Integration of Tools

Pietro Ceccato

International Research Institute
for Climate and Society
Earth Institute | Columbia University

Aim of the Session

To discuss the challenges and opportunities of different platforms to access climate, environmental, population and epidemiological data, to improve decision-making related to health
(in particular vector-borne disease)

Participants

Alex de Sherbinin
Center for International Earth Science Information Network (CIESIN)

Wafaa El-Sadr, Mailman School of Public Health

Kacey Ernst
Univ. of Arizona

Allison Lieber, Google Earth Engine

Matthew Lamb, Mailman School of Public Health

Pietro Ceccato
IRI

Integration of Tools

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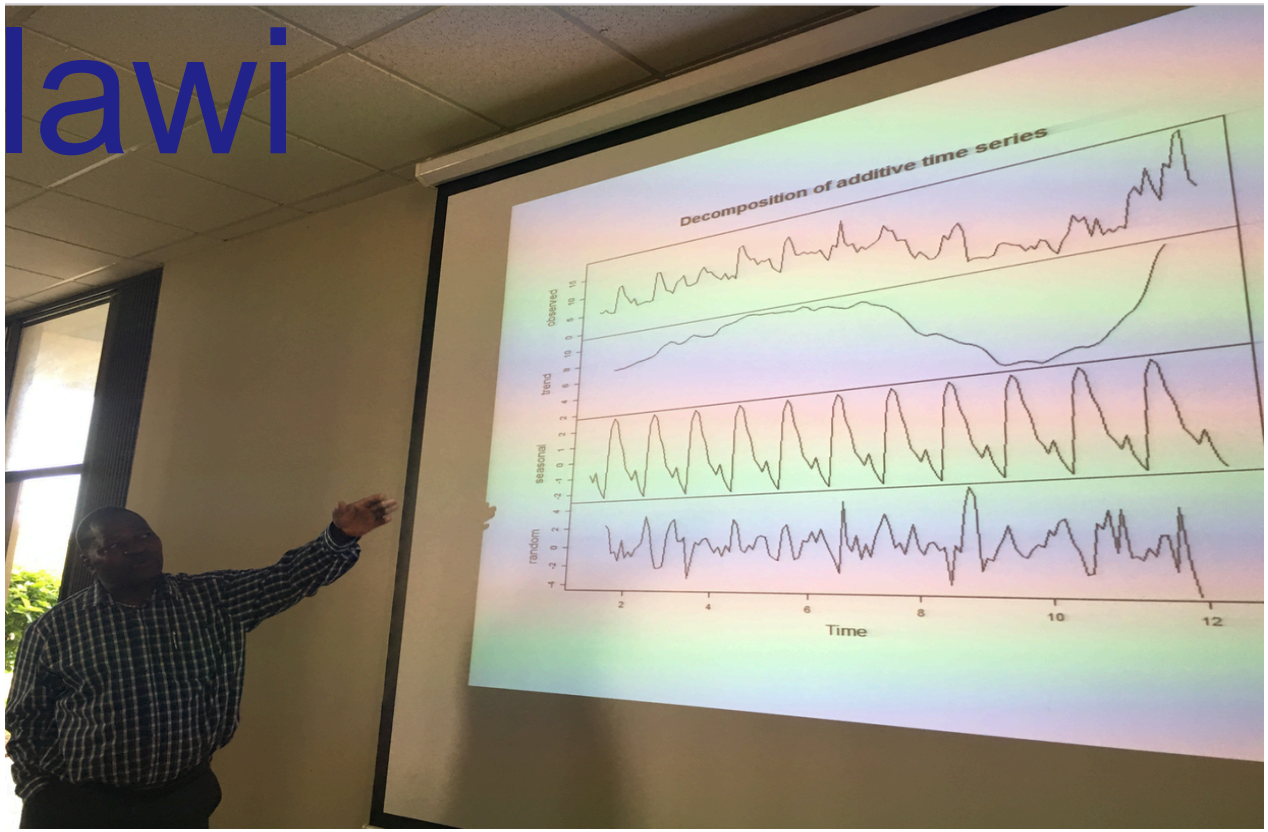
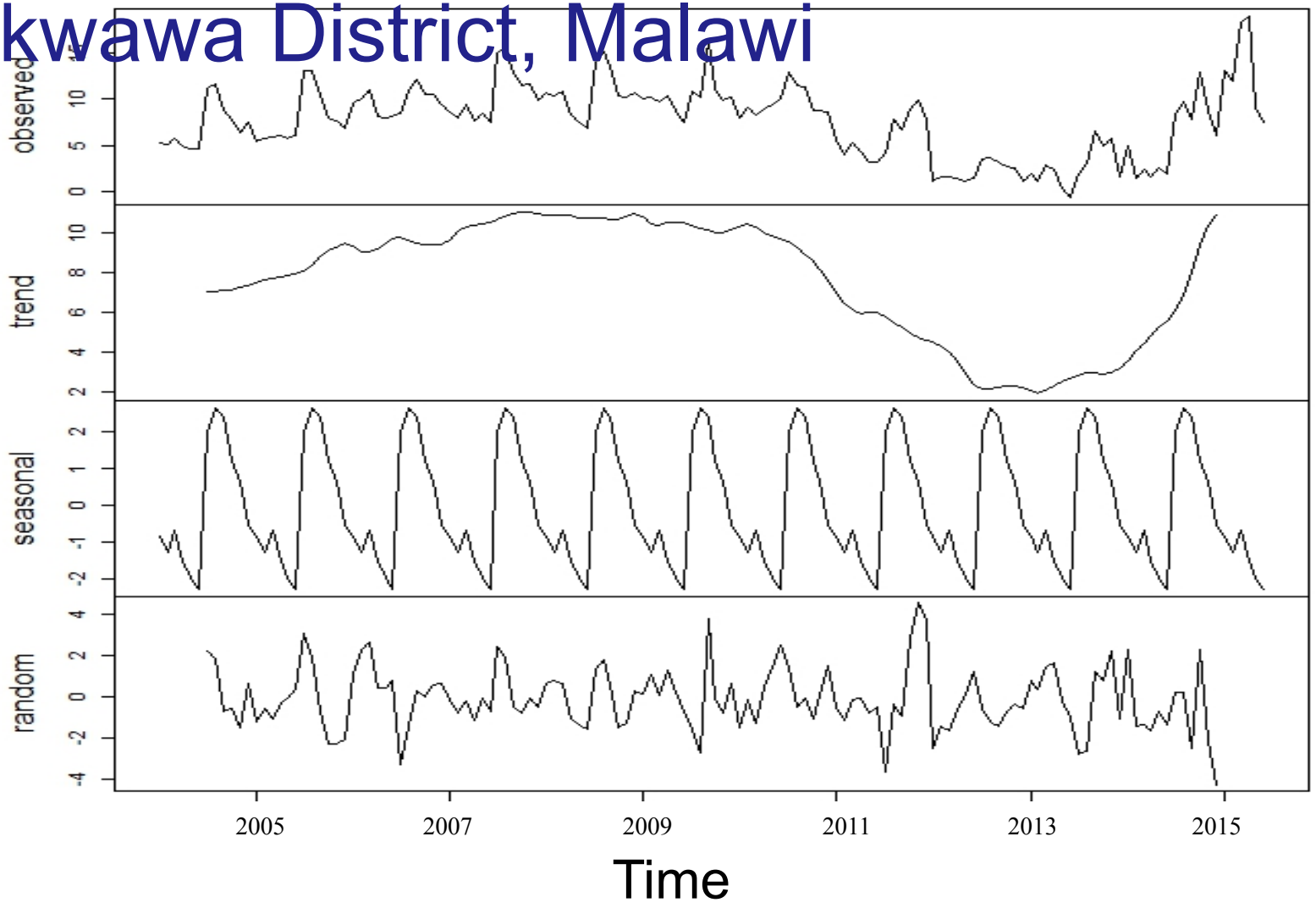
Ministry of Health, Malawi

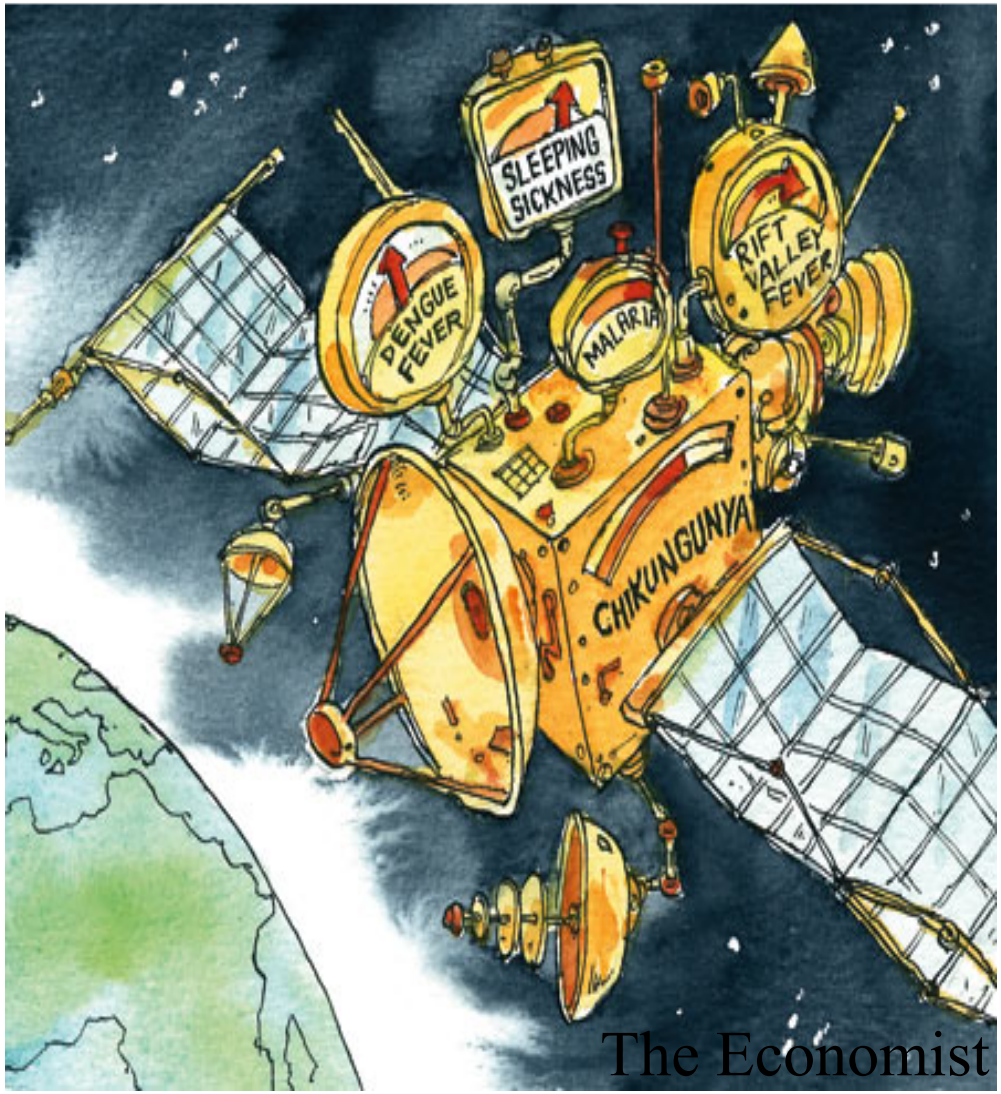


Gracious Hamuza - National Malaria Control Programme, GFCS training, College of Medicine, Blantyre, May 23-27, 2016

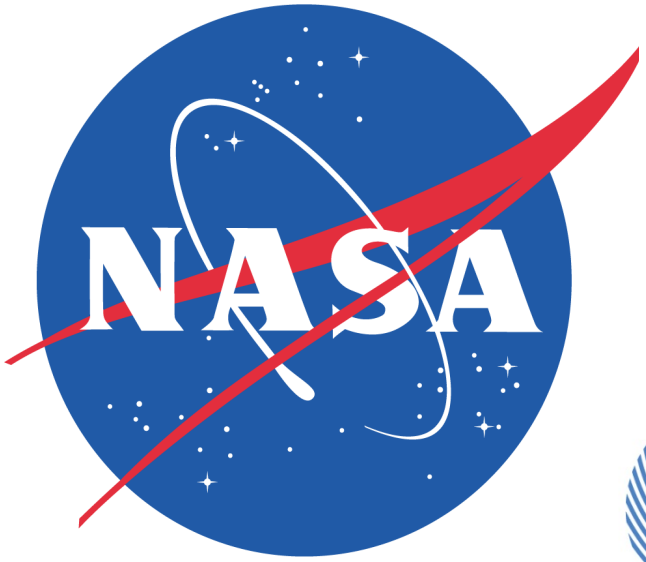
Decomposition of Malaria Data for Chikwawa District, Malawi



Where to Find Information on Climate?

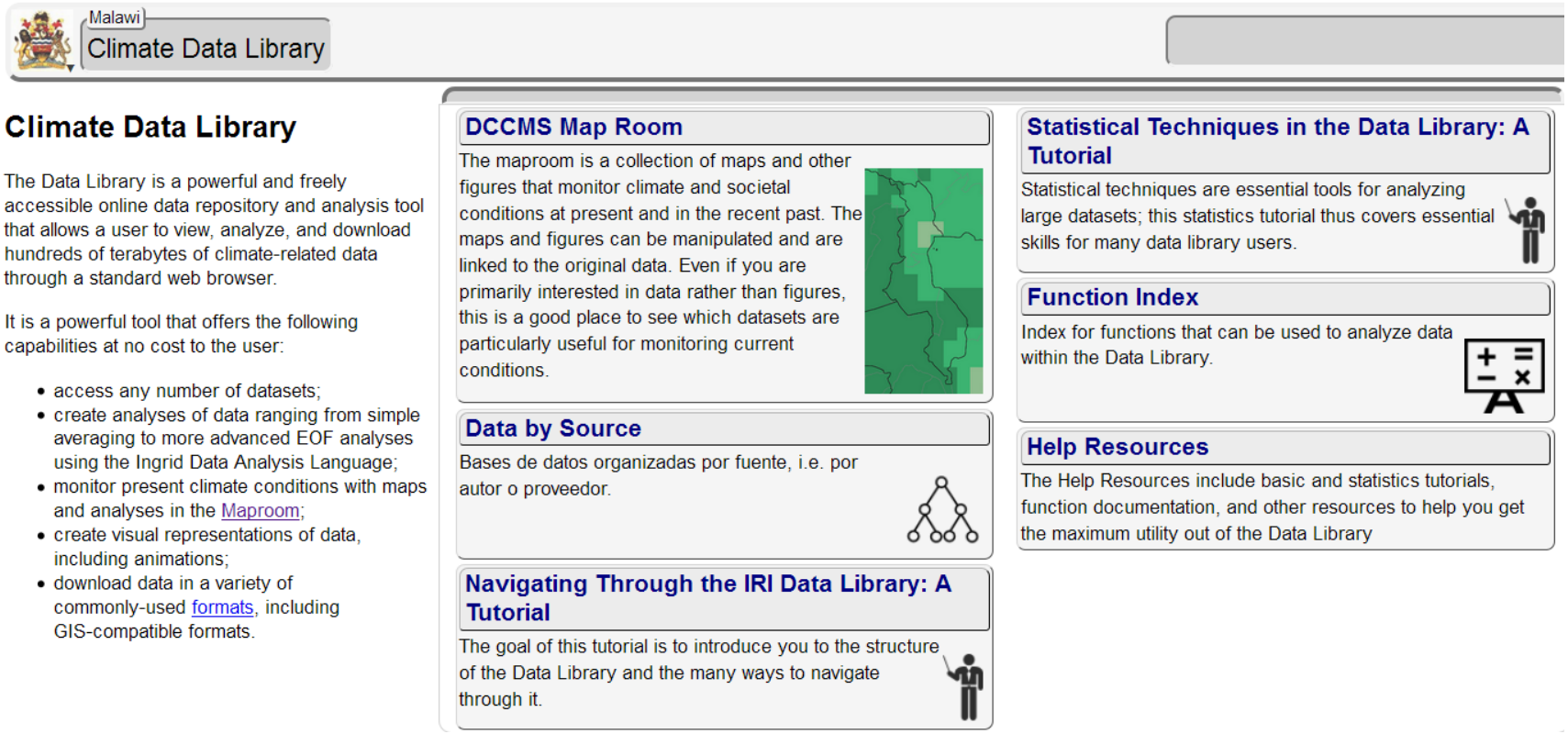



20 Years Ago…



NASDA
NATIONAL SPACE DEVELOPMENT AGENCY OF JAPAN

Where to Find Information on Climate?



IRI Data Library installed at the Malawi Meteorological Service:
http://datalib.metmalawi.com:8091/

IRI created the Data Library to Provide Easy Way to

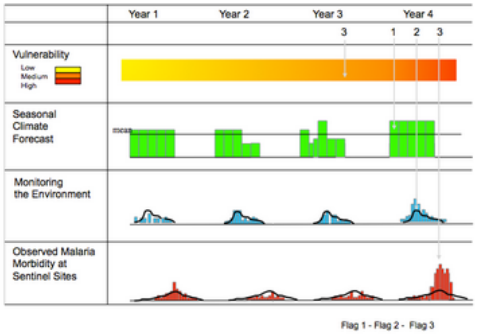
1. *Access*
2. *Visualize*
3. *Analyze*
4. *Download Data*

IRI Data Library platform

Malaria Early Warning System

The Malaria Early Warning System (MEWS) aids in the prediction of malaria outbreaks. The system consists of four elements; Vulnerability, Seasonal Climate Forecasts, Monitoring the Environment and Observed Malaria Morbidity. In certain regions, these products may be used to determine the timing and severity of an outbreak.

This maproom outlines each element of the MEWS. Each element contains products, some of which may be used to help determine the risk of a malaria outbreak in a specific region.



Using all of the elements as a system may be useful in understanding the socioeconomic and climatic drivers of malaria in particular regions. The diagram above depicts how the four elements can be employed on different time scales using flags to raise concern of a potential outbreak.

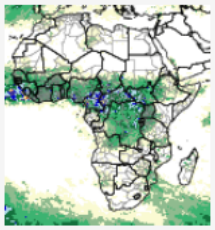
Climatic and environmental variables can

Vulnerability | Seasonal Climate Forecast | Monitoring The Environment | Observed Malaria Morbidity

Monitoring The Environment

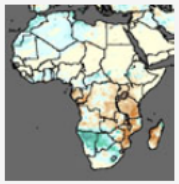
Dekadal (10-day) Precipitation

This map shows dekadal (10-day) precipitation estimates from the Climate Prediction Center.



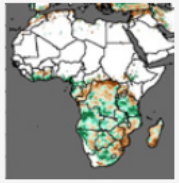
Precipitation Estimate Differences

This map shows dekadal (10-day) precipitation estimates as the difference from the short term average (from 2000 to last recent complete year).



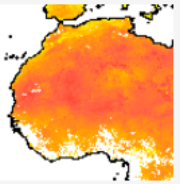
Precipitation Estimate Percentages

This map shows dekadal (10-day) precipitation estimates as a percentage of the short term average (from 2000 to last complete year).



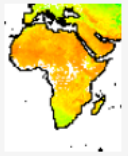
Inferred Maximum Air Temperature

This map shows approximated maximum air temperatures at 2 meters above the ground.



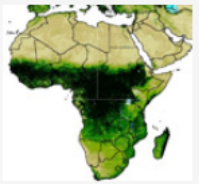
Minimum Land Surface Temperature (LST)

This map shows minimum land surface temperature (LST) used as a proxy for monitoring minimum air temperature.



Measures of Vegetation

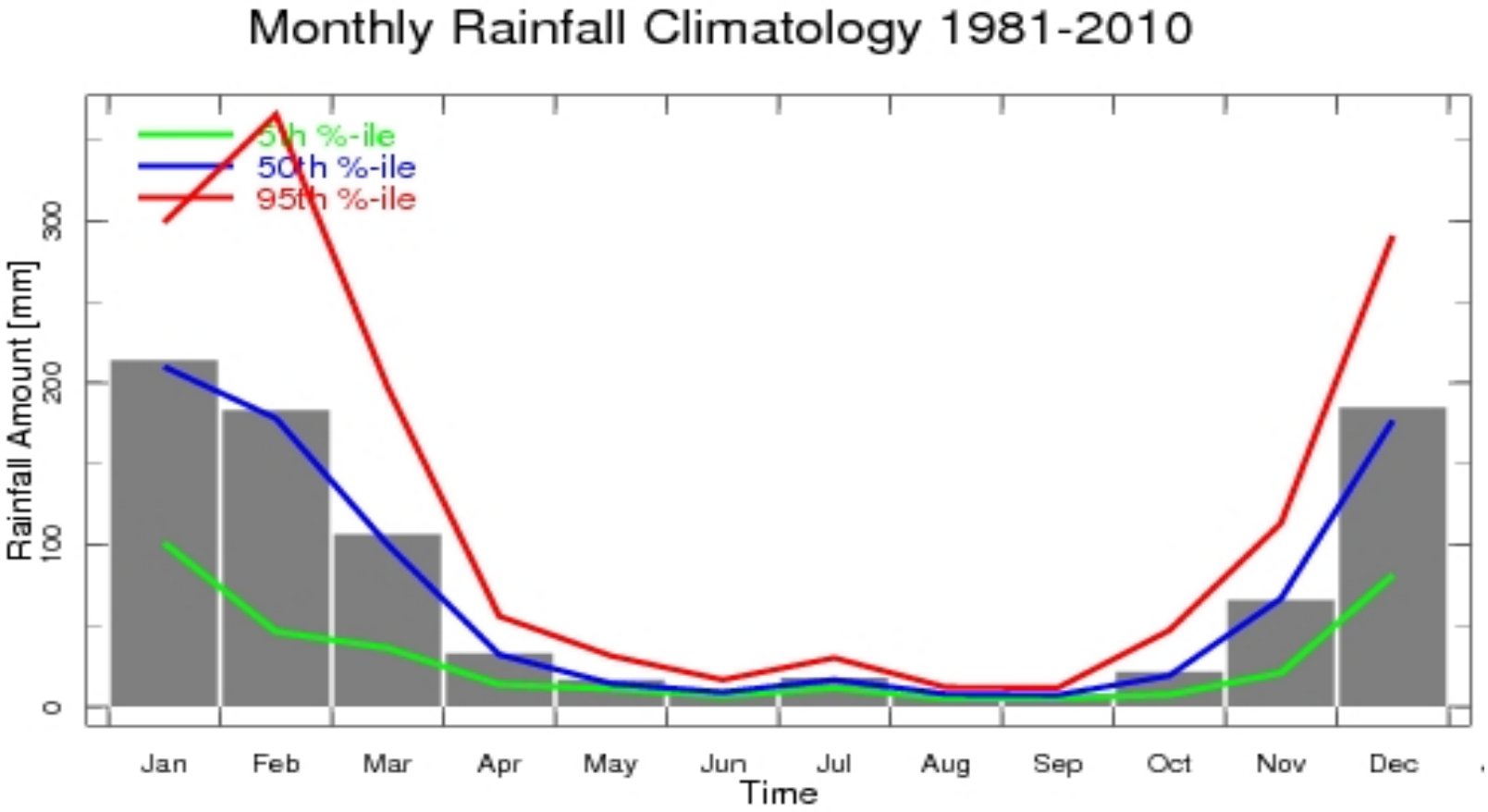
This tool produces maps of estimated vegetation using data from NASA's MODIS sensor.



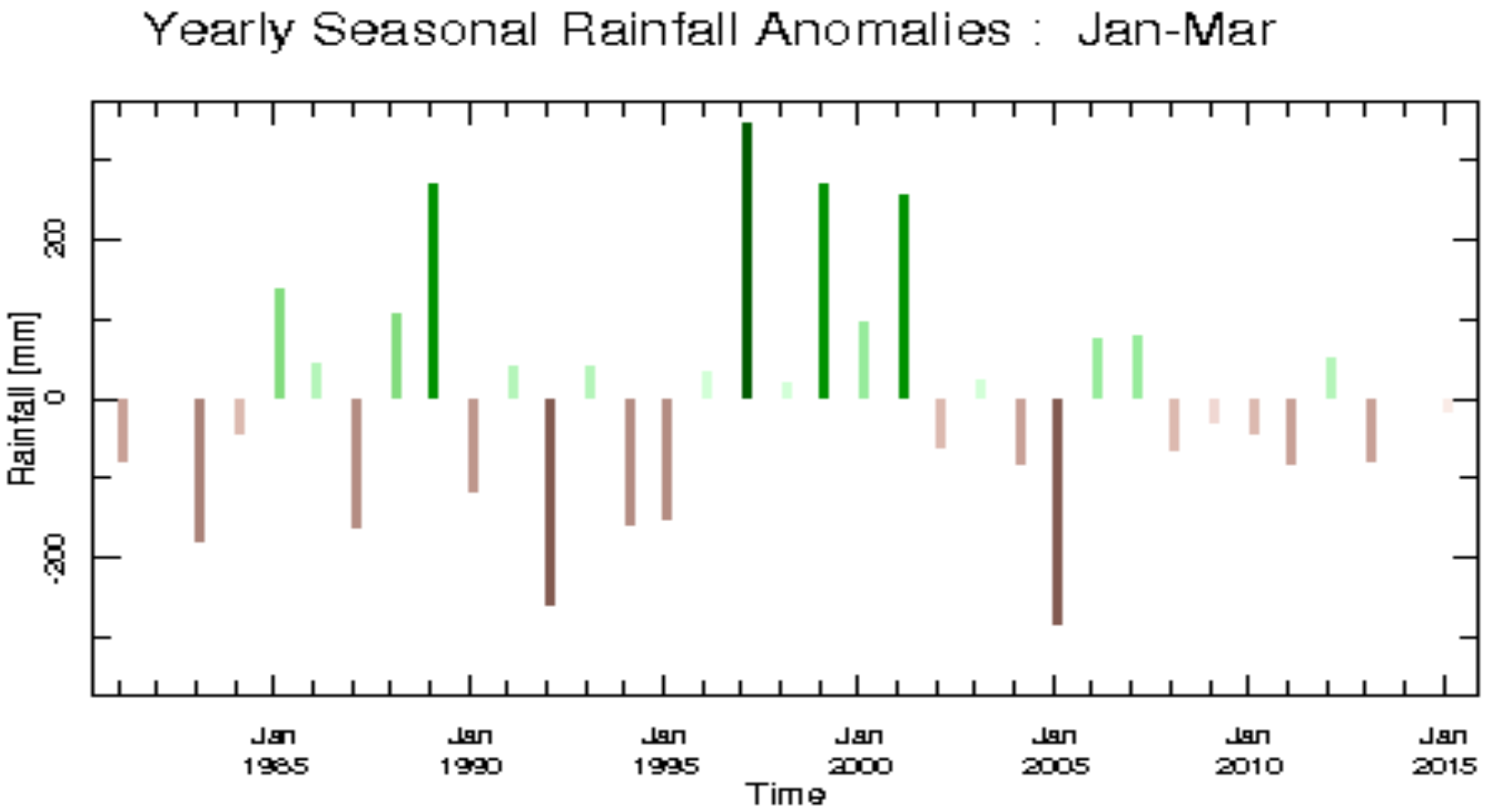
Vectorial Capacity

This map shows a Vectorial Capacity (VCAP) model that defines precipitation and temperature as the limiting factors of malaria incidence. VCAP is the daily rate at which future malaria inoculations could arise from a

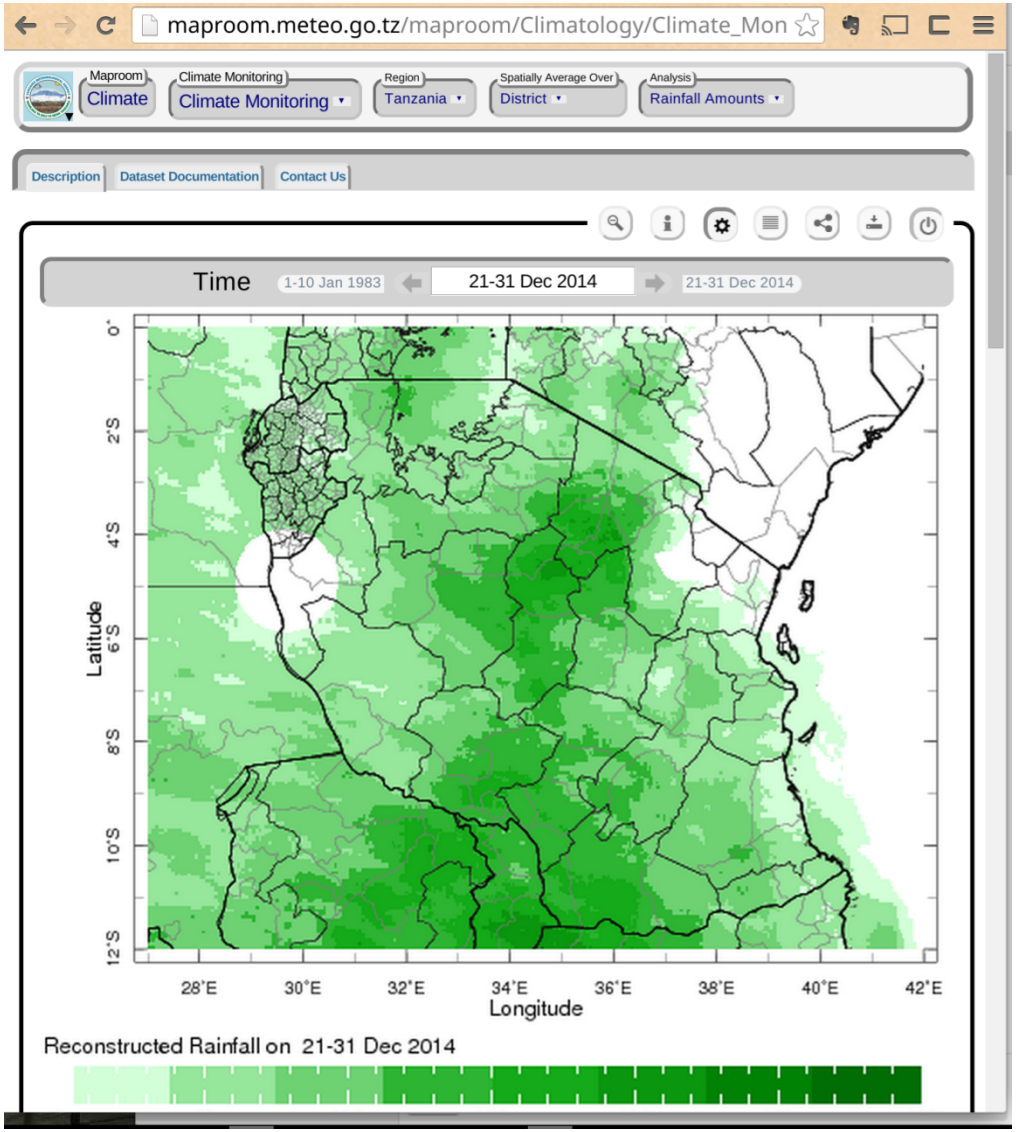
Rainfall climatology 1981-2010 in Chikwawa District

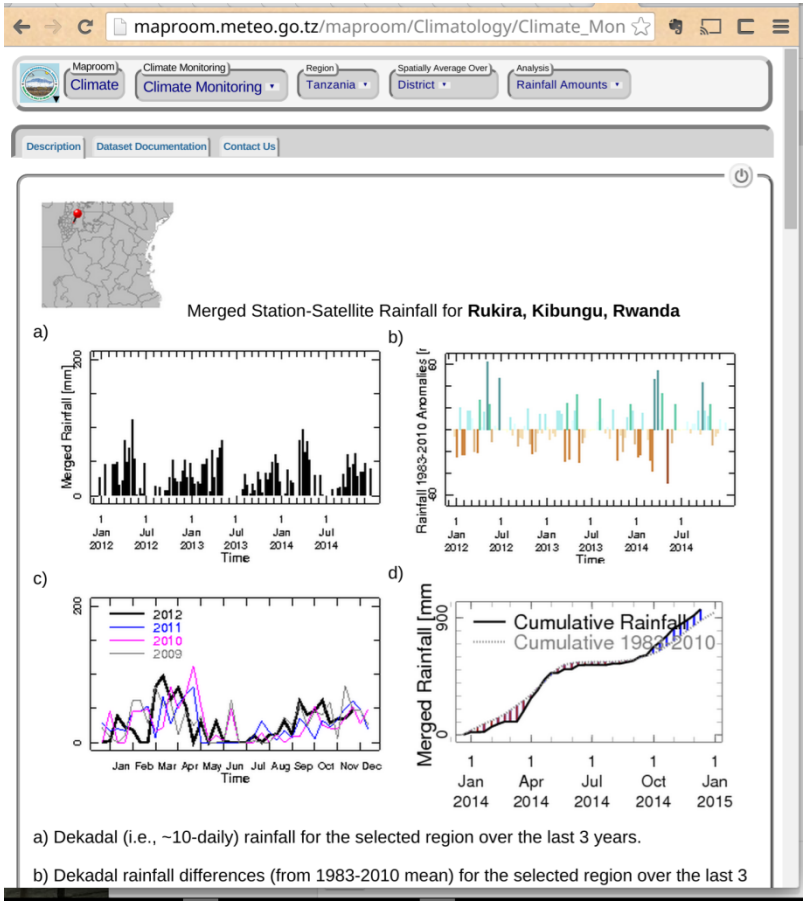


Precipitation anomalies Jan- March in Chikwawa District

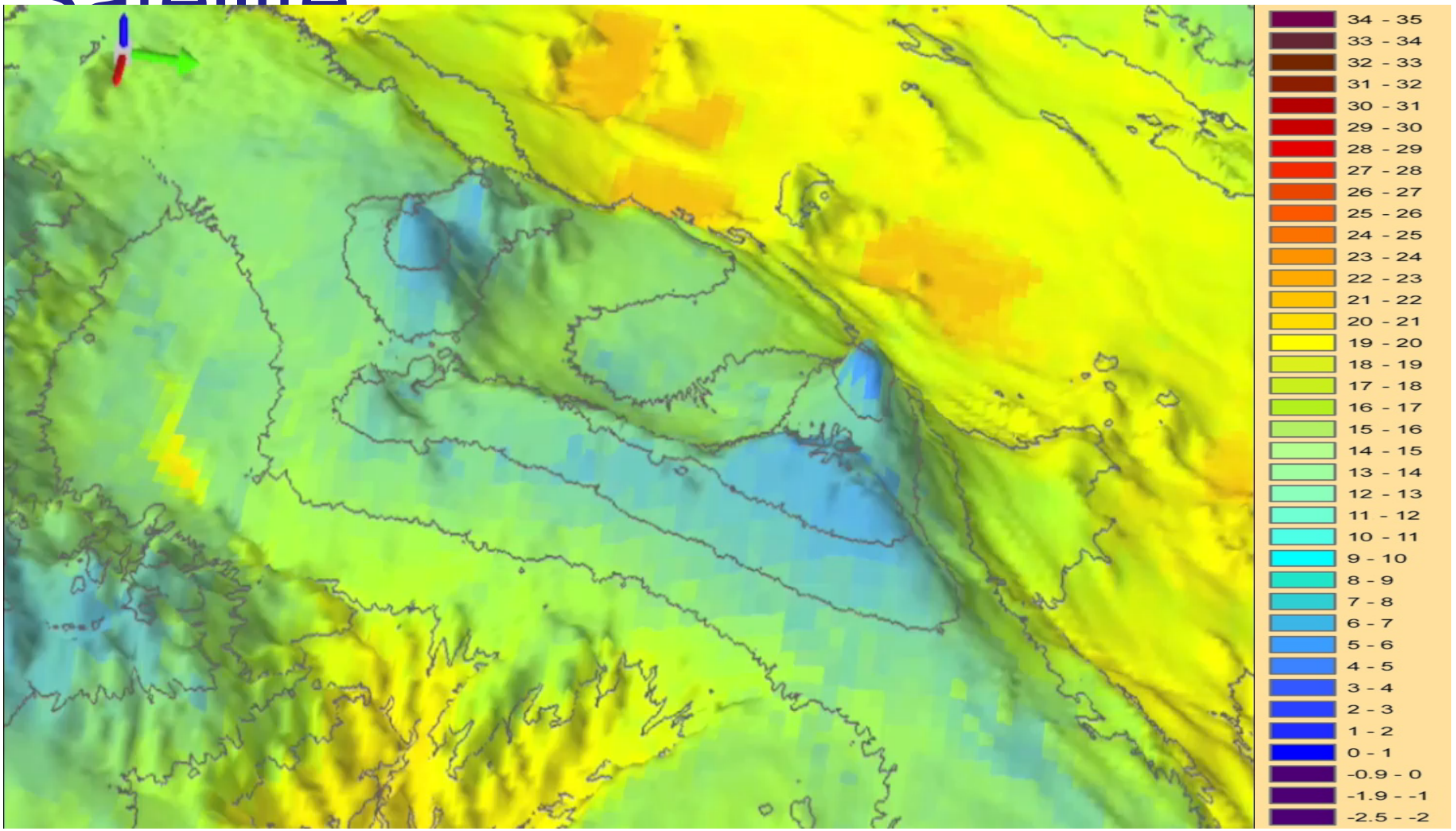


Library

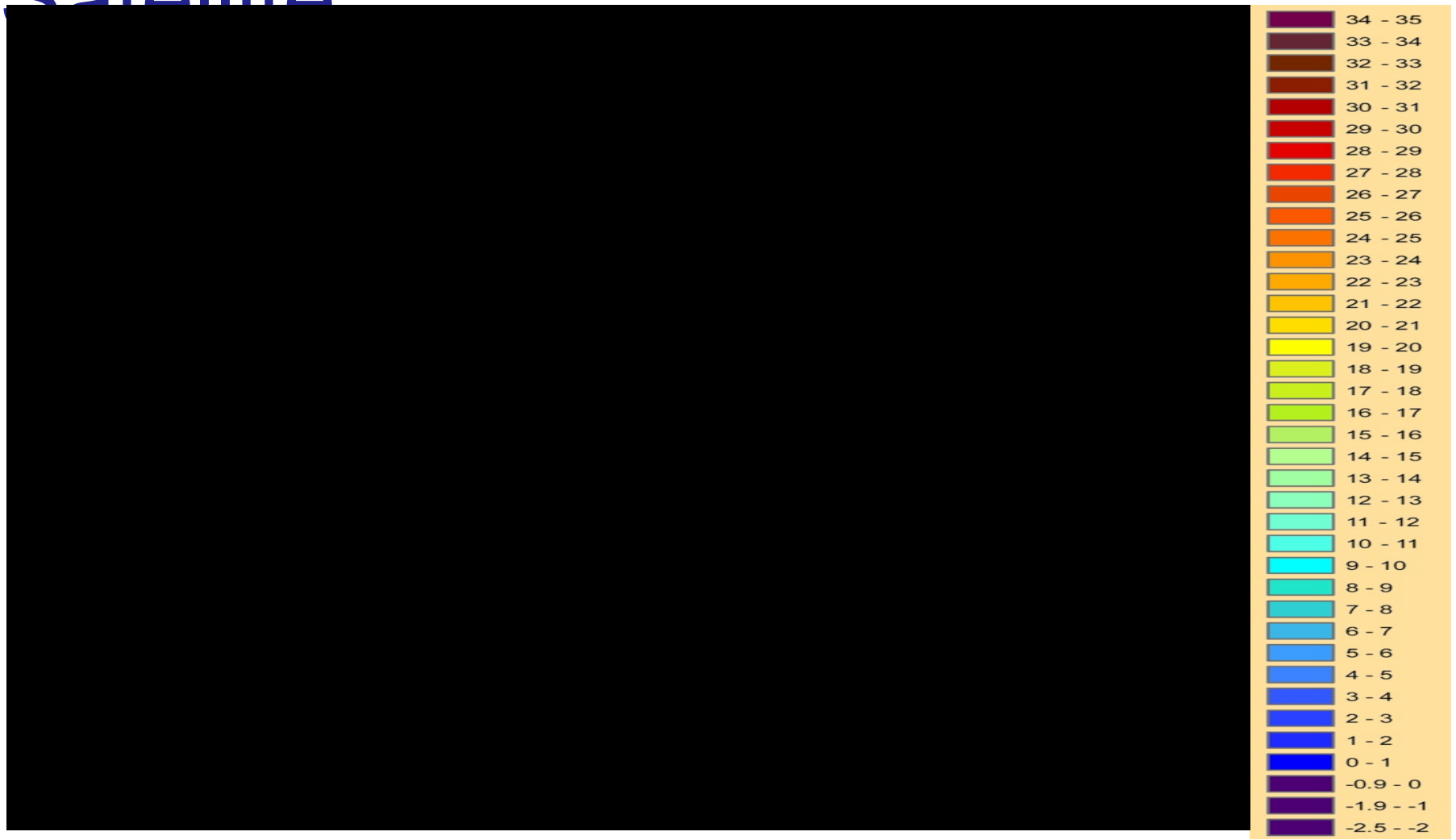

maproom.meteo.go.tz/maproom/Climatology/Climate_Mon
Maproom
Climate
Climate Monitoring
Climate Monitoring
Region
Tanzania
Spatially Average Over
District
Analysis
Rainfall Amounts
Description
Dataset Documentation
Contact Us
Time
1-10 Jan 1983
21-31 Dec 2014
21-31 Dec 2014
Latitude
Longitude
Reconstructed Rainfall on 21-31 Dec 2014


maproom.meteo.go.tz/maproom/Climatology/Climate_Mon
Maproom
Climate
Climate Monitoring
Climate Monitoring
Region
Tanzania
Spatially Average Over
District
Analysis
Rainfall Amounts
Description
Dataset Documentation
Contact Us
Merged Station-Satellite Rainfall for Rukira, Kibungu, Rwanda
a)
b)
c)
d)
Merged Rainfall [mm]
Rainfall 1983-2010 Anomalies
Time
2012
2011
2010
2009
Cumulative Rainfall
Cumulative 1983-2010
a) Dekadal (i.e., ~10-daily) rainfall for the selected region over the last 3 years.
b) Dekadal rainfall differences (from 1983-2010 mean) for the selected region over the last 3

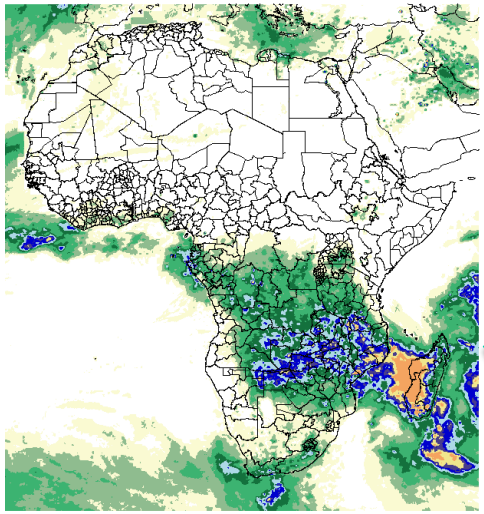
Temperature Estimated from Satellite



Air Temperature Estimated from Satellite



Dissemination of Information to Local Communities



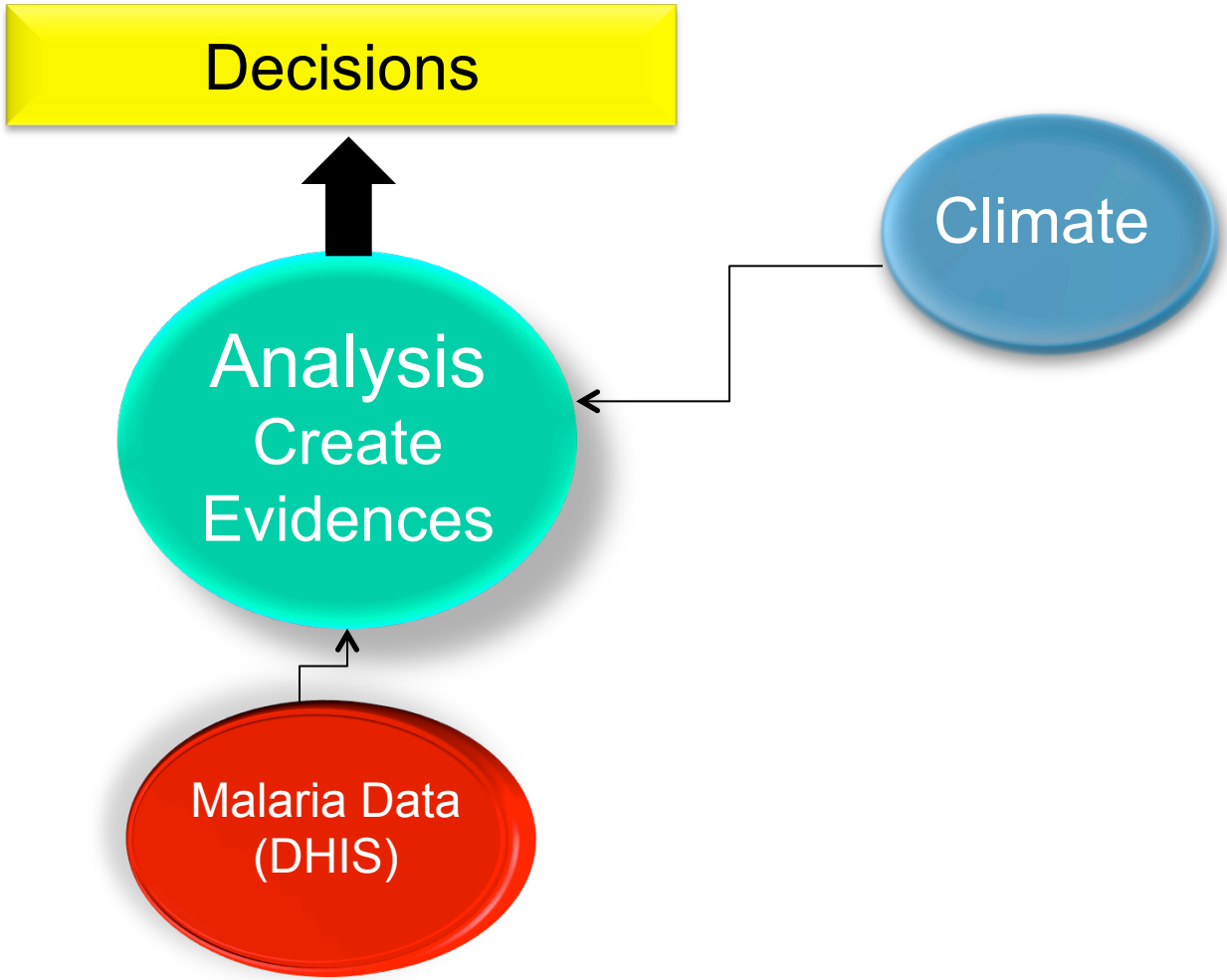
1–10 Jan 2014

IRI Data Library: http://iridl.ldeo.columbia.edu/maproom/

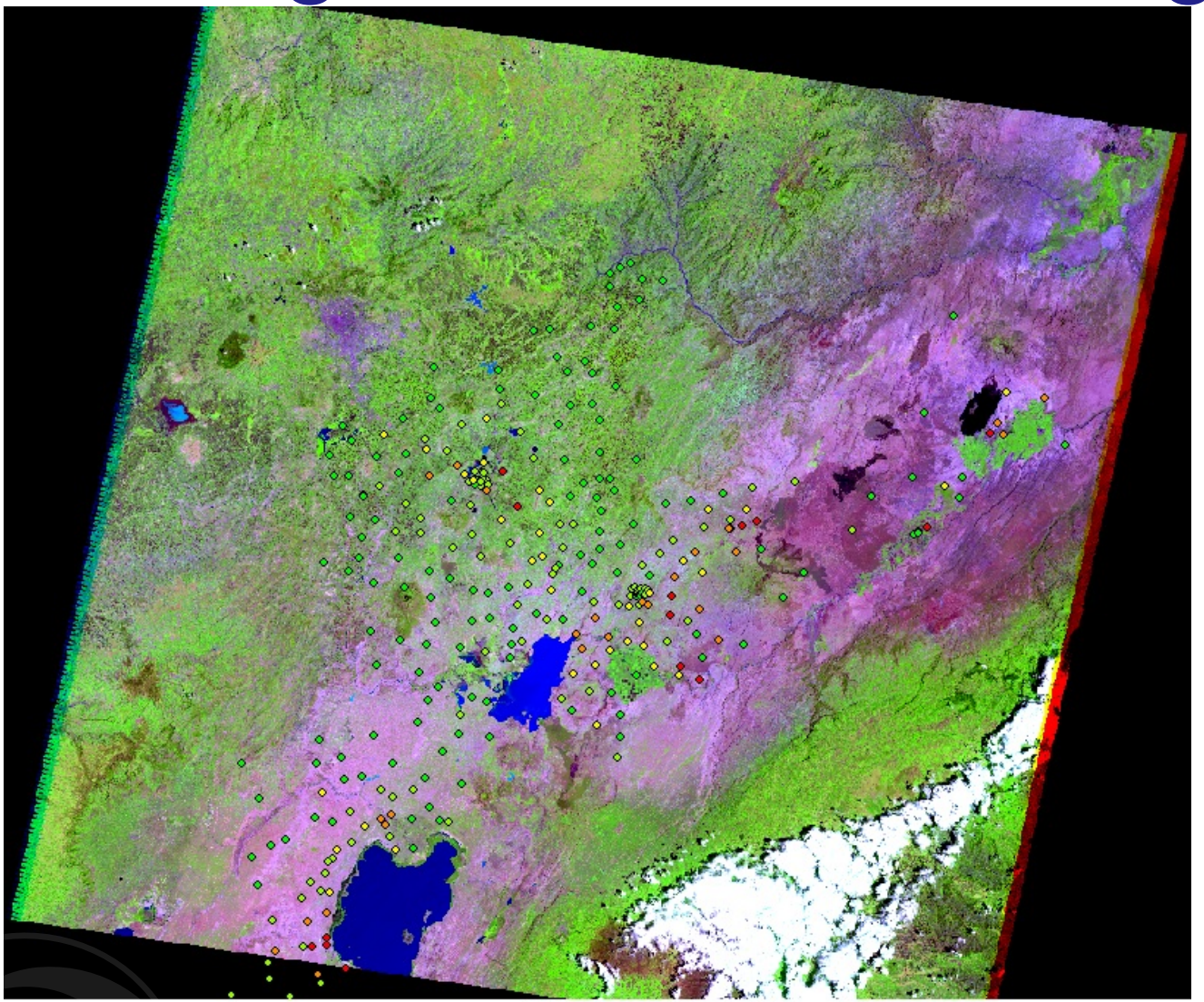
Connecting Space

To Village

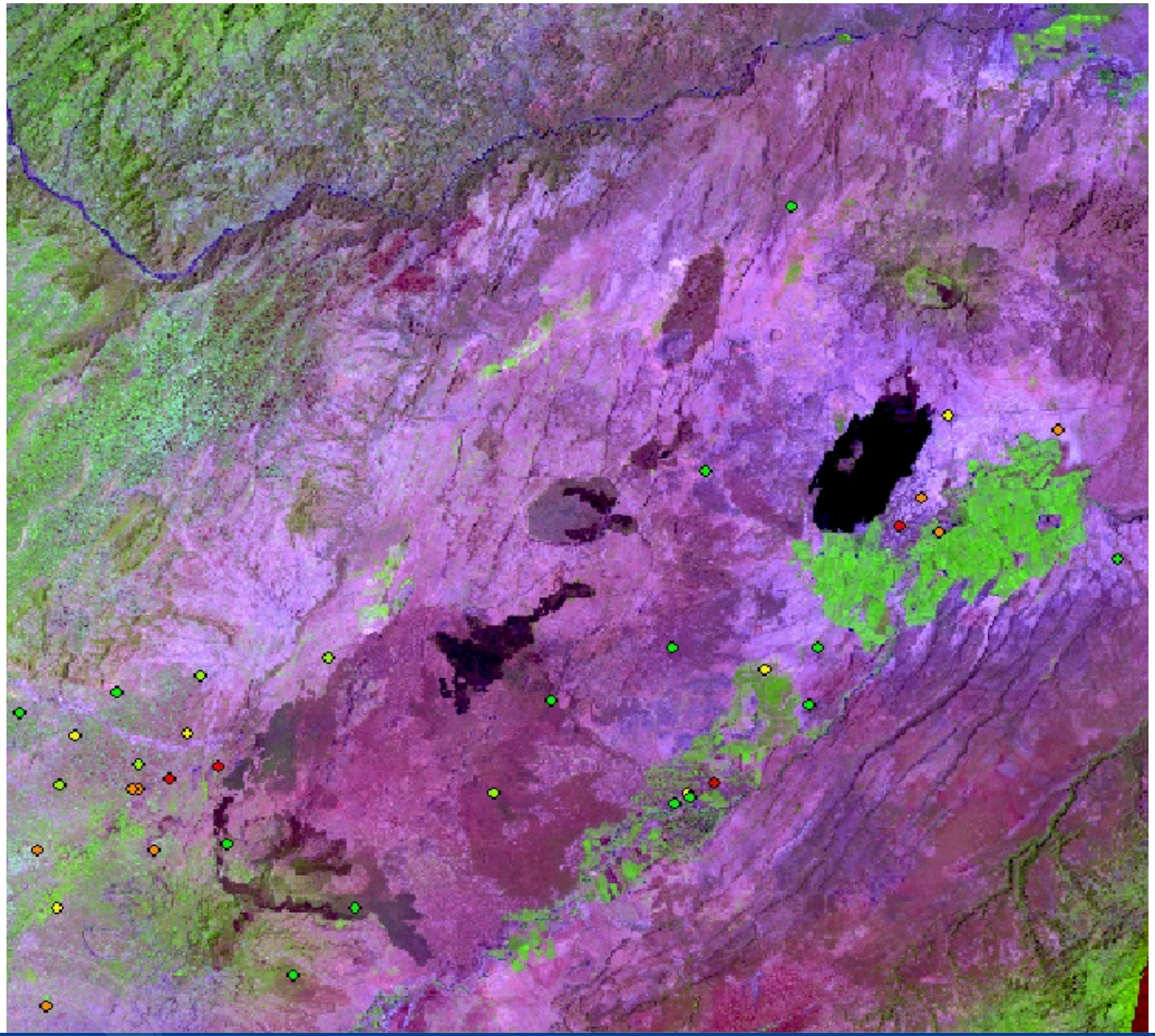
How Do Users Make Decision?

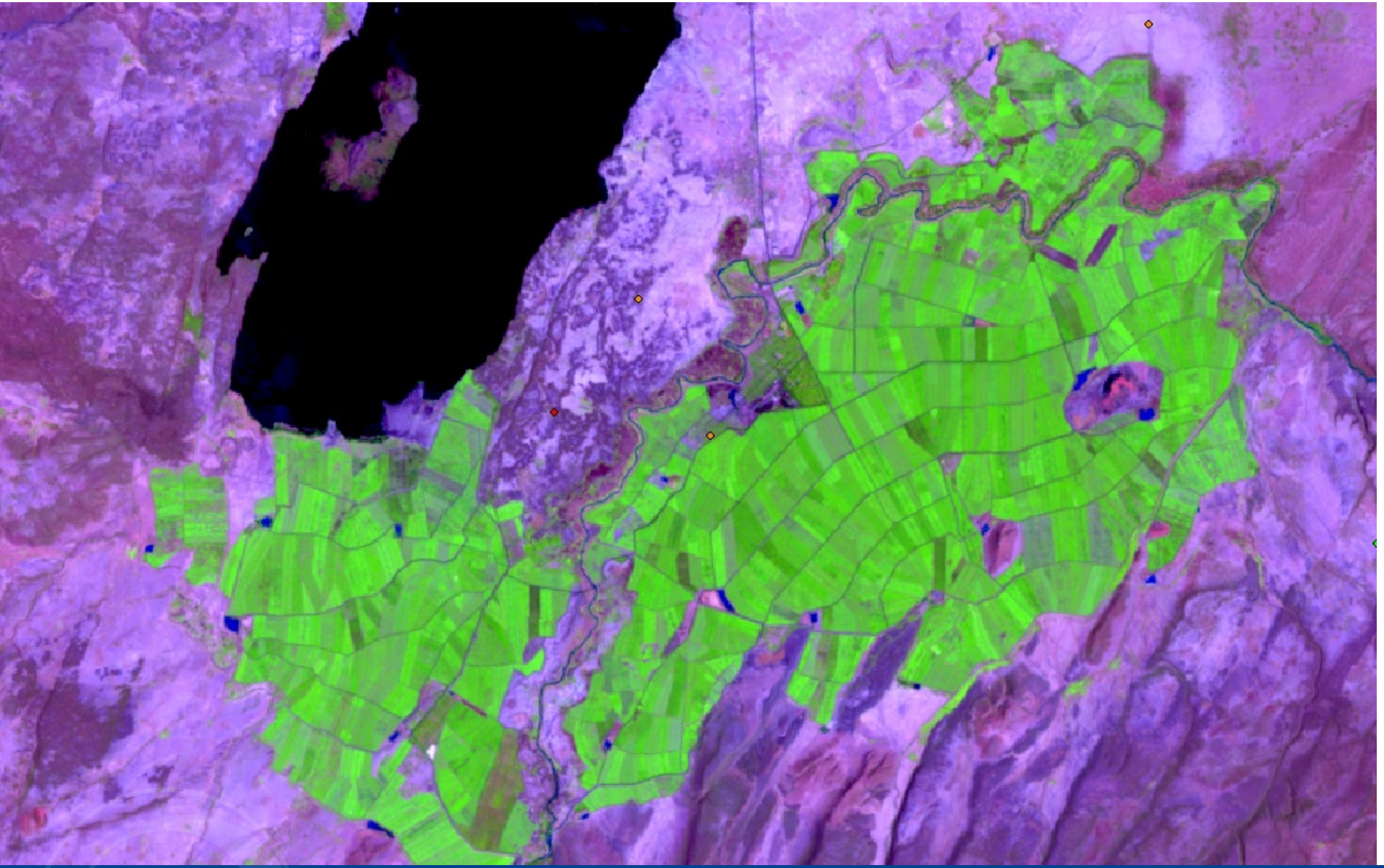


Monitoring Water Bodies/Irrigation w



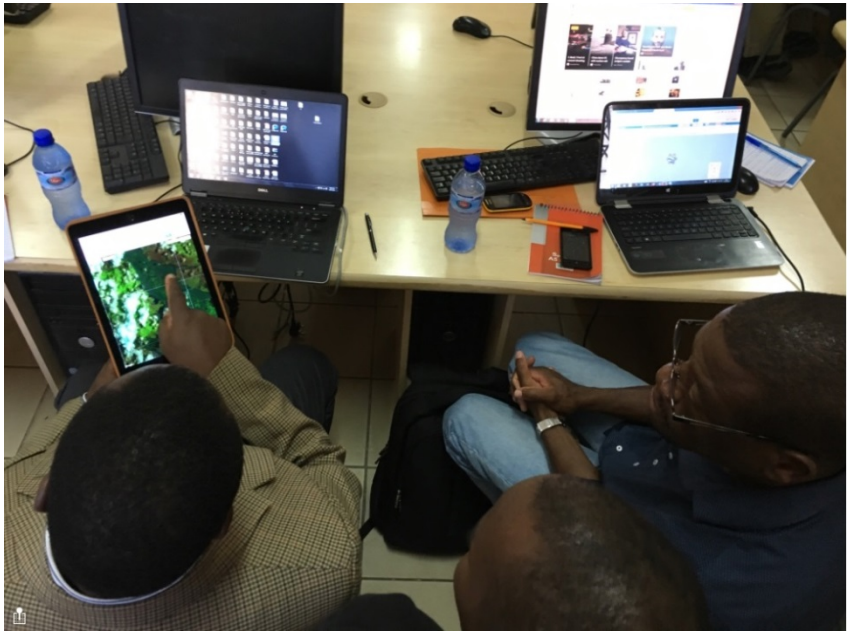
Rift Valley, Ethiopia



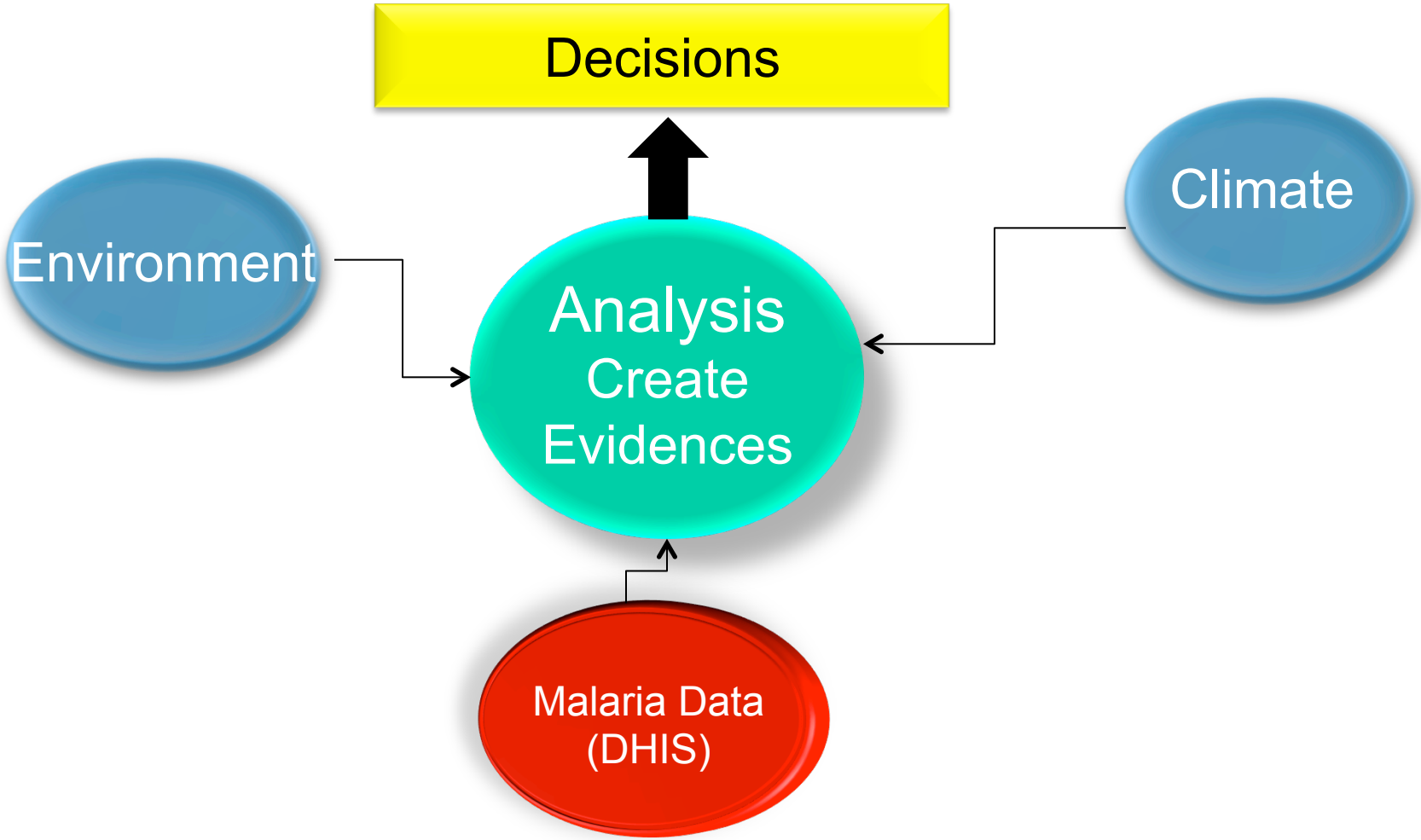


Ministry of Health in Malawi Using Google Earth Engine to Map Water Bodies from LANDSAT Images

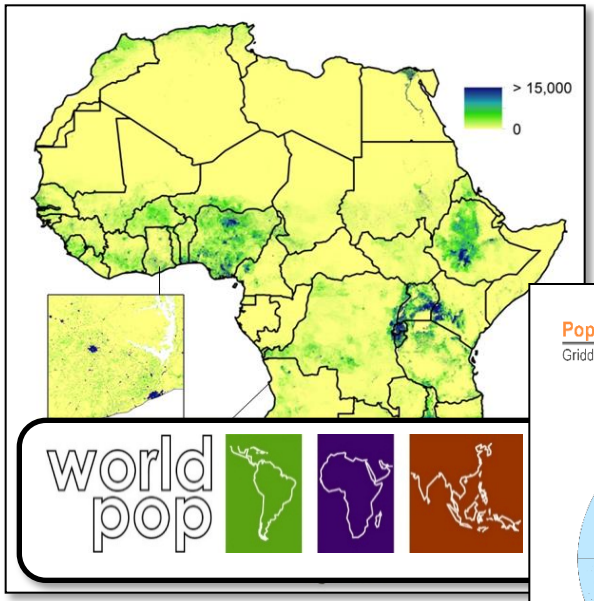
GFCS training, College of Medicine, Blantyre, May 23-27, 2016

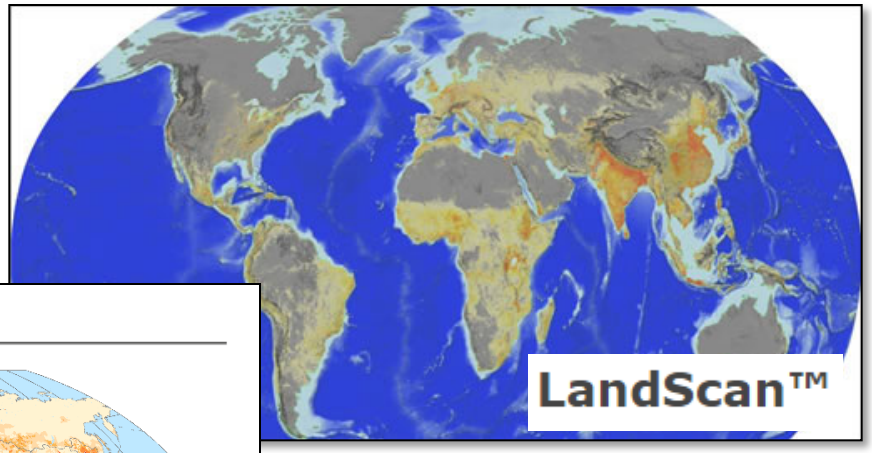


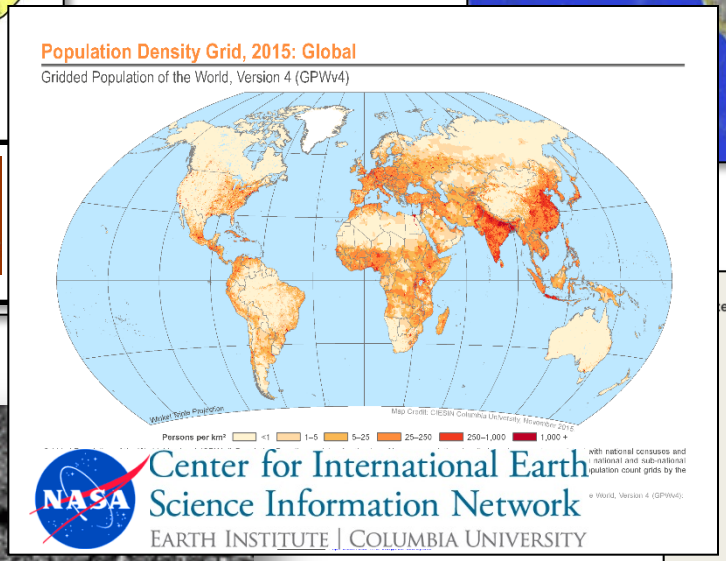
How Do Users Make Decision?

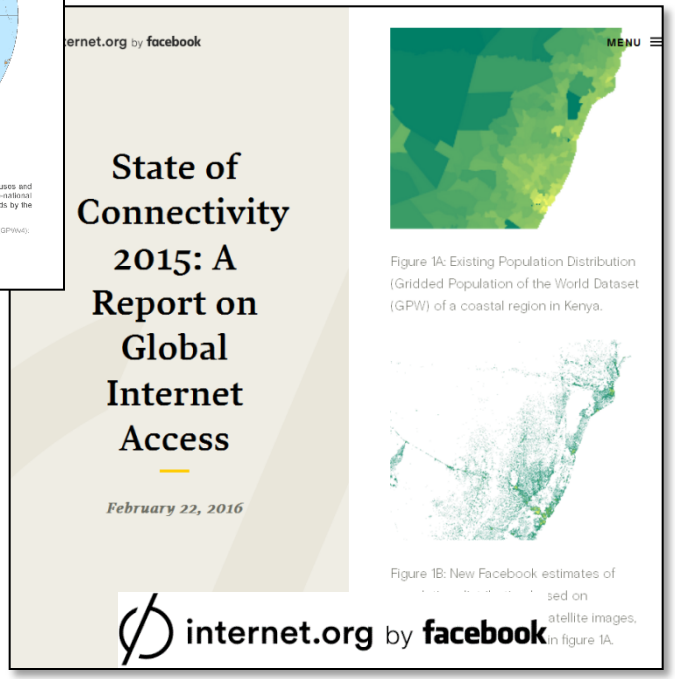


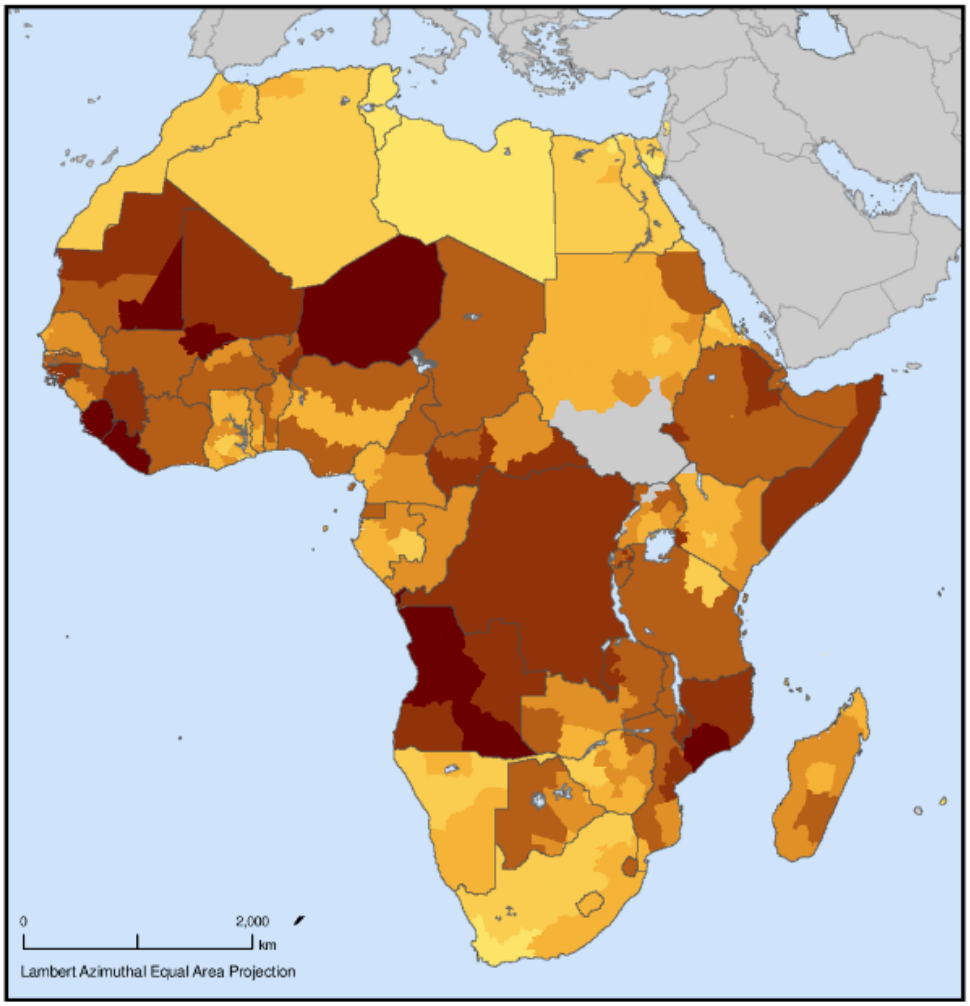
Population Data Layers











Africa
By Subnational Administrative Level

Measures of Poverty
Infant Mortality Rates [IMR]

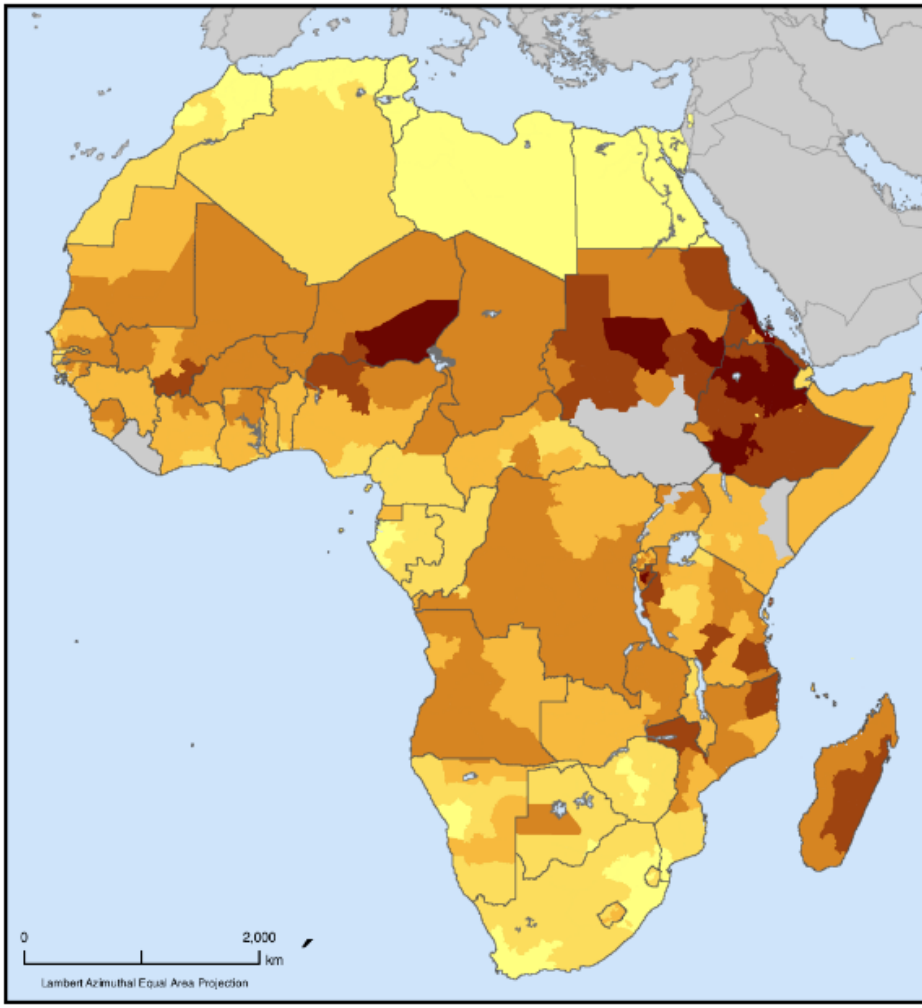
Subnational mortality rates are adjusted to 2000 using national trend data.
Original data for 96% of countries are from 1995 or later. All data are from 1990 or later.

Infant mortality rate, 2000. (per 1000 live births)

- less than 9.1
- 9.1 - 25
- 25.1 - 50.0
- 50.1 - 75.0
- 75.1 - 100.0
- 100.1 - 125.0
- 125.1 - 150.0
- more than 150.0
- No Data
- National boundary

Subnational boundaries have been removed from countries for clarity.

Copyright 2005. The Trustees of Columbia University in the City of New York.
Source: Center for International Earth Science Information Network (CIESIN), Columbia University. Global subnational infant mortality rates: maps and further documentation available at: http://www.ciesin.columbia.edu/povmap



Africa
By Subnational Administrative Level

Measures of Poverty
Child Malnutrition

Children are defined as underweight if their weight-for-age z-scores are more than two standard deviations (2 SD) below the median of the NCHS/CDC/WHO International Reference Population.

Percent of Children Age 0-5 Underweight

- < 10.1
- 10.1 - 20.0
- 20.1 - 30.0
- 30.1 - 40.0
- 40.1 - 50.0
- 50.0 <
- no data
- National Boundary

Subnational boundaries have removed from countries for c

Copyright 2005. The Trustees of Columbia University in the City of New York.
Source: Center for International Earth Science Information Network (CIESIN), Columbia University. Global subnational rates of child underweight status: maps and further documentation available at: http://www.ciesin.columbia.edu/povmap

managed NASA Socioeconomic Data and Applications Center (SEDAC)

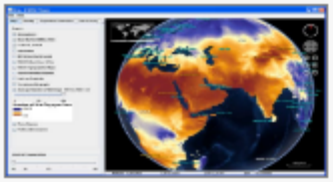
SEDAC Hazards Mapper

The SEDAC Hazards Mapper enables users to visualize data and map layers related to Socioeconomic, Infrastructure, Natural Disasters, and Environment and analyze potential impacts and exposure. The web app mashups layers from various sources including SEDAC, NASA LANCE, NASA GIBS, USGS, NOAA, ESRI, and others.

Population Estimation Service

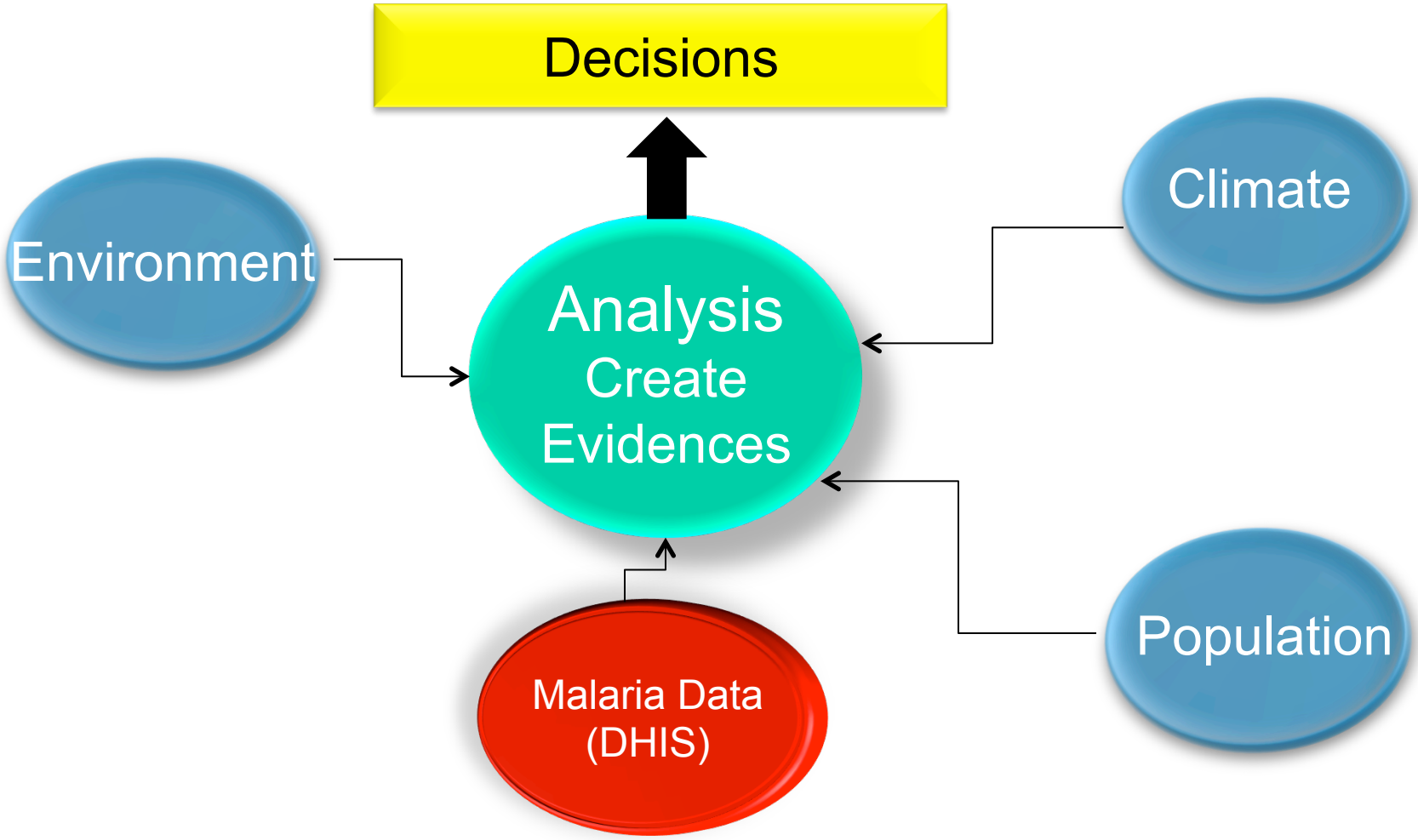
The Population Estimation Service is a Web-based service for estimating population totals and related statistics within a user-defined region. It enables users of a wide variety of map clients and tools to quickly obtain estimates of the number of people residing in specific areas without having to download and analyze large amounts of spatial data.

CHANGE Viewer



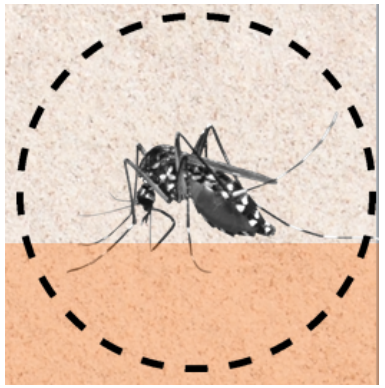
The Climate and Health Analysis for Global Education Viewer (CHANGE Viewer) was built using NASA World Wind, an open source, 3-D geo-visualization tool. CHANGE Viewer allows the exploration of climate science, human, and socio-economic data sets made available through the Data Library.

How Do Users Make Decision?



How to Detect Infrastructure?

Zika

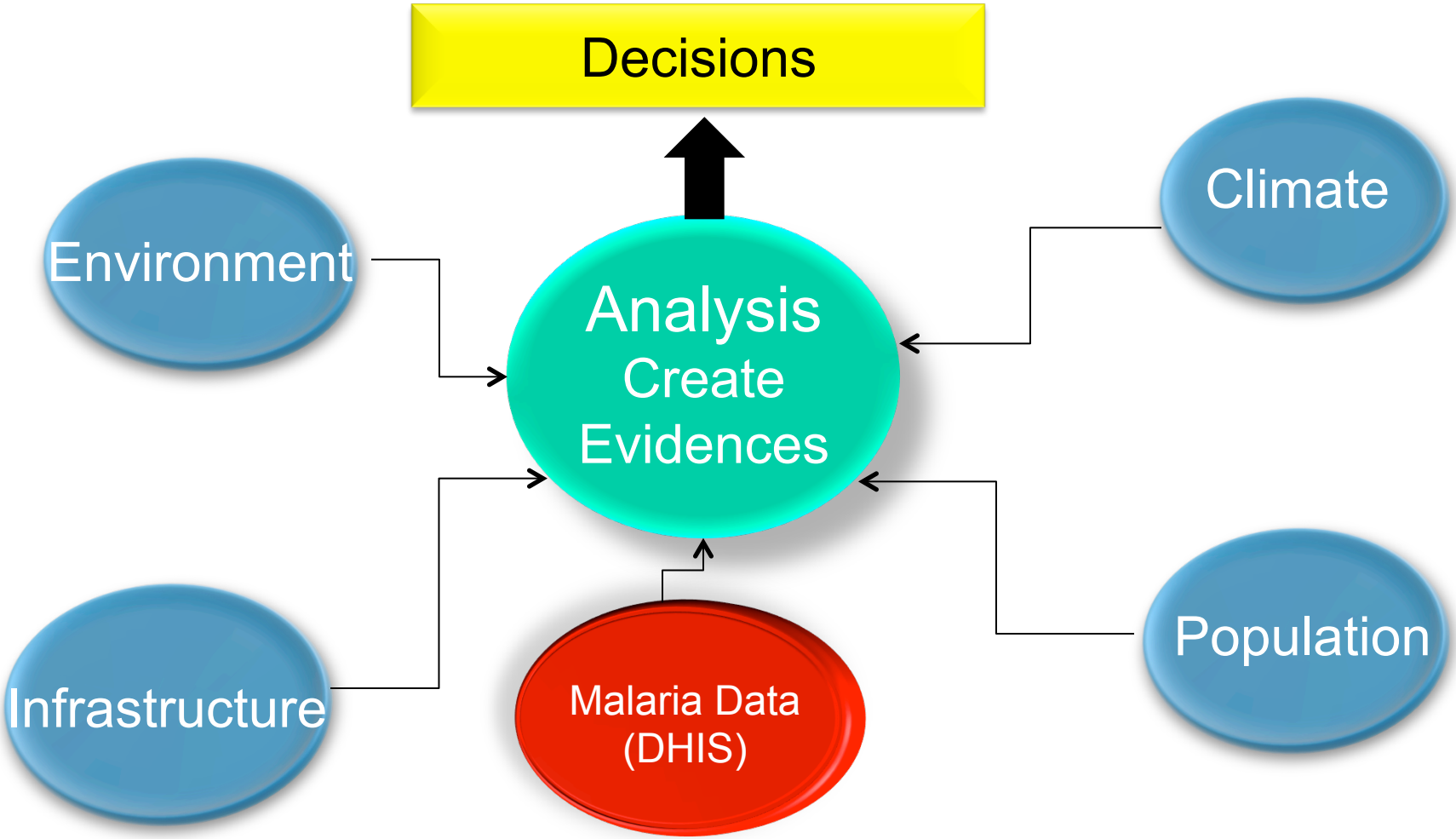


Water tank in Favelas (*e.g.* Rocinha favela)

Rio de Janeiro, Brazil

How Does Population Move?

How Do Users Make Decision?



How Can Users Analyze Data?

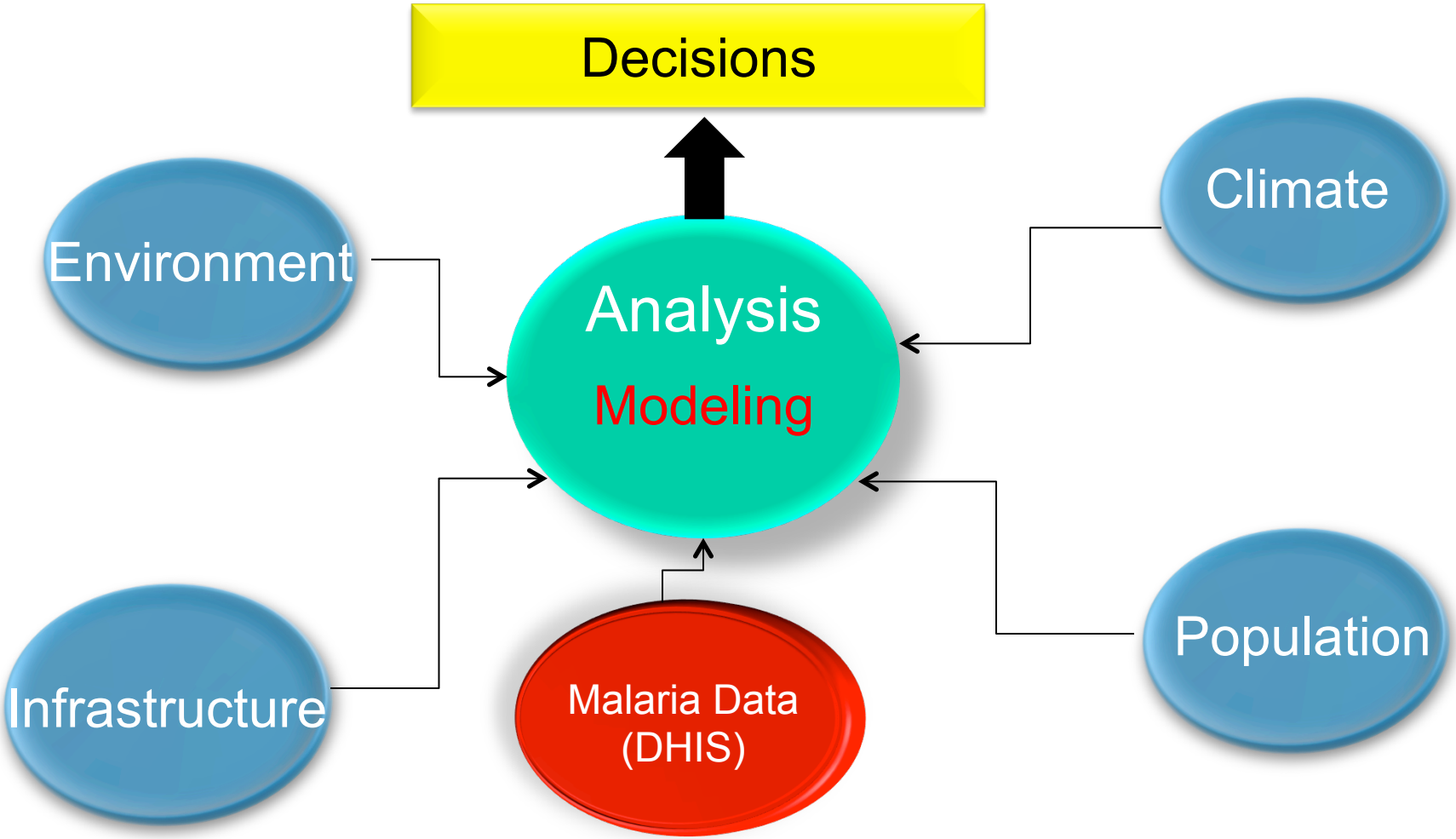
Model

Ministério da Saúde
FIOCRUZ
Fundação Oswaldo Cruz

$$
\begin{aligned}
y_i|\phi_i,\nu_i &\sim \text{Pois}(\mu_i) = \text{Pois}(e_i\rho_i) \\
\log\mu_i &= \log e_i + \log\rho_i = \log e_i + \beta_0 + \sum_{j=1}^{p}\beta_j x_{ij} + \phi_i + \nu_i \\
\phi_i &\sim \text{N}(0,\sigma_\phi^2) \\
\nu_i|\nu_{j\neq i} &\sim \text{N}\left(\frac{\sum_{j\neq i} w_{ij}\nu_j}{\sum_{j\neq i} w_{ij}}, \frac{\sigma_\nu^2}{\sum_{j\neq i} w_{ij}}\right) \\
\beta_0 &\sim \text{U}(-\infty,+\infty) \\
\beta_j &\sim \text{N}(0,a); \quad j = 1,\ldots,p \\
1/\sigma_\phi^2 &\sim \text{Gamma}(b,c) \\
1/\sigma_\nu^2 &\sim \text{Gamma}(d,e)
\end{aligned}
$$

(where a, b, c, d, e are suitably chosen fixed constants)

How Do Users Make Decision?



The International Research Institute for Climate and Society

IRI Data Library

http://iridl.ldeo.columbia.edu/maproom/