Project information

Project title

Indoor Air Quality in polar regions. The case of Tromsø

Year

2013/2014

Project leader

Sandra Huber, NILU

Participants

- Athanasios Katsogiannis, Sandra Huber, NILU
- Torkjel Sandanger, Eik Erik Anda, UiT
- Justin Gwynn, Ingvild Finne, Statens Strålevern
- Eirik Mikkelsen, NORUT
- Alessandra Cincinelli, Tania Martellini (University of Florence, Italy)
- Paolo Leva (European Commission)

Flagship

Hazardous substances, Theme: The effects of contaminants and climate change on human health, indigenous peoples and Arctic communities

Funding Source

Fram Centre

Summary of Results

At the initial project meeting in May 2013 we decided and agreed on sampling places and amount of samples. Private old houses with passive ventilation and new houses with active ventilation will be compared regarding concentrations of selected volatile and semi-volatile chemical compounds measured in indoor environments. The investigation includes also separate collection and measurement of particles and their size distribution.

Method development for sampling and analysis of volatile and semi-volatile chemical compounds were and are continuously under development at NILU; this part was and is funded internally by NILU. The sampling campaign and analysis of the samples was performed during October - December 2013. Analysis of some of the samples took also place in the collaborating laboratories in University of Florence (Italy) and in European Commission's laboratories in JRC - Ispra (Italy).

We collected indoor air samples from various microenvironments in the FRAM Centre and in various private houses (around 40 samples). In this places we measured aerosols and a series of volatile organic compounds, e.g. BTEXs (Benzene, toluene, ethylbenzene, xylenes), terpenes (limonene, pinene etc.), siloxanes and other important indoor parameters like naphthalene. Particle concentration and size distribution of the aerosols were also investigated.

From the obtained results we can see some clear differences between the occurrence of VOCs in FRAM Centre and in private houses. The concentrations in the latter (houses) tend to be higher for the sum of VOCs and for the categories of terpenes and siloxanes. BTEXs are higher in the microenvironments of the FRAM Centre, something that is probably due to the proximity to a busy road, to parking (cold engine starts) and other automotive-related activities.

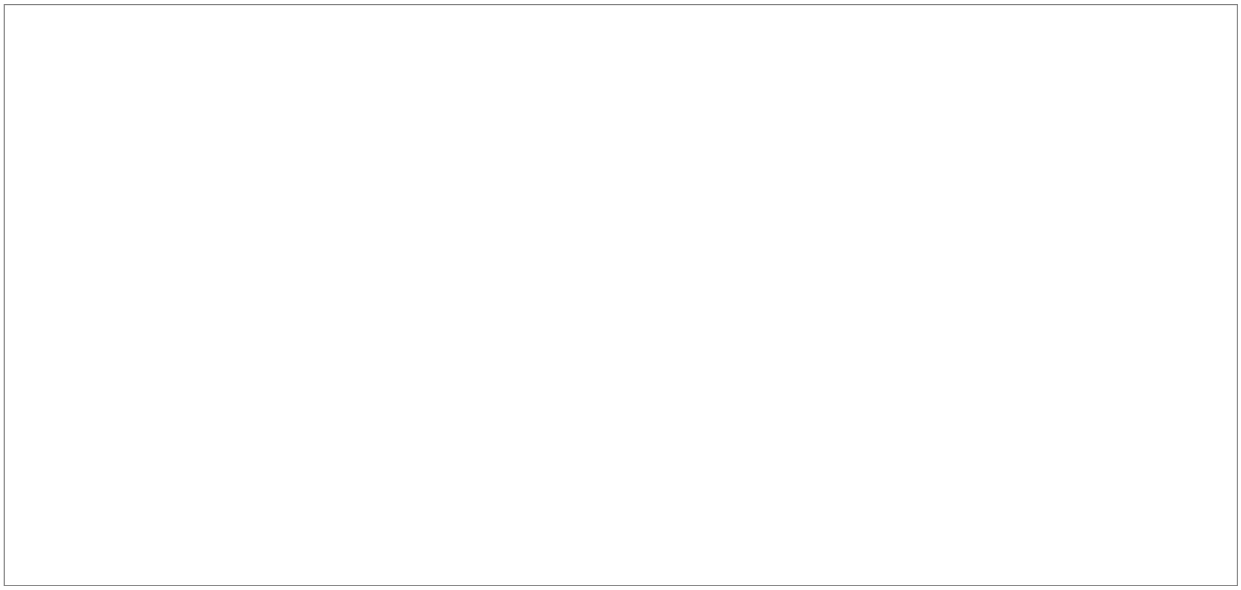
Regarding the private houses, the bathrooms are consistently the sites where the highest concentrations of VOCs are detected, likely due to the use of a variety of cleaning and personal care products.

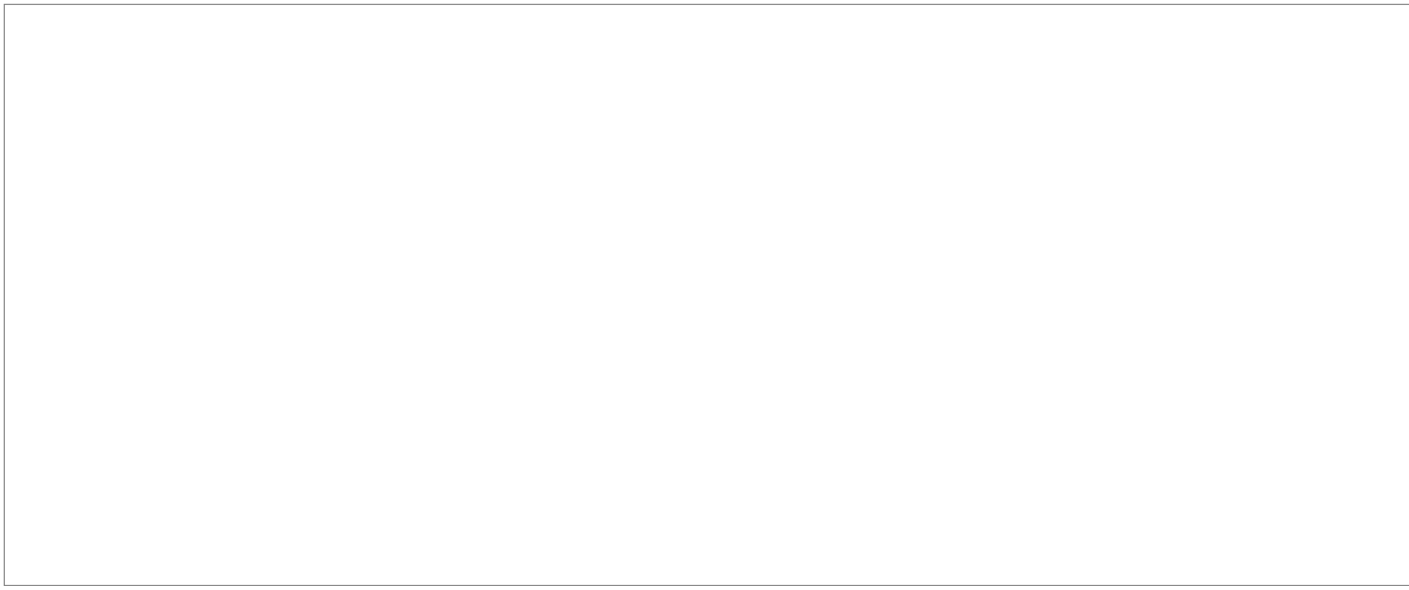
From the preliminary results of VOCs, we cannot have safe results about the impact of passive against active ventilation houses, or of the age of the houses.

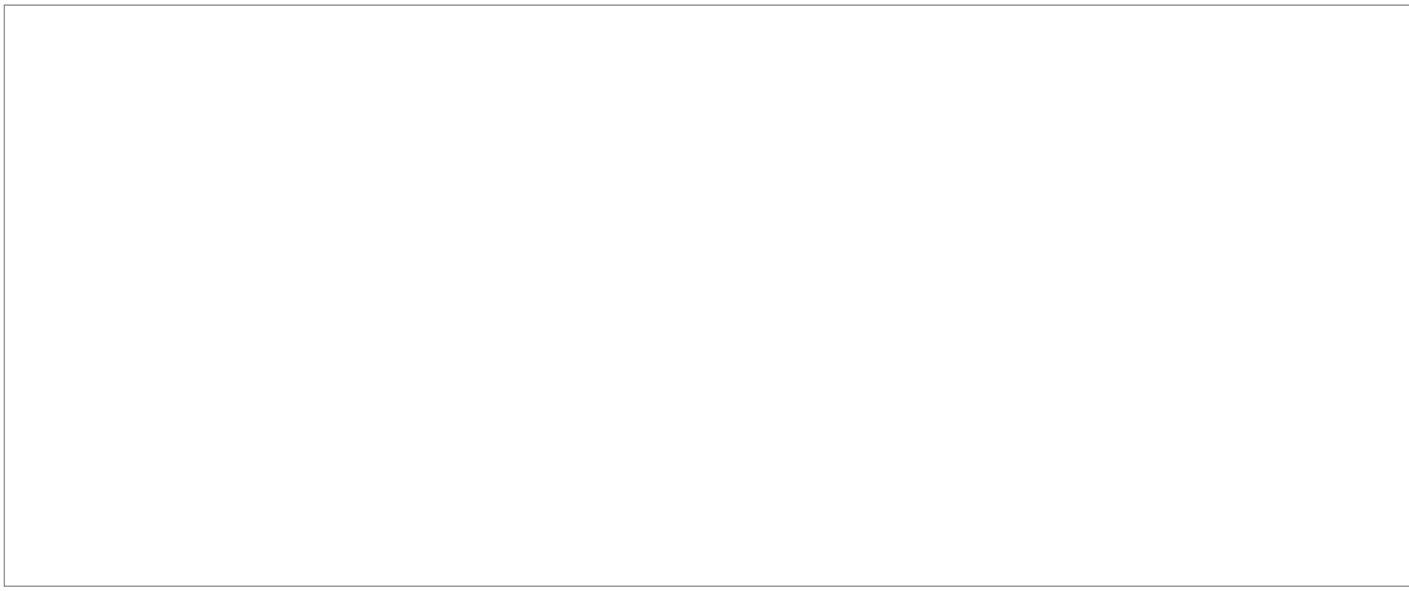
In comparison to scientific studies reporting indoor air concentrations from other places worldwide, it can be seen that, at least, for the measured substances, the concentrations measured at Tromsø, are relatively low, suggesting low exposure to humans. This is particularly evident if we look at the concentrations of total volatile organic compounds (TVOCs), which in the present study are calculated as the sum of all identified and measured VOCs (not all chromatographic peaks). In the past, scientists had proposed that for "comfortable indoor air quality", the concentrations of TVOCs should be around 300 $\mu g\ m^{-3}$, which as we can see at the following figures, is more or less the levels observed for all studied environments.

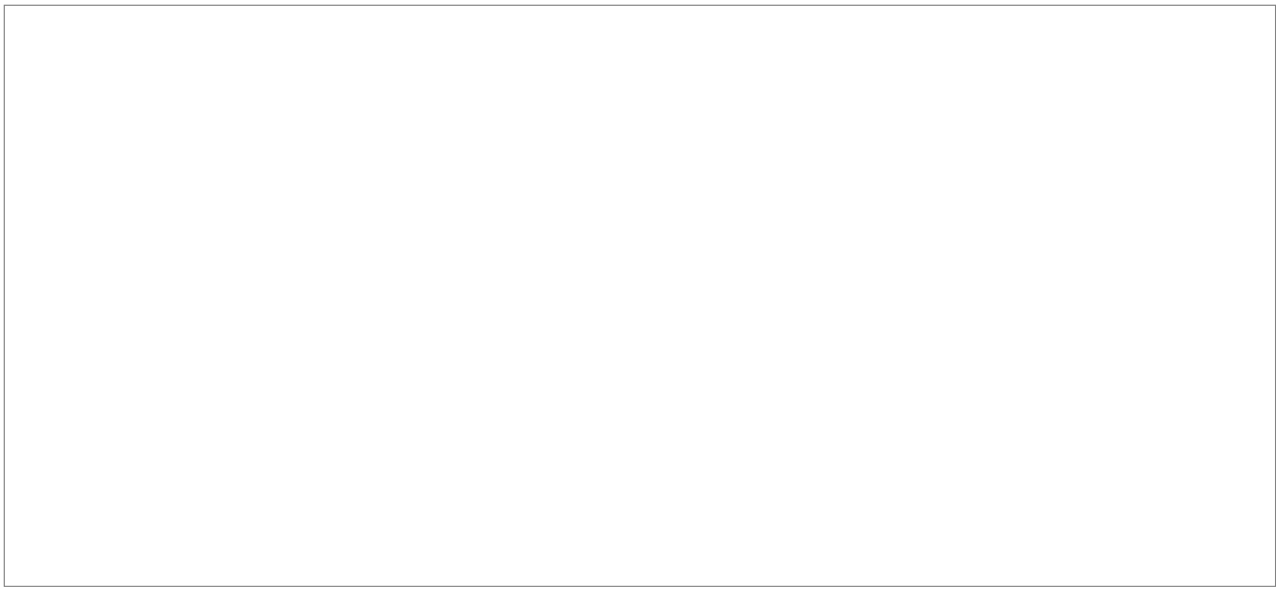
The concentrations of aerosols also present interest and suggest that more detailed work should be done. Particles with aerodynamic diameter smaller than 10 μm are generally at low levels in Tromsø houses, while the concentrations of heavier particles is much greater. From the details and particularities registered at each sampling site, it can be concluded that important factors for the elevated concentrations of heavy particles are the presence of indoor emitting sources (candles), the proximity to a road and also the proximity to a parking lot. These were characteristics observed at the environments where high concentrations of heavy aerosols were observed. Regarding the Fram Centre indoor microenvironments analysed, we note differences between offices and non-office environments, but also different profiles between offices. We note that the aerosol concentrations in sites like the gym or the printer/storage room are exhibiting higher concentrations than the offices, while the latter exhibit variability in the results, which, based on the characterisation of the office room conditions, is probably due to the cleaning levels of each room.

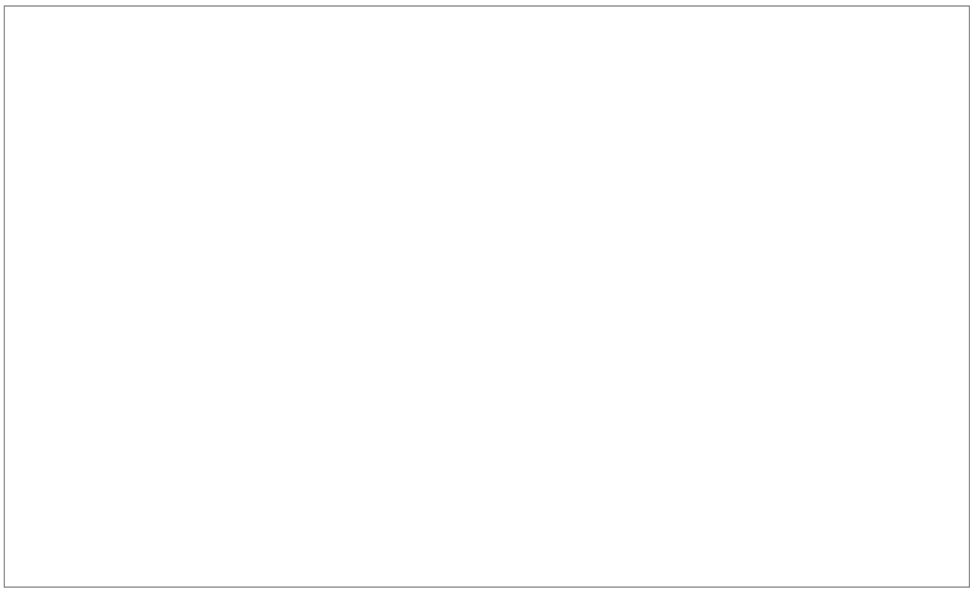
Some of the key figures are given hereafter:

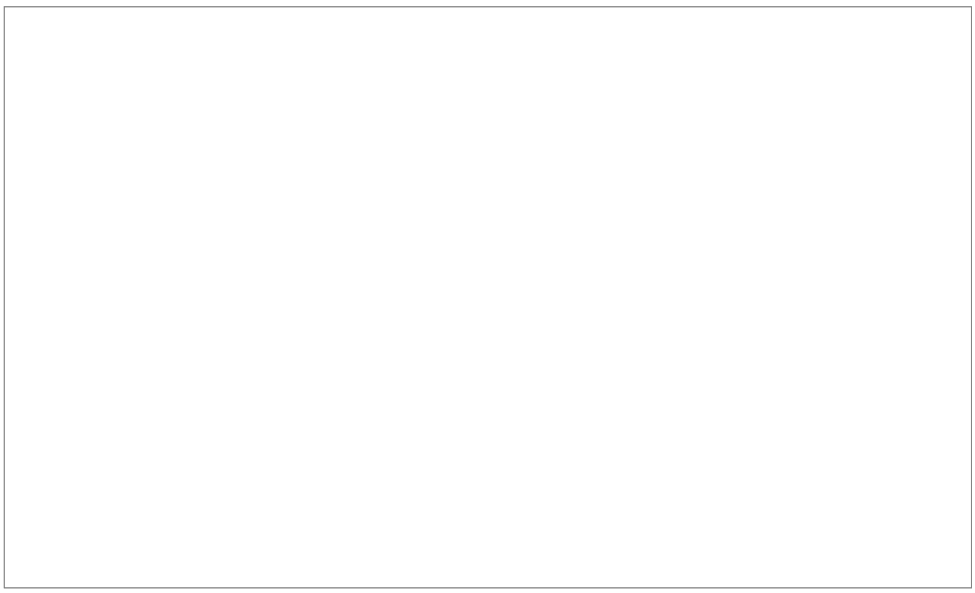


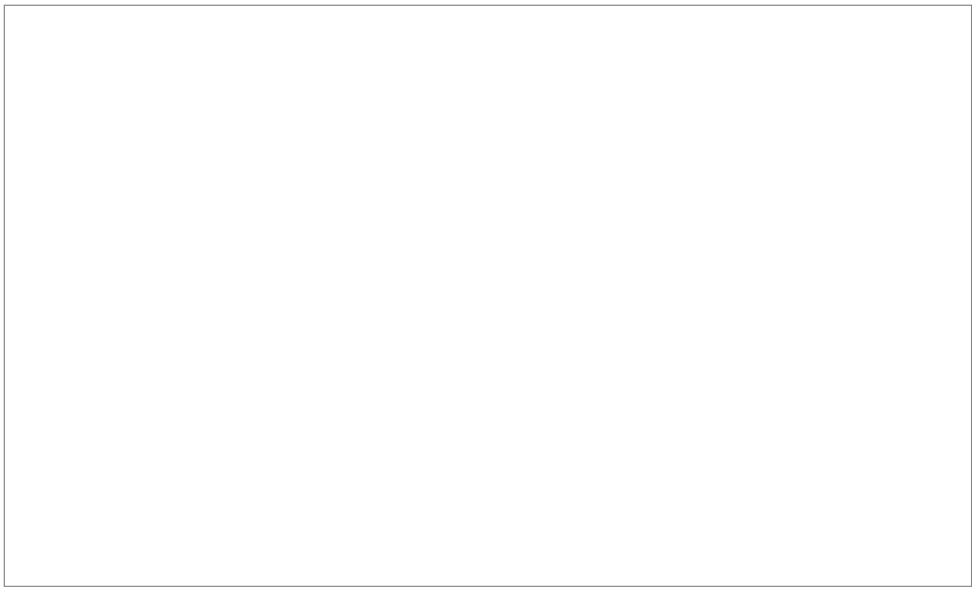












For the Management

See summary of results.

Published Results/Planned Publications

Planned publication: We have proposed the outcome of this project to be published in The Journal of Atmospheric Environment, in a Special Issue entitled: “Indoor Environment”.

The proposed paper entitled “Indoor air characterization of various microenvironments in the Arctic” was well received. The deadline for submission is 31 March 2014.

Communicated Results

See above

Interdisciplinary Cooperation

The results are discussed and evaluated by groups of Chemists, Environmental Scientists and Epidemiologists, with the aim to understand further what the health impact of indoor air pollution can be. In this direction, the project’s outcome is multi-dimensional and as such, upon completion, it will have benefited much from the Inter-disciplinary cooperation.

Budget in accordance to results

The Fram Centre funding provided the necessary motivation, platform and helped in bringing together scientists from various institutes and scientific fields. This specific project was initiated exclusively thanks to the Fram Centre funding.

Could results from the project be subject for any commercial utilization

No

Conclusions

a) Indicate future research and/or perspectives which the project results have led to

Future research needs to include a broader range of volatile and semi-volatile compounds present in indoor environments as for example PFAS, several PAHs, brominated and organophosphorous flame retardants and new emerging contaminants.

b) List and describe new methods or techniques that have been developed during the project or that the project has revealed a need for

There is a need for methods which provide fast and cheap sampling and instrumental analysis of indoor air.

Initial steps for method development of PFAS compounds were performed, but the method needs to be improved and validated.

Particle measurement of different microenvironments looks promising regarding a first estimation of concentrations and size distributions. For further and future investigations it is recommended to include also the nano-particle fraction in order to investigate the contribution of this fraction to the total PM and its health concern.