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

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Issue 96 - May 2013

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Research Updates

The Post are holding a 'Big Data' day on the 10th July at Dexter House, London. See their Events web page - "Insurance Data & Analytics"

Speakers will be talking about the benefits of capturing and analysing data across a range of perils and situations.

Oaks under Attack

Oak trees are under threat from larvae of the oak processionary moth, which has been attacking trees around London for the past month. There have been sightings across the capital extending from Richmond Common and Kew in the west to Croydon and Bromley in the south.

Ash Die Back Disease

The Food and Environment Research Agency (FERA) are researching ways of preventing ash die back disease from spreading.

14 chemicals are being tested including garlic extract and urea. They are being applied as a foliar spray.

Apparently, urea can be synthesised and would be used in an odourless, colourless and neutral form. It is already used to prevent the spread of a similar fungus, apple scab.

May Weather Forecast

Forecaster Helen Chivers from the Met Office reports a persistent high pressure system to the North and says temperatures will be hovering below average. She says, "May is going to be drier than average but this part of spring is usually dry, so we are starting from a low base."

The Environment Agency said groundwater levels had decreased during the past month although they were still at "normal or higher" capacity. Reservoir levels had decreased in some areas but the risk of drought was "no greater than average". SMD and Jet Stream plots on page 2.

Vegetation to the Rescue

See Page 10 for the latest research suggesting that as temperatures warm, plants may release gases that form clouds that could help to cool the atmosphere.

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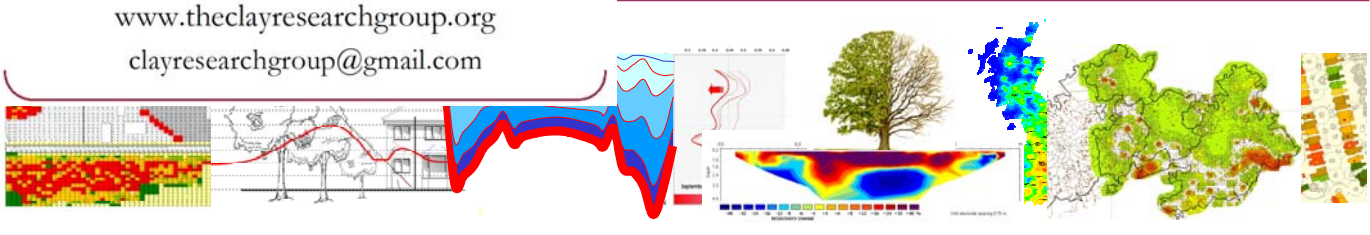

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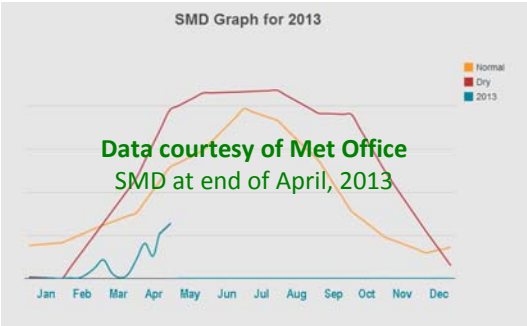
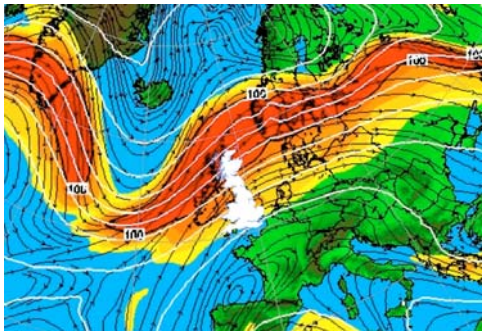
Weather Profiles

No threat of a surge so far judging by the SMD plot for North London. The soil is late drying and not a cause for concern at the moment.



Similarly, the Jet Stream (below) is hovering over the UK, reflecting the colder weather conditions.



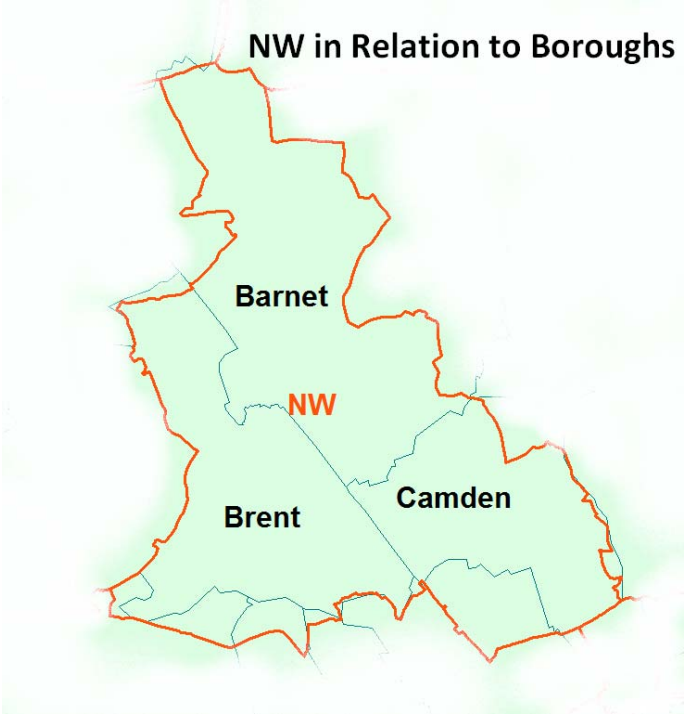
NW – Study Area

NW postcodes include some of the riskiest areas in the UK in terms of root induced clay shrinkage. The postcodes cover parts of Barnet, Brent and Camden.

In this edition we explore the modelled root zone, comparing it with actual claims to determine its value in Triage, diagnosis and underwriting.

As a by-product of our analysis, we found that, of all valid claims, only 18% were notified in June or before. The remaining 82% of valid claims were notified from June onwards.

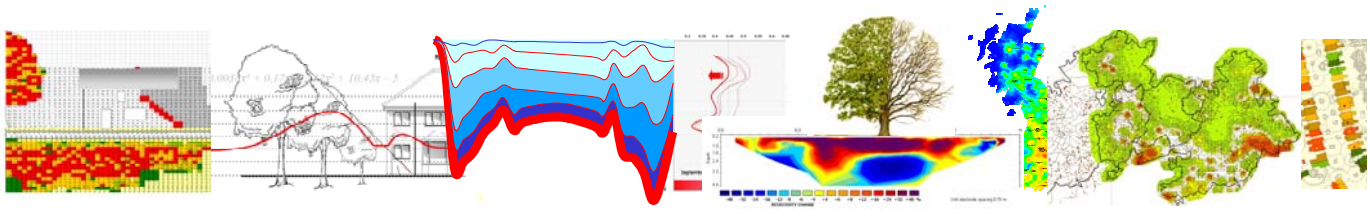
As one would expect, valid root induced clay shrinkage claims are far more likely to be reported in the summer months.



Outline of the NW postcode overlap with the Borough boundaries.

From a sample of 226 claims, 96 were repudiations and the balance of 130 claims were valid. Of the valid claims, 122 were attributable to root induced clay shrinkage.

The average initial reserve (there would have been changes in the life of the claim) was £8,400.



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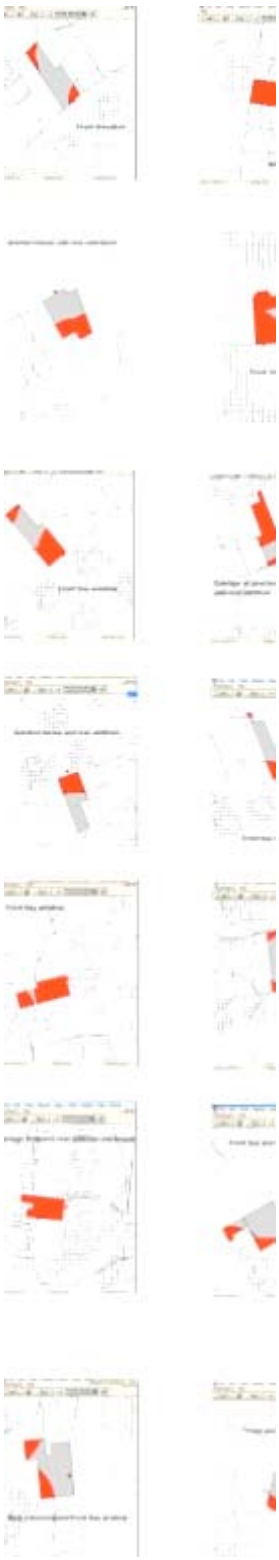


The Modelled Root Zone

We have no idea how far the roots of trees extend, or their depth. Or the species from which they emanate. That being the case, how did we build the model, and how is it performing? First, the model estimates the zone over which the potential for ground movement arising from root induced moisture change in fine grained soils might take place sufficient to cause damage to a low rise building. It hasn't been designed to locate tree roots. It has a statistical rather than an anatomical base.

Modelling is used in nearly all aspects of engineering and biology. Arboriculturalists model root zones every time they visit site. With experience from previous investigations and by referring to published work, they know that the roots from an Oak tree for example, might extend twice its height. In contrast, conifer roots might extend for shorter distances, but they are often planted closer to buildings and cause as much damage in terms of count.

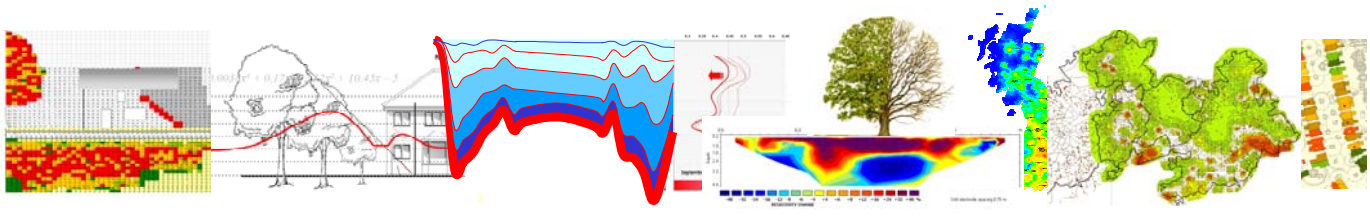
Conifers might be 1m from a building, whereas Oaks rarely are. Most involved with damage are planted a good distance away.

Of course, a model is a poor substitute for an arboriculturalist on individual claims, but when assessing thousands or even millions of trees remotely we have to accept some shortcomings.

The imagine to the left illustrates how we have gone about building the model and validating it. By studying actual claims and after detailed investigation – i.e. soils results and arboricultural assessment – we started to draw root zones using a variety of diameters, widening and then reducing, eventually arriving at a 'best fit' of 1.2 x the tree height. This identified the largest number of claims, without damning too many properties.

If the modelled root zones are too conservative (i.e. too great a radius), then we condemn more houses than is sensible. On the other hand, if the modelled zone is too small, we miss claims altogether. The model also has to take account of time. It isn't a 'one year snapshot', but has a 20 year predictive life.

Some 7 years on from the initial mapping, we review our findings.



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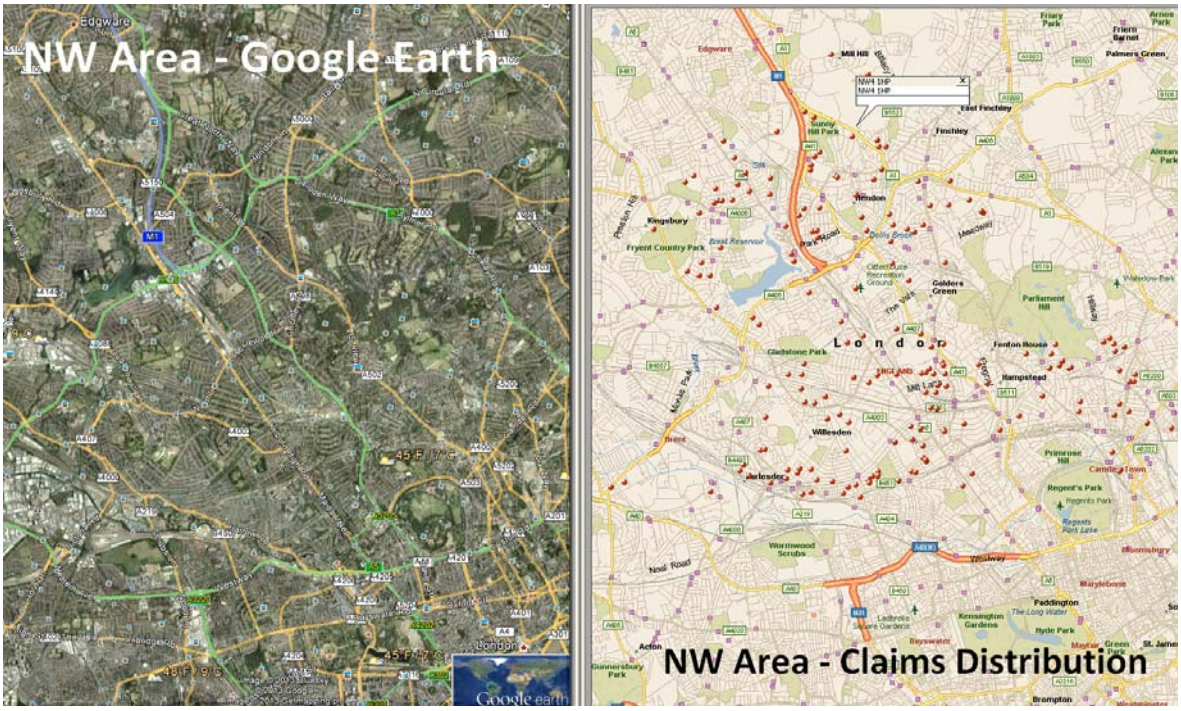
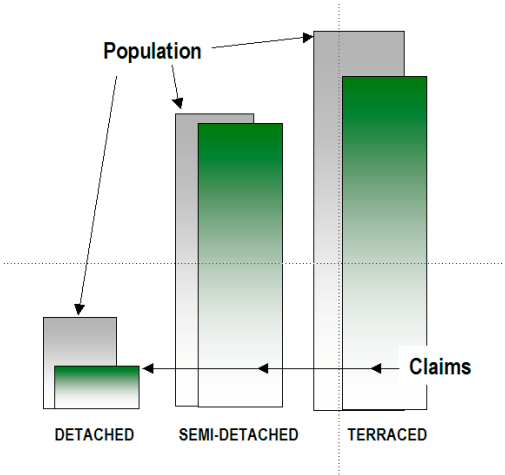
NW STUDY AREA

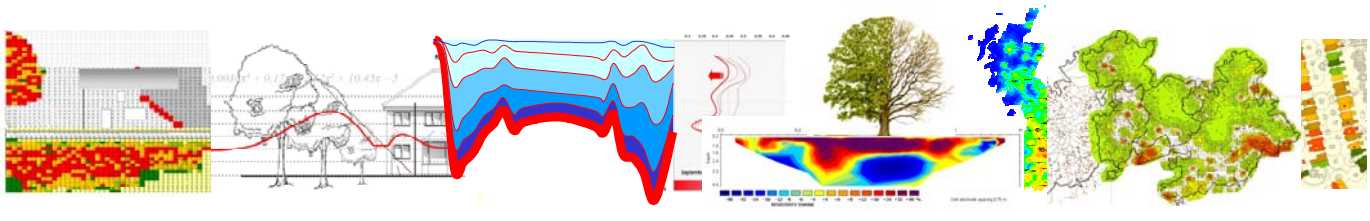


Area location and claim distribution. Left, a screen print from Google Earth and right, the claim distribution plotted as red dots on MS MapPoint. NW starts at the M1 to the north, and extends either side of the A5 and A41, widening towards the southern boundary defined by the A40. It includes all, or parts of, Hampstead, Willesden and Golders Green.



The distribution by house type for valid claims shown as a ratio to the housing population – not to the same scale.

The semi-detached house is slightly riskier and detached houses slightly less than the more common terrace but this is almost certainly the result of their environment – surrounding trees and geology - than the style of construction.



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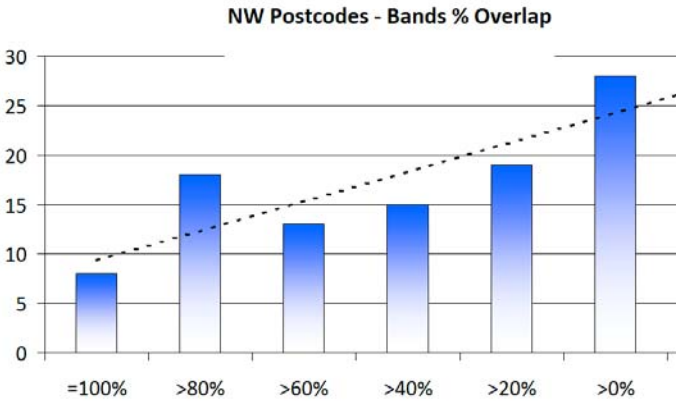
23% of the houses in the NW area fall outside the modelled root zones of trees and have been discounted from our analysis.

Of those with modelled root zones extending beneath the building, 8% had 100% cover over the building footprint which compares with 14% from the claims sample, suggesting that this is a risky situation.

The distribution of root overlaps from the model is shown below. The trendline confirms that there are far more properties with partial root zone cover. The largest population from the model is in the range >0 – 20%.



Modelled root zone overlap by distribution of the NW population. Around 8% of the properties have a modelled root zone covering the entire footprint.

This clarifies some earlier observations when we have noted that root zone coverage <20% is a risky situation – there are simply more of them.

The site plans on the following pages illustrate why NW is one of the higher risk postcodes – most of the houses are pre-1920. The highest risk in terms of age group due to the shallow depth of the foundations. See earlier study.

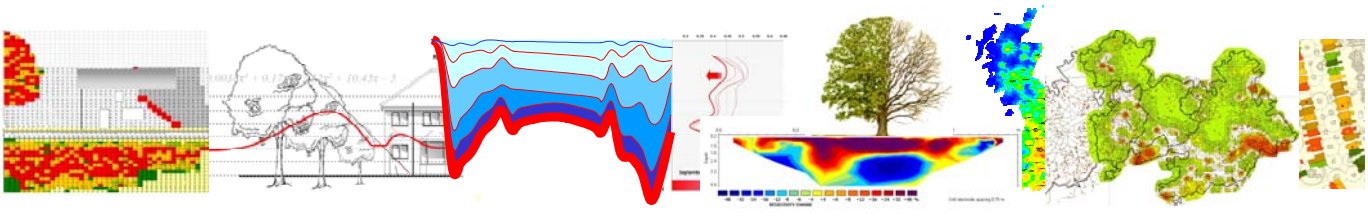
A fairly typical street scene in NW with maintained street trees and rows of early 1900 style, two storey terraced houses.

78% of the houses are Victorian/Edwardian. 63% are mid-terraced, 31% are semi-detached and 6% are detached.

Out of 137 claims (irrespective of cause), 32 (23%) included the phrase "joint", "junction" or "joint" to describe damage location, usually between the main house and the rear wing building or an extension - or bay window.

49 (36%) mentioned the front of the building, of which 22 (16%) related to a bay window. 38 (27%) claims cited damage to the rear of the building and 5 (3%) referred to the party wall.

Caveats: The sample of claims is from one insurer and does not represent all of the claims notified in this area. The claims were predominantly (but not exclusively) from the year 2003. Many houses with similar characteristics to those described have not been damaged, but as this is a one-insurer sample from a limited period, others will have been.



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The model missed 4 claims involving tree root induced clay shrinkage. This is because the trees were removed prior to the LiDAR survey in 2005.

Of the remainder, just over 50% had root zones from trees both front and rear.

21% had root zones emanating from trees to the front only and 20%, root zones from trees to the rear only.

Just under 14% of claims had a modelled root zone that extended across the entire footprint of the property.

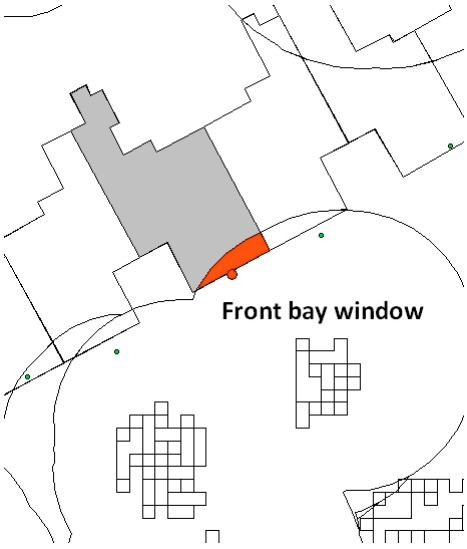
How do these figures compare with the tree population? In the last edition (Issue 95) we estimated that public trees within influencing distance of houses on clay soils account for something like 11.7% of the tree population across London.

The fact that 21% of this sample had root zones to the front of the building only, and excluding any with a contribution towards 100% coverage, suggests that Public trees in this location may be riskier, even though they are fewer in number.

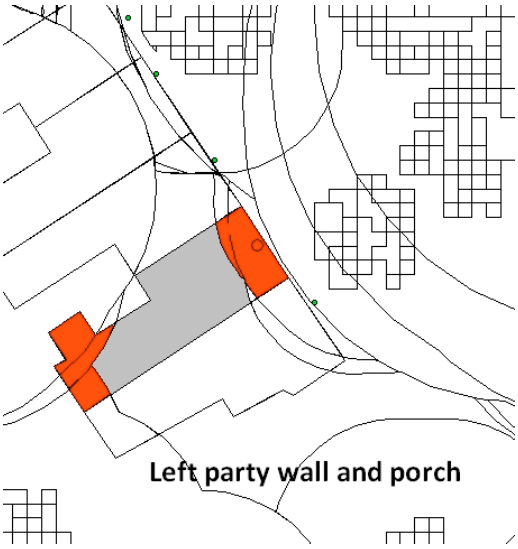
From our UK database, we know that public trees account for only 14% of total claims.

Sometimes the root zone might be nominal, and at other times, it might extend a little too far, but that is as we would expect and in fact – without wishing to be at all contentious – it probably performs as well as an on-site inspection.

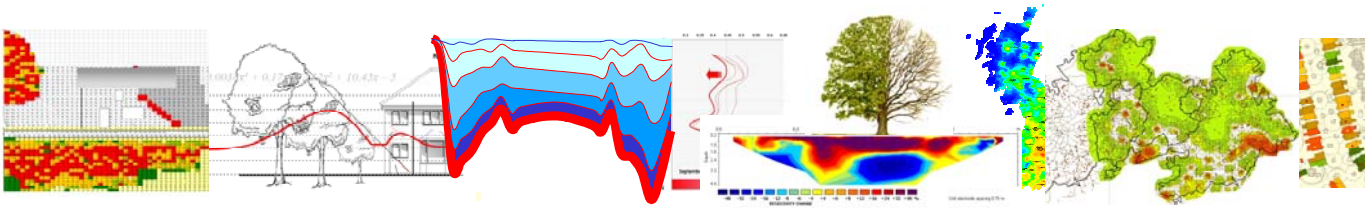
On the following page we have plotted individual examples. The text is taken from the engineers report on the area of damage.



An example of damage to the front bay window associated with (following investigation) a street tree. Had the root zone been less than 1.2 x the tree height, the model would not have identified the claim.



Modelled root zones to the front and rear often (from the claim sample, not the housing population) result in damage to the Party wall in Victorian and Edwardian houses. In this example, there was damage to the front bay as well as the party wall.



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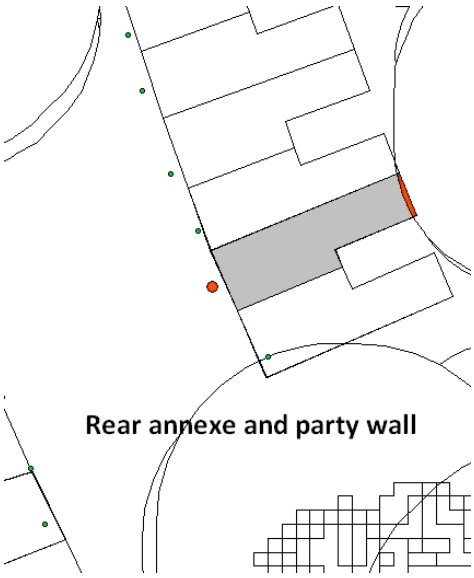
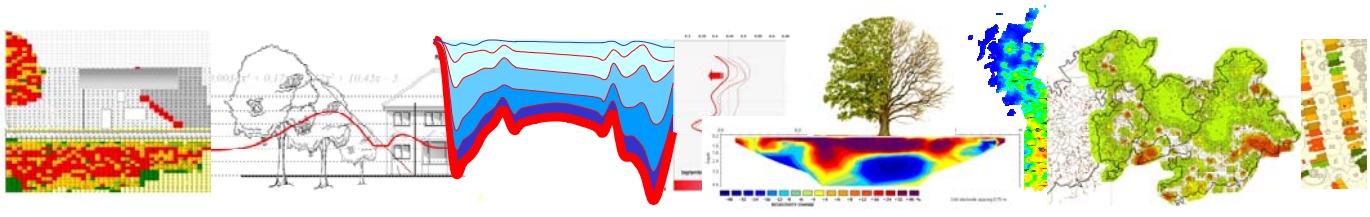


In the above example, although the root zones extend further beneath the rear of the property, damage is reported to the front porch and hallway.

Examples above and below illustrating the conservative scope of the root root zone in some situations. The root zones in these examples just catch the rear wall of the rear wing building, but the engineer reports damage to the party wall in both instances, suggesting the modelled root zone to be conservative in both cases.

To summarise. The modelled root zone is adequate for insurers needs and has uses in underwriting, triage and claims handling. Zones front and rear are perhaps riskier than any other category. This was the most dominant characteristic from the claims population accounting for 50% of cases. 100% root zone cover of the building footprint is risky when comparing claims against population. There is no way of comparing with the tree population across the Borough. Although the majority of houses with root zones beneath them have not suffered subsidence damage, there is a clear risk and one may take an 'over time' view with claims being notified regularly each year. The modelled root zone is sensible in capturing the risk, and probably not too extreme even in the absence of identification of species.



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A Typical NW Street Scene

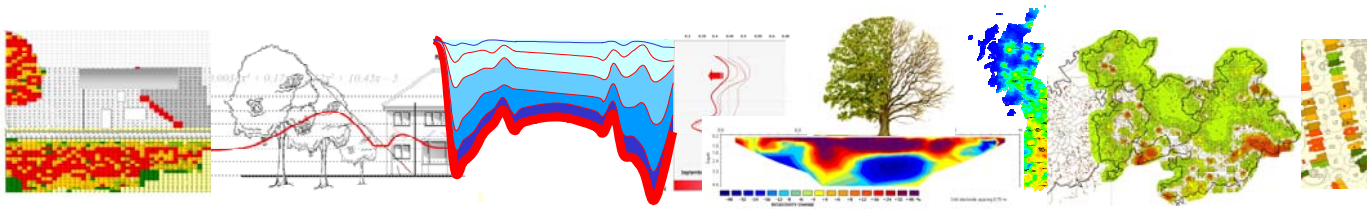
The preceding pages illustrate individual houses that have been damaged by subsidence, but how do they fit into the population? Are they exceptional? Is it the case that every house with a tree nearby suffers damage? Clearly not, as demonstrated below. Actual claim frequencies tell us the risk is low.

Above is an extract from the CRG subsidence model – bear in mind that shrubs etc., were not plotted in the LiDAR survey.

From a total of around 83 houses, 33 (39%) have a modelled root influence to the rear of the property (blue shading), and 23 (27%) have a modelled root zone overlapping the front of the property (red shading). 9 (11%) have root zones to both front and rear. In this random extract none of the houses have 100% roots overlapping the entire building footprint.

33 (40% - shaded green) are 'root free', leaving 50 (60%) notionally 'at risk'. From our five year 'valid claim' sample, we would only expect 0.3 claims per annum from 83 houses. So, whilst the model identifies 50 'at risk', the claims frequency suggests that it would take over 150 years to realise all of the claims if every tree caused damage at the current frequency, with a different tree involved for every new claim.

The model has an 'over time' benefit but is conservative in assessing risk, suggesting that a refinement relating to distribution of premiums may deliver value to underwriters.



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"In the Press"

"The University of Exeter is a member of a consortium awarded £2.4M by the Biotechnology and Biological Sciences Research Council (BBSRC) for urgent research into the ash dieback fungus and the genetics of resistance in ash trees. Ash dieback (*Chalara fraxinea*) is a devastating fungus that threatens our third most common broadleaf tree (after oak and birch)."

"The consortium brings together tree health and forestry specialists with scientists working with state-of-the-art genetic sequencing, biological data and imaging technologies to investigate the molecular and cellular basis of interactions between the fungus and ash trees."

"Led by Professor Allan Downie at the John Innes Centre (JIC), the consortium includes: the University of Exeter, The Sainsbury Laboratory, East Malling Research, The Genepool at the University of Edinburgh, The Genome Analysis Centre, the Food and Environment Research Agency, Forest Research, the University of Copenhagen and the Norwegian Forest and Landscape Institute. The research will also complement a project funded by the Natural Environment Research Council (NERC) at Queen Mary University of London to decipher the ash tree's genetic code."

Probable Maximum Precipitation and Climate Change

Kunkel *et al*

Geophysical Research Letters, April, 2013

"According to a newly-published NOAA-led study in Geophysical Research Letters, as the globe warms from rising atmospheric concentrations of greenhouse gases, more moisture in a warmer atmosphere will make the most extreme precipitation events more intense.

The study shows a 20-30 percent expected increase in the maximum precipitation possible over large portions of the Northern Hemisphere by the end of the 21st century if greenhouse gases continue to rise at a high emissions rate.

The models showed a 20-30 percent increase in maximum moisture in the atmosphere, which led to a corresponding increase in the maximum precipitation value."

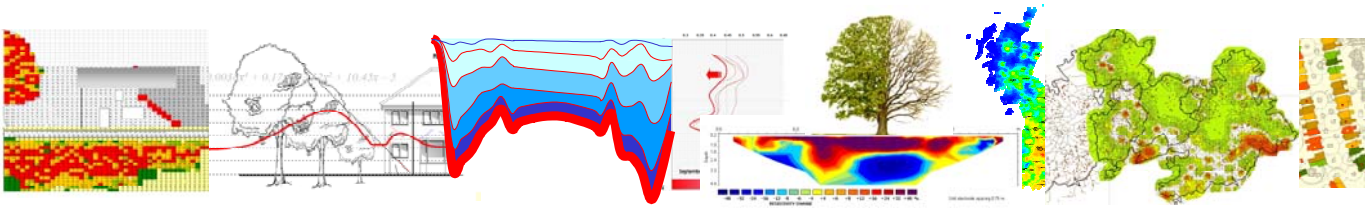
March 2013 on Reflection

From the Met Office Website

"Provisional full-month Met Office figures for March confirm it has been an exceptionally cold month, with a UK mean temperature of 2.2 °C."

"This is 3.3 °C below the 1981-2010 long-term average for the month, and ranks this March as joint second coldest (with 1947) in our records dating back to 1910. Only March 1962 was colder, with a record-breaking month mean temperature of 1.9 °C."

"This March was also much drier than average for the UK, with 62.1mm of rain falling during the month – just 65% of the 95.1mm average."



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Warming-induced Increase in Aerosol Concentration Likely to Moderate Climate Change

Paasonen P et al., University of Helsinki
Nature Geoscience, April 2013

Pauli Paasonen and his team identified a negative feedback loop in which higher temperatures lead to an increase in concentrations of natural aerosols that have a cooling effect on the atmosphere. He says, "Plants, by reacting to changes in temperature, also moderate these changes."

Paasonen explains “Plants release gases that, after atmospheric oxidation, tend to stick to aerosol particles, growing them into the larger-sized particles that reflect sunlight and also serve as the basis for cloud droplets.

"This does not save us from climate warming," says Paasonen. However, he says, "Aerosol effects on climate are one of the main uncertainties in climate models. Understanding this mechanism could help us reduce those uncertainties and make the models better."

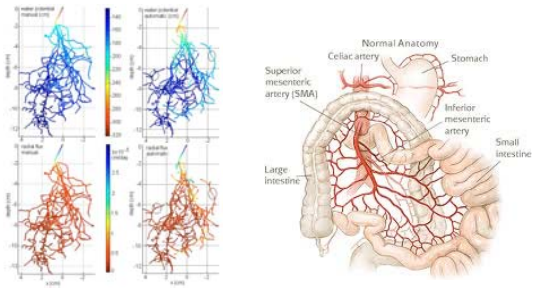
Science Daily reports “The researchers collected data at 11 different sites around the world, measuring the concentrations of aerosol particles in the atmosphere, along with the concentrations of plant gases, the temperature, and reanalysis estimates for the height of the boundary layer, which turned out to be a key variable. The boundary layer refers to the layer of air closest to the Earth, in which gases and particles mix effectively.

The height of that layer changes with weather. Paasonen says, "One of the reasons that this phenomenon was not discovered earlier was because these estimates for boundary layer height are very difficult to do. Only recently have the reanalysis estimates been improved to where they can be taken as representative of reality."”

Root Imaging

Using Magnetic Resonance Imaging, Laura Stingaciu of the Institute of Bio- and Geosciences, and her team have modelled the root zone of a 25 day lupin.

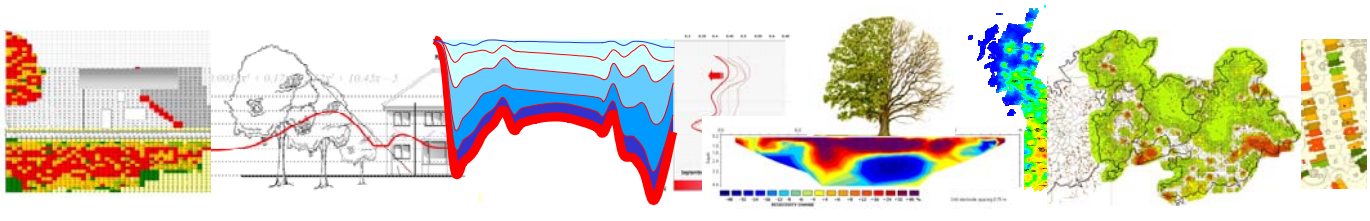
Their approach was apparently inspired by methods used to map blood vessels, augmented by ‘semi-manual reconstruction using virtual reality’.



Left, the MR image of the lupin root system, and right, the same method to image blood vessels.

The research team model water uptake using the Doussan model and report encouraging results.

Their paper can be viewed on the web at www.vadosezonejournal.org.



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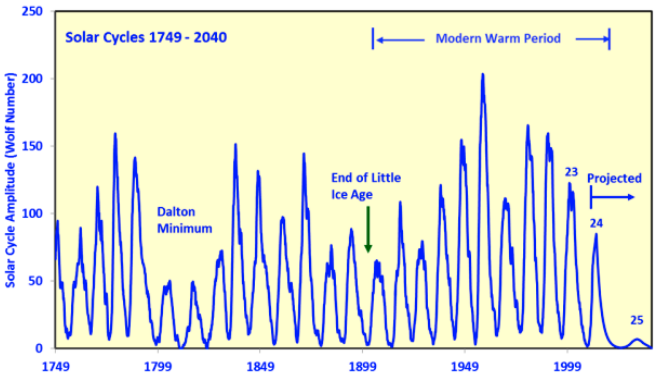
GLOBAL COOLING?

Scientists at Russia's famous Pulkovo Observatory have indicated that the world is in for a period of global cooling.

According to scientists from the Pulkovo Observatory in St.Petersburg, solar activity is waning, so the average yearly temperature will begin to decline as well.



Graph showing solar cycles by David Archibald

"The Voice of Russia" says "scientists from Britain are saying that forecasts for global cooling are far from groundless." Some experts warn that a change in the climate may affect the ambitious projects for the exploration of the Arctic that have been launched by many countries.

Yuri Nagovitsyn of the Pulkovo Observatory, says … "Journalists say the entire process is very simple: once solar activity declines, the temperature drops. But besides solar activity, the climate is influenced by other factors, including the lithosphere, the atmosphere, the ocean, the glaciers. The share of solar activity in climate change is only 20%. This means that sun's activity could trigger certain changes whereas the actual climate changing process takes place on the Earth".

Vladimir Kotlyakov, from the Russian Academy of Sciences, said: *'There are no grounds to claim that global warming will continue till the end of this century. Climate moves in natural cycles of warmer and colder, as well as drier and more humid times. Early signs of cooling are already there and the trend may pick up in coming years. Human activity and industrial discharges do have a great impact on the environment, but forces of nature are far more powerful.'*

GLOBAL WARMING?

the World Meteorological Organization (WMO) report that 2012 was the ninth warmest year since record begun in 1850 and the 27th consecutive year that the global land and ocean temperatures were above the 1961–1990 average.

2001 to 2012 were all among the top 13 warmest years on record. Arctic sea ice is at an all-time low – 18% less than the previous record low of 2007. rainfall across the globe increased and was slightly above the 1961-1990 long-term average; and Greenland ice sheet melted dramatically in early July.

WMO secretary-general Michel Jarraud said: *"The year 2012 saw many other extremes as well, such as droughts and tropical cyclones. Natural climate variability has always resulted in such extremes, but the physical characteristics of extreme weather and climate events are being increasingly shaped by climate change. For example, because global sea levels are now about 20 cm highthey were in 1880, storms such as Hurricane Sandy are bringing more coastal flooding than they would have otherwise."*