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PS 3.3 Changing Environment

Urban park effects on Naples air quality

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ICOS INTEGRATED CARBON OBSERVATION SYSTEM

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Outline

1. **INTRODUCTION**
   - Introduction on Urban Forests and Parks
   - Objectives
2. **MATERIAL & METHODS**
   - The Royal Forest of Capodimonte in Naples
   - Eddy Covariance in Capodimonte
3. **RESULTS**
   - Source area (footprint analysis)
   - CO_2 fluxes
   - PM concentration, fluxes and composition
4. **CONCLUSIONS**




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INTRODUCTION
Urban Park

CH_4, H_2O, CO_2

(Nowak et al., 2008)

(VOC, O_3, NO_x, PM)

(Paoletti 2009; Manes 2012)

ENVIRONMENTAL SERVICES

AFFECTING URBAN AIR QUALITY

(Nowak et al., 2016)

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INTRODUCTION
Urban Park

CH_4, H_2O, CO_2

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(VOC, O_3, NO_x, PM)

(Paoletti 2009; Manes 2012)

ENVIRONMENTAL SERVICES

↑

AFFECTING URBAN AIR QUALITY

(Nowak et al., 2016)

MODELS are often used to estimate air pollutants removal capacity

(Escobedo and Nowak, 2009; Alonso et al., 2011; Barò et al., 2014; Kim et al., 2014, Guidolotti et al. 2016).

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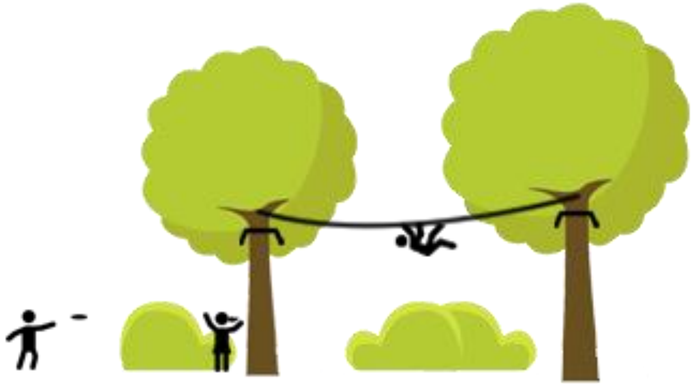
INTRODUCTION
Objectives

WE ESTABLISHED AN EDDY COVARIANCE URBAN FOREST STATION:

TO DIRECT MEASURE TRACE GASES FLUXES IN URBAN PARCK ECOSYSTEMS



TO UNDERSTAND ENVIRONMENTAL EFFECTS OF URBAN PARCK ON URBAN AIR QUALITY AND QUALITY OF LIFE OF CITIZEN

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MATERIALS & METHODS

The Royal Forest of Capodimonte in Naples

The Real Bosco di Capodimonte, a green area of **125 ha** located inside the urban area of Naples

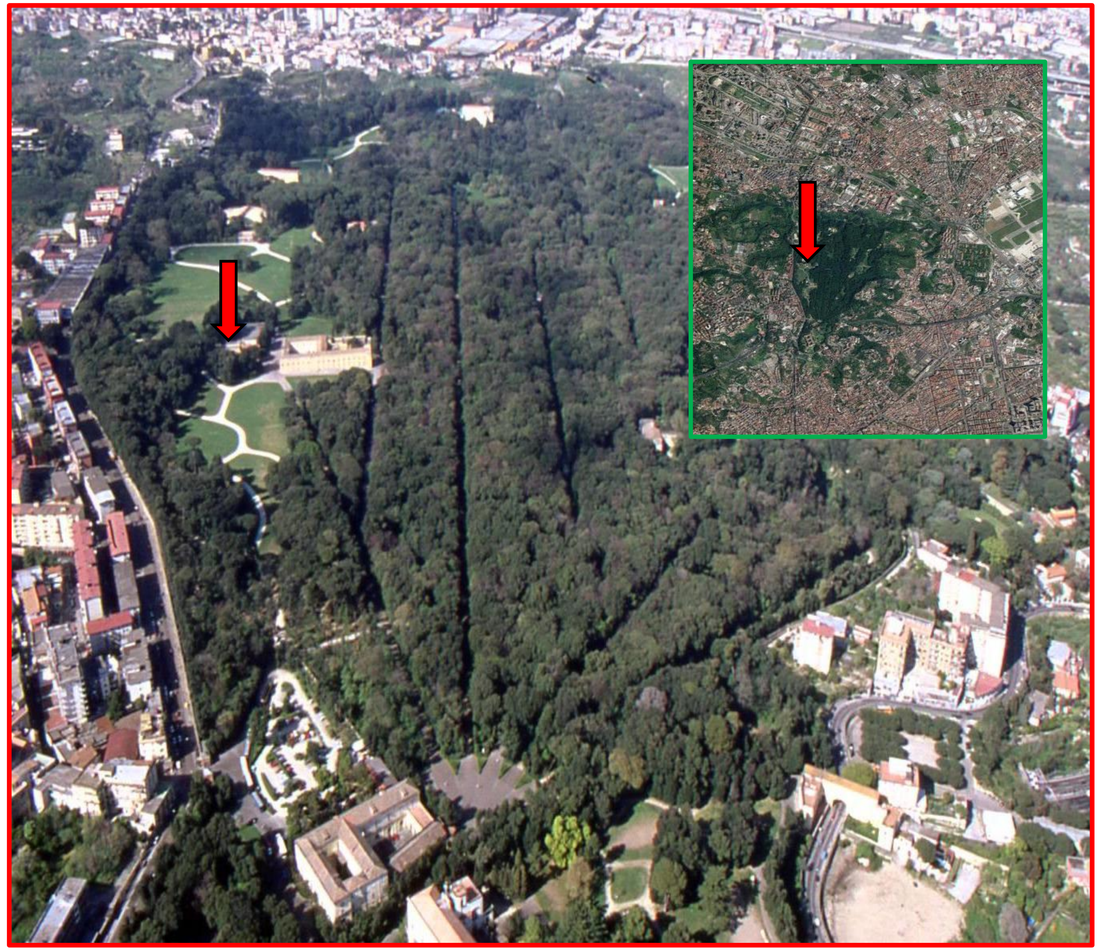
16.3 °C Mean annual temperature
8.4 °C Mean Temperature of coldest month
24.7 °C Mean Temperature of warmest month
855 mm Mean annual precipitation

Mixed Mediterranean forest dominated by:

- *Quercus ilex (**22 m** mean height)*
- *Pinus pinea*

Meadows: *Trifolium* and *Medicago.*

Several autochthonous and exotic tree species



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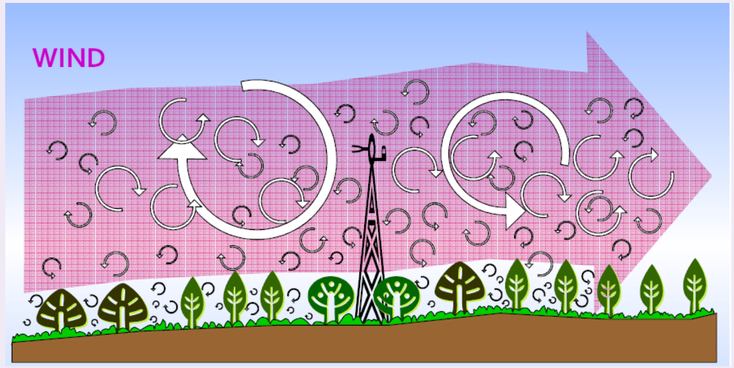
MATERIALS & METHODS

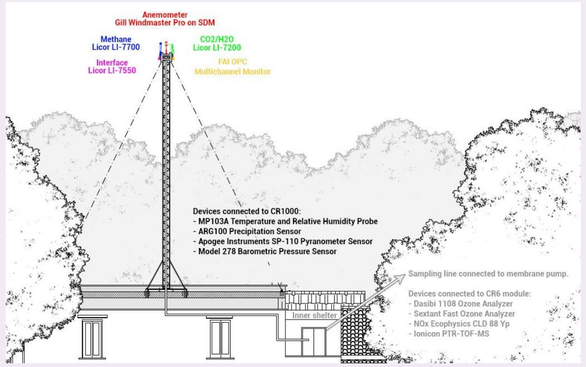
Eddy Covariance in Capodimonte

EDDY COVARIANCE...

- a micro-meteorological technique, based on the **turbulent air movement** (EDDIES) transporting masses (gases, PM)
- It is a reliable method to assess exchange of masses between biosphere and atmosphere



(from Burba et al. 2008)



(from Guidolotti et al. 2017)

- The flux tower (**25 m**) is above a small building
- Equipped with instruments to measure concentrations/exchanges of: **CO_2** , **H_2O**, **CH_4** , **O_3** , **PM**, **NO_X** and VOCs

… IN CAPODIMONTE

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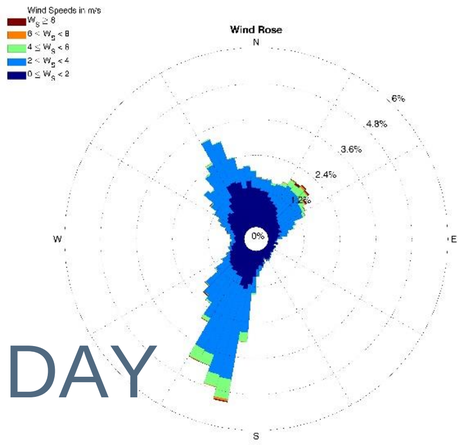
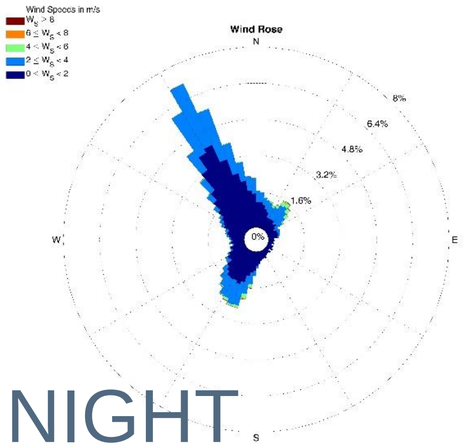
RESULTS
Footprint Analysis

(from March 2015 to September 2017)



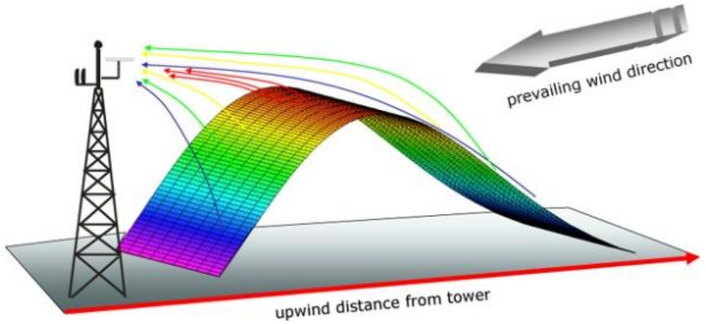
DAY



NIGHT

- White border represents up to **80%** of accumulated flux footprint
- The distance of 80% of accumulated footprint was about **100 m** around the tower

- **Land Cover Contribution**
- **41 %** from the mixed forest
- **13 %** from the meadow
- **46 %** from the buildings



Pallozzi et al., «Urban park effects on Naples air quality»

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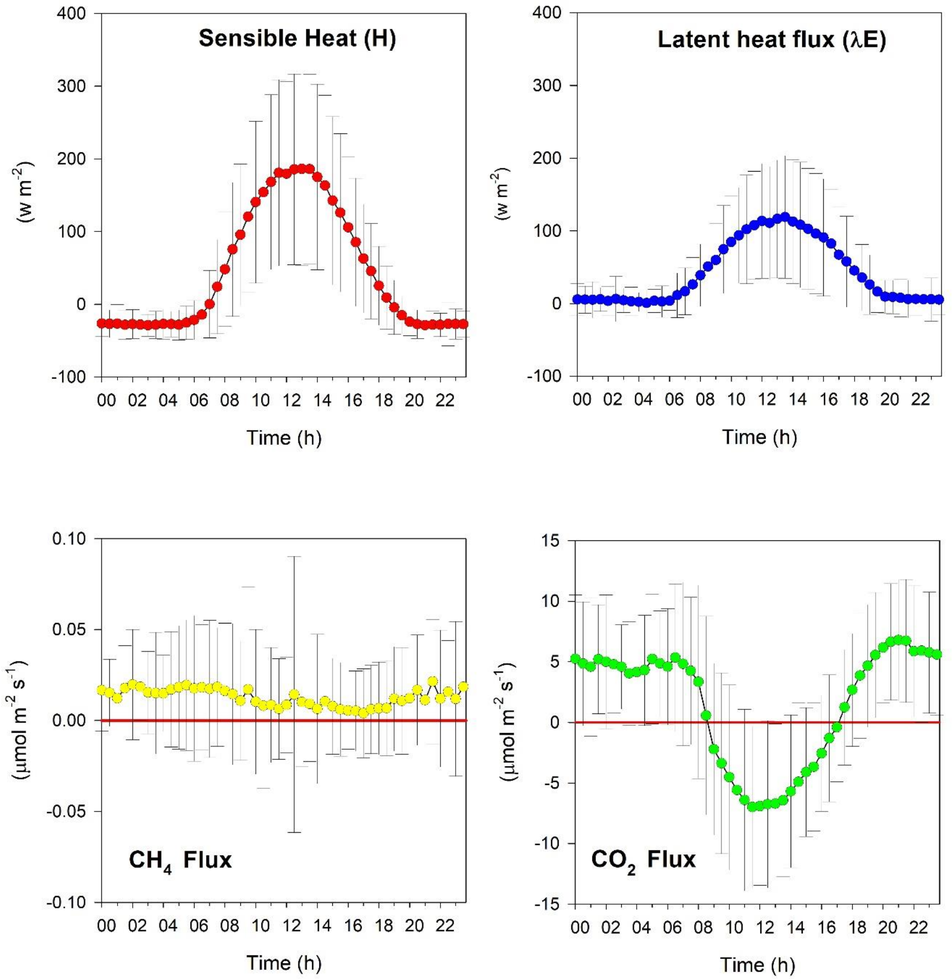
RESULTS

Average Diurnal Pattern

(from March 2015 to September 2017)

- Sensible Heat (H) is dominant with a maximum average of about 200 W m^{-2}
- Net CH_4 emission detected without any diurnal trend
- CO_2 fluxes averages ranged from – 5 to +5 µmol CO_2 m^{-2} s^{-1}



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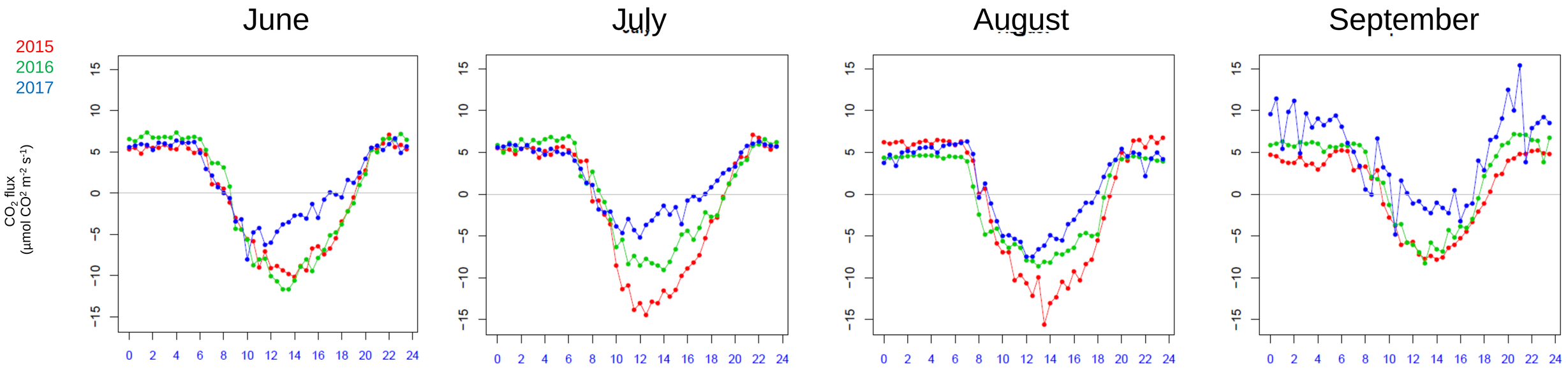
RESULTS

Interannual Variability of CO_2 fluxes *(from June to September)*

CO_2 and Energy Fluxes were gap-filled by the **REddyProcWeb** on-line tool (Max Planck Institute for Biogeochemistry)



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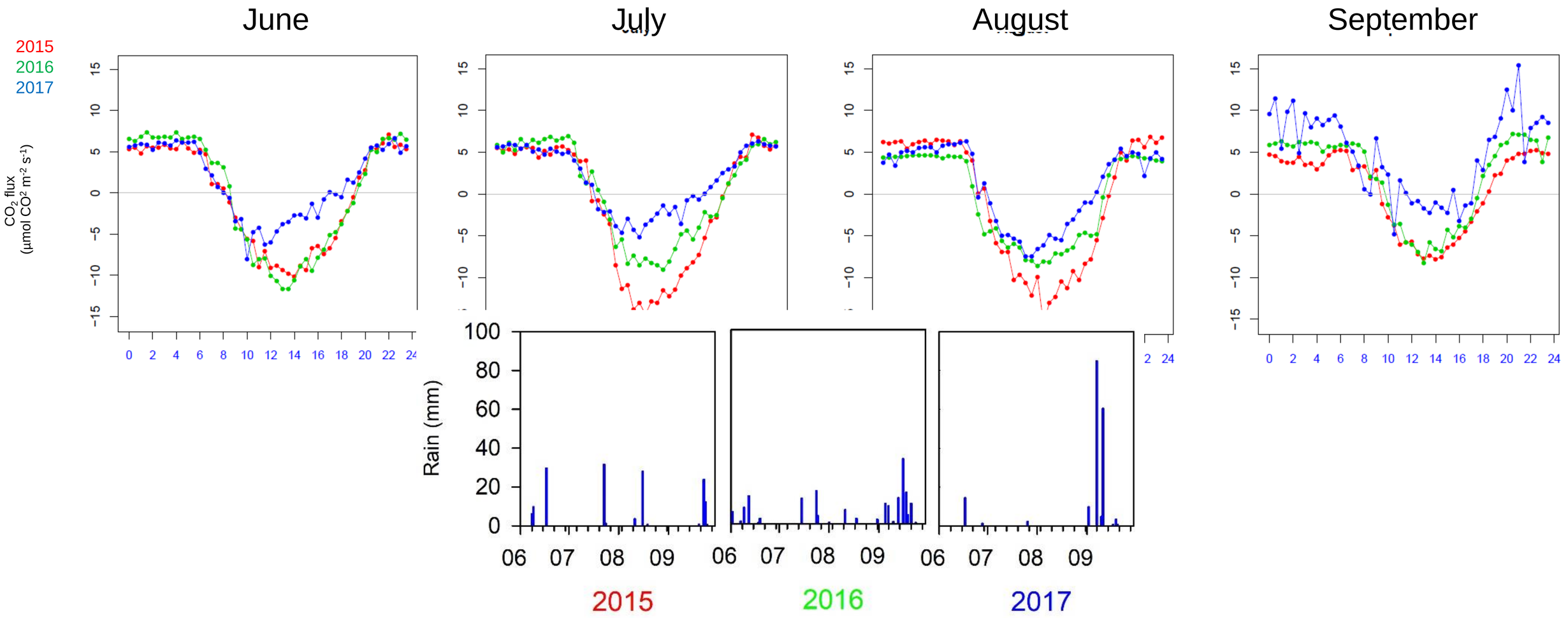

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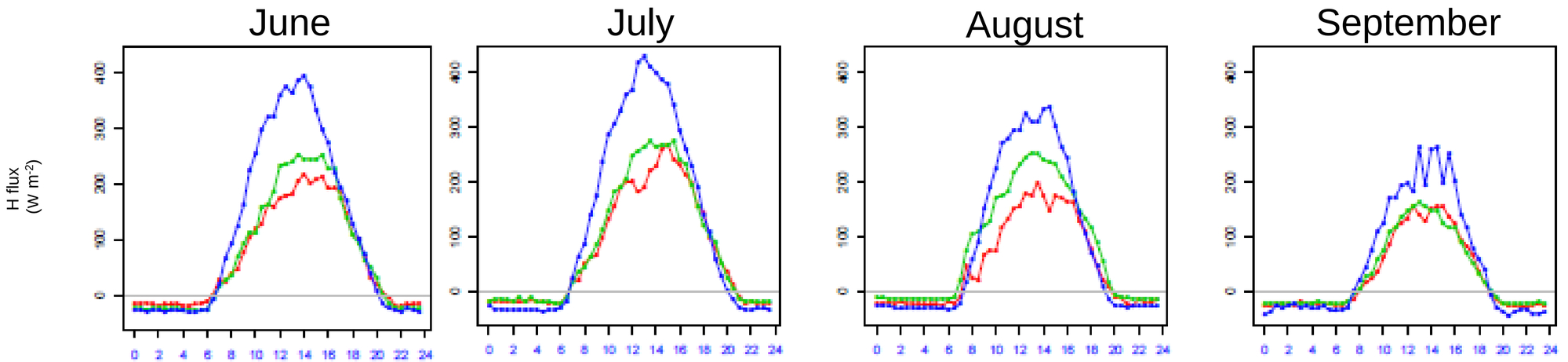
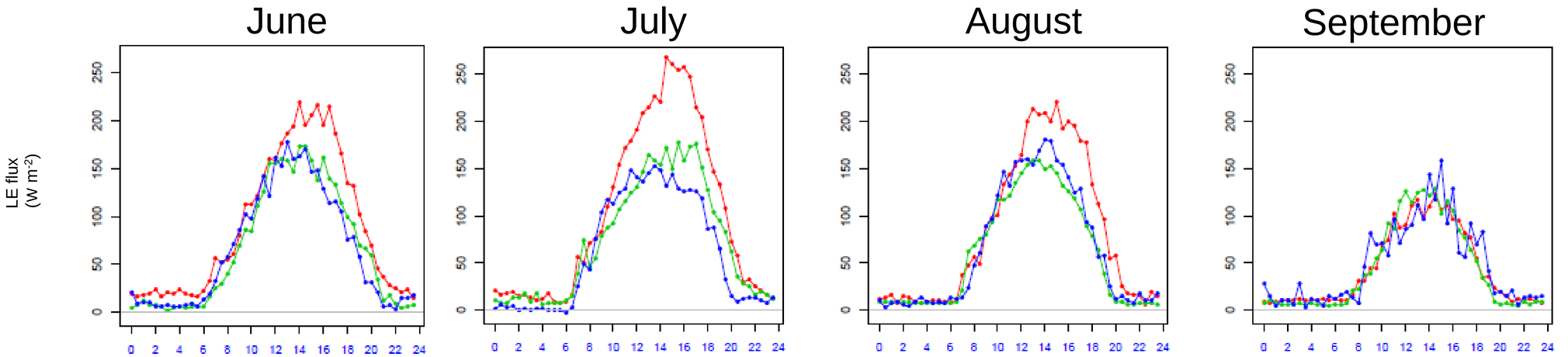
2015
2016
2017



2015
2016
2017



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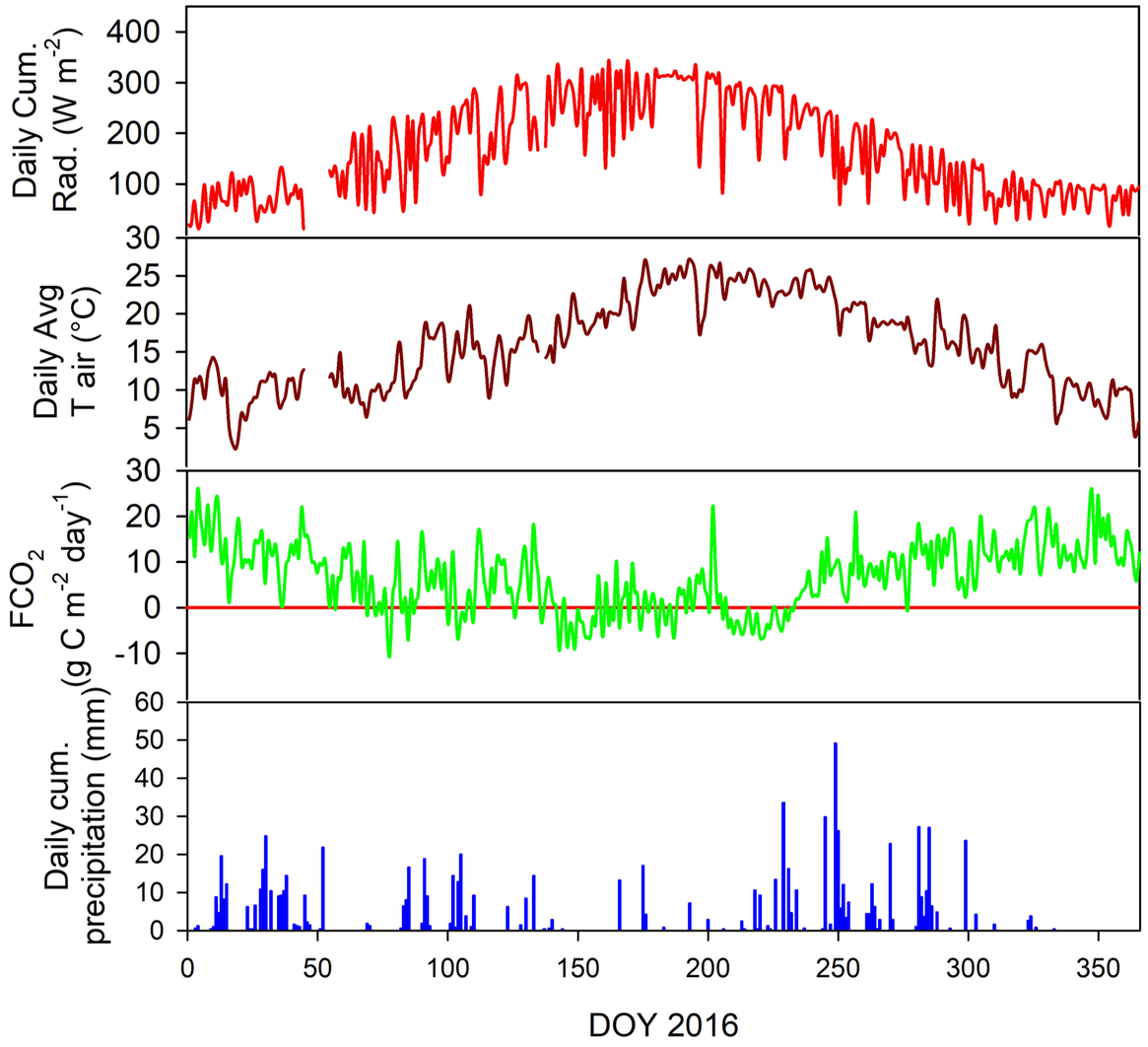
RESULTS

Carbon Balance 2016



NET LOSS OF **2400** g m^{-2} $year^{-1}$

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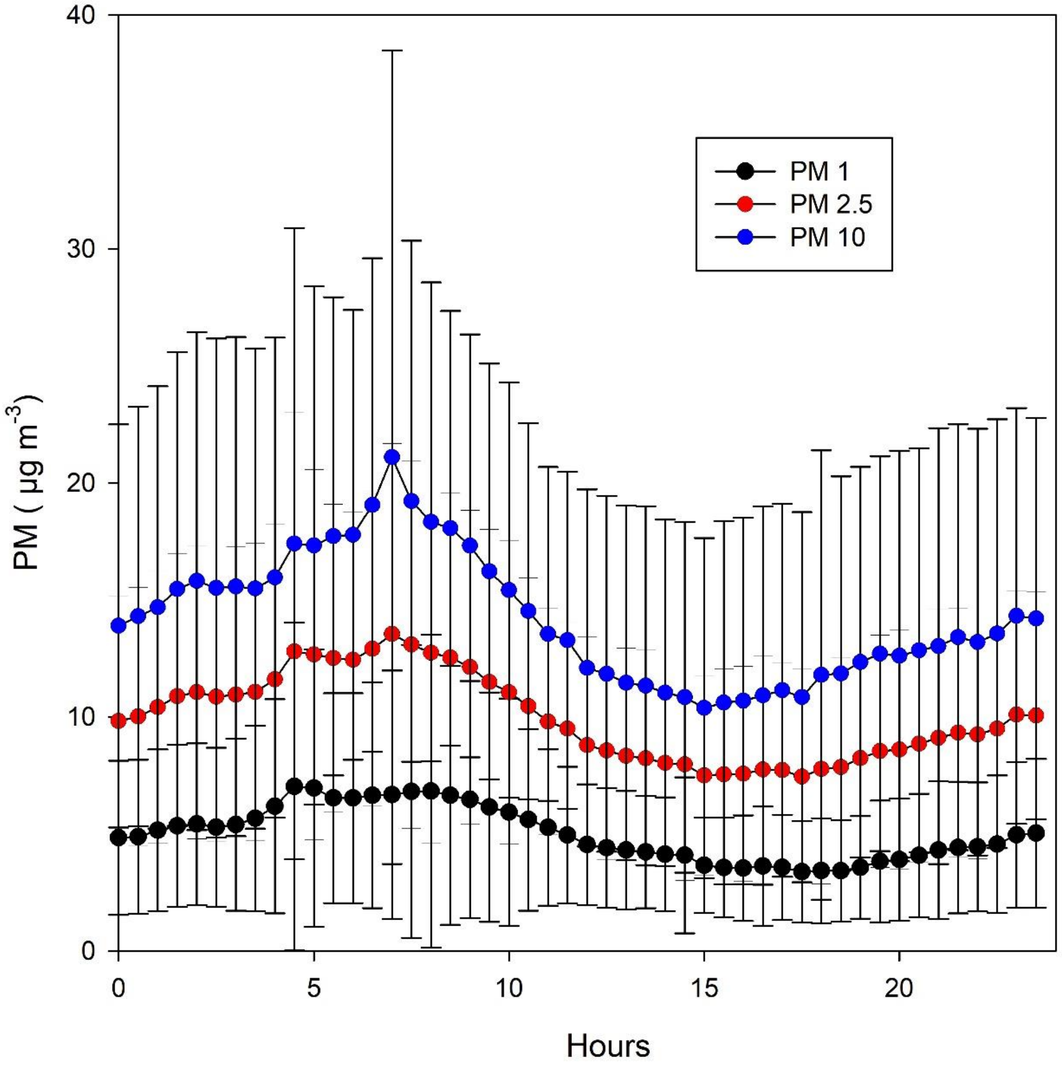
RESULTS

Particulate Matter (PM) Concentration *(from June 2017 to September 2017)*



- Highest concentration between 7 and 8
- Lowest concentration between 14 and 15

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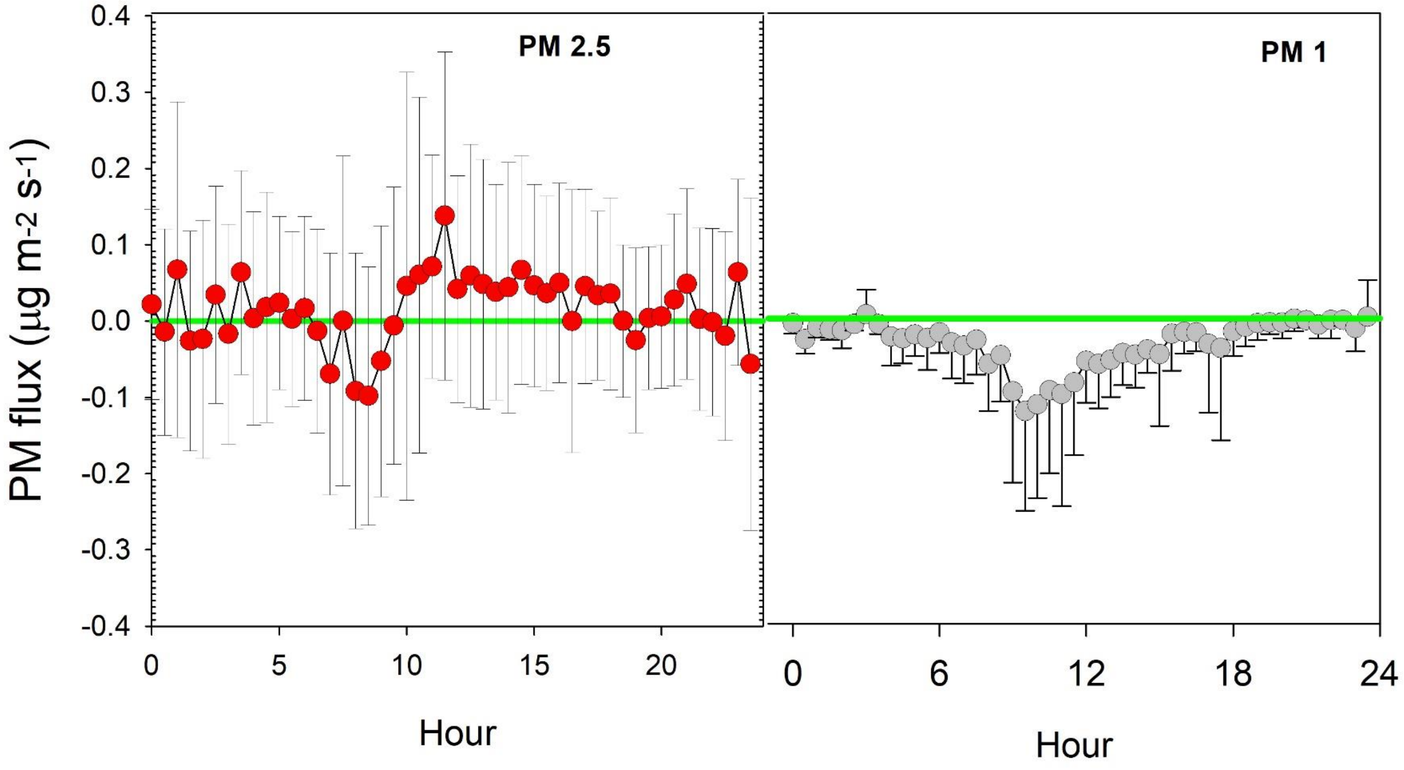
RESULTS

Particulate Matter (PM) Fluxes

(from June 2017 to September 2017)

- PM10 fluxes did not pass QC
- Not clear daily trend for PM 2.5 fluxes
- Peak of deposition of PM 1 around noon



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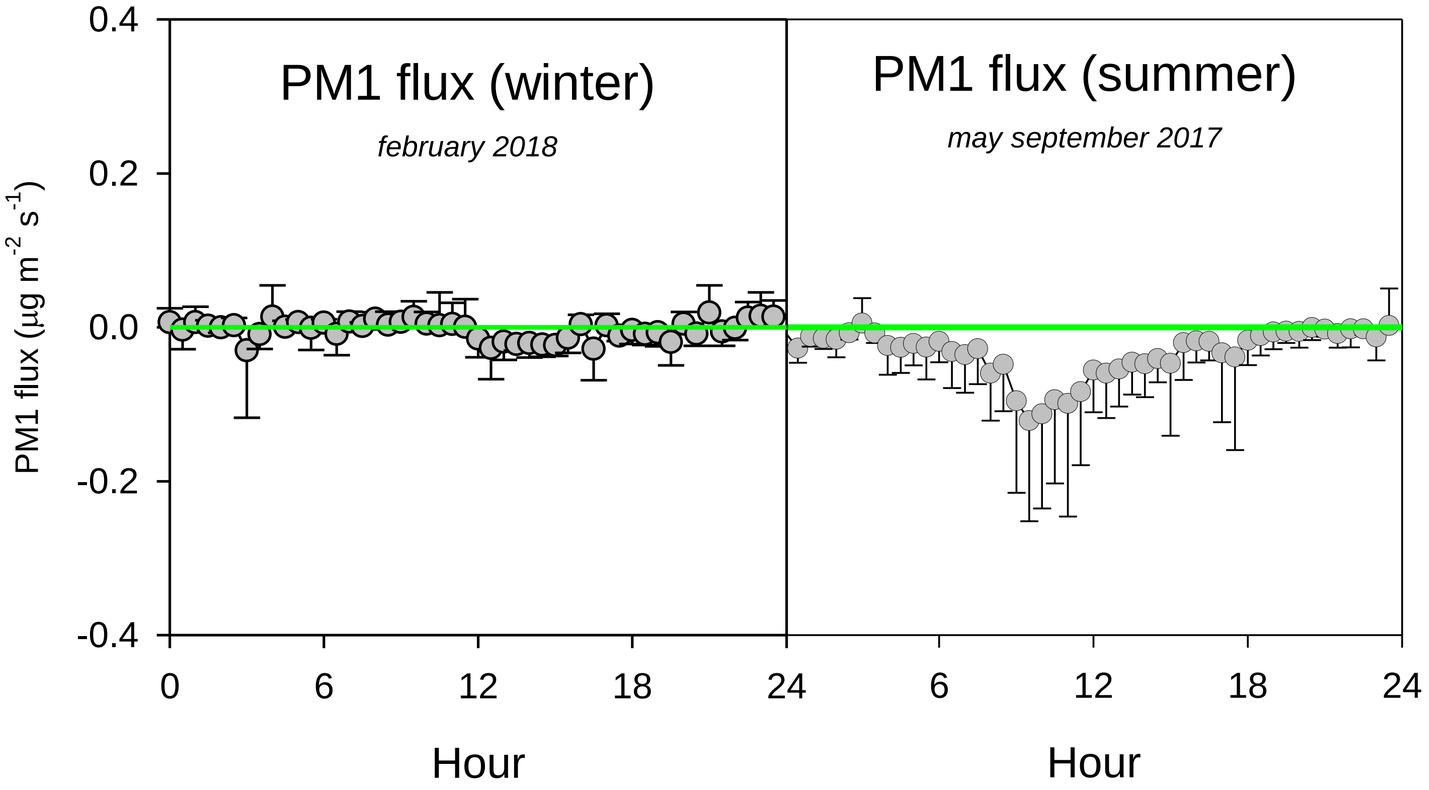
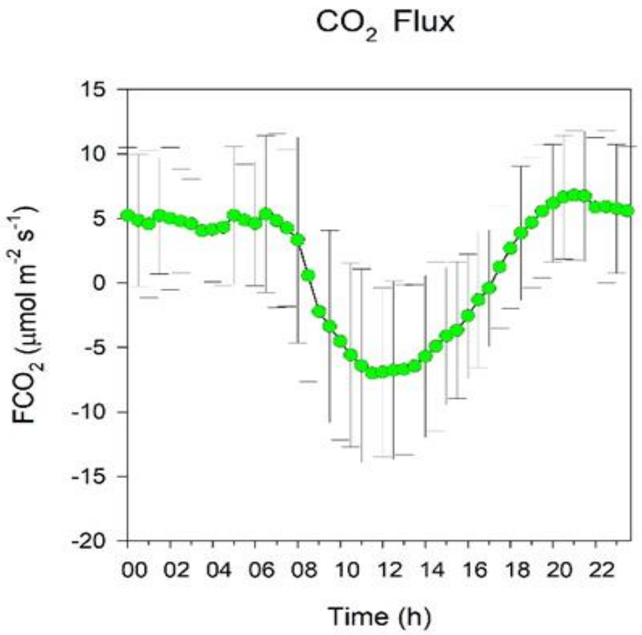
RESULTS

Particulate Matter (PM) Fluxes

(from June 2017 to September 2017)





A SPECULATION

Stomatal Mechanism?

(Burkhardt 2010; Fares et al. 2016)

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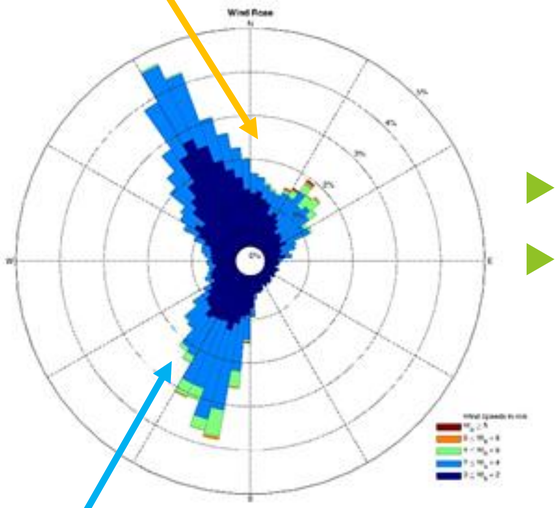
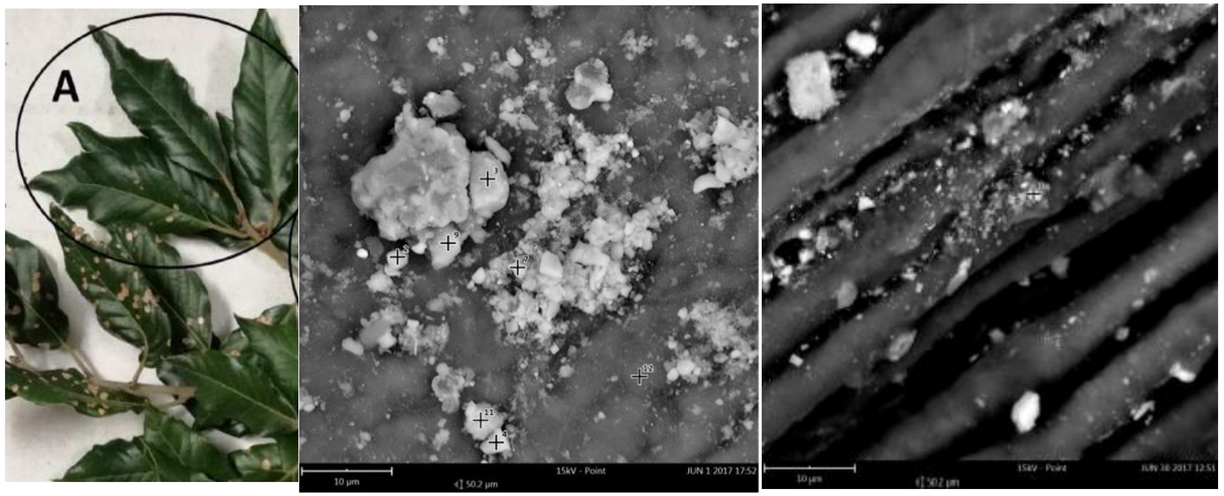
RESULTS

Particulate Matter (PM) Composition



SEM/EDX

- **SEM imaging**: particle size (volume Vi)
- **EDX analysis**: particle elemental composition (elemental concentration per particle)



- Locations 2 and 4: Highest levels of **Iron**, 11% and 15% with and Mg, Mn, Ca and P.
- Locations 1, 5 and 7: Associated with **Na, Cl** (sea elements) and K.
- Locations 6 and 3: Associated with **Al, Si** (earth based elements).

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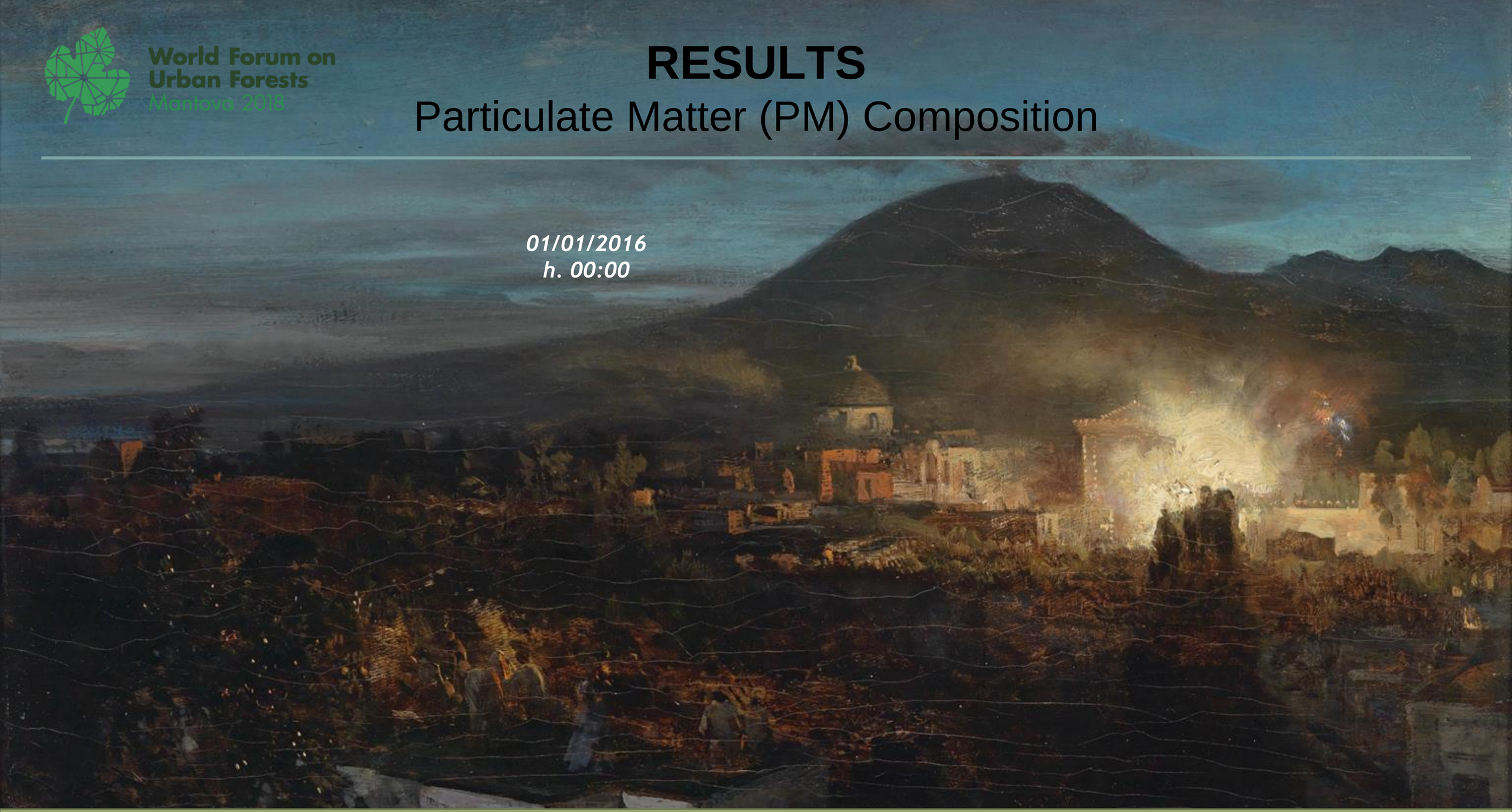
RESULTS

Particulate Matter (PM) Composition



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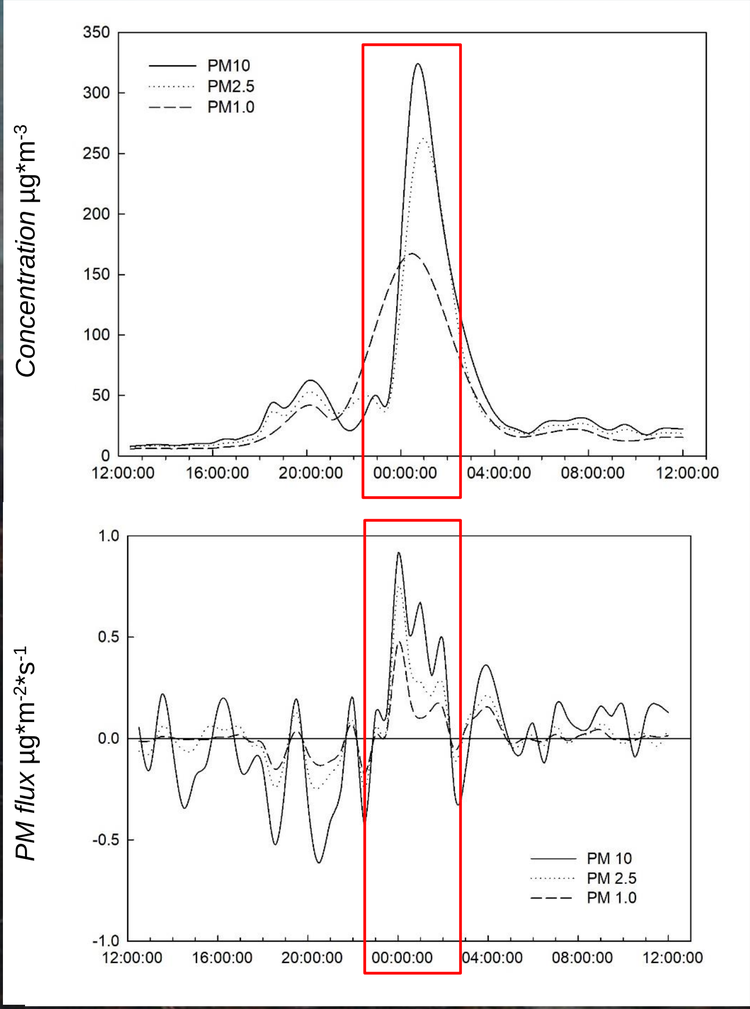

01/01/2016
h. 00:00 - 02:00
Peak of PM concentration and resuspension

→***SEM/EDX Analysis***
one month later (end January)

Magnesium
Titanium
Barium
Cupper
Strontium

Typical FIREWORKS Component

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RESULTS

Particulate Matter (PM) Composition

- **The vegetation of the Capodimonte park can only offset city carbon losses (deeper analysis of footprint required)**
- **Summer CO_2 uptake is driven by precipitation**
- **A clear deposition for PM1 during the central hours of the day (stomata?)**
- **Composition of PM deposed on leaves it depends on wind direction**
- **Don’t do fireworks!!!**

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THANK YOU!