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Teplice Health Program

Contributions from NILU

Progress Report for 1992
Project Proposals for 1993

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Summary

The Norwegian Institute for Air Research (NILU) has since September 1991 worked on contributions to the Teplice Health Program. This program is a Czech research program on the effects of air pollution on the health of the population in the Teplice district in North Bohemia, Important air pollution sources in this region are coal-fired power plants, glass works and other industry, home heating with coal, and road traffic. Prachatice, a relatively clean area in South Bohemia, is used as control area.

The activities in 1992 are reported in the first part of this report. They include:

- Monitoring of air pollution: Preparations for sending monitoring and sampling equipment to Teplice.
- Modelling of air pollution: Establishment of dispersion model on computers in Prague, preparation of input data base, and preliminary SO_2 distribution calculations.
- Health Symptom monitoring: Development of detailed project plan for a health symptom monitoring study in Teplice.

An objective for the Norwegian contributions to this program is, to as large extent as possible, to transfer equipment, analysis tools and knowledge to Czech partners and groups, for use by them to provide better data on air pollution and exposure, for use within the various health studies of the program.

In the second part of the report, project proposals for 1993 are presented for the following projects:

1. Monitoring of air pollution:
   - Evaluation of the monitoring program
   - Establishment of QA/QC program

2. Dispersion and exposure modelling of air pollution

3. Health symptom monitoring:
   - Cross-sectional study
   - Cohort study, pregnant women
   - Cohort study, susceptible children.

Teplice Health Program

Contributions from NILU
Progress Report for 1992
Project Proposals for 1993

1. Introduction

The Norwegian Institute for Air Research (NILU) is co-operating with Czech partners in the Teplice Health Program, a research program carried out in the Northern Bohemia Region of the Czech Republic (former Czechoslovakia).

The goals of the Teplice Health Program are:

1. To evaluate which environmental factors influence the health status of the population in Northern Bohemia, and to estimate quantitatively their effects in relation to other important factors, e.g., socio-demographic.

2. To propose and carry out preventive measures to mitigate the adverse environmental effects, and to evaluate the effect of these measures.

3. To devise methods for reduction of environmental pollution to achieve a level acceptable for ensuring minimal harmful effects on health.

NILU became involved in the Teplice Program in August 1991, through an invitation from the leadership of the program to participate in an international review meeting in Prague in September, including a survey visit to Teplice (NILU travel report RR 10/91).

As a result of this meeting, NILU was asked to propose contributions to the Program based on NILU's experience and interest.

NILU felt the program needed strengthening regarding the ability to provide estimates of the actual air pollution exposure of the population in general and of the study populations in particular. This would imply the need to specify the air pollution concentrations of the area with sufficient resolution in time and space. This would in turn imply calculations of air pollution concentrations by means of dispersion models, based on emission inventories and a sufficiently broad monitoring program for meteorological and pollution parameters.

Considering the long term nature of the program, NILU considered it of importance that contributions from NILU should, to the extent possible, be in the form of transfer of knowledge, equipment and models, to enable the various Czech groups within the program to perform the necessary calculations and measurements of exposure, to support the health studies.

In addition to monitoring and modelling, NILU was interested in proposing a health study regarding the occurrence of symptoms related to air pollution

exposure, termed "Health Symptom Monitoring". Two such studies have recently been performed in Norway with some interesting results.

Draft project proposals were made concerning monitoring and modelling of air pollution, and concerning Health Symptom Monitoring.

Contact was made with the US EPA researchers involved in the Teplice Program, to assure coordination of the EPA and NILU contributions. In January 1992, EPA and NILU researchers met in Prague, Teplice, and Prachatice in connection with the field study of air pollution measurements carried out by EPA (NILU travel report RR 2/92). The NILU proposals were discussed, and also presented at a joint project meeting between Czech scientists involved in the Teplice Program, US EPA and NILU.

Based on this, final proposals were made for the following three projects:

1. Monitoring of air pollution
2. Modelling of air pollution
3. Health Symptom Monitoring

The proposals were submitted to the Ministry of Environment of Norway, for consideration by the Joint Czechoslovak-Norwegian Commission on the Environment, as well as to the Project Leadership. The proposals are included in Appendix A of this report.

The proposals were accepted for funding in 1992 by the Commission in their meeting in Norway in May 1992.

The activities in 1992 under the three projects is described in this present report. An international peer review meeting on the Teplice Program was held in September 1992, at Liblice Castle. As a result of this, NILU was asked, in October, to continue the contribution to the Program along the lines started in 1992.

Project proposals for this continuing work in 1993 are included in this present report. The proposals are submitted to the Norwegian Ministry of Environment, for funding.

2. Progress Report for 1992

2.1. Project 1: Monitoring of air pollution

The project proposal is enclosed in Appendix A. It was based on the need to strengthen the monitoring part of the program including the following elements:

- transfer of the following monitoring and measuring equipment to the Institute of Hygiene in Teplice:
  - one SO_2 monitor, type Monitor Lab. 8850 S
  - two mobile (moveable) sampling platforms for sampling of organic constituents of air (PAH and other) in the volatile and particle phase ("PUF samplers").
  - two samplers for the sampling of thoracic particles (i.e. PM_{10}) in two size fractions (<2.5 μm and 2.5-10 μm).

- training in the use of the equipment, through a one-week stay in Treplice by a laboratory technician from NILU.

It was presupposed that the analytical capabilities for the particle and organic constituent analysis are available within the various analytical laboratories connected to the Program.

This selection of equipment was based on the knowledge of the main pollution problems of the Teplice District, as well as the wishes from the Institute of Hygiene.

Activities and Status:

- The newest version of Monitor Lab's SO_2 monitor (type 9850), was purchased and set up for testing at the NILU Instrument Laboratory. There turned out to be major technical problems with this new monitor version. NILU was forced to change the purchase to the older version, type 8850Swith which, NILU has positive experience. The monitor which then arrived at NILU medio November, turned out to be a yet older version. After complaint to the supplier company, the right monitor finally arrived at NILU shortly before Christmas. It is now being tested at our laboratory, before shipment to Teplice.

- A pressurized bottle of calibration SO_2 gas has been purchased for the Teplice project.

- The two PUF samplers have been built and are ready for shipment.

- The two PM_{10} samplers are being made ready for shipment. Presently a new flow control system for such samplers is being tested out at the Instrument Laboratory, for possible inclusion in the PM_{10} samplers for Teplice.

The plan for stay in Teplice by the NILU technician will be finalized when the instruments are all ready for shipment.

Preliminary description of the monitoring program

The project leader of this subproject, S. Larssen, participated in the Peer Review Workshop for the Teplice Program, held at Liblice Castle on 21-25 September. At this workshop, also the ongoing air pollution measurement activities were presented.

These presentations concentrated on the CATS program carried out by co-operating teams employed by US EPA and by the Teplice Program. The CATS program is a short-term measurement activity aimed at providing data for the characterization of the air pollution situation in Teplice and Prachatice, and for source apportionnement calculations to identify the main contributors to harmful air pollution in the area.

At Liblice, little emphasis was put on a full presentation of the routine monitoring activities in the Teplice, Most and Usti n.L. districts. Following is a brief, preliminary description of the monitoring program presently in operation by various institutions in the area.

Objectives of the monitoring program:
In addition to providing surveillance of air pollution based on comparison with air quality standards, the objectives of the monitoring are three-fold:

- To provide a basis for exposure assessment.
- To quantify effects of abatement measures on sources.
- To provide a basis for checking results from dispersion modelling.

Period:
The monitoring program should be long-term (covering the length of the Teplice study). It may (and probably will be) modified and changed over the years, according to experience gained and changing pollution situation.

Compounds:
- The monitoring program should include:
- SO_2
- Suspended particles, including PM_{10} and $PM_{2.5}$
  Samples for analysis of
  - PAH
  - Mutagenicity
  - As, Hg, heavy metals
- NO_x
- CO
- O_3
- Other compounds of interest, as defined by the health programs.

Program:
For air quality surveillance the following long-term monitoring program is going on in the Teplice/Ústí/Most area, with the following number of stations:

	Teplice	Most	Ústí
SO_2	4 C	1 C	2 C
	4 I	2 I	
Suspended particles	1 I	3 C	1 I
	2 C		
NO_x, NO_2	2 C	2 C	1 C
	3 I		1 I
CO	4 C	1 C	1 C?
O_3	4 C	1 C	

C - continuous
I - integrated (24 h values)

This program is operated partly by the Hygienic Services, partly by the Czech Hydrometeorological Institute, and is a long-term program.

As many as possible of these stations and instruments should be included in the data base to be established within the Teplice program.

A short-term measurement program conducted by the EPA and Hygienic Service in Teplice (CATS) has characterized the air pollution situation in Teplice during a period February-March, 1992 by extensive analysis of the chemical composition of particles at one station in Teplice. The same analysis of grab samples close to a number of sources is made to determine their contribution to the concentrations in Teplice. This experiment is planned to be repeated in the winter of 1992/93.

SO_2
The long-term monitoring program is rather extensive, and considered large enough to meet the objectives of air quality surveillance. A re-evaluation of monitoring sites might be needed.

Suspended particles:
The long-term program includes 5 continuous and 2 integrating sampling sites. There is no particle cut-off at the inlet, so particles up to may be 30 μm are sampled. An exception is the VAPS sampler at the Hygienic Institute in Teplice, which has a 10 μm cut-off at the inlet.

There is a need for more PM_{10} and $PM_{2.5}$ samplers in the network. These samplers, or at least some of them, must take samples for analysis of metals, PAH, mutagenicity. Some PM_{10}/$PM_{2,5}$ samplers should be continuous monitors.

NO_x, NO_2
There are 5 continuous samplers for NO_2 and NO_x already in operation. These compounds are not considered to represent the main pollution problem in the area so far. The network is considered adequate.

CO
There are 5-6 continuous samplers in operation. This is considered adequate, but some station sites may be re-evaluated, since it would be advantageous to have a street-side monitoring station.

Evaluation
A further evaluation of the monitoring program is proposed within Project 1 for 1993.

2.2. Project 2: Dispersion modelling of air pollution

The project proposal for 1992 is enclosed in Appendix 1. The plan included transfer of suitable dispersion models, and transfer of knowledge through visits by scientists at NILU and in Prague/Teplice. It was also planned to do preliminiary dispersion calculations based on available emission and meteorology data.

Activities and status:

The model calculations has been carried out in co-operation with Dr. Josef Brechler, Charles University, who was identified by the Teplice program leadership as our main partner on this project. Minutes from our meetings at NILU and in Prague have been included in Appendix C.

NILUs computer programs calculating pollution concentration distributions as a function of time have been installed on the following two computers in Prague:

- SUN SPARC work station at the Czech Hydrometeorological Institute (CHMI).
- Stellar Stardust computer made available to Dr. Brechler, Charles University at ASCOC computer center.

A description and an evaluation of the models is accepted for publication in the next issue of the Atmospheric Environment scientific Journal.

Two periods for model evaluation have been selected:

01.12.1989-29.02.1990
01.01.1992-31.03.1992

Dr. Josef Brechler stayed at NILU in the period from 22 June to 4 July 1992 to get acquainted with the calculation procedures and equipment. During this time

Dr. Brechler worked to establish a data base for Teplice on the computer, i.e. data on emissions, wind, dispersion, and pollution concentrations.

The following data have been included:

- Data on SO_2 emission, provided by Dr. F. Kotesovec. The survey covers all point sources in the Teplice district and only the larger point sources in the surrounding areas.
- Data for height of topography in area of calculations with a resoulution of 1x1 km^2
- Meteorological data for the period December 1989 to 31 January 1990.
- Data on pollution concentration in the area including the stations Teplice, Liberec, Litomerice, Most, Usti Nad Labem, Chomutov and Prachatice.
- Meteorological data for the period 1 January 1992-31 March 1992 from the station number 11438, 11464, 11467, 11502.
- Prague Libuse Airport Upper Air Soundings: for the period 1 December 1989 to 28 February 1990.

Plan for the future work: (see Project 2, Appendix B)

1. Completion of input data for the dispersion calculations.

2. Further development of model taking into account data characterizing the local wind and the structure of the boundary layer. In this connection we would like to include data presented in the Proceedings of the experiments Kopex-86 (Kopisty/Tusimice 2 June-7 July 1986).

   In some situations it is necessary to consider wind and dispersion conditions by the dynamic approach, i.e. "Numerical modelling of the atmospheric boundary layer over a hilly landscape" by Jaroslaw Svoboda, Institute of the Physics of the Atmosphere Czechoslovakia Academy and the diagnostic approach based on wind measurements, i.e.: "Diagnostic wind field model in a complex terrain" by Anna Szulénjiová, Department of Physics of the Atmosphere Geophysical Institute.

2.3. Project 3: Health Symptom Monitoring

Plan

The proposed Health Symptom Monitoring involves a methodology for surveying subjective symptoms of health effects using questionnaires. Health symptoms are then correlated to air pollution exposure. The study populations (children and adults) are chosen from the Teplice district and Prachatice. This methodology is considered useful relative to all the three goals of the Teplice Program, as listed on page 5.

The plan for this project for 1992 was to develop and submit project proposals for Health Symptom Monitoring including draft questionnaires, with the aim that the

projects would be carried out in 93/94, with a pilot study in winter 92/93. This involved discussion of the needs of the Teplice Program, and the capacity of the research team in Teplice.

In addition, participation in a Peer Review workshop was planned for September 1992. The workshop was to review all existing projects and result in a final, integrated research proposal for the Teplice Program.

Activities

MEETINGS HELD TO CLARIFY THE SCOPE OF NILU's PARTICIPATION

During 1992, we have had the following co-operation meetings and important communications regarding the health-oriented projects.

January 1992, Teplice, Prachatice, Prague. Orientation meeting to describe NILUs background in health symptom monitoring and exposure assessment. First description of the proposed projects. (A. Bartonova, S. Larssen). A travel report is available (NILU report RR 2/92).

March/April 1992. A draft project proposal for the health symptom monitoring projects was sent to Teplice (J.Clench-Aas).

May 1992, Teplice. An informal meeting with Dr Kotesovec, Program Director, on a project for evaluation of respiratory health in children in Oslo. The Oslo project is similar in design to one of our proposed health projects for Teplice (A. Bartonova, Dr. J. Moseng of Oslo Health Administration). This meeting was not financed through the Health Symptom Monitoring project, but took place in connection to an expert meeting on Health and the Environment, held in Prague.

Participation on a project status meeting in Olesnice, meeting with co-ordinators for statistical analysis, for database systems, and for several health projects (A. Bartonova).

September 1992, NILU Lillestrøm. Meeting between NILU (S. Larssen, J.Clench-Aas, A. Bartonova) and the Teplice Program leadership (Dr. F. Kotesovec, Dr. J. Jelinek). A Preliminary Agreement about further co-operation on the health projects was signed by both parties. The Preliminary Agreement is included in Appendix 2 of the Health Symptom Monitoring proposal (Appendix B).

September 1992, Liblice Czechoslovakia. Peer Review workshop. A joint workshop where all participating projects of the Teplice Program and all collaborating institutions presented the results of pilot studies and their further research plans to an international review group (chairman: Dr Eric Lebret, RIVM Bilthoven, the Netherlands). The review group has given their written recommendations to the individual projects. NILU presented the project proposal for health symptom monitoring. The project was recommended for continuation (see further under 2.4).

The need for an integrated (total) exposure assessment was stressed at the Workshop. The exposure assessment should link the air pollution monitoring and modelling to the health outcome for each individual. So far, no integrated project has been established in the program that would co-ordinate the exposure assessment needed for the various health projects, using results of the biological monitoring projects and modelling of air pollution. NILU was asked to participate in this work, specifically on establishing an exposure model for air.

NILUs participation at the Liblice workshop: S. Larssen, J. Clench-Aas, A. Bartonova, partly K.E. Grønskei and S.E. Walker.

October 1992, Teplice. Participation in a public meeting in Teplice, meetings with Teplice Program directors and with possible Czech co-operation partners (A.Bartonova).

NILUs participation in the public meeting was on request by the Program leadership. Following the meeting, the Norwegian contribution to the Teplice Program was mentioned as a part of the news release on national TV, and the local newspaper brought an article about NILU's involvement in the Program.

A travel report from the visit is available in Norwegian.

Status

Based on the discussions and meetings, NILU has revised the draft project proposal, and is currently preparing a detailed project proposal for Health Symptom Monitoring, and for a study "Effects of short-term changes in urban air pollution on the respiratory health of children with chronic respiratory symptoms". The latter is planned identical to a joint 7-countries study financed partly by the EEC and co-ordinated by Dr. Brunekreef of the Department of Epidemiology and Public Health, University of Waageningen, the Netherlands. Norway will take part in this study, and Oslo is one of the study cities. The work is a little behind the schedule due to problems in finding local project co-ordinators in Teplice with enough free capacity to carry out the work.

In addition to the health projects, NILU has also developed three questionnaires for indoor/outdoor monitoring. These will serve as part of the basis for a Czech questionnaire that will be tested together with the pilot study of indoor environment and indoor/outdoor monitoring. This work was done based on a request from Dr. Benes, co-ordinator of the air pollution monitoring programs.

3. Project Proposals for 1993

3.1. Introduction

The Teplice Program comprises a set of investigations of health effects that attempt to cover as wide a set of health effects as possible, both chronic and acute. As a result of the Peer Review of the project at Liblice in September 1992, it was strongly advised that improvements were needed in exposure estimating. The Peer Review Group said,

> "The issue of exposure assessment needs to be addressed urgently... It is the opinion of the review committee that in most health related studies, ecological designs in which two areas are compared are not acceptable in most situations. Individual estimates of exposure need to be obtained for the persons under study..."

At the October meeting in Teplice (with A. Bartonova present) NILU was asked formally by the Teplice Program directors to contribute to the following parts of the Program:

- air pollution monitoring (by participating in the monitoring and in quality assurance/quality control program (QA/QC)
- air pollution modelling,
- exposure assessment (responsibility for assessment of the exposure from the air, including planning)
- health symptom monitoring and respiratory symptom study in children. (The scope of NILUs participation in the health effect studies is dependent on finding specific partners for the co-operation. This should be clarified during November 1992.

Responding to this, the following proposals are presented in Appendix B:

Project 1: Monitoring of air pollution
Project 2: Dispersion and exposure modelling of air pollution
Project 3: Health Symptom Monitoring

The monitoring and exposure assessment program (projects 1 and 2) must include elements such as:

1) A long term air pollution monitoring program:
   - covering the main pollutants of interest for the health projects.
   - representative station locations covering the area, and representing different exposure situations.

2) Air pollution modelling, enabling the estimation of pollution concentrations at a large number of receptor points, e.g.:
   - homes of people in the study group
   - other locations where measurements are not done.

The dispersion models should be able to calculate

- the long-term (month, year) concentration fields
- short-term (hour, day) concentration fields,

based on emission inventories and meteorological data.

3) Within such a program, a data base must be established, consisting of:

- emission data, all sources, distributed in a grid system
- meteorological data (hourly data, starting 1992)
- air pollution measurement data (hourly/daily values, starting 1992)
- population data (to be updated regularly)
- population distribution within the grid system
- traffic density in the road network
- other traffic-related data.

4) Special, short-term measurement programs:

- measurements of individual's exposure (personal samplers)
- indoor/outdoor sampling, covering
  - homes with/without smoking
  - homes with indoor sources (gas, coal appliances) and of different construction
  - possibly institutions (schools, hospitals)
  - sampling in other microenvironments, e.g.
  - occupational exposure
  - traffic exposed areas.

This program, coupled with information obtained about the homes and activities of the persons/groups under study (collected through questionnaires/diaries) will enable estimates of actual exposure to be made, and also it will enable to quantify the effects of emission source controls, on the air quality and exposure situation.

The extent of exposure calculations to be done within this program must be determined by the needs for exposure estimates within each of the health projects. This will determine which compounds will be included (SO_2, PM_{10}, etc), and averaging times (hour, month, year).

Table 1 summarizes the proposed health studies in the Teplice Program with suggested compounds of interest, and averaging times.

Table 1: Assumed and described needs for air pollution exposure estimates in the health studies of the Teplice Program.

Health investigation	Investigator	Compounds of interest	Averaging time*	Comments**
Nutrition	Sevcik	Heavy metals, PCBs, chlorinated insecticides, PAHs, NO3		
Pregnant women	Vitnerova	heavy metals, *PCBs, PAHs*		
Mutagenicity	Watts et al,	PAHs & other organic mutagens	Weekly, Seasonally	This study is an air pollution exposure estimating study being done by the EPA
Biomarkers of exposure	Lewtas et al.	PAHs		These studies use external personal exposure monitoring for air-borne particles
Autopsy tissue bank	Lewtas et al.			
Toxic metals in biological materials	Subert	Heavy metals		
Mortality	Kotesovec	SO2,PM10/PM2.5, CO, NO2 and O3	24-hour	
Malignant tumors incidence	Kotesovec et al.			
Pregnancy outcome study	Deimek	SO2,PM10/PM2.5, CO, NO2 and O3		
Human semen quality - military recruits/miners	Darney	PAHs		This study is to be coupled to biomarkers study
Immunology				
Respiratory status	Horstman	SO2,PM10/PM2.5, CO, NO2 and O3	24-hour or less	
Respiratory status II	Vondra			

* Yearly in these studies means the need for a general index of air pollution

** If not specifically indicated in this column, it is assumed a mean value for the averaging time with a standard deviation will be sufficient

Table 1 cont.

Health investigation	Investigator	Compounds of interest	Averaging time*	Comments**
Neurobehavioral performance in children	Otto, Gebhart et al.	Pb, As and Hg	24-hour, weekly and monthly	
Miners	Novakova et al.	SO2,PM10/PM2.5, CO, NO2 and O3	y	Special consideration and measurements of the actual mines would be beneficial. Peak or 95% - 99%
Health symptom Monitoring	Clench-Aas et al.	SO2,PM10/PM2.5, CO, NO2 and O3	24-hour or less, weekly, monthly and yearly	Peak or 95% - 99% can be of interest

* Yearly in these studies means the need for a general index of air pollution

** If not specifically indicated in this column, it is assumed a mean value for the averaging time with a standard deviation will be sufficient

3.2. Summary of project proposals for 1993

The project proposals are enclosed in Appendix B. In the following, short summaries are given.

Project 1: Monitoring of air pollution

'The proposal include these activities:

- Evaluation of the existing long-term air pollution monitoring and measurement program.
- Establishment of a QA/QC-program.

The tasks and proposed time schedule are shown in Table 2. The time schedule presupposes that funding of the project is cleared in May/June 1993.

Table 2: Proposed activities and time schedule for Project 1.

	J	F	M	A	M	J	J	A	S	O	N	D
Evaluation of monitoring program												
1. Description of system					———	Δ						
2. Survey of needed exposure data (This task is a part of Project 2)					———	———	———	Δ				
3. Data base (This task is a part of Project 2)						———	———	———	———	Δ		
4. Evaluation									———	———	———	Δ
QA/QC program												
5. Documentation from US EPA and laboratories						Δ						
6. QA/QC program description									Δ (draft)			Δ (final)
- visits to laboratories						———	———	———	———			

Project 2. Dispersion and exposure modelling of air pollution

The aims of this project are:

- to establish a model capable of providing the estimates of air pollution exposure needed for the various health studies in the Teplice Program.
- to do preliminary exposure estimate calculations.

The dispersion and exposure calculation model consists of several elements:

- air pollution monitoring
- monitoring of meteorological/dispersion parameters
- emissions/population inventory

- dispersion models
- data on the individuals' location as a function of time.

Part of the groundwork for establishing this integrated model within the Teplice program was done in 1992.

During a meeting in Praha in February 1993 it was made clear that the within the modelling group in Praha/Teplice, there is not enough manhour and computer capacity to do the actual dispersion and exposure calculations. These will thus have to be done at NILU. However, the modelling group retains co-responsibility for establishing the wind field model for Teplice, and also the responsibility for establishing the data base of emission, population, meteorology and pollution concentration data.

The activities, time schedule and responsible groups are given in Table 3. The time schedule presupposes that the funding for the NILU activities is cleared in May/June 1993.

Table 3:

Activity	Time-period	Responsible groups	
		Norway	Czech Republic
1. Emission inventory, completion	Feb-Aug.		Teplice group
2. Establishment of needs for exposure estimates. Questionnaire to health groups	June-Aug.	NILU	
3 Establishment of program for location data of individuals (diaries)	June-Aug.	NILU	
4. Evaluation of the monitoring network for air pollution and meteorology (This is a part of Project 1)	Sep.-Nov.	NILU	
5. Establishment of dispersion/wind field models. Completion	June-Sep.	NILU	Modelling group (Brechler)
6. Exposure model development	Sep.-Nov.	NILU	
7. Establishment of data base for emissions population meteorological data air pollution data diary data for individuals	June-Oct.		Teplice group
8. Detailed exposure calculation schedule	Sep.-Oct.	NILU	Program directors, Brechler
9. Calculation of exposure estimates	Oct-Dec	NILU	(Modelling group)

() means "assisting partner"

Project 3: Health symptom Monitoring

The Teplice program would be strengthened by inclusion of a series of health studies aimed at examining the short-term health effects of the more traditional air pollution compounds, e.g. SO_2, NO_x, O_3 and PM_{10}. The program, as it currently exists, gives good coverage of the long term health effects of air pollution, especially of heavy metals and organic compounds such as VOC's, PAH's etc.

The Health Symptom Monitoring Program enables doing a faster appraisal of changes in the health status of communities, facilitating evaluation of preventive measures taken to reduce pollution. The Health Symptom Monitoring Program examines different population subgroups, especially those considered "at risk". The proposed Health Symptom Monitoring Program includes:

- A cross-sectional study of a random sample of 3 000 participants from Teplice city and 1 000 from Prachatice.

- A cohort study of adult non-smoking women (50 to 75 per group) selected from the above cross-sectional study, concentrating on symptom reporting and respiratory health.

- A cohort study of a subgroup of school children already participating in the Teplice program, concentrating on symptom reporting and respiratory health (75 exposed and 75 unexposed).

Where possible these studies are done in conjunction to already exisisting studies.

The studies are planned to be in the field by 1994 with reporting finished by the end of 1995.

3.3. Summary of cost estimates, 1993

	Work by NILU (NOK)	Work by Czech partners
Project 1: Monitoring of air pollution		
Evaluation of monitoring system	140 000,-	(2 man-weeks)
QA/QC program	200 000,-	(2 man-weeks)
Sub total	340 000,-	4 man-weeks
Project 2: Dispersion and exposure modelling		
Emission/population inventory. Completion	75 000,-	8 man-weeks
Needs for exposure estimates	50 000,-	
Program for location data	25 000,-	
Wind field/dispersion models	165 000,-	8 man-weeks
Exposure model development	95 000,-	
Data base	50 000,-	8 man-weeks
Exposure calculations	155 000,-	
Subtotal	615 000,-	24 man-weeks
Project 3: Health symptom monitoring		
Cross-sectional epidemiological study	225 000,-	200 000,-
Cohort study of adult women	240 000,-	80 000,-
Cohort study of susceptible children	315 000,-	115 000,-
Sub-total	780 000,-	
TOTAL	1 735 000,-	395 000,- + 24 man-weeks
Total need for funding by Norwegian Partners, 1993	1 735 000,-	300 000,- 1 855 000,-

Reporting of the activities for 1993 will be done in 1994, on 1994 budget.

In order to follow up the contributions to the program, the projects will continue in some form after 1993.

In Project 1, the QA/QC activities will continue.
In Project 2, the exposure assessment activity will be continued.
In Project 3, the Health Symptom Monitoring Program will be completed.

Costs beyond 1993 has been estimated only for Project 3, as follows:

	1994		1995	
	NILU	Teplice	NILU	Teplice
~~Cross-sectional study~~	~~370 000,-~~	~~100 000,-~~	~~125 000,-~~	~~0,-~~
Cohort, adult women	505 000,-	70 000,-	125 000,-	0,-
Cohort, susceptible children	540 000,-	135 000,-	0,-	0,-
Sum	1 415 000,-	305 000,-	250 000,-	0,-

The costs for continuing the projects 1 and 2 will be considerably less than for project 3.

3.4. Organization of co-operation

The contributions from NILU to the Teplice Health Program requires Norwegian financing, and it requires that work is done in Teplice/Prachatice by Czech partners.

The projects require that work groups and responsible contact persons are established in the following fields:

	NILU	Teplice
Monitoring, air pollution and meteorology	S. Larssen	Ivan Beneš
Emission and population data	K.E. Grønskei	Frank Kotešovec
Data base establishment	S.-E. Walker	Mirek Leixner
Dispersion/exposure modelling	K.E. Grønskei	Jozef Brechler
Exposure data needs	J. Clench-Aas	F. Kotešovec
Health symptom monitoring	J. Clench-Aas	Sones

4. References

Clench-Aas, J., Larssen, S., Bartonova, A., Aarnes, M.J., Myhre, K., Christensen, C.C., Neslein, I.L., Thomassen, Y., and Levy, F. (1991) The health effects of traffic pollution as measured in the Vålerenga area of Oslo. Summary report. Lillestrøm (NILU OR 7/91).

Larssen, S. (1991) The Teplice project. Expert meeting in Prague/Teplice, 31.8.-1.9.91. Lillestrøm (NILU RR 10/91). (In Norwegian.)

Larssen, S., Grønskei, K.E., and Bartonova, A. (1992) Visit in Czechoslovakia. Praha, Teplice, Prachatice, 8-19 January, 1992. Lillestrøm (NILU RR 2/92).

Program Teplice (1992) Peer Review Workshop. - Peer Reviewers recommendations - Liblice Castle, Czechoslovakia, Sept. 21-25, 1992.

Appendix A

Project Proposals for 1992

NORSK INSTITUTT FOR LUFTFORSKNING
Vår ref.: STL/EMN/O-8918/5. mai 1992

P R O J E C T P R O P O S A L

T H E T E P L I C E H E A L T H S T U D Y .
C O N T R I B U T I O N F R O M N O R W A Y

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1 INTRODUCTION

The Teplice district is an area in Northwestern Czechoslovakia that is heavily polluted by SO_2, NO_x, suspended particles and oxidants. A series of investigations are being initiated in the area to study the current air pollution situation and its impact on the health of the population with the aim of following the population over 10 years, assessing the current status and trying to measure the changes. Prachatice in Southwestern Czechoslovakia has been selected as a control area.

The Teplice health study is carried out by environmental and health authorities in the Czech Republic of CSFR. The study will provide information on environmental pollution, abatement strategies and health effects of pollution. The study is still in the planning phase, it will start during the fall of 1992. The co-ordinator for the study is Dr. Frantisek Kotesovec, M.D., director of the District Hygiene Station in Teplice. Dr. Radim Sram, D.Sc., M.D., Inst. of Experimental Medicine, Czech Academy of Sciences, is Scientific secretary for the study.

Through discussions and correspondance with the Czechoslovak project leadership, NILU has pointed out and gained acceptance for the need to strengthen the component of the study which should provide estimates of the actual air pollution exposure of the population groups under study. The project leadership is also interested in including a Health Symptom Monitoring project in the study. Also, during out visits in the area, the need for additional air pollution monitoring and measuring instruments has been pointed out to us.

The contribution to the study from NILU has been prepared through two visits to the area (in September 1991 and January 1992; NILU travel reports 10/92 and 2/92) and several notes on suggested contributions from NILU.

The present plan considers three areas of contribution from NILU to the Teplice Health Study:

1. Air pollution measurements.
2. Air pollution modelling.
3. Health symptom monitoring.

A workshop is planned to be held in Dobris, Czechoslovakia, in September 1992, for presentation of results from an Air Quality Assessment Program conducted in Winter/Spring 1992 by US EPA and the Teplice Study team in co-operation. It is proposed that the NILU contributions to modelling and health studies be presented and discussed at that workshop.

2 PROJECT PLANS

2.1 Air pollution modelling

2.1.1 Introduction

Air pollution dispersion modelling is a necessary part of the Teplice Health Study in order to:

- give estimates of the actual air pollution exposure of population groups under study
- assess effects on air quality of various emission reduction schemes.

The pollution situation in the Teplice area is complex. There is a multitude of sources of different type, pollutant composition, emission height and position relative to population centres. The topography creates a wind and dispersion field which must be characterized by measurement of dispersion parameters. Specifying spatial distributions of pollution concentrations, source-oriented dispersion models are necessary, as a complementary tool to receptor modelling and source apportionnement calculations that the US EPA is presently performing, based on data from the study area.

A necessary basis for performing air pollution calculations by means of dispersion models is

- an emission inventory
- meteorological data (wind speed and direction, turbulence and/or stability measurements).

The contribution from NILU includes the following activities:

- assistance in completing an emissions inventory for the model area
- assistance in designing a meteorology monitoring program
- providing air pollution dispersion models, and assistance in implementation, and performing model calculations.

As a basis for the further activities under this project, it is necessary to carry out a discussion identifying the specific needs for air pollution concentrations and exposure estimates within the health study, regarding

- air pollution compounds
- space resolution
- time resolution
- time scale.

2.1.2 Project description

Emission inventory

An inventory of the emissions in the Teplice district exists, which includes emission estimates of SO_2 and NO_x from point sources. Emissions from area sources (i.e. home heating, road traffic) are not yet included. The emissions inventory should be completed by Czech/Teplice personell through local data collection (i.e. data on fuel consumption, road traffic, population distribution).

NILU will provide advice on a systematic approach for preparing a complete emissions inventory. The inventory should give information on the variation in time of the emissions. Inventories should, in the first phase, be prepared on SO_2, NO_x and suspended particles. In later phases, other compounds related to healths effects, should be added.

Data base of meteorological parameters

A data base of meteorological parameters is a necessary input to dispersion models. The data base, which has to be prepared for the actual period of investigation, should include measurements of wind speed and direction, air temperature and dispersion parameters such as vertical temperature profile and/or data on turbulence intensity. The meteorological measurements should cover the various meteorological/topographical domains of the model area, including low level and high level stations.

NILU will assist local experts in defining a sufficient net of meteorological measurement stations, and in making a meteorological data base.

Air pollution dispersion models

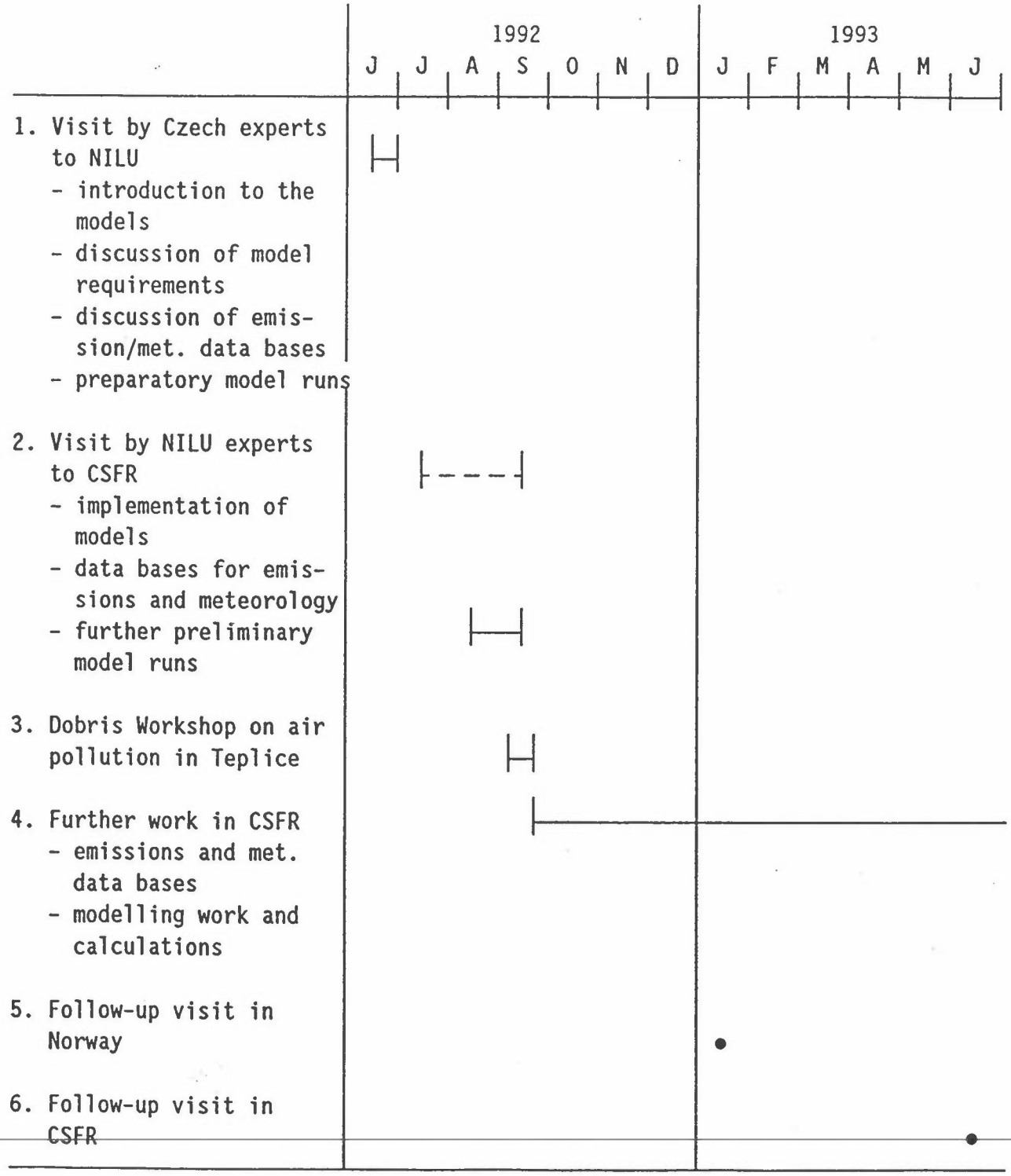
NILU will contribute to the establishment of an air pollution models in the study area in the following manner:

- Computer programs to calculate air pollution concentration fields (programs for combining data on emission, dispersion and concentration measurements of pollution components) will be made available on suitable computers, such as SUN SPARC work stations. We particularly have in mind models which are capable of estimating pollution concentrations in a grid on short time scales (e.g. hourly), which includes a statistical package for correction of calculated concentrations based on measurements.

- Czech scientists will work at NILU for a time period (a few weeks) to get acquainted with the calculation procedures and equipment, and to establish a data base for Teplice on the computer, e.g. data on emission, wind, dispersion and pollution concentrations, and use the model for the Teplice area.

- Model adjustment, and improvements of the input data base, e.g. on emissions and meteorology, will continue in Czechoslovakia, with assistance provided by NILU, within specified limits.

2.1.3 Time schedule



2.1.4 Cost estimate

Reference is made to ch. 2.1.3

1992

1. Visit by Czech experts to NILU (Dr's Brechler and Sram and/or Kotesovec)			
Accomodation, per diem			
Dr. Brechler 2-3 weeks	NOK	32 000,-	
Dr. Sram, 1 week	"	7 000,-	
Travel	"	7 000,-	
Manhours, NILU, 120 hrs	"	72 000,-	NOK 109 000,-
2. Visit by NILU experts to CSFR (Grønskei and Walker)			
Accomodation[1], per diem (1 week ea.)	NOK	7 000,-	
Travel	"	7 000,-	
Manhours, 80 hrs	"	48 000,-	" 62 000,-
3. Follow-up work at NILU			
Manhours, 40 hrs			" 24 000,-
4. Dobris Workshop (Grønskei, Walker and Larssen)			
Accomodation[1], per diem	NOK	7 500,-	
Travel	"	7 000,-	
Manhours 120 hrs	"	72 000,-	" 86 500,-
			NOK 281 500,-

1993

5. Follow-up visit to Norway (Dr. Brechler, 1 week)			
Accomodation[1], per diem	NOK	5 000,-	
Travel	"	7 000,-	
Manhours, NILU, 40 hrs	"	24 000,-	" 36 000,-
6. Follow-up visit to CSFR (Grønskei and Walker, 1 week)			
Accomodation[1], per diem	NOK	5 000,-	
Travel	"	7 000,-	
Manhours 80 hrs	"	48 000,-	" 60 000,-
			NOK 96 000,-

1 Assumed covered by CSFR

2.2 Air pollution measurements

2.2.1 Services offered

There is a rather extensive program for monitoring and analysis of air pollution components in the Teplice area. Measurement programs are run partly by the District Hygienic Services in the area, and partly by the Czechoslovak Hydrometeorological Institute, who is putting in operation several new monitoring stations with on-line communication to a central data bank.

To cover the various monitoring needs in the study, particularly for monitoring in the urban areas in the region, there is a need for further supply of instruments.

Based on discussions with the monitoring group of the Teplice study, and on availability of instruments at NILU, the following instruments are made available for the study:

1. One SO_2 monitor, type Monitor Labs ML 8850S.

2. Two manual samplers for PAH (vapour phase and particle phase). Air flow: about 500 m^3/24 hrs.

3. Three manual samplers for inahalable particles (PM_{10}), with separation into two size fractions, fine (<2 μm) and coarse (2-10 μm). Air flow: 15 m^3/24 hrs. A balance with 6 digits on the gram (±1 μg) is necessary for filter weighing.

2.2.2 Time schedule

The instruments will be made available and shipped to Czechoslovakia in September/October this year.

2.2.3 Cost estimate

Instrument costs			
SO_2 sampler		NOK 150 000,-	
PAH samplers	2 x	" 15 000,-	
PM_{10} samplers	3 x	" 10 000,-	NOK 210 000,-
Preparations and shipping			" 15 000,-
Mounting and instructing			
Travel + per diem		NOK 3 500	
Per diem		" 2 000,-	
Manhours 48 hrs		" 22 000,-	" 28 000,-
			NOK 253 000,-

2.3 Health Symptom Monitoring

2.3.1 Introduction

The Health Symptom Monitoring, planned to involve a large randomly selected population, will supplement the Teplice Program studies that investigate objective health effects on specialized populations. Personal exposure will be assessed based on the results of the air quality monitoring, and will be related to health events.

The suggested Health Symptom Monitoring represents a type of project that has not been performed in the CSFR before. The Czech partners have therefore asked to have detailed plans for the project, as well as additional discussions about all its aspects. A draft of more detailed Research Protocol is enclosed to this Proposal.

2.3.2 Summary of the Research Protocol

Health monitoring is a method of assessing the impact of air pollution on a population. Health monitoring consists of health investigations that attempt to elucidate the relationship between air pollution concentrations and health status where the definition of health used is that of WHO, "a state of full physical, psychological and social well being and not simply as an absence of disease or deformity" (WHO, 1985).

A future health investigation should 1) concentrate on describing the general health of the population and thus look for long-term effects, and 2) describe changes in health status in population subgroups over time, thus focusing on short-term effects of pollution.

Information should be obtained from both adults and children. Traditionally most international studies have focused on populations having asthma. These populations are defined as sensitive. However, because of both behavior and use of medication, these groups may no longer be sensitive. It is therefore also desirable with information from random populations. Earlier studies in Vaalerenga and Grenland in Norway, indicate that as much as 15% of the total population may show positive associations between reporting of symptoms of health effects and air pollution exposure.

We are suggesting three types of investigations: 1) cross-sectional study of the health status of a subset of approximately 10000 inhabitants, both adults and children, 2) cohort study of a subset of the participants in the cross-sectional study, for reporting of symptoms of adverse health and well being, and, 3) cohort studies of subsets of young school children for symptom reporting during a school year. The study on school children is planned in a fashion similar to investigation proposed for at least 6 countries in the European Community.

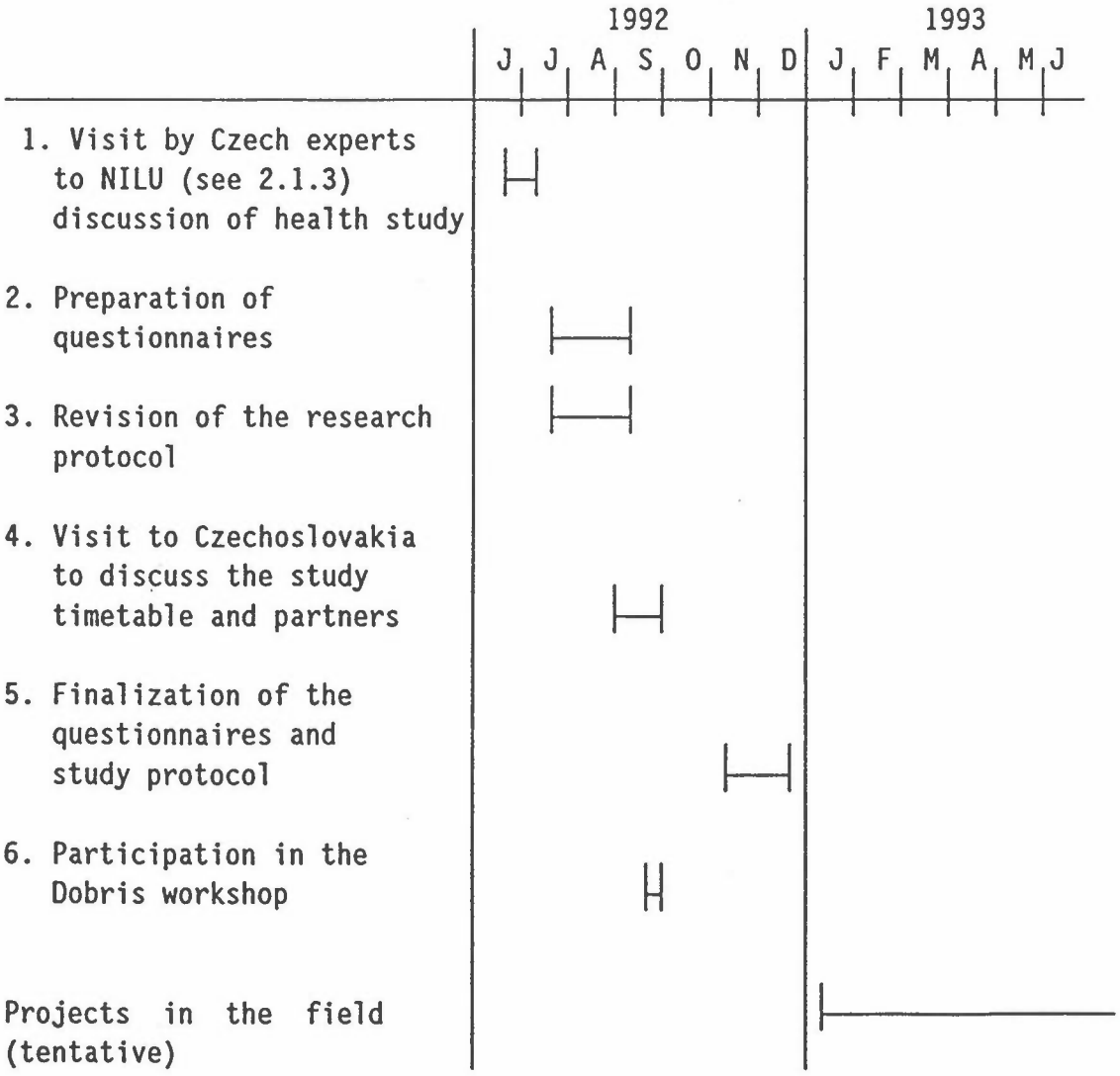
The proposed studies are designed based on results and experience obtained by a crossectional study done in Vaalerenga in Oslo and cohort investigations done in Vaalerenga and Grenland in Telemark in Norway.

The aim of the cross-sectional study is to document the degree to which air pollution exposure is associated with an increased prevalence of chronic diseases, reduced well being or increased reporting of symptoms of disease.

The cohort studies should supplement already existing knowledge of the effects of pollution gathered in Norway on the development of symptoms of adverse health by providing information for population subgroups exposed to high concentrations of pollution.

All study types should provide the basis for a health monitoring program that can if desired be repeated at a later date to measure changes in health status of the population.

2.3.3. Time schedule



2.3.4. Cost estimate

For point numbers refer to 2.3.2.

1. Visit by Czech experts to NILU (Dr Brechler, Dr Sram and/or Dr. Kotesovec)				
manhours, NILU 36 hrs			NOK	22 000,-
2. Preparation of questionnaires (in English)				
manhours, NILU				
for the cross-sectional study, 36 hrs	NOK	21 600,-		
for the cohort study, 18 hrs	"	10 800,-		
for the school children study, 18 hrs	"	10 800,-	"	39 600,-
3. Revision of the Research Protocol (also a determination of sample size)				
NILU manhours, 36 hrs			"	21 600,-
4. Visit to Czechoslovakia to discuss the plans and the questionnaires (Clench-Aas and Bartonova)				
accomodation[1], per diem (1 wk.)	NOK	7 000,-		
travel	"	7 000,-		
manhours, 80 hrs	"	48 000,-	"	62 000,-
5. Finalization of the questionnaries and study design;				
NILU manhours, 48 hrs	NOK	28 800,-		
Technical consultation on the questionnaire (outside NILU)	"	7 000,-	"	35 800,-
6. Participation in the Dobris workshop (Clench-Aas and Bartonova)				
accomodation[1], per diem (1 wk.)	NOK	7 000,-		
travel	"	7 000,-		
Manhours, 80 hrs	"	48 000,-	"	62 000,-
			NOK	243 000,-

1 Assumed covered by CSFR

3 SUMMARY OF COST ESTIMATES, 1992

Air pollution modelling

1) Visit by Czech scientists to NILU	NOK 109 000,-	
2) Visit by NILU scientists to CSFR	" 62 000,-	
3) Dobris workshop	" 86 500,-	
4) Follow-up work at NILU	" 24 000,-	NOK 281 500,-

Air pollution measurements

5) Instrument costs	NOK 210 000,-	
6) Shipping, mounting, instructions	" 43 000,-	" 253 000,-

Health symptom monitoring

7) Visit by Czech scientists to NILU (addition to 1))	NOK 36 000,-	
8) Finalization of protocol	" 97 000,-	
9) Visit by NILU scientists to CSFR	" 68 000,-	
10) Dobris workshop (addition to 3))	" 62 000,-	" 243 000,-

Appendix B

Project proposals for 1993

B1. Monitoring of air pollution
B2. Dispersion and exposure modelling of air pollution
B3. Health Symptom Monitoring

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PROJECT PROPOSAL

Date : 14. January 1993
Ref. : STL/EMN/O-92065
Author : Steinar Larssen

NILU contribution to the Teplice Health Program 1993
Project 1: Monitoring of air pollution

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1 Introduction

NILU has been asked by the Teplice Program Leadership for the following further contributions to the air pollution monitoring part of the program:

- General surveillance of the quality of the monitoring program.
- Propose a Quality Assurance/Quality Control (QA/QC) program, and participate in QA/QC procedures.

NILU will propose the following activities for 1993 within this project:

- Evaluation of the long-term air pollution monitoring and measurement program.
- Establishment of a QA/QC program.

2 Evaluation of the long-term air pollution monitoring and measurement program

The program should be evaluated in terms of:

- its ability to document the air pollution concentration levels in the Teplice and Prachatice districts regarding:
  - the compounds important to health effects
  - coverage of the different source exposure situations present in the district:
    - exposure from various large and medium-size point sources (power generation and industry)
    - exposure from home heating
    - exposure from traffic
    - coverage of various population centres in the district.
- its ability to function as a basis for comparing measured concentrations with those calculated by dispersion models.
- its ability to document changes in the air pollution situation as a result of abatement measures (control of sources, changes of fuels, etc.).

The basis for this evaluation would be:

- detailed knowledge of the total monitoring network which is in operation in the Teplice and surrounding districts, and in Prachatice, by the Hygienic Institutes, the Czech Hydrometeorological Institute and other institutions.

- the results from previous monitoring and measurement campaigns, especially the EPA-sponsored field campaign of winter 1992.

- the plans for further EPA measurements, and the plans for indoor/outdoor measurements during the winter 1992/1993.

- a survey of the requirements of exposure data needed in the analysis of health effects to be done within each of the health studies.

- an emission inventory, and dispersion model calculations of the air pollution concentration fields for various compounds under different dispersion conditions. This is necessary to fully evaluate the representativity of monitoring stations, and to judge the number of stations necessary.

The first three items on this list are already documented, while the survey of exposure data requirements needs to be done. This will be included as a part of Project 2.

3 Establishment of a QA/QC program

NILU can offer participation in a QA/QC program for the air pollution monitoring program of the Teplice study, based upon the QA/QC program initiated within the study by the US EPA.

The basis for this activity would be:

- documentation of the QA/QC program initiated by the US EPA.
- a list of the analytical laboratories involved in the Teplice Program, including their
  a) responsibilities
  b) analytical capabilities/methods/instrumentation
  c) manpower

The long-term QA/QC program can be planned and established only after this documentation is provided.

4 Project plan 1993

Evaluation of the monitoring program

A prequisite for the evaluation of the monitoring program is that the data base concerning emissions, dispersion (meteorological) data, air quality data and population distribution as described in Project 2 of this report, is available.

We propose the following project plan:

1. Full description of the monitoring system which includes all stations in the Teplice, Most, Ústi n.L. area, and in Prachatice, providing continous and/or 24 hr average data on one or more compounds. All stations in routine operation should be included, not only those already connected to the automatic data system. The description should include:

   - station locations on map, scale 1:1000-1:5000
   - description of immediate surroundings
   - instruments, methods
   - data collection/transfer to data base.

   This information must be provided by the Hygienic Institute group in Teplice, and should be available as a report in English.

2. A survey of the need for exposure data in the various health projects must be carried out by means of a questionnaire. This questionnaire should be worked out by the Teplice program and NILU in co-operation, starting with a proposal from NILU. This will be done as part of Project 2.

3. A data base, covering at least 2 winter months, of the following data must be available:

   - emission data, covering point sources and area sources.
   - meteorological data, ground level and upper air.
   - air quality data from as many of the monitoring stations as possible. Continuous SO_2 data are especially important.

   This data base is provided through the activities of Project 2.

4. Evaluation of the monitoring system regarding the points listed on page 42 This evaluation should be done at NILU, based on dispersion model calculations. The calculations should be done in co-operation with the Czech Teplice modelling team. The evaluation includes, if considered necessary, a one-week reconnaisance trip to Teplice and Prachatice.

   The evaluation should be finished by 30 November. It will contain advice about the monitoring program both in the short term (1-2 years) and longer term (>5 years).

Establishment of a QA/QC program

We propose the following project plan regarding QA/QC:

1. The QA/QC program initiated by the US EPA, and the list of laboratories and groups involved in air quality monitoring and measurement activities within the Teplice program, should be presented to NILU. The laboratory list should include:

   - the responsibilities of the laboratory within the program
   - the analytical capabilities of the laboratory, in terms of
     . instrumentation
     . methods used
     . personnel.

2. Establishment of a long term QA/QC program involving:
   - organization of program
   - visit by NILU personell to the laboratories
   - QA/QC plan.

5 Time schedule and cost estimate

Time schedule

Table 1 shows a proposed time schedule for the "Monitoring of Air Pollution" project for 1993.

The time schedule depends upon at what time it is clear that our projects will be funded. The schedule in Table 1 presupposes that fundings is cleared in May/June 1993.

Table 1: Proposed time schedule.

	A	M	J	J	A	S	O	N	D
Evaluation of monitoring program									
1. Description of system		———	Δ						
2. Survey of needed exposure data (in Project 2)			———	———	———	Δ			
3. Data base (in Project 2)				———	———	———	Δ		
4. Evaluation							———	———	Δ
QA/QC program									
5. Documentation from US EPA and laboratories			Δ						
6. QA/QC program description					Δ (draft)			Δ (final)	
- visits to laboratories				———	———	———			

COST ESTIMATE	NILU (NOK)	Teplice
1. Description of system	0,-	(1 man week)
2. Survey of needed exposure data: (provided in Project 2)	0,-	
3. Date base (provided in Project 2)	0,-	
4. Evaluation Work at NILU ~4 weeks Work in Teplice ~1 week Travel expenses (1 trip) NOK 10 000,-	140 000,-	(1 man-week)
5. QA/QC program Work at NILU ~4 weeks Work in Teplice/Praha ~2 weeks (4 person trips) NOK 40 000,-	200 000,-	(2 man-weeks)
TOTAL	340 000,-	

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PROJECT PROPOSAL

Date : 14. January 1993
Ref. : STL/EMN/O-92064
Author : Steinar Larssen
Knut Erik Grønskei
Jocelyne Clench-Aas

NILU contributions to the Teplice Health Program, 1993
Project 2: Dispersion and exposure modelling of air pollution

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1 Introduction

The Teplice Program comprises a set of investigations of health effects that attempt to cover a wide set of chronic and acute health effects. As a result of the Peer Review of the project in September 1992, it was strongly advised that improvements were needed in exposure estimating. The Peer Review Group said,

> "The issue of exposure assessment needs to be addressed urgently... It is the opinion of the review committee that in most health related studies, ecological designs in which two areas are compared are not acceptable in most situations. Individual estimates of exposure need to be obtained for the persons under study..."

In order to strengthen the Teplice Program in this respect, NILU was asked to provide assistance for establishing exposure estimates to the various pollutants of interest.

Exposure assessment is a necessary part of epidemiological studies of the health effects of air pollution. Air pollution exposure is the concentration of air pollution that each individual is actually exposed to as he moves within and between various microenvironments (indoor, home, work, outdoor, transport, etc.). Exposure assessment varies from providing an index that allows comparison of one individual to another with respect to air pollution exposure in a quantitative fashion, to providing short term (e.g. hourly) estimates of actual exposure concentrations. The index accounts for air pollution exposure at the geographic location of interest - usually the home. The precision needed in the exposure estimate depends on compound, range of exposure in the investigation area, health effect to be investigated and resources available.

Exposure can be estimated by measurements at fixed stations, or with active or passive portable equipment. It can also be estimated using dispersion modelling coupled to information on individuals' location gathered in diaries.

The projects studying various health effects of the environmental pollution situation in Teplice needs to be supported by a program which gives assessments of the exposure to air pollution that the various groups under study are actually exposed to. In the Teplice Program many different types of health effects are being measured. Attempts will be made to associate these effects to previous exposure to air pollution.

This implies that the exposure model to be used in Teplice should enable calculations of past, present, and future exposure, based on part, present and future input data/projections.

The dispersion and exposure calculation model consists of several elements, as shown in Figure 1:

- air pollution monitoring
- monitoring of meteorological/dispersion parameters
- emissions inventory
- dispersion models
- data on the individual's location as function of time (diary)

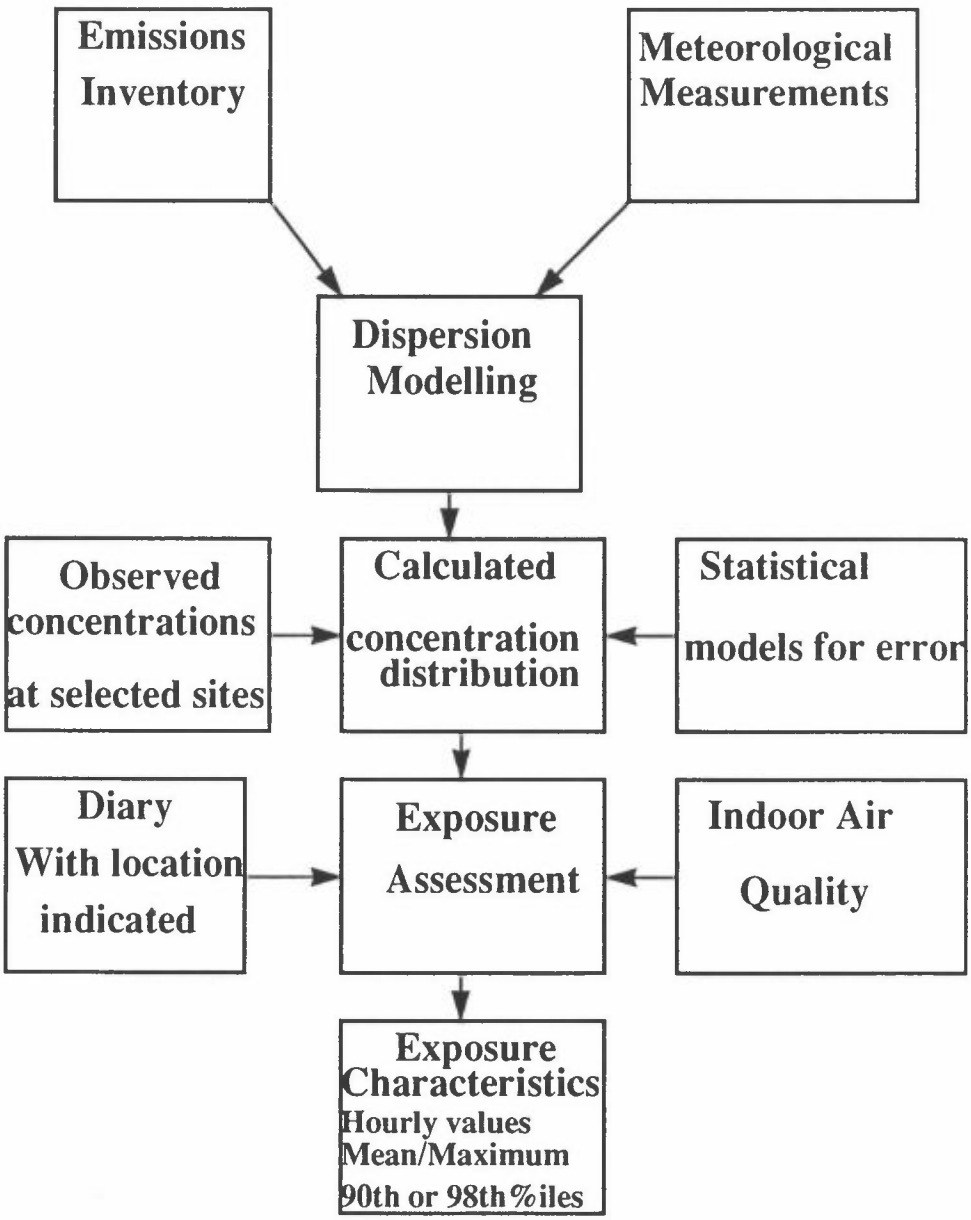

Figure 1: Outline of model for exposure estimating.

Part of the ground-work for doing dispersion calculations in Teplice was done in 1992 (see ch. 2.2 of this report, p. 10) A time dependent dispersion model was set up for Teplice and installed at two computer facilities in Prague. A preliminary input data base was established, containing emissions, meteorology and air pollution data for a test period (27-2.-2.3.92), and preliminary calculations of concentration fields performed.

2 Aims of the project

The aims of this project are:

- to complete the establishment of a dispersion model for the Teplice area enabling:
  - calculation of the contributions from various sources to the air pollution concentrations in the area, and to predict the effects of abatement measures on sources
  - providing a basis for calculating exposure estimates.
- to provide estimates of air pollution exposure for each group and/or participant in the various health studies that are useful to the Teplice project team.

3 General description of the project

The program for air pollution exposure estimation should consist of four parts:

- a program for air quality measurement,
- a program for air quality modelling on an hourly basis
- an estimate of exposure
- a control of some of the exposure estimates using portable measuring equipment.

Individual exposure estimates would be beneficial in all the health studies. However, the compounds of interest vary between studies. In addition to the traditional compounds of SO_2, NO_x, NO_2, CO, $PM_{2.5}/PM_{10}$, O_3, SO_4, NO_3, it may be desirable to estimate individual exposure to compounds such as VOCs, PAHs, heavy metals, etc. Also, the averaging time of the estimate will vary (from long-term average to hourly max.).

3.1 Areas for exposure calculations

Teplice

The participants in the health studies live and work in the Teplice region. Calculations are needed for pollution concentrations in specificed areas or buildings. In these areas concentration measurements and input data for the

calculation procedures should be known with high accuracy, i.e. location of emission, wind and dispersion conditions and concentration measurements.

The area of calculation are shown in Figure 2.

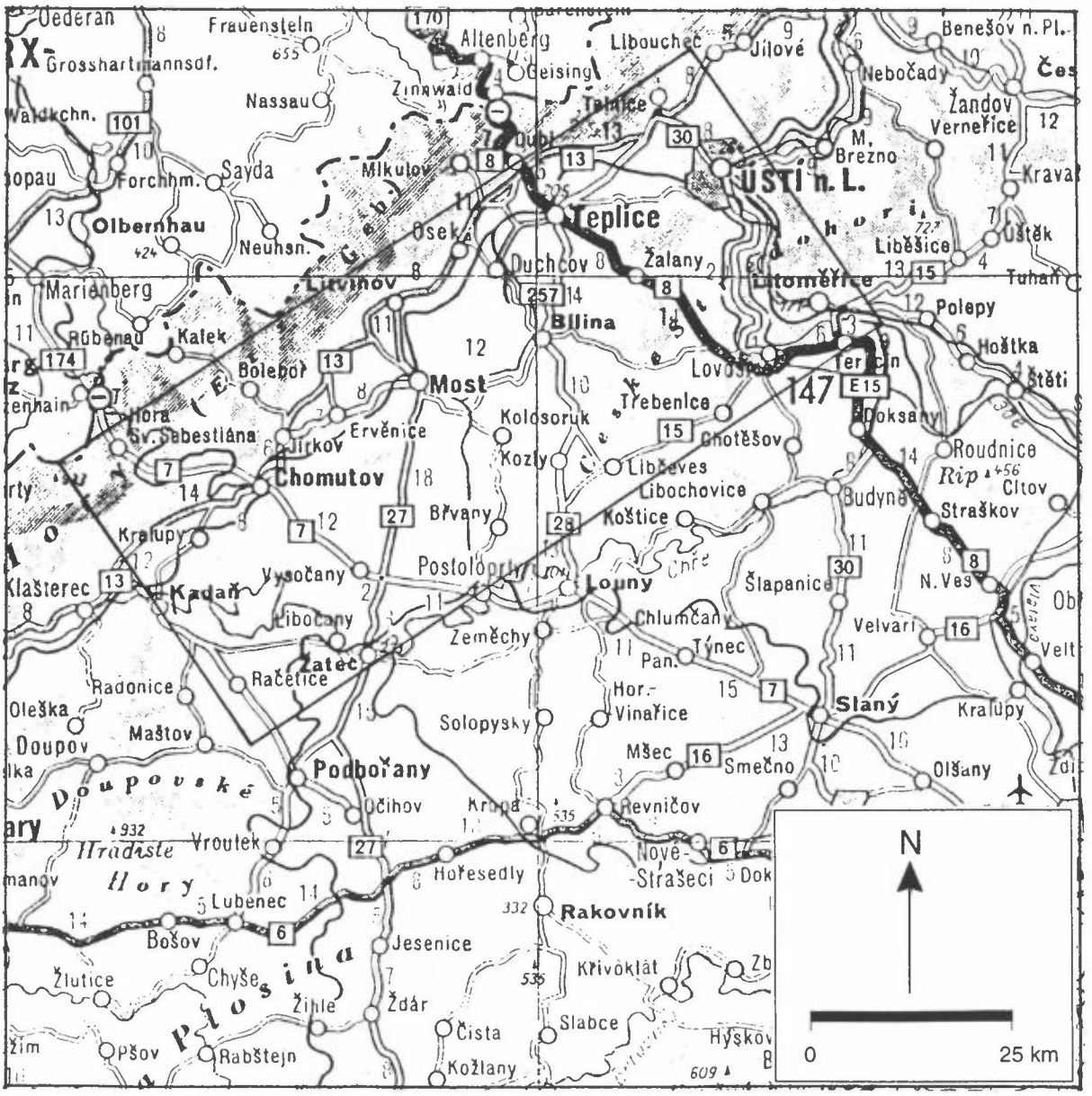

Figure 2: The area for calculations.

Prachatice

The area in Prachatice to be covered by dispersion/exposure estimates will be selected based on maps and population data.

3.2 Calculations of spatial pollution distribution in the Teplice area

The pollution situation in the Teplice area is complex. There is a multitude of sources of different types, pollutant composition, emission height and location relative to population centers. The topography creates a wind and dispersion field which must be caracterized by measurements of dispersion parameters.

Along the northern boundary of the area the Ore Mountains ("Kruzne Hory") rises to the level of 800-900 m above sea level (500 m above the valley floor) and is regarded as a barrier to fluxes of air pollution in local air pollution episodes.

Further it is assumed that when the influence of local sources causes high concentrations, most of the pollution is found within a mixing height less than 1 000 m above ground level. In order to be able to describe the vertical structure, five layers up to the level of 1 000 m above ground will be used (see Figure 3). The fluxes above the mountain top will occur in the upper layers in the model.

There is an influx of air pollution into the area from outside, which may be considerable. The following data will be used for describing the background concentrations in the surrounding area:

- Calculated concentration along the boundary as a result of regional scale model calculations.

- Measured concentration values on the background stations.

The background concentrations will be described by one constant additive part and one part varying over the area as a result of large scale calculations.

The dispersion models should enable calculating the long term (month, year) concentration fields and the short term (hour, day) concentration fields, based on emission inventories and meteorological data.

The selection of compounds for which calculations will be done depends on which compounds are important for the various health effects studied. A prerequisite is that the emission inventory exists for the compounds. The compound list will certainly contain SO_2, particles ($PM_{2.5}$ and possibly PM_{10}, and chemical composition of particles, including heavy metals) and probably NO_2 and O_3. The dispersion models available are able to provide dispersion and exposure estimates for these compounds.

There may also be a need for exposure estimates for VOCs, PAHs and other organic constituents. For these compounds, measurements are very important, since chemical transformations take place in the atmosphere. Given emission inventories, dispersion calculations and measurements may be combined to give exposure estimates.

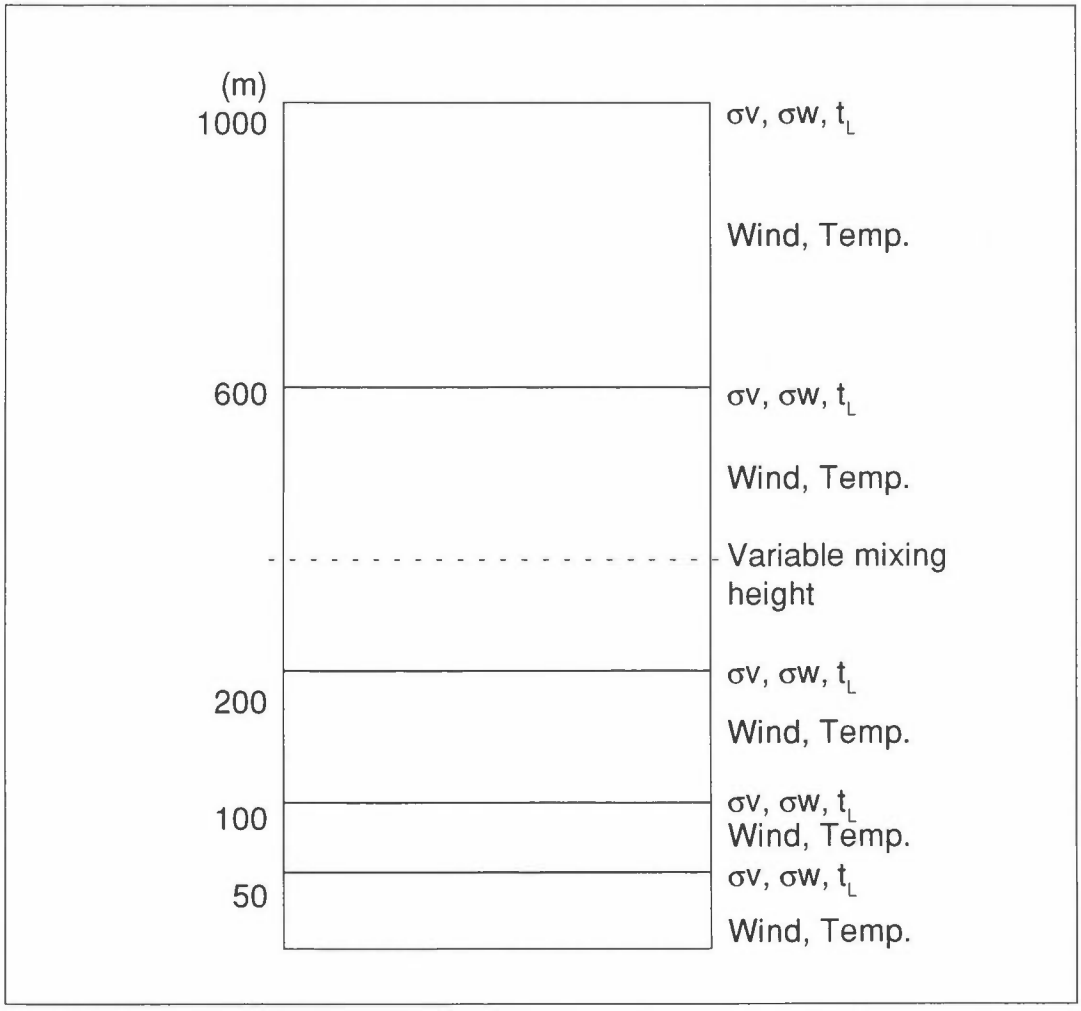

Figure 3: The vertical structure of the model. Data to be determined by meteorolgical model.
σv, σw= Horizontal and vertical wind fluctuations, t_L = Langrangian time scale, Wind = Windspeed and direction, Temp. = Temperature and vertical temperature gradient.

For each of these compounds the exposure estimates will represent different averaging times, dependent upon whether the health effects studied are short-term or long-term. This is further described in ch. 4.

3.3 Description of input data for the dispersion calculations in the Teplice area

3.3.1 Emission inventory

An inventory of the emissions in the Teplice district exists, which includes emissions estimates of SO_2 and NO_x from point sources. Emissions from area sources (i.e. home heating, road traffic) are not yet included.

The emissions inventory must be completed by Czech/Teplice personnel through local data collection (i.e. data on fuel consumption, road traffic, population distribution, etc.).

The data on SO_2 and NO_x emissions from point sources have been provided by Dr. F. Kotesovec. The survey covers all sources in the Teplice area and only larger point sources in the surrounding area (ref.: EK-Computing Emil Kopriva. 10 September 1991). The sources are located with an accuracy of 1 x 1 km. These sources are already entered into an emissions data base.

The work in 1993 must include more accurate location of sources:

- Small low level sources are not treated separately, but included in the area sources with a spatial resolution of 1 x 1 km^2. The remaining point sources should be located with better accuracy.

- Sources within a distance of 500 m from stations measuring pollution concentration should be located with an accuracy of 10 x 10 m.

- The remaining sources in Teplice area should be located with an accuracy of 100 x 100 m to obtain subgrid concentration data in the central area of calculations.

To complete the emission data base, the following source categories have to be included, and the emissions distributed in the grid system:

- home heating
- road traffic

Home heating

The following data are needed

- fuel consumption, pr. house or individual, for each heating process.
- the distribution of various home heating processes in the different parts of the area.
- emission factors for each process.

Road traffic

- Position of the end points of each main road link, within the grid co-ordinate system
- traffic data for the main road links (daily traffic, distribution passenger cars/trucks, velocity)
- emission factors (these may be provided by NILU).

The time resolution of the emission data varies from compound to compound:

- compound with accute health effects requires data with large resolution (~1 hour)
- compounds with long term effects requires only little time resolution (month, year).

The data on emission intensity should be reviewed and updated for the periods of the health investigations.

Data on emission of particles, supplied with information of source signature (elemental and chemical compound composition) has to be collected when using a receptor model based on analyses of many chemical components at receptor points. This analysis would be useful to identify the contribution of pollution from different groups of sources.

3.3.2 Data base of meteorological parameters

The data base which has to be prepared for the actual period of investigation should include measurements of wind speed and direction, air temperature and dispersion parameters such as vertical temperature profile and/or turbulence intensity. The meteorological measurements should cover the various meteorological/topographical domains of the model area including low level and high level stations, in the following manner:

- horizontal wind measurements close to the ground
- upper air measurement of wind and turbulence intensity (sodar and radiosonde measurements).

A numerical description of the wind and dispersion conditions in the area will be developed in co-operation with Dr. Brechler from Charles University and with the Institute of Atmospheric Physics in Prague. This description will be based on the data mentioned above.

The following meteorological stations are in operation:

Low level stations:

- Usti nad Labem Kockor
- Žatec-Velemyskoes
- Tušimice

Upper air stations/regional stations:

- Milešovka
- Prague-Libuše airport
- Kopisty

It will be evaluated whether the data from these stations are sufficient as basis for the dispersion calculations. It is probable that it is necessary to establish a ground level station in Teplice centre.

3.3.3 Air pollution monitoring

Measurements of air pollution provides data for exposure estimates directly for the area of measurement, and also data for comparison with and modification of dispersion model calculations.

The present air monitoring program in the Teplice area is briefly described in ch. 2.1 of this report.

In the Project 1 for 1993 (Monitoring of air pollution) it is proposed to do a detailed evaluation of the monitoring program, especially regarding how it serves as a basis for the exposure assessment program.

3.4 Dispersion models

The following dispersion models will be used to calculate air pollution concentrations:

- Multiple source gaussian dispersion model for calculation of long-term averages, based on the annual statistics of meteorological and dispersion parameters (wind, atmospheric stability).

- Time-variable dispersion model, for calculation of short-term averages (e.g. consecutive hourly averages), based on hourly dispersion (meteorological) data, and hourly wind field calculations.

The latter of these models is already installed at two computers in Prague. The multiple source Gaussian model will be provided for installation on PC.

The spatial resolution of the calculations (as for the emission inventory) is 1 km in the surrounding area. In addition, a subgrid model has to be used for the central

area of calculations. The subgrid model will be based on the Gaussian dispersion formulae.

The models are capable of calculating of SO_2, NO_x, NO_2, fine particles ($PM_{2.5}$, possibly PM_{10}), and CO.

3.5 Description of pollution concentrations in the Prachatice area

The Prachatice area is going to be used as a control in the health investigations. Since the pollution varies within this area also, an estimate for the spatial pollution distribution would be advantegeous for this area, too.

However, an emission survey will not be conducted in Prachatice as part of the Teplice Program. Thus, dispersion calculations for local air pollution in Prachatice can not be performed. The exposure estimates for Prachatice will thus be based mainly on the results from the monitoring stations in the area.

3.6 Measurements of indoor air quality

Since people spend at least 80% of their time indoors, indoor air quality is an important parameter to account for when estimating individual exposure to air pollution. Since air quality indoors can vary from country to country and area to area due to differences in climate, customs, building practices etc., information must be collected that will allow estimating air quality indoors based on a predetermined set of characteristiscs.

A program has been initiated to measure indoor air quality. The possible further need for indoor/outdoor measurements will be evaluated, on the basis of what is already being done in Teplice this winter (1993).

3.7 Estimating individual exposure

In this study a series of exposure estimates will be devised. The exposure estimates will be designed to aid in interpreting the health effects of different compounds in the different studies of the Teplice Program. In Table 1 we have listed probable and possible exposure estimates needed for each of the health studies. As part of this exposure assessment project, each research group doing health studies will be asked which exposure estimates (compounds/averaging time) they consider of importance to their health study.

Based on this, a program will be devised for providing data on the location of individuals as a function of time (through diaries or other methods), specific for each of the health studies.

Table 1: Assumed needs for air pollution exposure estimates in the health studies of the Teplice Program.

Health investigation	Investigator	Compounds of interest	Averaging time*	Comments**
Nutrition	Sevcik	Heavy metals, PCBs, chlorinated insecticides, PAHs, NO3		
Pregnant women	Vitnerova	heavy metals, *PCBs, PAHs*		
Mutagenicity	Watts et al,	PAHs & other organic mutagens	Weekly, Seasonally	This study is an air pollution exposure estimating study being done by the EPA
Biomarkers of exposure	Lewtas et al.	PAHs		These studies use external personal exposure monitoring for air-borne particles
Autopsy tissue bank	Lewtas et al.			
Toxic metals in biological materials	Subert	Heavy metals		
Mortality	Kotesovec	SO2,PM10/PM2.5, CO, NO2 and O3	24-hour	
Malignant tumors incidence	Kotesovec et al.			
Pregnancy outcome study	Deimek	SO2,PM10/PM2.5, CO, NO2 and O3		
Human semen quality - military recruits/miners	Darney	PAHs		This study is to be coupled to biomarkers study
Immunology				
Respiratory status	Horstman	SO2,PM10/PM2.5, CO, NO2 and O3	24-hour or less	
Respiratory status II	Vondra			

* Yearly in these studies means the need for a general index of air pollution

** If not specifically indicated in this column, it is assumed a mean value for the averaging time with a standard deviation will be sufficient

Table 1 cont.

Health investigation	Investigator	Compounds of interest	Averaging time*	Comments**
Neurobehavioral performance in children	Otto, Gebhart et al.	Pb, As and Hg	24-hour, weekly and monthly	
Miners	Novakova et al.	SO2,PM10/PM2.5, CO, NO2 and O3	*y*	Special consideration and measurements of the actual mines would be beneficial. Peak or 95% - 99%
Health symptom Monitoring	Clench-Aas et al.	SO2,PM10/PM2.5, CO, NO2 and O3	24-hour or less, weekly, monthly and yearly	Peak or 95% - 99% can be of interest

* Yearly in these studies means the need for a general index of air pollution

** If not specifically indicated in this column, it is assumed a mean value for the averaging time with a standard deviation will be sufficient

4 Project plan, 1993

The following activities are proposed for 1993, together with responsible group.

Activity/population	Time-period	Responsible groups	
		Norway	Czech Republic
1. Emission inventory, completion	Feb-Aug		Teplice group
2. Establishment of needs for exposure estimates. Questionnaire to health groups	June-Aug	NILU	
3 Establishment of program for location data of individuals (diaries)	June-Aug	NILU	
4. Evaluation of the monitoring network for air pollution and meteorology (this is a part of Project 1)	Sep-Nov	NILU	
5. Establishment of dispersion/wind field models. Completion	June-Sep	NILU	Modelling group (Brechler)
6. Exposure model development	Sep-Nov	NILU	
7. Establishment of data base for emissions population meteorological data wind field calculation air pollution data diary data for individuals	June-Oct		Teplice group
8. Detailed exposure calculation schedule	Sep-Oct	NILU	Program directors, Brechler
9 Calculation of exposure estimates	Oct-Dec	NILU	(Modelling group)

The time schecule is dependent upon funding for the NILU activities being cleared in May/June 1993.

Short description of activities:

1. Completion of emission inventory (point sources, domestic sources, traffic) is to be completed by the Teplice Group (responsible Dr. F. Kotešovec), according to description on pages 54-55.

2. Information is to be acquired from each of the health studies, through questionnaires, regarding the need in each health study for exposure estimates:
   - compounds
   - time average
   - time period
   - nature of estimate (concentrations at home address, at work, actual exposure, etc.).

3. A program needs to be established regarding the acquisition of the necessary individual's location data, based on pt. 2 above.

4. Se project 1.

5. Completition of dispersion and wind field models actually to be used for the exposure estimates in Teplice. Team work between NILU and Brechler's group.

6. Development of model to calculate individual's air pollution exposure based on
   - calculated concentration fields
   - location data.

7. A data base has to be established/completed which contains the data necessary to do the exposure calculations for the periods in question.

8./9. Planning and execution if the exposure estimate calculations.

In this project, it is proposed that substantial work is done by our Czech partners. It is necessary that working groups are established in Teplice in the following work fields, and responsible contact persons appointed:

- monitoring data, air pollution and meteorology
- emission and population data
- data base establishment
- dispersion/wind field modelling (contact person already established (Dr. Jozef Brechler)). Co-workers should be identified.

During a meeting in Praha in February 1993 it was made clear that the within the modelling group in Praha/Teplice, there is not enough manhour and computer capacity to do the actual dispersion and exposure calculations. These will thus have to be done at NILU. However, the modelling group retains co-responsibility for establishing the wind field model for Teplice, and also the responsibility for establishing the data base of emission population, meteorology and pollution concentration data.

5 Cost estimate

	NILU		Teplice
	Man-weeks	(NOK)	
1. Emission/population inventory Completion	~3 weeks 1 travel	75 000,-	~8 weeks
2. Needs for exposure estimates	~2 weeks	50 000,-	
3. Establishment of program for location data	~1 week	25 000,-	
4. Monitoring system evaluation (in Project 1)		0,-	
5. Dispersion/wind field models Completion	~6 week 2x2 travels to Teplice/Praha	165 000,-	~8 weeks
6. Exposure model development	~4 weeks	95 000,-	
7. Data base establishment	~2 weeks	50 000,-	~8 weeks
8. Exposure calculating schedule	~1 week	25 000,-	
9. Calculation of exposure estimates	~4 weeks	100 000,-	
10. Equipment/Computer costs		30 000,-	
		615 000,-	

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PROJECT PROPOSAL

Date : 14. January 1993
Ref. : JCA/EMN/O-92066
Author : Jocelyne Clench-Aas
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NILU contribution to the Teplice Health Program, 1993

Project 3: Health Symptom Monitoring

SUMMARY

Teplice district is an area in Northern Bohemia that is heavily polluted by SO_2, NO_x, and suspended particles. A series of investigations has been initiated in the area to study the current air pollution situation and its impact on the health of the population with the aim of following the population over 10 years and trying to measure the changes. Prachatice in Southern Bohemia has been selected as a control area.

Health monitoring is an investigation method that describes and characterizes symptoms of reduced health in a manner that can be related to environmental perturbations. Health monitoring consists of health investigations that attempt to elucidate the relationship between air pollution concentrations and health status.The definition of health used is that of WHO, "a state of full physical, psychological and social well being and not simply as an absence of disease or deformity" (WHO, 1985).

We are proposing Health Symptom Monitoring investigations, involving randomly selected populations, to supplement the Teplice Program studies that investigate objective health effects in specialized populations. Personal exposure, assessed based on the results of air quality monitoring and dispersion modelling, will be related to health symptoms.

The proposed Health Symptom Monitoring involves a cross-sectional and several cohort investigations. The cross-sectional investigation will enable quantifying the effect of air pollution on health, relative to socio-demographic and other factors. The cohort studies are aimed at constructing dose-response relationships between exposure and health symptoms. The suggested Health Symptom Monitoring builds upon similar studies performed in Norway.

Information will be obtained from both adults and children. Traditionally most international studies have focused on populations having asthma. These populations are defined as sensitive. However, because of both behavior and use of medication, these groups may no longer be sensitive. It is therefore also desirable with information from random populations.

The proposal includes three types of investigations:

- A cross-sectional study of a random sample of 3000 participants from Teplice city and 1000 from Prachatice.
- A cohort study of adult non-smoking women (50 to 75 in each group), selected from the above cross-sectional study, concentrating on symptom reporting and respiratory health.
- A cohort study of a subgroup of school children already participating in the Teplice program, concentrating on symptom reporting and respiratory health (75 exposed and 75 unexposed).

The study on school children will be coordinated with a similar investigation that is due to begin in at least 9 countries in the European Community. The investigation methods will be standardize with those used in other European countries so that results are comparable.

These studies are designed based on results and experience obtained by a cross-sectional study done in Vålerenga in Oslo and cohort investigations done in Vålerenga and Grenland in Telemark in Norway.

The aim of the cross-sectional study is to document the degree to which air pollution exposure is associated with an increased prevalence of chronic diseases, reduced well being or increased reporting of symptoms of disease.

The cohort studies should supplement already existing knowledge of the effects of pollution gathered in Norway on the short-term reporting of symptoms of adverse health by providing information for population sub groups exposed to high concentrations of pollution.

All study types should provide the basis for a health monitoring program that can if desired be repeated at a later date to measure changes in health status of the population over a longer period.

A cross-sectional survey study examines large numbers of individuals. It is an excellent tool to use when attempting to evaluate the health status of a particular geographic region. This study design assesses the relative impact of air pollution as opposed to other factors such as educational level, smoking etc. The study is relatively easy to do and by involving so many individuals, the results are credible. In the proposed cross-sectional study, 4000 inhabitants will answer a questionnaire (3000 in Teplice and 1000 in Prachatice) on their health, and location of home/workplace. The intent is to measure the prevalence of several chronic diseases, symptoms and attitudes with the intention of describing their distribution as a function of air pollution exposure.

Although a cross-sectional study may indicate the possibility of a contribution by air pollution to decreased health status of a population, it rarely allows isolating the compound responsible, or determining at what level a compound is most likely to be causing an effect. These questions are more satisfactorily handled using the cohort design.

The cohort design allows correlating short-term reversible changes in health status with corresponding changes in air pollution exposure. The aim is to study the temporal covariation of the health responses against a measure of exposure. In this investigation type, each individual is the unit of research. This reduces problems of confounding factors and allows each individual to be his/her own control. The collection of repeated data allows comparing health status to current or preceding air exposure.

The cohort studies suggested here study the impact of air pollution on ongoing health, focusing on health problems related to the upper and lower airways. In the one study, daily symptoms will be reported over given periods during the winter and summer by a cohort of adult women. In the other cohort investigation, a group of susceptible children will be chosen based on symptoms of lung disease the previous year. The children will report on medical problems, symptoms of adverse health and possibly take their own peak expiratory flow with a Mini-Wright Peak Flow Meter.

All the suggested studies are designed to associate health to various air pollution exposure indices. It is not felt that it is necessary to take any objective invasive tests, e.g. blood tests. The primary health parameters are the subjective symptoms and health information each participant gives. In the cohort study of susceptible children, peak expiratory flow will be measured with a Mini-Wright peak flow meter twice a day, supplemented by more

extensive weekly lung function testing. Skin tests for atopy determination will be done on each selected child.

The studies will be performed during 1994.

The Czech program staff (under the leadership of Drs. R. Sram and F. Kotesovec) will be responsible for medical aspects, and data collection, whereas NILU will be responsible for data processing and evaluation, inclusive exposure assessment. The exposure assessment depends upon the availability of sufficient, concurrent data on emissions, air quality and meteorological parameters.

All data collected and processed at NILU will be made available in a suitable form to be included in the Teplice program data base.

For NILU the investigators will be: Jocelyne Clench-Aas, Ph.D (Principal investigator for health studies), Steinar Larssen (Principal Investigator for air pollution exposure estimating), and RNDr Alena Bartonova, (Principal Investigator for statistical analysis).

The cohort study of susceptible children will be coordinated with a joint project with other countries in the EC that will be coordinated by Dr. Bert Brunekreef of the Dept. of Epidemiology and Public Health, University of Wageningen, NL.

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Research Proposal for Health Symptom Monitoring

Jocelyne Clench-Aas
Alena Bartonova

1. INTRODUCTION

Teplice district (see Figure 1) is an area in Northern Bohemia that is heavily polluted by SO2, NOx, suspended particles and oxidants. A series of investigations over a 10 year period was initiated in the area to study the current air pollution situation and its impact on the health of the population with the aim of following the population over 10 years and trying to measure the changes. Prachatice in Southern Bohemia has been selected as a control area.

Health monitoring is an investigation method that describes and characterizes symptoms of reduced health in a manner that can be related to environmental perturbations. Health monitoring consists of health investigations that attempt to elucidate the relationship between air pollution concentrations and health status where the definition of health used is that of WHO, "a state of full physical, psychological and social well being and not simply as an absence of disease or deformity" (WHO, 1985).

Health monitoring can be approached on two levels. One concentrates on describing on a population basis the long-term effects of air pollution, for example, immunological and birth defects. The second focuses on short-term or acute effects of pollution by registering changes in symptoms of adverse health or well being over time.

These two types of investigations use two different study designs. In the first cross-sectional design, one examines the long-term effects of air pollution (prevalence of certain airway diseases and symptoms, prevalence of other chronic diseases) on a population while controlling for confounding factors. Using refined measures of air pollution exposure one can then compare quantitatively the effects of pollution as compared to other confounding factors such as smoking on health. In the second design, the cohort investigation, one continually follows a group of individuals over a certain time interval allowing quantifying the risk of developing a set of symptoms of reduced health for a range of air pollution exposures.

In all air pollution related studies, it is important to define exposure. Air pollution exposure is the concentration of air pollution that each individual is in reality exposed to. Exposure reflects amount of time spent outdoors or indoors in addition to air quality indoors and outdoors. Indoor air quality is a function of indoor air pollution sources, building structure and ventilation. Exposure estimating can reflect estimates of actual air pollution concentrations for example hour for hour, or can also reflect typical high pollution situations, averages over longer time periods, peak values etc. Refining the estimate of exposure by calculating an individual estimate, allows ranking all the participants in a geographically delimited area by air pollution exposure. One of the advantages of cohort investigations is that if pollutants vary somewhat independently of each other, it is possi-

Figure 1: Location of the study investigation sites in the Czech Republic, Teplice (exposed) and Prachatice (control).

ble to distinguish the effects of different compounds. This is nearly impossible in the cross-sectional design.

2. THE AIM OF THE INVESTIGATION

The aim of the cross-sectional study is to document the degree to which air pollution exposure is associated with an increased prevalence in adults and children of chronic diseases, symptoms of reduced well being or increased reporting of symptoms of disease. The study should, for example be able to answer whether those individuals exposed to air pollution concentrations over a certain level have increased risk for asthma or chronic bronchitis or other chronic diseases.

The cohort study will be able to distinguish whether short term exposure to higher concentrations of air pollution leads to increased short-term reporting of symptoms in both adults and children with initial signs of lung disease (called "susceptible").

Both study types should provide the basis for a health monitoring program that can if desired be repeated at a later date to measure changes in health status of the population.

Since parts of this study are coordinated with a similar series of investigations in the European Community, the investigation methods will be standardize with those used in other European countries so that results can be compared. In addition, the proposed methodology builds upon similar investigations in Norway, so that the Norwegian data may serve as a comparison.

3. GENERAL DESCRIPTION OF INVESTIGATIONS

We are suggesting three types of investigations:

- Cross-sectional study of the health status of a sub-set of inhabitants of Teplice and the control area Prachatice during a certain time period in the winter and summer.

- Cohort study of a group of non-smoking adult women randomly selected from the above cross-sectional study for continuous reporting of symptoms of adverse health and well being.

- Cohort studies of subsets of young school children for symptom reporting during a school year.

The impact of air pollution on health can vary between its influence on the initiation of a disease, and the progression of the disease. In the suggested cross-sectional study, the intent is to measure the prevalence of attitudes, symptoms and of several chronic diseases, with the intention of expressing the prevalence as a function of air pollution. Cross-sectional studies are relatively easy to do. Since they involve many individuals, the results are usually credible. However, it is often difficult to isolate the effect of an environmental factor because of the simultaneous occurrences of confounding variables.

To provide for this, cohort studies are planned that have the advantage that problems of confounding factors are reduced. The cohort studies are designed to study the impact of air pollution on the ongoing health of the inhabitants, focussing on health problems such as those related to the upper and lower airways. Daily symptoms will be reported over given periods during the winter and summer by a cohort of adult women who have participated in the cross-sectional study. In the second cohort investigation, a group of susceptible children will be chosen based on symptoms the previous year and will report on medical problems, symptoms of adverse health, and take their own peak expiratory flow with a Mini-Wright Peak Flow Meter.

Cohort investigations impose a burden of reporting on each individual. Close cooperation is necessary between the participants and the investigation team doing the study.

All studies are designed such that health can be associated to various air pollution exposure indices. It is not felt that it is necessary to take invasive tests. The primary health parameters are the subjective symptoms and health information each participant gives. In the cohort study of susceptible children, it will be necessary to measure peak expiratory

flow with a Mini-Wright Peak Flow Mete twice a day. A standard health investigation (inclusive of a skin test for atopy detection) and complete lung function will be performed.

Air pollution exposure for each individual, will be estimated using results of extensive dispersion modelling in the area. Estimates of outdoor concentrations of air pollutants will be based on a combination of source oriented and receptor oriented models combining existing data on emission distribution with hour to hour data on wind, dispersion conditions and hourly concentration values at a number of study sites. Inconsistencies in the data on an hourly basis will be quantified, and this information may be used to specify uncertainties in the outdoor estimates. Measurements will be taken continually at several stations by stationary and mobile units. This measurement information, together with continuous information on meteorological parameters is the basis of the modelling. Modelling of air quality in the area will be done on an hourly basis for the time periods and geographic places of interest as a part of an ongoing monitoring program. The information will be used to create different indices of exposure to air pollution as for example, peak daily values, mean and/or median, the 75th, 90th and/or 98th percentile for use in the cross-sectional study. For the cohort study, continuous information on for example an hourly basis will be necessary for each geographic area of interest. For a graphical presentation of the study design see Figure 2. The exposure estimating will also utilize other sources of information, e.g. the planned indoor/outdoor measurement program.

A peer review board that reviewed project proposals connected to the Teplice Program recommended integrating panel studies of the effects of air pollution on respiratory health in adults and children. The contact between the various projects has been established and ways of integrating the project are currently being discussed

4. PROJECT ORGANIZATION

The project will be organized such that the Norwegian Institute for Air Research (NILU) will be responsible for quantifying air pollution exposure, data handling and analysis. NILU will also serve as the principal coordinator of the investigations. The Teplice Program coordinators will appoint personnel responsible for the practical aspects of the study on site.

For NILU the investigators will be: Jocelyne Clench-Aas, Ph.D (Principal investigator for health studies), Steinar Larssen (Principal Investigator for air pollution exposure estimating), Knut Grønskei (Principal Investigator for the dispersion modelling), and RNDr Alena Bartonova, (Principal Investigator for statistical analysis). In the Czech Republic, Dr. F. Kotesovec will be the central administrator of the study.

5. DETAILED DESCRIPTION OF HEALTH INVESTIGATIONS

As indicated (Figure 2) the investigations will comprise a set of health investigations tied to an extensive air pollution exposure estimating system. This study proposal has been discussed by both parties resulting in a joint intention agreement (see Appendix 1).

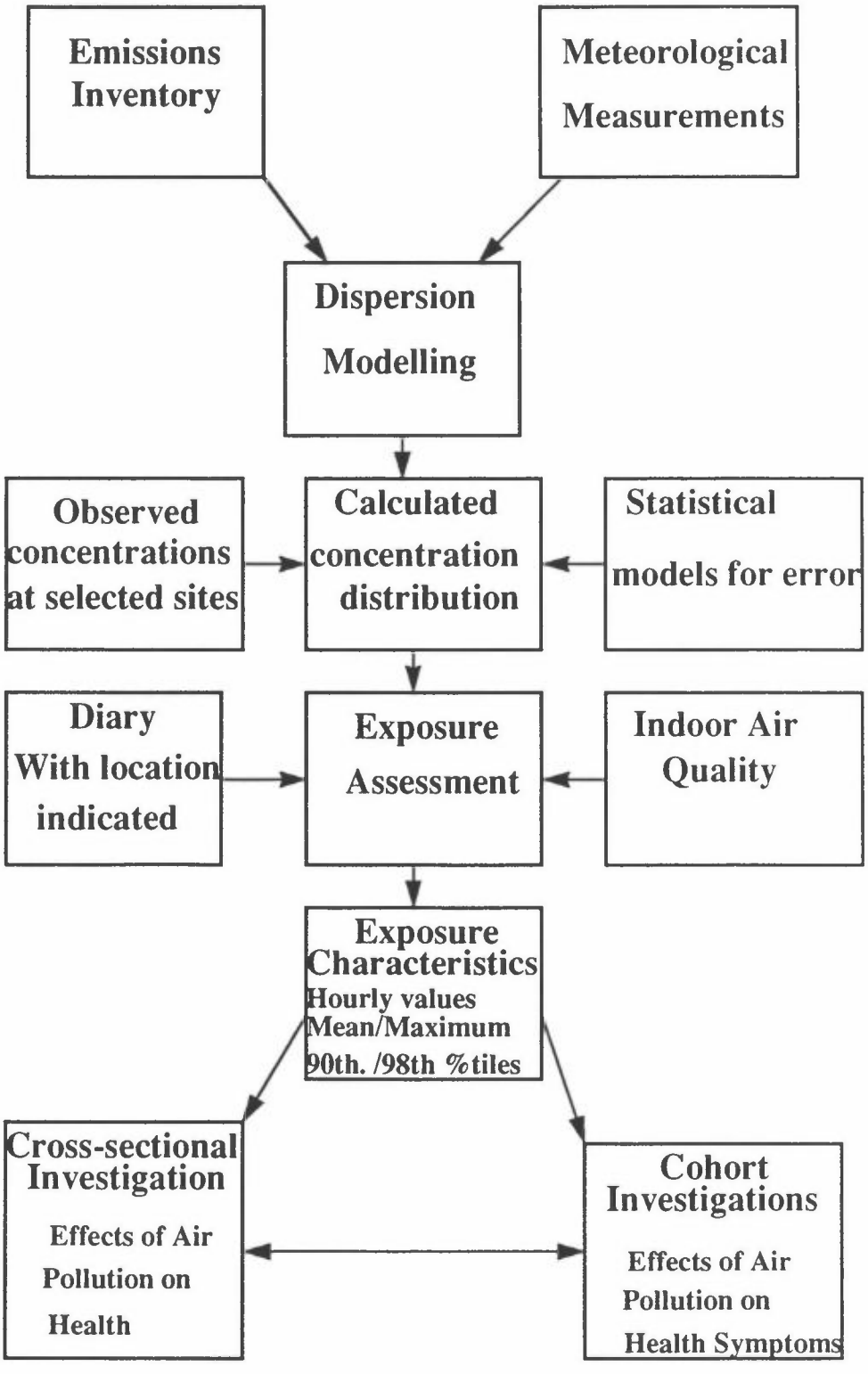

Figure 2: Organization of the investigations

5.1. Air pollution exposure estimation

A program for air pollution exposure estimation is quite extensive. It consists of four parts:

1. a program for air quality measurement,
2. a program for air quality modelling on an hour by hour basis,
3. an estimate of exposure,
4. a control of some of the exposure estimates using portable measuring equipment.

In this study a series of exposure estimates will be devised. Some of the compounds of interest are: SO_2, NO_x, O_3, $PM_{2.5}/PM_{10}$, NO_3 and SO_4.

The basis for an exposure estimate must be data with high temporal resolution, for example hourly. The estimate must account for geographic location of the home relative to local sources such as roads and point sources, as well as indoor air quality. It may be possible to account for time spent at home as opposed to work or school. This information will be collected by questionnaires.

This work relies extensively on geographical coding of addresses and other relevant information. This will be done in a manner agreed upon with the Teplice Program Coordination (TPC).

Using an hourly estimate of air quality as a basis (both outdoors and indoors), one can calculate percentiles of exposure, means or medians, maximum etc. Since it is conceivable that different diseases and symptoms are affected differently, some may be more sensitive to peak concentrations, others to longer means, different versions of the estimate will be used.

5.2. Detailed description of cross-sectional study

5.2.1 Study design

The investigation is aimed at studying the relationship between the prevalence of chronic diseases and exposure to air pollution. In addition, the prevalence of a set of adverse health symptoms will be investigated.

Such an investigation involves a questionnaire having four sections (seeAppendix 3). First will be a set of questions connected to the physical setting of the home both indoors and outdoors (f. ex. facing a road, new windows, etc.). Second will be a section covering socio-demographic questions. This section is needed in attempting to control for confounding factors. The third and fourth sections will include questions on the presence of chronic disease and symptoms of adverse health effects. The content of health questions will be partially based on former studies in Norway (Clench-Aas, et al., 1991, Hjorthol et al., 1990) and will include questions from the EF respiratory survey. The questionnaire will be thoroughly discussed with the TPC. In addition the study can help answer questions important in the investigation area such as questions concerning attitude or specific health effects. Efforts will be made to assure that the acquired information can be compared to that collected elsewhere and is reliable.

The study has two phases. A first phase in the winter of 1993/1994, with a full questionnaire, and a follow-up phase in the Spring/Summer where those questions involving symptoms will be repeated to see if there is any differences between winter and summer.

This questionnaire investigation can be repeated for example every three years.The collected information compared over time, may give a basis for evaluating changes in health status.

5.2.2 Field study

A random group of adults will be chosen from the respective areas and interviewed by qualified interviewers. Where the interviews will be held (for example, at home or at a central office) will be decided later by the project team. The following Spring/Summer (1994), those individuals responding in the first round will answer a much shorter questionnaire involving symptoms.

In the field, the study will be organized such that NILU will be responsible for the design of the questionnaire. However, an early draft will be sent to the Teplice project team and to other relevant authorities in both towns for comments. It will be possible to add questions in the questionnaire of interest to any of these parties. The Teplice project team will then be responsible for selecting the random sample of individuals that are to be interviewed, printing the questionnaire, doing the interviews and data entry. NILU will then be responsible for data handling and control.

The same process will be repeated in the spring with NILU responsible for designing the mini-questionnaires, whereas the local project management will be responsible for the administration of the mini-questionnaire to those individuals participating in the first phase and data entry.

After the data has been double punched and controlled, a copy of the data will be sent by the Teplice project team to NILU in a format they can use.

5.2.3 Choice of study participants

The 4000 people will be chosen at random, with 3000 coming from Teplice and 1000 from Prachatice.

It is necessary that the participants be chosen as a stratified random sample. The Teplice project team will be responsible for picking this sample from defined geographic units for the town and district of Teplice. The person responding to the questionnaire must be the person who was randomly selected. In addition, the person will answer health symptom questions for the child in the family nearest the age of 10.

Even though it sounds difficult to have so many people answer such a form, studies performed in Norway showed a response rate in the Bergen studies of symptoms of lung function of 70 to 90%. It is possible that the response rate will be even higher in a polluted area where people are concerned about their own and their families' health.

5.2.4 Choice of study period

It is desirable that the health symptom section of the study be repeated both winter and summer. The results of the Grenland study (NILU/NIPH, 1991) suggested that air pollution was more closely associated to health symptoms in the summer than in the winter. The winter study should be done in the months November to December to allow time to recruit individuals for the cohort study (see 5.3.1) and the summer season as close to July as possible (May - June).

5.2.5 Ethical considerations

All efforts will be made to keep the information anonymous. Participants will be identified with an I.D. number, the identity of which only the Teplice project team will know. All data will be stored in data directories that only a limited number of people will have access to. All reporting will be done without revealing either address or I.D. code.

5.2.6 Reporting and Publishing of the results

At the end of the study a joint NILU/TPC report will be written covering all major findings. In addition, the principal results will be sent to journals for publication and peer review. The findings will also be presented in appropriate seminars and conferences and made available to local and other authorities in a suitable form.

5.3. Detailed description of the cohort study of adult women

A cohort investigation will be conducted on a group of adult women based on participation in the cross-sectional investigation.

It is desirable to attempt to isolate the compounds in polluted air that are most responsible for adverse health effects. Health effects will be assessed by monitoring the occurrence of a set of symptoms of adverse health. By examining a cohort or panel of participants daily (requesting e.g. hourly information) one can associate health effects with those compounds that are high at that time. Since each person's health status at one hour (or other time interval) is compared with the same person's health status another time interval, he serves as his own control, diminishing problems of confounding factors.

The information thus acquired can be used for validating and interpreting results from the preceding cross-sectional investigation. In addition, the results of this study can be compared to those found in a similar population in other studies done in Norway.

5.3.1 Study design

Symptom reporting of the cohort of volunteers will be related to personal air pollution exposure based on where the participant is for each time point, for example at home or at work.

We are considering a study where panels of 50 to 75 adult nonsmoking women, one from Teplice town and the same from Prachatice will fill in a questionnaire over a 6 week period in the winter and a 6 week period in the summer.

The participants will fill out their diaries once a day. The diaries will provide information (e.g. hourly) on both each participants whereabouts and her reporting of symptoms of adverse health and are similar to the ones used in Grenland (NILU/NIPH, 1991) and Vålerenga (Clench-Aas et al., 1991).

Two studies have now been completed in Norway using similar methodology in men and women of all ages, one in an area of dense traffic and one in a region with much industry. We feel that a similar study in the Czech Republic performed by the same research team and using the same methods will allow a valuable chance to compare reporting of symptoms of health effects in a subgroup of the population, under totally different pollution situations. The investigation method can also be repeated in the same area for example every 3 years. Repeating the study will allow establishing if there is a change in the compounds that are most responsible for symptom reporting as the pollution composition alters and changes in frequency and duration of symptoms as pollution concentrations decreases.

5.3.2 Field study

NILU will be coordinator for the project. The local medical or other authorities will be responsible for the medical aspects. The Teplice project team will be responsible for the local coordination of the field study.

The Teplice project team will deliver the questionnaires to the participants with the help of NILU personnel. The study staff will be instructed by NILU as to how the questionnaires should be filled out. Manuals will be written to help both staff and participants.

After completion, information from the questionnaires will be double punched and the data sent to NILU where they will be analyzed using the data handling and analysis methods developed in the previous Norwegian studies.

An agreed upon data base will be transferred to the TPC main data base.

5.3.3 Choice of study participants

Panels chosen for investigation (one from Teplice and one from Prachatice), are adult non-smoking women (50 to 75 in each group), chosen from the random population answering the questions in the cross-sectional study.

5.3.4 Choice of study period

As mentioned in 5.2.4, it is desirable for both a winter and a summer season. Since some of the participants are chosen from the cross-sectional study it is necessary that the winter season begin in January to March, since the cross-sectional study will be done in November and December.

5.3.5 Ethical considerations

See 5.2.5 for further description of these considerations. It will not, however, be possible to dissociate the I.D. number from the address as is proposed in the cross-sectional study.

5.3.6 Reporting and publishing of the results

See 5.2.6.

5.4. Cohort study of susceptible school children

This investigation, is designed to study if increased concentrations of air pollutants cause increased problems of the airways in sensitive children. This study is integrated in a study being done by countries in the European Community (EC). The EC study proposes to investigate two groups each of 75 susceptible children (exposed and unexposed) in 9 countries. The common proposal for the EC study can be found in Appendix 2

Children with airway disease will be selected from schools in Teplice and Prachatice. Around 150 children with airway disease will respond for two winter months to a daily questionnaire. They will provide information on symptoms and need for medication. They will be provided with Mini-Wright Peak Flow Meters for the measurement at home and at school (2 times a day) of their peak expiratory flow.

5.4.1 Study design

The study will be designed so as to follow the symptoms of a group of children with similar health status. Symptoms reported by the children will be related to air pollution exposure at home and at school.

The administration of questionnaires (common to all countries) will be coordinated by the schools. The students will fill out their diaries once a day at home for 8 weeks, in winter. The diaries will provide information on both each students whereabouts and his/her reporting of symptoms of adverse health and are similar to the one used in Grenland (NILU/NIPH, 1991) and Vålerenga (Clench-Aas et al., 1991). The information will be collected for time periods during the day rather than on an hourly basis however.

The participating schools will be chosen based on a combination of number of students, exposure to pollution (inclusive the choice of control schools) and willingness to participate.

The Czech project leader will be Dr. Kotesovec, and the Norwegian project leader will be Dr. Jocelyne Clench-Aas.

The information from the questionnaires will be partially entered into a database in the Czech Republic and sent to NILU to be analyzed. Some of the questionnaires will be read using optical reading methods in Norway. The background data will be compressed in an agreed upon manner and a copy will be provided to the TPC main data base.

5.4.2 Choice of study participants

The parents of all children from 1st to 6th grades in the chosen schools will be asked to fill out a screening questionnaire. Those children that are then found to have experienced chronic respiratory symptoms in the year preceding the study will then be asked to participate in the cohort investigation. The desired sample size is 150 children evenly divided as exposed and unexposed to air pollution.

The screening questionnaire will be similar to the one used by all the participating countries in the European Community proposal.

5.4.3 Choice of schools

The schools will be chosen based on air pollution exposure. The school authorities will be then contacted and only those schools willing to participate will be kept in the study.

5.4.4 Choice of health parameters

Symptoms of adverse health will be monitored using questionnaires (Appendix 3). In addition each individual will measure his peak expiratory flow using a Mini-Wright Peak Flow Meter two times a day. If possible, the health of each child chosen and willing to participate in the cohort study will be characterized also using full lung function with spirometry, and by determination of atopy by skin test and possibly by determination of specific IgE.

The diary will also be used to collect information on medication use, respiratory infections and other relevant information on health status during the study.

5.4.5 Exposure estimating

This investigation should include the continuous measurements of NO_2, SO_2 and PM_{10}.

In addition as described in section 5.1., a complete set of meteorological variables will be collected on an hourly basis during the investigation period.

5.4.6 Choice of study period

This study will be performed in the winter 1993/1994. It is necessary to time this investigation together with the other countries in the EC study who will be in the field during the winter 1993/1994.

5.4.7 Ethical considerations

See 5.2.5. It will not, however, be possible to dissociate the I.D. number from the address as is proposed in the cross-sectional study.

A study of this nature requires approval from a series of responsible institutions: the local medical personnel, the Director of Schools, the school rectors, the teachers involved and the parents. Information will be disseminated in meetings with the involved parties.

5.4.8 Reporting and publishing of the results

See 5.2.6.

6. TIMETABLE OF INVESTIGATION

Each study has four phases, the planning phase, the field study, the analysis phase and the reporting phase. The study is planned to be started winter 1994 with a pilot study in the winter 1993.

7. COST ESTIMATE OF INVESTIGATION

Cost estimates are calculated here for all three health investigations. It is assumed that the air pollution monitoring, and the dispersion modelling are financed elsewhere. It is assumed that the investigation will cover the period 1993 to 1995.

7.1. Cross-sectional epidemiological study

Costs for Norwegian staff and equipment

Project Administration	NOK	60 000
Choice of subjects	NOK	10 000
Training the field staff	NOK	85 000
Field coordination	NOK	85 000
Final development of the questionnaire	NOK	35 000
Development of the data base from the questionnaire	NOK	70 000
Calculation of exposure index	NOK	40 000
Data transfer to the central Teplice database	NOK	10 000
Data analysis	NOK	120 000
Computer costs	NOK	25 000
Report writing	NOK	90 000
Travel	NOK	90 000
SUM	**NOK**	**720 000**

Costs for Czech staff and equipment

Project Administration	NOK	50 000
Questionnaire	NOK	50 000
Subject selection and recruitment	NOK	50 000
Field study	NOK	150 000
SUM	**NOK**	**300 000**
TOTAL SUM FOR STUDY	**NOK**	**1 020 000**

7.2. Cohort study of adult women

Costs for Norwegian staff and equipment

Project Administration	NOK	60 000
Choice of subjects	NOK	15 000
Training the field staff	NOK	85 000
Field coordination	NOK	85 000

Development of the questionnaire	NOK	45 000
Development of the data base from the questionnaire	NOK	70 000
Calculation of hourly exposure index	NOK	110 000
Data transfer to the central Teplice database	NOK	10 000
Data analysis	NOK	170 000
Computer costs	NOK	40 000
Report writing	NOK	90 000
Travel	NOK	90 000
SUM	**NOK**	**870 000**

Costs for Czech staff and equipment

Project Administration	NOK	40 000
Questionnaire	NOK	10 000
Field study	NOK	100 000
SUM	**NOK**	**150 000**
TOTAL SUM FOR STUDY	**NOK**	**1 020 000**

7.3. Cohort study of susceptible children

Costs for Norwegian staff and equipment

Project Administration	NOK	30 000
Planning of the study	NOK	45 000
Training the field staff	NOK	85 000
Field coordination	NOK	85 000
Questionnaires (development, printing and scanning costs)	NOK	80 000
Development of the data base from the questionnaire	NOK	80 000
Calculation of hourly exposure index	NOK	110 000
Data transfer to the central Teplice database	NOK	10 000
Data analysis	NOK	120 000
Computer costs	NOK	30 000
Report writing	NOK	90 000
Travel	NOK	90 000
SUM	**NOK**	**855 000**

Costs for Czech staff and equipment

Project Administration	NOK	30 000
Questionnaire	NOK	40 000
Purchase of PEF meters	NOK	30 000
Subject selection and recruitment	NOK	30 000
Field study	NOK	110 000
SUM	**NOK**	**250 000**
TOTAL SUM FOR STUDY	**NOK**	**1 105 000**

TOTAL SUM FOR 3 INVESTIGATIONS	**NOK**	**3 145 000**

This can be separated into the following amounts for each year:

Table 1: Separation of the budget into yearly amounts (in NOK) for each of the health projects

Project	1993	1994	1995	Total
Cross-sectional study Norwegian costs	225 000	370 000	125 000	720 000
Cross-sectional study - Czech costs	200 000	100 000		300 000
Cohort study random women - Norwegian costs	240 000	505 000	125 000	870 000
Cohort study random women - Czech costs	80 000	70 000		150 000
Cohort study susceptible children - Norwegian costs	315 000	540 000		855 000
Cohort study susceptible children - Czech costs	115 000	135 000		250 000
Total	1 175 000	1720 000	250 000	3 145 000

8. REFERENCES

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APPENDIX 1

JOINT CZECH/NORWEGIAN AGREEMENT

PRELIMINARY AGREEMENT BETWEEN THE REPRESENTATIVES OF THE TEPLICE PROGRAM AND NILU

The conclusions of a meeting in Norway between the Czech representatives of the Teplice program, Project Director, MUDr F. Kotesovec, and Project Coordinator, Doc. MUDr R. Jelinek, D.Sc.and representatives from the Norwegian Institute for Air Research (NILU), Mr. S. Larssen, Dr. J. Clench-Aas, Dr. A. Bartonova, on the September 7 -8, 1992 were as follows:

The two groups agreed to jointly propose to perform three investigations of relationship between air pollution and health, within the Teplice program:

- A cross-sectional study of a random sample of 3000 participants from Teplice city and 1000 from Prachatice.
- A cohort study of adults, concentrating on symptom reporting and respiratory health with detailed exposure assessment, using one, possibly two of the following groups already participating in the Teplice program:
    - Miners from Teplice and forest workers from Prachatice (50 to 75 from each location)
    - Pregnant women (primiparous), both those having a pregnancy covering the winter months and those having a pregnancy covering the summer months in both Teplice and Prachatice (50 to 75 per group, altogether 4 groups)
    - Military recruits from Teplice and Prachatice (50 to 75 in each group)
- A cohort study of a subgroup of 8 year old children already participating in the Teplice program, concentrating on symptom reporting and respiratory health with detailed exposure assessment (75 exposed and 75 unexposed).

The studies will be performed during 1994 with a pilot project in 1993. This pilot project should partially include currently collected data on daily activity from the groups of military recruits, miners and 8 year old school children. This aspect of the pilot project should incorporate exposure assessment for selected individuals of these groups, dependent on the availability of sufficient data on emissions and meteorology.

The Czech program staff will be responsible for medical aspects, and data collection, whereas NILU will be responsible for data processing and evaluation, inclusive exposure assessment. The exposure assessment depends upon the availability of sufficient, concurrent data on emissions, air quality and meteorological parameters.

All data collected and processed at NILU will be made available in a suitable form to be included in the Teplice program data base.

In order to assure compatibility of the questionnaires used in these studies to those already used in the Teplice program, the Czech party will provide NILU with existing questionnaires within 14 days, together with the results of the sociological survey performed previ-

ously this year. NILU will provide the questionnaires used in the Grenland study, the Vålerenga study and the Mauritius study.

In order to acquire proper information from a control group in Prachatice, it is necessary with equivalent exposure assessment in both Teplice and Prachatice. This requires sufficient data on emissions and meteorology in Prachatice.

The Czech party will provide a finalized framework for the three studies by the end of October. NILU will provide a revised draft proposal by mid-October.

It was agreed that it would be advantageous with a follow-up meeting.

MUDr F. Kotesovec
Project Director

Mr. Steinar Larssen
Head of Local Air Pollution Department

APPENDIX 2

EC COMMON AGREEMENT

ANNEX I

WORK PROGRAMME FOR CEC "ENVIRONMENT" PROJECT PL-910841

"EFFECTS OF SHORT-TERM CHANGES IN URBAN AIR POLLUTION ON THE RESPIRATORY HEALTH OF CHILDREN WITH CHRONIC RESPIRATORY SYMPTOMS"

Prepared by Bert Brunekreef, Ph.D. (Project Coordinator), Department of Epidemiology and Public Health, University of Wageningen, The Netherlands

1. TITLE

The title of the project is: "Effects of short-term changes in urban air pollution on the respiratory health of children with chronic respiratory symptoms".

2. OBJECTIVES

The objectives of the study are:

1. The first objective of the study is to develop and standardize epidemiological methods to document the relationship between short-term changes in exposure to air pollution and short-term changes in the health status of subjects with chronic respiratory symptoms.
2. The second objective of the study is to test the feasibility of these methods in small studies among children living in a number of urban areas spread over Europe, and among children living at some distance away from these urban areas for comparison.
3. The third objective of the study is to collect information on the relationship between exposure to airborne particulate matter and other air pollution components in selected urban areas and changes in health status among selected groups of susceptible individuals.

The expected achievements of the study are:

1. A core protocol will be developed that can be used by investigators throughout Europe to study changes in health status related to short-term changes in air pollution exposure - particularly of, but not necessarily restricted to, exposure to urban air pollution.
2. The feasibility of this core protocol will be established through a number of small scale studies conducted in different urban areas in Europe in close coordination between participating centers.

3. New information about exposure to urban air pollution (especially particulate matter) and related health effects associated with short-term changes in these exposures will be generated, that can be used to support new health based guidelines and standards for air pollution.
4. Cooperation in the field of air pollution epidemiology will be strenghtened in Europe, and the study can be extended to study areas particularly in eastern Europe when funds become available to conduct studies in these areas. The study can also be extended in the second phase of the Environment Programme to include other pollution seasons as well.
5. Baseline data for different EC countries on exposure to urban air pollution in cities with different air pollution profiles will be established. This will lay the foundation for future studies into chronic effects of urban air pollution.
6. The variability of peak expiratory flow, and of symptoms and use of medication will be established in uniformly selected groups of susceptible individuals in urban and rural areas in several different European countries in a standardized way.

Project methodology:

a. The basic design of the study is that panels of selected children will be followed in time over one winter season (1993/1994). Exposure to air pollution and health status will be carefully monitored over the observation period. In each participating country, there will be one panel of children exposed to urban air pollution, and one control panel of children living in an area in which air quality is largely unaffected by emissions from the urban area. In Germany, there will be two exposed, and two control panels. More specifically, children will be studied in and near Kupio, Finland (a relatively small town with a sub-arctic climate), Oslo, Norway (a large town with a nordic climate), Rotterdam or Amsterdam, The Netherlands (large towns with a moderate climate), Berlin, Germany (a town of about 3 million inhabitants with a moderate climate), Bitterfeld, Germany (a town with heavy air pollution of a more 'classical' type in the former GDR), Pisa, Italy (a medium sized town with traffic-dominated pollution in the northern mediterranean region), Birmingham, UK (a large town with mixed industrial and traffic emissions) and Athens, Greece (a town of

about 3.5 million inhabitants in the southern mediterranean region). A large variety of exposure climatic conditions will thus be studied.

b. The population to be studied will be children of (primary) school age, 7-11 years old, who have experienced chronic respiratory symptoms in the year preceding the study. Children in this age usualy do not yet smoke, and are unaffected by occupational exposures. Also, they can often be reached relatively easily in large numbers by working through the school system. The children will be selected from the general population of children with a screening questionnaire. The basis for this questionnaire is formed by the parent-administered WHO questionnaire for assessing respiratory symptoms in children. Reports of persistent cough, and/or attacks of shortness of breath with wheezing in the past 12 months will be used for selection. It can be expected that these symptoms will be reported for 5-10% of the general population of children in this age range.

The target panel size is 75 children; various studies have shown that this group size is large enough to detect group mean changes in lung function of about 1-2%. The necessary population base is therefore about 1,500 children at most. Screening questionnaires will be distributed and collected through schools, which makes the selection phase efficient and cost-effective. In addition, it is easier to obtain a priori estimates of exposure by looking at the location of a limited number of schools than by looking at the home addresses of more than one thousand children.

Each participating centre will select one panel of 75 children from a large urban area close to the centre, and another panel of 75 children from a rural or semi-rural area outside the direct influence of the urban area, but not so far away that it would be differentially affected by long-range transport of air pollution or meteorology. Depending on the circumstances, the control panel will be typically be 15-50 km away from the urban panel.

For further subject characterization, questions will be asked about doctor-diagnosed asthma, bronchitis and pneumonia, about serious respiratory disease in infancy, about allergy, and about the family history of respiratory disease and allergy. Also, determination of atopy by skin test and/or determination of total and specific IgE in serum will be used for additional characterization, in order to

investigate to what extent these characteristics are related to a subject's response to air pollution.

The measurement of the above-mentioned variables form the core of the study protocol. At least some centres will perform objective tests of lung function with spirometry and/or tests of bronchial reactivity for further subject characterization.

c. The period of observation for this study will be the winter season of 1993/1994 (November, December, January, February). In winter, pollutant concentrations in urban air may increase due to higher emissions and/or less dispersion than in the other seasons.

d. Assessment of exposure to air pollution will be achieved by measuring ambient air pollution, by obtaining information on sources of indoor air pollution in the home, and by obtaining information on activity patterns of the children. In addition, indoor exposure to NO_2 will be measured with passive samplers over the period of observation, and indoor exposure to particulate matter will be monitored in the homes of participating children with active samplers in a rotation scheme to make efficient use of equipment. Equipment and analysis will be provided by participating centers in Finland and The Netherlands having experience with these methods, to centers having no access to these methods.

Urban areas will be selected that as a minimum have existing monitoring stations with acceptable quality assurance procedures for SO_2 and NO_2. In addition, each participating center will operate at least one PM10 sampler in the urban area to collect consecutive 24-hour average samples. Equipment for measuring PM10 will, where necessary, be supplied and installed by one of the Dutch participants (Wageningen University) that has over four years of experience with these samplers. To ensure comparability of measurement results, procedures for operating the samplers and on-site instruction for monitoring personnel will be supplied by Wageningen University as well. The absence of major sources of SO_2, NO_2 and PM10 in or near the control area needs to be documented.

Information on sources of indoor air pollution will be obtained by questionnaire. Questions will be asked about exposure to environmental tobacco smoke (ETS), about unvented combustion appliances, about home dampness and about pets in the home. Questions will also be asked about the location of the home with respect to busy roads or other local sources of air pollution.

Rather than trying to obtain detailed time-activity patterns for each study subject for an extended period of time, parents will be asked to register important deviations from the usual patterns caused by illness, atypical weekend activities etc.

These are the minimum requirements for the core protocol of the study. At least some centres will, for additional exposure characterization, perform measurement of SO_2, NO_2 and PM10 in the control area as well. Some centers will use annular denuder systems for measuring atmospheric acidity, and will also measure Black Smoke, as many of the early studies in Europe have used this measure, and as the Black Smoke/PM10 ratio provides some information about the sources of the particles.

e. For health effect assessment, each panel will be followed in time for at least two months in the winter season when stagnant weather conditions, leading to increased air pollution concentrations, occur regularly in most European countries. Each subject will be equipped with a Mini-Wright peak flow meter to assess the development of expiratory peak flow over time. Peak flow will be recorded on three different times of the day, in the morning when getting up, in the afternoon on getting back from school, and in the evening before going to bed. Each subject (and a parent) will be instructed in the use of the PEF meter during a home visit.

In addition, parents will record respiratory symptoms and the use of medication for respiratory conditions of their participating child on each day of the study period. This way, at least 60 days of observations will be collected for each child.

f. Assessment of confounders and effect-modifiers. Standard meteorologic variables such as temperature, humidity and wind direction and speed will be measured in or near each participating urban area. These measures provide information about factors such as temperature, which may affect respiratory function directly and indirectly, and about factors such as wind speed and direction which govern atmospheric dispersion of pollution.

Information about respiratory infections occurring in the weeks before and during the study period will be collected also, as these may affect lung function and the reporting of respiratory symptoms and medication use. This information can be collected from the parents with the diary form.

g. Data will be analysed using proper time series analysis procedures.

Each centre will perform the analysis of its own data, using the same methods of analysis coordinated by the University of Wageningen in The Netherlands; in addition, a combined analysis will be performed by the University of Wageningen and the National Institute of Public Health in the Netherlands. The emphasis will be on analysis of repeated measures over relatively short periods of time (weeks to months). Combined analysis will also take place with respect to: 1) Baseline of exposure data; 2) Level and variability of peak expiratory flow data and diary respiratory symptom data in different study groups.

Milestones:

In a project with one concentrated observation period, and with the limited duration of two years, there can be no evaluation of preliminary results with the expectation that on the basis of this, alterations in design or methodology can still be implemented in the ongoing study. Rather, a thorough round of site visits by personnel of the coordinating centre is foreseen for the late summer and early fall of 1993, i.e., before the actual field work starts, to ensure that the highest level of standardization of methods is achieved before local study teams go out in the field. This follows a preparatory phase in the spring of 1993 in which detailed field and laboratory protocols will be developed and discussed in one or two multi-day workshops organized by the coordinating centre. An important milestone, consequently, will be the finalization of these protocols, no later than October 1, 1993.

Another milestone is reached after the end of the field work in the early spring of 1994. Then, the collected data will be evaluated for completeness and inclusion in the combined data analysis. No later than June 1, 1994 an overview in tabular form will be prepared giving a detailed account of the collected data.

The final milestone will be the study report. This is planned to be ready by January 1, 1995.

3. ROLE OF PARTICIPANTS

The study will be carried out in a total of eight communities exposed to urban air pollution and eight control communities with minimal exposure. For each set of study sites, one or two participating centres are

responsible for essentially doing their own study, according to the common protocol, independently of the other participants. Only in some specific forms of exposure assessment, technical support by the coordinating centre is foreseen and budgetted.

In the Greek contribution to the study, the design, supervision and data analysis will be provided by particpant no 3. The health effect assessment will be provided by participant no 4.

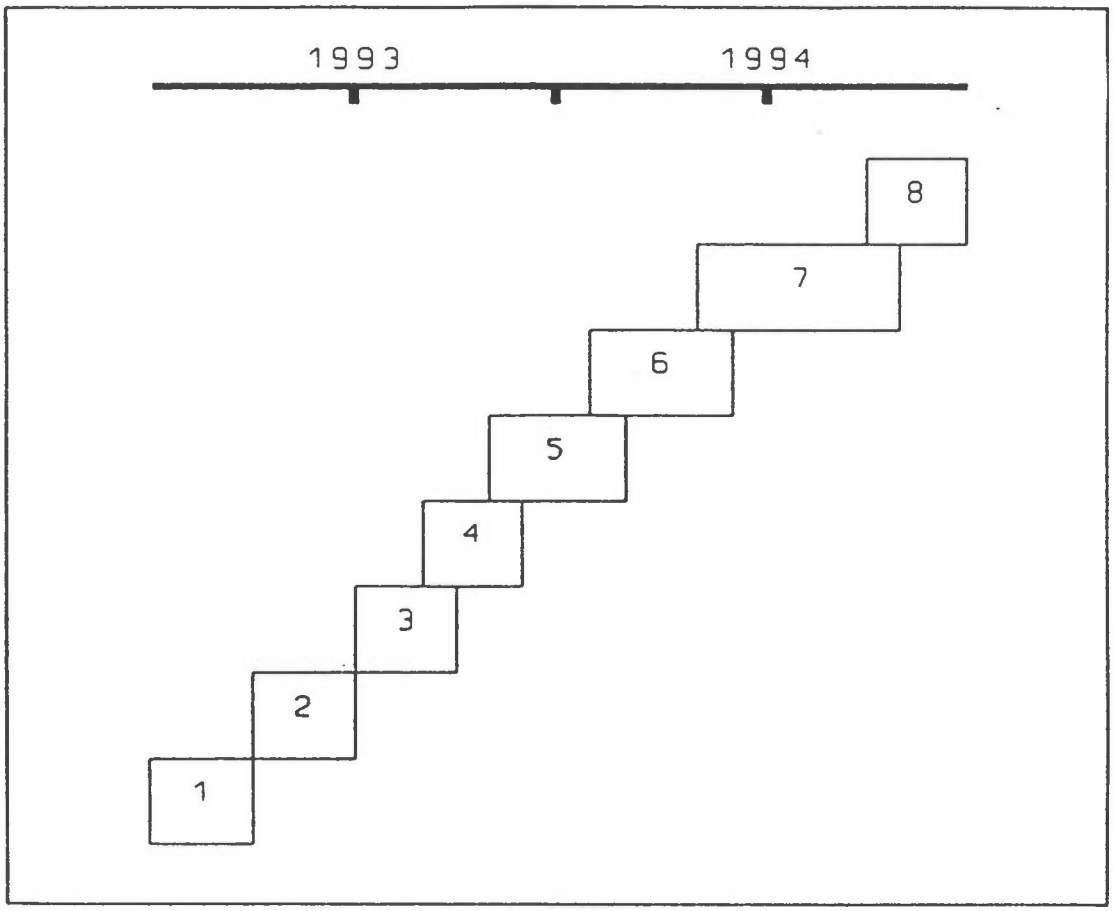
In the UK contribution to the study, Birmingham University (participant no 10) will provide the bulk of the study effort; a small personal monitoring study within the framework of the project will be provided by Warren Springs Laboratory (participant no 11).

The study will be coordinated by participant no 1 (the University of Wageningen in The Netherlands). Coordination will involve the preparation and chairing of the Project Management Team (PMT) meetings as well as other meetings associated with the project; the preparation of detailed laboratory and field protocols for the various parts of the study, to be agreed upon in the PMT; and a joint analysis and reporting of the data collected by the various participating centres. Participant no 7 (also from The Netherlands) will provide general assistance in the combined data analysis including the development of exposure indicators on the basis of the collected exposure data.

A Project Management Team will be formed consisting of one representative for each full proposer. The Project Management Team will consist of: B. Brunekreef (coordinator, The Netherlands), E. Lebret (The Netherlands), N. Englert (Germany), H.-E. Wichmann (Germany), A. Kalandidi (Greece), G. Baldini (Italy), J. Pekkanen (Finland), R. Harrison (UK), M. Williams (UK), J. Clench-Aas (Norway). This team brings together experience from, a.o., clinical medicine, respiratory epidemiology, environmental epidemiology, exposure assessment and data analysis. Decisions regarding the details of the project will be taken by the Project Management Team. To ensure full standardisation of the core protocol, a Project Group will be formed consisting of the Project Managment Team and one or two additional members for each participating center.

4. DELIVERABLES AND WORK PLANNING

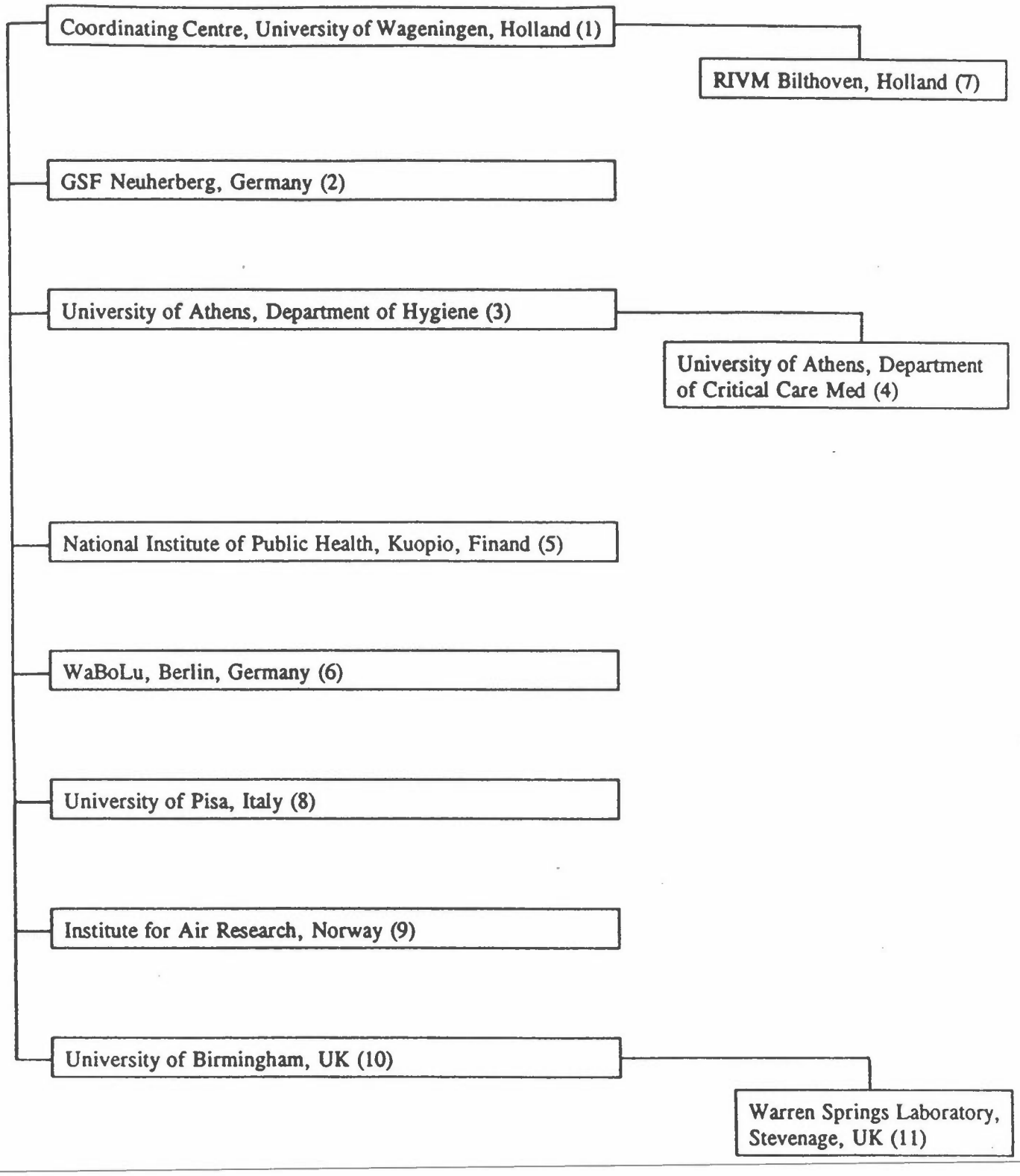
The deliverables are: a set of detailed laboratory and field protocols outlining how exactly the study should be done, by October 1, 1993; a tabular presentation of the collected data by June 1, 1994; a study report describing the main results of the study by January 1, 1995.
The interdependence between tasks has been described in the previous section.
The work schedule is as follows:



1. Preparation of draft detailed laboratory and field protocols for Project Management Team (PMT) meeting, end of March 1993 (Jan-Mar 1993)
2. Editing of protocols for workshop, end of June 1993 (Apr-Jun 1993)
3. Finalization of protocols (Jul-Sep 1993)
4. Study subject recruitment and characterization (Sep-Nov 1993)
5. Field observations (Nov 1993 - Feb 1994)
6. Data compilation and entry (Feb-May 1994)
7. Data analysis (May-Oct 1994)
8. Preparation of main study report (Oct-Dec 1994)

5. COMPLEMENTARY PROJECTS

There are no complementary projects



Organization diagram; numbers between brackets indicate particpant number; left row corresponds with number of (sets of two) study sites; left row indicates supporting institutions

Study Locations

1	Kuopio, Finland
2	Oslo, Norway
3	Birmingham, UK
4	Rotterdam/Amsterdam, Netherlands
5	Berlin, Germany
6	Bitterfeld, Germany
7	Pisa, Italy
8	Athens, Greece

APPENDIX 3

QUESTIONNAIRES

Winter 93/94	Area number				1-3
	I.D. number				4-7
	Interviewer number				8-9
	Date				10-15
		DAY	MONTH	YEAR	

I AM GOING TO ASK YOU SOME QUESTIONS. AT FIRST THESE WILL BE MOSTLY ABOUT YOUR BREATHING. WHEREVER POSSIBLE, I WANT YOU TO ANSWER 'YES' OR 'NO'

Wheeze and tightness in the chest	NO	YES	
1 Have you had wheezing or whistling in your chest at any time the last 12 months			16

IF 'NO' GO TO QUESTION 2, IF 'YES':

1.1 Have you been at all breathless when the wheezing noise was present?			17
1.2 Have you had this wheezing or whistling when you did not have a cold?			18
2 Have you woken up with a feeling of tightness in your chest at any time in the last 12 months?			19

Shortness of breath

3 Have you had an attack of shortness of breath that came on during the day when you were at rest at any time in the last 12 months?			20
4 Have you had an attack of shortness of breath that came on FOLLOWING strenuous activity at any time in the last 12 months?			21
5 Have you been woken by an attack of shortness of breath at any time in the last 12 months?			22

Cough and phlegm from the chest

6 Have you been woken by an attack of coughing at any time in the last 12 months?			23
7 Do you usually cough first thing in the morning in the winter?			24

(IF 'YES' OR AMBIVALENT, USE QUESTION 8.1 TO CONFIRM)

8 Do you usually cough during the day, or at night, in the winter?			25

IF'NO' GO TO QUESTION 9, IF 'YES':

8.1 Do you cough like this on most day for as much as 3 months each year?			26
9 Do you usually bring up any phlegm from your chest first thing in the morning in the winter?			27

(IF 'YES' OR AMBIVALENT, USE QUESTION 10.1 TO CONFIRM)

	NO	YES	
10 Do you usually bring up any phlegm from your chest during the day, or at night, in the winter?			28

IF 'NO' GO TO QUESTION 11, IF 'YES':

10.1 Do you bring up phlegm like this on most days for as much as 3 months each year?			29

Breathing

11 Do you ever have trouble with your breathing?			30

IF 'NO' GO TO QUESTION 12, IF 'YES':

11.1 Do you have this trouble

	TIC ONE BOX ONLY		
A) Continuously, so that your breathing is never quite right?	1		
B) Repeatedly, but it always gets completely better?	2		
C) Only rarely?	3		31

	NO	YES	
12 Are you disabled from walking by a condition other than heart or lung disease?			32

IF 'YES': 12.0 STATE CONDITION _____

AND GO TO QUESTION 13

IF 'NO':

12.1 Are you troubled by shortness of breath when hurrying on level ground or walking up a slight hill?			33

IF 'NO' GO TO QUESTION 13, IF 'YES':

12.1.1 Do you get short of breath walking with other people of your own age on level ground?			34

IF 'NO' GO TO QUESTION 13, IF 'YES'

12.1.1.1 Do you have to stop for breath when walking at your own pace on level ground?			35

Asthma

	NO	YES	
13 Have you ever had asthma?			36

IF 'NO' GO TO QUESTION 14, IF 'YES':

	NO	YES	
13.1 Was this confirmed by a doctor?			37

	YEARS		
13.2 How old were you when you had first attack of asthma?			38-39
13.3 How old where you when you had your most recent attack of asthma?			40-41

This questionnaire is based on the EC Respiratory Health Survey

13.4.1-6 Which months of the year do you usually have attacks of asthma?

	NO	YES	
13.4.1 January/February			42
13.4.2 March/April			43
13.4.3 May/June			44
13.4.4 July/August			45
13.4.5 September/October			46
13.4.6 November/December			47

13.5 Have you had an attack of asthma in the last 12 months?			48

IF 'NO' GO TO QUESTION 13.6, IF 'YES':

	NUMBER		
13.5.1 How many attacks of asthma have you had in the last 12 months?			49-50

	NO	YES	
13.6 Are you currently taking any medicines, including inhalers, aerosols or tablets, for asthma?			51

Other conditions

	NO	YES	
14 Do you have any nasal allergies including 'hay fever'?			52
15 Have you ever had eczema or any kind of skin allergy?			53
16 Are you allergic to insect stings or bites?			54

IF 'NO' GO TO QUESTION 17, IF YES:

16.1 Which insect?			55-56

16.2.1-3 What kind of reaction do you have?

16.2.1 breathing difficulty, feeling faint, nausea or fever			57
16.2.2 redness, itching or swelling at the site of the sting			58
16.2.3 other (please specify)			59

17 Have you ever had any difficulty with your breathing after taking medicines?			60

IF 'NO' GO TO QUESTION 18, IF 'YES':

17.1 Which medicine(s)?		61
		62

Your parents' smoking

	NO	YES	DON'T KNOW	
18 Did your father ever smoke regularly during your childhood?				63
19 Did your mother ever smoke regularly during your childhood or before you were born?				64

IF 'NO' OR 'DON'T KNOW' GO TO QUESTION 20, IF 'YES':

19.1 *When your mother was pregnant, in particular with you, did she*		TICK ONE BOX ONLY	
A) stop smoking before pregnancy?	1		
B) cut down or stop smoking during pregnancy?	2		
C) smoke as usual during pregnancy?	3		
D) don't know	4		65

More about yourself

	DAY		MONTH		YEAR		
20 When were you born?							66-71
21 What country were you born in?							72-74

	MALE	FEMALE	
22 Are you male or female?			75
23 How tall are you without shoes (height in cm)			76-78
24 How much do you weigh (weight in kg)			79-81

25 Marital status	Single		Married		
	Widowed		Sep./ Dev.		82
26 Nationality	Czech		Slovak		
	German		Other		83
27 What level of school have you completed?	None		Secondary		
	Primary		Tertiary		84

28 What is your salary per month (netto)?	Low (less than 3000 crowns)		
	Low middle (from 3000 to 5999 crowns)		
	High middle (from 6000 to 9999 crowns)		
	High (more than 10 000 crowns)		85

	NUMBER		
29 How many brothers do or did you have?			108-107 9

IF '00' GO TO QUESTION 30, OTHERWISE:

	NUMBER		
29.1 How many <u>older</u> brothers?			110-111
29.2 How many <u>younger</u> brothers?			112-113
29.3 How many of your brothers ever had asthma?			114-115
29.4 How many of your <u>other</u> brothers had eczema, skin or nasal allergy or 'hay fever'?			116-117
30 How many sisters do or did you have?			118-119

IF '00' GO TO QUESTION 31, OTHERWISE:

30.1 How many <u>older</u> sisters?			120-121
30.2 How many <u>younger</u> sisters?			122-123
30.3 How many of your sisters ever had asthma?			124-125
30.4 How many of your <u>other</u> sisters had eczema, skin or nasal allergy or 'hay fever'?			126-127

	NO	YES	DON'T KNOW	
31 Did your mother ever have asthma?				128
32 Did your mother ever have eczema, skin or nasal allergy or 'hay fever'?				129
33 Did your father ever have asthma?				130
34 Did your father ever have eczema, skin or nasal allergy or 'hay fever'?				131
35 Did you regularly share your bedroom with any <u>older</u> children before the age of 5 years?				132
36 Did you go to a school, playschool or nursery with other children before the age of 5 years?				133

This questionnaire is based on the EC Respiratory Health Survey

37 Did you have a serious respiratory infection before the age of 5 years?				134
38 Are you a full-time student?				135

IF 'YES' GO TO QUESTION 38.7, IF 'NO':

	YEARS		
38.1 At what age did you complete full-time education?			136-137

	NO	YES	
38.2 Are you currently employed or self-employed			138

IF 'YES' GO TO QUESTION 38.3, IF 'NO':

38.2.1 Are you currently looking for a job?			139
38.3 What is or was your current or most recent job? (Be as precise as possible)			140-142

_____

_____

38.4 Are you or were you

	TICK ONE BOX ONLY	
A) a manager working for an employer?	1	
B) a foreman or supervisor working for an employer?	2	
C) working for an employer, but neither a manager, supervisor or foreman?	2	
D) self-employed?	4	143

	NO	YES	
38.5 Does being at work ever make your chest tight or wheezy?			144
38.6 Have you ever had to change or leave your job because it affected your breathing?			145

IF 'NO' GO TO QUESTION 38.7, IF 'YES':

38.6.1 What was this job? (Be as precise as possible)				146-148

_____

_____

	NO	YES	
38.7 Have you ever worked in a job with exposed you to vapours, gas, dust or fumes?			149

IF 'NO' GO TO QUESTION 39, IF 'YES':

38.7.1 What was this job? (Be as precise as possible)				150-152

_____

_____

	NO	YES	
39 Is your workplace near a road with high density traffic?			153
40 Is your workplace near a strong air pollution source?			154
41 Is your workplace located in a rural area?			155
42 Does your workplace have several floor?			156
43 Do you work mostly indoors?			157

Your home

	YEARS		
44 How many years have you lived in your present home?			158-159
45 How many years have you lived in the Czech Republic?			160-161

46 *When was your present home built?*

		TICK ONE BOX ONLY	
A) before 1960	1		
B) 1961-1970	2		
C) 1971-1980	3		
D) 1981 or later	4		
E) don't know	5		162

47 *Which best describes the building in which you live?*

A) a mobile home or trailer	1	
B) a 1 family house detached from any other house	2	
C) a 1 family house attached to one or more houses	3	
D) a building for 2 families	4	

E) a building for 3 or 4 families	5	
F) a building for 5 or more families	6	
G) a boat, tent, van	7	
H) other (please specify)	8	

163

48 At what floor do you live	
at or below ground level?	
at the first floor?	
at the second and third floor?	
At the fourth or fifth floor?	
Over fifth floor?	

164

49.1-3 Does your home have any of the following?

	NO	YES	
49.1 central heating			165
49.2 ducted air heating			166
49.3 air conditioning			167

50.1-7 Which of the following fuels do you use for heating or for hot water?

50.1 open coal, coke or wood fire			168
50.2 open gas fire			169
50.3 electric heater			170
50.4 paraffin heater			171
50.5 gas-fired boiler			172
50.6 oil-fired boiler			173
50.7 other (please specify)			174

51 *What kind of stove do you MOSTLY use for cooking?*

		TICK ONE BOX ONLY	
A) coal, coke or wood solid fuel	1		
B) gas	2		
C) electric	3		
D) paraffin	4		
E) other (please specify)	5		175

	NO	YES	DON'T KNOW	
52 Do you have an extractor fan over the cooker?				176

IF 'NO' OR 'DON'T KNOW' GO TO QUESTION 53, IF 'YES':

52.1 When cooking, do you use the fan

	TICK ONE BOX ONLY	
A) all the time?	1	
B) some of the time?	2	
C) none of the time?	3	177

	NO	YES	DON'T KNOW	
52.2 Does the fan take the fumes outside the house?				178

53.1-5 Does the room which you use most at home during the day

	NO	YES	
53.1 have fitted carpets covering the whole floor?			179
53.2 contain rugs?			180
53.3 have double glazing?			181
53.4 have curtains?			182
53.5 have upholstered or soft furnishings?			183

54.1-5 Does your bedroom

	NO	YES	
54.1 have fitted carpets covering the whole floor?			210
54.2 contain rugs?			211
54.3 have double glazing?			212
54.4 have curtains?			213
54.5 have upholstered or soft furnishings?			214

	NO	YES	
55 Do you sleep with the windows open at night during winter			215

IF 'NO' GO TO QUESTION 56, IF 'YES':

55.1 Do you sleep with the windows open during winter

	TICK ONE BOX ONLY		
A) all the time?	1		
B) some times?	2		
C) only occasionally?	3		216

	NO	YES	DON'T KNOW	
56 Has there ever been any water damage to the building or its contents, for example, from broken pipes, leaks or floods?				217

IF 'NO' OR 'DON'T KNOW' GO TO QUESTION 57, IF 'YES':

56.1 Has there been any water damage in the last 12 months?				218

	NO	YES	
57 Do you have basement or cellar?			219

IF 'NO' GO TO QUESTION 58, IF 'YES':

	NO	YES	DON'T KNOW	
57.1 Does water ever collect on the basement floor?				220

IF 'NO' OR 'DON'T KNOW' GO TO QUESTION 58, IF 'YES':

	NO	YES	
57.1.1 Has this happened in the last 12 months?			221

	NO	YES	DON'T KNOW	
58 Has there ever been mould or mildew on any surfaces, other than food, inside the home?				222

IF ' NO' OR 'DON'T KNOW' GO TO QUESTION 59, IF 'YES';

58.1.1-6 Which rooms have been affected?

	NO	YES	
58.1.1 bathroom(s)			223
58.1.2 bedroom(s)			224
58.1.3 living area(s)			225

58.1.4 kitchen			226
58.1.5 basement or attic			227
58.1.6 other (please specify)			228

			229
58.2 Has there been mould or mildew on any surfaces inside the home in the last 12 months?			

	NO	YES	DON'T KNOW	
59 Do you use a humidifier, including any humidifier system built into your heating system?				230

IF ' NO' OR 'DON'T KNOW' GO TO QUESTION 60, IF 'YES';

59.1 What type of humidifier do you use?

		TICK ONE BOX ONLY	
A) humidifier built into heating system	1		
B) portable cold mist - ultrasonic or spinning disc	2		
C) portable hot mist vaporiser	3		
D) other (please specify)	4		231

59.2 Under what circumstances do you use your humidifier?

A) only when someone is ill - in their room	1		
B) to humidify the house	2		
C) other (please specify)	3		232

Animals, dust and feathers

	NO	YES	
60 Do you keep a cat?			233

IF ' NO' GO TO QUESTION 61, IF 'YES':

60.1 Is your cat allowed to into your bedroom?			234
60.2 Do all your cats stay outside the house?			235
61 Do you keep a dog?			236

IF 'NO' GO TO QUESTION 62, IF 'YES':

61.1 Is your dog ever allowed into your bedroom?			237
61.2 Do all your dogs stay outside the house?			238

	NO	YES	
62 Do you keep any birds?			239

IF 'NO' GO TO QUESTION 63, IF 'YES':

62.1 Are any of these birds kept inside the house?			240

63.1-12 When you were a child did anyone in your household keep any of the following pets?

63.1 cats			241
63.2 dogs			242
63.3 horses			243
63.4 birds			244
63.5 guinea pigs			245
63.6 hamsters			246
63.7 mice			247
63.8 rats			248
63.9 rabbits			249
63.10 gerbils			250
63.11 ferrets			251
63.12 others (please specify)			252

64.1-6 When you are near animals, such as cats, dogs or horses, near feathers, including pillows, quilts or duvets, or in an dusty part of the house, do you ever

64.1 start to cough?			253
64.2 start to wheeze?			254
64.3 get a feeling of tightness in your chest?			255
64.4 start to feel short of breath?			256
64.5 get a runny or a stuffy nose or start to sneeze?			257
64.6 get itchy or watering eyes?			258

Trees, grass, plants flowers and pollen

65.1-6 When you are near trees, grass or flowers, or when there is a lot of pollen about, do you ever?			
65.1 start to cough?			259
65.2 start to wheeze?			260
65.3 get a feeling of tightness in your chest?			261
65.4 start to feel short of breath?			262
65.5 get a runny or stuffy nose or start to sneeze?			263
65.6 get itchy or watering eyes?			264

IF 'NO' GO TO QUESTION 66, IF 'YES' TO ANY OF THE ABOVE:

65.6.1-4 Which time of year does this happen?	NO	YES	
65.6.1 winter			265
65.6.2 spring			266
65.6.3 summer			267
65.6.4 autumn			268

Diet

66 How often do you eat pre-packaged food such as tinned food or pre-prepared frozen meals?	TICK ONE BOX ONLY		
A) every day or most days	1		
B) at least once a week	2		
C) less than once a week	3		269

67 How often do you drink sweet fizzy drinks?			
A) every day or most days	1		
B) at least once a week	2		
C) less than once a week	3		270

	NO	YES	
68 Do you take snacks between meals?			271

IF 'NO' GO TO QUESTION 69, IF 'YES':

68.1-3 Which of the following would you have as a snack at least once a week?

68.1 savoury biscuits or crisps			272
68.2 sweets or chocolates or sweet biscuits			273
68.3 fruit or vegetables			274

69 Have you ever had an illness or trouble caused by eating a particular food or foods?			275

IF 'NO' GO TO QUESTION 70, IF 'YES':

69.1 Have you nearly always had the same illness or trouble after eating this type of food?			276

69.2 What type of food was this?

_____			310-311
_____			312-313
_____			314-315

69.3.1-6 Did this illness or trouble include

69.3.1 a rash or itchy skin?			316
69.3.2 diarrhoea or vomiting?			317
69.3.3 runny or stuffy nose?			318
69.3.4 severe headaches?			319
69.3.5 breathlessness?			320
69.3.6 other (please specify)			321

Smoking

70 Have you ever smoked as long as a year?			322

('YES' means at least 20 packs of cigarettes or 12 oz (360 grams) of tobacco in a lifetime, or at least one cigarette per day or one cigar a week for one year.)

IF 'NO' GO TO QUESTION 71, IF 'YES':

	YEARS		
70.1 How old were you when you started smoking?			323-324

	NO	YES	
70.2 Do you now smoke, as of <u>one month ago</u>?			325

IF 'NO' GO TO QUESTION 70, IF 'YES':

70.2.1-4 How much do you <u>now</u> smoke on average?

		NUMBER		
70.2.1 number of cigarettes a day				326-327
70.2.2 number of cigarillos a day				328-329
70.2.3 number of cigars a week				330-331
70.2.4 pipe tobacco in A) ounces/week				332-333
<u>or</u> B) grams/week				334-336

	NO	YES	
70.3 Have you stopped or cut down smoking?			337

IF 'NO' GO TO QUESTION 70.4, IF 'YES':

	YEARS		
70.3.1 How old were you when you stopped or cut down smoking?			338-339

70.3.2.1-4 <u>On average</u> of the entire time you smoked, before you stopped or cut down, how much did you smoke?

		NUMBER		
70.3.2.1 number of cigarettes a day				340-341
70.3.2.2 number of cigarillos a day				342-343
70.3.2.3 number of cigars a week				344-345
70.3.2.4 pipe tobacco in A) ounces/week				346-347
<u>or</u> B) grams/week				348-350

	NO	YES	
70.4 Do you or did you inhale the smoke?			351
71 Have you been <u>regularly</u> exposed to tobacco smoke in the last <u>12 months</u>? ('Regularly' means on most day or nights)			352

IF 'NO' GO TO QUESTION 72, IF 'YES':

	NUMBER		
71.1 Not counting yourself, how many people in your household smoke regularly?			353-354

	NO	YES	
71.2 Do people regularly smoke in the room where you work?			355

	HOURS		
71.3 How many hours per day are you exposed to <u>other people's</u> tobacco smoke?			356-357

Medicines and inhalers

	NO	YES	
72 Have you used any <u>inhaled</u> medicines to help your breathing at any time in the last <u>12 months</u>?			358

IF 'NO' GO TO QUESTION 73, IF 'YES':

72.1-6 ***Please look at the list of inhalers and indicate those which you have used in the last <u>12 months</u>***

72.1 beta-2-agonist inhalers marketed locally			359
72.1.1 If used, which one?			360
72.2 non-specific adrenoreceptor agonist inhalers marketed locally			361
72.2.1 If used, which one?			362
72.3 anti-muscarinic inhalers marketed locally			363
72.3.1 If used, which one?			364
72.4 inhaled steroids marketed locally			365
72.4.1 If used, which one?			366
72.5 other inhalers (non-steroid, single drug) marketed locally			367
72.5.1 If used, which one?			368-369
72.6 inhaled compound bronchodilators marketed locally			370
72.6.1 If used, which one?			3710

	NO	YES	
73 Have you used any pills, capsules, tablets or medicines, other than inhaled medicines, to help your breathing at any time in the last 12 months?			372

IF 'NO' GO TO QUESTION 74, IF 'YES':

73.1-9 Please read the list of drugs and indicate those which you have taken in the last 12 months

73.1 oral specific beta-2-agonists marketed locally			373
73.1.1 If used, which one?			374
73.2 oral non-specific adrenoreceptor agonists marketed locally			375
73.2.1 If used, which one?			376
73.3 oral anti-muscarinic drugs marketed locally			377
73.3.1 If used, which one?			378
73.4 oral methylxanthines marketed locally			379
73.4.1 If used, which one?			380
73.5 oral steroids marketed locally			381
73.5.1 If used, which one?			382-383
73.6 oral anthihistamines marketed locally			384
73.6.1 If used, which one?			385
73.7 oral compound bronhodilators without sedatives marketed locally			386
73.7.1 If used, which one?			387
73.8 oral compound bronchodilators with sedatives marketed locally			388
73.8.1 If used, which one?			389
73.9 other oral medications marketed locally			390
73.9.1 If used, which one?			391

	NO	YES	DON'T KNOW	
74 Have you been vaccinated for allergy at any time in your life?				410

IF 'NO' OR 'DON'T KNOW' GO TO QUESTION 75, IF 'YES':

	NO	YES	
74.1 Have you been vaccinated for allergy in the last 12 months?			411

	NO	YES	
75 Have you had any other injections to help your breathing at any time in the last 12 months?			412

IF 'NO' GO TO QUESTION 76, IF 'YES':

75.1 What injection(s)?

_____ 413

_____ 414

	NO	YES	
76 Have you used any suppositories to help your breathing at any time in the last 12 months?			415

IF 'NO' GO TO QUESTION 77, IF 'YES':

76.1 What suppositories?

_____ 416

_____ 417

	NO	YES	
77 Have you used any other remedies to help your breathing at any time in the last 12 months?			418

IF 'NO' GO TO QUESTION 78, IF 'YES':

77.1 What remedies?

419

420

421

	NO	YES	
78 Do you take drugs every day to help your breathing even if you don't feel short of breath			422

IF 'NO' GO TO QUESTION 79, IF 'YES':

78.1 Which drugs?

_____			423-424
_____			425-426
_____			427-428
_____			429-430
_____			431-432
_____			433-434
_____			435-436
_____			437-438

	NO	YES	
79 Do you take any drugs only for attacks of breathlessness?			439

IF 'NO' GO TO QUESTION 80, IF 'YES':

79.1 Which drugs?			
			440-441
			442-443
			444-445
			446-447
			448-449
			450-451

79.2 Do you take this drugs

		TICK ONE BOX ONLY	
A) at the onset of the attack?	1		
B) only when the attack becomes more severe?	2		452

	NO	YES	
80 Has your doctor ever prescribed medicines for your breathing?			453

IF 'NO' GO TO QUESTION 81, IF 'YES':

80.1 If you are prescribed medicines for your breathing, do you normally take

		TICK ONE BOX ONLY	
A) all of the medicines?	1		
B) most of the medicines?	2		
C) some of the medicines	3		
D) none of the medicines?	4		454

80.2 When your breathing gets worse, and you are prescribed medicines for your breathing, do you normally take

A) all of the medicines?	1		
B) most of the medicines?	2		
C) some of the medicines	3		
D) none of the medicines?	4		455

	NO	YES	
80.3 Do you think it is bad for you to take medicines all the time to help your breathing?			456
80.4 Do you think you should take as much medicines as you need to get rid of <u>all</u> your breathing problems?			457
81 Have you ever visited a hospital casualty department or emergency room because of breathing problems?			458
82 Have you ever spent a night in hospital because of breathing problems?			459

IF 'NO' GO TO QUESTION 83, IF 'YES':

	NUMBER		
82.1 How many times in the last <u>12 months?</u>			460-461

	NO	YES	
83 Have you ever been seen by a doctor because of breathing problems or because of shortness of breath?			462

IF 'NO' GO TO 84, IF 'YES':

83.1 When was the last time you seen by a doctor because of breathing problems or because of shortness of breath?

	TICK ONE BOX ONLY	
A) within last 7 days	1	
B) more than 7 days within last 4 weeks	2	
C) more than 4 weeks ago but within last 12 months	3	
D) more than a year ago	4	463

83.2 <u>Where</u> were you seen?

A) by a GP at home	1	
B) by a GP in his surgery of office	2	
C) by a specialist at home	3	
D) by a specialist in his surgery or hospital outpatients department	4	
E) in a casualty department or emergency room	5	
F) admitted to a hospital ward	6	464

84 Have you ever been treated by a doctor or have been admitted to a hospital for any?

	NO	YES	DON'T KNOW	
Asthma				465
Bronchitis				466
Pneumonia				467
Emphysema				468
Pleuritis				469
Other lung disease				470
Heart attack				471
Angina Pectoris				472
Other heart disease				473
Eczema, Atopic Dermatitis				474
Diabetes				475

	NO	YES	
85 Have you been ill the last 14 days?			476
86 Were you seen by a doctor or nurse?			477
87 Have you taken any medication the last 14 days?			478

	NUMBER		
88 How many days were you off work during the last 14 days?			479-480

89 Have you the last 6 months been bothered often, sometimes or never, of:

	Often bothered	Sometimes bothered	Never bothered	
Headache				481
Nausea				482
Coughing, airway irritiation				483
Sore throat				484
Pains in the neck, back, arms or shoulders				485

90 Have you the last 6 months been bothered often, sometimes or never, of:	Often bothered	Sometimes bothered	Never bothered	
Palpitation				486
Indigestion				487
Fatigue				488
High blood pressure				489
Dizziness				490
Itching, rash or allergy				491
Nervousness, anxiety or restlessness				492
Feeling depressed				493
Problems sleeping				494
Eye irritation				495
Having a cold or the flu				496
Respiratory trouble/problems breathing				497

END

DATE: _____ **YOUR I.D. NR:** _____

	Where are you?				Have you travelled?			Have you been shopping?			Smoking		Health and well-being															
	Where are you? (code)	Are you indoors	Is the window open	Are you outdoors	Much traffic	Average traffic	Little traffic	Much traffic	Average traffic	Little traffic	Smoked (nr.)	Passive smoking	Annoying noise	Annoying smell	Tired	Dizziness	Nervous	Headache	Nausea	Running nose	Feeling feverish	Eye irritation	Throat irritation	Wheezing in chest	Tightness in chest	Coughing	Are you sleeping ?	
					Minutes			Minutes																				
2400																												2400
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Appendix C

Minutes from meetings at NILU and in Prague on the air pollution dispersion calculations

C1

Minutes from teh meeting with Dr. Brechler at NILU concerning the air pollution modelling component of the Teplice Health Study.

Meeting place:	NILU	Time :	22.06.-04.07.1992
Participant :	Josef Brechler	Distribution:	Participants
	Sam-Erik Walker		Steinar Larssen
	Knut Erik Grønskei		

Our ref.: KEG/sbh/o-92064 Date: 9 July 1992

Dr. Josef Brechler from Charles University in Prague worked at NILU for the period from 22.06.-04.07.1992 to get acquainted with NILUs approach to air quality models, to exchange information and to discuss the applites. Dr. Brechler brought the following data, describing some part of the air pollution situation in Czechoslovakia:

1. An emission survey for large point sources in Czechoslovakia to be used for describing air pollution concentrations on a regional scale.

2. A dispersion model for evaluation of regional scale distribution of concentrations and depositions. These characteristics are evaluated on the grid mesh witn arbitratiliy chosen grid spacing and with oography and wind field evaluated using grid mesh of a grid step equal to 37.5 km both in x-direction and y-direction. It is also possible to evaluate data on fluxes on air pollution accross of any receptor-line within the area.

3. Data from Dr. Kotexovec on emission of SO_2 and NO_x with particular emphasis on Teplice and the surrounding area.

4. Data on pollution concentrations in the study area including Teplice, Liberec, Litomerice, Louny, Most, Usti Nad Labem, Chomutov and Preachatice. Meteorological data from the area including Tusimice, Milesovka, Zatec-Valemysleves and Usti and Labem-Kockov. The meteorolgocial measurements are given as hourly values for the period 01.12.1989-28.02.1990. The data re used as background information for the model to be developed for exposure estimation.

Dr. Brechler gave a lecture at NILU describing the meteorological and air quality conditions in Czechoslovakia.

Tasks for evaluating local models for the Teplice area are summarized in the following points:

1. Meteorological measurements should be collected for the area of Teplice.

2. Contact will be made with the Institute for Atmospheric Research (IFA) for the possible use of data from a diagnostic boundary layer model for the Teplice area.

3. Contact will be made with Dr. Ivan Benes to get data on meteorology and air quality for the 41 day study of air quality in Teplice last winter.

During Dr. Brechlers stay at NILU the following tasks were carried out:

1. Reional model calculations have been carried out to specify the level of background concentrations, i.e. concentrations and fluxes entering the area of investigation.

2. The NILU local model has been modified to work for the Teplice area. Some preliminary runs have been performed using the Teplice emission data to evaluate the models applicability. The area of calculation has been chosen to include the main cities for interest for the Teplice study. The co-ordinate system are rotated about 30 degrees for the x-axes to be prallel to the mountains and the main wind direction in the area. The horizontal extent is 50 x 40 km^2 and the vertical resolution is currently 3 layers below a flexible mixing height. The number of layers will be increased to five in later versions of the model.

3. Dr. Brechler brought back to Prague a magnetic tape containing the present version of the necessary input data.

4. A first description of how to run the local model for Teplice on a SUN SPARC-station has been written.

For each of future communications, E-mail addresses have been exchanged.

The following tasks are planned to be carried out before the September workshop.

1. The sensitivity of model calculations with respect to input parameters will be investigated, both in Prague and at NILU. The results will be discussed.

2. Data from the Czech. Hydromet. Institute in Prague may be used for preliminary definition of model input data in air pollution episodes.

3. A combination of regional model calculations, a local meteorological model and high resolution model calculations will be further discussed. Some calculated and observed concentrations will be compared, and a plan on the combination of source oriented calculated concentrations with observed values from measuring stations will be worked out.

C2

Miniutes from Prague meetings concerning the air-pollution modelling in the framework of the Teplice Project.

5 October 1992

In the framework of the Teplice Project there were organised two workshops in Prague and the Liblice castle. Simultaneously two meetings on air pllution modelling activity took part at the Czech Hydrometeorological Institute (CHMI) aimed to discuss the next collaboratioin between people working in the field of air pollution dispersion modelling and problems of data - both meteorological and emission ones.

Meeting 19 September at CHMI

Participants: J. Brechler, K.E. Grønskei, R. Ireson, J. Keder, J. Macoun, J. Novák, J. Pretel, P. Sedlák, J. Stehlik, J. Vyhnaliková, R. Vyhnánek, S.-E. Walker.

At this meeting all participants discussed the future outlook in modelling activities in the Teplice project framework. As a main task it was conluded that it was necessary to improve situation in collection and dissemination of data needed for dispersion modelling - it means all meteorological data, emission data and ambient air quality data. It was suggested to store all the above mentioned data at one plase and to establish a person that would be responsible for this task. It was also agreed that all available meteorological data from the modelled area should be stored including sodar data and meteorological mast measurement data.

The second item of this meeting was presentation of the software developed at the Systems Applications International (contract of US EPA) for the purpose of the Teplice project. The Czech party was given with software and user's guide by Dr. Robert Ireson.

Meeting 24 September at CHMI

Participants: J. Brechler, K.E. Grønskei, J. Keder, J. Macoun, S.-E. Walker.

K.E. Grønskei and S.-E. Walker worked at CHMI from 22-24 September. They provided the Czech party with an updated version of NILU model in the form of executables file and successfully tried to run this model at SUN SPARC work station at CHMI. On 24 September in the end of their stay at CHMI there were discussed following items dealing with Czech-Norwegian collaboration in the Teplice project framwork.

1. Norwegian party (NILU) will be provided with all necessary meteorological, emission and ambient air quality data covering periods from December 1989 to February 1990 and from mid of February 1992 to the end of March 1992. The same data from the measurement in the Teplice district (beginning of

measurements is planned to occur in the mid of November 1992) will be given to NILU too.

2. Norwegian party was provided by orography of the area of interest. This orography has a resolution 1 x 1 km in horisontal directions.

3. Norwegian party provided Czech party with updated version of NILU model and instructed how to run this software.

4. Norwegian party will provide Czech party with updated version of the NILU model aimed to the Teplice project dispersion modelling activities.

5. Both parties discussed a possibility to combine a model developed at the Department of Meteorology and Environment Protection (KMOP), Charles University, Prague with that developed at NILU. The former is a mesoscale model and can provide the NILU model with boundary data at the inflow boundaries. To do this NILU will specify the model levels where the boundary values are to be estimated from KMOP model. This item also depends on agreement of the head of the Teplice project whether this KMOP modelling acitivity will be accepted and supported from the Teplice project budget.

6. Dr. Brechler was also informed about possibility to run some computer experiments at NILU computing facilities via Internet and was provided with a NILU Internet address.

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ABSTRACT
Norway, through NILU, is contributing to the Czech research Program "Health effects of air pollution in Teplice", through 3 projects, concerning Air Pollution Monitoring (equipment assistance), Air Pollution Modelling and also planning of Health Symptom Monitoring and health studies. The contribution arefinanzed through the Czech-Norwegian Agreement on Co-operation in Protection of the environment. The present report contains a report for the activities in 1992, and projects proposals for 1993.

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