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 ◆ Software Analysis Tools
Artificial Intelligence

August 2018
Edition 159

The Clay Research Group

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Issue 159, August, 2018

A Dry Summer

The recent dry weather was temporarily interrupted in parts of the UK by heavy rainfall, but not sufficient it appears from the SMD chart to remove the threat of 2018 turning into a busy year with regard to claim numbers. See Page 3.

Colleagues in the industry have reported an upturn in numbers over recent weeks, and more dry weather is forecast. Could this turn out to be a 2006 event year?

TDAG Diary

An update from TDAG on a meeting held at the Royal Horticultural Society on the 10th July, 2018 can be downloaded from the CRG web site. Select the 'Newsletter' tab and select "TDAG, July 2018" from the drop-down list. The notes contain lots of interesting information and links.

Tom Clinton's PhD

To view/download Tom's PhD thesis dated June, 2015 and entitled "Electrokinetic Stabilisation as a Subsidence Remediation Technique", go to:

http://etheses.bham.ac.uk/7852/1/Clinton17PhD_size_reduced.pdf

The paper records his research both in the laboratory at Birmingham University and at the Aldenham site.

BGS Risk Model

The British Geological Survey are refining their risk model to take account of the effects of Climate Change. "Building resilient futures: how climate change could affect subsidence hazards" is a research project that will focus particularly on clay shrinkage.

The BGS prediction is that "subsidence hazards, on clay-rich deposits, are likely to increase in the future with increasing occurrence of longer drier summers and wetter winters."

The CRG are taking part in the initial assessment.

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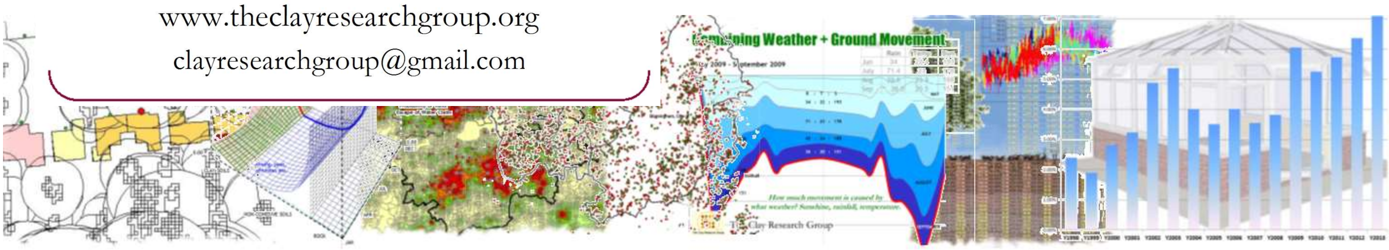

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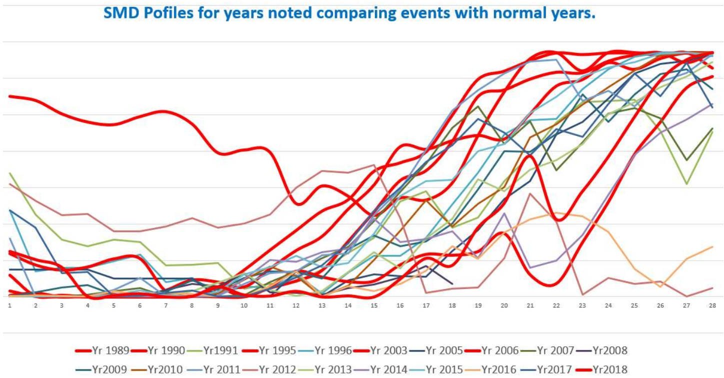
High Claim Numbers and SMD Profiles

2006 confounded prediction. The Soil Moisture Deficit (SMD) rose later in the year than usual and then followed a steep gradient to deliver around 48,000 claims. Until then, an early rise was regarded as an indicator of potentially high claim summer numbers, as can be seen using the 1990, 1995 and 2003 profiles. See graph below.



SMD Profiles for a selection indicated in the legend with event years in red. It can be seen that 2006 was exceptional in starting late but delivering around 48,000 claims.

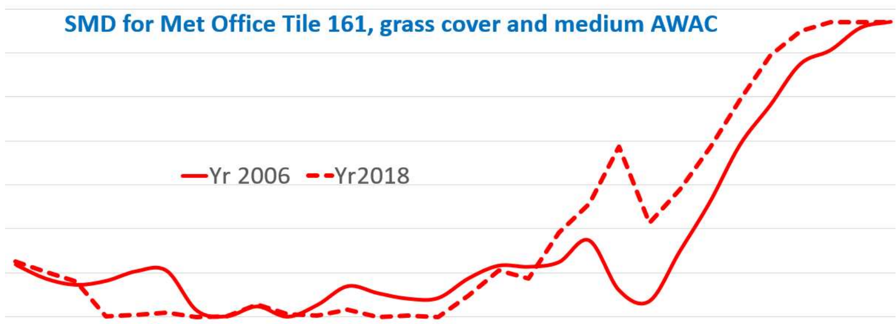
'Normal' year profiles either (a) fell below the surge profiles or (b) achieved a high initial deficit before intermittent rainfall reduced their influence.

2006 rose sharply before falling away, perhaps revealing a characteristic of tree physiology in response to drying and wetting cycles.

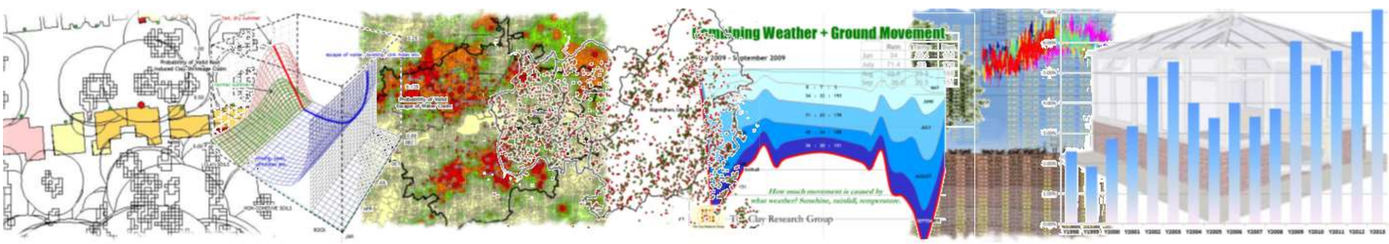
Below, the current SMD (shown dotted) is following a similar profile to 2006. It started later than the usual event year profile and is rising steeply at around the same time of year as 2006. The recent spell of rainfall across many parts of the country has had little influence.

The deficit remains at its peak level of 134mm, a figure that has extended over the last 5 weeks.

Whether 2018 delivers high claim numbers or not remains to be seen. The outcome will hopefully refine our understanding of whether the SMD has a role to play.



Comparing 2006 with 2018. The profiles and gradient are similar. An unusually late start in 2006 compared with other event years, and 2018 has hit the ceiling with a deficit of 134mm for the last three weeks. Recent rainfall has had little effect – so far.



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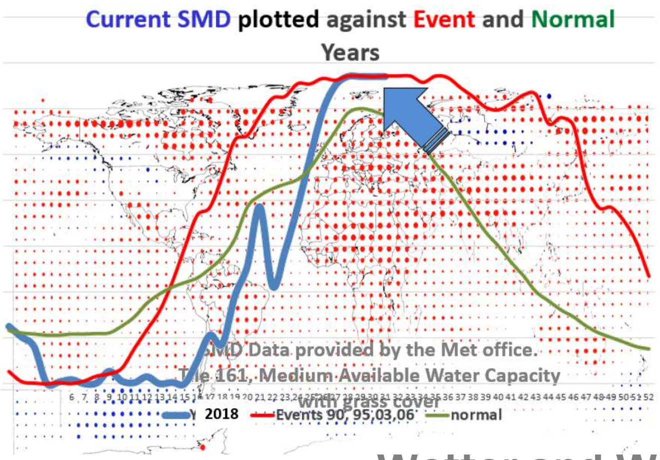


SMD Update

The SMD remains at its peak value (134mm deficit) for the fifth week running and apparently, claim numbers are rising.

The graph, left, plots the 2018 profile (blue) tracking the event year profile (red).

Wetter and Warmer

The Met Office confirms 2017 was the 5th warmest year in a record dating back to 1910.

Thanks to Tony Boobier for drawing our attention to the following extract from the Met Office web site …

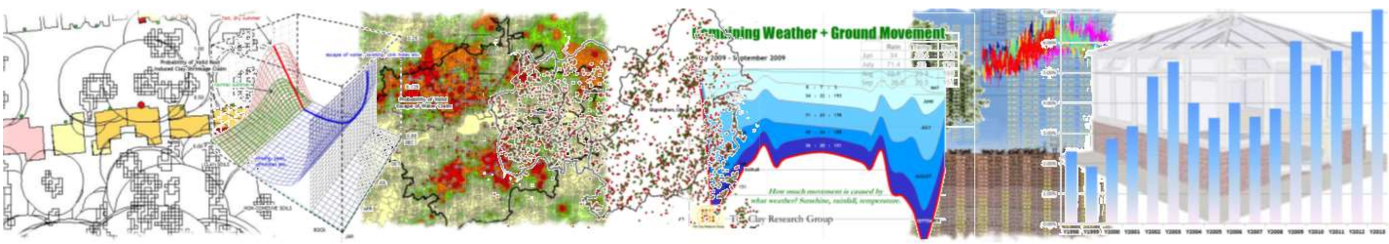
"The UK climate is warming. Average temperature over the last decade (2008-2017) was 0.8 °C warmer than the 1961-1990 average, whilst we've also seen 8% more rainfall and 6% more sunshine. In contrast to summer 2018, UK summers have been notably wetter over the most recent decade, with a 20% increase in rainfall compared to 1961-1990."

Ground Levels Adjoining the Aldenham Willow

Has the recent dry spell had an influence on the ground levels within influencing distance of the willow tree root system, and if so, how much?

Station 25 is furthest away from the tree and precise levels have detected subsidence of -75.1mm from the starting point in May 2006.

In contrast, Station 1, nearest the tree, continues to recover and has risen by 39.6mm at the time of the last reading in May 2018. In July, the reading was 17.1mm.



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Event -v- Normal Year Distribution

	Normal Year (all claims)	Event Year (all claims)		Increase in Surge
Jan	3016	2829		0.94
Feb	3661	3022		0.83
Mar	2694	2910		1.08
Apr	3613	2428		0.67
May	3226	2781		0.86
Jun	2613	2428		0.93
Jul	2952	3280		1.11
Aug	3145	5080		1.62
Sep	3226	10289		3.19
Oct	3952	10787		2.73
Nov	2823	6077		2.15
Dec	1581	3489		2.21
	36,502	55,400		

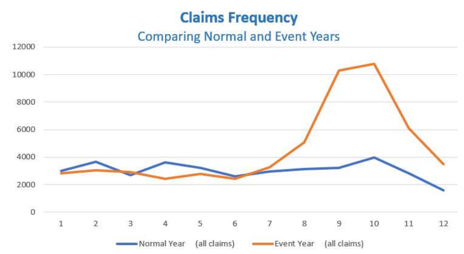
Illustrative table listing claims per month for a normal year and comparing them with an event year, showing the marked increase through the summer months.

Left, typical distribution profiles of claims notified, comparing a normal year with an event year.

As ever, the bare figures don't tell the whole story. They relate to total claims notified – which includes declinatures.

In an event year, there will be a higher percentage of valid claims, increasing the workload significantly. In a 'normal' year, valid claims may account for 50% or less whereas in an event year, that figure can increase to 80%.

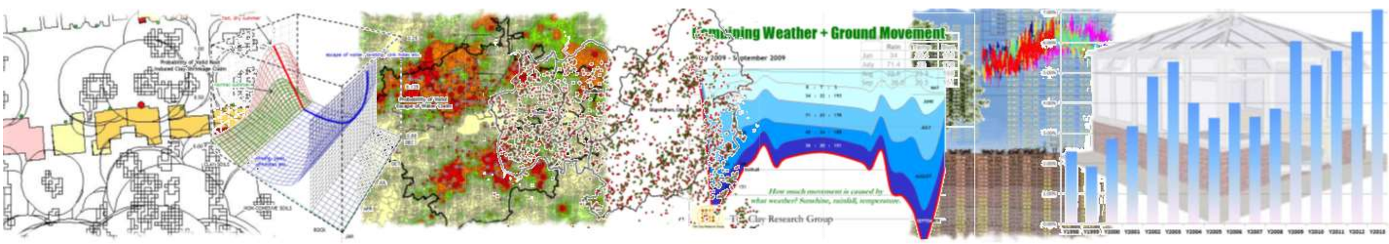
These average annual figures don't tell the story though. Not only do the figures and distribution change by year, but by month, by location and by peril. The change is less when dealing with escape of water claims - subsidence resulting from leaking drains or water service pipes tend to contribute a steady 20 – 30% of valids over the year with a fairly even distribution by month and location, although less where there is outcropping clay of course.



Graphing the difference between event and normal years to show the onset around July, peaking in September and October.

In contrast, clay shrinkage claims fluctuate considerably by month and by year. They are the ingredient of event years. The often-used reference to clay shrinkage claims contributing 70% of the total isn't the case in wetter years. In dry years, they may contribute 70% over the year, concentrated in locations where there is outcropping clay. It's also the case that there are a higher proportion of valid claims in these locations.

The clay shrinkage model isn't unlike flood. When flood strikes, insurers can be reasonably confident that a large proportion of the claims received will be valid. This is also the case with clay shrinkage claims in an event year.



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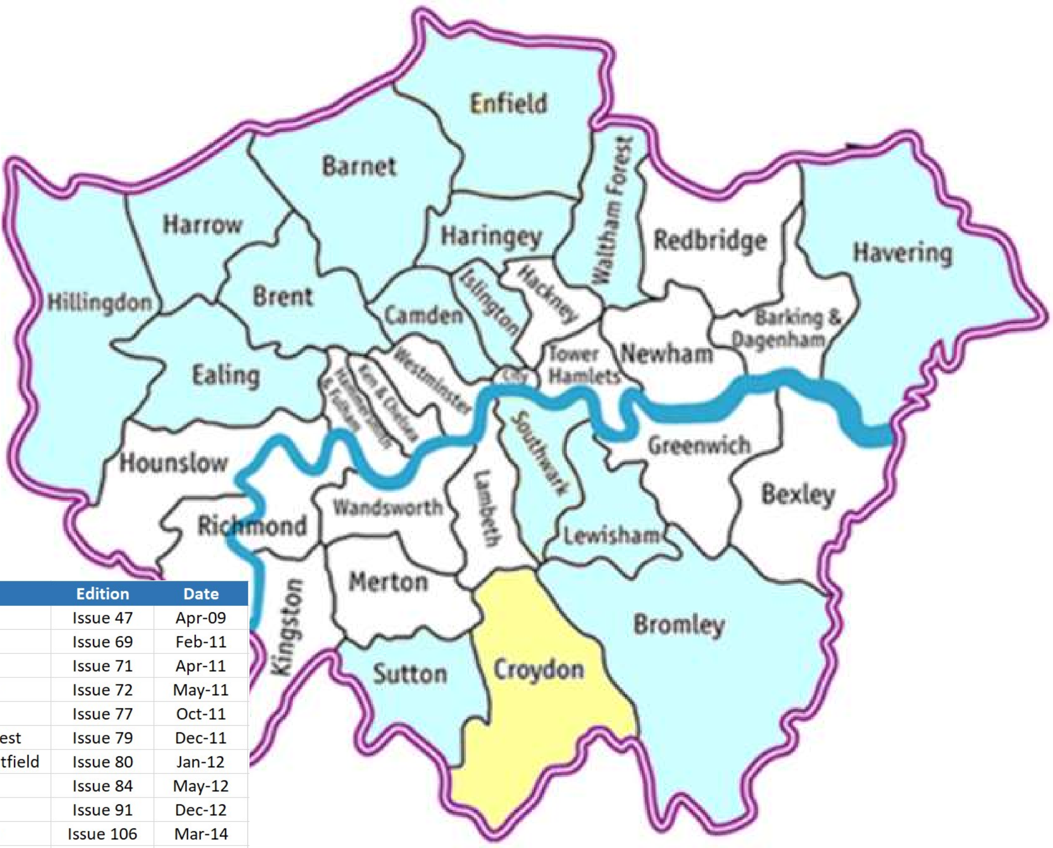
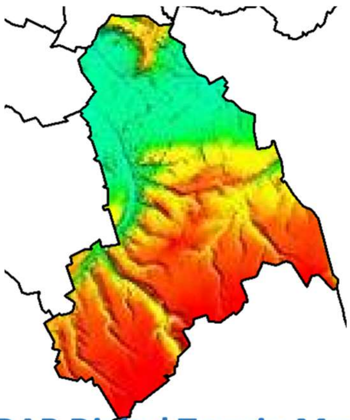
Croydon Borough – Risk of Subsidence

Croydon has a population of just over 380,000, a housing stock of around 153,000 and an area of 8,650 hectares. Private housing comprises 64%, social housing 16% and private rented accommodation 20%. All figures are approximate and taken from Census data.



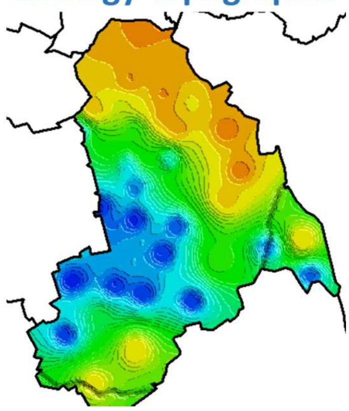
Borough	Edition	Date
Islington	Issue 47	Apr-09
Camden	Issue 69	Feb-11
Brent	Issue 71	Apr-11
Haringey	Issue 72	May-11
Barnet	Issue 77	Oct-11
Waltham Forest	Issue 79	Dec-11
Welwyn and Hatfield	Issue 80	Jan-12
Ealing	Issue 84	May-12
Sutton	Issue 91	Dec-12
Hillingdon	Issue 106	Mar-14
Havering	Issue 149	Oct-17
Harrow	Issue 150	Nov-17
Enfield	Issue 155	Apr-18
Southwark	Issue 156	May-18
Lewisham	Issue 157	Jun-18
Bromley	Issue 158	Jul-18

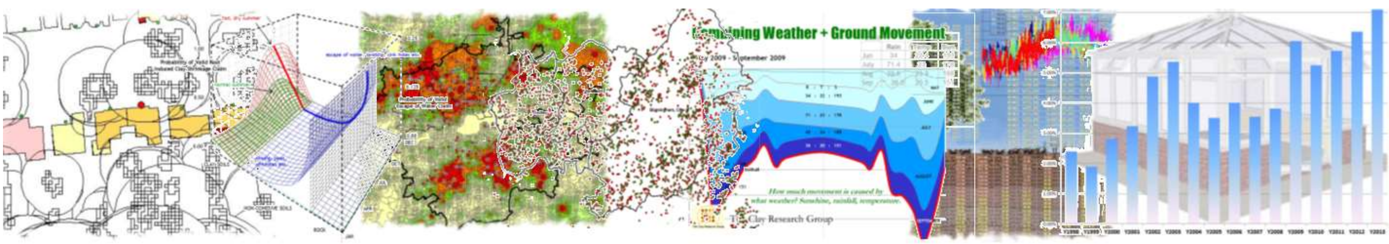
Right, a LiDAR contour map and a topographic map visualising the digital output.



LiDAR Digital Terrain Model

New Geology Topographic





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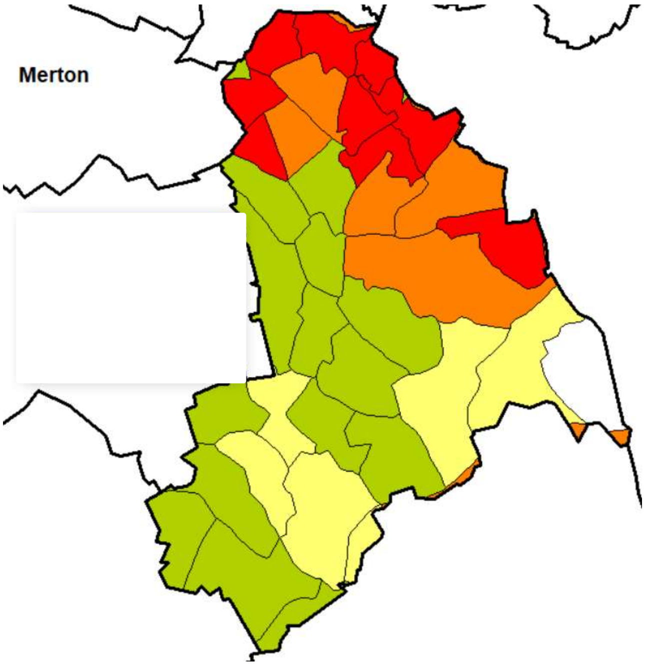
Croydon Borough – Study Area

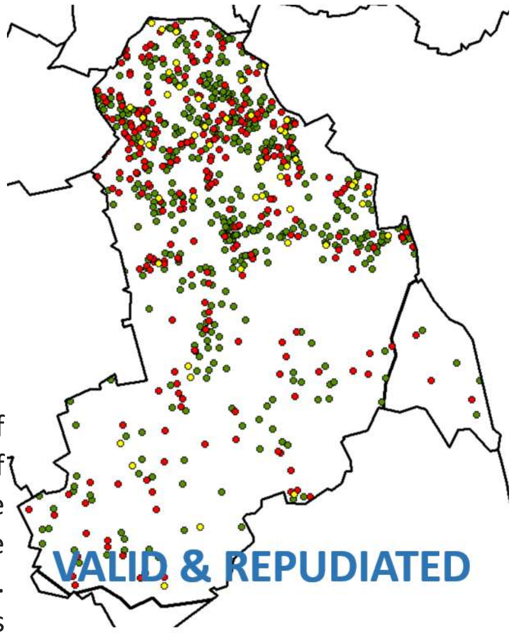


Left, the risk of subsidence by postcode sector, expressed as frequency for the sample held – that is, the number of claims in the sample divided by the housing population.

The distribution reflects the properties of the superficial soils.

More information on distributions is provided on the following page.

Right, a map showing claims distribution from our claim sample. As revealed by the sector map above, the main area of risk is to the north of the borough.

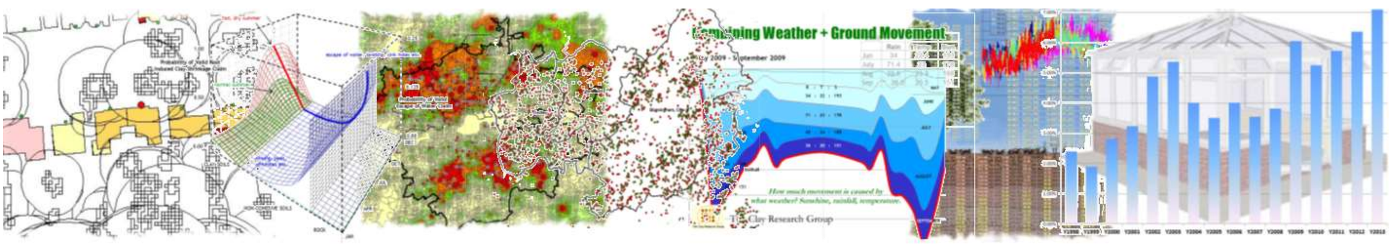


Above, dots representing full postcodes across the borough, revealing a higher density to the north.

Red and green distinguish between valid (green) and declined (red) claims.

The higher density of claims to the north of the borough reflects the housing density. See the 'full postcode' map, left. There are fewer houses to the south.

Even so, the sector map above reveals that the north is riskier when expressed as frequency.



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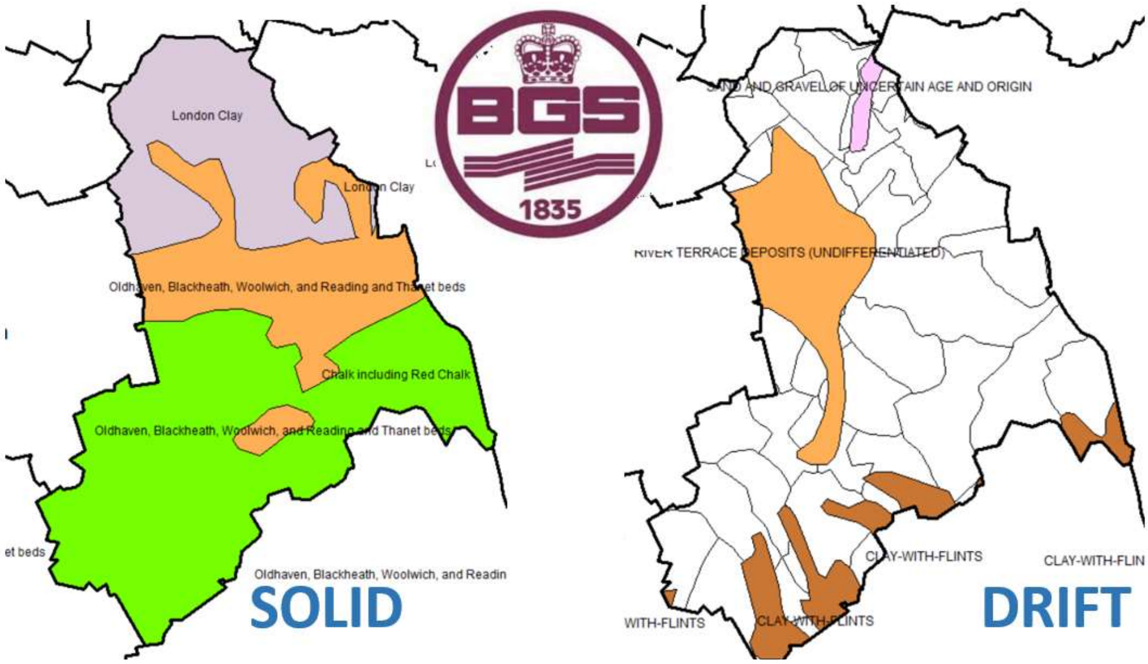
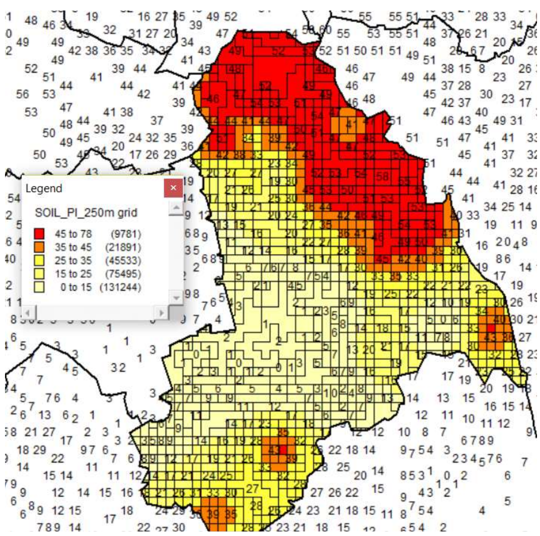
Croydon Borough Geology

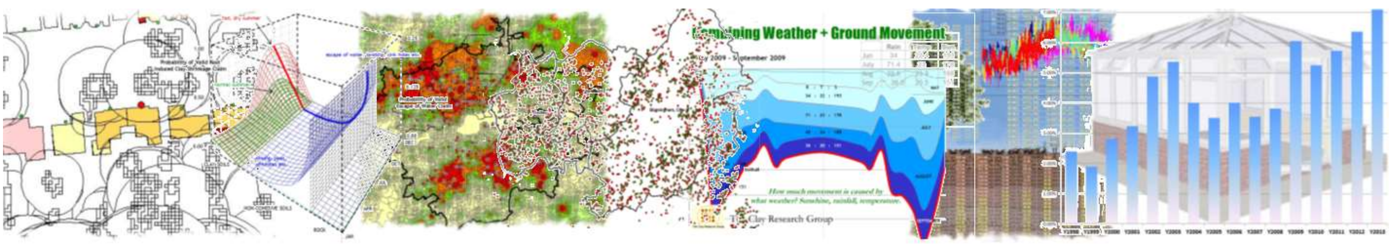




Following the format described in edition 156, above, the British Geological Survey 1:625,000 scale map of the area showing the various series which includes Oldhaven, Blackheath, Woolwich and Readings and Thanet beds with small areas of outcropping London clay, chalk and clay with flints to the south.

Left, the CRG geological map, built from site investigations and soil data obtained from the investigation of domestic subsidence claims, using interpolated data and plotted on a 250m grid.

The higher claims frequency mentioned on the previous page coincides with the area of outcropping London clay.



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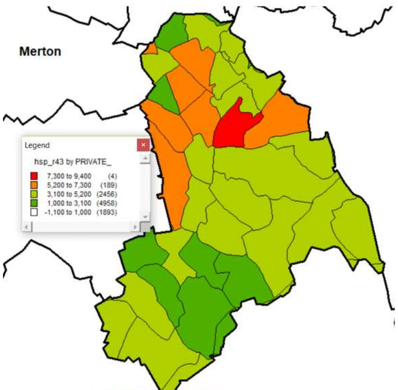
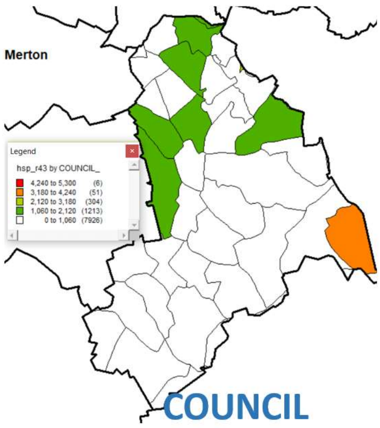
Croydon Borough – Ownership and Style of Construction

The ‘risk by ownership’ ranking reveals that the borough lies 29th the ‘by district’ table taking into account all properties but falls to 46th place if private houses alone are considered. It is in 9th place in terms of count of claims from the sample analysed.

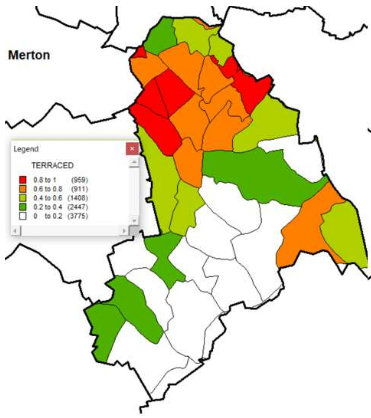


PRIVATE

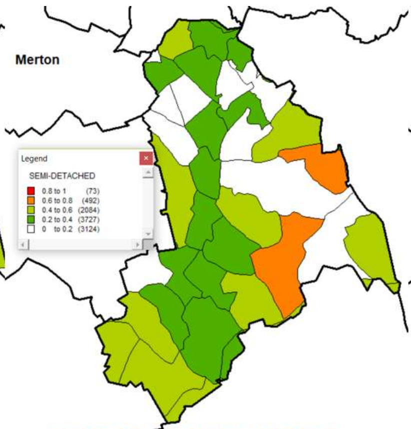


COUNCIL

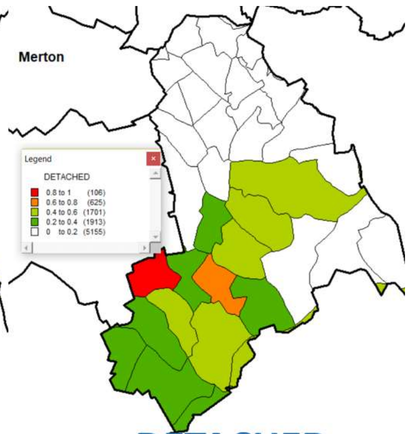
Below, distribution of houses by style of construction showing the concentration of terraced houses to the north of the borough, semi-detached to the mid and south and detached to the south.



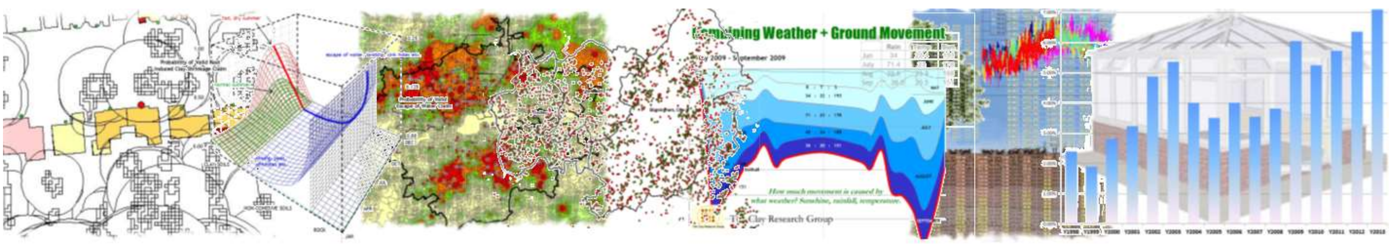
TERRACED



SEMI-DETACHED



DETACHED



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Triage – Croydon - District & Sector Rates

Continuing the theme of how past claims data can assist in Triage, below is a table showing the aggregated risk for the borough of Croydon, taking into account seasonal influence related to the underlying geology, variable across the borough.

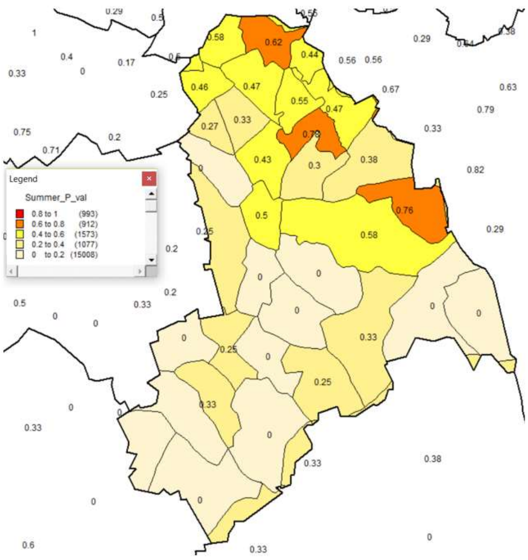
District	summer clay valid	summer EoW valid	Repudiation Rate (summer)	winter clay valid	winter EoW valid	Repudiation Rate (winter)
Croydon	0.611	0.151	**0.238**	0.09	0.36	**0.55**

The postcode sector maps below provide a granular view, plotting the likelihood of a claim being valid in the summer (left) and winter (right) months, variable according to weather conditions at the time of the enquiry.

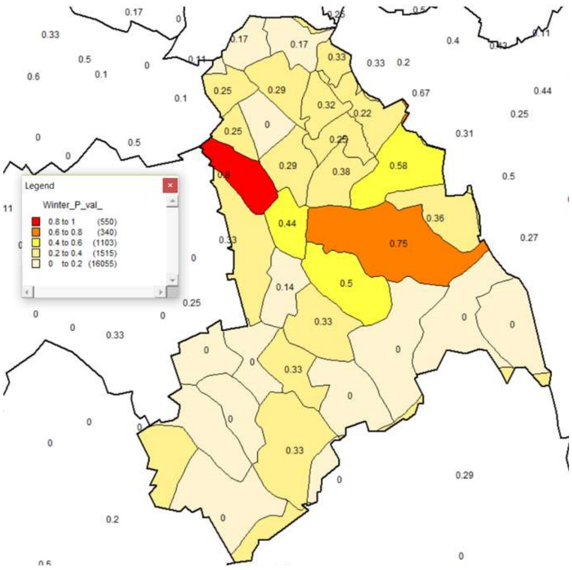
The probability of a claim being valid in the winter months reduces significantly in those sectors with shrinkable clay.

Conversely, EoW rates increase by a factor of nearly 3 in the winter.

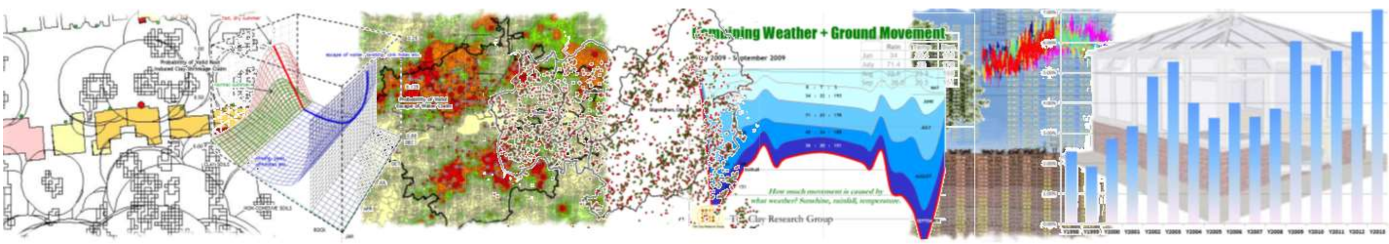
From the above table giving an aggregated view of the borough, it can be seen that the probability of a claim being valid, and due to clay shrinkage, is 0.611 in the summer, falling to 0.09 in the winter. Repudiation rates more than double in the winter.



Probability of a claim being valid in the summer months, by postcode sector.



Probability of a claim being valid in the winter months, by postcode sector.



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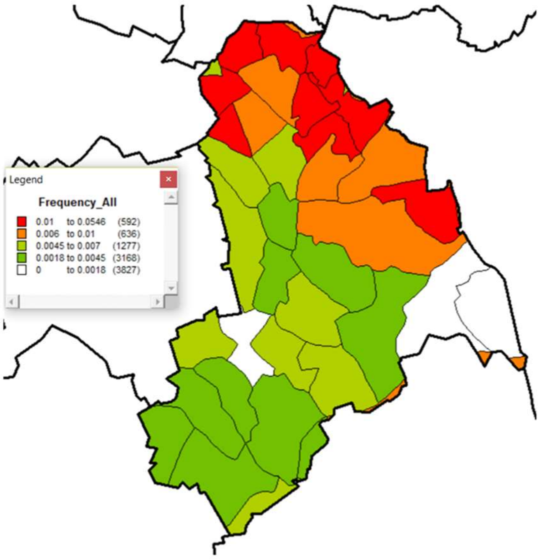
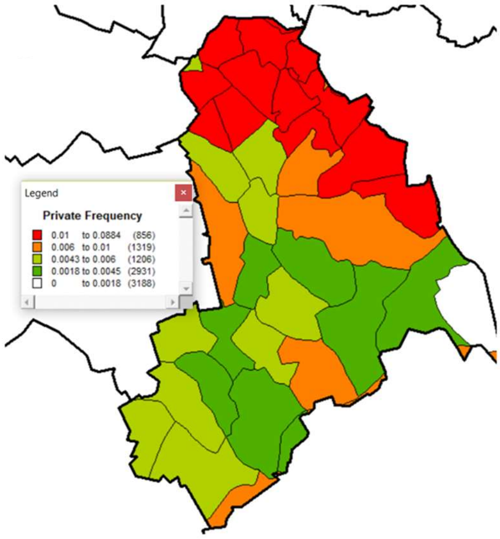
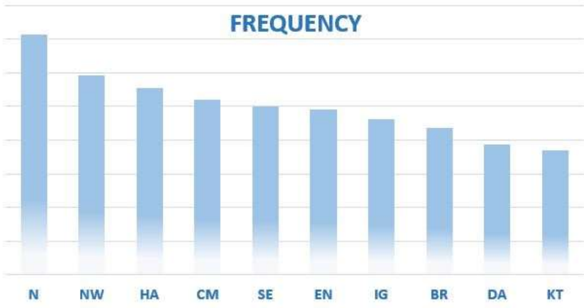
Croydon – Claim Frequency by Property Ownership

Claim frequency by ownership (all -v- private only) shown below. There is little difference between the categories. The legend covers the whole of the UK.





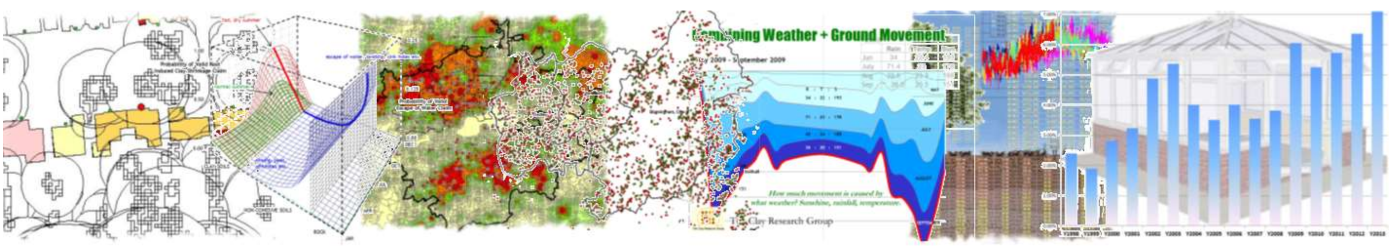
Claim Count – Claim Frequency



Right, comparing claims frequency for a number of postcode areas in the London area. Top, the number of claims expressed as frequency – claims/housing population.

Bottom, the number of claims.

The analysis would benefit from identifying valid claims by peril (clay shrinkage or escape of water) and distinguishing between social and private housing.



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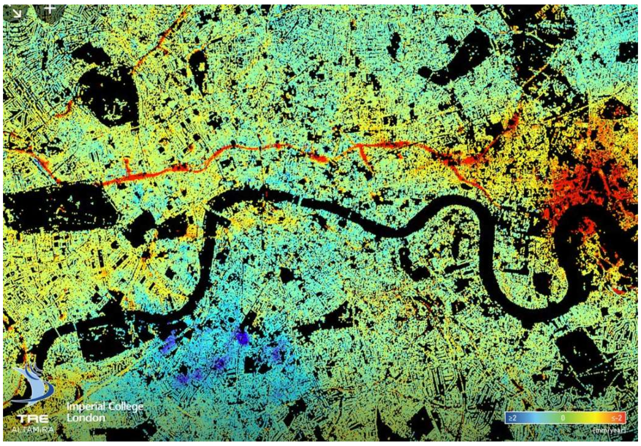
Ground Movement Map from Imperial College

Ground Engineering. 8th May, 2018.

Christine Bischoff's is using data provided by TRE Altamira for her PhD project in a collaboration between Imperial College and Tre Altamira.

Notable movement is shown underneath Brick Lane and crossing Regent's Park for electrical ducting projects, as well as settlement caused by the start of the Northern Line Extension Project near Kennington Park. The researchers think the areas of uplift (blue) south of the Thames may reflect seasonal changes in groundwater.



Using radar interferometry to detect movement within 1mm, satellite images were taken between May 2011 and April 2017 to measure where ground has moved.

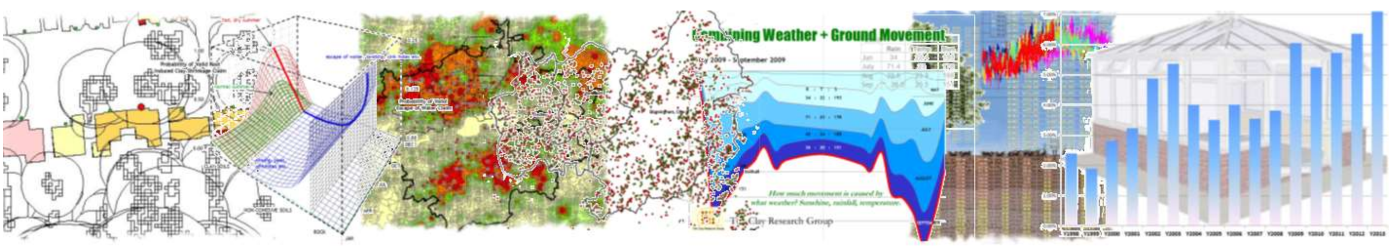
The red line corresponds to subsidence caused by tunnelling for Crossrail and the red spot just East of Canary Wharf is caused by dewatering of the deep Chalk aquifer, which was necessary for Crossrail's construction.

Geomatic Ventures

https://www.geomaticventures.com/uk-map

Researchers from Nottingham University have built a map of the UK, covering a two-year period from 2015 to 2017. The map was created using thousands of satellite radar images and an Intermittent Small Baseline Subset (ISBAS) analysis, a satellite remote sensing data processing algorithm. Geomatic ventures are a Nottingham University spin-off company.

For further information, see Ground Engineering, April 2018.



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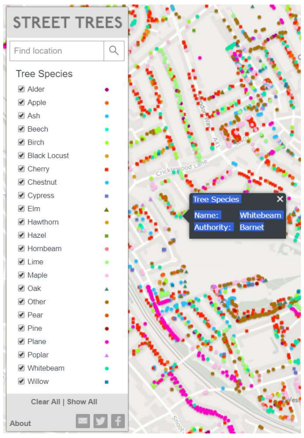
Street Tree Map from London Government

https://maps.london.gov.uk/trees/



The above web site provides access to a map of London plotting street trees by location and species. In the screenshot below, left, clicking on a dot reveals the selected tree to be Whitebeam under the control of Barnet council.

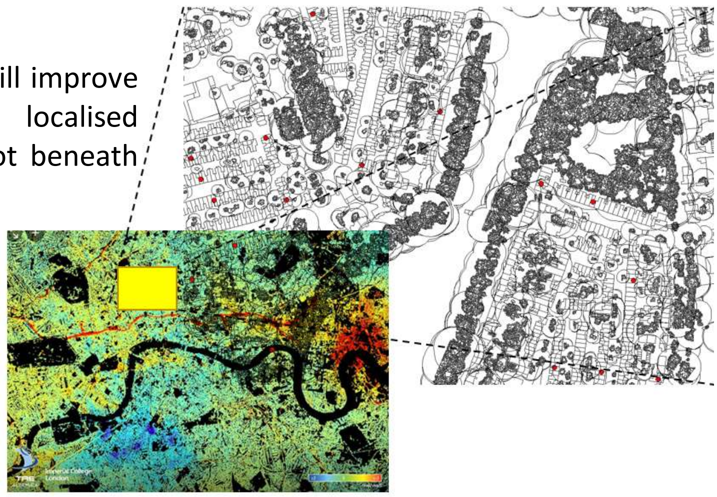
View the distribution by species by selecting 'clear all', and then ticking the box beside the tree(s) of interest. See example right showing the location of plane trees.

Prefer a satellite image as a background? No problem. Select from the options at the top right hand corner of the screen, sitting next to the 'zoom in' button.

Merging Maps

The end game is merging the various maps to deliver more detailed information. For example, overlaying the LiDAR outlines onto the various digital maps described would identify the tree location, species, height and allow users to determine the distance to a building.

No doubt the topographic data will improve in terms resolution allowing localised movement to be measured, if not beneath the tree, perhaps the buildings.



Mapping is an exciting area of research with rapid growth and improving definition/available data. It is a valuable tool allowing objective desk-top studies to be undertaken merging spatial and claims data.