



# GROUP ON EARTH OBSERVATIONS

## Human Health Infectious Diseases SBA Prioritization Results

**GEO Task US-09-01a**

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# GEO Task US-09-01a

## *Human Health Infectious Diseases SBA – Scope*

- ❑ Identify critical E.O. priorities within Human Health Infectious Diseases
- ❑ Consulted with UIC Task Co-leads and Advisory Group to narrow scope
- ❑ Infectious Diseases include:
  - Vector-Borne Diseases: transmitted by an Arthropod vector (23 diseases)
  - Non Vector-Borne Diseases: transmitted by water, food, body fluids, air or zoonotic hosts (21 diseases)
- ❑ Aeroallergens and Air Quality treated separately



# GEO Task US-09-01a

## Human Health Infectious Diseases SBA – Advisory Group

19 A.G. members

Name	GEO Country or Organization	Affiliation	Geographic Region	Area of Expertise/ Specialty
Ulisses E.C. CONFALONIERI	Brazil	FIOCRUZ	Americas	Remote sensing, Public Health
Stephen J. CONNOR	USA	IRI - WHO – PAHO	Africa Americas Asia	Remote sensing, Environment, Infectious Diseases
Pat DALE	Australia	Griffith University	Australia	Remote sensing, Environment, Infectious Diseases
Joaquim DASILVA	Zimbabwe	WHO - AFRO	Africa	Medicine, Public Health, Disease control systems
Ruth DEFRIES	USA	Columbia University	Africa Americas Asia	Remote Sensing, Land Cover Change
Gregory GLASS	USA	JHBSPH	Americas	Modeling Infectious Disease Risk
John HAYNES	USA	NASA	Americas	Meteorology, Remote Sensing
Darby JACK	USA	MSPH	Africa Americas	Development, economics, environmental health
Isabelle JEANNE	France	Consultant	Africa	Remote Sensing and Public Health



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## Human Health Infectious Diseases SBA – Advisory Group

Name	GEO Country or Organization	Affiliation	Geographic Region	Area of Expertise/ Specialty
Erick KHAMALA	Kenya	RCMRD	Africa	Remote Sensing
Patrick KINNEY	USA	MSPH	Africa Americas	Public Health
Uriel KITRON	USA	Emory University	Africa Americas	Infectious diseases ecology, GIS, Remote Sensing
Murielle LAFAYE	France	CNES	Europe-Africa	Human Health -Environment
Forrest MELTON	USA	CSUMB	Americas	Remote sensing, ecosystem modeling, decision support system
Jacques André NDIONE	Senegal	CSE	Africa	Climatologist working on Environment Changes and Health issues
Masami ONODA	Switzerland	GEOSS	International	Environmental policy, satellite program management and data policy
David ROGERS	Switzerland	HCF	Africa Americas	In-situ observation and utilization of E.O. information
Leonid ROYTMAN	USA	NOAA-CREST	Asia	Remote Sensing for Infectious Diseases
Juli TRTANJ	USA	NOAA	Americas	Human Health, Oceans



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## Human Health SBA - Documents

- ❑ The analysis used literature reviews, internet searches, and Advisory Group recommendations to identify documents which included references to Earth Observation parameters.
  
- ❑ A wide range of documents from **English, Spanish, Portuguese, French and Chinese** literature was examined including:
  - Peer-reviewed documents selected for the period 2000-2009 through:
    - ISI Web of Knowledge,
    - Google Scholar
    - CHAART Remote Sensing/GIS Human Health web site:  
<http://geo.arc.nasa.gov/sge/health/rsgisbib.html>
  - Reports obtained from:
    - UN World Health Organization (WHO)
    - UN World Meteorological Organization (WMO)
    - US National Aeronautics and Space Administration (NASA)
    - US National Oceanic and Atmospheric Administration (NOAA)
    - US The National Academies
    - International Federation of Red Cross and Red Crescent Societies (IFRC)



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## *Human Health SBA - Documents*

❑ Other documents obtained through:

– Requests made to Universities and Governmental agencies including:

- Emercom of Russia, Federal Center of Science and High Technologies, Civil Defense and Disaster Management All Russian Science Research Institute, FSO VNII GOChS (FC), <http://www.ampe.ru/web/guest/english> Prof. Vladimir Badenko, SPb State Polytechnical University, 195251, Saint-Petersburg, Russia
- Antioquia University, Columbia (email: [coocurpme\\_fcbog@unal.edu.co](mailto:coocurpme_fcbog@unal.edu.co))
- Universidad Nacional de Colombia (email: [coocurpme\\_fcbog@unal.edu.co](mailto:coocurpme_fcbog@unal.edu.co))
- Ministry of Health and Infectious Diseases Control Bureau in China (emails: [service@newhealth.com.cn](mailto:service@newhealth.com.cn), [manage@moh.gov.cn](mailto:manage@moh.gov.cn))



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## Human Health SBA - Analysis

A database was created to analyze the documents

<b>ID</b>	<input type="text" value="1"/>	<b>Type of Publication</b>	Peer-review
<b>Disease Name</b>	Malaria	<b>Authors</b>	Ceccato, P., Connor, S., Jeanne, I., Thomson, M.C.
<b>Vectors</b>	mosquito	<b>Year</b>	2005
<b>Agent</b>	Plasmodium sp.	<b>Journal</b>	Parassitologia
<b>Region</b>	Global	<b>Title</b>	Application of Geographical Information Systems and Remote Sensing technologies for assessing and monitoring malaria risk
<b>Country</b>		<b>Language</b>	English
<b>Variables</b>		<b>Endnote ID</b>	GL 64 Ceccato et al 2005
<b>Rainfall:</b> <input checked="" type="checkbox"/>	<b>Temperature:</b> <input checked="" type="checkbox"/>	<b>Land Use:</b> <input checked="" type="checkbox"/>	
<b>Relative Humidity:</b> <input checked="" type="checkbox"/>	<b>Wind:</b> <input type="checkbox"/>	<b>Biodiversity:</b> <input type="checkbox"/>	
<b>Dust:</b> <input type="checkbox"/>	<b>Water Bodies:</b> <input checked="" type="checkbox"/>	<b>Urbanisation:</b> <input type="checkbox"/>	
<b>Vegetation:</b> <input checked="" type="checkbox"/>	<b>Population:</b> <input type="checkbox"/>	<b>Chlorophyll:</b> <input type="checkbox"/>	
<b>Sea Surface Temp:</b> <input type="checkbox"/>	<b>Sea S. Height:</b> <input type="checkbox"/>	<b>Others:</b> <input type="checkbox"/>	
<b>Other, specify:</b>	<input type="text"/>		
<b>Who are the users?</b>	Health Risk Analysts	<b>How do they access the data?</b>	<input type="text"/>
<b>User additional information</b>	<input type="text"/>	<b>How are the data used?</b>	<input type="text"/>
<b>Data Used:</b>	ground <input type="checkbox"/> airborne <input type="checkbox"/> satellite <input checked="" type="checkbox"/>	<b>Additional information how data is used</b>	<input type="text"/>
<b>Specify:</b>	NOAA-AVHRR, LANDSAT, SPOT-VEGETATION	<b>What types of data do they need to do their job better?</b>	<input type="text"/>
		<b>Comments:</b>	Review based on remote sensing requirements for Mintry of Health

Record: 1 of 822



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## Human Health *SBA* - Documents

- Identified 822 documents:

Region	Number of Reports
International	198
Africa	130
Asia	198
Europe	64
North America	91
Oceania/Australia	39
Polar Region	1
South/Central America	101



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## Human Health *SBA - Prioritization*

### ❑ Prioritization of E.O. based on the burden of disease

- Diseases Burden list produced by UN WHO (2005); based on the “disability-adjusted life year (DALY)” a time-based measure that combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health
- The E.O. parameters are ranked based on the DALY values using a cumulative impact computed as follows:

$$\text{Cumulative\_Impact} = \sum_{i=1}^n \text{DALY}_i(x_i)$$

Where  $n$  = number of diseases;  $x_i$  = EO parameter for disease  $i$ ; and  $\text{DALY}_i$  = DALY value for disease



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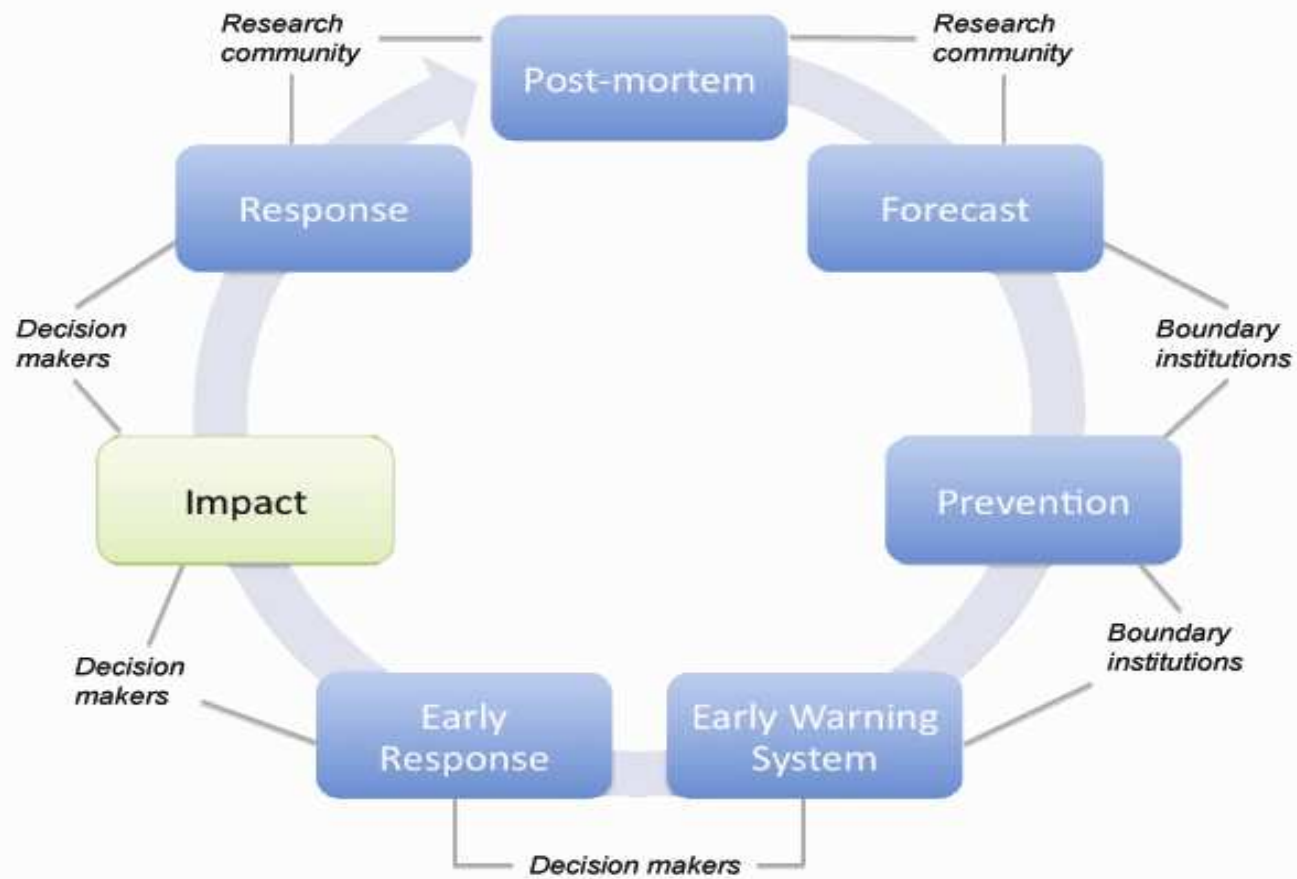
## Human Health SBA - Results

User Type	Examples found in the literature review and suggested by A.G. members
1. Research Communities	<i>e.g.</i> Modelers, Epidemiologists, Animal health scientists, Biologists, Climatologists, Ecologists, Entomologists, Environmental scientists, Epidemiologists, Geographers, Marine biologists, Parasitologists, Public Health risk modelers, Public health scientists, Remote sensing specialists, Veterinarians, Zoologists, Development researchers, some social science and political science researchers
2. Boundary organizations	<i>e.g.</i> UN WHO, UN WMO, UN FAO, National Meteorological and Hydrological Services, IRI, PAHO and USAID FEWSNet for Malaria Early Warning System, NASA (Applied Sciences Program), NASA SERVIR, Public Health Department Canada (Global Public Health Intelligence Unit), ISID (Pro-MED program), CNES (RedGems), ESA (Epidemio program), IFRC, Institut Pasteur, MARA, RBM, MARC (Australia)
3. Decision Makers	<i>e.g.</i> National and Sub-national Public Health Agencies, Policy Makers, General public, NGOs and Advocacy Group, World Bank



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## Human Health SBA - Results

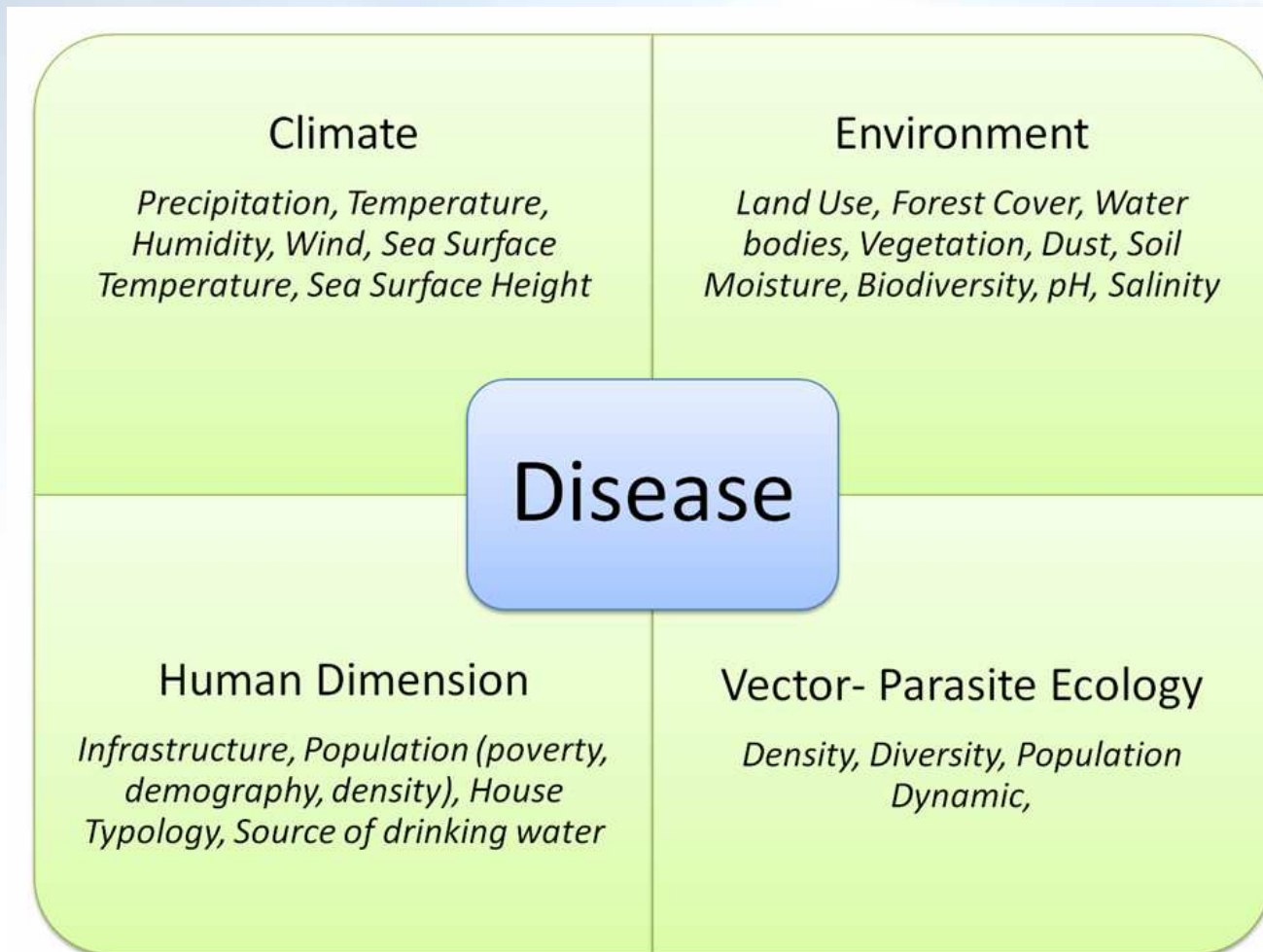




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## Human Health SBA - Results

Data, Information, Products are classified into 4 Observation Categories





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## Human Health SBA - Results

Observation Category	Parameter	Data-Information - Products (in-situ - airborne - satellite)	Characteristics of the Observations Parameters					
			Coverage/Extent	Spatial	Temporal	Accuracy	Latency	Disease
Climate	Precipitation	<p><b>1.In-situ:</b> <u>Data</u> Weather Stations managed by the National Meteorological and Hydrological Services</p> <p><u>Products</u> gridded data products derived from station observations</p>	Local. Extent depends on the country infrastructure established by the Met Services, sometimes supplemented by rain gauges installed by the Ministry of Health	Local measurement	Hourly, Daily, 7-days, 10-days, Monthly data	N/A	Depends on the met services (from real-time to days/months later. Data not necessarily free.	Acute Respiratory Virus, African Eye Worm, Barmah Forest Virus, Blue Tongue, Chagas, Chikungunya, Cholera, Dengue, Diarrheal Diseases, Fasciolosis, Hantavirus, Japanese Encephalitis, Leishmaniasis, Lyme's Disease, Lymphatic filariasis, Malaria, Meningococcal Meningitis, Plague, Rift Valley Fever, Ross River Virus, Shigellosis, Trachoma, West Nile fever, Yellow fever, Leptospirosis, Plague, Hemorrhagic fever, Fasciolosis, Hantavirus, Plague, West Nile fever



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## Human Health SBA - Results

Observation Category	Parameter	Data-Information - Products (in-situ - airborne - satellite)	Characteristics of the Observations Parameters					
			Coverage/ Extent	Spatial	Temporal	Accuracy	Latency	Disease
Climate								
	Precipitation	<p><b>2. Satellite</b> (GOES, Meteosat, GMS, GOMS, TRMM, SSMI, INSAT) <u>Data:</u> VS, IR, TIR, PM channels <u>Information:</u> rainfall estimate (e.g. CCD, CMAP, CMOPRH, RFE, TRMM) <u>Product:</u> rainfall anomalies, rainfall forecast (from GCM model outputs)</p>	Sub-national, National, Regional, Continental to Global	11km, 0.25°, 0.5°, 1°, 2.5°	3-hourly, Daily, 10-day, monthly data	Depends on the region, time-scale, products used (see Dinku <i>et al.</i> 2008a, b; Dinku <i>et al.</i> 2007 for more precision on accuracy)	Almost real-time (daily to three days after the last satellite acquisition) Rainfall forecast 3-6 months	<p>Acute Respiratory Virus, African Eye Worm, Barmah Forest Virus, Blue Tongue, Chagas, Chikungunya, Cholera, Dengue, Diarrheal Diseases, Ebola, Fasciolosis, Hantavirus, Japanese Encephalitis, Leishmaniasis, Lyme's Disease, Lymphatic filariasis, Malaria, Meningococcal Meningitis, Plague, Rift Valley Fever, Ross River Virus, Shigellosis, Trachoma, West Nile fever, Yellow fever, Ross River Virus</p>



# GEO Task US-09-01a

## Human Health SBA – Results Prioritization

### GEO Task US-09-01a: Priority Earth Observations for Human Health Infectious Diseases SBA Disease Burden Classification

Diseases	E.O. Parameter	Global Burden (1000 DALYs)
<b>Influenza (Acute respiratory virus)</b>	Temperature, Humidity, Rainfall, Wind, Urbanization, Population density, Vector population (Bird migration), Land use, Vegetation, Water bodies, Biodiversity, ENSO	94 603
<b>Diarrheal diseases</b>	Rainfall, Water Bodies, Land use, Urbanization, Sea surface temperature, Sea Surface Height, Salinity, Infrastructure (wells, latrines). pH, ENSO, SOI	61 966
<b>Malaria</b>	Rainfall, Temperature, Humidity, Population Density, Vegetation, Water bodies	46 486
<b>Meningococcal meningitis</b>	Temperature, Rainfall, Relative humidity, Wind, Dust, Land use, Population Density	6 192
<b>Lymphatic filariasis</b>	Rainfall	5 777
<b>Intestinal nematodes</b>	Rainfall, Water Bodies, Land use, Urbanization, Sea Surface Temperature, Sea surface height, Salinity, Infrastructure (wells, latrines)	2 951
<b>Trachoma</b>	Rainfall, Temperature, Relative humidity	2 329
<b>Leishmaniasis</b>	Rainfall, Temperature, Land use, Vegetation, ENSO	2 090
<b>Schistosomiasis</b>	Temperature, Water bodies, Land use, Urbanization, Soil moisture, Vegetation, pH	1 702
<b>Africa Trypanosomiasis</b>	Vegetation	1 525
<b>Japanese encephalitis</b>	Rainfall, Temperature, Relative Humidity	709
.....		15





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## Human Health *SBA* – *Additional findings*

- ❑ Towards more Integration between Epidemiology and E.O.
  - Maintain and strengthen diseases surveillance systems
  - Acquire, archive and access long-term environmental and epidemiological data
  - Develop capacity and train Decision-Makers to analyze and interpret data, information and products
  - .....
- ❑ Gaps Analysis
  - Gaps in Data
  - Gaps in Data Delivery
  - Gaps in Development and Feedback Mechanisms for Integrating epidemiology and E.O.
  - .....



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## Human Health *SBA* - Acknowledgements

- NASA: US 09-01a Task Co-Lead Lawrence Friedl, Amy Jo Swanson
- EPA - ERG
- Advisory Group Members
- Catherine Vaughan, Gilma Mantilla, Gino Chen

