HEAVY METALS IN PRECIPITATION AND IN AEROSOLS IN SWEDEN AND IN NORTHERN FINLAND

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Introduction

Measurements results of the elements, As, Cd, Co, Cr, Cu, Mn, Ni, Pb, V, Zn and anthropogenic sulphur in precipitation and in aerosols (PM_{10}) have been evaluated for the period 1999 to 2015 at four Swedish measurement sites. In addition the corresponding measurement result was also evaluated from the Pallas Matorova site in Northern Finland during the period 2009 - 2014. A statistically significant decreasing trend regarding many of the metals is observed.

Methods

The measurement sites are shown in Figure 1 and Table 1. Heavy metals in precipitation were measured by bulk samplers at all sites. At the Swedish sites Vavihill, Råö, Aspvreten and Bredkälen monthly samples were collected with three bulk collectors in parallel which was separately analysed. At Visingsö and Pallas single bulk collectors were used. Heavy metals in the PM_{10} fraction were measured at all sites except at Visingsö. The content of heavy metals was determined with ICP-MS. The sampling, handling of samples and sampling equipment as well as analysis was performed according to the EMEP manual for sampling and chemical analysis 2001. The Mann Kendall method was used for trend analysis.

Table 1. Measurements sites

Measurement sites	Degree North	Degree East	Altitude (m)
Vavihill (SE)	56.0281	13.1485	175
Råö (SE)	57.3939	11.9142	7
Visingsö (SE)	58.0781	14.3636	98
Aspvreten (SE)	58.8104	17.3982	25
Bredkälen (SE)	63.8482	15.3357	40
Pallas Matorova (FI)	67.9998	24.2398	335

Figure 1. Measurement sites

Results

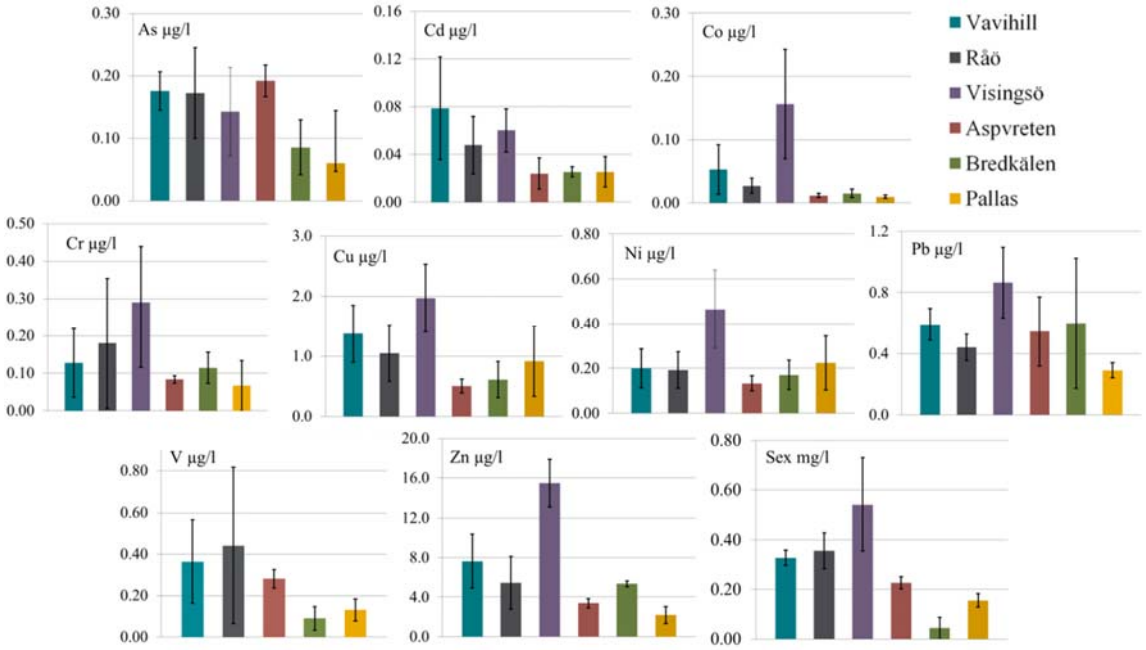

Figure 2. Seven years (six years regarding Pallas) average heavy metal concentrations in precipitation.

Average concentrations of heavy metals in precipitation are shown in Figure 2. Many of the elements show a south-north trend with the highest concentrations in the south. However, the elevated values at Visingsö and to some extent at Aspvreten contradict this trend. The likely reason is the occurrence of local sources in this part of Sweden. Likewise the Pallas site is affected by emissions of especially Cu, Ni and sulphur from industries on the Kola Peninsula (Boyd et al. 2009). A trend analysis gives significant statistical evidence for that the concentrations of As, Cd, Co, Cr, Cu, Ni, V and Zn have decreased at the most southern measurement sites, Vavihill and Råö, during the investigated period. The same is also true regarding Cd, Cr and V at the most northern sites, Bredkälen and Pallas. At Pallas Cu and Zn also showed a decreasing trend. No decreasing trend could be seen at Visingsö or Aspvreten. The present observations are also supported by the PM_{10} measurements.

Conclusion

The concentration of heavy metals in precipitation is normally low in Sweden and can to a great part be attributed to long range transport. The present investigation indicates that the emission of heavy metals in Europe decreased during the period 2009 – 2015.

Reference

Boyd, R.; Barnes, S-J.; De Caritat, P.; Chekushin, V.A.; Melezhik, V.A.,; Reimann, C.; Zientek, M. L. (2009). Emissions from the copper–nickel industry on the Kola Peninsula and at Norilsk, Russia. Atm. Environ., 43, 1474–1480.