

**Conseil Exécutif des Transports  
Urbains de Dakar (CETUD)**  
Route de Front de Terre, B.P. 17 265 Dakar-Liberté  
Tél. n°(221) 859 47 20 - Fax n°(221) 832 47 44  
E-mail.: cetud@telecomplus.sn

**Norwegian Institute for Air Research**  
P.O. Box 100, N-2027 Kjeller, Norvège  
Tél. n°(47) 63898000 – Fax n°(47) 63898050  
e-mail: cbg@nilu.no



<b>FINANCED BY:</b> Nordic Development Funds	<b>PROJECT REPORT</b>	
<b>Project:</b>	IMPLEMENTATION OF A CENTRAL LABORATORY AND AN AIR QUALITY MONITORING NETWORK IN DAKAR	
<b>Agreement:</b>	No 003/C/FND/05	

## **QADAK Mission 1, May-June 2005**

**Cristina Guerreiro, Bjarne Sivertsen and Herdis Laupsa**

REPORT NO:	12a
CONSULTANTS REFERENCE:	OR 45/2005 O-105010
REV. NO:	Version 1 (31.08.05)
NAME OF TASK	Project Management
ISBN:	82-425-1692-8

## Contents

	Page
<b>Contents .....</b>	<b>2</b>
<b>Summary .....</b>	<b>4</b>
<b>1 Introduction.....</b>	<b>5</b>
<b>2 Schedule and people.....</b>	<b>6</b>
<b>3 Project tasks .....</b>	<b>7</b>
3.1 Task 1 Evaluate existing management structure.....	7
3.1.1 Task 1.1 Collect and evaluate existing organisation of AQ work .	7
3.2 Task 2 Assessment of air quality levels in Dakar .....	7
3.2.1 Task 2.1: Identify existing air quality and meteorological data.....	7
3.2.2 Task 2.2: Identify main potential air pollution sources .....	8
3.2.3 Subtask 2.4: Design and perform screening study.....	9
3.3 Task 3 Establish central AQ Laboratory.....	9
3.3.1 Subtask 3.1: Specify laboratory requirements .....	9
3.3.2 Subtask 3.2: Specify personnel skills and manpower.....	9
3.4 Task 6 Establish and operate the Air quality Management System (AQMS) .....	10
3.5 Task 9 Institutional building and training.....	11
3.6 Task 11 Air Quality legislation advice .....	11
3.7 Task 12 Project Management .....	11
<b>4 Meetings.....</b>	<b>12</b>
4.1 Administrative meeting at Performance .....	12
4.2 Project kick-off meeting at CETUD .....	12
4.3 Meeting with DEEC GIS and map experts .....	12
4.4 Meeting with Direction de l'Environnement .....	13
4.5 Meeting with the transport engineers.....	13
4.6 Signing of contract between CETUD/NILU .....	13
4.7 Meeting at E.S.P Dep. Geomatique .....	14
4.8 Meeting at E.S.P. Dep. Physique Atmosphérique .....	14
4.9 Meeting with CERER.....	15
4.10 Meeting at the MET office.....	15
4.11 Meetings with Prestige.....	16
4.12 Meeting with Mr. Pascal Vardon at Ministère de L'Environnement .....	16
4.13 Meeting at Institut Pasteur, emission measurements .....	17
4.14 End of Mission meeting.....	17
<b>5 References.....</b>	<b>18</b>
<b>Appendix A Time schedule .....</b>	<b>19</b>
<b>Appendix B Contact persons.....</b>	<b>22</b>



<b>Appendix C Minutes of meetings.....</b>	<b>26</b>
<b>Appendix D Laboratory requirements on logistics.....</b>	<b>81</b>
<b>Appendix E Laboratory requirements on personnel skills and manpower ...</b>	<b>85</b>
<b>Appendix F List of documents collected .....</b>	<b>93</b>
<b>Appendix G Meteorological data from prognostic model.....</b>	<b>96</b>



## **Summary**

Financed by the Nordic development Found (NDF), the Norwegian Institute for Air Research (NILU) is supporting the Conseil Exécutif des Transports Urbains de Dakar (CETUD) in establishing a Central Laboratory with an Air Quality Management System for Dakar. This project is part of the component entitled as “Amelioration de la qualité de l’air en milieu urbain” (QADAK) of the “Programme d’Amélioration de la Mobilité Urbaine” (PAMU) operated by the Conseil Exécutif des Transports Urbains de Dakar (CETUD).

This is the report of the first mission to Dakar, Senegal, 30 mai to 7 june 2005. The main purpose of this mission was to sign the final contract between NILU and CETUD and to start the project through a first project meeting with several of the involved parties. The objectives and the content of the project were presented and several of the possible obstacles, resources, project organisation and important elements that may decide the success and sustainability of the air quality programme (QADAK) was discussed.

Several meetings were held with different institutes and companies to get a first overview over the information and competences existing in Dakar that can be relevant to this project. The institutes and companies met during this mission were: CETUD, DEEC, E.S.P Dep. Geomatique, E.S.P. Dep. Physique Atmosphérique, CERER, MET office, Prestige, Ministère de l’Environnement, Institut Pasteur and SPIDS.

This report has also been submitted in French (NILU OR 40/2005).



## **1 Introduction**

Financed by the Nordic development Found (NDF), the Norwegian Institute for Air Research (NILU) is supporting the Conseil Exécutif des Transports Urbains de Dakar (CETUD) in establishing a Central Laboratory with an Air Quality Management System for Dakar. This project is part of the component entitled as “Amélioration de la qualité de l’air en milieu urbain” (QADAK) of the “Programme d’Amélioration de la Mobilité Urbaine” (PAMU) operated by the Conseil Exécutif des Transports Urbains de Dakar (CETUD).

The main purpose of the first mission in May-June 2005 to Dakar Senegal was to sign the final contract between NILU and CETUD and to start the project through a first project meeting with several of the involved parties. The objectives and the content of the project were presented and several of the possible obstacles, resources, project organisation and important elements that may decide the success and sustainability of the air quality programme (QADAK) was discussed.

The project team also started collecting information and data. From NILU participated Cristina Guerreiro (CBG), Herdis Laupsa (HEL) and Bjarne Sivertsen (BS).



## **2 Schedule and people**

A schedule for the Mission had been prepared and was adjusted as the agreements and meeting progressed. The final time schedule is presented in Appendix A. One main objective of the Mission was to start collecting as much information about the existing air quality as well as organisations and institutions as possible.

We met a number of people including responsible administrators and experts at different levels. A list of names, institutions and mail addresses is presented in Appendix B.

### **3 Project tasks**

#### **3.1 Task 1 Evaluate existing management structure**

##### **3.1.1 Task 1.1 Collect and evaluate existing organisation of AQ work**

Contacts and meetings were held in order to understand the existing organisation of the air quality in Senegal. Relevant institutions contacted were:

- Direction de l'Environnement et des Etablissements Classés (DEEC) : Prévention et contrôle des pollutions
- Division des études d'impact environnemental et de la prévention et du contrôle des pollutions et nuisances de la DEEC
- École Supérieur Polytechnique, Dep. Geomatique
- École Supérieur Polytechnique, Dep. Physique Atmosphérique
- METEO office
- Syndicat Professionnel des Industries et Mines de Sénégal (SPIDS)

The Centre de Suivi Ecologique will be visited during the next mission, as there was no time to visit it during this mission.

Two reports with some description of the existing organisation and suggestions for future organisation, including the Central Laboratory, were collected:

Nordic Consulting Group (NCG), Projet d'Amelioration de la Mobilite Urbaine (PAMU) Qualite de l'air – Rapport Definitif, Decembre 2001.

Simon&Cristiansen Ingenieurs Conseils S.A., Étude sur la connaissance des sources de pollution et le niveau de contribution de chaque source identifiée à Dakar, Définition d'un programme d'actions – Rapport Définitif Volume I. Janvier 2000.

#### **3.2 Task 2 Assessment of air quality levels in Dakar**

##### **3.2.1 Task 2.1: Identify existing air quality and meteorological data**

Several meetings were prepared in order to get an overview of existing air quality and meteorological data in Dakar and to collect all available information at this stage. Relevant institutions contacted were:

- Direction de l'Environnement et des Etablissements Classés (DEEC) : Prévention et contrôle des pollutions
- Division des études d'impact environnemental et de la prévention et du contrôle des pollutions et nuisances de la DEEC
- Dep. Physique Atmosphérique
- METEO office
- CERER

**Meteorological data**

Some meteorological data was collected at the CERER and at the METEO office. These data are shown in Appendixes C9 and C10.

Meteorological data had been collected at NILU before the mission, based on large-scale weather forecast data for 2004. Wind speeds and wind directions had been prepared for one year as a basis for creating a typical annual meteorological database and to evaluate existing measured data in Dakar. The data is presented in Appendix G.

Pascal Sagna (CETUD) has provided the following table with average monthly Wind direction frequency for Dakar.

Tableau 3 : Tableau des éléments climatologiques à Dakar (moyennes 1961-1990 sauf pour les fréquences du vent au sol)

	J	F	M	A	M	J	J	A	S	O	N	D	AN	
Fréquences des directions du vent au sol de 1991 à 1995	N	67,0	75,0	81,0	79,5	57,5	23,0	11,5	10,0	16,0	49,0	66,0	65,0	50,0
	NE	20,0	12,0	3,5	2,0	1,5		1,0	1,5	3,0	7,0	14,0	24,0	7,5
	E	1,5	2,0					1,0	3,0	3,0	3,0	2,0	4,0	1,6
	SE							1,0	2,0	1,0	1,0			0,4
	S					1,5	3,0	9,0	12,0	10,0	1,0		1,0	3,4
	SO					2,0	9,0	12,0	10,5	10,0	2,0			3,8
	O	3,5	2,0	3,5	3,0	11,5	39,0	43,0	37,0	21,5	10,0	3,0	1,0	14,8
	NO	7,0	9,0	11,0	14,0	22,0	17,0	10,0	9,0	11,5	11,0	7,0	3,0	11,0
	Calmes	1,0		1,0	1,5	4,0	9,0	11,5	15,0	24,0	13,0	8,0	2,0	7,5
Précipitations		2,4	1,0	0,0	0,0	0,0	10,3	60,5	165,1	137,7	34,3	0,9	0,4	412,7
Jours de pluie		0,5	0,5	0,1	0,0	0,1	1,9	6,3	11,9	10,4	5,0	0,2	0,3	35,2
Insolation mensuelle		7,9	8,6	9,1	9,6	9,4	8,1	7,5	7,2	7,3	8,4	8,3	7,7	8,3

**Air Quality data**

The Département de Physique Atmosphérique at École Supérieur Polytechnique (E.S.P.) has done a measurement campaign of HNO<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, O<sub>3</sub> and NH<sub>3</sub> in Dakar in February and March 2004. NILU obtained an overview over the measured concentrations, shown in Appendix C7.

The Direction de l'Environnement has coordinated an air quality measurement campaign done by Institut Pasteur during August 2003- February 2004. Unfortunately the instruments used to measure ambient air concentrations were inadequate, as they are designed for gas detection around landfill and in combustion processes and not ambient air concentrations. Only the CO measurements gave reliable results. NILU has obtained a copy of this report from DEEC.

**3.2.2 Task 2.2: Identify main potential air pollution sources**

Traffic is the main air pollution source in Dakar. It is therefore necessary in this project to collect comprehensive data on traffic in order to be able to estimate emissions from traffic in Dakar. The digitalised traffic network in Dakar and output data from a traffic model for Dakar will be obtained from GMAT in Canada, which is currently doing a project on traffic characterisation and traffic planning in Dakar for CETUD. Emission factors for the different categories of vehicles circulating in Dakar



have yet to be obtained. The measurements on emissions from vehicles under technical control at CETUD cannot be used for modelling purposes, since measurements were done while the vehicles were in idle position .

A list of information collected about industries consumptions and storage capacities of chemical products in Dakar has been collected from the database at Division des Etablissements Classés. More detailed data concerning other potential air pollution sources identified has been requested.

Several contacts with the syndicat des industriels (SPIDS) and the project of an agreement of cooperation between CETUD and SPIDS have been established, in order to prepare a ground of cooperation between the industries and this project for future collection of data on industrial processes and emissions and cooperation on suggested emission reduction measures, etc.

Coordinates of most of the main industries in great Dakar area have been obtained from the GIS map of Dakar.

### ***3.2.3 Subtask 2.4: Design and perform screening study***

During this first mission, some passive samplers were located at 5 different sites in Dakar city to give a first indication of the ground level concentrations and to support the design of screening study to be performed during the second mission. For further details on this preliminary screening study and its results see a separate report (Guerreiro et al, 2005).

A possible location for measurements of particles and CO monitors to be operating during the screening study was identified. Contacts to get permission for the placement and operation of the monitors have been undertaken.

## **3.3 Task 3 Establish central AQ Laboratory**

### ***3.3.1 Subtask 3.1: Specify laboratory requirements***

A draft on the logistic requirements for the Laboratory (in Appendix D) were presented and discussed during the meeting with Direction de l'Environnement. For further details on discussion and conclusions see minutes in Appendix C3.

### ***3.3.2 Subtask 3.2: Specify personnel skills and manpower***

A draft on the requirements for the Laboratory on personnel skills and manpower (in Appendix E) were also presented and discussed during the meeting with Direction de l'Environnement. For further details on discussion and conclusions see minutes in Appendix C3.

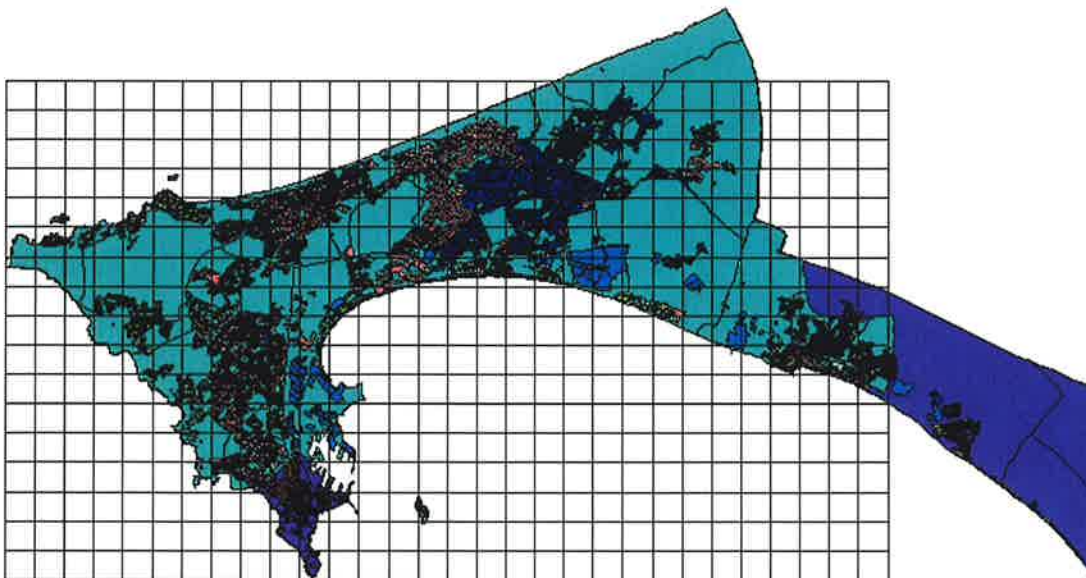
These requirements will be further revised and a new draft will be presented and discussed during the second mission to Dkar.

### **3.4 Task 6 Establish and operate the Air quality Management System (AQMS)**

The GIS map of Dakar et Banlieu (Projet JICA) has been obtained to this project from the Direction des Travaux Géographiques et Cartographiques (DTGC). The GIS map contains necessary information to this project like: region borders, location of main industries, population density, main roads, etc. The shape files will be imported into AirQUIS and a detailed list over all relevant information contained in the map will be made, together with a list of eventually missing information.

Satellite pictures of Dakar (Fonds de cartes sur Dakar et photos aériennes) have been obtained from DEEC. The geographical information contained in the pictures may help feeling gaps of information on the GIS map.

The modelling grid for great Dakar area has been established and is shown in Figure 1. The UTM coordinates of the origo (lower left corner of the grid) are 227500.00 W, 1620500.00 N. The number of grids are 30 in east-west direction and 17 in north-south direction. The grid size is 1000m x 1000m.



*Figure 1: Modelling grid for great Dakar area.*

### **3.5 Task 9 Institutional building and training**

During this first mission the members of the project team and of the two institutions directly involved in the project, CETUD and DEEC, were gathered during two main meetings, the Kick-off meeting (minutes in Appendix C1) and the End-of-mission meeting (minutes in Appendix C14). These meetings aimed at getting the members to know each other, understand the goals and the tasks of the project and start to work together.

### **3.6 Task 11 Air Quality legislation advice**

The collection of information on present environmental legislation was started. The documents collected are listed in Appendix F.

### **3.7 Task 12 Project Management**

NILU presented the plan and budget (“Plan d'intervention du personnel du consultant ») for the first 6 month (June to November 2005) to CETUD.

The project contract between CETUD and NILU and the contract between NILU and Performances were signed.

Contacts were undertaken in order to establish formal agreements between CETUD and the following institutions:

SPIDS

Meteo office

Detailed plans for the work after Mission 1 were presented and discussed in the final meeting of the 1 mission. The list is included in meeting minutes (Appendix C14) and specifies deadlines and responsible experts.

## **4 Meetings**

Several meetings were arranged during this Mission 1 of the QADAK project. The objective was to receive as much information as possible about existing data (emissions, traffic, meteorology, population distribution, industrial activities and digitalised data), legislation in Senegal and organisation of the air quality work in Senegal.

### **4.1 Administrative meeting at Performance**

An introductory meeting between NILU and Performances was held at Performance on Monday 30 May 2005. The schedules and meetings to be arranged during the Mission were discussed. Several meetings had to be reconfirmed and approved.

### **4.2 Project kick-off meeting at CETUD**

A project kick-off meeting was organised at CETUD on Tuesday 31 May 2005. The main objectives of this meeting was to present the content of the project to the project team and to the receivers of the air quality monitoring and management system at Direction de Environnement (DEEC) as well as to the client; CETUD.

The project manager, Cristina Guerreiro presented the project and gave a short description of the contents of all the tasks of the project, the goals, deliverables, time plan and team members responsibilities and expected contributions. The possible obstacles, which may reduce the sustainability of the programme, were presented and discussed. The programme for Mission 1 was also presented.

A minute from the meeting is presented in Appendix C1.

### **4.3 Meeting with DEEC GIS and map experts**

The aim of the meeting was to find out if the map experts at DEEC already have GIS data, which NILU may use for the AirQUIS application. In the discussions it was known that the GIS and map experts at DEEC have received different type of map files and some satellite photos. They had also recently received the ArcGIS9.0, but had not installed the programme, and did not seem to have training in the application of GIS systems.

A minute from the meeting is presented in Appendix C2.

#### **4.4 Meeting with Direction de l'Environnement**

A meeting with the director at the Direction de l'Environnement (DEEC) was organised on Tuesday 1 June 2005. In the presentations and discussions with Mme Fatima Dia Foure the following topics were covered:

The organisational structure of the new laboratory

The personnel (how many persons and which skills are needed) based on a memo prepared by B Siversten (Appendix E)

The laboratory location and facilities based on a memo prepared by B Sivertsen (Appendix D)

Dissemination of results and the possibilities of preparing information to the public

The new mobile station for water and air quality measurements, which we had been told was arriving at DEEC and is not part of QADAK.

Discuss the present AQ management structure and the proposed one in the Terms of Reference of the present project.

A minute from the meeting is presented in Appendix C3.

#### **4.5 Meeting with the transport engineers**

We met the traffic and transport experts at CETUD on 1 June 2005 to identify what type of traffic data had been developed and would be available for emission calculation in the Dakar area.

We learned that there is very complete and updated traffic data for Dakar, that has been collected and worked with during the last two years. NILU received the final report and CD with data from a study on traffic in Dakar made by Waterman international (2004). We were also informed that a study more complete and updated is now being done by GMAT, Canada, for CETUD and that we could have the results from it in August 2005. It was clear that we will be able to obtain from that study the digitalised static data on the traffic network in Dakar, dynamic data on the traffic flow in Dakar, based on the results from a traffic model and maybe some of the statistics on the vehicle park in Dakar.

A minute from the meeting is presented in Appendix C4.

#### **4.6 Signing of contract between CETUD/NILU**

The final contract between NILU and CETUD was signed on 1 June 2005.

In the meeting with Director Latyr Ndiaye at CETUD a number of points concerning formal agreements with some of the institutions with which we wanted to co-operate during the project and that may be strategical partners to the future Central Laboratory

were discussed. In addition, NILU presented the proposed plan and budget for the next 6 months.

A minute from the meeting is presented in Appendix C5.

### **4.7 Meeting at E.S.P Dep. Geomatique**

In the meeting with E.S.P. Laboratoire d'Enseignement et de Recherche en Geomatique (LERG) the work conducted and the expertise existing at LERG was presented to us and we discussed what type of GIS data is available at LERG for Dakar. Out of the many projects LERG is working on, related to mapping and GIS, NILU wished to know what LERG can do to produce or procure the GIS data needed in the QADAK project.

It was concluded that LERG would look for population data distributed on smallest possible areas/districts in the great Dakar region, as well as the borders of such regions digitalised.

During the meeting the size of the modelling area for AirQUIS was discussed. The conclusion was that a model area approximately 15(20) km x 30 km would cover the three administrative regions (Dakar, Pikine and Rufisque) which includes the increasing built-up area of greater Dakar.

There are 387 industries in the Dakar area. The emissions to the atmosphere are mostly from diffuse ground sources, but there are also major industries emitting through stacks. The main industrial belt is located along the south coast of the Dakar Peninsula. LERG will make available to this project the information they have on these industries.

For further details see the minute from the meeting presented in Appendix C6.

### **4.8 Meeting at E.S.P. Dep. Physique Atmosphérique**

The main objective for the meeting was to get an overview over the work conducted and the expertise existing at the Dep. Physique Atmosphérique and to discuss possibilities for professional cooperation.

During the discussion we could identify relevant projects, in which the department had been participating that included air pollution sampling. Dr Ndiaye had participated in at least two measurement campaigns measuring air pollutants using passive samplers and other simple VOC samplers.

The Africa Clean network, represented by Dr Ndiaye, did emission measurements of CO, HC and CO<sub>2</sub> on gasoline cars and opacity on diesel cars and small busses passing

the technical control at CETUD. Unfortunately these measurements can not be used to determine emission factors, since measurement were done while the vehicle was stopped.

The Dep. Physique Atmosphérique is interested in cooperation (formal partnership) with the future Central Laboratory.

For further details see the minute from the meeting presented in Appendix C7

### **4.9 Meeting with CERER**

The Centre d'Etudes & Recherches sur les Energies Renouvelables (CERER) has been taking measurements of meteorology and radioactivity for many years.

The main objective for the meeting was to identify available data and to discuss whether data could be made available for the QADAK project. Measurements of wind speed and direction, temperature, relative humidity and precipitation have been logged every 10 minutes for the last 2-3 years. The location of the measurement sensors is good and is representative for this area of Dakar. Some months with meteorological data was given to NILU.

Collaboration between the QADAK project and CERER is possible and for that propose the director of CERER should be formerly approached. A contribution from QADAK to the improvement of actual equipments of CERER would be requested.

For further details see the minute from the meeting presented in Appendix C8

### **4.10 Meeting at the MET office.**

The main objective for the meeting was to discuss the possible participation by the Institute for Meteorology (METEO) in the QADAK project and future cooperation with the Central Laboratory, and to identify meteorological data, collected by METEO, which could be useful to the QADAK project and later to the Central Laboratory.

METEO was interested and positive to a co-operation with the QADAK project, but METEO and CETUD would have to prepare a protocol specifying the role of each of the parties.

Dr Mactar Ndiaye stated that meteorological data from METEO could be provided to the project against the payment of a "nominal fee", which would not represent large expenses. NILU specified that the radiosonde station could provide valuable information concerning vertical profiles of temperatures as well as mixing heights to the project and to the Central Laboratory in the future. Long records of data, such as

climatological wind roses etc could also be useful. Annual reports were, however, not produced by METEO. Such data would have to be prepared specifically for that purpose and it was unclear to which extent METEO actually has the necessary data to produce such statistics.

We visited the automatic weather station at the airport, which is actually run by ASECNA. It seems like it is ASECNA who is storing all the data on an hourly basis, as well as the radiosonde data, twice a day.

For further details see the minute from the meeting presented in Appendix C9.

#### **4.11 Meetings with Prestige.**

The main objective of these meetings at PRESTIGE was to go through the work planned for Babacar Diop within this project and discuss its relevance to the project in the light of the new information on available traffic data for Dakar. With this in mind NILU wished to discuss with Prestige the possible contributions of Prestige to the project.

Prestige agreed that the work originally planned for M. Babacar Diop was already covered by the project GMAT was conducting for CETUD and presented several experts that could bring contributions to the project. The two most relevant experts were a jurist on environmental law and a IT expert with good knowledge of ORACLE software.

It was agreed that NILU would study Prestige propositions and would talk to CETUD about a possible change of the expert team, and would then make a contract proposal to Prestige.

For further details see the minutes from the meetings presented in Appendix C10 and C13.

#### **4.12 Meeting with Mr. Pascal Vardon at Ministère de L'Environnement**

The objective of this meeting was to discuss with M. Pascal Vardon the requirements for the stack emission measurements that DEEC is planning to order from Institute Pasteur, in coordination with M. Pascal Vardon. It was discussed that the necessary equipment and competence for this kind of measurements is at the present not available in Senegal.

NILU will give Mme Seck the US-EPA sampling procedures for these type of measurements and a list of necessary parameters to be measured and collected during such campaigns in the future. For more details the minutes from this meeting is presented in Appendix C11.



#### **4.13 Meeting at Institut Pasteur, emission measurements**

The main objective for the meeting with Laboratoire de Sécurité Alimentaire et de l'Environnement (LSAHE) at Institut Pasteur was to identify measurements of air pollutants performed at selected industries in Dakar, as well as in ambient air.

The stack measurements had been performed for the industries, represented by SPIDS (Syndicat Professionnel des Industries et des Mines du Sénégal). LSAHE had used a Bacharach type instrument originally designed for gas detection around landfill and in combustion processes.

We obtained copies of some of the concentrations measured at the top of the stacks. The compounds measured were NO<sub>2</sub>, SO<sub>2</sub> and CO. Only concentrations had been measured, no information on the flow rate was available, which makes it impossible to check if the emissions are within the legislated limits and to have the pollutant flow emitted for dispersion modelling purposes. We were not sure about the accuracy and precision of these measurements. However, we stated that the validity of using these data for emission estimates are limited as long as the sampling is not done according to international stack sampling standards and procedures. A minutes from this meeting is presented in Appendix C12.

#### **4.14 End of Mission meeting**

A meeting was arranged at CETUD on 7 June 2005 to summarise and to distribute responsibilities.

The main objectives with this meeting were to:

- Summarise the work done during the mission, results and conclusions,
- Make detailed plans for the work ahead based on the approved "Plan d'intervention du personnel du consultant"
- Distribute tasks and responsibilities
- Communication and reporting routines/ communication means inside the project team and to the outside world
- Discuss potential obstacles/problems identified and prepare strategies to avoid and/or handle them

A summary of tasks identified during Mission 1 was prepared and discussed. This represented the background for specifying further work, deadlines and responsible experts. Minutes from this meeting is presented in Appendix C 14.



## **5 References**

- Bang, J., Flugsrud, K., Holtskog, S., Haakonsen, G., Larssen, S., Maldum, K.O., Rypdal, K. and Skedsmo, A. (1999) Emissions from road traffic in Norway – Method for estimation, input data and emission estimates. Updated SFT report 93:12. Oslo, Statens forurensningstilsyn (SFT-report 99:04). (in Norwegian).
- Guerreiro, C., Laupsa, H. and Sivertsen, B. (2005) Passive sampling of SO<sub>2</sub> and NO<sub>2</sub> in ambient air in Dakar, Preliminary study, June 2005. Kjeller (NILU OR 46/2005).



## **Appendix A**

### **Time schedule**

Date	Meetings/actions	App
30. Mai	1000-1400: Meeting with Bruno at Performances  1400-1900: Getting known in Dakar. Decision and evaluation for the monitor and passive sampler location for the screening studies and emission source identification	C1
31. May	09.30 - 1730: Kick-off meeting at CETUD  Place passive samplers (Cafe du Rome and at CETUD)	C2
1. June	0800-0930 - Place passive samplers (Bruno 3 contact places)  0930-1100 - Meeting with Direction de l'Environnement  1100-1300 - Direction de l'Environnement Madame Touré  1500- Meeting with Mr. Babacar Diop (PRESTIGE), Mr. Ousmane Sy (CETUD) and Mr. Karfa Diako (CETUD)  1600- Meeting with Mr. Latyr Ndiaye Director of CETUD	C3 C4 C5 C6
2. June	0900-1100 - Meeting with E.S.P Dep. Geomatique, Cheikh Mbow and Aminata Guèye  1100-1300 - Dep. Physique Atmosphérique with Dr Seydi Ababacar NDIAYE  Look for a place to place the CO and PM monitors in October (2 <sup>nd</sup> mission).	C7 C8
3. June	0800 - 1000 - Meeting with Mactar Sall – CERER on met data 1000 - 1200 - Meeting with the METEO office  1600- Meeting with Prestige (contract)	C9 C10 C11
6. June	0800 - 0900. Mr. Pascal Vardon at building Administration. (Mme Aita Seck from DE)- financing emission measurements  0900- 1000- Mr. Garin at Institut Pasteur  1200 – Meeting with Prestige  1600-1800. - Presentation of the project «Diagnostic study on industriel pollution on the regional level and reduction perspectives” One of the consultants is Mohamed Diawara, membre d’AfricaClean.	C12 C13 C14
7. June	0900-1200 - Workshop on Pollution de l’Air et réduction GES , avec pour objectif de faire évoluer l’objectif actuel centré sur l’efficacité énergétique vers une prise en compte de façon plus large la qualité de l’air. Cet atelier sera par ailleurs animé par Moussa Diop, du département Production de la	



	Senelec 1400-1800 - Final Mission meeting Afternoon: Collect passive samples	C15
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## **Appendix B**

### **Contact persons**

## Air quality in urban environment of Dakar

Secteur	Institution	Contact	e.mail/telephone	Fonction	Activités
Environnement	DEEC	Cheikh Ndiaye Sylla		Directeur Adjoint	Résultats campagne de mesure 1 /SFP. Deuxième campagne en préparation Projet de campagne de mesures sur les cheminées industrielles, avec l'institut Pasteur
	DEEC	Fatima Dia Touré	fdtoure@sentoo.sn	Directrice	Implantation du laboratoire
	MENV	Pascal Vardon		Cons. Technique	Financement campagnes de mesure DEEC
	DEEC	Ernest Dione			Cartographie des Etablissements Classés
	DEEC	Ousmane Sow		Ing. Chimiste	Camion Laboratoire (financement budgétaire). Suivi de la qualité de l'air et des eaux
	DEEC	Ibrahima Sow	ibrah.sow@senlur.sn?	Spécialiste de la DE en Pollution de l'Air	Membre d'AfricaClean
	DEEC	Aita Savoul ( ?) Seck	aitasec@yahoo.fr		
Industrie	SPIDS	Philippe Barry		Secrétaire permanent	Cellule environnement-sécurité
	SPIDS	Cellule Environnement			Forum 6-8 juin au Novotel (Industries/environnement) Senelec (Moussa Diop), Sonacos (Mbaye Diagne), Sococim (Moctar Diaw), Ics (Mamadou Bocoum), SAR
	GTI	Serigne Diop		Ingénieur	Membre d'AfricaClean Etude et modélisation de la pollution de l'air à Dakar (cf memo ind-050525)
Laboratoires	ESP	M. Ndiaye	<a href="mailto:sandiaye@ucad.sn">sandiaye@ucad.sn</a> <a href="mailto:sasandiaye@yahoo.fr">sasandiaye@yahoo.fr</a> (221) 6481000		Laboratoire de Physique de l'Atmosphère Membre d'AfricaClean
Santé	UCAD	Amadou Diouf Aissatou Conte		Toxicologue	AfricaClean – Fac de médecine (toxicologue) Collaboration SPIDS - pollution et santé.
		Ali Badreddine	<a href="mailto:badreddine@sentoo.sn">badreddine@sentoo.sn</a> cell. (221) 638 43 02 (221) 821 48 76	Pleumologue	Allergologie Respiratoire - sidénologie

## Air quality in urban environment of Dakar

Secteur	Institution	Contact	e.mail/telephone	Fonction	Activités
Transports	DTR AFTU	Modou Kane Diaw			Contrôle technique Association de financement des professionnels du transport urbain (Sacré-Cœur)
	SENBUS	M. Kampo			Remplacement du parc de cars rapides (1ere commande en cours, de 350 bus)
	Prestige CETUD	Mr. Babacar Diop Ousmane SY	prestige@sentoo.sn	Consultant Ingénieur des transport	
	CETUD	Karfa DIAKO		Ingénieur en Aménagement et Trafic	
	CETUD CETUD	Latyr NDIAYE Pascal SAGNA	<a href="mailto:cetud@telocomplus.sn">cetud@telocomplus.sn</a> <a href="mailto:cetud@telocomplus.sn">cetud@telocomplus.sn</a> <a href="mailto:psagna@ucad.refer.sn">psagna@ucad.refer.sn</a> <a href="mailto:pascalsagna@hotmail.com">pascalsagna@hotmail.com</a>	Directeur Général Environnementalist e	QADAK
Cartes	DTGC DEEC	Patrick Deroue Gatta Ba	<a href="mailto:gattasouleba@yahoo.fr">gattasouleba@yahoo.fr</a>		SIG Dakar (projet Japonais 1997) Acquisition Arc GIS 9.0 en mai 2005 (projet Baie de Hann). Fonds de cartes de Dakar et photos aériennes 2004.
	ESP	Cheikh Mbow	<a href="mailto:cmbow@ucad.sn">cmbow@ucad.sn</a>	Chercheur	Laboratoire de Géomatique. Travaux sur la pollution industrielle
	ESP	Amadou T. DIAW	<a href="mailto:catdiaw@ucad.sn">catdiaw@ucad.sn</a>	Directeur	Laboratoire de Géomatique. Travaux sur la pollution industrielle
	ESP	Aminata Guèye			Master student
Meteo	DMN	Aida Niang	<a href="mailto:aida@env.leeds.ac.uk">aida@env.leeds.ac.uk</a> 562 59 84	Modélisation	
		M. Sene Cherif Diop		Environnement Chef de Division, intérim du DG	
		M. Mactar Ndiaye	<a href="mailto:matndiaye@sentoo.sn">matndiaye@sentoo.sn</a> 820 48 87	Directeur	



## Air quality in urban environment of Dakar

Secteur	Institution	Contact	e.mail/telephone	Fonction	Activités
Consultants					
	PRESTIGE	Ali Diouf	<a href="mailto:Prestige@sentoo.sn">Prestige@sentoo.sn</a> (221) 827 94 97	Directeur	
		Oumar Fall		Coordonnateur des études	
	Performances	Bruno Legendre	legendre@ariane-service.com performance@avc.sn  tlf :221 8230705 fax.221 230778		
	NILU OFFICE Dakar		221 8230777		



## **Appendix C**

### **Minutes of meetings**



## **Appendix C1**



<b>FINANCEMENT:</b> <b>Fonds Nordique</b> <b>de Développement</b>	<b>Minutes from meeting</b>	
<b>Projet:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR	
<b>Agreement:</b>	PAMU/FND/C/08/04	

## Appendix C1

<b>Title</b>	<b>Kick-off project meeting at CETUD</b>
<b>Date</b>	Tuesday 31. May 2005 0930-1730
<b>Participants</b>	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS), Herdis Laupsa (HEL) DEEC: Ibrahima Sow, Mme Seck, Gatta Ba, Performances: Bruno Legendre(BL), Cheikh Mbow CETUD: Pascal Sagna Prestige:Mr. Babacar Diop
<b>Author</b>	BS, HEL
<b>Distribution</b>	Mission report
<b>Reference No</b>	O-105010

### Objectives of the meeting

The objective of this first project meeting of the QADAK project was to present the content of the project to the participants and the receivers of the air quality monitoring and management system at Direction de Environnement (DEEC) as well as to the client; CETUD.

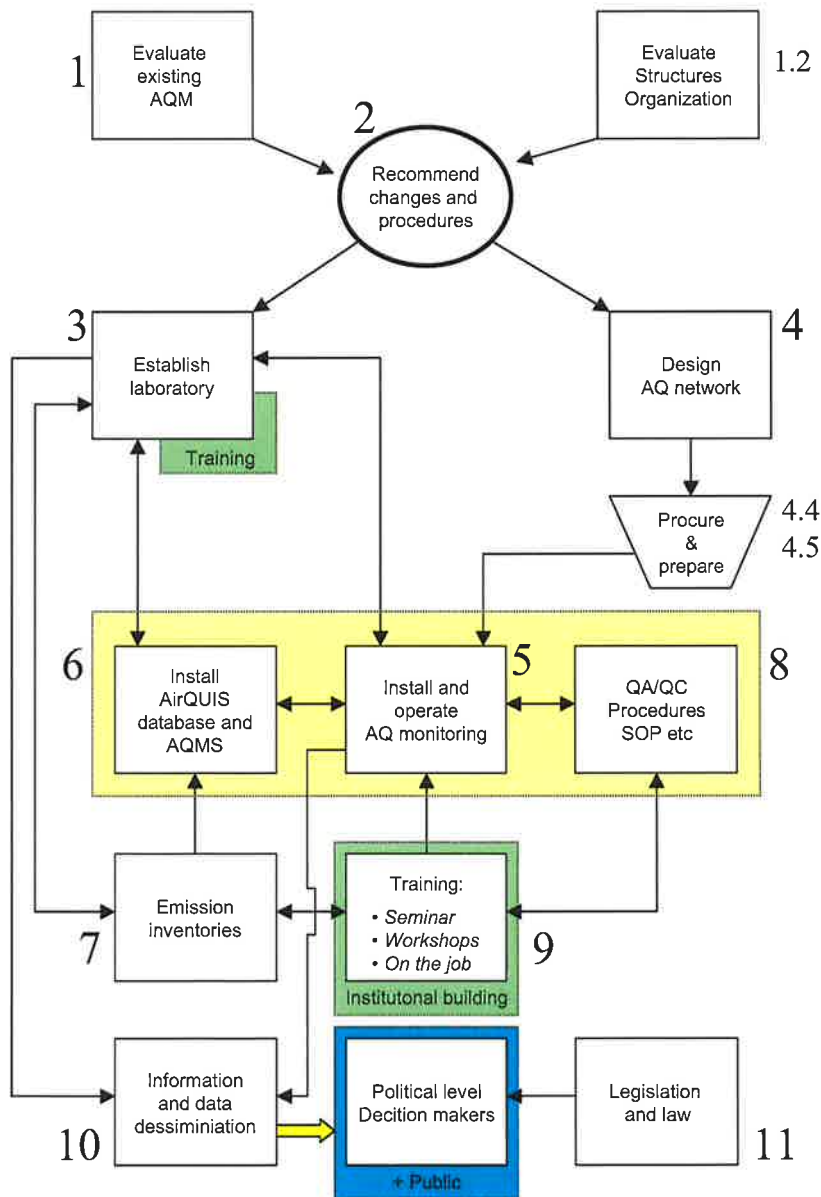
The meeting agenda was as follows:

- Welcome
- Presentation of the project team ;
- project goals ;
- project tasks ;
- deliverables ;
- time plan,
- Presentation of an equivalent project and expertise and facilities requirements for the AQ Lab - discussion
- Team members responsibilities and expected contributions,
- Presentation of the programme for Mission 1;
- Present, discuss and agree on the "Plan d'intervention du personnel du consultant" for the next 6 months to be presented to and approved by CETUD.
- Uncertainties/ success factors - discussion,

### Presentations

The project manager, Cristina Guerreiro presented the project and went through all the tasks of the project. A flow sheet as shown in Figure 1 was presented to demonstrate

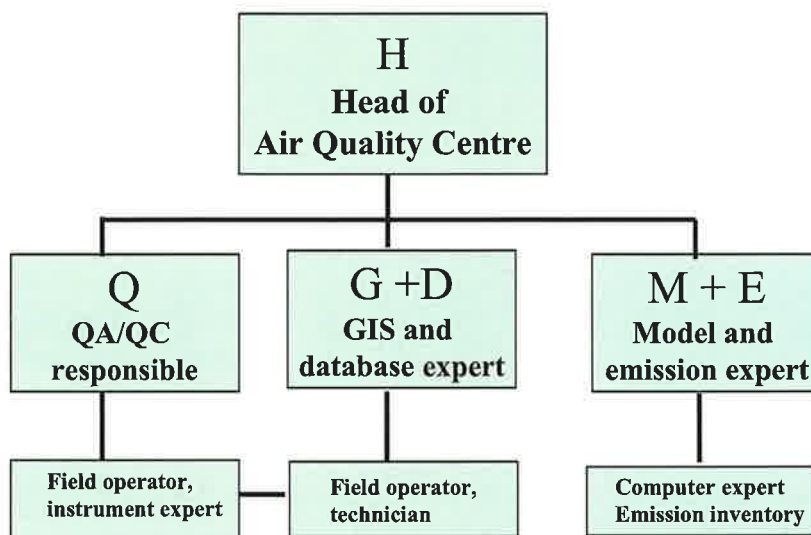
the sequence of tasks and the final objectives of the project. A summary of some of the transparencies presented is shown in the attachment to these Minutes.



**Figure 1: Flow chart showing the different elements and the tasks of the QADAK project.**

The 12 main tasks of the projects were further discussed in details and discussions and questions explained the needed input data as well as results.

B Sivertsen briefly introduced typical tasks and objectives of the air quality monitoring and management programme that NILU is operating worldwide.



*Figure 2: Example of a typical organisation scheme for an air pollution monitoring and management laboratory.*

Some of the tasks that are going to be undertaken by the future laboratory to be established at DENV are:

1. Air quality monitoring and data retrieval
2. Input data of air quality, emissions and meteorology
3. Database establishment and maintenance
4. QA/QC Reference Laboratory; calibrations and repair
5. Air Quality Assessment and Modelling
6. Reporting, locally and nationally
7. Data dissemination and Public information
8. African reporting needs (Africa Clean and BAQ-Africa)

A first indication of the organisational set-up for such an organisation could look as on the figure below.

Also the possible obstacles, which may reduce the sustainability of the programme, was presented and discussed. Some of these elements are:

- Political interest and understanding

- Available experts and personnel (training)
- Technical facilities (sites and laboratories)
- Adequate procedures (QA/QC)
- Economic resources
- Follow-up

### **Discussions**

During the discussions it was mentioned that motivation and salaries are important elements in keeping the programme sustainable. It was suggested that NILU should train more people than absolutely necessary, so that back up and changes could be undertaken. People should also be able to cover more than one field of expertise.

A way of making the programme liveable would be to attract student and to find ways to give them opportunities to prepare their Thesis within the topic of air pollution and pollution modelling. The responsibilities and obligations by the different parties as well as the need of communication between institutions should be presented in a memo.

Communication during the development of the project will be important. Monthly reports should be distributed to all participants directly and the use of Internet and E-mails should be established immediately. An Internet site and an e-mail address (qadak@nilu.no) to which copies of all communications within the project should be sent will be established. An e-mail informing all the team members will be sent as soon as the e-mail and web site are operative.

Mr. Ibrahima Sow, member of Africa Clean, informed the team that a commission for elaborating suggestions to norms/legislation exists in Senegal, called Association Sénégalaise de Normalisation (ASN) and that there is a group working with air pollution related legislation, headed by Khaly Ly and of which he is a member. This should to be the group to work with in Task 11.



## Appendix C2





<b>FINANCEMENT:</b> Fonds Nordique de Développement	<b>Minutes from meeting</b>	
<b>Projet:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR	
<b>Agreement:</b>	PAMU/FND/C/08/04	

## Appendix C2

<b>Title</b>	<b>Meeting with DENV GIS and map experts</b>
<b>Date</b>	Wednesday 1 June 2005 – 1000-1130 hrs
<b>Participants</b>	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS), Herdis Laupsa (HEL) DEEC: Gatta Ba, Mme Seck Performances: Bruno Legendre (BL), CETUD: Pascal Sagna
<b>Author</b>	BS, HEL
<b>Distribution</b>	Mission report
<b>Reference No</b>	O-105010

### Objectives of the meeting

The aim of the meeting was to find out if the map experts at DEEC already have GIS data, which we may need for the AirQUIS application.

### Presentations

The GIS and map experts at DEEC have received different type of map files and some satellite photos. They have only two different shape files. As far as we understood they have no applied the GIS programmes yet. They have recently received the ArcGIS9.0, but have not installed the programme.

The following shape files were available:

- Index\_ortho500m-dakar\_text\_text.shp – only some defined grid points
- Campagne2004\_tous.shp – locations of some industry (Sanitaire, pluvial and Industriel)

NILU copied some of the satellite pictures, just to see what type of data were available on these files. The two last numbers of the file name is the coordinates of the pictures, e.g.:

- O\_UTM\_Z28\_226000\_1631000.tif

In addition we received some other type of satellite pictures. These data was copied to a CD, which we brought back to NILU for further studies.

**Suivi de la qualite de l'air  
en milieu urbain de Dakar**



**CONSEIL EXECUTIF DES TRANSPORTS  
URBAINS DE DAKAR (CETUD)**

**The Norwegian Institute for Air Research (NILU)**

In a later meeting with Dr. Cheikh Mbow at the Laboratoire de Géomatique he received copies of these data, to evaluate and study the data to find out if we can use these files. We discussed the possibility for preparing the shapes. (See minutes from meeting with Laboratoire de Géomatique )



## Appendix C3



<b>FINANCEMENT:</b> <b>Fonds Nordique</b> <b>de Développement</b>	<b>Minutes from meeting</b>	
<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR	
<b>Agreement:</b>	PAMU/FND/C/08/04	

## Appendix C3

<b>Title</b>	<b>Meeting with Direction de l'Environnement</b>
<b>Date</b>	Wednesday 1 June 2005 – 1130-1300 hrs
<b>Participants</b>	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS), Herdis Laupsa (HEL) DEEC: Director Fatima Dia Toure, Ibrahima Sow, Gatta Ba, Performances: Bruno Legendre(BL), CETUD: Pascal Sagna
<b>Author</b>	BS, HEL
<b>Distribution</b>	Mission report
<b>Reference No</b>	O-105010

### Objectives of the meeting

The meeting with the Director of DEEC Mme Fatima Dia Toure was to present and discuss:

- The organisational structure of the new laboratory
- The personnel (how many persons and which skills are needed) based on a memo prepared by B Siversten
- The laboratory location and facilities based on a memo prepared by B Sivertsen
- Dissemination of results and the possibilities of preparing information to the public
- The mobile station, which we had been told was arriving at DEEC.
- Discuss the present and ToR proposed AQ management structure.

### Presentations

The logistic requirements for the Lab were presented, Bjarne Sivertsen (May 2005). Air Quality centre room and facilities. DEEC could not foresee any problem in meeting the presented requirements. The only possible problem is if the building that is going to be built will not be finished and equipped in time in relation to the project plan. It was agreed that in one year we would evaluate the advancement of the construction work and that if it was delayed the DEEC would start finding alternative temporary locals for the Lab.

The requirements in terms of expertise for the Lab. team and their academic background and functions in the Lab were presented, Bjarne Sivertsen (May 2005). Task and facilities for the future air quality management team. Mme Toure informed that a structure and constitution of the Lab. team was already planned and budget for by the DEEC and CETUD. In this team it was planned a head of Lab. and secretary as well as 3 experts. NILU informed that 3 experts would be the minimum as the 2<sup>nd</sup> level, but it would be absolutely necessary to have at least one field technical expert (electronic eng.) in order to maintenance and repair the instruments in the measurements stations and report directly to the QA/QC responsible. Mme Toure informed that the current strategy of the government is to cooperate/engage private operators for the technical maintenance « out-sourcing », which is the case presently for the maintenance of the informatics equipment. The DEEC has not budgeted for field technical operators.

A discussion around the proposed measures in order to meet the risk of the qualified personal from the lab. leaving the Lab after the training took place. The solution discussed in the kick-off meeting and rediscussed in this meeting were :

- To form more than one person on each lab function. Concerning the field operators and the other experts it is possible to form up to 5 persons.
- To recruit the specialists (AQ/CQ, SIG&DB, Modelisation) among sufficiently high qualified people in order to be able to exchange functions among each other in the future or in the case of absence and while waiting for recruiting a new specialist, in case of one of the specialists quitting.
- To involve and form personnel from other labs with related competences usefull for the AQ Lab . For example, Laboratoire de toxicologie de la faculté de Pharmacie, Laboratoire de Physique de l'Atmosphère, Locustox (laboratory specialised on pesticides)
- To promote university research work on a Master or PhD level in order to get students interested and aware of the work done by the AQ Lab and give interesting perspectives of employment.

A discussing of the AQ management structure proposed in the ToR took place. Mme Toure had not yet seen the figure but ment that the Observatoire Regional and the Comite de Pilotage would be the same organ, which would represent the main stakeholders, discuss possible mitigation measures for air pollution that the Lab would evaluate the effects and costs of, and make propositions in terms of measures and norms to the Ministry of Environment. (They would follow the work of the Lab. and garanty that it would answer to its operation objectives)

Mme Toure and Bjarne named possible ways of informing and awareness of the public on AQ in Dakar, like:

- a big screen with information on present AQ levels in Dakar in the Place de l'Independance;
- Presentation of the AQ levels in Dakar on TV, after the weather forecast.

- The use of newspapers and radio giving information on AQ in Dakar, connected to the weather information.

One possible mitigation measure named by the DEEC was to have paying stations for all vehicles entering the city in order to reduce the vehicle number and to collect financial means for the authorities to implement mitigation measures and manage AQ in Dakar. CBG mentioned that should a measure would be possible only after a operative and efficient public transport system was in place for the city.

Mme Toure named that a Film had been done for CETUD in 97 on air pollution problems in Dakar, asthma, etc.



## Appendix C4



<b>FINANCEMENT:</b> Fonds Nordique de Développement	<b>Minutes from meeting</b>	
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<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
<b>Agreement:</b>	PAMU/FND/C/08/04

## Appendix C4

Title	<b>Meeting regarding traffic data for emission modelling with the transport engineers</b>
Date	Wednesday 1 June 2005, 1500-1600 hrs.
Participants	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS), Herdis Laupsa (HEL) Performances: Bruno Legendre, Prestige: Babacar Diop CETUD: Karfa Diakho, Ousmane Sy, Pascal Sagna
Author	BS, HEL
Distribution	Mission report
Reference No	O-105010

### Objectives of the meeting

The objective of this meeting at CETUD was to find out what type of traffic data for emission calculation that is available for Dakar.

Based on information received at the first meeting at CETUD we wanted to discuss:

1. Road link network (static data)
2. Dynamic data (ADT, Time variation, Vehicle distribution)
3. Traffic factors (emission factors for the different vehicle types in Dakar)

### Presentations

A Canadian consulting company (Waterman international) performed a traffic study in 2004, with traffic counting in many places in the city. As part of this project the Canadian experts have operated traffic models for traffic management based on the Saturn software.

Based on these counting another Canadian Consulting Enterprise GMAT is currently doing a study on the traffic in Dakar. They have updated the Dakar road network and are running a traffic model Saturn. Their results should be available by mid of July. CETUD will clarify with the Canadians that NILU can obtain the GIS shapes for the road link network from this company. Mr. Diakho will together with Pascal Sagna see that NILU will get the allowance to use these data. . The static and dynamic traffic data needed for emission modelling will NILU get from the traffic model in July 2005. Emission factors are not procured in that study.



The Agence Autonome des Transports Routiers has data on the characterisation of the roads in Dakar.

The Direction des Transports Terrestres has the statistics on the type and age of vehicles registered and circulating in Dakar.

**References:**

We received the following report after the meeting with CETUD traffic experts:

*Waterman international (2004)*. Modélisation des carrefours sur le logiciel Saturn, Projet d'amélioration de la mobilité urbaine. Composante infrastructure routière sécurité routière. Méthodologie de la modélisation des transports.

We also received a CD with traffic counting at 48 different points



## **Appendix C5**



<b>FINANCEMENT: Fonds Nordique de Développement</b>	<b>Minutes from meeting</b>	
<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR	
<b>Agreement:</b>	PAMU/FND/C/08/04	

## Appendix C5

Title	<b>Signing of contract between CETUD/NILU</b>
Date	Wednesday 1 June 2005, 1600-1730 hrs.
Participants	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS), Herdis Laupsa (HEL) Performances: Bruno Legendre, CETUD: Latyr Ndiaye, Pascal Sagna
Author	BS, HEL
Distribution	Mission report
Reference No	O-105010

### Objectives and agenda for the meeting

The main objective of this meeting at CETUD was to sign the final contract between NILU and CETUD. In addition NILU wanted to clarify a number of points with Director Latyr Ndiaye.

The following topics were presented on our agenda:

1. Arrange a meeting with METEO
2. Permission to work with CETUD's traffic engineers in order to evaluate and collect available traffic data for Dakar.
3. Presentation of the plan and budget for the next 6 month
4. Sign the contract between CETUD and NILU
5. Clarify communication channels between NILU/Performances and CETUD

### Discussions and conclusions

1. CETUD has sent an official letter to METEO and the meeting will be on at 1000 on Friday 03. June. 2005.
2. CETUD's traffic engineers are available to meet NILU and help to get an overview over available traffic data at CETUD and to make these data available to this project.
3. The plan and budget for the next 6 month was presented and left for CETUD's reading and approval.

The Project Seminar previously on the agenda for month 3 of the project will be postponed to month nine, in order to have a project secretary available to help in the organisation of the seminar.

4. Contract was signed by NILU and CETUD
5. Mr Pascal Sagna is the person assigned at CETUD for this project. Communication between NILU/Performances and CETUD will be directed to him. He has the necessary mandate to administrate the project from CETUD's side and take the necessary operative decisions in order not to delay the project. He will inform Mr. Latyr Ndiaye about the development of the project ongoing and ask for Mr. Ndiaye's approval whenever necessary.



## Appendix C6



<b>FINANCEMENT:</b> Fonds Nordique de Développement	<b>Minutes from meeting</b>	
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<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
<b>Agreement:</b>	PAMU/FND/C/08/04

## Appendix C6

Title	<b>Meeting at E.S.P Dep. Geomatique (LERG)</b>
Date	Thursday 2. June 2005, 0900-1100 hrs.
Participants	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS), Herdis Laupsa (HEL) Performances: Bruno Legendre ESP: Cheikh Mbow, Aminata Guèye
Author	BS, HEL
Distribution	Mission report
Reference No	O-105010

### Objectives and agenda for the meeting

The main objective of this meeting at the Laboratoire d'Enseignement et de Recherche en Geomatique (LERG) was to get an overview over the work conducted and the expertise existing at LERG and to discuss what type of GIS data is available at LERG for Dakar. Out of the many projects LERG is working on, related to mapping and GIS, NILU wished to know what LERG can do to produce or procure the GIS data needed in the QADAK project.

We presented and discussed:

- Extended cooperation and support from Dep. Geomatique during the project.
- Scientific cooperation during the project and with the future Central Laboratory (students could do their thesis connected to the project and the future activities at the work Central Laboratory)
- Data needed for emission and dispersion modelling (emission data, population data and GIS data)

### Discussions and conclusions

#### GIS:

NILU explained which type of GIS data is needed in the AQ application. A shape file with the borders of the administrative regions within Great Dakar is necessary. These regions are used for distribution of area emissions and population distribution. NILU stressed the importance of using the highest available resolution of the regions and population data.

Dakar area are divided into three administrative regions (departments):

- Dakar

- Pikine
- Rufisque

NILU asked if it was possible to get a higher resolution on the administrative borders than departments. LERG informed that there is a cadastre for the city planning on GIS with smaller administrative areas than the departments.

NILU informed that the road link network shapes would be delivered by GMAT through CETUD. In addition shapes for presentation purposes are also needed (e.g. sea, the parks, coastline etc)

The coordinate system used at LERG is WGS84 or UTM 28.

*Population:*

The population data available are probably distributed on departments. LERG will check if population data are available on higher resolution.

*Model area:*

Model area should be approximately 15(20) km x 30 km to cover the three administrative regions and the growing built-up area.

*Industry:*

There are 387 industries in the Dakar area. The emissions are most diffuse ground sources, but there are also major industries emitting through stacks. The main industrial belt is located along the south coast of the Dakar Peninsula.

LERG will make available to this project the information it has on industries (name, type of activity, coordinates, etc) and on emissions.

*Meteorological data:*

LERG has used statistics from the METEO at the airport from 1950 to 2003 for their dispersion work, namely by Aminata Gueye for her DEA thesis.

*Cooperation:*

NILU will prepare a memo specifying the work and the allocated hours for Cheikh Mbow within the QADAK project.

We agreed upon that Cheikh Mbow would get all the data NILU has received from DEEC in order to analyse the utility of the data to the project.

Cheikh Mbow will assist NILU in building the GIS for Dakar with all the necessary shapes to the project.

**References**

**Suivi de la qualite de l'air  
en milieu urbain de Dakar**



**CONSEIL EXECUTIF DES TRANSPORTS  
URBAINS DE DAKAR (CETUD)**

**The Norwegian Institute for Air Research (NILU)**

SAFARI 2000 (PM data from a measuring station at the north border of Senegal during 1998).

Aminata Gueye, Diplôme d'études approfondies - Etude Environnementale sur les rejets et dechets dangereux dans la zone du Port Autonome de Dakar. Universite Cheikh Anta Diop de Dakar, Faculte des Sciences et Techniques, Institut des Sciences de L'Environnement.





## **Appendix C7**



<b>FINANCEMENT:</b> <b>Fonds Nordique</b> <b>de Développement</b>	<b>Minutes from meeting</b>	
<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR	
<b>Agreement:</b>	PAMU/FND/C/08/04	

## Appendix C7

Title	<b>Meeting at the E.S.P. Dep. Physique Atmosphérique</b>
Date	Thursday 2 June 2005, 1100-1300 hrs.
Participants	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS), Herdis Laupsa (HEL) Performances: Bruno Legendre, ESP: Dr Seydi Ababacar Ndiaye
Author	BS, HEL
Distribution	Mission report
Reference No	O-105010

### Objectives and agenda for the meeting

The main objective for the meeting was to get an overview over the work conducted and the expertise existing at the Dep. Physique Atmosphérique and to discuss possibilities for professional cooperation.

### Work on atmospheric physics and aerosols

Dr Ndiaye informed that the Dep. Physique Atmosphérique had been working on rain, cloud formation, physics of clouds. Earlier they had not worked on aerosols and gazes, but that work started 2 years ago when he joined the department. They form about 2-3 people a year on the master degree and normally these people stay in the Department to work.

Dr Ndiaye had participated in at least two measurement campaigns measuring air pollutants using passive samplers and other simple VOC samplers.

#### *Measurement campaign of HNO<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, O<sub>3</sub> and NH<sub>3</sub> in Dakar:*

In February and March 2004 a measurement campaign of pollutant has been performed in Dakar together with the University of Toulouse in France. They measured HNO<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, O<sub>3</sub> and HH<sub>3</sub> using passive samplers. They placed the samples on the top of the building Chambre du Commerce at the Place de l'Indépendance (urban background) and took 2 samples during 2 weeks with a sampling period of 1 week each time. The sensors were duplicated. The analysis were done at the Laboratoire d'Aerologie in Toulouse. The study called "PolCar" was done simultaneously at 8 cities in Africa.

The results from the measurement campaign are presented here under:

Component	Value [ppb]	Comment
NO2	24-26	
SO2	5-7.5	
O3	11-13	Low to be urban background? Obs. Difficult to measure O3 with passive samplers
HNO3	0.5-1	
NH3	10-14	
Benzene	60-70 ug/m3	10 min average, one site 2.5mg/m3

*Measurement campaign of VOC in Dakar:*

In October 2004 a measurement campaign of VOC has been performed in Dakar by the Africa Clean network together with the University of Dunkerque in France. They measured VOC by using a high-resolution pump (10 min. sampling) in 10 different places in Dakar city, where traffic was intense. The content of benzene, toluene, xylem in the samples was analysed in France.

A table with the measurement points listed was given to NILU. The results of this study have not been reported yet.

**Planned measurement campaigns**

They are going to do a measurement campaign of particles of size between 0.001 and 10 µm and a new VOC measurement campaign.

If needed, they could help NILU doing the screening study with passive samplers and CO and particle monitors.

**Emission from traffic in Dakar**

The Africa Clean network, represented by Dr Ndiaye, did emission measurements of light vehicles and small buses passing the technical control at CETUD.

They measured emission of CO, HC and CO2 on gasoline run cars and opacity on diesel run cars. Measurement of these emissions were done while the engine was on but the vehicle was stopped.

All the small busses in Dakar run on diesel and 90% of the light vehicles use diesel as fuel and 10 % gasoline.

**Professional cooperation**

Interested in cooperation (formal partnership) and feedback.

## **Suivi de la qualite de l'air en milieu urbain de Dakar**



**CONSEIL EXECUTIF DES TRANSPORTS  
URBAINS DE DAKAR (CETUD)  
The Norwegian Institute for Air Research (NILU)**

The NCG 5, 2 experts, one from Norway and one from Sweden (Ivar Felt, economist) contacted him 5 years ago when terms of reference were written. He did not get any feedback.

### **References**

POLCA

Africa Clean (measurement campaign).



## Appendix C8



<b>FINANCEMENT:</b> Fonds Nordique de Développement	<b>Minutes from meeting</b>	
<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR	
<b>Agreement:</b>	PAMU/FND/C/08/04	

## Appendix C8

<b>Title</b>	<b>Meeting with CERER</b>
<b>Date</b>	Friday 3 2 June 2005, 0800-0930 hrs.
<b>Participants</b>	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS), Herdis Laupsa (HEL) Performances: Bruno Legendre, CERER: Dr. Mactar Sall
<b>Author</b>	BS
<b>Distribution</b>	Mission report
<b>Reference No</b>	O-105010

### Objectives for the meeting

At the Centre d'Etudes & Recherches sur les Energies Renouvelables (CERER) we met with Dr Mactar Sall, who has for many years collected data on meteorology and radioactivity.

The main objective for the meeting was to identify available data and to discuss whether data could be made available for the QADAK project.

### Meteorological data



Dr Sall showed us the facilities and pointed out that meteorological data measured by CERER is available since 1988, but the station has been moved.

The tower shown on the photo to the left, measures wind direction and speed at two heights, 5 m and at 15 m above the ground. The measurements at 15 m are logged every 10 minutes. The location of the tower is good and should be representative for this area of Dakar.

The data from this specific tower is available for the last 2-3 years. Data is being logged in a German datalogger placed at the second level of the tower.

There were also sensors for temperature, relative humidity and precipitation.

Dr Sall mentioned that if collaboration should be developed between QADAK project and CERER, QADAK should formerly approach the director of CERER. A contribution from QADAK to the improvement of actual equipments of CERER would be requested.

NILU got a copy of meteorological data (wind speed, wind direction and temperature) collected at CERER in December 2003 and December 2004. The data give an indication of meteorological conditions in Dakar. The data resolution was 10 minutes. NILU has generated hourly average, which are presented here. Temperature data in December 2004 are of bad quality and are not presented. The wind speeds are on the average 2.6 m/s and 2.2 m/s in 2003 and 2004 respectively (**Figure 1** and **Figure 5**). Calm conditions ( $< 0.4$  m/s) occur only in 1% and 1.7 % of the measurement period (**Figure 4** and **Figure 7**). The wind direction is mainly from NNW to NNE in both periods (**Figure 2, Figure 4, Figure 6** and **Figure 7**). The temperature range was from 18 to 35 °C in December 2003.

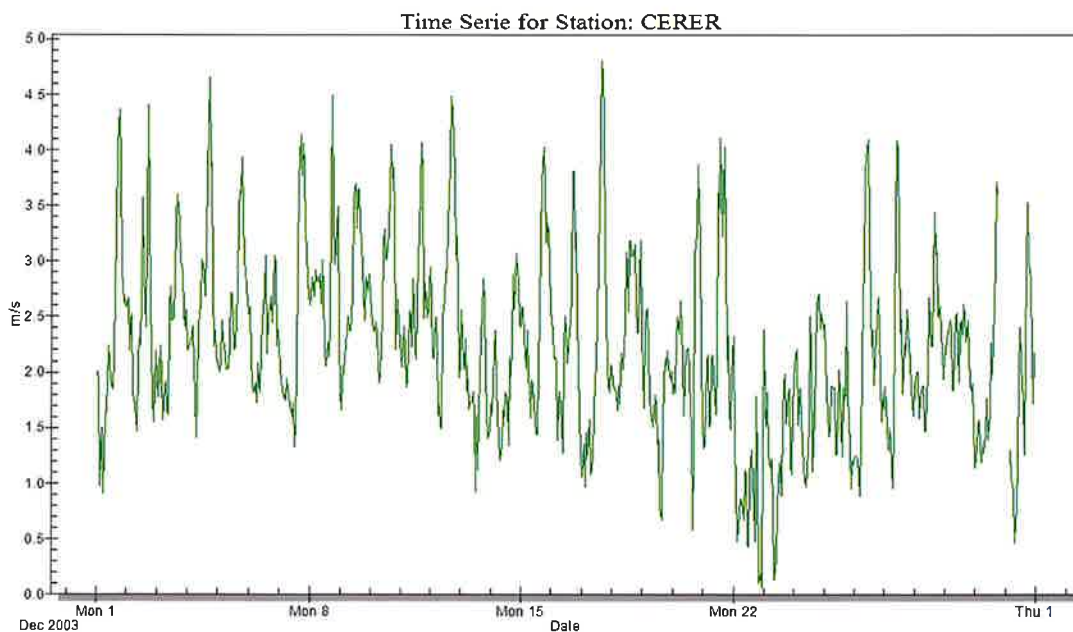


Figure 1: Wind speed measured at CERER in December 2003.

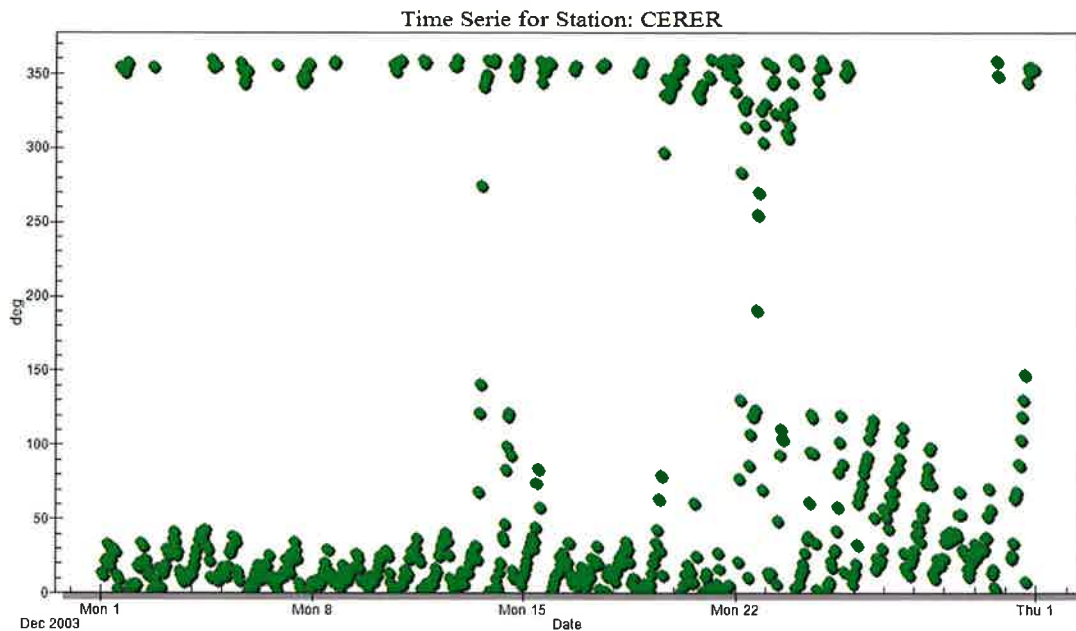


Figure 2: Wind direction measured at CERER in December 2003.

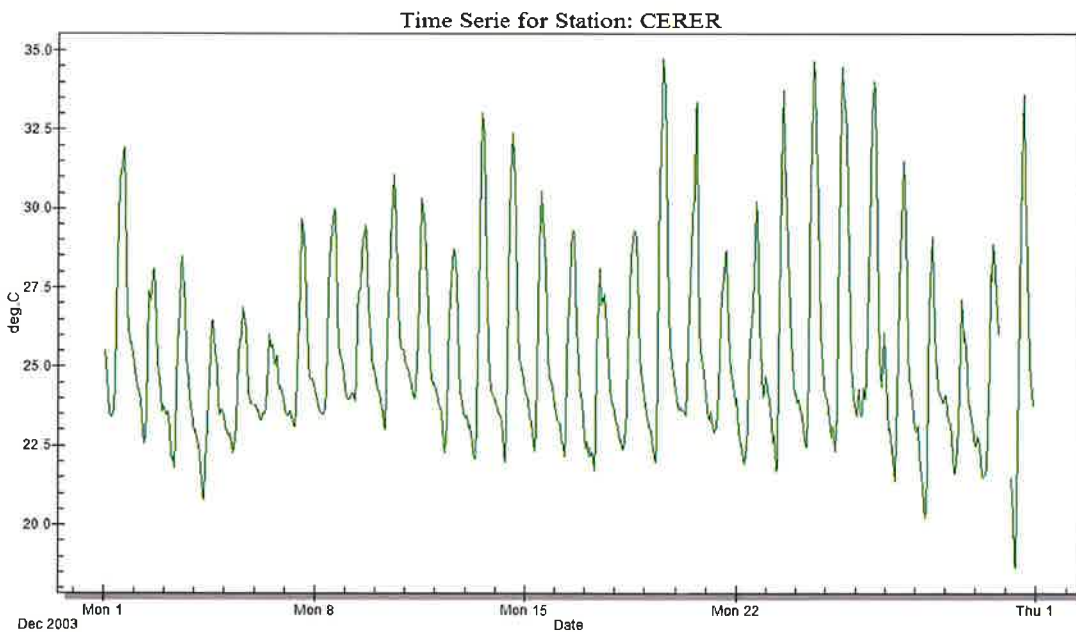


Figure 3: Temperature measured at CERER in December 2003.



Station Name: CERER

Period: 01.12.2003 -> 31.12.2003

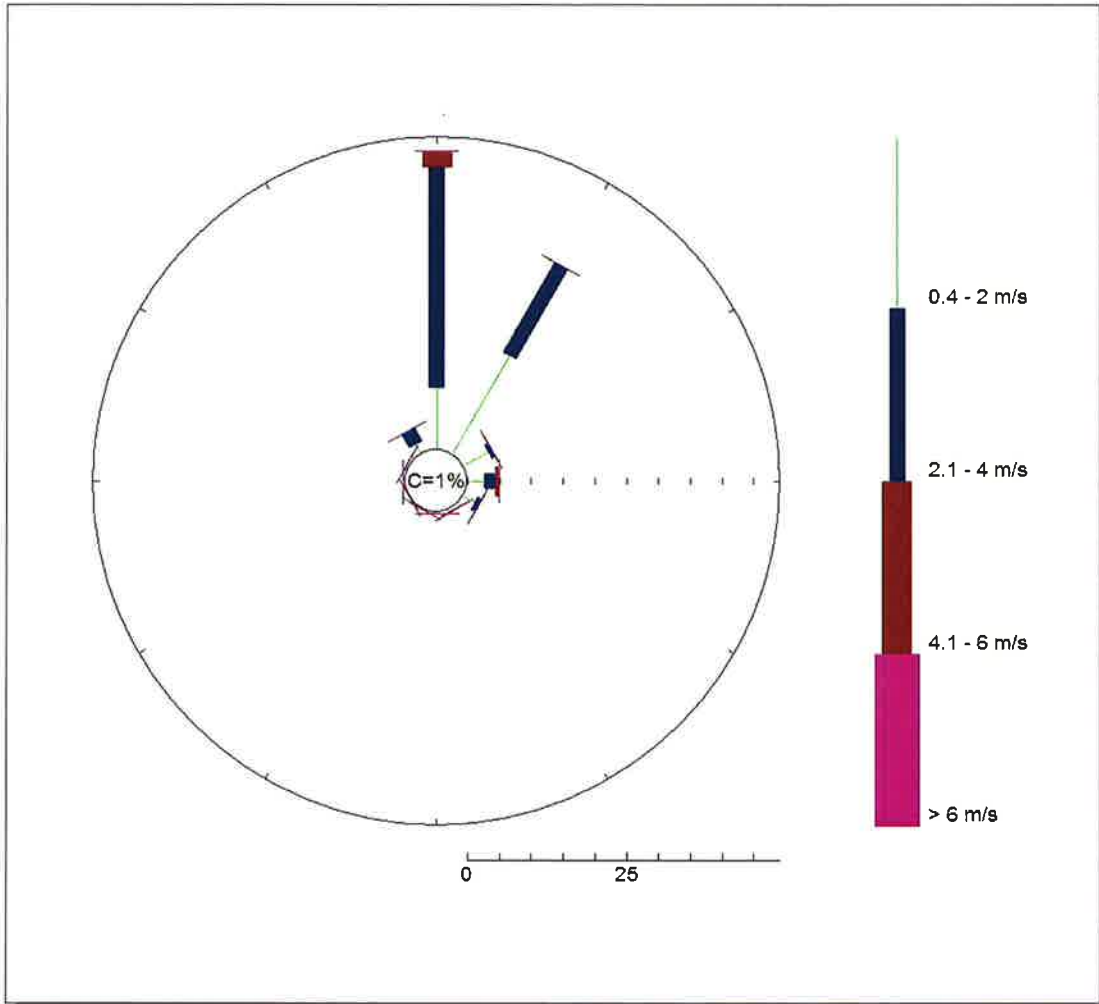


Figure 4: Wind rose measured at CERER in December 2003.

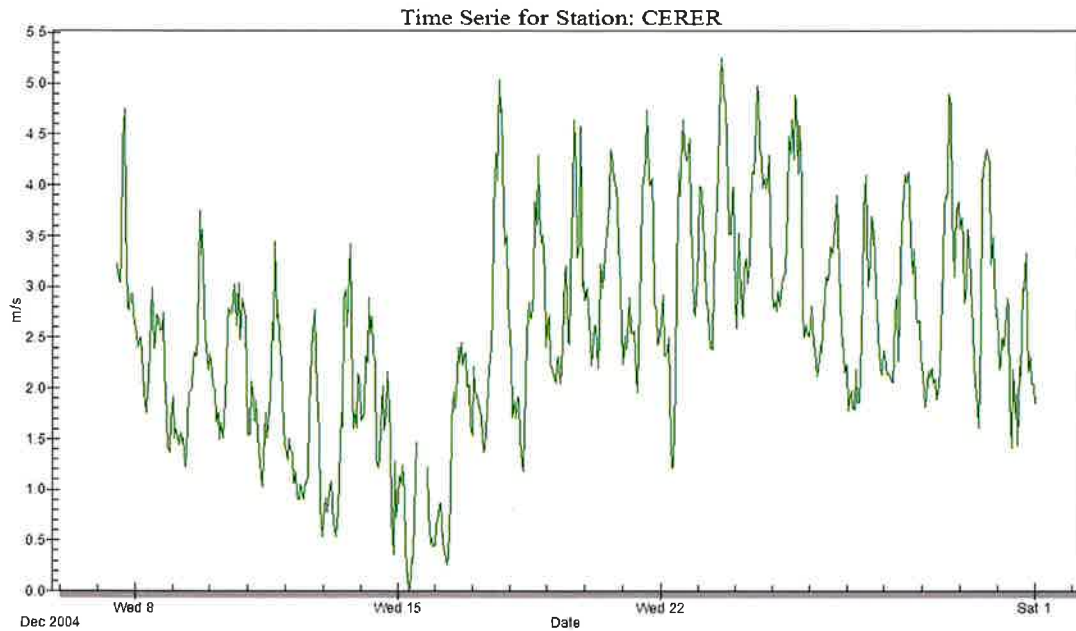


Figure 5: Wind speed measured at CERER in December 2004.

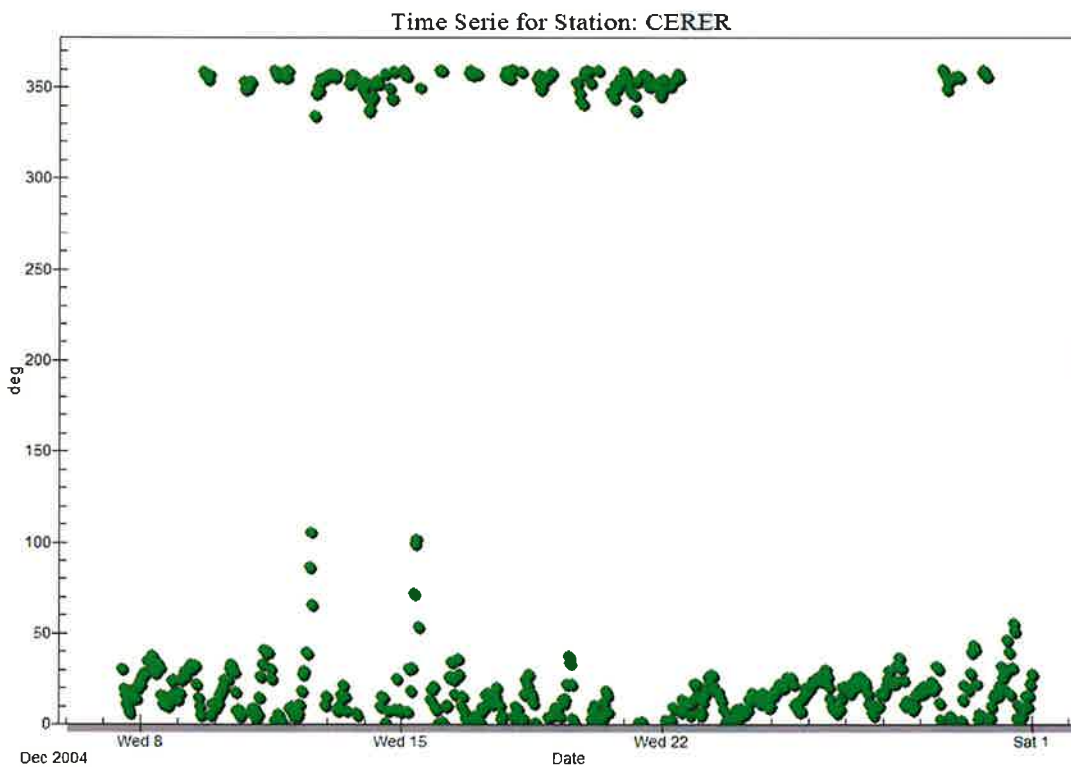


Figure 6: Wind direction measured at CERER in December 2004.

Station Name: CERER

Period: 01.12.2004 -> 31.12.2004

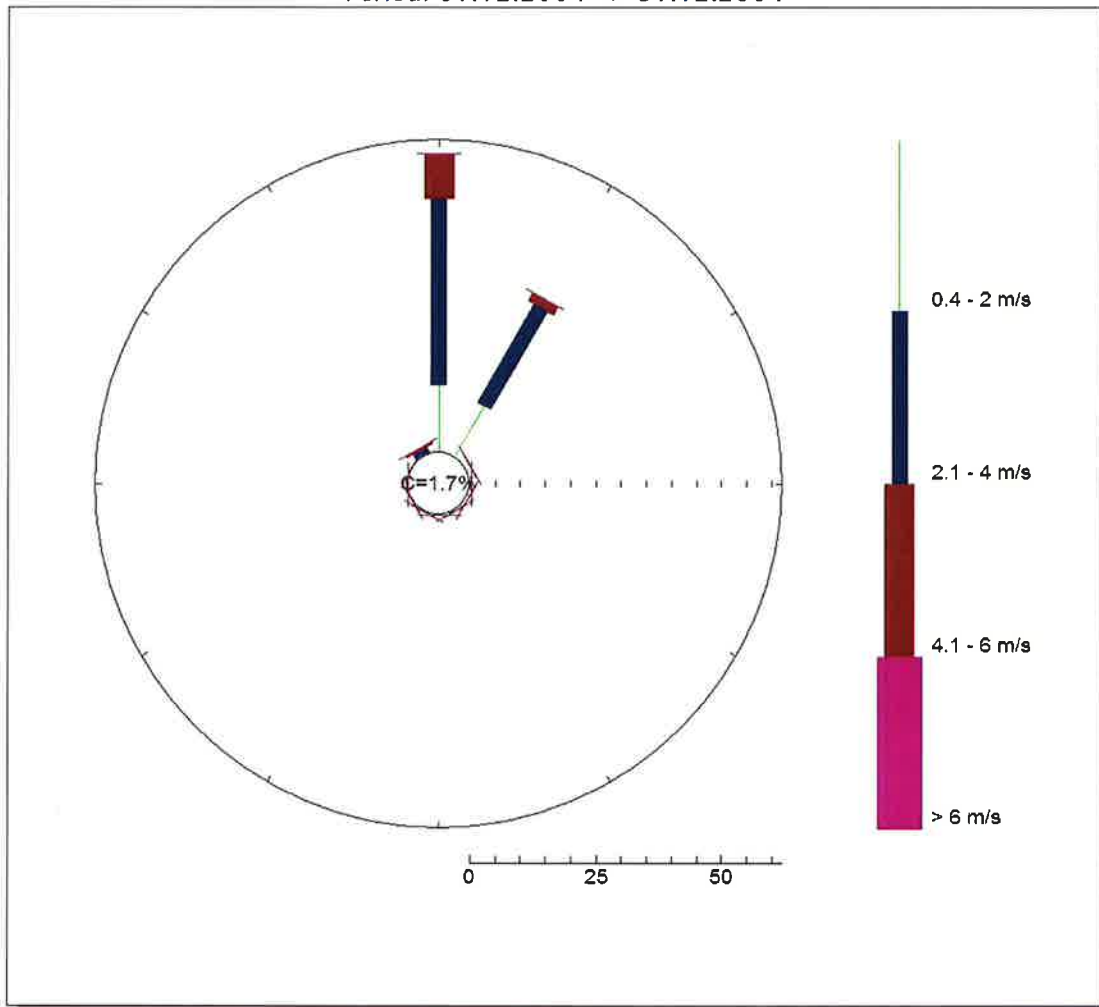


Figure 7: Wind rose measured at CERER in December 2004.



## **Appendix C9**



<b>FINANCEMENT: Fonds Nordique de Développement</b>	<b>Minutes from meeting</b>	
<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR	
<b>Agreement:</b>	PAMU/FND/C/08/04	

## Appendix C9

Title	<b>Meeting with the institute of meteorology, METEO</b>
Date	Friday 3 June 2005, 1000-1200 hrs.
Participants	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS), Herdis Laupsa (HEL) Performance: Bruno Legendre, CETUD: Pascal Segna METEO: Dr. Mactar Ndiaye, Mr Cherif Diop, Dr. Aïda Diongue Niang, Mr Chileto, Mr Sene
Author	BS
Distribution	Mission report
Reference No	O-105010

### Objectives for the meeting

The main objective for the meeting was to discuss the possible participation by the Institute for Meteorology (METEO) in the QADAK project and future cooperation with the Central Laboratory, and to identify meteorological data, collected by METEO, which could be useful to the QADAK project and later to the Central Laboratory.

### Meeting with the director

Dr Mactar Ndiaye, director of METEO Senegal, referred to the letter received from CETUD, and reconfirmed that METEO was interested and positive to a co-operation with the QADAK project. METEO can assist in implementing the project, but METEO and CETUD would have to prepare a protocol specifying the role of each of the parties. NILU emphasised the importance of METEO and the Central Laboratory scientific cooperation in the future, with exchange of data, information, experience and knowledge.

Dr Mactar Ndiaye stated that if the project needed meteorological data from METEO we would have to pay a “nominal fee”, which would not represent large expenses. He referred to Mr Chileto for data and to Dr. Aïda Diongue Niang for any support on identifying the existing data on different databases. Dr Aida is working in the Department of Research and Development (NCEP).

NILU specified that the radiosonde station could provide valuable information concerning vertical profiles of temperatures as well as mixing heights to the project

and to the Central Laboratory in the future. Long records of data, such as climatological wind roses etc can be used to study the representativity of shorter periods of meteorological measurements. Annual reports were, however, not produced by METEO. Such data would have to be prepared specifically for that purpose.

### **Meteorological data**

METEO is operating one automatic weather station at the airport in DAKAR. This is an ordinary SYNOP station and Dakar is regional centre for SYNO collection in West Africa. We visited the station, which is actually run by ASECNA. We were guided to the measurement site (see photo) and were informed about the data collection.



Not all data are imported to the database at METEO, and it was not clear whether the most complete database was at ASECNA or at METEO. It seems like it is ASECNA who is storing all the data on an hourly basis.

The radiosonde station releases two radiosondes every day; at 1200 GMT and at 2400 GMT. The radiosonde system was delivered by Vaisala, and was a standard DIGICORA system. These data are collected and stored by ASECNA .

One radiosonde had just been released when we were there, and we received the data from this ascent. The radiosonde measured profiles from the lowest layer in the atmosphere are shown in Figure 1 and 2 for 1200 GMT and 2400 GMT, respectively.

The profiles show a strong temperature inversion at about 500 m above the surface. At 12 GMT the wind was from around NNW in the lowest 100 m of the atmosphere. Above about 1000 m the winds were blowing from around east. The relative humidity was very high under the inversion, especially during nighttime. At night the relative humidity varied from 85 to 90 %, at daytime from 63 to 80 %. Above the inversion the relative humidity dropped to 6 to 16 % at daytime and 10 to 30 % at night.

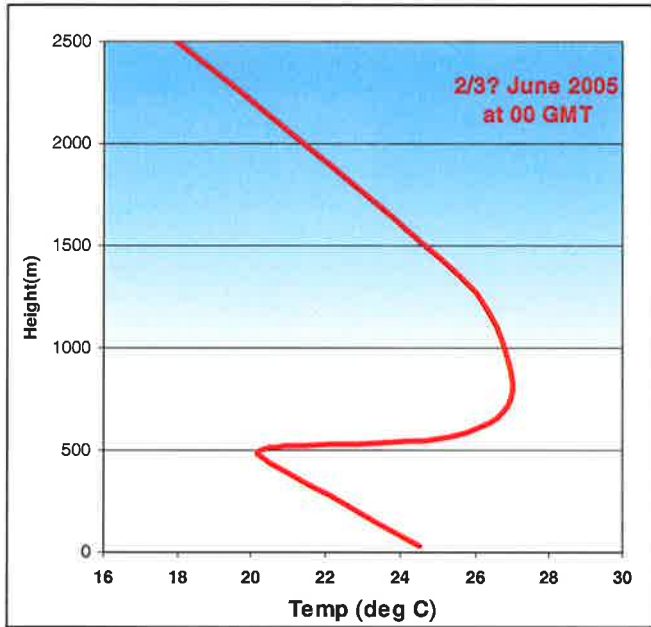


Figure 1: Temperature profile measured by the at 2400 GMT the 02 June 2005.

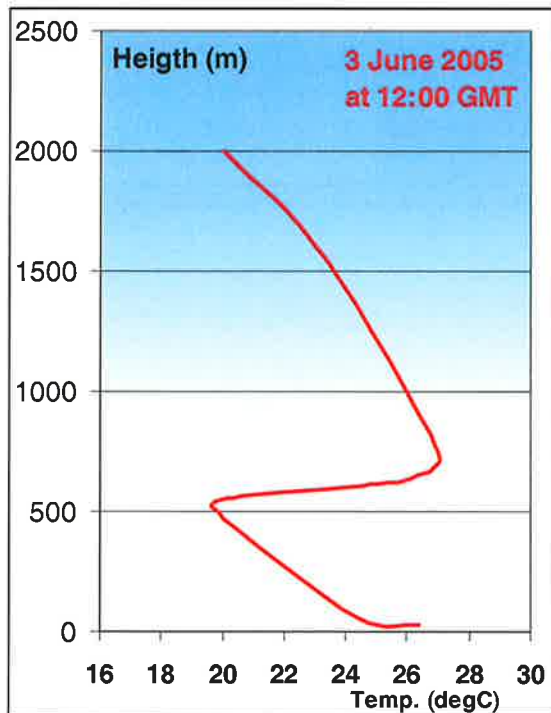


Figure 2: Temperature profile measured by the at 1200 GMT the 03 June 2005.

It seems like the surface layer above DAKAR is strongly influenced by the surrounding sea, and that easterly dry wind prevails above the strong surface inversion.

The impact on the dispersion of pollutants in the surface layer is evident. Especially at night time we should expect limited vertical diffusion of air pollutants through the inversion layer.

The wind tower at METEO is shown on the photograph here under.



### **Forecast models**

The METEO Senegal operates as the Regional Centre for Western Africa and is presently working on a regional prognostic model for the area. Presently they are using models available from international centres in US and Europe.





## Appendix C10



<b>FINANCEMENT:</b> Fonds Nordique de Développement	<b>Minutes from meeting</b>	
<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR	
<b>Agreement:</b>	PAMU/FND/C/08/04	

## Appendix C10

<b>Title</b>	<b>Discuss Prestige's contribution to the QADAK project</b>
<b>Date</b>	Friday 3 June 2005, 1600 hrs.
<b>Participants</b>	NILU: Cristina Guerreiro (CBG), Performance: Bruno Legendre, Prestige: Ali Diouf, Babacar Diop, Oumar Fall
<b>Author</b>	CBG
<b>Distribution</b>	Mission report
<b>Reference No</b>	O-105010

### Objectives and agenda for the meeting

The main objective of this meeting at PRESTIGE was to go through the work planned for Babacar Diop within this project and discuss its relevance to the project in the light of the new information on available traffic data for Dakar. With this in mind NILU wished to discuss with Prestige the possible contributions of Prestige to the project.

### Discussions and conclusions

NILU presented the original work plan for Babacar Diop within the project (attached). NILU explained that after the meeting at CETUD with Karfa Diako and Ousmane Sy, where Babacar Diop was also present, it became clear that the traffic data for Dakar that is needed for the project would be available in August 2005 from a traffic study GMAT is doing for CETUD.

NILU explained that these data will be up to date and of a much better quality than what we would have been able to produce within the QADAK project. Babacar Diop said he understood the present situation and that if the conclusion was that his services were no longer of need to the project he would draw back. He said further that he is busy with other businesses and that in his professional pride he would not accept to be paid for a work that is fictive and unnecessary.

Prestige studied the amount of time that was previewed for Babacar Diop in the project: 33 days or 264 hours. After being questioned by Prestige Bruno informed that the price agreed and accounted for in the project proposal and contract is 164 000 FCFA per day and Cristina added that the total amount previewed in the contract for Prestige participation in the project was 5,412,000 FCFA. No cuts had been done to

Prestige contribution during contract negotiations. Cuts were only applied to NILU's and Performance's budgets.

Prestige made clear that they would still like to work within this project and that they could offer other competence that may be useful to the project. Cristina said that NILU was open to suggestions from Prestige and that the participation of local expertise in this kind of projects is desirable.

Cristina left a copy of the technical proposal for Prestige to study and suggest alternative expertise to the transport engineer originally planned.

A new meeting between NILU and Prestige was agreed for Monday 6 June at 12 h.



## Appendix C11



<b>FINANCEMENT:</b> Fonds Nordique de Développement	<b>Memo</b>	
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<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
<b>Agreement:</b>	PAMU/FND/C/08/04

Title	<b>Meeting with M. Pascal Vardon at building Administration</b>
Date	Monday 6. June 2005, 0800 – 0900 h.
Participants	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS) DENV: Mme Seck Performances: Bruno Legendre(BL) MENV: Pascal Vardon
Autor	CBG
Distribution	Mission report
Reference No	O-105010

The objective of this meeting was to discuss with M. Pascal Vardon the requirements for the stack emission measurements that DENV is planning to order Institute Pasteur, in coordination with M. Pascal Vardon.

Cristina explained that in order to be able to use future stack emission measurements for comparison with the legislated emission limits and for air pollution modelling, it is necessary to measure the flow rate (Nm<sup>3</sup>/s) in addition to the pollutants concentrations. It was also explained that such measurements must be done following international specifications of equipment and sampling procedures and that was not the case in the last measurements made by Institute Pasteur.


It was discussed that the necessary equipment and competence for this kind of measurements is at the present not available in Senegal and that there is a need for it in a near future. It is unknown if it is available in a neighbouring country.

Pascal Vardon informed that the present means available to finance the measurements would not be enough to cover the formation of technicians and acquisition of measurements equipment for stack sampling.

NILU agreed to give Mme Seck the US-EPA sampling procedures for these type of measurements and a list of necessary parameters to be measured and collected during such campaigns in the future.



## Appendix C12

<b>FINANCEMENT:</b> <b>Fonds Nordique</b> <b>de Développement</b>	<b>Minutes from meeting</b>	
<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR	
<b>Agreement:</b>	PAMU/FND/C/08/04	

## Appendix C12

Title	<b>Meeting at Institute Pasteur</b>
Date	Monday 6 June 2005, 0900-1120 hrs.
Participants	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS) Performances: Bruno Legendre, LSAHE: Dr. B Garin
Autor	BS
Distribution	Mission report
Reference No	O-105010

### Objectives and agenda for the meeting

The main objective for the meeting with Laboratoire de Sécurité Alimentaire et de l'Environnement (LSAHE) at Institute Pasteur was to identify measurements of air pollutants performed at selected industries in Dakar, as well as in ambient air.

### About the measurements

In the meeting we met with Dr. P Garin who told us that he had not personally participated in the measurements, but could show us the instruments and experts used for these studies.



The stack measurements had been performed for the industries, represented by SPIDS (Syndicat Professionnel des Industries et des Mines du Sénégal). They had used a Bacharach type instrument delivered by Bacharach Europe (incorporating Geotechnical Instruments and Bacharach Instruments), based in Leamington Spa, England. The instrument is originally designed for gas detection around landfill and in combustion processes.

In the brochures it is stated that : The **GA45** biogas analyser is a low cost, entry-level gas analyser for accurate and reliable monitoring of Biogas. It utilises the same advanced technology as the industry field-

proven landfill analyser. Two models of the GA45 are available: the **GA45** and **GA45+**.

The **GA45+** has the extra capability of measuring temperature and additional gases with plug-in pods - Hydrogen Sulphide (H<sub>2</sub>S), Carbon Monoxide (CO), Sulphur Dioxide (SO<sub>2</sub>), Nitrogen Dioxide (NO<sub>2</sub>), Chlorine (Cl<sub>2</sub>), Hydrogen (H<sub>2</sub>) and Hydrogen Cyanide (HCN).



Both models will measure and display atmospheric pressure. As you would expect, the GA45 biogas analyser is also certified intrinsically safe for use in hazardous locations to safety classification ATEX EEx ibe II A T1.

### Stack measurements

We obtained copies of some of the concentrations measured in the top of the stacks. The compounds measured were NO<sub>2</sub>, SO<sub>2</sub> and CO. Only concentrations had been measured, no information on the flow rate was available, which makes it impossible to check if the emissions are within the legislated limits and to have the pollutant flow emitted for dispersion modelling proposes.

We were not sure about the accuracy and precision of these measurements. However, we stated that the validity of using these data for emission estimates are limited as long as the sampling is not done in conformance with international stack sampling standards and procedures.

SO<sub>2</sub> concentrations were often given between 20 and 100 ppm.

NO<sub>2</sub> stack concentrations were mostly 0.0 ppm.

At one stack (Cheminee) NO<sub>2</sub> was 0.4 ppm (SO<sub>2</sub> 4-5-ppm)

Another stack (C4 Fuite) the NO<sub>2</sub> was >20 ppm

### Ambient measurements

Pasteur institute also claimed to have undertaken measurements in the ambient air. They have used the same instrument as for stack measurements, and the concentrations are thus always less than the detection limit, except for CO in some cases.

These data can not be used to evaluate the air quality.





## Appendix C13



<b>FINANCEMENT:</b> <b>Fonds Nordique de Développement</b>	<b>Minutes from meeting</b>	
<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR	
<b>Agreement:</b>	PAMU/FND/C/08/04	

## Appendix C13

Title	<b>Prestige's contribution to the QADAK project</b>
Date	Monday 6 June 2005, 1200 hrs.
Participants	NILU: Cristina Guerreiro (CBG), Performance: Bruno Legendre, Prestige: Ali Diouf, Babacar Diop, Oumar Fall
Author	CBG
Distribution	Mission report
Reference No	O-105010

### Objectives and agenda for the meeting

The main objective of this meeting was to discuss possible contributions of Prestige to the project.

### Discussions and conclusions

Based on the technical description of the project Prestige presented a number of experts that could be valuable to the project:

- A jurist specialised within Environmental Law in Senegal for Task 11
- An IT & ORACLE expert for Task 6 & 9 (training)
- A civil engineer for Task 3
- Competence/experience related to land fields (waste disposal)
- Oumar Fall informed that he had competence within environmental measurements and instruments and that he had had a professional practice at AIRPARIF in Paris.

Cristina informed that Task 11 comprises evaluating the existing laws and regulations and advice on the additional implementing of regulations needed to complete a legal framework for ambient air quality management in Senegal. A jurist could contribute in compiling and evaluating the existing laws related to air quality, but proposing texts for new legislation is not within the project framework.

Concerning the civil engineer for Task 3, Cristina informed that the requirements for the Central Laboratory were very simple and already prepared, and that this laboratory consisted of 3 rooms within a bigger building that will be constructed for Direction de l'Environnement.

Concerning uncontrolled landfills, Cristina informed that they are air pollution sources during spontaneous combustion of the garbage, but the emissions would be punctual and extremely difficult to predict and estimate.

Concerning Oumar expertise Cristina commented that his background combined with the training that NILU will give within this project would form the necessary competence need in the Central laboratory in the future.

Cristina said also that a local IT & ORACLE expert could assist NILU in the installation of software at the Central Lab and in basic training in ORACLE.

Cristina and Babacar Diop agreed that Babacar Diop would not need to attend the meeting of the end of Mission 1 on Tuesday 7 June at 1400 hr at CETUD.

Ali Diouf commented that the amount budgeted in the project for Prestige is anyway very small and that whatever NILU's final proposal would be, Prestige's main interest is to participate in the project team, in order to build internal competences in the promising sector of air quality, and to work together with NILU since this project could generate new opportunities on a regional level in the future. Cristina agreed that this could be a pilot project for the region and said that a similar project NILU is conducting in Ho Chi Min city, Vietnam, has had such success that the Asian Development Bank has appointed Ho Chi Min city to have the best air quality management system in the region and has selected it for a pilot study on air quality and health.

It was agreed that NILU would study Prestige propositions and would make a contract proposal to Prestige as a sub-contractor within this project. Due to the intensive work program for the rest of the mission, Prestige and NILU agreed that this proposition would be sent to Prestige as soon as Cristina would be back at NILU.



## Appendix C14



<b>FINANCEMENT: Fonds Nordique de Développement</b>	<b>Memo</b>	
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<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
<b>Agreement:</b>	PAMU/FND/C/08/04

Title	<b>End of Mission meeting at CETUD</b>
Date	Tuesday 7. June 2005, 1400 -1800 h.
Participants	NILU: Cristina Guerreiro (CBG), Bjarne Sivertsen (BS) DENV: Mme Seck Performances: Bruno Legendre(BL), Cheikh Mbow CETUD: Pascal Sagna
Author	CBG
Distribution	Mission report
Reference No	O-105010

The objectives with this meeting were to:

- Summarise the work done during the mission, results and conclusions,
- Make detailed plans for the work ahead based on the approved "Plan d'intervention du personnel du consultant"
- Distribute tasks and responsibilities
- Communication and reporting routines/ communication means inside the project team and to the outside world

Cristina made a summary of all the meetings hold during the first mission and of the outcomes of those meetings.

The table below summarises detailed plans for the work ahead under each task following Mission 1, and specifies deadlines and responsible experts.

It was agreed that the communication may be done directly between experts involved in the project belonging to the different institutions (CETUD, NILU, Performances, DENV). A copy of each e-mail exchanged should be sent to [qadak@nilu.no](mailto:qadak@nilu.no) for archiving proposes.

Actions to take / To do		Responsible	Participants	Deadline
<b>1. Évaluation de la structure de gestion de la QA</b>				
1a	Read documents on current and earlier proposed AQ management structure	BS	BL, CBG	August
1b	Collect all norms and legislation regarding AQ in Senegal	BL		August
1c	Discuss with DENV the understanding of the current AQ management structure in Dakar			2 mission
1d	Discuss proposition for future structure	BS	BL, CBG	2 mission
1e	Present and discuss proposition on future structure with CETUD and DENV	BS	BL, CBG	2 mission
1f	Write report on evaluation of present and recommendation on future structure	BS		May 06
<b>2. Évaluation des niveaux de QA dans la ville de Dakar</b>				
2a	Make statistics and study collected met data Send feed back on the data to its sources and evt. order met data from the met office	CBG	HeL, BS	July
2b	Get a cooperation agreement with the Meteo office in order to get met data free of charge or at a symbolic price against formation of their experts on dispersion modelling	CETUD		June
2c	Air pollution modelling in industrial areas (bruk enhets utslipp, trenger bare vindroser)	CBG		September
	Screening by first passive sampling campaign (5 samplers)	HeL		July
2d	Design screening study for 2nd mission	BS	CBG, HeL	September
2e	Get permission for screening study in October	BL	BS	September
2f	Plan and prepare samplers & instruments for screening study	BS		September
2g	Get information from the "base de données des instituts classés" (Ernest Ndione)	BL		June

<b>Actions to take / To do</b>		<b>Responsible</b>	<b>Participants</b>	<b>Deadline</b>
<b>3. Mise en place du Laboratoire central de la QA</b>				
3a	Specify manpower needs and skills (qualifications)	BS	CBG, LM	August
3b	Specify the layout and contents of laboratory	BS	LM	August
3c	Announce jobs	DENV		September
3d	Selection/approval of candidates	BS & DENV		November
<b>6. Établissement et fonctionnement d'un Système de gestion de la qualité de l'air</b>				
<b>GIS</b>	Necessary shapes for Dakar GIS map: <ul style="list-style-type: none"> <li>• Road network within the model area</li> <li>• Coastline</li> <li>• Area borders on population distribution data</li> <li>• Airport area</li> </ul> Useful shapes if available: <ul style="list-style-type: none"> <li>• Built up area</li> <li>• Position of industries/stacks within the model area</li> </ul>	CB		
6a	Contact LERG in order to make the existing GIS map of Dakar available to the project	CETUD		June
6b	Check the contents of the GIS maps available at LERG and extract necessary shapes	CM		July
6c	Get road network for Dakar on GIS from GMAT (shape files)	CETUD		June
6d	Define modelling area for Dakar	CBG		June
6e	Extend/update GMAT's road network for Dakar to the modelling area (just main roads into Dakar)	CM		July
6f	Get population data on the smallest possible areas for Great Dakar	CM		October
6g	Define on GIS the borders of the population data areas	CM		October
6h	Get the most updated available statistics on charcoal consumption in great Dakar	CM	BL	October

<b>Actions to take / To do</b>		<b>Responsible</b>	<b>Participants</b>	<b>Deadline</b>
<b>7. Inventaire des émissions</b>				
7a	Collect all available data on emissions from some of the 380 industries identified	CBG	BL, CB, GB	October
7b	Collect traffic data for Dakar from the GMAT project for CETUD	CBG	CETUD	July/August
7c	Send stack measurements standards and parameters to be measured to Mme Seck, Inst. Pasteur, Mr. Vardon	BS	CBG	August
<b>9. Développement des capacités institutionnelles et formation</b>				
9a	Minutes of kick-off meeting and end-of-1 <sup>st</sup> mission meeting	CBG	BS, HeL, BL	June
9b	Plan Project Seminar in March 2006	CBG	BS, HeL, BL	October
9c	Propose participants for the Seminar	CETUD, CBG	BL	October
<b>11. Premier évaluation de la législation en vigueur en matière de qualité de l'air</b>				
11a	Make a compilation on present legislation	Prestige	DENV	September
11b	Collect data on air quality standards and limit values for Senegal	BL	DENV	September
<b>12. Gestion et durabilité du projet</b>				
12a	1 <sup>st</sup> Mission report "Rapport de démarrage"	CBG	BS, HeL, BL	August
12b	Rapports d'avancement trimestriels, rapports financiers, facturation	CBG	BL	August
12c	Plan d'intervention du personnel du consultant pour Dec 05 – Mai 06	CBG	all	November
12d	Establish formal agreement with Meteo	CETUD		September
12e	Establish formal agreement with SPIDS	CETUD		July
12f	Establish an e-mail address <a href="mailto:qadak@nilu.no">qadak@nilu.no</a> to send copies of all mails within this project	CBG		June
12g	Establish a WEB site for the project in order to share documents	CBG		August





## **Appendix D**

### **Laboratory requirements on logistics**



<b>FINANCEMENT: Fonds Nordique de Développement</b>	<b>MEMO</b>	The logo for QA DAK consists of the letters 'QA' in yellow and 'DAK' in orange, with a stylized house-like shape above the 'A'.
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<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
<b>Agreement:</b>	PAMU/FND/C/08/04

Title	<b>Air Quality centre room and facilities</b>
Subject	A first description of provisory facilities for the Central laboratory
Distribution	Cristina (CBG), Herdis (HEL)
Author	Bjarne (BS)
Date	26 May 2005
Référence No	O-105 010

## **The air quality monitoring and management centre (Central Laboratory), rooms and facilities**

Two rooms will be needed to operate the air quality monitoring and assessment programme:

1. The data acquisition and computer centre
2. A calibration and repair laboratory (Reference laboratory)

In addition there may be a request for an additional office for the Head of the Centre (The programme Manager).

## **The data acquisition and computer centre**

The computer room will act as the main centre in the air quality monitoring and management programme.



*Figure 1: The interior of a typical computer centre for an air pollution monitoring and assessment programme.*

This room will typically be about 5 m x 8 m and include desks and tables for a server with 3 clients. Three experts will be permanently located to this centre. The room need air conditioning.

## **Calibration and repair laboratory**

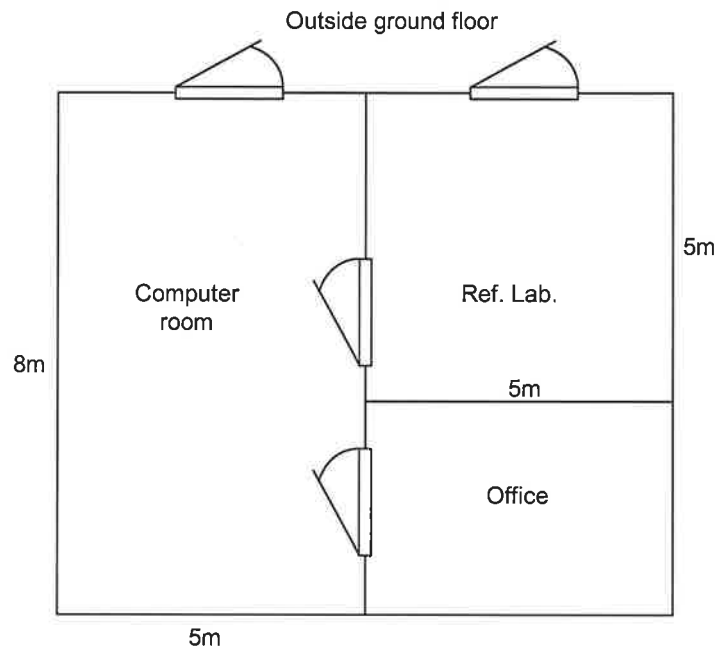
The calibration and repair laboratory will have to be at least 5m x 5 m. It will include chairs, desk and shelves for papers and printouts. A specific shelf is required for manuals and written procedures.

An instrument rack will be placed along one of the walls to include monitors for multipoint calibrations. The room will also contain calibration gases in steel bottles. The reference lab room air must be ventilated out in order to keep the span gas concentration levels at a minimum.

This room will need air conditioner to maintain a stable temperature in the reference laboratory. It is advisable to locate the room on the ground floor to reduce the difficulties in transporting instruments and calibration gases in and out.

## Office for project manager

It may be required to include a room for the project manager. The size of this air-conditioned office may be 3m x 5 m. The office will be equipped with a PC and possibly a client for the database and management system and a printer.



*Figure 2: Typical layout of the air quality monitoring and management facility.*



## **Appendix E**

### **Laboratory requirements on personnel skills and manpower**



<b>FINANCEMENT: Fonds Nordique de Développement</b>	<b>MEMO</b>	
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<b>Project:</b>	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
<b>Agreement:</b>	PAMU/FND/C/08/04

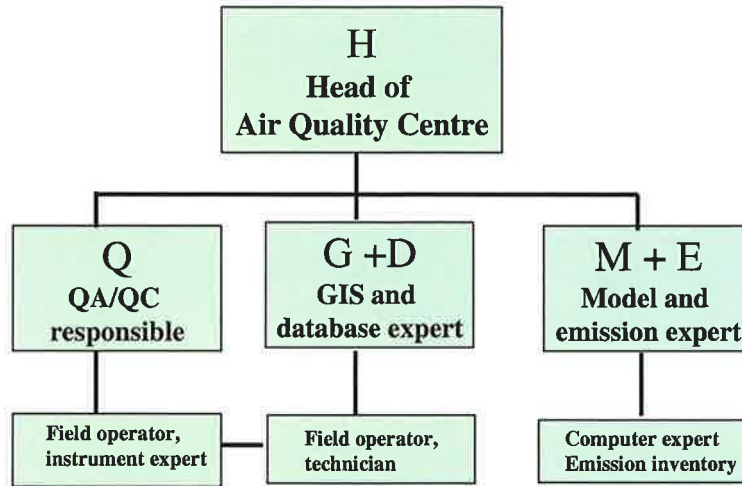
<b>Title</b>	<b>Tasks and activities for the future air quality management team</b>
<b>Subject</b>	Description of tasks and obligations for the personnel needed to undertake future operations of an air pollution monitoring and management center in Dakar.
<b>Distribution</b>	Cristina (CBG), Herdis (HEL), Bruno (BL)
<b>Auteur</b>	Bjarne (BS)
<b>Date</b>	25 May 2005
<b>Reference No</b>	O-105 010

## The air quality monitoring and assessment organisation

The new air quality monitoring and assessment centre in Dakar (AQMAD) will have to undertake several tasks as part of the future air quality monitoring system for Senegal. Some of these tasks will be to:

- Operate local monitoring programmes, sampling and analyses,
- Perform daily and weekly data checks and follow-up,
- Perform weekly calibrations and data controls,
- Retrieve data daily to the local data bases,
- Undertake QA/QC and SOP follow-ups,
- Perform modelling and collect relevant input data,
- Prepare emission inventories
- Report results on a monthly and annual basis,
- Produce state of the environment reports

To meet these requirements the administrative set-up of the centre may be organised as presented on the following Figure:



*Figure 1: Organisation of the air quality monitoring and managing centre.*

## Tasks and obligations

The AQMAD centre will have to train experts to undertake the different tasks presented above. They will have to operate a monitoring programme with adequate quality control and collect source data for the annual updated emission inventory. They may also perform model estimates as part of the permit procedures and impact evaluations.

A brief description of tasks to be undertaken by the different experts is presented in the following tables.

Function		Task description		Indicator and output
<b>H</b>	<b>Head of centre</b>	1	Supervise and develop job descriptions	Written descriptions
		2	Present budgets	Budget estimates
		3	Develop agreement and report to with CETUD	Minutes and reports
		4	Identify and develop training for the staff	Training assessment
		5	Identify textbooks, start establishing a "library"	
		6	Update various service contracts	Contract
		7	Prepare together with staff assessment reports	Reports
		8	Responsible for monthly status reports	Status reports
		9	Follow up on the total AQMS programme	Meetings and discussions
		10	Plan for future improvements and modifications	Discussions and reports
		11	Reports to the International community (WHO)	Reports and international meetings
		12	Data dissemination and Internet development	Reports and Web applications

Function		Task description		Indicator and output
<b>Q</b>	<b>QA/QC</b>	1	Define QA/QC requirements, Data quality objectives	Technical Memo
		2	Study international directives and collect documents, electronic and paper	Documents collected and filed
		3	Prepare list of manuals and books for data quality assurance	Archive
		4	Prepare routines for AQ data quality assurance; daily-weekly - monthly	Written manuals
		5	Responsible for the operation of a reference and calibration laboratory	Reference laboratory expert
		6	Prepare and apply routines for QA/QC of emission data	Manuals
		7	Describe routines and documents for data trace-ability	Descriptions and archive
		8	Discuss and prepare accreditation	



Function		Task description		Indicator and outputs
<b>D</b>	<b><u>Databa</u> <u>se</u></b>	1	Define and prepare the air quality database	Database operational
		2	Develop protocol for retrieving data	Written protocols
		3	Import hourly meteorological data	Data in database
		4	Import data from met-processor for modelling	Data prepared
		5	Emission inventory support, prepare templates	Written templates
		6	Plan and prepare data acquisition from monitoring stations	Data retrieval descriptions
		7	Keep updated records of all data available	Data records
<b>G</b>	<b>GIS</b>	1	Collect maps for all areas included in the monitoring and assessment programme	Maps available and stored
		2	Identify and get all digital maps available	Digital maps
		3	Obtain ArcView licence to be installed at Assessment centre	ArcView installed
		4	Get training in the application of ArcView	Training received
		5	Prepare digital maps for the GIS based database and assessment system	GIS to assessment tools
		6	Define modelling areas for Dakar	Modelling areas defined
		7	Prepare GIS with adequate layers for the “modelling areas	Digital model area maps defined

Function		Task description		Indicator and output
<b>E</b>	<b><u>Emissio</u> <u>n data</u></b>	1	Prepare templates for source data	Report templates
		2	Collect raw data and emission factors for emission inventory	Raw data reports documented
		3	Check traffic data, verify all factors and time variations	Memo to confirm
		4	Import emission data from industries and point sources	Emissions in database
		5	Evaluate emission factors, prepare national emission factors	Report on emission factors
		6	Update and quality assure area sources and population data,	Report consumptions and population distribution
		7	Prepare and report National emission inventory	Report to MWEP

Function		Task description		Indicator and output
M	Models	1	Collect and read textbooks on AQ modelling	Text books available
		2	Receive training in model applications	Training
		3	Use the available models as part of hand-on training	Prepare result memos
		4	Import input data to the models and run test examples	Concentration distributions
		5	Import other data from selected street canyons (3 Pilot areas!)	Data in OSPM
		6	Import complete sets of emission data for Dakar	Report on concentrations
		7	Evaluate model output data, quality assure and verify	Model validation report
		8	Prepare air quality assessment reports based on models and measurements	Report and workshop presentations
		9	Identify and participate in training courses on meteorology and modelling	

Function		Task description		Indicator and output
C	Computer experts	1	Receive training in using the air quality specific computer programmes	Training
		2	Operate the data retrieval computers at the computer centre	Daily retrieval and control of data
		3	Be acquainted with all updates on computers; hardware and software	Follow-up computers
		4	Support the rest of the staff in computer technical questions	Support functions

Function		Task description		Indicator
F	Field operators	1	Responsible for the daily operations of monitoring stations	Site visits
		2	Perform field calibrations	Calibrate
		3	Receive training in operation of specific instruments	Instrument training
		4	Maintain and repair instruments	Instrument knowledge
		5	Operate reference calibrations under QA/QC officer	Multi point calibrations
		6	Report deviations and malfunctions at sites and on instruments	Status reports
		7	Participate in any installations and changes in the field operations	Install and modify

## **Job qualifications**

Job descriptions for the personnel needed to operate the air quality monitoring programme and to report the results of measurements and assessments have been presented above. In the following texts we have briefly indicated what qualification is normally necessary to fill the different positions.

### **Head of Air Quality Centre**

The head of the centre should have a university degree (PhD) with at least 5 years of experience in scientific oriented work or a Civil Engineer/ MSc with at least ten years experience. The head of the centre should speak English and French and have some international experience in co-operative work. Preferably the person should also have some experience in computers and data handling. The head of the centre should also have some background related to environmental issues and be acquainted with reporting results from scientific work. Some background and knowledge of air pollution and air pollution legislation national and international may be required.

### **QA/QC responsible officer**

The quality assurance officer should have a university degree and have some background in computer and data science. This expert will have to supervise data retrieval and coordinate between the field operators and the data assessment experts. The QA/QC officer will be responsible for the daily data retrieval and quality controls, prepare print outs, check data, introduce calibration factors etc. He/she needs some background in statistical treatment of data, as one of the tasks will be the final acceptance of data to the database.

The QA/QC officer will also have to know instrumentation and the operations of instruments in the sense of calibrations and quality requirements. He/she will be responsible for the Reference Laboratory and will have to be experienced in managing people.

### **GIS and database expert**

The GIS and database manager will have to have sound experience in the use of computers and should also have a university degree with at least 5 years of experience in scientific oriented work. Preferably this person should have been working with digital maps. Some experience in the application of ArcInfo and ArcView would be preferred. He will also receive training in map data technologies.

The database expert also needs experience in computers data handling and the development of databases.

### **Model and emission inventory expert**

The modelling expert will need a university degree. Some experience in computer science and numerical methods will be preferred. Also modelling experience and basic mathematics, geophysics or environmental science background would be needed.



The modelling expert will have to co-ordinate several people and will have the responsibility for reporting. The person will have to master English and French language, and may be involved in international meetings for presentation of results.

### **Computer expert**

The computer expert will typically support the rest of the staff in questions concerning hardware and software problems. This expert will need sound knowledge in computer science. Preferably he/she will need university background or similar. English knowledge is crucial as some of the training will be in English.

Several years of experience in computer applications will be preferred.

### **Field operators, instrument experts**

Two field operators will be required to operate the air quality monitoring system designed for Dakar. One of the experts should be an engineer with electronic background. The other expert should have several years of experience in instrumentation and scientific instruments.

Both experts should understand English, as most of the training for operations, quality assurance and calibrations will be in English. Both of these experts will also be involved in maintenance and repair at the Reference Laboratory. They should thus be trained to check, repair and calibrate specific monitors.



## **Appendix F**

### **List of documents collected**

DOCUMENTATION

Titre	Auteur	Année	Source	
Etude sur la connaissance des sources de pollution et le niveau de contribution de chaque source identifiée à Dakar. Définition d'un programme d'action Id – tome 2 : cartes	Simon & Christiansen	2000	Pascal Sagna	CETUD
			Madeleine Diouf	DEEC
Impact du secteur du transport urbain sur la qualité de l'air à Dakar	Tractebel	1998	Pascal Sagna	CETUD
Lettre de politique sectorielle pour le sous-secteur des transports urbains	Ministère des transports	1996	Pascal Sagna	CETUD
Lettre de politique sectorielle de l'environnement	Min de l'Environnement			
Conférence régionale sur l'élimination du plomb dans l'essence en Afrique sub-saharienne	Banque Mondiale	2001	Gatta Ba	DEEC
Norme 05-062 – Pollution atmosphérique – norme de rejets	ASN	2003	Gatta Ba	DEEC
Arrêté interministériel fixant les conditions d'application de la norme NS 05-062	Min de l'Environnement	2004	Gatta Ba	DEEC
Norme 05-060 – Pollution automobile	ASN		Gatta Ba	DEEC
Code de la Route	Min des Transports	2004	Modou Kane Diaw	DT
Rapports 1 et 2 du Projet de Gestion de la Pollution Industrielle dans la baie de Hann	Tecsult	2004	Gatta Ba	DEEC
Décret sur les spécifications des Hydrocarbures (objectif essence sans plomb fin 2005)	Direction de l'Energie		Gatta Ba	DEEC
Summary and conclusions on the study on urban transport dysfunction and air pollution in Dakar	Banque Mondiale - SSATP	1999		
Fonds de cartes sur Dakar et photos aériennes 2004		2004	Gatta Ba	DEEC
SIG Dakar et Banlieu – Projet JICA	Projet JICA	1997	Patrick Deroué	DTGC
Niveau d'exposition au plomb éliminé par la circulation automobile – impact sur le stress oxydatif et le statut nutritionnel des enfants sénégalais	Amadou Diouf & co.	2001		
Difficulté d'adaptation des approches du transport urbain pour les villes en développement – analyse	Xavier Godar	2001	Les cahiers scientifiques du Transport	

Titre	Auteur	Année	Source
critique d'études des bureaux internationaux à Dakar			
<b>Code de l'Environnement</b>	Min de l'Environnement	2004	
Suivit de la Qualité de l'eau et de l'air au Senegal	Direction de l'environnement	2005	DEEC
Etude Environnementale sur les rejets et déchets dangereux dans la zone du port autonome de Dakar	Aminata Gueye	2004	Institut des Sciences de l'Environnement (UCADD)
Etude diagnostic sur les strategies et l'implication du secteur prive dans l'investissement du secteur de l'environnement au senegal, en Cote d'Ivoire et au Cameroun. Rapport de synthese de l'etude	SPIDS	2005	SPIDS
Evaluation Environnementale du projet d'Amélioration de la Mobilité Urbaine à Dakar	Tractabel	2000	CETUD
Average monthly Wind direction frequency (1991-1995) for Dakar	Pascal Sagna		Pascal Sagna
Modelisation des carrefours sur le logiciel Saturn, dossier technique, sous lot F1, Vol. II.	Waterman Int., SCIEPS, CATN	2004	CETUD



## **Appendix G**

### **Meteorological data from prognostic model**





## Evaluation of the wind data from Dakar

### Data

Forecast data from model grid point close to Thiès, Senegal

Resolution 6 h

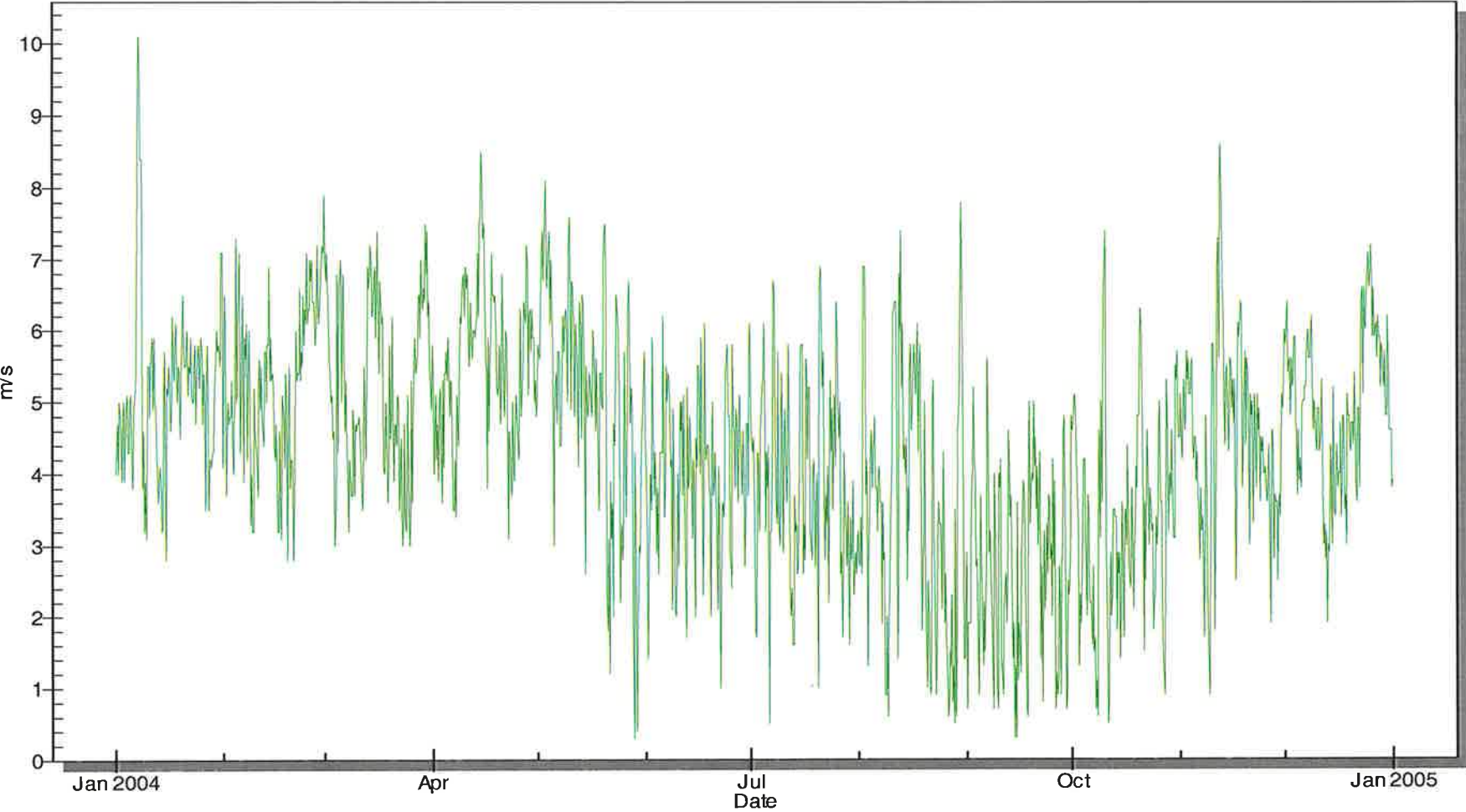
Period: 2004

### Analysis

- 1 Time series (wind speed and direction)
- 2 Wind roses:
  - 2004
  - 1 January 2004 – 1 May 2004
  - 1 May 2004 – 1 September 2004
  - 1 September 2004- 1 January 2005
- 3 Wind direction and average wind speed 2004

1. Time series (wind speed)

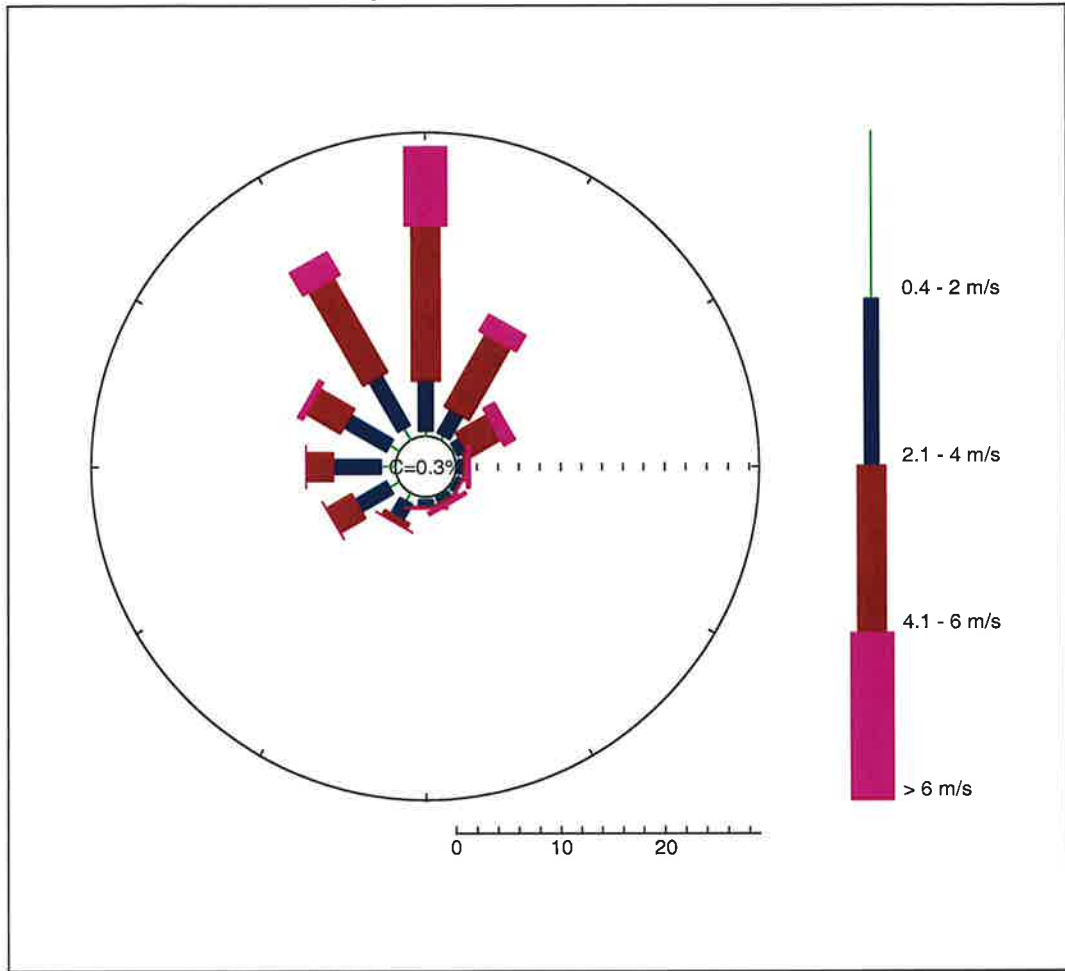
Time Serie for Station: Met. forecast model



2. Wind roses

Station Name: Met. forcast model

Period: 01.01.2004 -> 01.01.2005

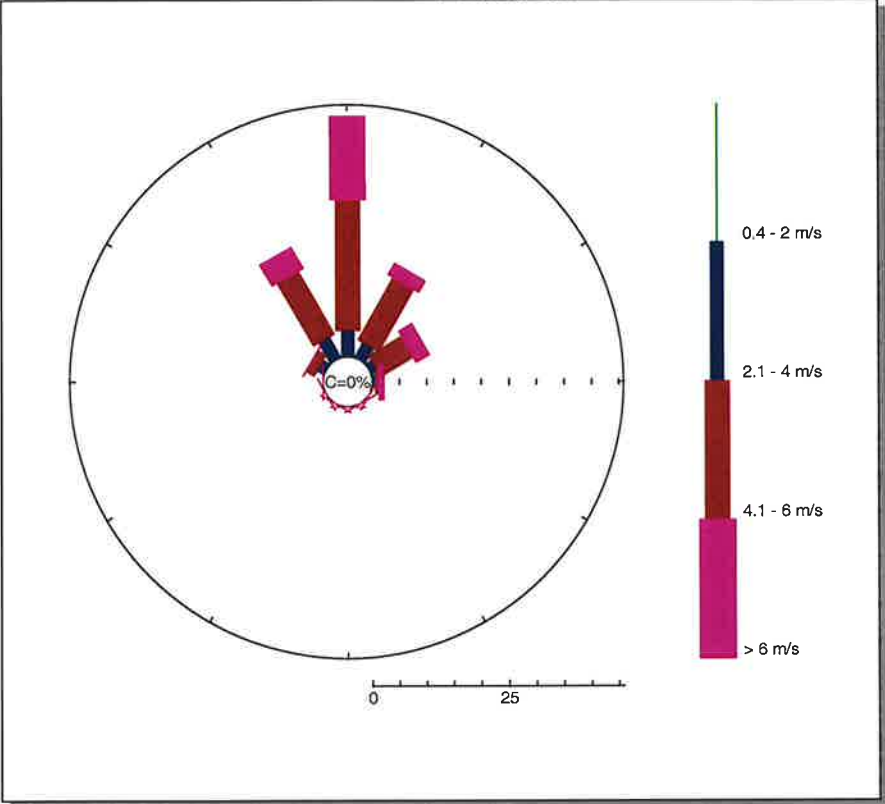


Air quality in urban environment of Dakar



Station Name: Met. forecast model

Period: 01.01.2004 -> 01.05.2004

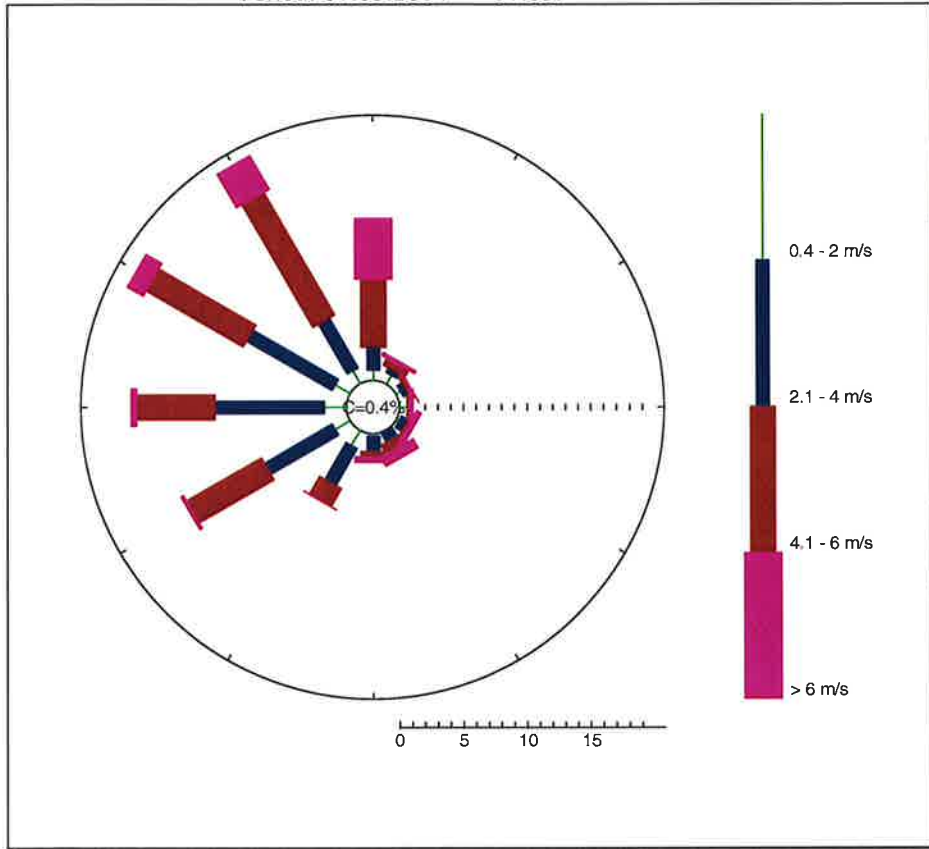


Air quality in urban environment of Dakar



Station Name: Met. forecast model

Period: 01.05.2004 -> 01.09.2004

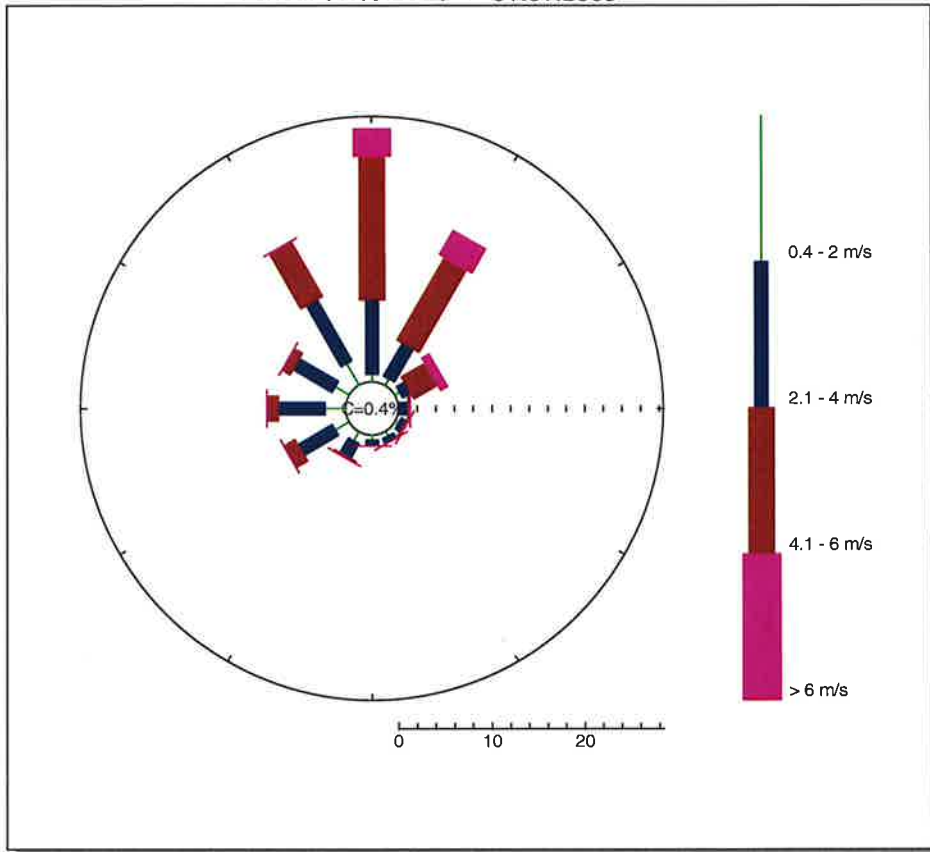


Air quality in urban environment of Dakar

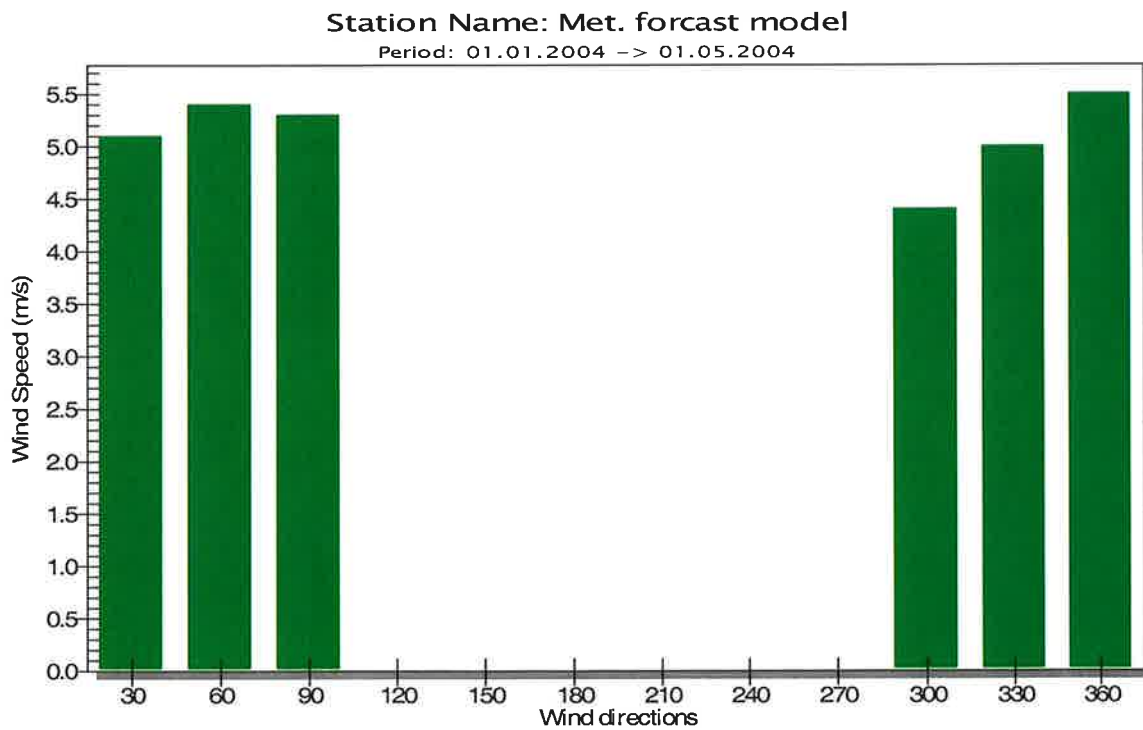
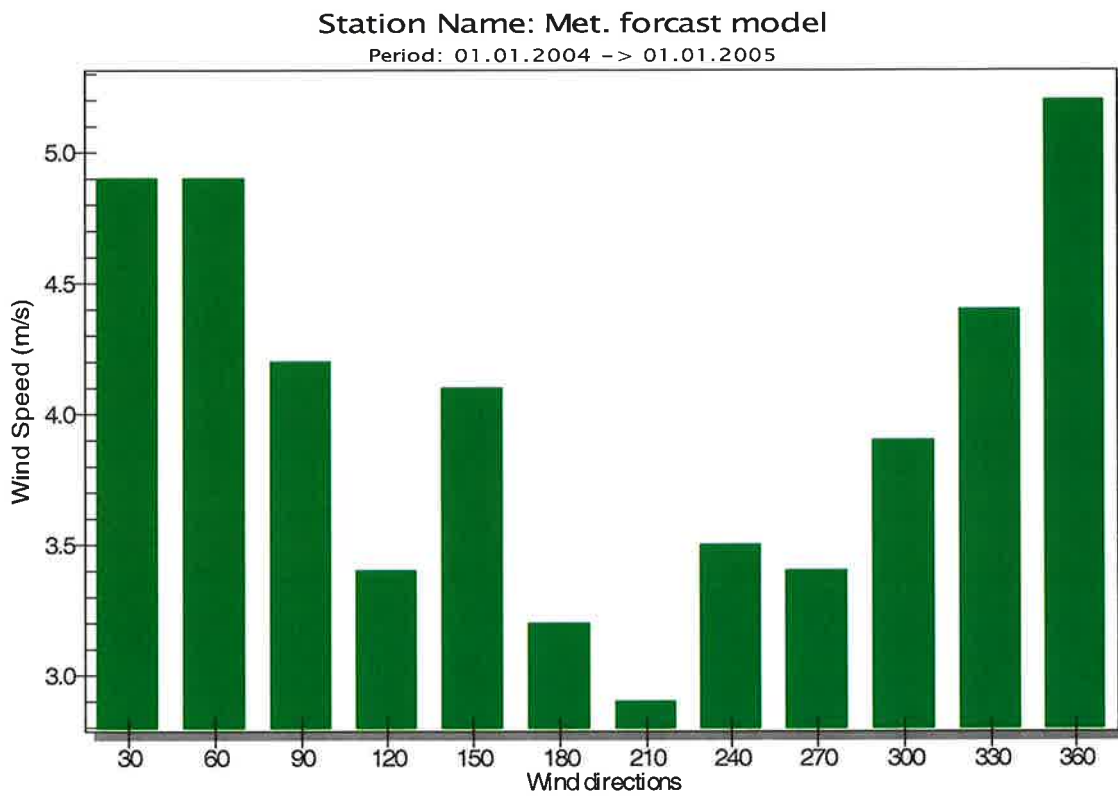


Station Name: Met. forecast model

Period: 01.09.2004 -> 01.01.2005

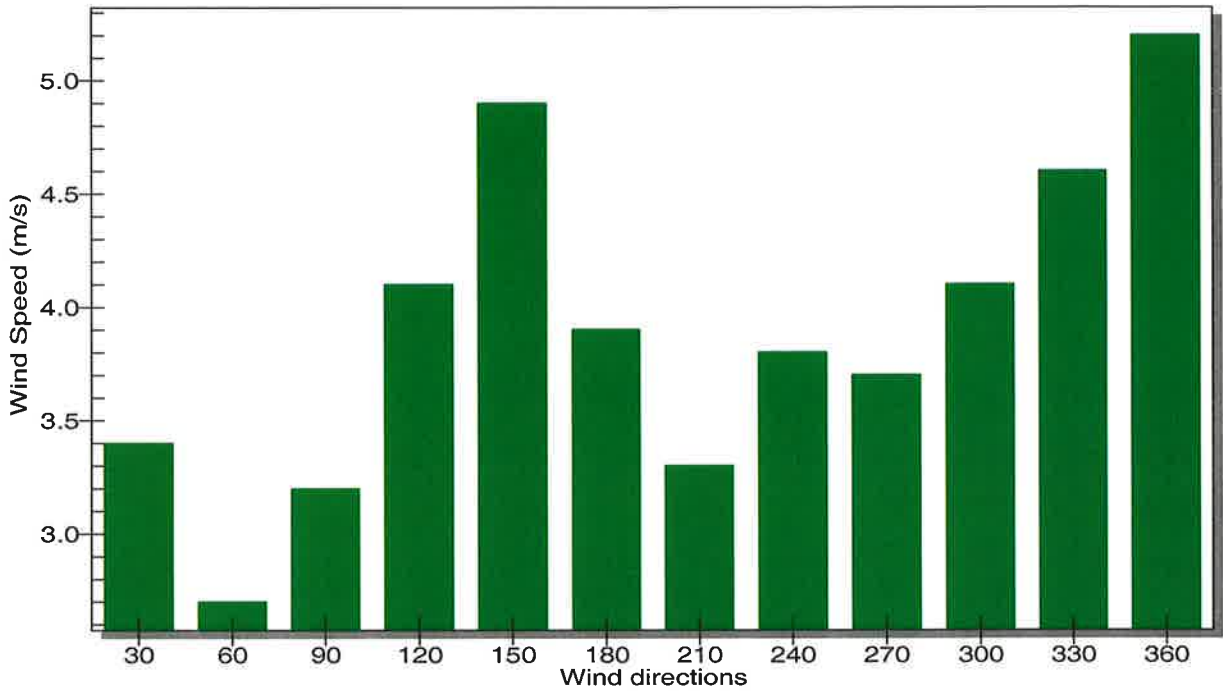


3. Wind direction and average wind speed



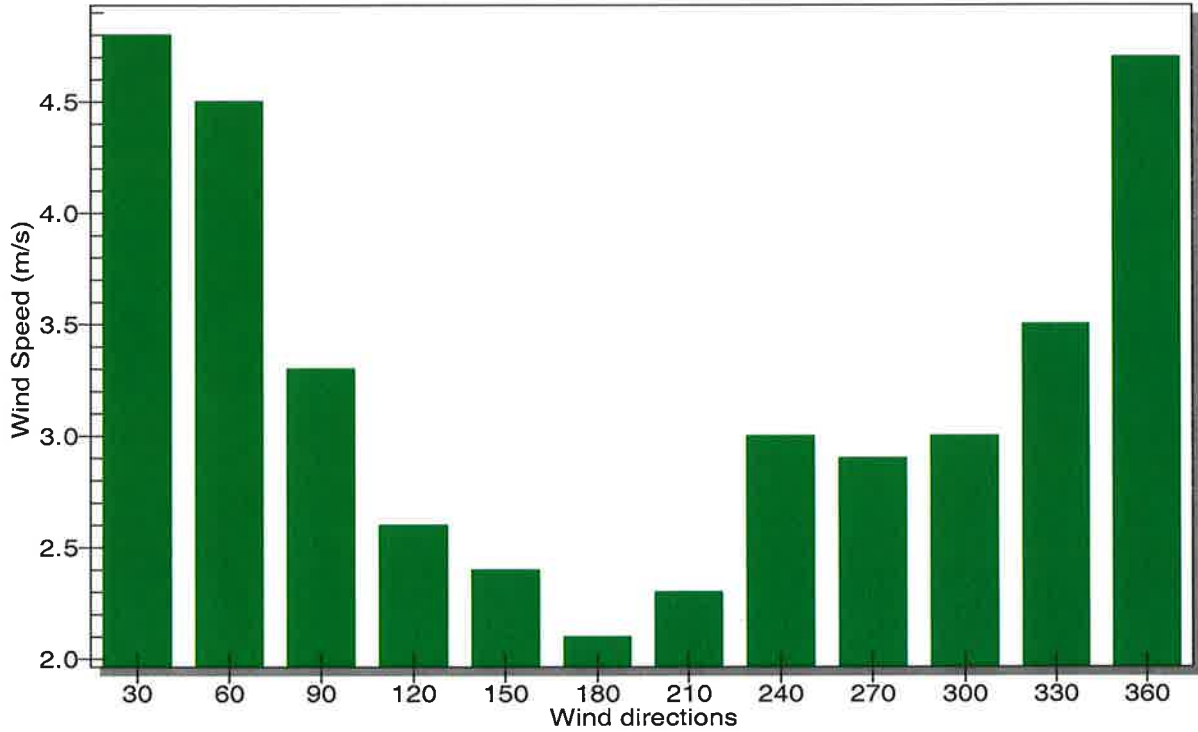
Station Name: Met. forecast model

Period: 01.05.2004 -> 01.09.2004



Station Name: Met. forecast model

Period: 01.09.2004 -> 01.01.2005







## Norwegian Institute for Air Research (NILU)

P.O. Box 100, N-2027 Kjeller, Norway

REPORT SERIES SCIENTIFIC REPORT	REPORT NO. OR 45/2005	ISBN 82-425-1692-8 ISSN 0807-7207	
DATE 07.03.06	SIGN. <i>Gunnar Jordfren</i>	NO. OF PAGES 104	PRICE NOK 150,-
TITLE QADAK Mission 1, May-June 2005		PROJECT LEADER Cristina Guerreiro	
		NILU PROJECT NO. O-105010	
AUTHOR(S) Cristina Guerreiro, Bjarne Sivertsen and Herdis Laupsa		CLASSIFICATION * A	
		CONTRACT REF. No 003/C/FND/05	
REPORT PREPARED FOR CETUD Route de Front de Terre P.B. 17 265 Dakar-Liberté Senegal			
ABSTRACT The Norwegian Institute for Air Research (NILU) is supporting the Conseil Exécutif des Transports Urbains de Dakar (CETUD) in establishing a Central Laboratory with an Air Quality Management System for Dakar. This is the report of the first mission to Dakar, Senegal, 30 mai to 7 june 2005. The main purpose of this mission was to sign the final contract between NILU and CETUD and to start the project through a first project meeting with several of the involved parties. Several meetings were held with different institutes and companies to get a first overview over the information and competences existing in Dakar that can be relevant to this project.			
NORWEGIAN TITLE			
KEYWORDS Air quality monitoring	Air quality assessment	Senegal	
ABSTRACT (in Norwegian)			

\* Classification

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