Center for
Geographic Analysis
Harvard University

AfricaMap Release I, Beta
A Framework to Support
Collaborative Research and Teaching
March, 2009
http://africamap.harvard.edu

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Preface

In November of 2008 the Phase I release (beta) version of AfricaMap was made available to the Harvard community and the public. The application can be accessed at http://africamap.harvard.edu. This document sets out the basic ideas behind AfricaMap and defines its characteristics and functionality for Phases I (the current phase) and II.

Background

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 be 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. For example 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. Users will be able to 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 funded project that is now being overseen jointly by Suzanne Blier and faculty and staff at the Harvard Center for Geographic Analysis (Peter Bol, Wendy Guan, Ben Lewis). 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. Thus faculty whose research is focused on Africa are served, such as Alan Hill (HSPH), Felton Earl (HMS), Robert Bates (FAS-Government), Henry Louis Gates Jr. (Du Bois Institute), Evelyn Higginbotham (African and African American Studies), Jacob Olupona (Committee on African Studies), Aziza Chaoni (GSD), Richard Wrangham (Anthropology) and many 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.

Four broad categories of mapping will be included in AfricaMap: 1) Contemporary maps available in the Harvard Map Collection and elsewhere; 2) Human Area Relation File Data related to Africa (information on African cultures - population density, languages, subsistence, beliefs, technologies, housing forms); 3) Historical maps of the continent (these will be geo-referenced); 4) Scholarly maps focused on Africa in various historical periods. The project will form a framework for referencing an array of materials important for different areas and periods (photographs, charts, videos, music segments, spoken language exemplars, etc.).

Scope of System - 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.

Functionality Phase I (current system)

Base data view and layer navigation

- Supports integration of user data with best commercial satellite services such as Google Maps and Google Earth or other types such as Virtual Earth or Yahoo.
- Select one or more overlay layers to view together with the base layer.
- Control 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

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, even when search returns hundreds of thousands of features..

Finding, viewing researchers' projects

- Search for any 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

Envisioned Functionality Phase II

Authentication and Access Control

- Allow users to create login and have own workspace with saved settings.
- Support access control for datasets and maps.

User Submitted Content

- Allow users to submit data or collections of data to AfricaMap for storage and/or display.
- Support user markup of maps.
- Support user addition of tags and comments.
- Support collaborative dataset development using Open Street Maps approach.
- Allow users to submit web services for inclusion to AfricaMap.
- Allow users to submit non-spatial data (such as text documents, photographs, video/audio files, etc.) to the system database with a tag to a location (point, line or polygon).

Data search and preview against HGL

- Search the Harvard Geospatial Library (HGL) and other catalogs for data.
- Add data found on other systems to the map view. Save connections.
- Search for non-spatial data through the Harvard Visual Information Access (VIA) system and other online systems.

Additional data content

- Census data
- Health data
- Slave trade routes
- Map access to books
- Map access to museum collections
- Complete Harvard Map Collection Index
- Fill out Projects Layer
- Flickr
- Wikipedia

Enhance Usability

- Perform usability testing
- Implement recommendations based on testing

Summary

This project begins to solve a basic problem for all scholarship on Africa that treats *where* things happen as necessary to understanding *how* and *why* they happen: finding the places on a map. Despite the existence of excellent public maps for Africa, to date there is no common source that allows students, researchers, and the general public to a) map Africa with a high level of resolution online, b) to see the whole of Africa yet also zoom in to particular places, c) to accumulate both contemporary and historical data supplied by researchers and make it permanently accessible online, and d) to work collaboratively with spatial information about Africa in an online environment.

The AfricaMap project aims to accomplish these goals over the next two years in stages with public and private support. It draws on the basic insight of geographic information systems that spatiotemporal data becomes more meaningful as more "layers" are added, and it makes use of GIS technology and online environments such as GoogleEarth to create a system that will be open to the public and will eventually be interoperable with any other online source that supplies information about Africa.

It has long been recognized that understanding spatial relationships in public health data is part of finding policy solutions to public health problems. The assumption underlying the AfricaMap project is that this holds true for a broad array of social phenomenon, from poverty to democratization, and that the analysis of any particular issue is furthered by seeing it in relation to other phenomenon. AfricaMap thus makes it possible for users to correlate physical geography and climate data, administrative geography and population distribution, public health data and cultural data on language and social practice.

The promise of the system is that it is cumulative, and that precisely because it gives researchers common base maps and the means of locating their data in space, it creates an incentive for using AfricaMap as a means of viewing their data and makes it easy to share that data or minimally to make the area of their research known to others. We hope that the proof of concept developed here in Phase I will provide a basis for long term external funding and collaboration with international institutions and colleagues at universities in Africa and elsewhere.
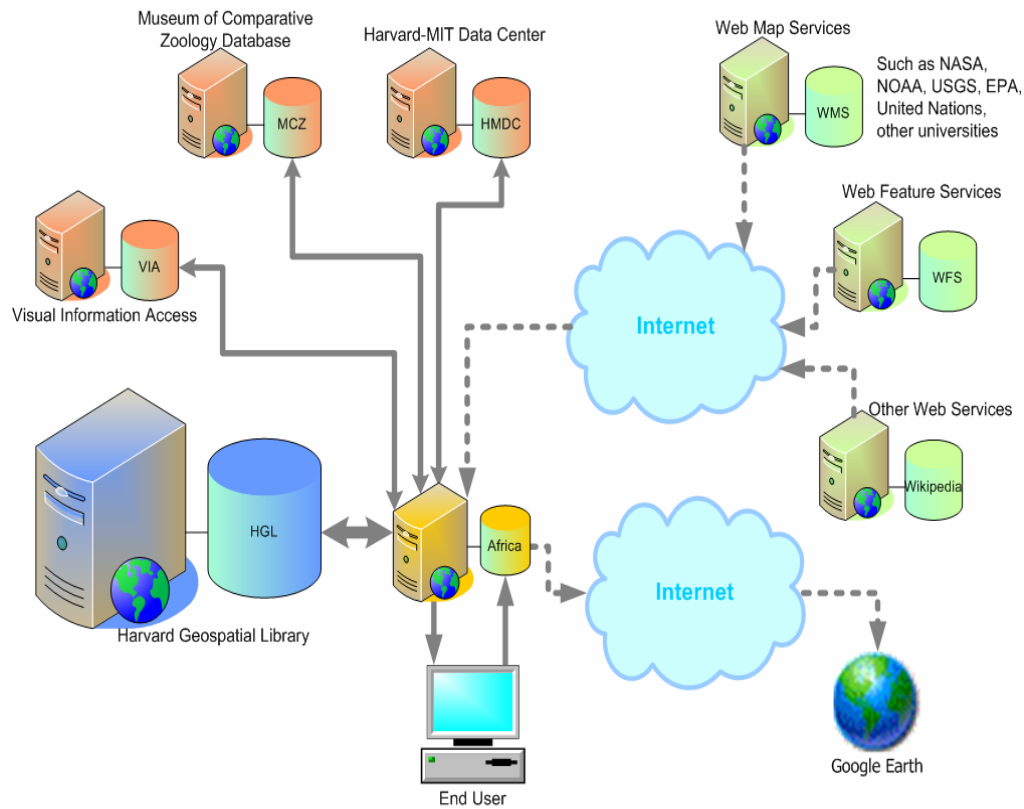
Appendices

Map-Series-Based Layers in Current Release

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**

Map Data Layers in Current Release

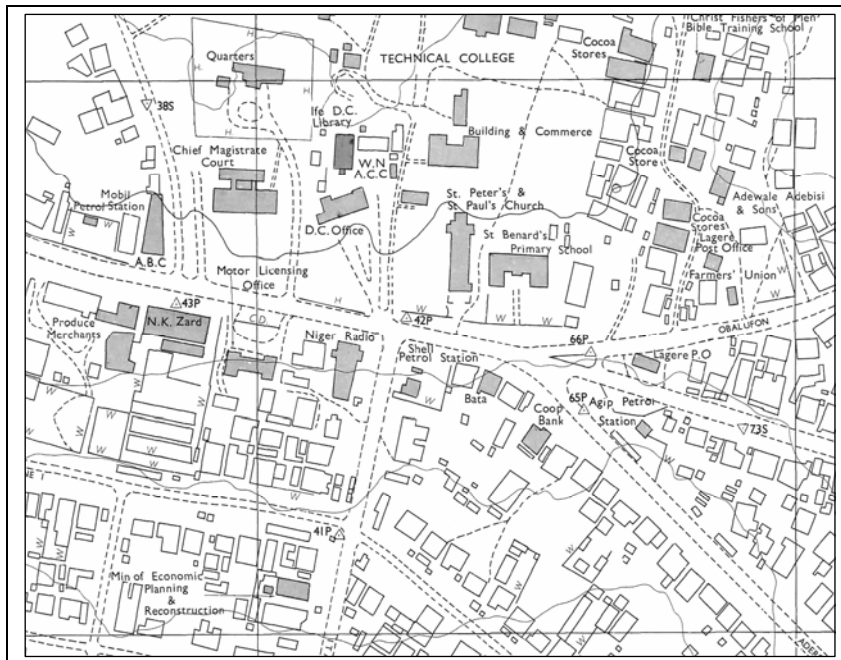| Map Name	# Features	Coverage
HRAF Ethnographic Atlas	847	100% continent
People's Ethnographic Atlas	1927	100% continent
Harvard Map Collection Index	260	100% continent
Projects Index	45	NA
Place Name Gazetteer	~1,000,000	100% continent
Admin Boundaries	17,155	100% continent
Population Surface	1 km 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**	

System Diagram

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

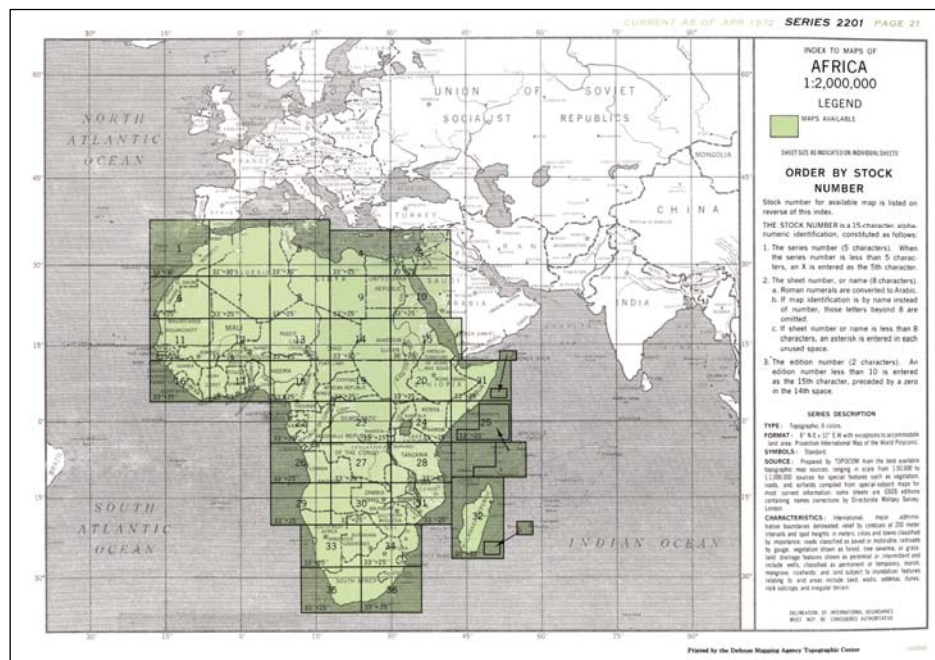### *Available online mapping for Africa*

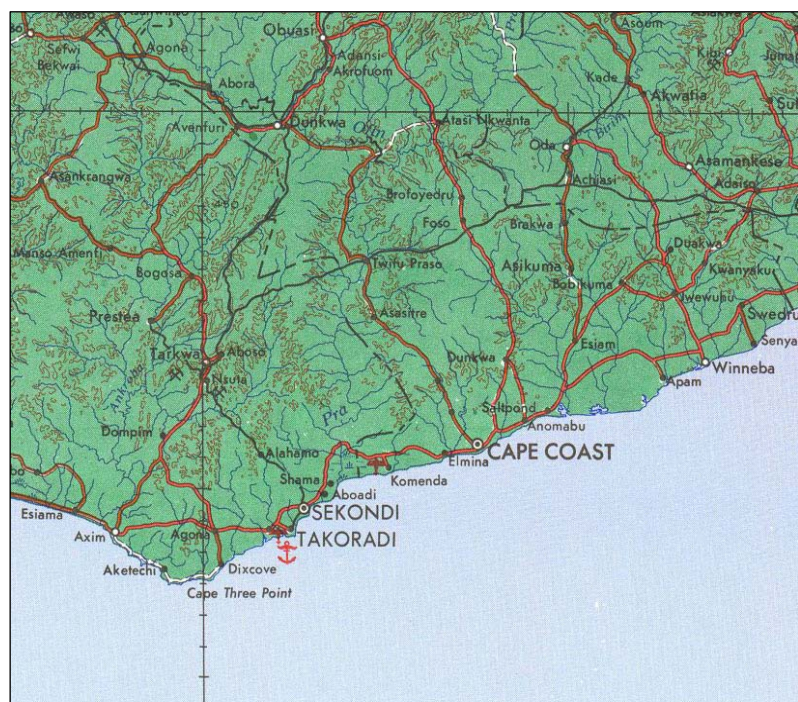*Mapping in Google for Most of Africa*

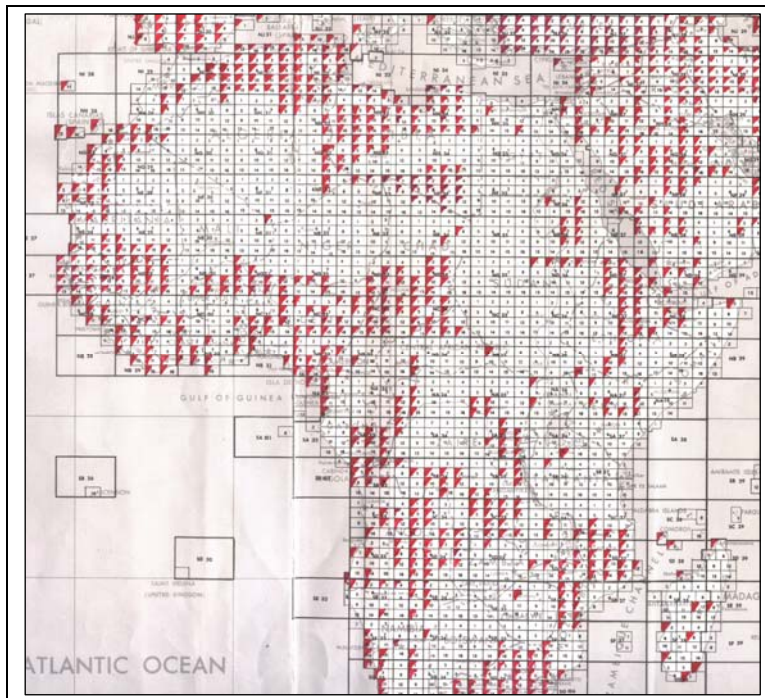*Base Mapping Available in Harvard Map Library for Same Location*

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)