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Web 2.0 and Neogeography. Opportunities for teaching geography

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Abstract

This paper is focused on the use of the geographical contents in Web 2.0 applications for didactics and particularly as a valuable source for many of the operations traditionally carried out when working with geographical data and issues in a GIS environment. The paper represents an introductory examination of to date well known topics concerning geographical data and software but with the focus of using them for teaching geographical issues and introducing them for the use of (online) Geographic Information tools.
In particular it will be pointed out how geographical questions can be raised and tackled by means of data and features spread over the web and containing geographical data. There is also an analysis of how they can be elaborated cartographically. The paper opens with a short introduction to the geographical "revolutions" that took place in the late XX and early XXI centuries in the digital age, with the advent of GIS and the so-called neogeography. A brief review on how GIS and geospatial technologies in general can be effectively used to disseminate geographical issues follows. The attention is then focused on an exercise, that can be proposed to geography students, or that is, the analysis of the Italian 2013 general election. The exercise foresees the use of geocoded tweets from Twitter, the popular social media, and some of the hashtags used in the pre-election periods (#elezioni2013) to observe their concentrations. The exercise also implies working with a free web GIS service such as GeoCommons, which together with other families of similar online software, make it possible to produce maps showing some thematic representations of the results obtained as well as analyzing the data with more than basic visualization functions.

Keywords: Geography, Cartography, Teaching, Neogeography, Twitter, Web 2.0, Italian Elections 2013, #elezioni2013

1. The revolutions of Geographic Information and support to teaching

The advent of Geographical Information Systems in the last decades of the 20th century and the so called "Neogeography" at the beginning of the following century represent two revolutions in the (recent) history of cartographic representation. In both cases such revolutions are the offspring of the digital age and, although the two phenomena share some similarities, they do not have the only common element in the mere digitalization of geographical contents and must be considered separately.

The initial pioneer applications of Geographical Information Systems date back to the 60s of the twentieth century with the CGIS - Canadian Geographical Information System (Coppock and Rhind, 1991) project, while the operational and commercial uses can be colllocated during the 90s and the early 21st century, when when there is a wide diffusion of commercial desktop GIS packages and a flourishing of journals, magazines and books (Longley et al., 1991; Burrough and McDonnell, 1998; Worboys, 1995 Iliffe, 2000 Robinson et al., 1995; Dorling and Fairbairn, 1997; Hearnshaw and Unwin, 1994; Raper, 2000). In these years the debate arises also on the consideration of Geographic Information as a “Science” rather than just “Systems” and on the relationship with the other disciplines (i.e., spatial analysis and quantitative geography: Cressie, 1991; Bailey and Gatrell, 1995; Fotheringham et al., 2000). These are also the years in which the relations with Internet and its applications start to spread. The teaching and dissemination side is generally occupied by courses at Master level on Geographic Information Science, delivered in a distance-learning fashion using the Internet, often at intercollegiate or international level (i.e., see the UNIGIS experience on distance learning GIS courses at EU level). Also we can recall the case of the US NCGIA (National Centre for Geographic Information Analysis) Core curriculum in GISystems (then evolved into GIScience) as a teaching environment for basic contributions on Geographical Information topics. The Internet also became the environment where Geographic Information applications start to be developed, particularly in terms of visualization of online geographical data or pre-prepared digital maps Longley et al. (2001).

The years of 2000 consolidate what started in the previous decade with a growing integration of the GIS world with the other disciplines referring to some spatial components. In these years the bases are established for the following revolution. A vast majority of data becomes in fact available also, and often, freely, such as satellite imagery and vector data. A growing alphabetization of users can also be observed, with digital geographic application being used in media and devices. Internet also becomes increasingly available to many users and offers the possibility to broadcast and distribute geographic information, once limited by bandwidth dimension. Three elements in particular can be highlighted at the basis of the spreading of Neogeography. First of all, the diffusion of the low-cost Internet networks, at least in Western countries, with (relatively) high speed networks and a considerable volume of transferrable data. A second element is the decision by US president Clinton in 2000 to eliminate the Selective Availability from in-clear GPS signals, thus eliminating the induced error and therefore enhancing the precision available also for private users to a few meters. A third element is the unprecedented diffusion of hand-held, mobile devices, starting from laptops and netbook computers, moving to ephemeral PDAs and now substituted by smartphones and tablets, now used not just for phone calls and text messages but for a wealth of applications related to Internet connections and personal location. Such a combination of different elements allows a public, which is wider than the “traditional” GIS users, to acquire, elaborate and present data with a geographical content, linking various elements to a geographical location. It is in fact possible to georeference images, short videos, comments, documents and other sorts of data and information. It is also possible to redistribute and share such contents with other users through the Internet, thus sharing the categories of content creators and users, as in the logic of “wiki” or “web 2.0” applications.

Goodchild (2007) introduced “Volunteered Geographic Information” (VGI), as the harnessing of tools to create, assemble, and disseminate geographic information provided by individuals voluntarily creating their own contents by marking the locations of occurring events or by labelling certain existing features, not already shown on the map. Goodchild (2007) introduced the concept of “citizens as sensors”, with neogeographers producing a small-g geography - different from the big-G Geography as the science of space and place - focused on the personal and individual, while Turner (2013) in conversation with Goodchild, extended the idea to cognizant individuals, with neogeography as "the domain of new possibilities that are now approachable by anyone". Goodchild talked about a democratization of Geographic Information, no longer just placed in the hands of a few professionals but available to a wide set of users. The term of VGI - Volunteered Geographic Information is also used (Elwood, 2008; Elwood, Goodchild and Sui, 2012) implying the presence of volunteers updating maps and producing a geographical content on their own. Eisnor (2006) interprets instead neogeography as a different "set of practices out or parallel from those of professional geographers, less related to standards and academics but more related to freedom of expression, this including also art". On the other hand, authors such as Turner highlight the technological aspects related to new devices and the ways of capturing geographical position and sharing it among different users and through the Internet.

Wilson and Graham (2013) recently stated scholars involved in geographical research are more and more admitting the power of what is referred to as "neogeography", Volunteered Geographic Information, etc. In particular they notice how neogeography highlights social practices that are explicitly spatially referenced and particularly the fact that it, rather than just collecting and presenting geographic information – what is possible as a "basic" function in a standard GIS package – "enacts new relationships in the coconstruction of spatial knowledge".

Neogeography appears therefore as something different from the "neo" initiatives in various periods of time attached to Geography as a discipline - let us recall terms such as "new geography" or "nouvelle geographie" – but more related to some technical and "fun" aspect of (geographical) data acquisition and manipulation. However, although Neogeography and Geography appear as separate phenomena, geographers and spatial scientists cannot ignore neogeography, particularly with reference to the possible interaction between the different communities and exchanges of expertise and knowledge.

The "old" pyramid proposed by Longley et al. (2001) highlighted a relationship between complexity, number of users and costs of GIS and applications. A higher degree of complexity that could be found in professional and desktop GIS corresponded to a lower number of potential users and increasing costs for software. If this can be considered true for the period of the "first revolution", recent enhancements of GIS and new solutions related to Web 2.0 and Neogeography can lead us to consider a different shape, where Internet GIS (2.0), virtual globes, mobile and Neogeographical solutions combine increasing levels of complexity, an increasing number of users and a reduction in costs (Figure 1).

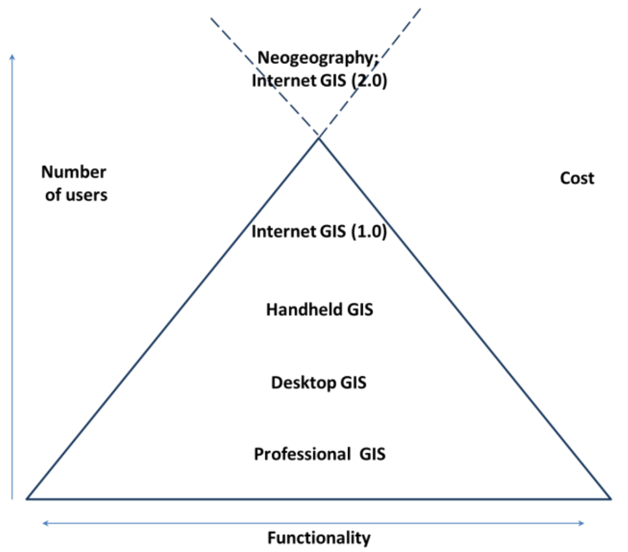

Figure 1. The pyramid of complexity, costs and users of GIS solutions. Source: elaboration from Longley et al. (2001), in Borruso (2013).

Teaching geographical contents however finds fertile ground over these two decades, in which geographical contents are tackled and managed in parallel with the digital revolution. In parallel the same events that favored the emerging of Neogeography are helping awareness and familiarity on the one side with technology, and with geographical issues on the other. The familiarity with mobile applications, together with the "democratic" use of digital imagery and other geographical data in the news and everyday applications, coupled with an increased interaction with the web paved the way for a new informed audience, able to visually explore and better understand geographical issues

(Bellezza, 2009; De Vecchis and Pesaresi, 2011; Favretto, 2009 a and b; Giorda, 2006; Pesaresi, 2007a and b). Apart from the benefit of having, from the geography teachers' point of view, an informed audience, the very spread of applications and phenomena implying "geolocation" (as coupling geographical coordinates to things on the Earth is today said in jargon) is increasing the need for prepared "volunteers" or simply "informed users" and therefore potentially increasing the actual audience for geographical courses. By way of example, a MOOC (Massive On-line Open Course) on the "Geospatial Revoultion" was recently produced by the Penn State University and broadcasted by the Coursera platform, reaching around 40,000 students (Robinson, 2013 a and b).

2. The geographical contents in web 2.0 applications

So a question arises: How can the present Web 2.0 be characterized by a geographical content and how can it be used?

As a starting point we have to recall a definition of Web 2.0 that to date represents a new way in which users interact with the Internet. The different definitions are quite recent and date back to the beginning of 2000 and the general idea is that it represents a system different from the top-down centralized web site, therefore integrated with the desktop, allowing the user to actively interact with the official content creator (Graham M., 2005; Graham P., 2005). The web is still seen as a platform where users can operate some functions on the web and re-distribute them. Websites can therefore represent an environment where participation can take place, allowing users to add value to a content they produce – maybe retrieving the raw materials from the web itself – before sharing it with other users / creators (O'Reilly, 2005; Robb, 2005).

The examples provided for a differentiation between the "Web 1.0" and the following "Web 2.0" can be related to two famous encyclopedias. The Encyclopedia Britannica and Wikipedia. The former represents the classical form of disseminating information in a top-down approach, with the different topics tackled by authors and readers just able to read them. The second one is characterized by being in a constant "draft" version, with contents being constantly updated by a wide community of authors, related to the Hawaiian word "wiki" meaning "quick" and aiming at a fast type of collaboration. Readers are invited to contribute and to update the different topics, so readers and contributors can coincide and therefore are part of a same community. As a result, there is a positive effect of the system of self-correction of errors, and early studies published on Nature (Giles, 2005) proved that the number of correct references was very close between the two encyclopedias.

Geographical and cartographical contents are strongly present in the Web 2.0 features and different families can be observed, all of these implying different types and characteristics. All these components can be considered also in terms of the use that can be made of them in academic teaching.

2.1 Active users' cartographic behavior

This is the most explicit work done by volunteers in creating geographical and cartographical contents in particular. Cartographical products realized under a "wiki" logic are to date quite widespread in different projects, spanning from the most anarchical realizations, with the most important and well known one, the OpenStreetMap project, to the users contributing to the update and correction of both commercial and public bodies' geographical data, as most car GPS receivers are doing in the private sector, followed by national mapping agencies in the other case (USGS, 2013). Projects such as OpenStreetMaps or Wikimapia plan the realization of a global cartography, with a logic of prosumers (= producers + consumers) realizing and updating maps adding details according to their knowledge of a certain place, helped by handheld devices hosting a GNSS (Global navigation and positioning satellite system like the US GPS) receiver as well as software capable of handling and managing the cartographic representation of such data. These data sources attracted the interest of GIS package vendors and Internet-related companies like Google now offering OpenStreetMap products as baselines for their search engines as well as a background cartographic layer where users can upload their own data.

Users however can be a valuable source also for official data producers as geographical data update is a costly and time-consuming activity, tackled with growing difficulties by both mapping agencies and private companies, with enormous risks of producing already out-of-date products and loss of market shares. So in many cases official producers are committed to producing the backbone of spatial data, allowing the users to highlight and update what has changed in time and therefore giving the official producer a role of validating body of crowdsourcing (outsourced to the crowd) activity. However, often such volunteers lack basic geographic skills, being more expert on the IT component. Also, "wiki" realizations are proving to be clustered in limited numbers of active users and locations (OSMstats, 2013).

2.2 Geographic informative content in social networks and media

Another kind of content is the one present in social networks and media. The latter do represent expressions of the Web 2.0 as well, hosting individuals' and organizations' comments and contents being shared through the Internet and among the communities of users. Documents, pictures, videos, text, news, etc. can be georeferenced and therefore located on a map. Social networks and media allow people to be in contact and share different kinds of contents. Recalling the graph theory, social networks (i.e., Facebook) in particular make it possible to establish some sort of relations among users by means of "friendship", allowing the establishing of links among nodes (=users) and a certain level of interaction with both direct connections and indirect connections (friends of my friends). Through a relationship like friendship, comments, videos, pictures and even maps and geographical contents can be shared, often also in a working environment where social networks can remotely connect colleagues in other rooms, departments, countries, etc.

Social media (i.e., Twitter) can also be presented as a network as in graph theory with nodes, links and flows. However, here the network is oriented, as we are not dealing with "friendship" but people "following" others and people having "followers", so a small number of people is followed by many other people, while most of the people follow more people than being followed. In this way a hierarchical structure of such network also arises, with quite a limited number of people expressing comments, ideas and images being followed and perceived by a vast quantity of public. Generally little space is given to a message that is no longer than 140 characters. Contents must be squeezed or readdressed to a website where broader information is stored.

Social networks and media host also a geographic component. This can be spontaneously declared by the user once they log in or the positional information can be detected by the device a person is using. Smartphones and tablets can be located by cell phone identifiers, and also the presence of smartphones having integrated GNSS – GPS devices make it possible to locate users and features they interact with quite precisely. Such media have the advantage, from a researcher's point of view, of producing a wealth of individual data and often such data is referred to quite a precise location. However quite a limited number of messages sent through the social networks and media host a location. Recent data however demonstrate that just a small percentage – around 5% – of messages sent through social media (or tweets) have a geographical component (Cosenza, 2013). In any case it is worth noting that, as these messages are public, this limited amount of locational information can also be useful in understanding, for instance, trends, moods and, going to the private markets, shopping habits of people fitted with a smart-phone or other portable device. Extra care needs to be taken with this kind of geographical data, as the level of detail is often very different from one kind of content to another, and the same goes for the quality – i.e., smartphones can use a GPS receiver or mobile network cell to locate themselves.

2.3 Cartographic productions 2.0

A third opportunity related to bottom-up, web 2.0 applications deals with the use of open source and open access software for traditional, as well as advanced, geographical analyses, coupled with the use of data freely available as those obtained – as outlined above – via crowdsourcing and volunteers. Desktop GIS packages used to offer a complete set of tools to operate on geographical data, while low-cost GIS and Internet GIS offered little more than basic navigation functions and visualization. To date also "geocomputation" is becoming stronger in Internet based applications, so not always is there a need to rely on stand-alone GIS packages (both free or commercial) and many operations can be performed by a web browser.

In particular, solutions such as GeoCommons (http://geocommons.com/) can be considered to carry out GIS analysis and visualization, in many cases allowing the user to focus on the data and the analysis with a basic knowledge of what is happening in the "black box". Such applications in fact allow the user to set a cartographic background on top of the one they can visualize the elaborations performed. GeoCommons allows the uploading of data from the user as well as the use of basic cartography and elaborations carried out by other users – still with a 2.0 approach. Furthermore, GeoCommons makes it possible to control important cartographic elements like class intervals, display, colours, etc., as well as providing statistics on the data (Figure 2).

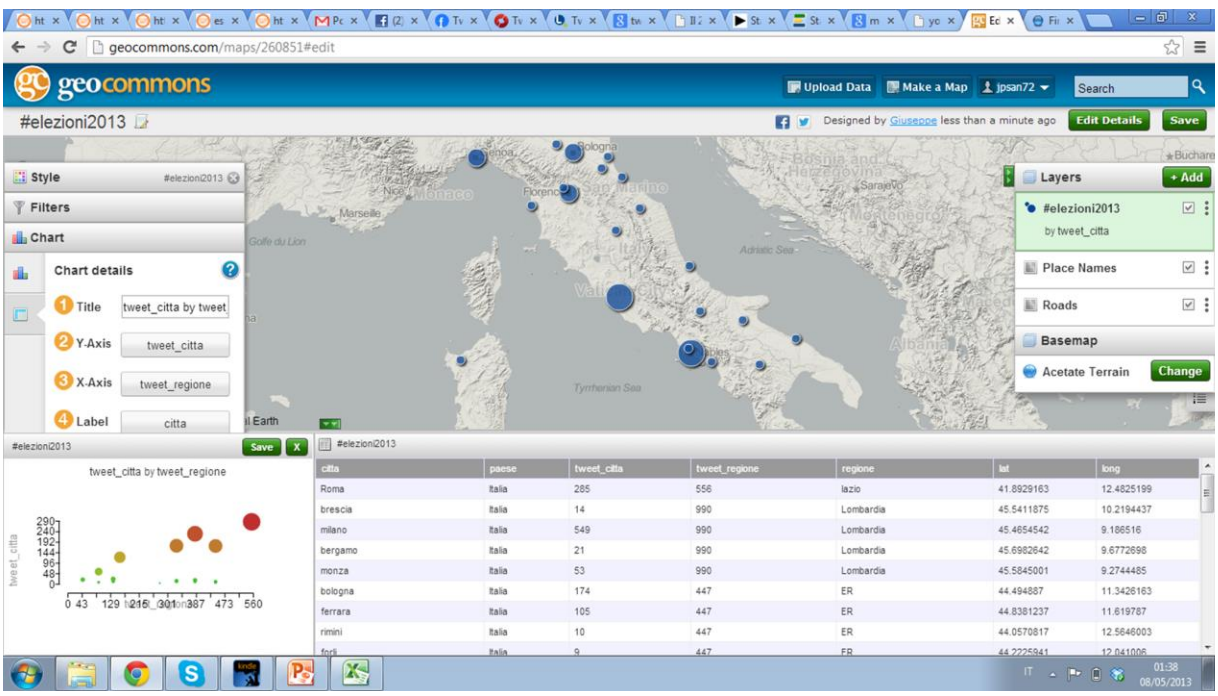

Figure 2. Thematic map of geocoded tweets hosting the hashtag #elezioni2013, via http://geocommons.com. Source: elaboration on geocoded tweets.

Other applications do exist allowing different levels of interaction with software and data. Similarly to Geocommons, ArcGIS on line by ESRI (ArcGIS.com) makes it possible to put together data from a variety of servers and also to upload one's own data, realizing thematic maps.

3. An exercise of geographic data retrieval and (web) mapping: general elections, tweets, cartography

In this paragraph a demonstration of the use of Web 2.0 in terms of data and software is carried out with the scope of showing how geographical exercises and analysis can be made using data and tools that are today readily available.

In doing this exercise the aim is to use data and software that is freely available or easily retrievable through the web in order to produce maps of social phenomena.

The interest in in analyzing the "2.0" side of the 2013 Italian general elections, by means of the short messages (140 characters) broadcasted as "tweets" using the popular social media Twitter. The second aspect was related to the possibility of using "2.0" tools to carry out geographical analysis and visualization without relying on expensive data and software, thus opening up opportunities for educational activities too.

In this case we propose a workflow implying the following steps to be followed by geography students:

1. Retrieve tweets from the social media "Twitter" holding a geographical component and a particular hashtag or research key (http://pro.topsy.com);
2. Transform tweets into – basic – geographical data, geocoding them through an on-line geocoder (http://www.gpsvisualizer-com);
3. Load them onto a on-line GIS, taking care of the data consistency and meta-data organization (http://geocommons.com);
4. Visualize them in an on-line GIS environment;
5. Analyse the data and represent them in the on-line GIS environment;
6. Make some comments on the data and results obtained.

The test was carried out using data on the Italian General elections by analyzing Twitter. In particular the tweets, or the 140 character text messages broadcasted to followers, containing a reference to the elections were analyzed. We analyzed those containing a hashtag – this is the name of a particular keyword with the "#" character at the beginning, useful for making queries on particular topics – like #elezioni2013. The problem is that this kind of research cannot match all the tweets and messages related to elections, as not all the users use hashtags in their messages. Another problem relies on the fact that only a short percentage of tweets can be geocoded. Actually, most of the users tweet via mobile phones and in very few cases is the geolocation function kept active, either by means of embedded GNSS (Global Navigation and Positioning Satellite Systems) or by mobile telecommunication network cell identification, so just a 5% percentage of overall tweets can be geocoded (Cosenza, 2013).

As Twitter allows the recording of tweets and trends for a very short time, other web-based programs were chosen to retrieve tweets using hashtags and geographical location. We relied on TOPSY Pro a web-based service to retrieve information on search and to analyze social features over the web (https://pro.topsy.com). In particular we restricted our analysis on tweets published in the two-month period preceding and including the general election days, from 1 January 2013 to 28 February 2013. It was therefore possible to include all the period before the elections of 24 and 25 February.

In Figure 3 it is possible to see how tweets were broadcasted in the election period with quite a stable trend during the first month followed by a dramatic acceleration during the weeks preceding the election and a peak in the election days.

Then the attention was focused on the geographical location of the tweets and different levels of aggregation were chosen. An initial analysis was made on the spatial distribution in the world, in Italy and in the regions.

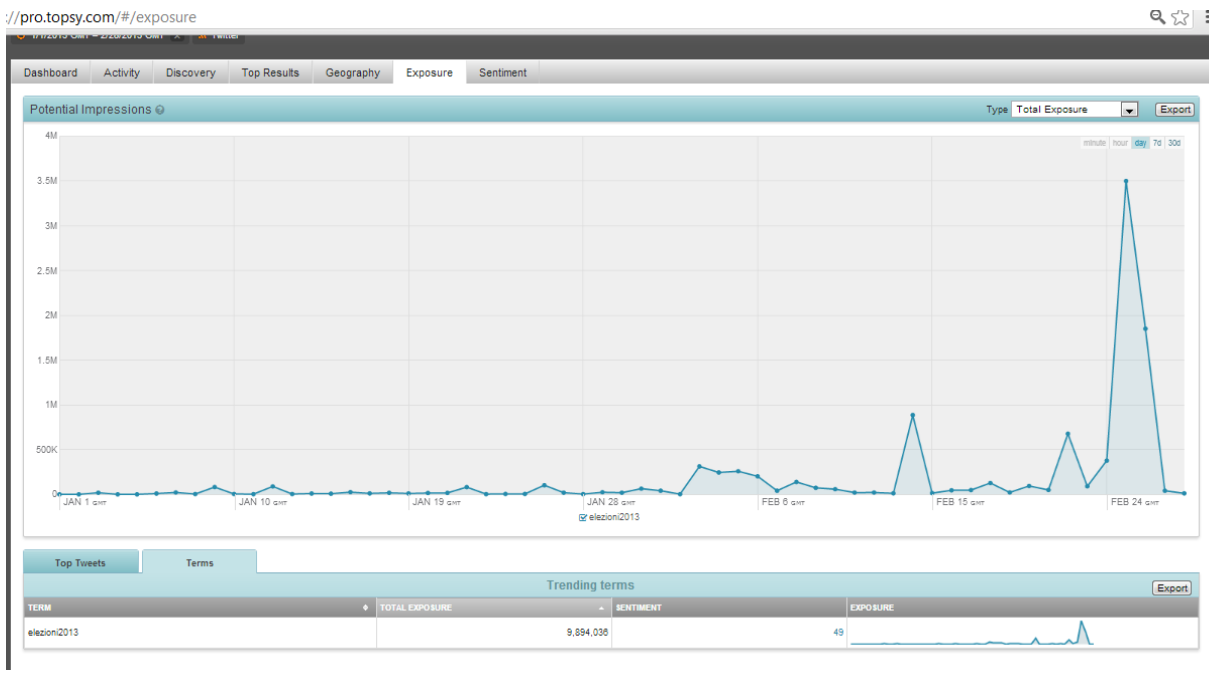

Figure 3. Exposure, or the number of times tweets with hashtag #elezioni2013 were displayed for twitter users, via https://pro.topsy. com.
Source: elaboration on geocoded tweets.

From Table 1 it can be seen that unsurprisingly most of the tweets were located in Italy, but other countries appeared (i.e., the US).

The absolute values concerning the Italian regions show Lombardy and Lazio prevailing as the top scorers in terms of tweets, followed by Emilia Romagna and Piedmont. Our tweets were than compared, as a distribution, with the ones of the overall population, this time aggregated to macro-regions like Northwest, Northeast, Centre and Southern Italy including the islands. The raw data can be observed in Table 2, while the percentage values are more interesting and can be observed in Table 3.

We notice in particular how a higher percentage of twitters is present in the Northwestern regions while in the Northeast and Southern Italy such values are lower than the population percentage. This can be related to the presence of press agencies and important newspapers as well as political and social movers and shakers. It must in fact be said that ordinary people but mainly important figures in the social, economic and political arena, as well as journalists, use twitter as a social media to communicate thoughts, impressions and voting intentions and their weight, in terms of followers and message diffusion, is undoubtedly higher.

From Table 3 we can also see that Northwestern and Central Italy were the most active areas in terms of tweets hosting #elezioni2013 hashtags.

Among the areas considered, cities play an important role. Milano, Turin and Rome host the highest absolute values in terms of tweets, followed by Naples. Such data were used also for a cartographic representation.

Locations	Estimated tweets
Lombardy	990
Lazio	556
Emilia-Romagna	447
Piedmont	394
Campania	385
Tuscany	329
Umbria	279
Veneto	164
Sicily	161
Liguria	158
Apulia	138
Sardinia	94
Calabria	48
Marche	48
Abruzzo	46
Friuli-Venezia Giulia	43
Trentino-Alto Adige	26
Basilicata	12
Valle d'Aosta	5
Molise	1
Italy	7427
World	8013

Table 1. Tweets estimated per geographical area with hashtag #elezioni2013.
Source: Istat, 2013; Twitter, 2013.

Area	Population 2012	Twitters	Tweets #elezioni2013
Northwest	15752503	1330100	1547
Northeast	11442262	709700	680
Centre	11591705	916500	1212
South and Islands	20607737	1475800	885

Table 2. Population, twitters and tweets estimated per macro geographical area with hashtag #elezioni2013.
Source: Istat, 2013; Twitter, 2013.

Area	% Population	% twitters	% #elezioni2013
Northwest	26.52	28.30	35.78
Northeast	19.26	15.10	15.73
Centre	19.52	19.50	28.03
South and Islands	34.70	31.40	20.47

Table 3. % of Population, twitters and tweets estimated per macro geographical area with hashtag #elezioni2013.
Source: Istat, 2013; Twitter, 2013.

In Figure 4 we can observe a screenshot of part of the procedure dedicated to importing data organized as a spreadsheet list of cities containing tweets hosting the hashtag #elezioni2013 aggregated at city level. GeoCommons allow both the geocoding of data listed in a spreadsheet with two columns dedicated to geographical coordinates in decimal degrees, and the geocoding of data based on some geographical name, such as a city or region. In this case the list of cities was previously referenced using an automatic web-based geocoding system (GPSvisualizer http://www.gpsvisualizer.com).

Figure 5 represents the cartographic visualization of the tweets hosting the hashtag #elezioni2013 aggregated at city level. GeoCommons makes it possible to choose the basic cartographic layer on top of which a user can overlay their datasets and elaboration. This simple example of point data can be used to present a graduated symbol map in which every city is plotted with a different dimension of dot, proportional to the value of tweets. The choice of class intervals can be made by observing the statistical distribution of the dataset. It is worth noting that such function is available also on destktop software but only a few years ago it needed to be operated outside the GIS environment and in standard spreadsheet packages, therefore keeping the process even longer even for expert users.

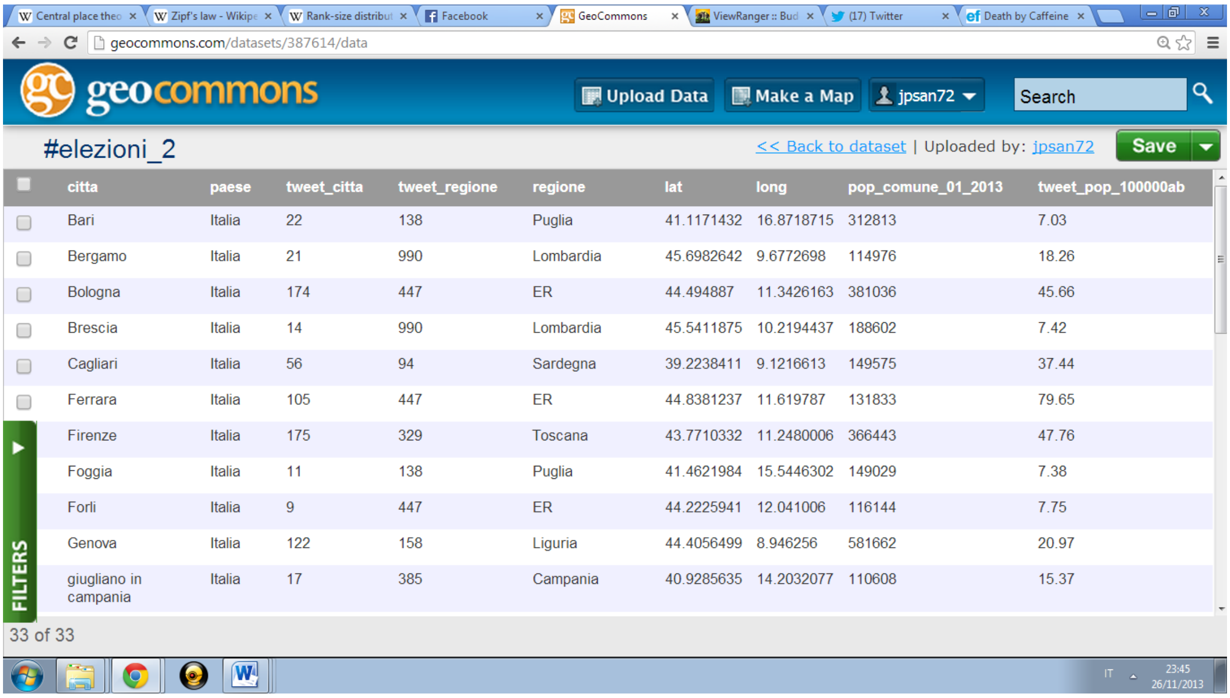

Figure 4. Cities containing tweets hosting the hashtag #elezioni2013 aggregated at city level via http://geocommons.com.
Source: elaboration on geocoded tweets.

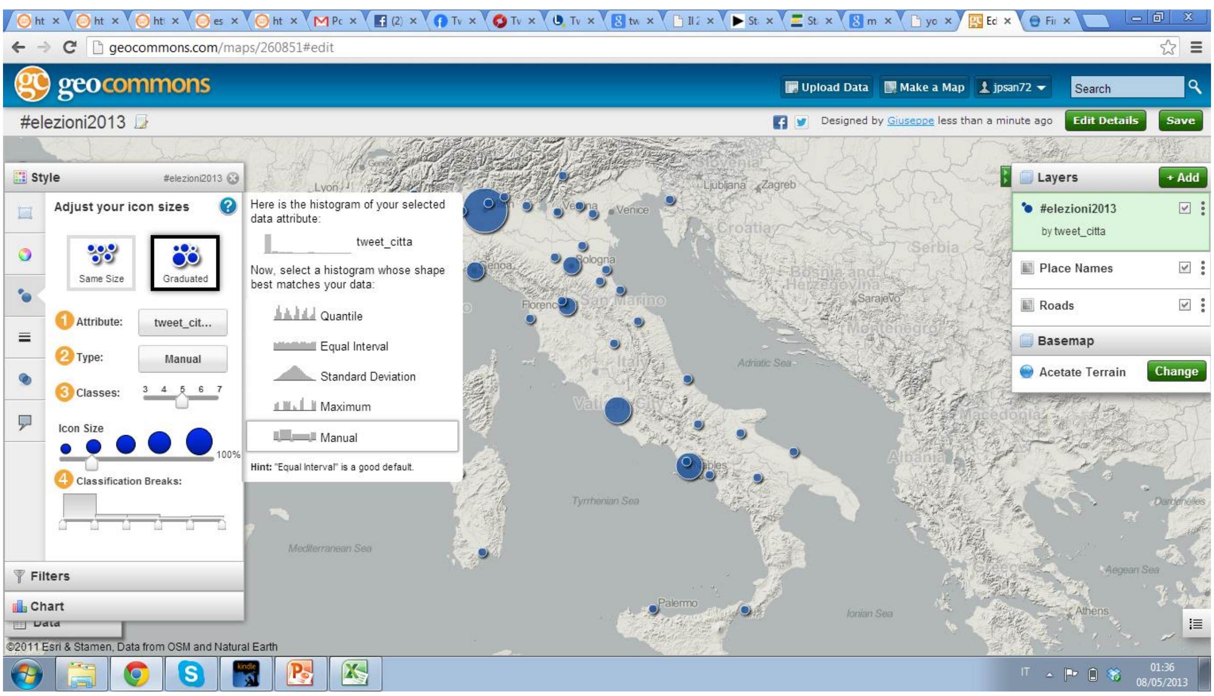

Figure 5. Graduated symbols of geocoded tweets, hosting the hashtag #elezioni2013, via http://geocommons.com.
Source: elaboration on geocoded tweets.

The results can be stored and shared with other users that can rely on such data for visualization and research purposes. So GeoCommons as well as the data used in this application can also be of valuable use for training people in Geographic Information and Geography. However it must be stressed that attention must be paid to data pre-processing and preparation, as the web-based system allows little room for errors in misspelling data and organization, so some basic GIS skills should be used in order to correctly visualize and effectively use the data.

4. Conclusions

In this paper we experimented a set of simple geographical analyses useful to analyze some aspects related to the recent Italian general election, in particular focusing on the spatial distribution of geocoded tweets, or messages broadcasted through the popular social media Twitter. The analysis showed a clustering of tweets using certain keywords or hashtags in some regions and cities, particularly the main cities and those hosting traditional media and political parties, such as Rome and Milan. A more in-depth analysis should be carried out, in order to better insert the usability of a limited amount of data like geocoded tweets with hashtags into the socio-demographic features of the Italian population. However at this stage such an analysis appeared mainly as an opportunity to perform operations that are now standard in a GIS environment using both data and software freely available on line and created with the contribution of users. Data were in fact collected as tweets aggregated at different geographical levels, like cities and regions. It was then possible to geocode them and to elaborate them into an on-line program allowing not just basic GIS and cartographic functions. The paper therefore reached an objective of exploring the possibility of low-cost data management, elaboration and cartographic realization, without the need to rely on complex and costly stand-alone GIS packages and therefore of opening new opportunities for teaching geographical topics.

Critical aspects must however be considered, as the need to validate data obtained through social media on one side, and the need to rely on more robust software for more in-depth analysis on the other, although the web-service used here proved to be quite interesting at least to present simple cartographic representations.

This kind of exercise implied working with data and transforming them into geographical ones, adding extra-information on their position and locating them on (digital) maps. Such kind of activity, as well as getting accustomed to GI tools and operations and geographic phenomena, can represent a valuable support to teaching for students having the opportunity to work with their hands on real geographical contents. Moreover, such activities could be promoted to train “neogeographers” and “volunteers” too, who often lack basic geographic skills and who could therefore act in their future data collecting activities with greater awareness.

References

1. Bailey T.C. and Gatrell A.C., *Interactive spatial data analysis*, Harlow, Longman, 1995.
2. Bellezza G., “Geografia, geomatica, cultura”, *Ambiente, Società e Territorio. Geografia nelle Scuole*, 5, 2009, pp. 21-25.
3. Borruso G., “Gli strumenti di informazione geografica nella didattica della cartografia”, *Bollettino dell’Associazione Italiana di Cartografia*, voll. 129-130-131, 2007, pp. 115-130.
4. Borruso G., “Cartografia e Informazione Geografica ‘2.0 e oltre’, Webmapping, WebGIS. Un’introduzione”, *Bollettino dell’Associazione Italiana di Cartografia*, 147, 2013, pp. 115-130.
5. Burrough P.A. and McDonnell R.A., *Principles of Geographical Information Systems*. Oxford, Oxford University Press, 1998.
6. Capineri C. and Rondinone A., “Geografie (in)volontarie”, *Rivista Geografica Italiana*, 118, 3, 2011, pp. 555-573.

7. Chilton S., “Crowdsourcing is radically changing the geodata landscape: case study of OpenStreetMap”, in VV.AA., *Proceedings of the 24th International Cartographic Conference* (Santiago de Chile, 15-21 November 2009), 2009, http://icaci.org/files/documents/ICC_proceedings/ICC2009/html/nonref/22_6.pdf.
8. Coppock J.T. and Rhind D.W., “The history of GIS”, in Longley P.A., Goodchild M.F., Maguire D.J. and Rhind D.W., *Geographic Information Systems*, Wiley, Chichester, 1991.
9. Cosenza V., “State of the Net”, 2013, http://www.blogmeter.it/blog/2012/08/24/state-of-the-net-archivio-blogmeter/.
10. Cressie N.A.C., *Statistics for spatial data*, New York, Wiley, 1991.
11. De Vecchis G. and Pesaresi C., *Dal banco al satellite. Fare geografia con le nuove tecnologie*, Rome, Carocci, 2011.
12. Dorling D. and Fairbairn D., *Mapping. Ways of Representing the World*, Harlow, Longman, 1997.
13. Eisnor D., “Neogeography”, 2006, http://platial.typepad.com/news/2006/05/what_is_neogeog.html.
14. Elwood S., “Volunteered geographic information: future research directions motivated by critical, participatory, and feminist GIS”, *GeoJournal*, 72, 3-4, 2008, pp. 173-183.
15. Elwood S., Goodchild M.F. and Sui D.Z., “Researching volunteered geographic information: spatial data, geographic research and new social practice”, *Annals of the Association of American Geographers*, 102, 3, 2012, pp. 571-590.
16. ESRI, ArcGIS on line, http://www.arcgis.com.
17. Favretto A., *I mappamondi virtuali: uno strumento per la didattica della geografia e della cartografia*, Bologna, Pàtron, 2009a.
18. Favretto A., “Vent’anni di World Wide Web: la cartografia è veramente di moda?”, *Ambiente, Società e Territorio. Geografia nelle Scuole*, 5, 2009b, pp. 8-13.
19. Fotheringham A.S., Brunsdon C. and Charlton M., *Quantitative Geography – Perspectives on Spatial Data Analysis*, London, SAGE, 2000.
20. GeoCommons, http://geocommons.com.
21. Giles J., “Internet encyclopaedias go head to head”, *Nature*, 438, 7070, 2005, pp. 1-20.
22. Giorda C., “Il cammino della cartografia dall’astrazione al paesaggio: la Terra vista da Google Earth”, *Proceedings of the 48 National Congress of AIIG – Italian Association of Geography Teachers* (Campobasso, 2-5 September 2005), 2006, pp. 247-251.
23. GISCloud, http://www.giscloud.com/.
24. Goodchild M., “Citizens as Sensors: The World of Volunteered Geography”, *GeoJournal*, 69, 4, 2007, pp. 211-221.
25. Goodchild M. and Turner A., “Neogeography and Volunteered Geographic Information: a conversation with Micheal Goodchild and Andrew Turner”, *Environment and Planning A*, 45, 2013, pp. 10-18.
26. Google Fusion Tables, http://www.google.com/ drive/apps.html#fusiontables.
27. Google Maps Engine, https://mapsengine.google.com/map/.
28. GPSVisualizer, 2013, http://www.gpsvisualizer.com.
29. Graham M., “Neogeograhy and the palimpsests of place: Web 2.0 and the construction of a virtual Earth”, *Tijdscrhift voor Economische and Social Geografie*, 101, 4, 2005, pp. 422-436.
30. Graham P., “Web 2.0”, 2005, http://www.paulgraham.com/web20.html.
31. Hearnshaw H.M. and Unwin D.J. (Eds.), *Visualization in Geographical Information Systems*, Chichester, Wiley, 1994.
32. Iliffe J.C., *Datums and Map Projections, for remote sensing, GIS and Surveying*, Caithness, Scotland, Whittles Publishing, 2000.
33. Longley P., Goodchild M.F., Maguire D.J. and Rhind D.W., *Geographic Information Systems*, Chichester, Wiley, 1991.
34. Longley P., Goodchild M.F., Maguire D.J. and Rhind D.W., *Geographic Information Systems and Science*, Chichester, Wiley, 2001.
35. NCGIA – National Centre for Geographic Information Analysis, “Core Curriculum”, 2000, http://www.ncgia.ucsb.edu/education/curricula/giscc/.
36. O’Reilly T., “What Is Web 2.0”, 2005, http://oreilly.com/web2/archive/what-is-web-20.html.

37. OSMstats, http://osmstats.altogetherlost.com/index.php?item=countries.
38. Pesaresi C., "Punti di contatto tra informatica e geografia: approcci e nuovi orizzonti didattici per la scuola", in Morri R. and Pesaresi C. (Eds.), *Innovazione cartografica e geografia, Semestrale di Studi e Ricerche di Geografia*, 1, 2007a, pp. 9-60.
39. Pesaresi C., "Google Earth e Microsoft Live Maps nella didattica della geografia. Uno zoom su alcuni paesaggi italiani", *Ambiente, Società e Territorio. Geografia nelle Scuole*, 6, 2007b, pp. 40-41.
40. Raper J., *Multidimensional Geographic Information Science*, London, Taylor and Francis, 2000.
41. Robb J., "Web 2.0?", 2005 http://globalguerrillas.typepad.com/johnrobb/2005/09/web_20.html.
42. Robinson A.C., "Maps and the Geospatial Revolution", MOOC Coursera, 2013a, https://www.coursera.org/course/maps.
43. Robinson, A.C., "Maps and the Geospatial Revolution: A Massive Open Online Course (MOOC) on Cartography", Presentation for the Department of Geography Coffee Hour, Penn State University, University Park, PA, 2013b.
44. Robinson A.H., Morrison J.L., Muehrcke P.C., Kimerling A.J. and Guptill S.C., *Elements of Cartography* (Sixth Edition), New York, Wiley, 1995.
45. Turner A., *Introduction to Neogeography*, Sebastopol, CA, O'Reilly, 2005.
46. USGS, "The National Map Corps", 2013, http://nationalmap.gov/TheNationalMapCorps/index.html.
47. VV.AA., "OpenStreetMap", http://www.open streetmap.org/.
48. VV.AA., "Wikimapia", http://www.wikimapia.org/.
49. VV.AA., "Wikipedia", http://en.wikipedia.org/wiki/Wikipedia.
50. Wilson M.W. and Graham M., "Guest editorial", *Environment and Planning A*, 45, 2013, pp. 3-5.
51. Worboys M., *GIS A Computing Perspective*, London, Taylor and Francis, 1995.