



Multidimensional presentations in GIS

Brno, 1/6/2006

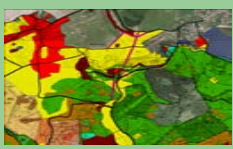
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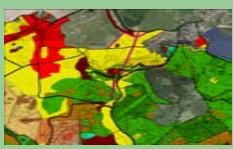
Practical exercise: Urban planning in Salt



From the beginning...

Three GIS paradigms according to Michael Goodchild:

- GIS as assistant.
 - Performing tasks that are too tedious, complex, inaccurate or expensive to do by hand
 - Pre 1995
- GIS as communicator.
 - Allowing us to share what we know about the planet's surface
 - Replacing earlier media
- GIS as a means for augmenting the senses.



From the beginning...

GIS as virtual reality: The 'emergence' of Google Earth

“Imagine, for example, a young child going to a Digital Earth exhibit at a local museum. After donning a head-mounted display, she sees Earth as it appears from space. Using a data glove, she zooms in, using higher and higher levels of resolution, to see continents, then regions, countries, cities, and finally individual houses, trees, and other natural and man-made objects.

Having found an area of the planet she is interested in exploring, she takes the equivalent of a ‘magic carpet ride’ through a 3-D visualization of the terrain.”



From the beginning...

- Al Gore, in 1998, said:

'I believe we need a 'Digital Earth'. A multi-resolution, three-dimensional representation of the planet, into which can embed vast quantities of geo-referenced data' [...]. 'Digital Earth was always intended to allow us to fly from space down through to progressively higher resolution data sets to hover above any point on the Earth's surface and then display information relevant to that location from an infinite number of sources' [...].

- Nowadays, Gore's dream are coming to reality!

- Through the use of technologies like Google Earth, it's possible to present and exchange geo-information within a large user group: The case of Born and Pedersen (*Behind the walruses*) (New Orleans)

- Online tools like Google Earth are changing the way we interact with spatial data

- There is a renewed hope that any sort of planet information will become accessible just with a few moves of the mouse

- ... and moreover, if Jack Dangermond says that 'Google Earth is just the most fantastic thing I ever seen' ...



From the beginning...

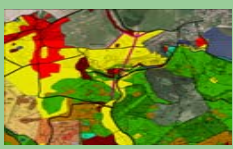
- Then, why not use this technology as a communication tool for plans concerning the development of public spaces (city, nature, countryside or water)?
- Geo-visualizations are supposed to stimulate people's creativity and involvement and to invite them to give information and to get informed.
- As more citizens become concerned about their local environment, easy-to-use virtual globes will facilitate the communication of spatial information between the stakeholders and government agencies





What can we consider multidimensional?:

- Multidimensional means data structure with three or more independent dimensions (X, Y, Z, Time, ...).
- This multidimensionality can be represented or not, depending on the representation environment.
- The geographic feature in the real world forms a single unique individual that can be represented as multiple digital objects of varying spatial, thematic, and temporal dimensions.



Some principles about 3D Scenarios:

Evolution and improvement of 3D technology:

- Advances in computer hardware and software, and...
- research & technical developments based on flight simulators...
- Have allowed to notably increase the possibilities on visualization tasks and give us the ability to immerse in 3D virtual worlds
- Simulators offers to end-users a:
 - Dynamic
 - Interactive
 - And Easy to use environment to...
- understand, explore and manipulate geographical data within visual representations (also in real time)



Some principles about 3D Scenarios:



NASA Dryden Flight Research Center Photo Collection
<http://www.dfrc.nasa.gov/gallery/photo/index.html>
NASA Photo: EC98-44397-1 Date: 1998 Photo by: (courtesy Ames)
Gordon Fullerton in PCA (MD-11) Simulator

Two examples of flight simulators developed by the NASA



NASA Dryden Flight Research Center Photo Collection
<http://www.dfrc.nasa.gov/Gallery/Photo/index.html>
NASA Photo: EC04-0288-2 Date: October 4, 2004 Photo By: Tom Tschida

The F-18 simulator at NASA's Dryden Flight Research Center, Edwards, California.

Some principles about 3D Scenarios:

The relation between different kinds of geodata and its representation is quite diverse and can be presented as can be seen in the table below:

	Visual representation			
GeoData	2D	2D + ΔT	3D	3D + ΔT
2D				
2D + Δt				
2.5D				
2D + Δt				
3D				
3D + Δt				

Font: Lammeren et al., 2004

2D: Two dimensional referenced data

2.5D: Digital Elevation Data

3D: Three dimensional referenced data, including three dimensional topology, as known from Computer Aided Design (CAD) software

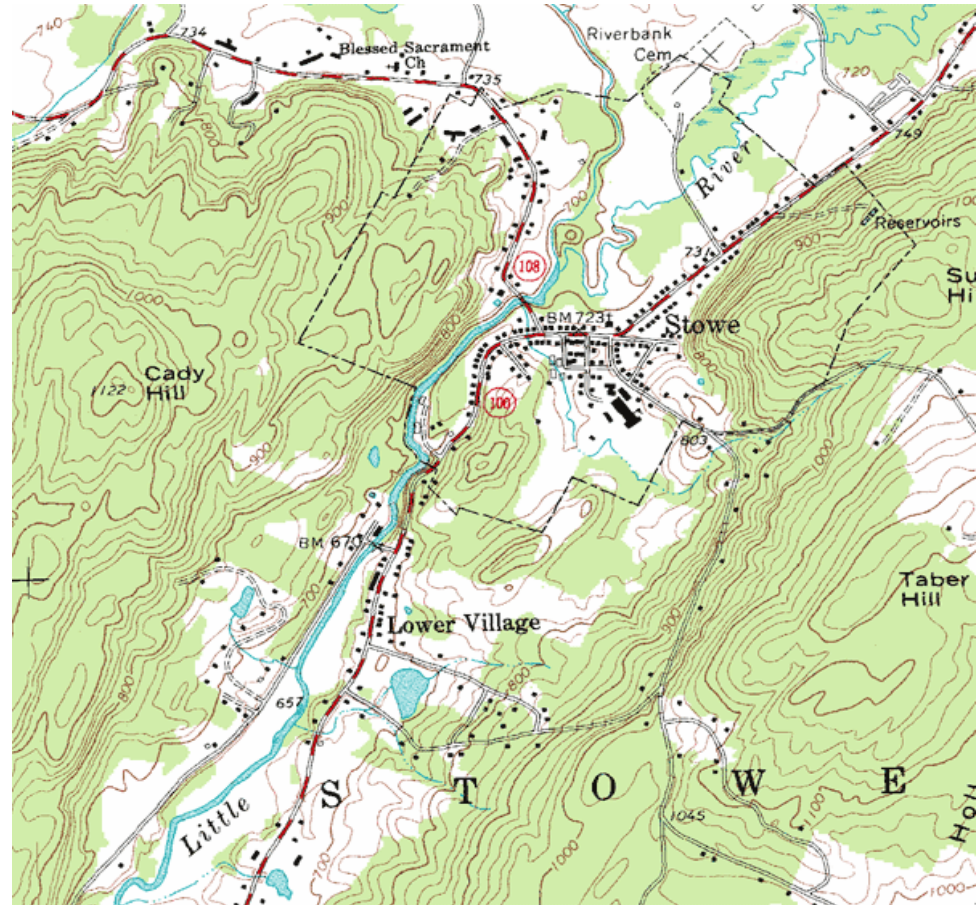


Some principles about 3D Scenarios:

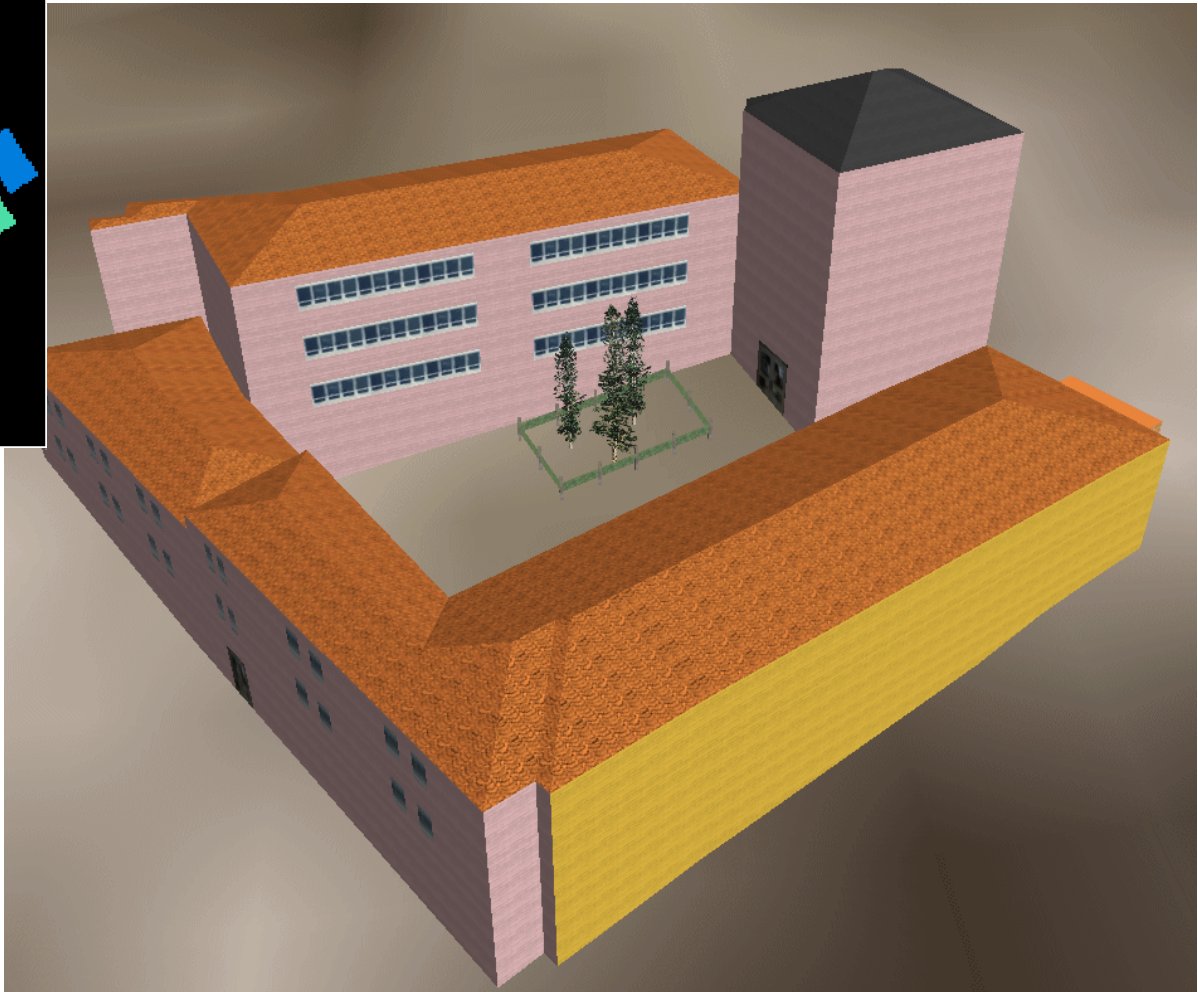
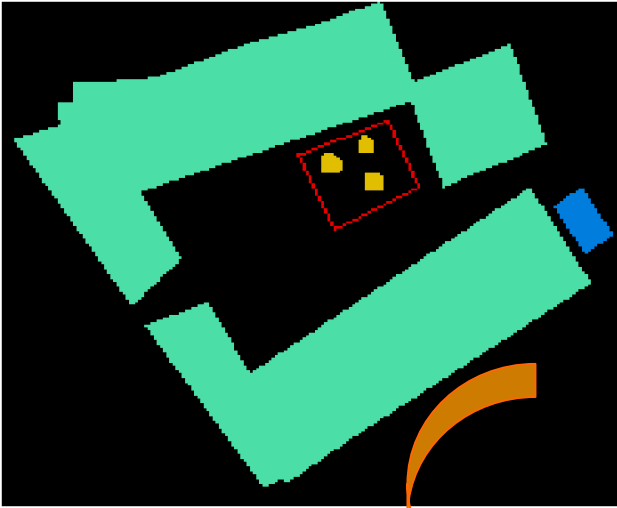
- For most users, read and understand traditional cartography and what the maps are showing could imply the need of a medium/high cognitive level in conceptual cartographic interpretation.
- 3D landscapes represent communication tools that allow experts and non-experts to use, explore, analyze and understand landscape information.
- 3D representation convey more landscape information in comparison with 2D representations.
- It seems that most users can easily read and understand this kind of representations in a more easy way.
- A more realistic understanding of traditional 2D raster datasets can be improved with representative 3D objects

Some principles about 3D Scenarios:

The interpretation of a simple topographic map, implies a medium knowledge about some cartographic parameters: *scale* and *distance*, *legend* *interpretation*, *symbolism by scale*,



Some principles about 3D Scenarios:

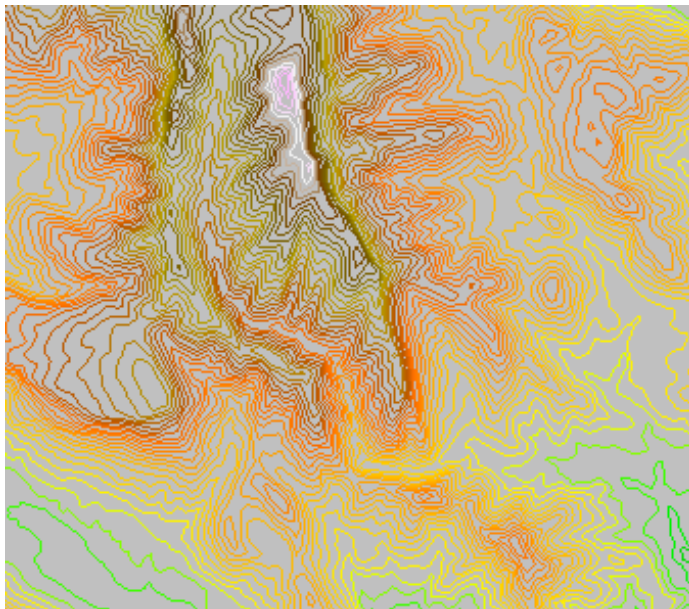


A 3D environment conveys a higher dose of information than a 2D environment

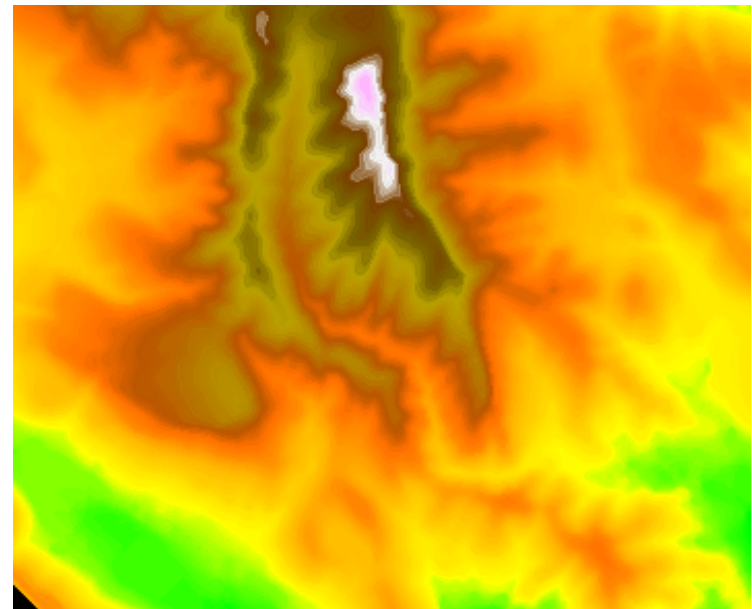


Some principles about 3D scenarios:

- 2D raster data + 3D objects = More realistic representation of the world. Then, ...
- ... higher level of comprehension!!
 - One example:



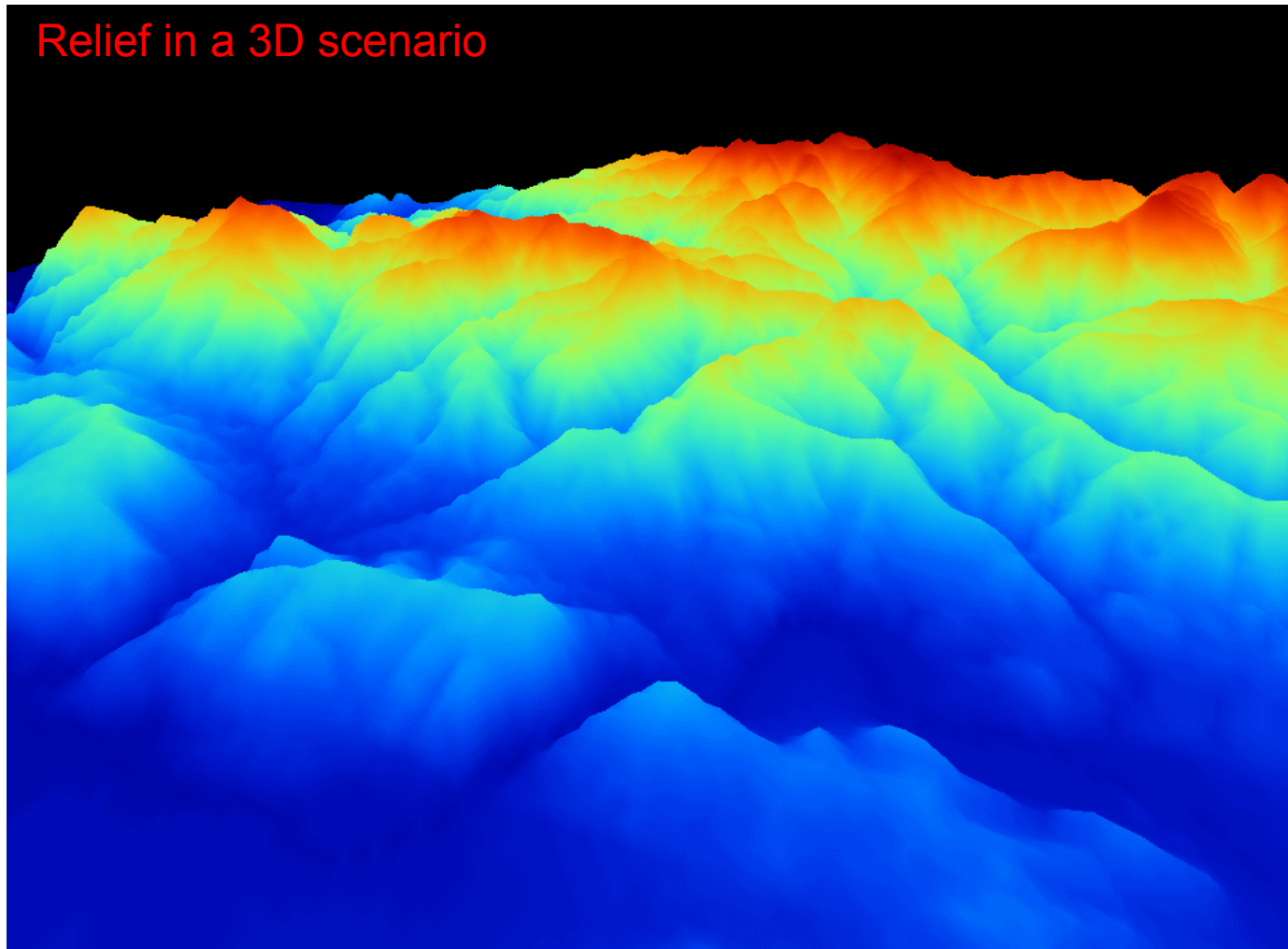
Contour lines



Raster surface



Some principles about 3D Scenarios:





Landscape modelling and geovirtual environments:

- **Virtual Landscapes** are a general type of geovirtual environment that includes 3D Terrain Models, 3D buildings models, 3D vegetation models, ...
- In fact, a **Virtual Landscape** represents a real or an imaginary part of a landscape by a **Landscape Model**
- A **Landscape Model** is composed in a hierarchical way based on **Landscape Objects**
- **Landscape Objects** are: Digital Terrain Model + 2D imagery data (such as aerial photography or topographical maps) + 2D planning data (such as cadastre data or street networks) + 3D building data + 3D biotype and vegetation data
- **Landscape Model** can also be complemented by graphic objects (annotations, virtual skies, legend, ...)



- You can generate and simulate future conditions and also past conditions to preview future changes or recreate ancient times





Geo-visualizations tools for interactive planning

Geo-visualization tools are becoming more flexible and accessible for general public as well as for professionals

Current use of geo-visualization: illustrate, visualise and present geodata

Future trends: more interactive and participatory use of geo-visualizations

Characteristics about this geo-visualizations tools:

- ...intuitive tools

- ...to be used on standard pc's

- ...with integrated and detailed information

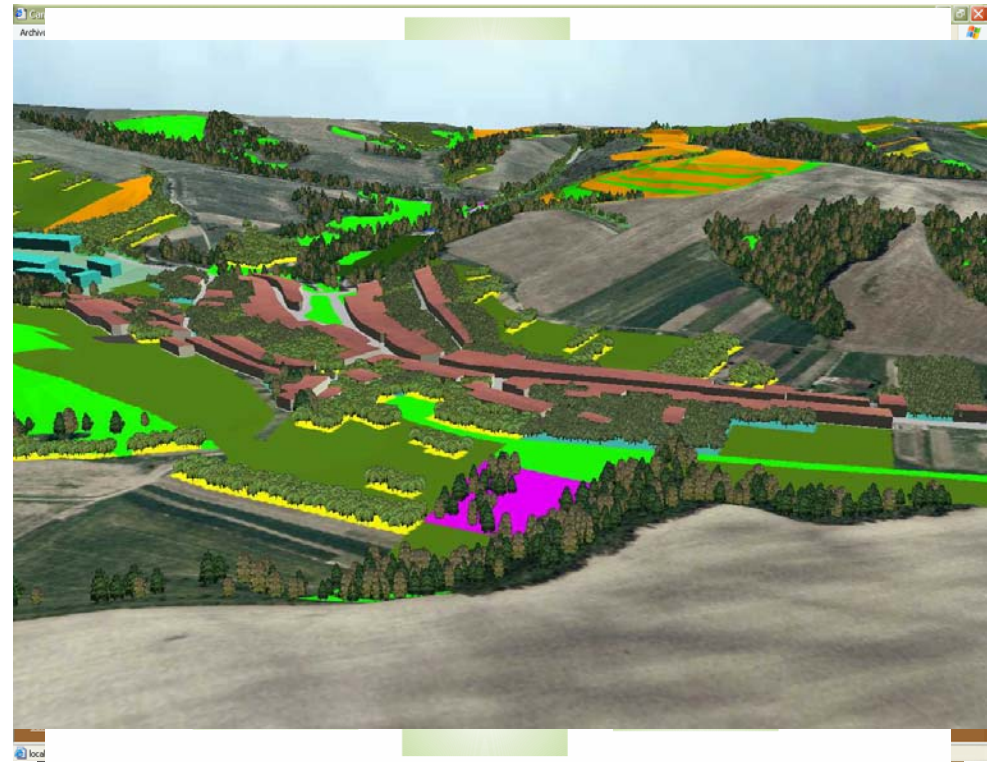
- ...offering an interface to navigate and explore different scenarios

- ...fascinating for end-users



Application areas for 3D + GIS:

- Landscape Planning and Landscape Architecture
- Urban Planning and Urban Architecture
- Environmental Information Systems
- Education and information.
- Disaster Management Systems
- Homeland Security Applications





Application areas for 3D + GIS: Some examples

- **Urban planning and Urban architecture:**
- Some animations in Los Angeles (USA)
 - [Take a tour](#)
 - [Take a tour II](#)





Application areas for 3D + GIS: Some examples

•Urban planning and Urban architecture:

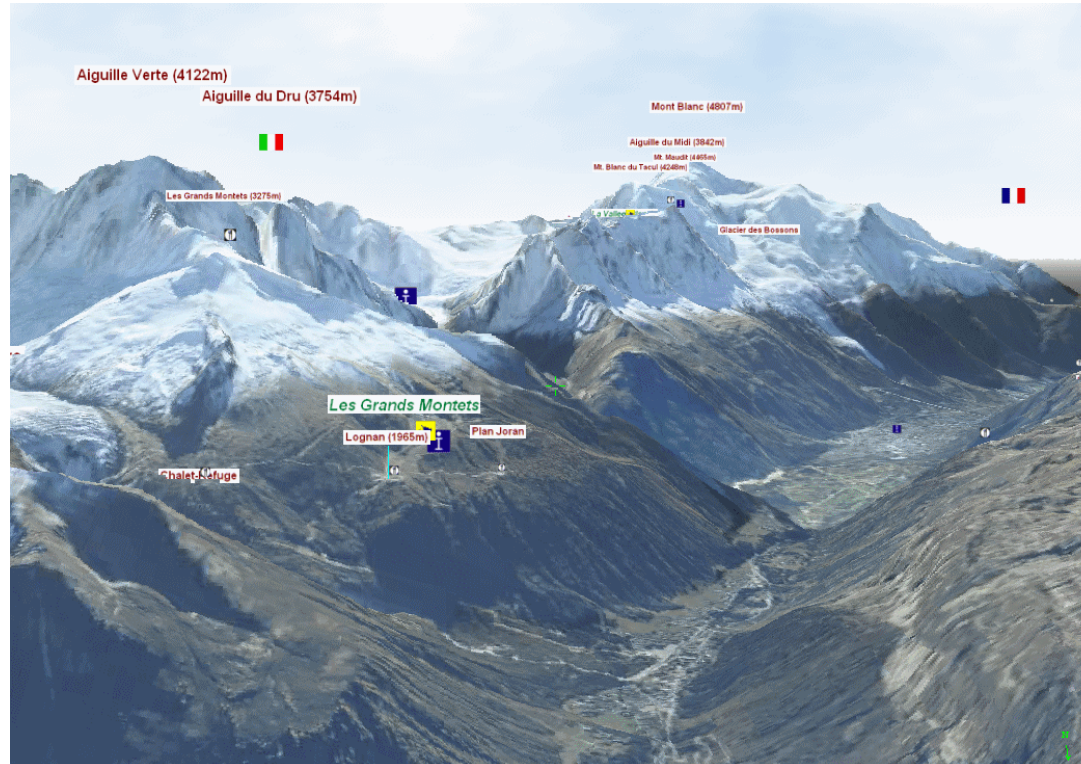
- Implementations in **Digital City Information Systems** where a user can click over a building and get a short video with related information
- CAD applications with more sophisticated techniques and tools allow us to explore a building (from outside and inside) during the design phase



Application areas for 3D + GIS: Some examples

• **Education** is a quite good area to use ‘virtual worlds’:

‘The impression of a 3D model scene, where the user can move around and see what’s going on, will be kept in mind much longer than the image of a map or an explanation in words’





Application areas for 3D + GIS: Some examples

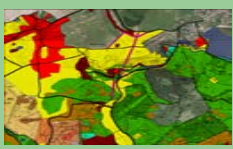
- Virtual reality offers unique possibilities to recreate and explore historic environments. The number of applications of this virtual scenarios in **Education** and **Information** (even in **Tourism** applications) are absolutely wide.



Application areas for 3D + GIS: Some examples

- Some more **Tourism** applications: The case of Prague





Application areas for 3D + GIS: Some examples

- **Training of pilots** to special airplanes and dangerous situations that can be managed much cheaper and more harmless using a computer system
- **Police and Emergency Teams:** recreation of crimes and accidents

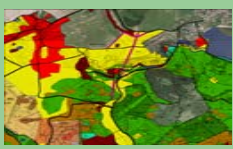


Application areas for 3D + GIS: Some examples

- **Landscape planning and Landscape architecture:**
- How to create a 3D scenario
- Some animations (University of Wisconsin)
 - Fly-through to show existing resources
 - New housing development along the coast
 - Different scenarios



- Multidimensional presentations and multimedia presentations are strongly related
- A lot of different multimedia products or presentations can be linked to a 3D object in a 3D scenario
 - Video
 - Audio
 - Images
 - PowerPoint presentations
 - Documents (*.doc or *.pdf)
 - Html pages
- Geoinformation on Internet!!!



Case study: University of Girona flyover

- Main Objective: to show the several campuses of the university through a flyover
- Participation in educational expositions
- Flyover linked to a competition in order to increase and to encourage an active participation
- [Demo](#)



Case study: The case of Meerstad

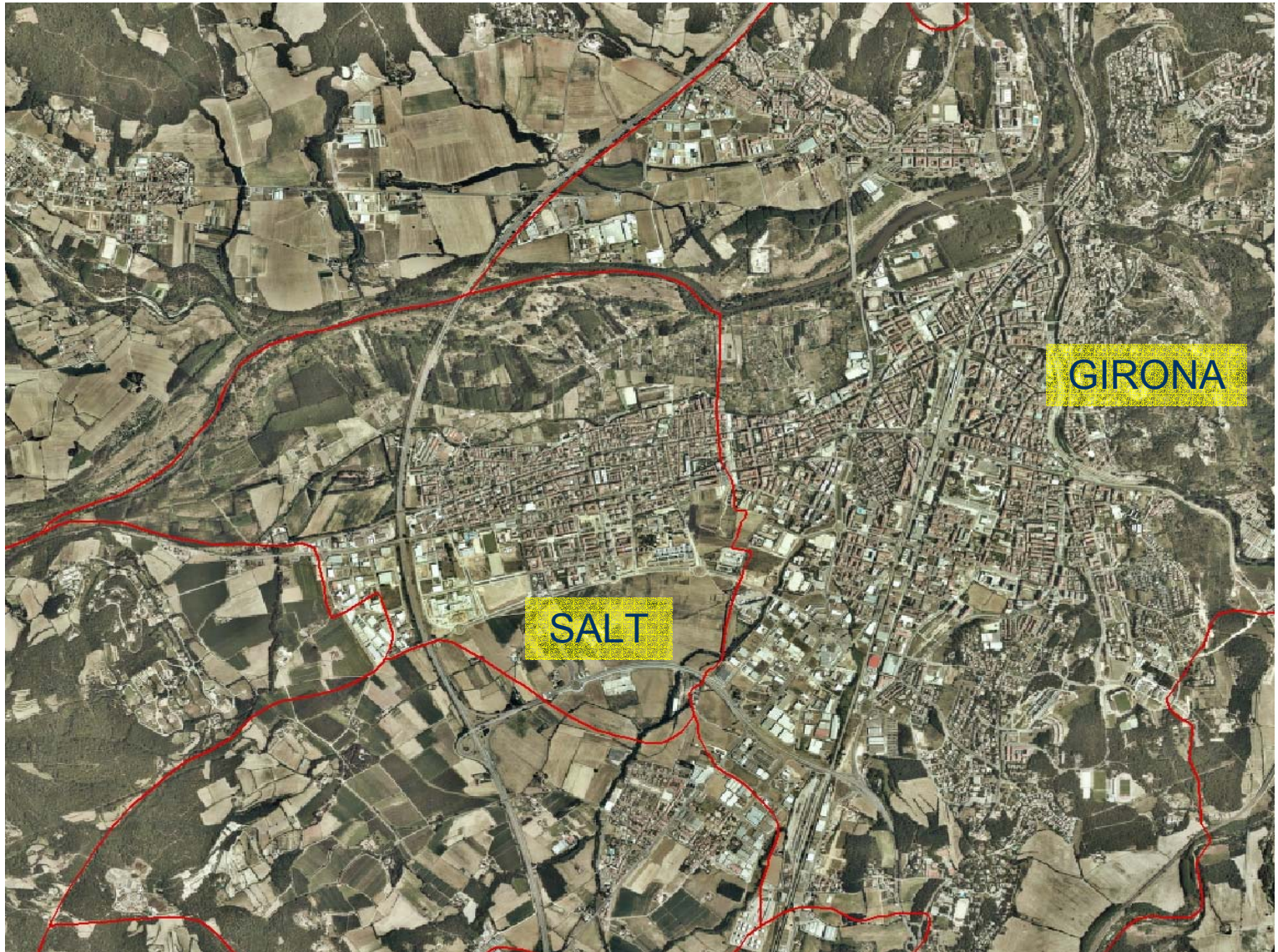
- Main Objective: show future landscape changes due to the planning of a new lake and city within an 700km² area in Groningen
- Spatial Information System integrating GIS + multimedia data + real time 3D visualization for the Dutch Ministry of Agriculture
- Used in participatory processes in urban planning
- Some elements in the scenario are link to multimedia files
- [Demo](#)

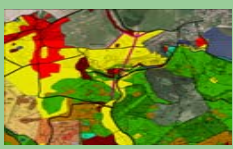


Case study: Salt 70 in PSPE Project (INTERREG III)

Municipality of Salt - **Urban improvement plan**







Causes:

During 60's, Girona was completely overpopulated by migration who came from the south of Spain. Then...

- ... huge urban and demographic growing during 60's & 70's in Salt (migration wave due to the Spanish civil post-war)
- During the last decades of this century, new migration waves take place in Salt coming from Africa, South and Central America, Eastern Europe, Asia...
- Some data about population:
 - 1960: 7000 inhabitants
 - 1970: 11.470 inhabitants
 - 2004: 27195 inhabitants
- Nowadays, foreigner people represents more than 25% of total population (from 73 different nationalities!!)



Results :

- Huge urban growth based on ‘verticality’ and without public spaces neither green areas
- Buildings constructed with ‘poor’ materials
- Several buildings with 6 or 7 (even more!) stories without elevator

Solutions :

53 actions related with:

- Public space and green areas improvement
- Rehabilitation of common elements in buildings
- Provision of public equipment
- Sustainability promotion
- Social, urban and economical improvement programmes, and accessibility and architectural barriers suppression.

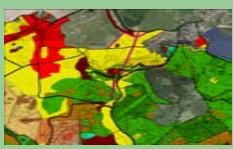


Up to now :

- Compulsory public participation processes in urban planning (by law)
- Participatory processes by ‘show of hands’ sessions during neighbour meetings, use of paper maps, pictures, projects documentation, ...

Results :

- Near chaotic meetings without clear results
- In so, so many cases, using traditional cartography it's quite difficult to identify and recognize an area (and its buildings or elements) and how it will be after a future urban project plan (even for people who use to deal with maps)



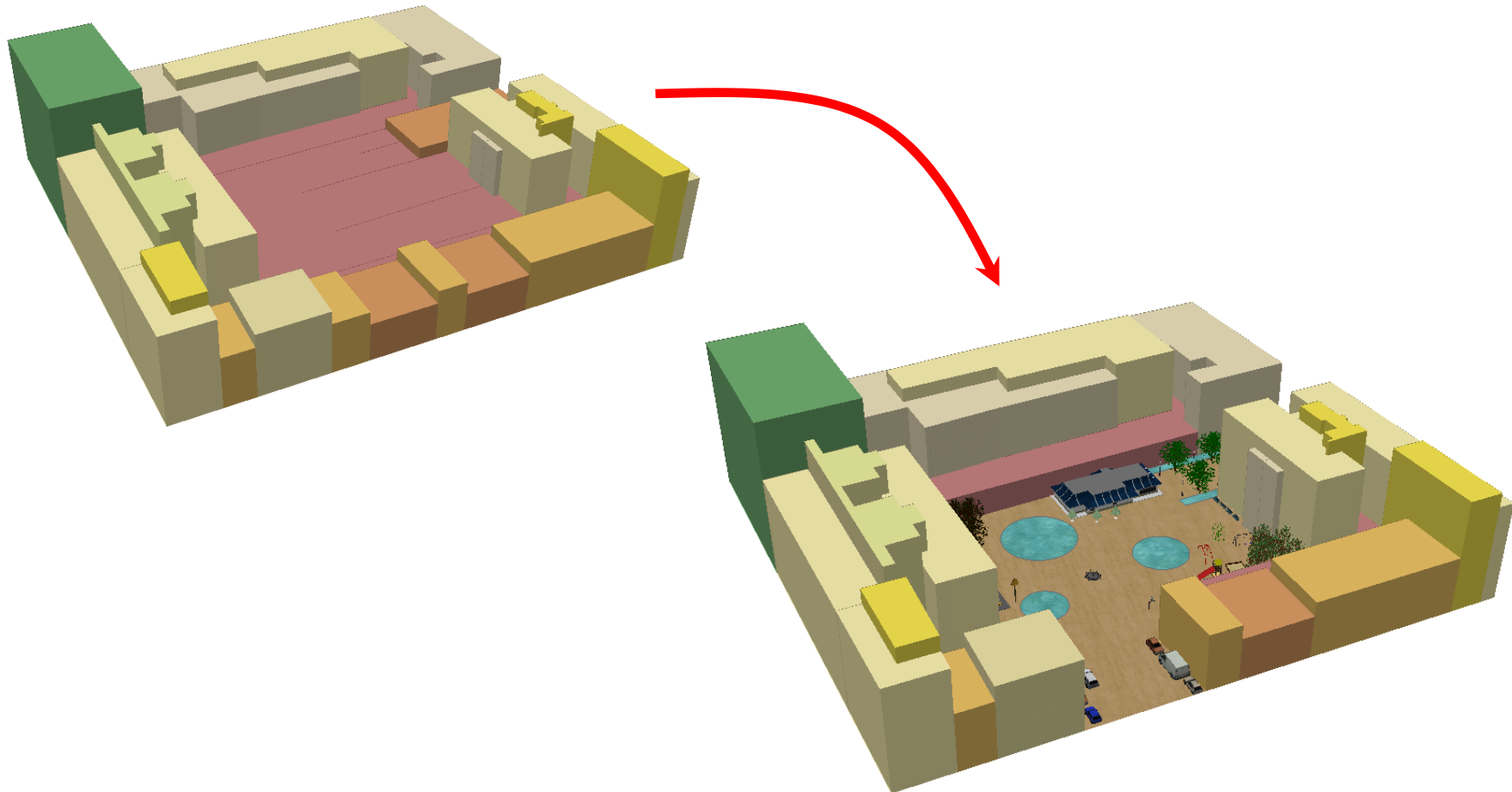
Future plans :

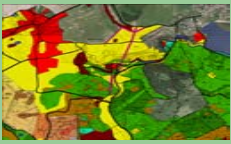
- To compose a flyover with all the new urban projects.
- Encourage an interactive public participation through this flyover.
- Development of interactive participative tools for end users.
 - Audio recording
 - html forms
 - Others, ...
- Demo



Practical exercise:

Design your own 3D scenario





Thank you

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