Miljöforskningsnämnden
Ansökan om projektbidrag inom Naturvårdsverkets forskningsprogram

Forskningsprogram
SNAP ■ **REPROSAFE** □ **FLIPP** Inriktning: Ekonomiska styrmedel □
Inriktning: Informationssystem och indikatorer IPP □

Projekttitel (svensk):
Förbättrad dos-responsinformation från epidemiologiska korttidsstudier av olika typer av luftföroreningar

Projekttitel (engelsk):
Improved dose-response information from epidemiological short-term studies of various air pollutants (IMPAIR)

Huvudsökande

Efternamn:	Förnamn:	Födelseår:	Kvinna □ / Man ■
Forsberg	Bertil	1956	Man

Organisation:	Institution:
Umeå universitet	Institutionen för folkhälsa och klinisk medicin

Adress:	Postnr:	Ort:
Yrkesmed By 6A	901 87	Umeå

Telefon:	E-post:	Tjänst:
090 7852751	bertil.forsberg@envmed.umu.se	Univ lektor

Medsökande

Efternamn, förnamn, tjänst, organisation, institution:
Johansson Christer, Avd ing, Stockholms miljöförvaltning SLB analys

Telefon:	E-post:	Kvinna □ / Man ■
08 508 28 93	Christer@slb.nu	Man

Sammanfattning

Som grund för riskvärderingar och kvantifieringar av hälsokonsekvenser behövs exponerings-responsfunktioner främst för samband med accepterad kausalitet, där effekten väger tungt ur folkhälsoperspektiv. Till dessa samband hör dödlighetens beroende av föroreningshalten det senaste dygnet - månaden och liknande samband för akuta sjukhusinläggningar och akutbesök Etablerade samband uttrycker idag riskens typiska beroende av grova indikatorer som PM10, vars källberoende varierar i tid och rum. Ur åtgärdssynpunkt är det nödvändigt att beskriva sambanden till specifika föroreningar såsom avgaser, vägdamm och sekundära partiklar. För jämförelser av olika föroreningars effekter på risken behövs dessutom haltdata av likvärdig kvalitet. Det planerade projektet syftar till att via tidsserieanalyser med geografisk upplösning beskriva exponerings-responssamband mellan specifika föroreningsslag och antal dödsfall respektive sjukhusinläggningar i hjärt- och lungsjukdom samt akutbesök för astma och kronisk obstruktiv lungsjukdom. Vi förväntar oss visa hur olika partikelslag har olika stor betydelse för olika hälsoeffekter och under olika årstider. Vi kan här tillämpa en ny typ av exponeringsdata som dels ger bättre jämförbarhet av olika föroreningars betydelse, dels lämpar sig väl för konsekvensberäkningar av möjliga åtgärder där luftkvalitetsförändringar beräknas med spridningsmodeller. I nuläget måste denna typ av modellerade haltförändringar eller haltbidrag vid konsekvensanalyser kombineras med exponerings-responsfunktioner från meta-analyser eller enstaka studier, baserade på halter enligt centrala punktmätningar. Avsikten är också att beskriva eventuell interaktion mellan föroreningarna, pollen och väder (kyla mm), vilket kan bidra till att förklara exempelvis de starka effekter som vi har sett i Sverige. Studierna kommer att avse Stockholmsområdet, och bygger på att modern tidsserie-analys kompletteras med högupplösta haltberäkningar och befolkningsdata. Flera projekt inom SNAP skulle kunna utnyttja de omfattande resultat som förväntas, dels för konsekvensberäkningar och dels som en ram för tolkning av utfallet i mer avgränsade studier.

	År 2004	År 2005
Summa sökta medel per år i kr:	528 000	288 000

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Sökta projektmedel fördelade på kostnadsslag	År 2004 (kr)	År 2005 (kr)
Personalkostnad inkl. soc. avgifter * Statistiker, fil lic Bo Segerstedt 3 månader per år Projektledare/Lektor Bertil Forsberg 1,5 månad per år Ingenjör (motsv) vid Stockholm Luft- och bulleranalys	140 000 80 000 200 000	140 000 80 000
Övriga omkostn exkl moms (förbrukningsmtrl, analyser, resor etc)** Resor för projektmöten i Stockholm Registerdata	10 000 10 000	10 000 10 000
Delsumma av ovanstående poster:	440 000	240 000
Förvaltningspåslag: ....20..... %	88 000	48 000
Totalsumma per år: (införs sid. 1):	528 000	288 000

*) 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
Nya metoder att skatta trafikförändringars konsekvenser för avgasexponering och hälsoeffekter *C Johanssons uppgifter redovisas i ansökan där Johansson är huvudsökande (gäller även 2000-03)*	CMF	2004-	Dokt tjänst	

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

Projekttitel	Finansiär	Tidsperiod	Beviljat Kr
Partiklar och akuta luftvägseffekter	Statens Energimyndighet	2000-2003	1,6 Mkr
Bättre metoder beskriva hälsopåverkan av vägtrafik	Vägverket	2002-2004 1kv	1,3 Mkr
Vägdamm och grova partiklars effekter på hälsa	Vägverket	2002-2004 1kv	658 000 kr
Hälsovinster av trängselavgifter	Naturvårdsverket	2003	300 000 kr
Miljömål för luft och biobränsleeldning	Statens Energimyndighet	2003	412 000 kr
Anslag från NV, Formas, EU via andra institutioner liksom uppdrag är här ej inkluderade			

Datum och sökandes underskrift, vilken samtidigt ger Naturvårdsverket tillåtelse att publicera sökandes namn på sin webbplats:	Datum och underskrift av prefekt eller motsvarande med namnförtydligande:

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.

Improved dose-response information from epidemiological short-term studies of various air pollutants (IMPAIR)

Main applicant: Bertil Forsberg

Co-applicant: Christer Johansson

Introduction

A large number of epidemiological studies have shown associations between ambient air pollution, especially particulate matter (PM) concentrations, and various health outcomes, (Brunekreef and Holgate, Lancet 2002;360:1233-42). In particular the short-term effects are well accepted as causal. Increased levels of PM10 increase the daily numbers of deaths, respiratory hospital admissions and cardiac hospital admissions (Forsberg CV ref 5,6,7,10, 13). The effect on mortality is not a harvesting phenomenon. Quite opposite could it be shown that the excess number of deaths doubles when the cumulative effects delayed up to 40 days are included (Forsberg CV ref 6,13), meaning that the relative increase in mortality (as % per µg/m3) comes close to half of the long-term effect. However, the vast majority of epidemiological studies have used ambient mass concentration of PM10 as surrogate of particle exposure. This measure is neither sensitive to the varying physico-chemical composition of PM over space and time, nor to the sources that contribute to the total mass concentration. Thus, these studies give limited guidance to our understanding of the underlying biological mechanisms and to design optimal abatement strategies.

The prevailing epidemiological view is that fine fraction PM (PM2.5) show stronger and/or more consistent associations to health than do the other pollutants, including coarse PM, nitrogen dioxide, ozone and other pollutants (Brunekreef and Holgate, 2002). This suggests a high toxicity of the PM2.5, but could also partly reflect that PM2.5 is often dominated by secondary particles and show small geographical variations within a city or region. Less variation means that the variation in exposure levels (including temporal variations) is quite easily indicated from a few fixed monitoring stations. The same is not thru for pollutants depending more on local sources and conditions, i.e. traffic exhausts and road dust, partly also ozone in inner-cities. Here the measurement sites tend to be too few to give good information. The degree of misclassification of exposure levels will affect the estimation or relative risks. Typically the bias is towards the null.

Aims

This project aims to give a better understanding of the role of different pollutants and to describe exposure-response functions useful for risk analyses and health impact assessment. In order to do so we need to improve the time-series analyses using:

1. more source-specific pollution indicators (*i.e.* primary traffic-related PM, road dust and long-range transported PM)
2. less misclassification in exposure estimates by using also dispersion models
3. also exposure estimates that correspond to the exposure scenarios used for HIA, which come from dispersion models
4. as broad and sensitive outcome variables as possible, which means that we at least initially have to work with several endpoints

Activities and relations to ongoing and co-operative projects

Experiences and resources built into this project

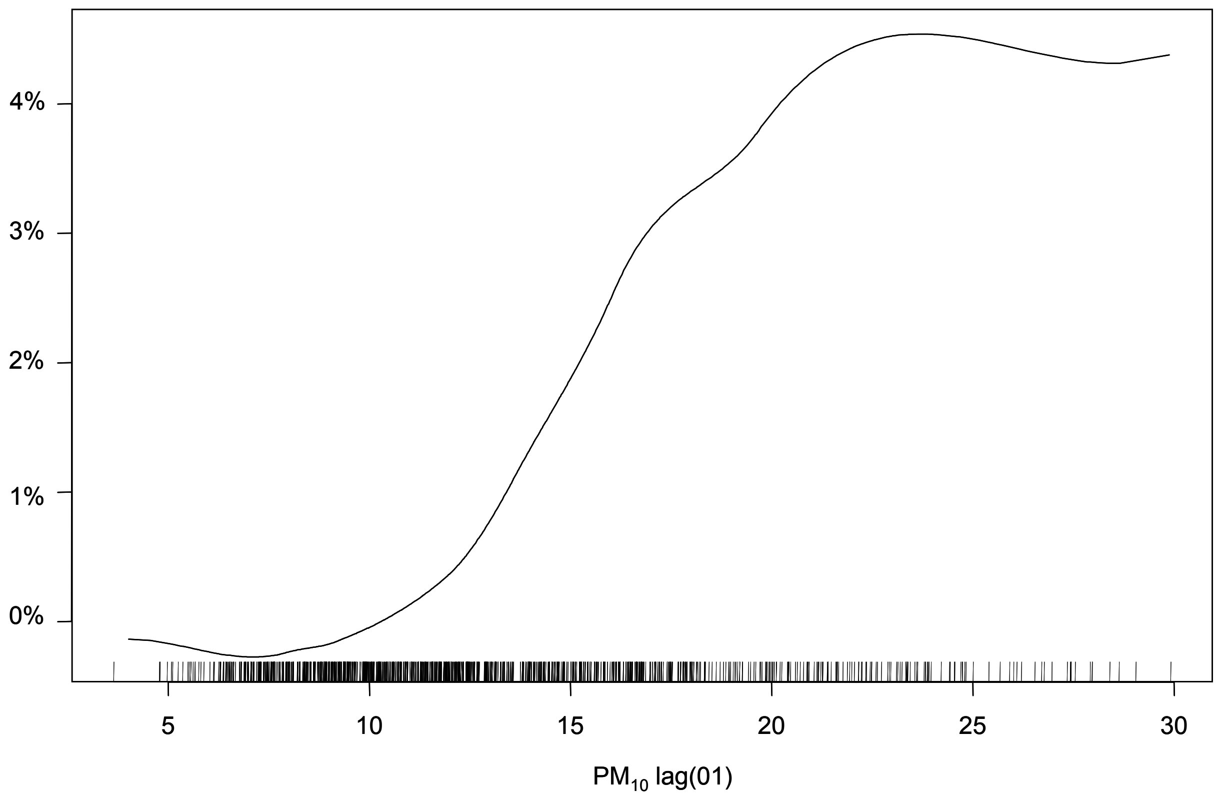
One important corner point for this project is that we have documented the existence of short-term effects of air pollutants, i.e. from PM10 and ozone, in the population of Greater Stockholm. We have also noted that the relative risk tend to be higher than elsewhere per unit increase in concentration (Forsberg CV ref 5,7 and manuscripts from APHEA2).

Another important corner point is our involvement in the large European multi-center study APHEA2 (Forsberg CV ref 5,6,7,9,10,11,13), making it possibly to have direct comparisons between the results produced when we use the APHEA2 modelling approach (now dominating recent European results) as compared to the results produced with improved exposure estimates, more source specific or/and spatially population weighted.

We will of course also make use of results from our ongoing Swedish projects to describe the effects of improved exposure estimates. In a related project at Umeå University on Road dust and coarse particles in Stockholm, funded by the Swedish National Road and Traffic Administration, we are using only fixed site measurements of PM10, PM2.5 and exhaust gases as well as and weather data to try to model road dust levels.

In the road dust project we have seen a significant effect of 2-day mean PM10 on the number of daily respiratory hospital admissions 1997-2000, with a lower threshold and the risk levelling off at high levels of PM10 according to a smooth exposure-response curve from a multi-pollutant model using Poisson regression with GAM. This may be an indication of less toxic PM10 when the levels are high due to resuspension of road dust.

The figure below [next page] is based on roof-top measurements only, and shows the relative increase (%) in daily numbers of respiratory hospital admissions relative to the lowest exposure level. The dots along the x-axis indicate the number of days. With a linear model (using the APHEA2 approach) the relative risk was approximately 4 % per 10 µg/m3 increase in the 2-day mean PM10 concentration. Without our estimation of the smooth exposure-response function, we would have less information to further investigate this association.



New exposure information that will be used

One ongoing SLB project, ending in 2004, is “Development of a model for calculation of PM10 in urban air” (“Utveckling och validering av modell för beräkning av PM10 i urban miljö”), supported by the Swedish National Road and Traffic Administration. The aim is to present a validated air quality dispersion model that can be used to quantitatively describe the total PM10 concentration as well as the individual contributions to PM10 of local road traffic emissions including road wear, brake wear exhaust etc. *We will build on this project to model better estimates of the temporal and spatial variation in the population exposure to road dust. This exposure information will be used in new time-series analyses in the proposed project. Spatial data will be used in combination with population data as population weighted exposure.*

The most common (and validated) use of dispersion models for environmental impact assessments for urban and traffic planning is to model NO_2 or changes in NO_2. Such information may be combined with population data, as have been done in recent health impact assessments. However, the exposure-response coefficients for NO_2 from time-series data, come from fixed site monitoring. This means that their validity in combination with modelled concentrations is unknown. *In this proposed project SLB will model time-series of daily NO_2 data which will be used as point estimates (corresponding to data from measurement stations) and in combination with population data as population weighted exposure. The Airviro system will be used as described on the web site of SLB (http://slb.nu).*

One ongoing related project is the PASTA project (“Partiklar i stadsmiljö”; “Particulate Exposure in Urban Areas”) supported by the Swedish Environmental Protection Agency, the Swedish Agency for Innovation Systems (VINNOVA) and also by the SNAP programme. It will continue until 2006. The hypothesis is that PM10 and PM2.5 are not very good indicators for health effects of particles. The main aims of PASTA are to evaluate the relationships between particle mass, number and surface area and other air pollution and traffic parameters. *We will within PASTA assess the health effects of particulate matter by evaluating short-term exposure-response relations between particle numbers and particle surface area and health effects. These results will be evaluated in relation to results for NO_2, soot, road dust and long-range PM from the now proposed project.*

In a new ITM project (PARSOOT) proposed to FORMAS the main objective is to assess the geographical and temporal distribution of soot in Stockholm, and to determine the particle size distribution of soot and how this varies in space and time. This will be achieved by establishing three permanent monitoring stations equipped with soot monitors in order to provide information on the diurnal, weekly and annual variations of the soot concentration in an urban area and in background air. Soot, measured as Black Smoke, has been shown to have a strong relationship with observed mortality and morbidity, and has been suggested to be more studied as a marker of combustion particles. We have shown that daily variations in the black smoke levels had significant effects on the risk of developing severe symptoms of shortness of breath, despite the fact that the soot concentrations were below 20 µg/m3, *i.e.* much lower concentrations than the guideline limit set by WHO (Forsberg CV ref 1). *Assuming that the FORMAS project will be funded, it is planned that the health assessment will be done within this epidemiological project, based on soot exposure calculations made by ITM/SLB using air pollution dispersion models that have been validated against the measured soot data.*

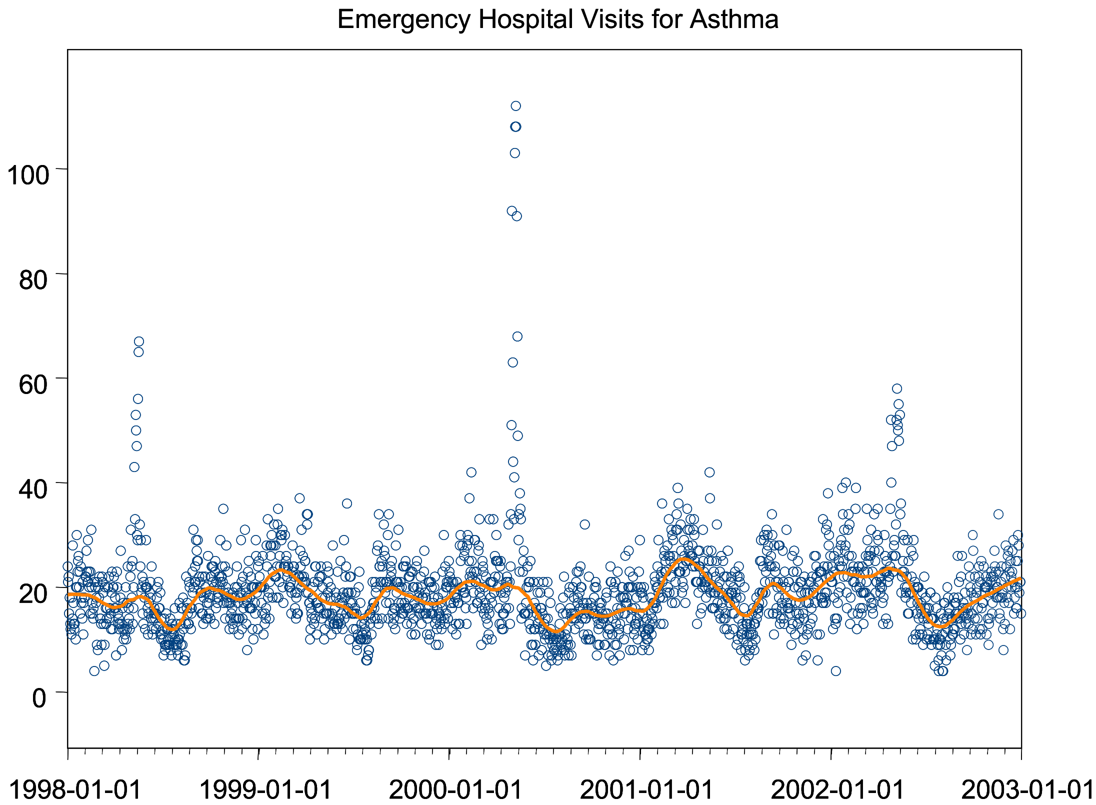
The concentration of long-range transported particles or regional background will be estimated from rural monitoring especially at Aspvreten south of Stockholm, and by studying the relations between different pollutants and measurement stations. *We will assess separately the effects of long-range transported particles.*

Health outcomes

The power of our epidemiological analyses partly depends on the length of the observation period and the variation in exposure levels. The frequency of the health events is also of importance for the modelling. Also from a public health point of view it is of course important to analyze the endpoints that will affect much the impact assessments. Thus, we plan to use a broad range of endpoints; daily non-violent mortality, cardiovascular mortality, respiratory hospital admissions (and a few subgroups such as asthma), cardiac hospital admissions (and a few subgroups as IHD) and emergency hospital visits for respiratory causes.

In Sweden it is fairly easy to get very good information on hospital admissions from the In-patient register at The National Board of Health and Welfare. The situation looks the same in many countries, why there are a lot of studies of *i.e.* air pollution effects on asthma hospitalizations. However, today acute asthma seldom motivates hospitalization. Most cases are taken care of at emergency departments or primary health care centres. Such data are much more time consuming to collect, since there is no central register. Since asthma is an important disease with clear associations to environmental exposures, we have collected information on emergency visits for asthma at hospitals in Stockholm. Emergency visits for asthma were nearly ten times more frequent than hospital admissions for asthma (approx. 2 per day) in the same population, and thus very important for our studies to take into account.

The high frequency and large fluctuations in emergency visits for asthma in 1998 through 2002 in Greater Stockholm is shown in the figure below.



Having all this information for the "APHEA2 population" in Greater Stockholm it will be possible not only to compare the time-series results obtained with "traditional" and improved exposure information, and the results between different types of pollutants, it will also be possible within the same population to compare the effects on *i.e.* respiratory mortality, hospitalizations and emergency visits.

Interactions

In our analyses we will also study potential interactions in the effects between season, weather (*i.e.* temperature), pollen concentrations and studied air pollutants.

SHORT CV BERTIL FORSBERG

Senior lecturer Bertil Forsberg, Dept of Public Health and Clinical Medicine, Umeå University, holds a MSc in environmental health and a PhD in epidemiology and public health (1997). He is presently involved in several studies on exposure to air pollution, weather and morbidity and mortality in Swedish and international projects such as EU-funded *APHEA-2, APHEIS, ECRHS* and *PHEWE*. Current Swedish projects lead by Forsberg are funded by The National Road Administration, The Swedish National Energy Administration, The Swedish EPA and The National Institute for Public Health. These projects are focussing on quantification of dose-response relations and methods for health impact assessment. Bertil Forsberg is a national (National Institute for Public Health) international (WHO) consultant and expert on air pollution and health. He is a member of EU Airnet Working Group on epidemiology and secretary of The Swedish association of Occupational and Environmental medicine. In 2001 he was first author to a book on outdoor air and health (Forsberg B & Bylin G, Uteboken) produced by the Swedish EPA and National Institute for Public Health.

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CV Christer Johansson

Christer Johansson är docent i kemisk meteorologi vid Stockholms universitet (SU) och arbetar som universitetslektor vid Institutet för tillämpad miljöforskning, Stockholms universitet, samt som avdelningsingenjör vid Stockholms stads Miljöförvaltning. CJ undervisar i luftkemi och spridningsmeteorologi inom såväl grundutbildning och högre utbildning vid främst Meteorologiska institutionen, Stockholms universitet samt är f n handledare för tre doktorander vid SU. CJ ansvarar för flera olika forskningsprojekt rörande den urbana luftmiljön med finansiering från Naturvårdsverket (SNAP), Vägverket, Vinnova och Stockholms stad.

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