Visualizing Climate Change: the Potential of Dome Presentations as a Tool for Climate Communication

Tina-Simone S. Neset [†1], Victoria Wibeck [‡1], Ola Uhrqvist [§1] and Jimmy Johansson [¶2]

[1]Centre for Climate Science and Policy Research, Dept. of Thematic Studies–Water and Env. Studies, Linköping University, Sweden
[2]C-Research, Linköping University, Sweden

Abstract

This study presents the outline of a climate visualization programme directed to various target groups that was presented in a dome environment. The efforts of climate and visualization researchers to jointly develop presentations for immersive environments on the cause and effect of climate change as well as potential responses both in terms of national and international policy as well as individuals' lifestyles are described. Further we discuss the results of an evaluation with 64 participants of dome presentations. The results point towards an initial support for the dome visualization in terms of increased engagement of the audience. Further, visual representations such as choice of colouring and volume bar charts that were expected to be problematic by the research group were considered straightforward by the audience. In this paper we discuss visual representation and climate communication, and to what extent climate visualization in a dome environment can contribute to enhance the audience's understanding of the complexity of climate change issues.

Categories and Subject Descriptors (according to ACM CCS): H.4.m [Information Systems]: Information Systems Applications—Miscellaneous, J.2 [Computer Applications]: Physical Sciences and Engineering—Earth and atmospheric sciences

1. Introduction

As the cause and effects of climate change are increasingly the focus of media debates, decision making, planning and educational efforts, climate researchers are facing a severe challenge of communicating the scientific basis of issues such as responsibility and effort sharing, as well as global and local effects of climate change.

Climate visualization, in terms of interactive research platforms, which use computer graphics for the creation of visual images related to climate change issues [NJL09], presents one possible way to enable interaction between climate researchers and the potential user.

This study aims to present the outline of interactive dome presentations and the evaluation of a series of presentations in an inflatable dome. The specific aim of the evaluation was to study the potential of climate visualization as a tool for climate communication as well as the visitor's perception of the dome environment as a platform for communication, education and discussions on issues related to climate change.

The evaluation was undertaken through a questionnaire designed to assess factors influencing the visualization experience and to what extent the presentations should be 'tailored' to fit specific target groups in terms of their interest and profile. A brief questionnaire was therefore constructed to balance a set of different factors, and consisted of seven focus areas comparable in relation to each other. The questionnaire started with a personal profile and included questions assessing how the respondents related to the process of understanding climate change. It was considered crucial to identify the needs and pre-knowledge of the participants since this influences their response to the visualization. Further, the questionnaire focused on the role of the presentation in relation to the participants' knowledge and how the unusual environment of the dome was experienced. Then the

† tina.schmid.neset@liu.se
‡ victoria.wibeck@liu.se
§ ola.uhrqvist@liu.se
¶ jimmy.johansson@itn.liu.se

focus turned to assess more reflective issues about what respondents experienced was missing by asking about areas of development. The last part of the questionnaire covered the impact on an individual scale from a more practical perspective, asking for instance, if the visit will change the respondents' behaviour in everyday life. Within each area of interest the questionnaire was mainly based on aggregate scales of agreement to different statements. The general ambition here was to let the questions go from concrete to more reflective. Finally, the questionnaire was complemented with open questions tailored to the specific group of respondents.

The reflections of a test group of climate researchers and other personnel at a Swedish governmental authority were captured directly after the dome presentation in form of a questionnaire. Participation in the survey was voluntary and of a total of 100 visitors, 64 answered the survey. Some of these were, however, incomplete. Some questions were addressed by as few as 47 participants, and were therefore not included in this analysis.

2. Background and Related Work

As the scientific knowledge on the cause, effect and complexity of climate change increases, so does the need for tools to communicate these. In a survey covering 31 European countries, more than one third of the respondents claimed that they did not feel very well informed neither about causes nor consequences or ways of fighting climate change. Around one in ten respondents stated that they were not at all informed [Eur08]. Thus, while 75% of the respondents said that they saw climate change as a very serious problem [Eur08], the level of self-reported knowledge varied between different European countries and many people felt that they lacked appropriate information. Other studies confirm that lay people often misunderstand the causes and effects of climate change [LP06, KR09], especially when it comes to complex systems dynamics affecting climate [SS07].

To address the public's knowledge gaps, many climate information efforts have taken their point of departure in a 'deficit model' of science communication, which means that the public is conceived of as suffering from a deficit in knowledge and understanding of science. In the deficit model, the remedy for increasing public trust in science is to provide lay people with an increased amount of information built on expert knowledge [Loc99]. The deficit model has, however, been criticized for ignoring research which demonstrates that available information will not be assimilated by lay people unless it is put in a context that is experienced as useful and relevant by the audience [KR09].

Communication researchers have repeatedly pointed to some urgent challenges for communicating climate change. It has been shown that even though alarmistic, 'doomsday' messages and visualizations could increase public awareness

Figure 1: *Inflatable dome with space for an audience of 25 visitors.*

of the serious consequences of climate change, such images and narratives are likely to bring about feelings of hopelessness and apathy in the audience [MD04, NC05, ONC09]. The challenge lies in communicating messages that can raise awareness while still empower people to take action. To achieve this, studies have pointed to the potentials of communicating local effects and responses to climate change, and to emphasize concrete action strategies [NC05, ONC09]. Another challenge lies in tailoring communication efforts to different audiences, taking the frames of interpretation of different target groups into account and engaging them in dialogue [MD04, Whi08, FWLB09, SCE09].

3. The Project

The WorldView project [NJL09] was launched in 2008 as a co-operation between the Centre for Climate Science and Policy Research, the Norrköping Visualization Centre-C, the Swedish Meteorological and Hydrological Institute and C-Research, Linköping University. One of the goals was to join climate researchers and visualization experts to create new ways of communicating climate research for various audiences and target groups for immersive dome environments, see figure 1. The inflatable dome that was used for the presentations had space for up to 25 visitors, seated on cushions on the floor. The dome has a 6.5 meter internal screen diameter. A centrally placed, tilted fish-eye lens, driven by a high-performance laptop with dual NVIDIA GeForce 8800TX graphics cards, creates a projection area of 180 by 135 degrees at a resolution of 1400 by 1050 pixels. The software was run by one technician and the presentation was held by a climate expert who followed a script but opened up for discussions during the programme.

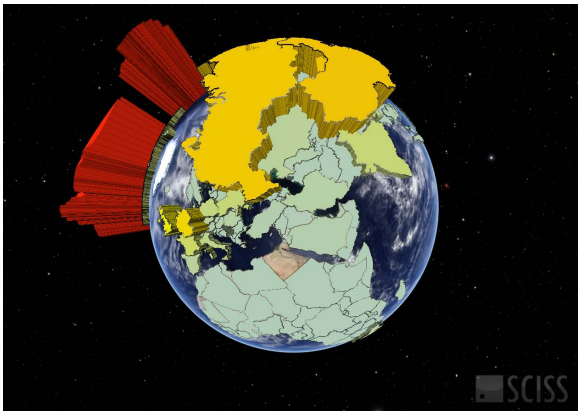
The narrative of the WorldView presentation was mainly based on a straightforward storyline based on three consecutive modules: cause, effect and action alternatives. Start-

ing with causes of climate change, the program included emissions of CO_2 and CO_2 equivalents (a sum of greenhouse gases) in total, per capita or in a historical perspective, see figure 2. The graphical representations are based on the software Uniview [Uni] which is a platform using advanced 3D computer graphics to create interactive presentations of scientific data. The Uniview Geoscope application enables the use of geospatial data sets as well as smooth transitions from local to global scales. During the production process, various visualization parameters (e.g. colour maps, thresholds, scales) were tested and discussed with a number of climate researchers. To avoid misinterpretation of colour and bar heights amongst the audience, the presenter explained the data set and representation during every session.

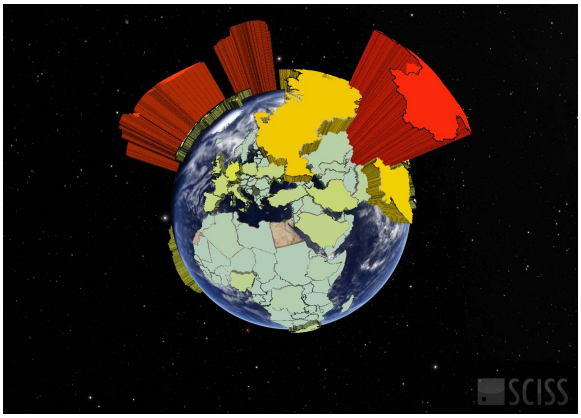
The comparative approach promoted the discussion on the topical principles for effort sharing, i.e. how responsibilities for taking action on climate change should be distributed. Which groups of countries bear responsibility and how, for instance, the funding of mitigation and adaptation activities should be divided between countries is an important discussion in the global climate negotiations. These three visualizations represent principles that were proposed by different groups in the lead up to the Copenhagen climate negotiations. This example corresponds well to the need for contextualizing national data sets and provides a quick and intuitive overview over the emission contributions of 180 countries. Effects of climate change were shown through regional data sets directly transferred from NetCDF format produced by the Rossby Centre, SMHI. Specific effects shown were temperature changes for the IPCC A2 and B2 scenario over Europe for summer and winter as well as changes in arctic sea ice cover and a local example of sea level rise.

Action alternatives were captured using an interactive electronic voting system that every visitor had received at the entrance, providing the possibility to press a number that represents an answer to questions concerning the global, national and individual scale. This voting system was used as a tool for spurring dialogue and contextualizing climate issues by encouraging the audience to reflect on their own behaviour and on policy options for mitigating and adapting to climate change. Questions ranged from asking for the participant's confidence in the EU's 20% reduction of green house gas emissions to their individual everyday choices in terms of 'what would you be prepared to reduce in order to achieve this goal?'. The results of these immediate surveys appeared instantly on the dome-screen and were discussed amongst the participants.

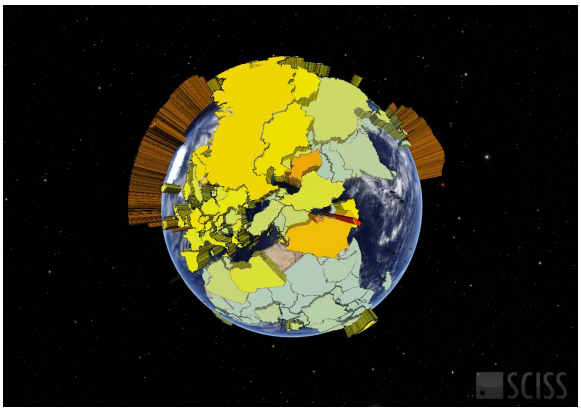
The visualization tools used enabled us to communicate complex geospatial data sets in what was, for most visitors, a new and interesting environment, and to present climate data that is usually stored in less accessible formats. Aside from the presentations for decision makers, EU ministers and the Conference of Parties (COP15) in Copenhagen, the WorldView project aims to create climate visualization modules



(a)



(b)



(c)

Figure 2: *Visualization based on data from the World resource institute's Climate Analysis Indicators Tool (CAIT), regarding (a) historical emissions per capita 1850-2005), (b) total greenhouse gas emissions for 2005 and (c) per capita emissions of greenhouse gases for 2005. Data set was produced by CSPR, Visualization by the Norrköping Visualization Centre-C, using Uniview by Sciss.*

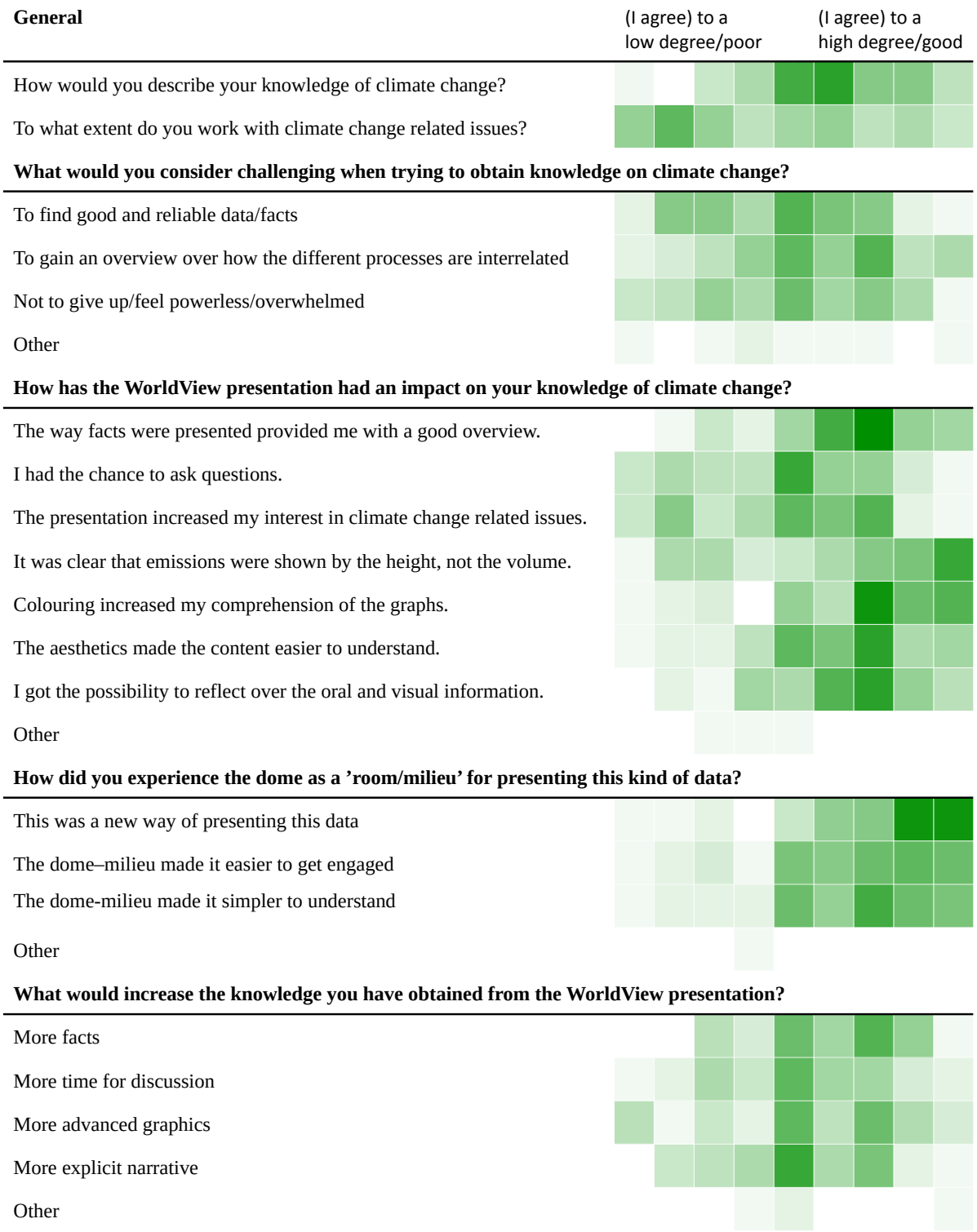


Figure 3: *Summarized results of the questionnaire, saturation is dependent on the number of respondents for each segment. The highest saturation corresponds to the maximum number of respondents.*

that can be adapted to education, science communication and decision making purposes. These modules are also conceptualized to fit the program of the Norrköping Visualization Centre-C for presentations and interactive environments that build on modern visualization technology.

4. Evaluation

Of the 100 visitors in the dome presentations, 64 answered the survey of which around two thirds were male and one third female.

79% of the participants were positive to recommending the presentation to their colleagues or friends, 8% responded indecisive and 13% replied negative. All of the negative respondents indicated a high self-grading regarding their knowledge on climate change and a low impact of the presentation on their knowledge. The main results of this questionnaire are summarized in figure 3. The test group that participated in this survey rated itself with a rather good knowledge regarding climate change issues but only worked to a low degree with these issues (see figure 3).

In general terms, the WorldView presentation was not considered to have had a significant impact on the respondent's knowledge of climate change, however in several cases this coincided with an indication of a good established knowledge on climate change issues. The presentation in itself was perceived in a very positive way. The two major questions regarding perception—the colouring and volume of the bar charts in the produced visualization—were valued as well understood and enhancing the understanding of the data sets. The dome itself as an environment for presenting this kind of data, was perceived by the majority of respondents to increase the engagement of the audience.

Responses to the presentation itself were disparate both with regard to the time for discussion, as well as graphics and narrative. The only area that could potentially be enhanced, was the amount of facts that could be included in the presentation. Further, the presentation was not rated as having a particularly large impact, but most respondents commented that it would be valuable for 'those who have not yet gained the same knowledge on climate change issues' and in particular for educational use.

5. Discussion and Conclusions

Earlier studies of climate communication and public understanding of climate change have pointed to the importance of engaging audiences in reflection on how they are affected by and can respond to the challenges posed by climate change. The evaluation of the WorldView presentation indicate that the dome environment is well suited for this task, especially when the presentation is formed in an interactive way to include discussions and reflections from the audience.

Another issue that supports the use of the inflatable dome is its portability, which has enabled the project to reach its audience at specific venues or at their place of work, as was the case in this survey study. Negative comments on the dome, from previous surveys, have always focused on two issues: (1) comfort (visitors were sitting on cushions on the floor), (2) quality of the projection in terms of sharpness and flicker. While these 'physical' restrictions will be eliminated in a permanent dome theatre, the accessibility will be more demanding in terms of geographical proximity. The need to involve visitors in an active dialogue that includes pre-and post-visit preparations poses a significant challenge to the organization of education material and development of narratives and presentations. This challenge could be met through a close co-operation between climate and visualization scientists and professionals trained in science communication and didactics.

References

[Eur08] Europeans' attitudes towards climate change, 2008. Special Eurobarometer 300, wave 69.2.

[FWLB09] FEATHERSTONE H., WEITKAMP E., LING K., BURNET F.: Defining issue-based publics for public engagement: climate change as a case study. *Public Understanding of Science 18* (2009), 214–228.

[KR09] KAHLOR L., ROSENTHAL S.: If we seek, do we learn? Predicting knowledge on global warming. *Science Communication 30* (2009), 380–414.

[Loc99] LOCKE S.: Golem science and the public understanding of science: from deficit to dilemma. *Public Understanding of Science 8* (1999), 75–92.

[LP06] LORENZONI I., PIDGEON N.: Public views on climate change: European and USA perspectives. *Climate Change 77* (2006), 73–95.

[MD04] MOSER S., DILLING L.: Making climate hot: communicating the urgency and challenge of global climate change. *Environment 26* (2004).

[NC05] NICHOLSON-COLE S.: Representing climate change futures: a critique on the use of images for visual communication. *Computers, Env. and Urban Systems 29* (2005), 255–273.

[NJL09] NESET T.-S. S., JOHANSSON J., LINNÉR B.-O. (Eds.):. *State of climate visualization* (2009), CSPR Report N:o 09:04, Centre for Climate Science and Policy Research, Sweden.

[ONC09] O'NEILL S., NICHOLSON-COLE S.: 'Fear won't do it': promoting positive engagement with climate change through visual and iconic representations. *Science Communication 30* (2009), 355–379.

[SCE09] STAMM K., CLARK F., EBLACAS P. R.: Mass communication and public understanding of environmental problems: the case of global warming. *Public Understanding of Science 80* (2009), 213–238.

[SS07] STERMAN J., SWEENEY L. B.: Understanding public complacency about climate change: adults' mental models of climate change violate conservation of matter. *Climatic Change 80* (2007), 213–238.

[Uni] Uniview: http://scalingtheuniverse.com.

[Whi08] WHITMARSH L.: What's in a name? Commonalities and differences in public understanding of 'climate change' and 'global warming'. *Public Understanding of Science 18* (2008), 401–420.