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

February 2018
Edition 153

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Issue 153, February, 2018

How many claims? How many trees?

Jon Heuch raised an interest point in a recent exchange. Just how many trees have been implicated in subsidence claims since the introduction of subsidence cover to the standard building policy? We make a 'best guess' estimate - see page 8.

Date for the Diary

TDAG have arranged two seminars, one in London and another in Birmingham. See their web site for details:

http://www.tdag.org.uk/

Working Together

Following on from exchanges with Andrea Plunknett and others there appears to be an agreement between most parties that finding a way to amicably resolve the more contentious tree root liability claims would benefit homeowners, local authorities, insurers and hopefully, trees implicated in causing subsidence damage.

Lengthy and costly disputes are a feature of this class of Third Party action. Optera, a specialist contractor who have shown an interest in helping to resolve such disputes, are offering to install a root barrier on a claim involving a dispute between an insurer and council at no cost, subject to review regarding suitability.

Risk by Sector – NW11 6

Continuing the theme from last month, this edition includes a study of another postcode sector from a London borough, NW11 6.

The purpose of sharing the study ties in with the theme above. If we can improve our understanding of risk then councils benefit by targeting tree maintenance work, insurers receive fewer claims and homeowners avoid the distress that such claims impose.

BGS Annual Science Review

The annual geotechnical science review from the British Geological Survey is available for download from:

http://www.bgs.ac.uk/annualreport/home.html

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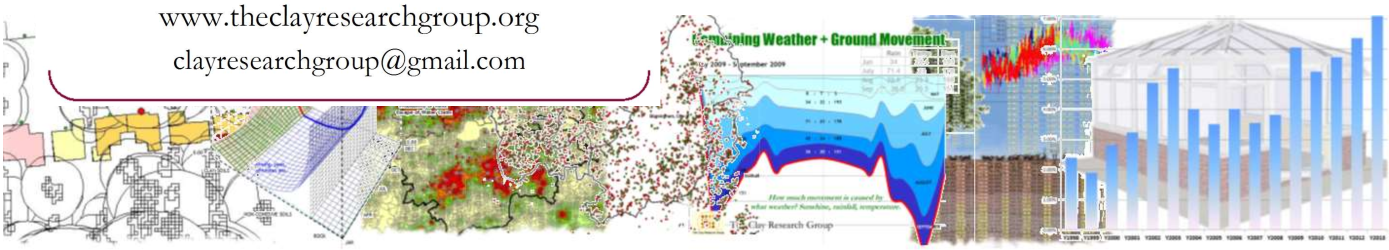

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Developing the Model

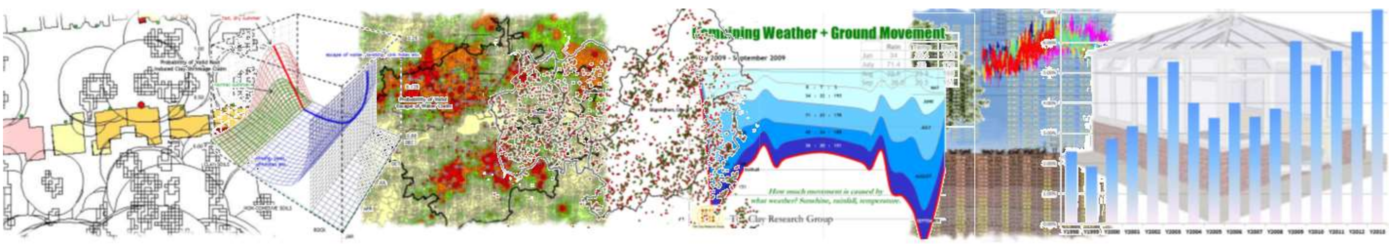
The subsidence risk model described in the previous edition identified houses at risk from root induced clay shrinkage, and although relatively few (compared with the tree population) will be damaged in any particular year, numbers are cumulative over time, as the exercise on pages 7 reveals.

Is there any way the model can predict which tree will cause damage at any particular time? Is damage inevitable when a house is identified as being at risk? No to both questions. Absolutely not.

However, as explored in last month's edition, experience informs us where the risk lies and the model is a conservative estimate because it doesn't account for trees with a height less than 4mtrs, or shrubs, both of which present a significant risk as the chart on page 8 confirms.

Thematic map showing properties rated according to the modelled root overlap. The map is for illustration purposes only and does not refer to the postcodes listed.

Postcode sectors N20 8 and NW11 6 are situated on predominantly outcropping London clay. What will a different geology reveal in terms of claim numbers, season of notification and the dominant peril? How will the settled costs compare? Next month we visit the Midlands, exploring B28 0, a postcode sector consisting primarily of mixed drift deposits overlying mudstone.



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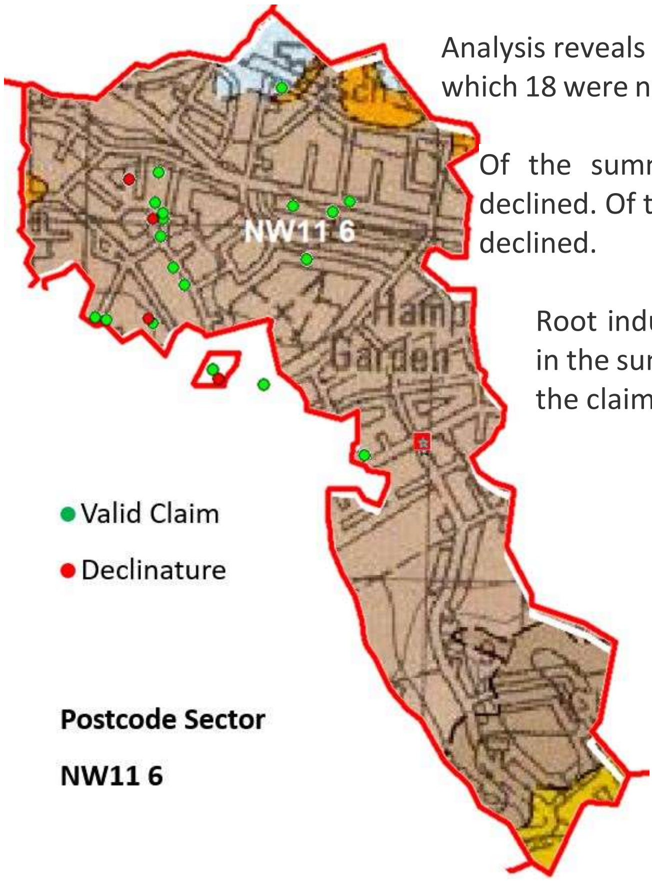
Study Area – NW11 6

Below, an extract from the 1:50,000 scale British Geological Survey map showing outcropping London clay in postcode sector NW11 6. Claims from a UK sample of 54,000 have been superimposed – green dots show valid claims, and red, declinatures. On the following pages, extracts showing individual claims against the modelled risk.



Analysis reveals 25 claims notified throughout the year, of which 18 were notified in the summer, and 7 in the winter.

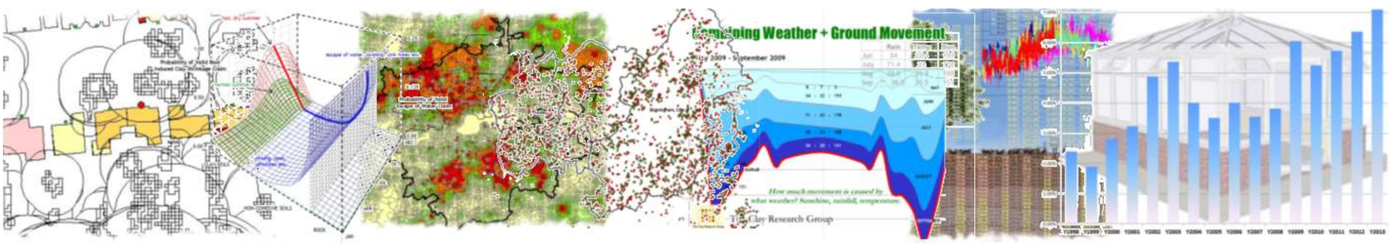
Of the summer claims, 17 were valid and 1 was declined. Of the winter claims, 3 were valid and 4 were declined.

Root induced clay shrinkage is the dominant peril in the summer months, with a 94% probability that the claim will be valid.

The three valid winter claims were also found to be due to clay shrinkage (late notifications relating to damage in the previous summer) and the 3 valid escape-of-water claims notified in the summer were most likely associated with shallow foundations bearing onto poor ground as described in last month's edition.

Of the 17 valid root induced clay shrinkage claims, local authority trees were implicated in 4 instances, neighbour's trees in 3, policyholders in 5 and both neighbours and policyholder trees in 5.

The measure of risk is based on the number of valid claims divided by the housing population. Which is the riskier, NW11 6 or N20 8? N20 8 had 18 claims, 9 of which were valid and 9 declined, with a housing population of around 1,500. NW11 6 has a housing population of over 2,500 households. Using valid claim count, NW11 6 has a frequency risk rating = 0.008, compared with 0.006 for N20 8. These figures are from our sample of 54,000 claims. The derived risk does not reflect any particular year or period.



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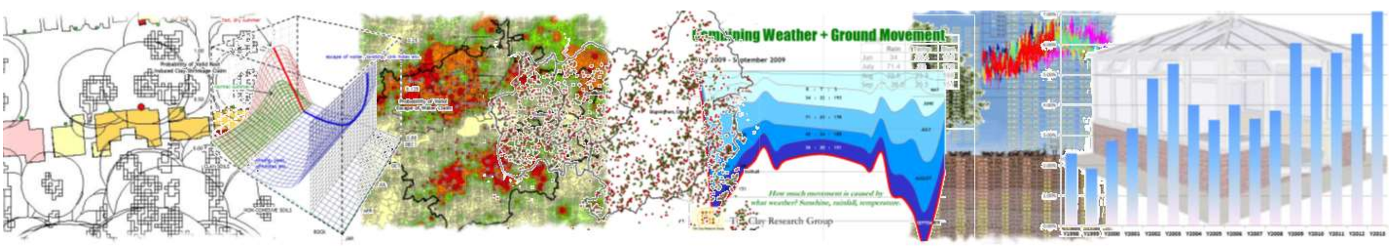
Study Area – NW11 6 – Valid Claims

A selection of claims correctly identified by the model as being at risk.



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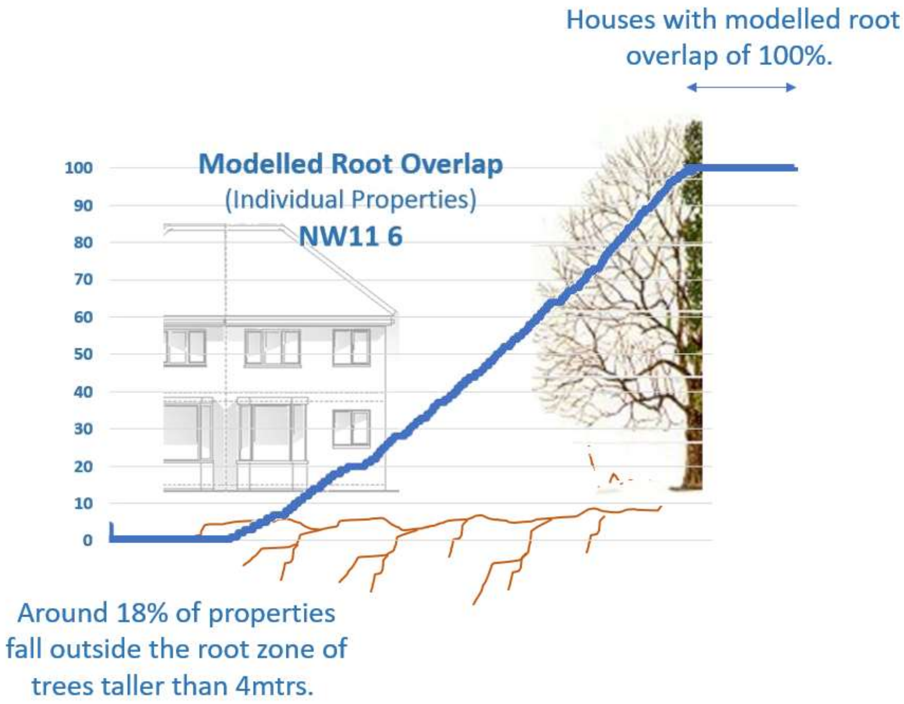
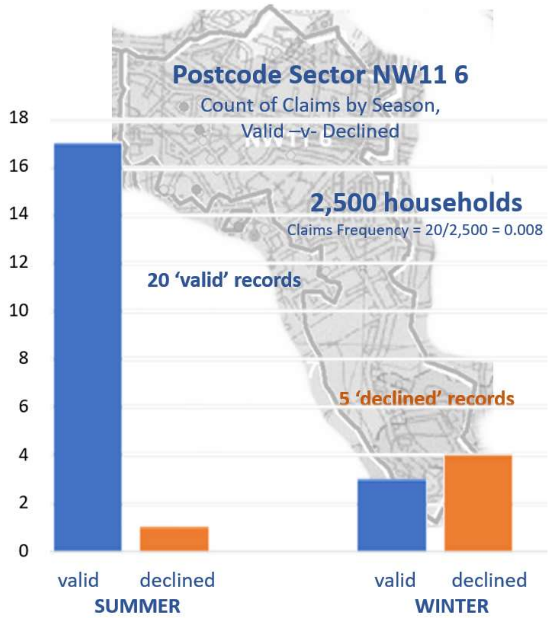
Study Area – NW11 6 – Risk by Property

Using the LiDAR model, it is estimated that around 18% of the properties in NW11 6 have no root overlap and 13% have around 100%.

The regular slope is similar to that of EN20 8 that appeared in last month's edition.

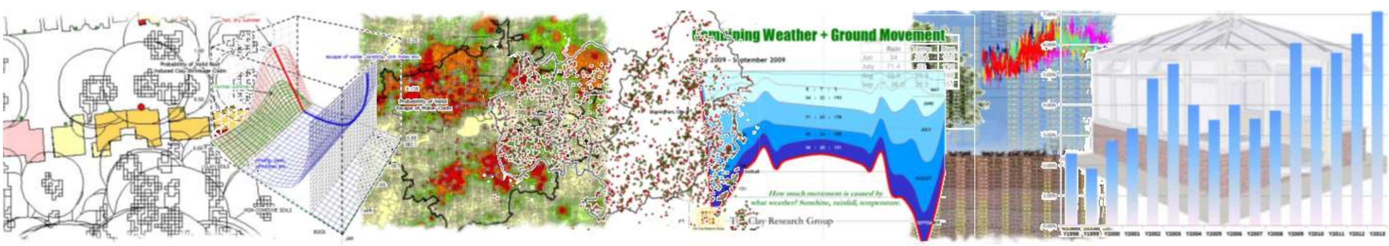




Developing a data driven understanding of risk and causation involves building a profile of claims by season.

What does a high-risk sector look like? Can we identify primary causation? How would such a model be used? Clearly it has value to underwriters, but can it support claims handlers and engineers?

On the following page we look at an outline of how the system might be constructed.



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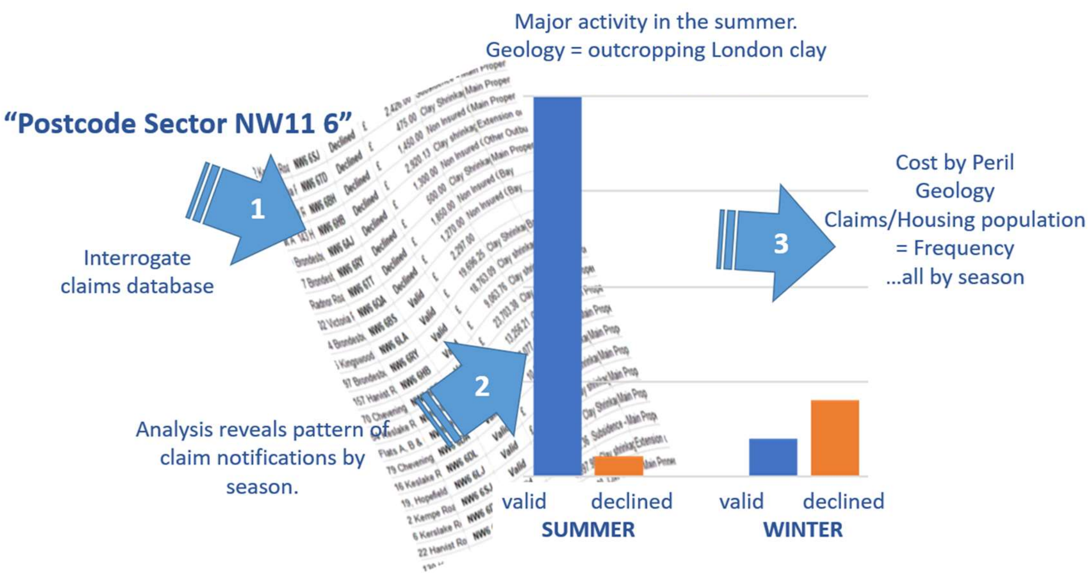
Can the geology be inferred from past claims experience?

Is it the case that an area might suffer root induced clay shrinkage claims one year, and escape of water claims the next? Clearly not as the peril is related to the geology.

If that is so, past claims experience has to be a useful tool for triaging new claims.

Quantifying the determining factors is a useful starting point for such a system, but how would it look?

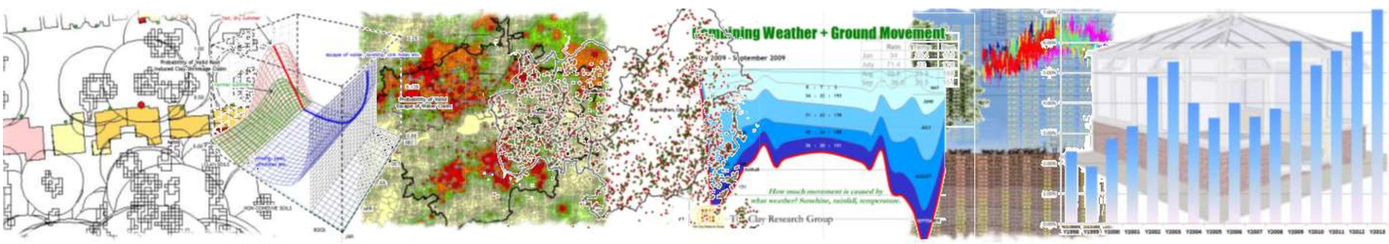
First, the system would search its existing claims database on entry of the postcode sector. The application retrieves the data and responds providing the geology, claims experience (valid or declined), costs, operating perils etc., all by season. This is the important guide to assist the claims handler/engineer to understand the likely cause.



Entry of the postcode sector triggers an examination of the claim history, categorised by season, and causation with a measure of frequency.

In the case of NW11 6 it can be seen that in the summer, the claim has a 94% probability of being valid and the most likely peril is root induced clay shrinkage.

The sample size is important in relation to a confidence value. Here the number of claims is high, which provides a greater confidence in the output.



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How many claims, how many trees?

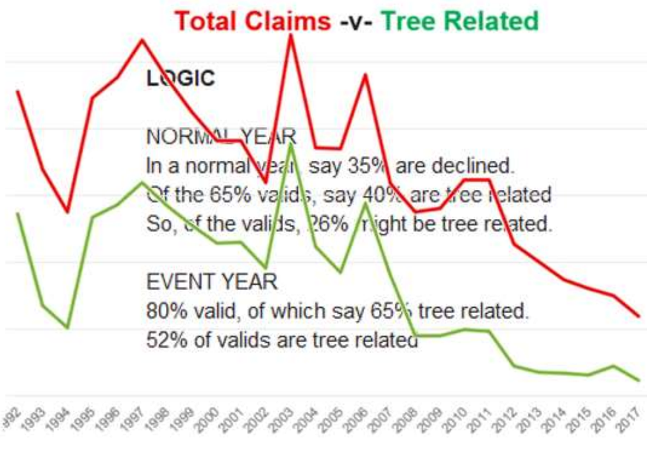
Dr. Jon Heuch raised an interesting point a few weeks ago when he asked how many trees have been implicated in subsidence claims since the introduction of cover in 1971. Clearly there is no hope of providing anything like a definitive answer, but our response was as follows.

According to the ABI annual report, 16.6 million houses have building insurance.

The ABI claims notified tables include 'all claims notified' - not just valid claims. On average, the number of valid claims is around 50% of total claims notified. This rises to say 70-80% in event years, and can fall as low as 20% in winter months of normal years. The 'claims recorded' table includes all causes - escape of water, sinkholes, mining, landslip, heave, sulphates etc., and re-opened claims.

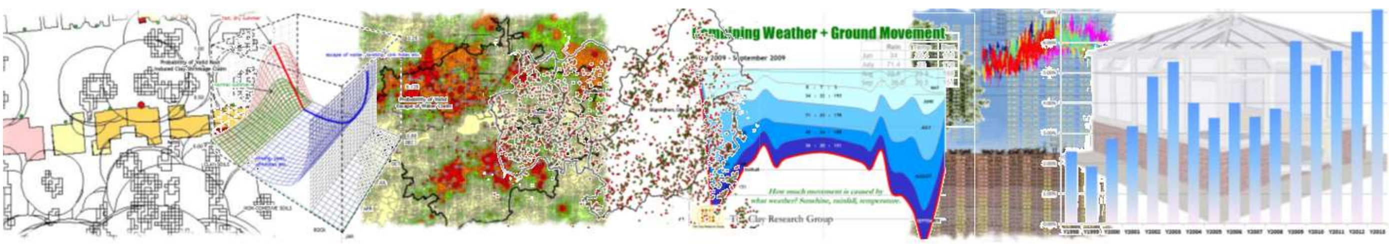
As a very general guide, claim frequency on clay = 0.2% and on 'not clay', = 0.07%. As will be seen from the ongoing study, these rates vary by postcode sector and season.

A deduction has to be made from the recorded claim numbers for declinatures and other perils - heave, escape of water etc. Taking these into account, our estimate is shown in the graph below. The calculation is based on 35% of claims being declined in a typical year plus a deduction for 'other perils', and in event years, that figures might be that 65% of valid claims are tree related from a total of 80% of valid claims recorded.



The red line plots claim numbers for the period 1992 – 2017. For our purposes, claims for the period 1971 to 1992 have been estimated at a reduced level, taking account of peaks in 1976 and 1984. The percentage of tree related claims is shown by the green line. A higher percentage of both valid and tree involved claims is linked to event years, and the number decreases in 'normal' claim years. An explanation of how tree related claim numbers have been calculated underlies the graph.

It is estimated that between 400,000 - 500,000 houses (say around 3% of the insured housing stock) may have suffered root induced subsidence damage, of which shrubs and conifers are the main culprit, and often dealt with without an arboriculturalists involvement.



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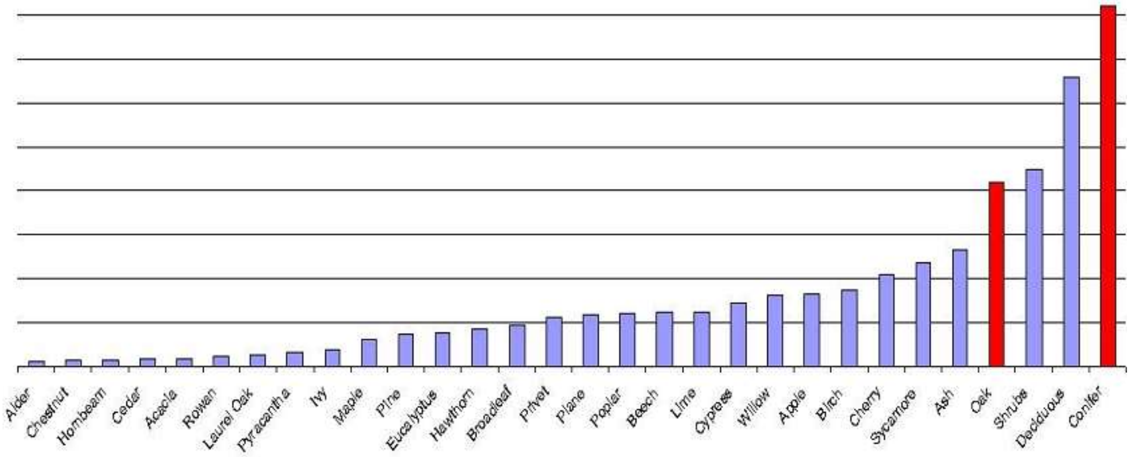
How many claims, how many trees?

The graph below, taken from the archive, illustrates the distribution by species. The majority of damage is caused by conifers and shrubs, nearly all of which will be in private ownership. Other species high on the list include oak, ash, sycamore etc., with plane and poplar around half way along

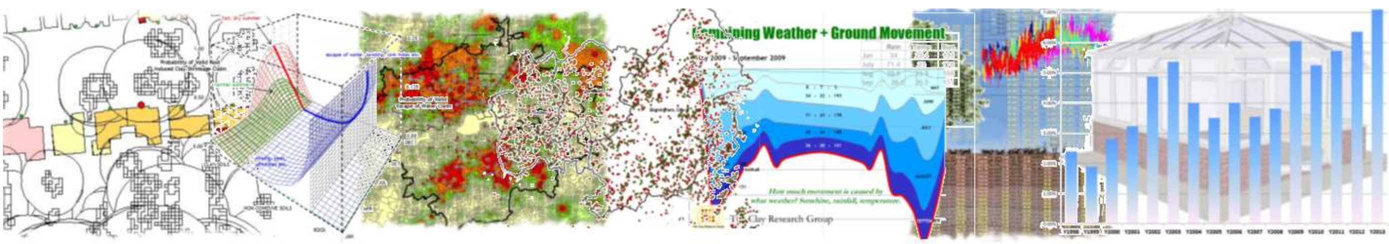


In summary, a 'best guess' suggests that around 400,000 – 500,000 subsidence related claims have involved vegetation across the UK since the introduction of subsidence cover. The great majority have involved trees and shrubs in private ownership. Averaging the total over the term of cover delivers a rounded figure of 10,000 a year, with wide fluctuations.

This takes into account event years like 2003 (over 50,000 claims with a high percentage of valid claims) with normal years (say 35,000 claims and a lower percentage of valid claims amongst them). Not all will have led to felling of the vegetation – many will involve trimming or canopy reduction.

To add to the complexity of estimating which trees might cause damage, the shrinkability of the soil has to be accounted for. Two trees of identical species, height and distance from a subsidence damaged property will respond differently, depending on health and local environmental conditions, and of course, the shrinkability of the soil. Right, housing distribution of soil by shrinkability – again, very approximate values based on actual site investigations.

	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 houses**



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Google Earth – going back in time

Google Earth provides a useful tool for reviewing past aerial photography and seeing if vegetation has changed over recent years. Select the "view historic imagery" button from the top toolbar, and move the slider along to see what is available – see right.

It may provide help when considering whether vegetation has been removed over recent years. In the case below, 'current' imagery shows no significant vegetation in close proximity to the property in April 2017.

In contrast, imagery from July 2013 reveals a large tree near to the property, as well as smaller vegetation across the road. By 2017, all had gone.

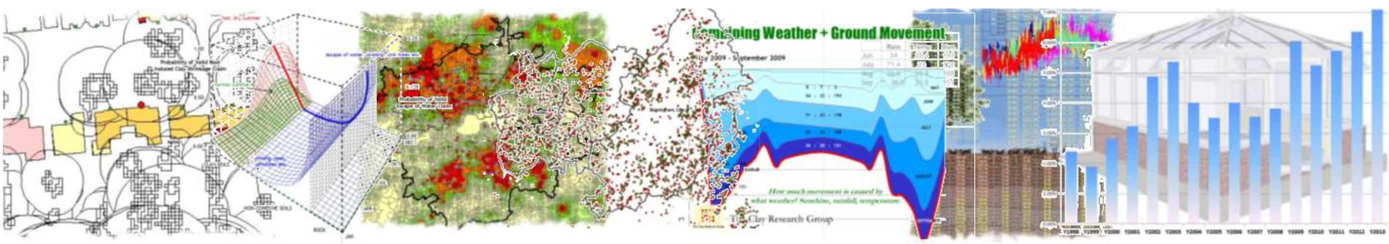
By way of illustration of its usefulness, imagine a claim notified in 2017 where on inspection, cracks were noted to the front and side elevation with no logical explanation. No vegetation, and drainage tests revealed no defects.

The cracks are wider at the bottom than the top, indicative of heave.

A quick review of imagery using Google Earth reveals the most likely culprit – assuming a clay soil of course.

In some instances, aerial photographs are available from 1945, although the quality is variable.

The images here reveal a very different street scene over a relatively short period of time.



"First Steps in Urban Air Quality"

TDAG have been working in collaboration with the Birmingham Institute of Forest Research and the School of Geography, Earth, and Environmental Science of the University of Birmingham, and the Lancaster Environment Centre of Lancaster University to produce a paper examining the role of trees in combating air pollution.

The paper is available for download at: http://epapers.bham.ac.uk/3069/

"How Tree Roots Respond to Drought"

Brunner I., *et al*

Swiss Federal Institute for Forest, Snow and Landscape Research

The above Open Access paper published by Frontiers in Plant Science provides a comprehensive overview of how the roots of trees cope with drought conditions. The introduction reviews published research, explaining that water uptake and distribution is controlled by aquaporins (a complex water conductor at a molecular level). Under drought conditions, Abscisic Acid (ABA) increases aquaporin expression, which translates into increased hydraulic conductance.

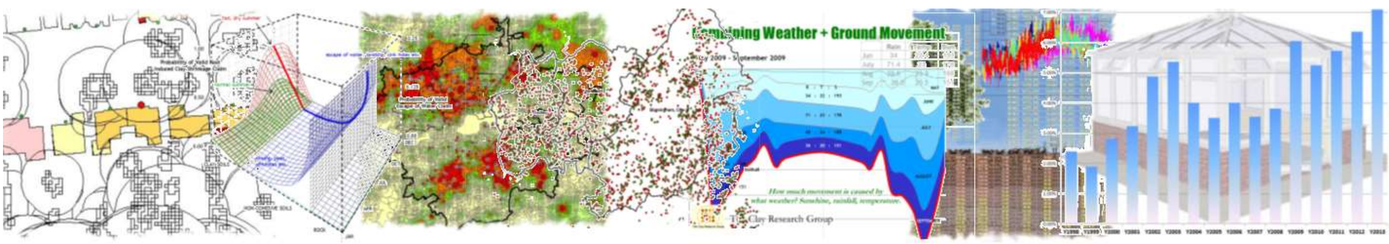
Water loss to the soil is reduced by the process of suberisation. Put simply, the cells along water channels become waxy and water loss into the surrounding ground is much reduced. The process increases the concentration of fructose which the authors explain, lowers the osmotic potential and again, enhances water uptake.

Ectomycorrhizal fungus grows in the root zone, increasing its surface area and improving water uptake. The paper is well worth reading by those of us with an interest in the response of roots to drought conditions.

"Nutrient foraging by mycorrhizas: From species functional traits to ecosystem processes."

Weile Chen, *et al*, Intercollege Graduate Degree Program in Ecology, The Pennsylvania State University.

Another paper exploring the role and importance of mycorrhizal fungus in nutrient foraging appears in the January, 2018 edition of the journal, Functional Ecology.



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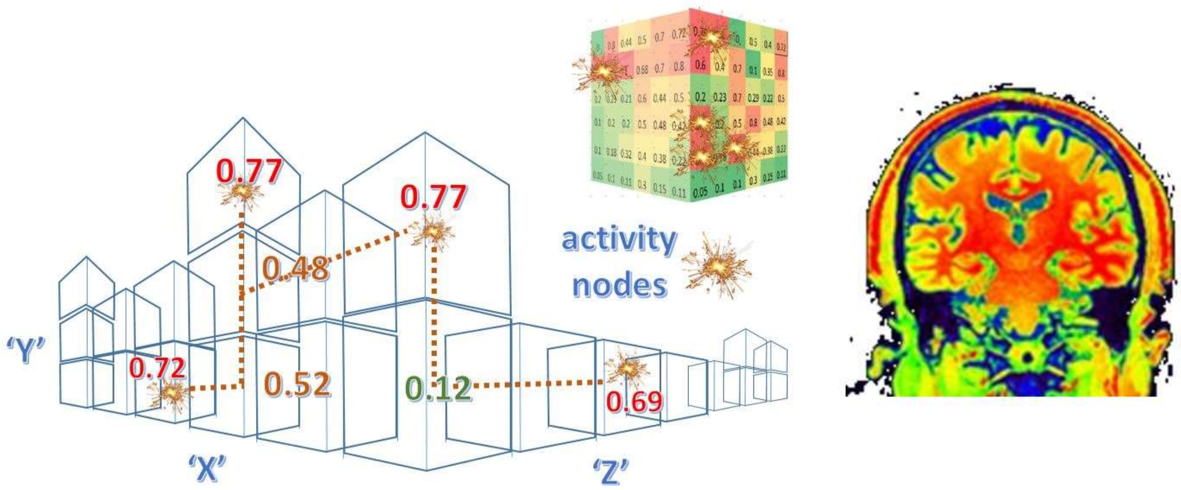
10 Years On. Building Systems for the Future.

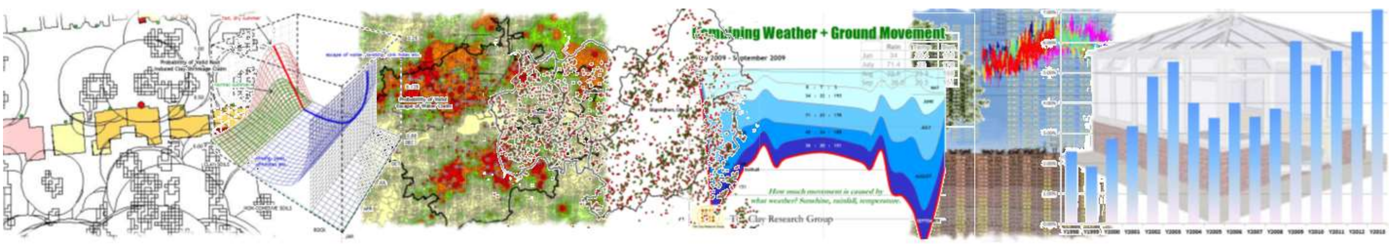
Humans like order. If we had designed the brain, it would consist of rows of orderly compartments, all labelled sequentially. ‘Apple’, ‘banana’, ‘orange’, sort of approach, listed alphabetically – a bit like a supermarket shopping experience. Frankly, the brain is a mess. Cables running in all directions, criss-crossing cells and firing in what seems a haphazard and chaotic way that defies understanding. It just isn’t logical.

The current industry approach requires order. Decision trees can plot a route using fixed parameters, or include probability estimates to predict outcomes. The former (fixed parameters) are best suited to controls where something is either on, or off. Machines and the like. “If temperature drops below 60 degrees, then sound alarm”.



Looking to the future, we need to add several levels of complexity, and the model will have to resolve ‘probabilities of ‘x’’ based on sometimes incomplete data plus environmental factors that combine in a wide range of ways to confound us, and are always changing.

A modelled approach has to cater for this, plus consider additional evidence as it becomes available. Results of site investigations, soil tests, drainage surveys and arboricultural reports etc. Whilst a decision tree maps the route and can give estimates of outcomes, they are less useful in the dynamic and uncertain world of subsidence claims handling. New data can be entered as it becomes available, but that means the initial assessment could be lost, or at best, harder to track down and assimilate into the decision tree for reflective analysis. In our view, the decision tree approach (“if ‘x’, then ‘y’, else…) is limited in terms of potential value for the future. We need a platform that will grow and has the potential to deliver more.



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Trees and/or Cubes?

To digress for a moment, when stimulation is applied to the body, or images viewed etc., use is made MRI to deduce which parts of the brain are involved. The neurologist might stick a pin into the patient's toe, and note parts of the brain 'light up' to deduce 'x' part of the brain registers the pain in a certain locality – or more likely, localities.

What if a complex probability cube could be built that records activity that is capable of analysis by expert systems – not by linear algorithms – with interpretation based on pattern recognition, rather than numbers?

By adding all pieces of data, we can sit back and let a pattern matching system do the work – perhaps. To achieve this, we need some means of recording data that is suitably complex, where some analysis – those parts where we have expertise - has already been undertaken. This is the idea of building a library of images of various claim scenarios – what do valid/declined/clay shrinkage/escape of water/landslip/heave claims look like?

The illustration on the previous page records where, in the cube, activity takes place for a range of perils. The pattern will be complex. A 3D image of the real world. Not black and white, but full of colour and, to the casual observer, haphazard and without meaning.

The starbursts, or sparks, represent the higher scores. It is these we are mapping in our imaginary MRI machine. Gatherings in certain locations will mean different things but visualising them can make sense of otherwise vague patterns.

How do we analyse a 3D cube? Slice by slice, layer by layer, calculating combined probabilities as we go, weighting each, and then combining the results based on actual investigations.

The cube is multi-layered, with the first set aside to store the initial assessment. Date of notification, damage description, style of property and location of damage etc. Other layers store and assess outcomes from the various investigations.

The cube stores outcomes following probability assessments. Some answers aren't going to be 'yes/no', and this is resolved by using the 0 – 1 scale. What is the probability that the suction graph is indicating desiccation? How likely is it that a 7m apple tree would cause 1,500kPa suctions, 10 mtrs away from the area of damage? The likelihood is low, and perhaps this would rate 0.06. Are the drains leaking? If so, is the point of leakage likely to be associated with the area of damage that has been described? If the leak is say 5mtrs from the area of damage, maybe the score would be 0.35, factored by the soil type with the score rising the less cohesive the soil and the lie of the land. More next month.