Piombo atmosferico in Artide: potenziali sorgenti e variazioni temporali

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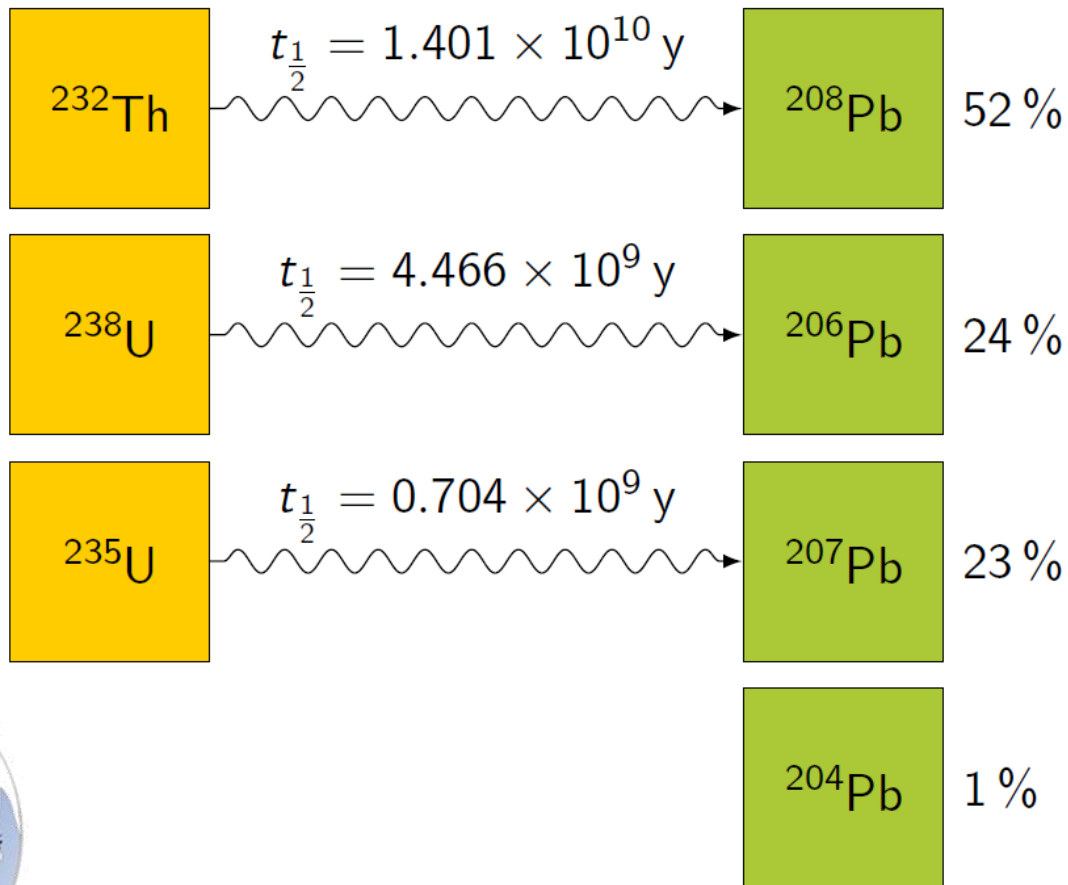
30 Maggio 2024

Motivation and context

- ✓ Legacy and emerging Pb in the Arctic

- ✓ Mitigation at source

- ✓ Marker of PM sources, transport and deposition

- ✓ Gruvebadet observatory

- ✓ Specific projects

  ARCTICA, BETHA-NyÅ, TRANSFER, ROSETTA,…
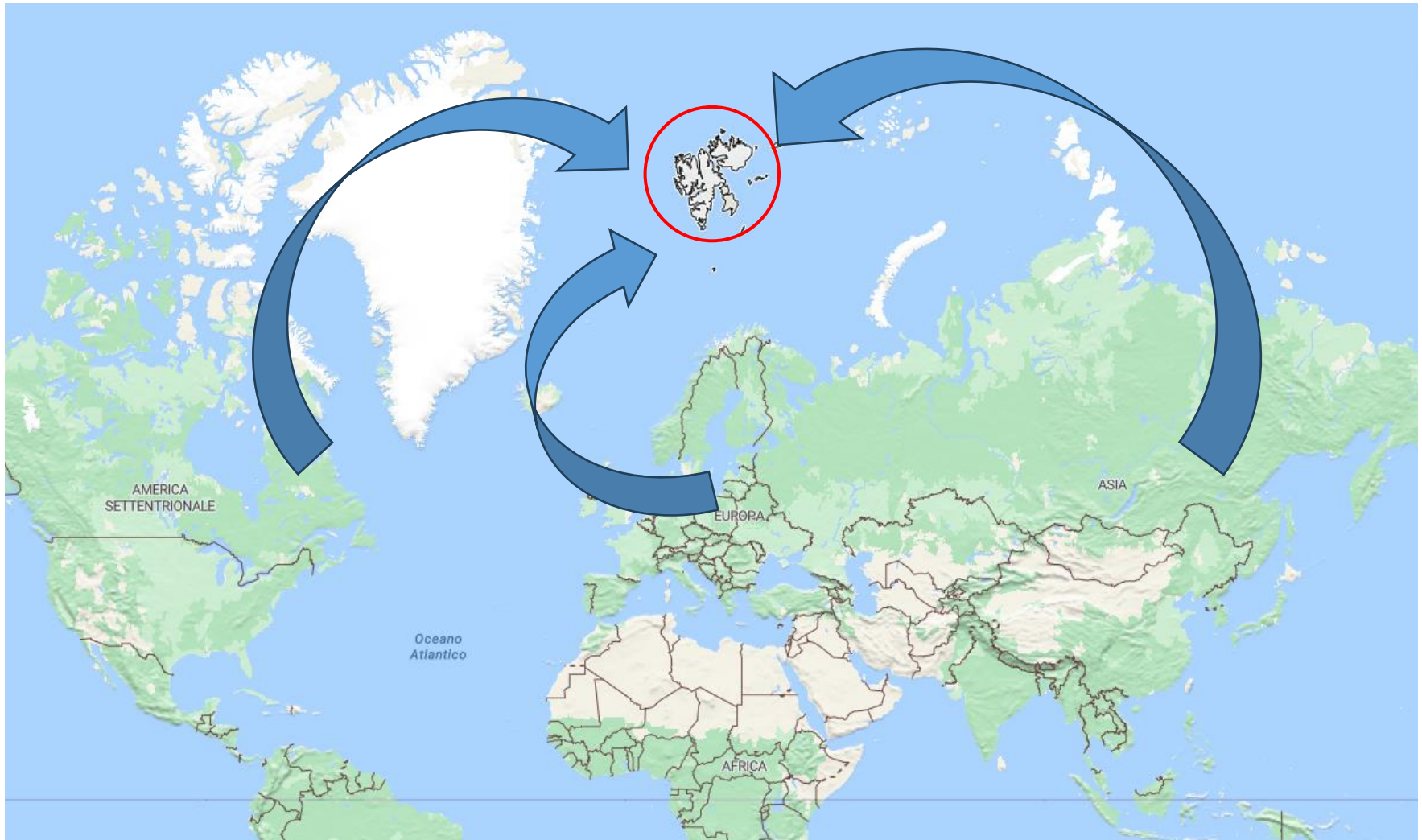 (ISP-CNR, UNIFI, UNIGE, UNITO, UNIPG, UNIPI, INFN)

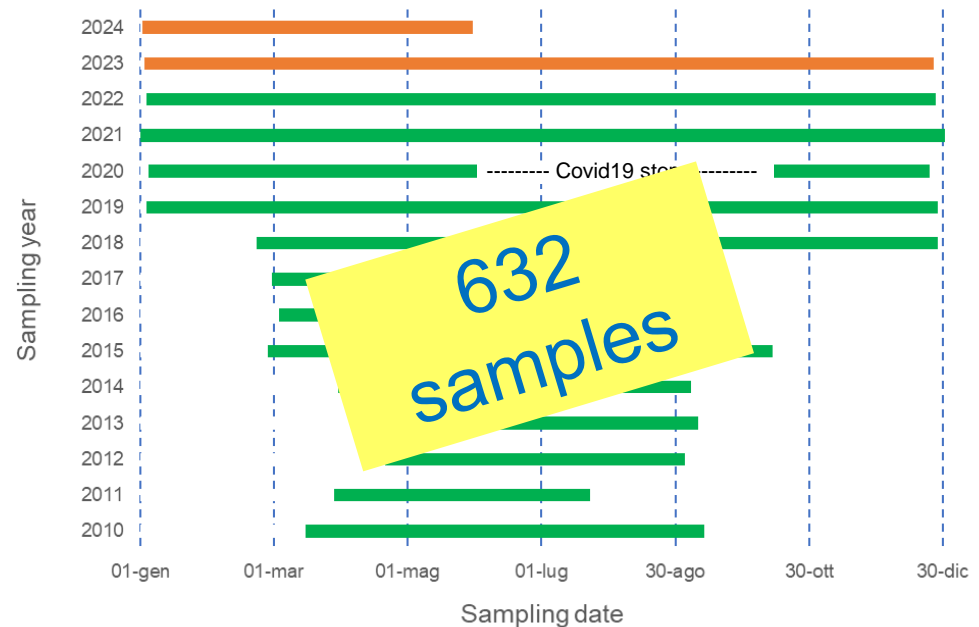# Pb isotopes

Study site

Potential source areas

Field work

Foto di Marco Casula (CNR-ISP)

Tecora ECHO PM$_{10}$ sampler

90-mm PTFE membrane filters
Flow rate: 150 L/min
Period: 2010-ongoing
Resolution: 4/7 days

632 samples

Covid19 stop

Analyzed   To be analyzed

Pb concentration and enrichment

$$EF = \frac{(Pb/Al)_{sample}}{(Pb/Al)_{UCC}}$$
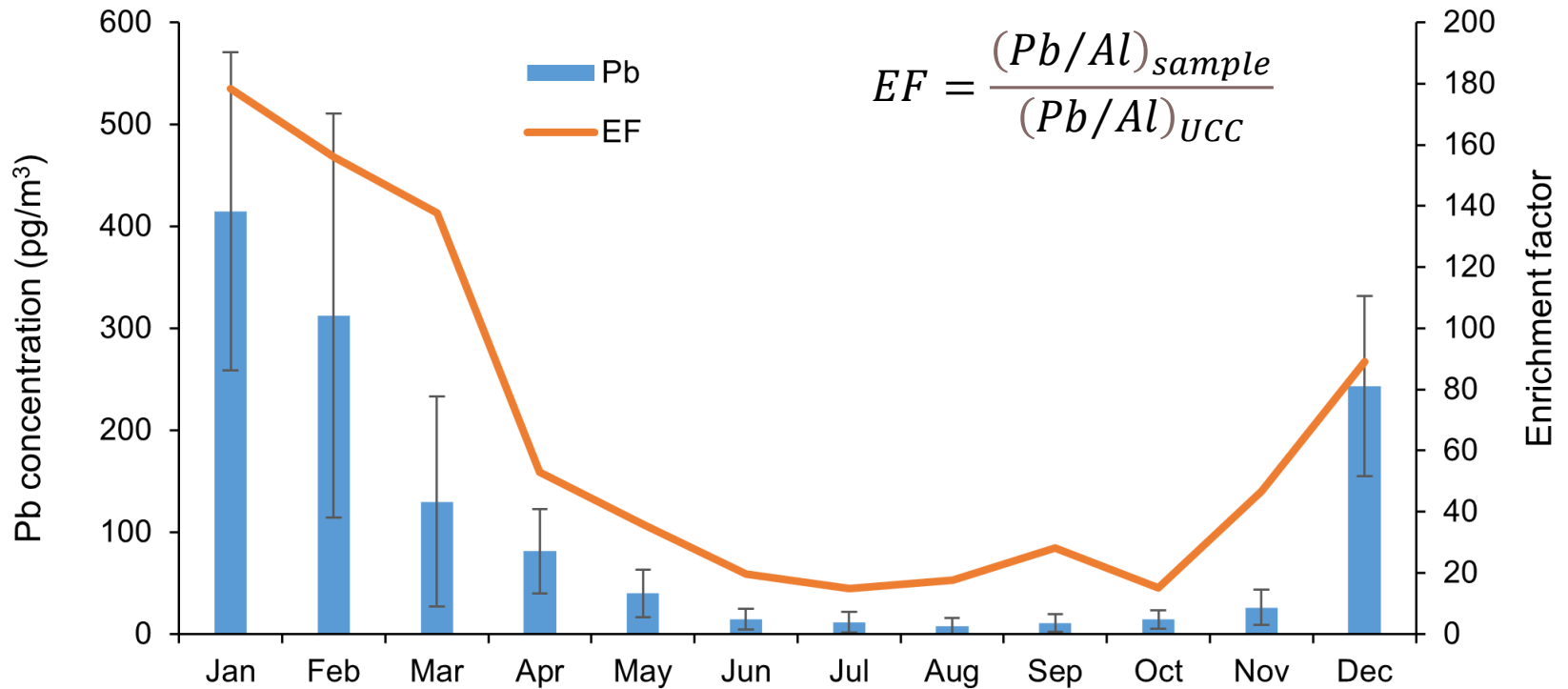
Temporal trend in Pb concentration and crustal enrichment factor in PM_{10} samples collected at Ny-Ålesund. The histogram bars are median values, while the error bars represent the inter-annual variations (2010-2020 for summer and spring samples; 2018-2020 for winter and autumn samples), expressed as IQR.

Pb isotopic composition
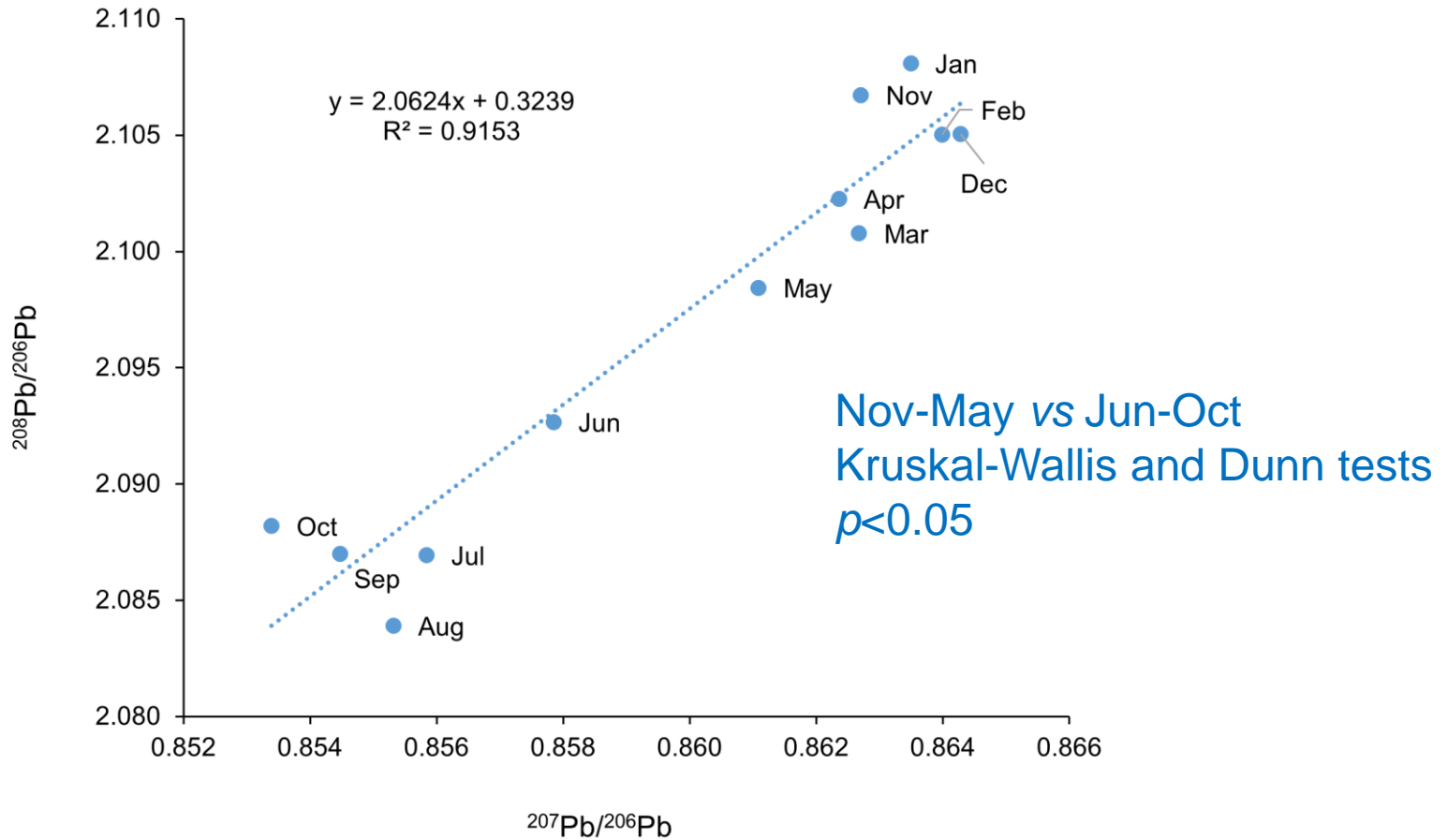
Temporal trend in Pb isotopic composition in PM_{10} samples collected at Ny-Ålesund in 2010-2020 for summer and spring samples and 2018-2020 for winter and autumn samples.

Anthropogenic and natural contributions
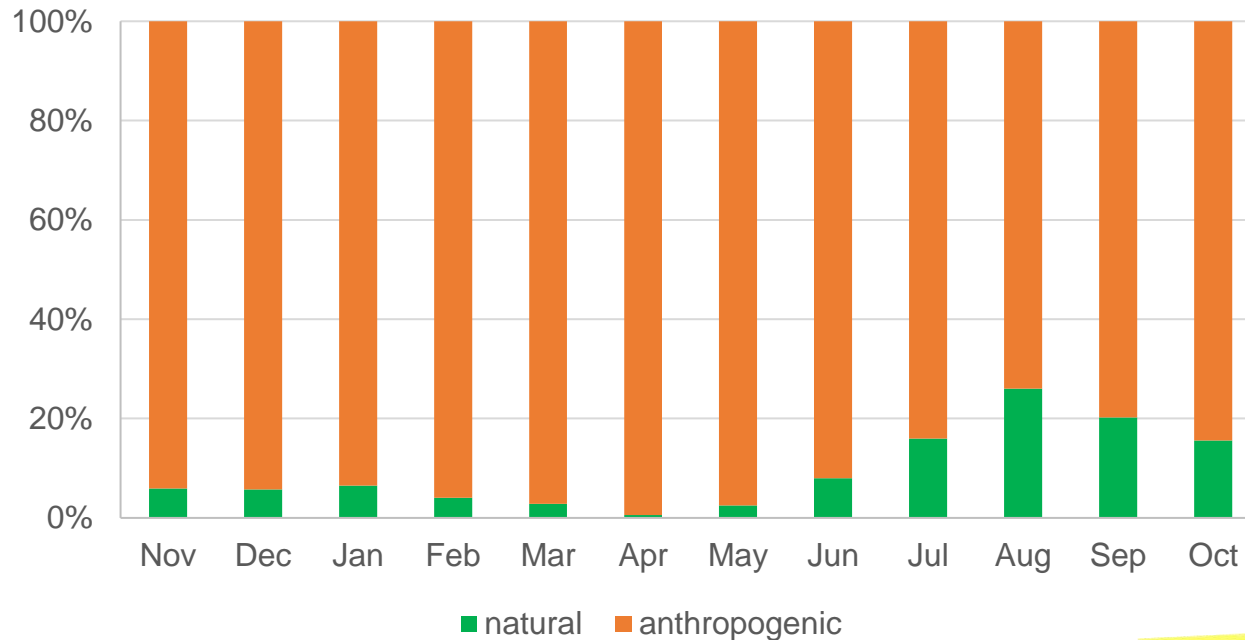
$$^{208}Pb/^{206}Pb = -0.071\frac{1}{EF} + 2.102$$

Robust regression on median values after grouping by EF classes

$$^{207}Pb/^{206}Pb = -0.038\frac{1}{EF} + 0.862$$

End-member	Extrapolation	$^{208}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$
Anthropogenic	EF = ∞	2.102 ± 0.001	0.862 ± 0.001
Natural	EF = 1	2.031 ± 0.007	0.824 ± 0.009

➢ %nat e %anthr from the Euclidean distance

The natural contribution

Temporal trend of natural and anthropogenic contributions in PM$_{10}$ samples collected at Ny-Ålesund (2010-20___ spring samples; 2018-2020 for winter and autumn samples).
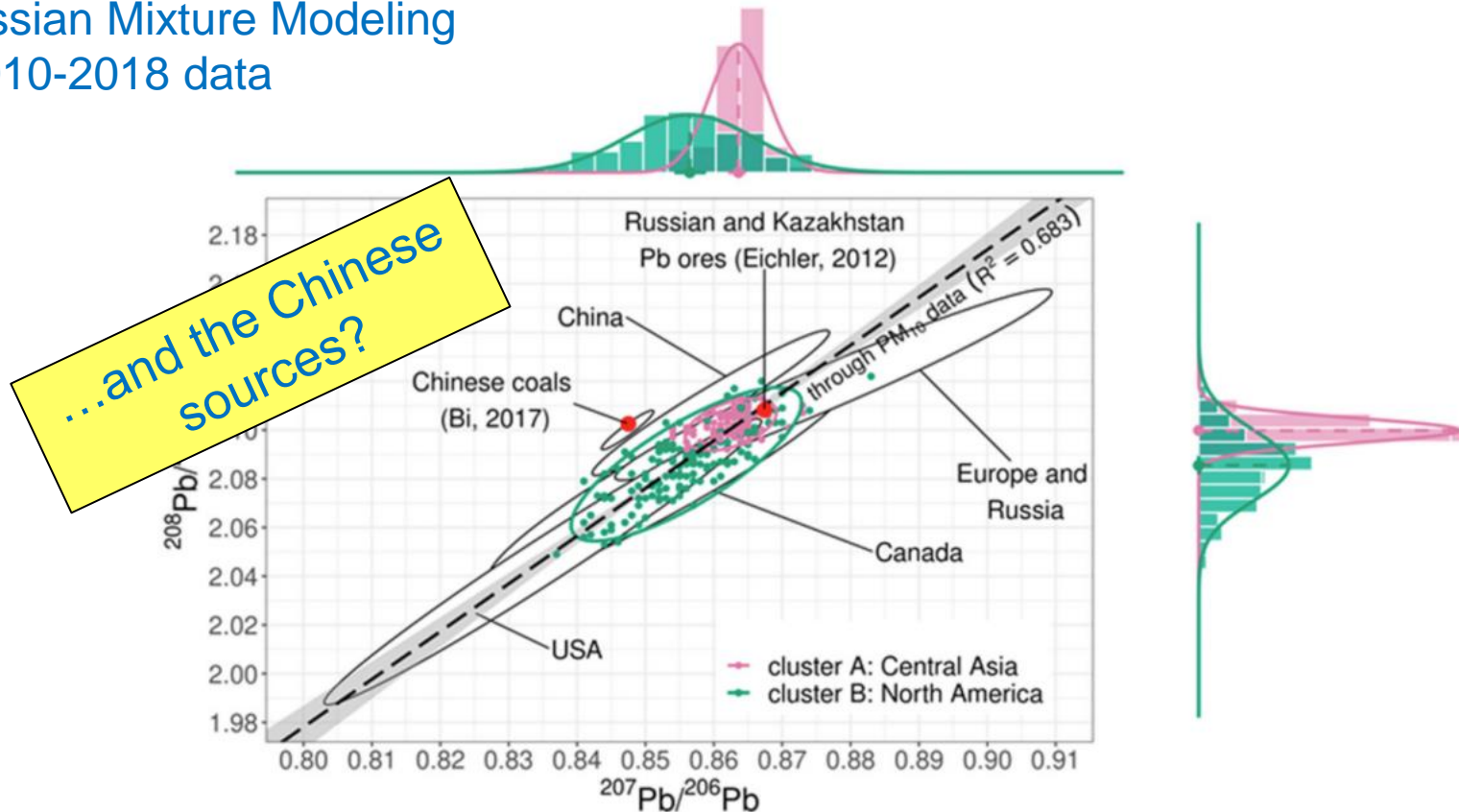
These data: 6-26%
Previous estimation (2010-2018): 5-16%
Also considering Pb-204 values (2017-2018): 1-27%

Work in Progress
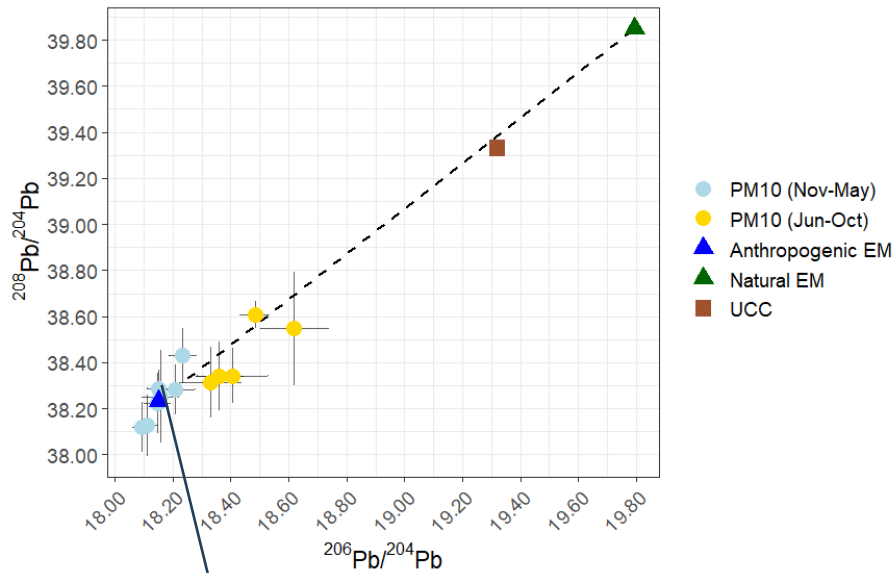
The anthropogenic sources

Gaussian Mixture Modeling
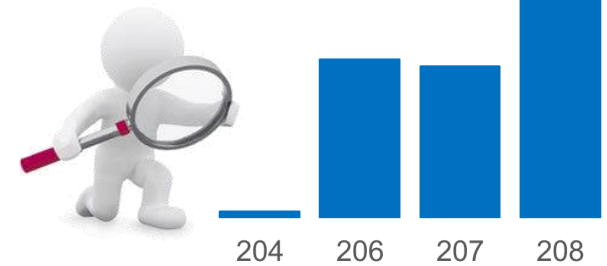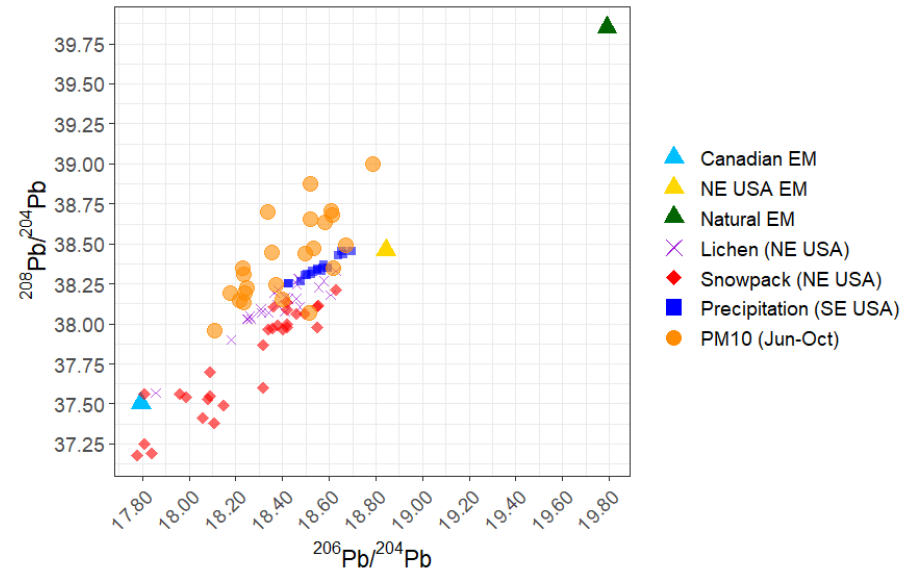of 2010-2018 data

A) Rudny Altai region, at the Russian and Kazakhstan border

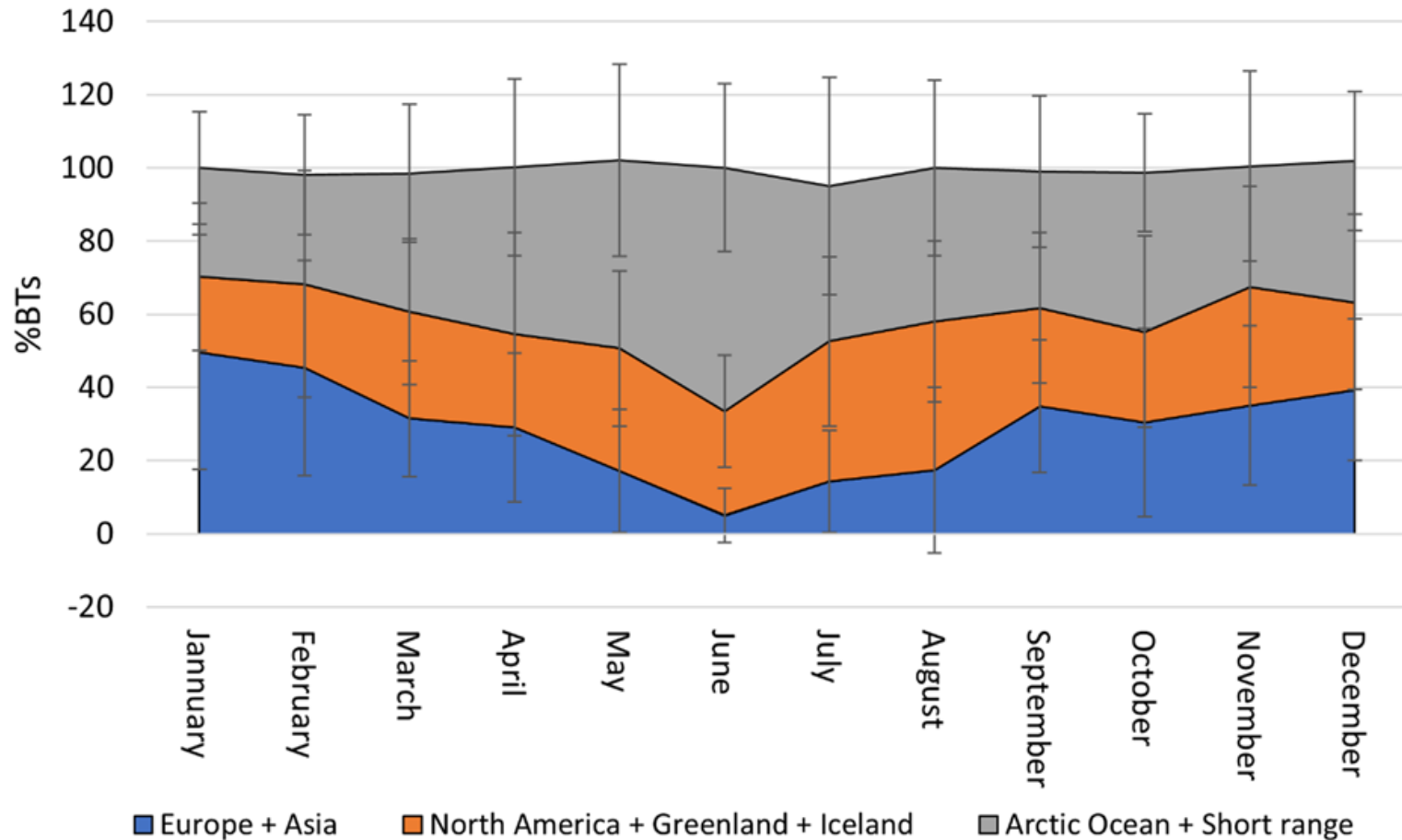B) Mixed contributions from US and Canadian sources (35:65)

Pb-204 values

Leninogorsk
Altai Region

Back-trajectory analysis

Back-trajectory analysis results. The percentage of BTs associated to each geographical macro-sector are calculated for each month of the period 2010-2020. The error bars are the corresponding standard deviations, and they represent the inter-annual variations.

Conclusions and perspectives

- ✓ Pb levels, enrichment and trends are well characterized

- ✓ Anthropogenic sources and their variations are defined

- ✓ The natural source(s) needs to be better investigated

- ✓ The Chinese fingerprint needs to be better disentangled or definitively excluded

- ✓ Pb data should be integrated with other chemical data on the same samples

Thank you for your attention