

Cartographic Styles between traditional and original (towards a cartographic style model)

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ABSTRACT: Cartographic representations are nowadays more and more explored but current online cartographic tools lack graphic and sophisticated tools to make expressive, original and better maps. One important aspect for us is to favor users' creativity in proposing them ways to effectively make customized maps adapted to their needs, preferences and intention. We focus on the notion of cartographic style: our long-term purpose consists in formalizing and implementing cartographic styles in cartographic tools to favor users' creativity during map design process. At this step of the research, we consider existing cartographic styles, traditional ones coming from NMAs, more creative ones coming from old maps, Internet, etc., but also future cartographic styles, coming from other domains (art, image, design, etc.). Our objective is not to list in an exhaustive way all possible cartographic styles, but to provide approaches to highlight visual characteristics to define or to build cartographic styles. These approaches allow us to discuss on the building of a model of a cartographic style.

KEYWORDS: Cartography, Style, Originality, Creativity, On-demand maps, Visual, Aesthetics

Introduction

The timeless power of maps, the potentialities of online cartographic tools and the increasing interest of general public to make maps by their own, disinhibit some data producers and mapmakers. A lot of initiatives are taken about cartographic representations to make better, more expressive or original maps: tools to create and modify styles on data (CloudMade¹ for OpenStreetMap data², Google API v3 for Google Maps³), maps design competitions (Check my map⁴, Atlas of Design⁵, International Cartographic Exhibition 2011⁶, etc.), new map design propositions (watercolor, toner and terrain maps⁷, sketchy ball pen maps⁸, etc.). Offering to Internet users various cartographic tools to make maps should be associated to more graphic tools and underlying expertise: it is the only way for users to customize cartographic representations as suitable as possible to their preferences, needs and intention. In order to improve these cartographic tools, it is clearly time, first to revisit visual renderings,

¹ <http://maps.cloudmade.com/editor>

² <http://www.openstreetmap.org/>

³ <https://developers.google.com/maps/documentation/javascript/styling>

⁴ <http://www.checkmymap.fr/creation-design/carte-metro-paris>

⁵ <http://atlasofdesign.org/>

⁶ <http://icaci.org/icc2011/>

⁷ <http://maps.stamen.com/#watercolor/>

⁸ http://vizzuality.github.com/VECNIK/examples/ny_map.html#12/40.7592/-74.0086

second to revisit them according to the geographical data and the phenomenon the user wants to render, the way he wants to graphically represent a message intended to a public, in a context, on a support.

In this paper, we assume that creativity of the mapmaker, during the map design process and in the resulting map, may improve map quality: it may help to express better what they need and want to do with their data. Some people think that everything has been done about cartographic representations whereas others propose and try more and more ways to render geographical data. We propose to favor such creativity has to be favored in cartographic systems in proposing at long term to users to handle cartographic styles adapted to their data, needs and preferences. A cartographic style may be considered as a manner to express something about geographical data. Our objective is to learn from traditional and original cartographic styles to propose a model of cartographic style implementable in cartographic systems. We thus focus on the complexity of the concept of a cartographic style: what does characterize a cartographic style? How could we identify or build cartographic styles? In a first part, we consider how cartographic styles may enhance users' creativity. In the second part, we propose approaches to emphasize main salient characteristics of styles (from existing maps and existing artistic styles). Finally, we discuss about building of a model of cartographic style, with the help of converging visual aspects coming from previous approaches.

Enhancing users' creativity with cartographic styles

Creativity is the ability for someone to imagine, conceive and implement a new idea or object, or to propose an original solution to a problem. Creativity is inherent to map design process: the mapmaker faces their needs, preferences and an intention to cartographic practices, tools and possibilities. Enhancing users' creativity in cartographic systems consists in bringing them methods and tools to handle inspiration sources and to refine graphic signs choices: customized map design may benefit from traditional and original cartographic styles. In this part, we first precise what nowadays does mainly prevent creativity in map design. Then, we specify the definition of cartographic styles, their traditional and original aspects, with the help of research works. Finally we detail some research objectives about cartographic styles.

What does nowadays prevent creativity in cartography?

Three aspects mainly preventing users' creativity are detailed in the following paragraphs.

First, the users may overstep the limits imposed unconsciously by cartographic standards and rules. People are used to handle some maps and/or color schemes and are often not able to imagine other colors to render their data. Students are according to that point the best example of the re-use of unconscious color schemes they are used to: in GIS classes about Quantum GIS⁹ learning, when French students are asked to load and to render as they want, a topographic dataset, almost 75% of them use color schemes very similar to standard color schemes of the two main producers of French maps. If they are

⁹ <http://qgis.org>

proposed to make something more individual or original, they consider their maps as good enough. In a worldwide context, we also observe that people often re-use to render their data, the color scheme of Google Maps or a color scheme visually very similar or mentally referring to Google Maps, certainly without realizing it¹⁰. It seems generally to be difficult to go out the standards: national maps are considered as standards overall for the users of the related country and convey cultural and cartographic conventions, but Google, Open Street Map (OSM), etc. provide now also cartographic standards and habits in terms of visual renderings. We notice that all those new standards reflect and convey some kind of conventions, expertise and experience making their symbol specifications more and more trustable and friendly for users, thus becoming references.

Second, the users may benefit from knowing and looking at the diversity of cartographic representations: inspiration sources could be provided to help them to imagine and conceive other cartographic representations. The initiative of the watercolor representation on worldwide OSM data had a terrific impact on the public. Nevertheless, as researchers, we have to show the potentialities of expressive renderings in also providing users some cartographic expertise to use these cartographic representations. Otherwise original cartographic representations would only be surprising or beautiful and not efficient in a cartographic sense.

Thirdly, the cartographic tools have to offer more methods and tools to favor creativity. Through a questionnaire, we asked cartographers about their practices and most of them declared combining GIS, image processing, vector drawing softwares and sometimes manual drawings, to make one map. Current graphic tools in online tools or GIS systems appear often to be insufficient to make expressive, original and new maps.

Favoring creativity through traditional and original cartographic styles

We propose to handle cartographic styles, which could be at long term integrated in cartographic systems, in order to answer to the previous three problems. Dictionaries define a style as a set of “visual”, “formal” or “aesthetic” characteristics that refer to “a certain manner to express something”. The word style is used in all domain of expression: most of all music, architecture and visual arts where the expression art movement is sometimes mainly used. Architecture considers some manners to build, to use materials, forms and structures. In visual arts, style is “...any distinctive, and therefore recognizable, way in which an act is performed or an artifact made or ought to be performed and made.” This definition is very interesting in our context of cartography because it highlights that style concerns both the process of making and the result. We may consider style as a category whose some elements appear visually similar and sometimes are due to a similar way of making. As a problem of categorization, similarities and differences have to be considered in the identification and characterization of styles in cartography.

As styles in artistic domains, a cartographic style is traditionally considered as a specific manner to render geographical information due to specific history and practice of cartography, in particular according to various uses of “content and appearance” (Kent

¹⁰ <http://maps.skobbler.com/>

and Vujakovic, 2009, Benova and Pravda, 2009, Beconyte, 2011). Content may depend on geographical data in use and impacts of preliminary geo-processing on those data (selection, generalization, schematization, etc.). Appearance may depend on representation choices: visual variables of Bertin (1967) and their way of combinations, toponyms, graphic generalization, etc. Both of them depend also on national landscapes for topographic maps, habits and cultural aspects on cartographic processes for all types of maps.

(Kent and Vujakovic, 2009) demonstrate that the diversity of European topographic styles is not due to the diversity of landscapes, but to the diversity of cartographic representations coming both from cartographic processing (abstraction and generalization) and symbol specifications. The authors consider that the landscape is rendered by symbols reflecting ideas, cartographic practices and conventions of a country: therefore, a cartographic representation may be automatically visually considered as belonging to a country. (Beconyte, 2011) highlights the complexity of the structure of a style mainly influenced by geographical space, time and culture. The author proposes to classify maps, with the help of three criteria (decorativeness, expressiveness and originality) applied to each component of the map or combined, into four style categories: 'minimal', 'standard', 'conventional' and 'conspicuous'. Several other styles are defined for each category (laconic, expressive, antique, artistic, etc.). Finally the author mentions that originality, as "the degree of deviation from standard visualization schemes for a particular map type", may be the best criterion to characterize a style. (Field and Demaj, 2012, Demaj and Field, 2012) classify a lot of various maps, by maps categories validated by experts – artistic, geologic, abstract, topographic, etc.. Other maps qualifications have been explored with words characterizing a general feeling on European legends applied to a same geographical dataset (Jolivet, 2009, Bucher et al., 2010).

Through these research works, we see that maps are usually ranked from traditional or standard to original. We emphasize that the concept of originality is ambiguous: it has to be considered face to the background of the mapmaker or the future map-readers. Topographic maps, mainly classified in traditional maps, may be seen as original for some users not belonging to related countries producing those maps. Topographic maps convey cultural and cartographic conventions and practices that they may be seen as traditional for some users, as original for others.

Objectives of our work

We consider a cartographic style as a complex concept made of "content and appearance" that we aim at formalizing. Research works have been done about models of cartographic legends and symbol specifications participating, both to content and appearance, through years (COGIT base model for map legends (Hoarau and Mustière, 2011), OpenGeospatial Consortium Norms: Styled Layer Descriptor (SLD)¹¹ and Symbol Encoding (SE)¹²): however they show now their limit to represent expressive and original (new?) ways to render geographical data. At long term, we thus would like to propose a

¹¹ <http://www.opengeospatial.org/standards/sld>

¹² <http://www.opengeospatial.org/standards/symbol>

model of cartographic style integrating or modifying existing map and legend models. At short-term, we need first to systematically define a cartographic style. In this paper, we focus on approaches to better define a cartographic style and to highlight and formalize main characteristics of a style, as a first step towards a complete and implementable model. Therefore, we would like to precisely identify and analyze their visual, formal and aesthetic characteristics, based on traditional and original maps.

Approaches to identify, characterize and build cartographic styles

We propose two kinds of approach to identify structuring and essential characteristics of a cartographic style: 1- we identify and characterize existing cartographic styles from existing maps (two cases), 2- we build new cartographic styles from existing artistic styles. To illustrate our research, we use here topographic data and maps, but our approach could be also applied to other maps types. Figure 1 summarizes these approaches.

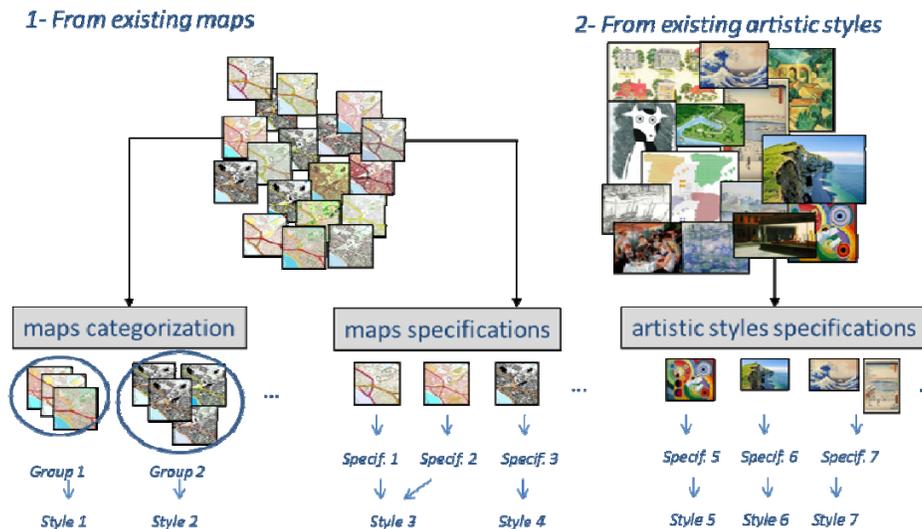


Figure 1. Approaches to define existing or new cartographic styles

Identifying existing cartographic styles from existing maps

Two ways are possible to identify and characterize existing cartographic styles: existing maps may be first visually grouped to highlight various styles, or second individually analyzed to extract systematically main visual characteristics of their styles.

Case 1: during our PhD thesis (Christophe, 2009), we made some cartographers classify map samples: by pairs of two experts, each group got a set of map samples printed on paper, as in a Memory card game¹³, had to group them and to give a name to each given group without any other indication. Eight pairs of experts start a first regrouping with 52 topographic map samples, made in applying various color schemes coming from a harmony book on a same dataset (Dominguès and Bucher, 2006). In the second step of

¹³ Figure 1 shows for case 1 a piece of each set of map samples the experts had to group.

the test, we add 33 new samples, of the same size, coming from scans of 1/50000 European topographic paper maps: we asked users, if possible, to add these new European samples to their existing groups, to modify or to create new groups, if needed. Figure 2 presents a piece of the map samples we used.

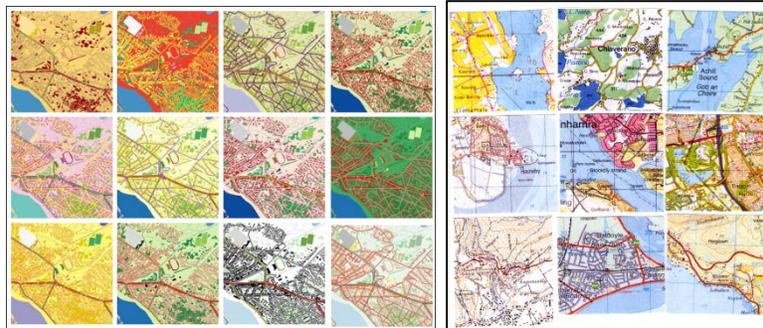


Figure 2. Piece of map samples to visually group: on the left, those from (Dominguès and Bucher, 2006) and on the right, those extracted from European paper maps.

Each pair of experts describe between three and thirteen groups (mean: 8 groups, standard deviation: 3.5). With the help of the names given to groups, we manually distinguish three relevant visual and perceptive criteria to group samples: a dominant hue or value for a hue, a reference to one salient type of geographical objects and a general feeling (this last criteria was often related to one of the two first ones). For seven pairs of experts out of eight, between 40% and 80% of the groups are characterized by a term related to a color or a contrast of colors. The saliency of road network has also been considered as relevant for the same majority of pairs which have proposed one or two groups based on this criterion. Figure 3 presents a group of map samples, made of existing samples and piece of European maps, characterized by a pair as a salient road network.



Figure 3. Map samples classified by a visual salient road network (Christophe, 2009)

The criteria chosen by experts to visually classify groups are relevant to our problem of characterizing a style: salient colors, salient geographical objects and general feeling. Therefore, these criteria may be used to identify cartographic styles in a given set of maps. However, this approach is very dependent of the map samples database (diversity, variability, representativeness, etc.) we have.

Case 2: we systematically analyze some maps to extract salient characteristics of their styles: we assume that if these characteristics are applied on any topographic data, users used to that style may recognize it. The question here is rather about making think about a well-known style than exactly reproduce a style and thus highlighting what is visually relevant. We select symbols specifications from the French 1/25000 national paper map (IGN-France), Google Maps and OSM: for each, we get road networks, buildings, forests, sea, city area symbologies back and apply them to a same topographical dataset coming from the IGN-France. Figure 4 presents three resulting maps (A: Google style, B: IGN style, C: OSM style).



Figure 4. Google Maps (A), IGN France (B) and OSM (C) styles on a geographic IGN France dataset.

We verify among some French people, used to handle Google, OSM and IGN-France maps, that each style is immediately recognizable, without any ambiguity. It highlights first that people may worldwide recognize Google Maps (A) and OSM (C) styles; second that French people, or people who have used French maps yet, may recognize the IGN-France style (B). We extract salient characteristics – colors, thickness of roads, hierarchy of road network, presence and colors of outlines and coastlines – and salient objects – road network, hydrography, buildings, background and forests – sufficient to make users, used to a style, think about this specific style. Adding toponyms with types of font used by these producers should disambiguate the problem better again.

Another test consists in asking people to recognize and compare two topographic styles coming from two national paper maps. The exercise may appear easy for people used to manipulate both French and Swiss paper maps, but not so easy for the others (Figure 5).

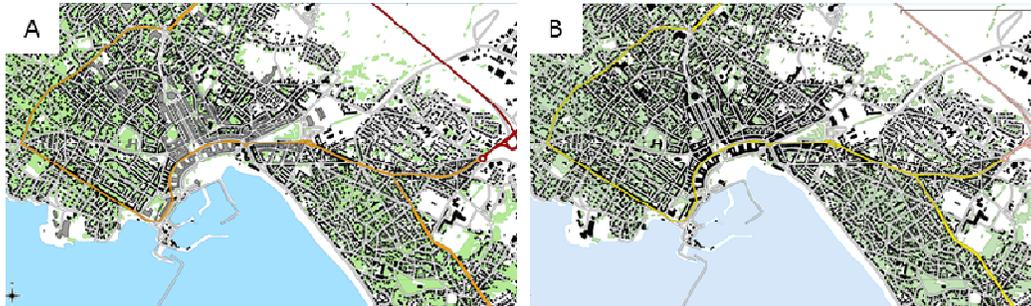


Figure 5. IGN France (A) and SwissTopo (B) styles on a geographic IGN France dataset.

With this last test, level of users' knowledge of an existing cartographic style – their living country, their background, their experience with maps of foreign countries, etc. – and again salient characteristics and geographical objects sufficient to make a well-known style recognizable – road network hierarchy, buildings, background. A test with Swiss data should be useful to evaluate visual effects of various geoprocessing practices.

Building new cartographic styles from existing artistic styles

The last approach consists in exploring visual arts in order to build new and artistic cartographic styles. Therefore, we analyze some art movements (what we know about movements and what we see on characteristics images of this movement) and some pieces of art (what we see on their images), extract main visual characteristics and provide guidelines to make maps inspired by this movement: guidelines are thus constitutive of a new artistic cartographic style. In this paragraph, we briefly present two of our research works implementing this approach.

A first research work concerns artistic cartographic styles inspired by famous Masters. We extract colors palette and colors composition rules from some paintings, characterized by powerful colors sets. This knowledge has been integrated to an automatic cartographic system COLorLEGend allowing users to handle and apply colors to their data, according to cartographic or painter composition rules, and to their preferences (Christophe, 2011). Figure 6 presents four possible maps according to cartographic and composition rules that could be made with a painting of van Gogh¹⁴. This method uses one image in input that is analyzed to extract colors and colors composition to build a style.

¹⁴ Vincent van Gogh, *La Chambre à Arles*, 1888, van Gogh Museum, Amsterdam, Netherlands.

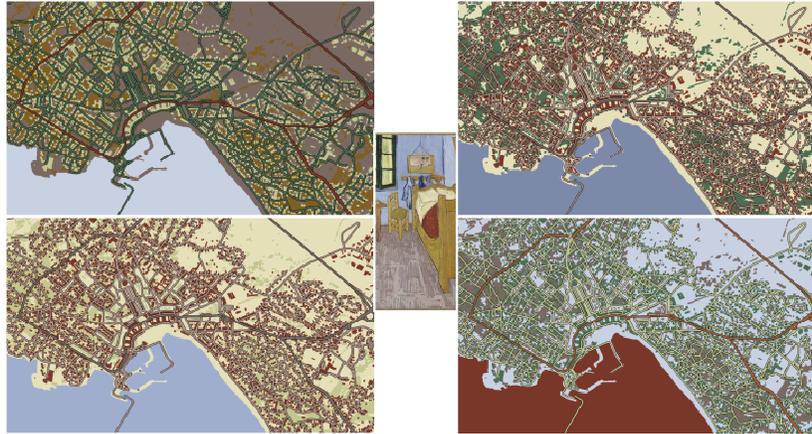


Figure 6. Some possible maps from a van Gogh's painting (Christophe, 2011)

A second research work concerns an artistic cartographic style inspired by an art movement, Pop Art, characterized by contrasted colors, Ben-Day¹⁵ dots, serigraphy effect and specific typography. We extract exhaustively visual characteristics from three inspiration images of Pop Art movement in order to build Pop Art maps: the guidelines we provide are constitutive of a Pop Art cartographic style. Figure 7 presents Pop Art maps that could be made with a given geographic dataset. This method uses several images in input that is analyzed to extract visual characteristics (colors, thickness, typography, coastlines) to build an artistic style.

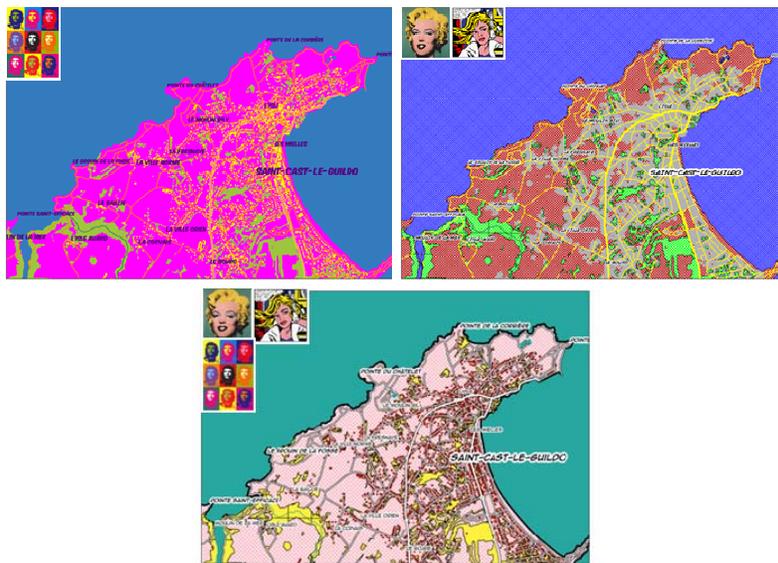


Figure 7. Three examples of Pop Art maps (Christophe et al, 2012)

These works highlight inspiration sources coming from visual art to build artistic cartographic styles. The first one mainly focuses on colors and colors contrasts to emphasize their visual impacts. The second one strengthens these colors and colors

¹⁵ 'Ben-Day dots' is a printing process coming from the illustrator and printer Benjamin Henry Day: it consists in colored dots closely or widely spaced, providing visual effects.

contrasts effects and emphasizes the visual impact of typography, dots as texture, relief effect thanks to serigraphy.

The two approaches described in this part allow us to highlight significant visual characteristics and objects participating to visually impact users.

Towards a model of cartographic style

In the previous part, we highlight main visual characteristics echoing various possible cartographic styles. With the help of these characteristics and of existing models of a map legend, our long-term purpose is the proposition of a model of cartographic style formalizing this complex concept; another issue consists in giving some implementation rules to make on-demand map systems able to generate maps with a specific cartographic style chosen by a user. Here we discuss about the complexity to build a model of cartographic style: which are the objects impacted by a cartographic style – the map, the data, the graphical signs, etc.? How could we formalize knowledge about use, practice, history, country, landscape that may impact a cartographic style?

Objects and methods impacted by a cartographic style

Several visual characteristics highlighted in the previous part could be integrated to the existing COGIT base map legend model (Hoarau and Mustière, 2011): cartographic styles may instantiate or modify existing graphical signs (colors, colors contrasts, thickness, hierarchy, shapes, sizes, dots texture, etc. related to *GraphicSymbol* in Figure 8). Nevertheless, applying a cartographic style is not only a matter of modifying classical visual variables: it may also imply some specific graphic designs. Figure 8 presents a simplified version of the COGIT map legend base model with the addition of methods for each object of the current legend base model. Directly on an existing map, general image processing – color filter, distortion, blur, transparency, watercolor effects, etc. – or addition of graphic elements overlapping the map or the key – drawings in the sea or in the map frame, drawn key, etc – may be proceed (see *blur()*, *addDrawings()* and *decorate()* methods on *Map* and *Legend* objects in Figure 8). Targeted geoprocessing on layers or objects – selection, generalization, schematization, line distortion, etc. (see *geomGeneralize()* and *geomSelect()* on *FeatureCollection* and *clip()* on *Feature* in Figure 8) – may also be proceed. It could also modify the rendering of one particular object or area in a layer, like distortion, schematization, emphasizing outlines and coastlines (see *distort()*, *schematize()*, *modifyOutline()*, *clip()* and *graphicGeneralize()* on *GraphicSymbol* and *graphicGeneralize()* on *SymbolizedFeature* in Figure 8). Finally, the typography and the clipping of toponyms may also be impacted by the style.

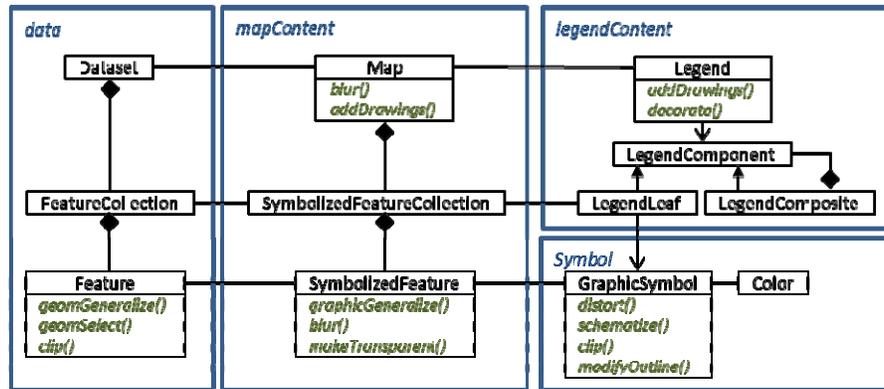


Figure 8. Examples of style methods (in green) on a simplified COGIT legend base model in UML (Hoarau and Mustière, 2011)

Formalizing knowledge about use, practice, history, landscape conveyed by a cartographic style

Other main visual characteristics we highlighted before concern knowledge about cartographic uses, conventions, practices and history, and then knowledge about related landscape for topographic maps. We think that this knowledge should be identified and classified, and after that, translated into rules in our model of cartographic styles. Knowledge about standards, cartographic history and cartographic practices of a national producer and of users may help us to formalize conventional and standard rules (for one country or worldwide), color schemes rules (each country has its own history and idea of efficiency of color schemes choices), contrast rules according to shapes and sizes of data (according thus to landscapes too), semantic rules (different relations between geographical objects). For instance, cartographic rules to preserve data have to be formalized: the visual result of the famous watercolor OSM base map is certainly surprising, beautiful and permits us to have another view of our worldwide data and Earth. Nevertheless, a main issue is at stake: the watercolor is a process thinning colors down, thus in our cartographic context, thinning geographical objects down involving disappearing or distortion, which is perhaps not the purpose of all users. Offering this kind of cartographic style is very important for users, only if provided with functionalities of evaluation and parameterization to preserve data according to their needs. However, we emphasize that rules are not intended to constraint mapmakers but to favor their creativity through inspiration sources from traditional to original cartographic practices and representations. Moreover, refinement is also encouraged to improve the expressivity of the maps.

Conclusions

This paper presents first results leading us towards a model of cartographic style to be implemented in cartographic systems. We highlight that cartographic styles should enhance creativity during maps design process and in final maps: it actually may help users to really fit their needs, preferences and intention. Then we propose to manage cartographic styles: however this concept is not formalized yet. Our purpose is to better define it with the help of two approaches, to identify styles from existing maps, and, to build styles from existing artistic styles. These approaches confirm and provide us

guidelines to formalize a cartographic style: we finally propose to add specific methods and rules to existing map legend models to be automatically able to manage styles.

Further work consist in working with research teams from Graphic Sciences to refine this proposition of model with specific graphic methods allowing us to make more expressive maps, and thus improving cartographic styles. Moreover, further analyzes are driven on the visual impact of the geographical dataset, its source, the geoprocessing that has been made on it, to go further on the visual impact of the data in comparison to the salient effect of symbols specification. Finally, users' experiments from various countries are planned to test our approaches in a larger scale, not only on topographic maps but also for instance on schematic or journalistic maps, in order to improve the definition and characterization of a cartographic style.

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