Grant agreement no. 243964

QWeCI

Quantifying Weather and Climate Impacts on Health in Developing Countries

D5.3a: Database (with climate, environment and disease datasets). Links to WP1.1 and WP1.2

Start date of project: 1st February 2010 Duration: 42 months

Lead contractor : CSE
Coordinator of deliverable : UCAD
Evolution of deliverable

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Deliverable accepted :

Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013)		
Dissemination Level		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	X
CO	Confidential, only for members of the consortium (including the Commission Services)	

Through bringing together scientists from different disciplines, including those involved with public health and animal health, the QWeCI project will contribute to a better understanding of linkages and mechanisms between disease transmission, disease diffusion, epidemics, and climate/environment variability and changes. It will start to lay down the foundation for the development of early warning systems to assist with epidemic reduction/prevention. Today, West Africa is an important region for studying climate impacts on public health and animal health.

This document outlines the collection of meta-data (climate, environment and disease datasets) which will be the input to database for the WP 5.3 pilot project studies.

1- Barkedji observatory and overview of disease-climate measurements

The study will be carried out in an area of 15 km of radius centred on the Barkedji village (14°47' - 14°53'W, 15°13' - 15°20'N). This area belongs to the Sahelian bio-geographic domain characterized by a short rainy season (from June to October) and a long dry season (November to May) with annual rainfall ranging from 300 to 500 mm. Through EU FP6 AMMA and other funding the different microhabitats have been classified within the study area. Among them, are a large number of temporary ponds, which are at the same time breeding and resting habitats of many mosquitoes. Some of them remain throughout the rainy season and will be the main source of water for people and livestock. The Barkedji site is one of the famous Environment and Health Observatories in Senegal. IPD have worked on the Barkédji site since 1990, and this Observatory has been the study area of several research projects.

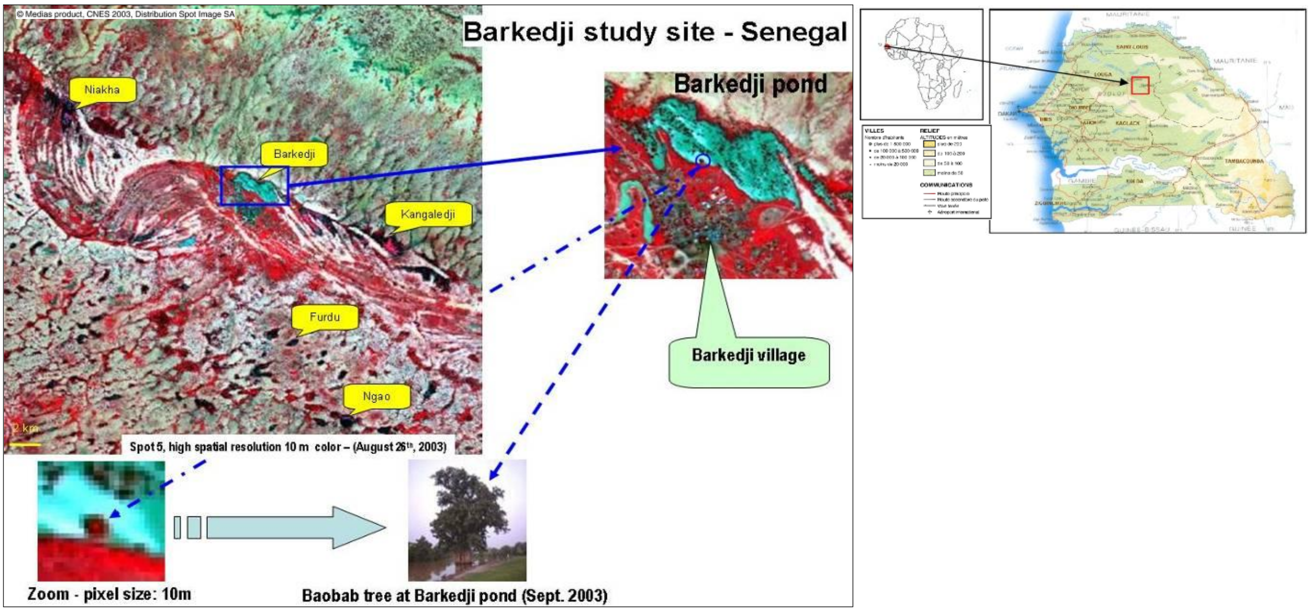


Figure 1: The Barkedji site, area of study for AMMA WP 3.4. The small red square outlines the studied area, covered with ponds, and within the Ferlo region. QWeCI area of investigations is the same than AMMA WP 3.4.

In Senegal, many mosquito species (*Aedes sp*. and *Culex sp*.) and livestock (Fontenille et al.1998; Diallo et al., 2000) have been found of being infected with Rift Valley Fever (RVF) virus. The epidemiological role of these mosquitoes species involved in RVF transmission cycle is complex.

RVF epidemics in Senegal (Diallo et al., 2005; Ndione et al, 2003 ; Ba et al, 2005; Ndione et al, 2008), do not seem to follow the same relationships as that over East Africa. During the rainy season the abundance of mosquitoes over the Ferlo is linked to dynamic, vegetation cover and turbidity of temporary and relatively small ponds. Research has led to the development of vulnerability maps based on the dynamics of the pond size, the distances over which the infected mosquitoes seek blood meals, i.e. the flying range of mosquitoes, their aggressiveness, and the localisation of villages and cattle pounds around ponds (Lacaux et al., 2007; Tourre et al., 2008; Ndione et al., 2008; Vignolles et al., 2009).

Several studies were carried out on malaria vectorial transmission in many bio- geographical areas in Senegal as part of program targeting its epidemiology or vectors bio-ecology. A meticulous analysis of these studies, however, indicates that they have up to now little or no operational aiming. However with the current weight of malaria in term of morbidity and mortality, the big challenge for the scientific community but also the political decision makers is rather to find for each geographical area and each ecological context operational, methods of control in order to reduce as much as possible the burden of the disease. Regarding to the therapeutic failure with drug resistance mainly due to their anarchistic use and in front of the absence of effective vaccines as well as the emergence of vectors resistance to insecticides, a better spatial and temporal planning for prevention and control activities is essential. Such an objective needs the development for forecasting tools or further early warning system integrating various parameters having a direct or indirect impact on the transmission.

Scarce are the entomological studies undertaken specifically on malaria epidemiology in Bakedji. Concerning the entomological aspect, this village is located in the sahelian transmission profile characterized by a seasonal transmission during the short rainy season (often less than 4 months and an entomological inoculation rate variable from one year to another but estimated at 20 infecting bites per person per year). The presence of temporary ponds which remain almost the only sources of water until January in the area and which dynamic is completely under rainfall control constitutes the local ecological characteristics which influence locally the interrelationships between the vectors, parasite and hosts. The first investigation realized in 1994-1995 revealed that *An. gambiae* and *An. arabiensis* constitutes the principal malaria vectors in the village (Lemasson et al., 1997). In spite of the presence of a large number of cattle in the village, the study showed a particular feeding behavior of these species with a preference for the human host (more than 60% of the blood meals of these two species are taken on human). Moreover, the study of their daily activity as well as their preferred biting places showed that these vectors bite during all the night with an activity maximum in the second part of the night and preferably inside the human dwellings. Because of their favorite breeding sites characteristic (sunny and clear water), the vectors are usually present only during the rainy season. According to the rhythm and frequency of the rains, this presence can continue until the beginning of dry season. Therefore, the malaria transmission is seasonal and is concentrated over 4 months of the year, from September to December with an entomological inoculation rate between 100 and 120 infecting bite per human per year. This transmission is likely sustained indifferently indoor and outdoor of human dwellings. Figures 1 and 2 present the two vectors fluctuation in the village during a study realized during the years 2002 and 2003.

In addition to these two vectors, the presence of *An. funestus* species whose larval breeding site is characteristic by the presence of a floating or emergent vegetation was described several time included in the village. This species, which is among the main vector of malaria, seems to be back in the area as it did recently in the contiguous zone of the Senegal River basin after a dam implementation. Another species strongly suspected in malaria transmission has been also recorded in the area. It is the case of *An. pharoensis*. Because of the perpetual extension of the village as well as geographical expansion, a study for re-actualizing the existing data is necessary. Thus, an ongoing study including all human habitations of the Bakedji village and the surrounding villages (28 villages) have revealed a heterogeneous distribution of the vectors in the area as well as very fluctuating densities.

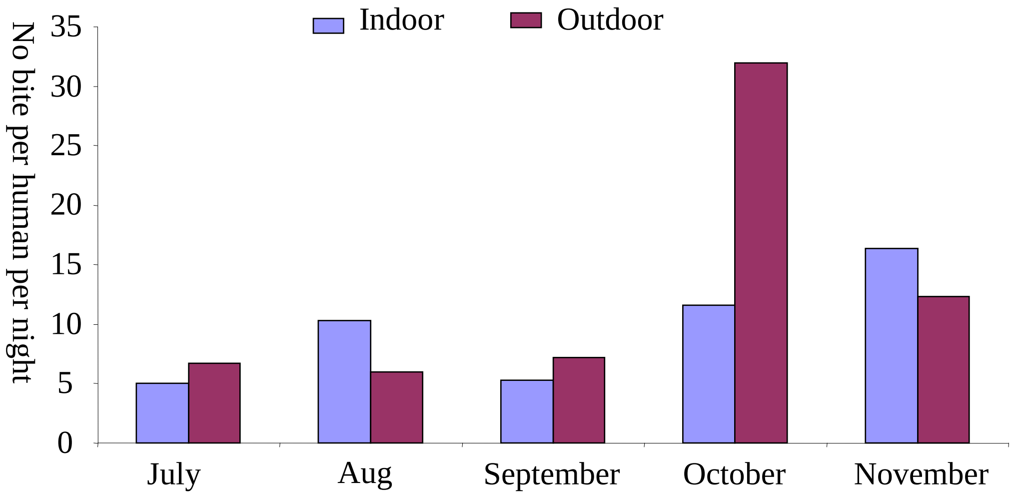


Figure 2: Variations of the number of vector bites per human per night during the 2002 rainy season in Barkedji

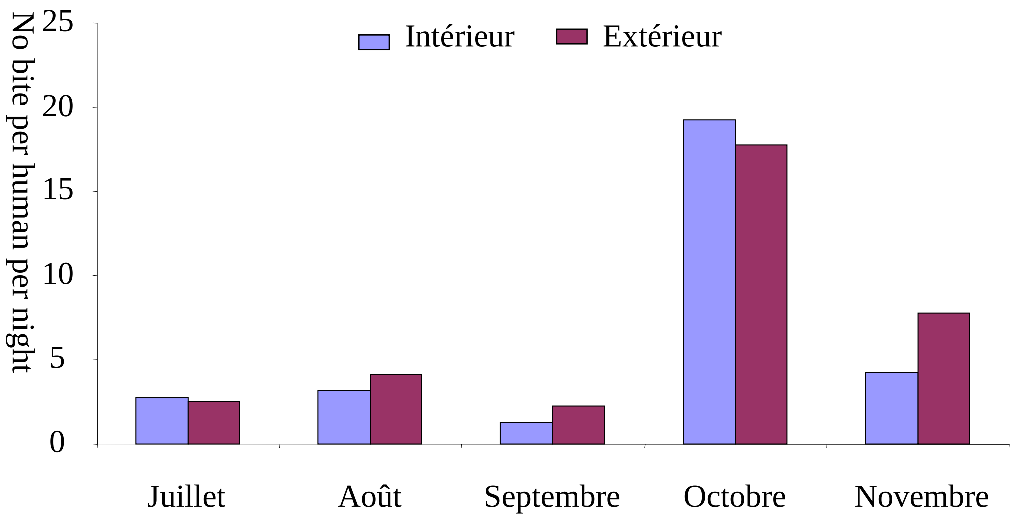


Figure 3: Variations of the number of vector bites per human per night during the 2003 rainy season in Barkedji

The only study well documented on the malaria morbidity and mortality conducted in 1994-1995 in the village of Barkedji (Molez and al., 2006) showed that the malaria onset are most common from November to January (70%). This study indicate further that the high intensity of the transmission and the persistence of the temporary ponds remain the key factors influencing the level of malaria morbidity and consequently on the development of a natural malaria immunity by the indigenous population.

Barkedji is located in the Sahalian transmission profile characterized by a seasonal transmission during the short rainy season. The presence of temporary ponds which remain almost the only sources of water until January in the area and which dynamic is completely under rainfall control constitutes the local ecological characteristics which influence locally the interrelationships between the vectors, parasite and hosts. Field activities monitored in Barkedji (which determinate data available) are:

- Water ponds level in Niaka, Ngao, Furdu and Kangaledji ponds (see photo 1) in Barkedji area;
- Rainfall using 10 rain gauge stations and 2 automatic weather stations located in Niakha (4.2 km in the north-east of Barkedji and in Belli Boda, around 8km in south-east of Barkedji) and around ponds (photo 2);
- Water quality data (ph, conductivity, temperature…);
- Entomological data collection;
- Clinical malaria data surveillance;
- Clinical livestock survey data will be collected through sentinel and transhumant herds;
- Other veterinary investigations:

Photo 1: Raingauge station in Barkedji

Photo 2 Limnimetric scale installation Niaka pond

2- Atmospheric database

This section presents detailed information regarding the available data for the purpose of the present deliverable. When those data could not be available for the project, statistical studies have been done to characterize the climate of Barkedji in the past.

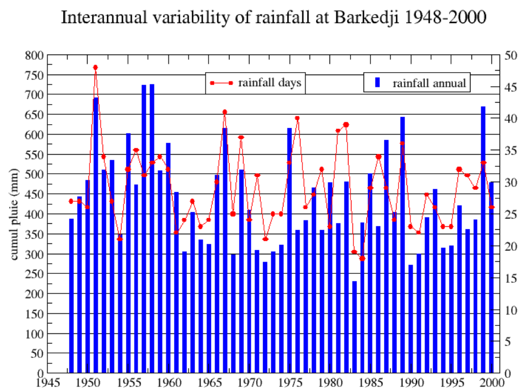
Daily precipitation amounts at Barkedji for 1948-2000 were collected by Morel for 2001-2008, the data are stored in the UCAD-CSE database thanks to EMERCASE, ACI-Ecologie Quantitative, CORUS and AMMA in relation with the Meteorological Agency. Due to the differences of their origins, data will be presented separately.

2.1 Rainfall for 1948-2000 period

Figure 4 shows the interannual variability of rainfall over Barkedji in the period 1948-2000 and number of rainy days for a threshold of 0 mm (a) and a threshold of 25mm (b). There are two distinct periods:

- 1948-1975 (28 years) characterized by more than half the years (16 years) with totals exceeding 450 mm (including 9 years with totals exceeding 600 mm) and 12 years
  with rainfall ranging between 300-400mm.
- 1976-2000 (25 years): characterized by more than half the years (16 years) with rainfall between 300-400 mm and 9 years with totals exceeding 450 mm.

Drought in the Barkedji area from 1975 is marked by an increased frequency of around 300-400 mm average annual rainfall; there was a particularly dry year (1983) during this period with an annual total of 225.0 mm. The number of days without rain threshold does not seem to discriminate the two periods wet and dry (Fig 4a). However, we observe that the years of wet periods often have a number of days of rainfall greater than 10mm at least to 20 (Fig 4b), while years of dry periods rather a number of days of rain less than 15. The number of rainy days with a threshold of 25mm does not seem to discriminate wet and dry periods.



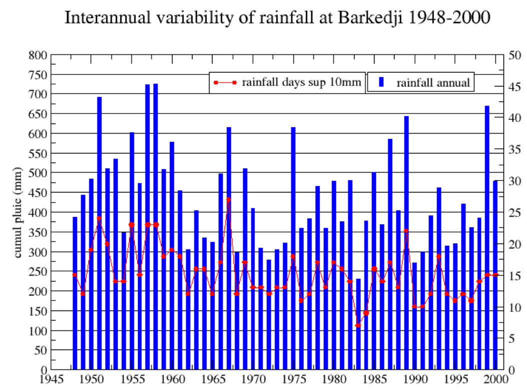
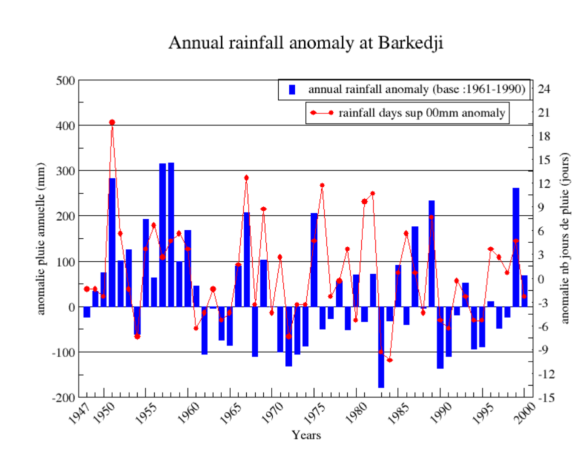


Fig 4 Annual average rainfall over Barkedji (mm) and rainfall days sup 00mm (a) and sup 10mm (b), from 1948 to 2000

Figure 5 Depicts time series of rainfall anomalies (mm) and rainfall days superior 0mm anomalies (day) in Barkedji for 1948 to 2000.

Strong positive rainfall anomalies are observed during the wet period 1948-1969, reaching 200 to 300mm between 1950 and 1960. The dry period is characterized by strong negative anomalies, above 100 for several years, reaching 150-200mm for 1983, 1990 and 1991.Rainfall days greater than 0mm anomalies do not seem to be very well correlated with rainfall anomalies (Figure 5a). However, Figure 5b shows good correlations between rainfall anomalies and rainfall days greater than 10mm anomalies.



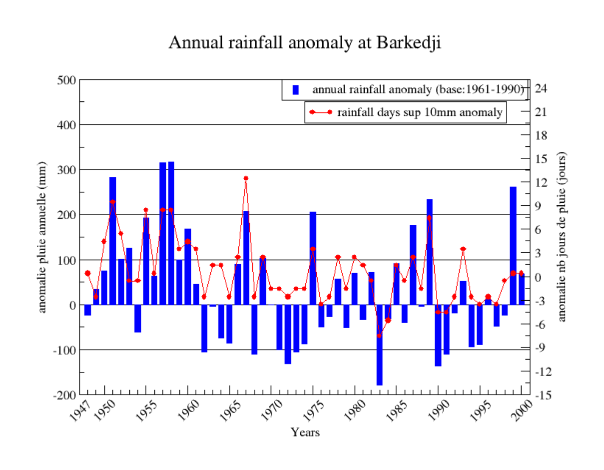


Fig 5 Annual average rainfall anomalies over Barkedji (mm) and rainfall days sup 00mm (a) and sup 25mm (b), from 1948 to 2000

The table below summarizes the meta-data used to obtain these results and are not available for the project but for which we can eventually do specific studies for the project needs.

METADATA

General Information

Instrument sheet code	Standard Rain Gauge installed by National Meteorology Service (now ANAMS)– But the historical data has been provided to JA Ndione during his postdoctoral research activities at LPAOSF by the late Robert MOREL (Agrhymet)
PI	
QWECI responsable	
Scientific objectives	Meteorological data collection over the period 1948-2000 (Barkédji), 1961-2000 (Dahra, Gassane, Linguere and Louga)
Funding source	
Work Packages	
Partners	
References	
GCMD science	Atmosphere
keywords :	

Temporal and geographical extent

Time range	
Begining date of measurements	1948-01-01 (1961-01-01 for other stations)
Ending date of measurements	2000-12-31
Geographical extent	
Sites and position of sensors	Barkedji (14°90 N, 12°47W) Dahra (15°33N, 15°48W) Gassane (15°30N, 14°83W) Linguere (15°38N, 15°12W) Louga (15°62N, 16°22W)

Information about data

Observation strategy	Operational synoptic observations
Provided parameter	Rainfall(mm), Sunshine(h), Minimum Temperature (°C), Maximum Temperature(°C),Minimum humidity(%), Maximum humidity(%), Wind(m/s)
Process level	
Quality information	
Methods used for data collection or process	
Sensors :	

Data access

Data file formats	Ascii and netcdf
Format description	See documentation accompanied data
Data transmission media	
Date of data availability	These data are not the propriety of UCAD/CSE and could not be available for the QWECI project.
Target database	
Use group	QWECI-members
Rules for using data	QWECI data policy

2.2 Rainfall for 2001-2008 period

Figure 6 shows the interannual variability of rainfall in Barkedji for 2001-2008 period and the rainy days number for a threshold of 0 mm (a) and a threshold of 25mm (b). Annual rainfall total during this period ranged between 250-500 mm. The two driest years (2002 and 2007) receive 250 mm and are between 20-22 days of rain (a). However, the wettest two years (2005 and 2008) have at least 28 rainy days of rain in total. The number of rainy days with thresholds of 5 and 10mm seems better discriminate wet and dry years that the number of rainy days sup-25mm.

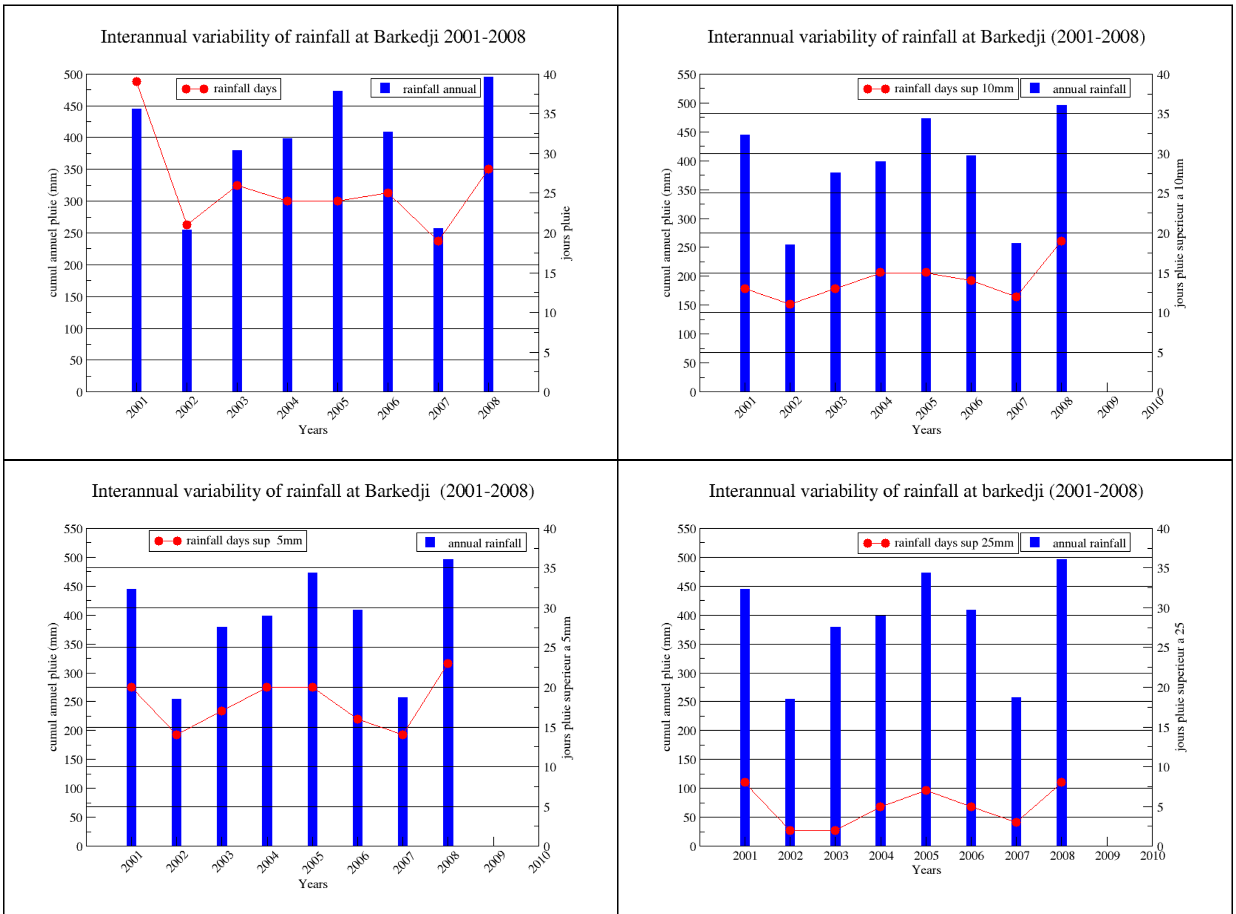


Fig 6 Annual average rainfall over Barkedji (mm) and rainfall days sup 00mm (a), sup 05mm(b), sup 10mm (c) and sup 25mm (d), from 2001 to 2008

Figure 7 shows rainfall anomalies at Barkedji and number of rainy days for different thresholds: 0 mm (fig a), 5 mm (fig b), 10 mm (fig c) and 25 mm (fig d) for the 2001-2008 period. It is observed that rainfall anomalies are well correlated to the number of rainy days greater than 25mm. This result clarifies the findings of Figure 6 where the rainy days with 0 mm and 5 mm thresholds appeared to better discriminate dry and wet years.

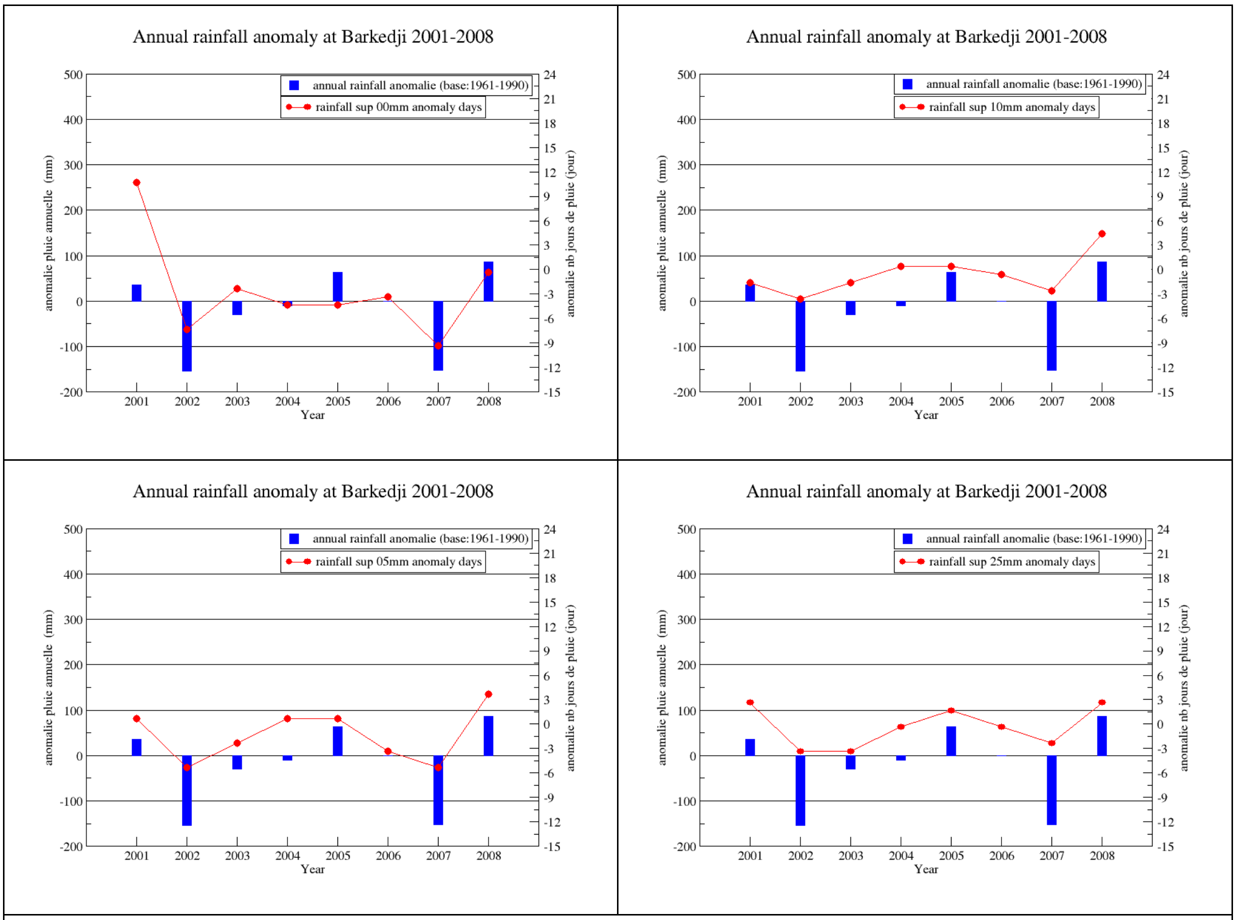


Fig 7 Annual average rainfall anomalies over Barkedji (mm) and rainfall days sup 00mm (a), sup 05mm(b), sup 10mm (c) and sup 25mm (d), from 2001 to 2008

The table below summarizes meta-data used to obtain these results and are available for the project.

METADATA

General Information

Instrumeny sheet code	UCAD/CSE observations
PI	
QWECI resp.	
Scientific objectives	
Funding source	
Work Packages	
Partners	
References	
GCMD science	Atmosphere

keywords	

Temporal and geographical extent

Time range	Months of measurements : June, July, August, September and October
Begining date of measurements	2001-06-01
Ending date of measurements	2008-10-31
Geographical extent	
Sites and position of sensors	Barkedji (14°90 N, 12°47W)

Information about data

Observation strategy	Environment and Health studies in Barkedji observatory
Provided parameter	Rainfall (mm)
Process level	
Quality information	
Methods used for data collection or process	
Sensors	

Data access

Data file formats	Ascii and netcdf
Format description	See documentation accompanied data
Data transmission media	
Date of data availability	31-07-2010
Target database	
Use group	
Rules for using data	

Exemple of ascii file (2001)	Header of netcdf file (2001)
152 0.	Barrkedji_pluieJJASO.2001 {
153 0.	dimensions:
154 0.	lon = 1 ;
155 0.	lat = 1 ;
156 0.	time = 153 ;
157 0.	variables:
158 0.	float lon(lon) ;
159 0.	lon:units = "degrees_east" ;
160 0.	lon:long_name = "Longitude" ;
161 0.	float lat(lat) ;
162 0.	lat:units = "degrees_north" ;
163 0.	lat:long_name = "Latitude" ;
164 0.	double time(time) ;
165 0.	time:long_name = "Time" ;
166 0.	time:units = "hours since 1957-01-01 00:00:" ;
167 0.	float Rain(time, lat, lon) ;
168 0.	Rain:units = "mm" ;
169 0.	Rain:long_name = "Rain" ;
170 0.	
171 0.	// global attributes:
172 0.	:title = "Barkedji station" ;
173 0.	:institution = "Laboratoire de Physique de l
174 0.	Atmosphere et de l Ocean Simeon Fonang (LPAOSF)-Dakar,
175 0.	contact: atgaye@ucad.sni" ;
176 0.	:source = "Centre de Suivi Ecologique-Jacques
177 0.	Ndione" ;
178 0.	:history = "Created at LPAOSF-Dakar by Abdoulaye
179 0.	DEME July-2010" ;
180 3.5	data:
181 0.	
182 0.	lon = -14.86 ;
183 0.	lat = 15.28 ;
184 0.	
………….	time = 389328, 389352, 389376, 389400, 389424, 389448,
……………..	389472, 389496,389520, 389544, 389568, 389592, 389616,
…….	389640, 389664, 389688, 389712,389736, 389760, 389784,
…….	389808, 389832, 389856, 389880, 389904, 389928, 389952,
290 0.	389976, 390000, 390024, 390048, 390072, 390096, 390120,
291 0.	390144, 390168, 390192, 390216, 390240, 390264, 390288,
292 0.	390312, 390336, 390360, 390384, 390408, 390432, 390456,
293 0.5	390480, 390504, 390528, 390552, 390576, 390600, 390624,
294 0.	390648, 390672, 390696, 390720, 390744, 390768, 390792,
295 0.	390816, 390840, 390864, 390888, 390912, 390936, 390960,
296 9	390984, 391008, 391032, 391056, 391080, 391104, 391128,
297 0.	391152, 391176, 391200, 391224, 391248, 391272, 391296,
298 0.	391320, 391344, 391368, 391392, 391416, 391440, 391464,
299 0.	391488, 391512, 391536, 391560, 391584, 391608, 391632,

300 38. 301 0. 302 0. 303 31.5 304 5	391656, 391680, 391704, 391728, 391752, 391776, 391800, 391824, 391848, 391872, 391896, 391920, 391944, 391968, 391992, 392016, 392040, 392064, 392088, 392112, 392136, 392160, 392184, 392208, 392232, 392256, 392280, 392304, 392328, 392352, 392376, 392400, 392424, 392448, 392472, 392496, 392520, 392544, 392568, 392592, 392616, 392640, 392664, 392688, 392712, 392736, 392760, 392784, 392808, 392832, 392856, 392880, 392904, 392928, 392952, 392976 ; , }

3- Environment database

Land use and land cover data, associated with ancillary data are available for the Barkedji Health and Environment Observatory window at CSE. They mainly come from Landsat (MSS an TM, 30 m resolution), SPOT and 5 (5 and 20 m), Topographic maps (1/200000) . Also a cartography of breeding sites is available thanks to AMMA project (Lacaux et al, 2007 ; Tourre et al, 2008 ; Ndione et al, 2009; Vignolles et al, 2009; Tourre et al, 2010; Ba, 2010).

4- Disease database

4.1. Data on malaria vectors and transmission in Barkedji pilot study

4.1.1. Anopheline fauna

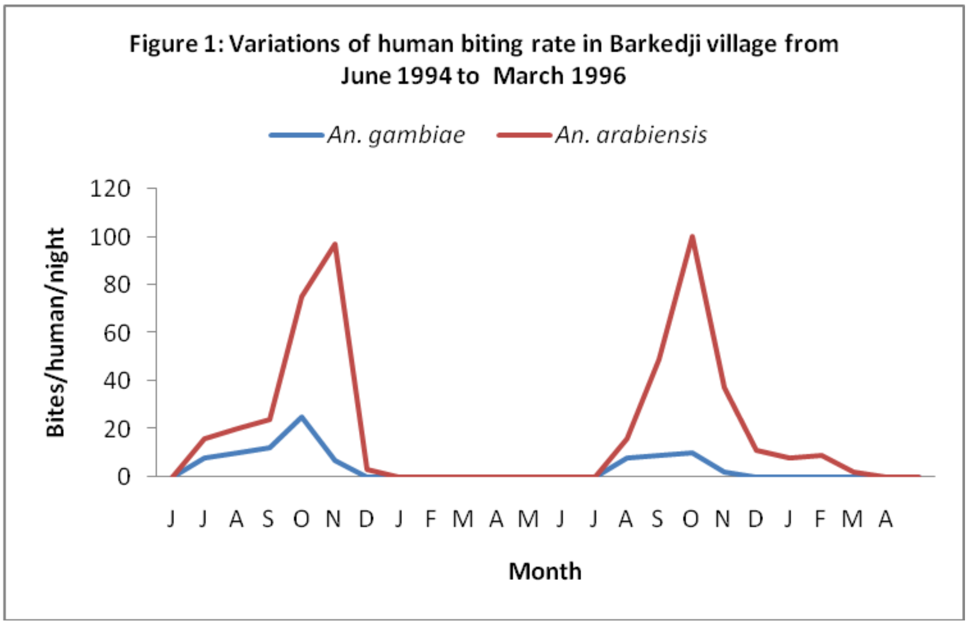
In Senegal, at least 20 anopheline species are described (Diagne et al ., 1994). Within these species, seven are known for their implication in malaria transmission participate in malaria transmission (*An. gambiae s.s*., *An. arabiensis*, *An. funestus*, *An. melas*, *An. nili* et *An. pharoensis)*. An. gambiae s.s., An. arabiensis and *An. funestus* have a widespread distribution and a huge role in malaria transmission whereas *An. melas*, *An. pharoensis* and *An.nili* are confined some areas and have a limited role in malaria transmission.
In Barkedji pilot zone, only *An. gambiae s.s., An. arabiensis, An. funestus* and *An. pharoensis* were described. The two first species represent more than 90% of anopheline species present in the area and represent the only anopheline species involved in malaria transmission, *An. arabiensis* being the main vector (63% of *Plasmodium falciparum* transmission) (Lemasson et al., 1997). *An. pharoensis* and *An. funestus* represent

respectively 0.08 and 0.1% (Faye, 2010). Due obviously to their scarcity, the role of these latter species were never reported in the area.

A recent study carried out recently in 28 villages belonging to four different land cover types (wooded savanna, shrubby savanna, bared soils and steppe), showed that whatever the land cover type considered, *An. arabiensis* constituted the main malaria vectors (Faye, 2010).

4.1.2. Population dynamics and seasonality

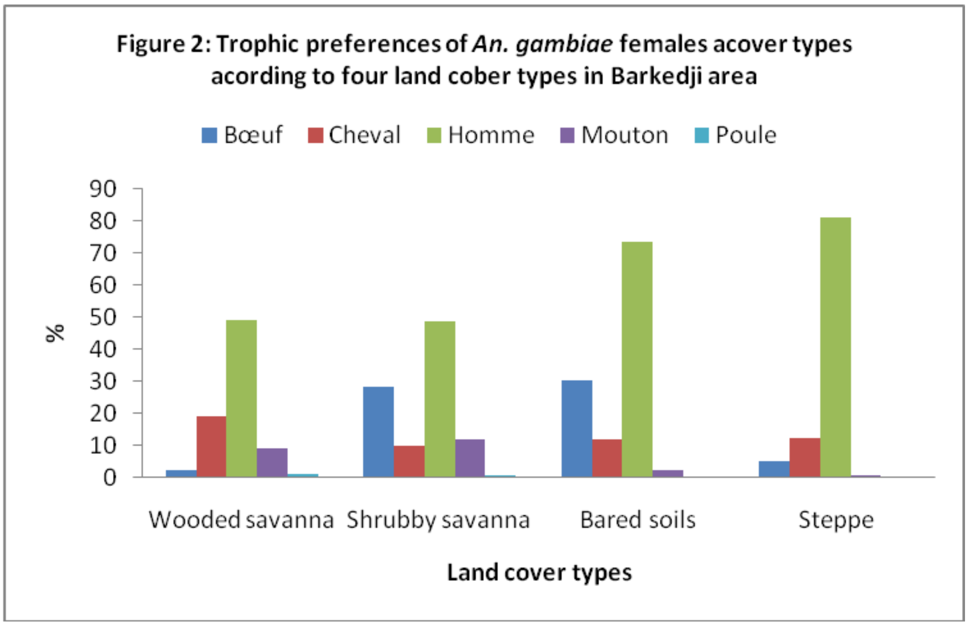
The study of population dynamics using human biting rates or indoor resting densities showed that it varied temporally depending on the rainy season. In 1994, the biting rate was maximal in October for *An. gambiae* with a peak during the first week of October. For *An. arabiensis*, the maximum rate was in November with a peak during the second week of November. In 1995, the human biting rate for *An. gambiae* was low with the maximum during the last week of October. For *An. arabiensis*, the maximum rate was in October, during the last week of the month. *An. gambiae* disappeared from collections earlier in the year than *An. gambiae* (Figure 1).



4.1.3. Host-seeking behavior

The transmission of malaria parasites within the Barkedji pilot study took place indoor and outdoor with respectively 56 and 57% of *An. gambiae* and *An. arabiensis* biting indoor (Lemasson *et al.,* 1997, Dia *et al.,* 2005).

Due to the presence of many domestic vertebrates' species, malaria vectors trophic preferences include human, bovine, ovine, equine and chicken hosts (Figure 2). In fact, a study of trophic behavior of malaria vectors in 28 villages within the study area by ELISA in relation to land/cover-land/use conducted from July to November 2009, showed a spatio-temporal heterogeneity of trophic preferences was observed according to the land/cover land/use, the savanna villages presenting the more diversified preferences. Human was the host of predilection. The anthropophilic rates varied significantly between the four ecosystems but also between the Steppe villages and the villages belonging to the others land/cover-land/use types. The temporal variations were also significant among wooded savanna and shrubby savanna villages. These observations show that the different land/cover-land/use types could influence the trophic behavior of malaria vectors in the area of Ferlo.



4.1.4. Malaria vectors and climatic factors

A study of the influence of climatic factors (temperature, rainfall and relative humidity) on malaria vectors relative frequencies and densities was realized in the study area according the land cover types. This study has shown that, taking into account the relative frequencies of *An. gambiae* and *An. arabiensis*, a positive correlation exists with temperature in all land cover types. However, a negative correlation was observed with rainfall and relative humidity (Figure 3).

In relation to rainfall, no significant correlation was observed in wooded savanna and bared soils with malaria vectors resting densities. However, a positive correlation was observed in villages from shrubby savanna and steppe. A positive correlation was observed in the four land cover with temperature.

4.2. Data on Rift Valley Fever virus (RVFV) vectors and transmission in Barkedji pilot study

The available information on vector could provide insights into the epidemiology and risk of RVFV infections in West Africa and may be use for a retrospective analyse to preparation for a model of forecasting, surveillance, control and outbreak management in West Africa.

In Senegal, a regular entomological investigation in the Ferlo region - an enzootic focus - have been set up since 1990 following the extension to Senegal of the RVFV first outbreak in 1987 in Mauritania. Such studies give insight about to study the population bionomic of vector and monitor circulation of RVFV. Such studies provide a huge amount of data but in a disparate profile.

4.2.1. Entomological Data for the period 1990-1998

Indeed, from 1990 to 1998, most of studies on the mosquito vectors bio-ecology in Barkedji - a village in the northern Senegal – was limited to population dynamic of vectors and focused on the temporary ground ponds and to a lesser extent to the villages and did not explore other areas attended by known vertebrate hosts of the viruses. These studies were also carried out on a monthly basis, which may have underestimated the temporal fluctuations of mosquito populations and were limited mainly to *Cx. poicilipes* and *Ae. vexans* (Fontenille *et al*., 1998; Traore-Lamizana *et al*., 2001).

Table 1 : Present Excel file format of existing data.

File No	Date	location	biotope	Sampling method	genus	species	Nb
972	20/07/93	Barkedji	Niakha pond	Lux-goat	*Culex*	*sp.*	1
973	20/07/93	Barkedji	BKJ village	LUX-shee	*Mimomyia*	*plumosa*	1
974	20/07/93	Barkedji	BKJ village	LUX-sheep+goat	*Culex*	*poicilipes*	2
975	21/07/93	Barkedji	Mogre pond	CO2 + LUX	*Culex*	*tritaeniorhynchus*	1
976	21/07/93	Barkedji	BKJ village	LUX-sheep+goat	*Culex*	*tritaeniorhynchus*	2
977	21/07/93	Barkedji	BKJ village	LUX-sheep	*Culex*	*tritaeniorhynchus*	2
978	21/07/93	Barkedji	Mogre pond	LUX-sheep	*Aedes*	*vexans*	1
979	21/07/93	Barkedji	Mogre village	LUX-sheep	*Culex*	*poicilipes*	1
980	21/07/93	Barkedji	Mogre pond	chicken	*Culex*	*neavei*	1
981	21/07/93	Barkedji	Mogre pond	sheep	*Culex*	*tritaeniorhynchus*	2
982	21/07/93	Barkedji	Mogre pond	sheep	*Aedes*	*vexans*	2

4.2.2. Entomological Data for the period 2002-2003

During the 2002 - 2003 rainy season a longitudinal study on population dynamic and a dispersal experiment of two Rift valley fever vectors (*Aedes vexans* and *Culex poicilipes*) in Senegal was conducted in Barkedji. Mark–Release–Recapture was used.
Mosquito collections were conducted from July to November in 2002 and from July to December in 2003 using several methods with the objective to monitor the virus circulation as well as, the dispersal and feeding pattern of RVFV vectors. Daily entomological investigations were undertaken from 26 July - 28 November 2002 and 10 day per month from July to December in 2003. Adult mosquitoes were collected each night around the Niakha ground pool and at each of 8 surrounding villages.

Mosquitoes were collected by carbon dioxide baited-CDC light traps, sheep baited traps, a backpack aspirator and bed net traps occupied respectively by human, cow, sheep and chicken. To protect the different hosts against mosquito bites, the two nets were combined as described in Ba et al. (2006).

Mosquitoes were killed by freezing at –18°C, sorted to species using available identification key (Edwards, 1941), and pooled on a chill table by species, sex, date, and trap or capture method. Pools containing 1-40 unfed mosquitoes were stored in liquid nitrogen until testing for virus isolation; after identification, engorged females were pooled one by one for later blood meal identification studies.

Table 2 : Present Excel file format of existing data.

Species	**Number**	**Geographic origine**	**Sampling method**	**Date**
Aedes vexans	127	Mare Niakha	CDC	1/07/02
Culex poicilipes	1	Mare Niakha	CDC	1/07/02
Anopheles pharoensis	1	Mare Niakha	CDC	1/07/02
Aedes vexans	112	Mare BKJ	CDC	1/07/02
Mansonia uniformis	3	Mare BKJ	CDC	1/07/02
Culex poicilipes	3	Mare BKJ	CDC	1/07/02
Aedes aegypti	1	Mare BKJ	CDC	1/07/02
Aedes luteocephalus	1	Mare BKJ	CDC	1/07/02
Aedes vexans	15	BKJ village	CDC	1/07/02
Aedes vexans	63	Mare Niakha	CDC	1/07/02
Anopheles gambiae	1	Mare Niakha	CDC	1/07/02
Aedes vexans	1365	Mare Niakha	PM	1/07/02
Aedes sudanensis	1	Mare Niakha	PM	1/07/02
Aedes mcintoshi	1	Mare Niakha	PM	1/07/02
Culex tritaeniorhynchus	1	Mare Niakha	PM	1/07/02
Aedes vexans	1232	Mare Niakha	PM	1/07/02
Aedes sudanensis	1	Mare Niakha	PM	1/07/02
Culex tritaeniorhynchus	2	Mare Niakha	PM	1/07/02
Aedes fowleri	1	Mare Niakha	PM	1/07/02
Anopheles gambiae	2	Mare Niakha	PM	1/07/02
Culex poicilipes	3	Mare Niakha	PM	1/07/02
Aedes vexans	22	Mare Niakha	CDC	1/07/02
Aedes vexans	80	Mare Niakha	CDC	1/07/02

Results obtained generate for the first time a more refined estimation of the physical and physiologic population dynamic as well as data on several aspects of the bionomic of the vectors including the flight range, age grading, the daily survival rate and an estimation of the population size of the two main vector *Ae. vexans* and *Cx. poicilipes*. From the mosquito pool constituted several RVF virus strains were isolated in 2002 and 2003.

4.2.3. Entomological Data for the period 2005-2007

From 2005 to 2007 an other approach was designed to study the RVF vectors in the same area covering a radius of 13 km centred on Barkedji village (14°47' - 14°53'W, 15°13' - 15°20'N). The first step in our study was to identify and classify the main microhabitat in the study area. Among the most important were temporary ponds, which were classified according to their ecological features as large ponds (LP) and small ponds (SP) (Bouyer, 2002). Large ponds are relatively deep, with a diameter > 100 m and a steep slope. Small ponds are relatively shallow, with a diameter < 100 m and a gentle slope. Large ponds remain flooded throughout the rainy season and sometimes 2 - 3 months afterwards. Small ponds are flooded after each rainfall event, but drying out usually after 1 - 2 weeks without rainfall.

The other main microhabitats in the area include woodlands, open fields and villages. The woodlands are wet depressions with trees. The open fields are vast grasslands that serve as pasture for livestock and camping areas for migratory herders. The layout of villages is usually based on a group of huts arranged around a central area and each compound has a shelter where livestock are kept overnight. These microhabitats were also classified according to their distance to the ponds.

Adult mosquitoes were collected using CDC light traps baited with dry-ice (Service, 1993a) in 80 sites covering the entire study area. Mosquitoes were collected for one night in each site on a biweekly basis, mainly during the short rainy season, from June to December 2005 and from July to November 2006. Collected mosquitoes were identified on a 'chill table' using morphological keys (Edwards, 1941; Service, 1993b; Diagne *et al.*, 1994).

From each trap, 10 specimens of the main vector species including *Cx. poicilipes*, *Ae. vexans*, *Ae. ochraceus* were dissected during each trapping session to evaluate parity based on the presence of ovarian dilations, as described by Detinova (1962).

The temporal and spatial dynamics, was estimated for each vector every two weeks in the different microhabitats. The results revealed a significant heterogeneity according to the geographic area but also in each geographic area according to the ecological habitat (ground pool, open space, wooded area, cultivated area, villages).

These data gathered during this period (2005-2007) are available in Excel file including information about the date and period of collection, number of trap sep up, habitat type where collection were performed, the species of mosquito collected, number of individual collected, number of individuals dissected, and the physiological status.

These set of entomological data while collected differently could be helpful in combination of retrospective environmental and climatologic data to realize a model to predict RVFV emergence.

Table 3 showing the key entomological parameters that could be extracted from the data bases.

Parameter	Time series	Timescale	references
Entomology			
<u>For malaria</u>			
- Anopheles biting rate and cycle	1994 – 1995	Monthly	Lemasson *et al.,* 1997
- Endophagous rate	1994 – 1995	Monthly	
- Trophic preferences and anthropophilic rates	1994 – 1995	Monthly	
- Parity rates	September to		Dia *et al.,* 2005
- Anopheles infection rates	November 2002	Daily	
- Anopheles entomological inoculation rates			
<u>For Rift Valley Fever</u>			
1. Vector abundance	1990-1998	Monthly	Traore-Lamizana et al., 2001
2. Vector densities	1990-1998	Monthly	Fontenille et al., 2005
3. Virus isolated from vectors	1993	Monthly	
4. Vectors temporal densities	2002 – 2003	Daily	Ba et al. 2005
5. Vectors feeding preference	2002 - 2003		Ba et al., 2006b
6. Flight range,	2002 - 2003		Ba et al. 2005
7. Age grading and daily survival rate	2002 - 2003		Ba et al. 2005
8. Vector daily activity	2002 - 2003		unpublished
9. Population size estimation	2002 – 2003		Ba et al. 2005
10. Virus isolated from vectors			
11. Vectors biodiversity	2005 to 2007	Every fortnight	Not yet published
12. Vectors temporal densities	2005 to 2007	Every fortnight	Not yet published
13. Vectors spatial densities	2005 to 2007	Every fortnight	Not yet published
14. Vectors temporal Parity rate	2005 to 2007	Every fortnight	Not yet published
15. Vectors spatial parity rate	2005 to 2007	Every fortnight	Not yet published

Data access

Data file formats	Excel file and paper format
Format description	See example shown in table 1 and 2.
Data availability	Except those collected from 2005-2007 as part the Eden Project and which are under the consortium policy all other data are the propriety of IPD and could in be used in defined conditions for the QWECI project.
Use group	QWECI-members
Rules for using data	QWECI data policy

4.2.4. Mosquito infection data

A total of 59 virus strains were isolated from mosquito collected in Barkedji in 1993 and 2002-2003. Comparative analysis of the 2 emergences shows several similarities such as i) *Ae. vexans*, was the only common vector and has a similar bimodal dynamic of populations with peak in august and in October (Fontenille et al. 1998, Ba et al. 2005), ii) they occurred during years of rainfall deficit compared to the normal in the area, and iii) they occurred between October and November although vector species were already abundant after the first rainfalls. However, several differences were noticed namely the number and type of vectors involved. In 1993, only *Ae. vexans* and *Ae. ochraceus* were involved in RVFV circulation, whereas 5 mosquito species (*Ae. vexans*, *Cx. poicilipes*, *Ae. fowleri*, *Ma. uniformis*, *Ma. africana*) were found infected in 2002-2003. Although, more isolates were obtained in the 2002-2003 emergence, infection rates were highest in 1993.

4.2.5. Animal infection

The different transversal investigation revealed globally low IgM antibodies prevalence rates (3 % in 1989 and 0.3 % in 1990) among domestic ruminants of the Ferlo zone with IgG antibodies varying from 10 % (1987) to 20 % (1990) (Zeller 1993, Gonzalez et al., 1988 ; Guillaud et al., 1988 ; Zeller et al., 1995).

Sentinel herd monitoring a circulation of the virus was recorded around temporary ponds in Barkedji in 1993 and 1 strain was isolated from a sedentary herd (Zeller et al., 1997). This isolation occurred in absence of clinical symptoms in human and animals. However in October 1999, a prevalence rates of 72.5 % of IgM as well as abortions rates of 80 % of pregnant females were observed in Ranerou a locality less than 40 km far from Barkedji (Sall, 2001). Since 2000, a silence post epidemic is observed in the herds of the region.

4.2.6. Human infection

There is no specific surveillance program for RVF in human populations in Barkedji. However infection in human cannot be ruled out when considering the seroprevalence of 22.3 of antibodies IgG against the virus obtained in 1989 in Yonofere (14.02 % among individuals 5 - 19 years old (Wilson 1994). In Barkedji prevalence rate of 6.12 % were revealed among children 5 - 15 years olds in 1993. (Zeller 1993).

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Acronymes

AMMA : Analyses Multidisciplinaires de la Mousson Africaine

CSE : Centre de Suivi Ecologique