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Research Paper

Evaluating presentation formats of local climate change in community planning with regard to process and outcomes

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HIGHLIGHTS

- Visualizations in a climate change planning process were assessed as very helpful by local stakeholders and residents.
- Visualizations presented in a virtual globe facilitated understanding and increased awareness during an open house.
- 22 months later most decision-makers still remembered or used the visualizations.
- Visualizations embedded into process informed policy, operational and built changes.
- Although the virtual globe presentation format was effective during the process it was less so in the long term.

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ABSTRACT

This study synthesizes two evaluations of a local climate change planning process in a rural town in British Columbia (Canada), which was supported through landscape visualizations. First, the impact of the visualizations, based on scientific environmental modeling and presented in three different presentation formats, verbal/visual presentation, posters and a virtual globe, was evaluated with regard to immediate impacts during the process. Second, the long-term impacts on decision-making and actual outcomes were evaluated in a retrospective evaluation 22 months after the end of the initial planning process. Two results are highlighted: according to the quantitative pre-/post-questionnaires, the visualizations contributed to increased awareness and understanding. Most importantly, the retrospective evaluation indicated that the process informed policy, operational and built changes in Kimberley, in which the landscape visualizations played a role. The post interviews with key decision-makers showed that they remembered most of the visualizations and some decision-makers were further using them, particularly the posters. The virtual globe seemed to be not a "sustainable" display format suitable for formal decision-making processes such as council meetings though. That may change with the further mainstreaming of visualization technologies or mobile devices. Until then, we recommend using display formats that can be re-used following a specific planning event such as an Open House, to ensure on-going support for effective decision-making over the longer-term.

1. Introduction

1.1. Climate change communication in urban and landscape planning

Climate change is a complex problem with impacts and interactions at global to local scales. Mitigation alone will not be sufficient to ensure a sustainable future: local communities need to adapt their planning to climate change impacts and adaptation (IPCC, 2014). While political and economic frameworks may be developed at international and national levels, local communities will play a key role in the implementation of both mitigation and adaptation actions (Moser & Dilling, 2007). Barriers to the communication and integration of climate change into spatial planning include the complexity of climate science and long time horizons (Blanco et al., 2009; Moser & Dilling, 2007). Climate change is only meaningful in community planning if the potential impacts and response options can be understood and handled within local planning processes and policy development (Batty, 2010); community vulnerabilities and possible climate change impacts need

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to be relevant to local decision-makers, stakeholders and citizens (O'Neill & Hulme, 2009). However, the long time scales do not align well with human cognition, which generally seems to be limited to anticipating 15–20 years into the future or 50 years at most (Tonn, Hemrick, & Conrad, 2006). These complex spatial and temporal dimensions partially explain why climate change has only recently begun to be addressed in local Canadian land use policies (e.g. Carlson, 2012). If they are to be effective, landscape and urban planning processes need to adopt visualization tools that make the spatio-temporal dimension of climate change apparent at the local scale and in the context of locally relevant themes.

1.2. Objectives of this study

This paper presents two evaluations: a process evaluation and an evaluation of the later outcomes of the Kimberley Climate Adaptation Project (KCAP). The paper explores different presentation formats for visualization media (see Gill, Lange, Morgan, & Romano, 2013), i.e. oral/verbal presentation, posters and virtual globes with multi-dimensional interaction (defined as spatial, temporal and thematic navigation), in terms of (a) whether they can have positive immediate impacts on local climate change planning processes, and (b) how the visualization media support long-term decision-making outcomes from those processes. Drawing on Pond et al. (2012), immediate impacts are defined as those changes for participants that occur during or immediately following the use of 3D landscape visualizations and tools in a process, including: changes in awareness, attitude and understanding (Bishop, Pettit, Sheth, & Sharma, 2013; Walter, Helgenberger, Wiek, & Scholz, 2007); affective responses (Sheppard, 2005; van Lammeren, Houtkamp, Colijn, Hilferink, & Bouwman, 2010); and new scientific insights (Bishop et al., 2013; Walter et al., 2007). The study fits into the framework for visualization evaluation suggested by Bishop et al. (2013), who used similar tools (based on the Google Earth API). Our study differs in its real-world application with the public as participants and by adding a novel retrospective component to assess effects on planning processes and decision-making. The specific planning process itself has already been studied and will be briefly summarized in this paper to enable a comparison with the later evaluation of outcomes.

The first objective of the process evaluation was to assess the preferences of participants for the different presentation formats: slide presentation, posters, and virtual globe. *The second objective* of the process evaluation was to measure any immediate changes in awareness about local climate change impacts and an increased understanding of the links between land use and climate change vulnerabilities during the KCAP's public Open House and in the process outputs, i.e. recommendations and plan documents. Until now, this quantitative pre-/post comparison has only been analyzed for an unpublished project report (Schroth, Pond, Muir-Owen, Campbell, & Sheppard, 2009). The *third objective* was to assess user feedback on visualization utility and specifically the multi-dimensional interaction for exploring spatio-temporal dimensions of climate change. These results have been previously published in Schroth, Pond, et al. (2011), and will be briefly summarized.

The novel *retrospective element* is part of a longitudinal study revisiting the long-term effectiveness of visualizations in planning processes, filling a gap in landscape visualization research identified by Bishop et al. (2013) and described below. The definition of "longitudinal studies" varies across disciplines; in this paper we are referring to qualitative longitudinal policy studies (see Holland, Thomson, & Henderson, 2006). Rist (1994) defines a longitudinal policy study as covering different phases of a policy cycle including policy formulation, implementation and accountability. Elliot, Holland, and Thomson (2008) further distinguish retrospective studies as a common and very efficient way of collecting longitudinal data, i.e. looking back at past events and collecting data about the impact such past events have had over time. In this paper, we used two formal data collection periods: during the initial event and process in 2008–2009 and during follow-up interviews in 2011. According to Elliot et al. such studies could be described as collecting data "retrospectively as part of an on-going prospective longitudinal study" (2008: 229). With regard to Bishop et al. (2013), Faludi (2000), Larsen and Gunnarsson-Östling (2009), Robinson and Tansey (2006), and Walter et al. (2007), the *objectives for the longitudinal study element* are:

(1) Evaluate whether key decision-makers still remember the visualizations.
(2) Determine the uptake of spatial planning and geo-visualization tools. Is there any difference between the virtual globe (multi-dimensional interaction) and other presentation formats in their long-term use?
(3) If so, did the visualizations add depth to the deliberation about local impacts and response options?
(4) Did the visualizations add to an increased capacity of participants to act?
(5) Evaluate retrospectively whether (a) the KCAP process in general and (b) the visualizations in particular had an impact on local decision-making processes.
(6) Evaluate retrospectively the actual outcomes such as policy or operational change and whether they suggest transformative or incremental change toward a shared goal.

A major limitation of such an explorative longitudinal study is the variety of external, potentially confounding variables. The follow-up interviews provided some indications of influences beyond the visualization tools, such as policy variables and the role of local champions, in shaping final outcomes. However, these interactions were not formally assessed in the final analysis.

2. Visualizations as tools for communicating climate change planning options

As tools for participatory local planning, landscape visualizations have been shown to help people understand possible future or alternative conditions (e.g. Al-Kodmany, 1999; Bishop & Lange, 2005; Danahy, 2001; Lange, 2001; Lewis, 2012; Orland, Budthimedhee, & Uusitalo, 2001; Pettit, Raymond, Bryan, & Lewis, 2011; Salter, Campbell, Journeay, & Sheppard, 2009; Schroth, Wissen-Hayek, Lange, Sheppard, & Schmid, 2011) and to "geodesign" these futures (Steinitz, 2012). In addition, several authors have addressed the potential of local landscape visualization as a tool specifically for improved communication of climate change implications (Dockerty, Lovett, Appleton, Bone, & Sünnenberg, 2006; Nicholson-Cole, 2005; O'Neill and Hume, 2009; Sheppard, 2005). Landscape visualizations of iconic local places function as a shared platform to integrate and communicate scientific data and local knowledge across multiple climate impacts and mitigation/adaptation strategies (Cohen et al., 2013; Sheppard, 2012). Recent work (e.g. Bishop et al., 2013; Cohen et al., 2012; Nicholson-Cole, 2005; Pettit, Bishop, Sposito, Aurambout, & Sheth, 2012; Sheppard, 2012) has thus established early evidence and principles to support the role of landscape visualization together with climate change scenarios in community engagement and decision-making.

Until recently, the body of work referred primarily to static landscape visualizations. While these have examined time sequences, various spatial viewpoints, and integrated or layered spatial datasets, only a few studies have now started to specifically evaluate the affordances of interactive landscape visualizations to communicate long-term climate change impacts (Bishop et al.,