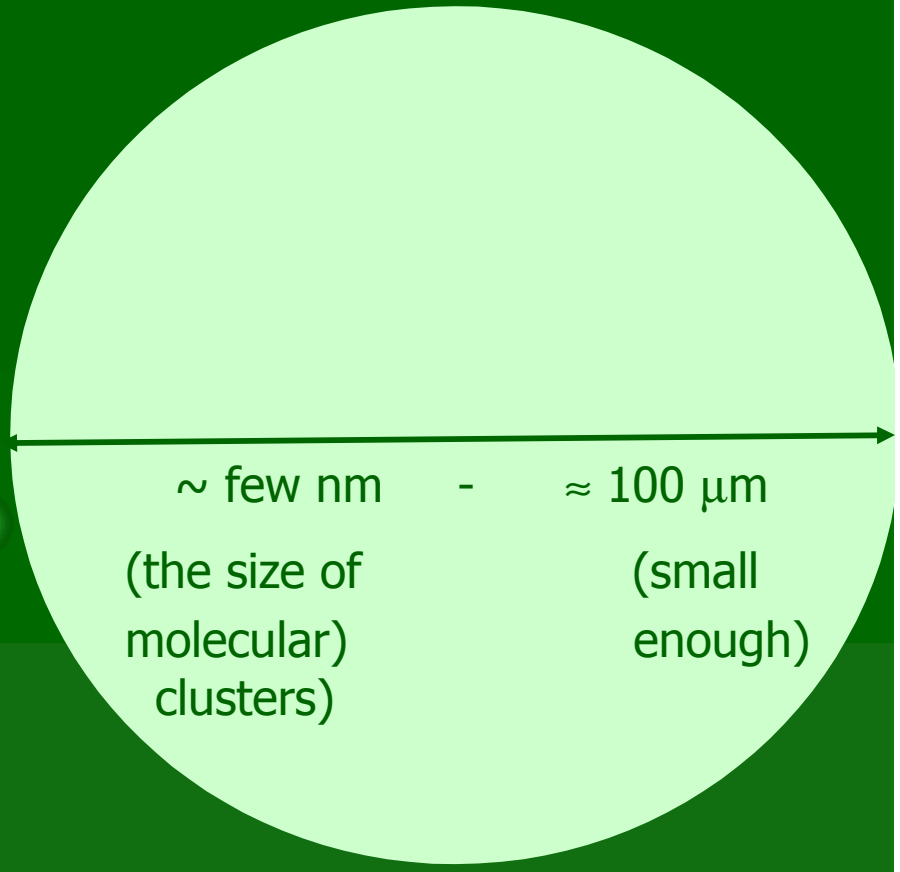
→ Sizes

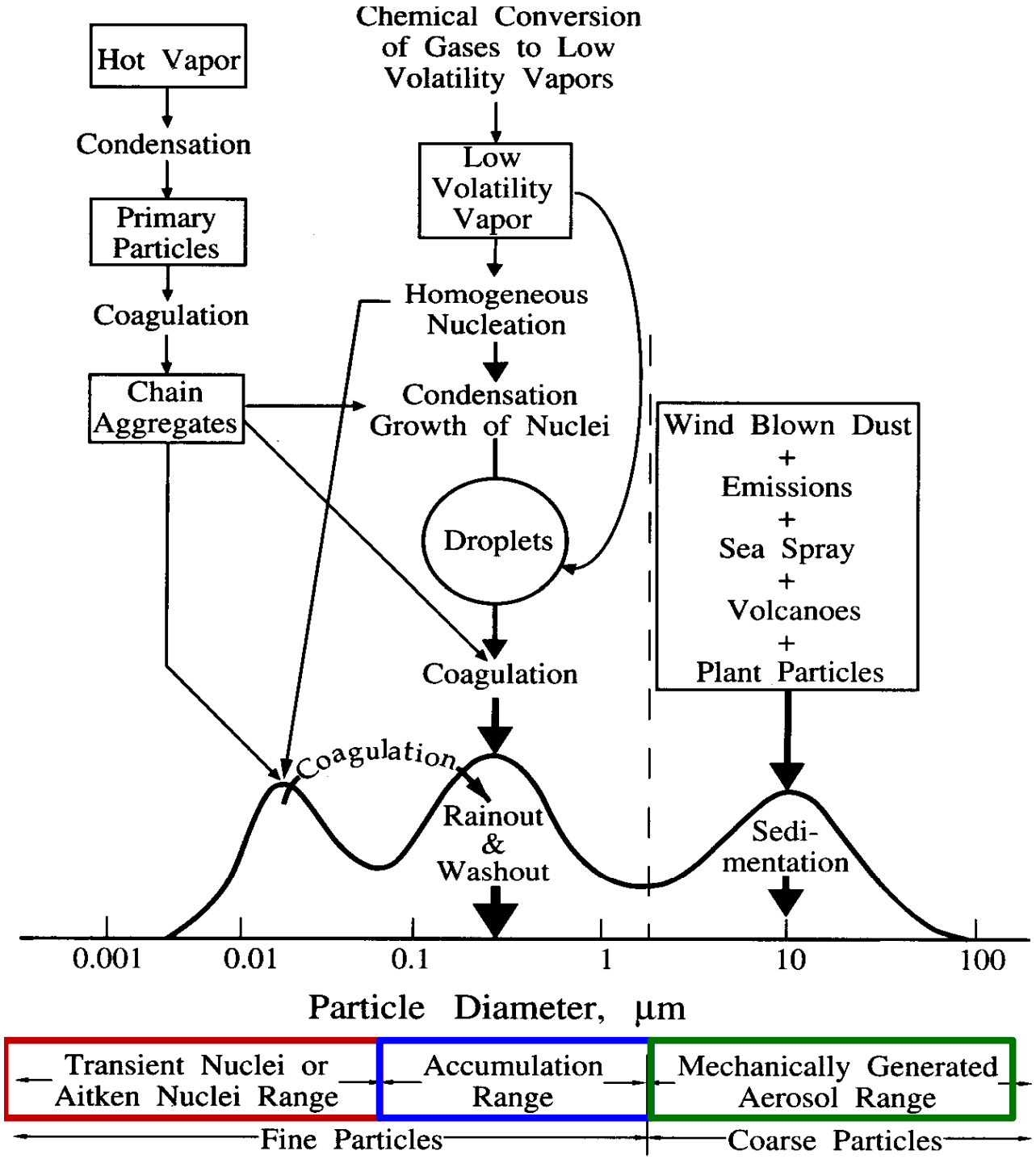
→ Other physical properties

→ Chemical properties

WHAT IS PM?

Formation processes
&
Subsequent reactions in the atmosphere





Mass distribution (Whitby, 1978)

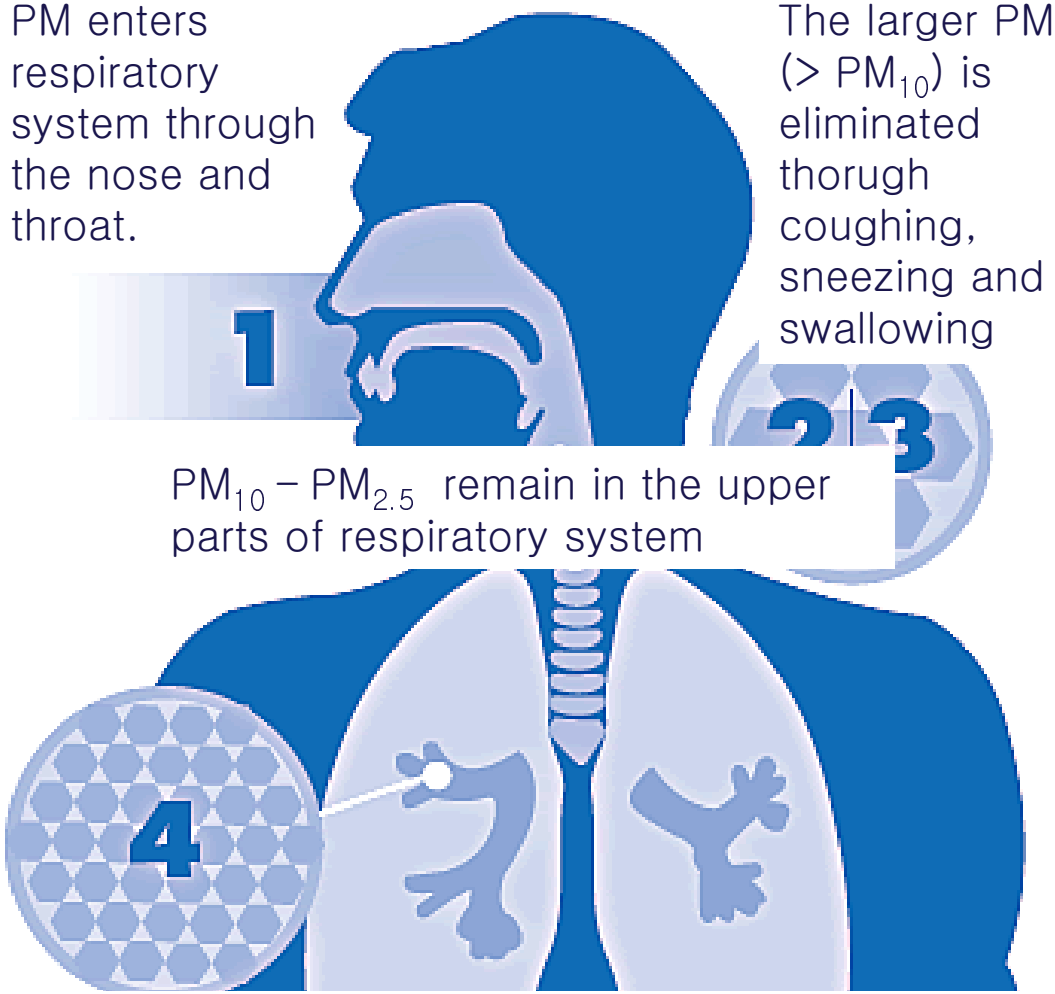
Founded in 1861

WHY IT IS IMPORTANT?

HUMAN HEALTH

PM enters respiratory system through the nose and throat.

The larger PM (> PM_{10}) is eliminated thorugh coughing, sneezing and swallowing



PM_{10} – $PM_{2.5}$ remain in the upper parts of respiratory system

$PM_{2.5}$ can penetrate deep into the lungs. It can enter alveoli, causing lung and heart problems, an delivering harmful chemicals to the blood system.

http://www.env.gov.bc.ca/epd/bcairquality/health/air-quality-and-health.html

WHY IT IS IMPORTANT?

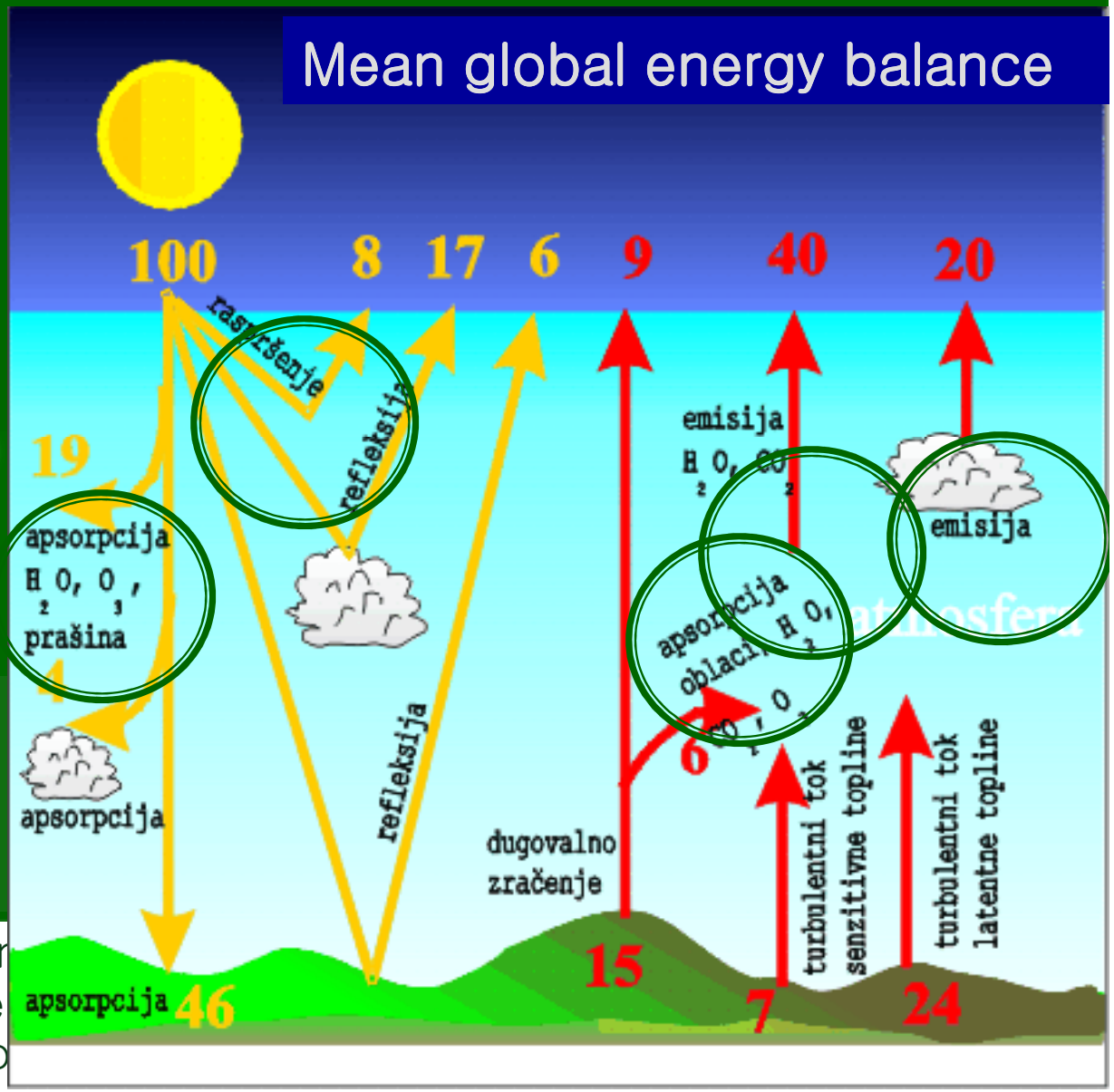
VISIBILITY

Industrial zone of Rijeka,
Croatia, 2 May 2011

WHY IT IS IMPORTANT?

Radiation &
absorption

CLIMATE



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WHY IT IS IMPORTANT?

Cloud formation

↓

CLIMATE

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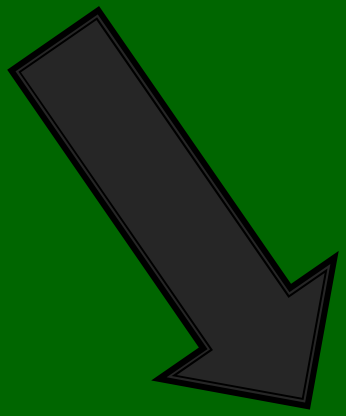
Founded in 1861
PMF
UNIVERSITAS STUDIORUM ZAGRABIENSIS MDCLXIX

SOURCES OF PM



Natural

Anthropogenic

Founded in 1861
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SOURCES OF PM

Natural

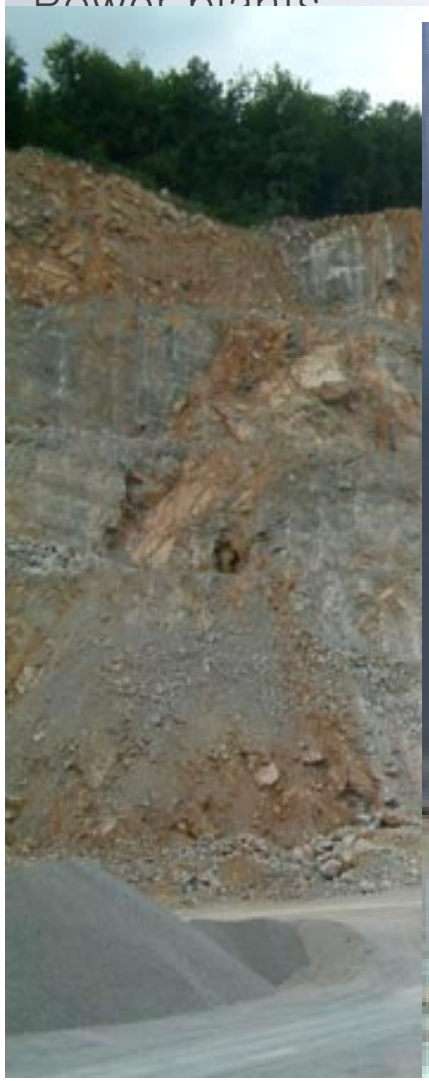
Forest fires

Sea spray
(e.g., bora wind in Senj
17 November 2007)

SOURCES OF PM

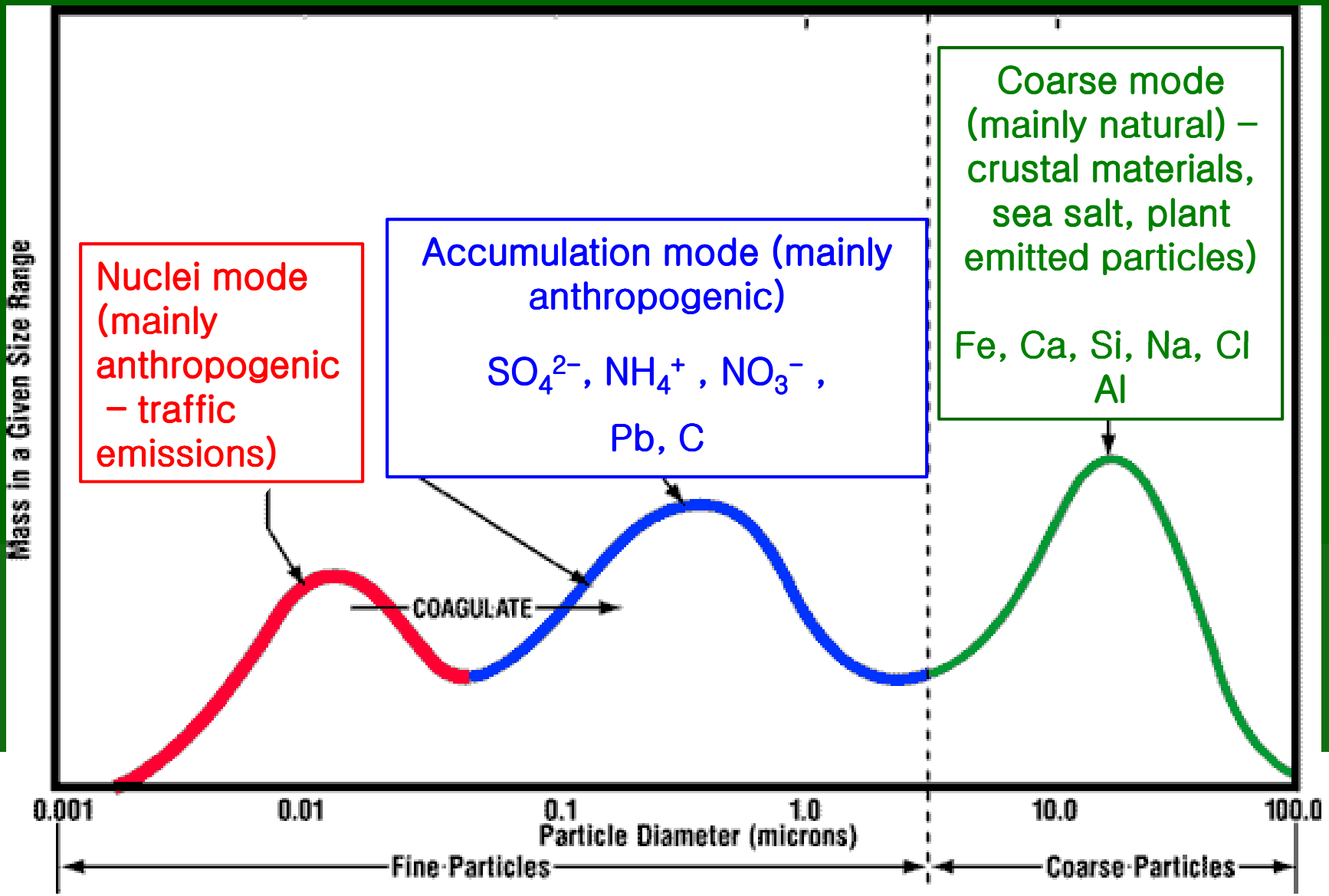
Power plants

try,

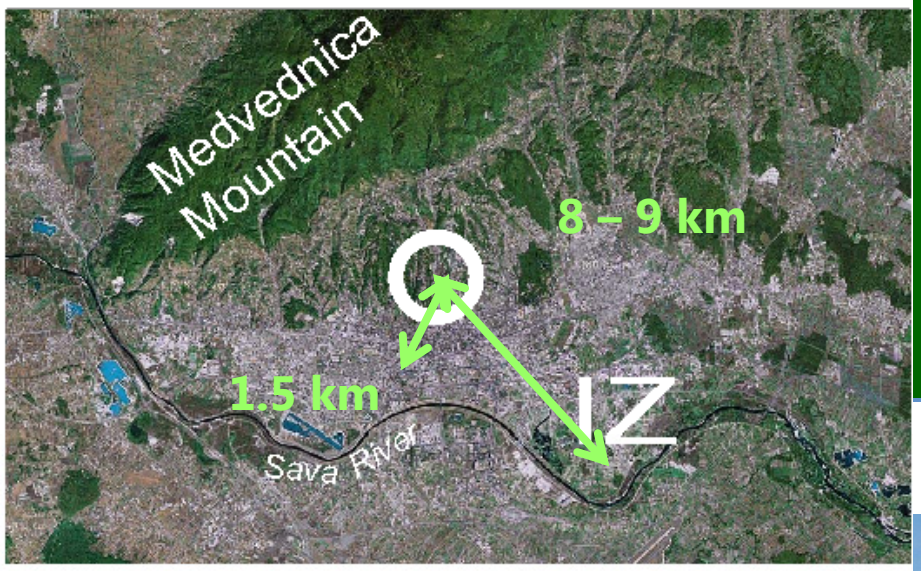


War activities
(Gulf War)

Numerous sources ⇒ Chemical & physical complexity



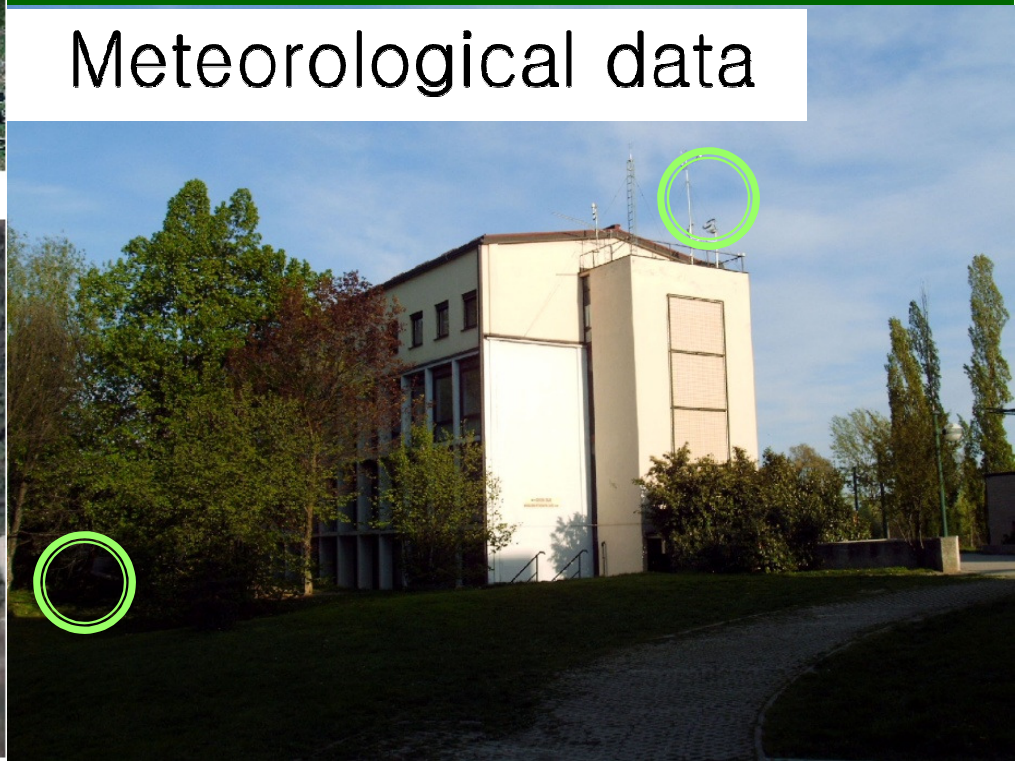
INDOOR PM EXPERIMENT



12 November 2012 – 26 April 2013

Total of 229586 1-min mean data per each measured variable

Meteorological data



DustTrak™ Aerosol Monitor TSI, Inc., Shoreview, MN, USA

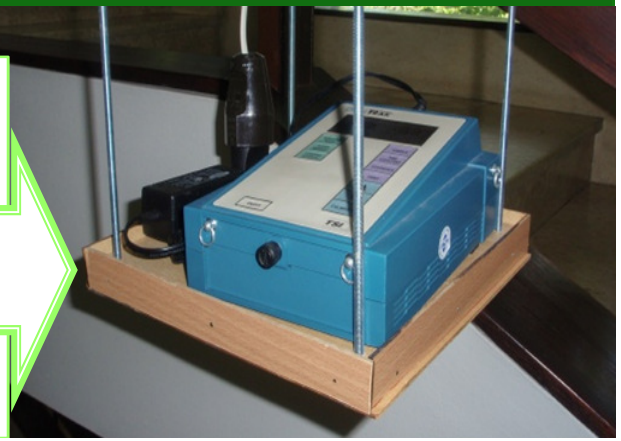
1-min mean mass concentrations at 1.7 m AGL

A - Model 8533:

PM1, PM2.5,
PM4, PM10, TSP

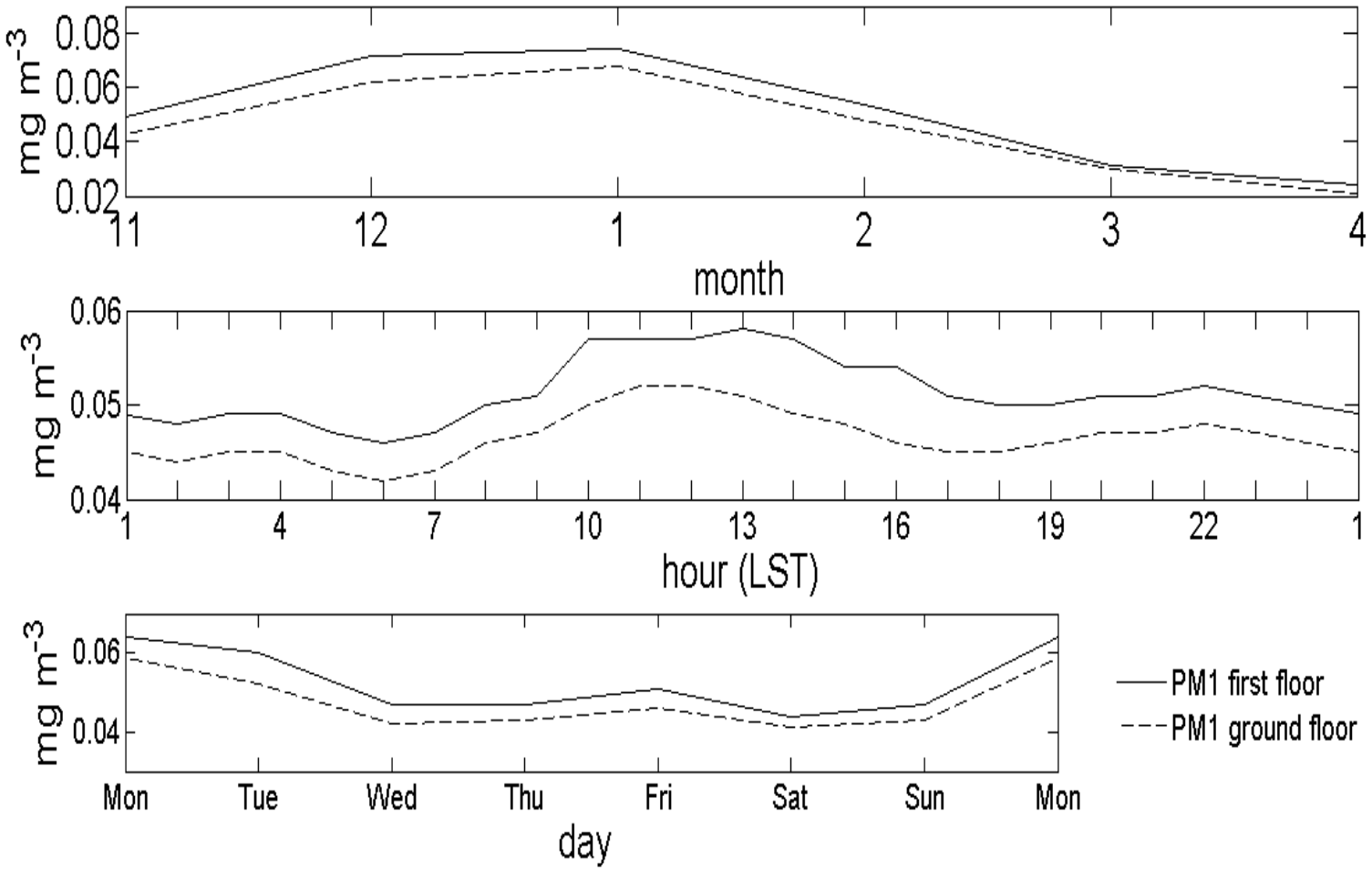
B - Model 8520:

PM1



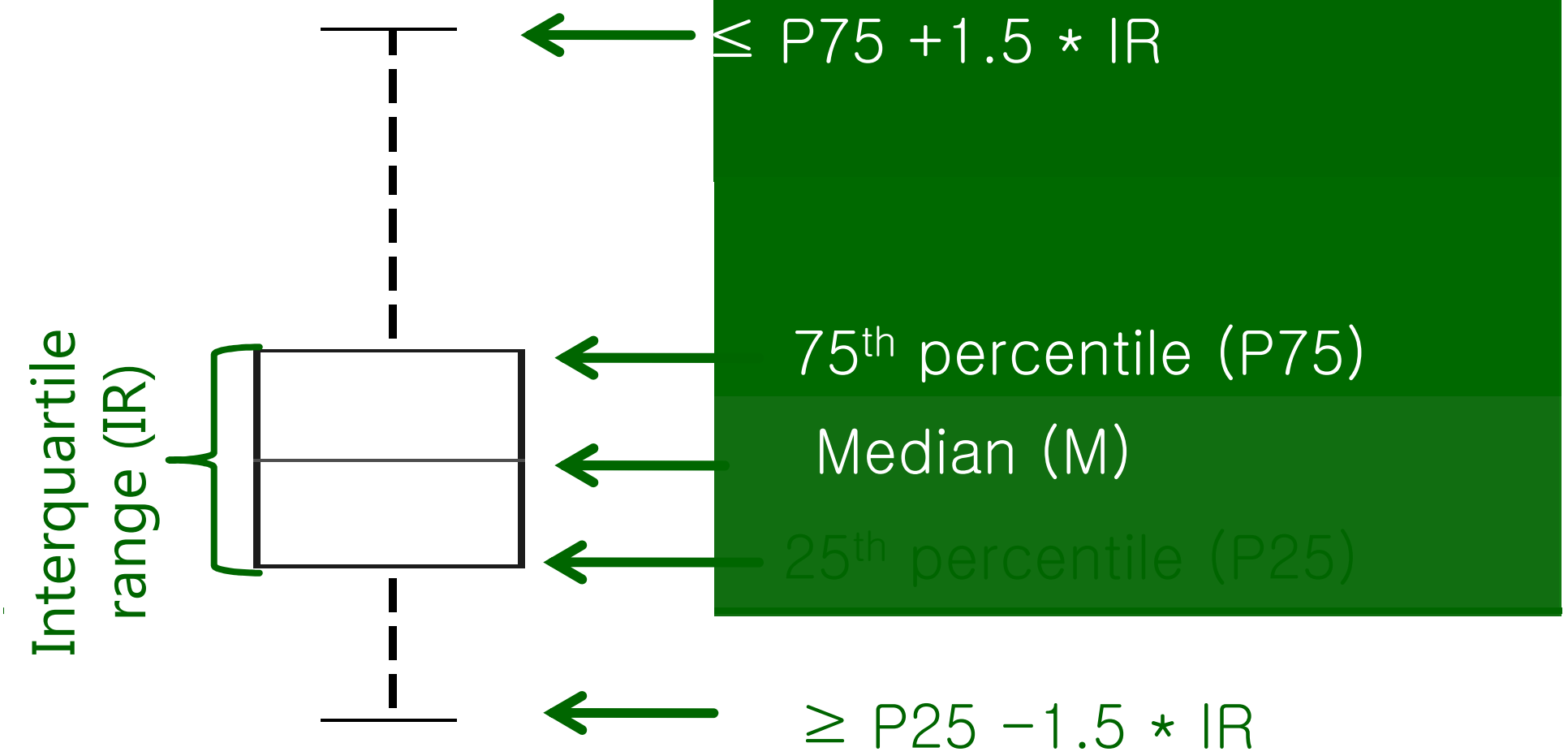
RESULTS (PM1)

Temporal variations



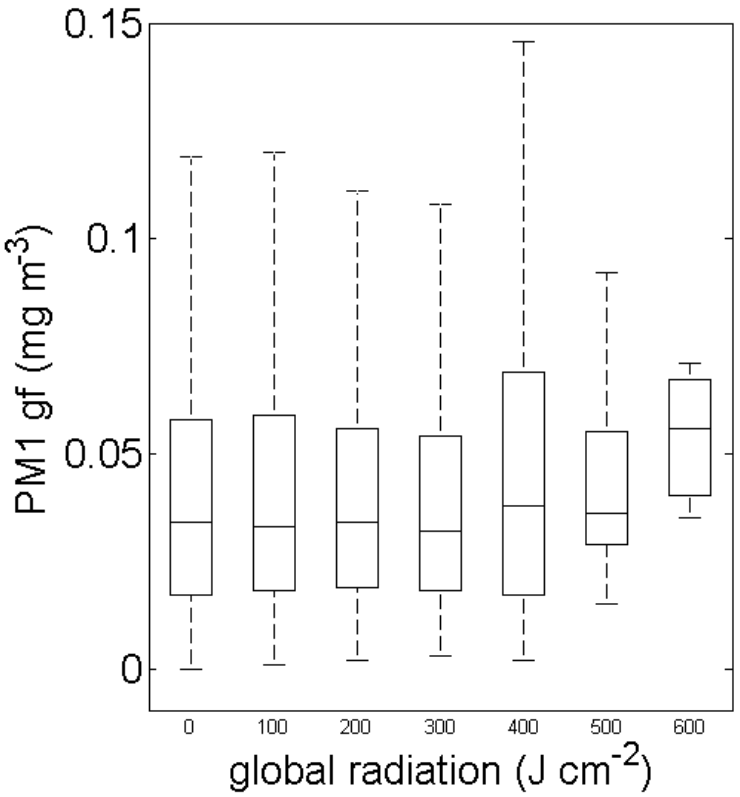
PM1 *vs.* meteorology

Box-plot

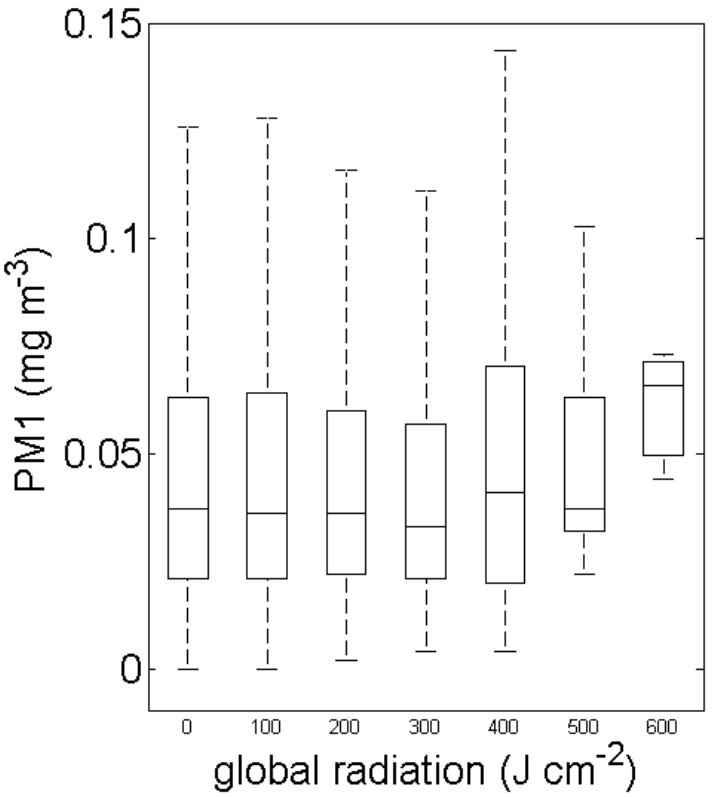


Global radiation

Ground floor

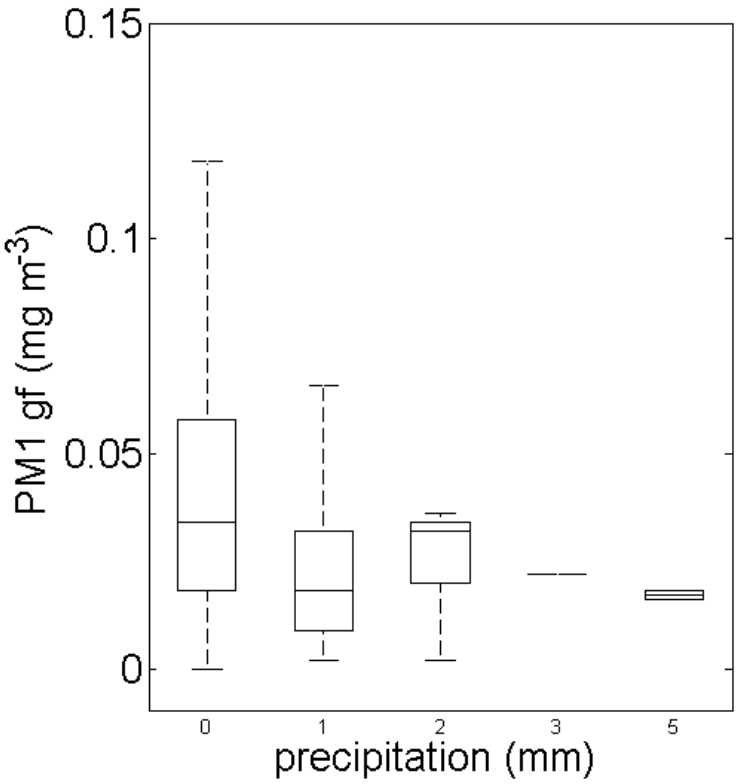


First floor

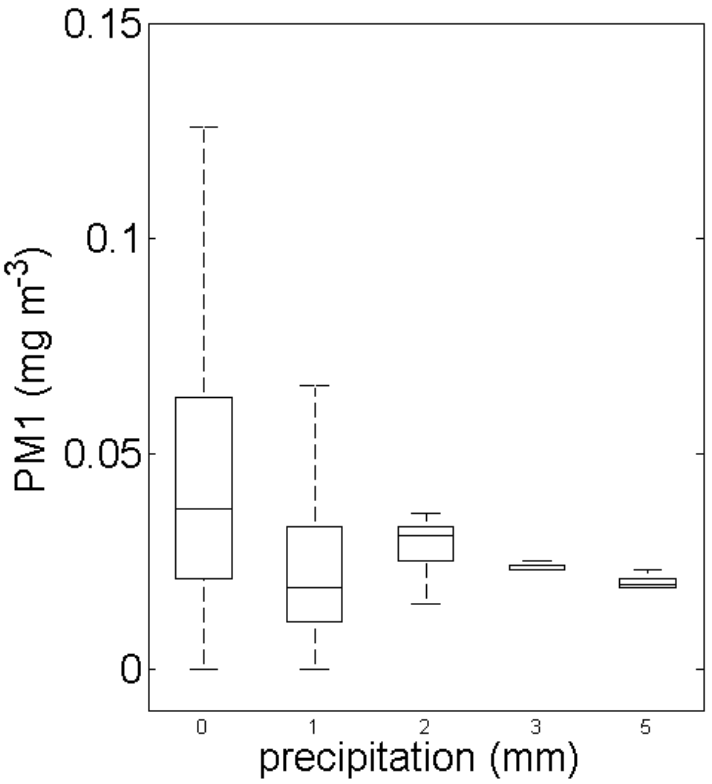


Precipitation

Ground floor

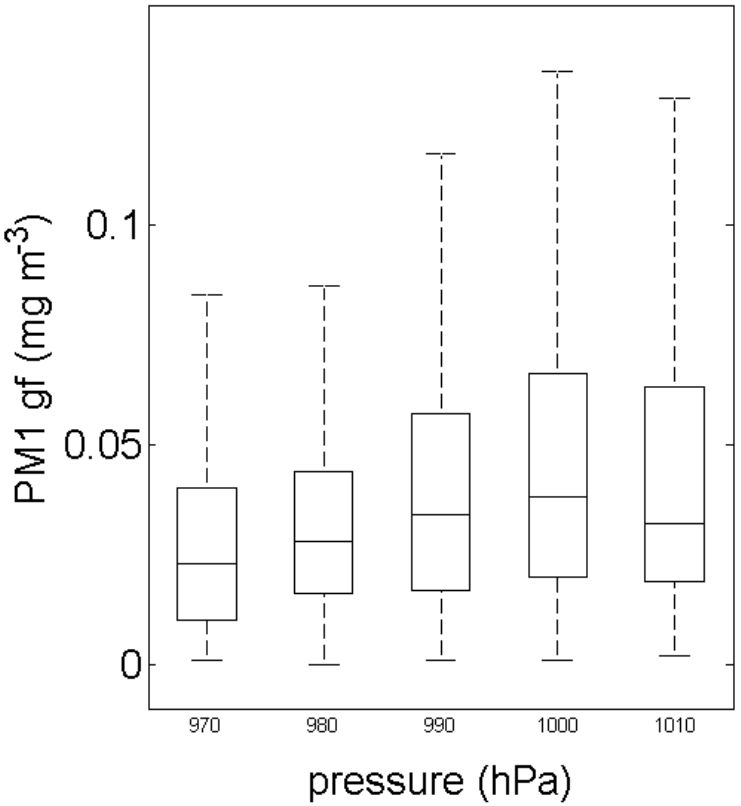


First floor

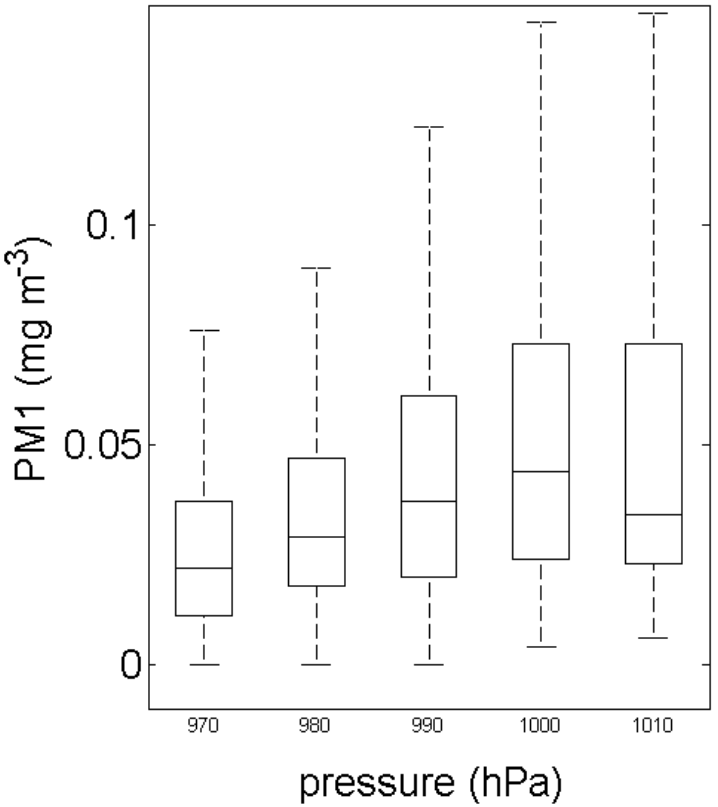


Air pressure

Ground floor

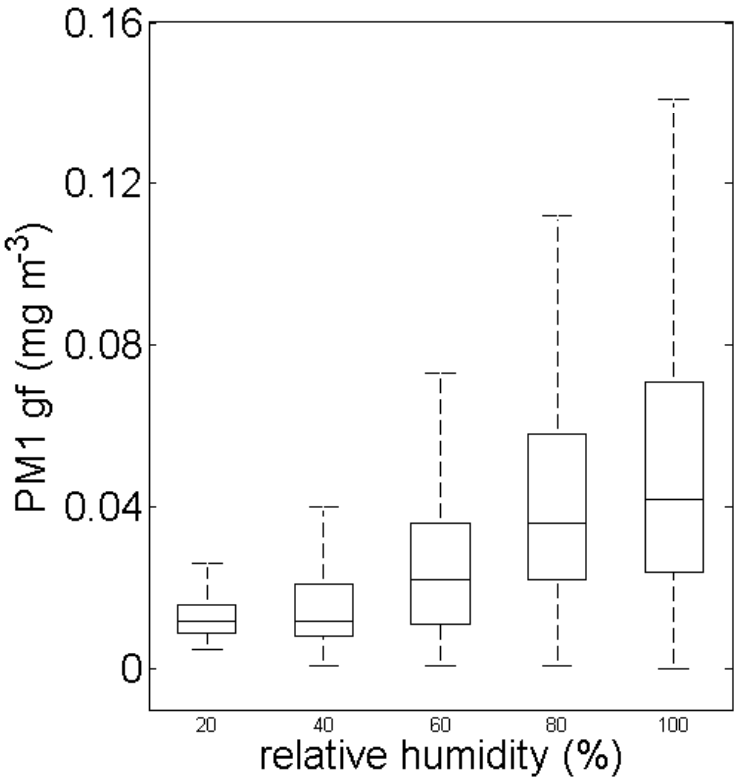


First floor

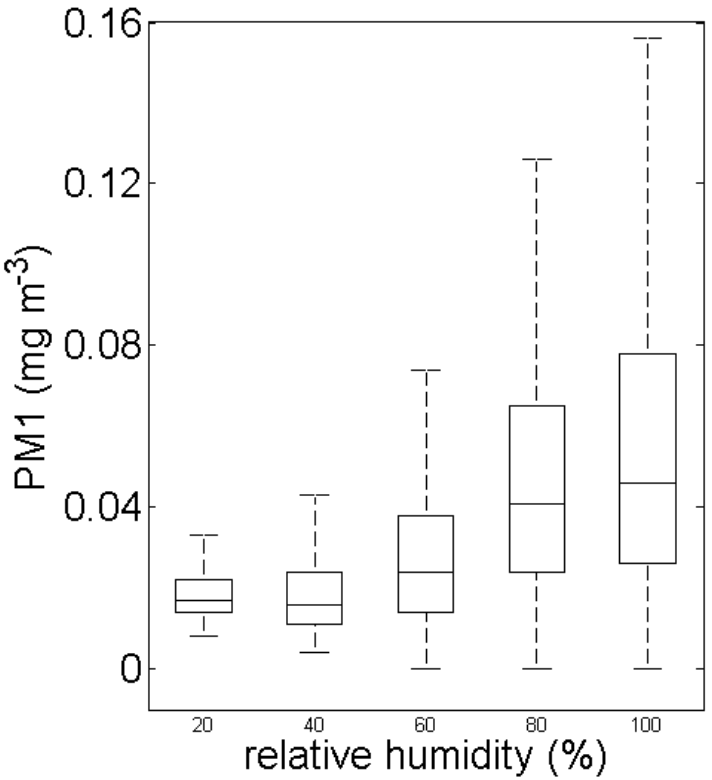


Relative humidity

Ground floor

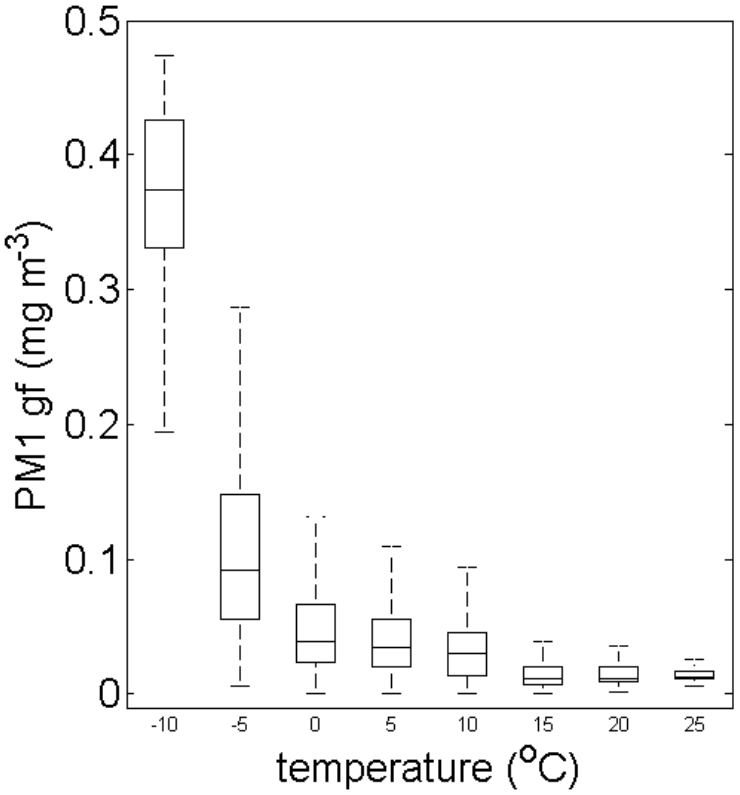


First floor

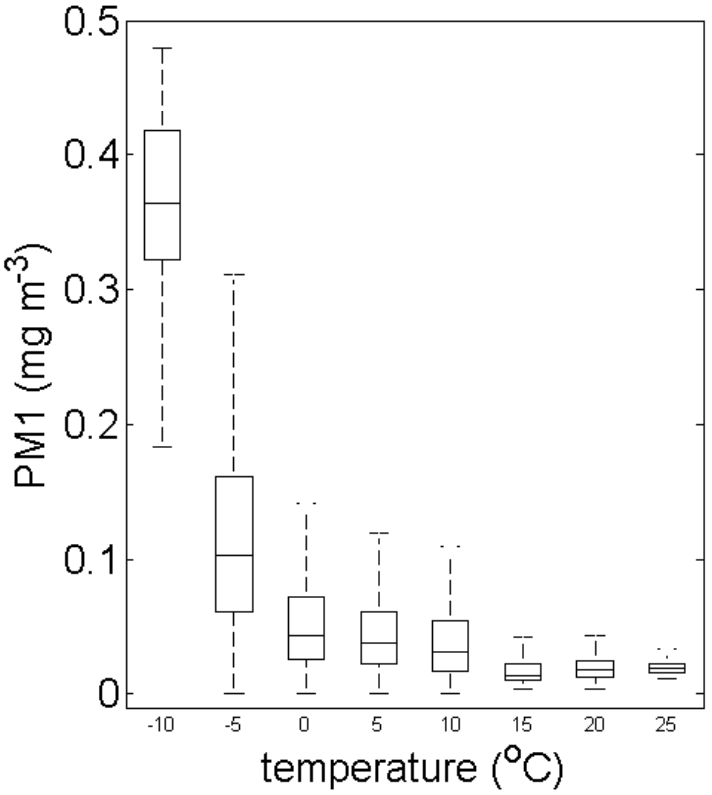


Air temperature

Ground floor



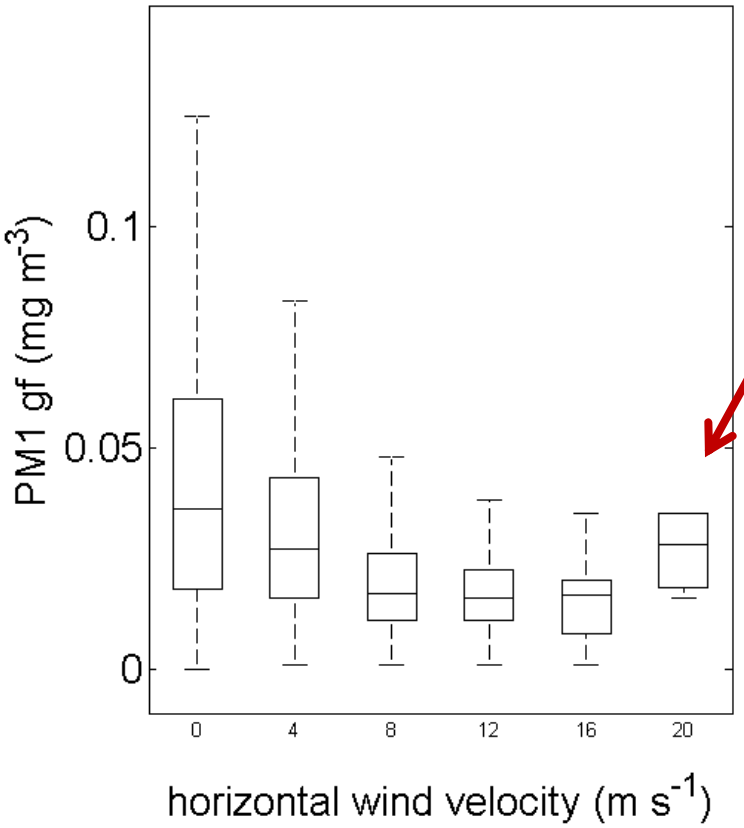
First floor



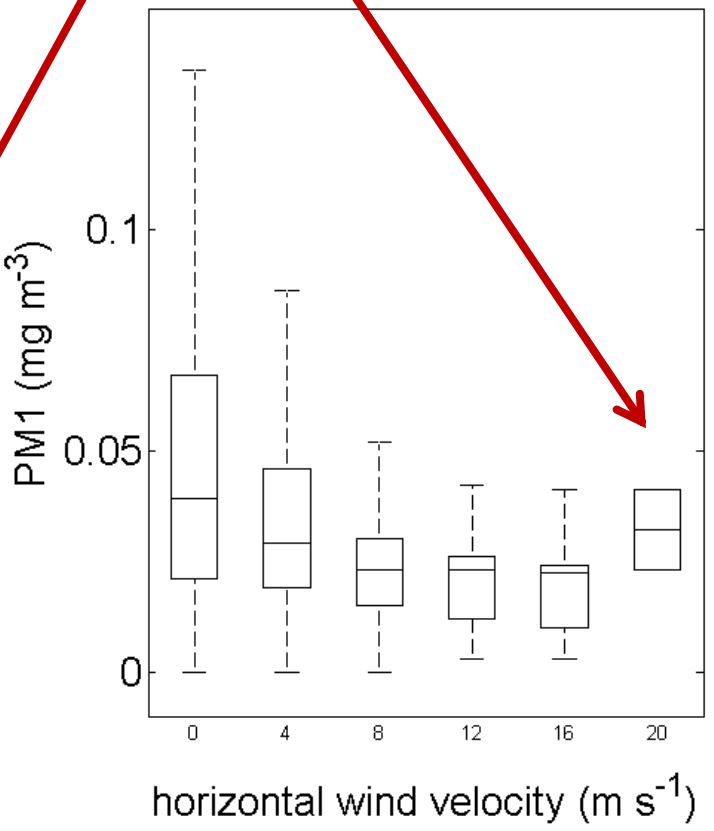
Horizontal wind velocity

Only 6 out of the total 229586 wind data were associated with horizontal wind speeds above 16 m s^{-1}

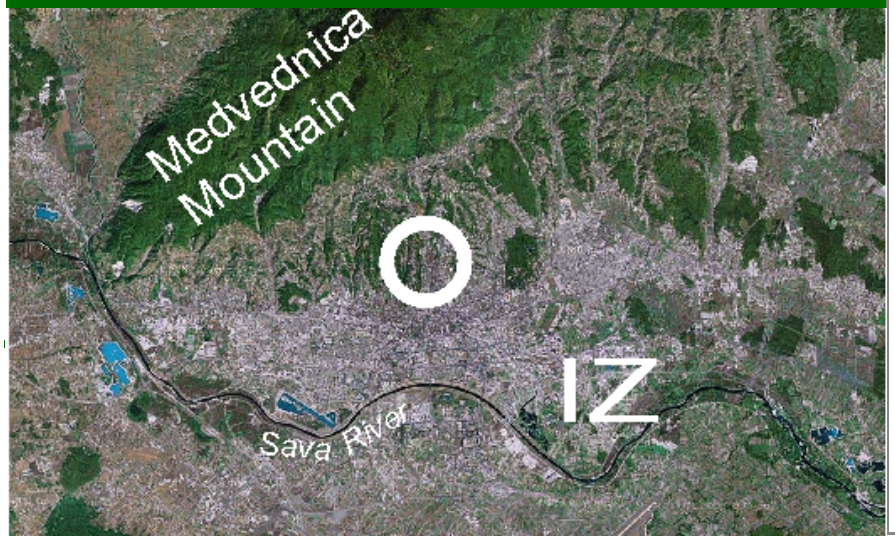
Ground floor

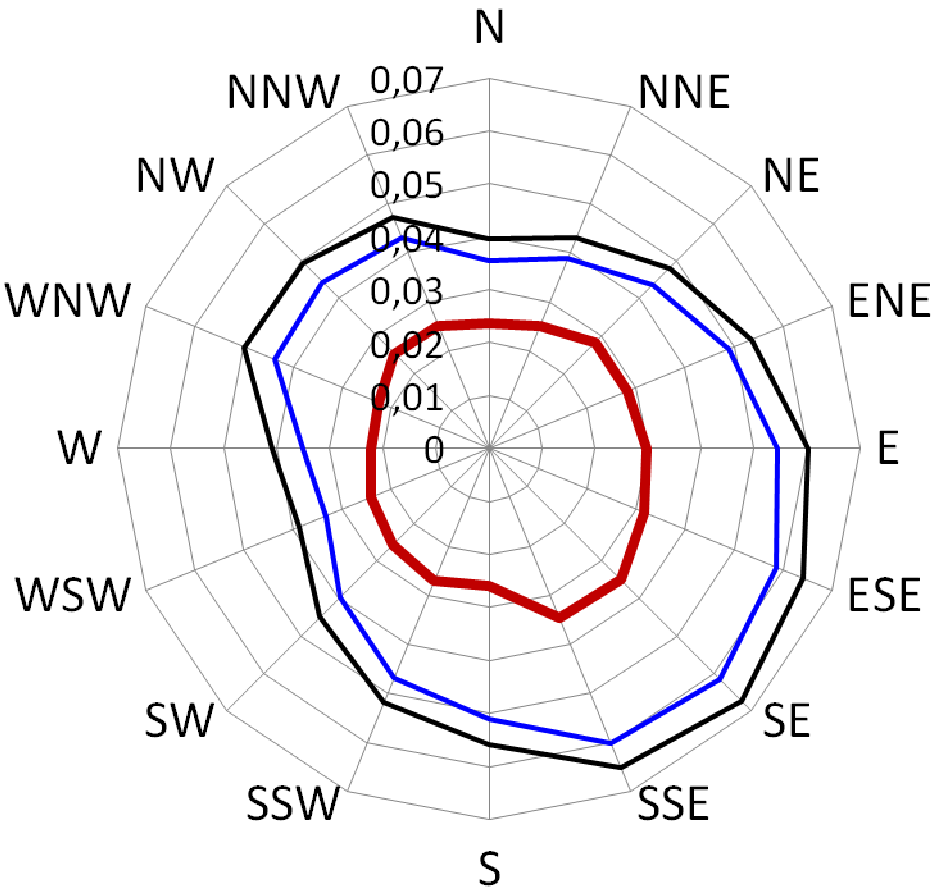


First floor



Wind direction



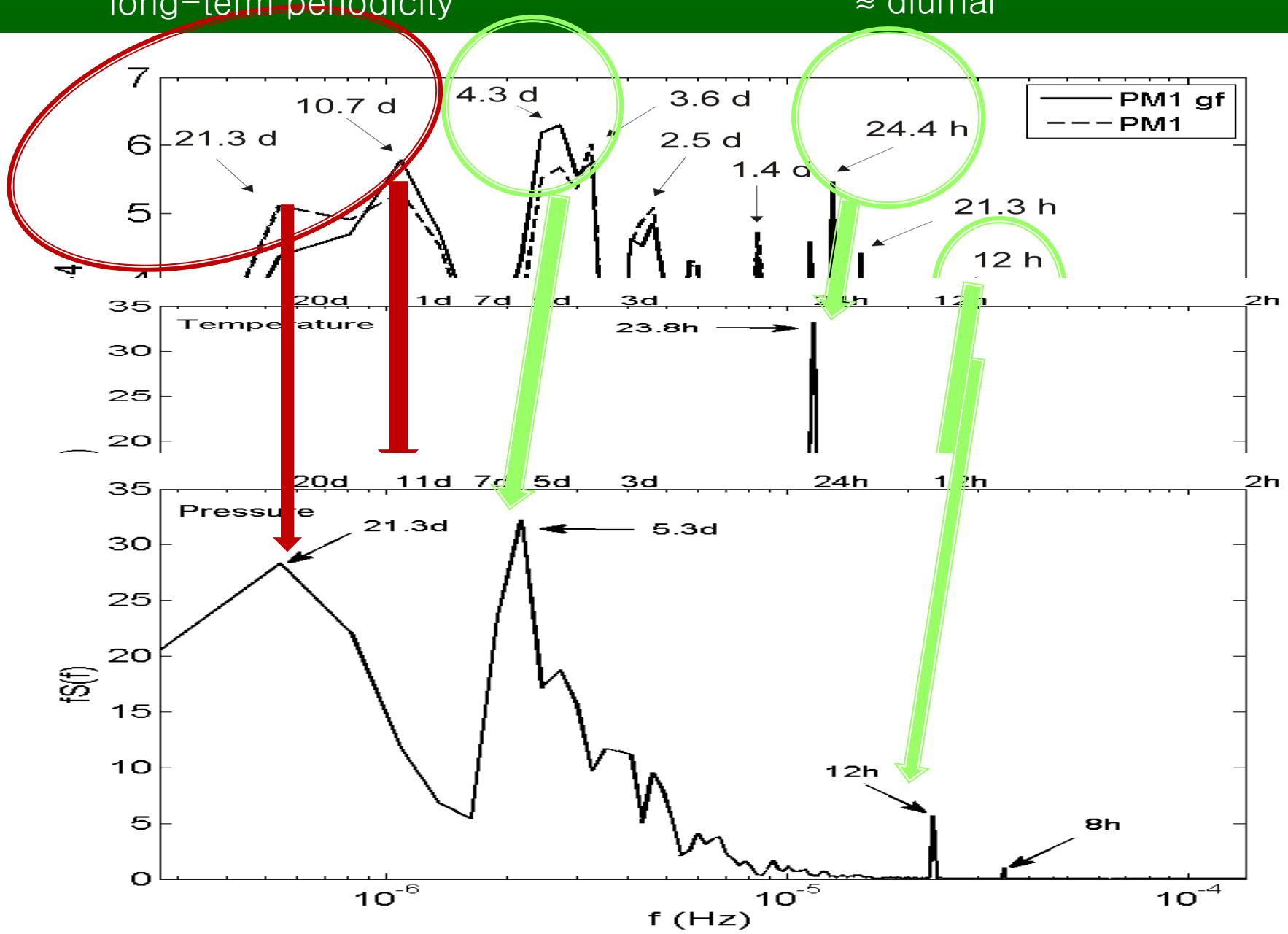


Spectra

long-term periodicity

cyclones

≈ diurnal



CONCLUSIONS

⇒ Wintertime indoor PM levels depend on the outdoor meteorological conditions

- [PM] increases with relative humidity, global radiation, and air pressure
- [PM] decreases with outdoor temperature, precipitation amount, and horizontal wind velocity

⇒ Indoor [PM] depends on the wind direction → signature of 8 – 9 km distant industrial zone

CONCLUSIONS

⇒ ground floor ≠ 1st floor
(outdoor air *vs.* resuspension)

⇒ Expected 7-day periodicity (Mon & Sat) seen in simple statistics, but not confirmed by spectra

⇒ Periodicity of [PM] and meteorological variables: semidiurnal, diurnal, and long-term (≈ 11 and 21 days)

⇒ Long-term periodicity & Rossby waves?

⇒ PM spectra more complex than meteorological spectra

GRACIAS