How to Visualize the Invisible Simulating Air Pollution Dispersions in a 3D City Model

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Introduction

In today's society there is an increased need for continuous citizen dialogue on urban development, starting early in the planning process (The Delegation for Sustainable Cities, 2012). This process involves many participants and demand new methods for communication. Simulation and visualization of future scenarios are increasingly used with the purpose of supporting urban planning. In order to handle these complex systems the 3D-media needs to be developed. When it comes to environmental issues, the need to visualize data is huge. Environmental aspects, especially invisible ones such as air pollution, are hard to present in a comprehensible way, and thus difficult to grasp. As a consequence these questions often get low priority compared to other issues in urban planning processes. By visualizing air pollutants in spatial 3D-planning models, a better understanding for various environmental aspects can be reached which consequently have an impact on the planning of new areas and buildings. Such models already exist today – in most cases presented from an aerial perspective (Calvillo, N. et al. 2008; Hudson-Smith, A. et al. 2007; Huber, A & Borland, D, 2008). However, to facilitate better understanding through visually more detailed information of for example air pollution at street level, a visual concept for 3D-city models needs to be developed where a "walk through" perspective at street level is included. This could for example enable different design alternatives to be evaluated regarding the level of pollution for both pedestrians and drivers, and critically affected areas to be assessed. In a micro-perspective the level of pollution on different floors in a building could be estimated and dealt with at an early stage. Street perspective is important for evaluating e.g. densification projects (Yuan, C. & Ng, E., 2012).

Problems and Aims

Here we present a *work in progress* on how to visualize air pollution dispersion in 3D from a street perspective. The aim is to contribute to the integration of analyses of air quality impact early in the planning process. The main focus is how to design a 3D-visualization of air pollutants for optimal comprehension, as well as how to spatially visualize different concentrations of pollutions at different levels in an efficient way. A specific problem is how to use colours and objects both in symbolic and in realistic ways. A crucial challenge for the project is the different requirements for street perspective and aerial perspective. Software for geo-visualization (e.g. dispersion models and ArcGIS) display information in layers. This way of presenting data is optimal for overviews of larger geographical areas from an aerial perspective. However, this presentation method is not applicable from a street perspective (Figure 1-2A,B).

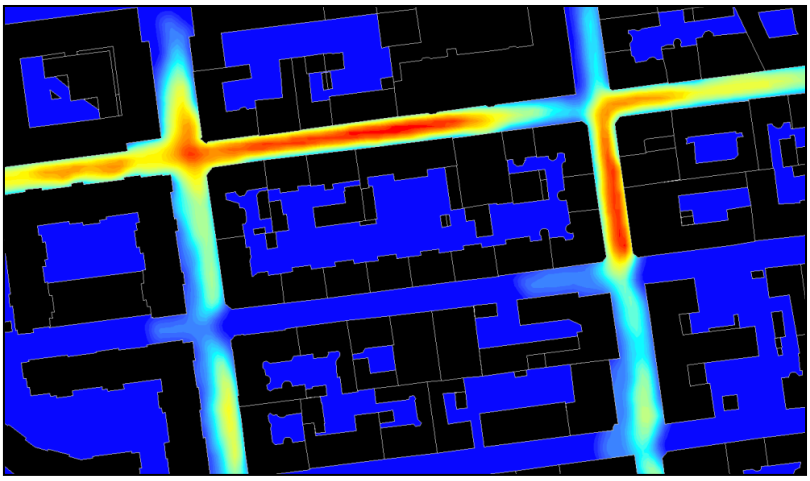

Figure 1. Air pollution data in 2D-planar view, displayed in separate layers (i.e. this image showing one layer).

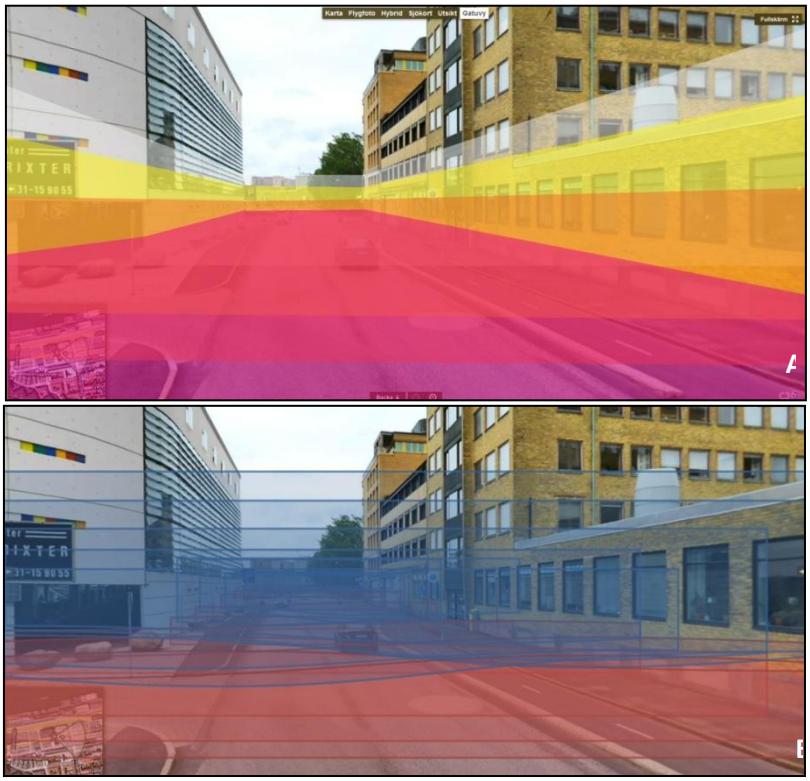

Figure 2A,B. Conceptual 3D-views of buildings and pollution data from a street perspective. Neither the presentation method with horizontal layers (A) as used in Figure 1, nor with vertical layers (B), are visually working.

Project description

In a pilot study between the IVL Swedish Research Institute and the Department of Architecture at Chalmers an urban area in central Gothenburg is studied regarding the quality of air following changes in the built environment. The project explores different ways to represent environmental factors in 3D-city models (Figure 3-4). Spreading calculations for particles will be carried out based on the plan for new buildings in the area. For comparison, a scenario of the current situation is being produced, based on existing calculations for emissions from traffic and harbour activities. The calculations were made in the software SoundPLAN based on geographic 3D-data input, generated in ESRI ArcGIS. The result regarding quantities of air pollution was extracted in high resolution grids for 16 vertical levels, using the Kriging method in ArcGIS. These grids then formed the base for a 3D-visualization through an interpolation between corresponding grid cells for adja-

cent vertical level. Finally, the air pollution visualization will be integrated and visualized in the 3D city model of Gothenburg.

Figure 3. Conceptual extracted data as a vertical line, based on the 2D-pollution data grid.

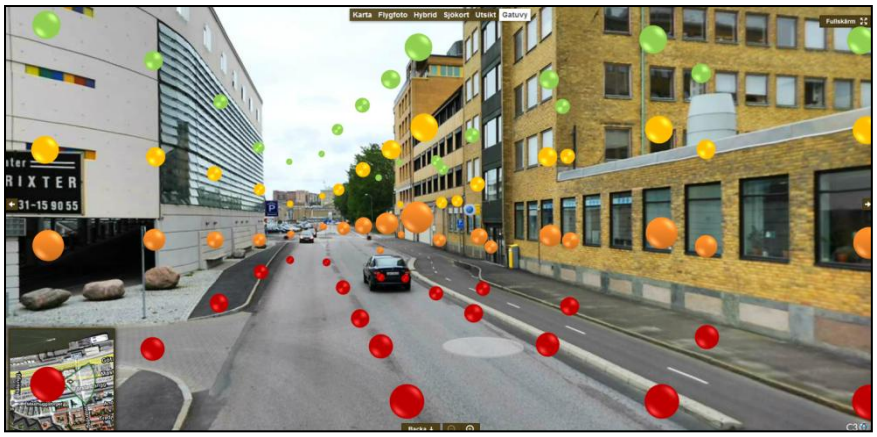

Figure 4. Conceptual extracted data as vertical points, based on the 2D-pollution data grid.

References

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