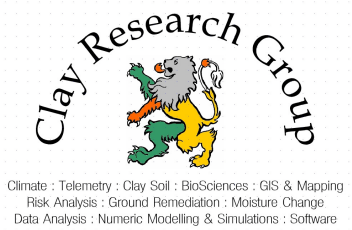
The
Clay Research Group

RESEARCH AREAS

Climate Change : Data Analysis : Electrical Resistivity Tomography
Time Domain Reflectometry : BioSciences : Ground Movement
Soil Testing Techniques : Telemetry : Numerical Modelling
Ground Remediation Techniques : Risk Analysis
Mapping & GIS : Software Analysis Tools
Intelligent Systems : Remote Monitoring
Electrokinesis-osmosis



December 2015

Edition 127

The Clay Research Group

CONTENTS

Issue 127, December, 2015

Thank you to ...

Our thanks to Aldenham School for allowing continued access to the research site and contributors to the newsletter in 2015 including Richard Driscoll, Peter Osborne, Tony Boobier and others. Also to Birmingham and Keele Universities for sharing their research in the area of subsidence and to Aston University for hosting the annual subsidence conference. Our thanks to Innovation, our major sponsors, to Crawford & Company for meeting the cost of precise levelling and a number of colleagues for their input and support. Our thanks are also due to colleagues in the industry who host copies of the newsletter on their web sites or alert their members to new releases (Gary Strong of the RICS in particular).

December Already

Storm Desmond has broken all records for the amount of rainfall in a 24 hour period and Cumbria has suffered extensive flooding.

Our prediction for 2016? Obviously far too early to say with any accuracy but our thinking at the moment is that we are unlikely to see any significant increase in subsidence claims next summer. El Nino and warming have increased atmospheric moisture and precipitation, delivering wetter summers. Trees - the cause of the majority of claims - are being watered even if the temperature is rising.

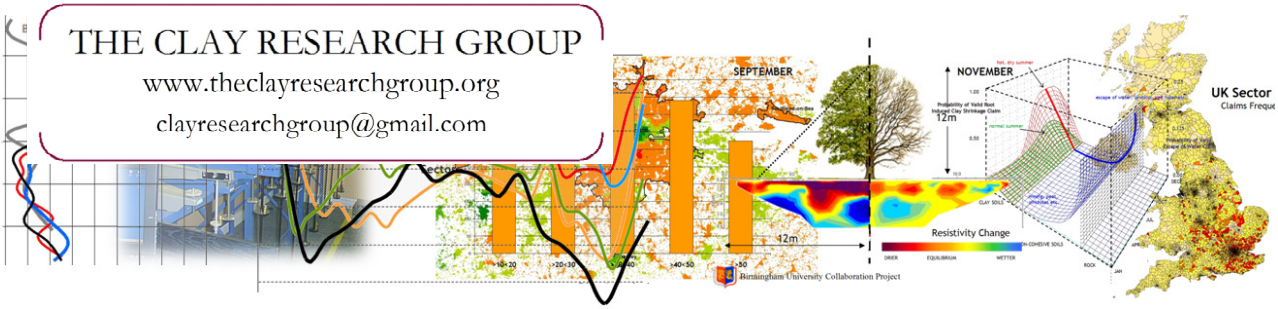
Academic Calendar

Another PhD student has benefitted from access to the Aldenham site. Tom Clinton from Birmingham University completed his work on the electrokinesis osmosis (EKO) treatment of clay soils just before the Annual Aston conference. More details inside.

An application for EPSRC funding (see edition 120 of the newsletter) by a consortium of 13 universities (including Birmingham and Keele and supported by the CRG) was unsuccessful unfortunately but the team will almost certainly be re-applying shortly.

The Year Ahead

The objective for 2016 is to complete our series on AI and provide examples of how it integrates with the more practical aspects of claims handling.



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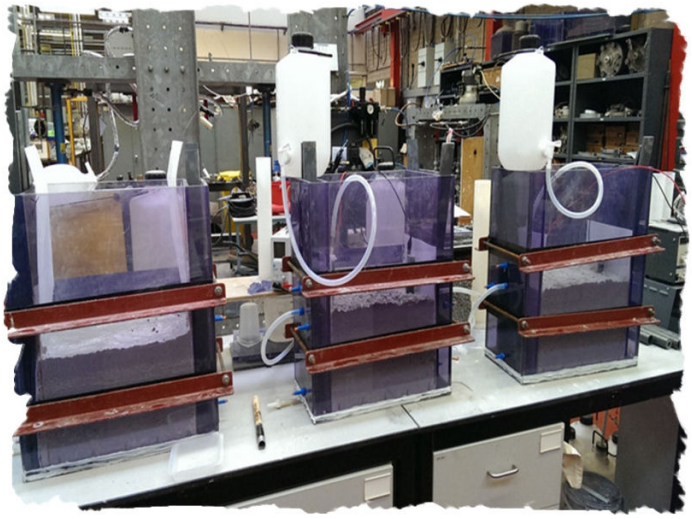
EKO research at the Aldenham site

Photographs courtesy Professor Ian Jefferson, Birmingham University

The work described here formed the basis of Tom Clinton's PhD thesis under the supervision of Professor Ian Jefferson from Birmingham University.



Test cells were established in the soils laboratory at Birmingham University

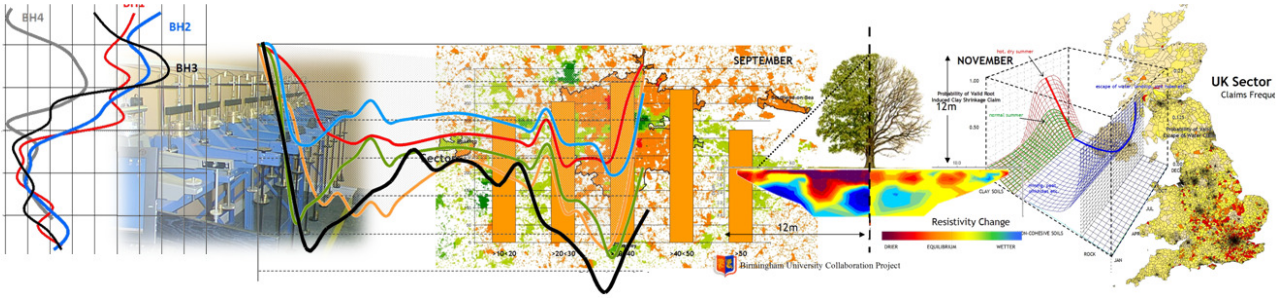
The benefits of stabilising shrinkable clay soils by passing an electrical charge through the soil, carrying with it stabilising fluids, has been used in geotechnics for some while.

The objective of this exercise, at least in the context of benefiting the resolution of domestic subsidence, lies in avoiding the shrinkage that usually accompanies treatment.

Tom started his work in the laboratory at Birmingham, filling tanks with clay soil (above), inserting probes and measuring electrical resistivity and the suitability of a range of chemical treatments.

The next phase involved setting up test beds on the site at Aldenham.

To compare how the ground responded to different electrode arrays and treatment fluids, four pads were constructed. One of the four was a control with no treatment applied.



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EKO research at the Aldenham site

Photographs courtesy Professor Ian Jefferson, Birmingham University

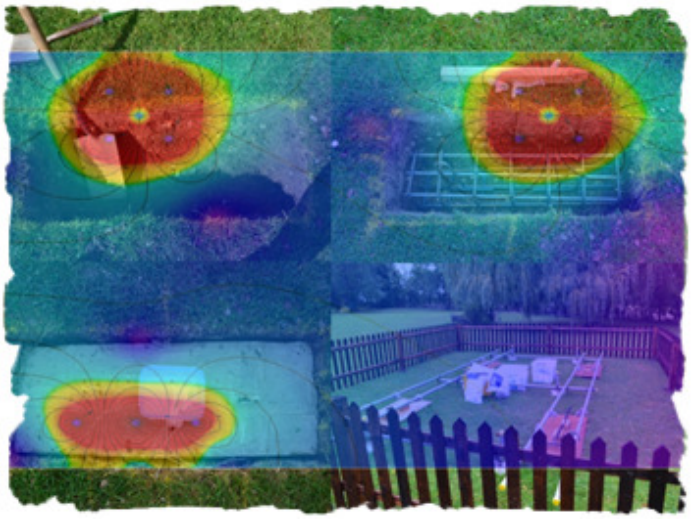
Left, a photograph of the four test beds with cables suspended by a lightweight scaffold and tanks (to the right of the picture) containing a range of treatment fluids.

Below, electrical resistivity images superimposed onto the four test beds to reveal changes both before, in the course of, and post-treatment.

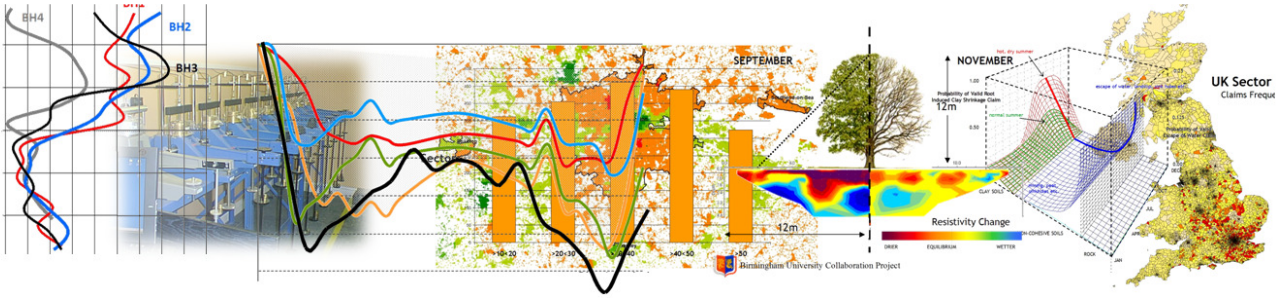
The project was completed in the summer of 2015.

Hopefully a paper will be published - subject we assume to Tom having the time now that he is in employment.

More research in this field may follow shortly. We understand that Birmingham are considering a student at the moment.



Resistivity imaging superimposed onto the test beds. The lower right bed is the control.



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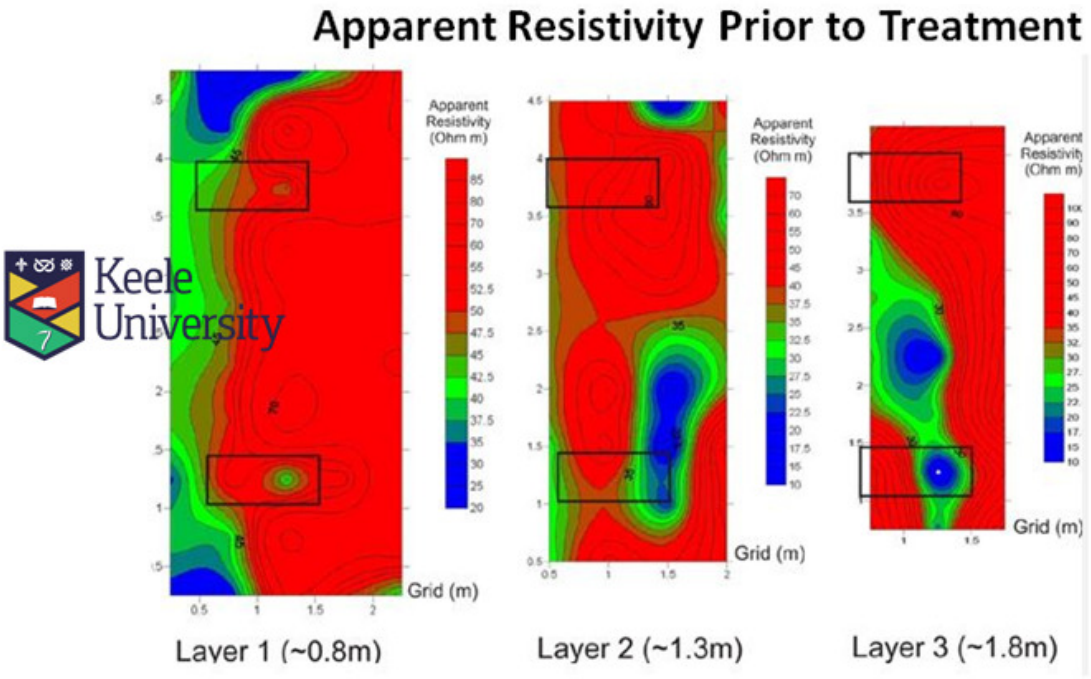
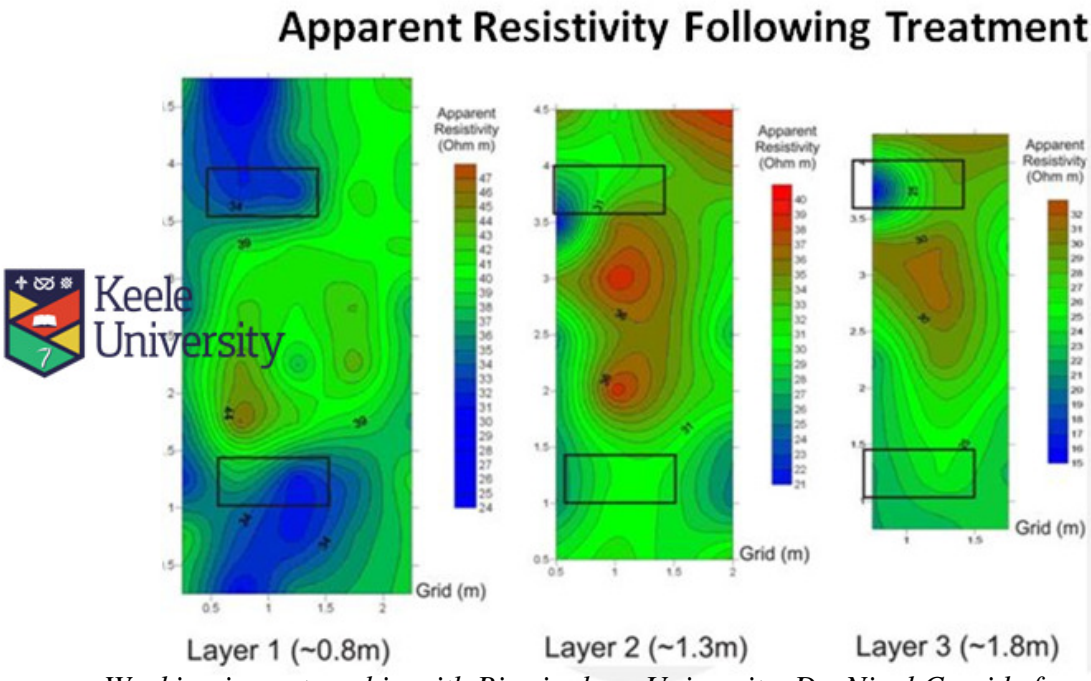
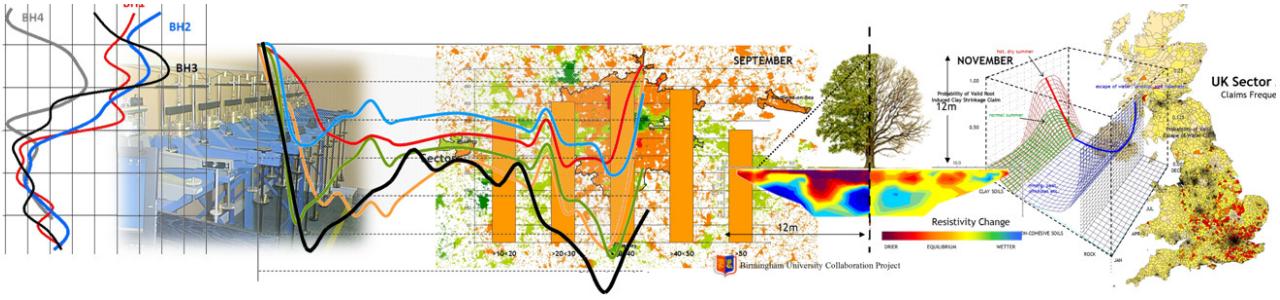




Working in partnership with Birmingham University, Dr. Nigel Cassidy from Keele University arranged and supervised the measurement of electrical resistivity at Aldenham and has provided the above images. Apparent resistivity at three layers (0.8m, 1.3m and 1.8mtrs below ground level) before and following treatment.



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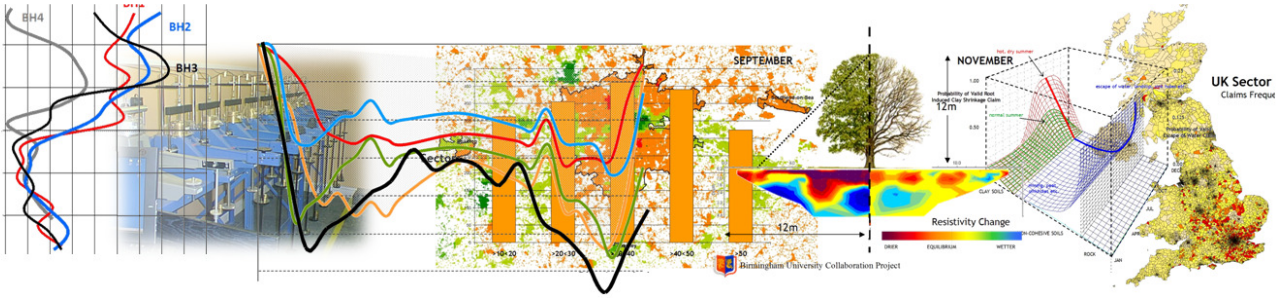
A Step Too Far?
The subtleties of being human.

Profiling is a powerful tool but suggesting that it replaces human interaction (not that anybody has) would - in our view at least - be a step too far.

Developing systems based on data can easily lead to the view that rules can be applied to profile individuals perhaps by occupation, age and circumstances. When we recognise that of the last 6 or so successful claims we remember that perhaps two people were carpenters, one was a doctor and some were anxious but others less so we can be drawn into codifying homeowners before we have the facts. Whilst a lot of excellent work is being done to understand how fraud presents itself, liability in the case of subsidence claims where we have strong evidence is best determined by a visual inspection rather than any complex algorithm - in our view.



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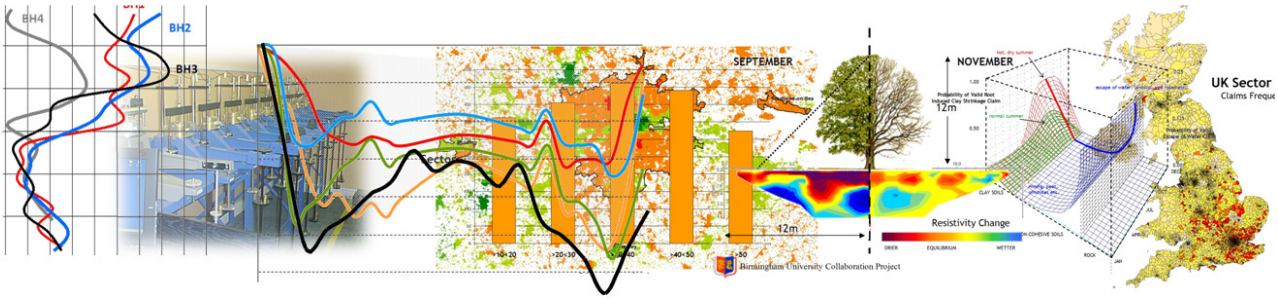
Much of the work we do in developing our AI application involves analytics. Finding correlations between datasets. For our part, this is mainly a case of manipulating spreadsheets manually (see issue 125) and resolving within a GIS capable of combining spatial elements - geology, claims, soil shrink swell potential and vegetation etc. The offer to automate and simplify this process by using IBM's 'Watson Analytics' proved interesting.

Watson Analytics is a web based application that can detect relationships between values stored in a structured database. Setting up an account was straightforward. We selected a small number of postcodes from our claims database which included (a) claim count (b) frequency and (c) the soil PI - or absence of - for the initial trial. The sample contained 48 postcodes out of a total of over 10,000.

The IBM web site describes their Watson Analytics application as follows:- *"Watson Analytics offers you the benefit of advanced analytics without the complexity. A smart data discovery service available in the cloud, it guides data exploration, automates predictive analytics and enables effortless dashboard and infographic creation. You can get answers and new insights to make confident decisions in minutes - all on your own."*

Watson provided an easy-to-use interface to upload our csv file. Analysis was fast and pain-free. The user is offered a range of options to access infographics, analysis, and reports. The graphs were attractive and easy to understand with options on presentation.

Data analysis was limited only by the small sample uploaded, but the output was thorough. Every combination was offered to show relationships between claims count, frequency and soil PI.



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IBM's Watson Analytics

This is a free-to-use (for the trial) application that delivers first rate output and will detect patterns that the casual user with a large and complex database might miss.

The limitation as far as the industry is concerned is perhaps the users database structure. Claim numbers, date of notification, address, claim validity are amongst the features commonly encountered.

Unfortunately other parts of the jigsaw - tree species, height and distance - soil type, results of monitoring and site investigations are either recorded in linked tables or not at all. Too much data exists in pdf files, E-mails and MS Office documents.

Various charts, graphs and reports produced by Watson shown left. Claim distribution by postcode sector (coloured, tiled chart), quality of the data (our sample scored 75% rated as 'good quality') and a range of graphs showing relationships are all available and easy to access.

The analysis of the subsidence database is a trivial problem for Watson. It is able to make associations between a range of data series quickly and efficiently and offer advice by selecting from the Explore, Assemble and Predict buttons.

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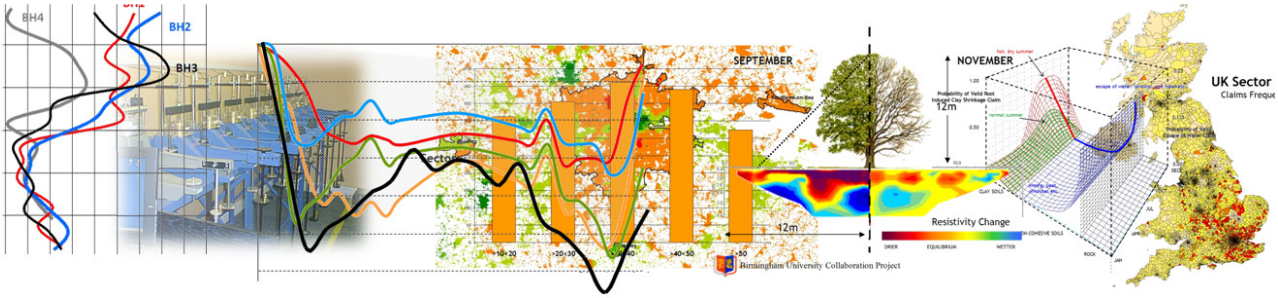
The challenge for the industry is assembling data in a meaningful way. Watson Analytics will be able to offer



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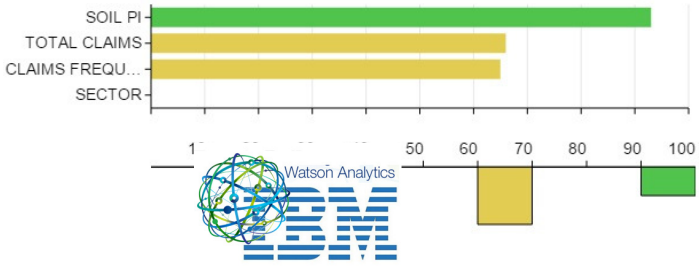
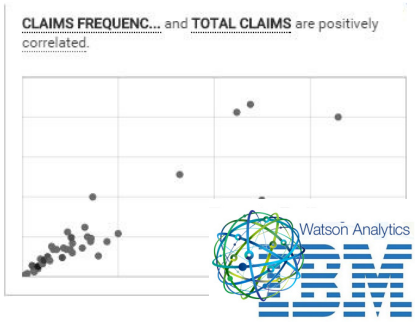
Watson Analytics produces a 'Data Quality' report for the strength and value of each series. Overall, our small data extract scored 75%.



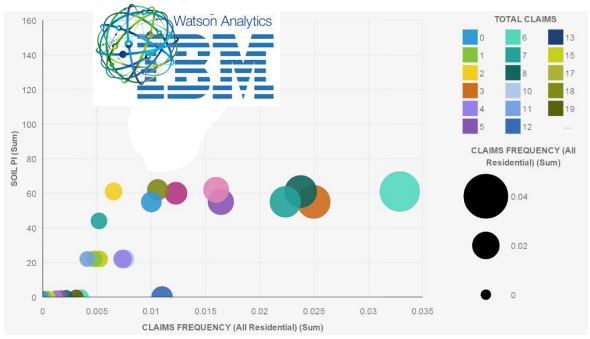


Claim Frequency -v- Count

As an example of finding relationships between the various series the application recorded the positive correlation between claims frequency and count and plotted the results graphically as shown left.

Claim Frequency -v- Soil PI

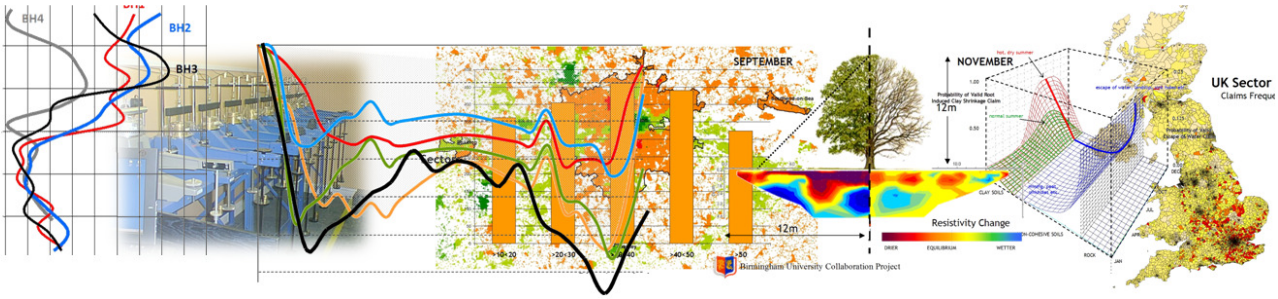
Right, the correlation between claims frequency and soil P.I. together with legend. Elsewhere in the application options are available to carry out further analysis.



Summary

This introductory exercise has indicated that Watson has significant potential in terms of data analysis for revealing correlations between the various components of a subsidence claim. Few will be surprised at the outcomes linking soil, weather and date of loss but the application has the potential to improve our understanding of the risk from vegetation etc. More importantly, Watson has the potential to deliver quantifiable outputs that will benefit underwriters and triage as well as diagnosis.

Next month we hope to test the output using a larger dataset more representative of those utilised by insurers and claim companies.



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Subsidence Premium

How much of the building insurance premium goes towards subsidence? Can we divert some of the income towards an 'avoid the claim' solution by adopting an 'Internet of Things' approach, offering homeowners movement sensors and telemetry as an early warning system?

Using some very broad brush calculations based on UK averages in terms of both claims, year of notification and premiums, it looks something like this. There are around 17m building policies (an increase from 16m over the last few years) and around 40,000 claims p.a. since 1990 (earlier years delivered fewer claims).

So, expressed as frequency, 40,000/17m = 0.0025. 2.5 houses damaged by subsidence per thousand every year, on average, variable across the UK. This figure increases in North London for example, and diminishes elsewhere.

An average spend of £277m p.a. equates to a claim cost of £6,925 but this is a total value. The figure of 40k claims includes repudiations. Taking an average year around 50% of claims are valid which increases the spend on valid claims somewhere around [£277m - (£450 x 20,000)] / 20,000 = £13,400.

It's a poor starting place with fluctuating average in terms of claims and costs, variable by year, but it is where we are.

To meet the cost of claims the portion of the building premium allocated to subsidence would be 277m/17m = £16.30.

Returning to the beginning, £16 is around 0.045 of the average annual premium - slightly less than 5%, the figure published by the ABI for the spend on subsidence in their 2014 end of year review.

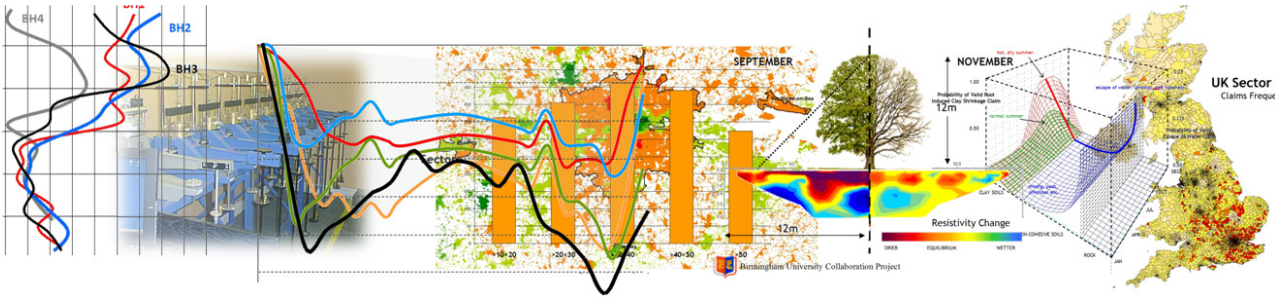
Averages actually work in our favour in the sense that the insurer can't re-calculate premiums based on last year's losses. The average policy life is somewhere around 6 years and changing premiums every year to take account of 1 in 7 year events would produce commercial problems.

In practice, our earlier thoughts that insurers might one day adopt a telemetry solution were naive based on the cost of an installation compared with premium income.

Insurers income just about covers the cost of expenditure and overheads with a modest profit.

A telemetry solution is more likely to be in the hands of homeowners and developers where purchasers will be seeking innovation and 'Internet of Things' solutions and insurers offering deductions on premiums - although as we have seen above, any deduction would be modest.

The benefit of telemetry lies in claims handling - obtaining accurate data more often and gathered with a reduced carbon footprint.



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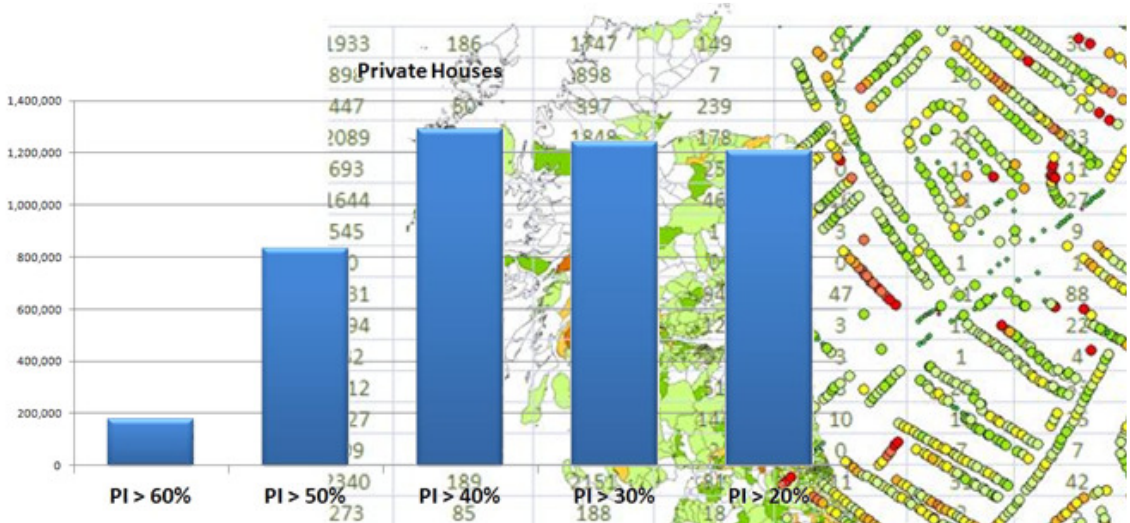
Count of Houses on Clay Soils with PI > 20%

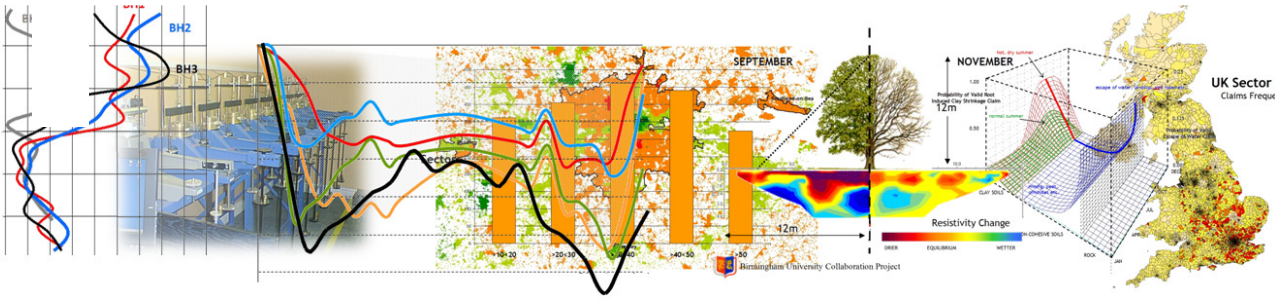


Using our 'soil by PI' map of the UK we estimate there are just under 15m private houses built on clay soils with a PI greater than 20%. Our model does not distinguish between geological series.

The estimate is based on the following. Where a site investigation has been undertaken, the PI has been taken as close to 2mtrs bGL as possible. This value has then been ascribed to the postcode sector.

Census data has been superimposed using a GIS and the values reflect the aggregate of private houses at sector level. The estimate does not cater for geological/demographic boundaries crossing a sector.

	Private Houses	
PI > 60%	175,829	
PI > 50%	834,248	
PI > 40%	1,291,246	
PI > 30%	1,239,957	
PI > 20%	1,205,794	
	4,747,074	total



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November Review

Met Office Anomaly Charts
Rainfall and Mean Temperature

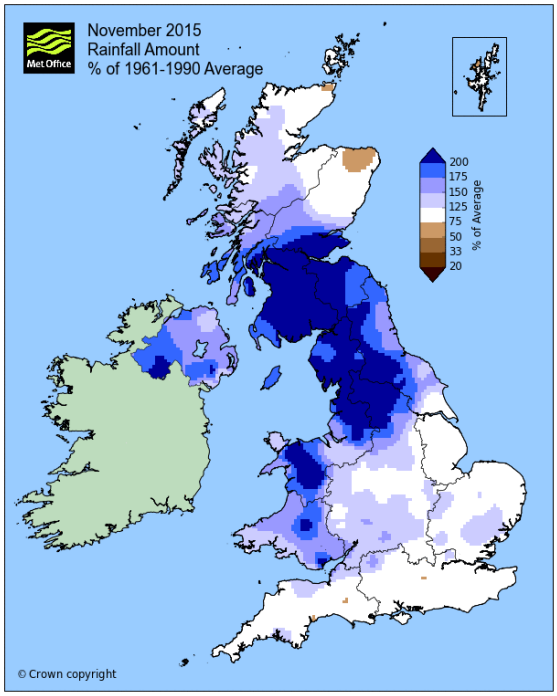
Wetter towards the north but about average in terms of rainfall for the south and south east of England.

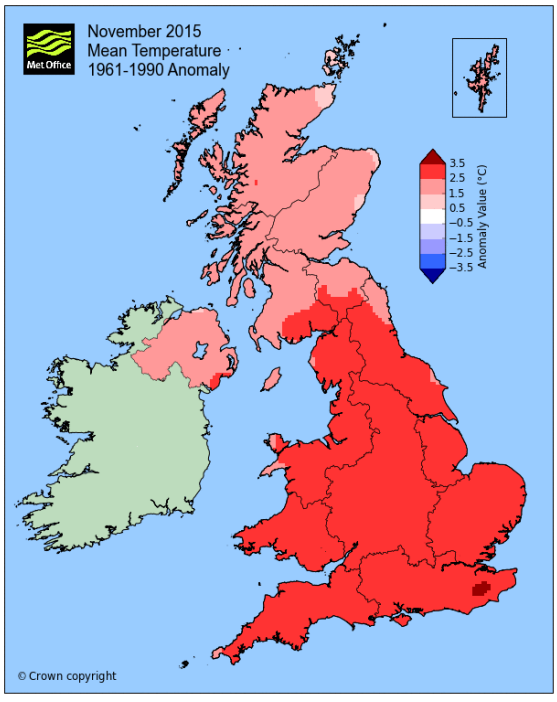
The Mean Temperature chart reveals that the UK was warmer than the 30 year average by a few degrees.

In short, November was a year of extremes and particularly for the north of England. More rainfall and warmer than usual. The outcome was fewer clay related subsidence claims and an early start to the more unusual ground collapse/flowing water categories to the north of England and Wales.

For further information, including images of interactive weather charts, go to ...

www.metoffice.gov.uk/public/weather





SMD Update

Met Office Data, Tile 161, Medium AWAC, grass cover.