MALAREO – EO in malaria vector control

GMES Global Land workshop

12-13 December 2011, Lisbon (Portugal)

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Contents

1. Environment – EO - Health
2. Vector-borne diseases (malaria)
3. MALAREO
4. Link with GLOB-LAND products
5. Will it be GM(H)ES?
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Contents

1. Environment – EO - Health
2. Vector-borne diseases (malaria)
3. MALAREO
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5. Will it be GM(H)ES?
WHO: “An estimated 24% of the global burden of disease and 23% of all deaths can be attributed to environmental factors”

UN Climate conference 2011: Health is becoming a key goal of climate policies and a priority in climate mitigation and adaptation actions.
EO can support policy makers to control, respond and prevent disease

- Use EO sensors to monitor key environmental events
- Incorporate EO information into spatial models, to help detect, monitor or predict disease
- Use EO data to prepare disease control measures
Environment – EO - Health

• Domains where EO can support public health
  – Air quality
  – Water quantity and quality
  – Infectious and Vector-borne diseases (VBD)
  – Temperature (e.g.: UHI)

• Users: WHO, Public health instances, regional/national/local policy makers,...
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Contents

1. Environment – EO - Health
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3. MALAREO
4. Link with GLOB-LAND products
5. Will it be GM(H)ES?
Vector-borne diseases

- Epidemiological remote sensing applications looks at parameters that are suitable to predict the environmental conditions for the vectors (e.g. land cover, temperature, precipitation etc.)
- Spatial analysis for:
  - A better understanding of risk factors
  - Better preparation of intervention/prevention
  - Assessing the effect of interventions/prevention
VBD - malaria

Climate suitability map for Malaria (MARA/ARMA)
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**VBD - malaria**

- 225 million annual cases worldwide, 212 million in Africa
- Close to 800,000 deaths each year
- 90% of malaria-related deaths occur in sub-Saharan part of Africa, the majority of deaths are young children

Estimated deaths from malaria per 1000 population, 2006
VBD - malaria

- Global strategy to fight malaria: Global Malaria Action Plan (GMAP)
  - **Vision**: substantial and sustained reduction in the burden of malaria in the near and mid-term, and the eventual global eradication of malaria in the long term
  - **Concrete targets:**
    - Achieve universal coverage
    - Reduce global malaria cases from 2000 levels by 75% in 2015
    - Reduce global malaria deaths to near zero preventable deaths in 2015
    - Eliminate malaria in 8 – 10 countries by 2015
    - In the long term, *eradicate* malaria world-wide by reducing the global incidence to zero through progressive elimination in countries.
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VBD - malaria

Figure: Copyright © 2003 by Prentice Hall, Inc. (http://wps.prenhall.com/)
Malaria is essentially an environmental disease
- The vector requires specific habitats with surface water for reproduction
- Humidity is required for adult mosquito survival
- The development rates of both the vector and parasite populations are influenced by temperature

The continued existence of malaria in an area requires a combination of
- high human population density
- high mosquito population density
- high rates of transmission from humans to mosquitoes and from mosquitoes to humans
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12-13 December 2011, Lisbon (Portugal)

Contents

1. Environment – EO - Health
2. Vector-borne diseases (malaria)
3. MALAREO
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• FP7 collaborative project
• Work programme topic addressed:
  – SPA.2010.3.2-03 EU-South Africa Cooperation in GMES (SICA)
• Project duration: 2 years
• Project start: 01/02/2011
• Total Cost: 580 279 €
• EU contribution: 497 326 €
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**Malareo - Partners**

<table>
<thead>
<tr>
<th>Partners (3)</th>
<th>Partner/Users (3)</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Remote Sensing Solutions (Germany)</td>
<td>• Medical Research Council (South-Africa)</td>
<td>• National and local Malaria Control Programs of Mozambique and South-Africa</td>
</tr>
<tr>
<td>• University of Kwazulu-Natal (South-Africa)</td>
<td>• National Malaria Control Program Swaziland</td>
<td></td>
</tr>
<tr>
<td>• Eurosense (Belgium)</td>
<td>• Swiss Tropical and Health Institute</td>
<td></td>
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</tbody>
</table>
Malareo - AOI
Project area: Border region South-Africa – Swaziland - Mozambique
Malareo - Objective

• The **main objective** of MALAREO is to support local malaria vector control and management in Southern Africa by
  – developing HR Earth Observation solutions
  – build local Earth Observation capacity

• User-driven and state-of-the-art
<table>
<thead>
<tr>
<th>MALAREO Product Definition</th>
<th>Required Methodology</th>
<th>Type of Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household Map</td>
<td>On-Top Methodology vs. manual mapping</td>
<td>NMCP for improved IRS</td>
</tr>
<tr>
<td>Water Body Map</td>
<td>Pixel-based NIR classification</td>
<td>NMCP for habitat identification</td>
</tr>
<tr>
<td>Land Cover Map</td>
<td>Object-based rule set classification</td>
<td>NMCP and STI for Malaria risk modelling</td>
</tr>
<tr>
<td>Water Body Map</td>
<td>Pixel-based NIR classification</td>
<td>NMCP for habitat identification</td>
</tr>
<tr>
<td>Distance to Water</td>
<td>Euclidean Distance</td>
<td>STI for Malaria risk modelling</td>
</tr>
<tr>
<td>Vegetation Indices</td>
<td>NDVI, NREVI, GNDVI</td>
<td>STI for Malaria risk modelling</td>
</tr>
<tr>
<td>Population Map</td>
<td>Land cover based disaggregation</td>
<td>NMCP and STI for Malaria risk modelling</td>
</tr>
<tr>
<td>Land Cover Change Map</td>
<td>Map-to-Image or Image-to-Image</td>
<td>Research and STI for Malaria area modelling</td>
</tr>
</tbody>
</table>

**Additional Data**
- Malaria Risk: Bayesian Modelling, NMCP
- Malaria Area: Bayesian Modelling, NMCP
Malareo – Capacity building

• EO and GIS capacity building of MCP staff
  – 1st training will take place in Durban from 6 – 10 February, 2012
Malareo – Expected impact

- Strengthen European/(South-)African collaboration
- Build capacities
- Contribute to (establishing) national EO monitoring centers
- Contribute to GEOSS
- Contribute to a better “Understanding of environmental factors affecting human health and well-being”
- Add value on top of ongoing projects in the region
- Built the basis of sustainable EO support to Malaria control programs (MCP’s)
- Set an example for MCP’s outside the project working area
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12-13 December 2011, Lisbon (Portugal)

Contents

1. Environment – EO - Health
2. Vector-borne diseases (malaria)
3. MALAREO
4. Link with GLOB-LAND products
5. Will it be GM(H)ES?
Projects like MALAREO could be/are a user of the GLOB-LAND products AND can foster the use of the GLOB-LAND products in other (non-EO) organizations

Adapt GLOB-LAND products to public health needs?

MALAREO: focus on the potential contribution of HR Land Cover (*fine-scale land cover maps*) information in spatial modeling of malaria risk <-> LR high temporal resolution products

NEED to have more detailed (space and time??) information on Temperature, humidity, precipitation
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*Link with GLOB-LAND products?*

- Potential products of interest from the Global Land Portfolio for Health (malaria):

<table>
<thead>
<tr>
<th>Name</th>
<th>Horizontal resolution</th>
<th>Frequency of product update</th>
<th>Error</th>
<th>Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine-scale land cover maps</td>
<td>10-30 m</td>
<td>1-5 years</td>
<td>15%</td>
<td>Pre-op</td>
</tr>
<tr>
<td>Fine-scale land cover change</td>
<td>10-30m</td>
<td>1-5 years</td>
<td>15%</td>
<td>Pre-op</td>
</tr>
<tr>
<td>Lakes maps. Wetlands/flood plains</td>
<td>30-250m</td>
<td>10-30 days</td>
<td>10%</td>
<td>Operational</td>
</tr>
</tbody>
</table>

- Other common needs as input for malaria spatial modeling (early warning models) and GLOB-LAND component (Precipitation, temperature, DEM, socio-economic data,...)
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12-13 December 2011, Lisbon (Portugal)

Contents

1. Environment – EO - Health
2. Vector-borne diseases (malaria)
3. MALAREO
4. Link with GLOB-LAND products?
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*Will it be GM(H)ES?*

- Keep track/link with ongoing research on epidemiology (EDENEXT, HealthyFutures, EPISTIS,...)
- Customize **systematic** global Land products (LR) for locating health risk areas (not necessarily Global coverage!)
- Customize **HR hot spot** Land products ‘ready-to-use’ as input for spatial modeling done by specialized institutions (e.g. Tropical health institutes)
- Standard **VHR hot spot** products used for direct support of health control (e.g. malaria control actions)
- EO capacity building in Public Health services!
Thank You!

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