Center for Geographic Analysis
Harvard University

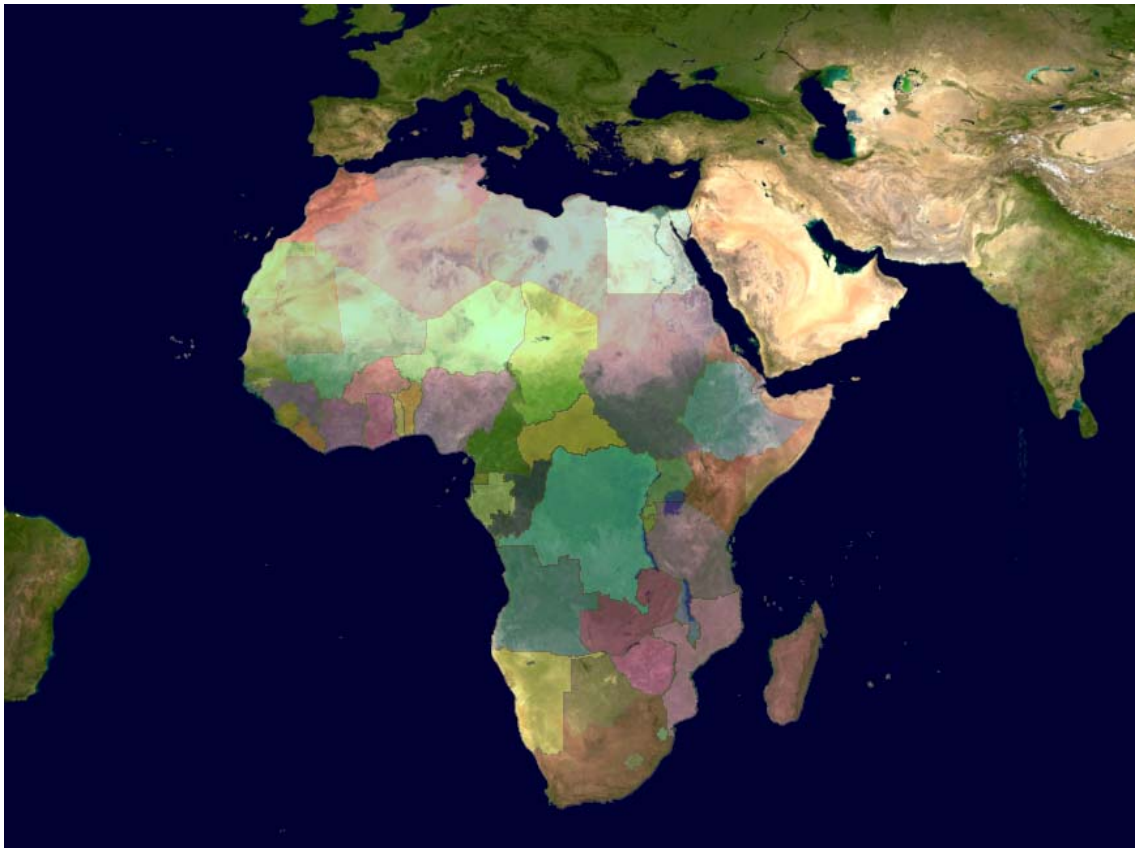
SPACE Spatial Perspectives on Analysis for Curriculum Enhancement

AfricaMap Release I, Beta Workshop

A Framework for Collaboration

March, 2009

http://africamap.harvard.edu



Workshop Funding provided by:
Spatial Perspectives on Analysis for Curriculum Development
http://www.csiss.org/SPACE/

Schedule

9:00 – 9:30	Signing in, logistics, getting set up.
9:30-10:00	Presentation by Wendy Guan, Director of GIS Research Services at CGA: Trends in Geographic Information Systems (GIS)
10:00 – 10:30	Presentation by Paul Cote, Graduate School of Design: Introduction to GIS Technology
10:30 - 10:45	Break
10:45 – 11:15	Presentation by Ben Lewis of CGA: Introduction to the AfricaMap Framework
11:15 – 12:00	Demonstrations by Ben Lewis: System with reference to research tasks
12:00 – 1:00	Lunch break
1:00 – 2:00	Hands-on Lab. Attendees will work through a series of exercises designed to cover the system's main functions. Help will be provided (s*ee details on page 6*).
2:00 – 2:30	Instructor summary of key functions with hands-on demo.
2:30 – 2:45	Break
2:45 - 3:30	Group Level Critique. We will divide into 5 groups and critique the AfricaMap system, developing ideas for improvement *(see details on page 15).*
3:30 – 4:00	Workshop Level Recommendations for Improvement. We will reconvene and derive a set of prioritized recommendations for future enhancements *(see details on page 15).*

AfricaMap Background

In November of 2008 the Phase I release (beta) version of AfricaMap was made available to the Harvard community and the public. This document sets out the basic ideas behind AfricaMap and defines its characteristics and functionality for Phases I (current release).

AfricaMap sets out to address the problem of data availability for Africa. Much public data exists, but it is so difficult to discover, let alone obtain that many research projects on Africa spend much of their budget gathering data. Most people in Africa have an even harder time accessing mapping of their own territories. When researchers do gather data it is often once again lost because there is no place to store it where it can be found.

The AfricaMap project represents a framework for organizing Africa data which can also be applied to other parts of the world. At its core is a digital base map of the continent, viewable dynamically at a range of scales, and composed of the best cartographic mapping available. Behind the scenes a gazetteer starting with over 1 million place names provides rapid navigation to specific locations on a vast landscape. As more detailed mapping becomes available it can be added to the system. There is no limit in terms of hardware or software to the amount of data that can be added to the system.

AfricaMap is not tied to a certain discipline but is interested in storing or referencing data from all disciplines. AfricaMap will encourage collaboration. Researchers will be able to define geographic areas of research so that others can find out about their work. The system employs a Services Oriented Architecture (SOA), which means that all the data that the system displays does not have to be stored on AfricaMap's servers. The data that is stored on the AfricaMap servers is made available to other applications as map services. In this way AfricaMap will become a node on the emerging geo-web.

Collaboration will be encouraged in various ways. Eventually it is hoped, users will be able to add data to the map for point and area locations. Users will be able to add links for location which point to online content such as photos, video, documents, web services. Users will be able to tag features with description, comments, or links to additional information. Currently users can bookmark any view of the system and come back to it or email the bookmark to someone so they can see the same thing.

The idea for AfricaMap was developed under a Provost Funds for Innovative Technology and the project is now being overseen jointly by Suzanne Blier and faculty and staff at the Harvard Center for Geographic Analysis (Peter Bol, Ben Lewis, Wendy Guan). It has the dual aim of supporting Harvard research that involves GIS work on the continent and of making data created in the course of research available to others. The project will support collections that include georeferenced scientific holdings, such as the specimen in collections of the Harvard Museum of Comparative Zoology (MCZ) and the Harvard Herbaria which would benefit from being made available to researchers in other fields.

Harvard offers over 115 courses on Africa each year. There are African research projects at all of Harvard's schools and many of its research centers and institutes, ranging from the cutting edge work of individual scholars to large scale multifaceted projects. During the summer of 2006 alone, there were 166 Harvard students doing their research somewhere on the African continent. Research topics range widely and include archeology, public health, arts, environmental sciences, and government policy.

The Harvard Geospatial Library is a catalog and repository of scanned, georeferenced paper maps and other geospatial data and that is continually expanded and enhanced. It has been identified as the foundation of a university-wide platform to support all areas of teaching and research using geospatial analysis. While many GIS activities on campus are decentralized and handled by individual schools or departments, the Harvard Geospatial Library, supported by the Harvard Map Collection and the Harvard University Library, is available to the entire university and to the public, and could be a useful tool for cross-disciplinary collaboration. The infrastructure of HGL includes a large amount of data stored on its own servers, and is also integrated with the University Library's Digital Repository System for long-term storage of large map images. In order to provide access to these data, HGL has a wealth of descriptive metadata, and allows users to conduct complex text and coordinate based searches. Once useful data is identified through a search, users can then build custom maps from HGL holdings and serve them out to client systems. At this time, the main access to HGL holdings is through the HGL web page, or through complex desktop software programs. However, access through other means is available, and is always being expanded. AfricaMap will leverage HGL functionality, storage and holdings in order to meet some of its technical challenges.

Overview of Functionality

Base data view and layer navigation

- Supports integration of user data with best commercial satellite services such as Google Maps and Google Earth, Virtual Earth, or Yahoo.
- Select one or more overlay layers to view together with the base layer.
- Control of transparency of layers
- Support panning and zooming from global to local (1:2000 scale) views.
- Control layer searchability by keyword and map-click (identify).
- Support text search and map click search against multiple layers.
- Support encoding of any system view in a URL (permalink).
- Support viewing of layers in Google Earth
- WMS services available to access layers via ArcMap and other desktop and web clients

Gazetteer

- Integrate with best general purpose gazetteer, GeoNames. Support regular updates to gazetteer.
- Support search for a place by name and/or type and highlight results, among hundreds of thousands of features.

Finding, viewing researchers' projects

- Search for Harvard research projects on the African continent by keyword or map click on project footprints.
- View project data on the map if available.
- View multiple overlapping projects and access project information and download data if available

Provide access to selected high resolution continental and country level maps

- More than 6000 maps sheets were scanned and referenced for the current release of AfricaMap

Hands-On Lab

In this section we will go through the AfricaMap system in detail. Assistants will provide help if you have trouble.

This section is organized around the 4 tabs *View, Map Layers, Places,* and *About.*

To start, we will go over the functions of the *View* tab.

1.1 View Tab

The *View* tab displays a base layer map (called Google Physical) when you first open AfricaMap. You can choose from several other base layers by clicking the "+" symbol at the upper right and selecting other base layers.

<demo>

1.1.1 Base Layers

We have four base layers from Google Maps in the system. These are all global layers and they make up the best commercial web mapping for Africa which is freely available. The same satellite and hybrid layers are also available for viewing in Google Earth.

- Physical – This map includes a shaded relief map which portrays changes in elevation. Zooming in far enough displays contour lines which denote elevation above sea level in meters. This map also includes some roads and place names and political boundaries. In addition, land cover is roughly portrayed in several shades of green, gray, and yellow.
- Streets – This layer contains roads, which are very incomplete for Africa. The layer also includes place names and political boundaries.
- Satellite – This layer is satellite imagery described above in Hybrid, without other information included such as political boundaries.

- Hybrid (streets and satellite) – This layer layers is constantly being updated with new satellite data and is made up of imagery of varying resolutions (level of detail) patched together. This layer also includes the information in the Streets layer overlaid with the satellite imagery. If you want to find out when a particular image was taken, go to the same area in Google Earth and it will display the date at the bottom of the screen.

<demo>

1.1.2 Navigation - Panning

You can move across the map laterally by simply clicking and holding your (left) mouse button down, then dragging the map. You can also use the tool at the top of the zoom bar in the upper left corner of the map, and click in the direction you wish to go.

<demo>

1.1.3 Navigation - Zooming

You can zoom in and out on the map (change scales) by clicking on the '+' or '-' icons on the zoom bar to the left. You can also click on the zoom bar or drag the zoom bar to change scales. Alternatively you can use your mouse wheel if you have one. The most precise way to zoom is by holding the shift key down, then holding down your (left) mouse button while dragging to create a window of the area you want to zoom to. When you release the mouse button you will zoom the area specified.

<demo>

1.1.4 Text Search

You can search for specific places in Africa (towns, rivers, mountains, etc.) by name using the *Text Search Box* just below the tabs. Before you search for places you will need to go into the *Map Layers* tab, open the *Place Names* category, and turn on the *All Places* layer for searching (second toggle). Then go back to the *View* tab and type in the location you wish to search for in the text box. After you search, you may want to zoom to the whole continent so that you can be sure to see all results. If there are no results for the area you are currently viewing you will get a message which advises you to zoom out.

<demo>

Some vector (point, line, or polygon) layers are currently searchable and some are not. Raster layers such as those developed from scanned paper maps are not currently searchable. All layers which are searchable such as the gazetteer layer *All Places*, will have two toggles in the Map Layers Tab. The left toggle turns the layer on and off for viewing on the map in the *View* tab. The right toggle determines whether a layer is searched from the *Text Search Box* or a click on the map.

NOTE: A gazetteer is a place name database which contains a latitude and longitude for each place name. See more on the gazetteer below in the *Places Tab* section.

When searching *All Places*, locations which match your search (or are close in spelling) are displayed on the map as red triangles. You can also search for text which occurs as parts of words. For example you could search for "sanger" and find all places names "sanger" and all places with "sanger" in the name, such as "sangerfut".

<demo>

A space in a search denotes "and" in terms of search logic. A search for "Tinama" will return three places, a town named "Tinama" in Mali, a lake named "Tinamaladia" in Mali, and a well named "Hassi Tinama Ou Ali" in Mali. You can make use of this "and" functionality to limit your search by adding a code for place type.

For example if you wanted to display only a lake with "Tinama" in the name you could type "tinama lake" or more precisely, "tinama LK". LK is the code for lake. Place-type codes are found in the *Places* Tab which we will discuss under the *Places Tab* section below.

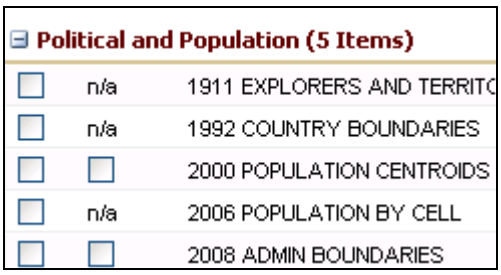
<demo>

A search against a layer goes against multiple fields at the same time. Appendix B gives a list of the searchable layers and the fields for each layer which are searched.

Sometimes one has to wait a few seconds for selected features to appear. Also, you may need to zoom out to see all features which match your query.

If you want to clear your search, click *Reset* which is to the right of the Text Search Box *Search* button.

NOTE: All layers which have two toggles in the *Layer List Tab* are searchable using the Text Search Box.



After a search, only those features selected are clickable on the map. Click *Reset* to enable all features to be clickable again.

<demo>

1.1.5 Sharing a Map View

At the upper right corner of the map is a *Link-to-this-Map* feature that allows you to create a bookmark (URL) for any map view. You can email this URL to a colleague so they can see what you see, or you can save the URL as a bookmark and come back to it later. *Link-to-this-Map* saves the settings in the URL for:

- map extent
- layers turned on
- layer order
- transparency settings for each layer
- text box search

<demo>

1.1.6 Saving a Map View

To save an image to a document file we recommend a free, downloadable screen capture utility called *Jing*: http://www.jingproject.com. Jing allows you to precisely capture any part of your map view and save it to a file. Jing also allows you to annotate and mark up your image before you save it. Jing will even allow you to capture on screen activities in an animation (with sound if you have a microphone attached to your computer).

<demo>

1.2 Map Layers Tab

The *Map Layers* tab lets you turn on map layers that you will then explore in the *View tab*. The *Map Layers* tab also provides access to information about each layer. Open the category you wish to explore by clicking the '+' symbol next the category name. For example click the '+' next to *Base Mapping* to see all the base mapping layers.

1.2.1 Base Mapping

A base mapping layer is a general purpose map displaying roads, political boundaries, towns, rivers and other essential features for orientation. In AfricaMap there are two types of Base Mapping, ours (or yours) and Google's. We use the Base Layers from Google (and potentially other commercial providers) which are accessed by the '+' at the upper right. These layers are always displayed behind our layers.

We also have a *Base Mapping* category in the *Map Layers Tab* which contains mapping Harvard has acquired or developed. Harvard's base mapping contains much information not available in the commercial layers, but the commercial layers provide much valuable information which Harvard does not have. Together these two sets of layers create a powerful base map for the continent. AfricaMap allows a researcher to use these multiple sets of base mapping together in new ways.

The collection of base mapping in AfricaMap is currently far from complete. There are thousands of base maps residing in various paper collections around the world which could eventually be made available to use in this way.

In many African countries there is no detailed online base mapping available. AfricaMap is intended, in part, as a means of providing best available digital base mapping for Africa to the world community.

1.2.2 Map Layer Tab Columns

The following column headings are available in the Map Layer Tab for each layer:

- **Add** – Use the *Add* column to turn layers on and off for display in the *View* tab. Any layer turned on here also appears in the Active Layer List (accessible by clicking the '+' sign to the upper right of the map view. Once in the Active Layer List, each layer has a transparency slider bar to control transparency. The order in which you turn layers on determines what layers display on top of other layers. A layer turned on later will display on top of a layer turned on earlier.
- **Search** – Turn the *Search* toggle on for a layer to enable both map-click and text searches. If *Search* is turned on for a layer and you click on the map, information will be returned for that layer which describes the location at which you clicked. In addition, when you use the text search you will be searching the data behind that layer and will display features matching your search on the map. *Search* is only available for some layers.
- **Name** – The name of the map layer.
- **Description** – The description of the map layer.
- **Date** – The year of the data.
- **Source** – The organization which created the data layer, except where paper maps are the source. In the case of paper maps, the organization which created the paper maps is provided as the source.
- **Scale** – The published, or in some cases estimated, scale of the data.
- **Extent Description** – Describes the extent of the layer.
- **Language** – The language used.
- **Legend** – Clicking *Legend* brings up a legend which the user can resize and place on the map.
- **Zoom** – Clicking *Zoom* takes the user straight to the map extent of the layer. This is useful for small layers which might be hard to find on a continental map of Africa.
- **Reference** – Clicking *Reference* displays source information for the layer.
- **3D** – Clicking 3D loads the layer to Google Earth. To take advantage of this functionality you must have Google Earth installed on your computer. To download the latest version of Google Earth, click here.
- **Metadata** – (Not yet populated) Clicking *Metadata* displays GIS metadata for the layer. In this case metadata is specially formatted information about spatial datasets.

- **Download** – (Mostly not yet populated) Clicking *Download* allows you to download the data for the layer.

1.3 Searching for Places

In AfricaMap the gazetteer is called "Places". A gazetteer is a table of place names with latitudes and longitudes for each name. AfricaMap has a gazetteer which comes from GeoNames.org and which contains about 1 million places. GeoNames is based mostly on the U.S National Geospatial Intelligence Agency database GNS (http://earth-info.nga.mil/gns/html/index.html). The gazetteer makes it possible to find and quickly display the locations of even very small villages as well as a variety of others types of place such as wells, streams, airfields, schools, etc.

There are two ways to access Places information. First, in the *Map Layers Tab* you can go under the *Place Names* category and turn on all places for display and/or searching. This approach lets you see and query (by Text Search Box or map click) all Places at once. This can be useful if you want o go to a particular area and see all Place information for that area.

At this point you can also type in a text query and highlight places matching your query.

<demo>

The text box can also be used to search any searchable layers in the system. (A searchable layer has an additional toggle for search in the Map Layers Tab.) For any search against any layer, including Places, a space between words denotes "and" in terms of search logic. This means that you can narrow your search using multiple words separated by spaces.

Because your search is run against multiple fields in the database, (documented in Appendix B) you can narrow a search for places with the name "Lagos" to include only those which are harbors, by adding the code for harbor (HBR). Example: "lagos HBR".

<demo>

Because the system automatically searches the Name, Alternate Name, Country, Feature Code, and Feature Type fields, it will find all places with "lagos" in the name which also contain the code for harbor. This results in one matching result whereas "lagos" would have returned 19 results.

It is important to point out, that AfricaMap performs loose searches. If you search for "lagos" you will also return words which contain "lagos" such as "Lagossa river" as well as names close in spelling such as "legos".

NOTE: Loose searches are more costly in terms of system resources than exact searches so *let us know if you think this is useful.* It may be we will eventually want to allow the user to perform exact searches by default (much faster) and loose searches as an advanced option.

1.4 Places Tab

In addition to searching for places by turning on the *All Places* layer in the *Map Layers Tab*, one can also search for places using the *Places Tab*. The *Places Tab* provides a breakdown of all the different types of Place in the system. One can turn on any combination of place types for exploration in the *View* tab. This list of place types is called an ontology. The list of place types here is not complete. For a list of all place types used in GeoNames, see: http://www.geonames.org/export/codes.html

In the Places Tab one can see the different types of place information available and the frequency of each type of place in the system. One can then turn on one or more type of place and see only that type on the map.

<demo>

It is possible to combine a text box query with a particular place type. For example if we turn on "wells" as our place type and then in the text search box type the well name "chaten" we see all wells named chaten.

<demo>

1.5 Clicking on a Layer to Return Attributes

When a searchable layer is turned on (see 1.1.4 above for more on searchable layers) clicking on that layer on the map will return information about the place you clicked on the layer. Two boxes will appear, one which lists the instances in the layer, and one which lists the details for a given instance. In some layers there will only be one instance. In others there will be multiple because the layer contains overlapping features.
Sometimes a layer which does not contain overlapping features will return more than one instance if you are zoomed out. In the case of Admin Boundaries it is returning nearby instances.

This functionality will likely be stopped in favor of returning one feature where there are no overlapping features in a layer. *Let us know what you think.*

<demo>

1.6 Clicking on Multiple Layers to Drill Down and Return Attributes

Now let's turn on multiple layers. In addition to "2000 Admin Boundaries" turn on "2008 Population Centroids" for both search and display. In most parts of the continent there is one centroid for each administrative boundary. Click on a centroid with a boundary around it. You will get two features back which may and may have the same name. In the Results box, you will see "Populations of Administrative Areas" and "Administrative Boundaries". Clicking on the instance under each will display the details for that instance in the second box.

<demo>

1.7 Searching Multiple Layers Using the Text Box as Filter

It is possible to perform a text search and highlight features in any searchable layer. For example under *Etho and Linguistic* category turn on *2001 Language Families*, then turn on *1959 Ethnographic* for searching, then turn on *All Places* for searching.

NOTE: The order that layers are turned on and off determines which layer displays on top of the other in the map. Layers turned on later display on top of layers turned on earlier.

Now zoom out to a continental view. Search for the ethnographic region "Bambara". You should see the ethnographic region highlight on the map as well as Place features for Bambara. Now zoom into that region. Fade off *1959 Ethnoraphic*. Now you can see the Bambara ethnographic boundary overlaid on top of the Language family map. Now turn on the legend for *2001 Language Families*. We can see that the Bambara region overlaps mostly with the Northern Mande and a little of the Fufulde language family group.

1.8 Searching Layers With Overlapping Features

Some individual layers such as the *Projects Index* (under the *Local Projects* category) and the *Harvard Map Collection Index* (under the *Harvard Collections* category) contain multiple overlapping features. When these layers are turned on for searching, depending on where the map is clicked, many features may be returned for a given click location.

The *Projects Index* layer is a map of the footprints of datasets which are not themselves spatial. A project in this layer can be either an ongoing or completed project. Ongoing projects typically do not have data available but describe an ongoing project and provide contact information. Completed projects often are linked to datasets or articles. The *Projects Index* polygons are filled with a translucent tan color such that the more projects that exist in an area the darker the color. Clicking on a dark area returns many projects, clicking on a light area returns a few.

NOTE: Unlike other layers in the system, text searches on the Projects Index layer are case sensitive.

It is possible to filter the Projects Index using a text query such as "Afrobarometer". Now when the map is clicked, only those projects with the word "Afrobarometer" are returned.

<demo>

1.9 Opening AfricaMap Layers in Google Earth

In the *Map Layers Tab* some maps are available for viewing in Google Earth via the "3D" column. In Google Earth one can overlay AfricaMap data with valuable layers which are available in Google Earth such as Open Street Maps. For non raster layers one can tilt and view AfricaMap layers

draped on a terrain model. However perhaps the most valuable feature Google Earth provides is the ability to mark up or annotate AfricaMap layers.

Google Earth provides tools for adding placemarks, paths, polygons, and image overlays features to a map and saving these markups with the layer to your own KML file which you can then share with others. Google Earth also provides a rich set of tools for adding links and content to your markup features. There is much documentation available on the web on creating these kinds of features in Google Earth. CGA runs a workshop on this a couple times a year if you are interested in more in depth on this. See http://gis.harvard.edu/icb/icb.do?keyword=k235&pageid=icb.page189848 for a schedule.

Here we will open the *1959 Ethnographic* layer and the *2001 Ethnographic Regions* layer (both in the Ethno and Linguistic category) in Google Earth and use them to delineate an ethnographic region using one or both of the layers as guides. We will add a text description to our polygon. Then we will save our description to a KML file called Ethno_comments_your_initial. To save, right click on the polygon you created and go to save as and place the kml file on your desktop.

<demo>

1.9.1 Saving and Sharing KML using MyMaps

Now let's go into my maps and add our polygon to the sharable map in Google MyMaps that I created. Go to maps.google.com. Then go to MyMaps and login. You may need to create a gmail account if you don't have one.

I gave you all edit access to my map called ethno_notes_BL. You should be able to select that layer and import the KML files you just created to add to this layer. Once you add your piece, everyone else should be able to see your piece. In this way a group of people could build a new GIS layer collaboratively using materials from AfricaMap or from other sources.

<demo>

1.10 Bringing Your Map Markups KML into a Desktop GIS

First we will load a WMS of the Soviet map being served from AfricaMap server to a desktop GIS system.

<demo>

Now we will open the KML file we created and load it to the map.

<demo>

You can now digitize using ArcGIS tools on top of AfricaMap data. If you are interested in learning more about ArcMap check out our learning resources on http://gis.harvard.edu.

<demo>

1.11 Open Source Alternative to ArcGIS - Udig

If you are affiliated with Harvard you have free access to ArcMap, but you may not always have access to a license or you may work with people who do not have access to ArcMap. If you have to pay for it, the least expensive version is about $1500. There are however several Open Source alternatives to ArcMap, work well for creating GIS vector data and working with AfricaMap data and web services.

.

One I like is called Udig, an open source desktop GIS application that is relatively easy to use.

Open Udig and load web the service:
http://cga-5.hmdc.harvard.edu/cgi-bin/mapserv?map=/opt/CGA/data/vec/vec.map

<demo>

Then create a polygon feature and save it. You can share this type of data with any GIS user, and perhaps even contribute it back to AfricaMap project!

<demo>

Group Level Critique

We will divide the workshop into 5 groups and critique the AfricaMap system, delinating its strengths and weaknesses within the groups. We will need one volunteer to document the group's decisions and be ready to report the group's views to the rest of the workshop.

To start wit we will consider the system from these perspectives. If you would like to add another perspective, please let us know and we will add it.

1. Functionality
    a. Current functions that work well
    b. New functions that would improve the system
    c. Recommended changes to current functions
2. Data available
    a. Current data that is especially useful
    b. New data that would improve the system
3. Ease of Use
    a. Areas of the system that are easy to use
    b. Areas that are not easy to use
4. Documentation
    a. Strengths
    b. Weaknesses

Workshop Level Recommendations

We will reconvene and derive a set of prioritized recommendations for future enhancements to the system.

ListServ

I plan to send everyone an invite everyone to join a listserv for further communications regarding AfricaMap. If you are interested, join up.

Contact Info

Ben Lewis
Center for Geographic Analysis
Harvard University
blewis(at)cga.harvard.edu

Appendix A - key system characteristics

Web-based - The system takes advantage of the latest techniques for making large amounts of data and mapping discoverable and usable through a standard web browser.

Public access to holdings - Core holdings are bing put in the public domain or licensed using a Creative Commons type license wherever possible. This means that researchers anywhere in the world will be able to download and use these original materials without major restriction.

Encourage replication - One reason Africa data is hard to find is that the data which exists is not yet well replicated. By contrast the base map for the United States (the Digital Raster Graphics files) area easy to find and exist on hundreds of servers.

Base mapping – Historic base maps for Africa are developed by scanning, cropping, and georeferencing maps from the Harvard Map Collection and elsewhere. Maps are digitized at a range of scales and for a range of time periods.

Dynamic gazetteer – The gazetteer together with the base map form the core of the AfricaMap system. These two datasets support one another over time, allowing the gazetteer to grow and improve, which will make it easier to find places on the base map.

Collaborative approach – Some tools to support collaboration between researchers are provided. In the first version a permalink feature will allow any view of the system to be captured in a URL which can be shared. In the next phase user created maps and map markup tools are anticipated. Researchers will be able to download base mapping and other datasets.

Multiple scales - The system will support research at a variety of scales from sites or cities to country or continent-wide projects.

Multiple media types - The system will support access to many types of media in addition to spatial data, including photos, maps, text, video, audio, and KML for Google Earth display.

Long term data access - Once maps are scanned, digitized, georeferenced it should not be necessary for anyone in the world to repeat that work. Making digital materials available over time is not easy because technology changes. Techniques will be used to ensure long term access to public domain digital materials wherever possible.

Improves over time - While the Harvard Map Library has large Africa holdings, it does not always have all maps for a given series, and there may be important series which it does not have. The goal is to fill in holes in the collection over time by sharing with other libraries and collections. Users will be able to submit data to Harvard using an online form.

Usability - Ease of use is of primary importance. It must be easy and quick for non-technical people to find the information they need. Researchers are the end users of this system and will be consulted frequently to guide the design of the user interface.

Text-based search of contents - Google-type text search against the contents of the entire system is possible with results displayed on the map.

Interdisciplinary approach - The system will bring together mapped data (and facilitate the mapping of data) from a wide range of disciplines including archaeology, public health, history, linguistics, literature, zoology, natural resources to name a few.

Global approach - The goal is to create a technical framework to support research on Africa which could also be applied to other parts of the world. It is hope that aspects of AfricaMap will be useful for organizations based in Africa whether it is the underlying data, data hosting services, map services, or the AfricaMap software.

Scalable – The data in the system will be cached as it is used. This approach greatly increases performance and reduces server load, making the system far more scalable than a traditional web-GIS.

Services oriented architecture (SOA) - The system will support access by other web and desktop systems and will in turn be able to access and display the maps on AfricaMap directly via web services. This means that other systems will not have to download the data to access it within their applications.

Cross Platform – AfricaMap can serve data services to other types of GIS platforms including ArcMap desktop and ArcGIS Server. In addition, AfricaMap can display data served up from other platforms. Data formats used will be open specification ones such as GeoTIFF, JPG2000, KML, and Shape.

Open Source – The software that runs AfricaMap is Open Source and available for users and organizations inside and outside Harvard to obtain and build upon.

Appendix B - Fields Which Are Searched by Text Search

Eventually fields (returned by map click) will be color coded to denote whether they are searched by text search.

Below are the searchable layers and the fields which are returned by clicking on the map. Those fields which are search via text search are highlighted in gray.

Place Names

- Place Name
- Alternate Names
- Country
- Feature Code
- Feature Type
- Description
- Population
- Admin District 1
- Admin District 2
- Longitude
- Latitude
- Elevation

Projects

- Project Name
- Keywords
- Primary Discipline
- Secondary Discipline
- Description
- Project Start Date
- Project End Date
- Contact Name
- Contact Org.
- Contact Email
- Project URL
- Project Data URL

Ethnographic Boundaries

- Ethnographic Region
- HRAF Code
- Note on code
- Keywords

Harvard Map Collection

- Name

- Country and Region
- Map Making Country
- Language
- Scale
- Start Date
- End Date
- Complete
- Call Number
- View Index

Population Centroids

- Name 1
- Name 2
- Name 3
- Name 4
- AdminID
- Area Sq Km
- Population 1990
- Population 1995
- Population 2000
- Population 2010
- Population 2015
- Density 2005 (sq km)
-

GADM

- Name 1
- Alternate Name 1
- Name 1 from Date
- Name 1 to Date
- Name 2
- Alternate Name 2
- Type
- FIPS Code
- HASC Code

Appendix C - Open Source Software Components Used to Build AfricaMap

OpenLayers - http://openlayers.org/

ExtJS - http://extjs.com/

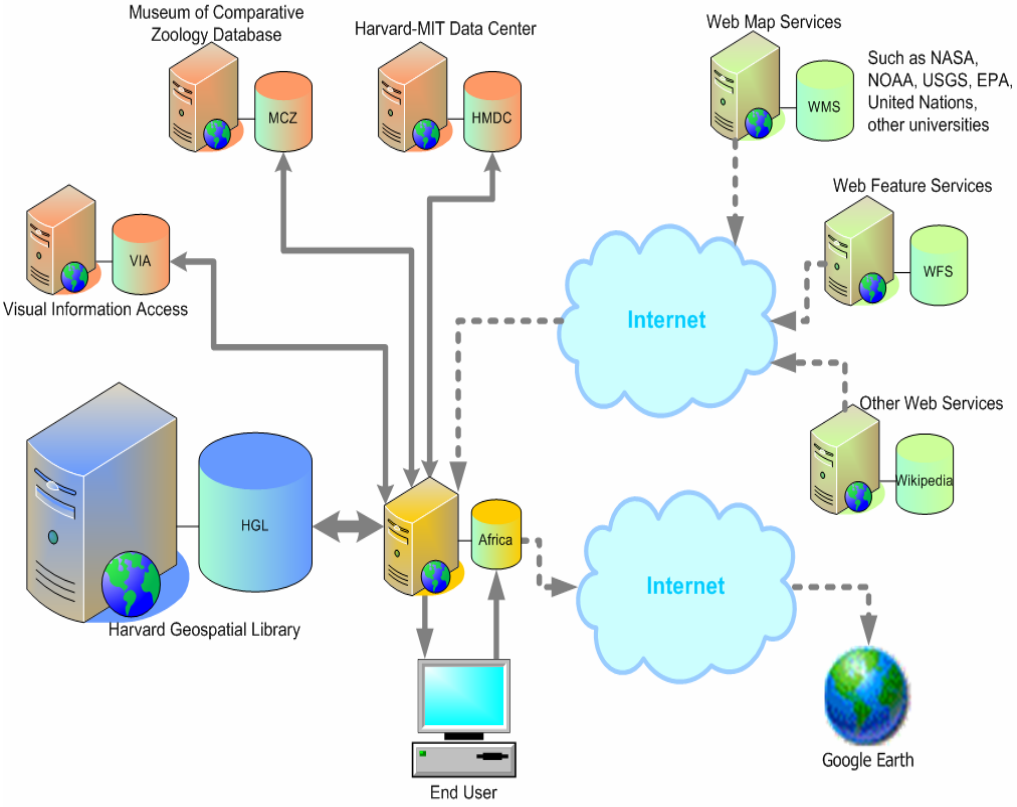
MapServer - http://mapserver.org/

GeoServer - http://geoserver.org/

PostGIS - http://postgis.refractions.net/

TileCache - http://tilecache.org/

Appendix D – Early System Sketch



Mapping Africa: a spatial portal for African Research – System Diagram

Appendix E – Layers in the Current Release

Map-Series-Based Layers

Series Name	# Map Sheets	Coverage	Scale	Year	Size on Disk GB
U.S ONC	47	95% continent	1:1,000,000	1979-1998	13
U.S. TPC	142	75% continent	1:500,000	1974-2002	40
U.S. JOG	1039	50% continent	1:250,000	1965-2005	58
U.S. Burundi	40	100% continent	1:50,000	1994	3
Soviet	550	100% continent	1:500,000	1962-2003	6
Soviet	3250	80% continent	1:200,000	1962-2004	40
Nigeria	1039	50% country	1:100,000 and 1:50,000	1960-1978	58
French 1898	62	100% continent	1:2,000,000	1898	12
Sierra Leone	190	100% country	1:50,000	1964-1973	3
Freetown	108	100% city	1:2,500	1941-1965	5
TOTAL	**6467**				**238**

Funding by Spatial Perspectives on Analysis for Curriculum Development

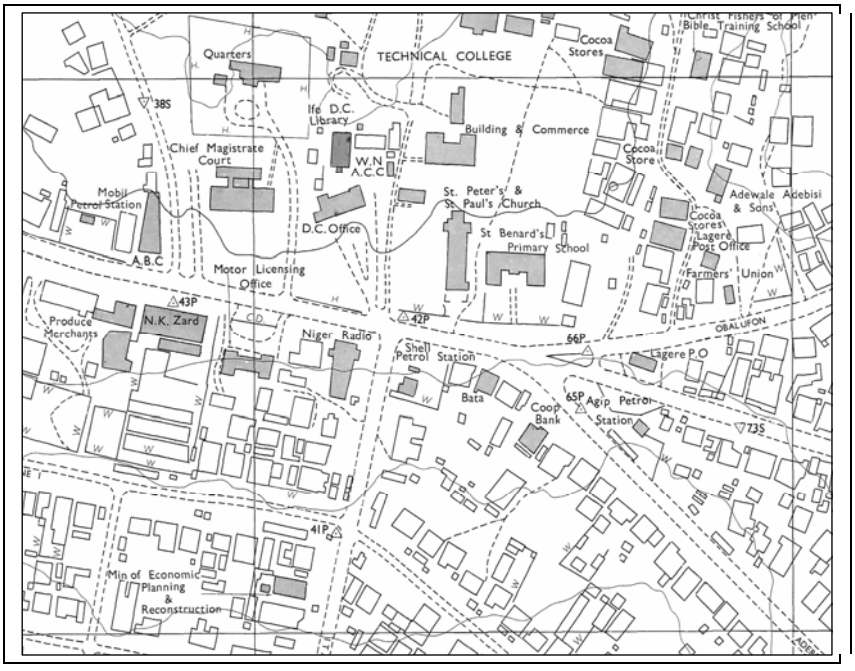
Map Data Layers

Map Name	# Features	Coverage
HRAF Ethnographic Atlas	847	100% continent
People's Ethnographic Atlas	1927	100% continent
Harvard Map Collection Index	260	100% continent
Projects Index	45	NA
Place Name Gazetteer	~1,000,000	100% continent
Admin Boundaries	17,155	100% continent
Population Surface	1 km grid	100% continent
Population Centroids	109,177	100% continent
Lakes and Rivers	150,572	100% continent
Soils Great Groups	4,909	100% continent
Surficial Geology	11,977	100% continent
Land Cover	5 km grid	100% continent
Power Plants	1637	100% continent
TOTAL	**1,298,506**	

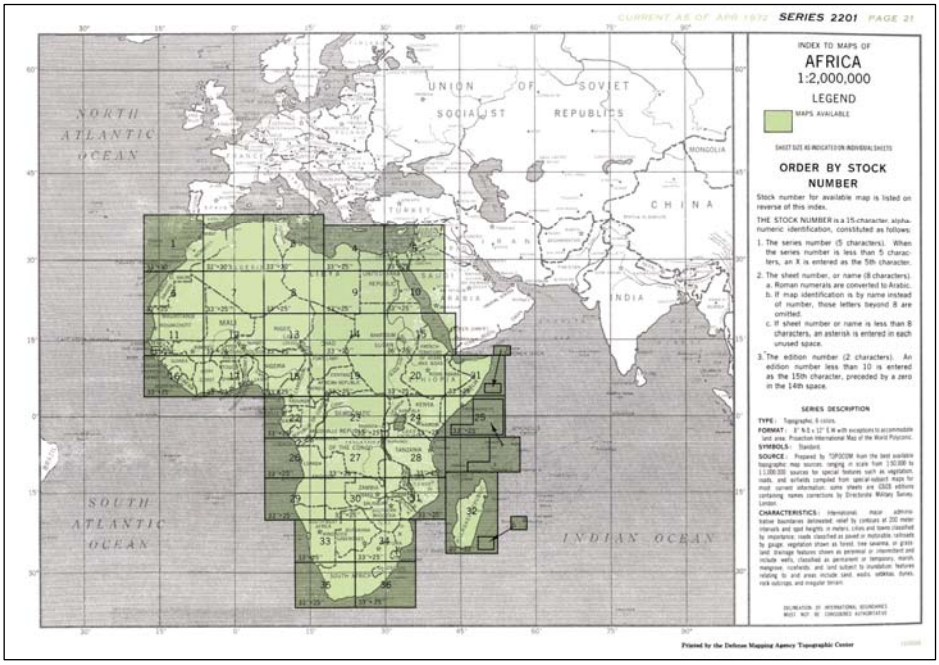
Appendix F – Base Mapping

Mapping in Google for Most of Africa

Base Mapping Available in Harvard Map Library for Same Location

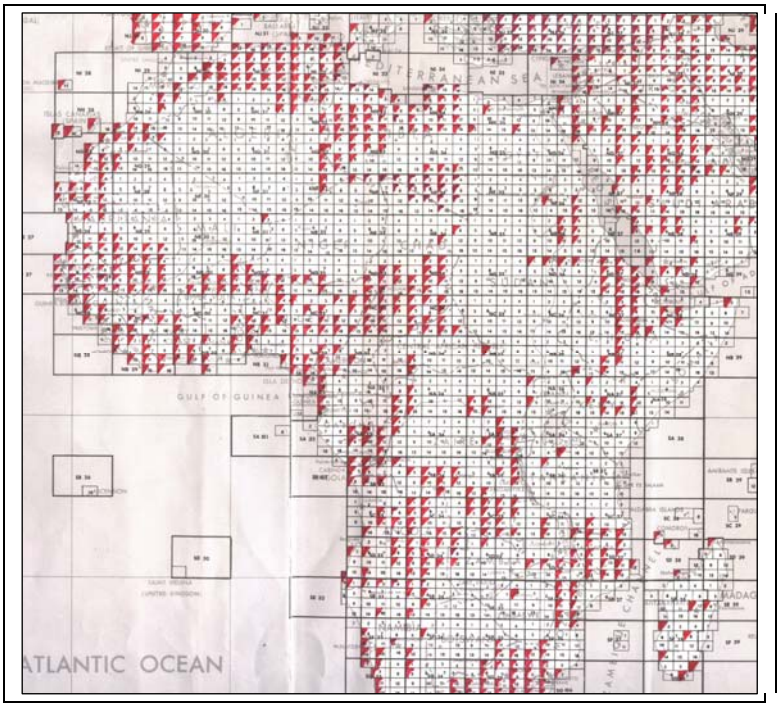


Continental Mapping Available from Harvard Map Library



Continental Mapping Level of Detail (1:2,000,000)

More Detailed Mapping from Harvard Map Library



More Detailed Mapping Level of Detail - 1980 (1:250,000)