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

June 2019
Edition 169

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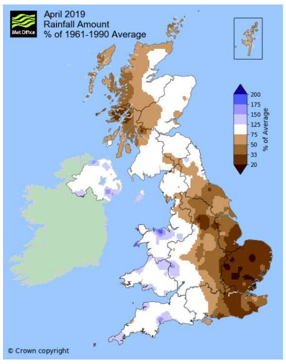
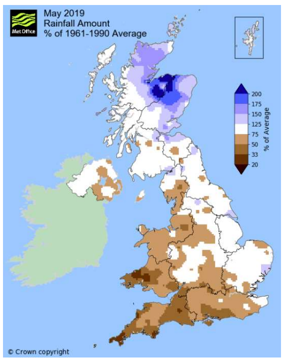
Issue 169, June 2019

Dry April, Wet May

The Met Office anomaly maps compare current weather patterns (temperature, hours of sunshine, rainfall etc) with various 30-year averages.



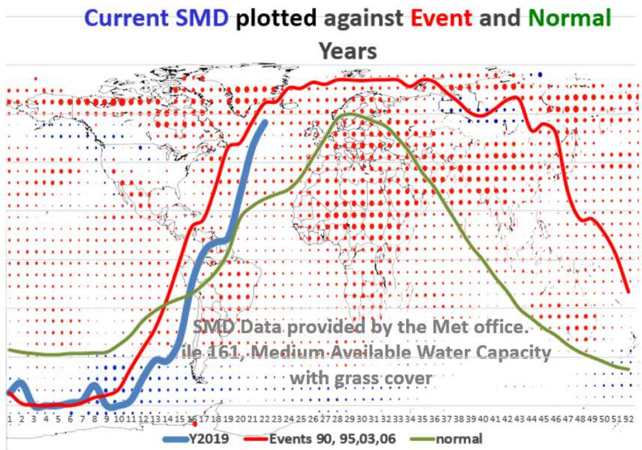


Above left, April 2019 was far drier than the 1961 – 1990 average, but rainfall over the last month has reduced the deficit as shown on the May map, above right.

2019 Surge?

The graph of the current Soil Moisture Deficit (blue line) reveals a steep gradient, tracking the event year profile.

The SMD value at the end of May exceeded 100mm, which is a figure that has a slightly better than 80% record of predicting a surge year.



Soil Moisture Deficit data from tile 161, supplied by the Met Office for grass cover, medium available water capacity soils.

However, the Met Office forecast mitigates the probability of surge when it says “wetter than average conditions are marginally more likely” for June, July and August and “above average temperatures are more likely than below average temperatures”.

So, warmer but wetter is the best guess at the moment, suggesting the threat of surge could be reduced over the next few months.

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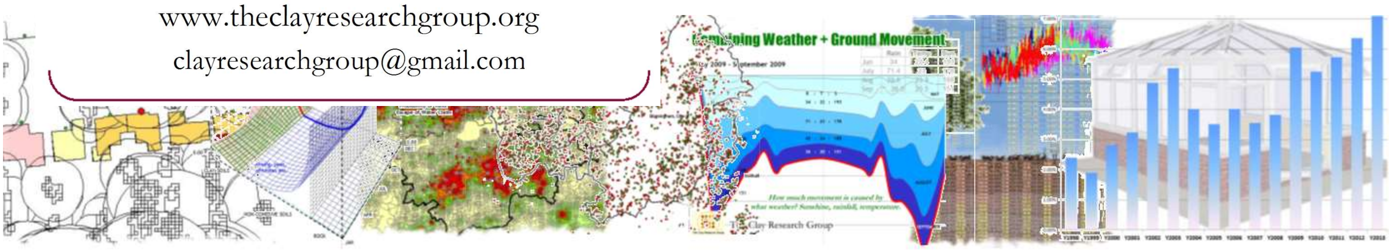

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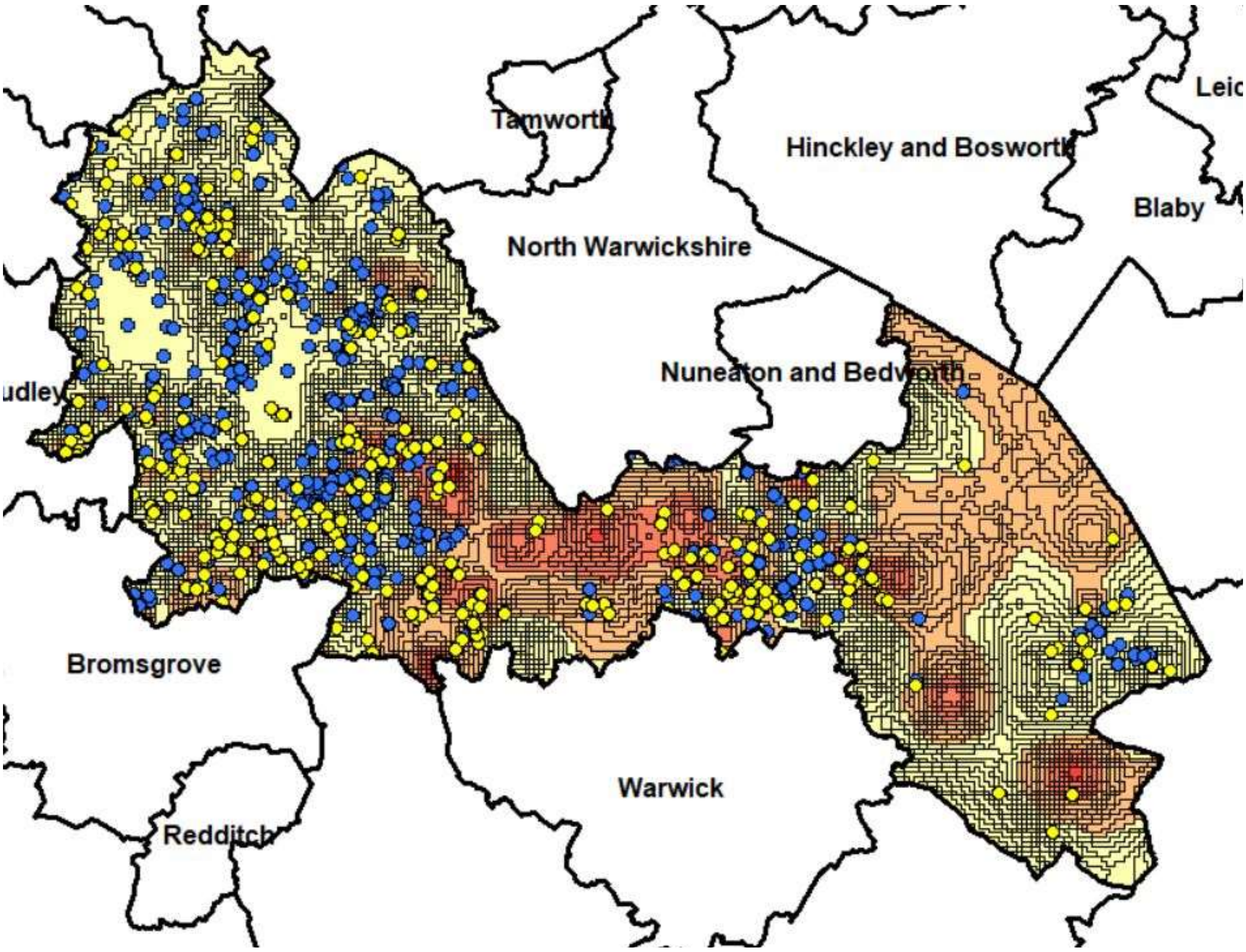
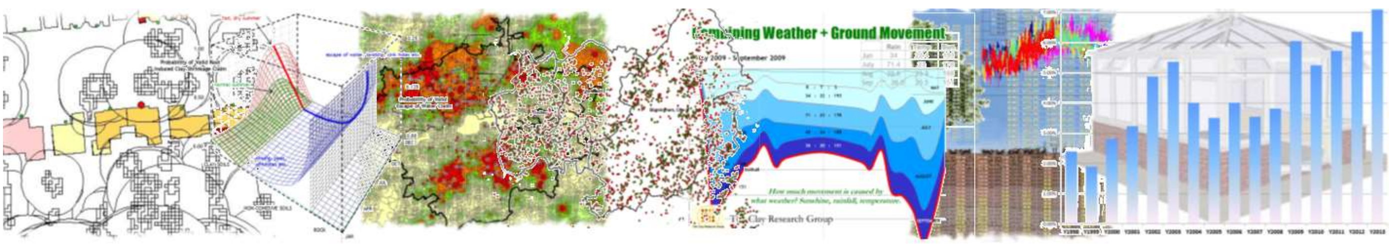
Follow the Geology

Below and on the following page, maps showing claims by cause (yellow dots = clay shrinkage, blue dots = escape of water) from a sample of 36,018 claims, of which 17,120 are clay shrinkage and 18,898 are escape of water (EoW). If there was an even distribution across the country (i.e., geology didn't play a part), the prospect would be that an EoW claim was 1.1 times more likely.



The above map covers Birmingham, Walsall, Sandwell, Solihull, Coventry and Rugby. The area has a variable geology with drift deposits and alluvial soils (yellow on the underlying map) and smaller areas of shrinkable clay from the Mercia mudstone series, shaded red. The soils map uses the results from actual site investigations, interpolated on a 250m grid.



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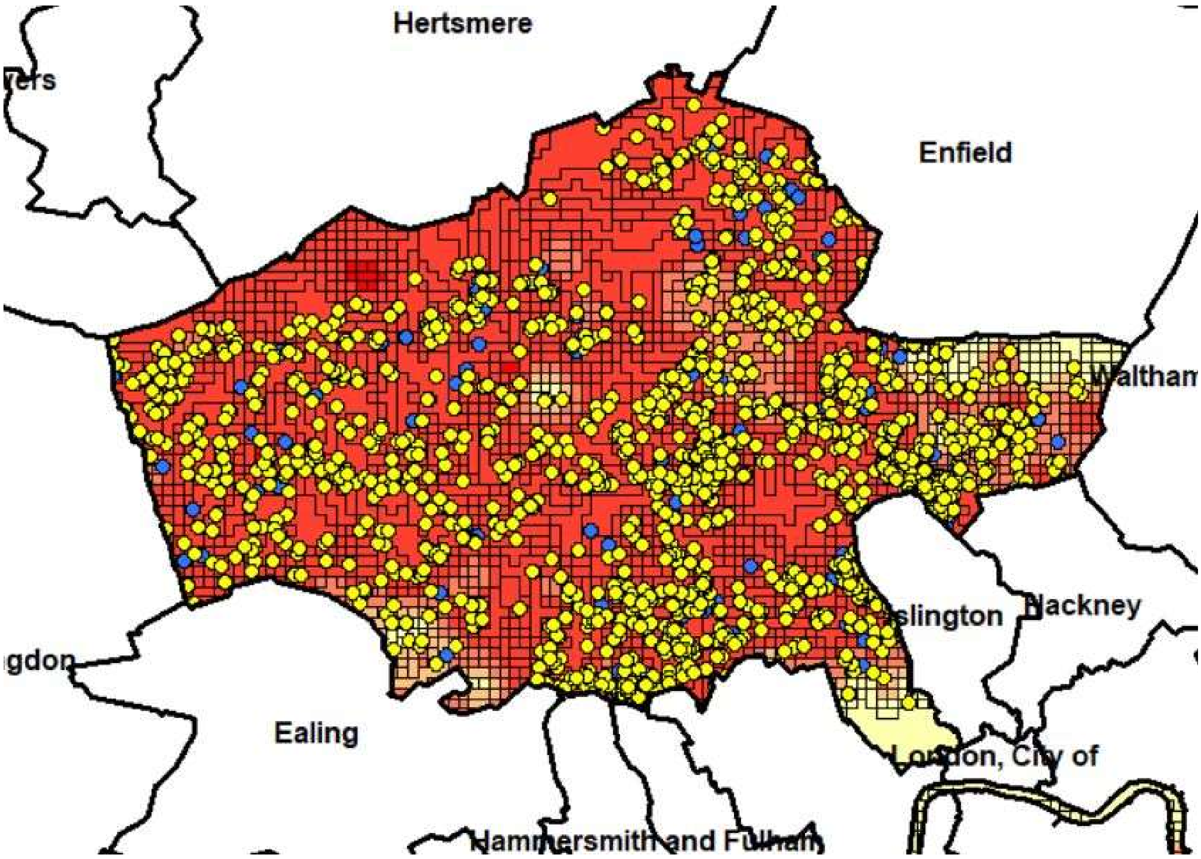
Follow the Geology *... continued*

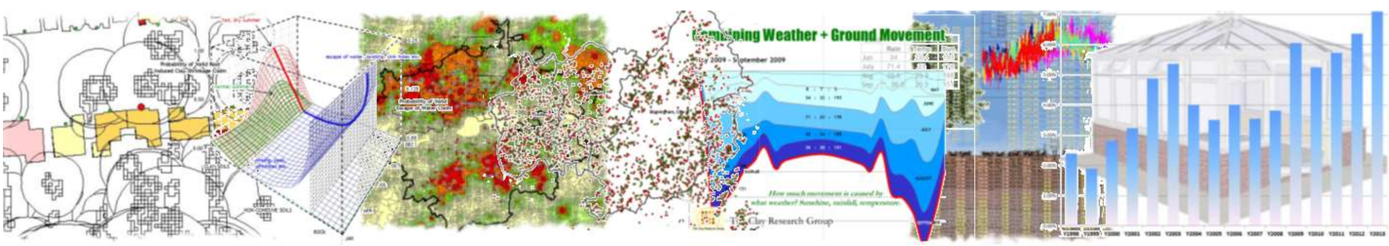
Below, the same exercise as the previous page, using the same claim sample and geological data, for the Harrow, Barnet, Brent, Camden and Havering areas of London.



From the sample, and assuming a uniform risk posed by the geology, we might expect an equal ratio between the perils by area, with some minor variations based on age of property etc.

To demonstrate the influence of the geology, in the London sample the ratio of clay shrinkage claims to escape of water = 1.6. That is to say, a valid claim in the areas noted is 1.6 times more likely to be due to clay shrinkage than EoW.

In the Midlands (previous page) a valid claim is 1.5 times more likely to be due to an escape of water. This significant difference is an indicator of the influence of the underlying geology in a 'normal' claims year – i.e., not a surge, when the difference would be greater.



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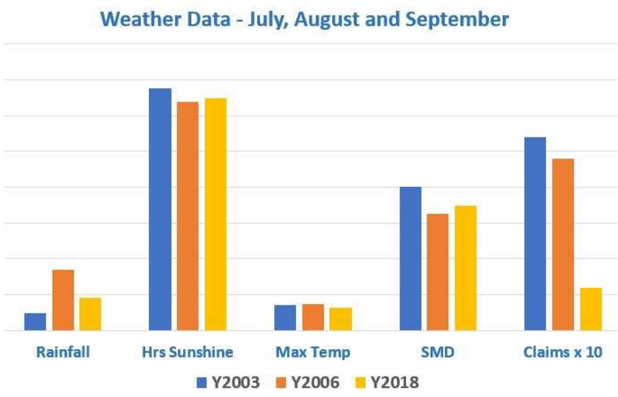
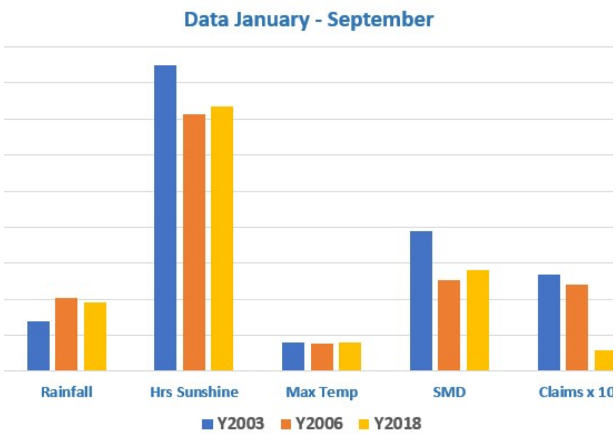
Surge -v- Weather

What are the drivers behind surge years, and how did 2018 compare with 2003 and 2006, two years that delivered high claims numbers?

The graph, right, plots rainfall, hours of sunshine, maximum temperature, SMD data compared with annual claim count, for the months of July, August and September.



Although 2018 had lower rainfall, more hours of sunshine and a higher SMD than 2006, (at least in tile 161 to the south east of England) claim numbers were much lower.



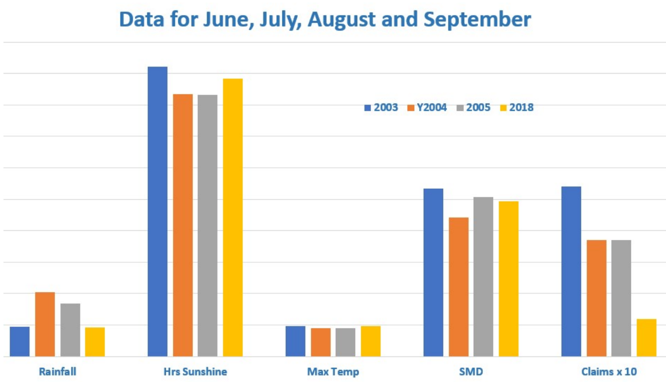
Or is it the case that weather from say January through to September (inclusive) is an influencing factor?

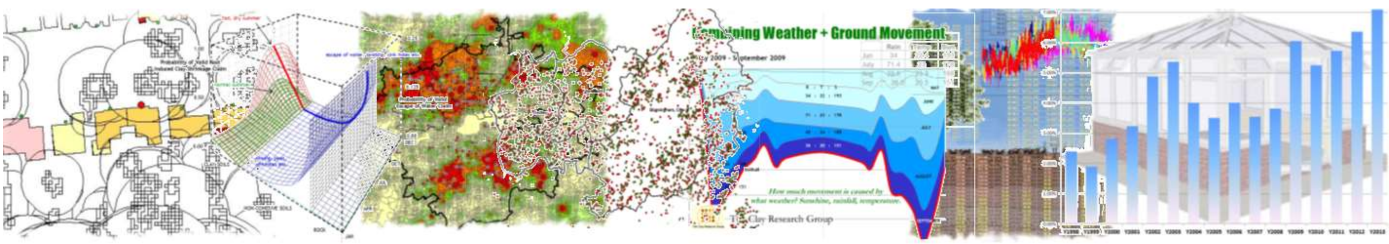
The graph left, has a similar profile to the one above, which suggests these months are not the main drivers.

Both graphs have similar profiles, with little to distinguish 2018 from the two event years, although gross annual claim numbers in 2018 were low.

Widening the analysis to include the 'normal' years of 2004 and 2005 and looking at the summer months of June, July, August and September doesn't explain why 2018 had far fewer claims over the course of the year.

It had less rainfall, more hours of sunshine, higher temperatures and the third highest SMD, but delivered far fewer claims than 2003, 2004 and 2005.





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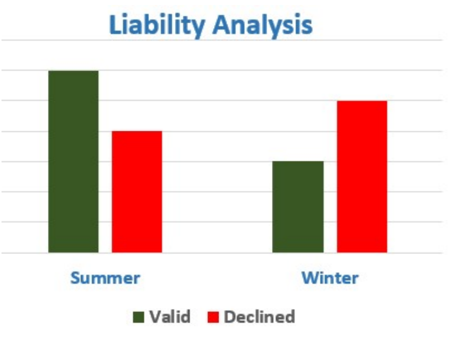
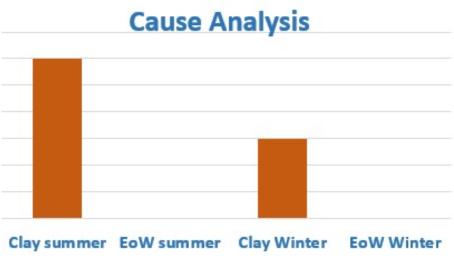
Using Past Claims Data to Determine Probability of Liability and Cause and to infer Geology





N20 8 - Claims plotted by postcode and by season provide a strong indication of the underlying geology.

Valid claims (blue) increase significantly in the summer, peaking around October. In contrast, declinatures (orange) show an increase in the winter months and reduced numbers in the summer. There are no escape of water claims in the sample.

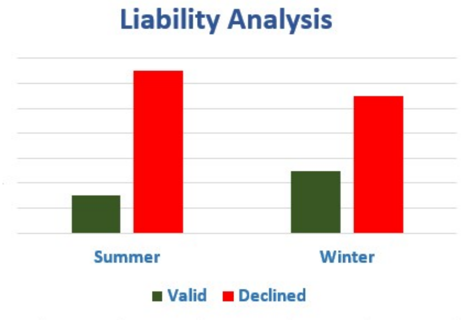
The data here suggests the area is underlain by a predominantly shrinkable clay soil. Referring to the BGS 1:50,000 series maps reveals the solid geology to be London clay with drift deposits of sand and gravel from the Stanmore series.

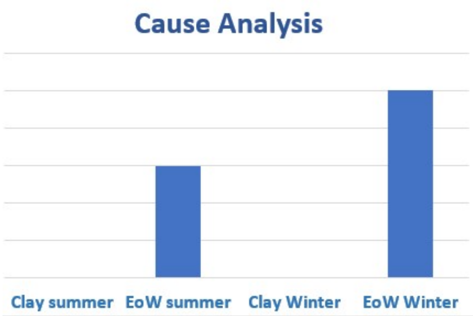
Total spend on valid claims from sample exceeds £175,000

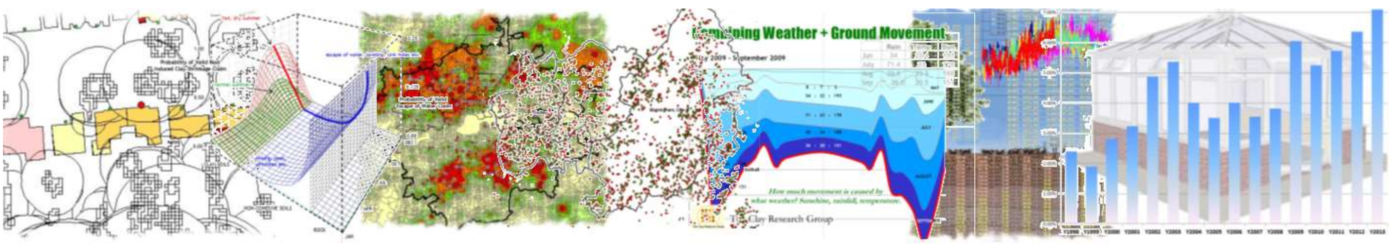
B13 9 – this has a different seasonal profile with fewer claims in the summer than the winter and a complete absence of clay shrinkage related claims, following the profile of a non-cohesive, predominantly sandy soil.

Reference to the BGS 1:50,000 scale map reveals widespread drift deposits of sand and gravel.

By mapping and analysing each sector, profiles can be constructed to help identify the risk of subsidence. Total spend on valid claims from sample = £76,000.







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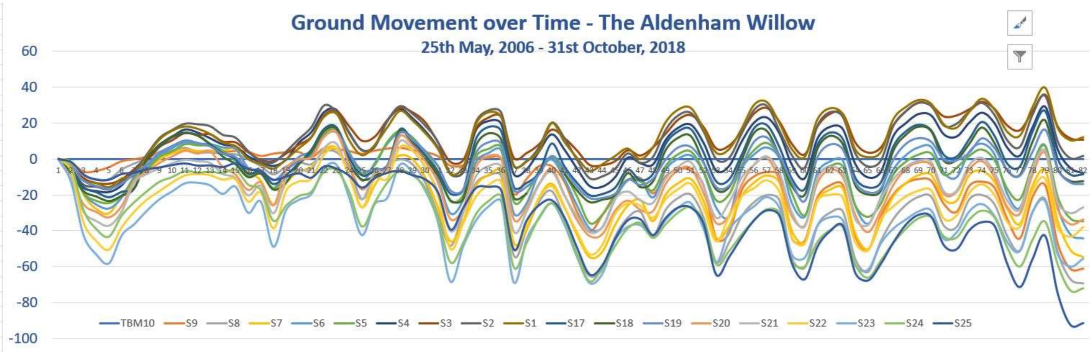
Quantum Mechanics and Subsidence. Evidence of a wave-particle duality?

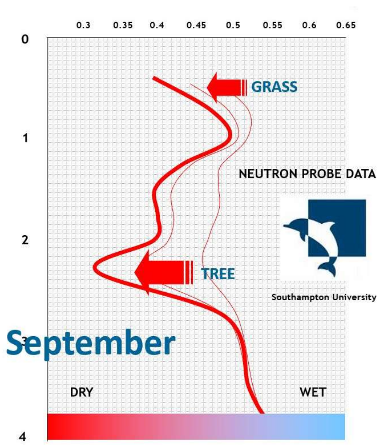
With tongue firmly in cheek, we are promoting the idea that we have discovered quantum subsidence, solving the relationship between Schrödinger's theories of wave forms, and Heisenberg's preference for particle led quantum mechanics.

The only thing we have had to tweak is Schrödinger's cat (not literally of course – don't contact the RSPCA), but more of that later. This is how it works.

First, experts have been measuring wave forms at Aldenham for the last 12 years. Their findings are beyond dispute. The ground moves up and down, and the wave form over 12 years is shown below. This confirms Schrödinger's view. Waveforms do exist.

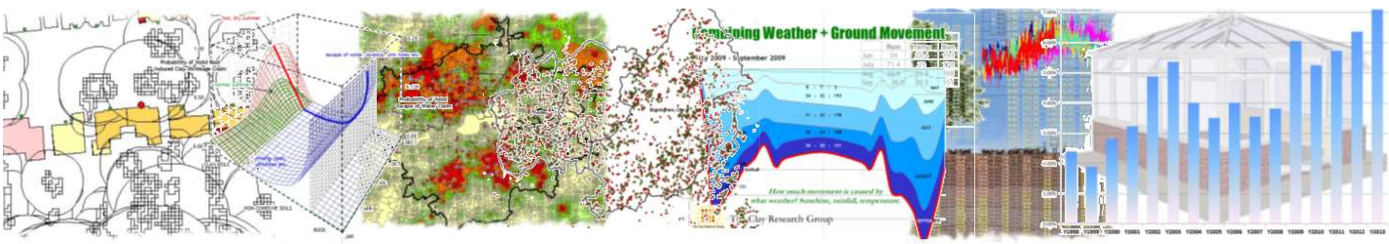


And then we have to tie this neatly into Heisenberg's view relating to quantum particle physics. See below. It is the action of these electro-dynamically charged (soil) particles that deliver the wave form above. The two aren't independent, but are intimately linked. They are the same, but different manifestations, depending on your viewpoint.



So, where does the cat fit in? The one we were going to tweak? Substitute 'tree' for cat and we are almost there. The cat sat in the box and was both alive and dead. For our example, trees cause damage, or don't, but exist in both states until cracks are observed – or we 'lift the lid'.

And then we move to the multiverse theory where the tree has caused damage in one universe, but not another, and doesn't exist in a third. It's complicated and we haven't explained ourselves well, but you get the (geological) drift. **NOTE:** None of our academic colleagues are associated with this article or support its findings.



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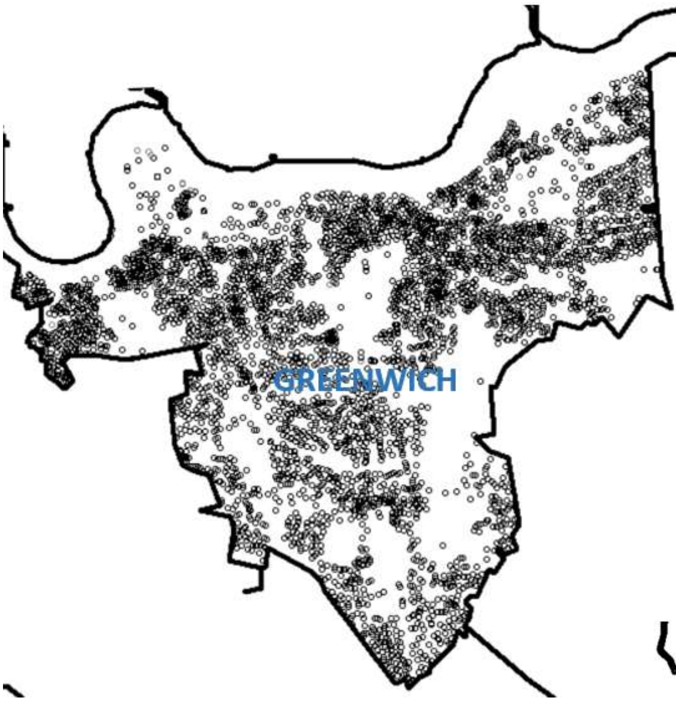
Subsidence Risk Analysis - GREENWICH

The following pages examine the risk of subsidence in Greenwich. The borough has around 108,690 houses, a population of around 273,000 and an area of 47km^2.

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
Croydon	Issue 159	Aug-18
Basingstoke & Deane	Issue 160	Sep-18
Merton	Issue 161	Oct-18
Wandsworth	Issue 162	Nov-18
Basildon	Issue 163	Dec-18
Redbridge	Issue 166	Mar-19
Leicester	Issue 167	Apr-19
Coventry	Issue 168	May-19

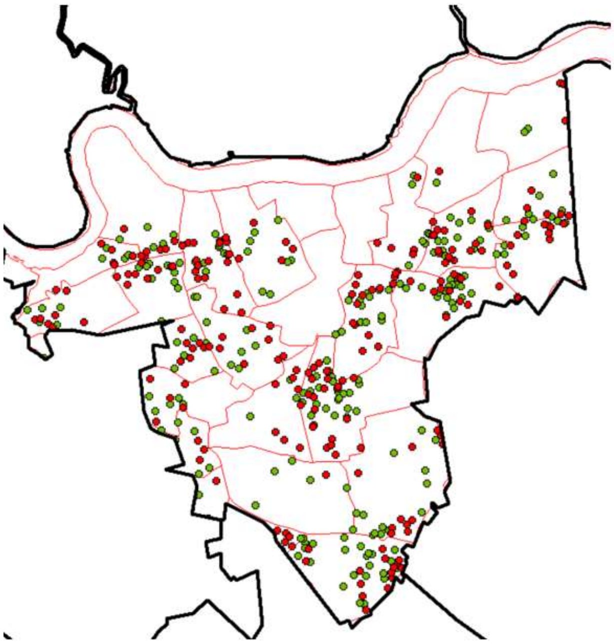
Table of earlier studies.



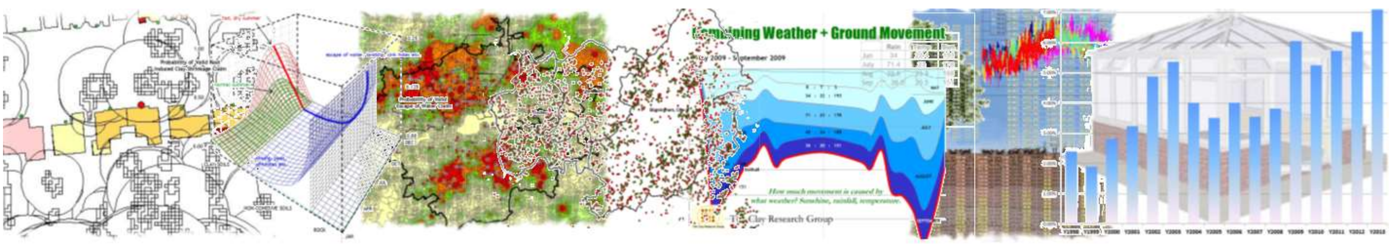
Above, the distribution of housing across the district shown by full postcode.

Right, the distribution of claims, both valid (green) and declined (red) from the sample held.

Greenwich comes 21st in our 'rank order of risk by district' table, with a rating of 2.49 in relation to the UK 'average by district' table. That is to say, it is 2.49 times greater risk than the UK average.



VALID and DECLINED CLAIM DISTRIBUTION



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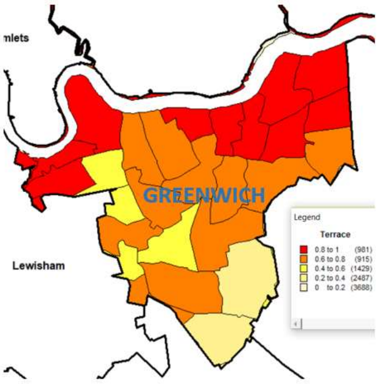
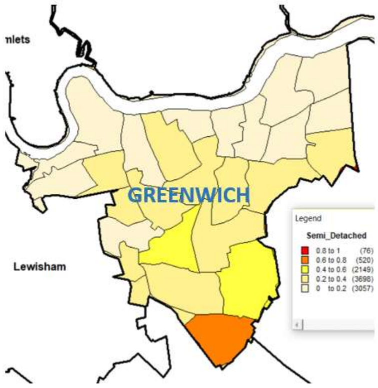
GREENWICH - Properties by Style and Ownership



TERRACED

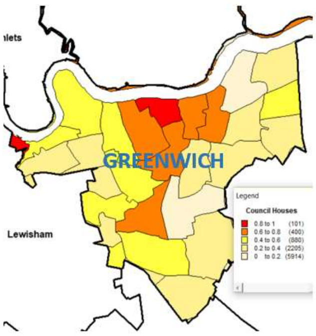


SEMI-DETACHED

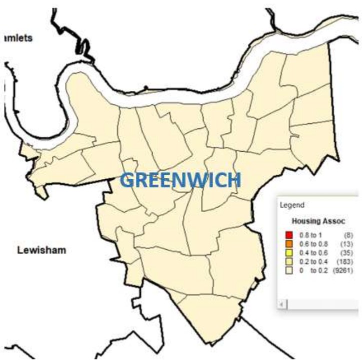
DETACHED

Above, the frequency distribution of differing house styles at postcode sector level showing the concentration of each style in relation to the total housing stock. The 2014 census lists 2,360 detached, 13,870 semi-detached and 38,280 terraced properties (all figures rounded). In addition to the above, there were around 52,460 flats and maisonettes and 890 bungalows at the time the census was taken.

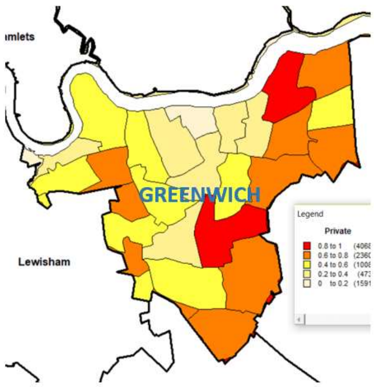
Distribution by ownership is shown below.



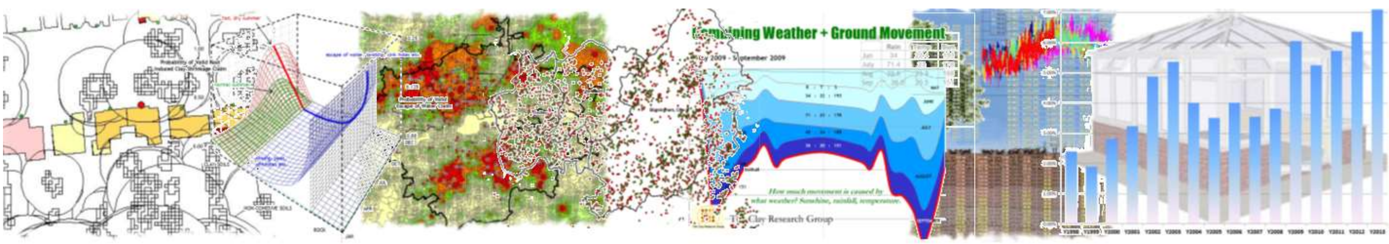
COUNCIL



HOUSING ASSOCIATION



PRIVATE



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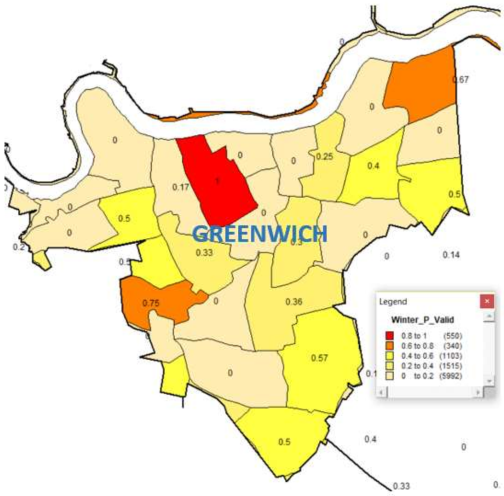
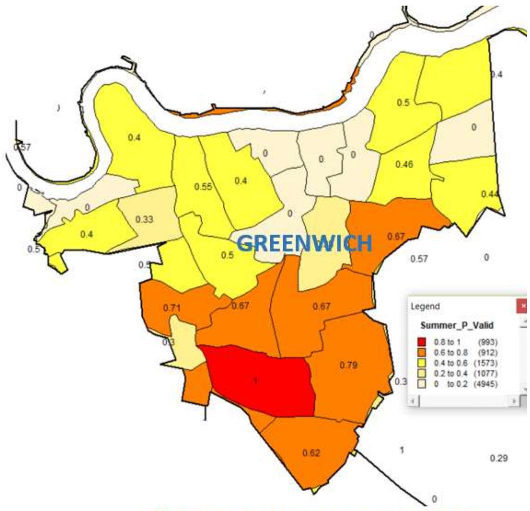
GREENWICH - Liability by Season and Geology

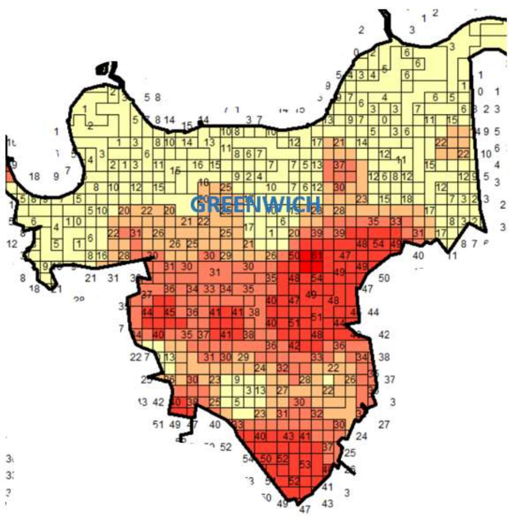


PROBABILITY VALID – WINTER

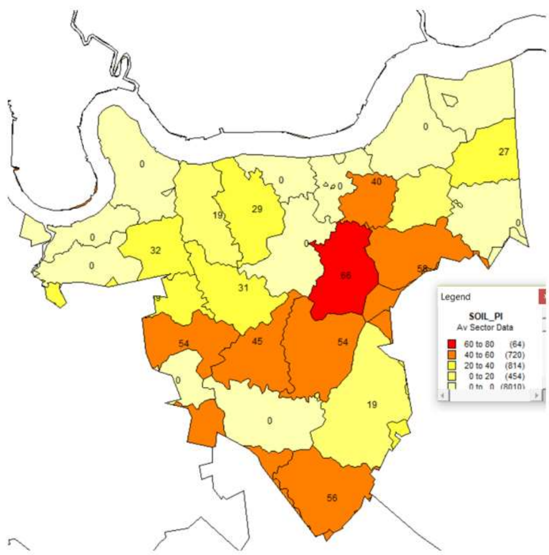


PROBABILITY VALID - SUMMER

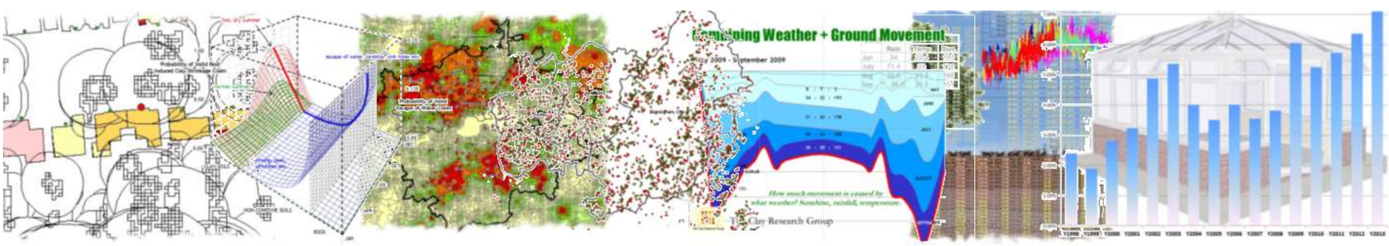
The probability of whether a claim is likely to be valid or declined varies by season (above) and geology (below). Claim frequency data by season can be used to infer the nature of the underlying soil (i.e. either cohesive or non-cohesive) and its relationship with the weather. Clay soils respond to warm, dry summers, but deliver far fewer claims in the winter months. Houses on non-cohesive soils tend to deliver fewer claims overall, but with less change by season. The shrinkable clay series has a variable PI across the district of between 20 – 50% as shown on the CRG map below. The divide between soil types roughly corresponds to the British Geological series maps, revealing the variable thickness of the drift as further exposed by the 'Total Private Claims' map on the following page.



CRG 250m DATA GRID



CRG SECTOR LEVEL SOILS DATA



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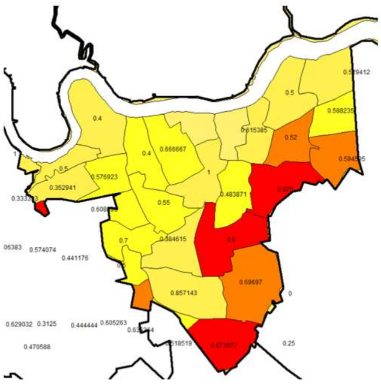
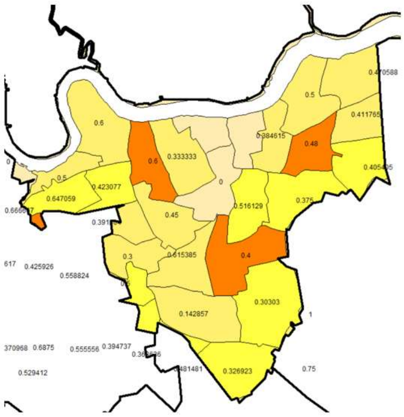
GREENWICH – Liability by Sector. Escape of Water and Council Tree Claims Distribution



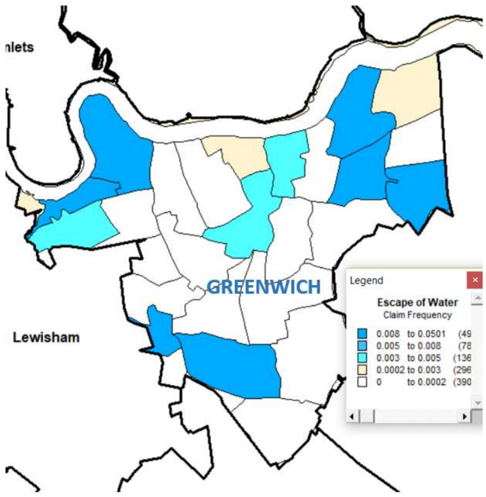
PROBABILITY of VALID



PROBABILITY of DECLINATURE

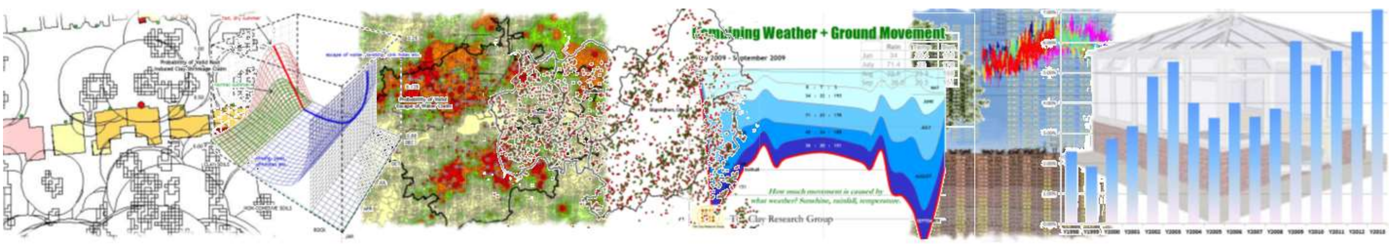
Above, mapping historic claim liability on a normalised scale revealing postcode sectors where the claim has either high or low probabilities of being accepted as valid or declined throughout the year, not taking into account any seasonal influence.

Below left, mapping the frequency of Escape of Water claims from the sample, showing the concentration to the north of the borough, adjoining the Thames, and a pocket to the south, corresponding with the presence of the predominantly non-cohesive and alluvial soils. Below right, dots on the 'Council Tree Claims' map, represent properties where damage has been attributable to vegetation in the ownership of the local authority. Is there an identifiable 'Hot Spot'?

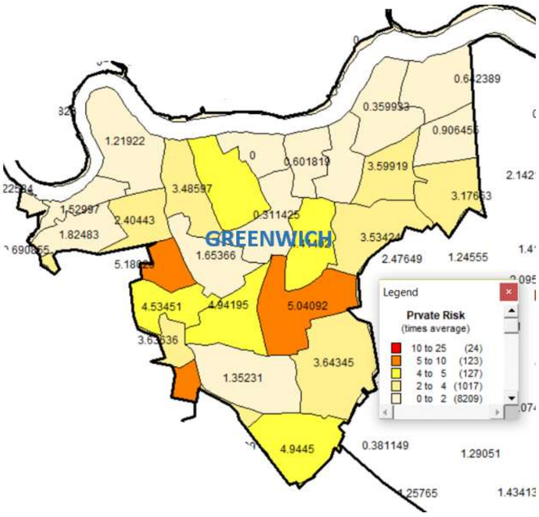


EoW – Frequency from Sample

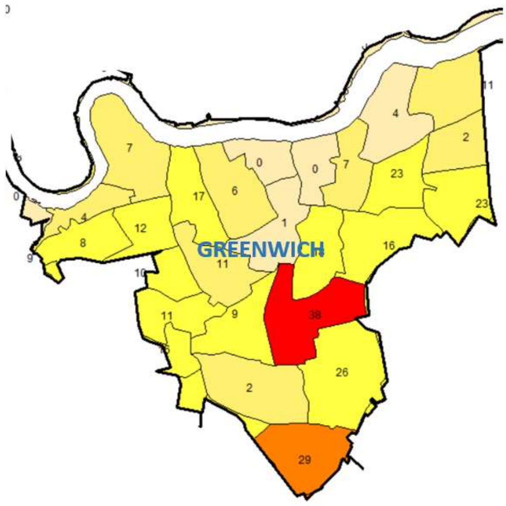
CLAIMS INVOLVING COUNCIL TREES



GREENWICH – Averages, Count & Probabilities



RISK AVERAGE COMPARED WITH UK



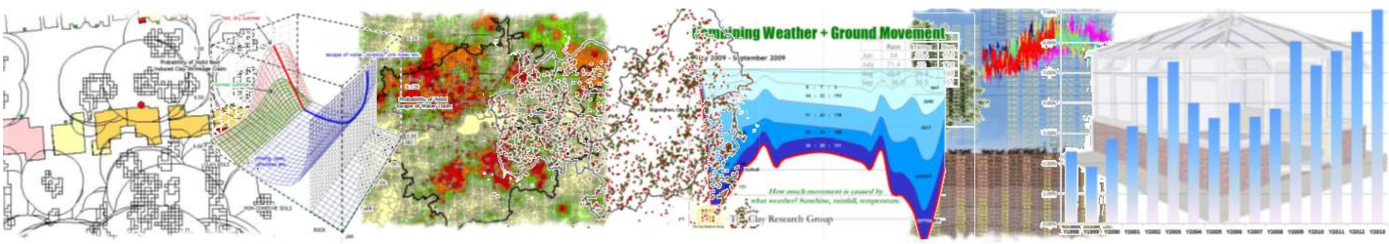
COUNT of CLAIM

Below, the figures reveal a borough with a more variable risk than those to the north west of London in terms of subsidence, and by season. The chances of a claim being declined in the summer are around 40%, and if it is valid, the chances of it being due to clay shrinkage will be around 60%. In the winter, the repudiation rate is higher at just under 40%, and if it is valid, the chance of a claim being due to an escape of water is around 58%.

The figures suggest a variable geology. By contrast, a borough like Harrow with a large coverage of outcropping London clay, has a likelihood of a valid claim being due to clay shrinkage of around 70% in the summer, falling dramatically in the winter months. Data is of course less reliable when there is geological variability across the district, as is the case here, when sector level analysis is preferable.

PROBABILITIES by SEASON – CAUSE AND LIABILITY

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Greenwich	0.358	0.260	0.382	0.26	0.36	0.382



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