

Source Apportionment of PM_{2.5} in Saint Maries, Idaho, USA

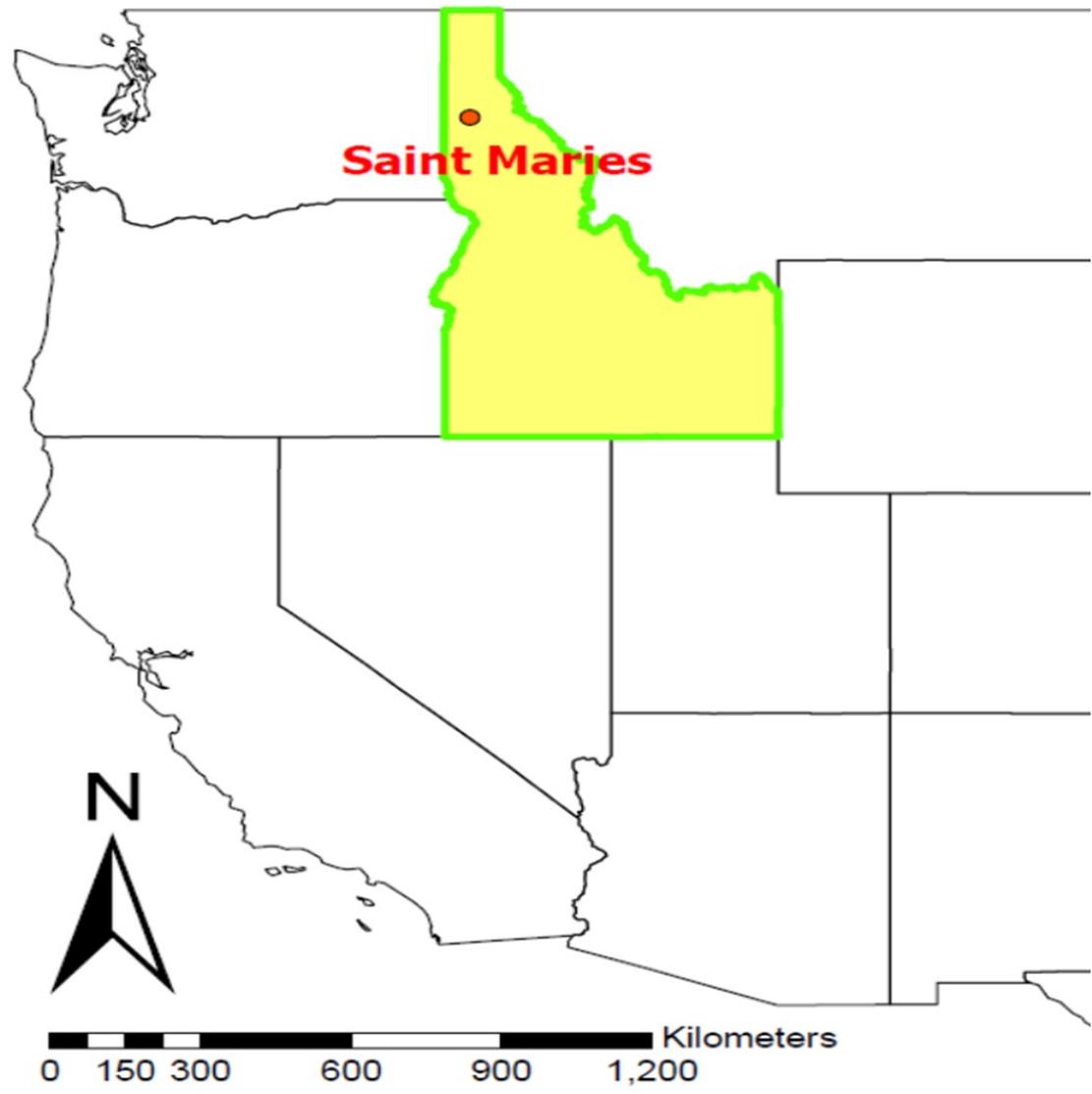
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Motivation

- Adverse health effects
- Concern: Elevated PM_{2.5} levels in Saint Maries



Chemical analyses and data preparation

- 90 PM_{2.5} filter samples
- 10 blanks
- January-March; October-December
- 2016-2018
- **X-ray fluorescence: elements** (e.g. Al, Si, Ca, Fe, Ti, Na, Cl, Mg, Sc, V, Cr, Ni, Cu, Zn, As, Se, Br, Rb, Sr, Yt, Cs, Ba, La, Ce, Sm, Eu, Tb, Pb, K)
- **Ion chromatography:** e.g. Na⁺, Cl⁻, NO₃⁻, SO₄²⁻, and NH₄⁺
- **EC: Tobias Associates Transmission Densitometer (Babs)** (Chow et al 2010)

The SANDWICH Approach

Measured PM_{2.5} species

SO₄²⁻ NO₃⁻ NH₄⁺ {Al, Si, Ca, Fe, Ti} OC EC {Na⁺, Cl⁻} {Mg, Ni, Cu, Zn, As, Pb ...}

PM_{2.5} mass:

PM_{2.5} = Sulfate + Nitrate + Ammonium + PBW + Soil + OM + EC + RS + OPP + NSS

Sulfate, Addjusted Nitrate, Derived Water, Inferrred Carbon
Hybrid Material Balance Approach

(SANDWICH)

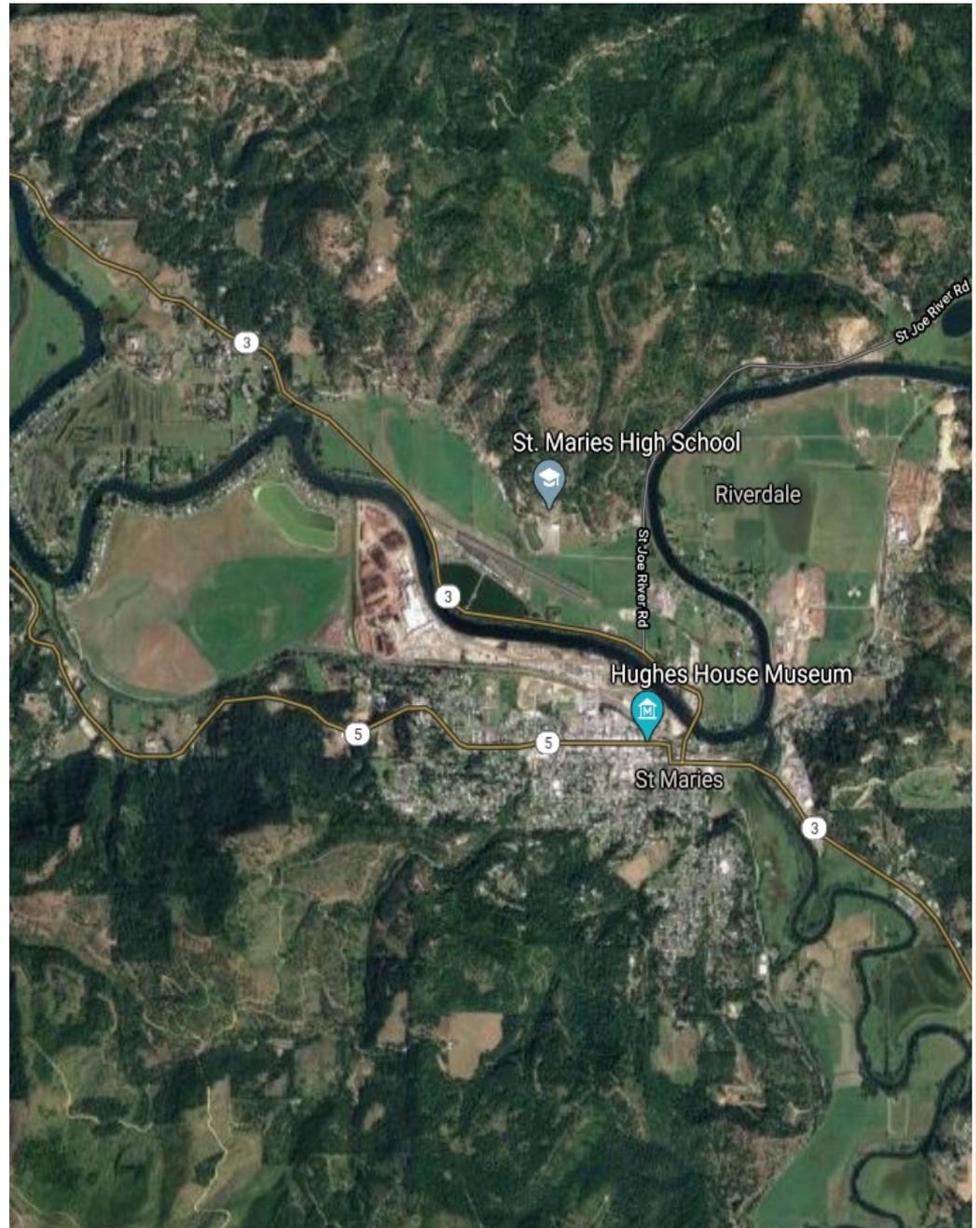
(Frank 2008)

Methods

- SANDWICH method (Frank, 2006)
- Modeled Attainment Test Software (MATS, 2014)
- Aerosol Inorganic Model (AIM)(Clegg et al., 1998)
- Interagency Monitoring of Protected Visual Environments (IMPROVE) (Solomon et al., 2014)

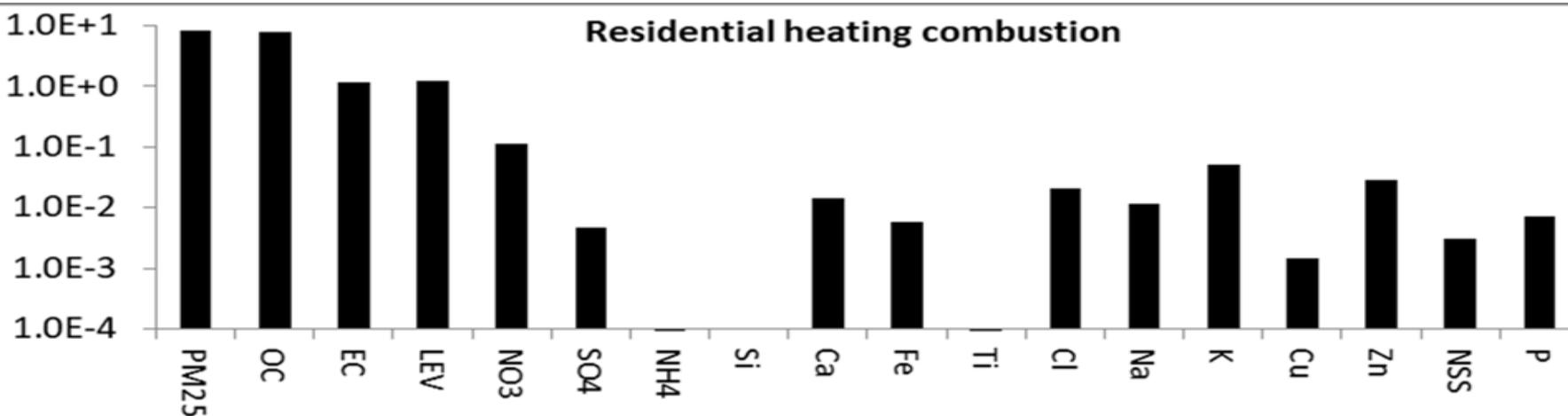
PMF runs

- The St. Maries data
 - ❖ 2016
 - ❖ 2017
 - ❖ 2018
- Positive Matrix Factorization (PMF) model
- Newest version PFM5.0
- Goal: Identify sources of air pollutants (e.g. $PM_{2.5}$)

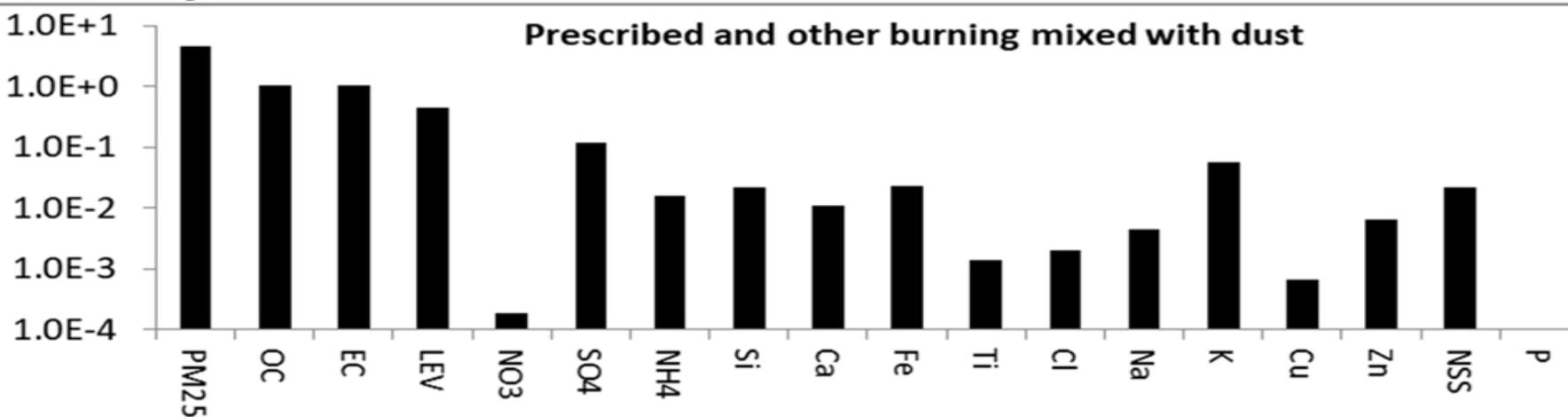


PMF results

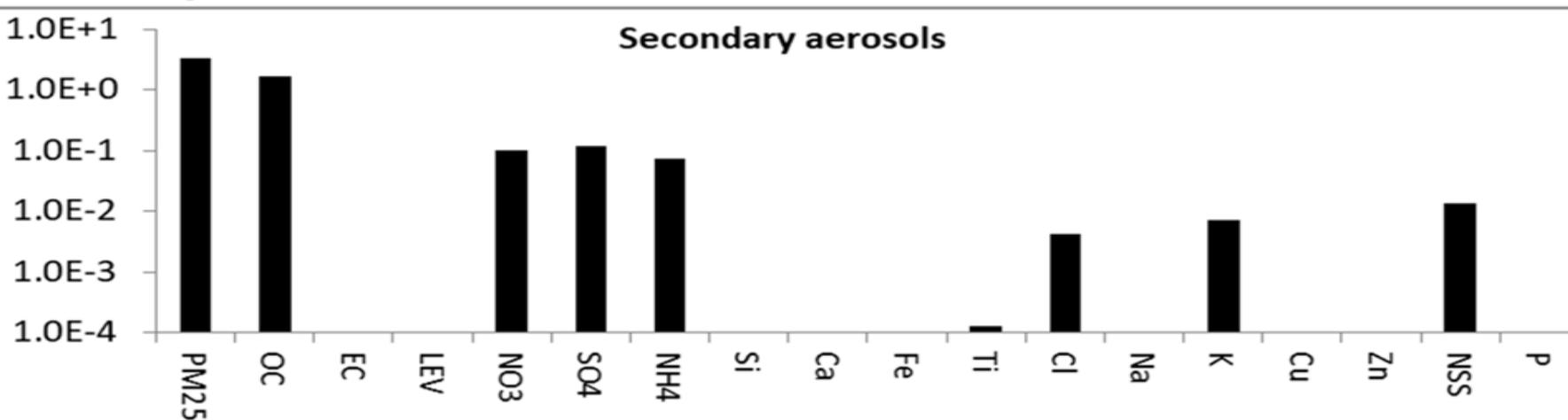
Residential heating combustion

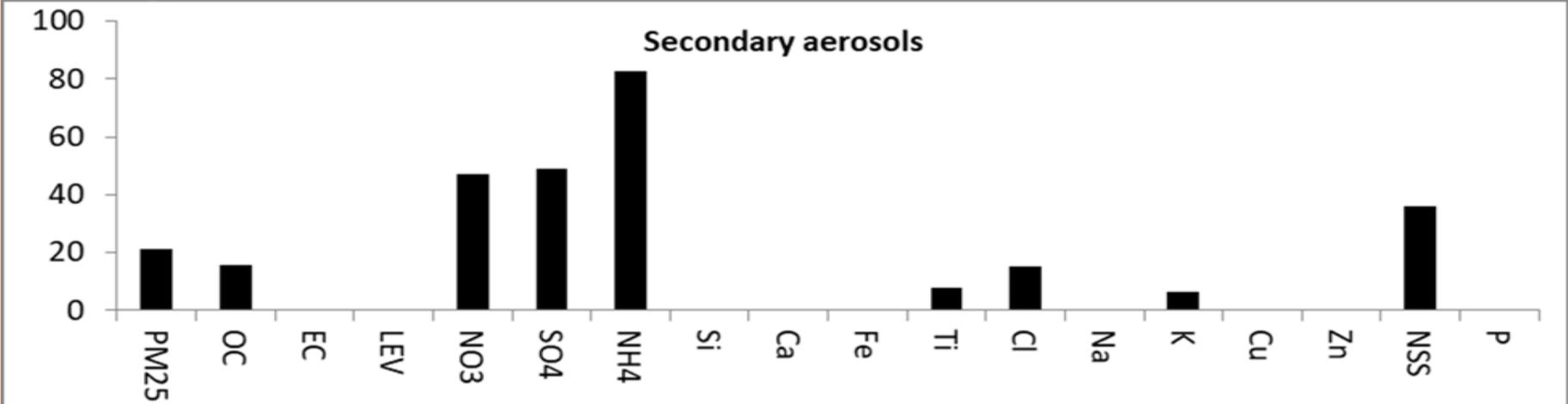
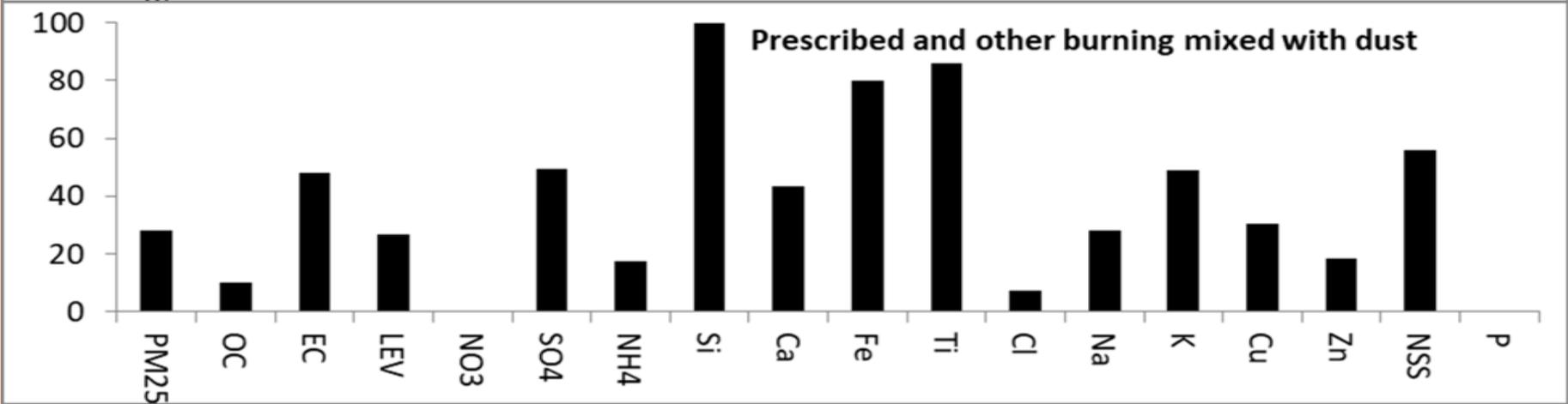
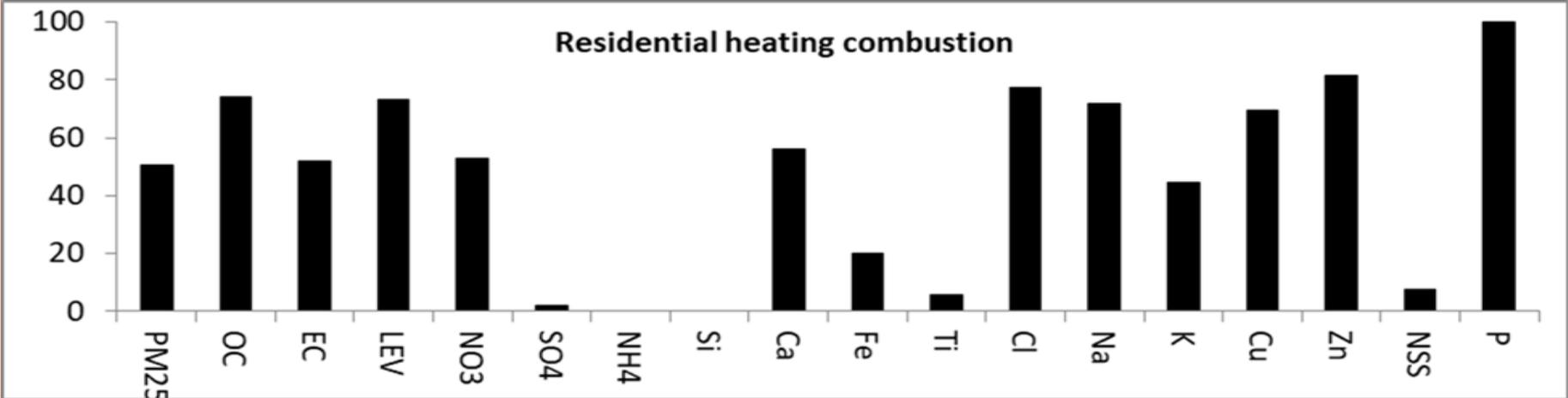


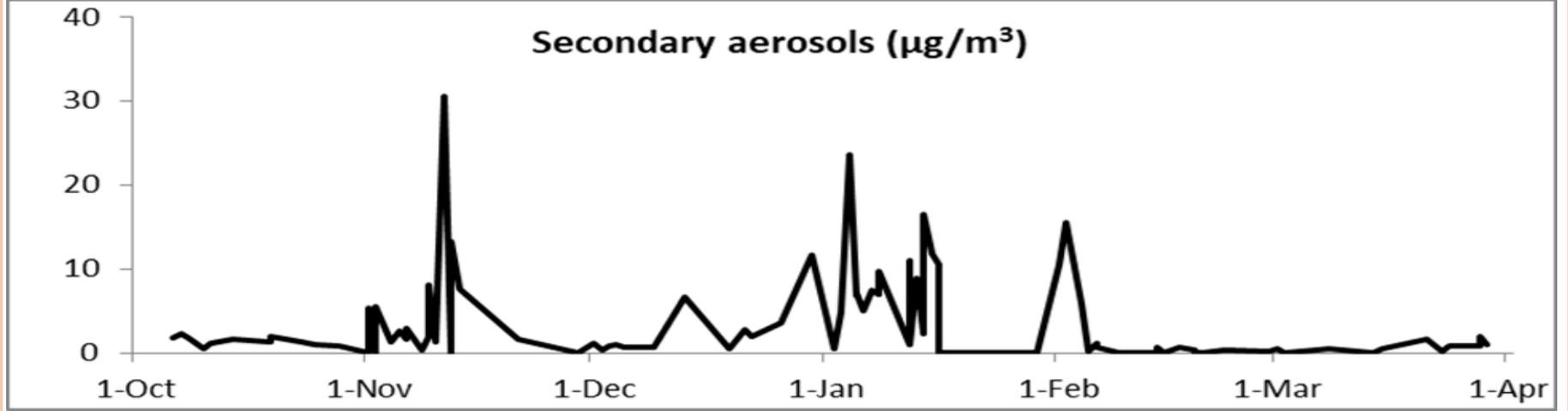
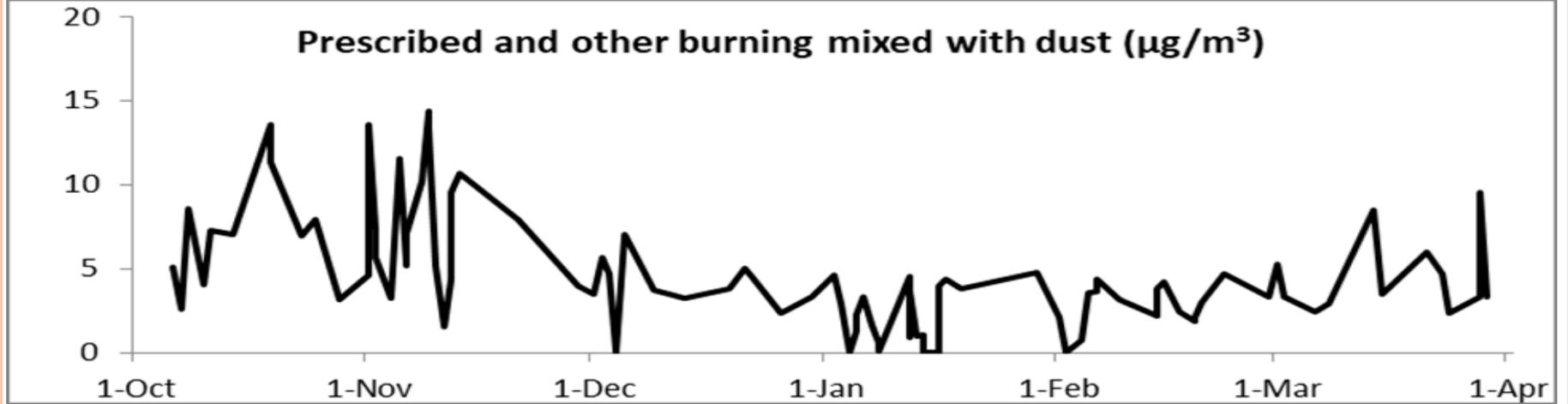
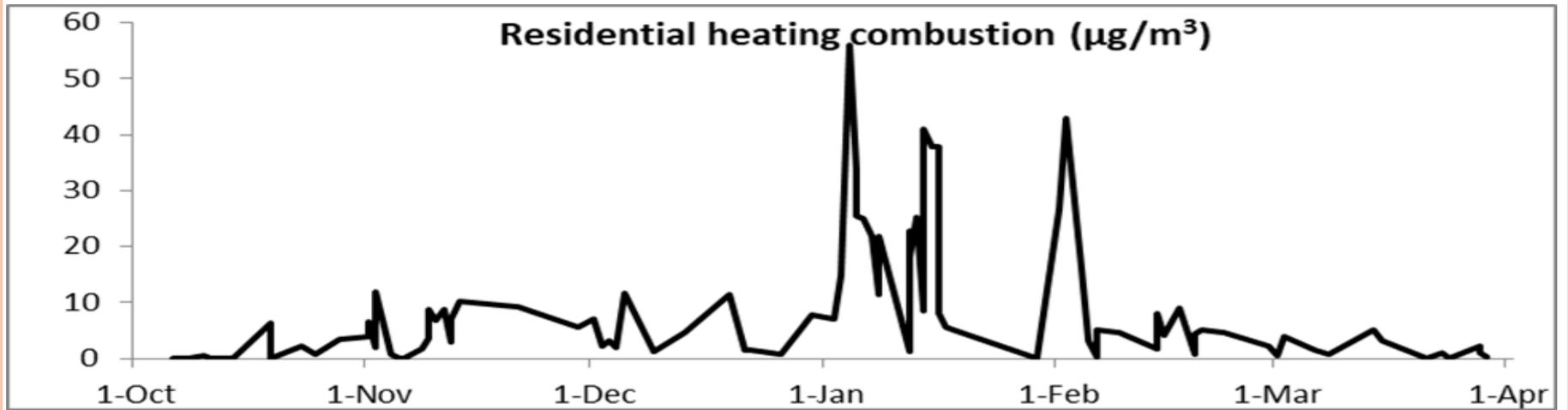
Prescribed and other burning mixed with dust



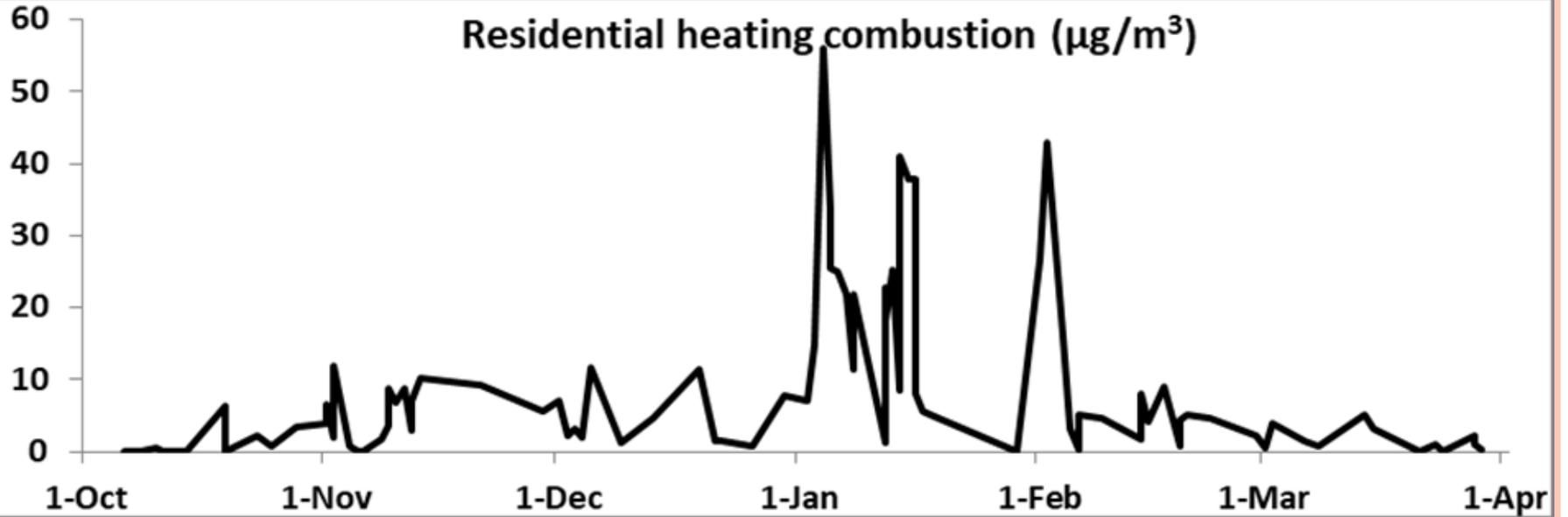
Secondary aerosols



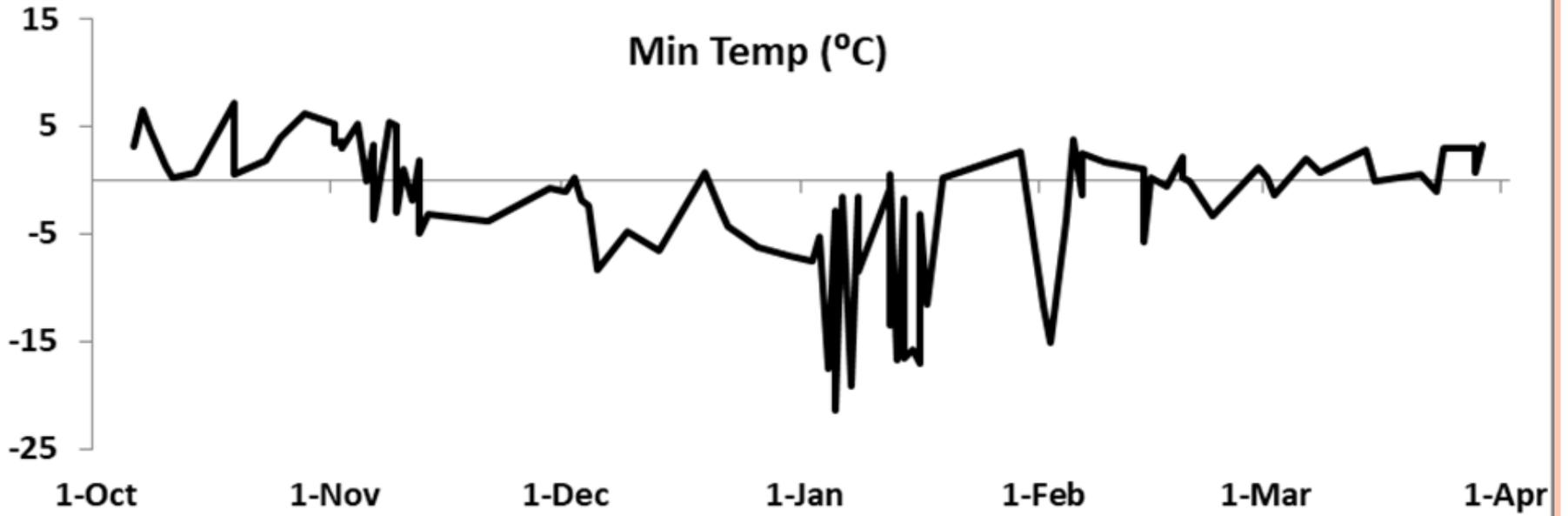


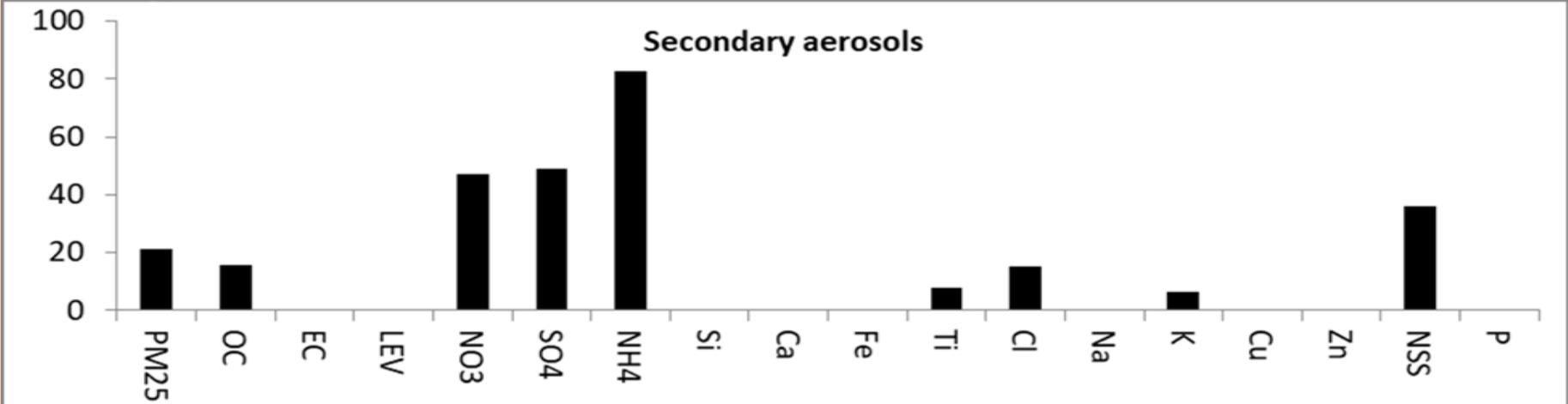
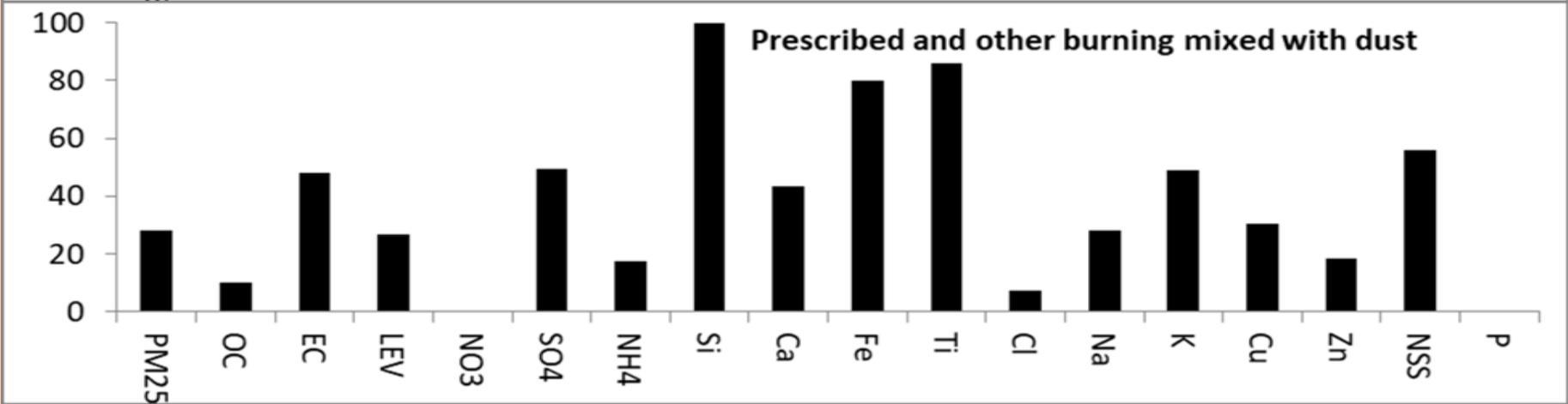
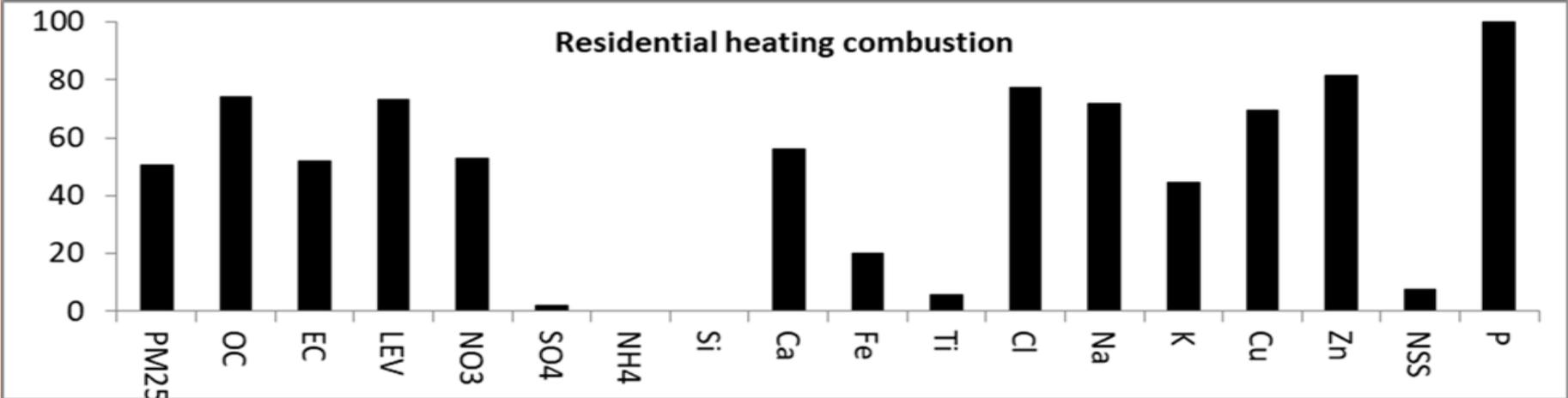


Residential heating combustion ($\mu\text{g}/\text{m}^3$)

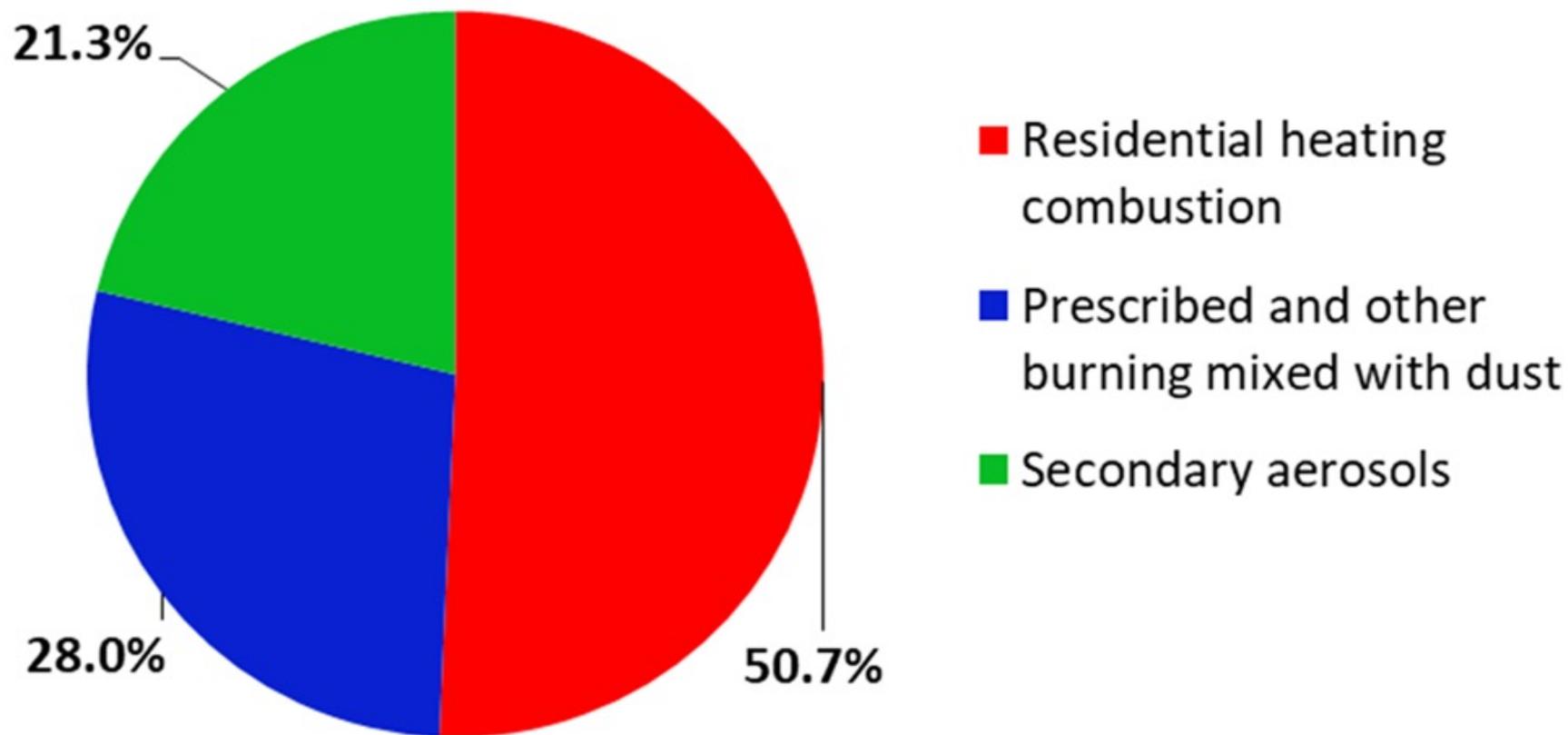


Min Temp ($^{\circ}\text{C}$)





PM_{2.5}



Summary and Conclusion

- Integrated approach combining the chemical analyses and PMF modeling to investigate the sources of PM_{2.5} concentrations in Saint Maries.
- Three major sources:
 - ❖ Residential heating combustion
 - ❖ Prescribed and other burning mixed with crustal dust
 - ❖ Secondary formation
- Biomass burning is the dominant source