Virtual Cilicia Project

How to use Google Earth as a visualization environment in an archaeological context

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Abstract

Over the past few years, archaeology has experienced a rapid development in geophysical prospection and remote sensing techniques. At the same time, the focus of archaeological research has shifted to landscape development and human interaction. To impart the results, new methods and techniques are necessary. Virtual globes such as Google Earth offer fascinating methods of giving interested amateurs the possibility to interactively explore ancient cities and landscapes. Thanks to the increasing usage of GIS in cultural heritage, the implementation of interactive three dimensional learning opportunities becomes less and less tedious, but the non-linear narrative story telling medium demands for a special adaption of the content. This paper summarizes the experience gained during the realization of the "Virtual Cilicia Project" and outlines the future potential of virtual globes in the field of cultural heritage.

1 Visualizing Archaeological Data using Virtual Globes – Potential and Challenges

The Virtual Cilicia Project[1] (s. Fig. 1) has been created to develop new methods to present the results of archaeological surveys and excavations not only to experts but also a wider audience. On the one hand, it is necessary to raise the awareness of the importance of cultural heritage sites, but on the other hand, the protection of cultural heritage causes high costs. Therefore the "sponsors" – often the taxpayers – have the right to be informed about the results of the conducted work in an appropriate manner. The use of new media offers the possibility of addressing the demands of a lay audience by choosing a more visual approach for the representation of archaeological research. Integrating results in a larger context can even provide additional value for experts too. Presenting data within virtual globes such as Google Earth[2], NASA WorldWind[3] or Marble[4] offers a wide range of different possibilities for a better understanding of archaeological records and findings within their geo-historical context. Unlike printed maps, virtual globes offer almost unlimited possibilities to adopt scale, level of detail and the density of information. Therefore, the user can benefit by choosing the adequate complexity of information and may explore an archaeological site, landscape or even region, interactively following his own desire. At the same time, this unguided user experience requires new narrative techniques and methods. Printed articles with a linear narrative structure have to be adapted according to the special requirements of the virtual globe: information should be provided in short standalone texts, referring to other sources with definitions and background information. The content should be created in an open data format such as KML, which may be used for future applications such as Web-GIS. Virtual Globes also allows the easy integration of existing 3D-models within a wider city or landscape.

[1] http://www.arch.unibe.ch/virtual-cilicia
[2] http://www.google.com/earth/
[3] http://worldwind.arc.nasa.gov/
[4] http://marble.kde.org/

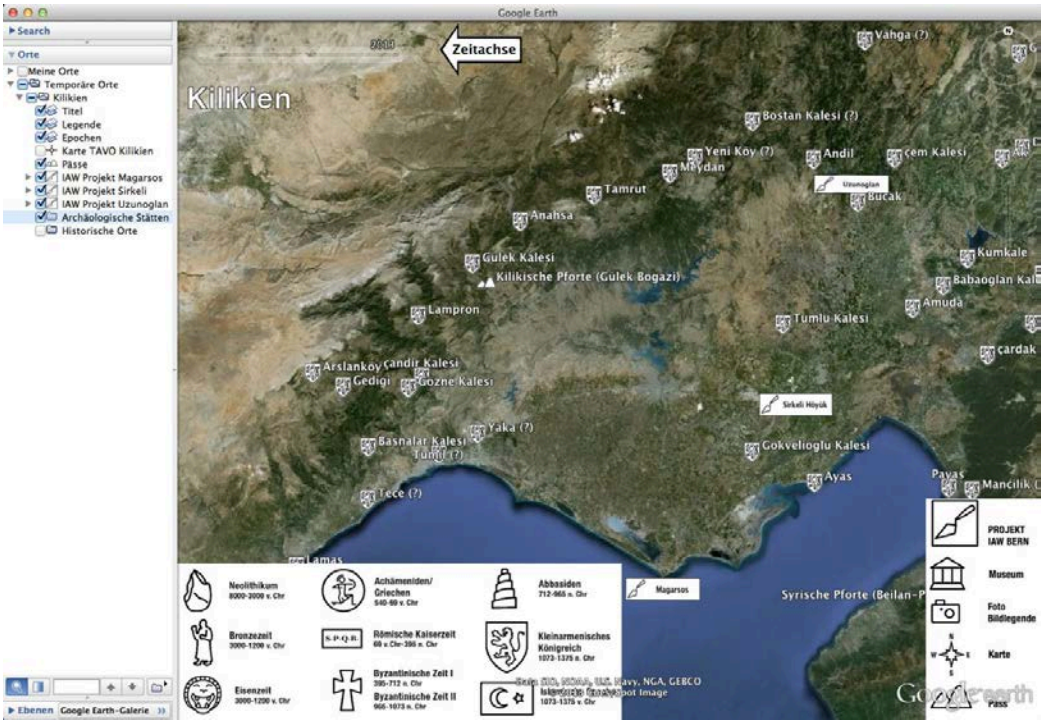

Fig. 1: Virtual Cilicia Project, Overview user interface

2 Case study: Historic development of Plain Cilicia (Turkey)

For several thousand years the alluvial Plain Cilicia (lat.: Cilica Pedias, s. Fig 2) constituted an important settlement cluster at the joint of Anatolia and the Levant[5]. This extremely fertile and strategically very important landscape is characterized by a sharp contrast of a vast plain enclosed by the steep mountains of the middle Taurus and Amanus. Traders and armies had to cross the mountainous ridge of the Taurus for millennia before passing the Cilician Plain on their way from Central Anatolia to the Levant and the Fertile Crescent.

Since 2005 the Institute for Archaeological Sciences at the University of Bern[6] has participated in a research cooperation with the Istanbul Üniversitesi and the Onsekiz Mart Üniversitesi Çanakkale. A particular focus is thereby placed on the combination of large-scale remote sensing[7] (using optical and SAR satellite imagery[8]) and exemplary investigations of prominent sites.

[5] Hild et al. 1990, Novák 2010, Ünal et al. 2007
[6] http://www.arch.unibe.ch/kilikien
[7] Lasaponara et al. 2011, Parcak 2009, Wiseman 2007
[8] http://www.arch.unibe.ch/tandem-x

These historical sites along the Pyramus differ in their function:

- Uzonoglan Tepesi[9], a hilltop sanctuary with a roman temple at a position overlooking the hole Cilician Plain and first marked with an Neo-Assyrian rock relief
- Sirkeli Höyük[10], a Bronze and Iron Age settlement mound at a geostrategic key-position at the end of the navigable extent of the river, close to the Misis mountains
- Magarsos[11], a heavily fortified Hellenistic harbor site located at the Cape Karataş

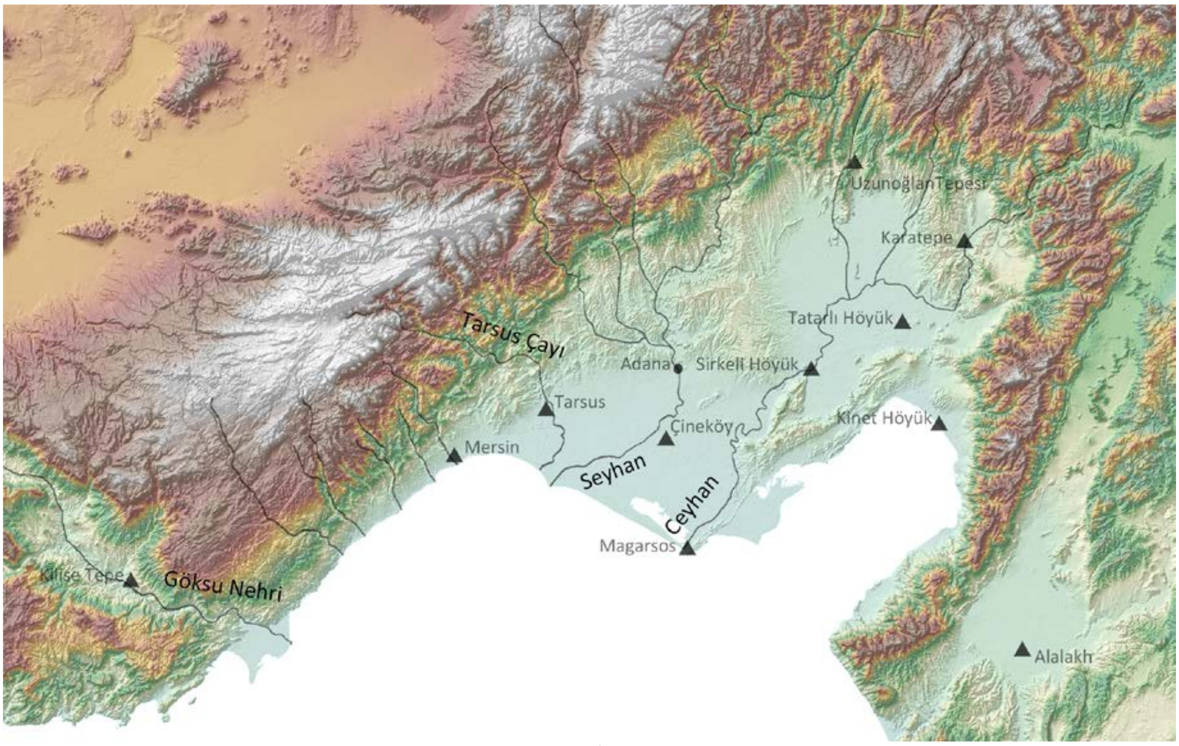

Fig. 2: Map of Plain Cilicia

As part of a seminar on archaeological plans and maps at the Institute for Archaeological Sciences of the University of Bern in 2011, the students began working on a Google Earth[12] application as a case study to experience the potential of virtual globes in research, teaching and knowledge transfer. This ongoing work offered the opportunity to develop a best practice approach by analyzing reference projects (such as ANE Placemarks[13], ArchAtlas[14], HyperCities[15], Megalithic[16]) and trial and error. After two years, the Virtual

[9] Rosenbauer 2009
[10] Ahrens et al. 2008, Ahrens et al. 2009, Ahrens et al. 2010
[11] Rosenbauer 2007, Rosenbauer 2011
[12] Dodge et al. 2008, Myers 2010
[13] http://www.lingfil.uu.se/staff/olof_pedersen/Google_Earth/
[14] http://www.archatlas.org
[15] http://hypercities.com

Cilicia Project contained about 50 place marks with descriptions, images and references of archaeological sites, from Neolithic to modern times. At Sirkeli Höyük, Uzunoğlan Tepesi and Magarsos (s. Fig. 3), the sites of major projects of the institute for Archaeological Sciences, and details like map overlays, photographs and a SketchUp[17] 3D model (s. Fig. 3) are implemented.

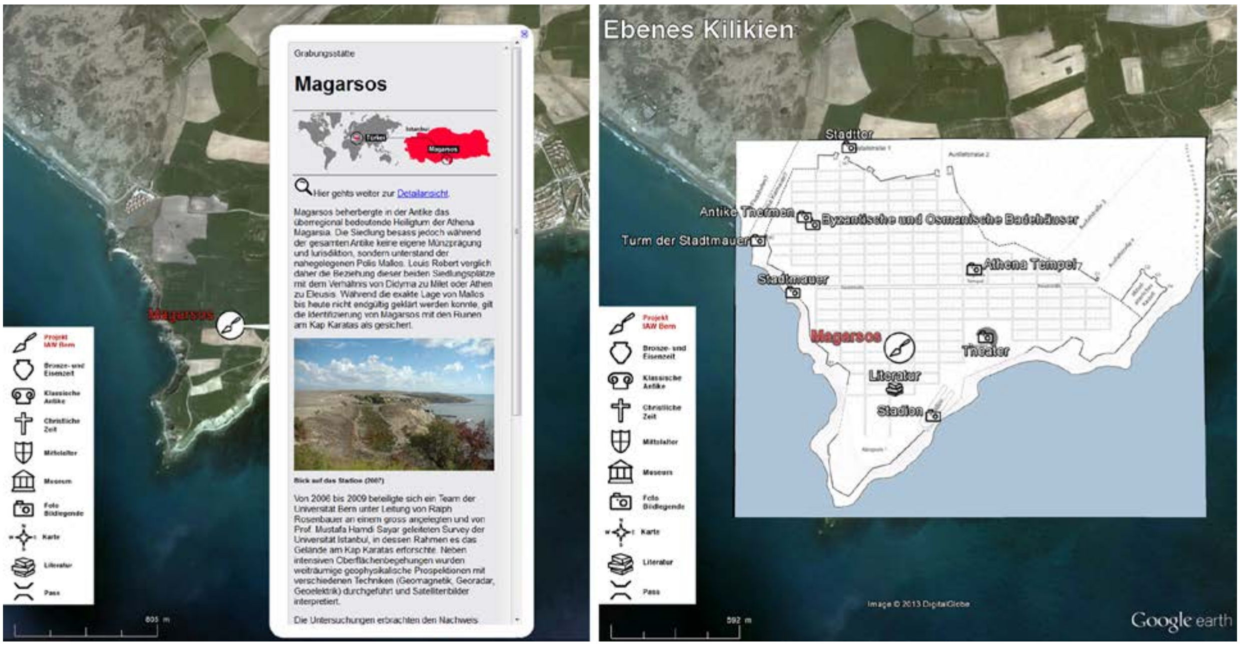

Fig. 3: Virtual Cilicia Project, Magarsos

With the integrated timeline in Google Earth the user can choose different points in time and timespans to select different historic constellations, giving vivid impressions about the settlement patterns and transformation processes (s. Fig. 1). The appearance of the placemarks and text balloons is created according to the corporate identity of the University of Bern (colours, font, formal aspects) resulting in a clear visual structure. To apply the corporate identity design to the code of the KML[18] files, and to quickly adapt design changes, cascading style sheets (CSS) and template files were used. The information elements are divided into different categories with distinctive icons. The past 10,000 years were subdivided into ten periods according to an established chronology, and distinguished by characteristic icons (s. Fig. 4). For each site, the time of occupation is stored in the database.

[16] http://www.megalithic.co.uk
[17] Tal 2009, http://www.sketchup.com
[18] Wernecke 2009

Fig. 4: Virtual Cilicia Project, icons

3 Current limitations, drawbacks and challenges

The presentation of projects in Google Earth currently suffers from three drawbacks: file size, client version and the elevation model. The size of files containing image overlays or 3D models can have a negative impact on the usability. The time required for the initial download can drive potential users away. The rendering of KML elements and HTML styles depends on the locally installed version of the Google Earth client or the browser API plugin. A further limitation is the elevation model used by Google Earth in large regions of the world with a relatively coarse profile. For example, the hill at Uzunoğlan Tepesi is in reality a few meters higher and a little wider than suggested by the model. This causes a serious problem for the seamless integration of the 3D-model into the scenery (s. Fig. 5).

The functionality provided by the Google Earth client to create presentations is very limited: only single placemarks and simple geometric features, such as lines and polygons, can be created and raster imagery to maybe used as overlays. For every element, the editing tools offer only basic functionality and are not suited for complex geometrics. But the main shortcoming is the lack of a handy project management. But the aforementioned limitations are caused by current technical issues and are not methodic problems. So, future versions of virtual globe software may hopefully lessen these issues.

Fig. 5: Virtual Cilicia Project, 3D Modell Uzunoğlan

4 Outlook

The combination of up-to-date high-resolution satellite imagery (provided by Google Earth), additional geographic data sources and photographs (such as Panoramio) enlightens various aspects of physiographic relations and offers a very vivid impression of landscapes and sites. Since virtual globes are being considered as an open platform, and the range of different data sources is supposed to grow enormous within the next years, additional potential is on the horizon: different data sources may be used at the same time allowing easy comparison of different localizations and reconstructions of sites. The XML based keyhole markup language (KML) permits the easy compilation of heterogeneous data sources. As a well-defined official OGC (Open Geospatial Consortium)[19] standard, it grants long time support and promises good future prospects. For the future we see a big chance for a crowdsourcing approach to generate and propagate geo-data. Therefore standalone applications or content management systems with user-friendly and comfortable interfaces have to be developed and made available to

[19] http://www.opengeospatial.org

the public. In some aspects, this situation is comparable to the limitations for HTML content before the dawn of the web 2.0.

Currently, team members involved in the creation of the "Virtual Cilicia Project" are helping to develop a content management system for chronological placemarks. The aim is to create a multi-project collaboration tool tailored to the needs of history enthusiasts and suited to crowd-source the generation of content (s. Fig. 6).

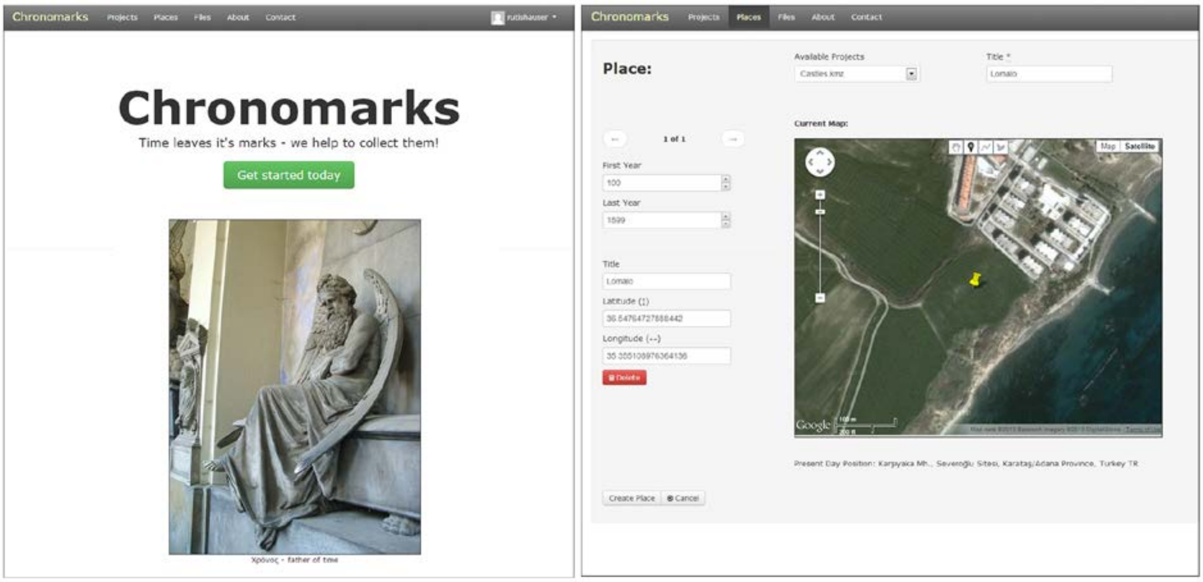

Fig. 6: Chronomarks, a KML CMS in development

For the future we expect ongoing integration of different geospatial techniques and methods, such as (web-) GIS, place mark collections, georeferenced interactive presentations and animations. It is hard to predict the exact direction of the development, but with no doubt, we will see a steady increase in the use of spatial data in the future. Once introduced, the spatial information may not only be used for visualization, but also for spatial analysis and complex modeling, therefore generating new questions and evidence for future research.

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