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Snow pollution over three decades in Luleå, Sweden

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Pollution de la neige sur trois décennies à Luleå, Suède

Snow pollution over three decades in Luleå, Sweden



Introduction

- Urban snow and snowmelt pollution studied for 50 years
- Previous focus were sources of pollution and accumulation of pollutants
- Changes in pollutants emission due to fast material evolution in vehicular sector, urban growth, and climate change
- Over time, certain pollutant concentrations may decrease, while others may increase, and new pollutants may emerge
- Need to update data on pollutants in snow for assessing impacts and developing new control measures

Aim

- Quantify occurrence of pollutants in urban roadside snow and examine changes in snow pollution in City of Luleå from 1995-2021.

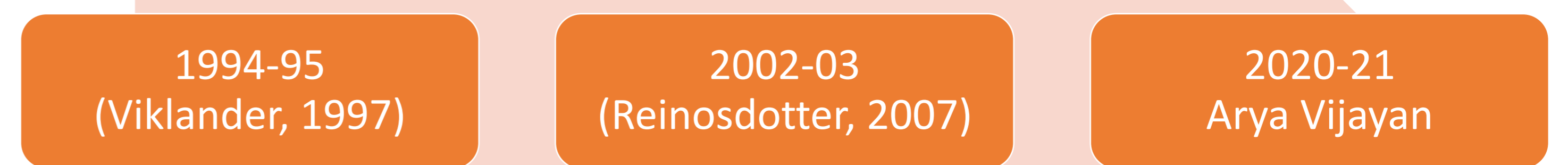


Fig. 1 Three sampling programs

Methods

- Three sampling programs (fig.1) were conducted in Luleå (table 1 & fig.2).
- Snow samples were extracted from the highest point of the snowbank (Fig.3) using a 1 m long titanium ice drill with 12 cm diameter (Fig 4).
- The extracted samples were melted at room temperature and representative subsamples were analysed for TSS, and metals (Zn, Cu, Cd and Pb).
- The obtained results were then compared to examine the patterns in pollutant levels across the period of 1995 to 2021.
- The data underwent statistical analysis using Wilcoxon signed-rank test to determine the significant differences in pollutant concentrations among three distinct sampling programs.

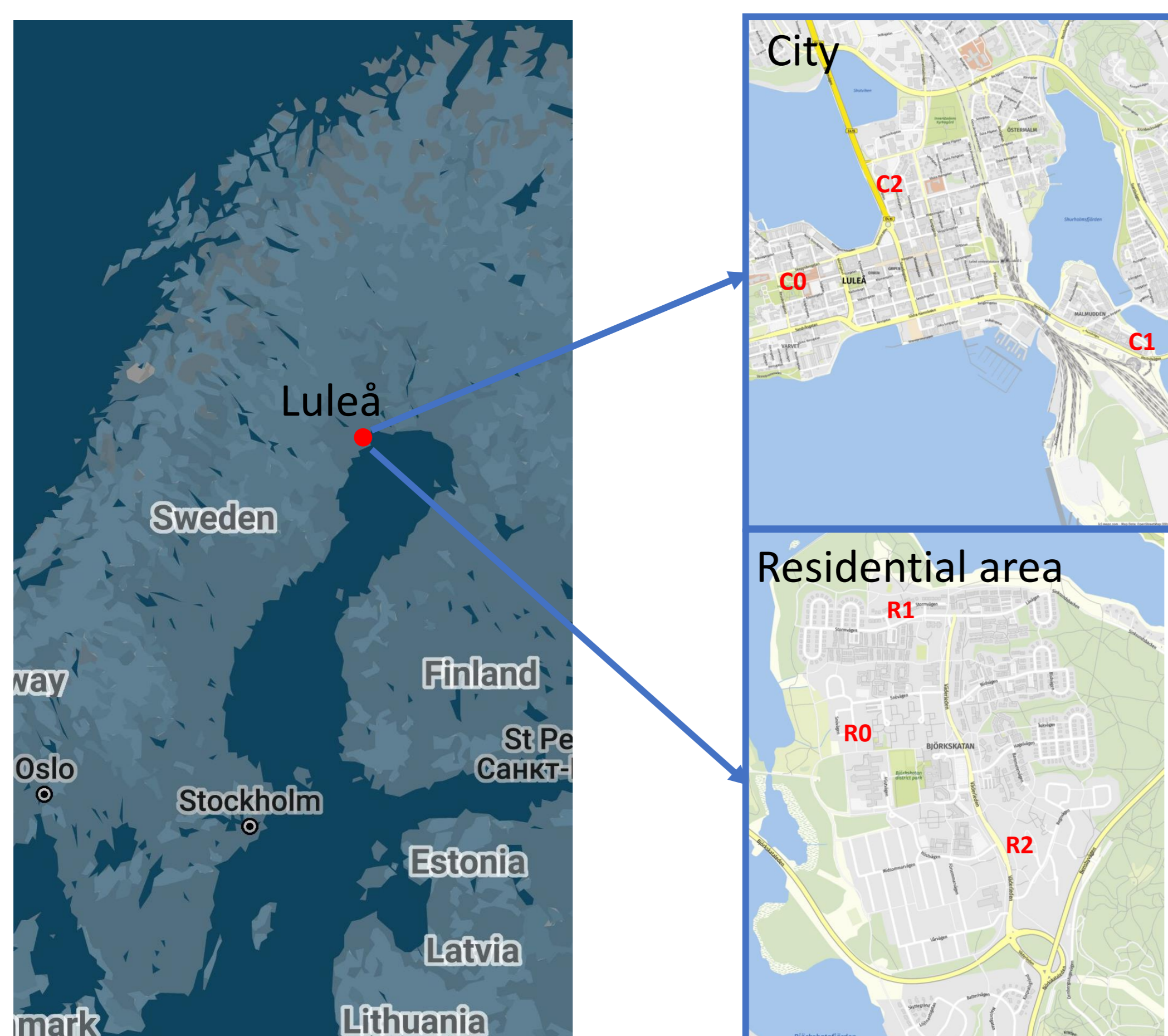


Fig.2 Geographical representation of Luleå, Sweden, highlighting the city and residential area with sampling locations C0, C1, C2, R0, R1, and R2



Fig.4 Titanium ice drill



Fig.3 Snowbank in the city (site C2) during three sampling occasions (Feb, March and Apr 2021)

Table 1 Sampling sites

Type of area	Traffic intensity (veh/day)	Notation	Comment
City	0	C0	Park in downtown
	13000	C1	Intermediate traffic
	21000	C2	Swedish highway – high traffic
Residential	0	R0	Away from streets
	1500	R1	Residential street – very low traffic
	4500	R2	Connecting road –low traffic

Results and Conclusions

The TSS, total Cu, Zn, Pb and Cd concentrations measured in snow samples collected during the three sampling programs for three snow ages (around 40 days, 80 days, and 120 days) are presented in fig. 5.

- Pb and Cd concentration decreased over time due the reduction of Pb and Cd in brake linings and tires, which resulted from the implementation of the EU directive on end-of-life vehicles.
- TSS, Zn, and Cu concentrations did not exhibit a clear trend over the study duration due to high variability of air temperatures and precipitation during sampling campaigns.
- Metal concentrations correlated well with TSS .

Future research will compare pollution load per unit areas to provide a more accurate assessment of pollution levels over time.

References

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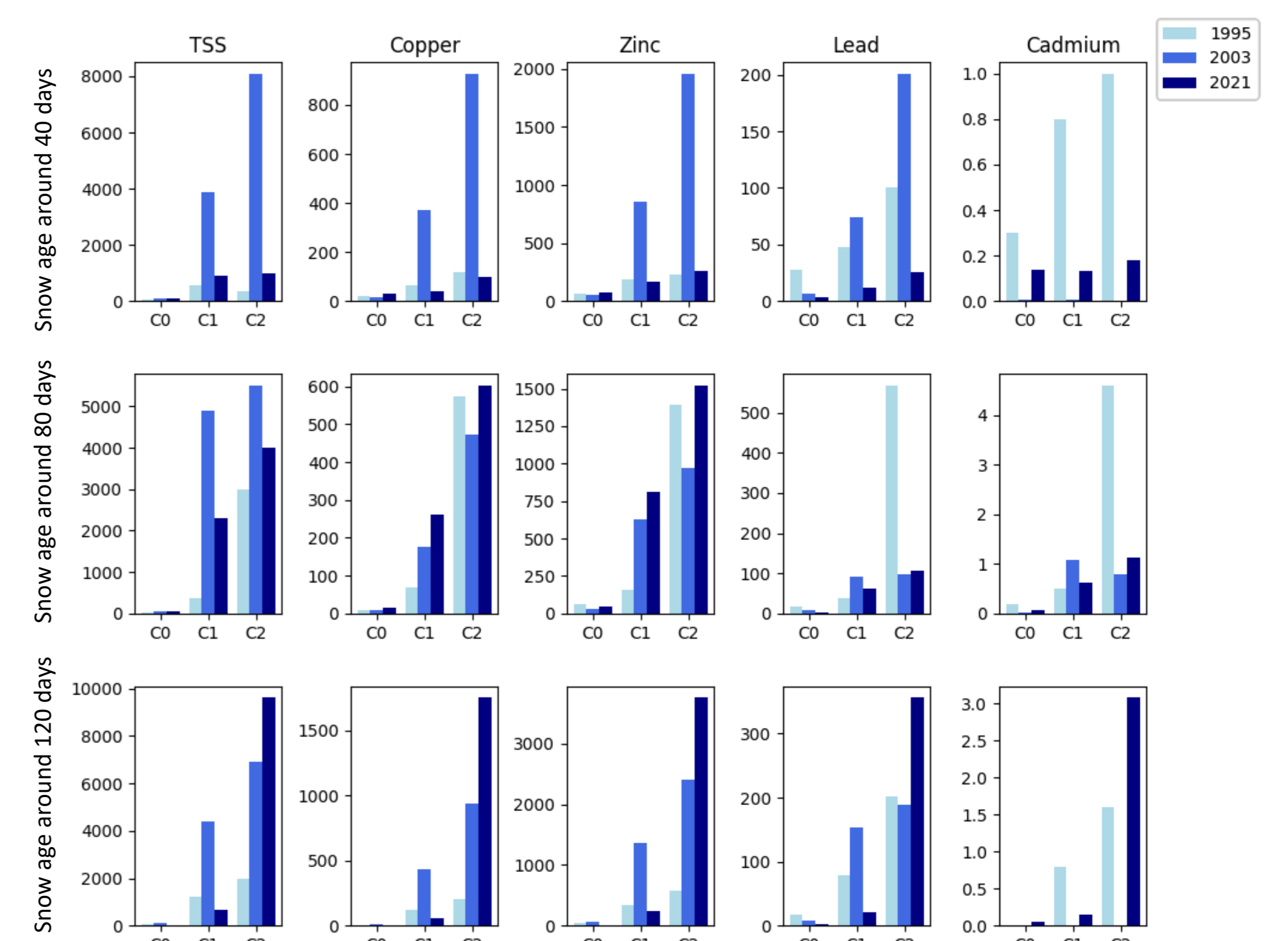


Fig. 5 Temporal and spatial variations TSS (mg/L) and metals (Cu, Zn, Pb and Cd in µg/L) in snow samples with varying ages collected from three distinct locations (C0, C1, and C2)