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Research paper

Customising virtual globe tours to enhance community awareness of local landscape benefits

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HIGHLIGHTS

- Virtual globes can help raise public awareness of local landscape benefits.
- Virtual globe applications can be customised to describe landscape features better.
- Collaboration with many stakeholders from project outset brings significant benefit.
- Schoolchildren are confident users of virtual globe visualisations.
- Compartmentalisation aids modification and transferability of visualisation tools.

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ABSTRACT

Our wellbeing depends upon the services provided by ecosystems and their components. Despite recent advances in academic understanding of ecosystem services, and consideration in UK national environmental policy, a greater awareness is needed at community and individual levels. Dynamic features of virtual globe applications have considerable potential for helping convey the multi-dimensional context of ecosystem services and promoting general awareness. In a case study targeting residents in a small urban fringe river catchment in Norfolk, UK, representatives from local authorities and responsible agencies collaborated with scientists to produce extensive customisation of virtual globes in this context. By implementing a virtual flight over the catchment, different views and scales are traversed to set the context for landscape features and ecosystem services. Characteristic sites, e.g. supplying cultural services, are displayed and relationships with the natural environment are explained using linked on-screen text. Implementation is cost-effective and described for practitioners in ecosystem and landscape management, who may be inexperienced in landscape visualisation. Supplied as three pre-packaged virtual tours, products are made available for download and are publicised at a variety of engagement events, including teaching events with schoolchildren. The tours have attracted public interest and generated positive feedback about improving knowledge of local natural assets. Schoolchildren show confidence with the interface, but supplementary problem based activities can improve learning opportunities. The capacity of virtual globes to support more participatory involvement of the public in local ecosystem management may increase in the future, but such visualisations can already help promote community awareness of local landscape benefits.

1. Introduction

1.1. Individual and community awareness of landscape benefits

Human well-being is inescapably tied to the natural environment. A landscape unit, such as a river catchment, can regulate the flow of water, provide crops and livestock, support nutrient cycling and supply landscape features for aesthetic enjoyment (e.g. Maltby et al., 2011). The benefits that humans obtain from the natural environment have been formalised in academic publications

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and government documents as 'ecosystem services' (e.g. Fisher, Turner, & Morling, 2009; Millennium Ecosystem Assessment, 2005) and this approach and nomenclature is gaining traction with decision makers and stakeholders (e.g. Potschin, Haines-Young, & Fish, 2011).

As natural and anthropogenic stresses continue to threaten the ability of the natural environment to maintain ecosystem services, a greater societal consciousness about human dependencies on terrestrial, freshwater and marine ecosystems is desperately needed. There have been great advances in academic understanding of the state of the natural environment and its value to society, for example through the pioneering work of the United Kingdom National Ecosystem Assessment (UK-NEA, 2011). Other countries – including Spain, Germany, Israel and the United States – are at different stages of developing similar ecosystem assessments. Adopting an ecosystem service approach to policy and decision making is a pragmatic way to examine the links between ecosystems and human well-being and to promote sustainable use in an equitable way. A range of actors, however, from national governments to individuals and communities, need to play roles in the initiation and implementation of responses to secure and improve the future delivery of ecosystem services.

An individual can act as a participant in the landscape, a processor of information from the landscape and a performer of biological and physical change (Zube, 1987). Such an individual, however, may be unaware of these roles and their potential to conflict with, or enhance, underpinning landscape structures and processes. While society has some appreciation of the benefits that the natural environment provides through the supply of food and clean water, environmental settings which deliver recreational opportunities (Brown, Montag, & Lyon, 2012), and even sequestration of carbon to mitigate climate change (Wild & McCarthy, 2010), a greater awareness at individual and community levels is needed to raise understanding of environmental assets and their value (UK-NEA, 2011). In a UK-government commissioned qualitative study, a stratified socio-demographic sample of respondents understood the concept of 'ecosystem services' but did not find the terminology useful without new evidence and reasons to listen (Defra, 2007). While the UK-NEA improved the evidence base at a national level, particularly with reference to ascribing value, this new knowledge has not filtered to public documents and vocabulary. Whether formal terminology is used or not, it is important for individuals to recognise that the natural environment delivers a flow of societal benefits that can be both tangible (e.g. drinking water) and intangible (e.g. aesthetic enjoyment).

1.2. Potential for promoting awareness through visualisation

Raising environmental awareness is an important first step towards increasing voluntary actions and community participation in decision-making. Digital landscape visualisation is a device with considerable potential in this context. As noted by Sheppard (2012, p.403), visualisations can "help people to know, see and recognise what was previously vague, abstract or hidden" which makes them particularly relevant for increasing public appreciation of ecosystem services. One of many remaining challenges in integrating the concept of ecosystem services in everyday landscape planning, management and decision-making, is the definition of appropriate visualisation techniques (de Groot, Alkemade, Braat, Hein, & Willemen, 2010).

Visual representations (maps, images and computer graphics) are powerful means of conveying landscape characteristics and can provide a common language in discussions on planning issues between technical and non-technical participants (e.g. MacEachren & Brewer, 2004; Sheppard, 2012; Van den Brink, Van Lammeren, Van de Velde, & Däne, 2007). In particular, spatial referencing can be an effective and intuitive shared framework in which to synthesise data (Wood, Dykes, Slingsby, & Clarke, 2007). Geographic-based visualisations have demonstrated benefits in improving communication, understanding and ultimately action, for example in the landscape planning process (Pettit, Bishop, Sposito, Aurambout, & Sheth, 2012) and improving foresight and action with respect to climate change (Sheppard, 2012).

Traditional visual media include, for example, physical models, diagrams, charts and maps, and these have been used as communication tools for centuries. More recently, technological and scientific advances have enabled representation of increasingly complex information in multiple dimensions (Lange & Bishop, 2005). The use of photomontages, two- and three-dimensional visualisations to ascertain public landscape preference have been widely discussed in the urban and rural planning literature (e.g. Laing, Davies, & Scott, 2005; Dramstad, Tveit, Fjellstad, & Fry, 2006; Lange, Hehl-Lange, & Brewer, 2008; Ode, Fry, Tveit, Messager, & Miller, 2009; Mell, Henneberry, Hehl-Lange, & Keskin, 2013; Todorova, Asakwa, & Aikoh, 2004). Three-dimensional visualisation of a place on Earth using a virtual globe offers more interactive possibilities than traditional static two-dimensional mapping, such as permitting direct manipulation of the interface for real-time browsing of satellite imagery and aerial photographs. Several studies have demonstrated that virtual globes can increase the level of engagement with scientific data, transferring 'known' information to the public domain in formats that permit a high level of user interaction with the data (e.g. Aurambout, Pettit, & Lewis, 2008; Pettit et al., 2012; Sheppard & Cizek, 2009). Four-dimensional representation offers further possibilities for greater uptake and understanding. For example, virtual globes can depict past environments through geological modelling (De Paor & Whitmeyer, 2011), display scientific datasets e.g. of snow and ice cover (Ballagh et al., 2011), or show how events unfold using time sequencing of spatial content (e.g. Polczynski & Polczynski, 2013; Schroth, Pond, Muir-Owen, Campbell, & Sheppard, 2009). As such, virtual globes have been used to help users interpret their past and present environment and plan for the future (e.g. Pettit, Raymond, Bryan, & Lewis, 2011; Schroth et al., 2011). Virtual globes are also used by NGOs and activist groups to disseminate information about their activities and concerns, e.g. through Google Earth's 'global awareness layers' (Elwood, 2010; Parks, 2009). Such dynamic alternatives could have significant advantages over traditional 2-D maps for representing and communicating changing bundles of ecosystem services in space and time (de Groot et al., 2010).

Visualisations are now a typical component of landscape research and practice (Lange, 2011); they are standard mechanisms to communicate activities concerned with the natural and urban environments of the past and present, and the creation of future environments. In practice, however, landscape visualisation for public information and community involvement requires a grasp of a range of disciplines including cartography, computer science, and cognitive science (MacFarlane, Stagg, Turner, & Lievesley 2005). Aspiring landscape visualisers will also have to manage possible public unfamiliarity with geospatial technology (Ball, 2002) and consult specialised texts on usability engineering and human-computer interaction (e.g. Haklay, 2010; Haklay & Tobon, 2003; Neilson, 1993). Visualisation developers should also have a wider appreciation of the cultural, social and political implications of contemporary visualisation methods (Elwood, 2010) and reference to specialised sub-disciplines, such as critical geographic information systems (GIS) and public participatory GIS, PPGIS (Ball, 2002; Elwood & Ghose, 2001; Sieber, 2006), may be relevant. While this plethora of literature correspondingly provides substantial support for the novice, landscape practitioners may also face various additional challenges such as limited budgets, time and personnel, and organisational restrictions such as access to sources of assistance

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