European Science Foundation

Exploratory Workshop
EMRC - Public Health

in collaboration with
European Community Respiratory Health Survey, ECRHS
Working Group on Air Pollution

Effect Assessment of Air Pollution in Europe: Background and Source Specific Exposure

March 17th – 19th 2002, Basel, Switzerland

Hosted by the
Institute for Social and Preventive Medicine
University Basel
(Director: Prof. Ursula Ackermann-Liebrich)

MINUTES OF THE WORKSHOP

summarized by Thomas Götschi, 17 May 2002

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Summary of main decisions and suggestions

Location of measuring sites

The influence of the location of the measurement sites selected on the measured values is an issue discussed in several parts of the workshop. The following was decided:

- In general, particular stations will not be excluded from the study, but their characteristics must be considered when describing and interpreting data.
- Historic stations (WP5) have to be reclassified concerning influence of traffic and other specific characteristics. The information collected within WP5 will be used therefore, however, the original classification into background and traffic stations has to be dropped. (A procedure will be developed in Basel)
- PM2.5 data sampled within ECRHS-II will not be corrected for site specific effects, but special characteristics must be taken into account when describing and interpreting data.
- For the more traffic-related measurements, such as NO2 and black smoke, a correction tool will be developed (thesis TG).

Many propositions have been made on how this problem could be faced:

- traffic data
- data on pollutants such as e.g. NO/NO2 ratio, etc.
- using GIS
- socio-economic data
- partial analysis on homogenous subgroups of centres (background/traffic)

PM2.5 data

- Missing data will be replaced using time weighed average, and where necessary and available by extrapolating from PM10 values. For detailed centre specific proceedings see page 20.

Suggestions:

- The WP6 data do not allow to study short term effects of air pollution. The purpose is to estimate a valid annual mean.
- Focussing on annual mean values, the original purpose of the ECRHS design, minimizes the problems of random variability given by the special design (only 84 measuring days per year).
- local authorities should be properly informed that ECRHS data may not be easily compared with their own measurements.
- A location assessment (influence of traffic etc.) should be done if possible by an independent person.

Historic data

- Historic sites must be ranked by criteria first to be established to assure comparability of the data. For criteria concerning traffic exposure and applied methods see page 23.

- A comparable data set must be achieved before starting health analysis.
- Modelling historic exposure with economic data should be done prior to do so with visibility data, if at all.

Suggestions:

- Missing PM10 data may be derived from TSP data.
- Correlation based imputation of missing data is not recommended.
- Visibility measures from airports could provide estimates for historic exposure to PM2.5
- Economic data could be used to estimate historic exposure to PM10 (as presented by Bart Ostro).

NO2 data

- Centres have to agree for the data to be used/summarized.
- The co-ordinating centre in London will provide a descriptive report of the NO_2 data.
- An e-mail discussion group will be started, for further discussions concerning the data. (by the centre in London?)
- Spatial variability is a main issue, therefore the main focus will be set on the centres with simultaneous measurements.

Suggestions:

- Traffic data, dispersion models, etc. could be used to address spatial variability.
- NO2 exposure levels could be corrected on an individual level.

Publications

- Marianne Hazenkamp will write a proposal for the first paper (PM2.5 method and winter data) and outline a second one (complete data and comparison to other measurements e.g. NO2). Discussion by e-mail. For details see page 21.
- In the 1st paper no blank correction will be applied.
- The location issue will be treated in the discussion section of the 1st paper.
- It should be mentioned in the paper that 2 centres did not store the filters in the fridge.

For further propositions concerning papers see page 21.

- It is suggested that a variance analysis of all blank filters is conducted. For later calculations only blanks with closed lid are used. The blank procedure should refer to EXPOLIS

Others

- Black smoke will be measured on the PM2.5 filters.

Suggestions:

- Oxidative capacity, sulfates and organic compounds are further analysis that could be done on the PM2.5 filters.

Arrival of participants: mostly on Saturday, 16.3.02

Day 1: Sunday, 17.3.02

Time	Issue	Who
13.00-13.20	**Welcome address; organisation; schedule; purpose**	U.Ackermann-Liebrich; Peter Burney; Nino Künzli
Introductory Session	**EXPOSURE ASSESSMENT IN LONG-TERM EFFECT STUDIES**	**Chair: Jordi Sunyer** **Protocolleur: Patrick Mathys**
13.20 – 13.35	**Setting the Workshop framework: Air Pollution Expoure Assessment in ECRHS II: approach, current state, issues to work on**	Nino Künzli
13.35 – 13.50	**Exposure Assessment in studies on long-term effects of air pollution:** Summary and conclusions from a WHO/HEI workshop (Feb 4th-6th, Bonn)	Michal Krzyzanowsky
13.50 – 14.05	**Air pollution exposure research in the Austria Health Study (AUPHEP)**	Helger Hauck
14.05 – 14.20	**GENERAL DICUSSION ON THE INTRODUCTION SESSION**	All

Minutes of the Introductory Session

Title: **Exposure Assessment in Long-Term Effects Studies**

Presentations:

Nino Künzli: Setting the Workshop Framework: Air Pollution Exposure assessment in ECRHS II: Approach, Current State and Workshop Issues
For a summary see the presentation handouts

Michal Krzyzanowsky: Exposure Assessment in Studies on Long-Term Effects of Air Pollution
For a summary see the presentation handouts

Helger Hauck: Air Pollution Exposure Research in the Austria Health Study (AUPHEP)
For a summary see the presentation handouts

General Discussion:

1. The output of the workshop should primarily address the next steps in the ECRHS II study but may also help to plan future studies.

The minutes of this workshop should be done as mentioned in the distributed "instructions of the minutes of the rapporteur". The collected minutes will be sent to all participants for review. Corrections and suggestions will then be integrated in the final set of minutes.

2. With regard to Michal Krzyzanowsky's presentation it was mentioned that migrants may have an important influence in the ECRHS study design. The exposure assessment for this group can be very difficult.

   The question of misclassification is an important issue in long-term exposure studies. Misclassification could be reduced using validation strategies as applied in time series studies. This open question together with the problems of emigrants should be discussed in one of the workshop groups.

   The question arose whether pollen-levels can interact with the observed air pollution and therefore should be part of the ECRHS dataset. Since there are not enough data available in all ECRHS centres and the pollen interaction may only influence short-time studies but are of only minor importance in long-term investigations this issue will not be addressed by ECRHS II. Furthermore the pollen may differ significantly between and even within the centres and are therefore difficult to deal with. The same is true for the bacteria/microbe-air pollution interaction.

3. It was pointed out that the presented Austria Health Study (AUPHEP) is different as far as the sample and the exposure data are concerned. In ECRHS there are health data for many persons but only "a few" exposure data available whereas in AUPHEP an extensive amount of detailed exposure data will be collected, however, the sample size is not large.

   AUPHEP was funded with about 1'000'000 € and in addition about 600´000 € was given in form of instruments.

Patrick Mathys, 28.03.2002

Theme A	**The ECRHS Experience: monitoring PM2.5**	**Chair: Achim Heinrich** **Protocolleur: Guiseppe Verlato**
14:20 – 17: 15 with a coffee break of 15 min around 15:45	**Presentation of fixed site PM2.5 data across European ECRHS centers:** Purpose: This start-up presentations and discussions will lead to clarifying the key issues to be worked on in Day 2 (Results; Design; Quality, comparison with other measures of PM etc.)	Marianne Hazenkamp-Von Arx Thomas Götschi and others +plenary discussions

Theme A - The ECRHS experience: monitoring $PM_{2.5}$

Sunday 17 March 2002, 14.20 - 17.00

Marianne Hazenkamp, Thomas Götschi: Presentation of fixed site $PM_{2.5}$ data across European ECRHS centers.

Marianne Hazenkamp: Introduction and results from WP6: $PM_{2.5}$ concentrations

Discussion:
Gerard Hoek is surprised by the high values of $PM_{2.5}$ which have been recorded in Northern Italy. This pattern does not represent a North-to-South gradient, as in Spain much lower values were observed.

The high pollution levels recorded in Italy could be partly attributed to technical differences: in Southern Europe monitoring stations are usually located in "hot spots", close to traffic roads (JH).

However, a similar pattern has been observed by other studies: the APHEA study found high values of PM_{10} in Pisa and Athens (JH). Moreover, in Northern Italy high concentrations of particulate matter have been recently recorded by official monitoring stations, and as a consequence local authorities have adopted several measures to limit private traffic (no traffic allowed on Sundays, traffic permitted to cars with an odd number on one day and with even number on the following day) (MH, GV). So, WP6 detected some real regional differences (JH).

The high pollution levels recorded in Italy could be underlain by the peculiar meteorological conditions which are found in the three Italian centres during winter. Indeed Turin, Pavia and Verona are located in the plane of the Po river (Pianura Padana), surrounded by mountains on its northern, western and southern sides. During

winter, rainfall and wind are often absent, and thermal inversion often occurs. However, no correlation between $PM_{2.5}$ levels and average values of meteorological variables (temperature, rainfall) have been found in a preliminary analysis (MH). Such an analysis is limited by the short period of observation, including just one winter and one summer (UA-L).

Another possible explanation for the high levels of $PM_{2.5}$ levels recorded in Northern Italy could be the large utilization of motorcycles in Italy (BO, NK).

$PM_{2.5}$ monitoring has come to an end in all ECRHS centres, but Reykjavik where the measuring device has been moved from a traffic station to a background station (?) (MH). It is a pity and a waste that instruments which cost a lot are now underused or not used anymore.

Thomas Götschi: Introduction and results from WP6: NO2 concentrations

Thomas Götschi: Quality of the $PM_{2.5}$ data (Quality assessment, location, limitations, questions)

Discussion

$PM_{2.5}$ and NO2 concentrations present a high day-to-day correlation in some centres, but not in others. Apparently, there is no clear, systematic difference between the two groups (TG).

This problem should be addressed carefully (GH). When a high temporal correlation is found between $PM_{2.5}$ and NO2 concentrations measured at the same fixed site, this is likely due to traffic, i.e. traffic is probably an important source of air pollution in that area.

The monitoring sites should be evaluated thoroughly, using all available information: maps should be inspected watchfully, local authorities should be inquired (JH), elemental analysis and black smoke should be taken into account (PM).

In particular, one needs to consider the height of the monitoring station, the distance from the nearest road and traffic intensity in that road (GH), prevailing wind direction (DN), the presence of buildings and bus stops in the surroundings (HH). The height of the monitoring station is important especially for traffic stations, while it does not influence the measurements by background stations (GH). The linear distance between the monitoring station and the nearest traffic road is not enough per se to evaluate traffic exposure, one should also consider whether there are obstacles in between, such as large buildings, and whether the street is canyon-type or not (HH). The location of the monitoring stations with respect to traffic roads is likely to be more important for NO2 measurements than for $PM_{2.5}$ measurements (DN). Also prevailing winds can be very important: for instance, in summer particulate matter from continental Europe reaches Sweden (DN).

According to some discussants, the difference among monitoring stations could affect remarkably consistency of WP6 results. To overwhelm this problem, BO suggests to perform partial analyses on homogeneous subgroups of stations, such as traffic stations and background stations.

Nevertheless the WP6 data bring new, original and important information to our knowledge on air pollution. Inconsistencies among monitoring stations do not invalidate

the WP6 results, but rather these inconsistencies need to be taken into account in the interpretation of WP6 results (NK).

Marianne Hazenkamp: Quality of the $PM_{2.5}$ data (Quality assessment, location, limitations, questions)

MH suggests to avoid correction for blanks. This issue will be discussed in the workshop.

Annette Pfeifer, Helger Hauck, Joachim Heinrich: Design and method – strengths and limitations and comparison with other measures of $PM_{2.5}$

Presentation by Annette Pfeifer

Discussion

The assembly tries to explain why the WINS method measured higher concentrations of $PM_{2.5}$ in Goteborg but not in Umea.
Also in Paris the TEOM method failed to detect the peaks in $PM_{2.5}$ daily concentrations, which are seen with the WINS method (MH).
Goteborg has higher traffic density and more industrial activities than Umea, but the difference is not large. Both cities are located on the coast, Goteborg on the North Sea and Umea on the Botnia gulf, but the saline concentration of the North Sea is much higher than the saline concentration of the Botnia gulf (AP). Thus, the volatile substances lost in Goteborg with the TEOM method could be related to marine salt (AP).
According to studies performed in the US, the TEOM method fails to detect chloride volatile compounds and ammonium nitrate (BO).
Elemental analysis of the filters will bring insight into the differences between the two methods.

Presentation by Joachim Heinrich

Discussion

The debate arises from the observation that the difference between the values recorded in Erfurt with the "Basel-Sampler" and the "Harvard Impactor" was mainly due to differences in the sampling scheme. A random error occurred with the WP6 scheme, as in two months (January and September) the Basel-Sampler worked on the days with the highest $PM_{2.5}$ levels.

The sampling procedure used for the WP6 study surely determined an increase in random variability (noise) but it does not necessarily imply the occurrence of a systematic error (bias) (PB).

GH suggests to concentrate on the annual means rather than on monthly means, which are more affected by random variability. Another consequence of this random variability is that filling-in missing data is more difficult (MH).

General discussion

NK underlines that the present dataset, although collected with high accuracy and containing very important information, may not be comparable with other

measurements. It is important to make this point clear with local authorities, which can have different data collected with different methods.

Technical problems should be taken into account mainly when making comparisons between WP6 data and data collected with different methods, such as TEOM which is widespread across Europe at present (MK).

The WP6 data do not allow to evaluate short-term effects of air pollution on human health, as done in the SAPALDIA study. The only purpose of the WP6 is to estimate a valid annual mean (NK).

To summarise, selection of monitoring sites, sampling of time periods and data quality are major issues to take into account when interpreting the results of WP6 (NK).

Minutes by Giuseppe Verlato 2 April 2002

Day 2 Morning: Monday, 18.3.02: 8:30 –12:45

Theme B	**RETROSPECTIVE EXPOSURE ASSIGNEMENT WITH MONITORING DATA – OPTIONS**	**Chair: Ursula Ackermann-Liebrich** **Protocolleur: Linnea Lillienberg**
8:35 – 8:55	**Critical evaluation of the historic air pollution: can it be used for ECRHS cross-sectional study analyses?** **including 5 min discussion**	Joachim Heinrich
8:55 – 9:25	**Input presentation**: Using Economic indicators to model background air pollution; validity and feasibility. The Global Burden of Disease experience **including 10 min discussion**	Bart Ostro
9:25 – 9:55	**The University of South California Children Health Study: Exposure assignment and effects: past – present – future** **including 10 min discussion**	John Peters

Theme B: Retrospective Exposure Assignment with Monitoring Data-Options

Critical Evaluation of the historic air pollution: can it be used for ECRHS cross sectional study analyses? *Joachim Heinrich*

A historic database is useful for assessing cumulative long-term exposure to air pollutants. The data in the database has been shown to highly correlate with current data, but there were exceptions. There are very few values between 1980-1990 in the data set. There is a need to do validation studies of the historic data. A lot of effort has to be put in to evaluate the air pollution data and to analyse the material. The next steps are to evaluate methods used and validate the data to categorise centres. The spatial variability between centres has to be calculated and temporal changes of air pollution levels must be analysed within each single centre. See copies of slides and the WP5 final report "Historic Data of Ambient Air Pollution in 37 European Cities of ECRHS I and II by Nino Künzli.

Discussion
A comment was that differences between centres were less in the last years (98-99) and that only centres with high differences should be used to categorise centres. It was also commented that routinely monitored data couldn't be used to estimate spatial variability within centres.

A subset of data and distance from the street could be used in a regression model to evaluate influence of distance. If there are good data of traffic and population density such a regression model can be used. It seems that 9 out of 30 centres had objective data on traffic density.

A remark was that an important question for the workshop B was if we can use the early nineties data. An answer was that we do not need to have the absolute truth. It is enough to look at the relative truth just to see how much the exposure reflects differences between centres.

Input presentation: Using economic indicators to model background air pollution; validity and feasibility. The Global Burden of Disease experience. *Bart Ostro*

There is a short abstract of the background for estimating PM Concentrations for the Global Burden of disease and 10 slides from the presentation in the material given to the participants of the workshop.

In the estimating of PM concentrations for the Global Burden of Disease, the impact of 20 risk factors was used including ambient air pollution. Attributable mortality risk were calculated for 3200 cities with > 1000,000 people. PM 2.5 and PM10 were used in the calculations. The data collected varied substantially with 75% from US and Canada, 21 % from Western Europe, 1 % from Africa and nothing from other regions. To estimate PM10 concentrations in all world cities with population >100 000 with lacking data an econometric model developed by the World Bank was used. This model was a function of energy intensity, economic intensity (GDP/km²) and population density and size. Results of the city model gave R^2 of 0.88. Correlation of estimates for 1999 was 0.87. All 7 factors used in the model contributed to the explanatory power of the model. However, the data shown are preliminary and were not presented graphically.

Discussion
The investigation gave very optimistic results and a question was if it was possible to use the World Bank Data on income etc. and do the same calculations with our data. Bart Ostro's answer was yes. Another remark was that economic data gives a different tool, which could bring us closer to sources, which is different from e.g. traffic intensity. A more critical comment was that we are making a tremendous job in the measurement part and extrapolating beyond this domain gives a lot of extrapolation.

There was a discussion on how predictive the model is. Bart Ostro answered that you can look at the outcome from the model. You can e.g. hypothesize why Turin falls outside the other centres, with the sites of the sampler a few m from a high traffic street.

Interactions between Europe and Africa cannot be used in the model but it might be possible to stratify for Eastern and Western Europe.

A conclusion from the discussion was that we have nice PM2.5 measurements. We could look at the economic model and use other factors, which we have, like traffic intensity and population.

The University of Southern California Children Health Study: Exposure assignment and effects: past – present – future *John Peters*

Are chronic respiratory effects caused by Southern California air pollution? A study to investigate this started in 12 communities 1993. In at least one station per community there were hourly measurements of O_3, NO_2, PM10 (TEOM) and two-week PM2.5 (filter) and two-week acid vapour. The children were investigated about different activities together with health outcome. In total were 6000 children of different age enrolled. People living close to intense traffic had significantly higher exposure to PM and other traffic pollutants. The results showed that the higher the traffic density the higher the asthma risk. Host factors like sport intensity influence the risks of getting asthma as well as genes and diet.
See copies of the 31 slides given to the participants.

Discussion
There was a discussion about the results that showed that children, who had moved from high to low pollution areas had an increase in the lung function growth rate whereas those moving from low to high pollution regions had a reduced growth during the four years observation time.

General discussion
There was a discussion that airport information on visibility and distance to the airport could be used to calculate individual doses and spatial variability instead of doing more measurements. Other did not see this information as useful.

Theme C	**SOURCE SPECIFIC AIR POLLUTION EXPOSURE ASSIGNMENT: OPTIONS?**	**Chair: Lucy Oglesby** **Protocolleur: Annette Pfeifer**
10:20 – 10:35	**Input presentation:** Assessing exposure to heterogeneously distributed source specific pollutants: assessing proximity to traffic. A review	Gerard Hoek
10:35 – 10: 50	**Input Presentation:** Source specific tracers of homogeneously distributed 'background pollution' based on the results of the EXPOLIS study	Patrick Mathys
10:50 – 11:05	**Input presentation**: Black smoke – a source specific cheap indicator. The EXPOLIS experience	Thomas Götschi
11:05 – 11:25	**General Discussion on Theme C**	All

Theme C, Monday 18 March 2002

Source Specific Air Pollution Exposure Assignment: Options

Input presentation: Assessing exposure to heterogeneously distributed source specific pollutants: assessing proximity to traffic. A review

Questions and discussion:
Was NO_x used in the studies?
Answer: No. Many sampling prints are needed. NO_x (primary emission) might not be better than NO_2 (aged emission). Most advantageous would be to measure both NO_x and NO_2.

On slide 20 the figures for benzene indoor and outdoor are switched, indoor value is lower than outdoor value.

VOC can be used as traffic marker for spatial variability.

Input Presentation: Source specific tracers of homogeneously distributed background pollution based on the results of the EXPOLIS study.

Questions and discussion:
Elemental composition of $PM_{2.5}$: For elemental analysis outdoor samples were used due to bigger mass concentration.

Correlation indoor/outdoor for $PM_{2.5}$: Correlation not very good due to additional indoor sources.

Helsinki differs from other cities which seems to be an analytical problem because the concentrations are close to detection limit.

Input Presentation: Black smoke – a source specific cheap indicator. The EXPOLIS experience.

Questions and discussion:
Since carbon behaves differently at different temperatures and different compounds are formed the question is whether this could lead to incorrect values? Black smoke is a direct measure for elemental carbon (EC) and since EC is the dominant light absorbing substance in the atmosphere the BS measurements are precise enough.

BS is a better indicator for Diesel traffic than $PM_{2.5}$.

General discussion on Theme C
No further questions on Theme C, but a comment on Theme B:
Visibility measurements (as used on Air Ports) are not used in our studies. Visibility could be a good indicator for fine particles. Correlation between particle measurements and visibility were studied in the U.S.. There the model was used for city specific values.
The method might not be relevant for the general population because Air Ports are usually far away. Even for long term studies visibility can be difficult to use.

Theme D	**SPATIAL VARIABILITY OF POLLLUTION: A CHALLENGE FOR THE ASSIGNMENT OF LONG-TERM EXPOSURE**	**Chair: Deborah Jarvis** **Protocolleur: Simona Villani**
11:25 – 11:40	**Input presentation:** Information on spatial variability of NO2 in the SAPALDIA cross-sectional study: was it helpful? Strenghts and Limitations	Christian Schindler
11:40– 11:55	**Input presentation:** Critical evaluation of the spatial variability information in the historic ECRHS monitoring data – interpretation, gaps, challenges	Josef Cyrys
11:55 - 12:45	**Within-area passive sampling NO2 assessment in ECRHS centers:** **flashs from local partners presenting their local study purpose, questions, designs, preliminary results (only 5 min. per speaker; not more then 3 overheads per person)**	Organisation: Marianne Hazenkamp speakers: Annette Pfeiffer Lars Modig Josef Cyrys Jordi Sunyer
12:30 – 12:45	**General Discussion on Theme D**	

Session D: Spatial Variability of pollution: a challenge for the assignment of long term exposure.

Input presentation: Information on spatial variability of NO2 in the SAPALDIA cross-sectional study: was it helpful? Strengths and limitations.

CS presents results from SAPALDIA Study summarising methods used too. He underlines that something might be improved, using outdoor home measurement and data on activity to estimate personal exposure.

Discussion

KH asks which kind of information is put in the model. CS answers that a lot of information was taken into account, among them distance from the road. LO explains that in SAPALDIA a correlation between scale of disturbance and mean levels of NO2 concentration by area was found rather than with the mean individual levels of NO2 concentration.

GH asks if there are differences among subjects with and without problems respect to scale. LO answers this aspect was taken into account and differences by gender and symptoms appeared.

Input presentation: Critical evaluation of the spatial variability information in the historic ECRHS monitoring data – interpretation, gaps, challenges.

JH reports briefly the results from spatial variability in Erfurt. To study spatial variability of NO2 concentration, two regression models were made. In the 1st model as explanatory variables were put only information on traffic categories (main street, …) and down centre vs. outskirts; in the 2nd model, GIS information (such as traffic intensity and population density) was put besides street site vs urban site and distance from the road. He concludes that about NO2 using data of only one central site for exposure assessment chronic effect studies might be biased. If traffic and population density were used, the bias might be reduced.
So he recommended using GIS information.

Discussion

BO asks where GIS data are taken. JH explains it was used a database from local authorities. Besides he precises that it was established the kind of place (i.e. street site) in a standardised way. It is discussed the nature of homogeneity areas: JH underlines different models lesser or more complex may be used to evaluate homogeneity.
PB says the models may be used as descriptive goals and not predictive one. JH does not agree. According to him, model derived from German towns might be applied to other areas such as Stockholm, since the model is very similar for different areas.

Conclusion

It seems useful using GIS data to build models which might be applied to others subjects. Nevertheless, there is the risk to have too much information (DJ).

Results from NO2 at home protocol (MH and TG)

MH presents a summary of NO2 at home protocol and a table with the centres participating. TG presents the results.

Conclusion

DJ underlines only a few numbers of centres are taking part to NO2 at home protocol, since it was not funded.

Results and model from Umea (LM)

LM presents preliminary results for NO2 at home protocol for Umea. A low correlation between NO2 indoor and outdoor appears**.**

Discussion

GH is surprised by low correlation found and suggests to study annual mean instead of seasonal mean. On the contrary JH underlines the necessity to adjust for season.
DJ remembers to every body the peculiarity of Scandinavia centres respect to the others ECRHS centres (more than 150,000 inhabits and a sampler for screening phase of study >3000 subjects).

Conclusions – According to DJ it is very important to evaluate the information deriving from all collected data, establishing some priority. NK agrees with the necessity to understand what it may be done as soon as possible. JS points out that even if there are a lot of data, it will be impossible to analyse them completely. JH says that PM2.5 concentrations are good proxy of indoor ones.
Finally, NK remembers that the goal is to derive valid long-term exposure for the use in the outcome related analysis.

Day 2 Afternoon: Monday, 18.3.02; 13:45 – 17:00

Parallel workshops in small groups. If a working group has achieved their goals, participants may join other groups

Time	Issue	Who
13:55 – 17:15	**WORKSHOP IN PARALLEL GROUPS ON THE FOLLOWING TOPICS** (details: to be developed according to needs)	
Workshop A	**PM2.5 IN ECRHS CENTERS** should cover all the methodological and results related issues as outlined in Theme 1	**Chair : Dan Norback** **Protocolleur: Annette Pfeifer**

Workshop A: PM2.5 in ECRHS Centers

Participants: Marianne Hazenkamp, Annette Pfeiffer, Simona Villani, Helger Hauck, Dan Norback, Peter Straehl,

1. Missing data

Discussion about how missing data or short sampling time is handled.
Decision:
Time Weighted Average is used.
If necessary extrapolated values from PM10 or PM2.5 measurements by local authorities will be applied.

Center by center

Verona: 4 months missing. Verona will be included in the report, but marked. In order to fill in missing data the data from Turin and Pavia are used for comparison. In addition other local measurements can be used.
Antwerp City: December missing, can be estimated from Antwerp South.
Ipswich: March only one value, cannot be used as a monthly mean.
Galdakao: February missing. December low concentration due to strong wind. Location must be considered, too.
Oviedo: Low concentration indicates some failure in sampling, element analysis will give more information.
Umeå: October missing. Due to low variability October does not need to be filled in.
Reykjavik: October excluded due to bad location (chimney). Then pump was moved to other location.
All remaining centers: o.k.

2. Storage of filter

Two centers did not store filters in fridge, which should be indicated in the paper. But since the filters are not cooled during mailing process there is some fault for all centers.

3. Blank discussion

Decision
In 1st paper no blank correction.
Later: Variance analysis with all blanks from all centers is suggested. Ref. to EXPOLIS, subtract 17 µg. For later calculations only the blanks with closed lid are used.
Decision
Marianne will come up with a proposal, which is discussed in a special e-mail-discussion group.

4. Location

In some centers the measuring equipment was placed close to a street. After discussions about further measurements in some centers it was decided that the location issue is treated in discussion part of the 1st paper. Later a location assessment has to be done, if possible by an independent person.

5. Papers

- Marianne: End of April draft on 1st paper will be finished. Methodology and results from winter data, including tables, location, sampling scheme, quality, winter mean and daily variability.
- Second paper will include annual mean, seasonal variability.
- Suggestion for a paper to explain the big variability among the centers, interpretation of an air hygienist (could be a person outside our group).
- Annual concentration vs true annual concentration in centers with high variability. Annette/Achim, comparison with other methods.
- Representative year: Later publication.

Workshop B	**RETROSPECTIVE EXPOSURE ASSIGNEMENT IN ECRHS What can we do to improve what we have? What can it be used for, what not? Needs, options, outline of next steps, etc.**	**Chair: Gerard Hoek** **Protocolleur:** **Achim Heinrich**

Workshop B: Retrospective Exposure Assignment in ECRHS

What can we do to improve what we have? What can it be used for, for what not? Needs, options outline of next steps etc.

March 18th, 2002, 14.00-17.00
Chair: Gerard Hoek
Rapporteur: Joachim Heinrich
Members: Sara Downs, Bart Ostro, John M. Peters, Roberto de Marco

We discussed the following key issues:

1. Ideal data set
2. Time window of exposure
3. Across center comparability
   3.1. Representativeness of exposure measure, selecting of sites
   3.2. Measurement methods
4. Gaps in the data
5. Errorness data
6. Other data sources

Ad 1
The ideal data set would be representative and standardized data set for all centers going back to 1980. However, what we have is limited in several aspects: only few data before the year of the first medical exam in 1990; etc.
We have to start with data that have been collected during the past 2 years. Availability of data on smoking is very important for adjustments.

Ad 2
The relevant time window depends on the question you were asking: we will have mainly 2 designs: cross-sectional and longitudinal. In particular for the cross-sectional approach of the first examination in 1990 we could include a large number of ECRHS centers (n=37). However only few data prior 1990, in particular for particle measurements inavailable. Additional to the cross-sectional study approach longitudinal studies are very important even data of a smaller number of centers could be used.

Ad 3
Across center comparability
Ad 3.1
Representativeness of exposure measures

What we need is an average population exposure. Whether to include data of all sites or not?
We recommended to start with looking at the data of all sites we have. Independent from air pollution the sites might be ranked according to influence of traffic-related emissions. The data of site description is a good presumption for site ranking. As specific criteria it was discussed: to rank the sites according to traffic flow within a 100 meters distance (high ≙ 10,000 cars/day). Other suggestions were to look at NO, mostly as NO/NO_2 ratio or at the ratio of NO_2/O_3. Information on classification of sites by agencies (zone + site) should be collected. The aim is to set up a 'clean data set' = comparable data; equally dirty, exclusion of centers should be minimized.
Criteria should be established for ranking the sites. On this basis a subset of 'clean data sets' should be determined for each single pollutant and by year.

Ad 3.2.
Methods
Gaseous measurements: less a problem; again we should start with centers with similar methods, but in a second step we should also include centers, which used none 'standard-methods'.
Particulate Matter: methods deviated from standard methods should not be excluded, deviation should be described.
It was recommended to start with the cleanest data set first. 'Clean' might mean: same methods or methods that have been documented to be the same. For particle concentration data only β gauge data should be used first. If comparability between TSP and PM_{10} could be shown, the TSP might be converted into PM_{10}.
Rec: With respect to the TEOM data we have to ensure that the data were corrected or were not corrected in all centers. It was recommended to convert TSP into PM10 data under specific circumstances: conversion factors were calculated for this specific area or a similar area; parallel data sets must be available for that specific period we are interested to convert the data.

Ad 4
Gaps in the data
PM_{10} data might be derived from TSP, but not $PM_{2.5}$. Furthermore, imputation of missing data on the basis of high correlation with other pollutants is not recommended.

Ad 5
Errorness data
Still have to look from where the averages were derived. There could be still systematic errors in it. Missing data at crucial times. Quality control

Ad 6
Other data sources
Visibility index at airports + humidity data could be used to estimate $PM_{2.5}$, even in the past. There is a protocol of QA/QC. An additional data set could be provided which might be important for a retrospective assessment of $PM_{2.5}$ exposure.
Economic data to predict PM_{10} (but not $PM_{2.5}$)
World Bank has estimated PM_{10} data from 216 cities (> 100,000 size) on the basis of economic data.

The idea would be to use this model to predict what the levels would be in the European cities. If we do not have data on PM_{10} we could predict.

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2 Setting of priorities

During the plenary session on Wednesday, March 19th, 2002 the following points were added.

1. Highest priority has setting up a group of centers with mostly clean data (comparable data) with respect to site selection (representing average air pollution exposure of the population) and methods
2. Prediction models for PM10 on the basis of economic data should be given a higher priority than collection of visibility data (plus humidity) at the airport.
3. Highest priority has to have a clean data set on air pollution first before doing health analyses.

Workshop C	**SOURCE SPECIFIC AIR POLLUTION EXPOSURE ASSIGNMENT: BLACK SMOKE AND OTHER ACTIVITIES WITH ECRHS PM2.5 FILTERS**	**Chair: Nino Künzli** **Protocolleur: Jordi Sunyer**

Workshop C: minutes by J.Sunyer and T.Götschi

Participants: Lucy Oglesby, Nino Künzli, Jordi Sunyer, Peter Burney, Patrick Mathys and Thomas Götschi

Conclusion 1
A main criterion for sources of interest is their policy relevance.
Conclusion 2
The main source of interest is traffic. For all other sources the available data is probably insufficient (Industry, incinerators, etc.). In ECRHS there is a wide range of traffic-related information available, such as:

-NO2 measurements at fixed sites and spatially distributed (at home)
-Elemental analysis (Pb, Zn, etc.)
-Measuring sites characteristics (streets and traffic volume)
-objective data on traffic volume in some cities
-socio-econometric data

Conclusion 3
Reflection measurements (black smoke) on the PM2.5 filters would provide an additional traffic specific indicator. We therefore recommend to measure black smoke on the ECRHS-II PM2.5 filters.
Conclusion 4
In comparison to PM2.5 and other measurements reflecting background air pollution (e.g. sulphur from EAS), traffic indicators are expected to be more heterogeneously distributed within study areas. The choice of the measuring site is therefore expected to have an important influence on the measured levels. We discussed several approaches to handle that problem and agreed on the necessity to develop a tool, which standardizes the measured levels with regard to the characteristics of the site they were measured.
Conclusion 5
such a tool would result in a correction of the measured levels of pollutants that are expected to be influenced by traffic (black smoke, NO2, etc.).
uncorrected data may confound the results for example due to different “site selection philosophy” in southern European countries.
the corrected data would be used for health analysis.

Oxidative capacity, sulfates, and organic compounds are further measurements which could be conducted on the filters, although all of these are destructive.

A correction for exposure levels on an individual level could only be done for NO2, if at all.

Thomas Götschi

Workshop D	**SPATIAL VARIABILITY: PLANS WITH THE NO2 DATA: what can we do, will we combine the data? how, who, when, main local questions,**	**Chair: Christina Luczynska** **Protocolleur: Lars Modig**

ECRHS- meeting Basel, 2002-03-17 – 2002-03-19

Minutes from workshop theme D

Workshop title:

Within-area passive sampling NO_2 assessment in ECRHS centres

Workgroup participants:
Deborah Jarvis
Christina Luczynska (chair)
Linnéa Lillienberg
Lars Modig
Giuseppe Verlato

Aim

To get the best possible measurement of the population's exposure to NO_2 from the fixed site measrements.

Key Issues

- What would be the effects of spatial variation in NO_2 in the ECRHS
- What contributes to spatial variation of NO_2?
- How can we use available data to measure spatial variation?
- What decisions need to be made about spatial variation?
-

Discussion
Why do we measure NO_2 at home?
This was done as a complement to the questions concerning gas cooking and to further investigate the heterogeneity found in the relationship between gas cooking and respiratory symptoms between centres. The outdoor measurements would be used for calculating the indoor/outdoor ratio to further explain the contribution of gas to the indoor levels.

To be able to investigate the spatial variability within a city, the measurements at home should be compared with the results from the fixed station during the same time period. The fact that not all at home measurements have a corresponding value from a station measuring point limits the use of the results. This means that we should primarily focus on the seven centres (Umeå, Reykjavik, Tartu, Basel, Verona, Huelva, Oviedo) that have simultaneous measurements at the fixed site and at the homes taking part in the Indoor protocol and, secondarily, look for single measurements that by chance were simultaneously carried out. If 12 out of 14 days overlap the measurements can be considered simultaneous.

In the comparison between fixed and at home measurements we should look for factors affecting the variability. Traffic, measuring height, distance to roads, season, questionnaire data on distance to road are possible factors. We should also analyse the variability between different home measurements.

The measurements at home are not randomly selected which will be a problem if we what to use the results to describe the spatial variability within a whole city.

Plenary discussion and open questions
Is it possible to use the available within city data to estimate the exposure for all participants within the same city?

We need better adjustment for time not only by season. We have to look at more specific time periods. Jordi Sunyer suggested that available data from fixed sites can also be used for estimating the annual mean home level for individuals.

Dan Norbäck proposed a more crude approach to estimate exposure by using information on traffic intensity around each house.

It was also suggested that dispersion models could be used to describe the spatial variability - this is the approach proposed in a Swedish study. Another suggestion from Achim Heinrich was to divide each city in different exposure zones and use this to classify the exposure.

It was finally proposed that we should concentrate on the descriptive report of the data before any further analyses are done.

Proposed decisions and responsibilities

- The Co-ordinating Centre in London will provide a descriptive report of the NO_2 data. This will include identifying centres with concurrent measurements, but also measurements that were concurrent by chance. Analyses of factors that affect the variability between 'fixed and home' and 'home and home' will also be performed.
- Centres have to agree for the data to be used/summarized.
- An e-mail discussion group will be started, for further discussions concerning the data.

Timetable

The fixed site measurements are already available. Work on the home measurements can begin when all centres have completed measurements and the data set is prepared in Basel.

Rapporteur Lars Modig

Day 3 Morning: Tuesday, 19.3.02

Plenary to summarize all the main Group work, define tasks, and ev. even take time to WRITE things down, if not already done !

Time	Issue	Who
(if still needed: 8:00 – 8:30	**(Program Day 2: organisation: Meeting of the Coordination Group and the Workshop Group Chairs to plan the day)**	
8:30 – 8: 50	What's next in the Working Groups: Short summary of the Chairs Organisation / re-grouping for Workshop	All Chairs
preliminary schedule: 8:50 – 11:00 including coffe break	**Working Groups continue**	all
11:00 – 13.15	**Plenary:** Summary feedback on decisions from the Working Group Discussion Next steps: how does what until when	
13:15 – 14: 15	**Lunch and adjourn**	