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The RICS COBRA Conference is held annually. The aim of COBRA is to provide a platform for the dissemination of original research and new developments within the specific disciplines, sub-disciplines or field of study of:

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- Legal aspects of construction and procurement
- Public private partnerships
- Health and safety
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The property industry

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Peer review process

All papers submitted to COBRA were subjected to a double-blind (peer review) refereeing process. Referees were drawn from an expert panel, representing respected academics from the construction and building research community. The conference organisers wish to extend their appreciation to the following members of the panel for their work, which is invaluable to the success of COBRA.

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In addition to this, the following specialist panel of peer-review experts assessed papers for the COBRA session arranged by CIB W113

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Climate change and urban areas: development of a climate change risk and vulnerability assessment tool

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Abstract

Assessment of climate change risks and vulnerability is essential in order to inform and implement appropriate adaptation strategies. Disastrous effects of extreme weather events such as the heat waves across Europe in 2003 highlight the adaptation imperative. Regional spatial planning and urban design can help to reduce the vulnerability of communities to these risks.

The Green and Blue Space Adaptation for Urban Areas and Eco Towns (GRaBS) Interreg IVC project (2008-2011) involves four research institutions and ten European municipalities. GRaBS aims to develop good practice adaptation action plans to help co-ordinate the delivery of adaptation strategies within the project partner's areas. The preparation of these adaptation action plans is informed by an Assessment Tool, which highlights climate change vulnerabilities and risks in urban areas.

This paper reports on the development of the Assessment Tool at the University of Manchester, and the results of pilot and user testing with the GRaBS project partners. The approach is based on the findings of the Adaptation Strategies for Climate Change in the Urban Environment (ASCCUE) project, which implements a risk framework, focusing on the three elements; hazard, vulnerability and exposure. Thus, the Assessment Tool assesses vulnerability of population and infrastructure in urban areas to climate change impacts (in particular flooding and heat stress). It also enables spatially relating patterns of vulnerability with risk where data is available. The tool follows the principles of an on-line Public Participation GIS, and is built using the Google Maps Interface.

The results of the pilot study confirm that the Assessment Tool is seen as innovative, cost effective, intuitive and simple to use and navigate. Furthermore, by helping to visualise vulnerability of urban areas it may be useful in supporting planning of both emergency responses and long-term land use changes.

Key words: Climate change adaptation; urban areas; vulnerability; risk assessment; PPGIS.

1. Introduction

Europe's climate is changing, and temperatures are projected to increase over Europe at levels higher than the global average – by 2-6°C by the end of this century, depending on the greenhouse gas emissions scenario considered (EEA, JRC and WHO, 2008). In addition, precipitation patterns are expected to change significantly, with intensification of recently experienced seasonal and geographical changes, with Northern Europe experiencing wetter winters and drier summers, and southern Europe also experiencing reduced precipitation (EEA, JRC and WHO, 2008). These changes in climate are likely to result in increased incidences of climate impacts such as flooding, drought, heat waves and sea level rise. In addition, the frequency of extreme weather events (floods, storms, droughts) doubled during the 1990s and is projected to continue. Such extreme events, rather than gradual change over long time-periods, cause the most significant risk to humans and natural systems (EEA, JRC and WHO, 2008).

Increasing concern is being raised about the potential impacts of climate change on urban environments. Around 50% of the world's population currently live in cities, a figure expected to increase to over 60% over the next 30 years, with most of the anticipated growth expected in developing countries (Wilby, 2007). With growing numbers of people living in cities, the potential exposure to climate change-related impacts is also increasing.

Urban areas are distinct due to their unique social, environmental and economic characteristics (Gill *et al*., 2008), which change the patterns of energy exchange between land and atmosphere (Bridgman *et al*., 1995). The capacity for heat storage is increased by the mass of construction material and the potential for evaporative cooling is reduced due to less vegetated surfaces. Consequently, there is a cumulative effect from urbanisation which results in significantly higher ambient temperatures than the surrounding countryside; in London for example the difference may be up to 7°C on a warm summer day (Wilby, 2007). This effect is known as the urban heat island (UHI), and is intensified by climate change (Wilby, 2008).

The warming of urban environments in summer is an important issue for human comfort (Wilson *et al.*, 2008). Whilst climate change is likely to reduce winter mortality, there will be an increase in summer mortality associated with heat stress. A recent example is the European summer heat wave in 2003, which resulted in 80,000 excess deaths across twelve European Countries (European Commission, 2008). Therefore cooling the urban environment is a high priority for urban planners and designers (Smith and Levermore, 2008) as the building stock is generally ill-equipped to cope with high temperatures (Hacker and Holmes, 2007). In addition, urbanisation results in altered hydrological processes, with changes in rates and volumes of surface runoff of rainwater, in part due to the altered surface cover of the urban area (Whitford *et al*., 2001), causing increased incidences of flooding. Green and blue spaces can help to mitigate warming effects as urban greening acts to modify heat absorption and emission, thereby altering the urban microclimate (Smith and Levermore, 2008). Green space also reduces surface water runoff and improves infiltration of water into the ground, thereby lowering runoff rates and volumes, and reducing the risk of flooding (Wilby, 2007; Gill *et al*., 2008).

Assessment of risk can help with improving the resilience of urban areas to present climate hazards in addition to providing information to guide strategies to reduce future risks associated with climate change impacts. Risk can be conceptualised through a framework comprising the three elements of hazard, vulnerability and exposure (Crichton, 2001), figure 1. Thus, assessment of climate change risk can be approached through understanding the elements of hazard, vulnerability and exposure, where:

- Hazard is defined as the extent, severity and probability of the hazard of interest (in this case, climate change affected phenomena);
- Exposure refers to the degree to which elements at risk may come into contact with the hazard of interest; and,
- Vulnerability is defined as the susceptibility to damage of the elements at risk to a particular hazard at a particular intensity (as determined by the degree of exposure which could occur) (Lindley *et al*., 2006).

Risk assessment with the use of the hazard – exposure – vulnerability framework is advantageous because it enables consideration of the inherent vulnerability of infrastructure or population, rather than only focussing on impacts (Lindley *et al.*, 2006). The ability to identify locations where vulnerability is high is central to targeting the development of climate change adaptation strategies. Adaptation strategies act to reduce vulnerability by lowering exposure and increasing resilience of elements at risk to climate hazards. Where vulnerability is lowered, the risk associated with impacts of climate hazards is significantly reduced (Lindley *et al.*, 2006).

Figure 1: Risk triangle (Crichton, 2001)

2. The GRaBS project

The Green and Blue Space Adaptation for Urban Areas and Ecotowns (GRaBS) project is a network of leading pan-European organisations involved in integrating climate change adaptation into planning and development at local and regional scales. The project aims to facilitate the much needed exchange of knowledge and experience as well as the actual transfer of good practice on climate change adaptation strategies to local and regional authorities. The project involves four research institutions and ten European municipalities (table 1). One of the aims of GRaBS is to develop a vulnerability and risk assessment tool, which each partner will utilise during the project to inform the development of their Adaptation Action Plans - documents which will help to guide adaptation decision making within their organisations.

Table 1: GRaBS partners

Partner	Location of organisation
Town and County Planning Association (TCPA)*	London, UK
University of Manchester**	Greater Manchester, UK
London Borough of Sutton	Sutton, UK
North West Regional Development Agency	North West region, UK
Southampton City Council	Southampton, UK
Provincial Government of Styria	Styria, Austria
Municipality of Kalamaria	Kalamaria, Greece
KU CORPI	Klaipeda, Lithuania
The Amsterdam City District of Nieuw-West	Amsterdam, Netherlands
Regional Environment Centre for Eastern Europe	Bratislava, Slovakia
Etnambiente SRL	Catania, Sicily, Italy
University of Catania	Catania, Sicily, Italy
Province of Genoa	Genoa, Italy
City of Malmö	Malmö, Sweden

***** Lead partner, with central management, communication and administrative responsibility
** Responsible for developing the assessment tool and a database of case studies

3. Vulnerability, risk and climate adaptation decision tools

A wide range of on-line tools are available for risk assessment and risk management. However, there is debate surrounding what comprises such a tool in relation to climate adaptation (Lindley, 2009). The US Global change research programme states that there must be three core elements to climate change related decision support, incorporating: providing mechanisms through which methods can be evaluated; development of information and other resources that are transferred from a research-based environment to an operational environment; and, assistance for stakeholders to prepare assessments for use within decision-making to inform other relevant stakeholders, the media and general public (Lindley, 2009).

An expert paper conducted for the GRaBS project reviewed a range of existing climate change and risk assessment tools to contextualise and position the GRaBS assessment tool (Lindley, 2009). This review identified the following five main types of tools, which were classified based on their functional elements (Lindley, 2009):

- Risk and adaptation decision-making frameworks (process orientated) – these may or may not include data or links to models and methods for analyzing data;
- Portals or ‘platforms’ for accessing a suite of data, other tools or guidance for risk and adaptation decision-making. This may include manipulating or visualizing data from other sources but does not include the creation of new data in response to user inputs;

- General risk or impact assessment techniques and approaches which can be applied to climate change risk and adaptation assessment;
- High level or screening models where new data are created based on inputs on datasets from one or more offline models. These would usually provide functionality to allow data to be manipulated and analyzed to provide new information which may be in real time; and,
- Detailed models (usually for individual risk themes or sectors) which require considerable data and resource input and often a high level of technical competence.

The review identified that there is currently no existing tool specifically for vulnerability assessment, and therefore, the GRaBS project presents an opportunity to add value to the range of tools available (Lindley, 2009). Whilst some tools offer wider climate change risk assessment and can be considered state-of-the-art, they are focussed on specific sectors or small geographical areas. Further, the review reported a current paucity in tools specifically focussed on cities and associated themes of interest (Lindley, 2009). The expert paper provided a number of recommendations to assist in the development of the GRaBS tool, to ensure that it is innovative and provides a use that is beyond that of existing tools. The recommendations included: to place the tool within a clear risk management and adaptation assessment framework/process; to house the GRaBS tool within a website which acts as a data/tool portal; to ensure that terminology is clear and full documentation is provided for users; to ensure that the functions include those provided in existing tools; and, to consider the possibility of a data upload element in the tool (Lindley, 2009).

4. The GRaBS Assessment Tool

The GRaBS assessment tool is currently being developed at the University of Manchester. This is a free interactive web mapping service, which is being built using the open source MapServer platform. The aim of the GRaBS assessment tool is to develop collaboratively an innovative, cost effective and user friendly assessment tool, to highlight climate change risks and vulnerabilities in urban areas in order to aid the strategic planning and delivery of climate change adaptation responses.

The functional specification of the assessment tool was developed with the GRaBS partners through the completion of a User Needs and Requirements Analysis (UNRA). The UNRA asked each partner to provide information on what they wanted the tool to do, the types of analysis they wanted to complete, and to identify relevant datasets for their particular case study area. The UNRA revealed that users wanted the tool to:

- Map risk and vulnerability to climate change hazards and show spatial distributions;
- Allow map overlay to enable identification of priority areas for adaptation actions;

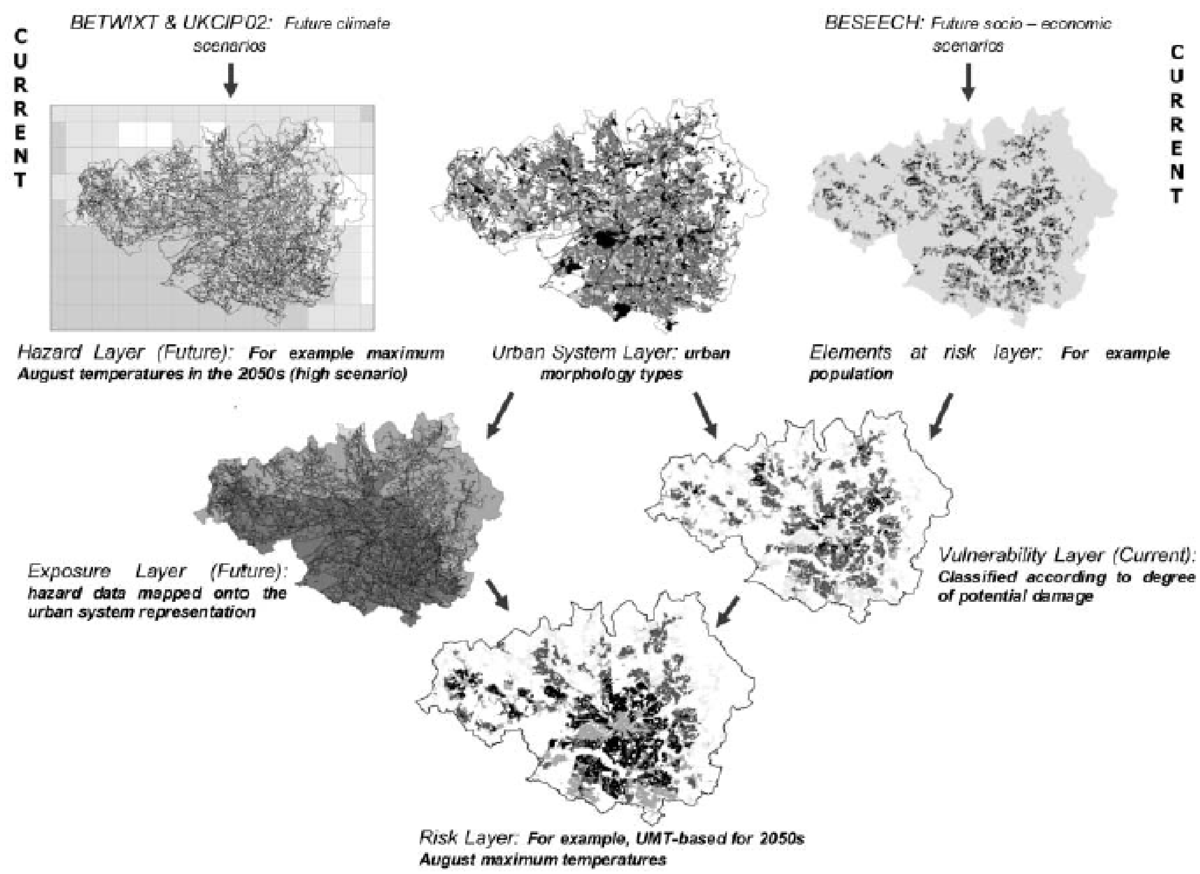
- Identify relative patterns of risk in urban environments;
- Show the severity of the impacts;
- Generate a list of climate hazards and receptors;
- Inform preparation of planning documents to enable accounting of climate change impacts on people, property, assets and infrastructure; and,
- To be fully accessible to all stakeholders online, including residents, developers, local business, utilities and councils.

The tool takes a Public Participatory GIS (PPGIS) approach. PPGIS refers to the uses and applications of geospatial information and GIS technology used by a range of stakeholders including members of the public, individually or within groups, for participation in public processes that affect their lives, and it encompasses data collection, mapping and analysis, often to support the decision-making process (Kingston, 2002; Tulloch and Shapiro, 2003). PPGIS is linked to social theories and methods from planning, anthropology, geography and other social sciences, and enables public access to cultural, economic and biophysical data generated by governments, private sector organisations and academic institutions (Aberley and Sieber, 2002). It has been noted that PPGIS is most effectively applied via partnerships developed between individuals, communities, non-governmental organisations, academic institutions, governments and the private sector (Aberley and Sieber, 2002).

The tool builds on work undertaken for the EPSRC-funded research project, Adaptation Strategies for Climate Change in the Urban Environment (ASCCUE) (Handley and Carter, 2006; Lindley *et al*., 2006; Lindley *et al*., 2007). The ASCCUE project methodology is explicitly spatial in nature, and focuses on representing each element of risk (figure 1) as individual map layers which are overlaid in GIS to build a complete representation of risk (Lindley *et al*., 2007), figure 2. Adoption of this risk assessment approach for the GRaBS tool has several advantages, including (after Lindley *et al*., 2007):

- Promotion of a consistent approach – it promotes a consistent approach between the EU and partner scales of the GRaBS tool;
- Scalability of the methodology – it provides a framework for nested assessments at different levels such as regions and cities down to local levels;
- Flexibility of the method – important in GRaBS where availability of relevant geospatial data varies between partner organisations, and also the ability to incorporate new data as it becomes available; and,
- Communicability - the highly visual outputs provide a useful method to help to communicate ideas about the spatial distribution of vulnerability and risk, and the need for implementation of different strategies in different areas.

Figure 2: ASCCUE layer-based risk assessment methodology (Lindley *et al.*, 2007)



The assessment tool uses the Google Maps application programming interface (API). This is a free service that embeds the functionality of Google Maps into the tool. Thus, analysis functions are built on top of Google Maps, which is used as the underlying map base. Google Maps was chosen from a practical and user perspective, as it works for all of the European partners (who have different proprietary GIS software), it is very simple to use and navigate, and familiar to most users. This is important since many proprietary on-line mapping systems assume that the user has a certain degree of GIS knowledge and an understanding of relevant terminology, whilst analysis of users suggests that they may not (Kingston *et al*., 2010). In addition, the easy ability to click on the map to zoom in and view written information helps the inexperienced user to overcome map-reading problems (Kingston *et al*., 2000).

The tool can be categorized as a high level or screening tool because the data used in the model is processed off-line, and the tool does not involve real-time processing of models (Lindley, 2009). However, the tool enables real-time data manipulation and visualisation and therefore offers functionality which is similar to existing tools considered state-of-the-art in terms of decision support for climate adaptation (Lindley, 2009). In addition to geospatial data, the tool includes a wealth of contextual information contained in pop-out text boxes, including the definitions of key terms, background information, and links to the data sources. Provision of this type of information is important to ensure that terminology is clear and full documentation is provided to the user so they can gain an understanding of the geospatial data being presented and its specific metadata.

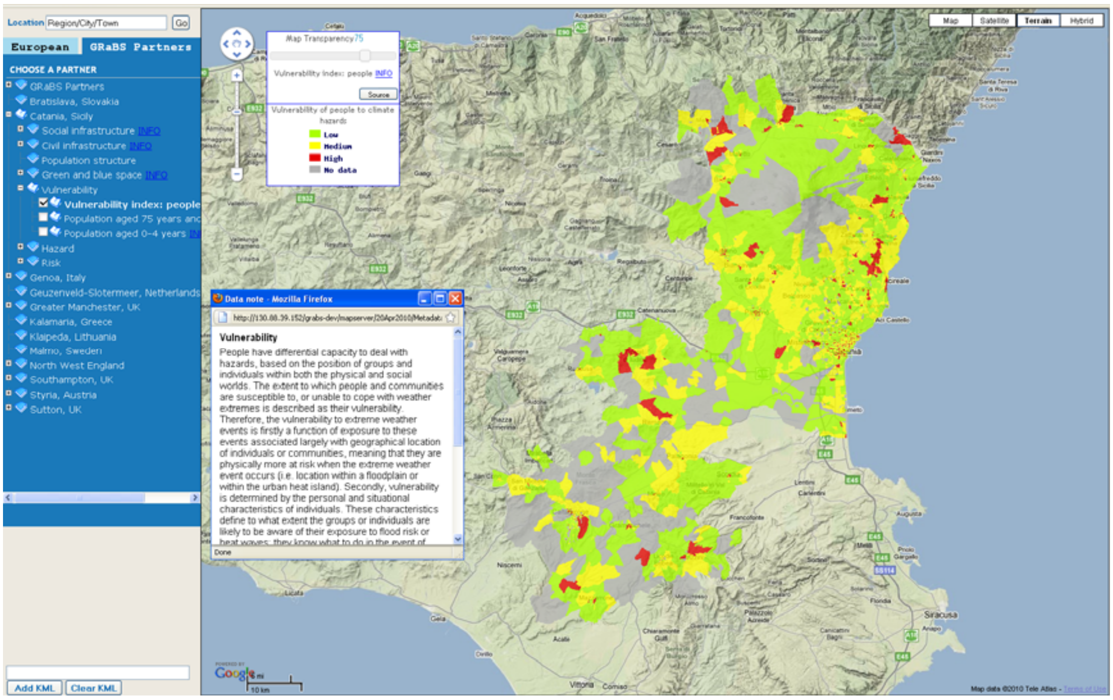
The on-line tool highlights climate change vulnerabilities and risks at a range of spatial scales from EU-wide to neighbourhood. A key element of the GRaBS assessment tool is the handling of the issue of vulnerability as a critical element of climate change risk (figure 1). Vulnerability relates to the susceptibility of elements at risk (e.g. people, critical infrastructure) to climate hazards such as heat stress or flooding (Lindley *et al.*, 2006). Climate change risk is high where vulnerable elements at risk are exposed to climate hazards. The ability to identify locations where vulnerability is high is central to building adaptive capacity and delivering adaptation actions. Associated adaptation strategies act to reduce vulnerability by lowering exposure and increasing resilience of elements at risk to climate hazards. Where vulnerability is lowered the impacts of climate hazards is significantly reduced (Lindley *et al*., 2006).

The GRaBS assessment tool aims to highlight vulnerability to climate change impacts at various spatial scales. The tool has two main levels: European and partner or case study level. At the European level, the tool brings together geospatial information relating to climate change and vulnerability of receptors including populations and critical infrastructure. The GRaBS project is European in scope, and therefore the inclusion of the European level of the Assessment Tool is very important to enable the partners to gain an EU perspective on the issues climate change impacts and of adaptation planning. Also, for some organisations where local scale data is not available, for example relating to climate change impacts, accessing the European level data provides a valuable aid to decision making. Development of the European level of the tool has revealed that open access European-wide data on climate impacts and vulnerability is extremely challenging to source, access and process. There is no existing comparable platform which contains this wide range of data at this scale, and even starting to bring together the widely dispersed data on, for example, population, climate and hazards, is of real value to advancing knowledge and supporting decision making. In addition, it highlights a key paucity in the availability of data at this scale for adaptation planning.

The partner, or case study level, is partner-specific to the GRaBS project, and includes a platform for each of the partners (table 1, excluding TCPA). The detail available at the partner level is dependant on the availability of appropriate geospatial information, which varies widely depending on the geographical area, with some partners having more comprehensive data on vulnerability of people (e.g. all UK partners from census data), whilst other partners have more information on the location of critical infrastructure. Figure 3 shows a screenshot of the partner level of the GRaBS assessment tool.

The tool also includes the ability for users to upload their own data locally, thus extending the functionality and potential application of the tool. This function is also important to ensure the future-usability of the tool, as new datasets can be added as they become available, in addition to enabling users to upload sensitive or restricted data which is not available for public use. The facility for users to upload data locally also enables the visualisation of different scenarios to be quickly and effectively visualised and presented to stakeholders in real time as they develop alternative policy options.

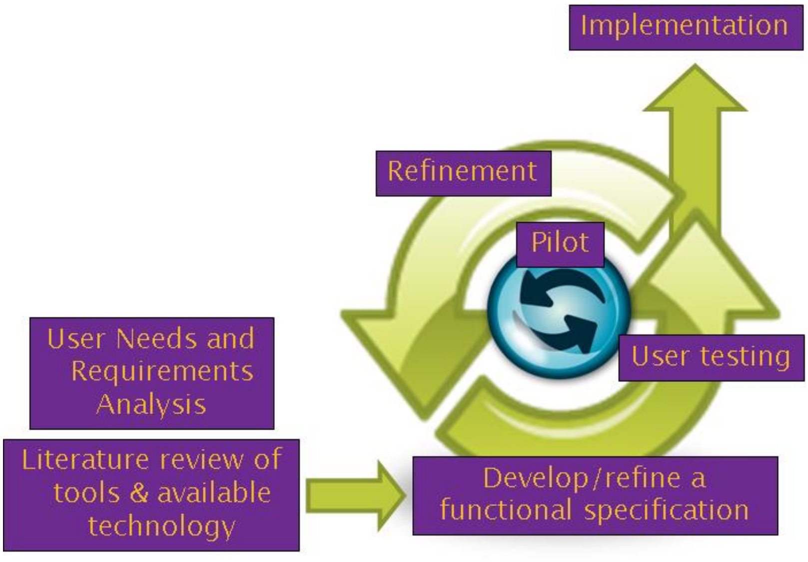
Figure 3: A screenshot of the GRaBS assessment tool (version 1.1) showing the vulnerability of people to climate hazards such as high temperatures in Catania.



4.1 Assessment tool pilot and user testing

Within the GRaBS project, there is a strong emphasis on developing the tool in partnership with all of the project partners, to ensure that the final product is user-friendly, relevant and useful as a decision-aiding tool. The pilot process and user testing are methods by which the project partners can become involved in the development of the tool through testing it during its development, and providing comments and feedback. These comments and feedback can then be incorporated into further developments of the tool in a cyclical process which began with the literature review of other tools available and the UNRA to develop a functional specification (figure 4).

Figure 4: Tool Development



The assessment tool pilot took place during March 2010, with participation from three GRaBS partners. This was followed by user testing during April-May 2010, when all 14 organisations (around 30 people in total) participated. The aim of the pilot and user testing was to test the usability, appearance and functionality of the Assessment Tool platform, which included testing and providing feedback on the functionality, menus, display, data and information.

The Pilot consisted of a "Storyline" for all partners to work through alongside using the Assessment Tool online. Three alternative storylines presented realistic climate change impact situations demanding action from decision-makers and included: the risk of flooding in the London Borough of Sutton; protection of critical infrastructure from climate impacts in Styria; and, risk of high temperatures in Catania, Sicily. The storylines were accompanied by a step-by-step guide, which takes the user through how to use the online tool, its functionality, data and information in the tool, and how the information could be applied to supporting the development of Adaptation Action Plans. Partners worked through one selected storyline, and after familiarising themselves with the tool, they completed a questionnaire, which was designed to provide feedback and comments on the tool menu, functionality, display, and storylines.

4.2 Results of pilot and user testing

The pilot process was undertaken with version 1.0 of the assessment tool, and provided some useful initial feedback before the more comprehensive user testing phase of the tool development. Version 1.0 of the tool was further developed to take account of the pilot comments before the user testing phase, which included: simplifying the menu structure; improving visual aspects of the tool e.g. providing clearer legends, colours and fonts; and, new functions such as data query (enabling the user to view the underlying data values), transparency and removable and collapsible pop-up boxes, providing comprehensive information about the mapped output and data source to provide the user with more flexibility with the display. The remainder of this paper is focussed on the results of the user testing on version 1.1 of the tool following the pilot process.

4.2.1 Ease of use

All GRaBS partners who completed the questionnaire (10 organisations) were familiar with using Google Maps, and 9 out of 10 knew the Windows Explorer menu system. In addition, all partners said that navigating through the levels of menu at the partner level was very easy or easy. This, combined with the fact that only 6 out of 10 respondents were familiar with GIS, suggests that the choice of the Google Maps platform and Windows-like menu for the Tool made it easy to use and navigate and that many simple operations could be performed in an intuitive manner. This validates the choice of using the easy to use and familiar Google Maps platform and windows explorer menu system, and highlights that not all users of the GRaBS tool will have GIS knowledge and experience.

4.2.2 Information included in the tool

Four respondents found the European datasets useful, however, two of the partners found them irrelevant, and four found them neither irrelevant nor useful. This may be associated with the coarseness of data at the European level, which is difficult to scale down to be useful in a spatial planning context. In addition, the organisations may be too focussed on their particular area of interest (in two cases a NUTS 2 level region, while the other eight at NUTS 3 level or lower) to regard information at a higher level useful. Interestingly, the majority (6) of the respondents found the descriptions of European data very useful. This indicates that although the data may be coarse in scale, the European data is not completely irrelevant, and the information provided about the data includes important background information on the issues of climate change, vulnerability and adaptation, including, for example, explaining key terms and highlighting why each layer may be important to consider. Thus, the analysis of the European data may be more challenging and its applicability may be useful for organisations outside the GRaBS partners, interested in comparing between regions in Europe or larger business partners e.g. to infer supply chain issues. This finding also indicates that there is a challenge for organisations that produce EU-scale data, for example the European Environment Agency and Eurostat, in communicating the value and utility of this data at the regional and local scale.

In terms of the amount of information provided, the respondents gave a full range of answers, from "too little" to "too much", but many of them thought that there was not enough information to support their decisions. As we explain in the next section, there is a difficult trade off between the volume of data some users demand and the utility and usability of the tool. This may be associated with the nature of the data included in the tool, which includes publicly available, unrestricted information. Also, many of the partners are still to supply their full set of data and information. The conflict between the sensitivity of data and its public availability is resolved to some extent by a function which allows the user to add their own data in kml format. This function uploads the data locally via a URL link and is therefore not visible to other users of the tool. Seven respondents declared that they were interested in adding their own data to the tool and were likely to use this function.

4.2.3 Tool display and functionality

The tool enables overlay of up to six layers or themes. However, it is recognised that adding lots of new data to the tool can have an impact on its functionality. In particular, users reported problems with analysing and interpreting the output when overlaying more than three layers of data even when the transparency of layers was set to a high level. This refers more specifically to overlaying certain types of themes, in particular, continuous polygon data rather than point and line themes. The function for a user to physically combine data themes to produce a new theme (as would be possible within a GIS) cannot be incorporated within the tool because the MapServer platform converts the proprietary spatial data into an image (png format). This speeds up the map rendering process, and ensures that the user of the tools does not have access to the source GIS data. Thus, the data is analysed offline and the user only views an image of the data. This illustrates the trade-off between speed and GIS functionality that was necessary in the development of the tool, and resulted from the UNRA where users indicated that they wanted to be able to display and analyse complex information and numerous datasets within minutes. However, there are few instances where continuous polygon data needs to be overlaid and interpretation of such analyses can be assisted by appropriate colour schemes employed, but ultimately lies in the capability of the user to distinguish between combinations of colours.

4.2.4 Application of the tool by partners

The application and use of the tool by the partner organisations is affected by the amount, quality and spatial resolution of data. Some of the respondents (4) indicated that the tool may be used for spatial planning. However, the low spatial resolution of some types of data can be an obstacle in applying the tool to spatial planning and urban design where location-specific decisions are being taken. Nevertheless, the tool could be valuable when developing broader spatial planning policies and guidelines. The tool was seen as an excellent means of raising awareness among the public and decision makers, for example at stakeholder workshops, about the issues of climate hazards and vulnerability and a way to visualise “what can happen and what we need to take action on”. This highlights the effective role that PPGIS can play in awareness raising and assisting with education and social learning for new generations (Rambaldi *et al*., 2006).

5. Discussion and conclusion

Feedback from the pilot and user testing highlights that the GRaBS tool is considered a cost-effective, intuitive and simple to use decision-aiding tool for climate adaptation. The GRaBS tool also has great potential in contributing to raising awareness of climate change risks and vulnerability. McCall (2004) notes that it is difficult to overestimate the visual impact of GIS outputs, which is not only the quantity of bits of information that can be summarised in an image (compared to e.g. a written report or tables), but the quality of the information – the clarity, simplicity of distinguishing and ease of making comparisons. Thus, an approach based on PPGIS is ideal for communication purposes.

Some important issues have been raised by other authors in relation to applying a PPGIS approach that are also applicable to the GRaBS tool. Firstly, maintaining the confidentiality of sensitive data, and respect for rights, specifically, the trade-offs involved in maintaining confidentiality whilst optimising access to information by the public (McCall, 2004). The GRaBS tool is a free and open-source tool, which unfortunately conflicts with the licence agreements of many geospatial datasets (both public and private-sector), constraining the amount of data that can be included in the tool. The function to add data locally helps to mitigate this issue to some extent. Secondly, the issue of maintaining the currency of the tool, including updating the data and information, which is a costly and time-consuming undertaking (McCall, 2004). Whilst the importance of ensuring that the development and maintenance of the assessment tool continues beyond the GRaBS project was identified at an early stage by the GRaBS partners, a funding stream through which this could be supported has not yet been secured. Finally, GIS highlights rather than solves data deficiencies (McCall, 2004). This is an important issue, particularly at the local level where on-line mapping enables zooming to a very small-scale and some geospatial data layers may not be accurate enough to be interpreted at this level. This highlights the importance of providing metadata for each dataset in the tool to advise users about each theme.

The tool is still under development with a view to produce the final version in late 2010. Further developments currently being investigated include the potential to incorporate additional functions such as push pins (to enable highlighting of locations of interest) and comment boxes, to enable a more interactive facility, which could be extremely effective when utilising the tool for community participation events. An analysis of how the tool is used by the partners will also be undertaken towards the end of the GRaBS project in 2011.

Appendix: GRaBS assessment tool website

The GRaBS on-line assessment tool can be accessed at www.ppgis.manchester.ac.uk

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