USE OF GEO-ICT TO TACKLE GLOBAL, NATIONAL AND LOCAL ENVIRONMENTAL ISSUES

Urban Governance and Climate Change

How can geo-ICT be used by municipal governments and cadastral organisations to contribute to sustainable urban governance? Based on a review of recent literature and initiatives for registering heat efficiency of houses, heat-loss mapping and the Solar Atlas Berlin, the authors argue that geo-ICT and land administration organisations are vital for sustainable urban governance to assure the integrated sustainability of the policies used to tackle global, national and local environmental issues.

While efforts to avert serious climate change seem to have run out of steam, it has become visibly apparent that the effects of climate change on a global scale can no longer be reverted or even controlled. This has been widely recognised in the wake of the United Nations Climate Change Conferences in Copenhagen (Denmark) in December 2009 and in Cancun (Mexico) in November 2010; the human race must accept climate change and learn to live with it as best it can. Following the Copenhagen accord, it was proposed that by 2020 rich countries should be donating USD100 billion per year to poor countries for investment into climate change mitigation and climate change adaptation strategies in equal measure. In addition to their cash, rich countries are also expected to share their knowledge and experience regarding sustainable urban governance policies and practices, including flood defence, zoning and spatial planning laws as well as land development plans and technological know-how for implementing them effectively.

NORTHERN EUROPE

Northern European cities regularly perform well in terms of sustainability according to the 2012 'Sustainable Cities Report' [1] which was launched at the RIO+20 United Nations Conference on Sustainable Development.

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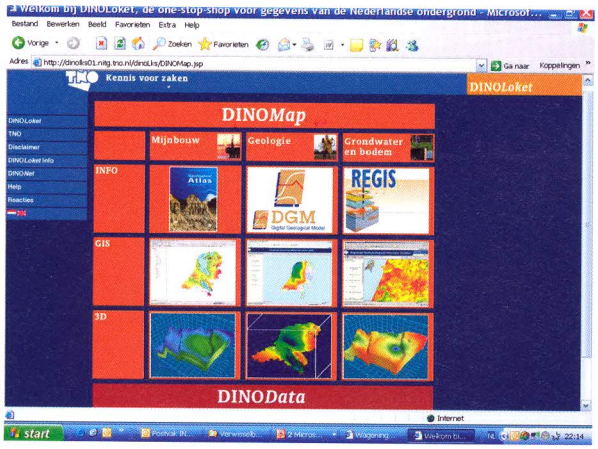
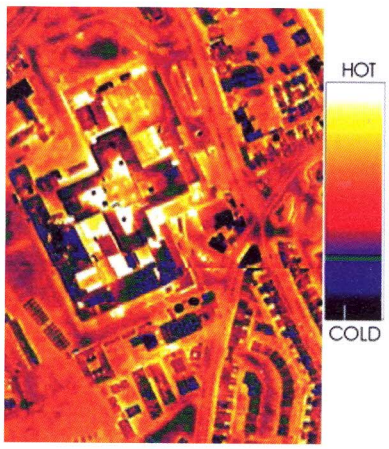
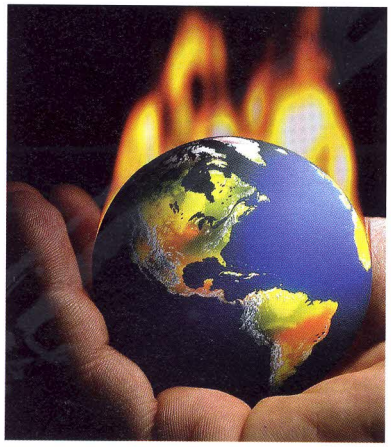


▲ *Figure 1, Dinoloket collates data on soil, groundwater, seismicity and other geodata related to the subsurface of The Netherlands; the public data is freely accessible to everybody.*



▲ *Heat loss of the Royal Free Hospital in Hampstead, London, revealed by thermal aerial image (source: Horton Levi).*



▲ *The human race must not only accept, but also live with climate change as best it can.*

Oslo (Norway) received the European Sustainable City Award in 2003 for example, while Copenhagen has built an excellent track record on environmental issues by combining its strong municipal character with national policies. The Economist Intelligence Unit also named the city as the greenest in Europe. Stockholm, (Sweden) attained the European Green Capital Award in 2010, and Helsinki (Finland) was ranked top for environmental politics in the European Green Cities Index. The city has been lauded for its citizens' awareness of environmental matters and active support of Helsinki's environmental policy, and it also has an excellent record of air quality, waste utilisation and construction. Its energy production is efficient, with 90% of new buildings and refurbishment projects using renewable sources and hence achieving lower emissions. The abovementioned cities have several things in common: (1) a strong municipal vision for the city as a green hub based around economic, social and cultural growth, in line with nature's ability to sustain that growth ecologically; (b) focused efforts on improving transport sustainability, such as policies to encourage 40% of commuters to cycle to work; (3) an integrated administration system based on advanced geo-ICT, consideration of the environment in budgets and excellent planning, reporting and monitoring.

ENERGY LABELS

As one of the signatory parties to the Kyoto Protocol, the Dutch government recognises the urgency and scale of the global climate challenge: taking the year 1990 as the benchmark, its goal is a 30% reduction in greenhouse gas emissions by 2020, preferably as part of a European effort. Since 55% of The Netherlands' land area is susceptible to flooding, the country has to prioritise its monitoring of the average (rising) seawater level, the higher run-off and discharge predictions for the major rivers and extreme precipitation forecasts. However, the government also realises that water management measures should go hand in hand with land use, nature conservation, urbanisation, transport and recreation objectives. Therefore, the National Adaptation Policy employs integrated land-use planning which combines sustainable coastal defence measures with river water systems, sustainable cities, climate-proof buildings and climate-proof agriculture. The Dutch Kadaster supports governmental land acquisition to implement anti-flooding measures and puts its land consolidation expertise to good use in helping the government to improve the agricultural sector's ability to withstand the effects of climate change and to create sub-catchments for river water, for instance. Due to sea-level rise, salt water is penetrating further into the estuaries of the rivers Rhine and Meuse, thus causing higher salt concentrations, and Kadaster provides information to support land-based, anti-salinisation spatial planning.

Since 1 January 2008, Dutch law has stipulated that houses and buildings require an energy label at the time of a sale or rental transaction, indicating the amount of energy consumed during regular use. Kadaster created a new information category for these details, and approximately 50,000 labels have been registered to date. They are open for public inspection, as is all cadastral data. Hence, Kadaster uses geo-ICT to support the government in providing information not only about land tenure, value and use of land and houses, but also about public properties and environmental restrictions on usage, noise, soil pollution and nuisance (Figure 1).

HEAT-LOSS MAP

Up to 25% of heat generated in houses can be lost through roofs, accounting for much of the total energy consumption in urban areas. The resulting higher levels of emissions can contribute to climate change. Using geo-ICT to accurately visualise heat-loss data in buildings can represent the first step towards

georeferenced heat-loss maps which show energy usage at peak times and enable areas with high heat losses to be identified. The article by Hay et al., published in the March 2010 issue of *GIM International*, demonstrates that it is already possible to obtain a free-of-charge, automatic assessment of waste-heat footprints simply by clicking on houses in Google Maps for selected areas of Alberta (Canada). This pilot project, which combines software, hardware, data provision and a web portal, may evolve into a system covering the entire city. Hay et al. state "On entering the site, the user sees a Community HEAT Map overlaid on Google Maps, representing a continuous waste-heat surface defined within the civic boundaries of each community. This surface is created through an interpolation of the average roof top temperatures of each house, which are differentiated according to ten classes, from cold (blue) to hot (red). This scale allows evaluation of multiple communities at a glance." The systems also helps to identify the top 10,000 hottest houses in an area, thus providing planners and policymakers with a firmer foundation for offering incentives and advice, such as sponsoring energy-saving retrofits, highlighting necessary repairs on weaker parts of a roof or verifying the effectiveness of renovations. By entering information about their roof material into a computer model, citizens can determine its ability to radiate absorbed energy, which in turn leads to accurate, and house-specific, energy-consumption and energy-saving advice. Combining a house's measurements, retrieved from the city's cadastral data, with the roof's recorded temperature enables not only an estimation of the heating costs per day using various types of fuel, but also a calculation of the total annual costs and potential savings – both in monetary and carbon-footprint terms.

SOLAR ATLAS BERLIN

Initial calculations for the German city of Berlin suggested that about two-thirds of the entire energy consumption by the city's small businesses could be generated by placing solar panels on roofs throughout the city. These findings led to the creation of the Solar Atlas Berlin, aimed at:

- displaying the location of existing solar installations in the city
- visualising the potential of the solar industry in Berlin
- highlighting rooftops suitable for solar-panel installation.

To calculate the potential for solar energy production, a 3D city model has been developed and integrated in the Solar Atlas. The project description states: "To create the model, the city's about 500,000 buildings in an area of 890km^2 were surveyed using aerial photography, and their roofs were measured with lasers. In addition, detailed models were created for about 80 landmarks, five of which can even be explored from the inside (Olympic Stadium, Sony Center, the Reichstag building, DZ-Bank, and the Central Train Station)." The 3D model allows the solar energy potential to be calculated by combining data on insulation, roof size, potential electricity generation, potential carbon savings, power in kilowatts and investment volume. Owners and investors in real estate, for whom the Solar Atlas has been especially developed, are able to find out how suitable the roof is as a potential source of energy and assess the viability of an investment.

POLICY MEASURES

Supporting governments in encouraging sustainable urban development in view of climate change, cadastres can use geo-ICT to develop focused policy measures in several areas of urban planning and governance, and especially in infrastructure planning, energy efficiency for adaptation to and mitigation of climate change, and green building developments. The specific policy implications are as follows:

- Policymakers should draw on geo-ICT to minimise land-use transitions in urban areas that may be detrimental to the quality of soil, water balance or habitat quality at specific locations
- Cadastres and geo-ICT can provide the spatial information infrastructure for calculating the integrated energy performance of buildings, for sponsoring energy-saving retrofit incentives, for implementing changes in taxation for communities with accurate house-specific energy modelling and high heat losses, and for producing consistent and reliable evaluations of energy use in buildings to ensure compliance with building regulations and for energy-performance certification purposes
- Institutional arrangements, legal frameworks, fiscal incentives, processes, standards and 3D models to support new land development strategies (i.e. land zoning, allocation, evaluation and monitoring for greening real estate markets) and deliver information to citizens and decision-makers should be promoted as key approaches towards developing climate-change mitigation and adaptation policies and sustainable urban governance.

MORE INFORMATION

1. www.sustainablecities2012.com/images/uploads/documents/SC2012.pdf

FURTHER READING

- Berlin Partner GmbH, 2011 Berlin Solar Atlas, vol. 2011, Berlin Business Location Center.
- Hay, G. J., Hemachandran, B., Kyle, C. D., 2010, Home energy assessment technologies: free waste heat footprints, *GIM International*, vol. 24, nr. 3.
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- Van der Molen, P., 2009, Cadastres and Climate Change, Paper presented at the FIG Working Week, Eilat, Israel.