

Recent results from a continuous wave stepped frequency GPR system using a new groundcoupled multi-element antenna array

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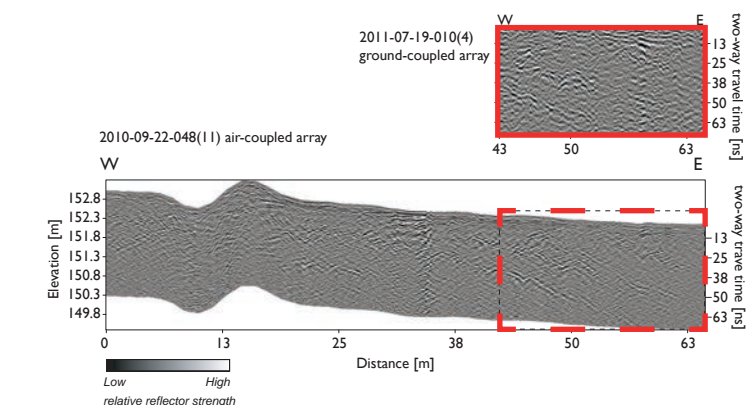
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Introduction initial results are presented from a new vehicle towed multi-channel ground coupled antenna array, using a 3d-Radar GeoScope MkIV continuous wave stepped frequency (CWSF) GPR. Trials with a G0605¹ and G1922 ground coupled prototypes compared favourably to previous results using an air coupled V1822 array,² showing improved depth penetration (red boxes)

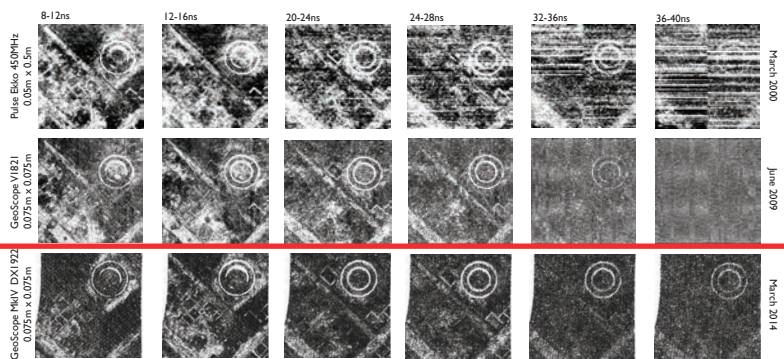
Methodology following improvements to the initial design a production DXG1820 array has been tested on a range of sites. Data was collected from all 20 antenna elements, spaced 0.075m apart across a bandwidth of 60MHz to 3GHz with a frequency step of 4 to 10MHz depending on site conditions.

Results initial trials concentrated on sites with waterlogged soils where the ability of the ground coupled antenna and wide bandwidth would be fully tested, followed by extensive high sample density (0.075m) surveys over a range of site types (*see overleaf*).

Conclusion ground coupled antennas have improved energy transfer to the subsurface over typical archaeological site conditions in England (water logged soils). This has increased the depth of penetration compared to the previous air coupled array used with this system and allows rapid data acquisition (1ha/hour @ 0.075m x 0.075m sample density 60MHz to 3GHz bandwidth). Whilst this provides detailed, large area GPR coverage it has been necessary to develop software to process the resultant data sets during field acquisition together with semi-automated anomaly detection abstracting vector outlines of significant responses.



Silchester Romano-Celtic Temple GPR test grid



¹ Linford, N, Linford, P and Payne, A 2012 'Stonehenge Monument Field And Barrows, Wiltshire, Report On Geophysical Surveys, September 2010, April And July 2011'. English Heritage Research Reports Series 34/2012

² Linford, N, Linford, P, Martin, L and Payne, A 2010 'Stepped-frequency GPR survey with a multi-element array antenna: Results from field application on archaeological sites'. Archaeological Prospection, 17 (3)

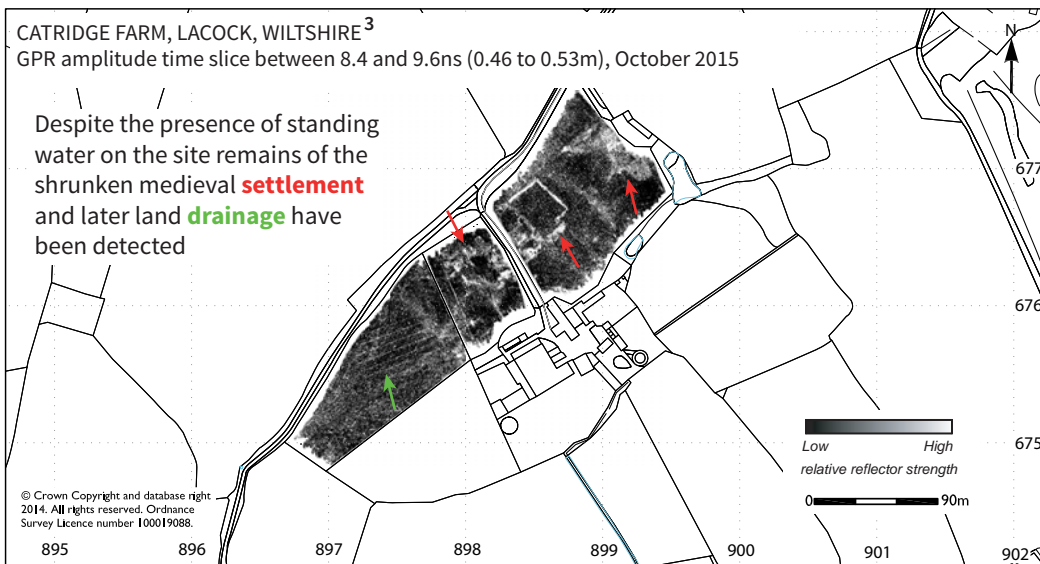


Historic England



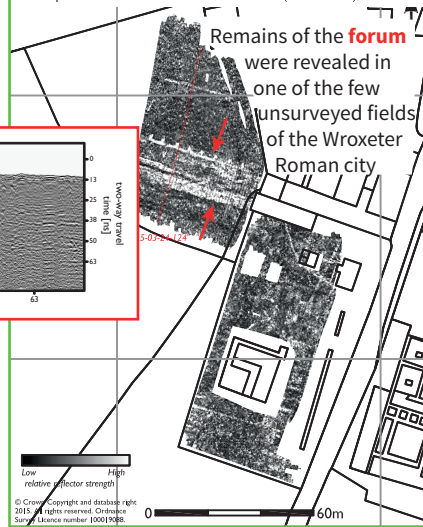
CATRIDGE FARM, LACOCK, WILTSHIRE³
GPR amplitude time slice between 8.4 and 9.6ns (0.46 to 0.53m), October 2015

Despite the presence of standing water on the site remains of the shrunken medieval **settlement** and later land **drainage** have been detected



Software has been developed to allow in field processing of the data during acquisition - individual **profiles** and full georectified amplitude **time slices**. One advantage of the CWSF system is the ability to **suppress RF** interference where this may obscure the identification of significant anomalies.

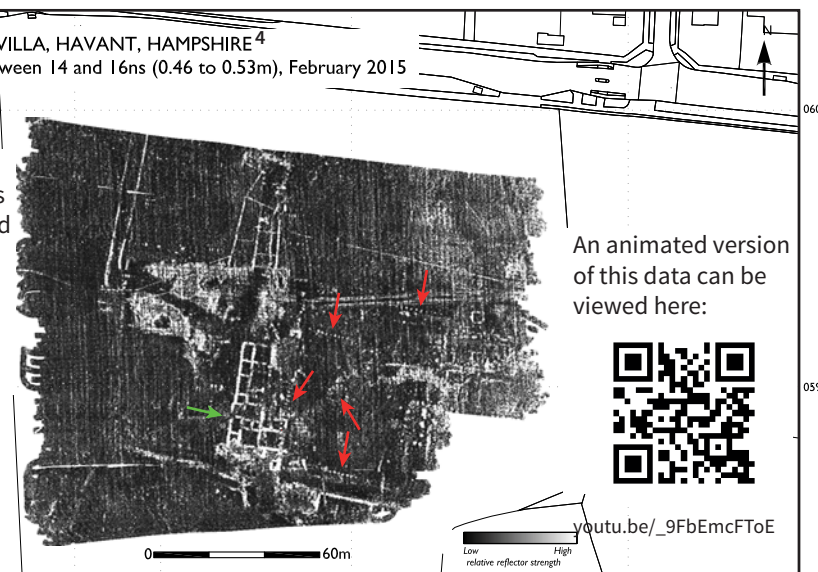
WROXETER ROMAN CITY, SHROPSHIRE⁵
GPR amplitude time slice between 19.4 and 21.9ns (0.84 - 0.95m), March 2015



Remains of the **forum** were revealed in one of the few unsurveyed fields of the Wroxeter Roman city

WARBLINGTON ROMAN VILLA, HAVANT, HAMPSHIRE⁴
GPR amplitude time slice between 14 and 16ns (0.46 to 0.53m), February 2015

Extensive Roman remains, including lines of **post holes**, enhanced earth resistance data at this water logged site and suggested a more complex phasing to the **main villa**



An animated version of this data can be viewed here:

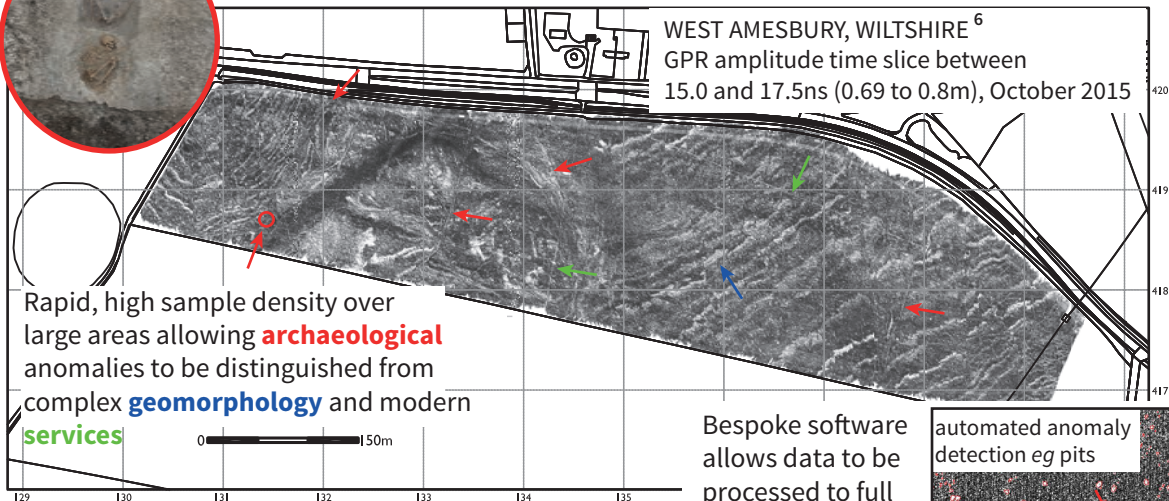


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inhumations excavated from the site of a bifurcated prehistoric ditch identified in magnetic and GPR surveys

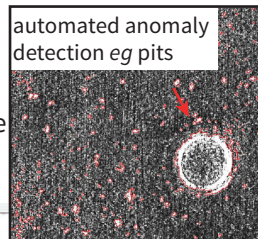


WEST AMESBURY, WILTSHIRE⁶
GPR amplitude time slice between 15.0 and 17.5ns (0.69 to 0.8m), October 2015

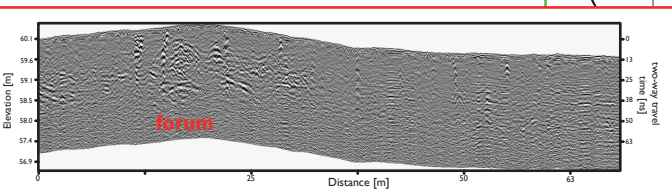
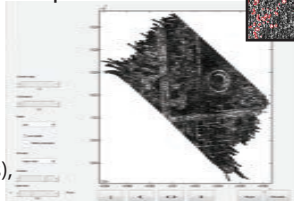


Rapid, high sample density over large areas allowing **archaeological** anomalies to be distinguished from complex **geomorphology** and modern **services**

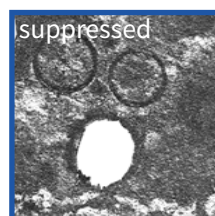
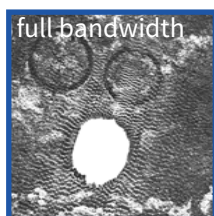
Bespoke software allows data to be processed to full georeferenced time slices during field acquisition^{7,8}



subsequent analysis allows abstraction of specific anomalies



RF interference from a 450MHz GPS base station modem has been suppressed



³ Linford, N, Linford, P, Payne, A and Caswell, E 2015 'Catridge Farm, Gastard, Lacock, Wiltshire: Report on Geophysical Survey October 2014'. Historic England Research Reports Series 4/2016.
⁴ Linford, N 2015 'Warblington Roman Villa, Havant, Hampshire: Report on Geophysical Survey, February 2015'. English Heritage Research Reports Series 82/2015.
⁵ Linford, N and Linford, P 2015 'Wroxeter Roman City, Shropshire. Report On Geophysical Survey, March 2015'. Historic England Research Reports Series 81/2015.
⁶ Linford, N, Linford, P and Payne, A 2015 'Stonehenge Southern WHS Survey, West Amesbury, Wiltshire, Report On Geophysical Surveys, October 2015'. Historic England Research Reports Series 95/2015.
⁷ Sala, J and Linford, N 2012 'Processing stepped frequency continuous wave GPR systems to obtain maximum value from archaeological data sets'. Near Surface Geophysics, 10 (1), 3-10.
⁸ Linford, N 2014 Rapid processing of GPR time slices for data visualisation during field acquisition. In Lambot, S, Giannopoulos, A, Pajewski, L, André, F, Slob, E and Craeye, C (Editors), Proceedings of the 15th International Conference on Ground Penetrating Radar 2014