VISUALIZING THE PAST: TOOLS AND TECHNIQUES FOR UNDERSTANDING HISTORICAL PROCESSES

A Geospatial and Temporal Tools and Standards Supplement
to the White Paper for the National Endowment for the Humanities

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Geospatial and temporal tools and standards.

As with many things connected to the web, geospatial and temporal technologies and standards evolve quickly. The content in this document reflects a snapshot in time, and should be viewed as a starting point for identifying appropriate tools and standards. Unless noted otherwise, the descriptions are from the URLs listed with the description.

Standards

The following standards offer a variety of ways to find and request maps and map related information, as well as for ways of encoding information. ISO 8601:2004 defines standard ways of formatting dates and times. The OGC CAT standard establishes ways in which catalog systems can be created to facilitate searching for geospatial information and data. The OGC also has developed standard methods of transferring maps (WMS), vector data (WFS) and raster data (WCS), as well as for interfacing with distributed sensors (SOS). While SOS may seem unrelated to humanities research, temporal information is an important element being captured by sensors and people interested in sensor based data may want to utilize data from multiple sensors simultaneously, so tools being developed utilizing this standard may be of use to humanities scholars interested in viewing multiple temporally enabled data sets from multiple data stores. KML offers a standard way of encoding geospatial data for easy distribution, including the ability to include a date stamp.

ISO 8601: Data elements and interchange formats -- Information interchange -- Representation of dates and times

ISO 8601:2004 is applicable whenever representation of dates in the Gregorian calendar, times in the 24-hour timekeeping system, time intervals and recurring time intervals or of the formats of these representations are included in information interchange. It includes

- calendar dates expressed in terms of calendar year, calendar month and calendar day of the month;
- ordinal dates expressed in terms of calendar year and calendar day of the year;
- week dates expressed in terms of calendar year, calendar week number and calendar day of the week;
- local time based upon the 24-hour timekeeping system;
- Coordinated Universal Time of day;
- local time and the difference from Coordinated Universal Time;
- combination of date and time of day;
- time intervals;
- recurring time intervals.

ISO 8601:2004 does not cover dates and times where words are used in the representation and dates and times where characters are not used in the representation.

ISO 8601:2004 does not assign any particular meaning or interpretation to any data element that uses representations in accordance with ISO 8601:2004. Such meaning will be determined by the context of the application.

http://www.iso.org/iso/catalogue_detail?csnumber=40874

CAT: Catalogue Services

The OpenGIS® Catalogue Services Interface Standard (CAT) supports the ability to publish and search collections of descriptive information (metadata) about geospatial data, services and related resources. Providers of resources use catalogues to register metadata that conform to the provider's choice of an information model; such models include descriptions of spatial references and thematic information. Client applications can then search for geospatial data and services in very efficient ways. See also the OGC Catalogue 2.0 Accessibility for OWS-3 Discussion Paper

[http://www.opengeospatial.org/standards/dp], the OWS-4 CSW ebRIM Modelling Guidelines Interoperability Program Report (IPR) [www.opengeospatial.org/standards/dp] and the OpenGIS® Catalogue Service Interface Standard 2.0.1 - FGDC CSDGM Application Profile for CSW (Best Practice) [http://www.opengeospatial.org/standards/bp].

http://www.opengeospatial.org/standards/cat

WMS: Web Map Service

The OpenGIS® Web Map Service Interface Standard (WMS) provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, etc) that can be displayed in a browser application. The interface also supports the ability to specify whether the returned images should be transparent so that layers from multiple servers can be combined or not.

http://www.opengeospatial.org/standards/wms

WFS: Web Feature Service

The Open Geospatial Consortium Web Feature Service Interface Standard (WFS) provides an interface allowing requests for geographical features across the web using platform-independent calls. One can think of geographical features as the "source code" behind a map, whereas the WMS interface or online mapping portals like Google Maps return only an image, which end-users cannot edit or spatially analyze. (authors' note: WFS (Transactional) supports modifying features).

http://www.opengeospatial.org/standards/wfs

WCS: Web Coverage Service

The OpenGIS® Web Coverage Service Interface Standard (WCS) defines a standard interface and operations that enables interoperable access to geospatial "coverages" [http://www.opengeospatial.org/ogc/glossary/c]. The term "grid coverages" typically refers to content such as satellite images, digital aerial photos, digital elevation data, and other phenomena represented by values at each measurement point.

http://www.opengeospatial.org/standards/wcs

SOS: Sensor Observation Service

The OpenGIS® Sensor Observation Service Interface Standard (SOS) provides an API for managing deployed sensors and retrieving sensor data and specifically "observation" data. Whether from in-situ sensors (e.g., water monitoring) or dynamic sensors (e.g., satellite imaging), measurements made from sensor systems contribute most of the geospatial data by volume used in geospatial systems today. This is one of the OGC Sensor Web Enablement (SWE) [http://www.opengeospatial.org/ogc/markets-technologies/swe] suite of standards.

KML

Google submitted KML (formerly Keyhole Markup Language) to the Open Geospatial Consortium (OGC) to be evolved within the OGC consensus process with the following goal: KML Version 2.2 has been adopted as an OGC implementation standard. Future versions may be harmonized with relevant OGC standards that comprise the OGC standards baseline

http://www.opengeospatial.org/standards/kml

Examples of software supporting OGC geospatial standards

Software and standard matrix information derived from OGC website listing of "**compliant**" or "implementing" software, or from software *website*. See http://www.opengeospatial.org/resource/products/compliant and http://www.opengeospatial.org/resource/products/implementing for a more complete and up-to-date listing.

	Client (C) Server (S)	**WMS**	**WFS** T= transactional	**WCS**	**SOS**	**CAT**	**KML**
ArcGIS Explorer	C	1.0 1.1 1.1.1 1.3.0				CS/W 2.0.1 CAT 2.0.2	*yes*
ArcGIS Server 9.3.1	S	1.0 1.1 1.1.1 **1.3.0**	**1.0.0** 1.1.0	1.0 1.0.0 1.1.0 1.1.1		(Geoportal Extension: 1.0 1.1.1 CS/W 2.0.1 **2.0.2** CAT2 AP ebRIM 1.0.0 CAT2 ISO AP 1.0.0 CAT2 ebRIM part2 1.0.0)	(Geoportal Extension: 2.1.0 2.2)
GeoNetwork 2.1	C & S	1.0 1.1.1				1.1.1 CS/W 2.0.1 CAT2 AP 19115/19119 0.9.3	
GeoServer 1.5	S	1.1.1	1.0.0 (T)1.0.0	**1.0**			2.1.0
IGIS 1.1	C & S	1.0 1.1 1.1.1 1.3.0	1.0.0 1.1.0 (T)1.0.0	1.0 1.0.0 1.1.0 1.1.1 c1 1.1.2	0.1.4 1.0.0		
MapFaces 0.3	C	1.1.1 1.3.0		1.0.0 1.1.0	1.0.0	CS/W 2.0.1 2.0.2	
PULSENet Client 1.0.0	C	1.0 1.1.1	1.0.0		1.0.0 0.1.4	CS/W 2.0.1	2.1.0
PULSENet SOS 2.0.0	S		1.0.0				(KML/SWE Adapter 1.0.0: 2.1.0)
Space Time Toolkit 3.0	C	1.0 1.1 1.1.1 1.3.0		1.0.0 1.1.0	1.0.0		
Web Enterprise Suite 11.0	C & S	1.0 1.1 1.1.1	1.0.0 (T)1.0.0 1.1.0	1.0.0 1.1.2	1.0.0	CS/W 2.0.1 CSW 2.0.2	2.2.0

Software Packages

The following information is derived from the websites listed with each item. Additional software packages that are not listed in the table above (or on the listed OGC websites) are included below as examples of additional tools that that support basic system needs (e.g. databases) or more specialized needs (e.g. temporal information). The software versions may be different than what is listed in the table because it represents the version listed on the associated website.

ArcGIS Explorer 900

ArcGIS Explorer is a free, downloadable GIS viewer that gives you an easy way to explore, visualize, and share GIS information. ArcGIS Explorer adds value to any GIS because it helps you deliver your authoritative data to a broad audience.
With ArcGIS Explorer, you can:

- Access ready-to-use ArcGIS Online basemaps and layers.
- Fuse your local data with map services to create custom maps.
- Add photos, reports, videos, and other information to your maps.
- Perform spatial analysis (e.g., visibility, modeling, proximity search).

http://www.esri.com/software/arcgis/explorer/index.html

ArcGIS Server 9.3.1

ArcGIS Server makes it easy for organizations to share mapping services and applications across the Web.

With ArcGIS Server, you can

- Connect more people with the information they need to make better decisions.
- Publish fast, intuitive Web mapping applications and services tailored to your audience.
- Simplify access to your services, data, and imagery.

ArcGIS Server supports desktop, Web-based, and mobile workflows. It helps you protect and manage your mapping information, and it provides a scalable platform that satisfies everything from the simplest to the most complex Web mapping requirements.

http://www.esri.com/software/arcgis/arcgisserver/index.html

David Rumsey's tools/site

The David Rumsey Map Collection was started over 25 years ago and contains more than 150,000 maps. The collection focuses on rare 18th and 19th century maps of North and South America, although it also has maps of the World, Asia, Africa, Europe, and Oceania. The collection includes atlases, wall maps, globes, school geographies, pocket maps, books of exploration, maritime charts, and a variety of cartographic materials including pocket, wall, children's, and manuscript maps. Items range in date from about 1700 to 1950s. (authors' note: The 2D GIS viewer contains a "TimeViewer" tool for animating multiple layers from the collection).

http://www.davidrumsey.com/about

Electronic Cultural Atlas Initiative

A matrix of spatial and temporal information with associated cultural information or attributes. It must include at least one dynamic map with multiple layers, or multiple maps. It is created by an author or team

of collaborators with a specific focus, theme, and/or intended audience. The focus can be either large or small scale in time and space. Information included can be either generalized or complex and detailed. The spatio-temporal information must be integrated with the additional cultural material and documentation in a user interface that allows browsing back and forth between the different dimensions. (authors' note: ECAI tools include a clearinghouse and a customized version of *Time*Map™, see below)

http://ecai.org/culturalAtlasPortal/AboutCulturalAtlases.html

Geonetwork 2.4.2

GeoNetwork opensource is a standards based, Free and Open Source catalog application to manage spatially referenced resources through the web. It provides powerful metadata editing and search functions as well as an embedded interactive web map viewer. This website contains information related to the use of the software.

http://geonetwork-opensource.org/

Geoserver 2.0.1

GeoServer is an open source software server written in Java that allows users to share and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards. GeoServer is an open source software server written in Java that allows users to share and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards.

Being a community-driven project, GeoServer is developed, tested, and supported by a diverse group of individuals and organizations from around the world.

GeoServer is the reference implementation of the Open Geospatial Consortium (OGC) Web Feature Service (WFS) and Web Coverage Service (WCS) standards, as well as a high performance certified compliant Web Map Service (WMS). GeoServer forms a core component of the Geospatial Web.

http://geoserver.org/display/GEOS/Welcome

Google Earth 5

Google Earth lets you fly anywhere on Earth to view satellite imagery, maps, terrain, 3D buildings, from galaxies in outer space to the canyons of the ocean. You can explore rich geographical content, save your toured places, and share with others. (authors' note: supports KML & WMS data).

http://earth.google.com/

IGIS

IGIS has the exhaustive list of GIS, Remote Sensing, Image Processing, 3D modeling, 3D animation and Real Time Location Based Services. This product has combined functionality of our earlier offerings such as GISPro, ImagePro, Surface View, Virtual View and Q-Pad and superior to any competitor's product.

http://www.scanpointgeomatics.com/igis_product_features.html

MapFaces 0.3

MapFaces includes application templates, JSF components with Javascript widgets, and a geospatial library for the construction of enterprise class application servers which generate and support web based client applications for the presentation, manipulation, and analysis of geographic data and metadata. (authors' note: components include MapPane, LayerCotrol, ChartPane, TreeTable, and TimeLine)

http://mapfaces.codehaus.org/

Open Layers 2.8

OpenLayers makes it easy to put a dynamic map in any web page. It can display map tiles and markers loaded from any source. MetaCarta developed the initial version of OpenLayers and gave it to the public to further the use of geographic information of all kinds. OpenLayers is completely free, Open Source JavaScript, released under a BSD-style License. (authors' note: the project website states that the program supports WMS & WFS)

http://openlayers.org/

PostgreSQL 8.4.2

PostgreSQL is a powerful, open source object-relational database system. It has more than 15 years of active development and a proven architecture that has earned it a strong reputation for reliability, data integrity, and correctness. It runs on all major operating systems, including Linux, UNIX (AIX, BSD, HP-UX, SGI IRIX, Mac OS X, Solaris, Tru64), and Windows. It is fully ACID compliant, has full support for foreign keys, joins, views, triggers, and stored procedures (in multiple languages). It includes most SQL:2008 data types, including INTEGER, NUMERIC, BOOLEAN, CHAR, VARCHAR, DATE, INTERVAL, and TIMESTAMP. It also supports storage of binary large objects, including pictures, sounds, or video. It has native programming interfaces for C/C++, Java, .Net, Perl, Python, Ruby, Tcl, ODBC, among others, and exceptional documentation.

http://www.postgresql.org/about/

PostGIS 1.5.0

PostGIS adds support for geographic objects to the PostgreSQLobject-relational database. In effect, PostGIS "spatially enables" the PostgreSQL server, allowing it to be used as a backend spatial database for geographic information systems (GIS), much like ESRI's SDE or Oracle's Spatial extension. PostGIS follows the OpenGIS "Simple Features Specification for SQL" and has been certified as compliant with the "Types and Functions" profile.

http://postgis.refractions.net/

PULSENet™ : Client 1.0.0, SOS 2.0.0

Currently, sensor networks consist of isolated systems of sensors that communicate in different formats and are accessed by disparate and proprietary interfaces. These isolated networks are not interoperable; each isolated network of sensors or even each type of sensor within the network usually requires its own software for sensor asset management (i.e., sensor discovery, data retrieval, tasking, etc.). Furthermore, adding a new sensor type to a sensor network often requires significant integration of time and money. Since these isolated networks are usually controlled by different organizations with different operational requirements, it is often difficult or impossible for a user looking to capture and analyze particular types of sensor data on a global, national, state, or even smaller scale.

Sensor data, as with other intelligence, has even higher value when it can be fused with data from multiple sources. High-value sensor data often goes unexploited due to the failure of traditional information management systems to discover, manage, and relate this data. This failure, caused in part by the technological and organizational stovepipes that exist in today's sensor networks, results in a gap between data and users' ability to transform data into actionable knowledge.

http://www.is.northropgrumman.com/products/pulsenet/

SIMILE Widgets

Free, Open-Source Data Visualization Web Widgets, and More.

This is an open-source “spin-off” from the Simile project at MIT. Here we offer free, open-source web widgets, mostly for data visualizations. They are maintained and improved over time by a community of open-source developers.

- Timeline: Visualize temporal information on an interactive drag-able timeline
- Timeplot: Plot time series and overlay temporal events over them.

http://www.simile-widgets.org/

Space Time Toolkit 3.0

The Space Time Toolkit (STT) is a Java-based toolkit that provides advanced capabilities for integrating spatially and temporally-disparate data within a highly interactive 3D display environment. Unlike most tools that require that data be converted to a common spatial and temporal grid before integration, the STT allows one to ingest swath, map-projected, station, event, or path data in whatever spatial and temporal domain in which it exists. The STT then allows the end-user to select the 2D or 3D display domain and then on-the-fly maps all data into that domain as needed. In addition to the user-selection of the spatial domain, the end-user has equal control over the aggregation and resolution of the temporal domain. Tutorials will be added soon to assist new users in STT3 operations.

http://vast.uah.edu/index.php?option=com_content&view=article&id=16&Itemid=55

*Time*Map

*Time*Map TMJava is a novel mapping applet which generates complete interactive maps with a few simple lines of html. It provides a way of easily enriching web pages with historical or contemporary information that goes far beyond static jpg map images. It's easy for beginners, yet provides completely customisable power and distributed backend database connectivity for the expert. It's free for personal use.

*Time*Map's unique time-handling provides an engaging and intuitive method of delivering historical, community, government, research and business information. Combining mapping and the time dimension gives new ways of visualising urban growth, the spread of empires, heritage sites, environmental change, weather patterns, traffic flow, earthquakes, mobile network faults, and much more — ranging in time scale from millions of years to seconds.

*Time*Map time-filters and animates maps on the fly, connects to datasets anywhere on the web and can search for and load thousands of local maps dynamically as you zoom and pan. *Time*Map can filter huge datasets server-side and download only the data needed, or work standalone off a CD. It adapts legends dynamically as scale changes and generates hyperlinks on-the-fly between objects on the map and web pages, and is completely customisable with XML. Yet the applet weighs in at only 350K!

*Time*Map's Windows tool, TMWin, allows you to build and publish interactive maps on your web site without any programming skills. You can use your own data or map data from the Electronic Cultural Atlas Initiative's (www.ecai.org) data clearinghouse.

For advanced users *Time*Map can be extensively customised with XML and JavaScript. TMJava source code is available to members of the *Time*Map Open Source Community.

The *Time*Map project team can provide rapid response support to user, from neophyte to IT professional, as well as a full range of custom database and *Time*Map programming services. (authors’ note: while *Time*Map has become an open source project, some of the original development team shifted their focus to a new project called Heurist)

http://www.timemap.net/index.php?option=com_content&task=view&id=19&Itemid=166

Timemap.js

Timemap.js is a Javascript library to help use Google Maps with a SIMILE timeline. The library allows you to load one or more datasets in JSON, KML, or GeoRSS onto both a map and a timeline simultaneously. By default, only items in the visible range of the timeline are displayed on the map.

Version 1.5 Now Up!

This version includes a lot of code cleanup, pretty code documentation generated with jsdoc-toolkit, improved loaders for GeoRSS (now with polygons and polylines) and KML (now with multiple geometries), and new loaders for the Flickr and Google Spreadsheets APIs. See the changelog for more details.

http://code.google.com/p/timemap/

Web Enterprise Suite XI

Introducing Web Enterprise Suite XI. an integrated suite of applications, based on open standards, working together to provide one of the most comprehensive, interoperable, geospatial portal development systems available.

Web Enterprise Suite XI components have been based on Open Geospatial Consortium/ISO interoperability specifications, allowing seamless connections to the ever-expanding world of web services. Whether it is first responders feeding data and information back to central decision makers or analysts and planners searching many disparate data sources for vital information, Web Enterprise Suite provides all the tools necessary to create a common operational picture and the framework for quick, accurate and informed decision-making.

Web Enterprise Suite XI is comprised of over a dozen components, many of which are stand alone applications, which have been specifically designed to be integrated with each other and third party applications. Due to this advanced, component based architecture, implementation and deployment of a complete data discovery portal (including e-commerce capability) is now fast and very cost effective compared to the costly systems of the past.

http://www.compusult.net/cslt_prod_dm.html