

Building an early warning system (EWS) for Rift valley fever in Ferlo (Senegal): what can be expected from remote sensing?



**Jacques André NDIONE^{1&5}, Jean-Pierre LACAUX², Yves M. TOURRE³, Cécile VIGNOLLES⁴,
Delphine FONTANAZ⁴, Murielle LAFAYE⁴**

1- Centre de Suivi Ecologique (CSE), BP 15532, Dakar-Fann, SENEGAL, jacques-andre.ndione@cse.sn

2- Université Paul Sabatier, Toulouse, France

3- Météo-France, Département de la Climatologie, Toulouse, France

4- Centre National d'Études Spatiales (CNES), Toulouse, France

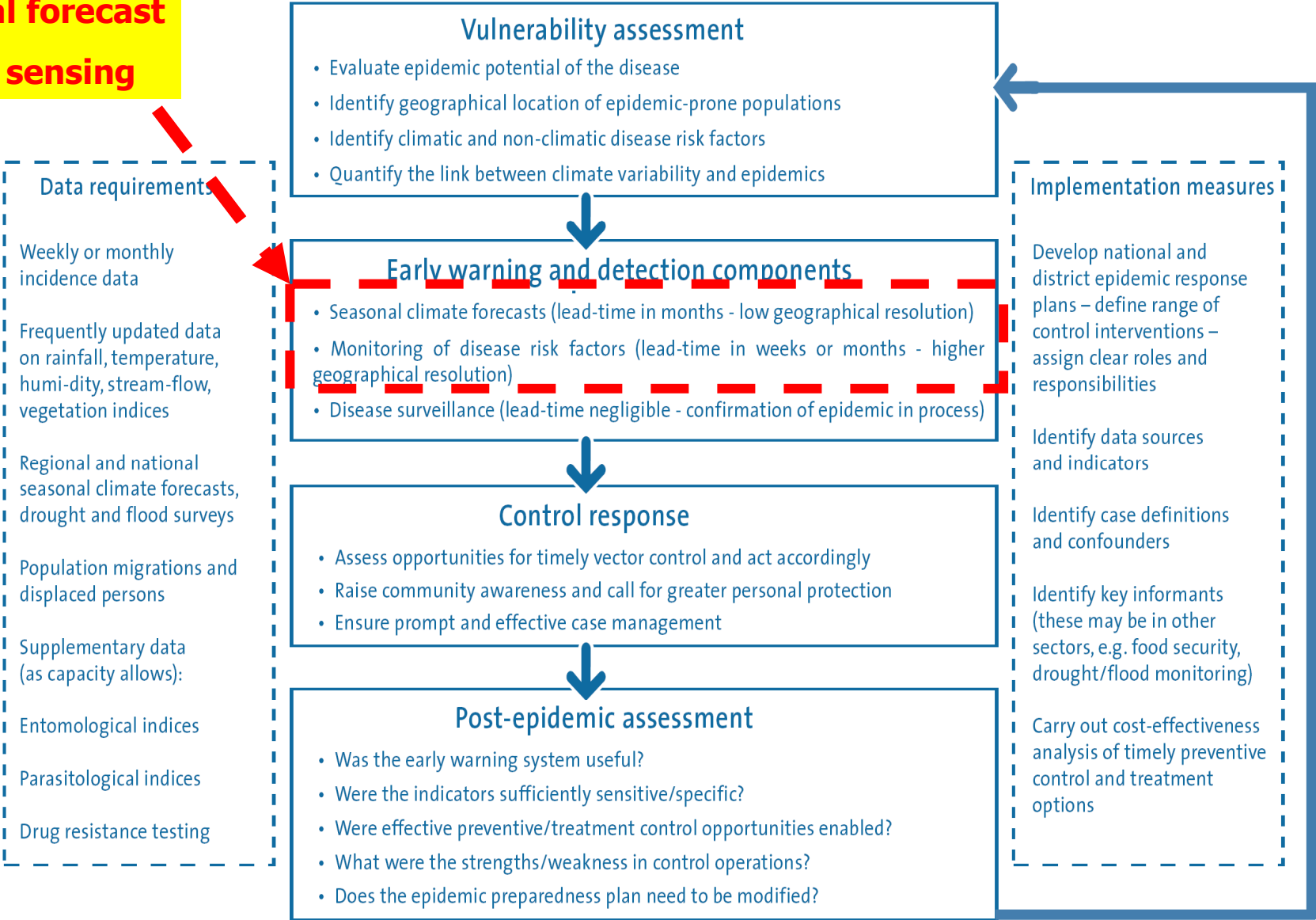
5- Laboratoire de Physique de l'Atmosphère et de l'Océan Siméon Fongang/ESP-UCAD, BP 5085 Dakar-Fann, SENEGAL

Agenda of my talk

- Introduction
 - Some considerations on RVF
 - Study area: data and methods
 - Results
- Conclusion and Perspectives: Lessons learned

Climate sensitive disease and EWS

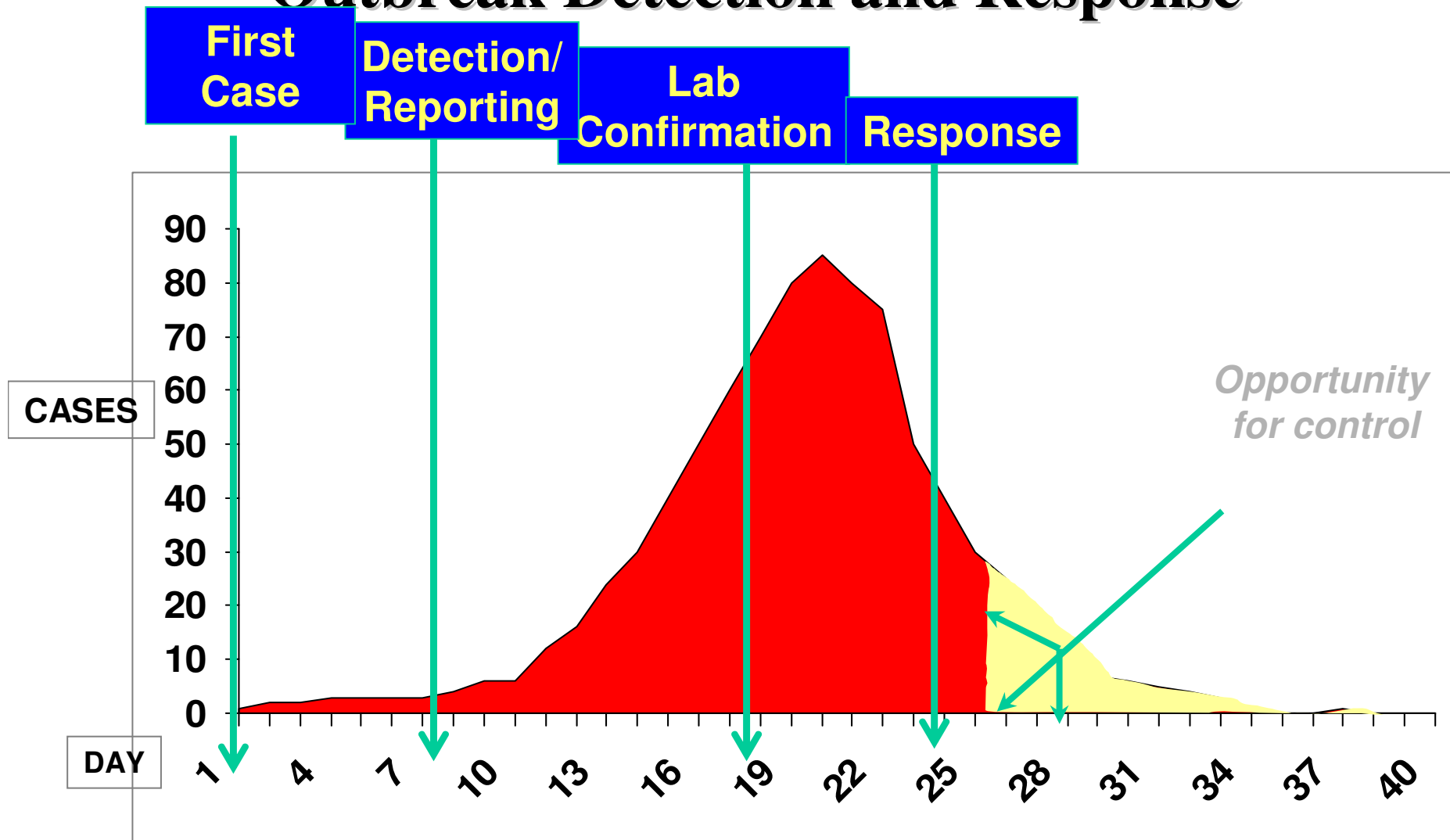
Seasonal forecast
Remote sensing



FRAMEWORK FOR DEVELOPING EARLY WARNING SYSTEMS FOR CLIMATE SENSITIVE DISEASES (WHO, 2005)

Why building an HEWS?

Outbreak Detection and Response



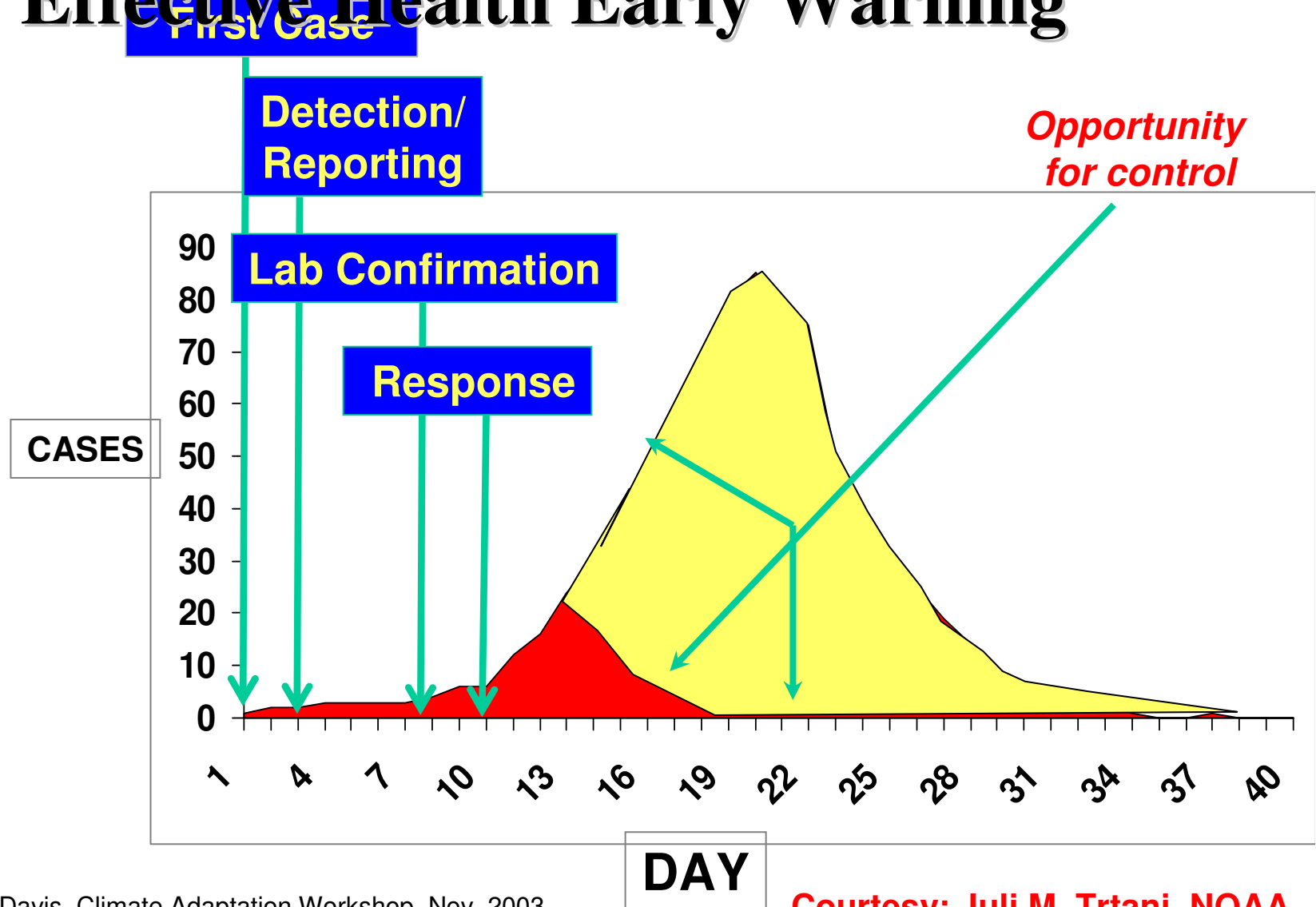
Courtesy: Juli M. Trtnanj, NOAA

Adapted from J. Davis, Climate Adaptation Workshop, Nov. 2003

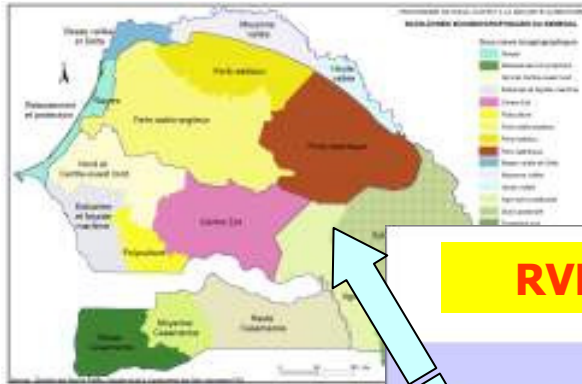
Why building an HEWS? (2)

Effective Health Early Warning

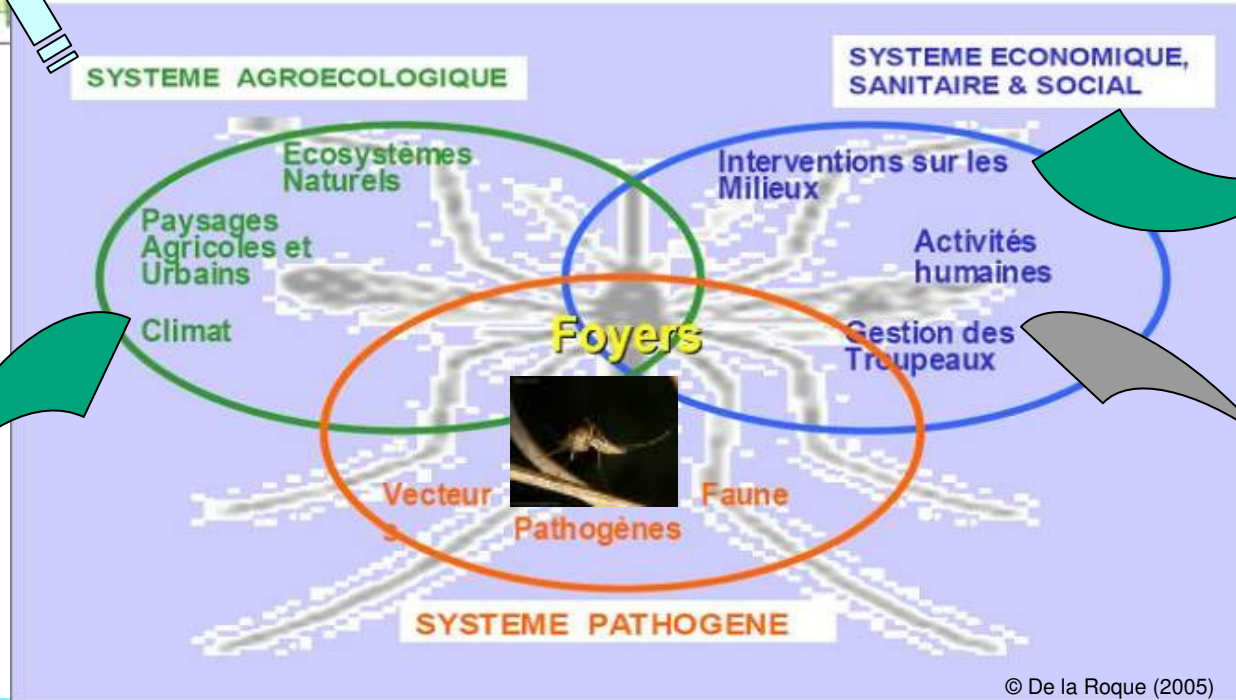
Enough background on disease emergence...



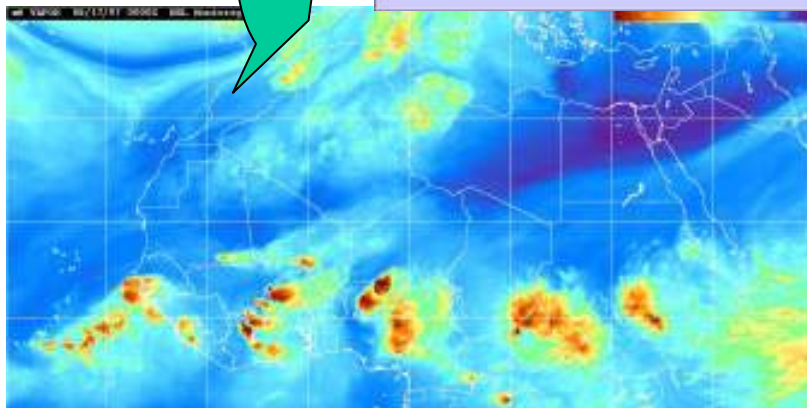
Rift valley fever (RVF)?



RVF : a disease at the crossroads of 3 systems

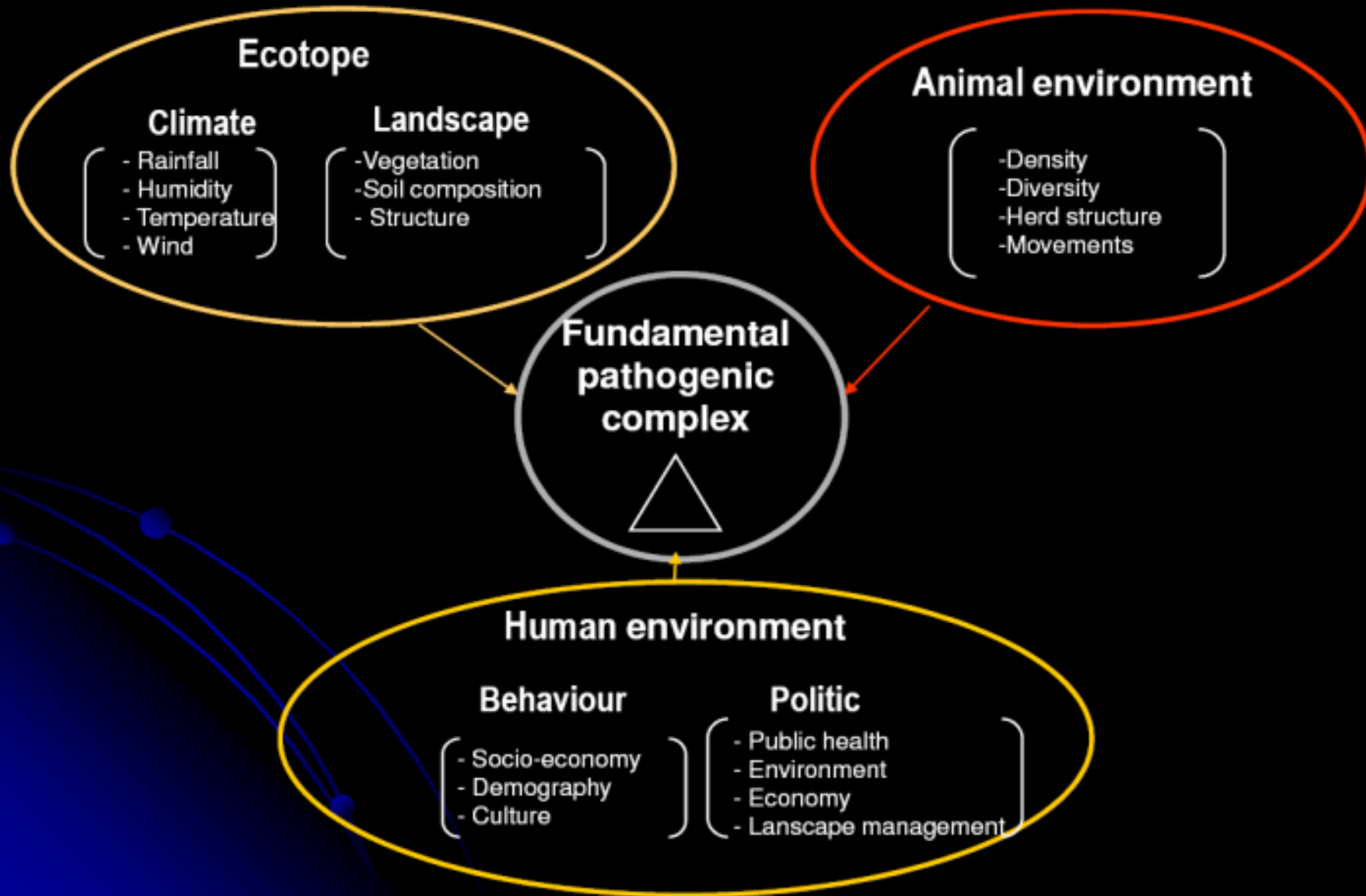


© De la Roque (2005)

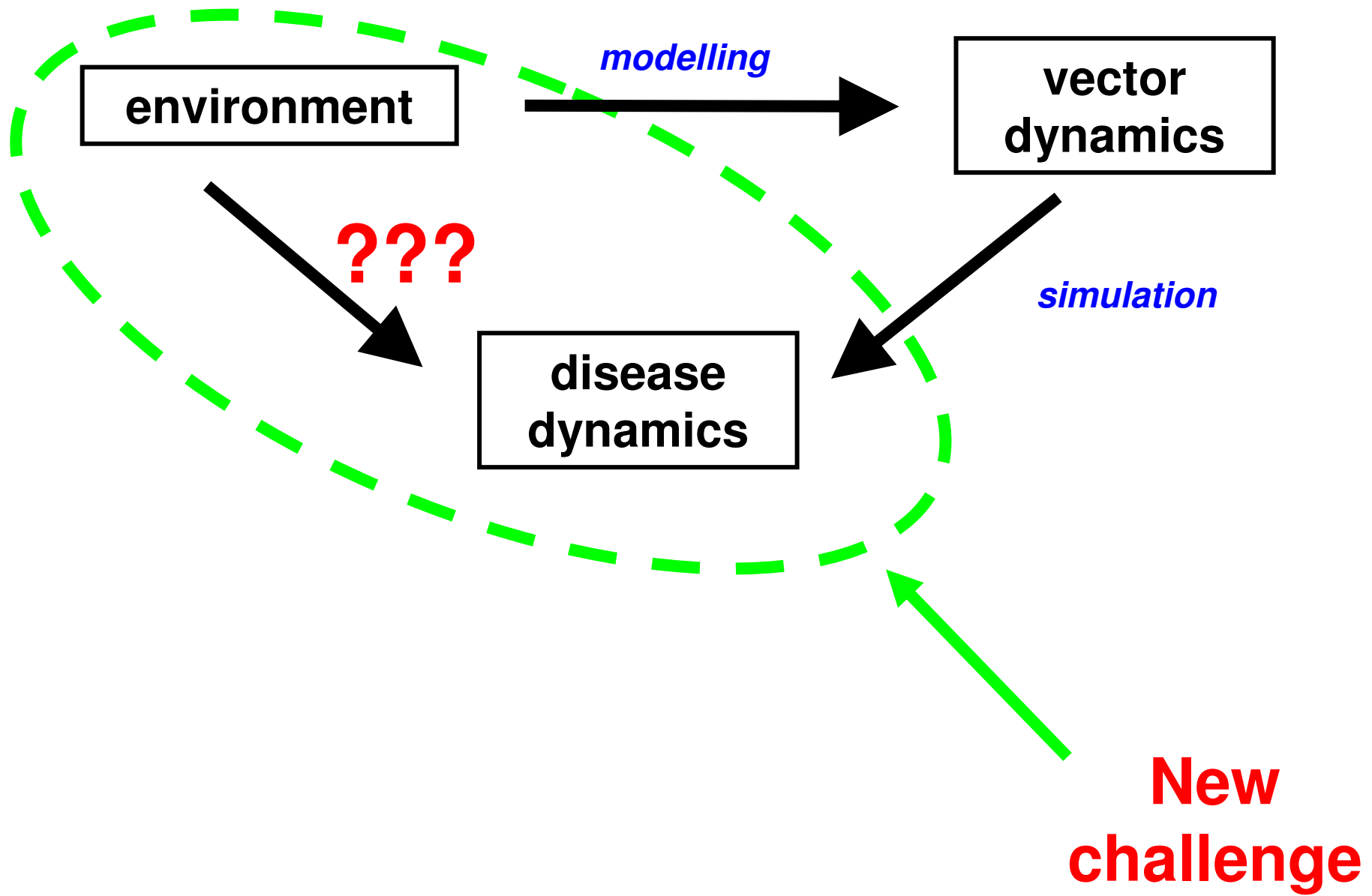


Epidemiological system

(from Rodhain, 1985)



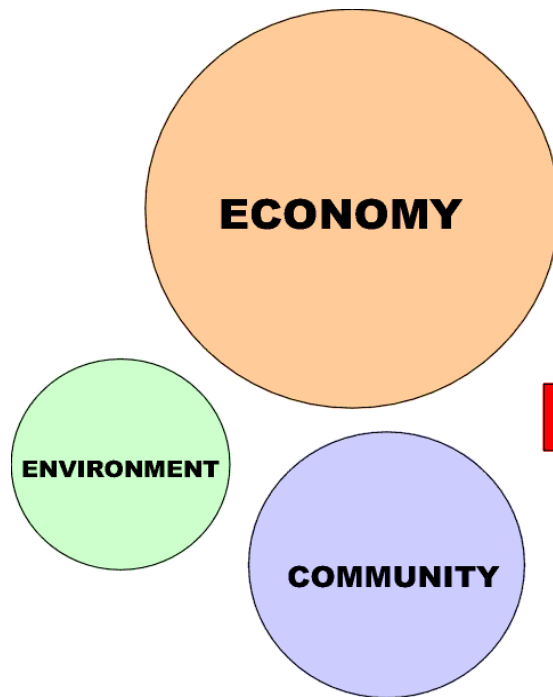
Courtesy: V. Chevalier, CIRAD



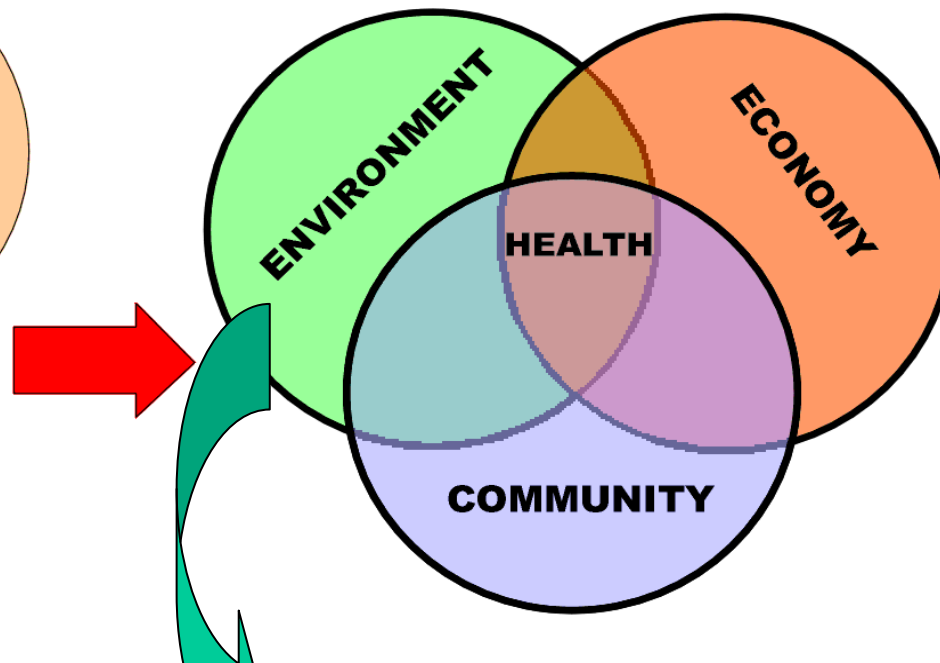
What does health means?

A “state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity.” (WHO, 1948)

Classical Approach



Ecohealth approaches



High contribution of Remote sensing on environment issues ⇒ **Tele-epidemiology becomes a reality...**

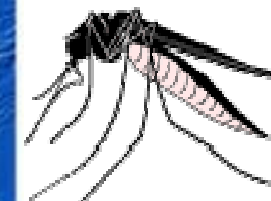
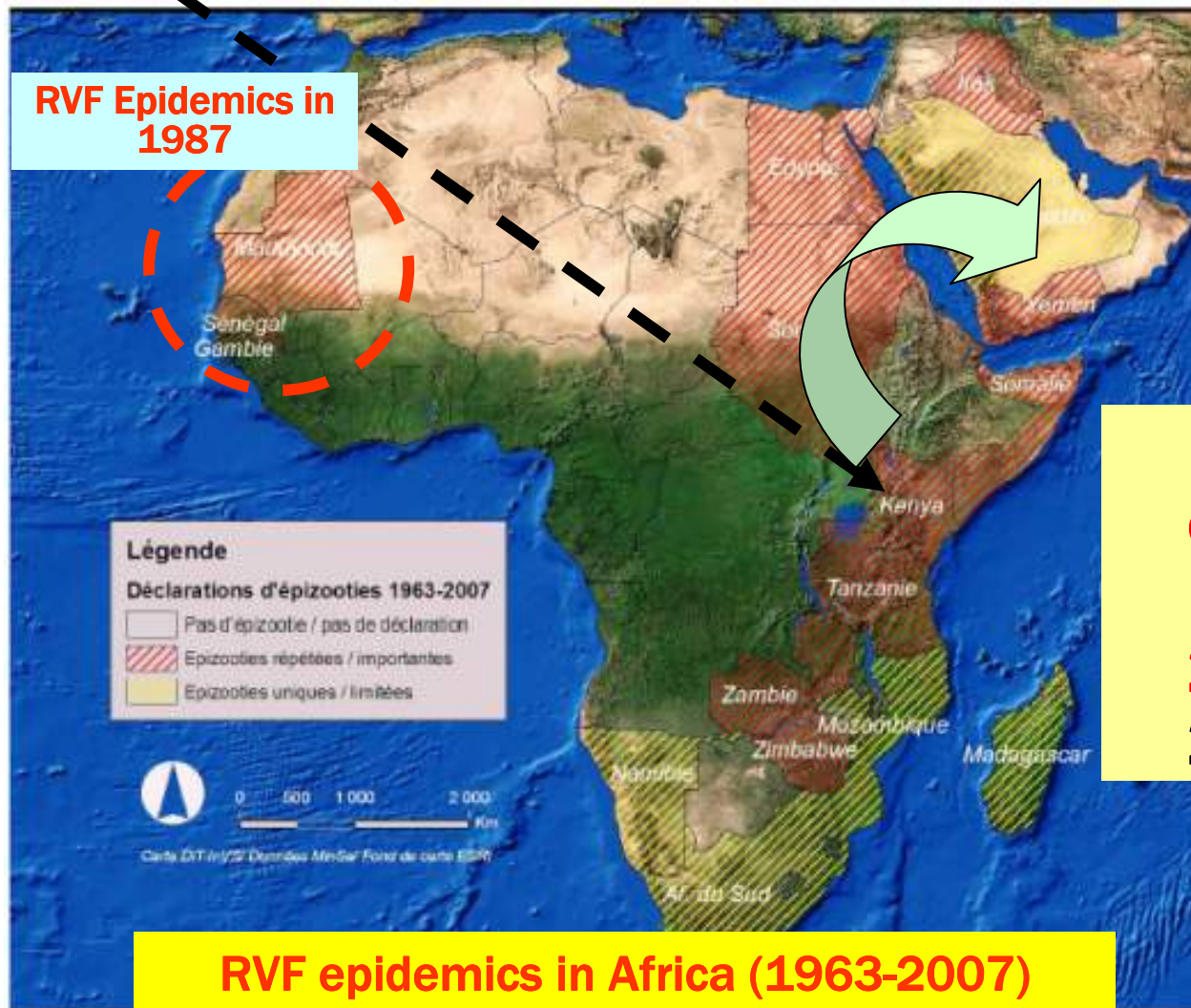
Rift valley fever (RVF)? (3)

Historical overview...

RVF has been described for the first time in **1931**, in **Kenya** by **Montgomery and Stordy** (Christophe et al., 1997)

Since **2000**, **RVF outbreaks** occurred in **Asia** (Yemen and Saudi Arabia)

2008 : **RVF virus** circulation in **Mayotte** (AFSSA, **2008** ; Sissoko, **2009**)



Some historical marks for RVF events in Senegal...

October 1987: Rosso RVF epidemics (Sall, 2001)

October 1993: RVF virus was isolated from the floodwater mosquitoes *Aedes vexans* and *Ae. Ochraceus* (Fontenille et al, 1998) and from one of the sheep

October-december 1994: outbreak of RVF in Ross-Béthio (Sall, 2001)

November 1998: outbreak of RVF in Diawara ; isolation of RVF virus for the first time in *Cu. poicilipes* (Sall, 2001 ; Diallo et al, 2000)

October-november 1999: outbreak of RVF in Ranérou (Sall, 2001)

October-november 2002: outbreak of RVF in Barkédji (Ba et al, 2005), in Galoya and Dabia Olédji (OIE, 2002)

November 2003: outbreak of RVF in Saint-Louis, Dagana, Podor, Matam and Bakel (OIE, 2003)

November 2004: outbreak of RVF in Dagana (OIE, 2004)

In summary what we know today?

RVF vectors in Senegal : *Aedes vexans*, *Aedes ochraceus*, *Aedes dalzieli*, *Culex poicilipes* (Fontenille et al, 199 ; Diallo et al, 2000)

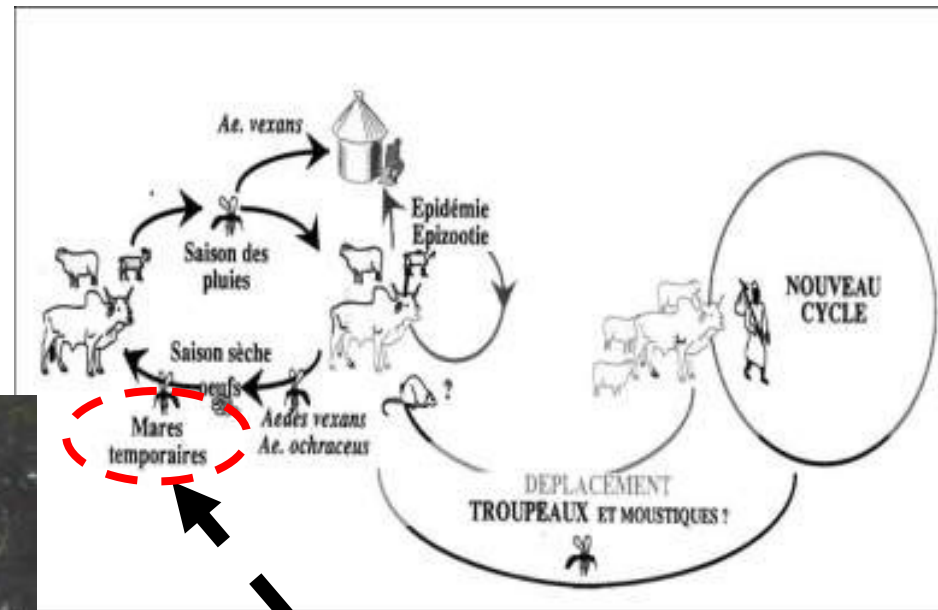
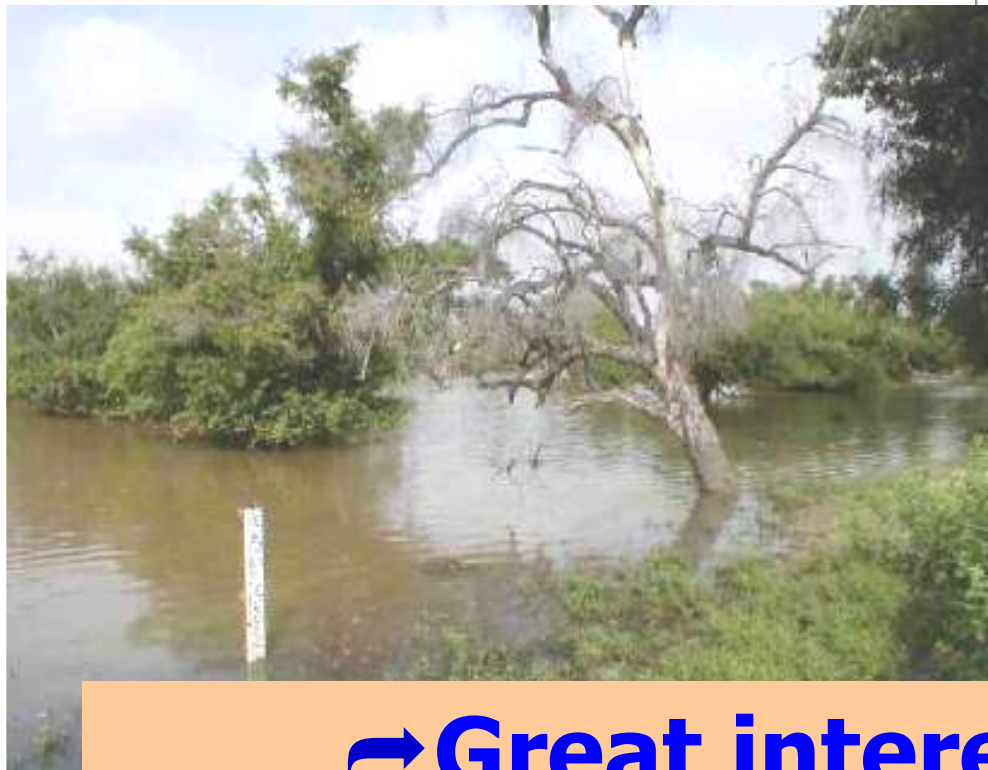
3 new vectors since 2003 (Ba et al, 2009 & Ndione et al, 2009; *coming papers*)

Feeding behaviour : RVF vectors **use the same type of breeding sites and also feed on cattle and sheep** as the main vectors in East and South Africa

Ba et al (2005) show **that Aedes and Culex mosquitoes can be found as far as 620 and 550m from the edges of ponds**

RVF and rainfall: in Senegal (Ndione et al, 2003; Ndione et al, 2008), **RVF epidemics do not seem to follow the same relationships as over East Africa** (Linthicum et al, 1999).

In summary what we know today? (2)



RVF epidemiological cycle in Ferlo (Diallo, 1995)

↪ **Great interest on pond!**

↪ **Why?**



Ponds = area of free access to water for livestock

Ponds = area of free access to water for local populations in some places

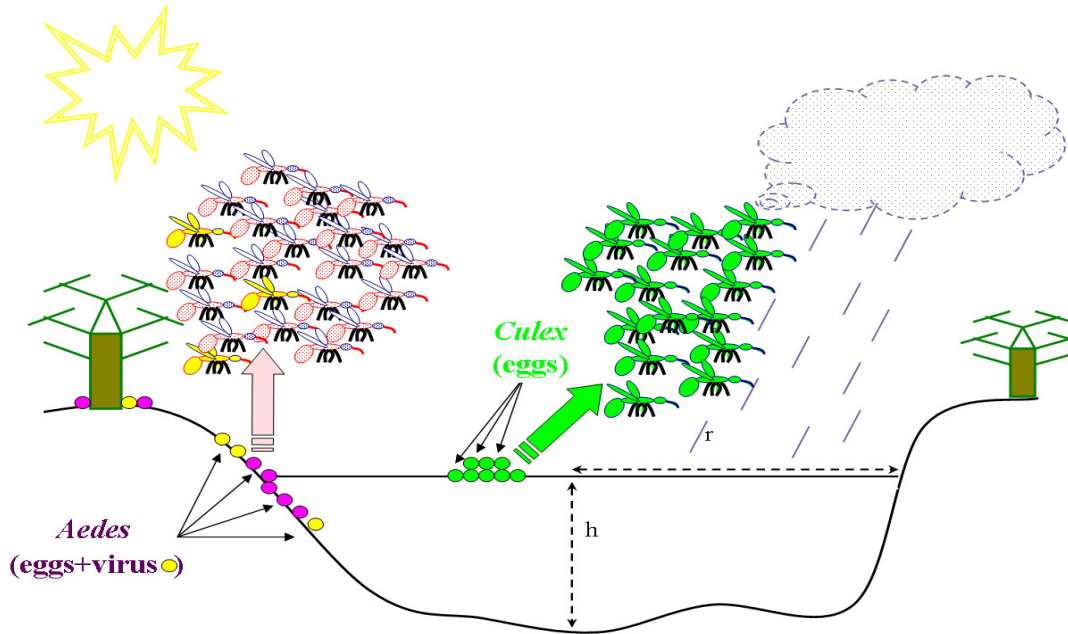
Ponds = breeding sites for RVF vectors

Ponds = key zones where cattle and RVF vectors can meet

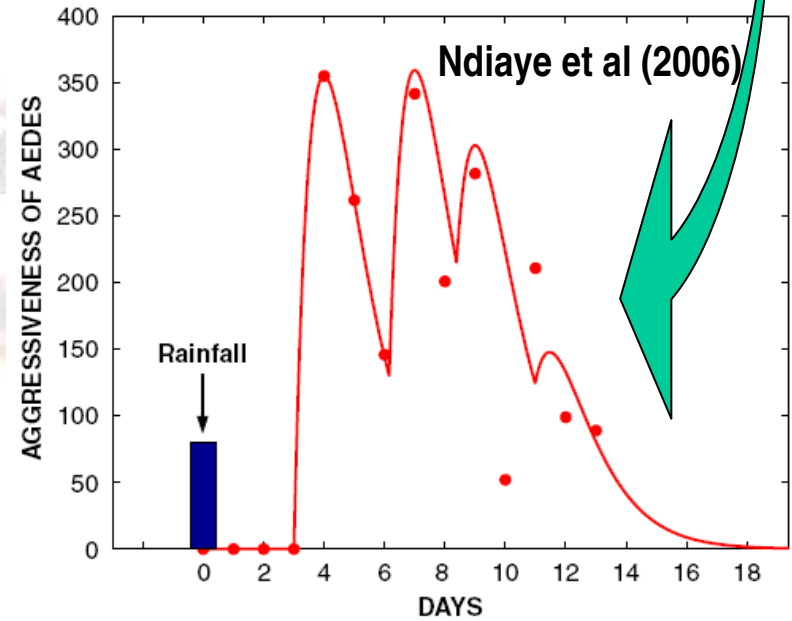
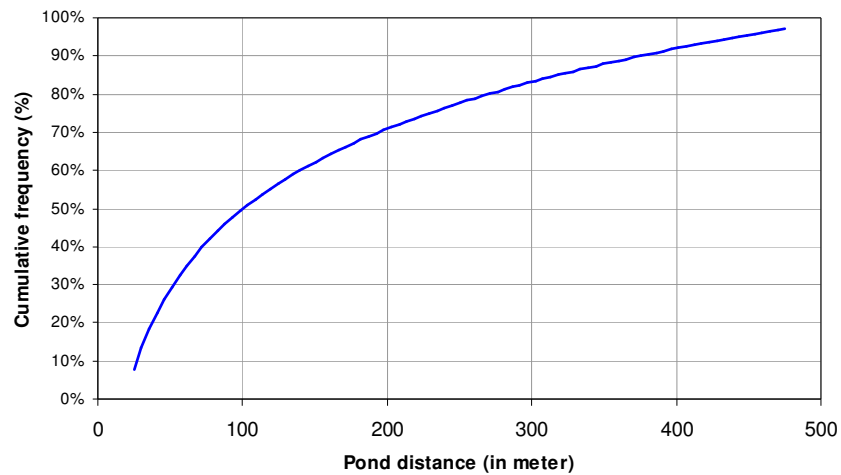


Pond is a key component of socio-economic population life in Ferlo area, associated with a high sanitary risk...

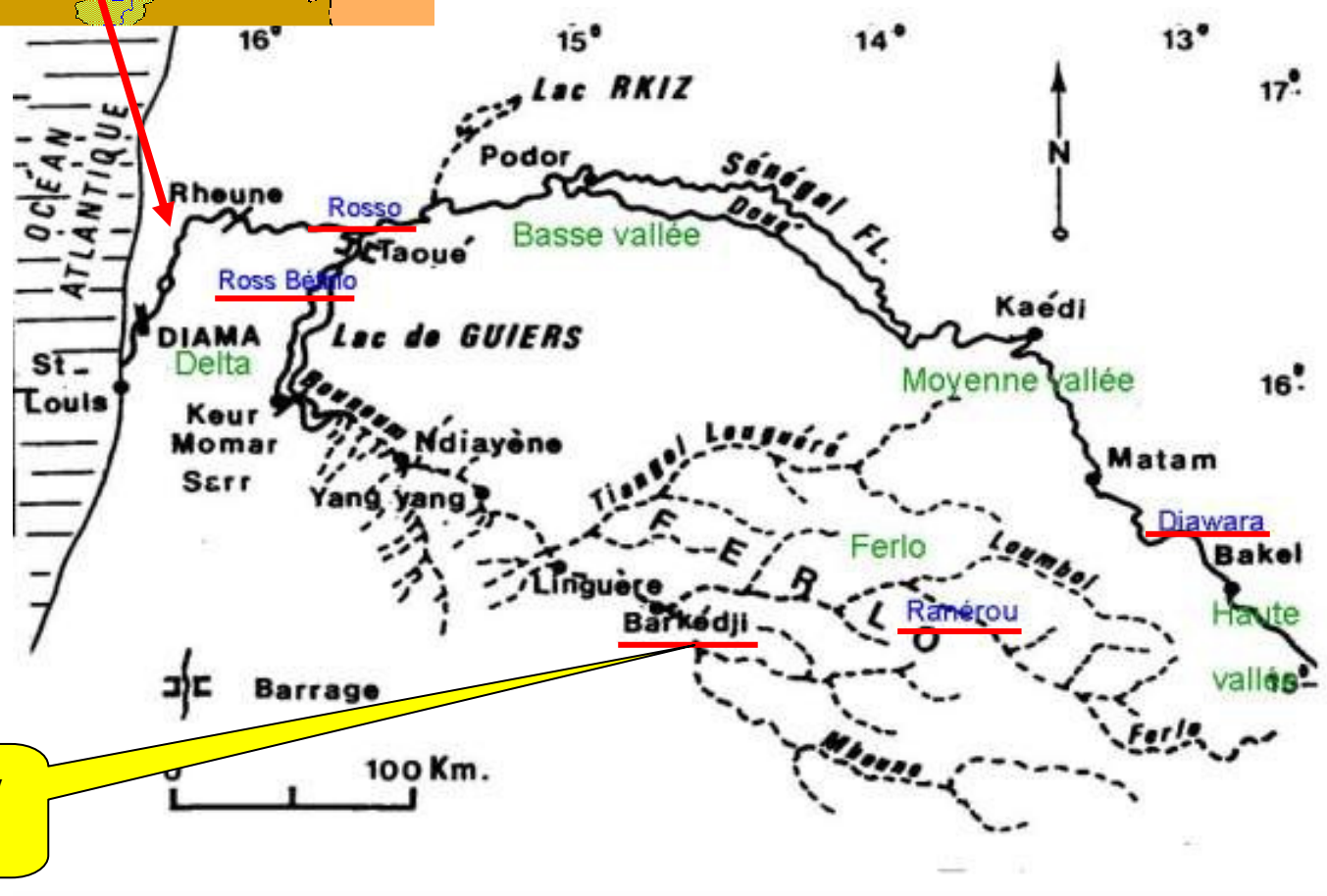
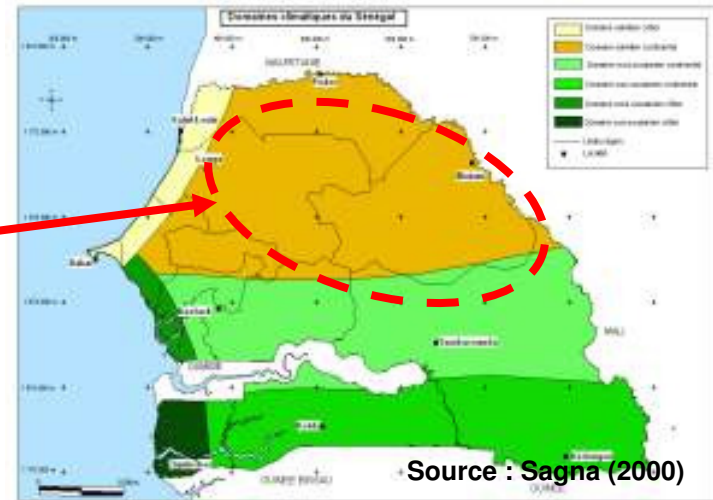
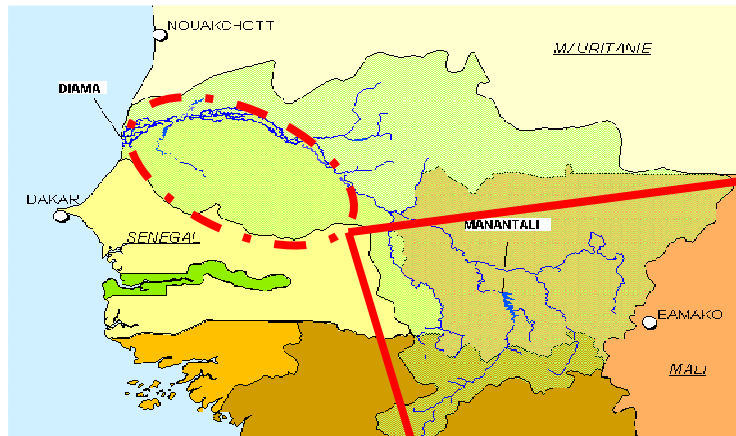
From Rainfall Event to Vectors' Aggressiveness



Aedes vexans (%) versus pond distance (meter)

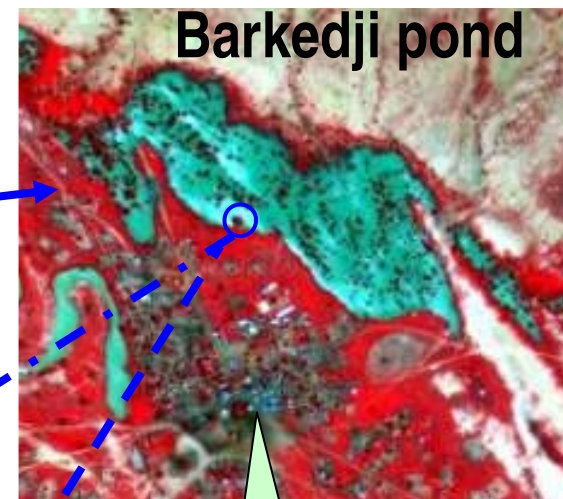
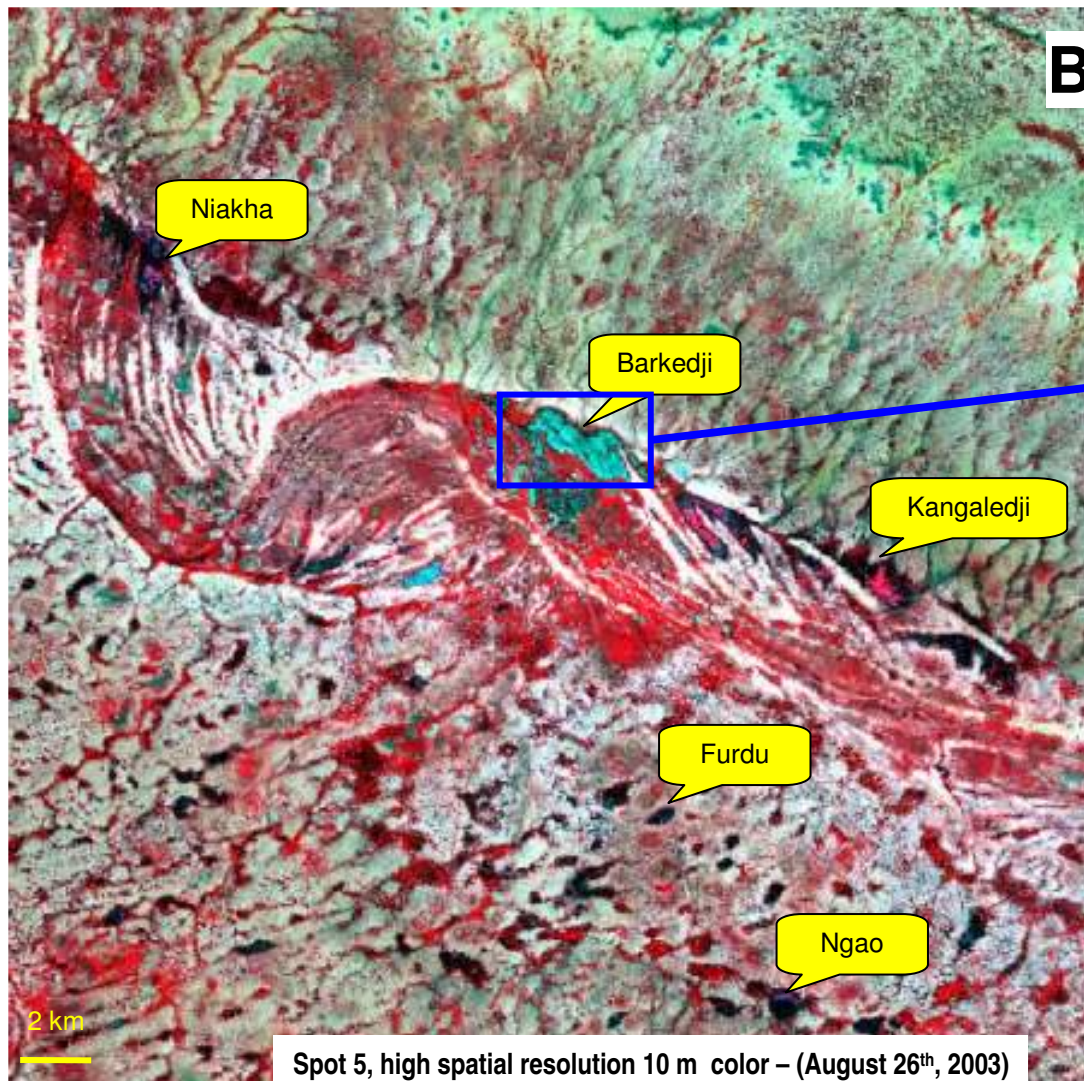


Area under investigation in Senegal

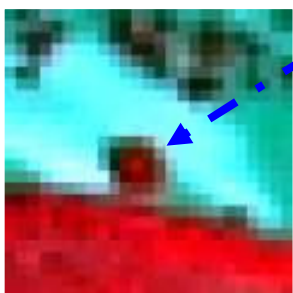


Study area

Barkedji study site - Senegal



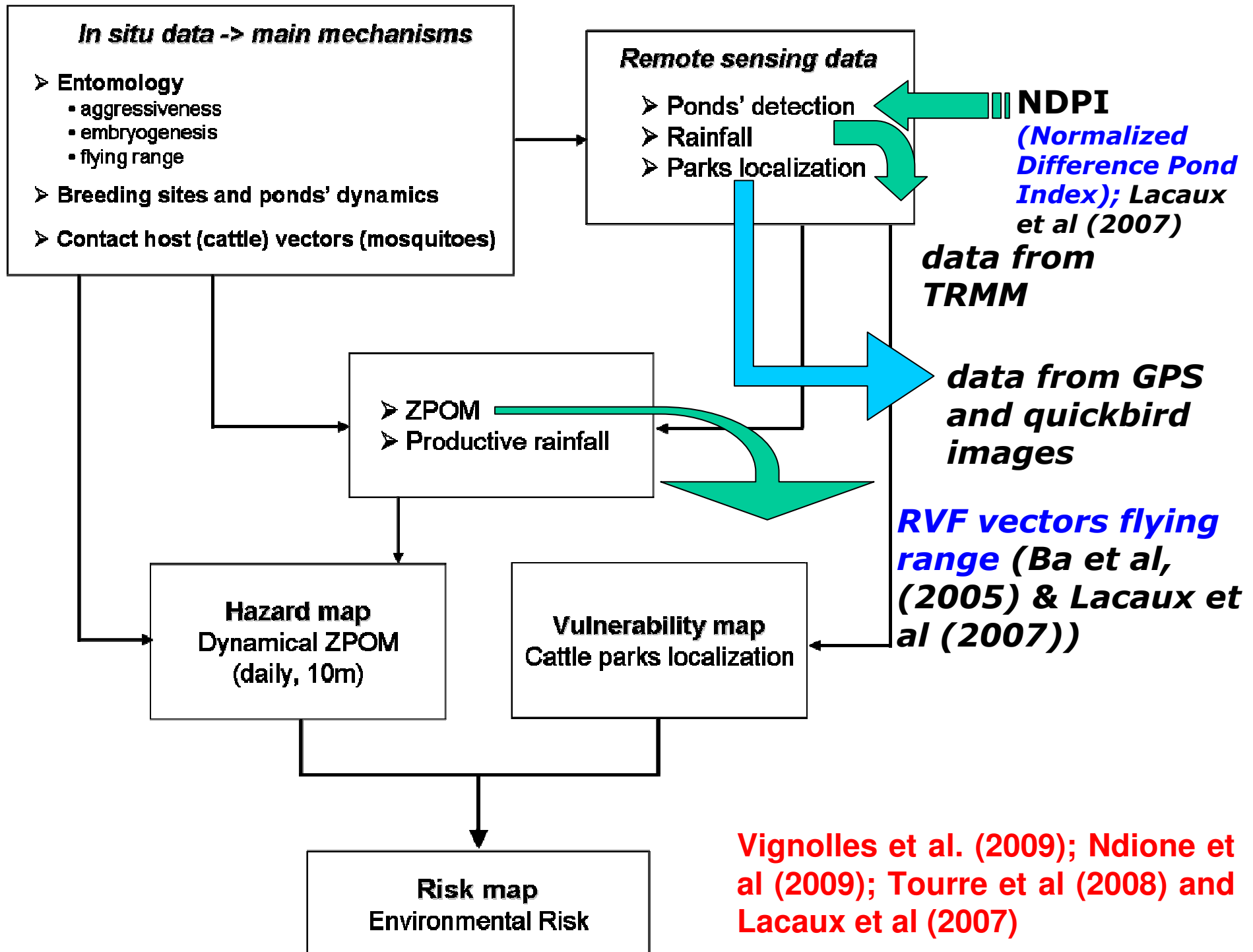
Barkedji village



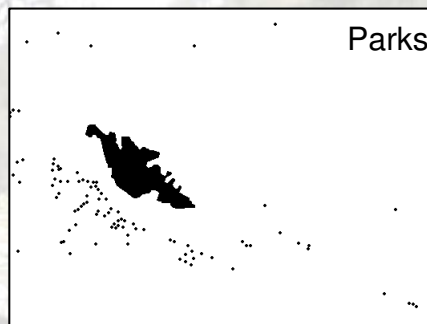
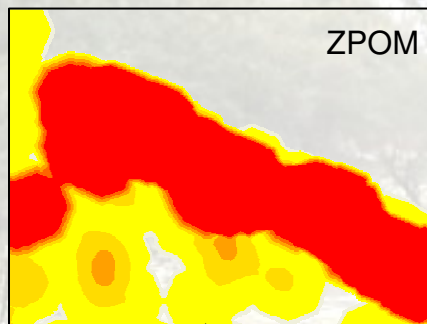
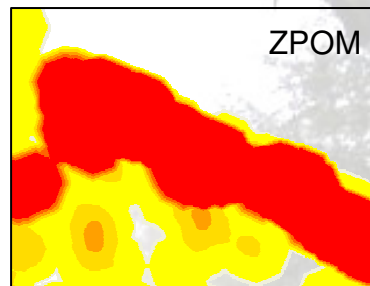
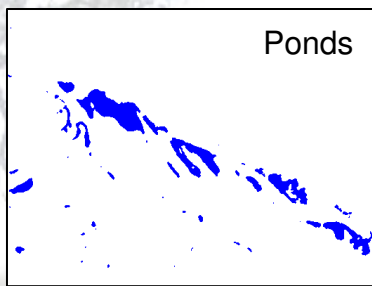
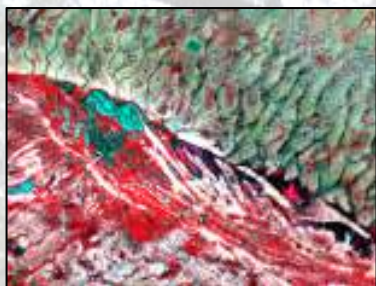
Zoom - pixel size: 10m



Baobab tree at Barkedji pond (Sept. 2003)



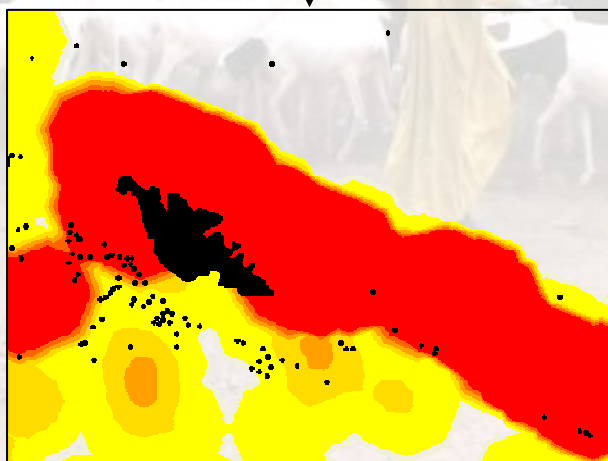
From Remote Sensing to Risks



Hazards

Vulnerability

Risks



Some parks...



Photo by Jacques-André Ndione, 2006



Photo by Jacques-André Ndione, 2008



Photo by Jacques-André Ndione, 2008

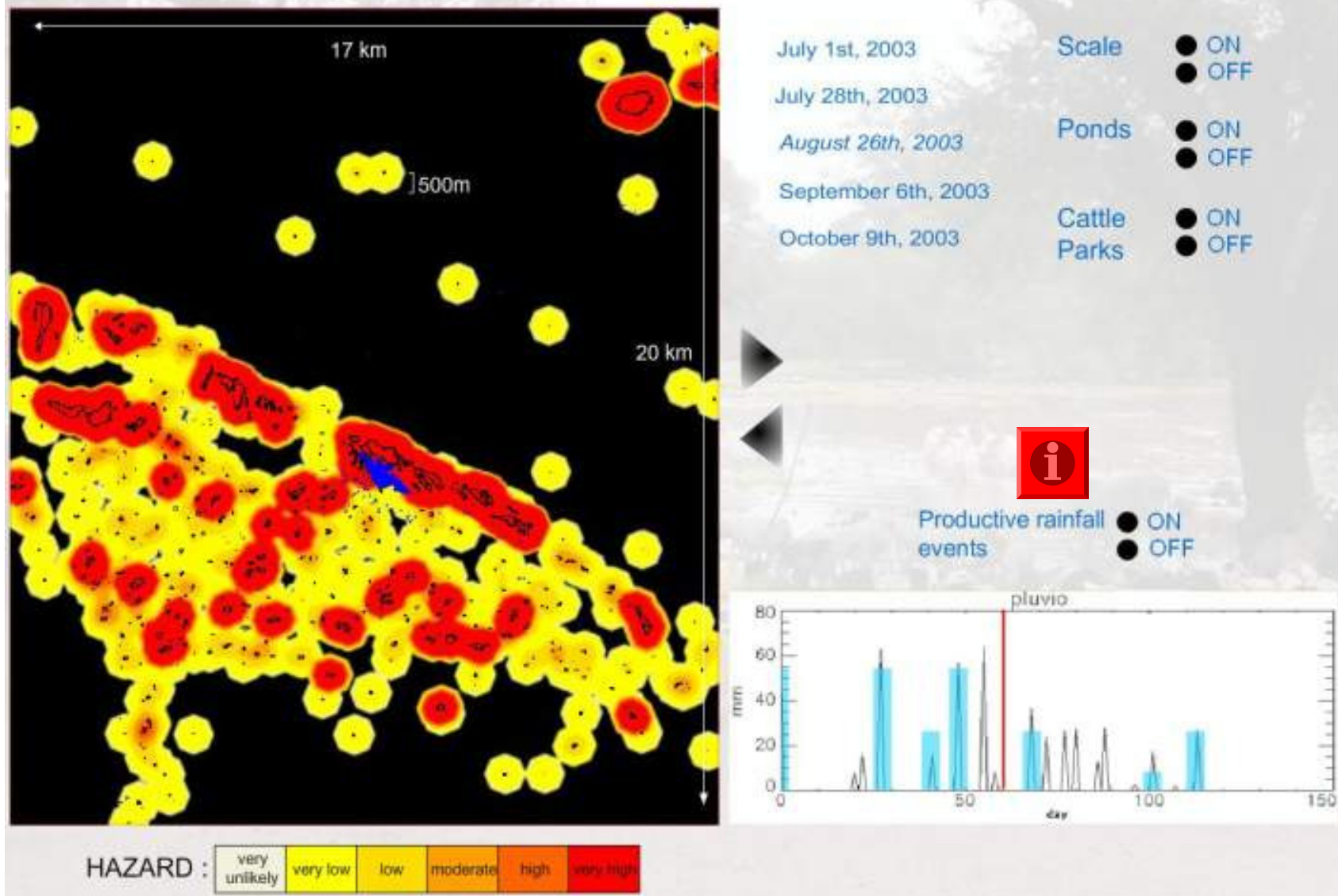


Photo by Jacques-André Ndione, 2008



©Emercase, 2003

Dynamical ZPOM and associated risks



Simulation available online:

<http://www.geospatialhealth.unina.it/fulltext.php?ida=75>

Conclusions and Perspectives: lessons learned

From June 28th to October 31st, 2003

7 productive rainfall events (out of 20) linked to *Aedes* aggressiveness

56 days (~1 out of 2) with no risk

15% of parks are never under risk

1 day out of 3 (5) with more than 20% (30%) of parks under high risks

Conclusions and Perspectives: lessons learned

Thanks to remote sensing, \Rightarrow 1st risk maps

Next step: VALIDATION (*adaptRVF Project*)

Integrate risk maps to GIS;

New steps towards HEWS (Health Early Warning System)...

Multidisciplinary approach \Rightarrow better understanding of emergence mechanisms

Some needs are remaining:

Find new indicators on pond's hydrology, water quality, vegetation cover...) in relation with:

- **Vectors dynamics;**
- **Livestock distribution around ponds, socio-economics considerations...**

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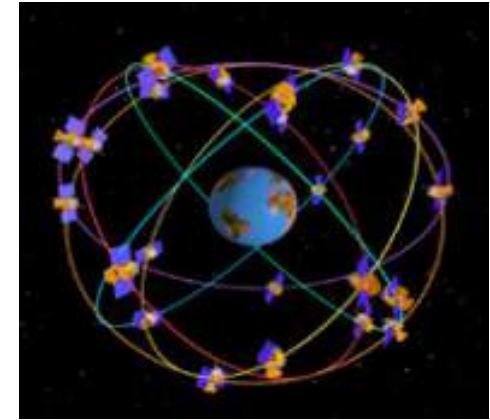
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**and its partners
for this conference**



***Remote sensing data are important,
but in-situ measurements are also
crucial...***



***At the end, all the HEWS should be based on remote
sensing products...***



Niakha pond limnometry instrumentation



Kangaledji pond limnometry instrumentation



Digital elevation model mission in Barkedji area

(Fev - March, 2008)





Starting up of raingauge station in Barkedji village





Basic weather station setting up not so far from Niakha pond





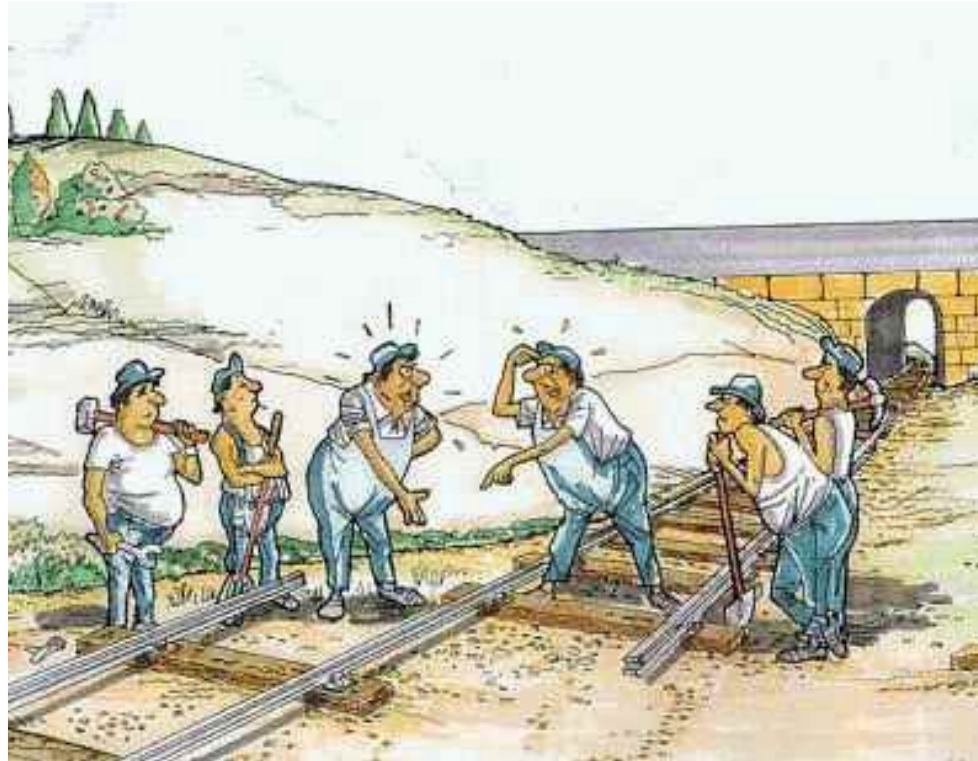
Water quality data collection in Niakha and Kangaledi ponds





Larvae RVF vectors sampling data collection in Ngao and Niakha ponds





Many thanks
to you.

Special thanks
to CNES.

