From Global Consequences to Local Responsibility in Energy Consumption and Consumer Behaviour

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Keywords: Virtual Globes, Digital Earth, Sustainable Energy, EnergyPLAN, Managed Code, GRIFINOR.

Abstract

Following the ideas and thoughts of Digital Earth (Gore, 1998), many different solutions for Digital Globes have emerged within the last 10 years (Butler, 2006). They have brought a wide range of geo-related applications for mass-market through the Internet (Goodchild, 2008). In the same period there has been a rising of awareness when it comes to issues such as global warming and climate change. From a geovisualization perspective the obvious applications in relation to the growing awareness have been illustrations showing results of e.g. the models for warming up the globe and the sea level rising (Google, 2008, Buki, 2007). These visualisations of global consequences play an important role in the understanding of the eco-systems and how the behaviour of people in general will interfere with climate and the effects on the environment.

But showing the effects on Earth as such is not the only way to use digital globes in the struggle for better understanding of the global situation. There is a need for integration of important knowledge about more specific sub-systems. The amount of domains which develop individual models for their specific contribution to the mega-models are growing rapidly (Shupeng and van Genderen, 2008). Each of these domain specific models has their own scale of reference and although the main part of them does hold a reasonable geographic reference, it is far from the truth to say that they use the same or similar regions. This is a genuine Spatial Data Infrastructure complexity (Grossner et al., 2008). Even though there are several important initiatives within the geospatial scientific community, such as the INSPIRE of the European Union and other initiatives on geodata interoperability and standardization, do not expect to see a solution to this complexity just around the corner. One of the important problems relates to the issue of scale. An example: Even though we now know that more CO_2 in the atmosphere will influence the global warming through the theory of the green house effect, each contribution to the reduction of the amount of CO_2 have to come from something, someone and somewhere. There are numerous sources to the emission of CO_2 and they use different models to calculate the volume and dispersion. The road to global understanding is difficult and very scattered from the complexity of mixing different datamodels in different scales.

One of the important answers to the challenge of global climate change is local responsibility in energy consumption and consumer behaviour. Centre for 3D GeoInformation has been asked to participate in a project where the municipality of Frederikshavn, the most northern municipality in Denmark, has committed itself and its inhabitants to reduce the use of carbon based energy sources and eventually become self-sufficient within energy consumption before the year 2015. The geographic project area is the city of Frederikshavn approximately 37 km^2. The goal is to change the source of energy to 100% sustainable energy sources. The definition of sustainable energy is in this project confined to solar, wind, biomass and energy from the burning of waste. The share of sustainable energy in the project area is at the moment 24%. The plan is to raise the level to 40% within a very short time frame – which is before United Nations Climate Change Conference in Copenhagen in December 2009 (in short called COP15). The next

phase goes from 2009 to 2015 where the goal of 100% sustainable energy sources should be reached.

The total amount of energy produced from fossil fuel in the project area today is app. 623 GWh (GigaWatthours). That is 135 GWh for power production, 323 GWh for heating and industry and finally 165 GWh for transportation (Lund and Østergaard, 2008). It is a huge challenge for everyone involved in this project to fulfil these goals. The success of the implementation of these ideas are very much dependent on the corporation of both industry, politicians and not least the citizens, who should act with the knowledge presented for them and change source of heating in their homes. They should also be ready to invest in cars that run on sustainable energy such as biomass or electricity.

The demand for dissemination of information based on the individual household and the unique situation of each and every family within the project area is obvious. Production, pipeline infrastructure and units of consumption are all objects that can be found in a geographically based datamodel, and making all the information available through the use of a 3D City model could create a new innovative type of spatial computer-human interface and open up new possibilities for a two-way interaction where each citizen or family would take on more responsibility for their own situation and report back to the project how they want to participate in the battle for a cleaner Earth.

The purpose of our participation in such a project will be to combine an object-oriented 3D city model (GRIFINOR) (Bodum et al., 2005) with an energy consumption model called EnergyPLAN (Lund and Münster, 2003). The project with the title Energy City Frederikshavn has been started recently (2008) with support from the European Regional Development Fund, and the main motivation behind it is to make a serious change of behaviour within the whole community and make Frederikshavn to an example city for other municipalities to follow.

The main idea of the project is to show how different scenarios from a numeric model produced by EnergyPLAN can be visualised through a 3D city model. The visualisations will be presented to the public and the politicians of the municipality. This will make an important contribution to the decisions that have to be taken to fulfil the goals of the overall project of Energy City Frederikshavn. It is important to understand that it is not only a political agenda, but also a common project for both businesses and the citizens of Frederikshavn. Without their contribution to the solution; it becomes almost impossible to reach the overall goal. The combined model will also become generally available through a web service where each individual or company have the possibility to see how much he/she contributes to the overall budget and where the energy comes from.

The 3D city model is a spatial representation generated through the software platform GRIFINOR. The concept and idea of GRIFINOR has been presented before (Bodum et al., 2005, Kjems et al., 2009). The objects do not only contain geometry and attribute data but will also contain behaviour (functions). The communication between and handling of these enhanced objects is made possible by means of the concept introduced in Java where objects are created in bytecode and subsequently executed with Java virtual machine. This principle is here referred to as Managed Objects (MO). The main advantage of the MO's is the ability to hold different representations and at the same time be dynamic due to the executable bytecode. The real challenge in the project will be to develop the system in such a way that the users can understand and interact with the output through a web-based interface. The article will therefore also present some initial ideas for usability studies, which will be an important part of the system development.

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