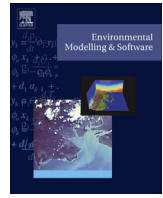




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## An open source Java web application to build self-contained web GIS sites



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### ABSTRACT

This work describes OWGIS, an open source Java web application that creates Web GIS sites by automatically writing HTML and JavaScript code. OWGIS is configured by XML files that define which layers (geographic datasets) will be displayed on the websites. This project uses several Open Geospatial Consortium standards to request data from typical map servers, such as GeoServer, and is also able to request data from ncWMS servers. The latter allows for the displaying of 4D data stored using the NetCDF file format (widely used for storing environmental model datasets). Some of the features available on the sites built with OWGIS are: multiple languages, animations, vertical profiles and vertical transects, color palettes, color ranges, and the ability to download data. OWGIS main users are scientists, such as oceanographers or climate scientists, who store their data in NetCDF files and want to analyze, visualize, share, or compare their data using a website.

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### Software availability

OWGIS is free and it can be downloaded as a Web application Archive (WAR file) from <http://owgis.org/>. This WAR file contains the stable version of OWGIS and can be deployed in any servlet container, like Apache Tomcat. The source code of OWGIS is maintained at GitHub and it can be downloaded by enthusiastic users and developers from <https://github.com/olmozavala/OWGIS.git>.

### 1. Introduction

Over the last decades the amount of geospatial data has grown rapidly as a result of the number of satellites and the use of Global Positioning Systems (GPS). To assist in the analysis and visualization of all this data, several geographic information systems (GISs)

and Web GIS sites have been developed (Steiniger and Hunter, 2012). Some of the Web GIS sites share common functionalities, such as access to raw data or the ability to overlap different layers (Kulawiak et al., 2010; Karnatak et al., 2012; Nair and Katiyar, 2011). Web GIS sites that display environmental data, like the Pacific Islands Ocean Observing System (Voyager) or the Web GIS sites developed by the European Environment Agency, have an even larger set of common features, such as the ability to identify layer data at any coordinate, and the capability to plot data in real time. However, there is not, to the best of our knowledge, any open source program that automatically generates Web GIS sites with a minimum set of features that allow efficient publication of 4D geospatial data.

A common procedure for publishing georeferenced data on a Web GIS site includes the following steps. First, generate the data to be published. Then, upload the data into a map server such as MapServer (Kropka, 2005), GeoServer (Deoliveira, 2008), ArcMap Server, ncWMS (Blower et al., 2013), etc. Finally, with a group of programmers and web designers, build the web interface (the Web GIS site) to display the data for the user. This interface provides several ways to visualize and serve data, and, even when most Web GIS sites do not have direct access to the data, they normally obtain

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the data through map servers. The software described in this paper greatly simplifies the final step, building Web GIS sites, thus reducing the time and costs for publishing geospatial data on the web.

Free and Open Source Software (FOSS) that helps building Web GIS sites already exists. Fig. 1, adapted from Steiniger and Hunter (2013), shows the FOSS GIS software that is available to aid publishing geographic data on the web at any of the previously discussed steps. The software in the *Desktop GIS* category are programs that run on personal computers and are able to display, query, update, and analyze geographic data. Quantum GIS (Shekhar and Xiong, 2007) and GRASS (Neteler et al., 2012) are two of the most mature FOSS desktop GIS programs. These two programs can accomplish a multitude of tasks and have been used to prepare and analyze environmental data for several projects (Gkatzoflias et al., 2013; Grinand et al., 2013).

The *Web Map Servers* category accommodates software that provides several options to access and visualize georeferenced data through standards of the Open Geospatial Consortium (Web Mapping Services (WMS) (de la Beaujardiere, 2006), Web Feature Services (WFS) (Vretanos, 2005), and Web Coverage Services (WCS) (Baumann, 2010)). The two best-known web map servers are MapServer and GeoServer, both of them offer vector and raster support and have comparable functionality to similar proprietary software (Steiniger and Hunter, 2013).

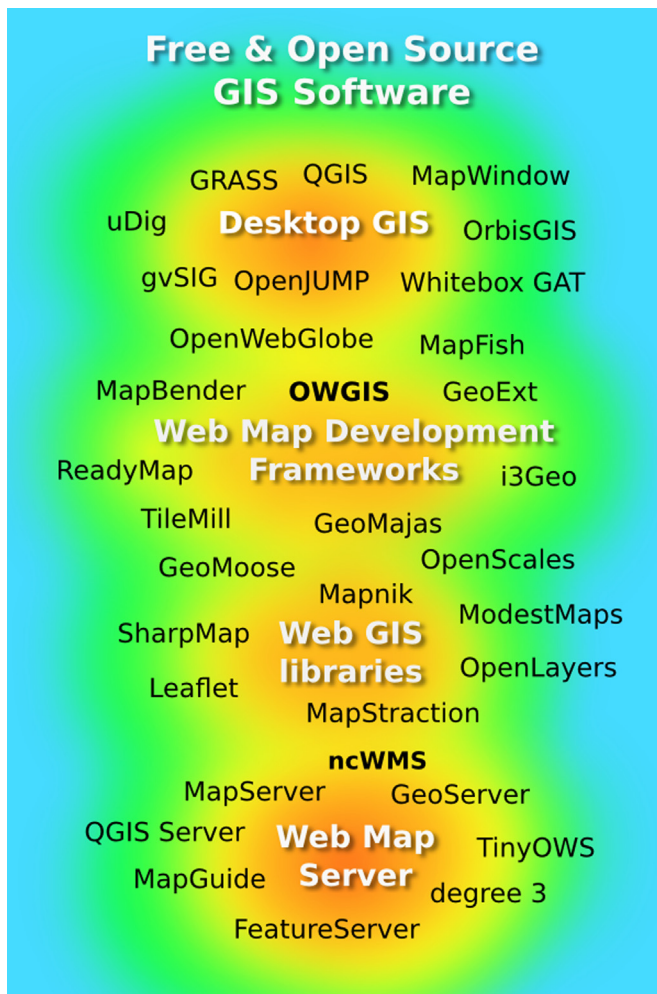


Fig. 1. Simplified scheme of the free and open source geographic information software for the web. Adapted from Steiniger and Hunter (2013).

Another web map server, that is worth mentioning for the environmental modeling community, is the ncWMS which has the particular feature of being able to serve 4D data stored as NetCDF files, a widely used file format for storing environmental model datasets (Rew and Davis, 1990). The DEFENSE (Tiranti et al., 2014), and the interactive visualization system by Kulawiak et al. (2010) are some examples of environmental decision support systems that use FOSS web map servers.

The *Web GIS libraries* and the *Web Map Development Frameworks* are two categories that encompass GIS software used to build the final interface to display geographic data as dynamic maps on the web. The web GIS libraries are application programming interfaces (APIs) for the visualization and manipulation of spatial data that implement the WMS, WFS, etc. OpenLayers (Hazzard, 2011) is one of the most extensive libraries in this category, it is implemented in JavaScript. Finally, the software in the *Web Map Development Frameworks* category, contribute with tools for creating advanced web applications. These frameworks use the web GIS libraries and contain tools for the management of layers, menus, and themes of the Web GIS sites. Some well known programs in this category are Mapbender3 (<http://mapbender3.org/>), GeoMajas (<http://www.geomajas.org/>), MapFish (<http://www.mapfish.org/>) and GeoMOOSE (<http://www.geomoose.org/>). OWGIS belongs to this last category as it gives an easy way to develop Web GIS sites through the configuration of XML files. The main feature that differentiates OWGIS from the rest of the development frameworks is the set of tools that OWGIS provides to visualize 4D data through the web.

OWGIS (<http://owgis.org/>), originally *Open Web GIS*, is an open source software that creates self-contained Web GIS sites with common features used by the scientific community. OWGIS is a Java web application that generates websites by automatically writing HTML and JavaScript code. The websites built with OWGIS are configured by XML files and can accommodate maps with layers served through any map server, such as GeoServer, that complies with the WMS standard. OWGIS is also capable of constructing Web GIS sites that display 3D data served by the THREDDS servers (Domenico et al., 2006) or the ncWMS servers, using the WMS extension proposed by Blower et al. (2013).

The current features that OWGIS provides on the generated Web GIS sites are: multiple languages, animations, mobile interface, Contextual Query Language (CQL) filtering ([http://en.wikipedia.org/wiki/Contextual\\_Query\\_Language](http://en.wikipedia.org/wiki/Contextual_Query_Language)), identify features, the ability to download data as KML, GeoTIFF or shape files, and the capacity to plot vertical profiles and vertical transects at different locations. Though some of these features are already available in many Web GIS sites, regardless of whether or not they display scientific data or other types of geographic data, OWGIS allows building and maintaining new sites with all these features by simply editing XML files.

OWGIS is being developed at the Center for Ocean-Atmospheric Prediction Studies (COAPS), Florida State University (FSU), in collaboration with the Universidad Nacional Autónoma de México (UNAM). OWGIS is currently used as the interactive visualization map of the Digital Climatic Atlas of Mexico (Zavala-Hidalgo et al., 2010), which has been available since 2009 and provides access to more than 2000 layers of oceanic climate, climate change scenarios, bioclimatic parameters, and socioeconomic indicators, among other variables. OWGIS is also used by the Deep-C Consortium (<http://deep-c.org/>) to display oceanographic data from the Gulf of Mexico.

The paper is organized as follows. Section 2 describes the architecture of OWGIS and the design principles that it follows when creating websites. Section 3 explains how to configure OWGIS for new applications. Section 4 illustrates the current features provided by OWGIS. Section 5 describes a specific case study where OWGIS is

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