A case study of the usefulness of $\delta^{13}C$ and $\delta^{15}N$ for PM source apportionment under different meteorological conditions

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- UniParthenope: Elena Chianese, Angelo Riccio

NAPOLI PM 2026

ATMOSPHERIC ENVIRONMENT

Acknowledgments

Angelo Riccio e Elena Chianese, UniParthenope

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UniCordoba

Carmina Sirignano
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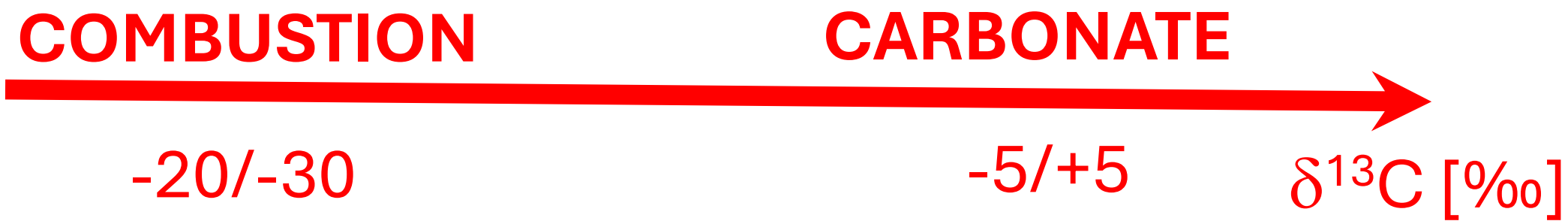
Anikò Angyal, ATOMKI

Rationale

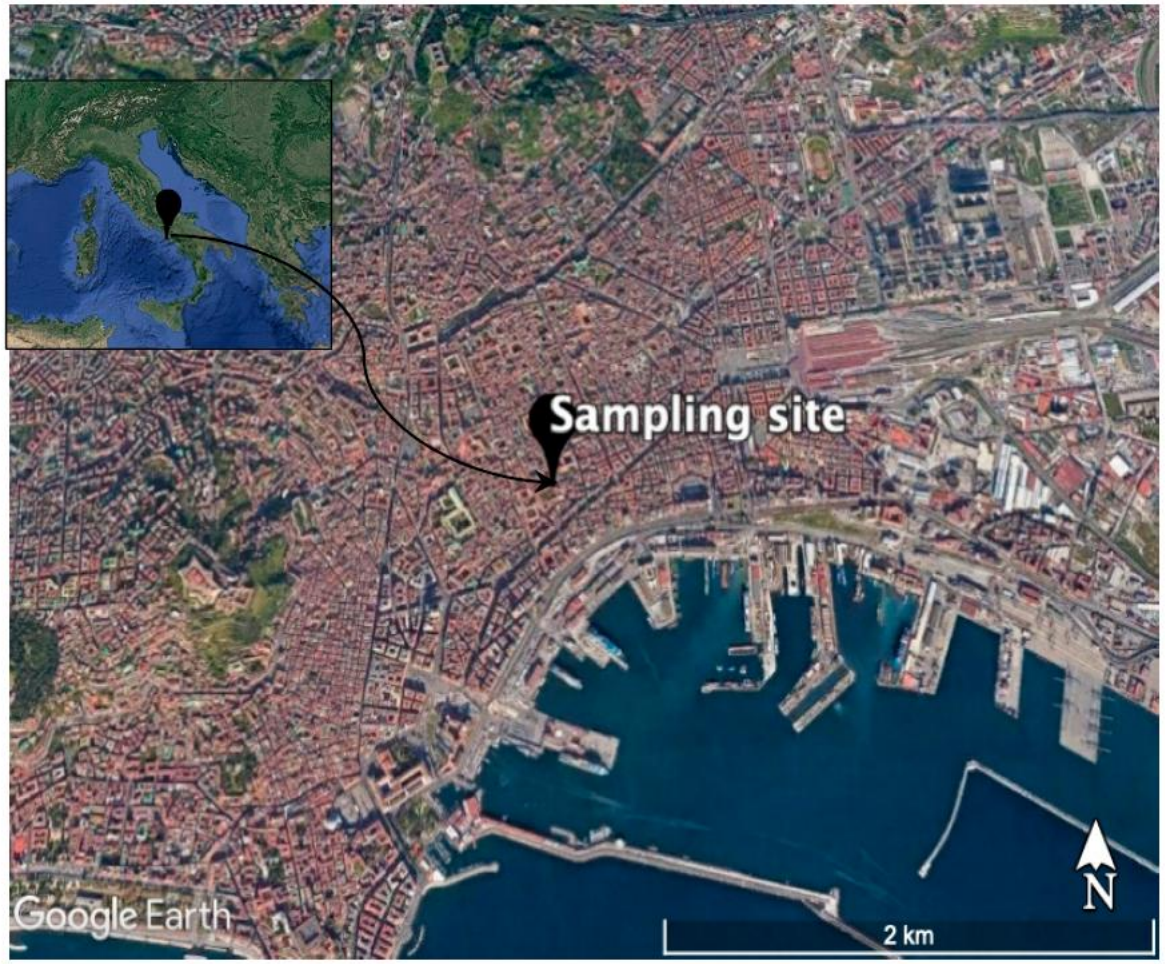

COMBUSTION
CARBONATE
-20/-30
-5/+5
δ13C [‰]


VOLATILIZATION
COMBUSTION
-40/-10
+0/+20
δ15N [‰]

Methods: Sampling

AriaSaNa

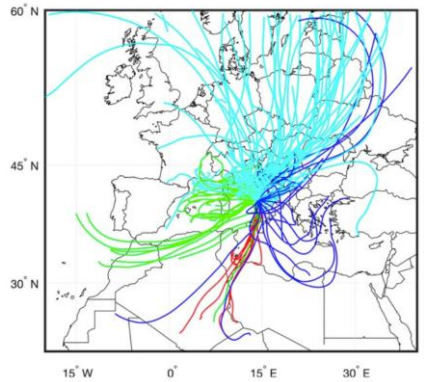
PM2.5 PM10



May 2016 VS Nov 2016 - Jan 2017

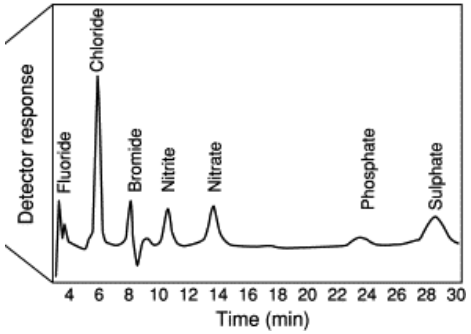
Methods

- Meteorology: wind roses, wind speed and direction, back-trajectories

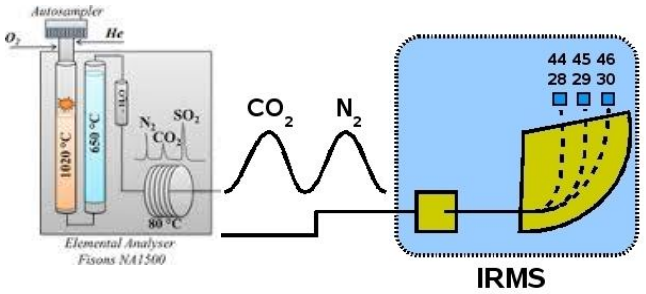


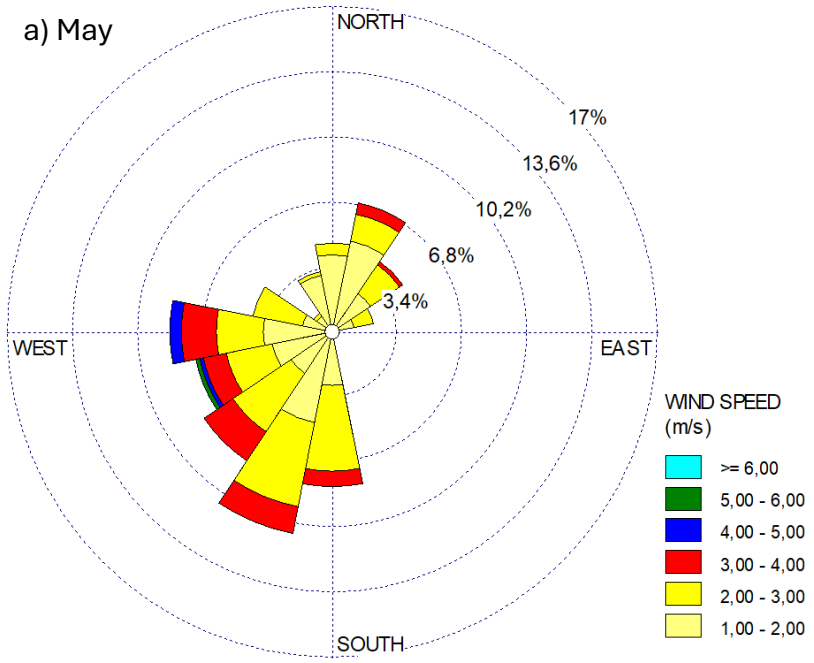
- Ion chromatography: major ions

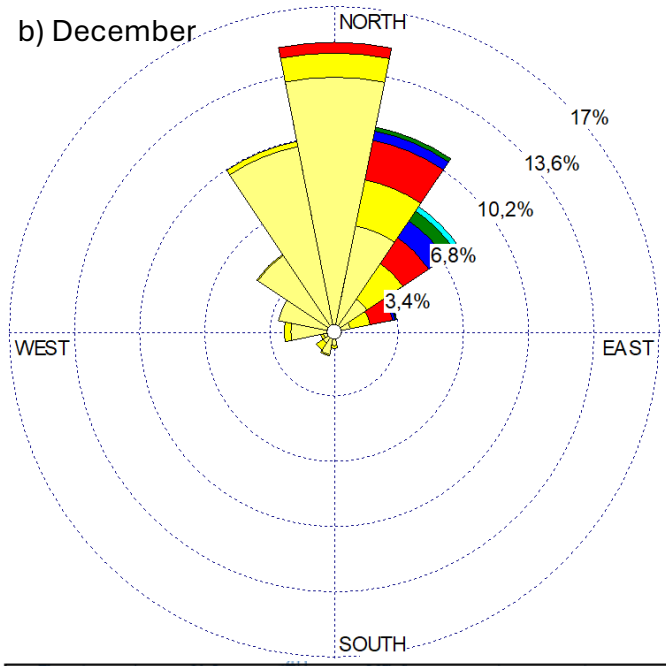
  (NO_3^-, NH_4^+, SO_4^{2-}, Ca^{2+}, K^+, Na^+, Cl^-, etc…)

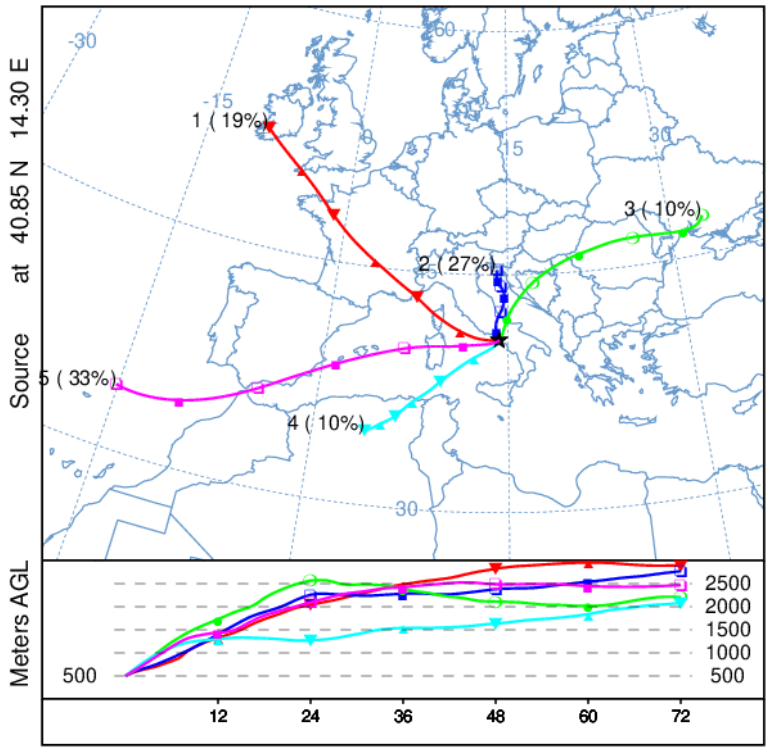


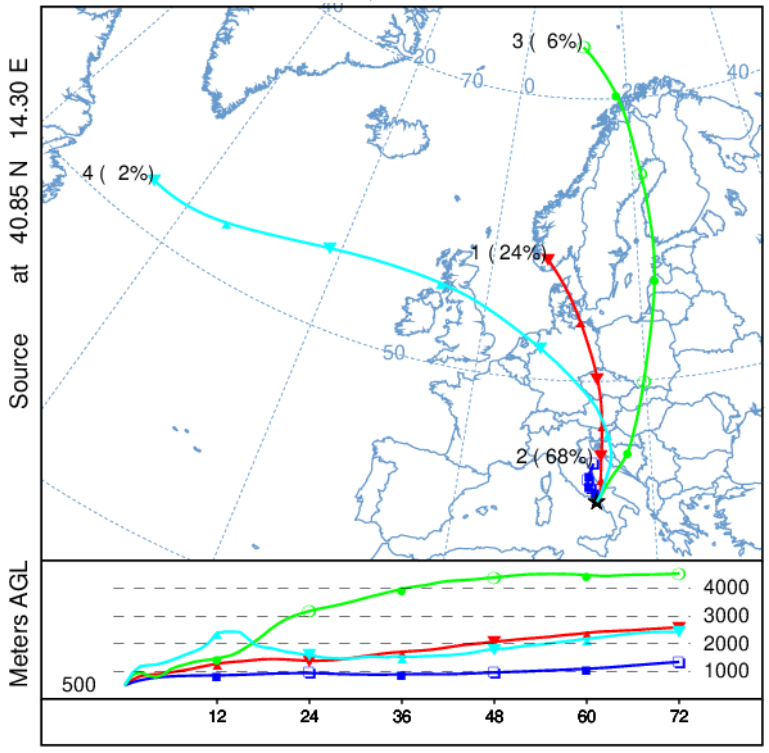
- Elemental analysis + Isotope Ratio Mass Spectrometry: total PM, C, N and isotopes ($\delta^{13}C$ and $\delta^{15}N$)





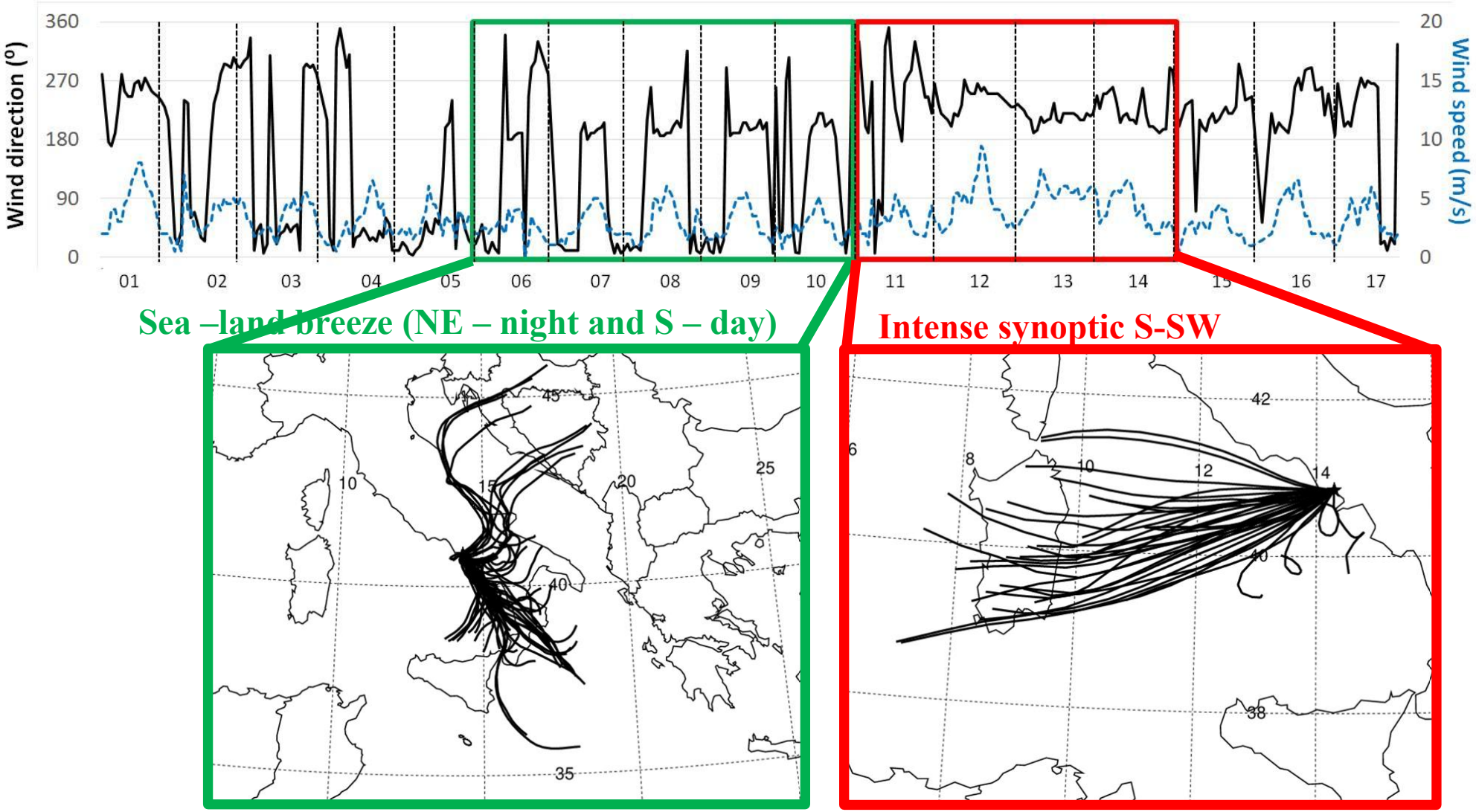


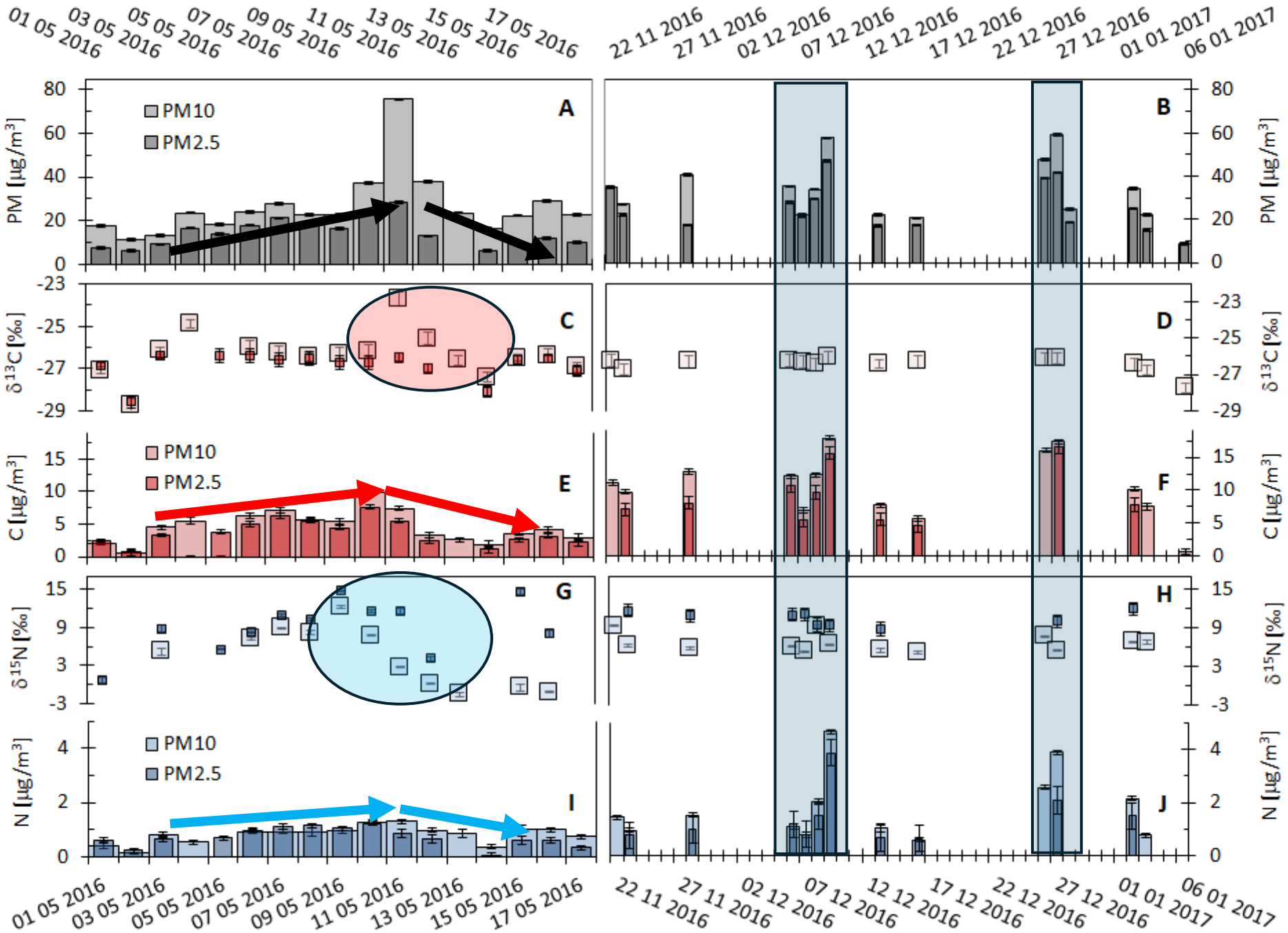




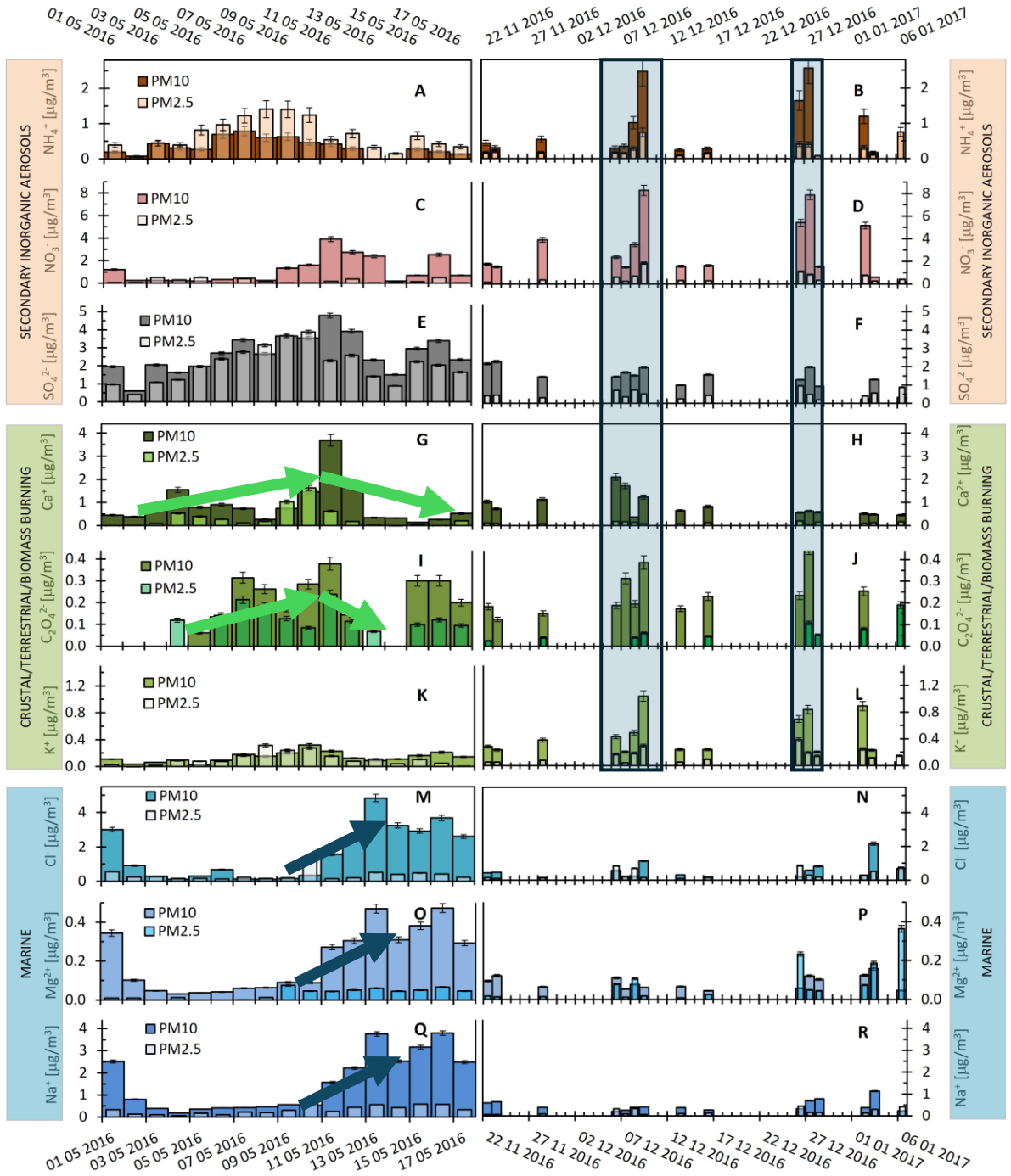
Results: meteorology - May vs december

Results: meteorology - May



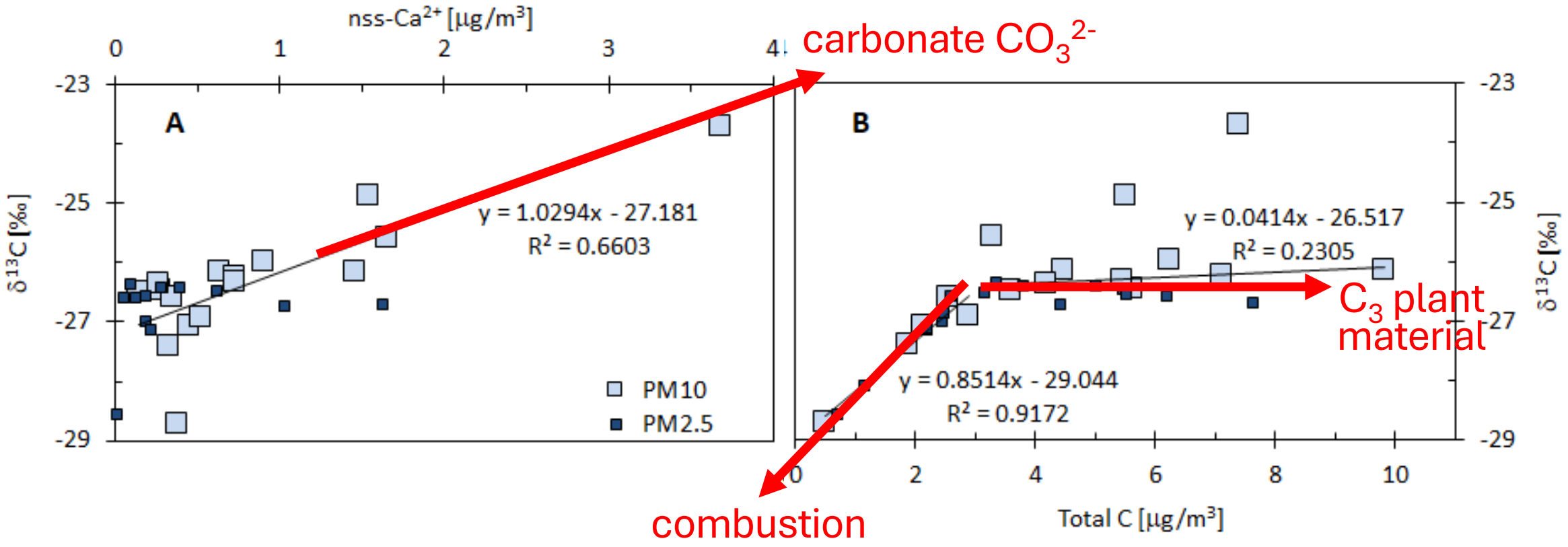


Results: total PM, C, N and isotopes

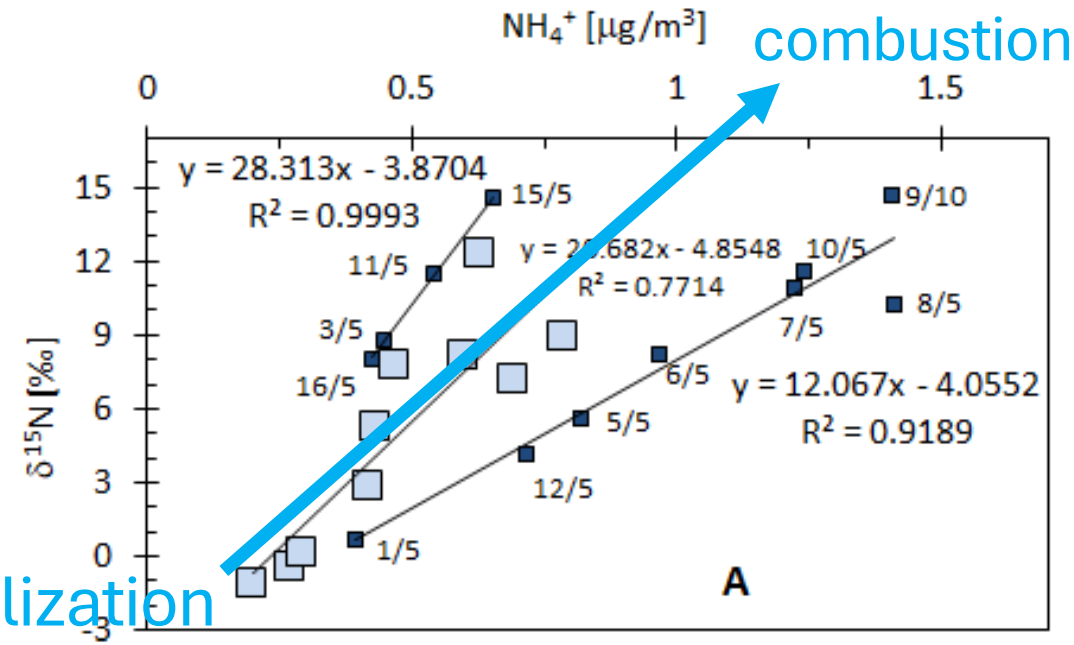


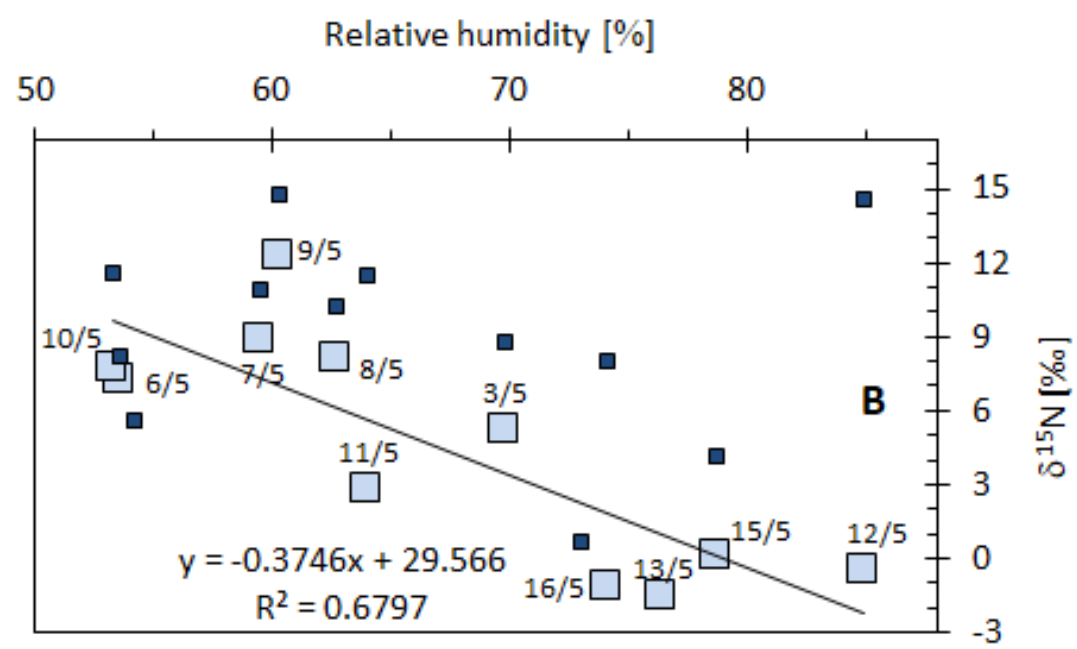
Results: Major ions

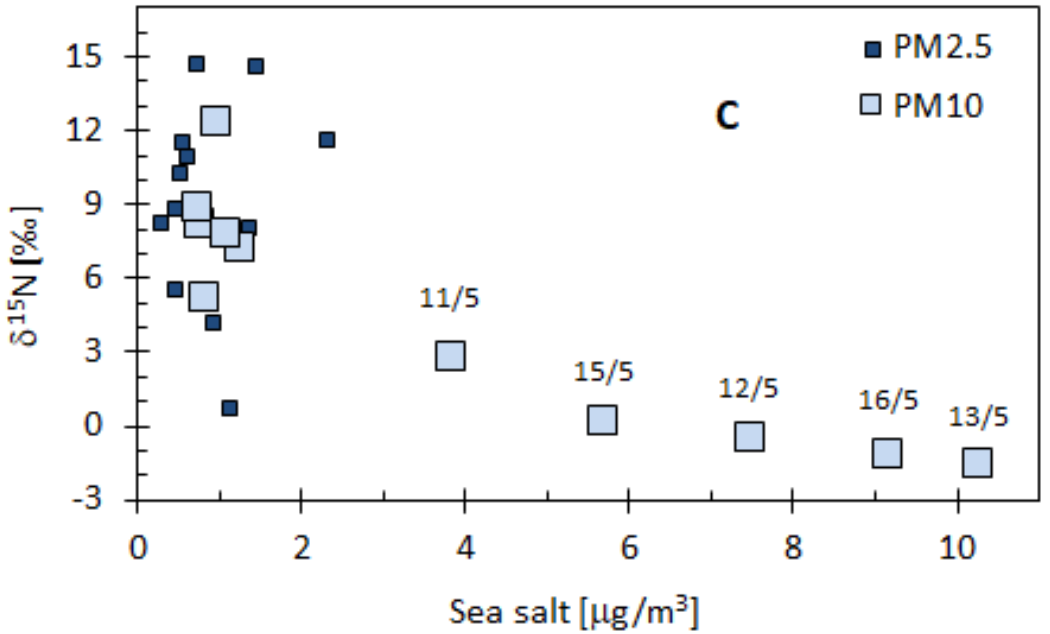
Results: correlations of carbon



Results: correlations of nitrogen







$$NH_4^+{}_{(aq)} \rightleftharpoons H^+{}_{(aq)} + NH_3{}_{(aq)}$$

Conclusions: strengths

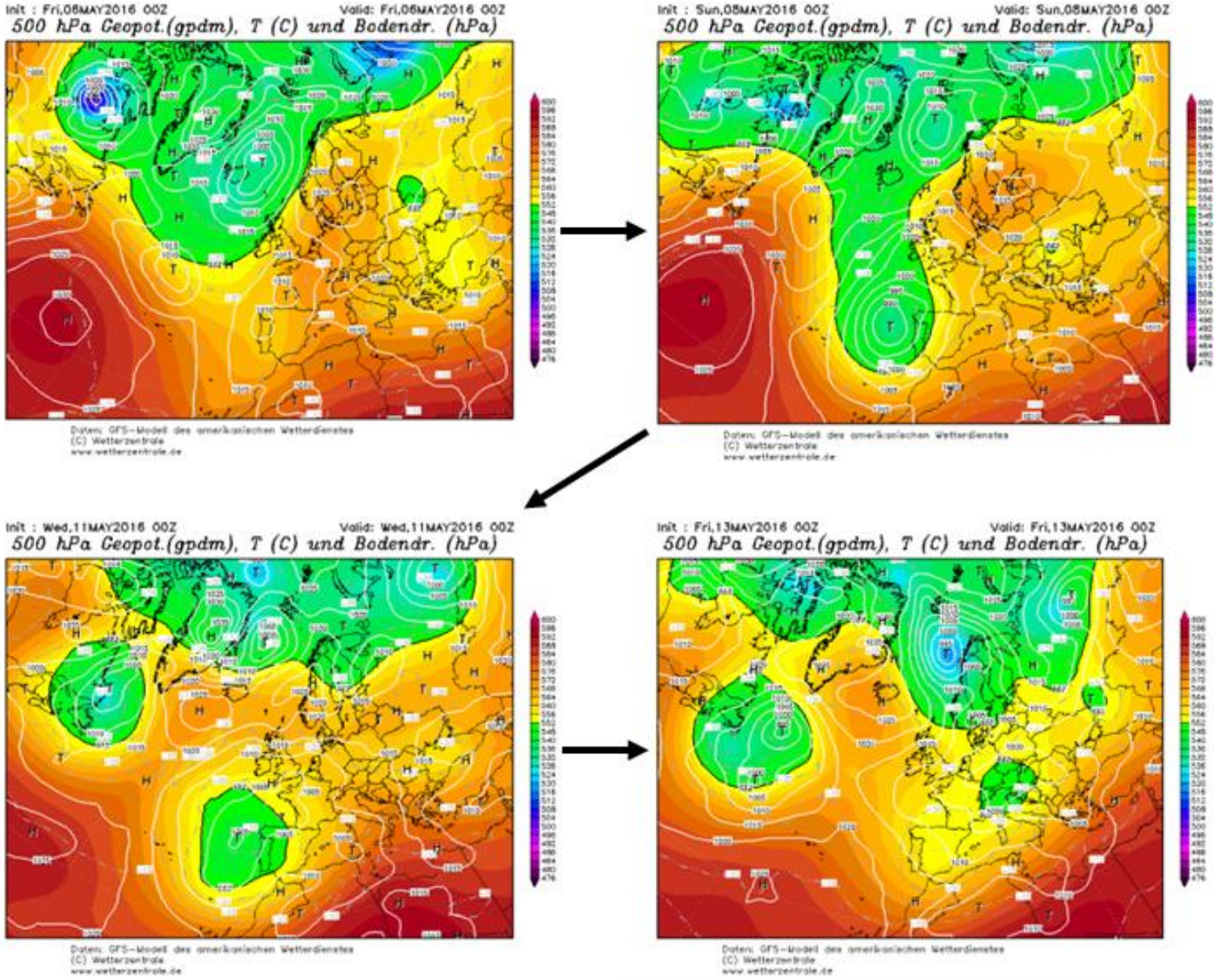
- $\delta^{13}C$ helped identify a contribution from carbonate C (CO_3^{2-}) of about 18 % (range 11-23 %)
- $\delta^{15}N$ showed a shift from volatilization to combustion sources
- Both isotopes suggest a higher proportion of combustion derived N and C in the fine fraction than in the coarse fraction

Conclusions: limitations

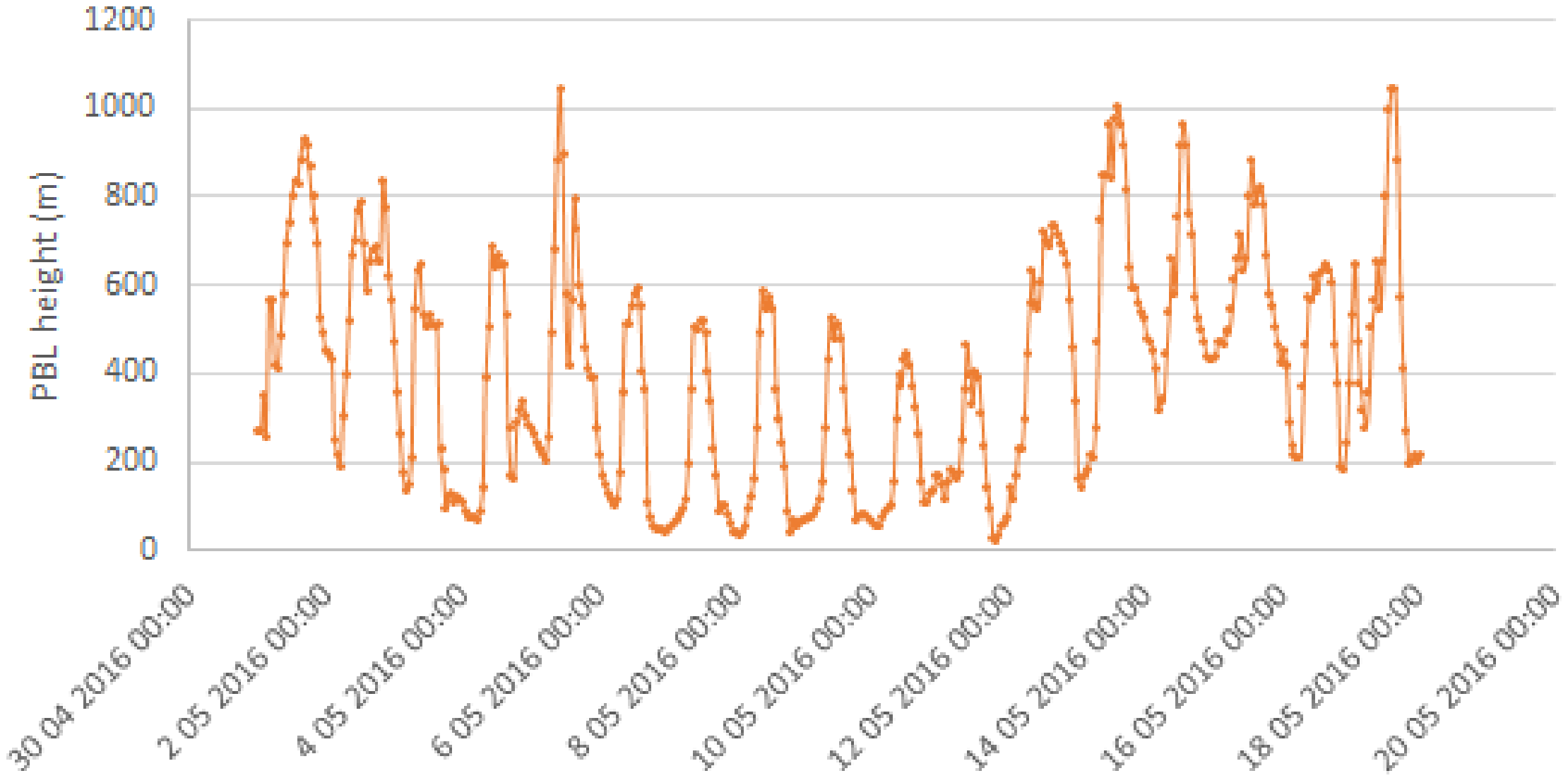
- $\delta^{13}C$ and $\delta^{15}N$ had limited power during biomass burning events in autumn
- Need for a comprehensive characterization of isotope signatures of sources and fractionations
- Need to couple isotopic measurements with other tools (major ions, meteorological info, etc…)

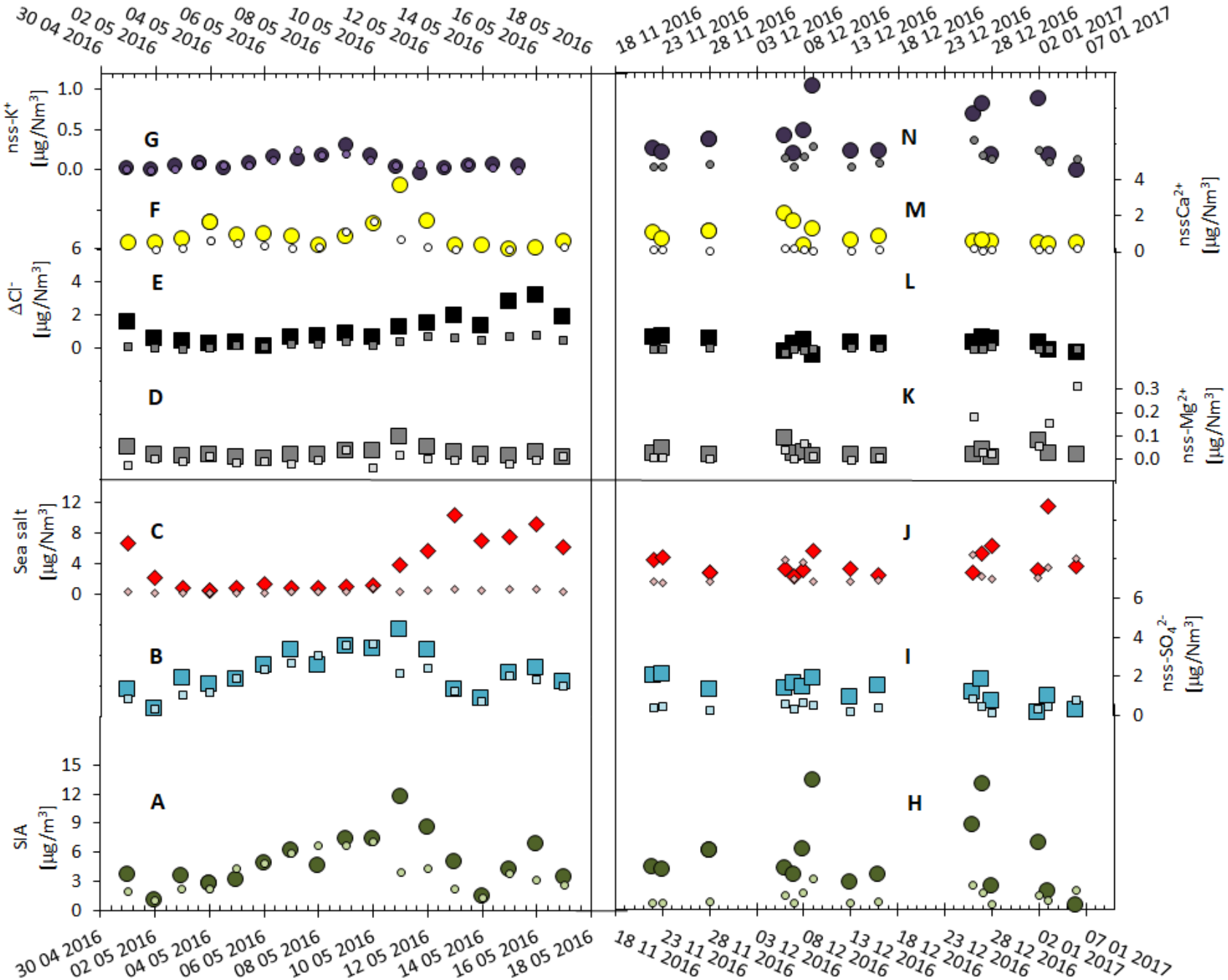
Thank you

Meteorology: May

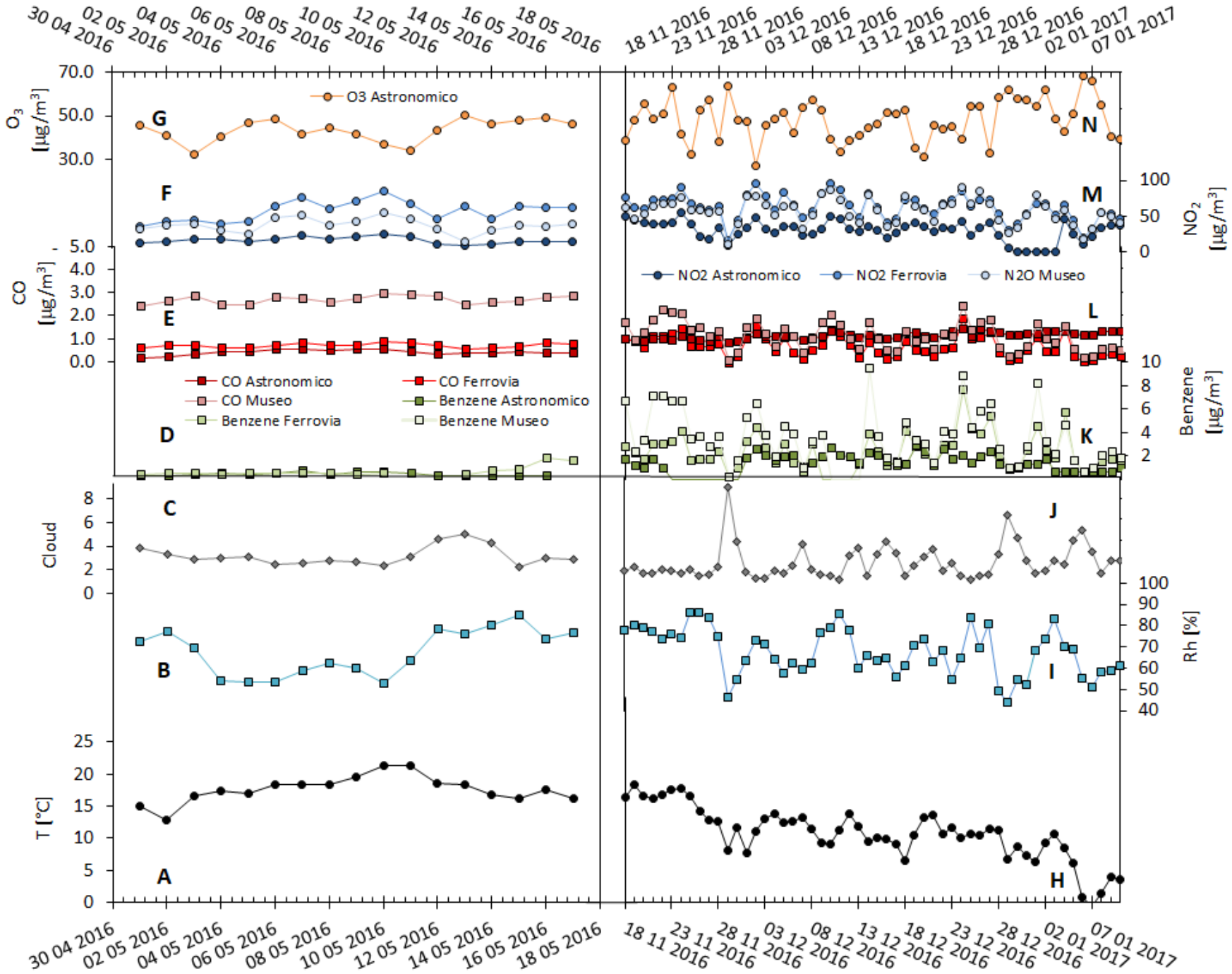


Meteorology: May

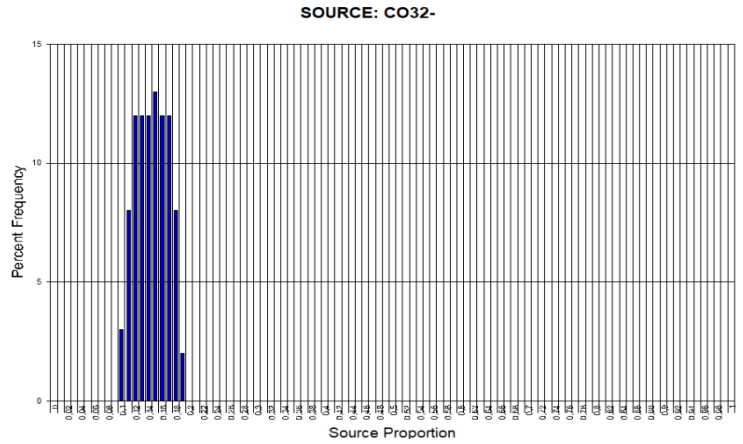


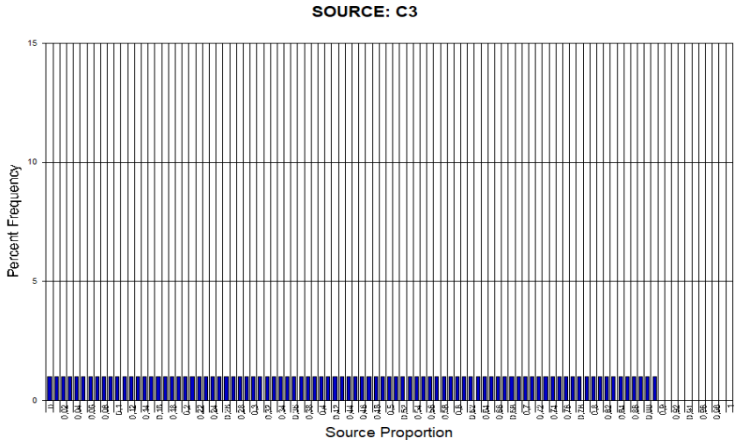


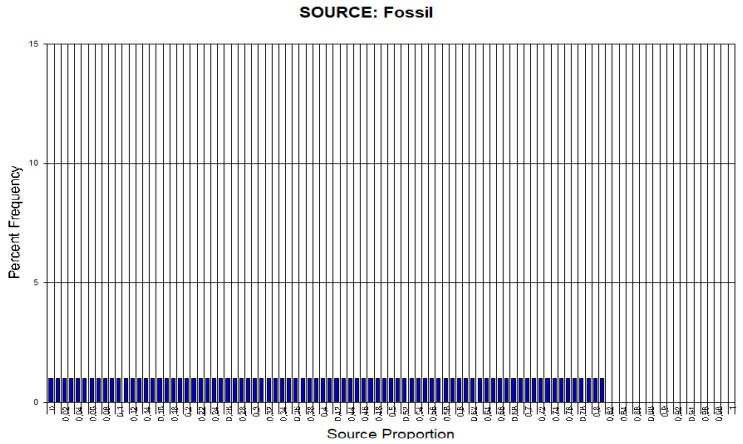
Results: fractions



Meteorological parameters and air quality data







Source apportionment: ISOSOURCE

$$\delta^{13}C_{MIX} = f_1\delta^{13}C_{source1} + f_2\delta^{13}C_{source2} + \cdots$$

Isotope fractionation

$$NH_4^{+}{}_{(aq)} \rightleftharpoons H^{+}{}_{(aq)} + NH_{3\,(aq)}$$