

25 years of snow-based air pollution studies in Estonian oil shale processing region

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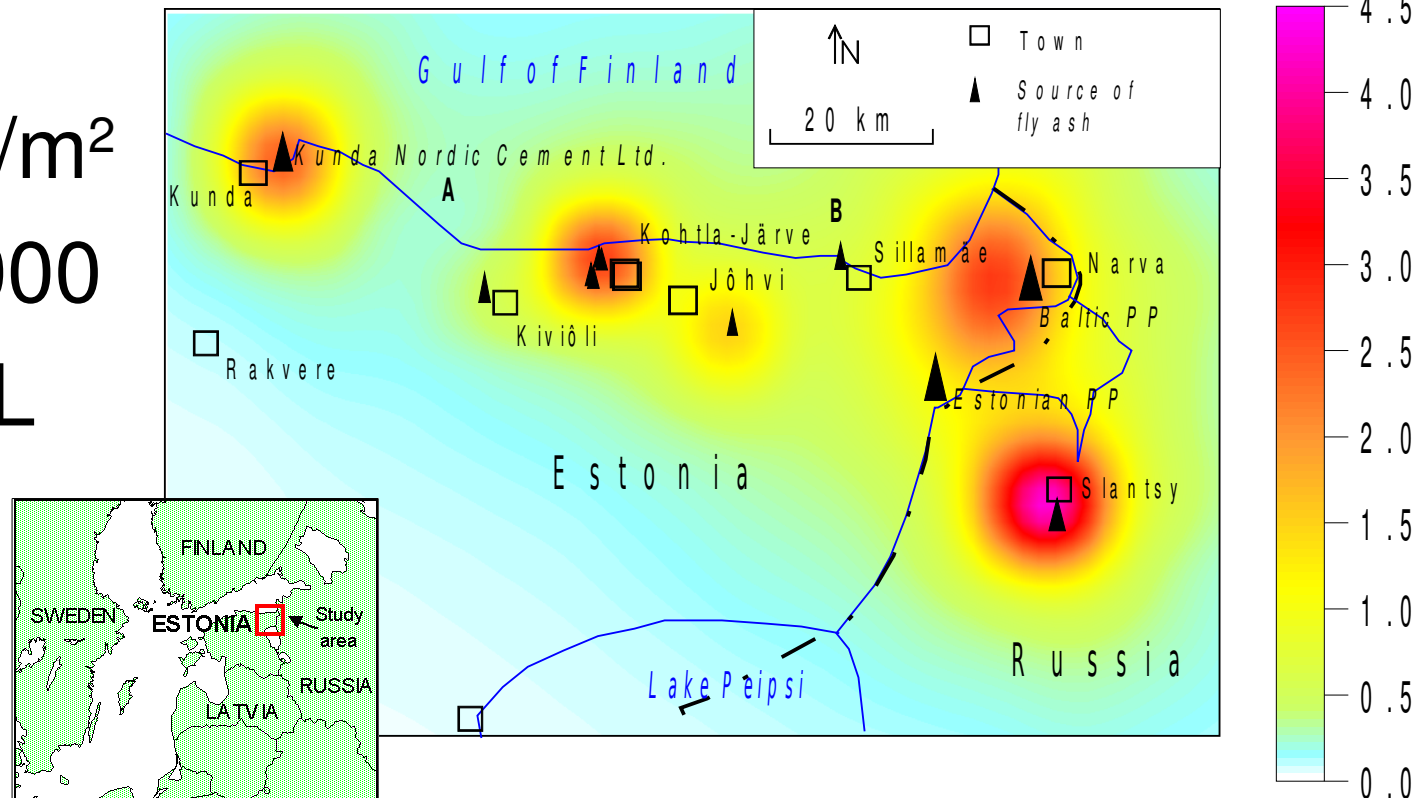


Heavy pollution loads

- Combusting *Kukersite* - just like limestone. High loads of Ca, Mg etc., high pH > 6 – alkalisiation, just opposite to acidification.

- Fly ash load, kg/m² 1960-2000

AEROPOL model



Effects to ecosystem of bog: increased pH and nutrients load

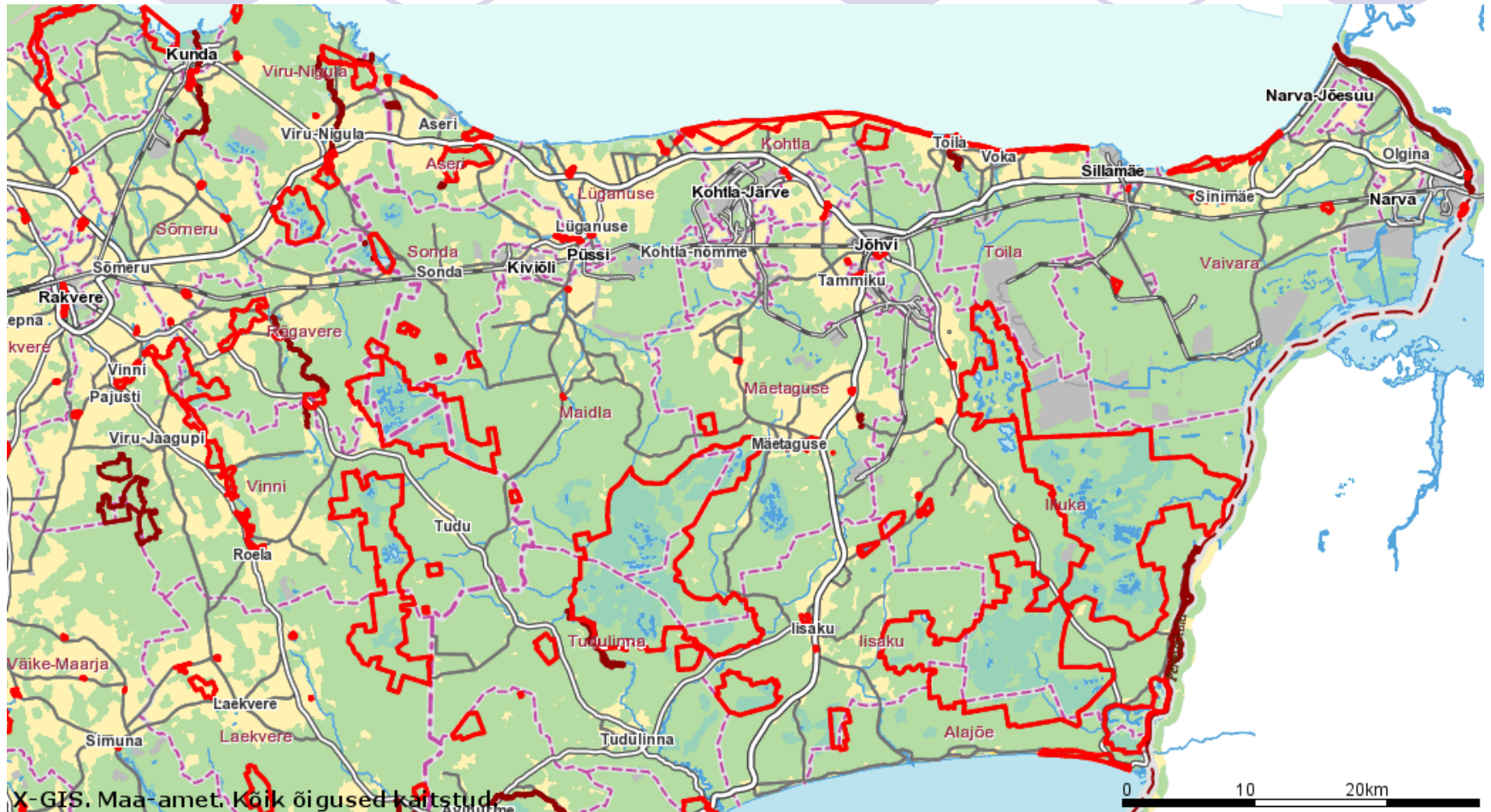


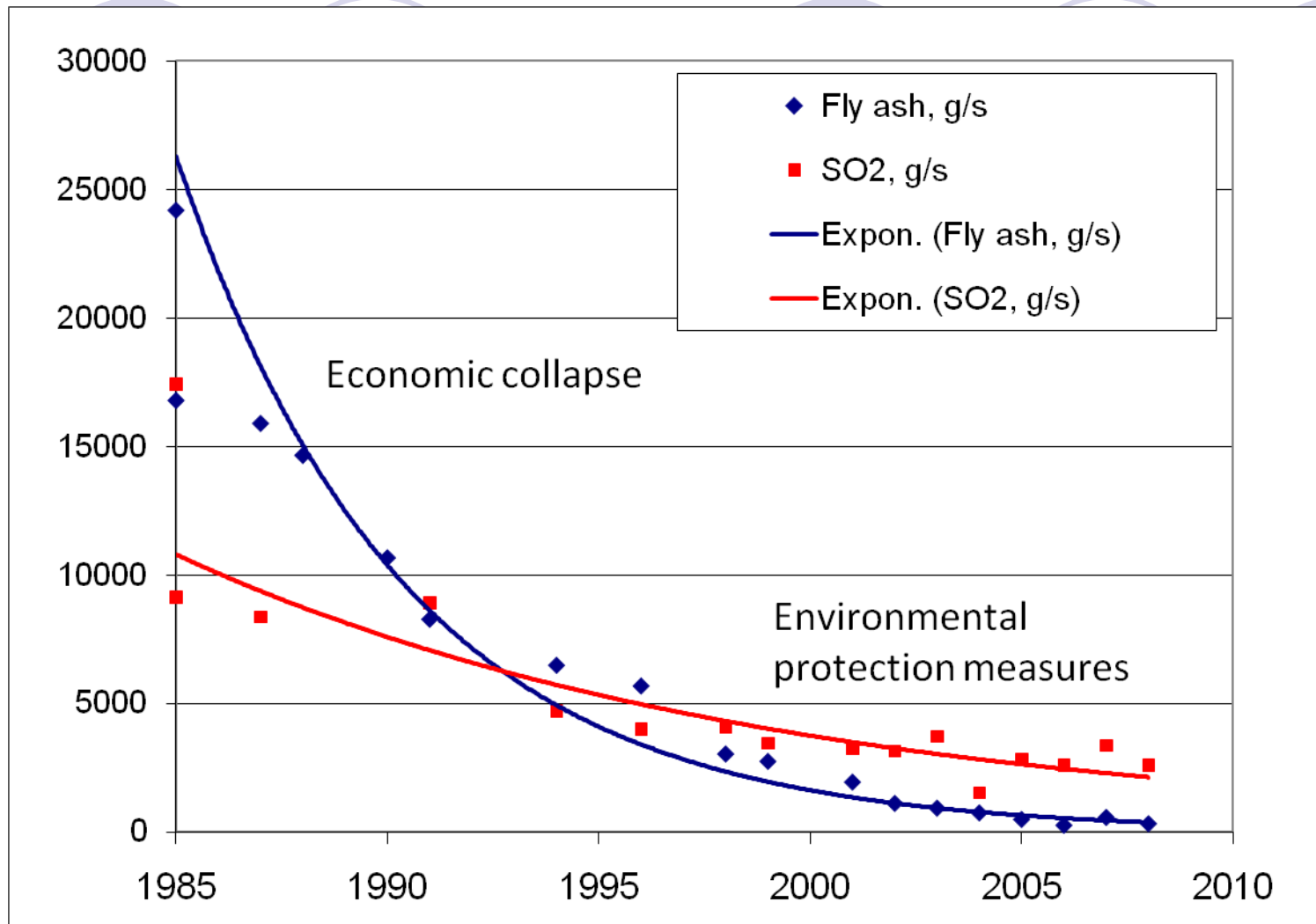
Normal



Heavy ash influx

Industry and nature protected areas





Emissions from NE Estonia and Slantsy
 wintertime estimation, g/s

Snow sampling -

a cost-efficient method to determine the deposition fluxes during snow accumulation.

- First applied in NE Estonia in March 1985, then nearly each stable winter – good results nearly in 1/3 of winters.
- Analysing the snow melt water – pH, anions, cations, (suspended mineral matter, trace metals ...)

concentration

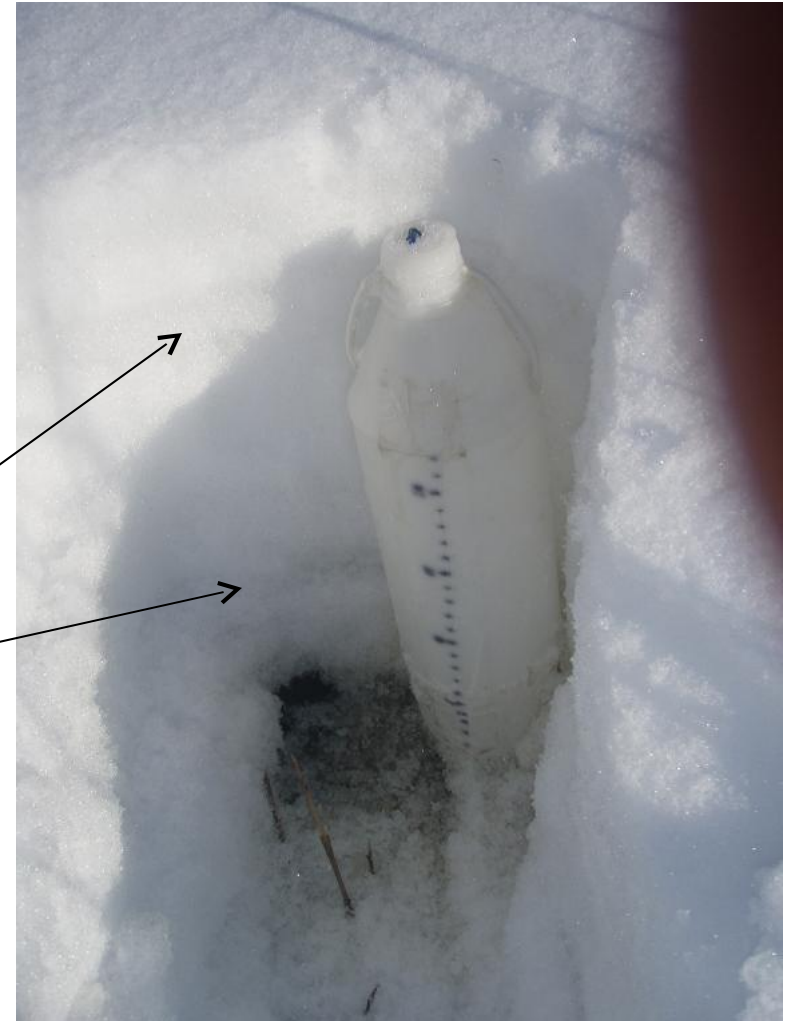
Flux = -----

area × time



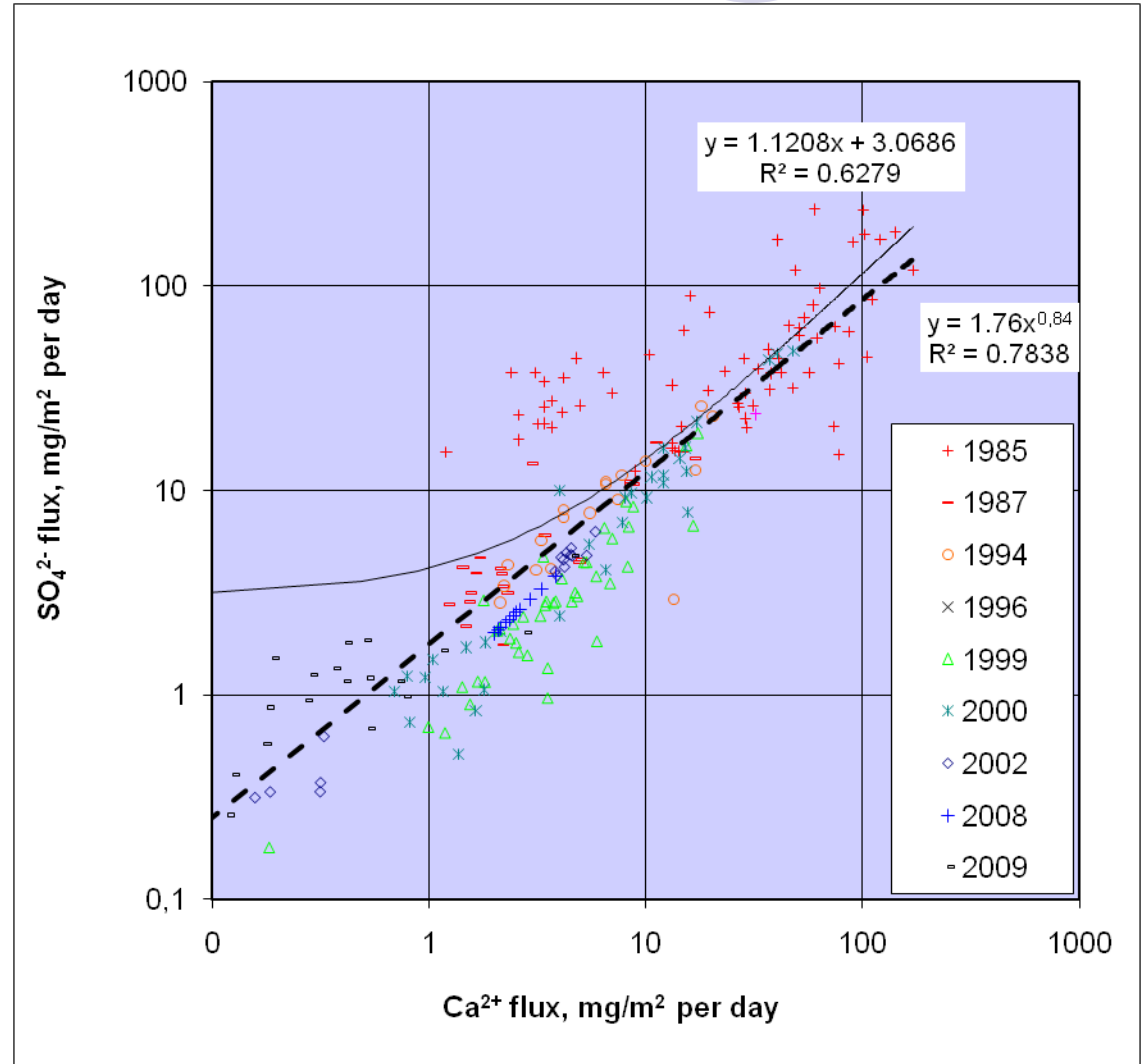
Snow sampling

- Secondary aim – for validation of atmospheric dispersion-deposition models for fluxes.
 - next presentation
- Multiple layers, i.e. shorter time intervals – if the layers are distinguished and identified.
- Ice crusts from short thawing episodes are good markers.



Two most abundant ions in snow water of NE Estonia are Ca^{2+} and SO_4^{2-}

Typical $\text{Ca}^{2+} : \text{SO}_4^{2-}$ ratio is close to 1:1

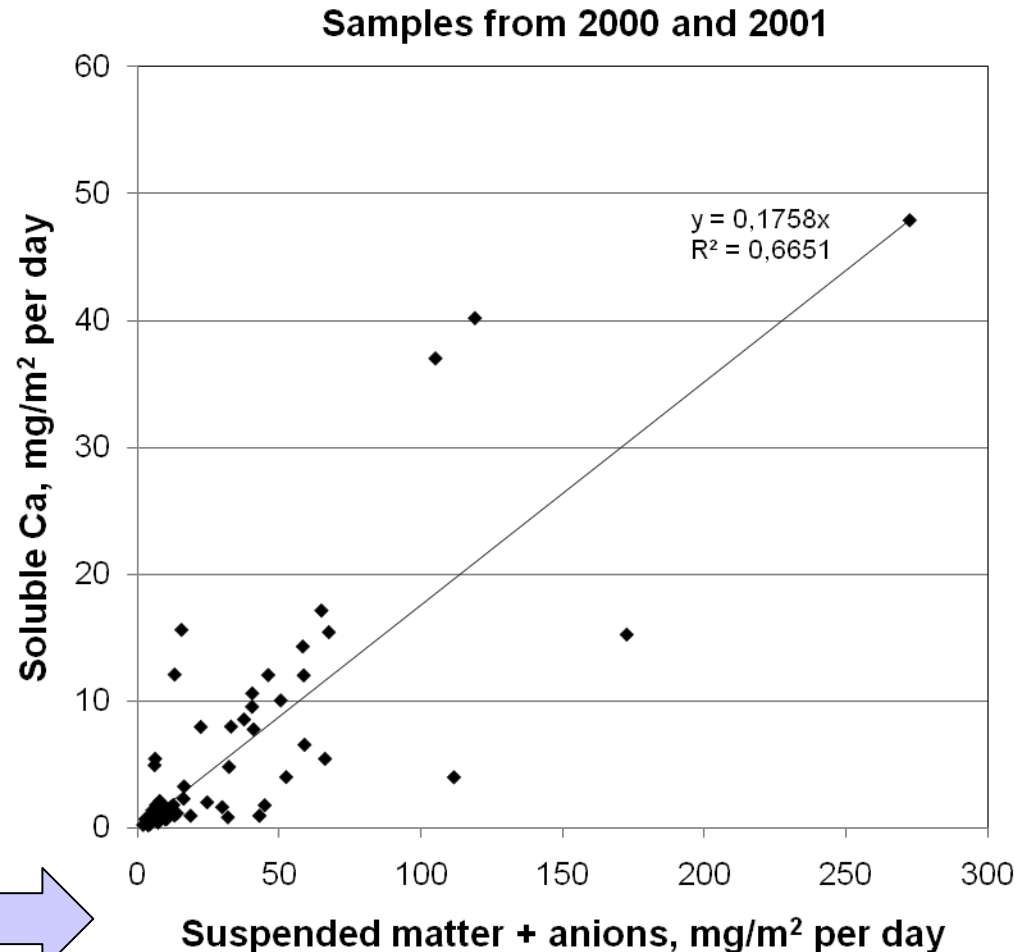
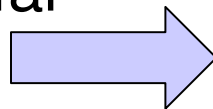


Building the bridge between emissions and snow samples

How to estimate the total flux of fly ash, as we know separate components?

Pets *et al.*, 1986: there is about 30.5% CaO in stack ashes (in free and composite forms), i.e. about 21.7% Ca.

Indeed, snow water measurements not far from that (~17.6%).

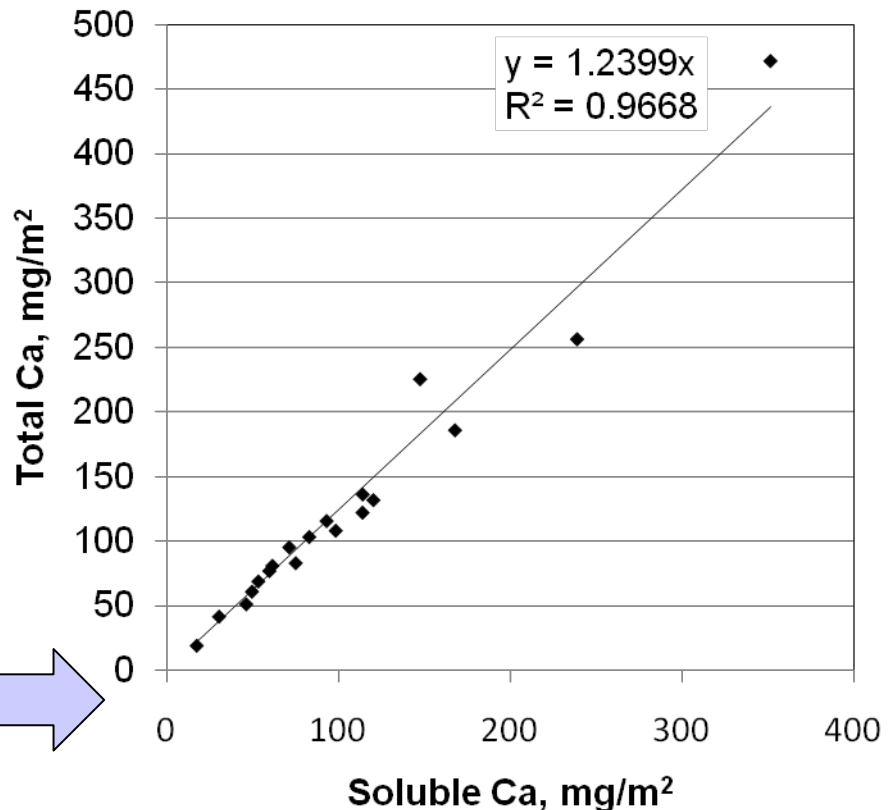


Building bridge between emissions and snow samples

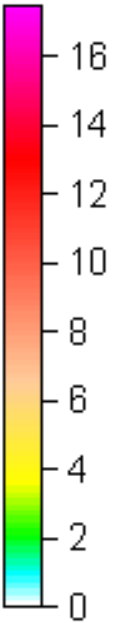
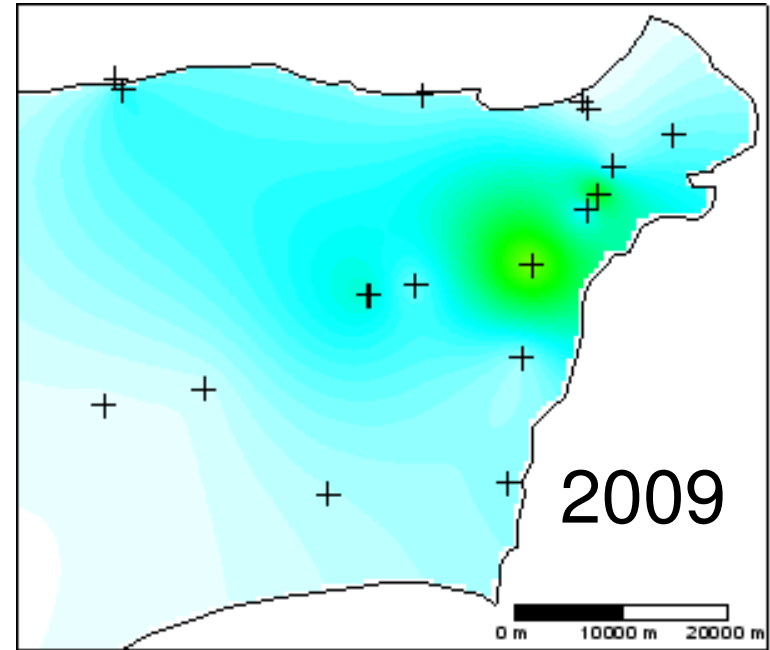
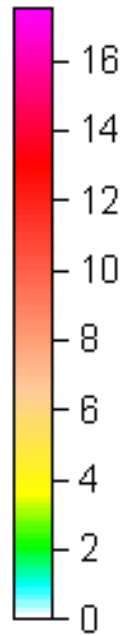
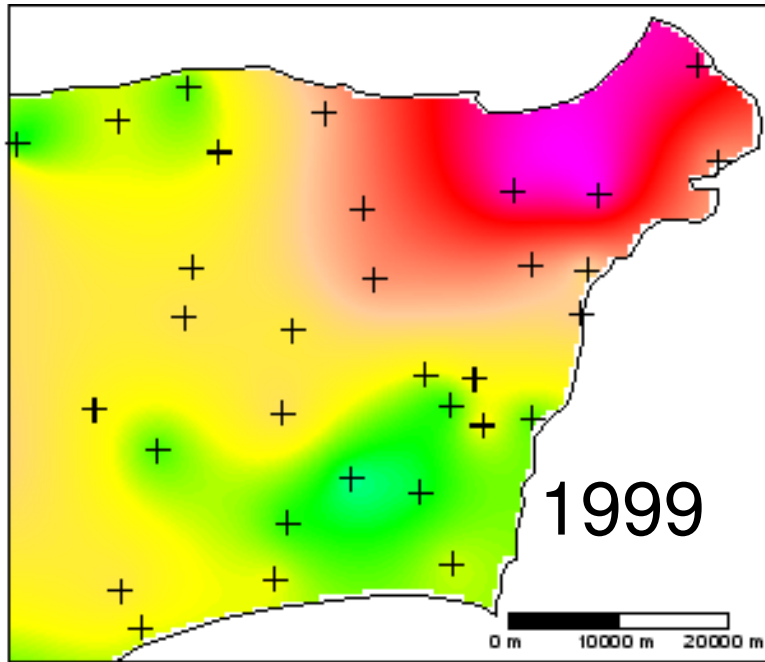
Moreover,
a minor but remarkable part
of Ca remains not solved.
In 2001 the analysis
included metals in
suspended mineral
matter.
A result: taking into account
insoluble Ca adds 24% to
total Ca.

$17 \times 1.24 = 21.8\%$ perferct fit!

Ca total vs. Ca solved, 2001

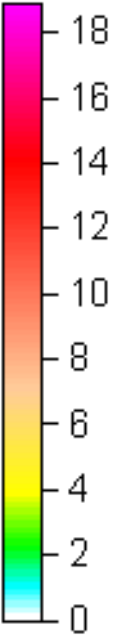
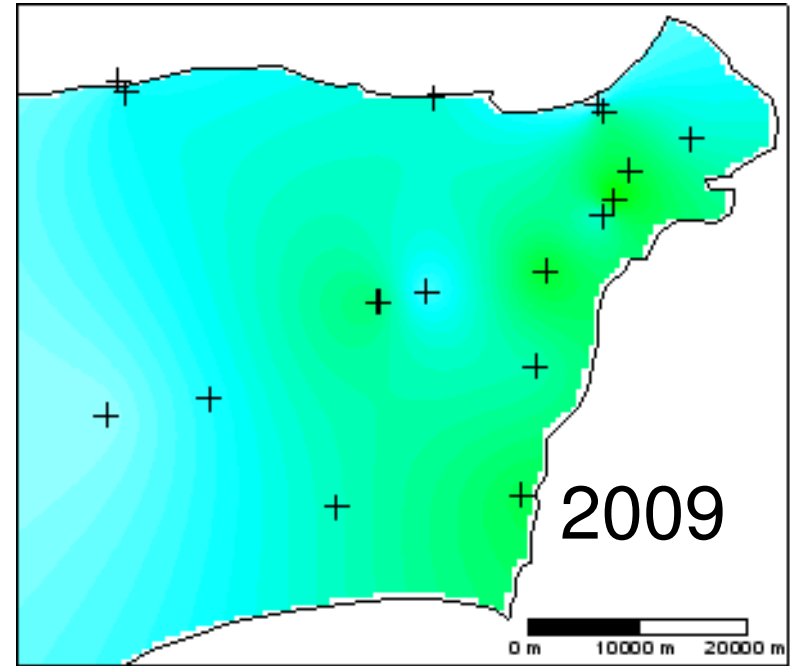
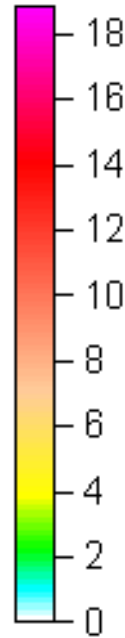
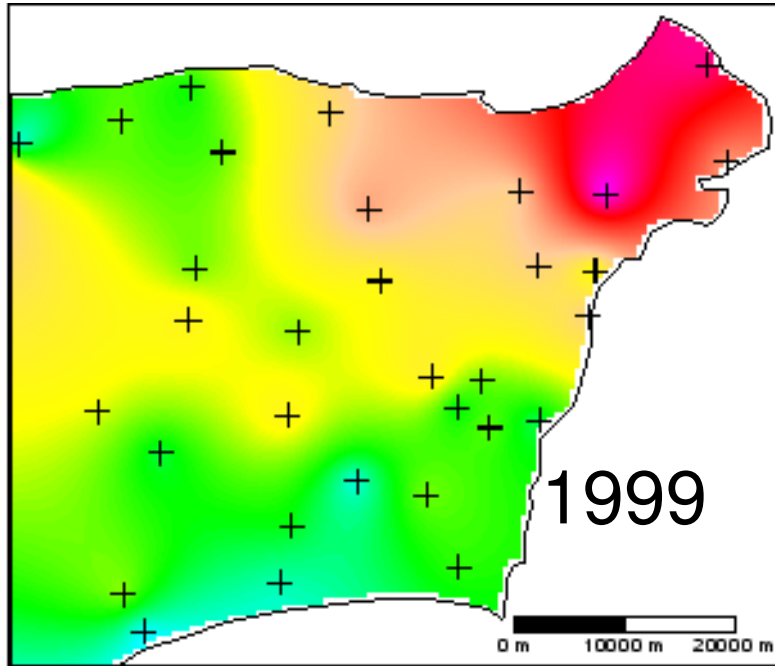


Mapping the deposition



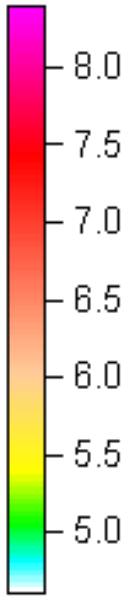
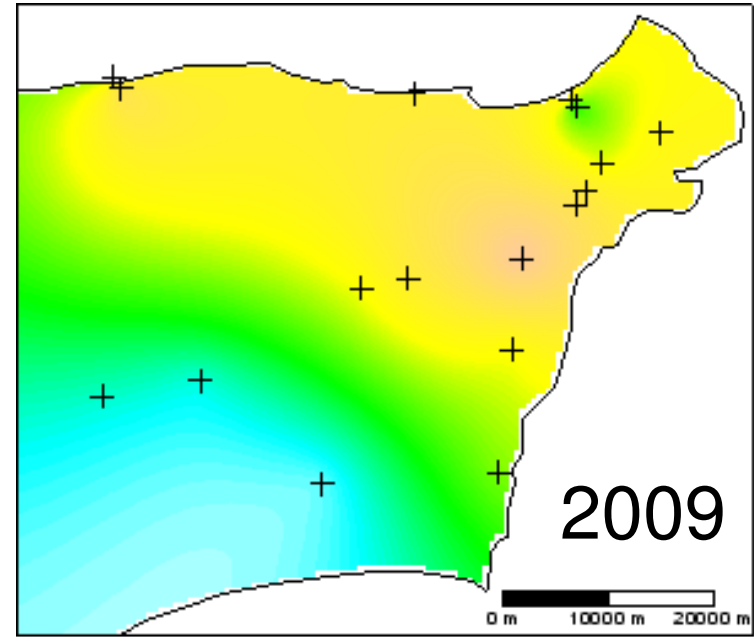
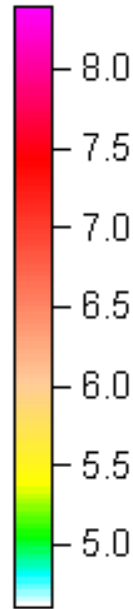
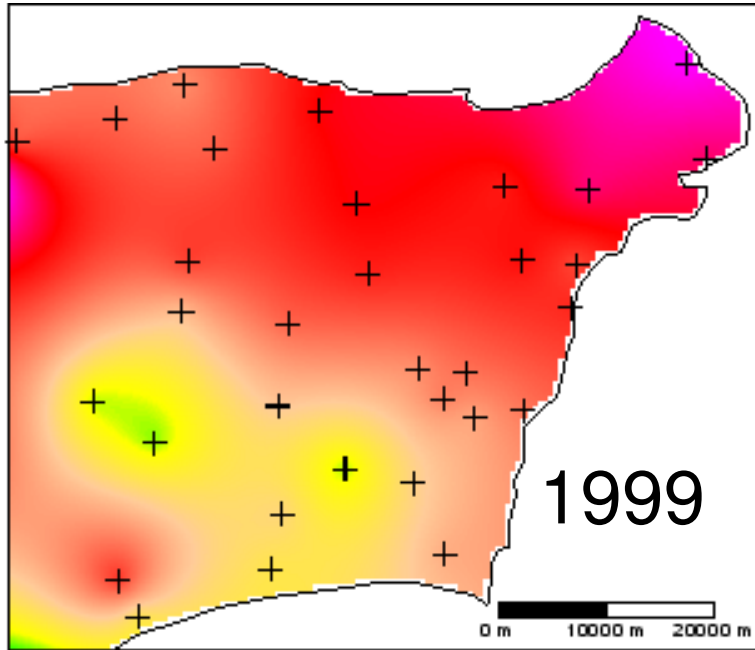
Ca^{2+} , mg/m^2 per day

Mapping the deposition



SO_4^{2-} , mg/m^2 per day

Mapping the deposition



pH of snow water

Snow campaign 2010 – a challenge

completed by March 19 in NE Estonia



- 20 sampling sites
- 2 snow layers from each
- depth up to 80 cm
- water storage up to 200 mm
- support from national monitoring system – samples from other parts of the country.



Thank you!