Department of Natural Resources and Environment (DONRE) Ho Chi Minh City

NORAD
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Ho Chi Minh City Environmental Improvement Project
Air Quality Monitoring Component

Mission 5, November 2004; Status report (QR10-11), Understanding air quality and data dissemination

NILU
Norwegian Institute for Air Research

HEIA
Ho Chi Minh City
Environmental Improvement Project
Air Quality Monitoring Component

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Mission 5, November 2004; Status report (QR10-11), Understanding air quality and data dissemination

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List of Abbreviations

ADACS	Automatic Data Acquisition System
AQI	Air Quality Index
CO	Carbon monoxide
CEN	European Committee for Standardisation
CLRTAP	Convention on Long Range Transport of Air Pollutants
DANIDA	Danish International Development Assistance
DONRE	Department of Natural Resources and Environment
DOSTE	Department of Science, Technology and Environment.
EDC	Environmental Data Centre at DONRE
EPU	Environmental Protection Unit
GIS	Geographical Information System
HCMC	Ho Chi Minh City
HEIA	HCMC **E**nvironmental **I**mprovement Project **A**ir Quality Monitoring component
HEIP	HCMC **E**nvironmental **I**mprovement Project
ISO	International Organization for Standardization
NEA	National Environmental Agency
NILU	Norwegian Institute for Air Research
NO_2	Nitrogen dioxide
NORAD	Norwegian Agency for Development Cooperation
MPI	Ministry of Planning and Investment
PM_{10}	Particulate matter with diameter Less than 10 micrometer
$PM_{2,5}$	Particulate matter with diameter Less than 2,5 micrometer
PIU	Project Implementing Unit (PIU)
QA	Quality Assurance
QC	Quality Control
SO_2	Sulphur dioxide
SOP	Standard Operating Procedures
SVN	Schmidt Vietnam Co. Ltd

1 Task 1. The AQ system for HCMC

1.1 Introduction

The Norwegian Institute for Air Research, NILU, has been appointed to undertake the NORAD funded part of the air quality monitoring component of the Ho Chi Minh City Environmental Improvement Project (HEIP). The NORAD supported part of the project (phase 2) is based on a DANIDA funded (phase 1) project, and it is a component of the ADB funded Ho Chi Minh City Environmental Improvement Project. The UNDP through the "Environmental Management Ho Chi Minh City, Air Quality Monitoring Project" was responsible for phase 1 of the project,

The Executing Agency for the **H**o Chi Minh City **E**nvironmental **I**mprovement Project **A**ir Quality Monitoring component (HEIA) was the Department of Science, Technology and Environment (DOSTE). After re-organisation of DOSTE the Department of Natural Resources and Environment (DONRE) has taken over the responsibility. A Project Implementing Unit (PIU) has been established under the HEIP programme, and this will co-ordinate and manage all activities required for the daily implementation and management of the components, while reporting and maintaining continuous contact with the MPI. The PIU will be responsible for the administration and supervision of the implementation of the Air Quality Monitoring component.

The NORAD project undertaken by NILU has now been established and is being operated by trained DONRE experts. During the last year DONRE has received training and is operating both the measurements as well as the air quality management system AirQUIS. Mission 5 to HCMC was undertaken from 4 November to 4 December 2004, and included:

- Sign agreement for the establishment of a Reference Laboratory and continued institutional building
- Upgrading the AirQUIS system and continue training local experts
- Data quality controls of air quality and meteorological data
- Continue collecting emission data for modelling purposes
- Perform some model test runs using new input data
- Discuss the establishment of a Reference Laboratory including time schedules for instrument purchase and testing
- Prepare paper on air quality in HCMC

- Prepare input to a state of the air quality report for HCMC based on the on-line data collection
- Status and final reporting of the HEIA project.

The daily schedule for Mission 5 is presented in Appendix A1

A brief status report of the HEIA project was prepared in connection with the Review team from the Norwegian Pollution Control Authority (SFT) who visited HCMC 11 to 16 November 2004. The Review Team had planned meetings with HEPA and with the NILU project manager in Ho Chi Minh City in November 2004.

Installations, training, data follow-up and reporting have been elements already in place at DONRE/HEPA. A follow-up programme including the establishment of a Reference laboratory as well as further training and institution building has been developed and presented to NORAD.

The following tasks and topics related to the project were briefly described in the memo, prepared for the review team:

- Instrument installations and audits
- System integration
- Database and planning tool (AirQUIS installation)
- Data collection and management
- Data assessment, interpretations and air quality status
- Input data for modelling (emission data collection)
- Capacity building
- Reference laboratory and further training

The project has been undertaken according to the original plans and contracts, and has also been kept within the estimated budget available. For further details see Appendix A2.

2 Task 2. Design and update

2.1 Monitoring sites operated

A final updated list of monitoring stations were prepared in connection with discussions about a possible health related project to be conducted by the Asian Development bank. The table below summarizes the stations, station characteristics and positions.

Table1: Air pollution measurement sites in HCMC, site characteristics and positions.

Stations				Indicators					UTM 84 N	
ID	Code	Name	Charact.	PM10	NO2	SO2	O3	CO	X coordin (m)	Y coordin (m)
1	DO	DOSTE	Traffic		X	X	X	X	684,430	1,192,220
2	HB	Hong Bang	Traffic		X		X	X	681,620	1,189,460
3	TD	Thu duc	Res/Ind		X	X			693,640	1,199,790
4	TS	Tan Son Hoa	Urb Bkg		X	X	X	X	682,830	1,193,930
5	TN	Thong Nhat	Traffic	X	X	X		X	680,690	1,193,530
6	BC	Binh Chanh	Traffic	X	X	X		X	674,500	1,183,000
7	ZO	Zoo	Urb Bkg	X	X	X	X		686,420	1,193,370
8	D2	District 2	Res/ind	X	X	X	X		691,160	1,193,510
9	QT	Quang Trung	Urb Bkg	X	X	X	X		677,940	1,200,080

A map of HCMC with the locations of the nine sites is presented in Figure 1. The five stations established by NILU as part of the NORAD financed programme seem to be working well, while several of the instruments installed by the Danida project was presently out of operations. Some of the instruments may be repaired as soon as spare parts are being made available.

However, the PM_{10} monitors delivered by the Danida project all seem to be out of function, and cannot be repaired. HEPA has expressed need for additional PM_{10} monitors. This is not possible within the NORAD budgets.

Also the meteorological equipment is still not working well. It is of utmost importance that these instruments will work in the future and NILU is looking into the possibility of replacing some of the sensors in the near future.

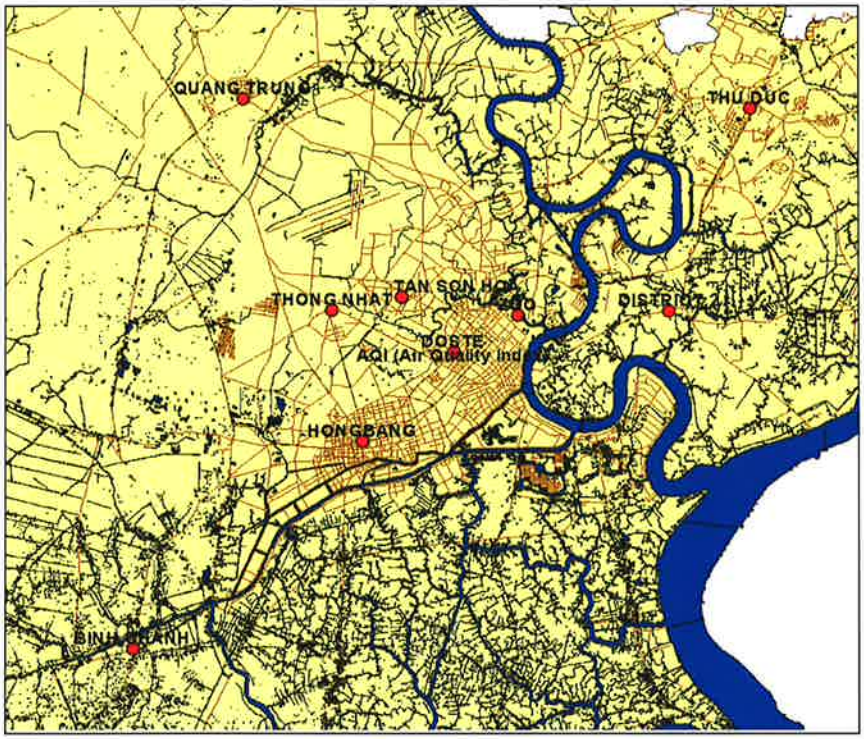


Figure 1: The location of the nine automatic air quality monitoring sites in HCMC.

3 Task 3. Procure and install

3.1 Specifications

All basic instruments as well as computer equipment needed to operate the air quality monitoring system including the GIS based air quality database and planning system has been delivered and was specified in Appendix C of Mission report 3.

NILU has been co-operating with HEPA during the last few months to specify and support in defining the necessary spare parts for operating the system. See also Ch. 8.4.

In August we specified that the consumables covered by the project is about 70.000 NOK. The extra 5 OPSIS internal modems, which had been requested from HEPA cost 3.570 NOK each.

NILU prepared and sent the consumables and the modems as one package with the value of app. 90.000 NOK for the packing list and Proforma Invoice. HEPA received a separate invoice for the modems.
NILU also prepared s spare part inquiry to the API Supplier regarding price and delivery time. The costs for these spare parts were covered by HEPA.

3.2 AirQUIS installations and modifications

Installations of AirQUIS at HEPA were undertaken on 3 –5 November 2003. Improvements and modifications were implemented during the Mission 5 in November 2004.
A list of deliveries connected to the AirQUIS work during Mission 5 is presented in Appendix C

4 Task 4. Assure system integration

4.1 Evaluate OPSIS system and improve routines

NILU extended the existing data retrieval system from 4 to 5 new measurement stations supported by NORAD. All 9 stations are now operating well in the total system. ENVIMAN Comvisioner supported by the DANIDA project is running well at together with the NORAD supported AirQUIS database and management system at HEPA..

4.2 Integrating the existing data retrieval system into AirQUIS

Data are automatically entered into the AirQUIS database and data quality controls have been improved during the Mission 5.

The automatic import module and the automatic AQI routine, which was implemented from November 2003 is working well. The figure below shows an example of the AQI values produced by AirQUIS every day during 2003.

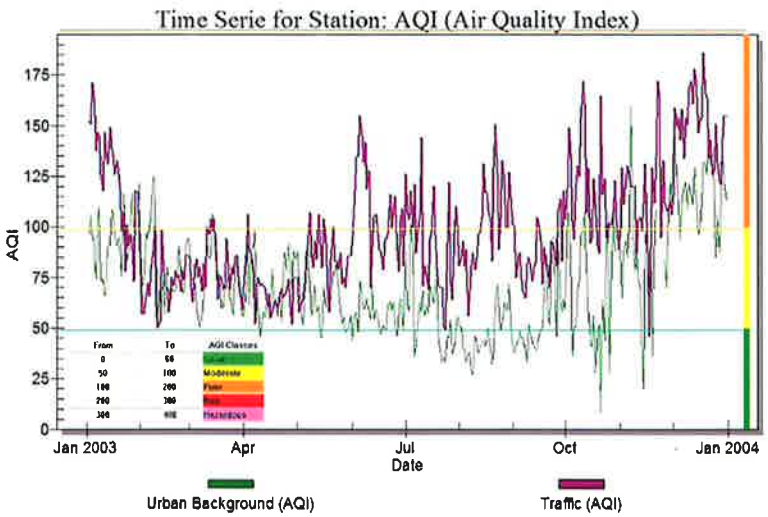


Figure 2: Daily AQI values in HCMC for traffic sites and urban background sites, 2003.

Figure 2 shows the daily AQI for traffic and urban background environments in HCMC for the year 2003. The AQI values generated based on data from traffic stations are generally about 60 % higher than those generated from urban background stations. The air quality is most often characterised as moderate to poor.

5 Task 5. Quality Assurance (QA/QC)

5.1 Design QA/QC and documentation materials

Data collection is being followed up on a daily and weekly basis using the QA/QC procedures prepared by NILU. The field operations require that trained monitoring experts are visiting the stations every week. Other experts have been trained for using the data retrieval systems and the databases. QA/QC at all levels is an important issue that should be kept alive through regular auditing of the system, also in the future.

Some of the field operators or special assigned experts will be responsible for maintenance, repair and calibrations. The instruments in question contain:

- Automatic gas monitors
- Automatic ambient suspended particle monitors
- Automatic Weather stations

The establishment of the Reference and maintenance/repair laboratory will ensure that the programme will sustain good quality.

5.2 Quality control at data retrieval

The daily control of the data is manually undertaken as soon as data have been retrieved. Data checks and data quality is being registered in a daily data validation manual.

The quality of data in the final database was checked and verified during Mission 5. It was found that the follow-up of final data quality including identification and flagging of errors had not been followed up adequately. New routines for printing and additional controls of data were developed and implemented.

A short description of the new quality routines is presented in Appendix E1. These will be checked at the next mission during the establishment of the Reference Laboratory.

5.3 QA/QC training

Additional training concerning quality assurance, calibrations, repair and maintenance will be performed as part of the establishment of the Reference Laboratory at HEPA.

Through the statistical assessment and evaluation of data for the first two years of measurements it has been seen that quality routines will have to be updated. All routine operations and the use of standard operational procedures (SOP) and monitoring operations seem to have been followed up adequately. This will again be checked during the next phase of the project.

5.4 Station Audit descriptions

Simple station audits were performed during Mission 4. More detailed audits will be undertaken at the beginning of the Reference laboratory phase of the project. Visits to the stations during Mission 5 have proven that all station- and instrument logbooks are adequately followed up. The stations are kept clean and in good order.

Some instruments were out of order due to lack of spare parts. These are now being ordered and instruments will be repaired and set in operation again.

5.5 Data corrections for wind and temperature

The meteorological sensors, however, are still not functioning according to expectations. Much work was undertaken during Mission 5 to correct and produce "new" and improved data needed for the operations of the database and some of the statistics to be performed on the air quality/meteorological data.

Correction factors introduced for obtaining better wind direction data are shown in Appendix E2. Similar procedures were used to create a lower temperature parameter based on the measured temperatures at 30 m level on the tower (upper temperature), See Appendix E3.

We concluded again that some of the sensors might have to be changed in the future.

6 Task 6. Install and improve AirQUIS performance

6.1 Prepare AirQUIS platform and GIS

The AirQUIS system was installed at during Mission 3 in November 2003. The PC server and the client PC was then connected to the existing network in the DONRE data centre.

The GIS maps and different layers and shape files have also been installed and tested. The following topics are completed:

- Administrative regions for HCMC are completed.
- Measurement station sites are completed.
- Main roads and road links
- Rivers and water ways

The stack coordinates available have to be checked and corrected again. New roads, which are being counted, now need to be incorporated.

HCMC administrative region for 24 districts, 9 measurement stations, 45 stacks, 63 roads and a grid of 43 EW and 35 NS with 1 km resolution have been entered and verified.

The status of the AirQUIS GIS platform can be seen in Figure 3.

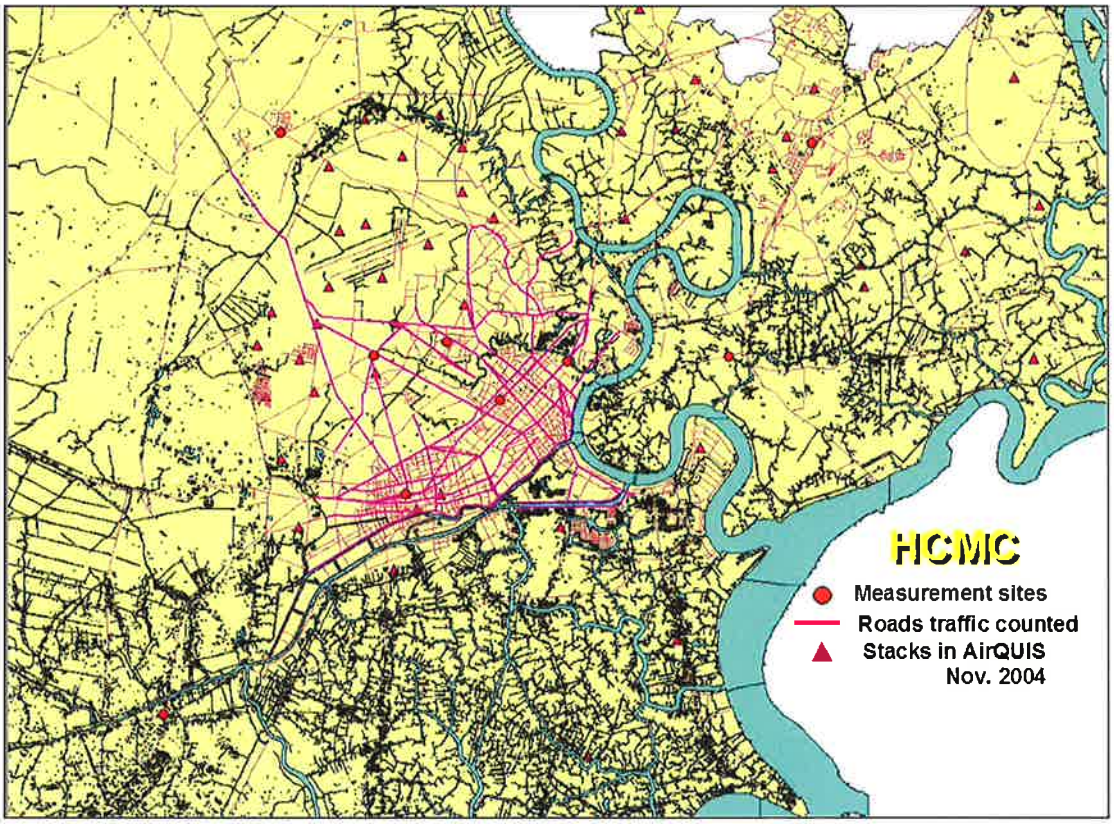


Figure 3: The GIS platform in AirQUIS with measurement site positions, roads counted, stacks, rivers and administrative regions. (The stack positions will be verified again).

6.2 Further development and testing

NILU is continuing to improve AirQUIS regarding stability, performance and features, and new releases of AirQUIS have been made available for HEPA during the whole HEIA project period. The GIS system had some minor bugs that were corrected during Mission 5.The current version of AirQUIS version #421 at HEPA enables the users to modify and save the line sources after the shape has been imported as AirQUIS Theme. The previous GIS problem is now solved.

Training was given concerning the creation of a local Oracle database with AirQUIS (see Appendix F).

7 Task 7. Air Quality Modelling

7.1 Prepare input data

HEPA has been working on the preparation of input data to the models. Traffic counting has not proceeded as fast as anticipated. However, during mission 5 a new campaign was launched to count all major roads surrounding the city centre.

Model estimates are based on emission data from line-, point-, and area sources. The possible relations between different source types and different result data sets are shown in Figure 4.

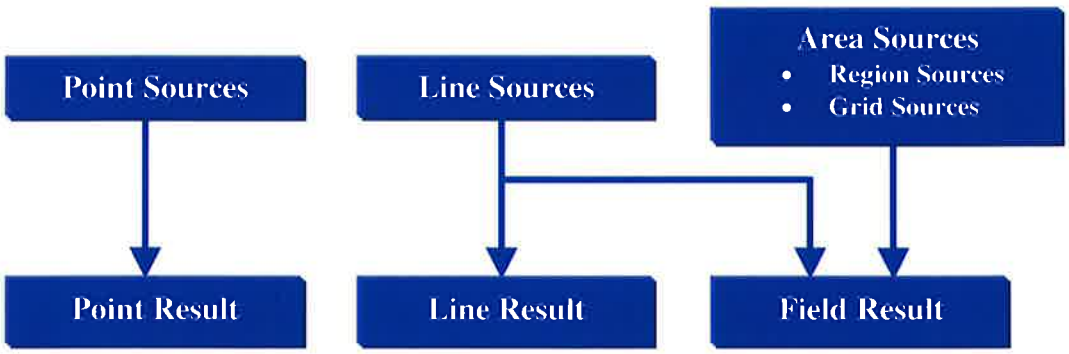


Figure 4: Graphical presentation of emission sources and emission results.

The result emissions can be stored as field data sets for area sources, line and field data sets for road links and point data sets for point sources. In addition, the model may have to perform spatial transformations, and scale the resulting values in order to convert to the desired units for the resulting data set.

7.2 Emission inventories

The emission inventory of point sources started at HEPA after Mission 3. The emission inventory work has been based on templates from AirQUIS and the methodology given by NILU as presented in previous Mission reports.

7.2.1 Point sources

The principle of modelling emissions from point and area sources is very simple. For consumption data the emission will be calculated as:

$$Q = Consumption \times \text{“}Consumption\ Emission\ Factor\text{”}$$

where
Q = Emission rates

If emission data for the sources is available as initial input, there is of course no such calculation.

A total of 35 industries with coordinates have been collected by HEPA. 45 stacks have been identified with 30 processes together with consumption data given as ton per year. More stacks are under verification. The validity period for most of these stacks is 2003. The fuels included are: fuel oil, coal and diesel heavy oil.

The positions of the stacks in the AirQUIS GIS system are being verified and corrected.

7.2.2 Population distribution, area sources

To improve the quality of area source estimates population distributions for each ward within every District of HCMC was obtained during Mission 5.

For District 1 in the central part of HCMC the data looks as shown in the Table below. This information will be used during the next phase to estimate the remaining area source part of the traffic emissions.

Area, Population of regions HCMC

No	Name of District and Ward	Area(Km2)	Population (people)
	HCMC area	**2094.34**	**5 250 257**
I	**District 1**	**7.72**	**226 735**
1	Ward B?n Nghé	2.49	21 429
2	Ward B?n Thành	0.93	21 257
3	Ward Cô Giang	0.36	23 915
4	Ward C?u Kho	0.34	20 584
5	Ward C?u Ông Lãnh	0.23	17 959
6	Ward Đa Kao	1	23 528
7	Ward Nguy?n Thái Bình	0.49	19 441
8	Ward Nguy?n Cư Trinh	0.76	25 914
9	Ward Ph?m Ng? Lão	0.49	22 636
10	Ward Tân Đ?nh	0.63	30 072

The data may also be used to distribute the human generated emissions of particles as area sources. However, more basic information of fuel types and activities has to be obtained first.

7.2.3 Line sources and traffic emission data

Templates and methodologies for traffic counting and line source emission estimates were given to HEPA during Mission 3 and 4. (Sivertsen et.al. 2003, NILU OR 84/2003). During Mission 4 a total of 77 road nodes with coordinates and 63 road links had been identified.

Figure 5 below indicated the roads counted as green lines and also the roads selected for counting during and after Mission 5 (blue lines).

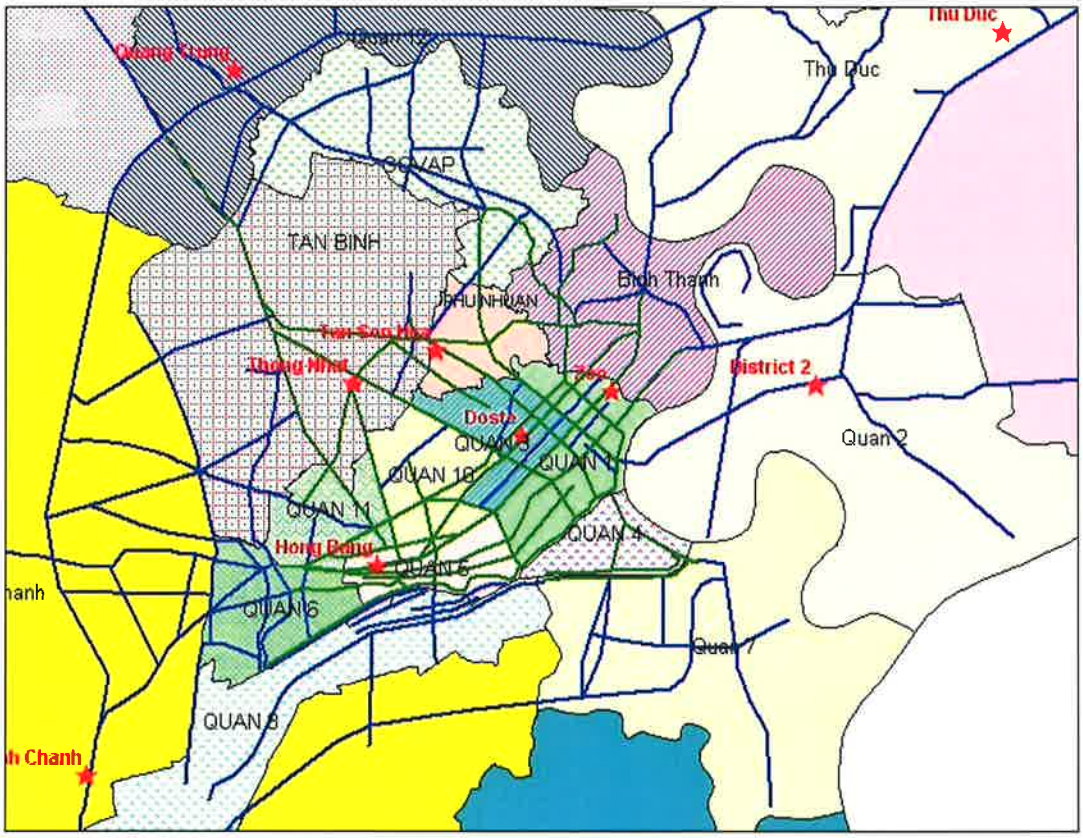


Figure 5: Roads where the traffic density have been counted (green) and where counting started during Mission 5.

A time schedule for the counting started during Mission 5 is presented in Appendix G1. Students have been engaged together with HEPA experts to perform the counting. Both total average daily traffic as well as diurnal variations (counting every hour in selected streets) are included in the work.

The emission estimates based on Vehicle Classes are Average Model year, Average driving distance, fuel consumption, basic factor, aging factor and speed dependency factor is mainly based on European methodology, but emission factors are based on experience in Asia.

7.3 Dispersion modelling

Mr. Dam was trained during a study visit to NILU to use the dispersion models available in AirQUIS. The first model tests have been undertaken based on input data from HCMC. During the summer 2004 more model runs were presented.

The main results of some of these model runs performed along the main road running towards north-east (Hanoi) in the TuDuc area was that the emissions from the road is totally domination the concentration distributions in this area.

All compounds simulated in the EPISODE model are treated as non-reactive species with the exception of NO, NO_2 and ozone. For the dispersion and transport calculations these components are also treated as non-reactive but at the end of every hour the photo stationery state assumption is applied and the concentration of these components is calculated accordingly.

The photo stationery state is the instantaneous equilibrium between the following three reactions:

$$NO_2 + hv \text{ ------> } NO + O$$
$$O + O_2 + M \text{ -----> } O_3 + M$$
$$O_3 + NO \text{ -----> } NO_2 + O_2$$

The steady-state assumption implies that NOX (the sum of nitrogen oxides) and OX (oxidants) are conserved. By these assumptions the three components NO, NO_2 and ozone can be found by the solution of a second-degree equation in Ozone.

The AirQUIS models also require good quality meteorological input data. We are still not satisfied with the situation regarding this issue, but we are working together with HEPA to solve the problem.

8 Task 8. Field Operations

8.1 Operational phase

The air quality monitoring system in HCMC has now been entered into an operational phase. Data is retrieved to the AirQUIS database automatically, and the database seems to be complete.

Field operations undertaken by the trained monitoring experts using the QA/QC system at all levels seem to work adequately.

The analyses of the data in the database has revealed that there are still missing data from time to time. In some cases there has not been sufficient follow-up of the final data. However, missing data are mainly due to power failures of various kinds. Some of the monitors have been out of order for shorter or longer periods due to lack of spare parts. These matters have all been discussed and it is believed that the operations might be still improved.

8.2 Maintenance and service

Some instruments (from Danida) have now been operated for more than 5 years. The lifetime of some of these monitors are between 5 and 10 years. To keep up good quality data they need to be checked and maintained properly. NILU normally recommends a yearly overhaul of the instruments. This will in the future be one of the tasks of the reference and maintenance laboratory.

The PM_{10} samplers provided by the Danida project are all out of operations, and it is not believed that these instruments can be utilised any more.

8.3 Consumables and spare parts

During the HEIA project NILU has supported consumables and spare parts. This service has terminated. However, NILU has still given advice and support to HEPA. An example of the spare parts needed to operate some of the instruments delivered by the Danida project is presented in Appendix H1.

8.4 Dynamic calibrations

After signing the contract and agreement between DONRE and NILU about the establishment of a Reference Laboratory and additional training it is now clear that the Reference laboratory will be established at DONRE/HEPA.

The required dynamic calibrations will then be performed after instructions and training provided by NILU.

The locations for the Reference Laboratory at HEPA will be identified as soon as the new building and the moving of HEPA has been undertaken in the beginning of 2005. as well as undertake the necessary training for maintenance and calibrations. Support

The programme will identify the necessary equipment for the Reference Laboratory, perform the procurement and test and verify the equipment before shipping it to HCMC. A training programme including on-the-job training will be performed and instrument and station audits will be added as part of the Reference laboratory tasks.

9 Task 9. Data interpretations

9.1 Understanding AQ

Much of the time during Mission 5 was spent on the evaluation and assessment of the data. The work was undertaken as part of the development of a status report concerning the general air quality situation in HCM City.

The results and development was discussed with the HEPA staff and the report was presented in a seminar as part of the training during Mission 5.

9.2 Meteorological data

The errors that are still present in the meteorological data were modified and "corrected" as presented in Appendices E1 and E2.

This time only upper temperature data and wind speed data at the DOSTE station seem to be of adequate quality. We will have to do something with this problem. However, presently there are no funds available from outside sources to purchase new equipment.

9.3 Statistical evaluation

The air quality data available in the AirQUIS database was used to present typical annual average concentrations as well as discuss the possibilities of exceeding national and international limit values for air quality.

It was concluded from the analyses that the main air pollution problem in HCM City consists of suspended particles and oxidants measured by ozone.

Further the conclusions from the measurements after 3 years of operations were:

- The main problem is suspended particles, and PM_{10} concentrations are frequently exceeding limit values
- High ozone concentrations have been observed on dry hot days, also exceeding international standards and limit values

- NO_2 concentrations seldom exceed limit values, but very high concentrations have been observed in and close to roads and streets
- Generally high concentrations of suspended particles and oxidised pollutants occur along streets and roads
- The Air Quality Index values as defined in HCMC seldom reach bad or hazardous level, but this is also dependent upon the definition of limit values
- 8-hour average CO concentrations exceed limit values during rush hours in several streets

The annual average PM_{10} concentrations are presented in Figure 6 below.

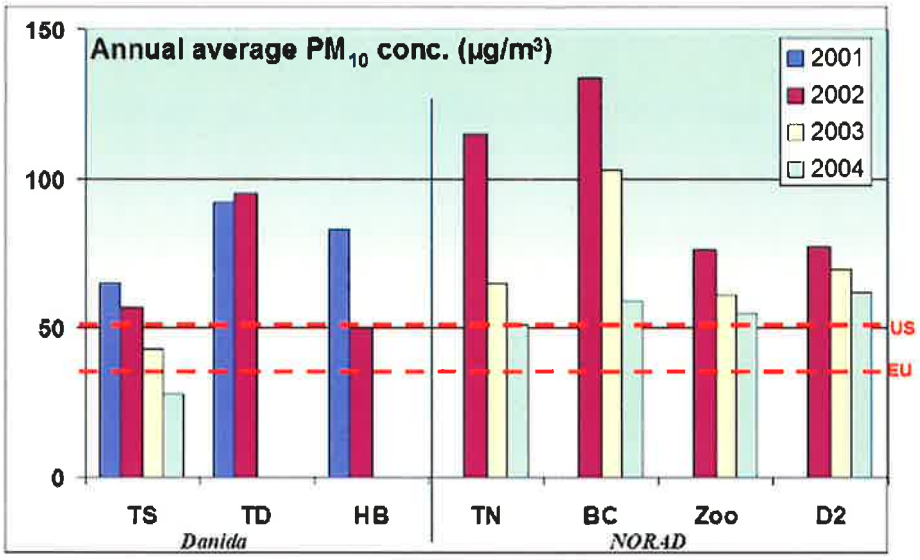


Figure 6

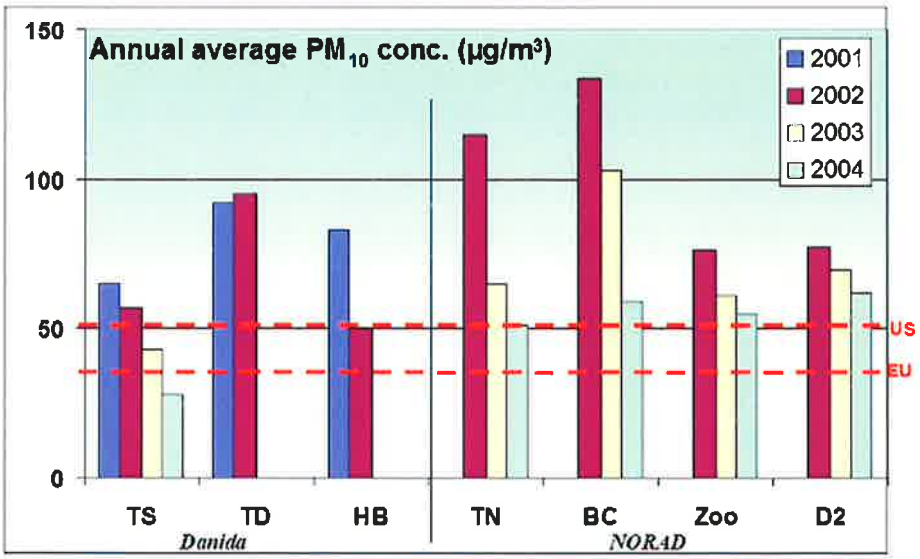


Figure 6: Annual average PM_{10} concentrations measured at 7 sites in HCM City from 2001 to 2004.

As can be seen from the figure all sites show that the limit values as given both by the US EPA and the European Directives have been exceeded. Vietnam have not specified limit values for PM_{10}.

More details concerning the air quality in HCM City is presented in the report on the status of air quality in HCM City (Sivertsen et.al., 2004a). These results were also presented at the "Better Air Quality, BAQ Conference in Agra India in December 2004. (Sivertsen et.al. 2004b).

9.4 Reporting Air Quality Index (AQI)

The Air Quality Index (AQI) procedures developed in 2003 have been generated automatically every day for more than a year. The values for 2003 can be seen in Figure 2 Chapter 4.2.
The AQI values generated based on the traffic stations are higher and are more often characterised as "bad air quality" than the data taken from the urban background stations. Poor air quality has AQI values above 100. Figure 7 indicates that the traffic stations are much more often in this range. Also the traffic AQI was on the average about 40 % higher than the urban background.

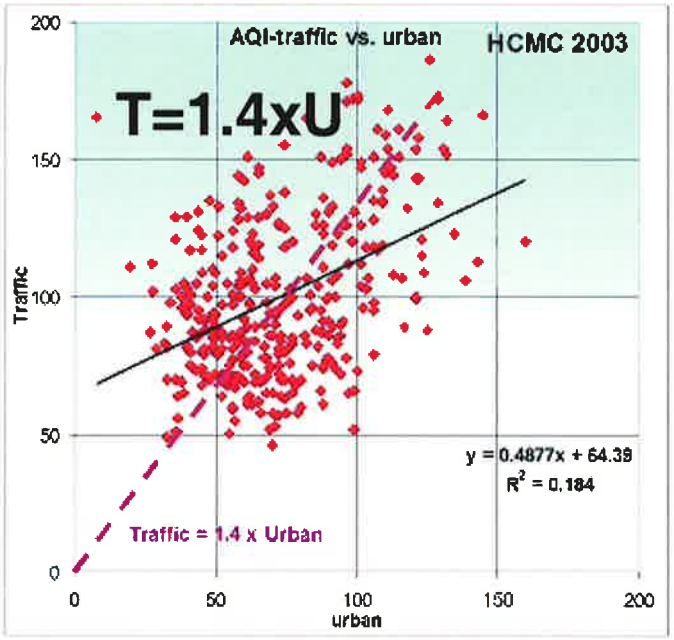


Figure 7: AQI at traffic stations versus AQI values at the urban background stations.

This indicates that the man air pollution problem in HCH City is related to traffic.

9.5 Internet presentations

NILU has demonstrated and introduced for HEPA the concept of how to present Air Quality Information and establish a Air Quality Web Portal.

Establishing of a web site for HEPA is not a part of this project. However, HEPA decided to establish a HEPA web site with HEPA resources and assistance from NILU.

NILU as an Air Quality Service Provider will provide HEPA the solution as a service hosted from NILU Norway. The web site is under testing by HEPA. Before releasing of the HEPA web site, NILU will need an approval from DONRE including a signed Leasing Agreement for the HEPA web site service.

See: www.nilu.no and www.luftkvalitet.info for more information about NILU as Air Quality Service Provider.

The development of a web site for HEPA was discussed during Mission 4, and the work was undertaken during Mission 5. The examples below demonstrate the features of the HEPA web site.

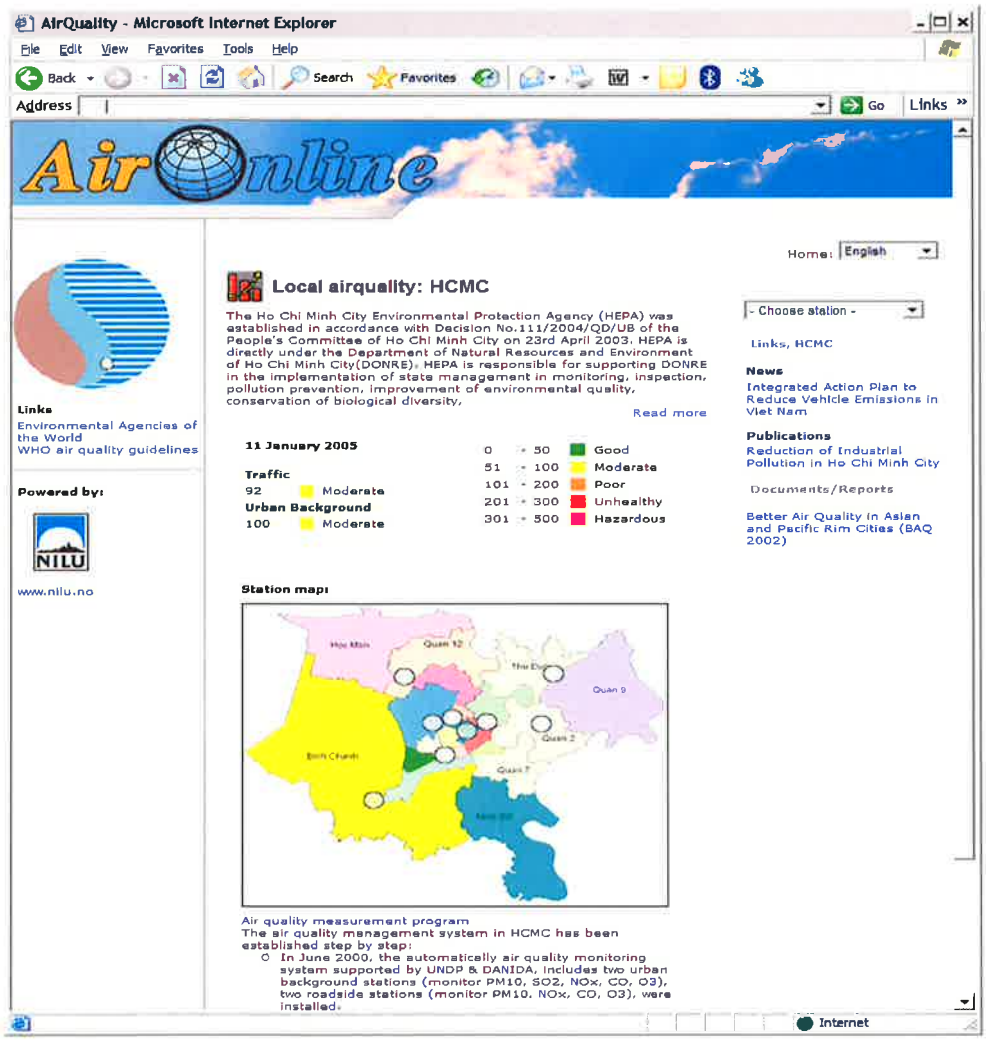
HEPA Web Site Portal

This is the start page for HEPA Web Portal:

HEPA – AirOnline

The AirOnline provides the following features:

- Multilanguage – Vietnamese and English
- Visualization of the daily HCMC Air Quality Index (AQI) for Urban and Traffic based on the HTML input file produced by AirQUIS. HEPA will FTP the daily AQI to NILU
- Visualisation of the monitoring network on a scanned electronic map of HCMC
- Description of the measurements stations
- Features for providing links
- Features for uploading documents and reports as links
- Feature for administration of the Air Quality Information Dissemination Portal - AirOnline



10 Task 10. Air Quality Assessment

10.1 Use of AirQUIS

The AirQUIS system is presently being used for developing statistics as input to the air quality assessment. It is further being prepared to improve modelling capacity so that it can also be used for air quality management and planning. The preparations of adequate input data are still ongoing and before a rather complete emission inventory has been prepared the planning system used for the whole city will not work properly.

However, in many cases it is already possible to perform simple impact assessment studies using the models for single sources or groups of sources and line sources. One such modelling exercise was performed for sources located in the Thu Duc area. The results of these model estimates showed that the impact of emissions from the traffic along the main road to Hanoi was larger that the impact from industrial emissions included the power plants.

The collection of good quality meteorological data as well as input data to the models is still going on. When this work is finalised it will improve the ability to use AirQUIS for air quality assessment and planning.

10.2 Improved model estimates for exposure evaluations

The models available in AirQUIS for concentration estimates as well as for the modelling of exposure to the population is continuously being revised and improved at NILU. The versions prepared for the HEIA project in HCMC have been evaluated and is updated to represent the best available models for estimates of concentrations based on emission- and meteorological data as input. The modelling system available in AirQUIS has only briefly been tested and used in HCM City. Work was also undertaken to improve the system during Mission 5.

As part of future requirements for model estimation of concentration distributions as well as exposure estimates every hour in selected receptor points the models may have to be modified again to include a statistical optimisation of the estimates

A Now-cast model has recently been built as an integral part of the AirQUIS system and can be run directly from menus offered within the system. It combines observed air quality data with model simulations to produce assimilated fields for the components such as NO_2, PM_{10}, SO_2 and Ozone. It will also calculate the Air Quality Index (AQI). The various elements of the Now-cast model are shown in the flow chart given in the Figure 8 below.

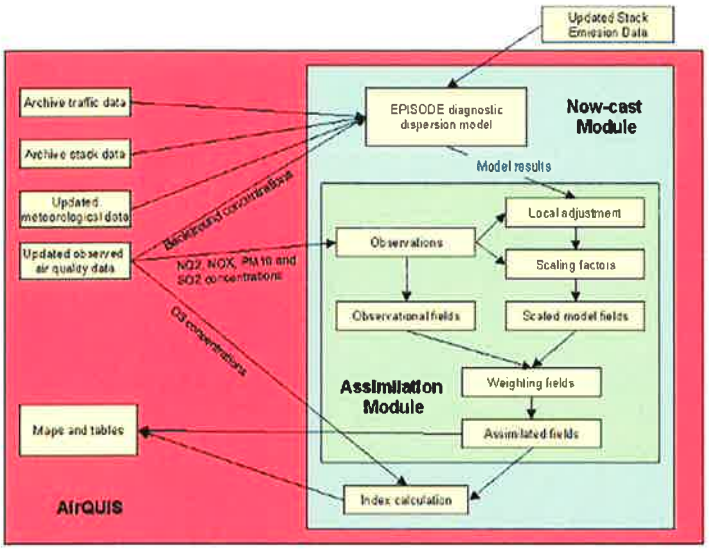


Figure 8: Data and logical flow diagram showing the AirQUIS data flow structure used for the automatic Now-cast model.

The elements of the Now-cast model consist of:

- Input data from the AirQUIS database made up of
  - Archived traffic data
  - Archived stack emission data
  - Updated meteorological data
  - Updated air quality observational data
- These data are sent to the EPISODE dispersion model which calculates hourly concentration fields using
  - Emission models for traffic and point sources
  - An Eulerian grid model
  - The INPUFF Gaussian puff model
  - The HIWAY line source model for traffic
- Simulated concentration fields are then sent to the assimilation module, which adjusts model results using updated observational data interpolated onto the model domain. This module uses:
  - Local positional adjustment
  - Scaling factor calculation
  - Observational field interpolation
  - Weighting factor field calculation
  - Assimilation of model and observed fields

- The Air Quality Index calculation is then made using
  - Assimilated field calculations for the relevant air pollutants given in the AQI procedures.

10.3 Abatement and planning

As part of the additional funds made available from NORAD the training of HEPA experts will continue. The AirQUIS modelling and planning procedures will be used as they already have been installed at HEPA. Emission reduction scenarios may be based on the Master Plan or Action Plans available for HCMC. The preparation of emission scenarios based on measures to improve the air quality in HCMC will be undertaken by local experts.

In the case of an additional ADB financed project on air quality and health among the poor people of HCM City, it will be necessary to modify and improve the modelling system according to the procedures presented above based on the newly developed Now-cast procedures.

11 Task 11. Capacity building

At the end of the NORAD financed HEIA project we have signed the contract for a continuation including the development of a reference laboratory as well as additional training in the air quality assessment and planning.

The additional funds made available from NORAD will help to improve the operational capacity and the Quality Assurance part of the air quality monitoring programme and also improve the capacity concerning air quality management and abatement strategy planning.

11.1 Instruments, monitors and QA/QC procedures

Training concerning the operations of instruments as well as collection and quality controls has been given during the HEIA project as hand-on training by the instrument provider API directly to one of the HEPA experts.

Additional training will also be a key issue in the development of the Reference Laboratory. This training will also include maintenance and repair in addition to the procedures for dynamical calibrations of the monitors.

Additional training in the use of the AirQUIS system for daily quality check of data was undertaken during Mission 5. New procedures were also established as seen in Appendix E1.

11.2 AirQUIS training

The main part of the AirQUIS training programme was based on seminars and workshops prepared at NILU for selected experts from HEPA/DONRE. (Laupsa and Johnsrud, 2003). Additional training has been given by mail and during Mission 5.

Experts have been trained to undertake the collection of emission data for the emission inventory in AirQUIS. Also the dispersion models should after Mission 5 be well known to at least one expert at HEPA.

HEPA technical personnel have been trained in how to install a local AirQUIS database for testing purpose during mission 5.

11.3 Use of models

Mr V T Dam was trained in the application of models at NILU in February 2004. A first simple models estimation was undertaken during this training. Later Mr Dam has also imported emission data as well as meteorological data to the models to perform simple estimates of concentration distributions in the Thu Duc area. The input data are still not completed enough to perform a complete model estimate of the concentration distribution over HCM City. However, this work is underway and we foresee that during the next phase of the NORAD/NILU support we will have to add to the training in the application of the models.

11.4 Statistics and reporting

During Mission 5 a considerable part of the time was used to prepare a status report on air quality in HCM city. (Sivertsen et.al. 2004). The report was presented in a seminar at HEPA and at the BAQ conference in Agra India.

During the development of this report a number of statistical programmes available in AirQUIS were used. The outcome as well as input data and limitations were discussed with HEPA experts as part of the training. We still believe that further training may be needed in the preparation of air quality statistics and data interpretations.

11.5 Abatement strategies

Procedures for air quality impact assessments as well as preparation of abatement options and scenarios started during the HEIA project. However, it will be further needs for adding to this part of the institutional building programme.

Cost-benefit analyses can be used to evaluate the best possible options to reduce the air pollution load seen from an economic point of view. The results of such analyses again should lead to the development of Action plans.

Within the limited budget NILU can together with the client define the strategic objectives of an Air Quality Management and planning System (AQMS), and support the selection of tools, modules and components to be used in a specific situation and for a defined area of interest. Training in the application of AirQUIS as a basis for performing abatement strategy planning will be prepared, but the work itself will have to be undertaken locally. NILU may, if wanted, participate in the process as part of the on-the-job training programme

11.6 Further institutional building

HEPA and DONRE have been re-organised. The present office buildings and the computer centre at HEPA will not be their permanent location. We were told that they would move again into a new building within a few months. A group of 9 experts is presently working with environmental data and issues linked to pollution. These experts need to have updated knowledge of methods and data to represent the key personnel in the future Division of Environmental Quality, Monitoring and Assessment (EQMA) at HEPA.

The air quality monitoring programme as well as the air quality management system established and developed at HEPA in HCM City should be used in the further development of air pollution administration in Vietnam. It will be important to build on the expertise established through the NORAD supported HEIA project. The HEPA/EQMA Centre should market its capacity as the main air pollution experts in Vietnam. The establishment of the new centre may thus need further training as part of the institutional building.

As part of the continued NORAD funded project NILU will do its best to update and to assure that the EQMA centre have the best tools available and that adequate training is being given to the staff.

The central authorities in Hanoi represented by the Vietnam Environmental Protection Agency (VEPA) have already contacted HEPA/NILU to learn about the system in HCM City and to discuss possibilities for future co-operation. See Chapter 12.

12 Administrative meetings

12.1 Administrative meetings

Several meetings were organised at DONRE and HEPA during Mission 5. The results of these meetings may be found in the appendices as Minutes from the meetings or in various memos. Project meeting have also been held at NILU.

12.1.1 Project meetings

Project meetings have been held at NILU to follow-up the project. Minutes of these meetings have been sent to HEPA/DONRE. The last meeting held after Mission 5 and as a preparation for the extended Reference Laboratory project can be found in Appendix L1.

12.1.2 Meeting at DONRE head office

In preparatory meetings for the last Mission (5) of the HEIA project and during the planning of the contract signing at DONRE HEPA/NILU was asked to present the down payment schedule, the status and the available reports linked to the invoices. (See Appendix L2)

A summary of the reports that have been developed during the project was presented. Copies of the reports as well as some background material presented to the DONRE/HEPA experts were also been made available on a CD presented to DONRE.

12.1.3 Meeting with Swisscontact

Swisscontact had asked for a meeting with HEPA/NILU to receive information of the air quality monitoring and management programme developed and operated in HCM The Swiss-Vietnamese Clean Air Program SVCAP is currently conducting a situation analysis on the availability and quality of air pollution data in Hanoi. Based on the situation analysis, they plan to come up with a concept for the future air quality monitoring system in Hanoi, included

Lukas Heer is the Project Manager of SVCAP, and was heading the delegation to HPA: For further information see Appendix L3.

12.1.4 Meeting with VEPA/MONRE, Hanoi

Dr. Hoang Duong Tung, Director for the Centre for Environmental Monitoring, Data and Information (CEMDI) at VEPA/MONRE and Mr. Thai Minh Son from MONRE in Hanoi visited HEPA HCMC on 23 November 2004 to discuss the NORAD financed HEIA project and possible future co-operation between HEPA and VEPA. They were informed about the work undertaken as part of the NORAD project and were impressed and interested in a follow-up programme (See Appendix L4).

After the meeting it was clear that VEPA and HEPA have the intention for a close cooperation regarding utilising the competence and experience gained by HEPA through the NORAD funded project.

Further objectives and needs for the air quality monitoring and management in Hanoi and for Vietnam were discussed during the BAQ seminar in Agra India on 7 December 2004. NILU has also been asked to participate in a meeting called by the World Bank in Hanoi on 26 January 2005.

12.1.5 Preparations for the new Ref-lab project

The contract for the new project with a budget of 1,7 mill NOK was signed between DONRE and NILU on the establishments of a Reference Laboratory including maintenance and repair capacity building, plus additional training for the application of the AirQUIS system for air quality planning in HCMC.

The main objectives of the new project are to improve the institutional capacity at HEPA/DONRE.
The main tasks to be undertaken in the project are:

1. Specify and approve the physical location and features of the laboratory
2. Design the reference laboratory
3. Procure equipment
4. Test and verify equipment
5. Shipping of equipment
6. Install, verify and test the equipment in the laboratory
7. Develop training programme for maintenance, repair and calibration
8. Develop QA/QC programme related to Reference laboratory activities
9. Perform audits and train the ref-lab personnel
10. Update the database and collect input data
11. Meteorological data, training and improve instruments
12. Perform training in air quality assessment, seminar
13. Improve modelling capacity
14. Undertake impact evaluation

15. Prepare HEPA for undertaking abatement planning
16. Improve data dissemination and information

The location and layout of the laboratory has been discussed but the final design will depend on the new building and facilities made available to HEPA during the first months of 2005.

Also the procurement procedures and the purchasing of necessary instruments were discussed. Details have been presented in Appendix L1.

12.1.6 Future tasks and obligations

At the end of the Mission a meeting was held to summarise the performances so far. This Mission 5 is the last Mission of the original HEIA project. All the tasks given in the project proposal have been undertaken.

The air quality monitoring and management system is up and operating well in HCM City. The quality assurance, data collection and the databases are working properly. The remaining installation of an adequate reference laboratory for calibrations, maintenance and repair was identified early in the project, and ha now been financed by NORAD to be installed during the next year.

The staffs have been trained to collect input data for the modelling and assessment work. These tasks will be further followed-up by NILU during the next phase of the project.

Some immediate action to be taken in the near future were specified and discussed. A list of tasks and obligations is presented in Appendix L 5. A major effort will be to continue collecting input data for the modelling and assessment study.

NILU is pleased to be able to further follow up the good work that has been undertaken by the trained experts at HEPA/DONRE. The new Rference laboratory project will assure that the future co-operation will further improve the quality of the measurements as well as enable better model estimates to be presented.

13 References

Bøhler, T. and Sivertsen, B. (1998) A modern air quality management system used in Norway. Kjeller (NILU F 4/98).

DOSTE (2002) Report on Issue no. 2 Energy Efficiency Improvement of Urban Transport System and Mitigation of GHGs and other harmful emissions. Case study of Ho Chi Minh City, Vietnam. Hochiminh City, Department of Science technology and Environment of HCM.

Laupsa, H. and Johnsrud, M. (2003) Ho Chi Minh City Environmental Improvement Project, Air Quality Monitoring Component; AirQUIS Workshop no. 1 held at Norwegian Institute for Air Research (NILU), 31 March – 11 April 2003. Kjeller (NILU OR 20/2003).

Sivertsen, B. (2001) Project proposal: Ho Chi Minh City Environmental Improvement Project. Air Quality Monitoring Component. Kjeller, Norwegian Institute for Air Research (October 2001).

Sivertsen, B. and Thanh, T.N. (2002) Ho Chi Minh City Environmental Improvement Project. Air Quality Monitoring Component. Presentation at the kick-off seminar at DOSTE, HCMC 15-16 April 2002. Kjeller (NILU F 13/2002).

Sivertsen, B., Thanh, T.N. and Hole, L.R. (2002) Ho Chi Minh City Environmental Improvement Project. Air Quality Monitoring Component. Inception Report, April 2002. Kjeller (NILU OR 28/2002).

Sivertsen, B., Thanh, T.N. and Hole, L.R. (2002) Ho Chi Minh City Environmental Improvement Project. Air Quality Monitoring Component. Mission 1, April 2002, Inception Phase. Kjeller (NILU OR 23/2002).

Sivertsen, B., Dreiem, R. and Thanh, T.N. (2003) Ho Chi Minh City Environmental Improvement Project. Air Quality Monitoring Component. Mission 2, November 2002, Status Report (QR3), Installations performed. Kjeller (NILU OR 2/2003).

Sivertsen, B. (2003) Passive sampling of SO_2 and NO_2 in ambient air in Ho Chi Minh City. November 2002. Kjeller (NILU OR 15/2003).

Sivertsen, B., Thanh, T.N. and Ødegaard, R. (2003) Ho Chi Minh City Environmental Improvement Project. Air Quality Monitoring Component. Mission 3, November 2003, Status Report (QR6), AirQUIS installed and trained. Kjeller (NILU OR 84/2003).

Sivertsen, B. and Thanh, T.N. (2004) Ho Chi Minh City Environmental Improvement Project. Air Quality Monitoring Component. Mission 4, November 2003, Status Report (QR7-9), Data assessment and training. Kjeller (NILU OR 51/2004).

Sivertsen, B., Thanh, T.N., Le, K.V. and Vo, D.T. (2004) The air quality monitoring and management system for HCMC, Vietnam, Presented at the Better Air Quality Conference, Agra, India, December 2004.
URL: http://www.cleanairnet.org/baq2004/1527/article-59135.html

Sivertsen, B., Thanh, T.N., Le, K.V. and Vo, D.T. (2005) The air quality monitoring and management system for HCMC, Vietnam. Kjeller (NILU OR 1/2005).

Slørdal, L.H., Walker, S.-E. and Solberg, S. (2003) The urban air dispersion model EPISODE applied in AirQUIS 2003. Technical description. Kjeller (NILU TR 12/2003).

Appendix A

Task 1. The air quality System for HCMC

Appendix A1: Daily schedules

Mission 5, November 2004

Day	Hr.	Assignment	NILU	HEPA/ DONRE	Done
Monday 8 Nov	0830	Meetings ADB health study Identify data quality in AirQUIS	BS	 VTD	ok
Tuesday 9 Nov	0830	Work with the AirQUIS database, install "new" data	BS	VTD	
Wednes 10 Nov	0830	Memo status + database work	BS	VTD, LVK	ok
Thursda 11 Nov	0900-1130 1330 -	Meeting DONRE with SFT assessment team	BS	LVK, VTD +	
Friday 12 Nov	0830-1130 1330	Contract negotiations Discussions to be continued	BS+SFT BS	LVK	
Monday 15 Nov	0830	AirQUIS data for report Start collecting traffic data again Prepare paper for Agra	BS BS	VTD VTD	
16 Nov	1030-1130 1330 -	Signing of Contract Reflab Data handling AirQUIS	BS+SFT BS	LVK, NTTH SFT	
17 Nov	0830 -	Reporting and paper Discuss data collecting for emission inventories	BS BS	VTD, LSQT,NBQ, NTH	
18 Nov	0830 -	AirQUIS data evaluation Status emission data collection	BS BS	 VTD	
19 Nov	0830 - 1700	Discuss paper and reports Mr The to HCMC	BS	LVK, VTD	
22 Nov	0830 – 1300	Install latest AirQUIS version Test database, run statistics for annual report Web discussions	TNT BS BS, TNT TNT, BS	VTD	
23 Nov	0830 1000 0900 1400	Finalise presentation for BAQ Meeting VEPA, Dr Tung AirQUIS and computer cleaning Data cleaning	BS BS, TNT TNT BS	 LVK, NDT VTD	
24 Nov	0830 – 0930 1030	Finalise report for BAQ Meeting with SwissContac Site visits Paper BAQ	BS BS	VTD, VTD	
25 Nov	0830 1030 1330	Paper and data evaluation Testing GIS in AirQUIS Internet discussion continue Data for annual report	BS TNT TN BS	VTD, LSQT, NBQ, NTH	
26 Nov	0830	Test new version of AirQUIS BS day off ?	TNT BS	VYD, NBQ, NTH	
29 Nov	0830- 1000	Data reporting Meeting about the Reference laboratory	BS, TNT BS, TNT,	VTD,	

Day	Hr.	Assignment	NILU	HEPA/ DONRE	Done
30 Nov		Summarise input data models	BS	VTD	
1 Dec		Emission data summary	BS	VTD	
2 Dec		Reporting	BS, TNT	VTD	
3 Dec		Final meeting, summary	BS, TNT		

Appendix A2: Daily schedules

Memo

Title	**Project status summary, November 2004**
Purpose	A summary of the project status as of November 2004.
Distribution	Mr. Khoa, Mr Dam, The Nguyen Thanh (TNT), Rolf Dreiem (RD)
Author	Bjarne Sivertsen
Date	November 2004
Reference No	O-101143

1. Introduction

The following brief status of the HEIA project was prepared in connection with the Review team from the Norwegian Pollution Control Authority (SFT). The Review Team normally studies the progress reports for the Air Quality Monitoring System component. The team had planed meetings with HEPA and with the NILU project manager in Ho Chi Minh City in November 2004.

Four Missions to HCMC have successfully been undertaken and reported. Installations, training, data follow-up and reporting have been elements already in place at DONRE/HEPA. A follow-up programme including the establishment of a Reference laboratory as well as further training and institution building has been developed and presented to NORAD.

The following tasks and topics related to the project are briefly described in this memo:

- Instrument installations and audits
- System integration
- Database and planning tool (AirQUIS installation)
- Data collection and management
- Data assessment, interpretations and air quality status
- Input data for modelling (emission data collection)
- Capacity building
- Reference laboratory and further training

The project has been undertaken according to the original plans and contracts, and has also been kept within the estimated budget available.

2. Instrument installations and audits

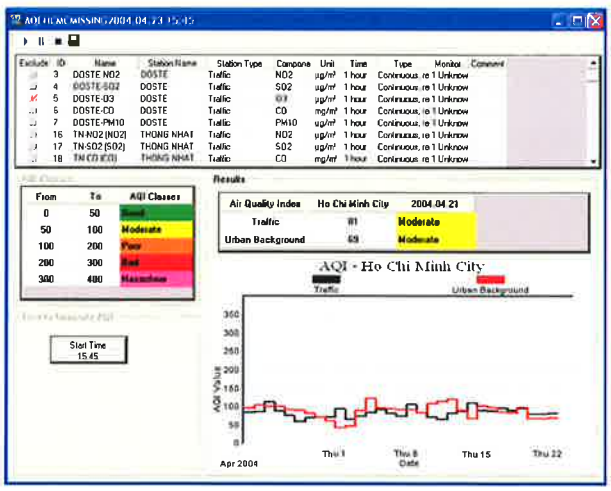
The air quality monitoring network in HCMC has been installed completely and is now being operated adequately. The nine stations (4 from Danida and 5 from NORAD) as well as the site characteristics is given in the Table below.

Station				UTM 84 N	
ID	Code	Name	Charact.	X coordinate (m)	Y coordinate (m)
1	DO	DOSTE	Traf	684,430	1,192,220
2	HB	Hong Bang	Traf	681,620	1,189,460
3	TD	Thu duc	Res/Ind	693,640	1,199,790
4	TS	Tan Son Hoa	Urb Bkg	682,830	1,193,930
5	TN	Thong Nhat	Traf	680,690	1,193,530
6	BC	Binh Chanh	Traf	674,500	1,183,000
7	ZO	Zoo	Urb Bkg	686,420	1,193,370
8	D2	District 2	Res/ind	691,160	1,193,510
9	QT	Quang Trung	Urb Bkg	677,940	1,200,080

A simplified Audit to the sites was performed on 20 April 2004. The result of this investigation indicated that the stations are kept well and that the operational procedures developed and trained by NILU are followed. A more detailed audit will be undertaken and reported in November 2004 by the NILU instrument expert.

3. System integration

The existing data retrieval system, which was supported to DOSTE by the previous DANIDA project had to be integrated into the NORAD supported systems. This work has been undertaken successfully by NILU. HEPA/DONRE collects data from all the measurement stations once a day by using the Danida/OPSIS data retrieval system.



The manually operated system for generating Air Quality Index (AQI) values has been computerized by NILU as it was expressed by DONRE the need for reducing the manual work for generating these AQI values. The new automatic import module and the automatic AQI routine have been tested and accepted by DONRE.

4. Database and planning tool (AirQUIS installation)

Installations of the database and planning system; AirQUIS at DONRE were undertaken in November 2003. Configuration and testing of the automatic import modules for retrieving air quality data on-line into the AirQUIS database was tested and verified.

Some improvements and modifications have been implemented between November 2003 and November 2004. Continuous communication between NILU and DONRE/HEPA has been the key to presently having a well operating system at HEPA: Mr Dam has been visiting NILU a second period for training in using the system as well as training in the use of dispersion models. The AirQUIS system is presently in daily use at HEPA.

The AirQUIS system is being used for several purposes. Most important to this point in time has been the import of air quality data, data statistics and assessment as well as the presentation of daily AQI values. However, HEPA is also preparing the system for impact assessment and planning.

The following status concerning the use of AirQUIS in HCMC may be summarised as follows:

- Administrative regions for HCMC are completed.
- Measurement station sites are completed.
- Stack coordinates are under verification.
- Road Nodes and Road links are still under updating.
- Grid: 40EW and 35NS with 1km resolution.
- Additional shape file for river is completed.

HCMC administrative region for 24 districts, 9 measurement stations, 45 stacks, 63 roads and a grid of 43 EW and 35 NS with 1 km resolution have been entered and verified.

HEPA is now also continuing the collection of input data for modelling. The most important and comprehensive task here is the development of an emission inventory for HCMC.

5. Data collection and assessment

Data collection is being followed up on a daily and weekly basis using the QA/QC procedures prepared by NILU. The field operations require that trained monitoring experts are visiting the stations every week. Other experts have been trained for using the data retrieval systems and the databases. QA/QC at all levels is an important issue that should be kept alive through regular auditing of the system, also in the future.

Some of the field operators or special assigned experts will be responsible for maintenance, repair and calibrations. The instruments in question contain:

- Automatic gas monitors
- Automatic ambient suspended particle monitors
- Automatic Weather stations

The establishment of the Reference and maintenance/repair laboratory will ensure that the programme will sustain good quality.

Air quality and meteorological data, which has been imported on a routine basis into the AirQUIS database, has been evaluated and presented. The validity and the content of these data as well as discussions on air quality assessment and understanding have been presented in several workshops.

Several errors were identified in the meteorological data already since the beginning of the NORAD financed project. Some of these errors have been corrected for, such as stability and wind directions. However, the instruments do still not operate adequately, and NILU has considered supporting HEPA with new sensors.

6. Data management, interpretations and air quality status

DONRE experts have now been trained to use the AirQUIS system for air quality management. The first introduction and training was undertaken during the seminar at NILU in March-April 2003. Mr Dam also visited NILU in February 2004 to receive training in the use of dispersion models, and the first model runs have successfully been presented.

Presentation of air quality data aimed at performing air quality assessment has been based on AirQUIS statistics. Presentations designed for documentation, state of the environment reports, monthly reports as well as annual reports has provided a need for using the AirQUIS system

Monthly reports should include more statistics based on combinations of air quality data with meteorological data as well as frequency distributions and percentages of exceeding national standards. The generation of an **annual report** was discussed during Mission 4 and a layout developed during these discussions will be used to produce the first typical annual report at the end of the project (Mission 5)

7. Input data for modelling (emission data collection)

Preparations of input data to the models are under way. Based on specifications and templates given to DONRE during previous missions and as part of the model training sessions, DONRE experts are now collecting the data input needed.

A major part of this work is linked to obtaining emission data. Training in air pollution modelling, including preparation of input data, was given at NILU.

For point sources a total of 35 industries with coordinates have been collected. 45 stacks have been identified with 30 processes together with consumption data given as ton per year. 12 more stacks are under verification. The fuels included are: fuel oil, coal and diesel heavy oil. During the November Mission 2004 further discussions will be undertaken on how to obtain the necessary input data for estimating area sources such as small enterprises.

The traffic data is not easily available from e.g. traffic models operated in HCMC. Such models do not exist here. The collection of traffic data may therefore be more comprehensive than foreseen at the beginning of this project. We have presently divided the line sources into:
5 road classes classified as

1. High way
2. Road between two towns/provinces
3. City centre street
4. Residential area street
5. Industrial area street

4 vehicle classes have been classified as

1. Lorry (heavy)
2. Van (light)
3. Bus
4. Motorbike

As of April 2004 a total of 77 road nodes with coordinates and 63 road links have been identified. This work continues during Mission 5 and beyond. The new NORAD project will support some of the further training and input needed from NILU to manage this task. One of the main input parameters is the collection of emission factors. Presently we have used factors collected from different project in Asia. Adjustments to the situation in HCMC and Vietnam should have been applied. However, studies of emissions from various vehicle classes in Vietnam have not started yet.

We have also realised that the project will have to support financially students to be engaged in further traffic counting. Mr Dam has prepared a schedule for the streets to be counted, and students will be paid to perform the counting according to the procedures developed by NILU.

8. Capacity building

Capacity building and training has been an important part of the NORAD financed HEIA project. There have been more needs for training identified as the project has proceeded.

The additional funds made available from NORAD will help to improve the operational capacity and the Quality Assurance part of the air quality monitoring programme. Some of these funds will also be used to improve the capacity concerning air quality management and abatement strategy planning.

Additional training will also be a key issue in the development of the Reference Laboratory at DONRE based on the additional funds provided by NORAD.

Further training may be needed in the preparation of air quality statistics and data interpretations even if this was one of the topics of Mission 3. The preparation of the annual report will be one way of proceeding on these topics.

For future needs it has been indicated that some support may be requested from NORAD by DONRE linked to institutional building and continuation of the existing NORAD project in HCMC. It seems that it may be difficult to obtain support for further instrumentation from NORAD in the future. DONRE may therefore first of all request support for institutional building from NORAD.

9. Reference laboratory and further training

As part of the maintenance and calibration procedures we identified already during our first Mission that the establishment of a Reference laboratory would be needed in HCMC. This laboratory is of crucial importance for keeping up a good quality monitoring system, which will meet international requirements.

General institutional strengthening through air quality lectures and seminars has been designed specifically for the needs for DOSTE/HEPA. It is vital for the project that the information and data collected from the monitoring stations is ultimately used to improve the air quality in HCMC. The programme will give valuable information on the air quality in HCMC and assessment on how the situation is compared with air quality standards. The additional training planned as part of this project will represent a good platform for preparing action plans to reduce emissions and air pollution impacts.

The continuation of the HEIA project through the newly funded Reflab project by NORAD will be an important contribution to ensure sustainability in the project already undertaken.

Appendix C

Task 3. Procure and install

Delivery list

Prosjekt	HCMC Mission 5
Projekt No	O-101143
Customer	HEPA
Delivery Date	03 December 2003

No of Items	Item Description	Status
Documentation on CD		
1	MATHEW as applied in the AirQUIS System Model description (09-2002-lhs.pdf)	Delivered
1	Models Module Users guide (Models Module_users guide_v1.pdf)	Delivered
1	Oracle 9.2 server and client installation (Oracle server and client installation.pdf)	Delivered
1	AirQUIS Admin and Main Module (1-2004-airquis-hel-zmb.pdf)	Delivered
1	AirQUIS Geographical Module (User Guide_Geograpical Module.pdf)	Delivered
1	AirQUIS Measurement Module (3-2004-airquis-mj-zmb.pdf)	Delivered
1	AirQUIS Emission Inventory Module (hel-User GUIDE_emission.pdf)	Delivered
1	Air QUIS Templates (2-2004-airquis-hel-zmb.pdf)	Delivered
1	General description of emission calculations in AirQUIS (Emission_explain.pdf)	Delivered
Directory miss5 on Dam's PC		
1	AirQUIS 2003 Application version 2.0.421	Delivered
1	MDAC 2.8 (MDAC_TYP.EXE)	Delivered
1	Oracle client 9.2.04 (OraWin9204.exe)	Delivered
1	SQL-script CreateKernelAndInitData.sql	Delivered
1	AirQUIS_Setup_407.exe	Delivered
1	How to create local Oracle database with AirQUIS (local airquis database.doc)	Delivered
1	Leasing Agreement (Leasing contract.doc)	Delivered
Services		
1	AirOnline at http://www2.nilu.no/hcmc/	Delivered
1	AirOnline Administration Module at http://www2.nilu.no/AirQuality/hcmc/index.cfm?fa=login.showform	Delivered
1	Installation of AirQUIS 2003 2.0.4.21 on Dam's PC	Delivered
1	Short training session of AirOnline Administration Module	Delivered

Appendix E

Task. 5 Quality Assurance (QA/QC)

Appendix E1

MEMO

Data quality control at data retrieval

Data from monitoring stations with telephone lines are being retrieved every day. The daily control of the data is manually undertaken as soon as data have been retrieved. Data checks and data quality is being registered in a daily data validation manual.
Whenever errors or strange data are identified from the database, the field operators will have to be notified, so that errors in calibrations or in instrument performance can be checked and corrected as soon as possible.

The following procedure has to be followed:

1. Poll the data (automatic or manual) from the station
2. Poll calibration data (zero/span) every week, evaluate levels, and report to operators.
3. Check the data in the data editor and verify the raw data in AirQUIS
4. Identify flags, change concentrations only if necessary (normally very seldom if ever!)
5. Check the concentration during the calibration hour once a week, and compare with the recorded concentrations. Verify validity of the calibration hour.
6. In case of errors or questions notify the station operator
7. Every week after station visits get the final calibrations results, and correct zero line (from zero correction) and trend using the calibration data.
8. In case calibration has been performed with span gas standards, get standard gas concentrations as well as reading on the monitor from station operators.
9. If readings deviate from gas standard concentration with more than 15%, adjust trend on data prior to calibration.

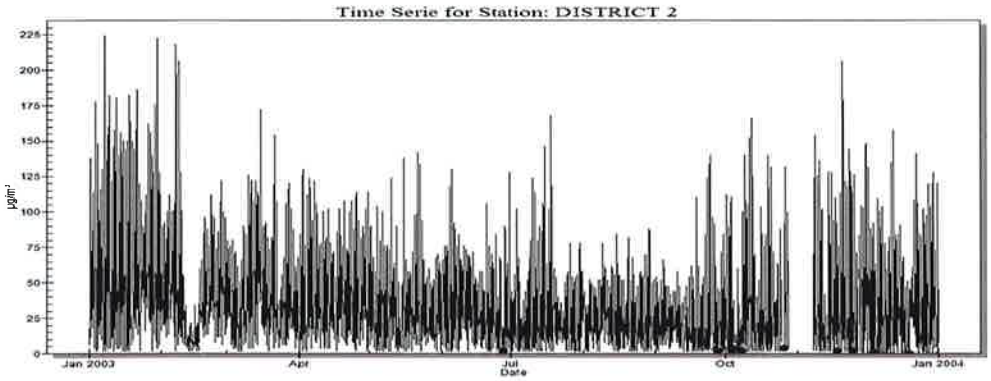
Record of data corrections

At the end of every month print the graph for every station and for every parameter (air pollutants and meteorology). The graphs and the data should be studied carefully to identify:

- Why are there missing data (could they be retrieved?)
- Are the zero lines real?
- Have calibration values been taken into account?

- Are there any further errors in the data that need to be flagged?

Correct final "errors" and finalise the database, included flags and remarks. Print the data again, and mark every parameter with Okay when finished.



Store printed graph in specific paper file and add comments etc..

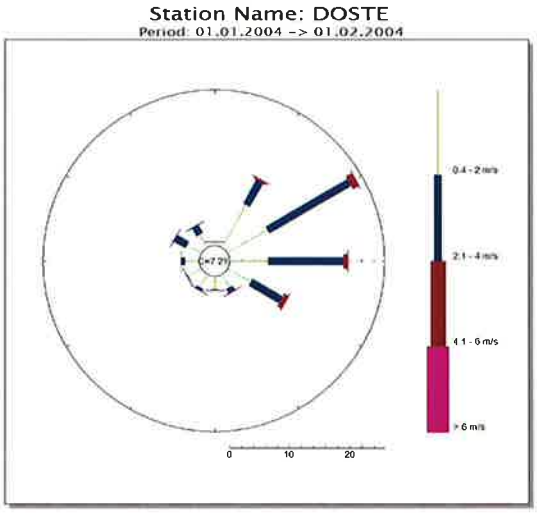
At the end of the months also prepare statistics needed for the monthly report, and check that the statistics, such as 99 percentiles and average values seem to be correct.

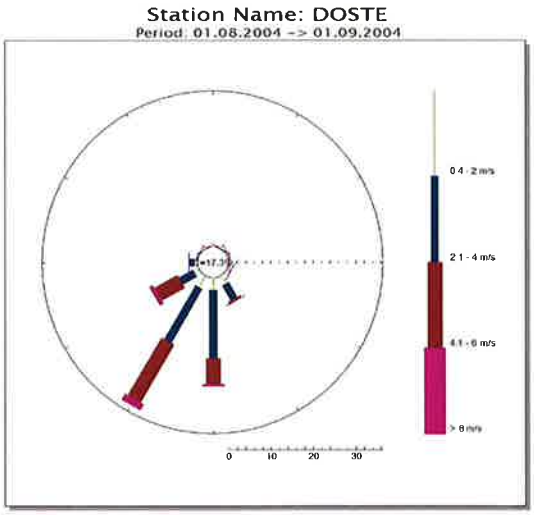
Appendix E2

MEMO

Wind direction corrections

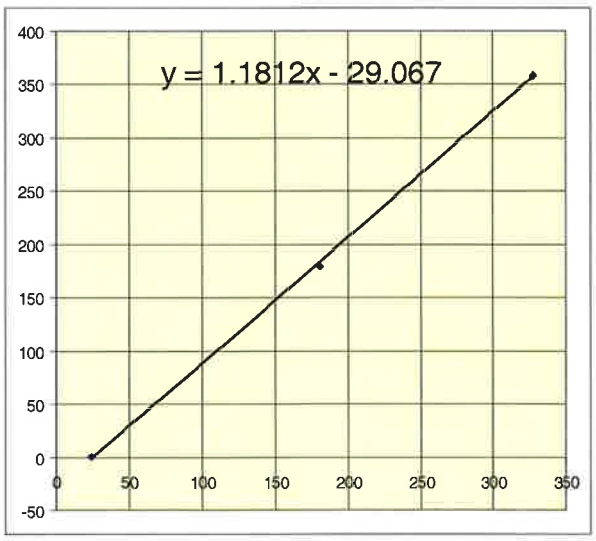
From the wind roses presented below it is clear that there is still an error in the wind direction data.





Both the months of January and August 2004 shows NO wind from northerly direction. This error has been present in the data since the measurements started after installations by the Danida project.

Wind direction, which should vary from 0 to 360 degrees, only range between 24 and 327 degrees, were corrected by introducing a simple linear correction factor:



DD(new) = 1.18xDD(old)-29.1

This gave us a new database, which included the full range of wind directions.
Whether the error in the measuremtn were of exactly this character could not be verified. Untill we know more, or manage to change the sensor completely, we will use this correction factor.

Appendix E3

MEMO

Lower temperature

To estimate the atmospheric stability using the temperature gradient, we will need the temperature at two levels. Temperature measurements are performed at the highest level in the tower at Doste. Temperatures from the lower level at the shelter about 3 m above the surface does not work. These data were also investigated during Mission 3 (see Appendix I, Mission 3 report). A temperature gradient was at that time estimated using a Bulk Richardson number approach, applying the measurements of radiation (indicator for heat flux), temperature at the tower, relative humidity (for estimating adiabatic temperature gradient) and wind speed:
DelT = 30*(1,05-0,005*F3)/100-((0,007*G3*(H3+(1,05-0,005*F3)/100))/(E3*30))

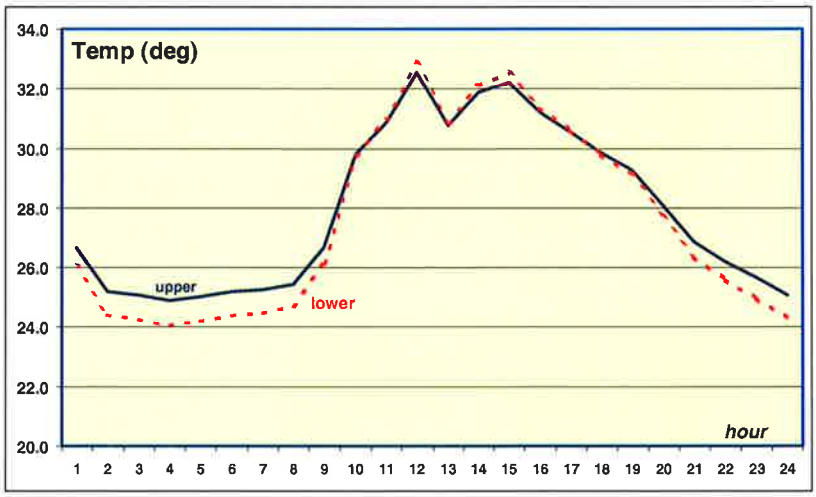
During Mission 5, however, only the wind speed and the upper temperature data were operating. We thus had to develop a simplified procedure for estimating a lower temperature. We assumed that the daytime lower temperature (during convective conditions) were about 0.5 degrees warmer than the temperature measured at 30 m. During nighttime conditions the lower temperature could be 1 to 2 degrees lower than the upper temperature. In addition we have assumed that the lower atmosphere is isothermal at sunrise and sunset.

To establish the lower temperature we may assume an exponential equation:
y = 8.4978exp(0.0418x)

However, through testing we found that a linear equation:

y = 1.1515x - 4.5835

may work as well.



The figure shows a typical diurnal variation of the upper temperature (measured) and the lower temperature estimated.

Appendix F

Task 6. AirQUIS Training

How to create local Oracle database with AirQUIS

Operational Manual

November 2004
Author: The Nguyen Thanh
User Group: The HEPA Team

Introduction

This document describes how install a local AirQUIS oracle database running with the AirQUIS application.

1. How to install local AirQUIS oracle database and AirQUIS application

   a) Install local Oracle server for AirQUIS. Please see documentation for AirQUIS 2003 ORACLE server and client – Section Installation of ORACLE 9i server for AirQUIS.

   b) Install all the software listed in the installation list from the Oracle Client 9.2.04 setup.

   c) Add a 'Net service Name' for the Oracle database. Please see documentation for AirQUIS 2003 ORACLE server and client – page 26.

   d) Create the AirQUIS database. Please see documentation for AirQUIS 2003 ORACLE server and client – Create ORACLE 9i database for AirQUIS.

   e) Run the initial setup SQL-script CreateKernelAndInitData.sql.

   f) Run the AirQUIS setup application e.g. AirQUIS_Setup_407.exe.

   g) Run the latest Service Pack for AirQUIS when available from www.airquis.com.

2. Problem reporting procedure

If you encounter problems using the system and you are not able to solve them locally you should report the problems to NILU. Use the Procedure for Reporting Problems.

Appendix G

Task 7. Air Quality Modelling

Memo

Title	Schedule for traffic counting
Purpose	Present the schedule for traffic counting in HCMC, November – December 2004.
Distribution	Bjarne Sivertsen (BS), The Nguyen Thanh (TNT)
Author	Vo Than Dam
Date	November 2004
Reference No	O-101143

SCHEDULE FOR TRAFFIC COUNTING

Team I: M.Hằng, Dũng (Date 29/11 – 6/12/2004)

No	Name of street	Locations selected for counting
1	Tỉnh lộ 45	Doanh Trại QĐNDVN (gần cây xăng Hiệp An)
2	Tỉnh lộ 34	Ngã 3 Nguyễn Hữu Thọ- Nguyễn Văn Linh
3	Nguyễn Văn Linh	Trạm Thu Phí
4	Huỳnh Tấn Phát	Cây xăng 153 Huỳnh Tấn Phát
5	Đường 3/2	Nhà Hát Hòa Bình
6	Nguyễn Thị Minh Khai	TTVH 97 NTMK
7	Phạm Thế Hiển	2225PTH, CSXSTP Quang Minh
8	Trần Xuân Soạn	Cây xăng dầu số 4 (gần Lâm Văn Bền)
9	KCX Tân Thuận Tân Thuận Đường 16	 Bưu Điện KCX Đội bảo vệ

Team II: Liên, Quốc (Date 07/12 – 13/12/2004)

No	Name	LoPeriodtions selected for counting
1	Âu Cơ	BCH Quân Sự p. Phú Trung (952 Âu Cơ, gần ngã 3 Thoại Ngọc Hầu)
2	KCN Tân Bình - Tây Thạnh - Đường số 2	 NM Cơ Khí Tiến Tuấn (Gần khu phố 3) Đội bảo vệ và PCCC KCN (gần đường 19/5)
3	Tân Kỳ Tân Quý	Cây xăng TK-TQ (9/5 TK-TQ)
4	Lý Tự Trọng	Gần Sở TNMT
5	Lũy Bán Bích	Cây xăng gần Hoà Thạnh
6	Kinh Dương Vương	UBND Quận Bình Tân
7	Quốc lộ 1	Trạm Thu Phí(gần TKTQ)
8	Tỉnh lộ 10	UBND P. Tân Tạo A (B1/4 Tỉnh lộ 10)

Team III: Đức, Huy (Date 14/12 – 20/12/2004)

No	Name	LoPeriodtions selected for counting
1	Quốc lộ 22	DNTN Xăng Dầu Hoàng Anh
2	Tỉnh lộ 8	UBND Xã Hoà Phú
3	Tỉnh lộ 9	UBND Xã Bình Mỹ
4	Tỉnh lộ 15	UBND Tân Thạnh Đông
5	Trường Chinh	Cửa hàng xăng dầu 45
6	Quang Trung	PERIOD Quận Gò Vấp
7	Nguyễn Oanh	Trường Sĩ quan Vimhempich
8	Nguyễn Văn Bứa	Cửa hàng xăng dầu Xuân Thới

Team IV: T.Hằng, Tuấn (Date 21/12 – 28/12/2004)

No	Name	LoPeriodtions selected for counting
1	Kha Vạn Cân	Cá sấu Hoa Cà (bên phải – cơ điện lạnh Chiến)
2	Tỉnh lộ 43	UBND phường (bên phải)(gần KCN Bà Chiểu)
3	Lương Định Của	UBND Q2
4	Nguyễn Thị Định	PeriodfePhong Lan
5	Quốc lộ 13	Cân Nhơn Hoà (bên phải)
6	Khu chế xuất LT	
7	Khu chế xuất LT	
8	Nguyễn Xí	Đoạn giữa đường
9	Phan Đăng Lưu	Doanh trại quân đội (bên trái)

Detailed schedule

Monday (29/11): Nguyễn Văn Linh (12 people/3 periods)
Period 1(6h – 14h): **T. Hằng** (0918509175), 3 students
Period 2(14h – 22h): **Quốc** (0908479718), 3 students
Period 3 (22h – 6h): **Tuấn** (0908127730), 3 students

Tỉnh lộ 34 (6 people/3 periods)
Period 1(6h – 14h): **Liên** (0918818881), 1 student
Period 2(14h – 22h):**M.Hằng** (0989018020), 1 student
Period 3(22h – 6h): **Dũng** (0908250301), 1 student

Tuesday (30/11): Trần Xuân Soạn (9 people/ 3 periods)
Period 1(6h – 14h): **T. Hằng** (0918509175), 2 students
Period 2(14h – 22h): **Quốc** (0908479718), 2 students
Period 3(22h – 6h): **A.Đức** (0918206933), 2 students

Phạm Thế Hiển (9 people/ 3 periods)
Period 1(6h – 14h): **M.Hằng** (0989018020), 2 students
Period 2(14h – 22h): **Liên** (0918818881), 2 students
Period 3(22h – 6h): **Huy** ( ), 2 students

Wednesday (1/12): 3/2 (17 people/ 3 periods)
Period 1(6h – 14h): **Quốc** (0908479718), **M.Hằng**(0989018020),4 students
Period 2(14h – 22h): **Dũng** (0908250301), **Liên**(0918818881), 4 students
Period 3(22h – 6h): **Tuấn** (0908127730), 4 students

Thurdays (2/12): Nguyễn Thị Minh Khai (17 people/ 3 periods)
Period 1(6h – 14h): **T. Hằng** (0918509175), **Quốc** (0908479718),4 students
Period 2(14h – 22h): **M.Hằng** (0989018020), **A.Đức** (0918206933) ,4 students
Period 3(22h – 6h): **Dũng** (0908250301), 4 students

Friday (3/12): Tỉnh lộ 45 (12 people/ 3 periods)
Period 1(6h – 14h): **Liên** (0918818881), 3 students
Period 2(14h – 22h):**Huy**( ), 3 students
Period 3 (22h – 6h): **Quốc** (0908479718), 3 students

Tân Thuận (6 people/3 periods)
Period 1(6h – 14h): **T. Hằng** (0918509175), 1 student
Period 2(14h – 22h): **Tuấn** (0908127730), 1 student
Period 3(22h – 6h): **A.Đức** (0918206933), 1 student

Monday (6/12): Huỳnh Tấn Phát (12 people/ 3 periods)
Period 1(6h – 14h): **Liên** (0918818881), 3 students
Period 2(14h – 22h): **Dũng**(0908250301), 3 students
Period 3 (22h – 6h): **Tuấn** (0908127730), 3 students

Đường số 16 (6 people/ 3 periods)
Period 1(6h – 14h): **M.Hằng** (0989018020), 1 student
Period 2(14h – 22h): **A.Đức** (0918206933), 1 student
Period 3(22h – 6h): **Huy** ( ), 1 student

Tuesday (7/12): Tân Kỳ Tân Qúy (9 people/3 periods)

Period 1(6h – 14h): **T. Hằng** (0918509175), 2 students
Period 2(14h – 22h): **Dũng**(0908250301), 2 students
Period 3 (22h – 6h): **Quốc** (0908479718), 2 students

Tỉnh lộ 10 (9 people/3 periods)
Period 1(6h – 14h):**Hằng**(0989018020), 2 students
Period 2(14h – 22h): **Liên** (0918818881), 2 students
Period 3 (22h – 6h): **A.Đức** (0918206933), 2 students

Wednesday (8/12): Quốc lộ 1 (12 people/ 3 periods)
Period 1(6h – 14h): **Liên** (0918818881), 3 students
Period 2(14h – 22h): **Dũng**(0908250301), 3 students
Period 3 (22h – 6h): **Tuấn** (0908127730), 3 students

Lý Tự trọng (6 people/ 3 periods)
Period 1(6h – 14h): **M.Hằng**(0989018020), 1 student
Period 2(14h – 22h): **T. Hằng** (0918509175), 1 student
Period 3 (22h – 6h): **Huy**( ), 1 student

Thurday (9/12): Âu Cơ (9 people/ 3 periods)
Period 1(6h – 14h): **T. Hằng** (0918509175), 2 students
Period 2(14h – 22h): **A.Đức** (0918206933), 2 students
Period 3 (22h – 6h): **Quốc** (0908479718), 2 students

Lũy Bán Bích (9 people/ 3 periods)
Period 1(6h – 14h): **M.Hằng**(0989018020), 2 students
Period 2(14h – 22h): **Liên** (0918818881), 2 students
Period 3 (22h – 6h): **Dũng**(0908250301), 2 students

Friday (10/12): Kinh Dương Vương (17 people/ 3 periods)
Period 1(6h – 14h): **Liên** (0918818881),**M.Hằng**(0989018020),4 students
Period 2(14h – 22h): **A.Đức** (0918206933), **Huy** ( ), 4 students
Period 3 (22h – 6h): **Tuấn** (0908127730), 4 students

Monday (13/12) Tây Thạnh (9 people/3 periods)
Period 1(6h – 14h): **T. Hằng** (0918509175), 2 students
Period 2(14h – 22h): **A.Đức** (0918206933), 2 students
Period 3 (22h – 6h): **Dũng**(0908250301), 2 students

Đường số 2 (9 people/ 3 periods)
Period 1(6h – 14h): **Liên** (0918818881), 2 students
Period 2(14h – 22h): **Quốc** (0908479718), 2 students
Period 3 (22h – 6h): **Huy** ( ), 2 students

Tuesday (14/12): Quốc lộ 22 (12 people/3 periods)
Period 1(6h – 14h): **Liên** (0918818881), 2 students
Period 2(14h – 22h): **M.Hằng** (0989018020), 2 students
Period 3 (22h – 6h): **Dũng** (0908250301), 2 students

Nguyễn Văn Bứa (6 people/3 periods)
Period 1(6h – 14h): **T. Hằng** (0918509175), 1 student
Period 2(14h – 22h): **Tuấn** (0908127730), 1 student
Period 3 (22h – 6h): **Huy** ( ), 1 student

Wednesday (15/12): Tỉnh lộ 8 (8 people/3 periods)
Period 1(7h – 19h): **Tuấn** (0908127730),**T. Hằng** (0918509175), 2 students
Period 3 (19h – 7h): **A.Đức** (0918206933), 4 students

Tỉnh lộ 15 (8 people/ 3 periods)
Period 1(7h – 19h): **M.Hằng** (0989018020), **Liên** (0918818881), 2 students
Period 3 (19h – 7h): **Quốc** (0908479718), 4 students

Thurday: Trường Chinh (17 people/ 3 periods)
Period 1(6h – 14h): **Liên** (0918818881),**T.Hằng** (0918509175),4 students
Period 2(14h – 22h): **Tuấn** (0908127730), **Huy**( ),4 students
Period 3 (22h – 6h): **Dũng**(0908250301),4 students

Friday: Quang Trung (17 people/ 3 periods)
Period 1(6h – 14h): **Quốc** (0908479718),**M.Hằng** (0989018020),4 students
Period 2(14h – 22h): **A.Đức** (0918206933),**Huy** ( ), 4 students
Period 3 (22h – 6h): **Tuấn** (0908127730),4 students

Monday (20/12): Nguyễn Oanh (17 people/ 3 periods)
Period 1(6h – 14h): **M.Hằng** (0989018020),**Liên** (0918818881), 4 students
Period 2(14h – 22h): **Dũng**(0908250301), **Huy** ( ),4 students
Period 3 (22h – 6h): **A.Đức** (0918206933), 4 students

Tuesday (21/12): Kha Vạn Cân (9 people/3 periods)
Period 1(6h – 14h): **T. Hằng** (0918509175), 2 students
Period 2(14h – 22h): **Tuấn** (0908127730), 2 students
Period 3 (22h – 6h): **Huy** ( ), 2 students

Tỉnh lộ 43 (9 people/3 periods)
Period 1(6h – 14h): **M.Hằng** (0989018020), 2 students
Period 2(14h – 22h): **Dũng** (0908250301),2 students
Period 3 (22h – 6h): **Quốc** (0908479718), 2 students

Wednesday (22/12): Lương Định Của (9 people/3 periods)
Period 1(6h – 14h): **T.Hằng** (0918509175), 2 students
Period 2(14h – 22h): **Liên** (0918818881), 2 students
Period 3 (22h – 6h): **Dũng** (0908250301), 2 students

Nguyễn Thị Định (9 people/3 periods)
Period 1(6h – 14h): **M.Hằng** (0989018020), 2 students
Period 2(14h – 22h): **A.Đức** (0918206933), 2 students
Period 3 (22h – 6h): **Tuấn** (0908127730), 2 students

Thurday (23/12): Quốc lộ 13 (12people/3 periods)
Period 1(6h – 14h): **Liên** (0918818881), 3 students
Period 2(14h – 22h): **T. Hằng** (0918509175), 3 students
Period 3 (22h – 6h): **Huy**( ), 3 students

Đường phụ KCX Linh Trung (6people/3 periods)
Period 1(6h – 14h): **M.Hằng** (0989018020), 1 student
Period 2(14h – 22h): **Quốc** (0908479718), 1 student
Period 3 (22h – 6h): **A.Đức** (0918206933), 1 student

Monday (27/12): **Đường chính KCX Linh Trung (9people/3 periods)**
Period 1(6h – 14h): **T.Hằng** (0918509175), 2 students
Period 2(14h – 22h): **Dũng** (0908250301), 2 students
Period 3 (22h – 6h): **Quốc** (0908479718), 2 students

Nguyễn Xí (9people/3 periods)
Period 1(6h – 14h): **M.Hằng** (0989018020), 2 students
Period 2(14h – 22h): **Liên** (0918818881), 2 students
Period 3 (22h – 6h): **Tuấn** (0908127730), 2 students

Tuesday (28/12): **Phan Đăng Lưu (17 people/ 3 periods)**
Period 1(6h – 14h): **M.Hằng** (0989018020), **T.Hằng** (0918509175), 4 students
Period 2(14h – 22h): **A.Đức** (0918206933), **Huy** ( ), 4 students
Period 3 (22h – 6h): **Dũng** (0908250301),4 students

Appendix H

Task 8. Field Operations

Spare parts and gases

NILU checked and verified prices for spare parts and gases, which HEPA will have to obtain for operating the Danida supported stations

Part No.	Quantity	Unit price USD	Total price USD	Comments
PU0000022	30	64	1 920	
013970000	2	927	1 854	NB: This is the complete pump unit with bracket, fittings, etc.
PU0000020		638	0	NB: This is only the pump itself for 100A, 300, 400A
PU0000011	5	132	660	NB: For the NOx pump supplied by us
005140300	02	1 046	2 092	
KIT000124	02	1 038	2 076	
014080100	04	918	3 672	
002620100	04	783	3 132	
013400000	04	1 023	4 092	NB
011440100	04	2 241	8 964	NB: The block is not sold as a separate item
KIT000093	04	325	1 300	
FL0000001	30	5	150	
OR0000001	60	5	300	
014080100	04	918	3 672	
KIT000041	03	647	1 941	NB
014680000		708	0	NB
011930000	03	1 605	4 815	NB: Part no corrected
021070000	03	573	1 719	
002730000	10	53	530	
007980000	02	703	1 406	
004020500	04	751	3 004	
KIT000032	02	2 152	4 304	NB: 5 year warranty from 15. May 2002
009530000	04	1 258	5 032	
015810000	05	206	1 030	
005260100	03	381	1 143	NB: Not used in any instrument supplied by us
005260200		458	0	NB: For M400A supplied by us
015090000	03	1 287	3 861	
Sum Total			**62 669**	

Delivery time is 4 to 6 weeks. Prices are given exclusive freight.
The final costs are dependant on the USD exchange rate

Description	Size	Valve	Price USD (AL)	Price USD (AGA)	Price USD (BOC)
500 ppb NO i NO2	10 L	DIN 8	1 731		2 441
500 ppb SO2	10 L	DIN 8	1 825		2 698
50 ppm CO	10 L	DIN 8		1 237	
500 ppb NO in NO2	50 L	DIN 8	2 511		2 939
Duration			6 months	24 months	60 Months

USD
6.5

The prices above are given from 3 different gas suppliers. These are: L'Air Liquid, AGA and BOC
Delivery time is 6 to 8 weeks. Prices are given exclusive freight.

The final costs are dependant on the USD exchange rate

Appendix J

Task 10 Air Quality Assessment

Appendix K

Task 11. Capacity building

Appendix L

Task 12. Administrative Meetings

Appendix L1

Minutes

Title:	**Project meeting no. 9**
Date	16 December 2004
Participants:	Bjarne Sivertsen (BS), The Nguyen Thanh, (TNT), Rolf Dreiem (RD), Leif Marsteen (LM), Rune Ødegaard (RuO), Gunnar Jordfald (GJ)
Prepared by:	B Sivertsen
Distribution:	Participants, Paal Berg (PB) HEPA (Le Van Khoa, Mr. Dam)

1 Agenda

1. Project status just now, economic success
2. The end of HEIA project- reporting
3. Audits to stations in HCMC, when and how?
4. The contract for the new project – name?
5. Procurement of instruments and equipment for Reflab. (see attached)
6. Installations and testing; needs, when, where?
7. Training needs assessment.
8. Time schedules and further work.
9. Other matters

1 Summary of meeting

2.1 Project status just now

The HEIA project was finalised during Mission 5 in November-December 2004. The plans have been followed and performed according to the contract. A contract for a follow-up project on the development of a Reference Laboratory and additional training was signed during a ceremony at DONRE in HCMC.

We are finalising the last two reports and this meeting is the preparation for the next phase. A final invoice for the HEIA project will be sent HEPA and NORAD before the end of this year.

2.2 The end of HEIA project- reporting

A complete list of reports was prepared for DONRE during Mission 5. The last two documents will be printed in January. Five Mission reports, several memos, minutes from meetings and manuals have also been issued as part of the project development. A few of these documents are also included on the HEIA CD.

2.3 Audits to stations in HCMC, when and how?

A preliminary audit to all stations in HCMC was performed during Mission 4. A final audit to be undertaken "at the end of the HEIA project" was indicated for the HEPA personnel. This station audit had to be postponed till the beginning of 2005.

This audit will then be combined with training for the new Reflab project and will be undertaken during the first Mission to HCMC in the new project.

2.4 The contract for the new project – name?

The contract for the new project was signed on 16 November 2004 at DONRE in HCMC. A good acronym for the\is project has yet not been identified. HEIA-2 is probably the easiest and best one.

The main tasks to be undertaken during HEIA-2 are:

1. Identify the physical location and features of the laboratory
2. Design the reference laboratory
3. Procure equipment
4. Test and verify equipment
5. Shipping of equipment
6. Install, verify and test the equipment in the laboratory
7. Develop training programme for maintenance, repair and calibration
8. Develop QA/QC programme related to Reference laboratory activities
9. Perform audits and train the ref-lab personnel
10. Update the database and collect input data
11. Meteorological data, training and improve instruments
12. Perform training in air quality assessment, seminar
13. Improve modelling capacity
14. Undertake impact evaluation
15. Prepare HEPA for undertaking abatement planning
16. Improve data dissemination and information

The facilities for the Reference laboratory will be identified, and the room prepared for installing the equipment for undertaking calibrations as well as maintenance and repair.

The project also includes training in QA/QC, repair and maintenance as well as further training in modelling and impact assessment work.

2.5 Procurement of instruments and equipment for Reference laboratory

During the meetings with HEPA we were informed about prices of instruments for the Reference Laboratory, which was given directly to HEPA from API. The prices were based on the specifications presented by NILU. The prices for deliveries of instruments directly to HEPA in HCMC seem to be cheaper than purchasing the equipment from via Norway (See Attachment 2).

NILU has received a request from HEPA to purchase directly. The probability of receiving instruments, which may be defect, is very limited. HEPA will have to assure that the warranty will take care of this.

The warranty period should start at the delivery day, which should be specified by HEPA: Depending on the availability of the reference laboratory facilities we will suggest that this date is 1 August 2004, so that Rolf may arrive in HCMC from medio August to install and train.

After a discussion of the different alternatives as well as the practical work to be undertaken the meeting decided to purchase directly from API to HEPA in HCMC.

2.6 Installations and testing; needs, when, where?

Based on the decisions taken in the meeting we will prepare the installations to be undertaken directly in HCMC. Rolf will have to be present from the moment the instruments are unpacked.
We have indicated in a mail to HEPA that to start the process we will have to undertake the following tasks:
1. Request API to give HEPA a formal and written quotation
2. Send a copy of this document to NILU as soon as possible
3. Ask API to specify that the guarantee/warrantee period start at delivery, which HEPA should specify to a specific day, e.g. 1 August 2005!

To follow this procedures we will have to assure that the new Reflab laboratory has been checked and found okay, and that all benches, shelves and air condition etc is in place BEFORE the instruments are installed in the Laboratory.

Rolf will then support the unpacking, installations and see that necessary testing and training will be undertaken. (This will hopefully be Mission 2 at the end of August?)

2.7 Training needs assessment.

A training assessment programme will have to be developed both for the Reference laboratory and for the additional input to the institutional building related to air quality assessment and management.

NILU instrument experts will perform the necessary training for the operation of the Reference laboratory included additional QA/QC procedures. Together with the HEPA field operators NILU will also follow up calibration procedures and maintenance. NILU experts will undertake hand-on training in instrument maintenance, field calibrations, multi-point calibrations and repairs. Additional workshop and seminars will be planned and undertaken as part of the establishment of the Reference laboratory.

The objectives are also to improve the capacity building and to assure that the HEPA personnel will be able to conduct air quality assessment studies and air quality planning.

Within the limited budget NILU can together with the client define the strategic objectives of an Air Quality Management and planning System (AQMS), and support the selection of tools, modules and components to be used in a specific situation and for a defined area of interest. Training in the application of AirQUIS as a basis for performing abatement strategy planning will be prepared, but the work itself will have to be undertaken locally. NILU may, if wanted, participate in the process as part of the on-the-job training programme.

If the ADB project on "Air quality and health impact among the poor" will be a reality, NILU will support HEPA in addition to perform the necessary exposure estimates needed for this project. Further training will thus be needed both in HCMC and at NILU.

2.8 Time schedules and further work.

A total of 4 Missions have been planned during HEIA-2 project. The two main Missions to HCMC will be undertaken in August 2004 and in October/November 2005 depending upon the infrastructure and availability of laboratory in HCMC.

A short visits will also be paid to HCMC at the beginning of the project to design, prepare and identify the needs. At the end of the project there will be a summary workshop and discussions of results of the air quality assessment and planning work.

2.9 Other matters

HEPA and Mr Dam will be notified about the decisions and asked to start the process of procuring instruments directly from API to HEPA.

Attachment

3 Instruments for the new Reference Laboratory

There are two options for the procurement and installations of instruments for the new Reference Laboratory.
To purchase all instruments in Norway, from Furevik and install and test at NILU
To purchase directly from API to HEPA in HCMC. They seem to have received some favorable prices. (see below)

Ref lab deliveries

Inventory List

Reference laboratory

Items	Model (Example)	Cost 1000	Cost Nilu	US	Comments
		NOK	USD	USD	
SO_2 monitor	API100	100	15 385	10 286	
NOx monitor	API200	100	15 385	10 712	
O3 monitor	API400	90	13 846	7 780	Travelling standard
CO monitor	API300	80	12 308	10 263	
Zero air generator	API701	30	4 615	4 509	
Zero air gen. compressor	1hae-11t-m104x				Cost incl. in Zero air generator
Multigas mulitpoint calibrator	API700	130	20 000	14 399	
SO_2 cal. gas, 100 ppm, ref std.	NIST	14	2 154	1 815	Incl. regulator
NO cal. gas, 100 ppm, ref std.	NIST	14	2 154	1 815	Incl. regulator
CO cal. gas, 5000 ppm, ref std.	NIST	14	2 154	1 815	Incl. regulator
Flow calibrator	BIOS DryCal	25	3 846	6 347	
PC with monitor	GW P5-133	10	1 538	2 000	Can be locally supply
PC Software	MS Office 95	5	769		
PC printer	HP 682C DJ	2	308		
Lab. env., Rel. Hum.+Temp.	Va HMP 231	80	12 308	12 308	
Lab. env., Air Pressure	Va PTB 201AD				Incl. in Lab. env., Rel Hum.+Temp.
Lab. env., CO detector	SA 3000 SI				Incl. in Lab. env., Rel Hum.+Temp.
Rack for monitors (2 pcs)	EDR20086	10	1 538	1 538	
Aircon+ furnitures etc		110	16 923	10 000	Can be locally supply
Repair tools	BACO	4	615	615	
Laboratory items	Fittings, filters etc.	5	769	769	
	Total	**823**	**126 615**	**96 971**	
				29 645	

The NILU prices are the ones we indicated in the proposal. We may manage a better deal?

We will have to discuss procedures, security, insurance and other factors influencing the two alternatives, before we make a decision – in the meeting!

Appendix L2

Memo

Title	**Payment schedule and reports available**
Purpose	To summerise the different reports presented during the HEIA project
Distribution	Mrs Tuyet Hoa, Mr. Khoa, The Nguyen Thanh (TNT)
Author	Bjarne Sivertsen
Date	November 2004
Reference No	O-101143

In the contract for the HEIA project the payment schedule was linked to some major milestones of the project. The following milestones were identified:

1. Planning, administration
2. Review existing monitoring programme – Inception report, Quarterly report 1 (QR 1)
3. Procurement of instruments, second quarterly report (QR 2)
4. Field installations finalised, status report (QR 3)
5. Establish data retrieval and QA/QC system, status report (QR 4)
6. AirQUIS installed and trained, first data presentations reported (QR 5)
7. Workshops and seminar on air quality assessment and abatement, (QR 6)
8. Data assessment, relative importance of sources (QR 7)
9. Plan of action for measures to be taken to reduce air pollution in HCMC (QR 8)
10. Capacity building and training, on-the-job, workshops (QR 9)
11. Further upgrading, improvements and understanding air quality, seminar (QR 10)
12. Information and data dissemination, evaluate Internet applications? (QR 11)
13. Final report

The payment schedule given in the Table below included the milestones presented above:

Pay-ment	Indicator, status	Month nr.	1000 NOK	1000NOK accumul
1	Planning, administration	1	300	300
2	Review existing monitoring programme – Inception report, Quarterly report 1 (QR 1)	3	500	800
3	Procurement of instruments, second quarterly report (QR 2)	6	2 500	3 300
4	Field installations finalised, status report (QR 3)	10	600	3 900
5	Establish data retrieval and QA/QC system, status report (QR 4)	12	350	4 250
6	AirQUIS installed and trained, first data presentations reported (QR 5)	15	500	4 750

Pay-ment	Indicator, status	Month nr.	1000 NOK	1000NOK accumul
7	Workshops and seminar on air quality assessment and abatement, (QR 6)	18	200	4 950
8	Data assessment, relative importance of sources (QR 7)	21	250	5 200
9	Plan of action for measures to be taken to reduce air pollution in HCMC (QR 8)	24	300	5 500
10	Capacity building and training, on-the-job, workshops (QR 9)	27	200	5 700
11	Further upgrading, improvements and understanding air quality, seminar (QR 10)	30	200	5 900
12	Information and data dissemination, evaluate Internet applications? (QR 11)	33	250	6 150
13	Final report	36	250	6 400
	Total		**6 400**	

A summary of the reports that have been developed during the project is presented in the Table below. These reports as well as some background material presented to the DONRE/HEPA experts have also been made available on a CD presented to DONRE.

Report	Project title (short version)	NILU report	Dated
QR 1	HEIA Inception Report	OR 28/2002	April 2002.
QR 2	Mission 1, Inception Phase report.	OR 23/2002	April 2002
QR 3	Mission 2, Procurement and installations performed.	OR 02/2003	Nov. 2002
QR 4	Field installations and Passive sampling of NO_2 and SO_2 at selected sites in Ho Chi Minh City.	OR 15/2003	April 2003
QR 5	QA/QC and SOP manuals	Manual Nov 2002	Nov 2002
QR 6	Mission 3, AirQUIS installed and trained.	OR 84/2003	Nov. 2003
QR 7	Seminar at DOSTE and at NILU, several training memos available	F 13/2002 + F Reports	April 2002
QR 8	Mission 4, Data assessment and training	OR 51/2004	April 2004
QR 9	AirQUIS Workshop no. 1 held at NILU. Kjeller (Norway).	OR 20/2003	31 March – 11 Apr2003
QR 10	On the job workshops, data interpretation	Memo	Nov 2003
QR 11	Mission 5: Upgrading improvements and understanding	OR xx/2004	Nov 2004
	Final report, report on air quality in HCMC		

Several memos, minutes from meetings and manuals have also been issued as part of the project development. A few of these documents are also included on the HEIA CD.

Appendix L3

Minutes of Meeting with Swisscontact

Title	**Meeting with Swiscontact at HEPA 24 November 2003**
Participants	Mr Lukas Heer (Swisscontact Hanoi), Mr. Roy Eugster (Zurich), Mr. Reto Schupbach (Zurich), Mr. Vo Thanh Dam, Mr. Bjarne Sivertsen (BS) and Mr. The Nguyen Thanh (TNT),
Distribution	TNT, LV Khoa, Mission 5 report
Author	BS
Date	25 November 2004
Reference No	O-101143

Swisscontact had asked for a meeting with HEPA to receive information of the air quality monitoring and management programme developed and operated in HCMC.

Swisscontact, the Swiss Foundation for Technical Cooperation (www.swisscontact.org) has been mandated by the *Swiss Agency for Development and Cooperation* SDC (www.deza.admin.ch) to implement the first phase of the Swiss-Vietnamese Clean Air Program (SVCAP).

The overall goal of SVCAP is to contribute to the prevention of a possible further degradation of the air quality in Hanoi and surrounding. The purpose of the first phase (SVCAP-I, 09/04 – 12/07) is to support the creation of favourable conditions for the reduction of air pollution by means of the definition and implementation of an integral air quality management system, focusing on Hanoi and surrounding.

Lukas Heer is the Project Manager of the Swiss-Vietnamese Clean Air Program (SVCAP), a quite new, Swiss funded long-term initiative which aims at supporting the Vietnamese Government at National and city level (focus in the first phase 2004 - 2007 is on Hanoi) in preventing the further deterioration of the air quality in Vietnam and its urban centres.

SVCAP is currently conducting a situation analysis on the availability and quality of air pollution data in Hanoi. Based on the situation analysis, they plan to come up in December with a concept for the future air quality monitoring system in Hanoi, included regular emission inventories (and dispersion models, at a later stage), as the base for subsequent implementation steps in line with program objectives. Based on our preliminary assessment, capacity building is likely to play an important role within the program.

Through four components, SVCAP-I will focus on capacity building and institutional strengthening, resulting in the long-term in a sustainable implementation of air pollution reduction measures.

The Swiss Agency for Development and Cooperation SDC, through Swisscontact, acting as its implementation agency, contributes up to CHF 3'417'000.- (approx US$ 2'500'000.-) as follows:

- Fully-fledged project management office over the whole project period and Swisscontact management/expert team, consisting of one full-time Project Manager, four full-time Program Officers and support staff (in-kind contributions)
- Technical assistance in form of international and national/regional consultancy (in-kind contributions)
- Direct financial contributions to the SVCAP-I program activities

The Vietnamese partners provide mainly in-kind contributions with regard to human resources, data and information and working infrastructure.

We stressed and were supported by Mr Heer that it will be important to closely coordinate future activities from the HEPA side and from the Swiss side, in order to avoid overlaps and rather create synergies, if possible. They are looking into the possibility of creating a database for air quality planning and are investigating the projects already undertaking by different agencies such a NORAD. Danida, CIDA, JICA and US-AED. The World Bank initiative in the transport sector will also be considered.

The Swiss experts were very interested in the emission inventory, which presently is being developed for HCMC. They have that as a major priority on their list for activities in Hanoi.

Appendix L4

Memo

Title	**MONRE/VEPA project for integration**
Purpose	Discuss and propose HEPA/NILU input to Hanoi and Vietnam National air quality integrated programme
Distribution	Mr. Khoa, Mr Dam, The Nguyen Thanh (TNT)
Author	Bjarne Sivertsen
Date	November 2004
Reference No	O-101143

Dr. Hoang Duong Tung, Director for the Centre for Environmental Monitoring, Data and Information (CEMDI) at VEPA/MONRE and Mr. Thai Minh Son from MONRE in Hanoi visited HEPA HCMC on 23 November 2004 to discuss the NORAD financed HEIA project and possible future co-operation between HEPA and VEPA. They were informed about the work undertaken as part of the NORAD project and were impressed and interested in a follow-up programme.

After the meeting it was clear that VEPA and HEPA have the intention for a close cooperation regarding utilising the competence and experience gained by HEPA through the NORAD funded project.

We have indicated in a mail to VEPA that a project proposal could be established based on the success from the air quality management project (HEIA) in HCMC. By providing Hanoi the necessary competence transfer from HCMC for institutional building in Hanoi, we believe, will give this proposal a good platform for seeking for funds e.g. from NORAD.

We have proposed an approach for VEPA regarding preparing a the proposal to be discussed with NORAD. The main activities may be concentrated at capaciy building including:

- Training in understanding the Air Quality Management
- Air Quality Management based on DPSIR framework
- Monitoring network design
- How to maintain and perform quality assurance work on the existing measurement stations
- How to integrate existing measurement data from the existing stations in Hanoi into a centralized measurement database
- QA/QC and data quality procedures; improving data flow and air quality data availability
- Air quality statistics and reporting procedures
- Dissemination of air quality information to the public using online data and Internet techniques

- Air quality management at different levels and between authorities starting with VEPA in Hanoi and HEPA in HCMC

The project will include the establishment of an Air Quality Management Platform to meet the requirements of a Centralised Air Quality Monitoring Network for Hanoi and later for Vietnam.

A main objective of these efforts for integrating all activities related to air pollution investigations, monitoring and management in Hanoi will be to assure that activities will not be duplicated and that all parts are co-ordinated to reach the same goal.

The first phase of the project will aim at handling the existing measurement stations through the establishment of:

- Routines for operating the monitoring network
- The use of an Air Quality Management System in Hanoi
- An Online Air Quality Dissemination System using Internet

As part of the procedure we will have to evaluate the HEIA project in HCMC as seen from VEPA in Hanoi. A letter of intent for cooperation between VEPA and HEPA will have to be prepared and objectives, methods, project organisation and time schedules will be prepared.

The experience established at HEPA in HCMC may provide services and support concerning:

- Design operation and management of air monitoring network
- Maintenance and quality assurance of data from the measurement network
- Establishment of an air pollution emission inventory
- Performing air quality assessment using state-of-the-art air quality management system
- Publishing air quality information using online air quality dissemination system on Internet
- Reference Laboratory for maintenance and repair of measurement equipments, dynamic calibration, verification of measurement standards and methods etc.

To get an overview of data from the measurement stations, HEPA can assist VEPA to evaluate the data. To be able to perform the evaluation, HEPA need to retrieve data.

Since there is no money at the moment, HEPA has proposed the following solution:

1. Can VEPA export data into ASCII-file from the data loggers and/or data retrieval systems in the measurement stations?
2. Transfer the exported ASCII-file from the measurement stations to HEPA preferably by FTP. If not possible, then E-mail can be used.
3. HEPA will use the automatic import module in AirQUIS to import the exported ASCII-files from VEPA.
4. HEPA will evaluate and comment the quality of the measurement data for VEPA.

Summary:

- VEPA is responsible for exporting data into ASCII-files and transfer these to HEPA
- HEPA will import the measurement from the ASCII-files and evaluate the data for VEPA

  In short, if VEPA manage to get funds then the new project will introduce new data loggers, automatic data acquisition system for getting data automatically to a centralised database.

  In the mean while, please provide HEPA with the following information, if possible:
  1. What kind of the instruments, data loggers, modems and data retrieval software including PC-equipment and operative system (if any) exist at the stations?
  2. The possibility of connecting to the stations using modem
  3. What components, values and units do the data loggers collect?
  4. What are the routines for retrieving the measurement data
  5. What kind of quality assurance routines exists at the stations (station log, instrument log, calibration, spare parts and consumables)
  6. Who undertakes repair and dynamic calibration of the instruments? Do you have maintenance contracts with instrument suppliers?

The file contains the following structure:

- Col 1 - Date (the format is flexible e.g. yymmdd)
- Col 2 - Time (the format is hh:mm). The time step is 1 hour and must be continuously meaning 24 values for each day. No measurements can be filled with nothing (blank) or 0, dependent on how the instruments and data loggers are configured.
- Col 3 - Values from a specific component
- Col 4 and so on - Values from other components from the same station. Quality Control (QC) flag for each component can also be included in this file as columns e.g. in between or at the end of columns. AirQUIS does provide automatic QC-flag with specific predefined rules from the user and QC-level when importing measurement data.

Please specify in a separate document the name and unit of the columns in the document. If you are including the QC-flags please also specify the flag types. You can also provide a file for each component, but it's more efficient to export all the components in one file for each station.

It's important that all the columns have fixed positions, because The Automatic Module in AirQUIS will assign the properties (eg.g Date, Time, Values from the columns in the file).

In a comment from Dr Tung he states that:
VEPA role is to manage and support monitoring stations at national wide. From this point of view, we try to develop a common standard, methodology and use a common tool/software at provincial and central level.
It could help all of us to manage, share information, data within national network. Therefore we would like very much to expand NILU/HEPA experience in air monitoring and inventory, data management.

May I suggest that at the beginning, NILU-VEPA jointly develop a proposal on mentioned topics, particular on data management, software and training for air monitoring stations? After that we could implement first in Hanoi and some other air stations belong to VEPA network. If a proposal approved, during implementation phase, we can use HEPA people as resource person/local consultants/expert to carry out a project.

Appendix L5

Memo

Title	**Tasks to be undertaken at HEPA after Mission 5**
Purpose	List of tasks that HEPA will have to undertake after Mission 5 to HCMC.
Distribution	Mr. Khoa, Mr. Dam, The Nguyen Thanh (TNT), Rolf Dreiem (RD), Leif Marsteen (LM)
Author	Bjarne Sivertsen (BS)
Date	November 2004
Reference No	O-101143

The following tasks have to be undertaken at HEPA after Mission 5:

1. Correct all air quality data for October and November 2004 and prepare new printout
2. Update the quality assurance file with monthly printouts every month after corrections and flagging, printed versions into the book
3. Produce lower temperatures for DOSTE station in the future, and check that the database is complete for 2004
4. Correct wind directions at Doste station according to procedures given by BS
5. Run monthly wind roses from Doste station, import to a word file and mail to NILU,
6. Get monthly wind roses from the Meteorological service in HCMC, and compare to the Doste wind roses
7. Generate 24 hour average PM_{10} concentrations and store in database
8. Generate moving 8-hour average CO concentrations and store in database
9. Change and correct the stack co-ordinates in AirQUIS
10. Visit all Districts to discuss with responsible environmental experts in each District the locations of industrial areas, type of industries and possible information for emission estimates,
11. Identify industrial areas and locate them in the GIS maps (as industrial shapes) in AirQUIS
12. Continue traffic counting and import information to AirQUIS and send information to NILU
13. Perform more model tests and send results to NILU (to TNT & BS)
14. Finalise the HEPA Web site (VTD, TNT)
15. Support the import of traffic area source emissions estimated from population distributions in each Ward (BS/VTD)
16. In the future prepare monthly statistics in summary report to be specified by BS (VTD)
17. Prepare facilities for the Reference laboratory

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ABSTRACT

Mission 5, as part of the NORAD financed HEIA project, was undertaken to HCMC from 4 November to 4 December 2004. The air quality monitoring and management system has now been established and is being operated by trained HEPA/DONRE experts. During Mission 5 we signed an agreement for the establishment of a Reference Laboratory and continued institutional building. NILU upgraded the AirQUIS system and we continued training the local experts. Data quality controls of air quality and meteorological data have been performed, and we continued collecting emission data for modelling purposes. During the mission we also prepared a paper on air quality in HCMC, which also will serve as a state of the environment report.

NORWEGIAN TITLE

KEYWORDS		
Air quality monitoring	Air quality assessment	Vietnam

ABSTRACT (in Norwegian)

* *Classification*
- *A Unclassified (can be ordered from NILU)*
- *B Restricted distribution*
- *C Classified (not to be distributed)*