Sval-POPs project: evaluating the spatial variability of POPs concentrations in snow

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Background

Persistent organic pollutants (POPs) concern scientists due to their **long environmental lifetimes** and **negative impact** on the biological functions of multiple organisms (Muir and de Wit, 2010). These contaminants are delivered to the Arctic from lower latitudes via **long-range transport**, or come from local sources in limited amounts (Hung et al., 2010; Octaviani et al., 2015; Reimann et al., 2009). Their **monitoring in Svalbard focuses on concentrations in the air and biological tissues** (AMAP, 2016), although they have been shown to occur in snow (Kallenborn et al., 2011) and ice cores (Hermanson et al., 2005), and **snowfall may be a path for their efficient delivery** to terrestrial environment (Lei and Wania, 2004). However, the **heterogeneity of snow prevents** wider **extrapolations** of any local data on snow concentrations of POPs.

Aim

To establish a stronger background for spatial comparisons of snow chemistry studies directed at persistent organic pollutants (POPs).
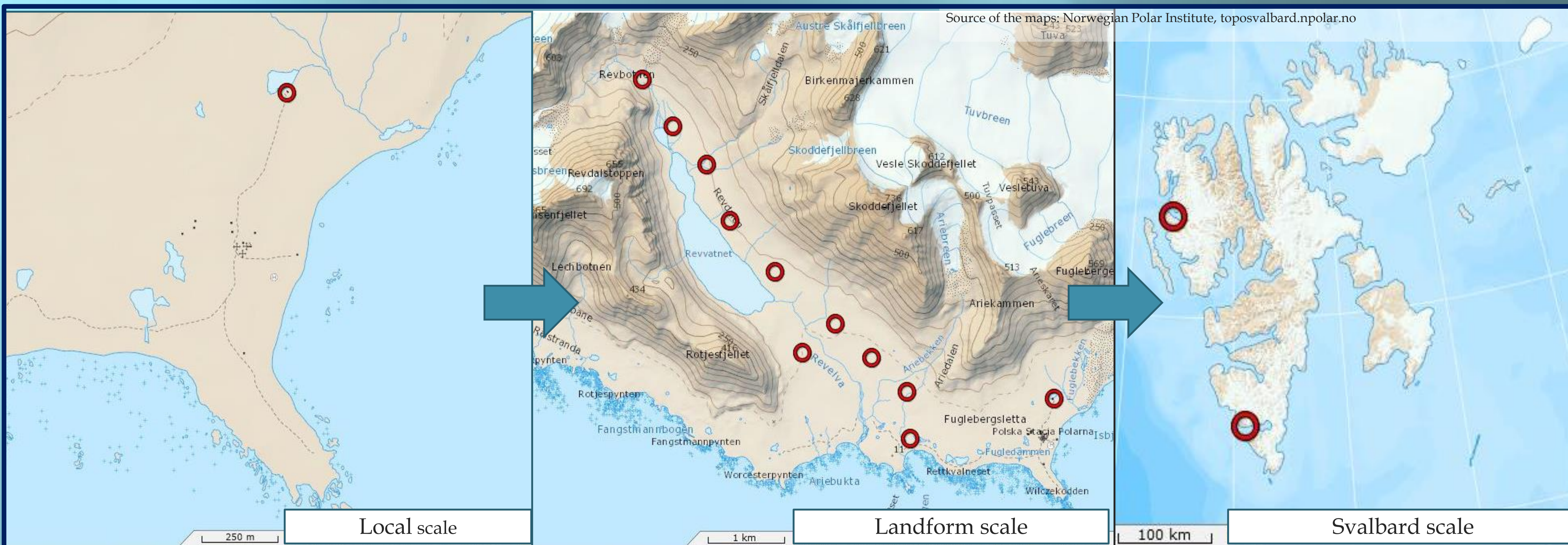
Objectives
1. Deciding on the best sampling practice, from two different sampling approaches (the Polish and the Italian team).
2. Enabling a wider use of the analytical methods, through publishing metadata on the analysis steps and laboratory conditions.
3. Performing a laboratory cross-check between the two groups conducting research projects at the same time.
4. Describe the natural spatial variability of POPs concentrations in snow at three spatial scales, providing a better background for future spatial extrapolations.

Sampling - spatial variability scales

- local (2–5 meters): 4 times, HRN and NyA, 3 samples each site + random points of the landform sampling
- landform (0.5–1 km between points, within one valley, glacier, or mountain slope): at least 1 sampling per site, after fresh snowfall if possible
- across Svalbard (Ny Alesund – Hornsund), approx. 200 km distance.

The expected outcomes of the project

1. Sharing a dataset on snow properties in Hornsund and Ny Ålesund.
2. Describing the potential of snow as a monitoring medium for POPs concentrations, in the context of spatial heterogeneity and inter-lab differences.
3. Providing a thorough method description for the applied field sampling and laboratory analysis of POPs concentrations in snow.

Source of the maps: Norwegian Polar Institute, toposvalbard.npolar.no
Local scale | Landform scale | Svalbard scale

Benefits for other SIOS users

Publications: an article on spatial variability of POPs in the snow cover of Svalbard, with a *Methods* section on the applied sampling approaches and sample processing / analyte determination.
Datasets: snow physical properties & POPs concentrations in snow at 3 spatial scales, in Svalbard.
Networks: strengthening the collaboration between Polish and Italian research units in Svalbard, aiming for more comparisons between Ny Ålesund and Hornsund environmental monitoring results.

Fieldwork plan

TO DO LIST:
- Spatial sampling (landform scale)
- Local sampling together, to compare procedures
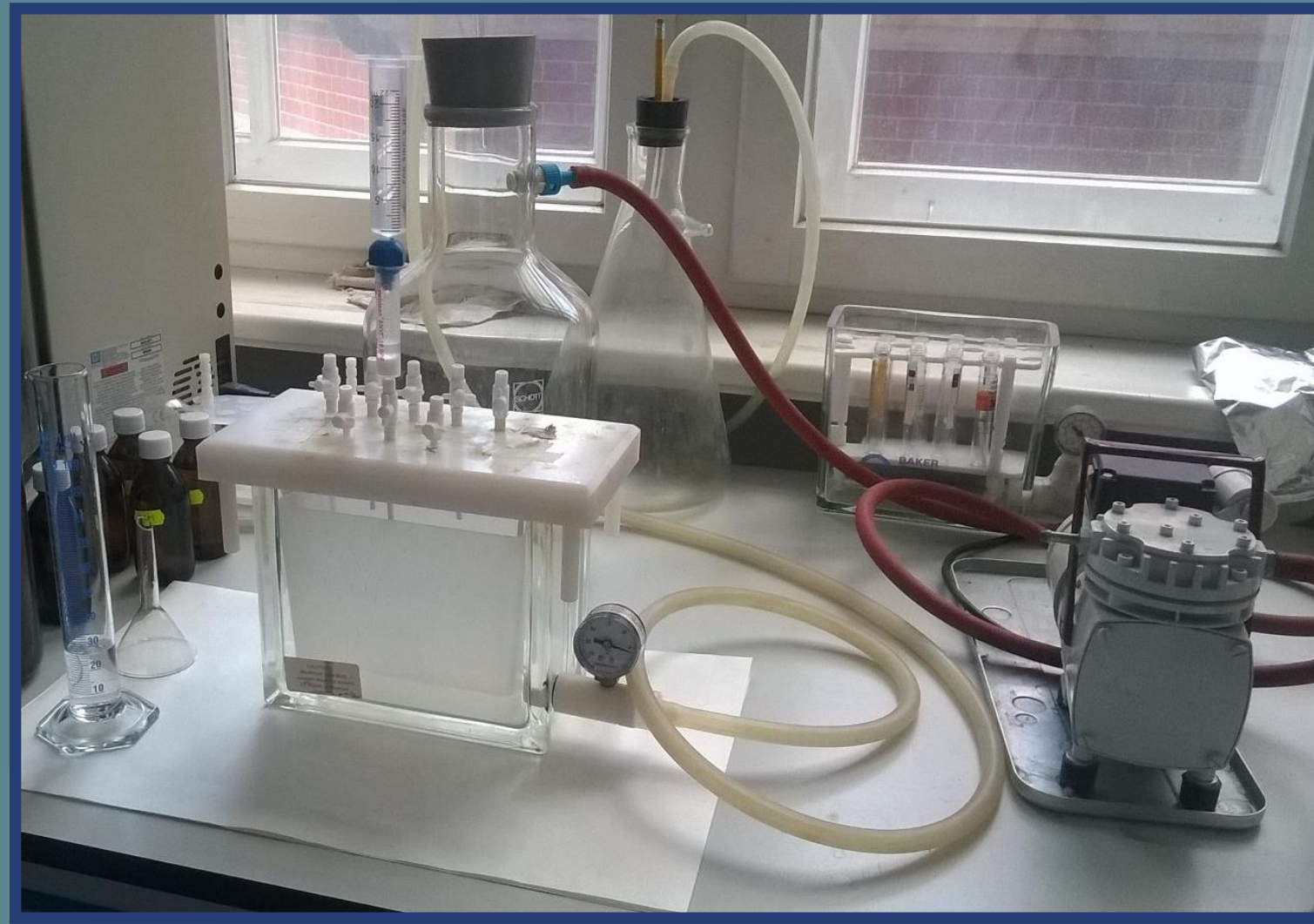- Compare laboratory processing procedures

Photo by K. Kozak

Photo by T. Budzik, C2S3 project

Methods

Analytes: polychlorinated biphenyls (PCBs) and HCB (hexachlorobenzene), which is an organochlorine pesticide (OCP).
Laboratory cross-check: an exchange of test samples, i.e. double analyses of the same material from Ny Alesund and Hornsund in both laboratories (at least 5 samples). Result: inter-laboratory error level calculated.
Laboratory analysis QA/QC:
surrogate, isotope-labelled standard solution to estimate losses of analytes in the whole analytical process,
internal standard injected just before the analytical step on the GC-MS,
field and equipment blanks checked,
Estimated parameters: repeatability, recoveries, LOD, LOQ, linearity

Analytical procedure step	Hornsund / GUT, Poland	Ny Alesund / CNR-IDPA, Italy
Sampling container, pre-rinsed with deionised water and methanol	Teflon bag (+ amber glass)	Aluminium or stainless-steel bucket
Pre-concentration / extraction on site	Supelco ENVI C-18 SPE columns; ethyl acetate and dichloromethane (DCM)	Oasis WAX/HLB cartridges; hexane and DCM
Final determination method: GC-MS (gas chromatography coupled with mass spectrometry).	GC MS/MS Agilent Technologies Column HP-5 MS	GC-MS, Agilent Technologies, Column HP-5 MS

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