Virtual globe visualisations to improve public engagement with an urban fringe landscape: Gaywood Valley Project, Norfolk, UK

Harwood, A. R.[1], Lovett, A. A.[1], Turner, J. A.[1]

[1]School of Environmental Sciences, University of East Anglia, Norwich Research Park, Norwich, NR4 7TJ. United Kingdom.
Tel: +44 (0)1603 591353 Fax: +44 (0)1603 591327
amii.harwood@uea.ac.uk

Summary:
Virtual tours were produced using Google Earth as a platform to actively engage the public with spatio-temporal information. These tools were developed in the scripting language KML and were augmented with HTML and COLLADA three-dimensional models. They were made available on the Internet for public download. Tours encompassed information on landscape characteristics, accessible greenspace and walks, as well as providing a guide through educational data such as geological outcrops and past climates. This research contributed to a wider project aimed at increasing the awareness and use of a river valley which is currently under-utilised by both urban and rural communities.

KEYWORDS: Google Earth; KML; virtual tours; Google SketchUp.

1. Introduction

Three-dimensional visualisation of a place on Earth using a virtual globe offers more interactive possibilities than traditional static 2D mapping. Virtual globes can help users interpret their present environment and plan for the future (e.g. Sheppard and Cizek, 2009; Pettit et al., 2011); they can also provide a window into the past, e.g. through geological modelling (De Paor and Whitmeyer, 2011). Furthermore, users of virtual globes can be made aware of spatial trends and implications while not explicitly realising they are being educated (Patterson, 2007).

As part of the Gaywood Valley Sustainable Urban Fringes (SURF) Project an innovative set of virtual globe visualisations were commissioned to help raise awareness and use of the local landscape by neighbouring communities. These tools are now available to download from a University of East Anglia- (UEA) hosted website (http://www.uea.ac.uk/env/research/reshigh/gaywood, accessed November 2011). For more information on the SURF partnership and the background to the Gaywood Valley Project, the reader is referred to the official website (http://www.sustainablefringes.eu, accessed November 2011).

2. Research themes and data sources

Google Earth was selected from of the available virtual globes (e.g. NASA World Wind, Microsoft Bing Maps, ESRI Arc Explorer, see review in Tuttle et al., 2008) because it is freeware and arguably the market leader. It also has a comprehensive support network. Keyhole Markup Language (KML) was used to render geographic data and auxiliary information. A comprehensive discussion of basic KML is provided by Wernecke (2009).

Three research themes were established through consultations with core members of the Gaywood Valley Project. These themes included physical attributes of the catchment and changes through time.

At the start of the Project there was an absence of publicly available information about Gaywood Valley, certainly there was no centralised reference source. A GIS was used to collate information and generate new spatial data e.g. on points of potential interest to local communities.

1. Introduction to Gaywood Valley

The first theme gave an overview of the catchment, the river and places that may be recognisable by the end user. The user is taken on a virtual tour from the river source to the mouth at the port of King's Lynn, Norfolk. Key points of interest are highlighted and described. Information was gathered from consultation with members of the Gaywood Valley Project and collated from numerous online sources and official websites.

2. Geology and Past Climates

The Geology and Past Climates tour was designed to help users appreciate the link between the types of rocks that outcrop at the surface, their changes with depth and the time period and conditions under which they formed. Key data sources were: the British Geological Survey (http://www.bgs.ac.uk/data/services/kml.html, accessed November 2011) and the Norfolk Geodiversity Partnership (2010).

3. Green Infrastructure

The final tool focused on showing users how to get out into the valley by displaying public rights of way, cycle routes, health walks and accessible greenspace. The majority of data were obtained from Norfolk County Council (NCC).

3. Tool development

3.1 Basic conversion of GIS data into KML

At a basic level, Google Earth can be used to view satellite and aerial imagery of the catchment. Thematic layers can then be draped over the surface of the globe as 'ground overlays' and locations on the globe, specified by a longitude and latitude, can be marked with an icon (these are known as 'placemarks'). GIS data were converted into a format compatible with Google Earth (KML) using ESRI's ArcGIS. Placemarks were also digitised directly in Google Earth. Custom icons were used and placemark balloons were enhanced with HTML coding for formatting, colour scheme, hyperlinks and photographs (Figure 1).

3.2 Three-dimensional models

The full abilities of KML are not unlocked without linking the virtual globe with COLLADA 3D models (De Paor and Whitmeyer, 2011). COLLADA is the scripting language of Google SketchUp and, like KML, also be viewed and edited in a text editor.

Several 3D models were created in Google SketchUp by drawing and extruding shapes. These included the ruins of a church, a geological cross-section, an arrow showing the long axis of the Gaywood Valley and an arrow depicting the direction that glaciers moved across the catchment. The models were exported from SketchUp as KMZ files. KMZ files are compressed folders that can be read by Google Earth. In this case they contained a COLLADA model (*.dae) and an associated KML file that would open the model in Google Earth. Using Network Links (Wernecke, 2009) these KML files could be linked to other KML files in the same theme.

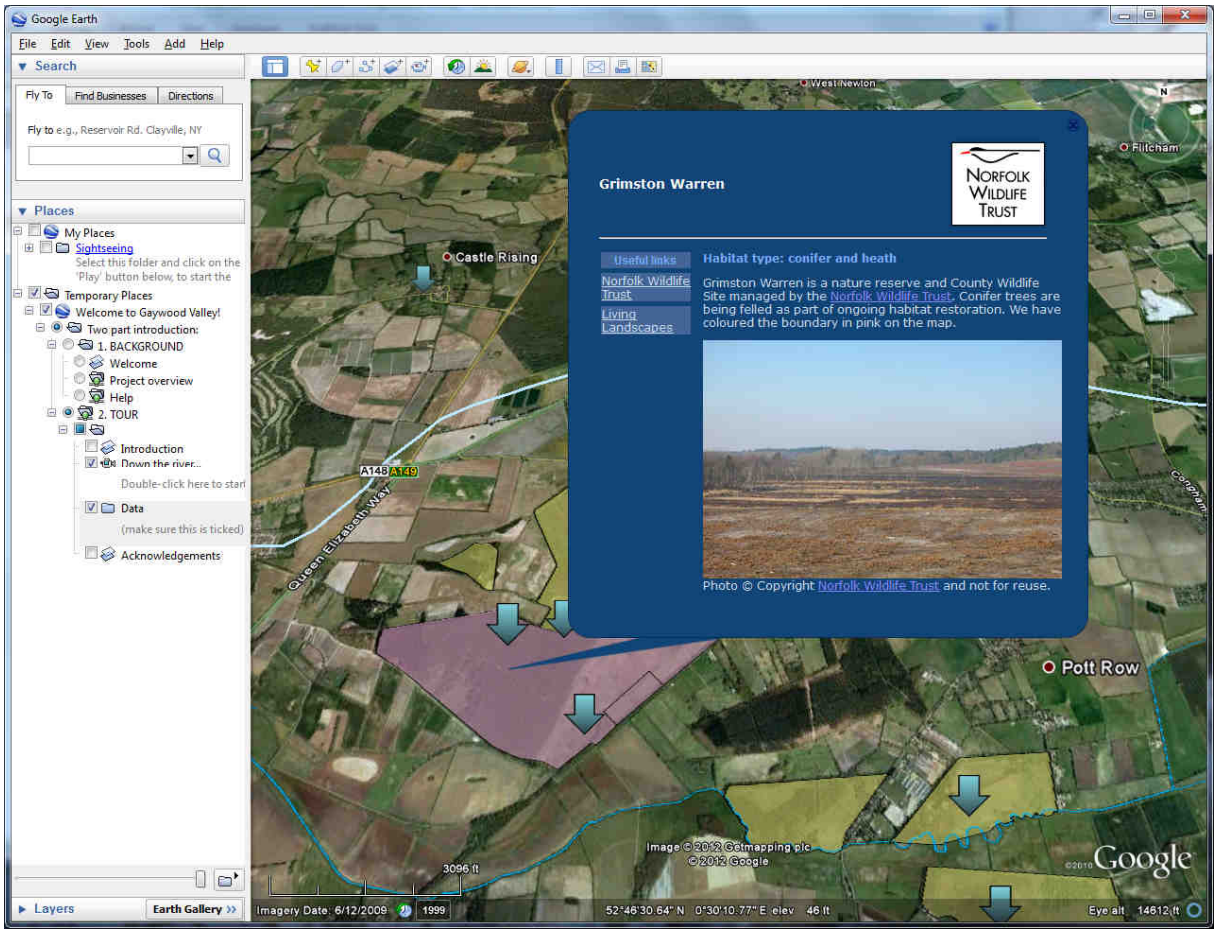

Figure 1. Custom arrow icons are placemarks with custom balloons coded in HTML.

3.3 Touring and animation

Tours were not only used to move the user around the Gaywood Valley. A combination of different camera angles, pauses, screen overlays and moving 3D models provided an engaging experience for the user. A complete on-screen narrative was provided for the Introduction and Geology tours. These narratives included user instructions supplemented by a series of screen overlays which explained the other information shown on the screen (see Figure 2). However, users could also leave or pause the tour and explore the virtual globe and layers for themselves, at their own speed.

Several of the 3D models created in SketchUp were initially given a negative altitude so that they were not visible. A model could be updated to rise to a new altitude over a fixed duration of time; therefore models could appear slowly from the ground (e.g. Figure 2).

The appearance (and disappearance) of screen overlays and the movement of models were controlled using ‘AnimatedUpdate’ tags in the KML of the tour.

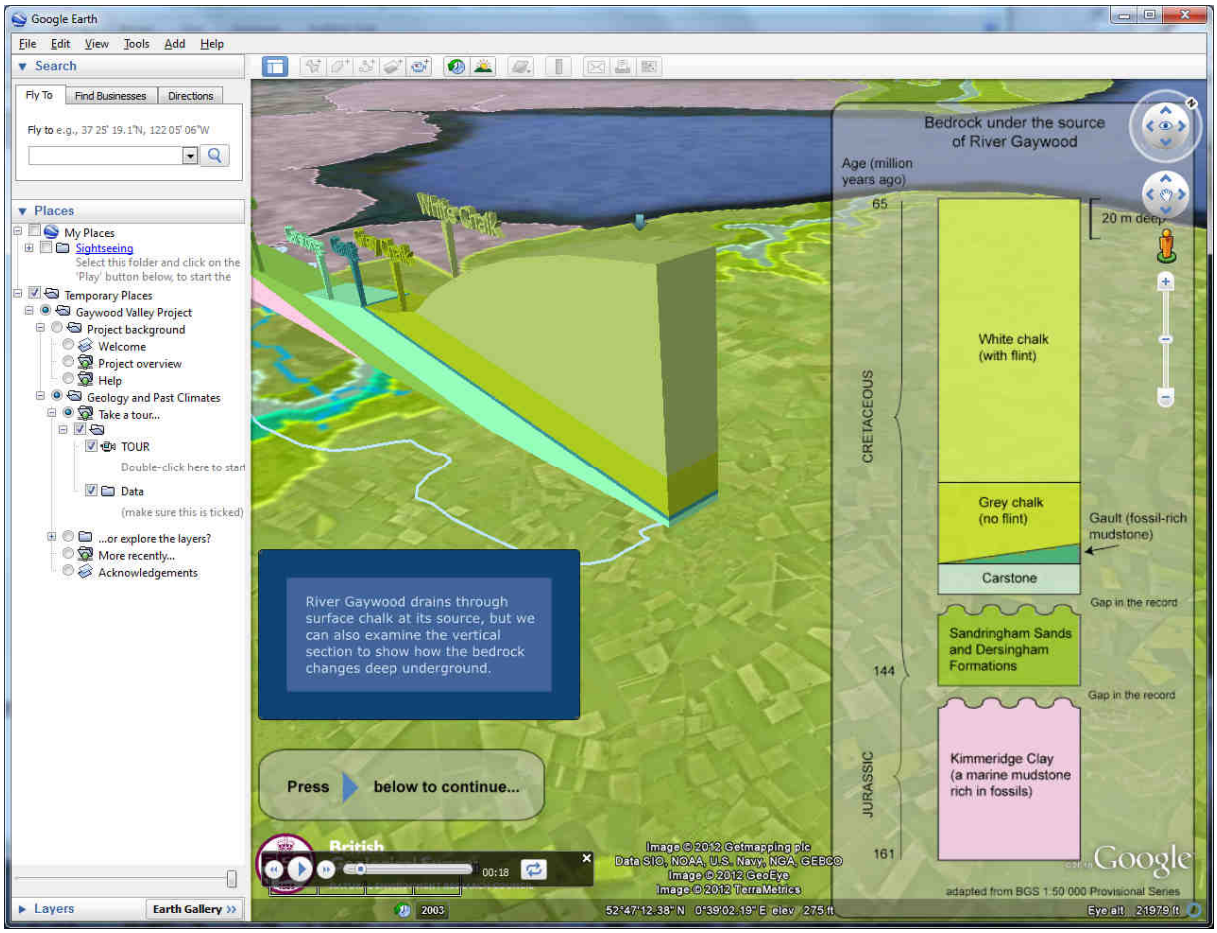

Figure 2. The Geology and Past Climates Tour has a combination of ground overlays, screen overlays, placemarks and 3D models; these work together to form a narrative for the end-user.

4. Evaluation

Evaluation of the uptake of this research is in progress at the time of writing. The first step has been to produce three deliverables (KMZ files) which are being used by members of the public. Over three-hundred visits have been made to the KMZ download website in the first three months since it's unveiling.

The public launch of the Gaywood Valley Project in May 2011 allowed testing of near-complete virtual globe tools. In this first outreach session, a public demonstration was given and a passive version of the Introduction to Gaywood Valley tour was shown. UEA researchers were available to answer questions and receive informal feedback from members of the public and town council. These tools are also being tested at several events with primary school children. Supplementary worksheets and other teaching materials have been developed for this purpose.

5. Conclusions and future research

- This is an academic research project where a set of deliverables have been produced and are currently being used to engage members of the public with the landscape on their local urban fringe.
- The three Google Earth tools can be utilised by different age groups and the extent of interaction can be controlled by the user.

- It is the network links between KML files, screen overlays, placemarks, 3D models, time-sliders and tours that are particularly powerful when combined to form a narrative and make this project innovative.
- The techniques described in this paper have potentially much wider uses in environmental science education and also as a mechanism for the dissemination of scientific research.

6. Acknowledgements

This research was funded by the Gaywood Valley Sustainable Urban Fringes Project which is supported by the Interreg IVB North Sea Region Programme and is partly funded by the European Regional Development Fund. Data were obtained from NCC, BGS and the Norfolk Geodiversity Partnership. Special thanks to Gemma Clark at NCC, Tim Holt-Wilson at the Norfolk Geodiversity Partnership for geological advice and Lauren Parkin for creating initial drafts of the teaching materials. This project has also benefitted from helpful comments by Richard Treves.

7. References

De Paor D G and Whitmeyer S J (2011). Geological and geophysical modelling on virtual globes using KML, COLLADA and Javascript. *Computers & Geosciences*, 37(1), 100-110.

Norfolk Geodiversity Partnership (2010). *Norfolk's earth heritage*. Norfolk Geodiversity Partnership. Norwich, 74pp. Available for download from: http://www.nbis.org.uk/gap, accessed November 2011.

Patterson T C (2007). Google Earth as a (not just) geography education tool. *Journal of Geography*, 106(4), 145-152.

Pettit C J, Raymond C M, Bryan B A and Lewis H (2011). Indentifying strengths and weaknesses of landscape visualisation for effective communication of future alternatives. *Landscape and Urban Planning*, 100(3), 231-241.

Sheppard S R J and Cizek P (2009). The ethics of Google Earth: crossing thresholds from spatial data to landscape visualisation. *Journal of Environmental Management*, 90, 2102-2117.

Tuttle B T, Anderson S and Huff R (2008). Virtual globes: an overview of their history, uses, and future challenges. *Geography Compass*, 2/5, 1478-1505.

Wernecke J (2009). *The KML handbook: geographic visualisation for the web*. Addison-Wesley, Upper Saddle River, NJ 368pp.

8. Biography

Dr Amii Darnell is a Senior Research Associate at the University of East Anglia, Norwich. Amii has a BSc in Environmental Earth Science and postgraduate qualifications in Geographical Information Science (PhD, 2010). Her research interests include: error and uncertainty in spatial models and GIS as an aid to decision making. Professor Andrew Lovett is a Professor of Environmental Sciences at the University of East Anglia with a particular interest in the use of GIS for environmental decision making and landscape visualisation. Dr Jenni Turner is a lecturer in Earth Sciences at the University of East Anglia, with research interests in tectonics, sedimentology and Quaternary palaeoclimates.