STRIKING VARIETY OF THE MOUNTAIN CHAINS APPEARANCE ON SATELLITE IMAGES PROVIDED BY GOOGLE EARTH

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Abstract: *In 2005 the Google search engine released an interesting web site named earth. For the first time we may watch the earth from above driving the scale of a satellite photomosaic of the globe at scale of perhaps 1:50 mln to 1:300 000 for a chosen place close-up. We can learn a lot and even make our own discoveries finding in the image things which are not represented in maps. We are also tempted to compare 'natural' color satellite images to maps and if we concentrate on mountains there are things worth noticing. Mountain ranges on images are more diverse than in maps which is obvious when we take into account the variety of vegetation and minerals on the surface. But on images we can also see better the unique forms and spatial arrangement of mountains. Photographic depiction is inspiring and helps to find a way between reality and its unrealistic models found sometimes in popular atlases. In this paper the images of several mountain chains carefully selected will be compared with traditional depictions. Advantages and disadvantages of 'photographic' depiction will be discussed.*

INTRODUCTION

The inspiration for this text was not only the Google Earth web site. It was also Tom Patterson's web site where I found two articles. One about Hal Shelton, the other about incompatibility of satellite images to cartgraphic conventions.

From 2005 in Google Earth web site one can find the image of the earth in natural colors as it was 'seen' from the distance of 700 km from Landsat 7 satellite during years 1998-2000. Natural colors applied in the image are not real colors but their simulation mathematically derived from two infrared channels and one green (742). Couple of thousand single scenes colected during 3 years were mosaiced seamlesly. The image is almost free of clouds and snow and only glaciers are visible on tops of high mountains. Exceptional manner of the image presentation is in short, the possibility of zooming from 1:50 milion scale to 1:300 000 and the possibility of rotating and tilting. This way the observer is not limited to view the image of the earth with North at the top orientation and straight from above. The image orientation and suitable perspective are selectable.

Apparently, during last several years the earth was so well photographed from satellites that making one image covering the earth’s surface became real. Till now four such images were created independently. In 1997 The Living Earth image with the ground resolution of 4.5 km was made from NOAA images.

Figure 1: The Living Earth (http://www.livingearth.com/)

In 2000 the Blue Marble Earth with 1 km pixel was mosaiced from Modis data, and from Landsat TM 7 scenes two global images with 15 m pixel were created: EarthSat Naturalvue and TerraColor.

Figure 2: Blue Marble Earth (http://earthobservatory.nasa.gov/Newsroom/BlueMarble/)

The EarthSat Naturalvue is now used by Google for web sites Google Earth and Google Maps. As the first two low resolution images are exposed in the web just to make the sell of the printed version, the NaturalVue presented by Google is fully tied to the internet and its modern style of presentation.

Figure 3: EarthSat Naturalvue (http://www.earthsat.com/HTML/naturalvue/)

Popularity of the world map in Google one could estmate as high if 30 milion responses come for the key words "Google Earth" and 55 milion for the key words "Google Maps". It might be the evidence that people want to see their house or place of planned holidays. But it is also possible that people are interested in how the earth looks like from height especially as there is no map to show it. The role of a general small scale map for several decades is played by physical map with hypsometric colors. Lately it is in competition with a simplified shaded relief map. The atlas editors approach their customers very economically. They sell the old maps together with few satellite images or put one satellite image on the cover.

NEW GENERAL MAP

It looks as if there was no new concept for the general map design for schools and popular atlases. Maps which would be related to nature to a greater extent than traditional physical maps. The problem is not solved by another versions of pleasing, colorful physical maps nor by modest in coloration maps with shaded relief. Both styles of representing the image of the earth are misleading because they seem to be so regular that can not be untrue. But they are true only within the limits of applied principles and moreover they encourage to careless generalization of the relief.

The idea of a new general map which would have the appearance of the real earth was well understood by XXth century cartographer Hal Shelton, to whom T. Patterson and N. Kelso dedicated an aeticle. His great achievments were never so popular as various versions of physical map with hypsometric colors. Regretingly Hal Shelton had no followers because his marvelous maps were inimitable and there was too litle will and patience to analyse his craft. Natural-color maps of Hal Shelton constitute a class for its own in map classification.

Tom Patterson himself is interested in a new general map which would fit in a class of his ‘Generalized Environmental Mapping', but he wants the map be based on a single rule easy to automate. However, if we consider what we have at our disposal in comparison to Shelton, we could think of a map demanding more effort from our side. Besides the great map patterns we have satellite images of the original, classified land cover data and digital elevation models and finally we have powerful computers.

The idea of such new map is challenging us especially if we think of portraying mountain areas which are most difficult to portray. The new general map one can imagine as a map of the earth's physiognomy i.e. its appearance from height. By the way, it is a wonder why the look of the earth's surface has not happened yet to be a subject of a map. Such a map deserves the name 'physical' more than any other as it would represent the earth physiké (in Greek) meaning nature (in Latin) or natural environment in the least controversial manner, which is the look of it.

Basing the general map design on any relation of arbitrary selected elements of the natural environment may lead to similar misunderstandings as it is in the case of hypsometric physical map. If the land on such a map is not to be white as on old chorographic maps, then the only equally neutral solution seems to be to show the land looking similarly to its real look. However, it is not a straight forward solution and there is much room for cartographic modelling. Actually, we do not know exactly what the real look of the earth is because even on satellite images there are applied different models of the 'real look' known as simulated natural colors. The Living Earth of NOAA is different from Blue Marble Earth of Modis and from one Landsat 7 satellite scenes two different images were composed, EarthSat Naturalvue and TerraColor.

Apparently, the look of the map is important not only for efficiency in transmiting a certain amount of information. The cartographer is also responsible for impressions created by his map on the users, for the manner he showed the world. As Daniel Montello noticed, maps made by cartographers can shape the cognitive maps of the people, moreover, 'map design is about the design of human cognition'. We may only imagine how responsible is the job of portraying the world on maps as for many students these maps may be the first and the most influential on their cognition of the world.

MOUNTAINS IN GOOGLE

For cartographers the lack of a contemporary, general map is a good message. In spite of having mapped and photographed the whole earth, there is still something to do in the area of modeling and presentation. The earth image in Google can not be a substitute for such a map as there is too much diversity of all kinds in it, but some excerpts from the image are inspiring. We can see how sufficient is natural shading to expose the variety of forms and how different landscapes are depicted with the use of a moderate color palette.

Watching the earth image in Google one can be fascinated upon discovering how differently can look the mountains in reality. Such experience is instructive for map makers in tempering their disposition to ease the job when depicting mountains. Actually, not all examples can serve as patterns at all scales, specially when smaller ranges disappear at scale 1:5 million. Most interesting are close-ups at scale of about 1:500 000.

Fig. 4. Altay Mountains at scale ca. 1:5 000 000 and the enlarged section at scale ca. 1:500 000 (courtesy of Google Earth)

What strikes one in the image of mountains is the clearly visible shaded relief and the palette of colors unusual for maps. Besides Hal Shelton, no one could depict the mountains like this, however, even he could not allow himself to use colors so freely as the nature does.

Fig. 5. Himalaya Mountains, excerpt at scale ca. 1:500 000 (courtesy of Google Earth)

Amazingly visible are the valleys. Viewing the image we can see clearly that mountain areas consist not only of mountain chains but also of valleys which are not so apparent on popular small scale maps. Some valleys in the image look more distinct because of color contrast between green forests and mountain tops in beige.

Fig. 6. The Alps and The Caucasus Mountains at scale ca. 1:5 000 000 (courtesy of Google Earth)

Mountain areas, cut by apparent valleys look in images different than on maps. On physical maps with hypsometric colors the whole mountain area is orange, on shaded relief maps the area has several gray tones. Consequently, the mountains in the image occupy less space but their structure can be seen more easily. The structure is still enhanced with white outline when the tops of some higher mountains are covered with snow or ice. Mountain areas appearing as a system of chains and blocks are easier to perceive and understand. Their look is also better related to the real character of the location.

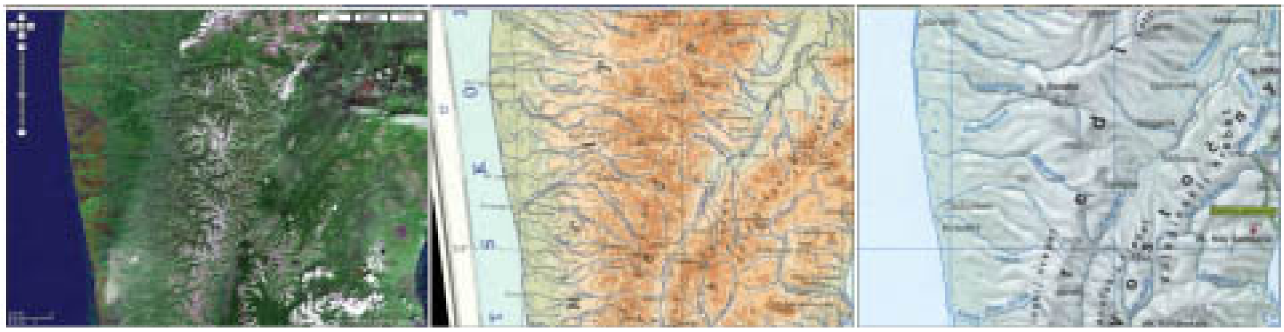

Fig. 7. Sredinnyj Hrebet on the Kamchatka Peninsula, excerpt at scale ca. 1:5 000 000 (courtesy of Google Maps, The World Atlas Moscow, Nowy Atlas Świata GeoCenter)

Mountain systems appear in images as different spatial structures. They are composed from isolated mountains or they form chains separated by passes or they are made of ridges.

Fig. 8. The Olutorskij Hrebet, The Alps and The Atlas Mountains, excerpts at scale ca. 1:500 000 (courtesy of Google Maps)

The mountains themselve are shaped in different way with the tops sharp or flattened and smooth.

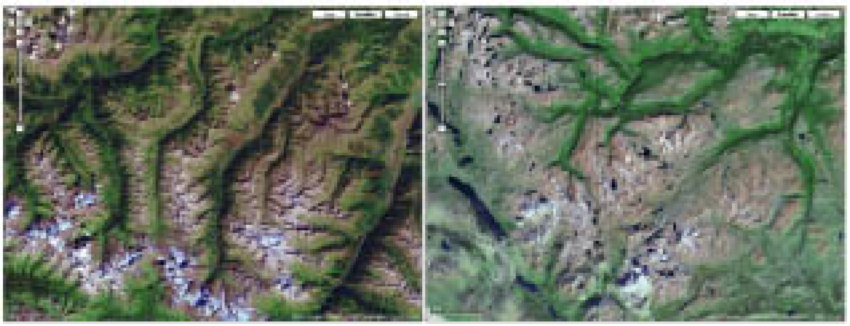

Fig. 9. The Caucasus Mountains and The Scandinavian Mountains, excerpts at scale ca. 1:500 000 (courtesy of Google Maps)

Besides the form there is vegetation which makes the variety of mountain appearance in satellite images. It is the presence of vegetation or lack of it that amazes the observer with sometimes strange combination of colors.

Fig. 10. The Andes, The Himalaya, The Himalaya, excerpts at scale ca. 1:500 000 (courtesy of Google Maps)

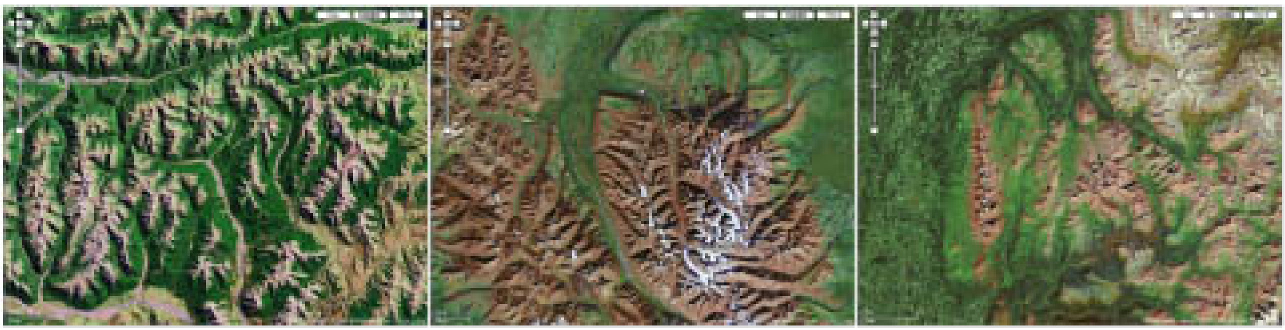

Fig. 11. The Southern Alps, The Cherskiy Range, The Ural Mountains, excerpts at scale ca. 1:500 000 (courtesy of Google Maps)

CONCLUSIONS

Google Earth with its sophisticated method of presentation deserves the name of a World Atlas of the 21st century. For the first time one can see how the earth looks like from far and close at any location, in chosen tilt and orientation. It is very educative and very cartographic, in spite of being based on an image instead of a map.

From a cartographic point of view a natural color image of the earth may be regarded as the raw data set for a new physical map showing the earth's physiognomy. It is high time to review the rules of generaization and allow for more details in depicting the mountains on small scale maps.

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5. URL: http://maps.google.com/

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Jacek Drachal was born in 1954, graduated in 1978 from the Warsaw University of Technology with a Master of Science in Photogrammetry and Cartography. Since 1978 employed at the Institute of Geodesy and Cartography, Warsaw, Poland, first at the department of Remote Sensing then at the department of Cartography. In 1991 PhD degree for digital image processing applied to cartography. Experience in Cartography, Remote Sensing, Photogrammetry and Digital Image Processing. Software Expertise in Intergraph Microstation and image processing systems of OVAAC8, Intergraph, Adobe, PCI and Erdas. Publications, mainly in Polish scientific journals, concern scanning and processing of satellite images, the resolution and legibility of remote sensing digital images and the application of cartographic design to photomaps. Author and co-author of several satellite image maps of Warsaw at scales 1:25000, 1:50000 (two awarded for innovative technology and design), road atlas of Poland at scale 1:250000 (5 editions), tourist photomaps of Slowinski National Park and Polish Tatra at scale 1:20000. Member of ICA commissions on Mountain Cartography and Mapping from Satellite Imagery. Consultant in several international projects in Algeria (1985), Iraq (1985), Belgium (1992, 1993, 1994) and China (1997). His research interests include digital cartography, application of remote sensing to natural resource mapping, photographic maps..