Innovations in Geographic Information System Mapping Technology

GIS Working Group Meeting, October 2017

December 2017

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PEPFAR

MEASURE Evaluation

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ACKNOWLEDGMENTS

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CONTENTS

ABBREVIATIONS

ANC	antenatal care
ANC+4	4 or more antenatal care visits
FDGIS	First Draft GIS
GIS	geographic information systems
HOT	Humanitarian OpenStreetMap Team
MCSP	Maternal and Child Survival Program
MOOC	massive open online course
NGO	nongovernmental organization
NPO	nonprofit organization
OSM	OpenStreetMap
PEPFAR	United States President's Emergency Plan for AIDS Relief
USAID	United States Agency for International Development

INTRODUCTION

Background

To promote and improve the use of geospatial data by the implementing partners of the United States President's Emergency Plan for AIDS Relief (PEFPAR), MEASURE Evaluation—funded by the United States Agency for International Development (USAID) and PEPFAR—convened a meeting of the Geographic Information Systems (GIS) Working Group in Washington, DC, on October 23, 2017. The group has been meeting at least annually since 2000, giving GIS specialists and users a regular opportunity to share their experiences with spatial data and platforms, and to keep up to date on recent developments in GIS technology and its uses for global public health. Over the years, several springboard discussions from these meetings have resulted in publications and have led to further collaborative work within the project.

This year, 47 participants from 21 organizations gathered at the offices of Palladium (one of MEASURE Evaluation's partners) in Washington, DC, for the one-day meeting. Attendees were developers, GIS specialists, program managers, and health advocates from USAID, the United States Centers for Disease Control and Prevention (CDC), and the Office of the Global AIDS Coordinator (OGAC), and from nongovernmental organizations (NGOs) such as the Bill & Melinda Gates Foundation, Esri, Blue Raster, Northrup Grumman, and Palladium.

The agenda provided a stage for presentations on new offerings and innovations in GIS technology as well as on research and project findings from the field. These presentations were intended to equip workshop participants with time-saving and more effective tools and techniques, expanding their GIS capabilities. These new analytical tools allow users to engage with spatial data in ways that produce meaningful analyses faster, more efficiently, and with more detail, allowing decision makers to focus HIV programs "on the right things, in the right place, at the right time" in order to achieve PEPFAR's goal of controlling the AIDS epidemic.

Purpose

Since its inception, this working group has been a meeting point for GIS professionals in the field of international health. Each year, the meeting's goals have responded to the evolving landscape of health GIS. This year, MEASURE Evaluation set the following goals for the meeting:

- Show examples of state-of-the-art use of geospatial tools and data.
- Showcase innovations in the field of GIS mapping and their applications to global health and international development.
- Explore community-based information systems and their potential applications to GIS.
- Discuss programmatic needs and priorities for GIS, emphasizing field applications of new technologies.

This report shares the insights, innovations, and research that engaged the working group at this meeting. Presentations covered a wide array of topics but can be distilled to two overarching topics: "innovations" and "research and discoveries" (see Appendix 1 for the meeting agenda).

Presenters were allotted 45 minutes for their presentations, followed by questions and comments from participants. Questions were fielded by the meeting's facilitator, John Spencer, of MEASURE Evaluation, University of North Carolina at Chapel Hill, as well as online using PollEverywhere.

Organization of the Report

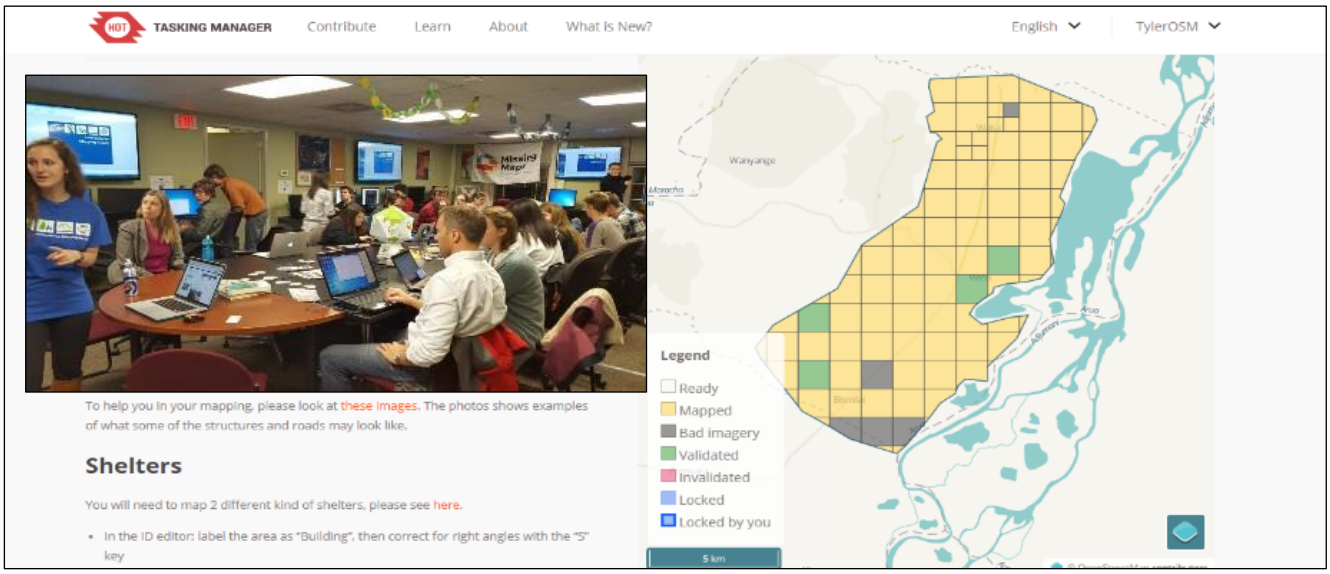
This report has two main sections: *Innovations* and *Research and Discoveries*. The Innovations section describes presentations related to new tools, technologies, and other offerings of some of our guest experts. The Research and Discoveries section showcases some of the work that our presenters have done on upcoming tools, techniques, and data analysis.

INNOVATIONS

With the goal this year of presenting innovation in technology related to GIS tools, we invited presenters from across the industry representing organizations with rich histories in geospatial innovation as well as newcomers with breakthrough advancements.

OpenStreetMap: Open Geodata for Health and Development Programs

OpenStreetMap is a staple platform for any geospatial professional, and this year the GIS Working Group was afforded the opportunity to hear from Tyler Radford from the Humanitarian OpenStreetMap Team (HOT) of mapping experts on the offerings of HOT as well as new products on the horizon.

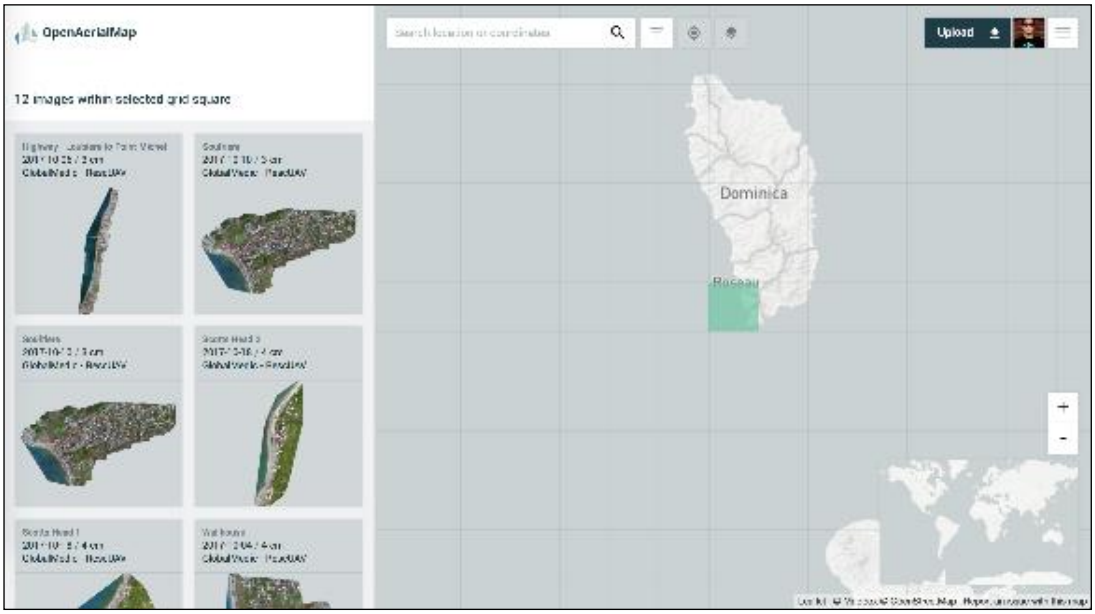


Above: A team of volunteers enters data in an OSM-sponsored mapathon. The map to the right shows an inventory of areas mapped, helping to track progress.

Mr. Radford outlined some of the ways that OpenStreetMap (OSM) is filling in the global database of mapped areas even in the most remote rural areas of the world. This platform of map files is being used to help local governments to digitize their localities, offering enhanced services and resource allocation to their constituencies. Users worldwide have populated HOT's OSM platform with maps through mapathons, by working on their own, and by working collaboratively as members of HOT.

Above: More than 1 million objects were entered and edited during the OSM campaign to map the city of Gueckedou, Guinea.

Organizations and projects can submit unmapped areas of interest to the HOT OSM tasking manager, where crowdsourced volunteers can vectorize features such as roads, footpaths, and buildings from satellite views. Once a desired area is identified, a grid is overlain to subdivide the area for editing by the volunteers. Experienced validators check the edited areas and approve, re-edit, or reject them, making certain that the data obtained through OSM are acceptable and useful on the ground. OSM has 3 million registered users. In addition to that platform, HOT has created OpenAerialMap: a repository for global aerial, satellite, and drone imagery. With OpenAerialMap, users can see imagery collected and catalogued that will automatically overlay with OSM, offering a new level of analysis.



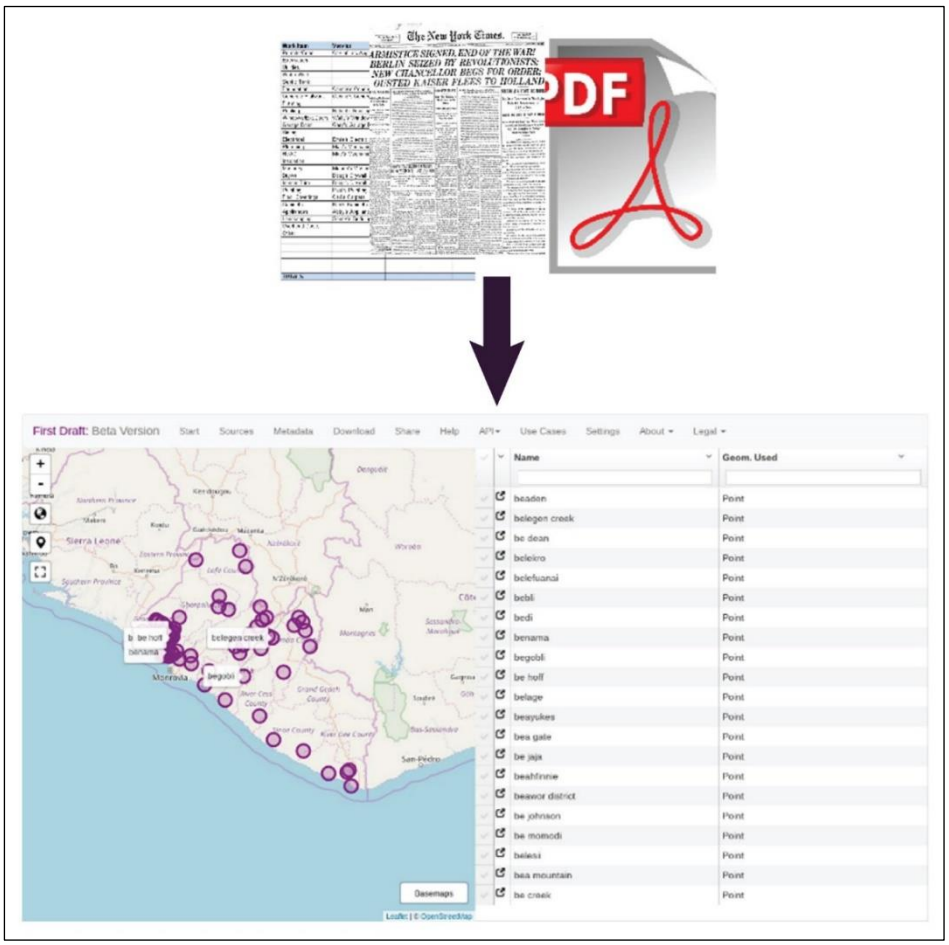
Above: The OpenAerialMap interface is shown here displaying available satellite and drone data for a city in Dominica.

HOT has engaged in partnerships with the Red Cross, Doctors Without Borders, and Youth Mappers and collaborated with Digital Globe, the Bill & Melinda Gates Foundation, the Clinton Health Access Initiative, and USAID GeoCenter.

Artificial Intelligence and Web GIS: First Draft GIS and GeoTIFF.io

First Draft GIS (FDGIS) is a company offering cutting-edge solutions to some of the more time-consuming processes in map analysis. Daniel Dufour, FDGIS's chief executive officer, presented the company's signature application, First Draft GIS, which allows users to render a rough-draft map from any unstructured or semistructured data source.

First Draft GIS



Above: First Draft GIS allows users to upload unstructured data to produce a best-guess estimate of map locations.

The first program created by FDGIS makes the process of creating the first draft of a map easier and more efficient. Sources can be Excel spreadsheets, newspaper articles, web pages, or even pdf files. First Draft GIS's machine learning-based algorithms determine where data should populate, even with less-

developed data sets. If a given data set has a collection of names of cities, FDGIS will look through its database of names and find a country or region that contains a critical mass of those city names, and assign locations to the data, based on the best match for each city. To do this, FDGIS gives preference to cities with the highest population and the lowest administrative level, and assigns a weighted score for each country. Creating the first draft of a map is often the most tedious stage of mapping, because data cleaning is required for finding adequate location matches. The resulting map data from this tool still require cleaning, but the tool can process the largest frontloaded portion of data matching in seconds. This allows more time to be spent on what really matters: analysis.

The company plans to add to the tool the ability to work with place names in multiple languages and to create one comprehensive "mega-gazetteer."

GeoTIFF.io

Mr. Dufour also presented the company's second website creation, designed to aid simple analyses of tagged image file format (TIFF) files. Housed on the website GeoTIFF.io, this tool offers fast, simple analysis of raster files. Because the processing happens on the user's device, the software requires no installation. After uploading your raster file to the website, users can identify the value of individual pixels and calculate the maximum, mean, median, minimum, mode, and sum of an area they designate. Action Against Hunger has used this tool to provide grazing data to pastoralists in western Africa.

GIS for Global Health: Esri Applications

Tripp Corbett manages the NASA account for Esri, one of the largest commercial software companies in the GIS community. Mr. Corbett shared some of the Esri applications that support activities to strengthen health information systems.

Above: ESRI's World Imagery collection is available to assist with Humanitarian OpenStreetMap feature editing.

Although Esri is known for its proprietary ArcGIS platform, Mr. Corbett focused on the company's free resources under the rubric "Maps for Everyone." The following are a few of the apps that Esri offers to help nonprofit organizations (NPOs) collaborate and build their capabilities. ArcGIS Explorer is a mobile app that allows users working in either a public or private domain to find, analyze, and share maps. Free access to the ArcGIS Earth mapping tool allows users to display data, sketch placemarks, measure distances and areas, add annotations, and integrate application programming interfaces (APIs) and spatial data kits (SDKs).

- To build Esri's open source offerings, ArcGIS also provides access to APIs, SDKs, and code through Esri Open Code. At no cost, users integrate the power and functions of ArcGIS in their code and scripts.
- Esri is making authoritative data easier to find with the Global Data Hub, collecting ArcGIS Online groups on public-facing websites so people can find and download an organization's data in a variety of open formats easily.
- The Open Humanitarian Data Repository is increasing access to humanitarian information. During the Ebola outbreak, this repository collected a comprehensive collection of openly available data on the outbreak across West Africa.
- Esri has partnered with OSM to offer an *en suite* platform for OSM editing tasks, streamlining the process for obtaining OSM data for project and research areas.
- To increase the capabilities of users and help them keep up with the fast-paced developments in the ArcGIS platform, Esri has created a catalogue of massive open online courses.

Mr. Corbett said that, besides these free resources, the commercial ArcGIS suite of products is available at a discounted rate to NGOs and NPOs. Registered NGOs and NPOs can secure an ArcGIS subscription for $100 per year.[1]

[1] During the meeting, some of the participants expressed an interest in knowing if USAID data are shared in ArcGIS Online. A search produced the following:

- 685 data layers http://www.arcgis.com/home/search.html?q=USAID&t=content&start=1&sortOrder=desc&sortField=relevance&focus=layers
- 560 web maps http://www.arcgis.com/home/search.html?q=USAID&t=content&start=1&sortOrder=desc&sortField=relevance&focus=maps
- 321 apps http://www.arcgis.com/home/search.html?q=USAID&t=content&start=1&sortOrder=desc&sortField=relevance&focus=applications
- 31 tools http://www.arcgis.com/home/search.html?q=USAID&t=content&start=1&sortOrder=desc&sortField=relevance&focus=applications
- 196 miscellaneous files http://www.arcgis.com/home/search.html?q=USAID&t=content&start=1&sortOrder=desc&sortField=relevance&focus=files

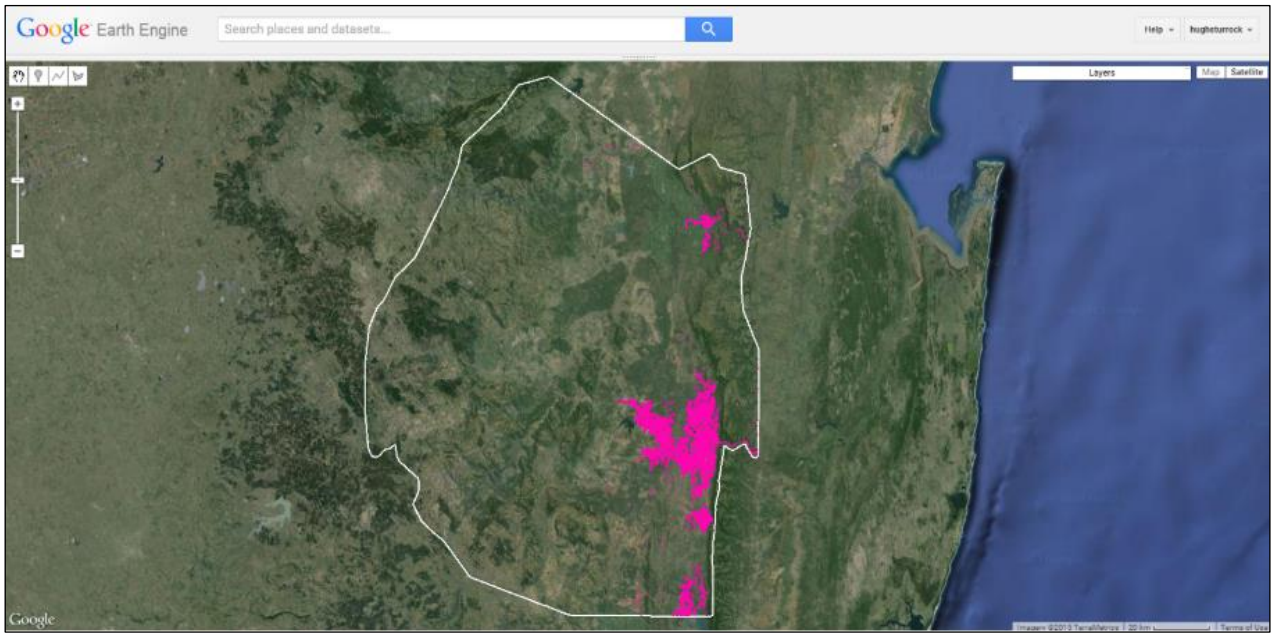
The Living Atlas of the World, which may also be of interest, has an additional 5,223 data layers available to ArcGIS users: https://livingatlas.arcgis.com/en/#s=0.

Google Earth Engine: Cloud-Based Geospatial Data Analysis for Everyone

Joining the working group remotely, Allison Lieber, of Google, presented our audience with the latest spatial technologies and offerings from her company.

> *Google Earth Engine combines a multi-petabyte catalog of satellite imagery and geospatial data sets with planetary-scale analysis capabilities, and makes it available for scientists, researchers, and developers to detect changes, map trends, and quantify differences on the Earth's surface.*
>
> Source: https://earthengine.google.com/

Ms. Lieber presented several practical uses of Google Earth Engine and of Google software for health practitioners, such as Disarm.io, which is powered by Google Earth Engine.



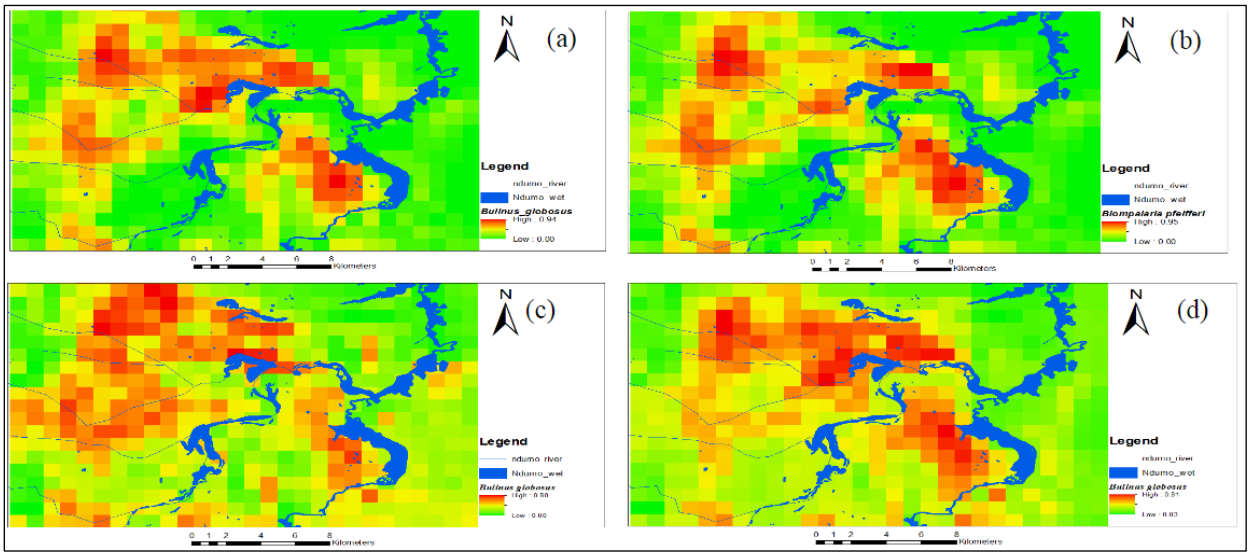
Above: Disarm.io determines most-at-risk areas for malaria over a four-month period.

One use of Disarm.io is automated malaria risk mapping. Disarm.io was created to compile relevant data automatically and generate risk assessment maps with one click. By aggregating data sets on precipitation, elevation, households, and variables, Disarm.io can produce monthly risk maps that evolve over the course of the year, showing when and where to apply an intervention.

The application can also coordinate with task manager software that tracks activities such as bed net distribution, spraying, and surveillance visits. This allows users both to analyze data and propose responses to issues the data uncover, in a single application.

The potential of platforms such as Disarm.io rests on Google Earth Engine's analytical capabilities. Earth Engine provides access to and interoperability of a wide array of historical imagery and data sources on a planetary scale. Coupled with organizational data and algorithms, these features allow geospatial and temporal analysis that can inform solutions in many contexts. Earth Engine brings together imagery and data from more than 40 years of remotely-sensed data from a constellation of satellites and sensors, creating a public catalogue of more than 200 public data sets, 5 million images, and 5 petabytes of data, with 4,000 images added daily.

In the latter half of Ms. Lieber's presentation, she showed more examples of how Google Earth Engine can be used to measure risk for diseases and infections based on the data and imagery analysis compiled within Earth Engine. Diseases cannot be observed remotely, but Earth Engine can be extremely useful in predictive analysis through proxy indicators. For example, in determining risk for schistosomiasis, Google Earth Engine helped the World Health Organization identify suitable habitats for snails that are vectors of the infection.

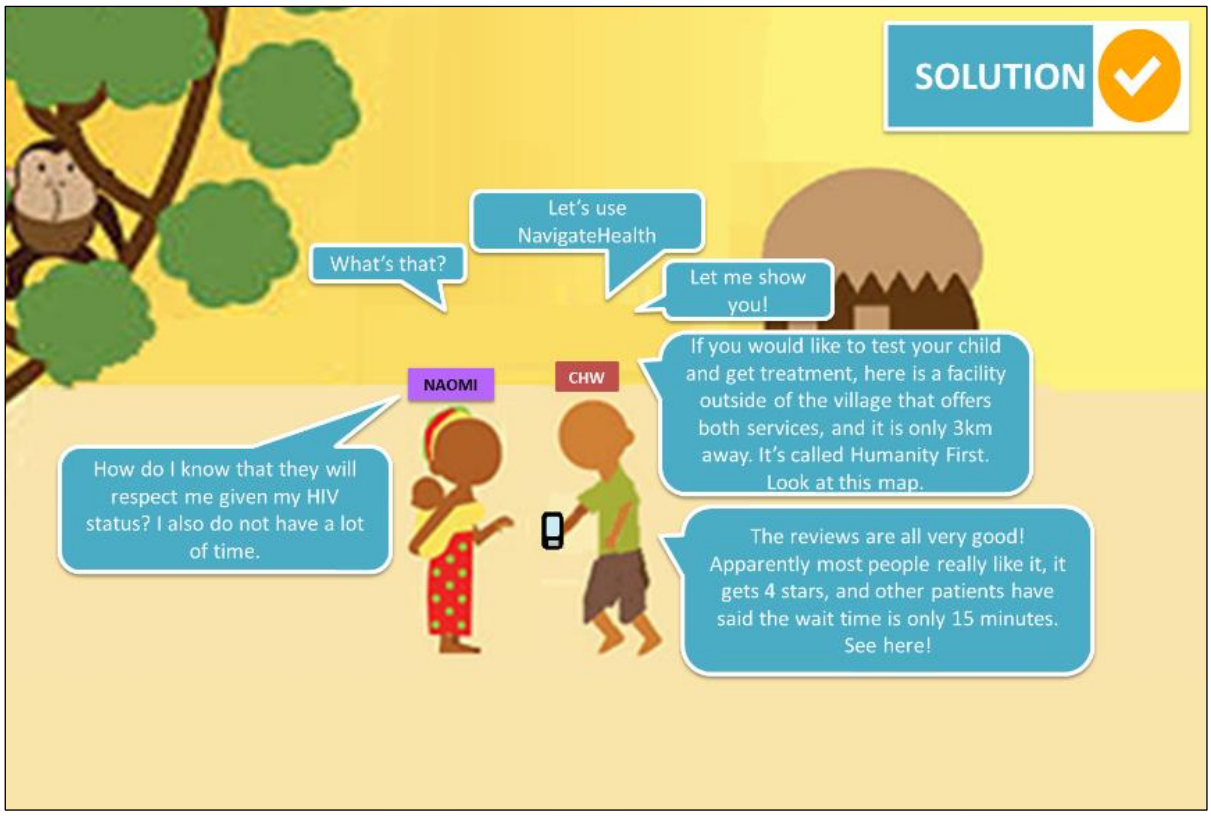


Above: This Google Earth Engine screenshot displays a spatial analysis of risk posed by the presence of snail vector species.

Earth Engine's interactive coding platform—hosted at code.earthengine.google.com—gives users the ability to add coding scripts to enhance their analyses of Earth Engine imagery and data. Ms. Lieber concluded with examples of how organizations have used Earth Engine to measure surface water and predict flooding on coastal plains.

RESEARCH AND DISCOVERIES

The new tools and products offered by our presenters are ultimately only as useful as the projects using them. The work outlined by our presenters also brought important insights into the human element that is required to make these tools effective. The following presentations showcase some of the research that our colleagues are conducting, and the innovative applications of GIS technology to some of the questions that arose during their work.



Above: A community health worker uses the NavigateHealth tool to offer health service advice to his client.

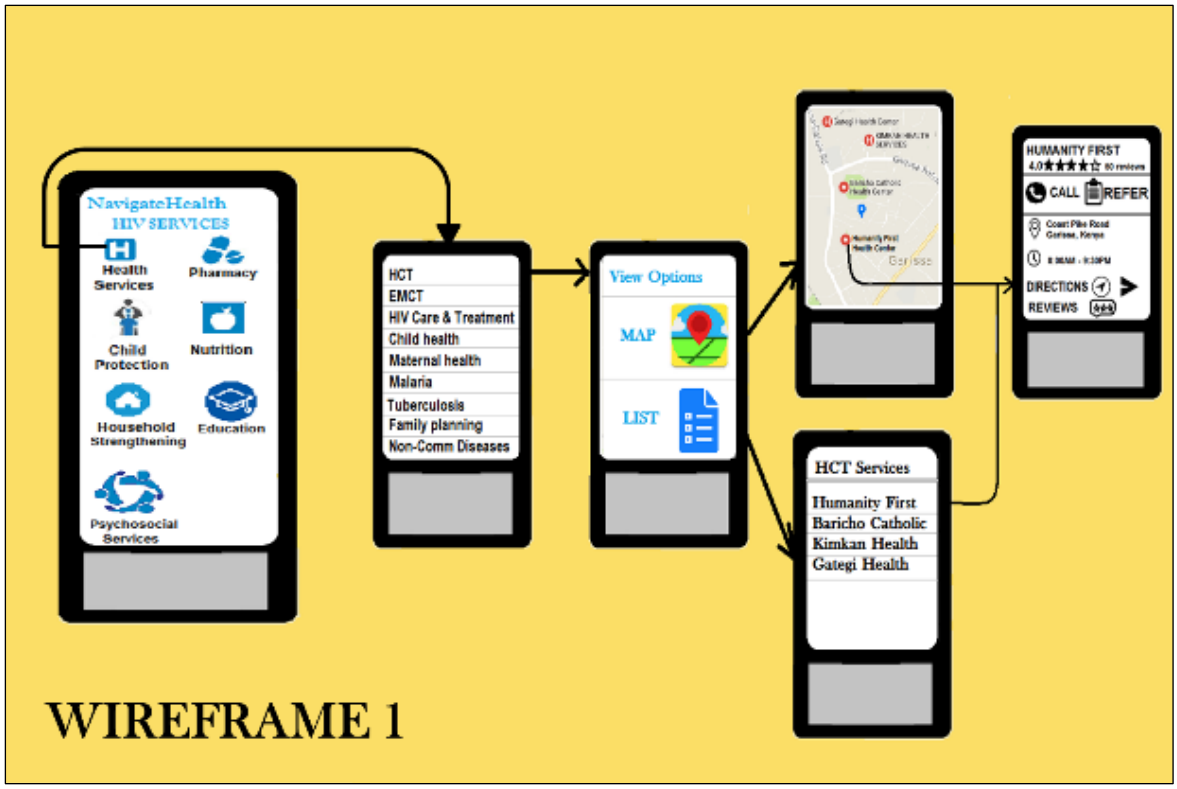
MEASURE Evaluation: NavigateHealth App

Dawne Walker, of MEASURE Evaluation, Palladium, presented her pilot proposal for the NavigateHealth tool, designed to help local health workers serve their clients better through a ratings and recommendations platform for health facilities. NavigateHealth would allow an mHealth system to digitize the mapping of HIV and other health services (facility- and community-based programs and pharmacy services) and give clients information about the quality of the services. Community health workers (CHWs) would be able to access the system on an Android-based smartphone to determine where to send clients for such services as voluntary counselling and testing (VCT), prevention of mother-to-child transmission of HIV (PMTCT), pharmacies, and household economic strengthening.

Some of the desired functions of the tool are the following:

- A list of service outlets
- Services provided at these outlets
- Detailed maps of and directions to nearby service outlets, based on the client's current location
- Contact information for the service outlets
- Directions and time to a selected service outlet, which would be sent to the client by SMS (short message service, a type of low-cost texting)
- Referral form sent by SMS to the client to take to the service delivery outlet
- Crowdsourced reviews of service outlets

Using NavigateHealth, CHWs would be able to recommend facilities and service centers to their clients as well as interface between the facility and the client prior to the client's first visit. By SMS the client would be given directions to the facility and any notes by the CHW for the facility regarding the client's case. This app centers on HIV-related care, but other possible uses are emergency nutrition, child protection, and psychosocial support services.

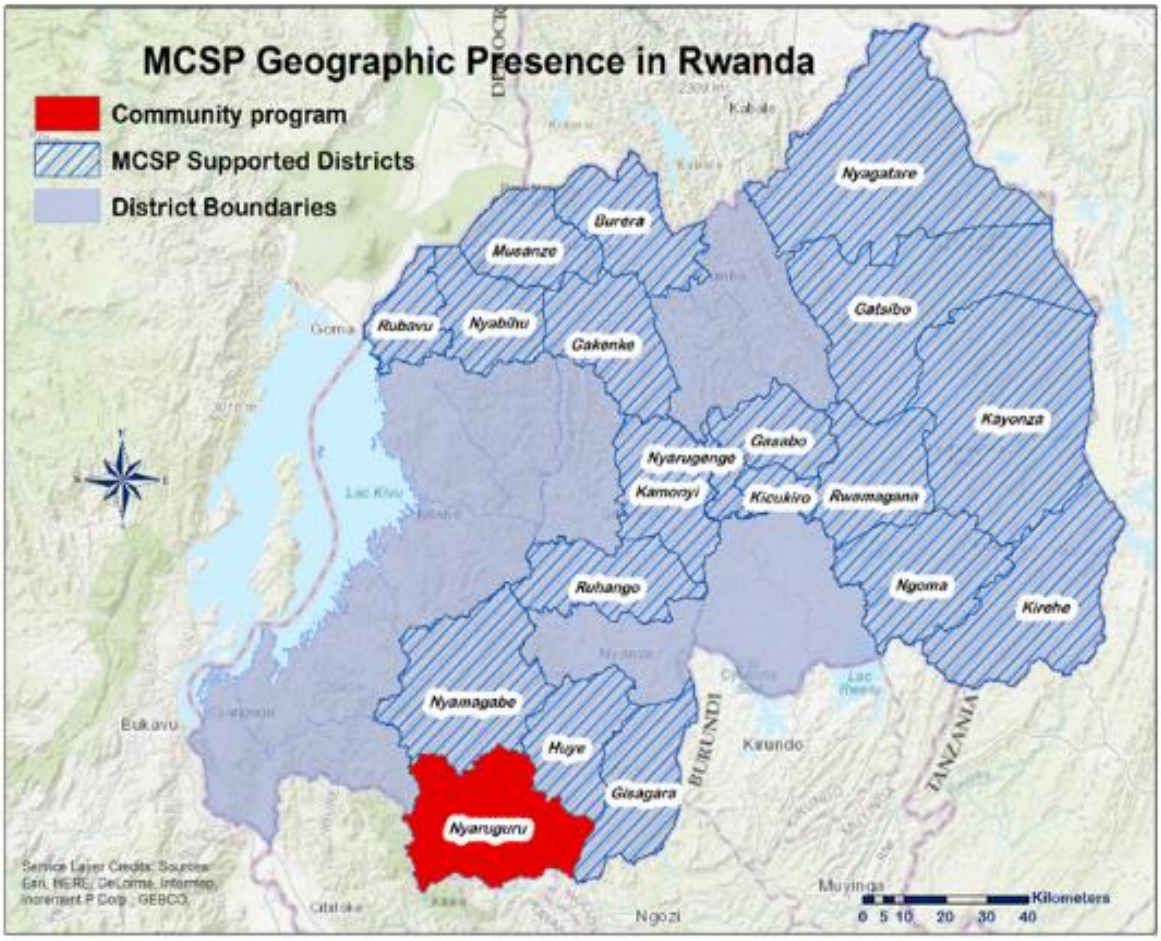


Above: A wireframe of the CHW smartphone interface

Maternal and Child Survival Program: Mapping Factors Related to the Use of Antenatal Care Services in Rwanda

Yordanos Molla, senior specialist for monitoring and evaluation in Rwanda's Maternal and Child Survival Program (MCSP), and her team had been tasked to assess why many pregnant women failed to see antenatal care (ANC) service providers for the recommended four or more check-ups (ANC4+).

Demographic and Health Survey data showed that although 99 percent of women in Rwanda were attending at least one ANC visit, only 44 percent attended four or more. The team conducted the assessment to learn how to increase the use of these services.



Above: This map shows districts in Rwanda where the Maternal and Child Survival Program is present.

They began by defining the relationships among the data available both from the Demographic and Health Survey and from the MCSP. This revealed that the distribution of women engaging in four or more ANC visits was not a normal distribution curve, implying that there must be some sort of variation in the population.

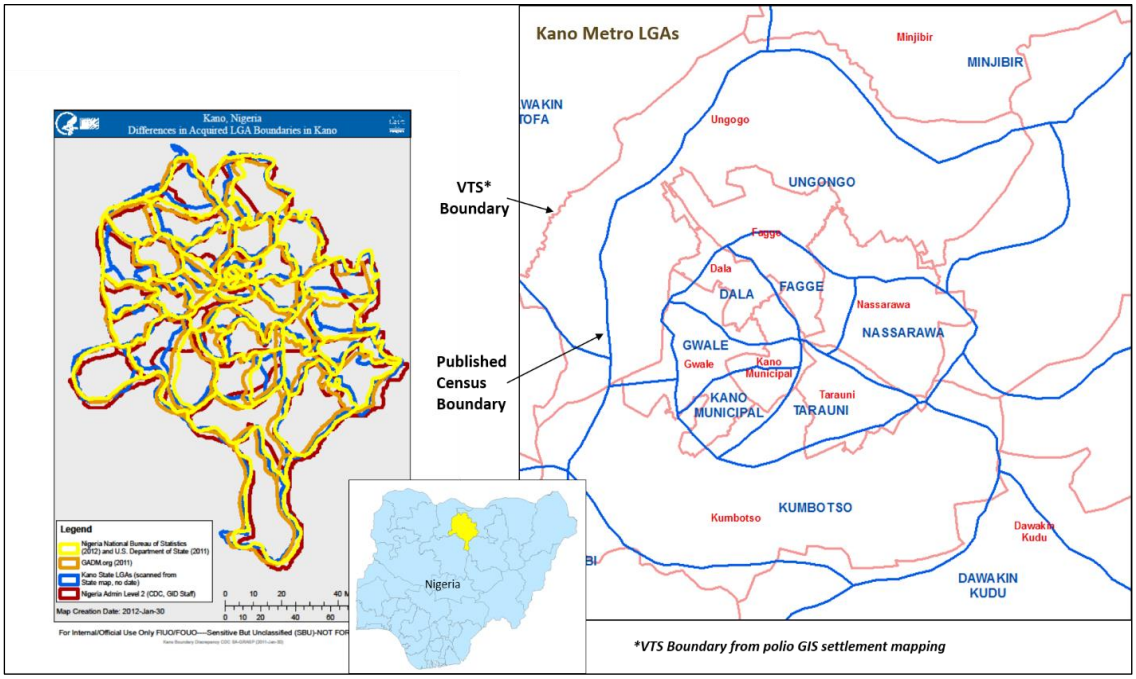
Looking for correlations between ANC services use and women's poverty, ANC services use and facility readiness, and readiness of facilities with women's poverty, Ms. Molla's team found none. They then moved on to hotspot analysis to explore clustering, wondering whether it was possible to see distribution

patterns of indicators even in the absence of statistical correlation. They found several clusters, but these were consistent only in that they showed the South to have relatively higher reported ANC4+ use along with the negative indicators of poor literacy, poor toilet facilities, and poor access to improved water sources. Although facility readiness was determined to not be a major factor in ANC4+ uptake, MCSP provided focused ANC trainings to ANC providers where facility readiness was found to be low in the South.

MCSP also helped facilities make action plans to improve ANC services and to keep stocks of iron, folic acid, and important lab tests in supply. They found several results from their research:

- ANC 4+ service use is neither related with assessed sociodemographic characteristics of the population nor with health facility readiness
- Routine data shows positive change in ANC 4 + service utilization following introduction of community based support
- Focus on community health interventions is important, in addition to strengthening health facility readiness

The Bill & Melinda Gates Foundation: How the Polio Eradication Effort in Nigeria led to a Quest for Global Geospatial Reference Data



Above: These maps of the Kano district in northern Nigeria display the variation between administrative boundaries across multiple data sources.

Vincent Seaman, of the Bill & Melinda Gates Foundation, presented his experience from a polio vaccination campaign in Nigeria and the development of the Geospatial Reference Information Database,

which made the campaign possible. Nigeria had experienced a decrease in the number of polio cases for years through 2010, when it was 21. Steep increases in the number of cases in 2011 and 2012 prompted the Gates Foundation to undertake the vaccination campaign. Because the polio response was organized at the ward level, the team needed accurate maps, so they could reach every village. Maps at this level are known to be inaccurate at best and more often completely unreliable. Mr. Seaman's team engaged in several activities to create an accurate depiction of the wards in northern Nigeria, improving population estimates and thus more complete intervention coverage. One of the strategies for creating more comprehensive maps was to give geographic positioning system-enabled phones to vaccinators, who would make home visits in each of the wards. The phones automatically recorded location pings at timed intervals, giving an outline of the routes the vaccinators took. With 12,000 phones in the field each day, a rough shape of boundaries could be produced. Hamlets and other small homesteads were surrounded with 750-meter buffers to estimate their footprints. Once the outlines of the villages and settlements were set, a Thiessen distance polygon[2] was created between all neighboring wards, producing a roughly accurate shapefile for Nigerian wards.

Within these ward boundaries, accurate depictions of the associated population were required. Mr. Seaman's team created an algorithm that differentiated classifications of residential areas using rich feature descriptors composed of edge, texture, lines, and spectral attributes. The result was a much-improved, granular estimation of where to focus vaccination activities. A deeper discussion of the team's work is in the Gates Foundation's PowerPoint, linked on the same page as this report. The website GeoPoDe.world offers the foundation's population projections across Nigeria, in an open source platform available for public use.

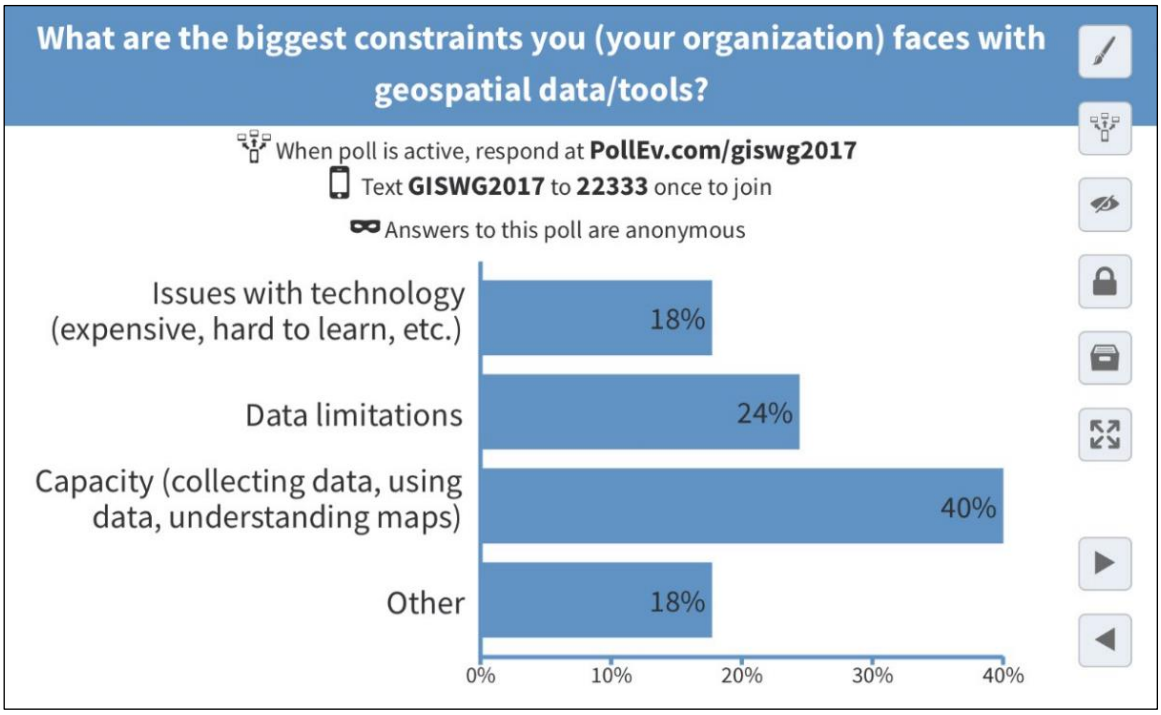
Above: The site GeoPoDe.world is a repository of the Bill & Melinda Gates Foundation's population projections for Nigeria.

[2] A Thiessen polygon is one whose boundaries define areas that are closer to that point than to any other point. In other words, a line drawn perpendicular to a line joining two points will exactly bisect the area between them.

AUDIENCE INTERACTION SURVEYS

At the outset of the meeting, John Spencer unveiled a new audience participation tool: a smart phone application and web link called PollEverywhere. Meeting attendees participated in a practice question, to could get a feel for the software. Then they were encouraged to use PollEverywhere to comment or ask questions during presentations. This allowed the presenters to continue uninterrupted and audience members to comment in real time.

Toward the end of the day, a survey was sent out to audience members, and the answers were discussed as a group. The PollEverywhere application was very well-received.



Above: This is a screenshot from the PollEverywhere application.

Poll Questions/Survey

Q1. What are the biggest constraints you (or your organization) faces with geospatial data and tools?

Q2. What one data set do you wish you had but don't?

Q3. What geospatial capability do you wish your organization had but doesn't?

Q4. Is there a solution or tool we have not discussed but the group should be aware of?

Q5. What is the greatest opportunity not being met? What fruit is hanging the lowest that could be picked?

Audience Responses

Q1 Response (Biggest Constraints)	Count
Capacity (collecting data, using data, understanding maps)	18
Data limitations	11
Other	8
Issues with technology (expensive, hard to learn, etc.)	8
Total	**45**

Other thoughts from participants: We need a clearinghouse for data; lots out there that need to be distributed. At the same time, data are still missing for small, rural places or rapidly growing places. More people need to be working on these data sets to ensure good-quality data.

Q2 Response (Data Desired)

- Income data
- Population data by age and gender; subcountry population data, census data (4)
- Accurate administrative boundary data (5)
- Up-to-date accurate health facility lists (with stable unique identifiers) (3)
- Data on how clients are using GIS data (tied to behavior change?)
- GeneXpert location data for all PEPAR countries
- Hotspots of health inequity around the world
- Maps of houses and human structures
- Detailed and updated roads and footpaths
- More precise, higher-resolution data in general
- Better metadata (data about the data)

Q3 Response (Capability Desired)

- Machine learning, artificial intelligence (2)
- More specialists; more training and capacity (5)
- Data governance
- Scalable high-performance computing
- Proof of value of data analytics
- Better training for diverse audiences

Q4 Response (Solutions)

- Street view
- Drones (2)
- Ushahidi (a Kenyan website that collected reports of post-election violence and mapped them)
- Spatialcurrent.io (planetary-scale geospatial search and visualization)
- Priorities for Local AIDS Control Efforts (PLACE) mapping tool; other QGIS plugins
- Spatial statistics
- Key populations; sensitive information display

Q5 Response (Opportunities)

- Publishing data using maps in public health journals
- Facilities registries
- Raster processing in web browser
- Better sharing of capacity and work
- Locally-collected basic reference data
- Implementation on the front line (not just systems-level thinking)
- Expanding covariates for non-GIS users; better partnering and co-ownership with others

CONCLUSIONS

The format for the GIS working group has changed over the years. This year, the group deviated from the normal format of group-based work and discussion to provide only lectures on advances in GIS work. This decision gave our audience the opportunity to hear from some of the leaders in the GIS community and allowed them to learn more about other organizations and about some cutting-edge GIS tools and techniques. This report constitutes a portal for some of the most exciting GIS products and offerings of 2017 in global public health work. Feedback from the audience showed a demand for the group to continue to grow, possibly with more frequent and larger meetings and a marriage of the presentation style of this year with more interactive displays.

APPENDIX A. MEETING AGENDA

Agenda
October 23, 2017

MEASURE Evaluation GIS
Working Group Annual Meeting
Palladium, 1331 Pennsylvania Ave NW, 6th floor

Meeting objectives

By the end of the meeting, participants will have:

- Seen examples of state-of-the-art use of geospatial tools and data
- Learned about innovations in the field of GIS mapping and their applications to global health and international development
- Learned about community-based information systems and their potential applications to GIS
- Discussed programmatic needs and priorities with regards to GIS, with an emphasis on field applications of new technologies

Time	Session
8:30 am to 9:00 am	**Registration and Reception, Breakfast**
9:00 am to 9:15 am	Welcome
	John Spencer, *Senior GIS Technical Specialist, MEASURE Evaluation, UNC*
9:15 am to 9:30 am	Participant introductions
9:30 am to 10:15 am	"Open mapping for health and humanitarian action using OpenStreetMap"
	Tyler Radford, *Executive Director, Humanitarian OpenStreetMap*
10:15 am to 10:30 am	"Mapping factors that are related with ANC service use in Rwanda: linking health facility and population-based survey data"
	Jennifer Duong & **Yordi Molla**, *MCSP (Maternal and Child Survival Project)*
10:30 am to 10:45 am	**Coffee/snack break**
10:45 am to 11:30 am	GIS for Global Health
	Tripp Corbett, *NASA Account Manager, Esri*
11:30 am to 12:15 pm	"AcEsri GIS Apps to Support Health Information Systems
	Daniel Dufour, *Founder and CEO, First Draft GIS*
12:15 pm to 12:45 pm	"NavigateHealth—a 'Yelp'–like app to support community health workers in finding the best service delivery point for their clients, based on GIS and crowd-sourced data"
	Dawne Walker, *Senior M&E Advisor, MEASURE Evaluation, Palladium*
12:45 pm to 1:45 pm	**Lunch**
1:45 pm to 2:45 pm	"How the polio eradication effort in Nigeria led to a quest for global geospatial reference data"
	Vincent Seaman, *Interim Deputy Director for the Strategy, Data and Analytics, Bill & Melinda Gates Foundation*
2:45 to 3:30 pm	"Google Earth Engine: Health Applications of Google's Cloud Platform for Big Earth Data"
	Allison Lieber, *Program Manager for Google Earth Outreach, Google*
3:30 pm to 3:45 pm	**Snack break**
3:45 pm to 4:30 pm	"Programmatic needs and priorities—the application of GIS to field programs"
	John Spencer, *Senior GIS Technical Specialist, MEASURE Evaluation, UNC*
	Sky Barlow, *GIS Associate, Palladium*
4:30 pm	**Meeting end**

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APPENDIX B. PARTICIPANTS

Name	Position	Organization
Aaron Mulhollen	Geographer	U.S. Census Bureau
Adele Waugaman	Senior Digital Health Advisor	USAID
Allison Lieber	Program Manager	Google
Amanda Quintana	Program Analyst	USAID
Amobe Onovo	GIS Specialist	USAID/Nigeria
Andrea Long-Wagar	Senior Infectious Disease Advisor	USAID
Andrew Inglis	Data Scientist	GSHC-PSM
Anubhuti Mishra	Data Analyst	CDC
Becky Wilkes*	GIS Specialist	MEASURE Evaluation, UNC
Bekim Katja	GIS Team Lead	JSI Applied Tech. Center
Chris Penders	Africa Regional Lead	USAID
Daniel Dufour*	Founder and CEO	First Draft GIS
David Thorin Saeger	Data Analyst	USAID
Dawne Walker*	Senior M&E Advisor	MEASURE Evaluation, Palladium
Elizabeth Pleuss	Public Health Advisor	USAID
Gary Merritt	FSO-public health	USAID (ret.)
Gina Sarfaty	Geospatial Specialist	Office of HIV/AIDS, USAID
Igor Honwana	GIS Specialist	USAID/Mozambique
Jackie Britchford	Senior M&E Associate	Palladium
Jennifer Duong	MCSP Project	MCSP, JSI
Jim Tobias	Senior GIS Developer	Northrup Grumman
John Spencer*	Senior Technical Specialist, GIS	MEASURE Evaluation, UNC
Joshua Oluchukwu Okafor	GIS Fellow	USAID/Rwanda
KaeAnne Parris	Health Scientist	CDC
Katy Gorentz	Associate	Chemonics
Lilian Pintea	VP Conservation Science	Jane Goodall Institute
Lucy Dixon	GIS Analyst	USDA
Mike Edwards	Biostatistician, Sr. Advisor	MEASURE Evaluation, JSI
Morgan Brown	Research Analyst	Population Services Int'l
Nathan Heard	Health Analyst	OGAC, Dept. of State

Phil Satlof	**Project Manager, DHS Program**	**Blue Raster**
Rory Nealon	**Geospatial Info Mgmt Officer**	**USAID/OTI**
Sarah Wiant	**Program Assistant**	**USAID**
Shaylen Foley	**Associate with DIAS**	**MEASURE Evaluation, Palladium**
Shazad Ahmed	**Data Analyst**	**ICF/CDC**
Skylar Barlow*	**GIS Associate**	**Palladium**
Stephanie Mullen	**Senior M&E Advisor**	**MEASURE Evaluation, JSI**
Steven Peck	**VP of M&E**	**Palladium**
Thomas Barnum	**AAAS Fellow**	**USAID**
Tom Fish	**GIS Analyst**	**The DHS Program (ICF)**
Tom Fitzwater	**Geospatial Specialist**	**U.S. Census Bureau**
Trevor Croft	**Technical Director**	**IFC International**
Trinadh Dontamsetti	**Health Geographic Analyst**	**ICF International/DHS**
Tripp Corbett*	**NASA Account Manager**	**ESRI**
Tyler Radford*	**Executive Director**	**Humanitarian OSM**
Vince Seaman*	**Deputy Dir, Strat, Data & Analysis**	**Gates Foundation**
Yordanos Molla*	**M&E Senior Specialist (MCSP)**	**MCSP, Save the Children**

- Indicates a presenter or facilitator

APPENDIX C. SUMMARY OF PARTICIPANTS' EVALUATIONS OF THE MEETING

- Number of participants: 47
- Number of organizations represented: 21
- Types of GIS users: Technical 60%, nontechnical 30%, mixed 10%
- Reported usefulness of meeting: Average of 4.5, with 5 being very useful
- Format of meeting: 77% found presentation format best; others preferred a mix of group work
- Location of meeting: 97% found meeting location useful; 10% found screen hard to see
- PollEverywhere: Nearly everyone found the software useful and engaging; advantages mentioned were the ability to comment "on-the-fly" without interrupting the speaker, increased engagement of introverts, increased collaboration among participants, and ease of use

Suggestions for Future Meetings

- Post-meeting collaboration opportunities
- More interactive sessions
- More engagement of group during the year between these meetings
- Ideas for ways to expand impact on monitoring and evaluation and program management
- Engaging activities such as hackathons and mapping design workshops
- Open the meeting to USAID's Bureau of Democracy, Conflict, and Humanitarian Assistance and the Office of Foreign Disaster Assistance
- More case studies and more country-specific examples
- Continued focus on innovations with tangible field potential

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