CNES Satellite data and modeling for Public Health

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CNES Strategic Action Domains

Civil applications

Security & Safety

Acces to Space

Space Sciences

Earth environment climate

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CNES strategy towards Societal Benefit Domains

Civil applications

- Ressources management
- Crisis & Natural hazards management
- Numeric Access & Services
- Transports
- Health

Security & Safety

Earth Environment Climate
# CNES and e-Health

## Telemedicine

- 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
  - Aerosols
  - Particules
  - Asthma
  - algal bloom
  - vibrio/ cholera
  - bilharzia
  - cyanobacteria
  - malaria
  - dengue
  - Rift Valley
  - West Nile…
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

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 variation

3- INNOVATIVE Risk Maps using SPACE TOOLS

ZPOM modeling as a contributor for EWS

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“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

SERTIT
NIPD Shanghai
Bilharzia around Poyang Lake, China
1 - Understanding mechanisms at stake

- 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 around Poyang Lake, China

1 - Understanding mechanisms at stake

Bilharzia is endemic along Yangtze and in lake Poyang region, Jiangxi Province.
Bilharzia around Poyang Lake, China
1 - Understanding mechanisms at stake

Understanding Ecology of the Vector

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2 – Developing ADAPTED PRODUCTS integrating SPACE TOOLS
Space tools applied to Bilharzia monitoring around Poyang lake, China

Lake surface inter-annual variation monitoring

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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
Urban Malaria in Dakar City, Senegal
1 - Understanding mechanisms at stake

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

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

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

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

Comparing predicted and measured Anopheles n° bites.person/night

Detecting breeding sites

Soil
“Tele-epidemiology” & Rift Valley Fever in Senegal

Météo France, France
Association Reflets, France
Direction des Services Vétérinaires, Senegal
Centre de Suivi Ecologique, Senegal
Institut Pasteur de Dakar, Senegal
1 - Understanding mechanisms at stake

From rainfall event to vectors’ aggressiveness

2003 TRMM daily rainfall data

Aedes vexans (%) versus pond distance (meter)

Mosquitoes Flying range

Cumulative frequency (%) vs Pond distance (in meter)

Adapted from Bà et al 2005

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2 – Developing ADAPTED PRODUCTS integrating SPACE TOOLS
Space tools applied to Rift Valley Fever in Senegal, Ferlo region

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

Project AdaptFVR

funded by MEDDLT - 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

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)
Thank you

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