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FINANCED BY: Nordic Development Funds	**PROJECT REPORT**	QADAK

Project:	IMPLEMENTATION OF A CENTRAL LABORATORY AND AN AIR QUALITY MONITORING NETWORK IN DAKAR
Agreement:	No 003/C/FND/05

QADAK Mission 1, May-June 2005

Cristina Guerreiro, Bjarne Sivertsen and Herdis Laupsa

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Contents

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.

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 “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).

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).

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

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 : 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	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
des	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
directions	E	1,5	2,0					1,0	3,0	3,0	3,0	2,0	4,0	1,6
du	SE							1,0	2,0	1,0	1,0			0,4
vent	S					1,5	3,0	9,0	12,0	10,0	4,0		1,0	3,4
au	SO					2,0	9,0	12,0	10,5	10,0	2,0			3,8
sol	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
de 1991 à 1995	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	3,0	0,2	0,3	35,2
Insolation mensuelle		7,9	8,6	9,1	9,6	9,4	8,4	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_3, NO_2, SO_2 O_3 and NH_3 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 proposes, 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 preformed 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.

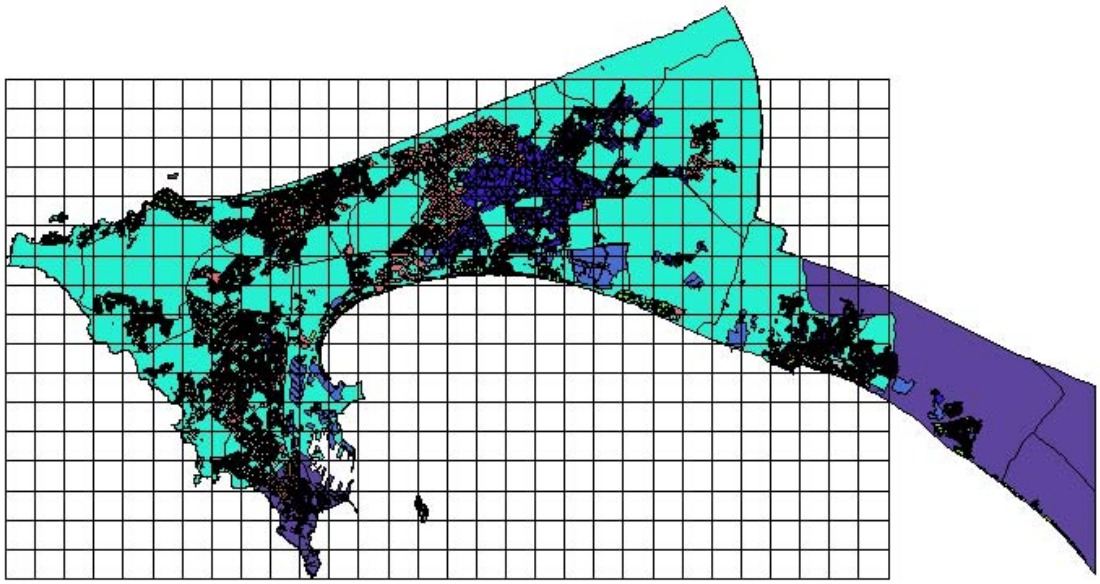

Figure 1: Modelling grid for great Dakar area.

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 meeting 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. Laboratorie d'Enseignment et de Reserche 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 CO2 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 Securite 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.

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_2, SO_2 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 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. og Skedsmo, A. (1999) Utslipp fra veitrafikk i Norge – Dokumentasjon av beregningsmetode, data og resultater. Oppdatering av SFT-rapport 93:12. Oslo (SFT-rapport 99:04).

Guerreiro, C., Laupsa, H. and Sivertsen, B. (2005) Passive sampling of SO_2 and NO_2 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 (2nd 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

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
					Forum 6-8 juin au Novotel (Industries/environnement)
	SPIDS	Cellule 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	sandiaye@ucad.sn sasndiaye@yahoo.fr (221) 6481000		Laboratoire de Physique de l'Atmosphère Membre d'AfricaClean
Santé	UCAD	Amadou Diouf		Toxicologue	AfricaClean – Fac de médecine (toxicologue)
		Aissatou Conte			Collaboration SPIDS - pollution et santé.
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	NILU OFFICE Dakar		221 8230777		

Appendix C

Minutes of meetings

Appendix C1

Appendix C2

Appendix C3

Appendix C4

Appendix C5

Appendix C6

Appendix C7

Appendix C8

Appendix C9

Appendix C10

Appendix C11

Appendix C12

Appendix C13

Appendix C14

Appendix D

Laboratory requirements on logistics

Appendix E

Laboratory requirements on personnel skills and manpower

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 Madeleine Diouf	CETUD 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

Titre	Auteur	Année	Source	
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 critique d'études des bureaux internationaux à Dakar	Xavier Godar	2001	Les cahiers scientifiques du Transport	
Code de l'Environnement	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'Ivore et au Cameroun. Rapport de synthese de l'etude	SPIDS	2005	SPIDS	
Evaluation Environnementale du projet d*Améliorisation de la Mobilite 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

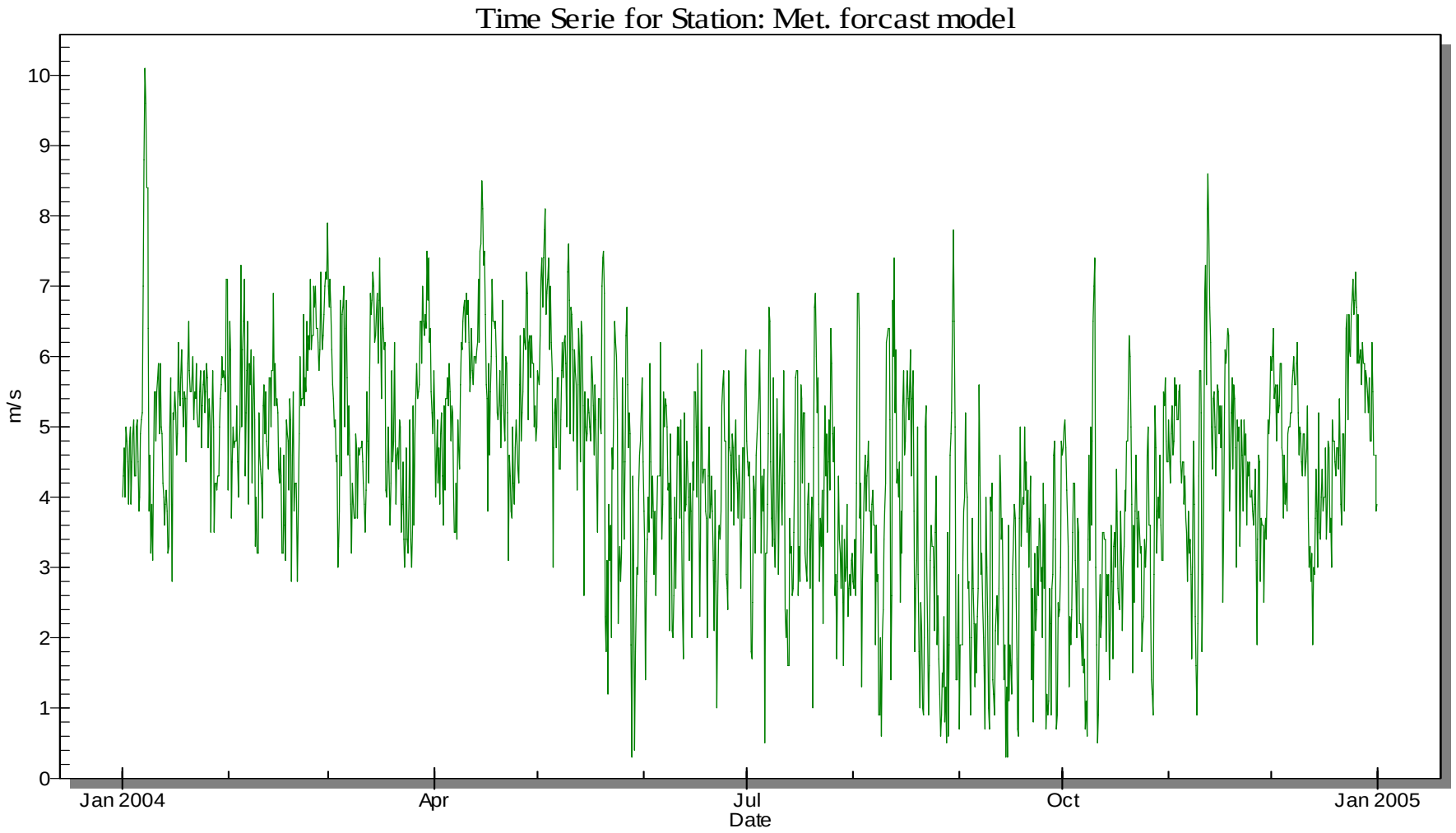
Analysis

1 Time series (wind speed and direction)

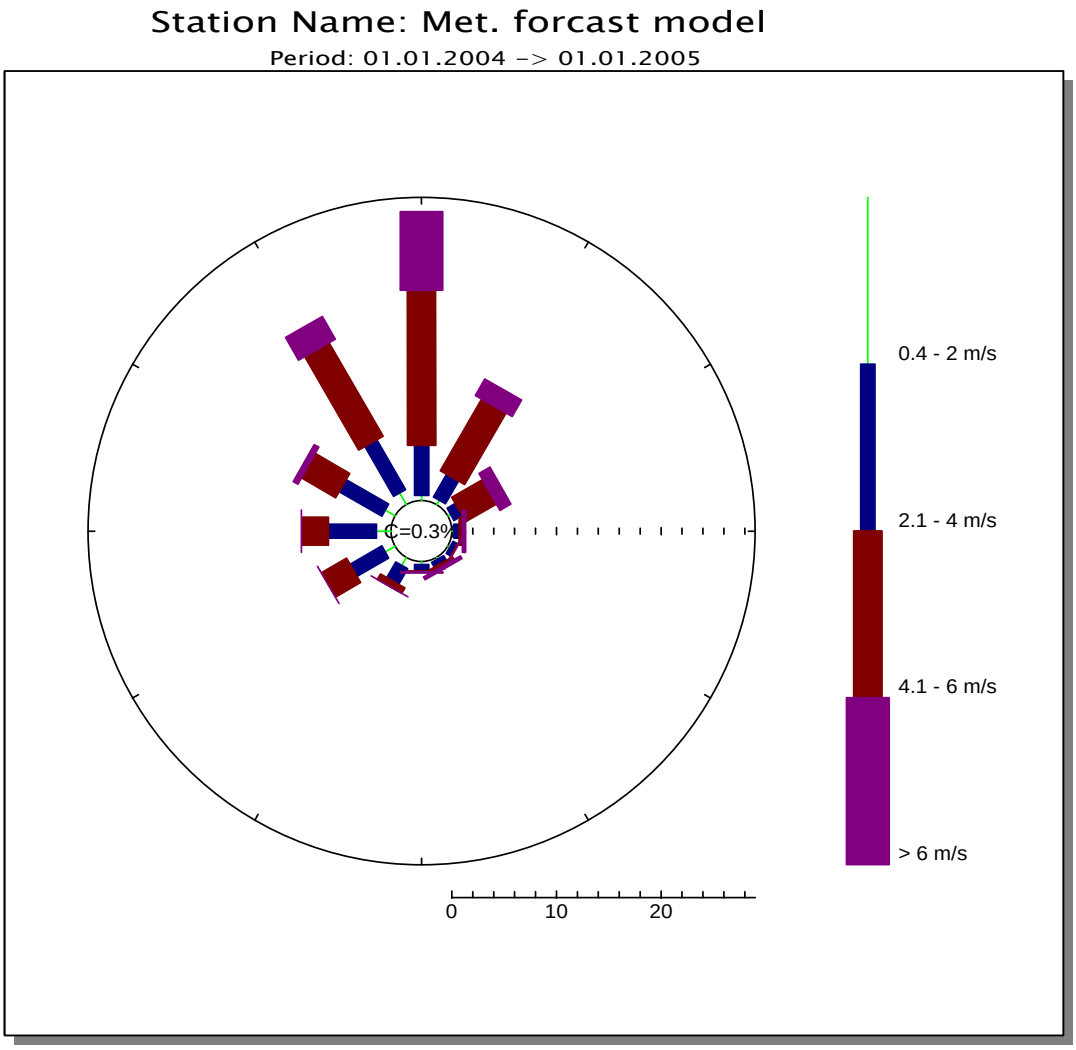
2 Wind roses:
2004
1 January 2004 – 1 May 2004
1 May 2004 – 1 September 2004
1 September 2004- 1 January 2005

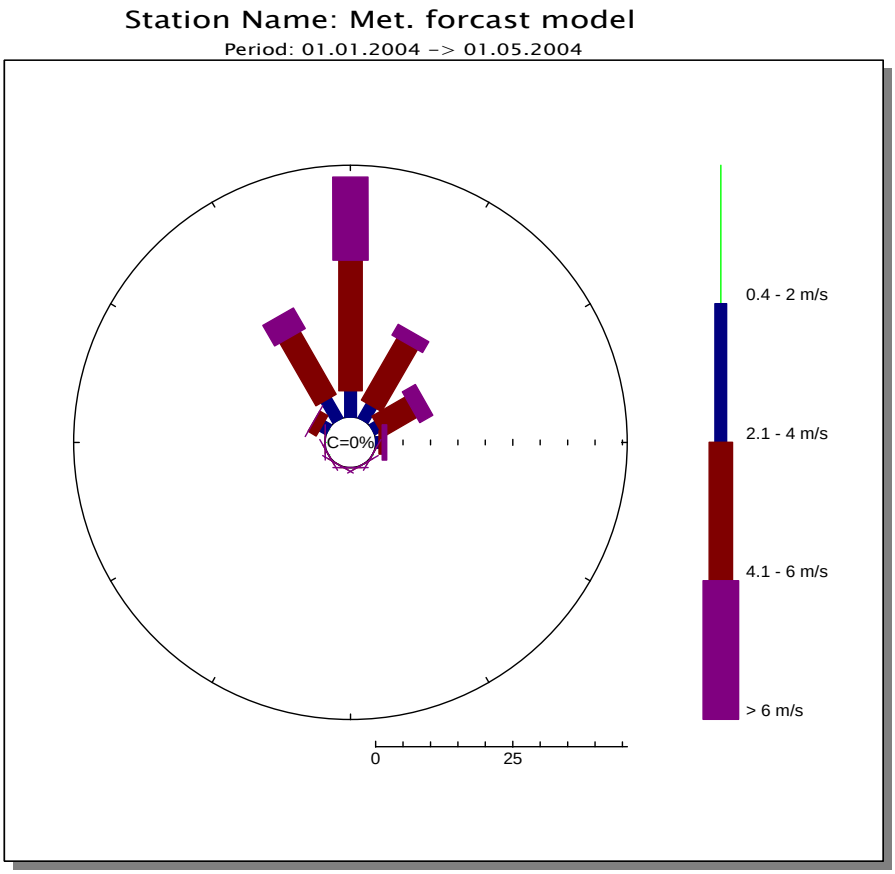
3 Wind direction and average wind speed 2004

1. Time series (wind speed)



2. Wind roses


Station Name: Met. forcast model
Period: 01.01.2004 -> 01.01.2005
C=0.3%
0
10
20
0.4 - 2 m/s
2.1 - 4 m/s
4.1 - 6 m/s
> 6 m/s


Station Name: Met. forcast model
Period: 01.01.2004 -> 01.05.2004
C=0%
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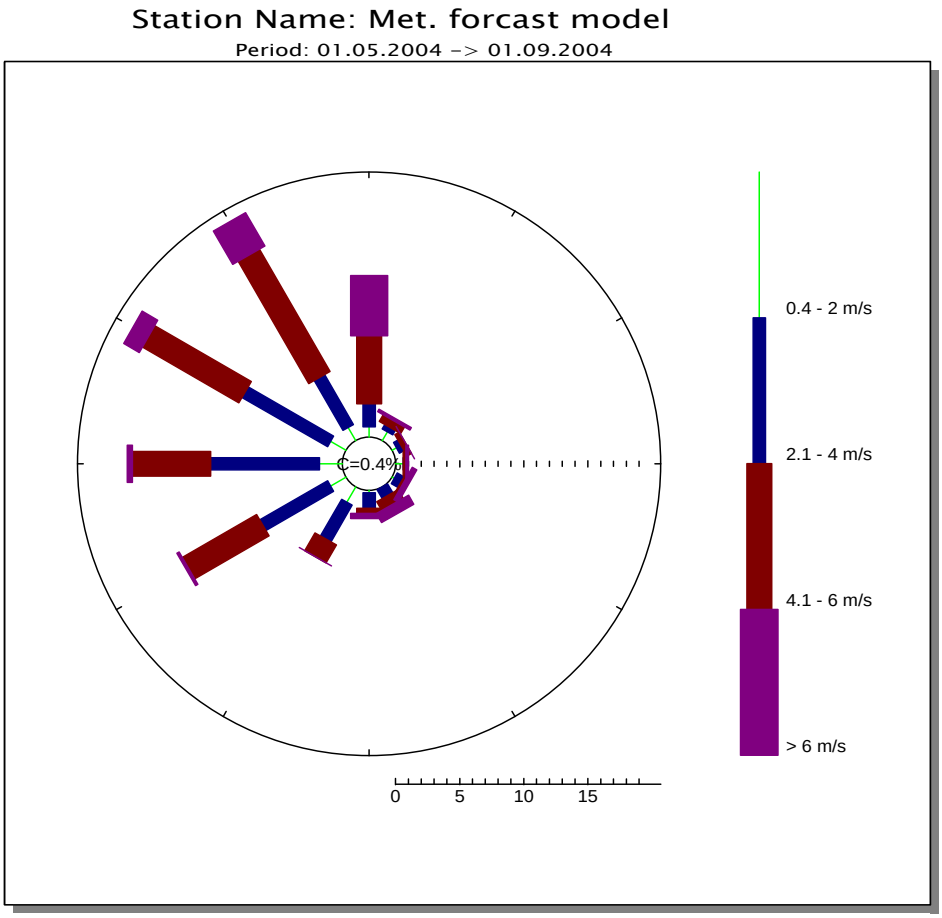
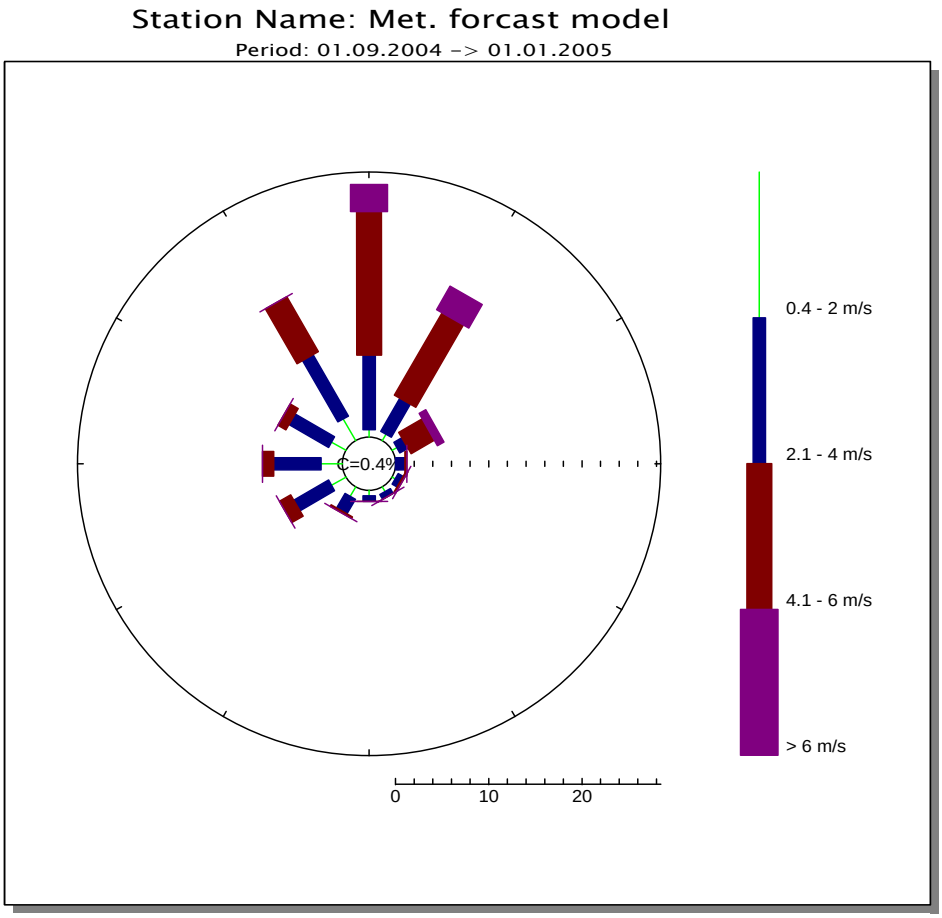
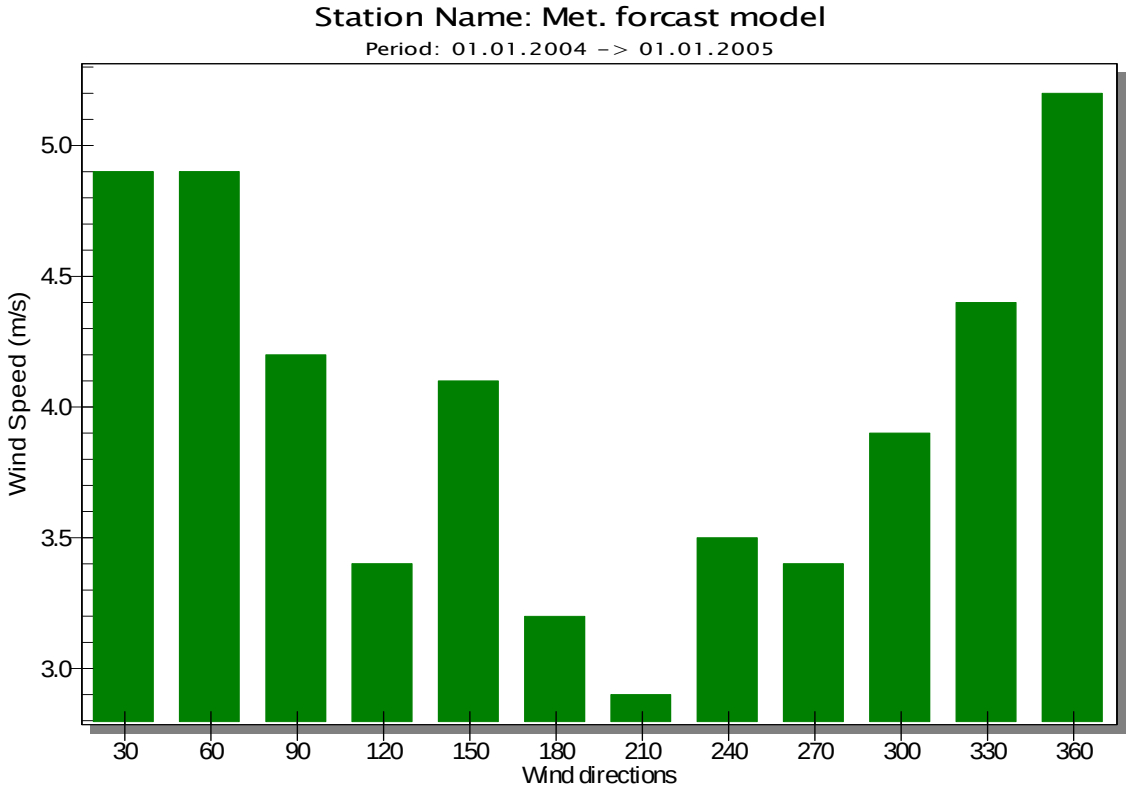
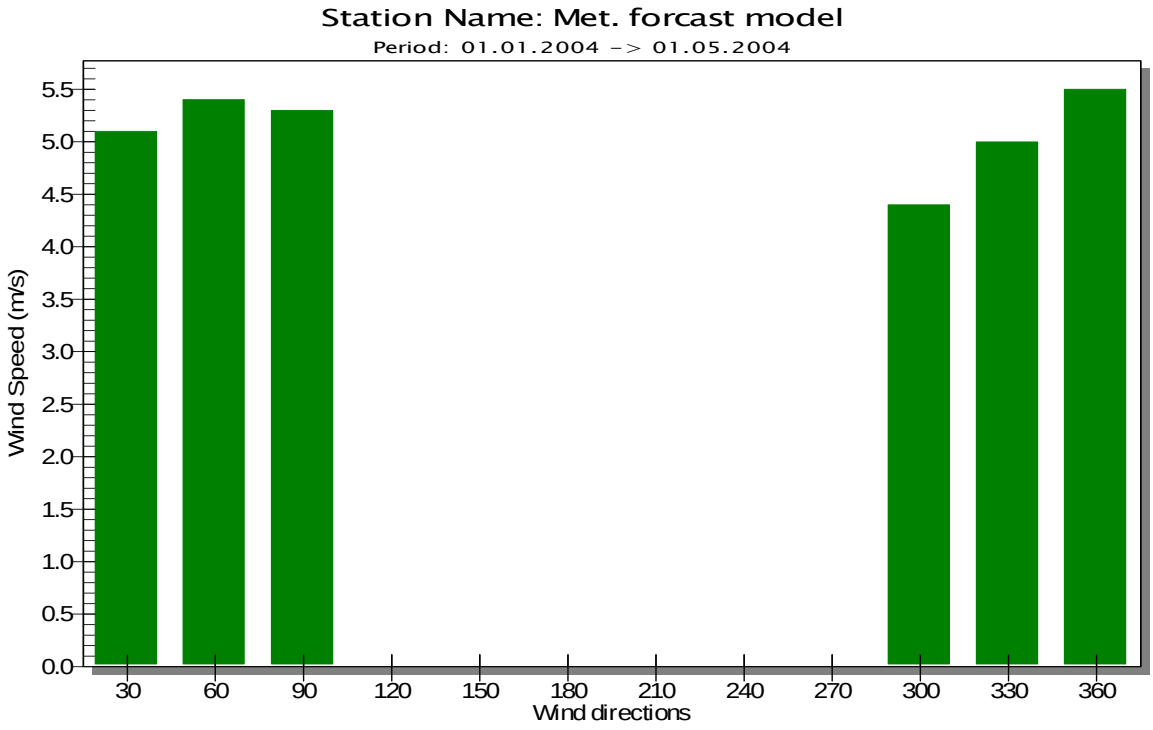
25
0.4 - 2 m/s
2.1 - 4 m/s
4.1 - 6 m/s
> 6 m/s

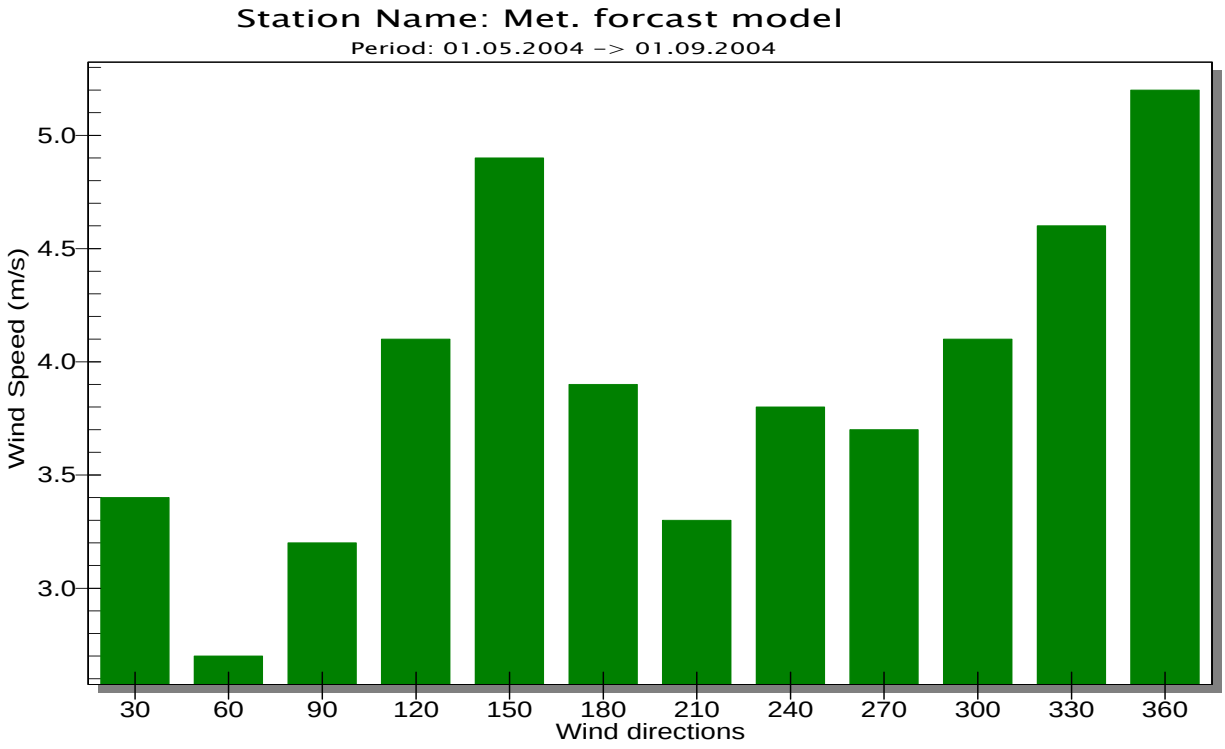

Station Name: Met. forcast model
Period: 01.05.2004 -> 01.09.2004
C=0.4%
0.4 - 2 m/s
2.1 - 4 m/s
4.1 - 6 m/s
> 6 m/s
0
5
10
15

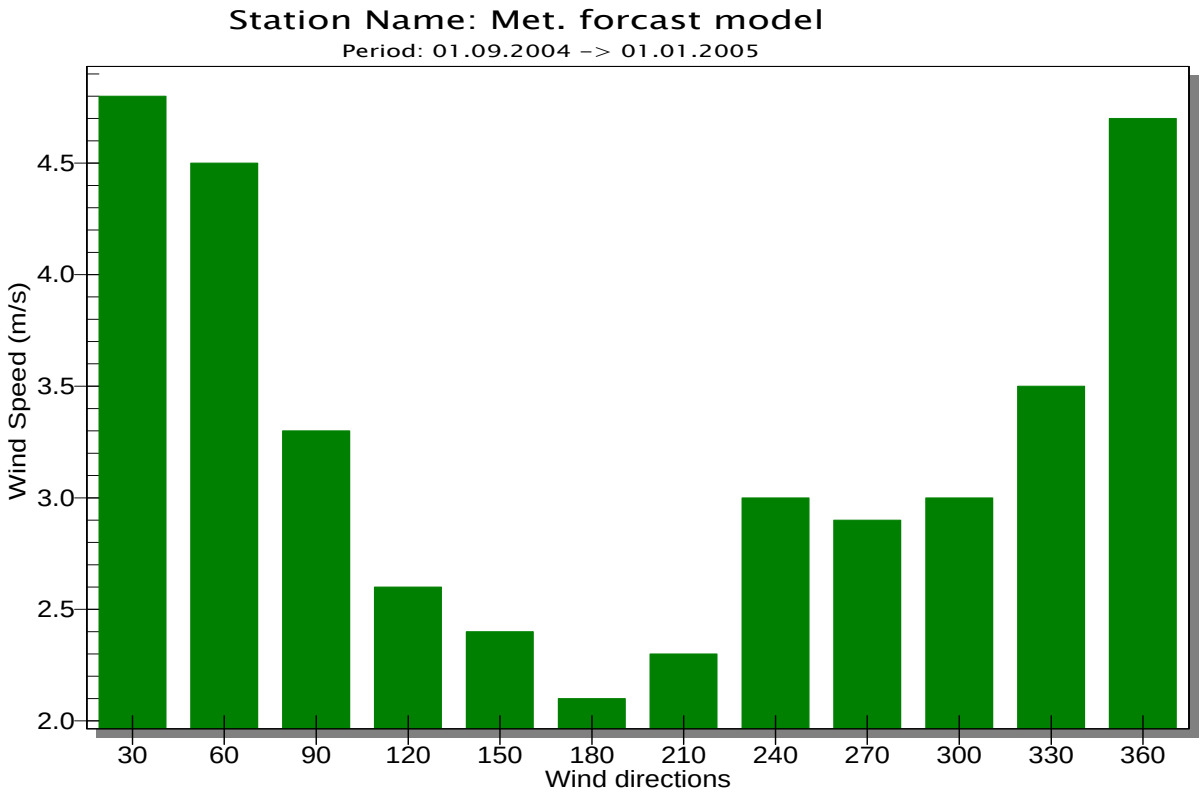

Station Name: Met. forcast model
Period: 01.09.2004 -> 01.01.2005
C=0.4%
0
10
20
0.4 - 2 m/s
2.1 - 4 m/s
4.1 - 6 m/s
> 6 m/s

3. Wind direction and average wind speed






Station Name: Met. forcast model
Period: 01.05.2004 -> 01.09.2004
Wind Speed (m/s)
5.0
4.5
4.0
3.5
3.0
30
60
90
120
150
180
210
240
270
300
330
360
Wind directions


Station Name: Met. forcast model
Period: 01.09.2004 -> 01.01.2005
Wind Speed (m/s)
4.5
4.0
3.5
3.0
2.5
2.0
30
60
90
120
150
180
210
240
270
300
330
360
Wind directions

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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)

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A Unclassified (can be ordered from NILU)
B Restricted distribution
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