DO WE NEED A NEW TYPE OF JOURNAL OF MAPS MORE SUITED FOR THE BIGDATA GEOSPATIAL ERA? THE JOURNAL "TERRA DIGITALIS": A CASE IN POINT

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Abstract

The recent evolution of information technologies has radically transformed various aspects of cartographic practice. However, the peer-reviewed publication of scientific maps has changed little. Despite their scientific relevance, a wide range of GIS-based maps are outside the scope of publishable products. Among others, interactive maps, dynamic maps and 3D maps are excluded simply for reasons of format. In this paper, we present the main ideas behind the design and operation of a new type of journal that supports the publication of the scientific map types referred above, as well as the publication of geospatial data collections and online information services relevant to the geoscientific community, which can be accessed through OGC standard. Finally, the potential of this type of journals and its relevance to support the ongoing paradigm shift are discussed, towards the paradigm of a window of access to spatial data and associated knowledge derived from bigdata processing algorithms.

Keywords: *Web Cartography, Scientific Digital Journals, Digital Earth, OGC Web Services, Spatial Data Infrastructures.*

On Exactitude in Science

Jorge Luis Borges, *Collected Fictions*, translated by Andrew Hurley.

...In that Empire, the Art of Cartography attained such Perfection that the map of a single Province occupied the entirety of a City, and the map of the Empire, the entirety of a Province. In time, those Unconscionable Maps no longer satisfied, and the Cartographers Guilds struck a Map of the Empire whose size was that of the Empire, and which coincided point for point with it. The following Generations, who were not so fond of the Study of Cartography as their Forebears had been, saw that that vast Map was Useless, and not without some Pitilessness was it, that they delivered it up to the Inclemencies of Sun and Winters. In the Deserts of the West, still today, there are Tattered Ruins of that Map, inhabited by Animals and Beggars; in all the Land there is no other Relic of the Disciplines of Geography.

—Suarez Miranda, *Viajes de varones prudentes*, Libro IV, Cap. XLV, Lerida, 1658

INTRODUCTION

It can be argued that this dazzling mockery of Borges about the usefulness of the "Geographic Disciplines" is in the process of losing sustenance and validity. It is true that behind the ironic smile of Borges lies the inevitable tension between the objectives of accuracy, precision, generality and pragmatic utility, inherent in every scientific model. Even more so if the representation is analog, as cartographic paper models are, and the object of study is something as intricate, dynamic and complex as the planet itself. However, can we consider that Borges' joke still has sustenance? Let's see…

If we could invoke Borges body and soul and sit him in front of a computer connected to the Internet, we could sustain this dialogue:

Look Borges, this "window" that you see here is called "Google Earth". It's like the map of the empire that you imagined but covers the entire planet, on many different scales.

Really? - he would say incredulously, show me then the street of Serrano 2135 in the neighborhood of Palermo in Buenos Aires. There I lived from 1901 to 1914.

This street is no longer called Serrano. Now it's called Jorge Luis Borges. The number is the same[1]*. On the ground floor is this hairdresser ... "Damn frizz", look*[2]*.*

Amazing! Can we see the whole planet through this device? Take me to my house at number 28 of the Grand-Rue, two blocks from the church of Saint-Pierre, in the center of Geneva. I never saw the facade. When we moved there, I was already blind[3] *...*

So… In a couple of decades, the map jumped from paper to the memory of a computer, and then from the computer to the network, provided with its indefinitely additive storage and processing capabilities.

To the astonishment of digital migrants, Geomatics now strives to build vastly more ambitious maps, that encompasses not an empire but of the entire planet, and seek to register the location of things that change "little" over a "long" period of time, like continents[4], bunkers, fortresses, forests, mountains, mines, waterways, cities; and of objects that changes its state and/or position "frequently" like apartments for rent[5], ships[6], airplanes[7], subway cars, buses, traffic along the roads of a city[8] and… more importantly, People! Not only now, but all the time!

These cartographic products are visual representations of georeferenced objects, registered in huge databases, connected to sensors, that updates its position and state on the fly. The ongoing technological transition give rise to the emergent field of "Big Geospatial Data" as a specific and salient aspect of the "Internet of Things" [1]

By jumping from the paper to the computer, thanks to geographic information systems technology, the map became numeric, and potentially multi-scalar, and multi-thematic. Rather than information on the spatial relationships of a fixed set of objects, in a given place and time, the map became a window connected to the underlying data [2], which can be the result of static or sequential measurements, the product of statistic calculations or spatiotemporal simulation models . Then, by jumping from the computer to the network, thanks to the spatial interoperability standards and web mapping technologies, measurements, calculations and models of a particular scientist, acquire the potential to join, in a synergistic way, to those of all others, giving shape, density and substance, to this emerging digital replica of the planet, encompassed in the concept of digital earth [3, 4]

In stark contrast to this explosive expansion of the volume, speed, and diversity of geographic information, the refereed publication of maps occurs, in a sense, as if its main substrate continued to be on paper. In the case of printed journals, this is well justified by the limitations of formats and costs. For electronic map journals, perhaps the bottleneck has been the added layer of complexity and cost, required to deal with the "transcription" of the original GIS-based map to an interactive Web based, equivalent. As a result, there is a wide range of GIS based cartographic and geospatial information products that despite of its scientific relevance, are not publishable in peer-reviewed journals. Among others, interactive maps that show the underlying database, with capabilities to filter objects, query its attributes and present them at various scales; dynamic maps that synthetically exhibit the spatiotemporal variations of a process; 3D maps that facilitate the understanding of processes where the relief plays a key role; and publicly available scientific maps and research collected, data available through OGC services; excluded all from this type of journals, simply for reasons of format.

In this research, we present characteristics of "Terra Digitalis", the first online peer-reviewed journal of interactive maps, geoscientific data collections, and geospatial web services. This article outlines the main elements of design and implementation of this journal. First, the objectives and design principles are presented. Then the range of publishable products is defined. As a result, we give the general outline of tools and processes to handle cartographic products

[1] In Google Earth it is easy to locate any address in unaccounted cities. The house where Borges was born is here
[2] In this place there is now (01/05/2018) a beauty parlor and a commemorative plaque
[3] House where Borges lived his last years in the center of Geneva
[4] Ancient earth
[5] Apartments for rent today, in the city of Sofia, Bulgaria
[6] The site Marine Traffic allows to track the location of all ships on the planet in real time. This is the traffic right now in the black sea near Varna, Bulgaria
[7] The Flight radar24 site allows you to track the location of each aircraft on the planet. This window shows the current status of airspace over Bulgaria.
[8] For instance, this is the state of the traffic right now, near my apartment, in Mexico City

through the editorial flow. Finally, we discuss the role of such a journal in the improvement of geoscientific communication and the issue of data validation in the field of geographical sciences.

OBJECTIVES AND DESIGN PRINCIPLES OF THE TERRA DIGITALIS JOURNAL

The editorial process is a complex dialog, that involves the management and orderly registration of the back and forth interchange between authors, editors, reviewers and style editors, from the submission of the article up to its publication online.

Fortunately, for a journal with limited resources like ours, the open source software Open Journal Systems (OJS) [5, 6], allows to automate such process efficiently. OJS is optimized for the publication of scientific texts, whose content –text, equations, graphs, images; can easily be accommodated to fit the restrictions of a printed sheet. Unfortunately, in the case of maps, this restriction has consequences. To begin with, the representation of objects and their relationships in a given space imposes graphic conventions very different from those required by text documents. For reasons of scale, readability and aesthetics, the formats are usually much larger. Furthermore, the map conceived as something fixed, printed on a sheet of paper, which in the end is nothing more than a metaphor, dismisses its connection with the underlying data and code. In all the refereed cartographic journals we reviewed[9] this issue is attended in a limited way, by offering the possibility to download a high-resolution copy of the map.

We formulated a project of designing and implementing a refereed map journal that would extend the capabilities of existing ones, by enabling the publication and interactive visualization of high quality digital cartographic products such as:

- Static maps
- Interactive 2D maps
- 3D maps
- Geoscientific data collections
- Scientific/Technical descriptions of the content and implementation of operating, institutional OGC services.

Two important guidelines for the design of the journal were:

- Base the development on free and open source tools
- Offer free access, not only to published articles, but also, with the consent of the authors, to the underlying data, through open geospatial interoperability standards.

METHODS

A map, as a scientific product, is not self-explained. Additional materials including text, equations and graphs are required to argue the relevance and scientific novelty of a cartographic product. These additional contents are well handled by OJS. Taking advantage of the possibility to add complementary galleys within the OJS interface, a first innovation we propose is to develop specialized visualizers, external to OJS, but with their own DOI linked to the main article. This core feature allowed us to focus on the adaptation of optimized visualizers for each of the referred cartographic products.

Another useful consequence of the separation between the text and the map galleys is that it allowed us to divide the editorial process into two separate but interdependent paths, which can run in parallel. The first one is managed inside OJS, the second one is managed through an assorted mix of desktop and server-side geospatial content management tools.

The process of peer review and edition of maps can be characterized as follows:

- The author sends a static map (a high-resolution image or pdf file) and the corresponding article.
- After the map is accepted (in the case of interactive 2D or 3D maps), the author must send a map package in ArcGIS or QGIS format, containing all layers and style specifications of the map and of each layer.

[9] There are several lists that could serve as good starting point to elaborate a comprehensive compilation of the characteristics of the existing Cartography and Geographic Information Science Journals. For instance, this one: list of relevant GIS Journals; or this Journals in Cartography, GIS and Geovisualization.

- Metadata are required for the map as a whole, and for the author's created layers.

For the publication of a geoscientific data collection, the general requirements are the same with the following specificities:

- The focus of the article is centered in substantiating and documenting the novelty and relevance of the data collected.
- A support map is required to show the extension, density and distribution of the data, which can be published as an interactive map.
- The author accepts to publish the data through a CC-BY-NC-SA license,
- The data can be downloaded and accessed remotely via OGC compliant client software
- The metadata of the collected layers are required.

The requirements for the publication of institutional OGC services are the following:

- Only stable geoscientific information services, provided by institutions, that generate an abundant and continuous flow of data, from local or remote sensors, are considered for publication (via motu proprio or by invitation). (for example: meteorological, seismological, and environmental contamination data services).
- The focus of the article lies on the relevance and structure of the web services provided, explaining the nature of the sensors, the access policies and the means of accessing the data.
- A set of support maps is required.
- Web links to the institutional web page of the service are required.
- OGC links to the data and maps are required
- The data should be publicly available without cost.

RESULTS

To efficiently implement the process of editing interactive maps, we set out to automate it as much as possible using existing software tools, preferably open source, and if necessary fill in the gaps with our own code.

The software tools to be used depend both on the initial data and on the final cartographic product that is to be implemented (figure 2). In the field of geosciences, the two most commonly used desktop GIS are QGIS, (free and opensource), and ArcGIS (commercial software).

In case the map is based on ArcGIS:

1. The starting point is a map package (in mpk format) sent by the author.
2. From this file the map document is reconstructed.
3. Through the "Bridge" plugin, each of the layers that make up the map is exported to Geoserver, generating its style specification (in sld format) and the corresponding metadata
4. These layers are published as OGC services.
5. We write the code in php and/or java script, that uses OpenLayers or Leaflet libraries, to generate interactive maps.
6. This code consumes data through OGC connections

In case the map is based on QGIS:

1. The starting point is a map package (in geopak format) sent by the author.
2. From this file the map document is reconstructed (qgs).
3. If the map to be generated is:
    a. An interactive 2D map that will consume gojson data: We use the qgis2web qgis plugin to generate i) the json data for each layer, ii) the style specification, and iii) the js code of the interactive map that consumes this code,

b. An interactive 3D map that will consume gojson data: We use the qgis2three qgis plugin to generate the same 3 components referred to above

c. A dynamic map that will consume data through OGC services: for each layer i) We generate the SLD specification, ii) we export it to geoserver, iii) we publish the data as OGC service, and iv) we write the php/js code that consumes the data

In any case, we have the option to adjust, extend or replace the code of the data or the map to fine-tune the style of the layers, add multimedia contents, and modify, extend or redesign the functionality of the interactive map. These interactive objects can be linked to the main article as additional galleys, simply by providing its URL, which can reside anywhere in the worldwide web.

The same scheme, with some adjustments, can be used for the collections of geo-scientific data and the institutional geospatial data services.

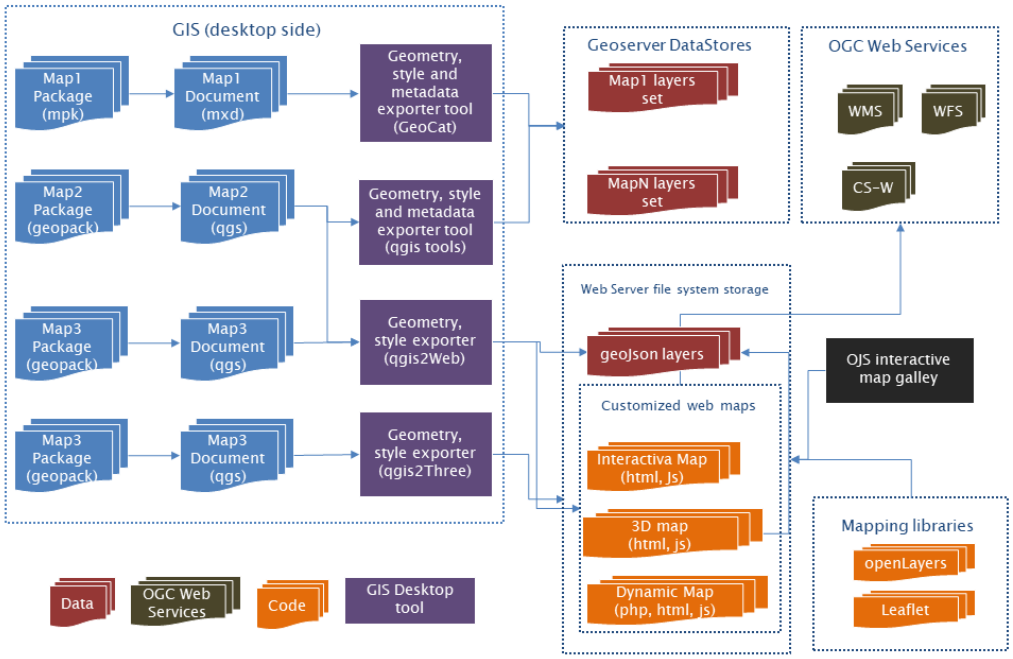

Figure 1. Outline of the tools and process to generate the different types of interactive maps used in the article galleys

DISCUSSION AND CONCLUSION

An innovative platform for the online publication of multiple cartographic types is presented in this research. Web-based interactive maps are a (at least 15 years old) mature technology. Likewise, the software for the editorial process of peer-reviewed journals has been available for about 15 years. In the meantime, the Spatial Data Infrastructures (SDI) have evolved into robust geospatial interoperability standards. The core innovation of this research consisted in the mix of software tools from these three domains to make available, for the first time, a peer-reviewed journal of interactive maps.

In current Geographic Information Science (GIS) journals, the editorial focus lies on the one hand on the novelty and robustness of the mathematical algorithms which underlie the generated map, and on the other hand, on the quality of the cartographic design as a scientific communication tool.

In the case of the present research, an additional focus is the relevance of the access to the underlying data. As a consequence, the cartographic enhanced (in 3D and time) content may offer a richer appreciation of the depicted processes or phenomena. Additionally, the opportunity for the geoscientific community to hook on the SDI of the journal from any OGC compliant desktop GIS means that the data is available for users and purposes other than those they were created for. A contribution of this type of journal could be an incentive towards a culture of replication, validation and reuse of data and codes in geosciences.

The added complexity corresponding to the additional layer within the editorial process, however, has implications such as the inclusion, within the permanent editorial team, of geo-informatic qualified staff. Furthermore, the emergence of such type journals may not be a sufficient incentive to leverage the natural resistance of individual researchers to share their datasets.

We are currently working on improving the integration between our system and GeoNode, -a collaborative tool for the management of spatial data contents, in order to facilitate the authors to participate directly in the editing of their layer metadata. Also, to allow subscribers to explore and connect to the spatial resources of our magazine.

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