

Open source GIS for archaeological data visualisation and analysis

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Summary: This paper demonstrates how Oxford Archaeology North have successfully adopted open source geospatial software, in particular the desktop GIS packages gvSIG and Quantum GIS (QGIS), in an active move away from proprietary mapping software such as AutoCAD or ArcGIS. Open source GIS has been successfully applied for the visualisation and analysis of archaeological survey data, proving extremely capable of handling 2D and 3D vector and raster data. Oxford Archaeology have successfully introduced the use of open source illustration software, Inkscape, for the editing of vector maps and the production of high-quality publication-standard illustrations.

KEYWORDS: archaeology, open source GIS, Quantum GIS, gvSIG, Inkscape

1. Introduction

At Oxford Archaeology North we have been striving to move away from the use of proprietary software, especially in the geospatial sector of our work. Instead, we aim to use open source GIS software wherever possible, both for data maintenance during the fieldwork stage and for later analysis (Table 1).

Table 1. The transfer to Open Source methodologies within Oxford Archaeology North

<i>Task</i>	<i>Old Workflow</i>	<i>New Workflow</i>
Site survey using Total Station or GPS	Geomatics Department only	Any Archaeologist
Visualisation of archaeological survey data	AutoDesk Map AutoCAD and ESRI ArcGIS	Open Source GIS: gvSIG, Quantum GIS, PostGIS, GRASS
Illustration, figure production for client reports and monographs	Geomatics Department only Adobe Illustrator, InDesign etc. Graphics Department only	Open Source Illustration software Inkscape Any Archaeologist

1.2 Problems

Proprietary software can place archaeological data under the threat of becoming "locked in", as it is usually saved in proprietary formats. For instance, the use of CAD software can present a threat for the archaeological data with its inability to maintain topology.

Our approach has formerly been criticised and the move away from CAD and other proprietary spatial software declared problematic by fellow archaeologists. The main issue we faced was the lack of documentation and training time. Archaeological site survey and GIS is still frequently considered a specialist task, inaccessible to the archaeologist fieldworker. We aimed to eliminate this thinking.

As commercial archaeology usually faces a large amount of time-pressure, it has been argued that teaching staff the use of open source GIS would be time-consuming. It became increasingly clear that having good documentation would lead to more cost effective training methods for staff as well as safer, more sustainable data archives overall.

2. Solutions

In 2009, as part of a large-scale road scheme, we had the chance for the first time, to set up the data visualisation project for the fieldwork phase fully in open source GIS software. We selected our in-house software, gvSIG OA Digital Edition as our desktop GIS package for data visualisation and initial analysis. For extended functionality we used QGIS alongside this.

The gvSIG OA Digital Edition, based on gvSIG 1.10 has been adapted by the company in a way that would make it easier to use, not only within archaeology, but also for other users: some program menus were restructured, installation was made easier and a number of GRASS GIS modules were integrated. In addition, the English language user interface was improved.

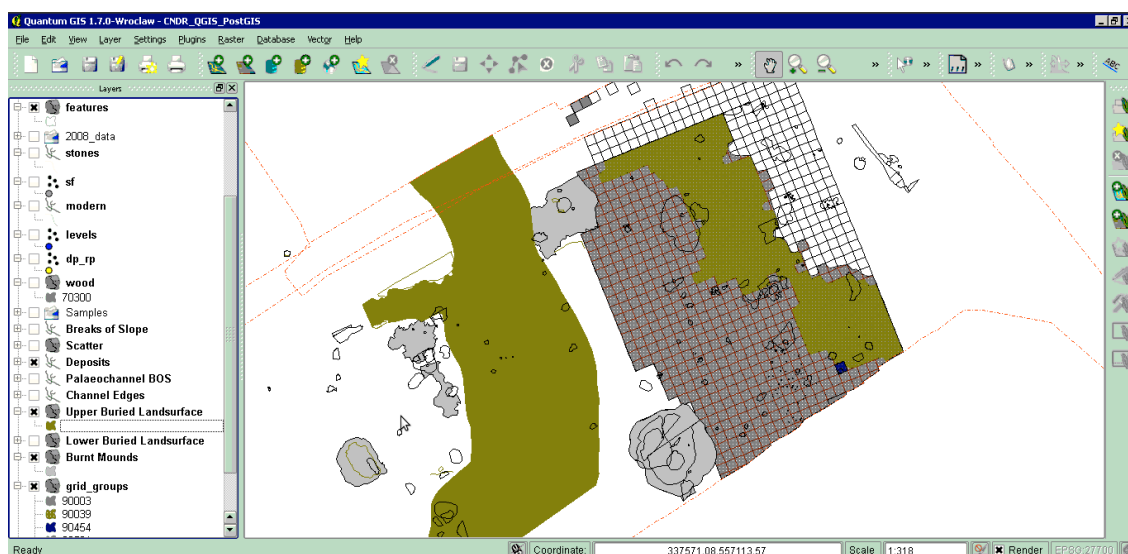
The GRASS GIS inclusion was done at a later stage and integrated a number of commands into the SEXTANTE toolbox, which forms part of gvSIG. This greatly enhanced the software's capabilities through almost eliminating the need for the user to understand and apply the often complicated GRASS setup and workflow, enabling them to use the highly powerful GRASS commands often unavailable in desktop GIS applications. GRASS is often used to convert between different file and vector type formats, copes with CAD DXF data very well, and is powerful when it comes to 3D modelling. Being able to make these customisations is a freedom only granted by open source GIS software.

2.1 The Workflow

After successfully setting up a project on site, the data from previous phases of the same project was exported from CAD in ESRI shapefile format and thus linked to the GIS. We then used the gvSIG OA Digital Edition on a daily basis to import the downloaded survey data, to print maps, make database queries and georeference images, both hand-drawn site plans and hi-view photographs. Some initial digitising was also undertaken (this usually being part of the post-excavation process).

During the excavation, databases were set up in Microsoft Access, as Oxford Archaeology's migration to PostgreSQL databases had not taken place at the time. However, all archaeological databases, both those produced during the fieldwork and the post-excavation stages were later successfully imported into a PostgreSQL database, complete with a spatial PostGIS component (Figure 1).

Figure 1. Archaeological data visualisation in Quantum GIS via PostGIS



3. Documentation

Our on-site work-flow, was documented in detail and released a on online manual (Hodgkinson 2010, see Figure 2), which in turn was tested on site and refined on by using it as training material for staff. This manual would both guide the archaeologist though the steps of setting up their survey equipment and also explain to them the downloading of the data including an introduction to gvSIG, digitising and producing of maps.

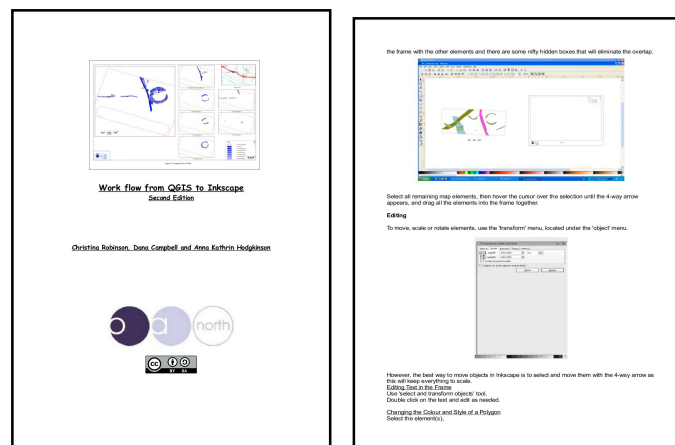
Figure 2. Survey and GIS Manual



3.1 Illustration

Until recently the illustration of of high-quality printable maps for official client reports took place exclusively in proprietary software, as appropriate cartography tools were not available in open source GIS software. However, we developed a further methodology, involving new, improved cartography tools in gvSIG and QGIS, which we combined with powerful open source illustration software, Inkscape, and produced highly satisfying results, which have been used in official reports. Therefore, the Survey and GIS work-flow has been extended, and a second manual has been published focusing on high-quality map illustrations and additional cartographic techniques available in QGIS and Inkscape (Robinson, Campbell and Hodgkinson 2010) (Figure 3).

Figure 3. Survey and GIS Manual



4. Conclusions

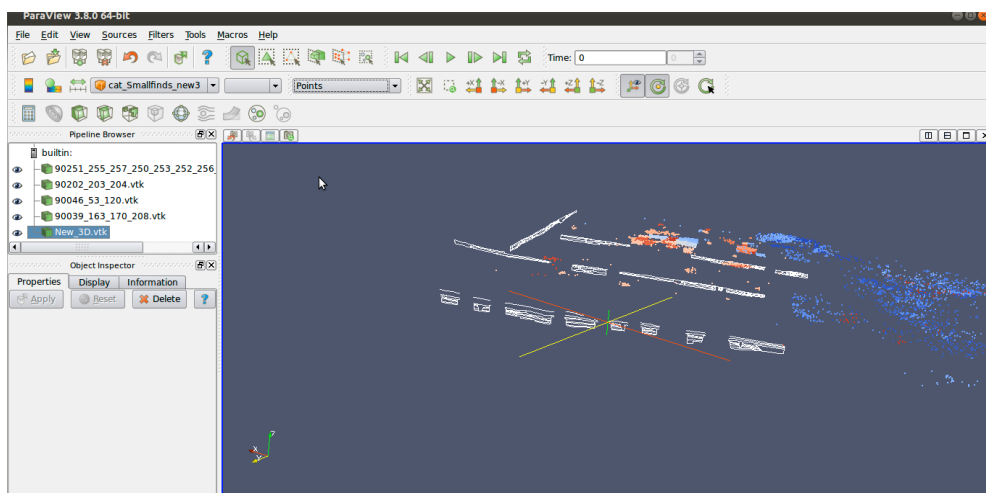
These manuals represent a powerful demonstrator of the potentials of open source software and of open methodologies; both have been published online under a creative commons license, and disseminated widely.

Whilst we were initially faced with a slight reluctance to adopt the new work flow, this has now been overcome, and the last two years have seen an increasing number of our fieldwork projects being visualised using open source GIS rather than CAD. In general we have found that fieldwork project officers and managers are usually more open to adapt whatever technology suits the surveyor best, “works” fast and efficiently, and outputs the desired results. Given the analysis and query capabilities of GIS it has been possible to convince several archaeologists that on-site GIS can help keep track of the data much more efficiently and produce results already during excavation, making the archaeology more accessible to clients and the public. Furthermore, the use of Inkscape by able, but not Illustration-specialised archaeologists, speeds the production of high-quality maps for reports and publications up and may lower staff costs.

We have recently begun to use photogrammetry and other 3D visualisation and analysis methods in connection with archaeological projects. In this process we have also tried to use as many free and open source tools as possible, such as visualisation software Paraview (Figure 4). We are able to import 3D meshes in DXF format into GRASS and convert them to interpolated surfaces using open source software. Nevertheless, we have found that in other (rare) cases CAD is occasionally still necessary for 3D modelling, in particular for building surveys. However, as the open source GIS packages such as GRASS GIS are becoming increasingly capable, even this use of proprietary software may be avoidable.

It can be stated that any file formats encountered in our workflow are compatible with any GIS application, and can easily be made compatible with CAD, should this be required. QGIS, GRASS and gvSIG are able to export ESRI shapefiles as well as DXF files, which can be loaded into CAD, while CAD files can be saved as DXF and imported into GIS. This prevents loss of data and ensures continuity.

Figure 4. 3D modelling in Open Source software Paraview



Since the release of these first two manuals a number of other downloadable resources have been published under the same Creative Commons license. These encompass further documentation on QGIS, PostgreSQL and PostGIS for archeological use (Robinson 2011a, Robinson 2011b), a guide on 3D Visualisation and Analysis (Hodgkinson 2011b), in addition to guidance on different models of survey equipment (Hodgkinson 2011a). A list can be found in the References section of this paper.

These manuals have also been known to be of use outside commercial archaeology, for instance in university teaching, and their adoption within other industries has been encouraged.

Our methodologies and manuals have proven successful, archaeological data maintained within an open source software environment is safer and more sustainable and will be accessible for a longer time.

5. Acknowledgements

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6. References

Hodgkinson, A.K. (2010). *Open Source Survey & GIS Manual*. Documentation. Oxford Archaeology North. <http://library.thehumanjourney.net/367/>

Hodgkinson, A.K. (2011a). *Download of the Leica 700 and 800 series Total Station*. Documentation. Oxford Archaeological Unit Ltd. <http://library.thehumanjourney.net/656/>

Hodgkinson, A.K. (2011b). *3D Visualisation and Analysis of archaeological vector and raster data using open source geospatial software*. Documentation. Oxford Archaeological Unit Ltd. <http://library.thehumanjourney.net/659/>

Robinson, C., Campbell, D and Hodgkinson, A.K. (2010). *Archaeological maps from qGIS and Inkscape: A brief guide*. Documentation. Oxford Archaeology North. <http://library.thehumanjourney.net/366/>

Robinson, Christina (2011a) QGIS Handy Hints. Documentation. Oxford Archaeological Unit Ltd. <http://library.thehumanjourney.net/657/>

Robinson, Christina (2011b) Basic introduction into pgAdmin III and SQL queries. Documentation. Oxford Archaeological Unit Ltd. <http://library.thehumanjourney.net/658/>

7. Software Sources:

gvSIG OA Digital Edition: <http://oadigital.net/software/gvsigoade>

gvSIG Community Edition: <http://www.gvsig.org/web/>

Quantum GIS: <http://qgis.org/>

PostGIS: <http://postgis.refractor.net/>

PostgreSQL: <http://www.postgresql.org/>

GRASS GIS: <http://grass.fbk.eu/>

Inkscape: <http://inkscape.org/>

Paraview: <http://www.paraview.org/>

8. Biography

Anna Hodgkinson works as a Geomatics Supervisor by Oxford Archaeology North. Her

responsibilities cover field survey and analysis of archaeological GIS data, in addition to the training of fellow staff.
She is furthermore undertaking a PhD in Egyptian Archaeology at the University of Liverpool.