

Forskningsprogram			
SNAP <input checked="" type="checkbox"/>		REPROSAFE <input type="checkbox"/>	FLIPP <input type="checkbox"/> Inriktning: Ekonomiska styrmedel <input type="checkbox"/>
Inriktning: Informationssystem och indikatorer IPP <input type="checkbox"/>			
Projekttitel (svensk): Kombinerad exponering av luftföroreningar och buller – en förbättrad värdering samt kvantifiering av hälsokonsekvenser			
Projekttitel (engelsk): Combined exposure of air pollution and noise – an improved assessment including quantification of health consequences			
Huvudsökande	Efternamn: Sjöberg	Förnamn: Karin	Födelseår: 1960
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Medsökande	Efternamn, förnamn, tjänst, organisation, institution:		
	Telefon:	E-post:	Kvinnor <input type="checkbox"/> Man <input type="checkbox"/>

Miljöforskningsnämnden

Ansökan om projektbidrag inom Naturvårdsverkets forskningsprogram

Sammanfattning på svenska strukturerad enligt följande: 1) Projektets betydelse för programmet
2) Miljörelevans och förväntad betydelse för miljöpolitiken 3) Mål och hypotes 4) Metodik och genomförande
5) Kommunikationsinsatser i relation till programmet:

1) Projektets betydelse för programmet

Det föreslagna projektet kommer att ge kompletterande underlag för bedömning av:

- generell befolkningsexponeringen avseende partiklar och polycykliska aromatiska kolväten (PAH) i omgivningsluft;
- hälsoeffekter av befolkningens exponering för partikelhalter;
- möjliga interaktioner mellan buller och hälsoeffekter av luftföroreningar.

2) Miljörelevans och förväntad betydelse för miljöpolitiken

Miljö kvalitetsnormer används som i lagstiftningen som ett juridiskt verktyg för att, på längre sikt, nå politiskt uppsatta miljömål. Utvecklingen av normer baseras i stor utsträckning på olika typer av miljö kvalitetsdata. Det finns ett stort behov av metoder att beräkna hälsoeffekter för att kunna uppskatta antalet människor som utsätts för skadliga nivåer av såväl luftföroreningar som buller, och därmed förbättra underlaget för olika åtgärdsbeslut.

3) Mål och hypotes

De huvudsakliga målen för det föreslagna projektet är:

- er hålla en förbättrad bild av befolkningens exponering för hälsorelaterade partiklar;
- utveckla en enkel och kostnadseffektiv metod att uppskatta exponering av PAH (B(a)P) utifrån PM₁₀-mätningar
- uppskatta hälsokonsekvenser av partikelexponering;
- uppskatta befolkningens exponering för kombinationen luftföroreningar och buller i olika intervall.

4) Metodik och genomförande

I ett pågående projekt inom SNAP-programmet har den s.k. Urban-modellen utvecklats för att bättre kunna beskriva de lokal meteorologiska spridningsförutsättningarna. Inom Urban-mättnätet har också ett stort antal små- och medelstora kommuner i landet under de senaste åren mätt PM₁₀ i urban bakgrundsluft. Tidigare studier har visat på en god korrelation mellan sot och PAH. En metod för att uppskatta sotinnehållet på PM₁₀-filtren kommer att utvecklas. Filtren analyseras därefter med avseende på sotinnehåll och PAH (B(a)P), i syfte att studera korrelationen mellan dessa föroreningar. Om det föreligger en korrelation kan en kostnadseffektiv metod för uppskattning av sot på PM₁₀-filter användas för att generera hälsoeffektrelaterade data, som i sin tur kan användas i Urban-modellen för att beräkna befolkningsexponering avseende sot och PAH.

Vidare kommer, baserat på beräkningar av befolkningens exponering och tillgängliga dos-responssamband, hälsokonsekvenser av partikelhalter över specifika nivåer, t.ex. miljö kvalitetsnormen för utomhusluft, att kvantifieras.

Inom den nationella miljöövervakningen har människors exponering för buller beräknats. Utifrån exponeringsdata avseende både buller och luftföroreningar, uppskattas antalet människor som utsätts för den kombinerade effekten i olika exponeringsintervall. Dessa resultat kan sedan användas för beräkning av hälsokonsekvenser.

5) Kommunikationsinsatser i relation till programmet

Resultaten från projektet kommer att dokumenteras och publiceras i rapporter och vetenskapliga tidskrifter samt presenteras på seminarier, konferenser etc. såväl nationellt som internationellt.

	År 2004	År 2005
Summa sökta medel per år i kr:	480 000	430 000

Miljöforskningsnämnden
Ansökan om projektbidrag inom Naturvårdsverkets forskningsprogram

Sökta projektmedel fördelade på kostnadslag	År 2004 (kr)	År 2005 (kr)
Personalkostnad inkl. soc. avgifter *		
Övriga omkostn exkl moms (förbrukningsmtrl, analyser, resor etc)**		
Delsumma av ovanstående poster:		
Förvaltningspåslag:		
Totalsumma per år: (införs sid. 1):		

*) Specificera namn, tjänst **) Specificera

Samtliga övriga miljörelaterade projekt för vilka de sökande har beviljats anslag eller söker anslag för 2004-2006. OBS Även EU-finansiering.

Projekttitel	Finansiär	Tidsperiod	Sökt kr	Beviljat kr
Utveckling av en modell för kvantifiering av befolkningens exponering för luftföroreningar i Sverige (Development of a model for quantification of general population exposure to air pollution in Sweden).	SNAP	2004	140 000	140 000

Miljörelaterade projekt för vilka sökande har beviljats anslag för 2000-2003 OBS Även EU-finansiering

Projekttitel	Finansiär	Tidsperiod	Beviljat Kr
Utveckling av en modell för kvantifiering av befolkningens exponering för luftföroreningar i Sverige (Development of a model for quantification of general population exposure to air pollution in Sweden).	SNAP	2002-2003	360 000
Utveckling av en modell för kvantifiering av befolkningens överexponering för luftföroreningar i Sverige i förhållande till uppsatta målvärden.	Socialstyrelsen	2002-2003	480 000

Datum och sökandes underskrift, vilken samtidigt ger Naturvårdsverket tillåtelse att publicera sökandes namn på sin webbplats: 2003-10-14 Karin Sjöberg	Datum och underskrift av prefekt eller motsvarande med namnförtydligande: 2003-10-14 Peringe Grennfelt, Vice VD
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Ansökan skall bestå av detta formulär jämte högst sex sidor lång projektbeskrivning på **engelska** (strukturerad som den svenska sammanfattningen samt en redovisning av kunskapsläget). Referenser till egna publikationer ges med sifferhänvisning till CV. Andra referenser ges i löpande text. Sökandes och eventuell medsökandes CV får omfatta högst två sidor. Inga bilagor kommer att beaktas vid bedömningen. Ansökan (max 10 A4-sidor, 12 punkters teckenstorlek) skall inlämnas i **original + 15 kopior samt elektroniskt** till ansok@naturvardsverket.se. Häfta ihop ansökan och använd hålat papper. Ansökan skall ha inkommit senast den 15 oktober 2003 till Naturvårdsverket, Forskningssekretariatet, 106 48 STOCKHOLM.

Combined exposure of air pollution and noise – an improved assessment including quantification of health consequences

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Current knowledge

The outdoor air quality situation in Sweden has improved dramatically during the last decades, due to the control measures adopted, at both national and international levels, and due to local infrastructure planning. The concentrations of sulphur dioxide has for example decreased more than 90% since the early 1970's and also the concentration levels of nitrogen dioxide and soot show a decreasing trend. Despite the successful work to reduce emissions from both stationary sources (industries, energy production) and mobile sources (traffic), health impact of exposure to ambient air pollution is still an important issue.

Air quality standards as well as measurement procedures are well established for a number of parameters. Most of them are expected to remain stable over time with respect to parameters and measurement methods (there may however be changes in relation to the actual values). Ozone, nitrogen dioxide and benzene are such parameters. Particles are however much more complicated. Present standard on PM₁₀ and proposed standard on PM_{2.5} have been questioned, being a very vague standard with an expected limited relation to health effects. Polynuclear aromatic hydrocarbons (PAHs) is found on fine particles, often classified as one of the most serious health risks related to air pollution in urban air. A new daughter directive for i.a. benzo(a)pyrene (B(a)P) has also been proposed (*Proposal for a directive of the European Parliament and of the Council relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air, COM(2003) 423 final, 2003/0164 (COD)*)

IVL has developed an empirical model, the Urban model, based on air pollution monitoring data from more than 15 years of measurements in small to medium sized cities in Sweden within the framework of the so-called "Urban air quality network". The model is a useful tool to assess the risk for exceedances of environmental air quality standards in urban environments in Sweden.

The Urban air quality network has provided important input to assess trends of public exposure to several critical air pollutants, such as nitrogen dioxide, benzene and soot. Recently PM₁₀ was added to the monitoring program, and also some additional pollutants (PM_{2.5}, PM₁, PAHs, Cd, Ni, As) have been added in some of the cities within the national air quality monitoring program (financed by the Swedish EPA) and the research program BHM (financed by STEM, *preliminary report, Omgivningsklustret*).

In many areas the air pollution levels of specific compounds still exceed the health related air quality standards, and health effects of exposure to air pollutants, even at moderate levels, have been shown in many studies during recent years. The EU daughter directives on air quality and the national environmental quality standards show that there is an obvious risk for exceedances of the standard for nitrogen dioxide and PM₁₀ in the largest cities in Sweden.

In the European co-operative programme APHEIS (Air Pollution and Health: a European Information System), health benefits of reduced levels of PM₁₀ and black smoke have been studied. The conclusion was that even very small and achievable reductions on air pollution levels have an impact on public health, and that this impact justifies taking preventive measures, even in cities with low levels of air pollution (APHEIS, Health Impact Assessment of Air Pollution In 26 European Cities, Second-year report 2000-2001). In a new phase of APHEIS (finishing during 2003) the health impact will be expressed in more terms, i.e. the potential years of life lost (PYLL) due to particulate air pollution (and pollution above specific limit values) in these cities. The approach used in APHEIS and by the Swedish APHEIS centre at Umeå university, including the use of carefully selected exposure-response assumptions, can be used for a national assessment of these impacts.

Vehicular traffic is an important source of both air pollution and road traffic noise as well as other environmental exposures. The relationship between each of these exposures and their respective impacts are nevertheless most often studied separately. The combined effects of air pollution and noise on people's environmental annoyances have been studied in Oslo (*Klæboe et al., Oslo traffic study – part 1: an integrated approach to assess the combined effects of noise and air pollution on annoyance, Atmospheric Environment 34 (2000), 4727-4736*). The results indicated that the higher the road traffic noise levels people are exposed to, the more likely they are to be highly annoyed by exhaust smell at a specified air pollution level and vice versa. An attempt has also been made to find exposure-effect relationships in order to assess the combined impacts of exposure for air pollution and noise (*Klæboe, R., unpublished data*).

The importance of the project in relation to the program

The principal scope of SNAP is to provide new information pertinent to the quantitative risk assessment of adverse health effects from air pollution. Indications on health effects are found for several specific components such as particles, PAHs, metals and organic carbon (OC) (*www.who.int*).

The proposed project will mainly contribute to the following aims within the SNAP program:

- to estimate the national public health impact of exposure to ambient air pollution;
- to investigate potential interactions with noise in relation to health effects from air pollution.

Relevance

Environmental quality standards (EQS) are used in EU directives and national law as a legal instrument to specify more general environmental objectives and define levels of pollution and disturbance to which humans may be exposed without risk of significant nuisance or to which the environment or nature may be subjected without danger or manifested nuisance. Environmental Objectives emerge from the political processes in setting goals for the future society. The mean is to use environmental quality standards that by legal means can be enforced. However, standards emerge from scientific investigations largely based on environmental quality data.

There is an increasing need of tools to estimate the magnitude of the health effects in order to evaluate the number of people exposed to harmful air pollution and noise levels and hence to improve the basis for decisions on control strategies. The proposed project will greatly contribute to the research capacity building in Sweden concerning easy applicable and effective methods for air quality and noise assessments and quantification of health consequences.

Objectives

The objectives of the proposed project are mainly to

- generate an improved picture of the general exposure to health related particles;
- develop a simple method to estimate the general public exposure to PAHs (B(a)P) from PM₁₀ measurements;
- quantify the general health consequences of population exposure to particle levels exceeding specific levels, i.e. regional background, environmental goals and standards for ambient air in Sweden;
- present an estimation of the number of people exposed to both air pollutants and noise for different exposure intervals.

Furthermore, the methods elaborated can be applied for future assessments of exposure of air pollution and noise and related health consequences.

Methods and accomplishment

In an on-going project, "Development of a model for quantification of general population exposure to air pollution in Sweden", financed by the SNAP program, the Urban model is improved to make it possible to use for quantification the general population exposure of different ambient air pollutants on a national level. A so-called correlation factor/mixing index, based on locally arisen concentrations caused by local meteorology, has been developed with a resolution of 2*2 km over Sweden, using the advanced dispersion and meteorological model TAPM (The Air Pollution Model). In TAPM parameters like topography, sea temperature, land use, local wind systems (sea and land breeze, urban heat island circulation) and inversions are

considered. An initial comparison between air concentration levels calculated with the model and measurement data for some urban areas shows a good correlation.

The “concentration” of soot has until now been estimated continuously in Sweden using light reflectance measurements on cellulose filters (depth filters) since 1967 (*OECD, Methods of measuring air pollution p.15, Organisation for Economic Co-operation and Development, 1964*). Air sampling is made through a long tubing, implying that mainly accumulation mode particles are sampled. In an earlier study (*Ferm and Galle, Method for determination of graphite in aerosols (in Swedish), IVL report B666, 27pp, 1982*) it was, however, shown that the light transmission as well as the light reflectance (which is easier to measure) of exposed membrane filters were better correlated to the total carbon content (excl. carbonates).

Within the Urban air quality network PM₁₀ is sampled on Teflon membrane filters in urban background air. Earlier studies have shown that soot is well correlated to PAH (*Brorström-Lundén, E., Measurements of Semivolatile Organic Compounds in Air and Deposition, Department of Analytical and Marine Chemistry, Göteborg, 1995*). To get an estimate of the soot (graphite) content of PM₁₀ a method will be developed for the light reflectance to be measured in connection with the weighing. By analysing the concentration of PAHs of the PM₁₀ filters a possible correlation between the soot content and the PAH (B(a)P) concentration will be evaluated. If a correlation is found, the cost-effective light reflectance method for determination of soot content of PM₁₀ filters can be used to generate health effects related data on both soot and PAHs to be applied in the Urban model to estimate the general public exposure to those compounds. The PM₁₀ samples to be analysed will be chosen, from the Urban network, in such a way that the results will be complementary to the results achieved within the BHM study.

Soot particles have a much smaller aerodynamic diameter than 10 µm. If there are light absorbing particles in aerodynamic sizes between 2.5 and 10 µm, the correlation between PAH and light absorbance on PM₁₀ filters will be poorer. The light reflectance on simultaneously exposed PM_{2.5} and PM₁ samples will therefore also be analysed and correlated with the PAH concentration. This is also important for future work, since it is very likely that EU directives of PM_{2.5} or PM₁ will come. Smaller particles have a larger impact on health.

Using the improved Urban model the number of people exposed to a specific concentration level of a certain air pollutant can be estimated and geographically distributed exposure patterns can be achieved. Based on exposure-response relationships, and by applying PM₁₀ data generated during the last years within the Urban network, the model will be further developed to make it possible to estimate health impact due to air pollution and quantify the health consequences of particle levels exceeding the environmental quality standard for ambient air in Sweden.

The project is further linked to the APHEIS program which has been designed to provide information on air pollution and public health for decision makers, environmental health professionals and the general public.

Ingemansson has made the last two calculations on the number of people exposed to road traffic noise over 55 dB(A) for the Swedish EPA:s “National Environmental

Monitoring” for the years 1995 and 2000. In addition, more detailed noise mappings regarding all types of noise sources has been made for complete communities, for example, Huddinge, Lerum and parts of Stockholm.

The results of these projects will be used to make an estimation of the number of people exposed to the combined effects of air pollutions and noise, which can be used as a basis for assessments of combined impacts.

A literature study will be made to search for existing dose-response investigations on the combined effect of air pollution and noise exposure.

Communication/presentation of results

The results of the project will be documented and published in reports and scientific journals, presented in seminars/conferences etc. both on the national and international level.

Costs

All costs are given in SEK excl. VAT.

Activity	Responsible organisation	2004	2005
Project co-ordination, air pollution exposure assessments	IVL Svenska Miljöinstitutet	200 000	200 000
Quantification of health consequences	Umeå University	100 000	100 000
Noise exposure assessments	Ingemansson Technology AB	150 000	100 000
Travel costs		30 000	30 000
Total		480 000	430 000

Swedish Environmental Research Institute (IVL)

CURRICULUM VITAE

October, 2003

NAME: Karin Sjöberg

YEAR OF BIRTH: 1960

NATIONALITY: Swedish

PROFESSION: M.Sc. Chemical Engineering

POSITION IN FIRM: Department Manager, Environmental Surveillance,
Emissions and EIA (since 2000)

YEARS WITH FIRM: Since 1984

POSITIONS HELD: 1995-1999 Head of section for Environmental
Monitoring and Impact Assessments

1986-1995 Principal investigator in projects
concerning different aspects of air
pollution

1984-1986 Project assistant in section for Regional
Air Pollution

KEY QUALIFICATIONS

Karin Sjöberg has been working in the field of air pollution since 1984, focusing on different aspects such as emissions to air, atmospheric transport, transformation, deposition of air pollutants, air quality in the urban, regional and rural scale and also health and environmental effects. The experience covers monitoring and data handling as well as evaluations and environmental impact assessments. Furthermore, she participated in the elaboration of a quality manual for accreditation of the monitoring and analysis work at IVL in the beginning of the 1990s.

In recent years she has been focusing on development of evaluation tools and elaboration of regional and local monitoring strategies, in Sweden as well as internationally, in relation to existing EU-directives, Swedish environmental quality standards etc, and also measures.

On behalf of the Swedish Environmental Protection Agency she is responsible for The National Databases for Rural and Urban Air Pollutants respectively, incl. co-ordination of national air quality data submission to EU. Furthermore, she is responsible for the Swedish part of the European monitoring network (EMEP) within the UN-ECE, as well as the national ozone alert system (according to the EU ozone directive).

International experience comprises participation in projects concerning i.a. mapping of air pollution levels in Europe, Asia and Africa, building up an air quality laboratory in Thailand, implementation of regional air monitoring programmes in Asia and a UN mission as an air quality expert regarding evaluation of the pollution situation in Albania.

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Wideqvist, U., Vesely, V., Johansson, C., Potter, A., Brorström-Lundén, E., Sjöberg, K., Jonsson, T. (2003). Comparison of measurement methods for benzene and toluene. *Atmospheric Environment* 37 (2003) 1963-1973.