

CNES Satellite data and modeling for Public Health

Murielle Lafaye
Environment-Climate-Health Program Responsible

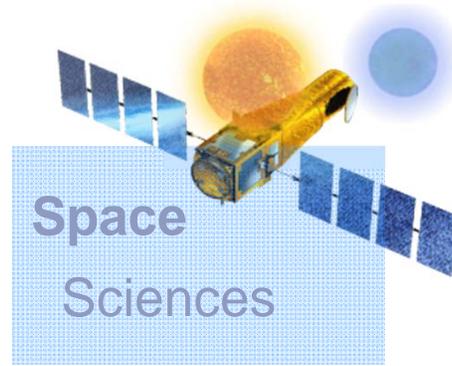
Directorate Strategy and Program
Applications and Valorisation Department

CNES Strategic Action Domains

Civil applications



Space
Sciences



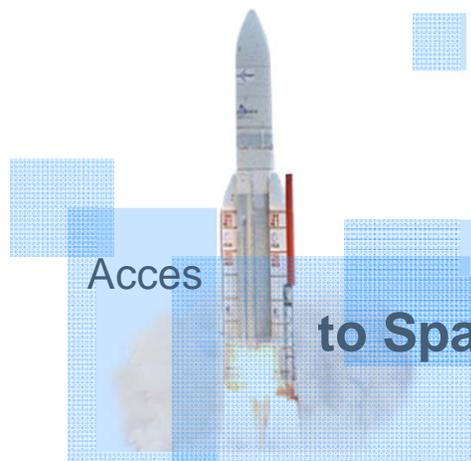
Security & Safety



Earth
environment
climate



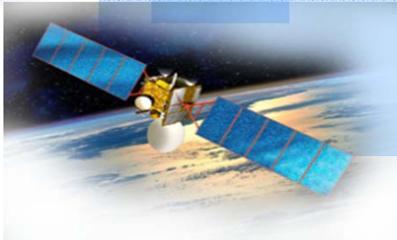
Acces
to Space



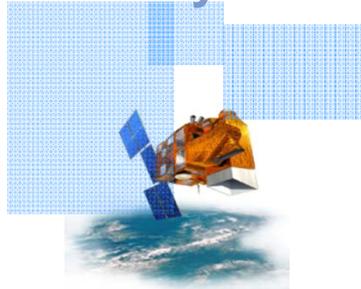


CNES strategy towards Societal Benefit Domains

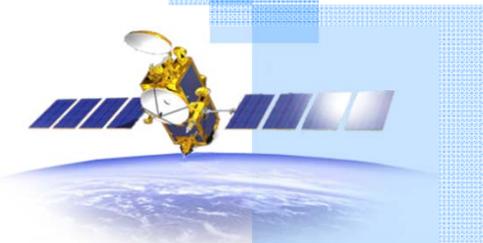
Civil applications



Security & Safety



Earth Environment Climate



Ressources management

Crisis & Natural hazards management

Numeric Access & Services

Transports

Health

Telemedecine

Ease access to healthcare
In mobile or isolated areas

DIABSAT mobile van

French Guyana network

PSMA crisis facility

S2E epidemiological networks

EPIDEFENDER / IMOGENE

Tele-epidemiology

Characterize Environmental Risk for
air-borne, water-borne & vector-borne diseases

Gaz

algal bloom

malaria

Aerosols

vibrio/ cholera

dengue

Particules

bilharzia

Rift Valley

Asthma

cyanobacteria

West Nile...

La Télésanté
L'Espace au service de la santé

1 - Improving access to healthcare

Treating patients at remote and mobile sites

2 - Environment / Climate / Health

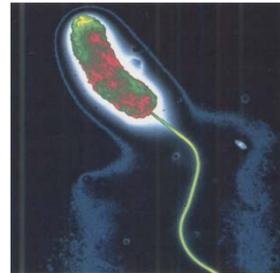
Monitor, predict and prevent epidemics

Tele-epidemiology consists in monitoring and studying the propagation of human and animal diseases (water, air and vector borne diseases) which are closely linked to climate and environmental changes, based on space technology. The French Spatial Agency (CNES) has thus developed a concept based on a deterministic approach of the climate-environment-health relationships and on an original and really adapted space offer.

“Tele-epidemiology” Conceptual approach

Multidisciplinary approach linking disciplines

Environment
Climate



Entomology

Social Science



Microbiology



Veterinary

1- UNDERSTANDING the MECHANISMS favoring EMERGENCE and PROPAGATION

Diagnostic: extract and identify the main physical and biological mechanisms at stake

Observing strategy: monitoring and assembling multidisciplinary in-situ datasets

2- DEVELOPING well ADAPTED PRODUCTS integrating Space tools

Remote-sensing monitoring of environment, linking epidemics with confounding factors

Remote-sensing from space: use of products, fully adapted to spatio-temporal scales of varia

3- INNOVATIVE Risk Maps using SPACE TOOLS

ZPOM modeling as a contributor for EWS

“Tele-epidemiology” Partnerships & Projects

- Conceptual approach currently applied to different infectious diseases :
 - MALARIA in URBAN Areas: Puerto Iguazu (Argentine) and Dakar (Senegal)
 - MALARIA in RURAL Areas: Burkina Faso and Paraguay
 - RIFT VALLEY FEVER in Senegal
 - BILHARZIA in China
 - VIBRIO related diseases (diarrhea, cholera) in the Mediterranean basin
 - DENGUE in Argentina
 - LEISHMANIASIS and MALARIA in Algeria
- Towards Early Warning System ⇒ Rift Valley Fever in Senegal



“Tele-epidemiology” & Bilharzia around the Poyang lake in China

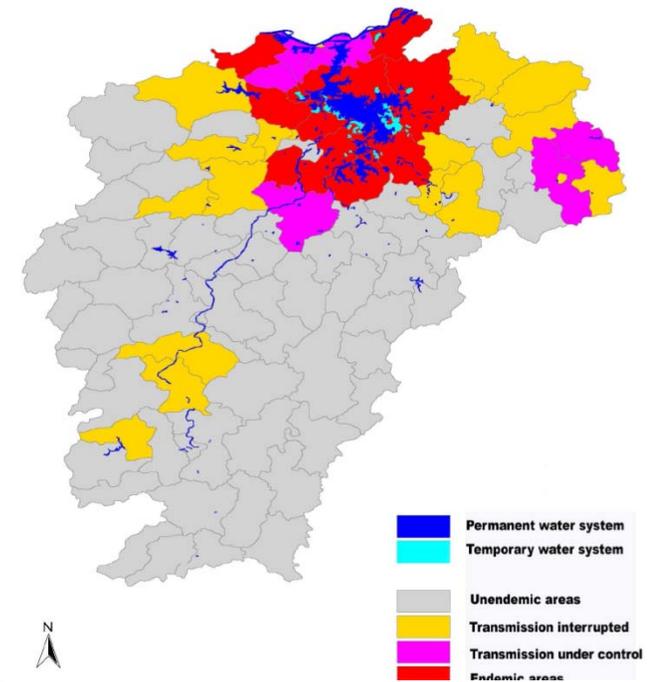
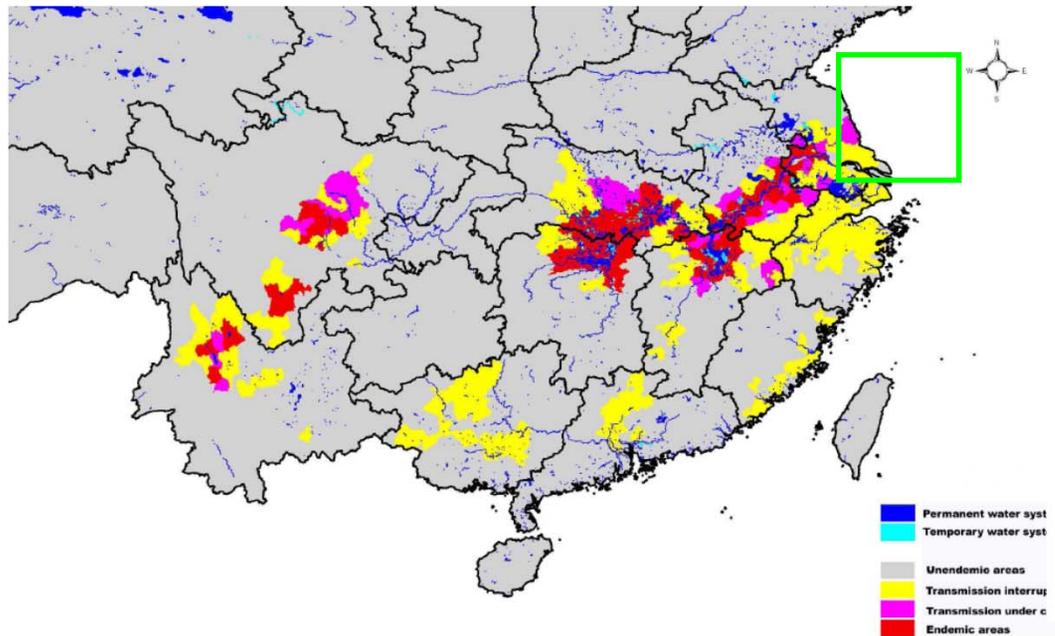


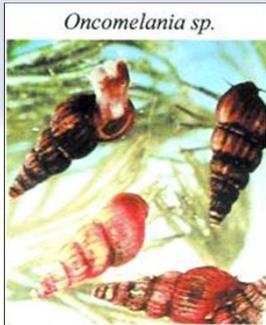
- Biggest soft water lake in China
- Jiangxi Province:
 - 43 million inhabitants
 - 250 inhab/km²
- Mousson lake:
 - Surface varies from 1000 km² to 4000 km²
 - Level varies up 10 to 18 m
- Very rich biotope :
 - Wetlands of international concern (RAMSAR)
 - Key wintering area for South-East Asia



Bilharzia is endemic along Yangtze

And in lake Poyang region, Jiangxi Province





Polygonum



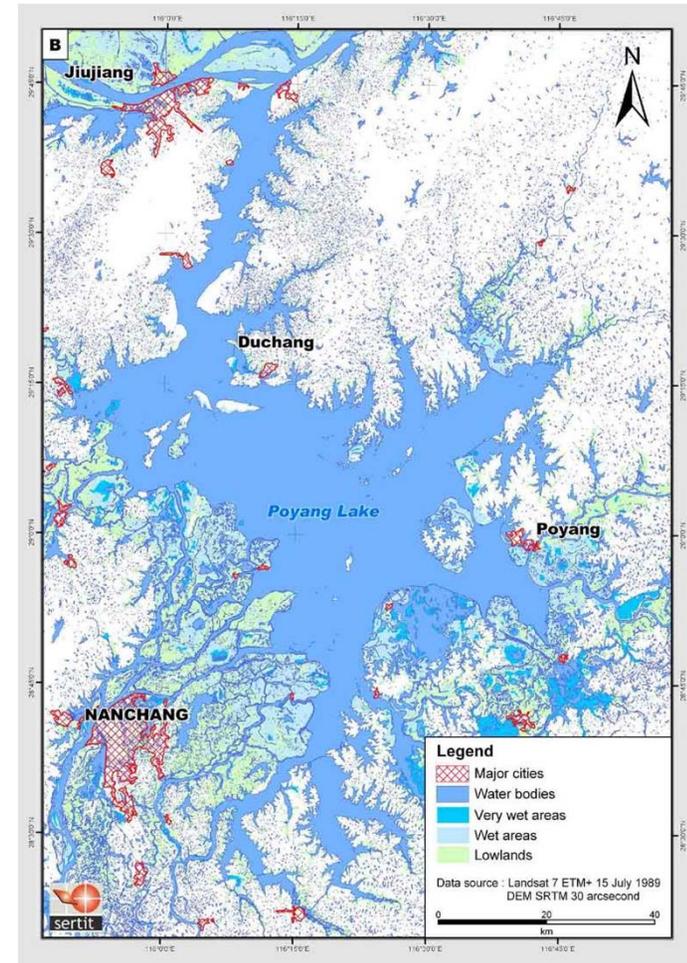
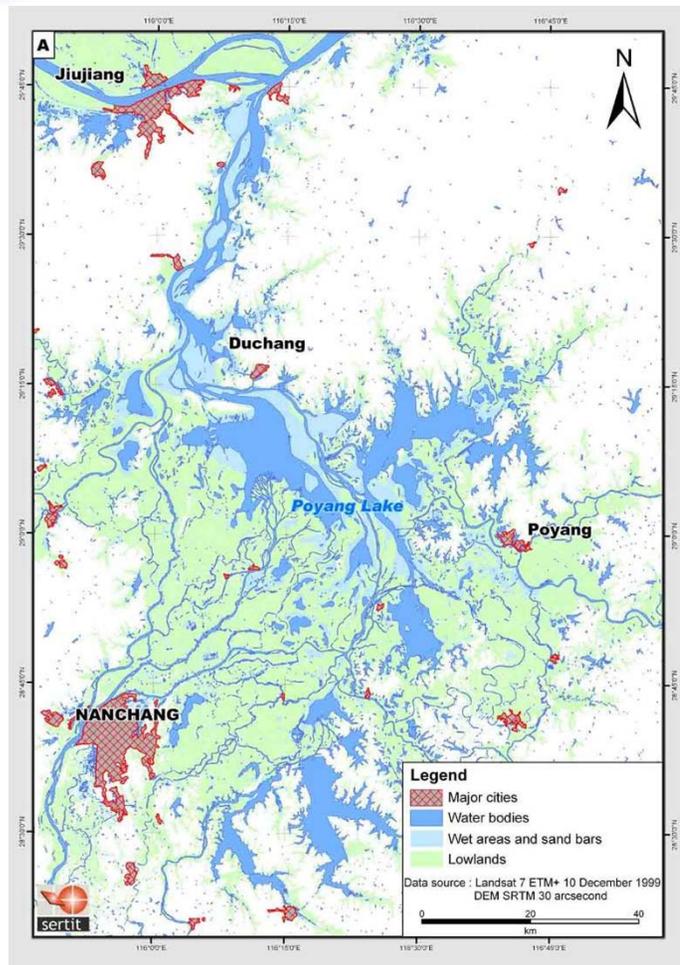
Carex



Understanding Ecology of the Vector

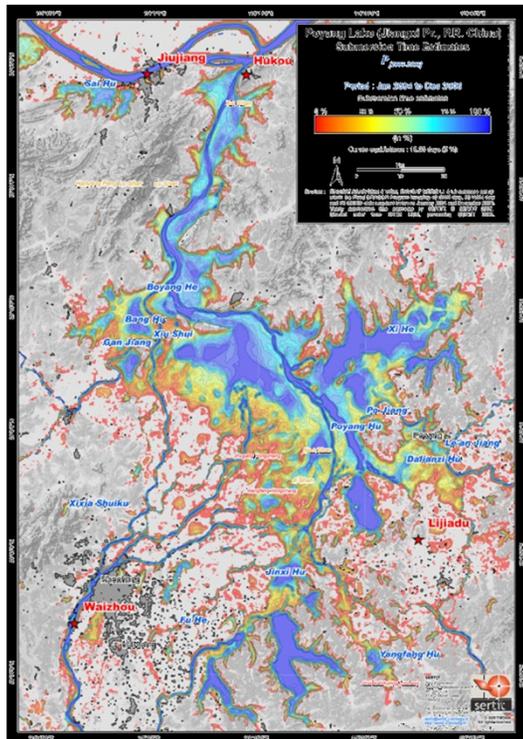
2 – Developing ADAPTED PRODUCTS integrating SPACE TOOLS

Space tools applied to Bilharzia monitoring around Poyang lake, China

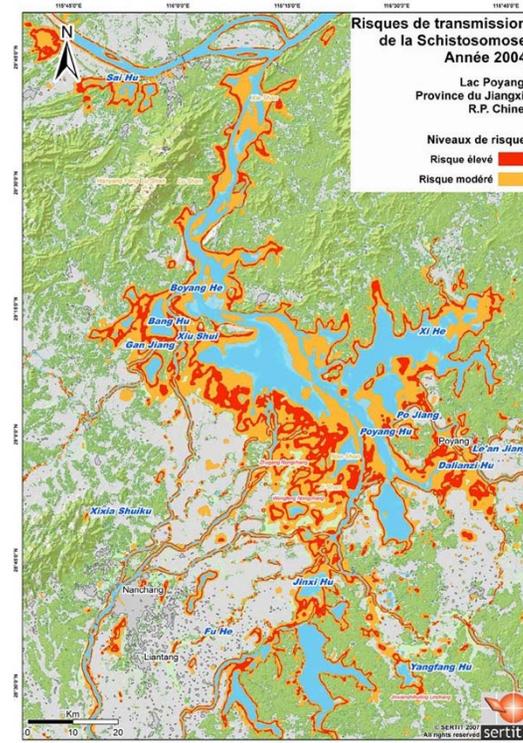


Lake surface inter-annual variation monitoring

3-“Tele-epidemiology” from Applied Research towards Services Bilharzia, Poyang Lake, China



Annual submersion time



ZPOM for Molluscs



“Tele-epidemiology” & Urban Malaria in Dakar City, Senegal



IRBA, France

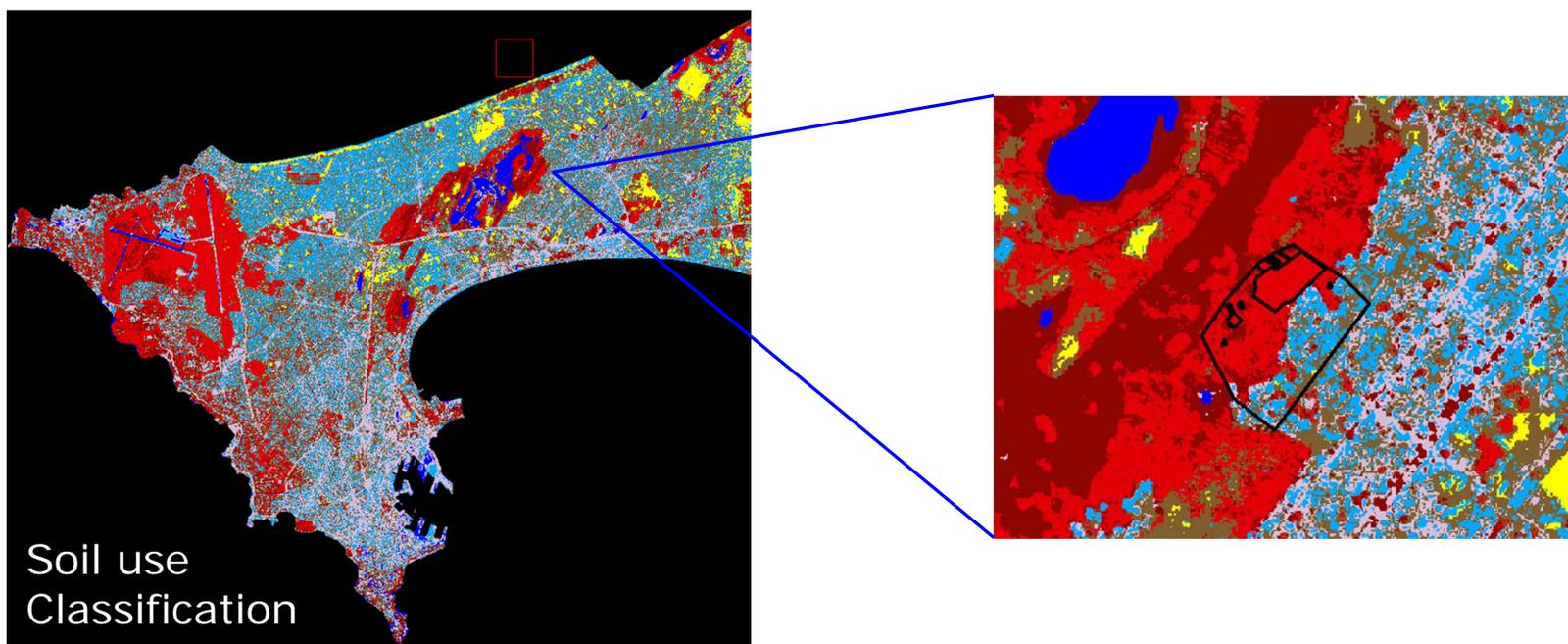
Observatoire Midi-Pyrénées – Laboratoire deAérologie, France

IRD Dakar, Senegal

Diversity of Anopheles Breeding sites



2 – Developing ADAPTED PRODUCTS integrating SPACE TOOLS A Remote-sensing tool applied to Urban Malaria in Dakar city, Senegal

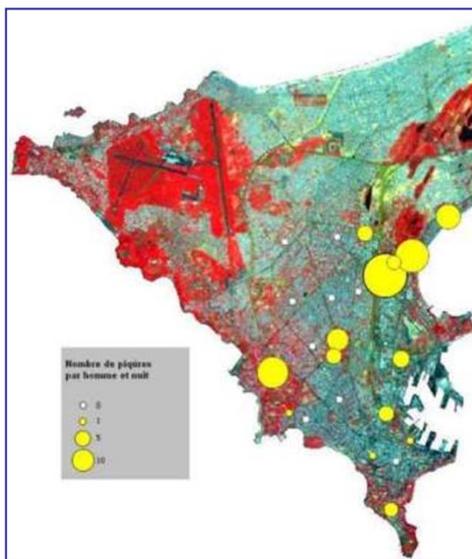


Detecting breeding sites

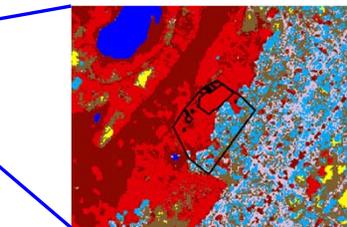
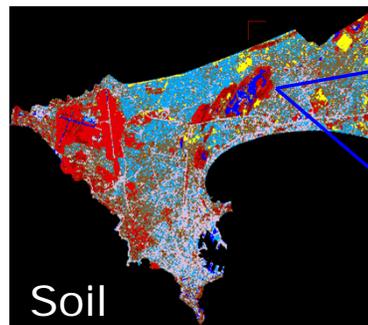
3-“Tele-epidemiology” from Applied Research towards Services Urban Malaria, Dakar, Senegal

PhD of Vanessa Machault, funded by IRBA & CNES
with scientific support of Laboratoire d’aérodologie & IRD

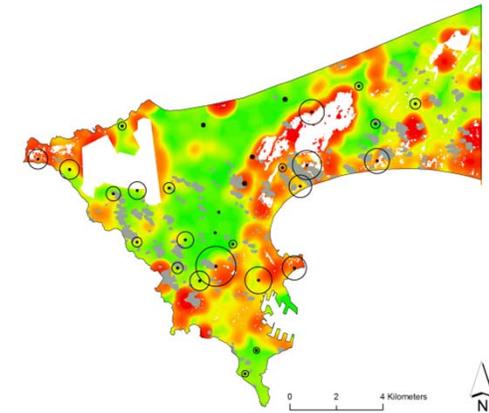
+ **EEOS Malaria** **SIRS, SERTIT, IRBA** funded by API2010 CNES



Anopheles n° bites.person/night (field data)



Detecting breeding sites



■ Clouds
 □ Mask (airport and water collections)
 Nb of Anopheles bites per person per night in Sept. 09 (predicted)
 ■ < 100
 ■ 100 - 199
 ■ >=200
 Nb of Anopheles bites per person per night in Sept. 09 (field data)
 • 1
 ○ 10
 ○ 100
Comparing predicted and measured Anopheles n° bites.person/night

“Tele-epidemiology” & Rift Valley Fever in Senegal



CENTRE NATIONAL D'ÉTUDES SPATIALES

Météo France, France

Association Reflets, France

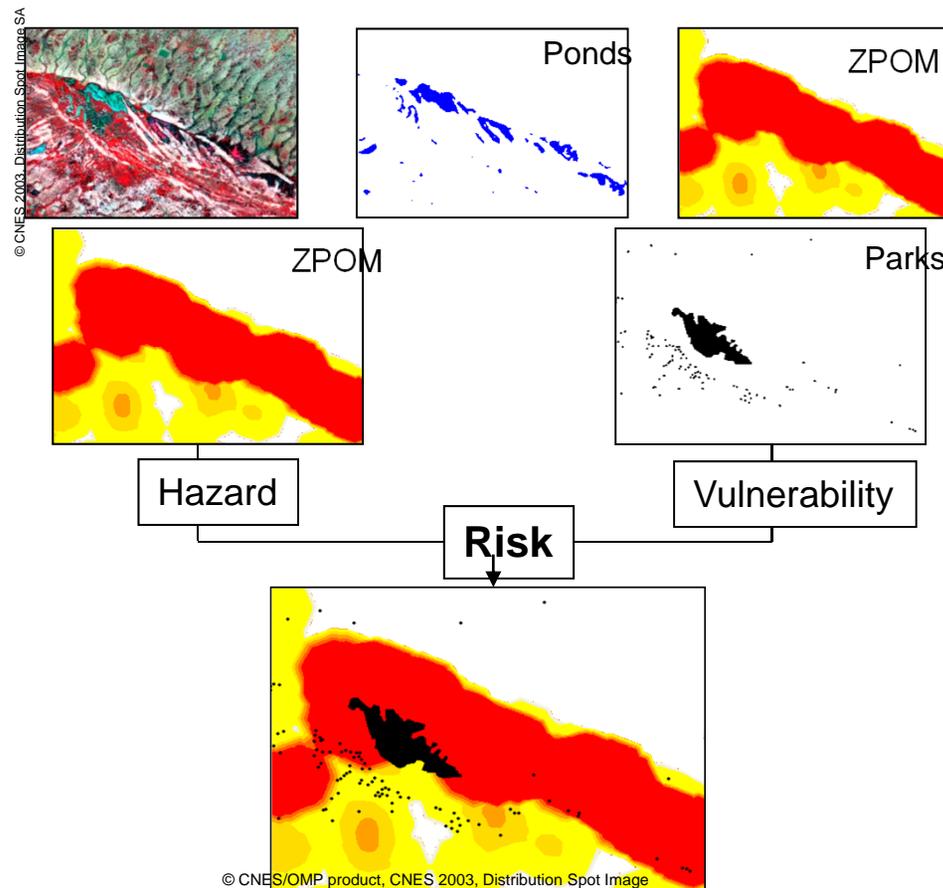
Direction des Services Vétérinaires, Senegal

Centre de Suivi Ecologique, Senegal

Institut Pasteur de Dakar, Senegal

2 – Developing ADAPTED PRODUCTS integrating SPACE TOOLS

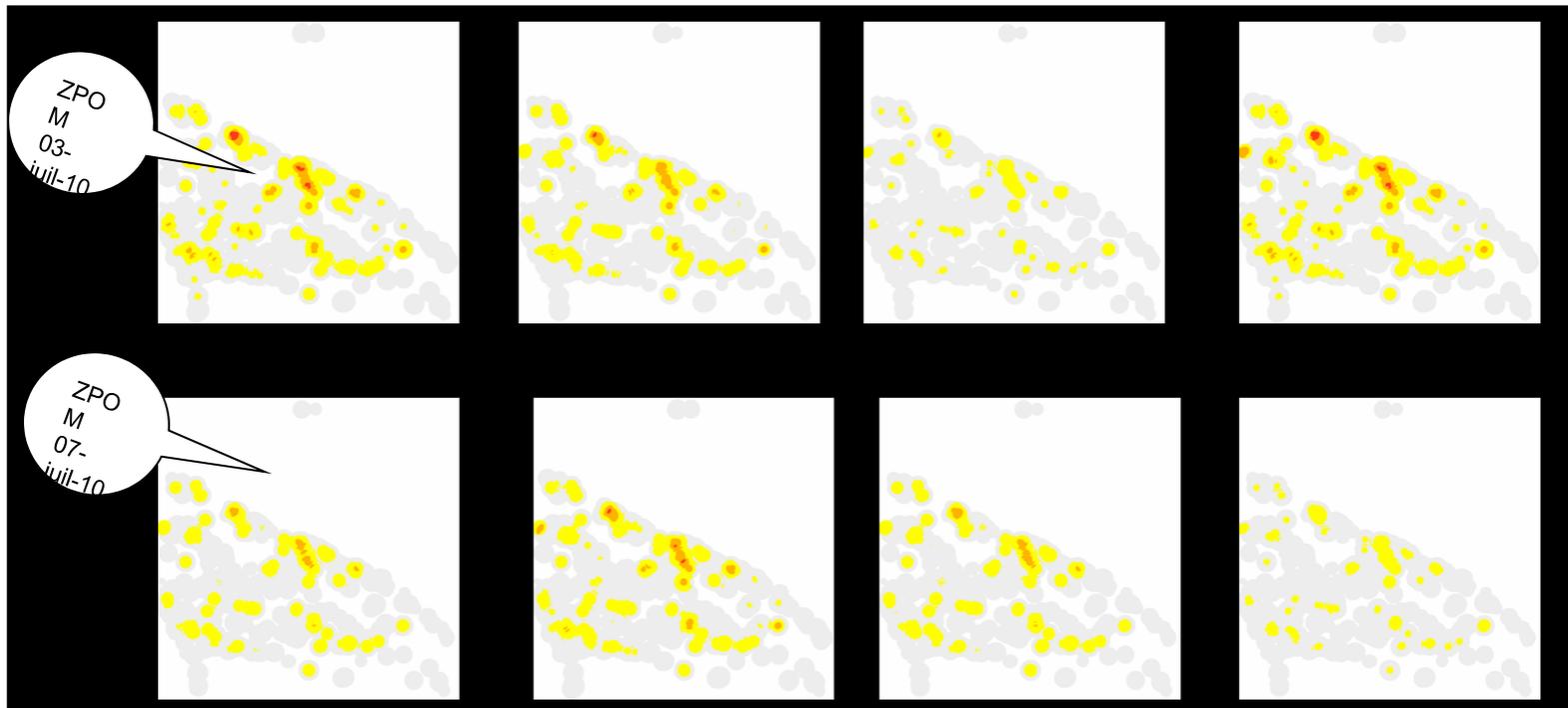
Space tools applied to Rfit Valley Fever in Senegal, Ferlo region



**3-“Tele-epidemiology” from Applied Research towards Services
Rift Valley Fever, Ferlo region, Senegal**

Project AdaptFVR

funded by MEDDTL - GICC Program





CNES strategy for developing the use of satellites in Societal Benefit Areas

At National level : developing business opportunities

Users community

Scientific community

Industrial partners – services providers

At International level : promoting the use of space for SBA & Health

GEO Workplan 2009-2011 + Workplan 2012-2015

Community of Practice “Health & Environment” co-leads CNES, WHO, ICMR



CEOS SBA Health (leader CNES)





CNES strategy for developing the use of satellites in Societal Benefit Areas



GEO SBA Health Workplan 2012-2015

HE-01 Tools and Information for Health Decision-Making

C1 Air-borne Diseases, Air Quality and Aeroallergens:

C2 Water-borne Diseases, Water Quality and Risk

C3 Vector-borne Diseases

C4 A Holistic Approach to Health: Transmission Dynamics, Urban Health Forecasting, Linkages and New Technologies

HE-02 Tracking Pollutants

C1 Global Mercury Observation System

C2 Global Monitoring of Persistent Organic Pollutants, Emerging Contaminants and Global Change Indicators



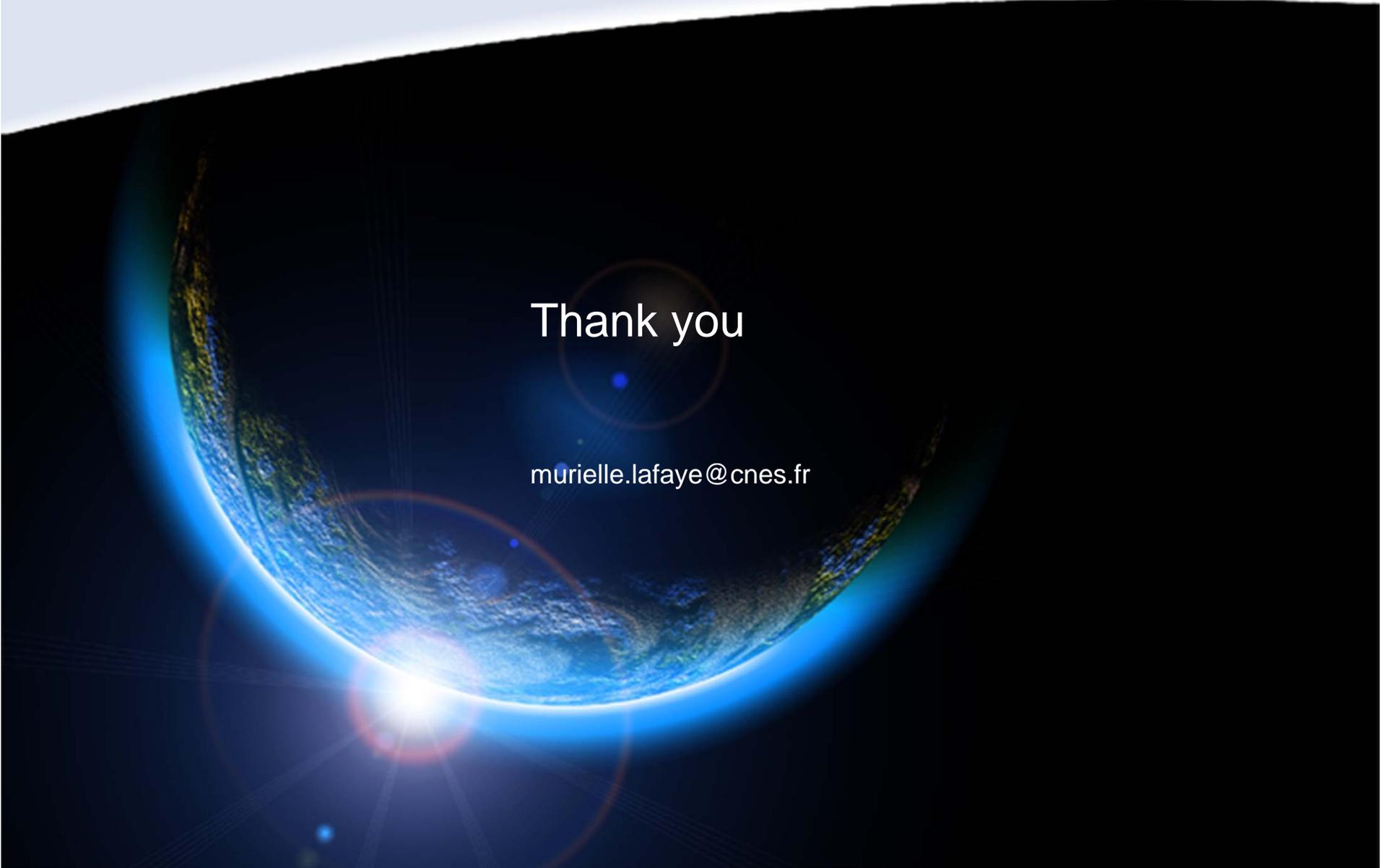
CNES strategy for developing the use of satellites in Societal Benefit Areas

COES SBA Health Tasks addressing GEO Workplan 2012-2015



- HE-11-01_C1 EO contribution to Air-borne Diseases, Air Quality and Aeroallergens
- HE-11-01_C2 EO contribution to Water-borne Diseases, Water Quality and Risk
- HE-11-01_C2 EO contribution to C3 Vector-borne Diseases

- ✓ sharing experience between space organisms using remote sensing
- ✓ identify relevant EO information and indicators
- ✓ ease providing health users with really adapted products at pertinent scales (time and resolution)

The background of the slide is a photograph of the Earth as seen from space. The planet is curved, showing blue oceans and green landmasses. A bright sun is visible at the bottom left, creating a lens flare effect. The text 'Thank you' is centered in the middle of the image.

Thank you

murielle.lafaye@cnes.fr