GIS, Virtual Reality, and Coastal Communities: A Role in Coastal Management

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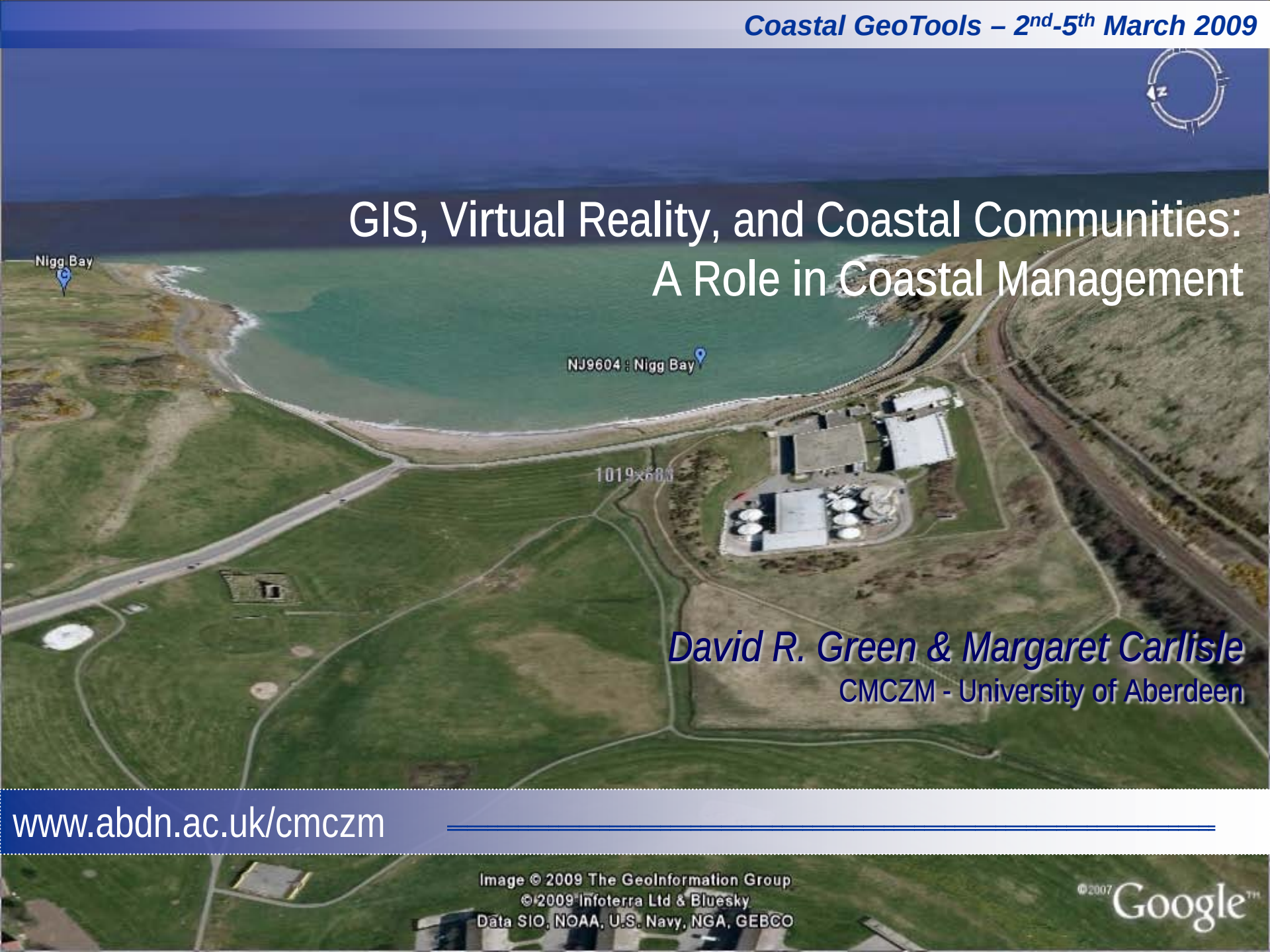
www.abdn.ac.uk/cmczm



Abstract

GIS, Virtual Reality, and Coastal Communities: A Role in Coastal Management

Geographical Information Systems (GIS) and the related spatial technologies have been widely applied in numerous coastal applications. Recent developments in GIS-based visualisation tools now provide a powerful means to provide a wider audience with the opportunity to identify the impact of developments at the coast, become interactively engaged in the planning and decision making process, and consider the outcome of environmental modelling scenarios. Visualisation with the aid of virtual reality (VR) tools provides new ways to provide a more complete and realistic idea of physical, human and environmental changes to coastal environments. Aside from the more expensive and elaborate VR tools available there are now many cheaper alternatives that offer an opportunity to build simulations and scenarios which allow coastal stakeholders to become more actively involved in important coastal issues such as coastal areas at risk from flooding, proposed waterfront developments, user conflicts and marine spatial planning, and the environmental impact of the proposed location of offshore planning applications involving renewable energy. This paper explores the potential of GIS and a number of low cost software tools, including Google Earth (GE), as a means to visualise spatial data and information – both raster and vector – for a number of applications relevant to coastal management. The paper also discusses some of the different ways in which such tools might be exploited and packaged in the future.

Introduction

- GIS and the related spatial technologies have been widely applied in numerous coastal applications, including identifying the impact of developments at the coast, supporting the planning and decision making process, and modelling environmental scenarios.
- Additionally, Virtual Reality (VR) tools have enabled visualisation of such coastal applications, facilitating a more complete and realistic idea of physical, ecological and socio-economic changes to coastal environments.
- Virtual Reality criteria:
    - Dynamism (change over time or in space)
    - Interactivity (ability of the viewer to control the position and field of view)
    - Graphic realism (level of similarity to reality)
    - Immersion (physical involvement in medium)

Examples

Following are some examples of simple GIS/VR applications:

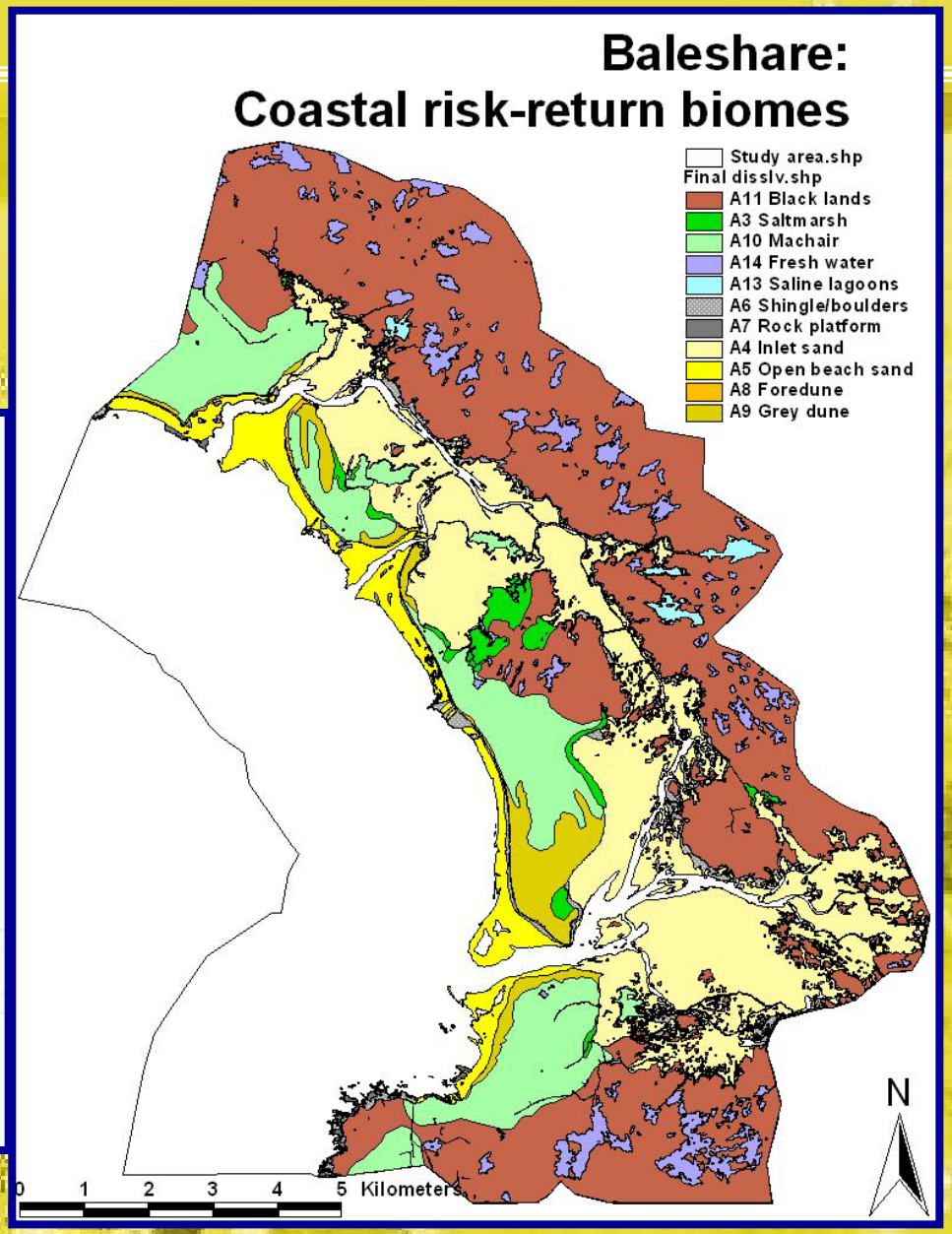
- **Biome mapping in ArcView**
- **Biome display in Google Earth using MapWindow and Shape2Earth**
- **Animated time-series in ArcView/Quicktime**
- **GIS and Waterfront Development in Google Earth and GE SketchUp**
- **Sea Level Rise and Coastal Flooding in Global Mapper and Quicktime**
- **Bathymetry using fully interactive VRML in ArcView**
- **Underwater tour in Google Ocean**
- **Maritime Spatial Planning and Offshore Renewables using Google Earth, GE Sketchup, and Fraps**
- **Weedmat Mapping using Erdas Imagine, ArcView, MapWindow and Google Earth**
- **Virtual Fieldtrips using ArcView, VRML, Google Earth, and Flickr**

Note: Some examples are held on the University of Aberdeen CMCZM website at where they may be viewed *"in action"*. http://www.abdn.ac.uk/cmczm/about.htm

Example 1 – coastal area at risk of flooding

Aim: Biome (habitat) mapping

Tool: ArcView 3.3 GIS



Example 2 – coastal area at risk of flooding

Aim: To overlay biomes onto satellite imagery & DTM

Tools:

- Google Earth GE
- MapWindow (freeware GIS)
- Shape2Earth (low-cost plug-in)

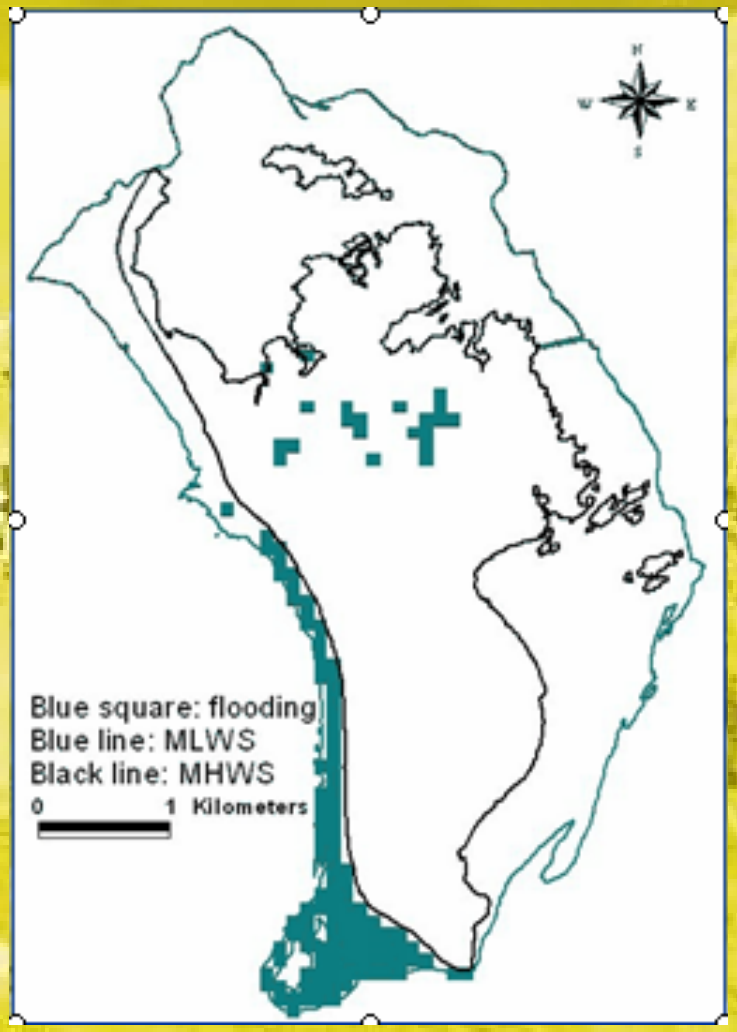
Green: Machair
Yellow: Vegetated dunes

Example 3 – coastal area at risk of flooding

Aim: To visualize flood event of January 2005

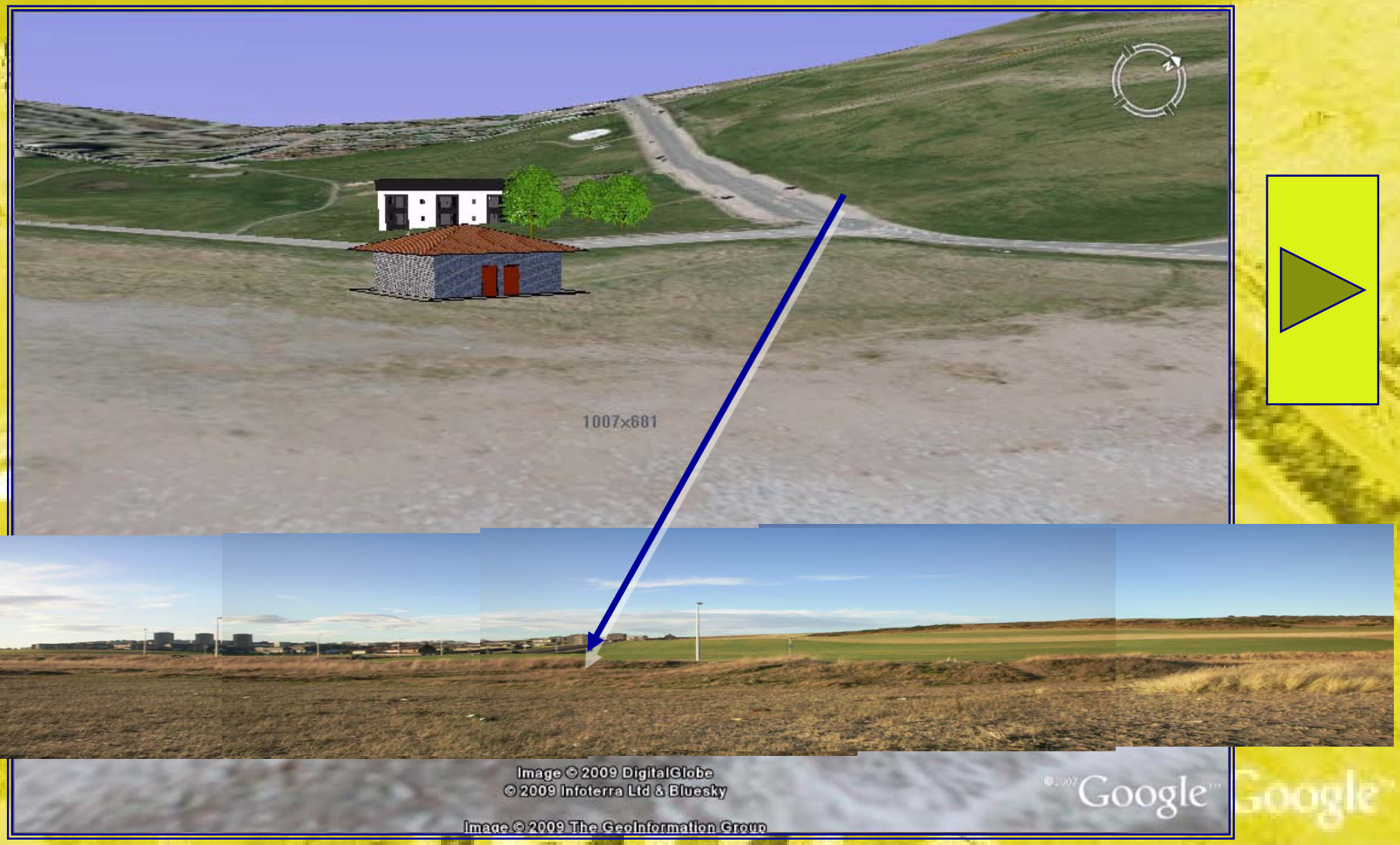
Tools:

- ArcView 3.3
- Irfanview (freeware image display)
- Apple Quicktime (low-cost media player)



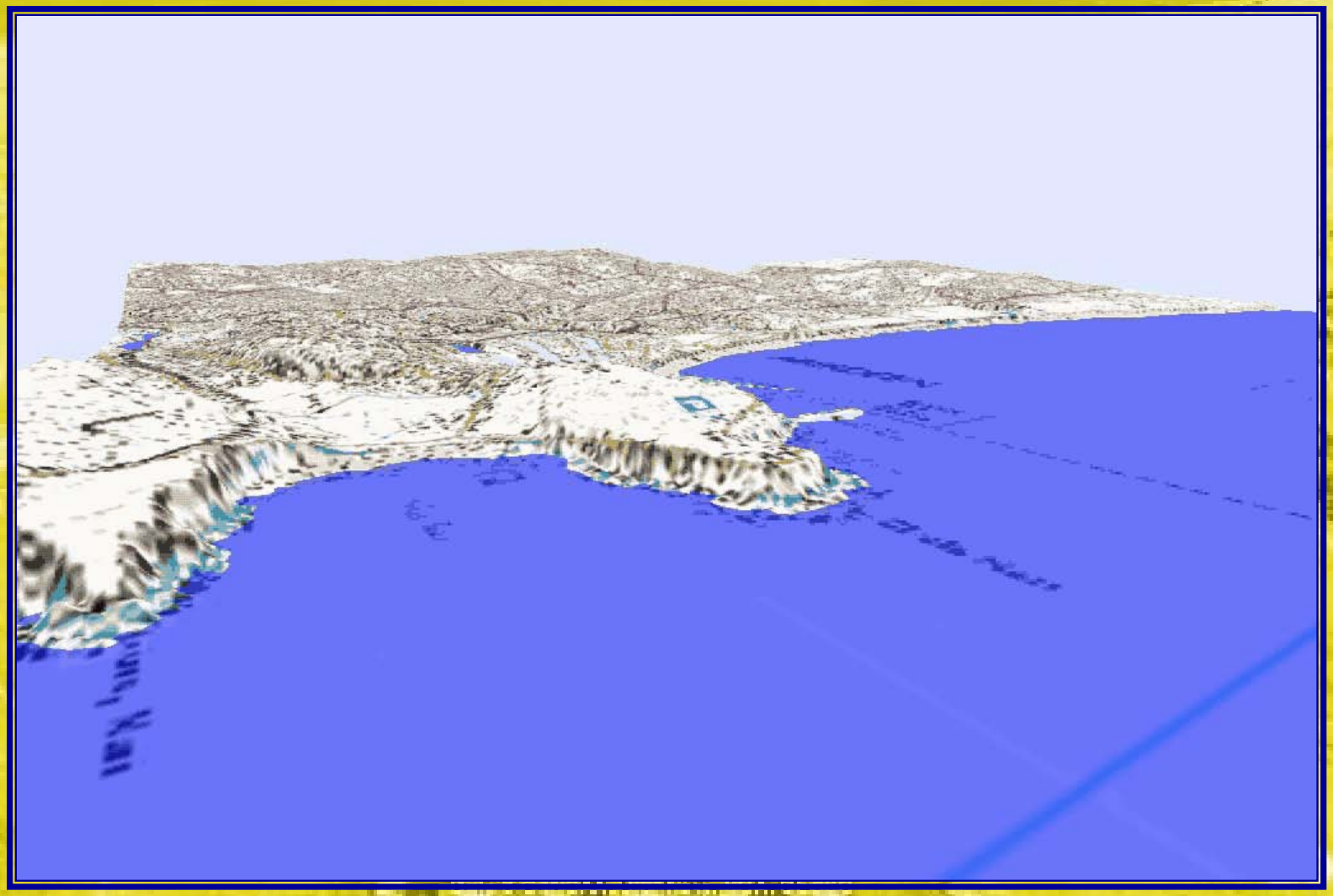
Example 4 – building and waterfront development

Aim: To Visualize Waterfront Regeneration - **Tools**: Google Earth and GE SketchUp



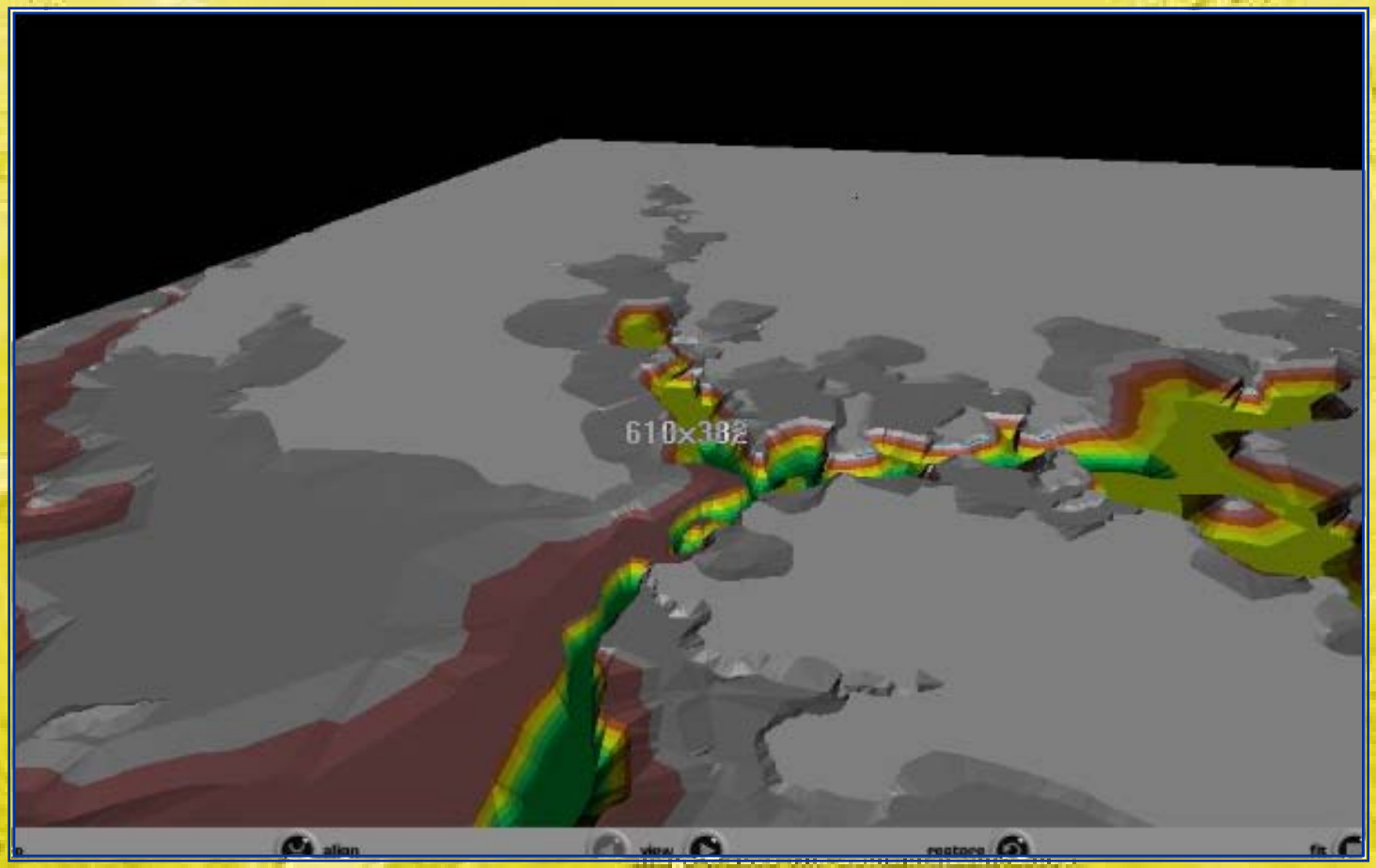
Example 5 – sea level rise and flooding

Aim: To Visualise Climate Change Impact - **Tools**: Global Mapper and Quicktime



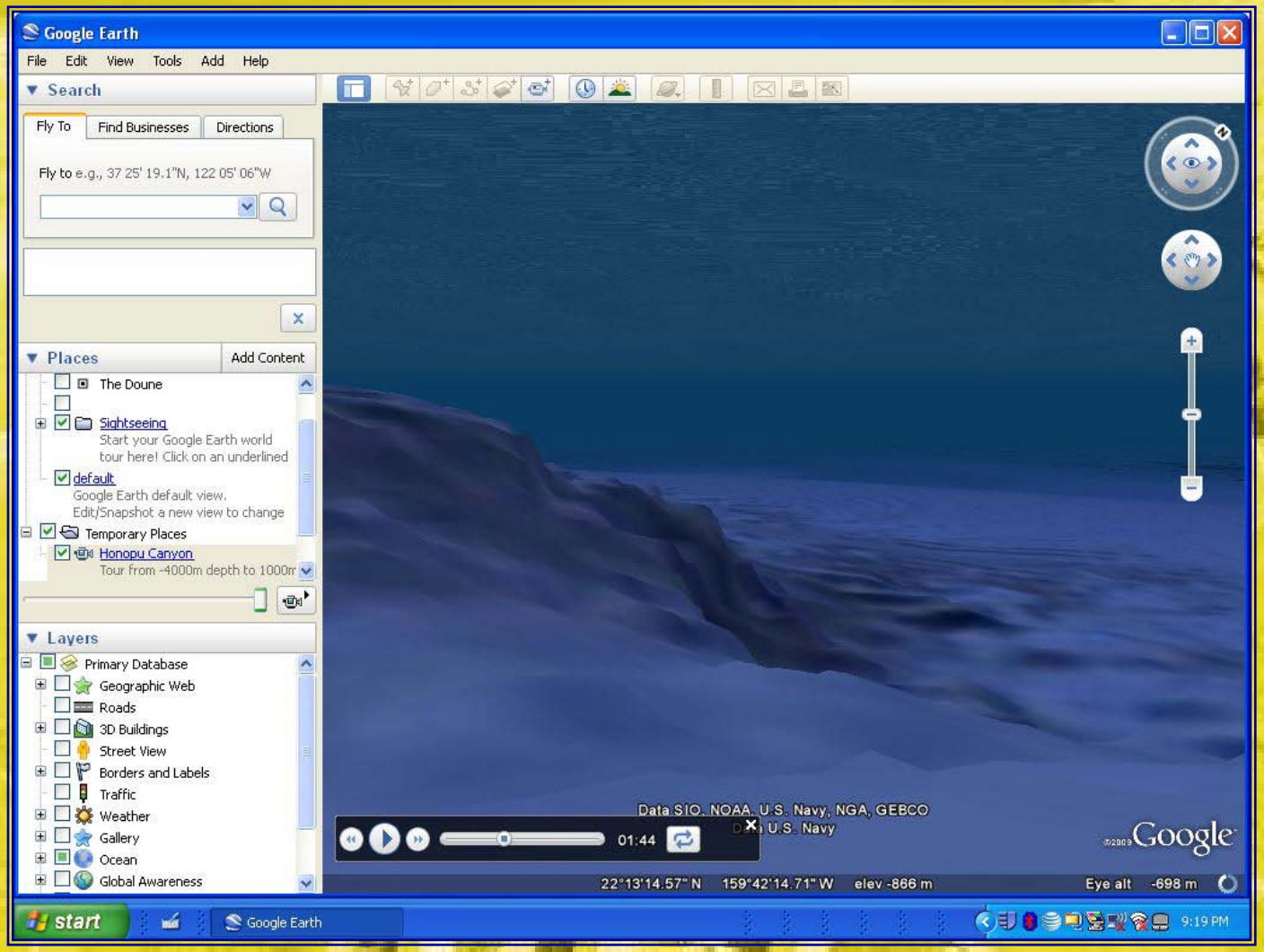
Example 6 – bathymetry

Aim: To visualize bathymetry Tools: ArcView 3.3 & VRML



Example 7 – bathymetry

Aim: To visualize bathymetry - Tools: Google Ocean



Example 8 – maritime spatial planning and offshore renewables

Aim: Visualize Aberdeen Offshore Windfarm Proposal

Tools: ArcView 3.3, Google Earth, MapWindow, GE Sketchup

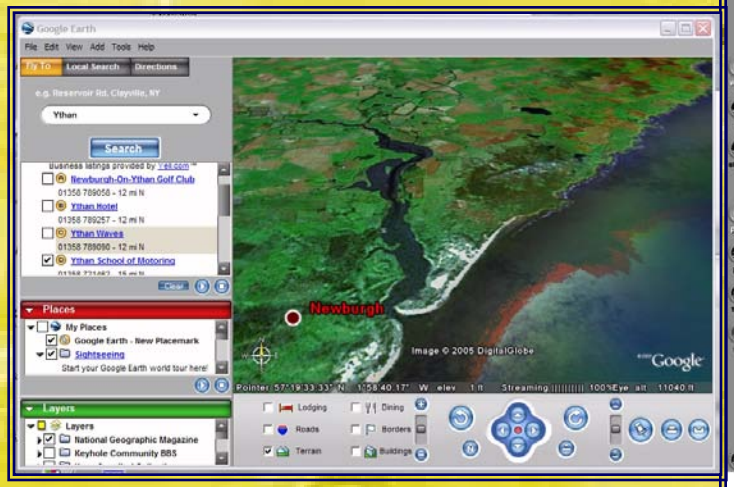
Example 9 – weedmat monitoring and mapping

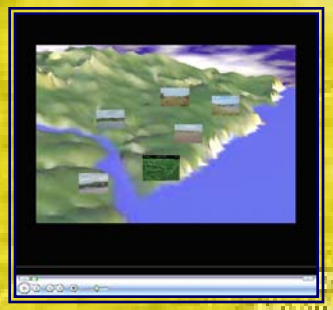
Aim: Visualize Multi-Temporal Macro-Algal Weedmats /Sediment
Tools: Erdas Imagine, ArcView 3.3, Google Earth, MapWindow, and GE Sketchup

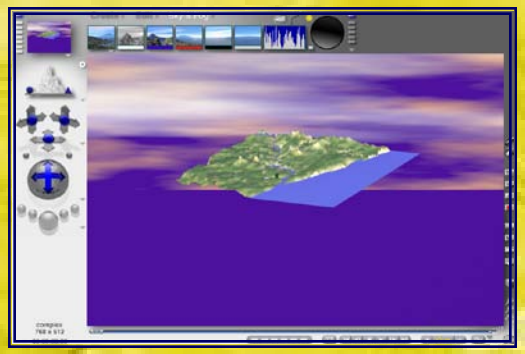
Example 10 – virtual fieldtrips

Aim: Visualize Coastal Environment

Tools: ArcView 3.3, Google Earth, VRML







Conclusions

There are **VR options** to suit every combination of:

- Data availability
- Finance availability
- Technical expertise

The **important criteria** to keep in mind are:

- Accessibility (cheap, ease of use, widespread use)
- Functionality (2D analytical capability, 3D buildings capability, time series capability)
- DTM quality (free, accurate, bathymetric)
- VR quality (interactivity, dynamism, graphic realism)

Conclusions

- Very powerful suite of tools
- Can be combined in various different ways
- Numerous different coastal/marine applications

  - **Education:** Teaching & Training
  - **Research:** Spatial Analysis
  - **Consultancy:** Practical Applications
  - **Management:** Practitioner

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Thank You

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