

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



April 2015

Edition 119

The Clay Research Group

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The Annual Subsidence Conference

CPD Accredited Course at Aston University

This year's conference covers a wide range of topics and brings us up to date with current work in the field of electrokinesis osmosis, below ground investigations, business processes and claims handling from leaders in their respective fields. The program is available for download from the CRG web site under the 'newsletters' tab.

The 'Driscoll Rule' Provenance and Use

Few soil tests have been as widely used in the detection of desiccation as the one comparing moisture content with index properties of clay soils, devised by Richard Driscoll over 30 years ago.

This month Richard reminds us that the method "should be applied with caution and should always be supported by other evidence". See page 2.

Bayesian Soils, Trees, Climate and Risk

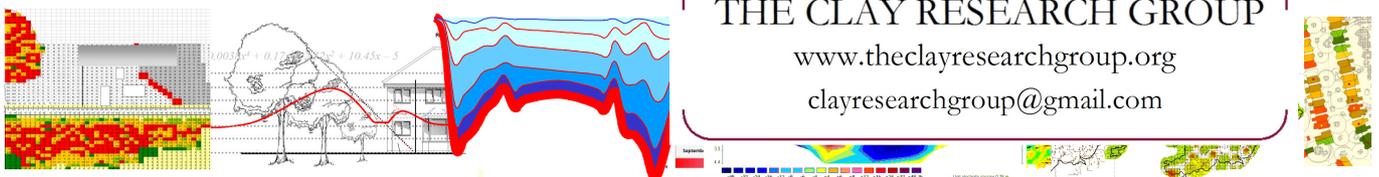
Bayesian statistics have been mentioned in several recent research papers covering a wide range of topics including the identification of soils, dynamic growth models for trees and of course, climate. Many of us use this approach when assessing the risk these elements present when combined. Last month Norwegian Geotechnical Institute technical director Suzanne Lacasse delivered the 55th Rankine Lecture at Imperial College and spoke about probabilistic modelling in engineering. Lacasse explained how event tree analysis (ETA) can be useful to consider the impact and consequence of an initiating event. "ETA is a systematic approach that offers a diagnostic tool that can aid decision making."

Research Updates

Mandipropamid - an ABA mimic

Researchers at the University of California are looking for what are known as 'ABA mimics'. Chemicals that trigger a drought response in plants by closing the stoma at times of drought, emulating the action of abscisic acid (ABA), the so-called 'root to shoot' hormone.

This has relevance when trying to retain trees implicated in cases of root induced clay shrinkage and may avoid the need for severe and disfiguring crown reduction or tree felling. Page 12.



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The 'Driscoll Rule'

Richard Driscoll clarifies the use of the Atterberg Limits to assess desiccation

In my experience of the commercial investigation of subsidence cases, the so-called 'Driscoll rule'¹ has been widely and often misleadingly used. This 'rule' states that 'significant' desiccation exists if $w < 0.4w_L$ where w is the soil sample moisture content and w_L is the Liquid Limit (w_L and Plastic Limit w_p are Atterberg Limits).

As these quantities are routinely and cheaply provided from soil testing laboratories, the 'rule' may very readily be adopted. However, as explained in Digest 412², there are several reasons why the 'rule' may not apply. The 'rule' was written for a speciality symposium-in-print for geotechnical engineers, with the aim of generating interest in and further study of the relationships between w and other soil index values.

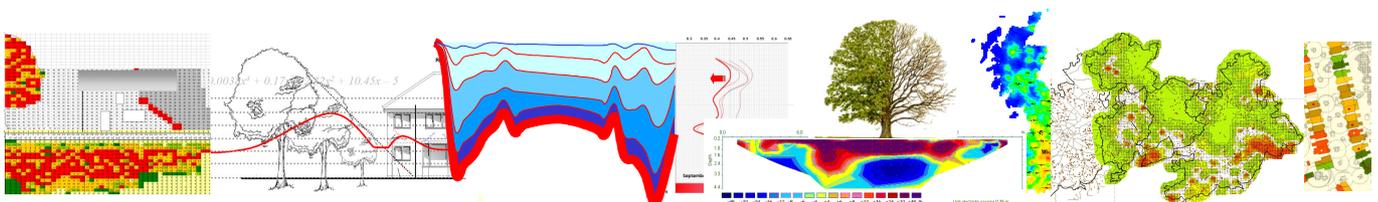
The $w < 0.4w_L$ criterion was proffered as a crude estimate of the onset of significant desiccation; it suffers from several problems:

- The changes in water content caused by desiccation are often small, especially for the more plastic clays. They may be difficult to detect within the limits of accuracy of determining Atterberg Limits or, indeed, the soil water content. Different techniques for measuring Liquid Limit are allowed in BS 1377 for soil testing; also, variations between different laboratories using the same technique, and between the same laboratory using different techniques, have been reported widely.
- Because $w < 0.4w_L$ is entirely empirical, it cannot take account of the differing stress histories to which natural clays have been subjected. Differing stress histories (or degrees of over-consolidation (arising from the removal of over-burden in geological time) may result in two soils in identical states of desiccation (or soil suction), with identical index properties, having different water contents; no criterion based on Atterberg Limits could hope to account for these differences.
- Furthermore, it does not take account of the general decrease in soil water content with depth encountered in most over-consolidated clays.

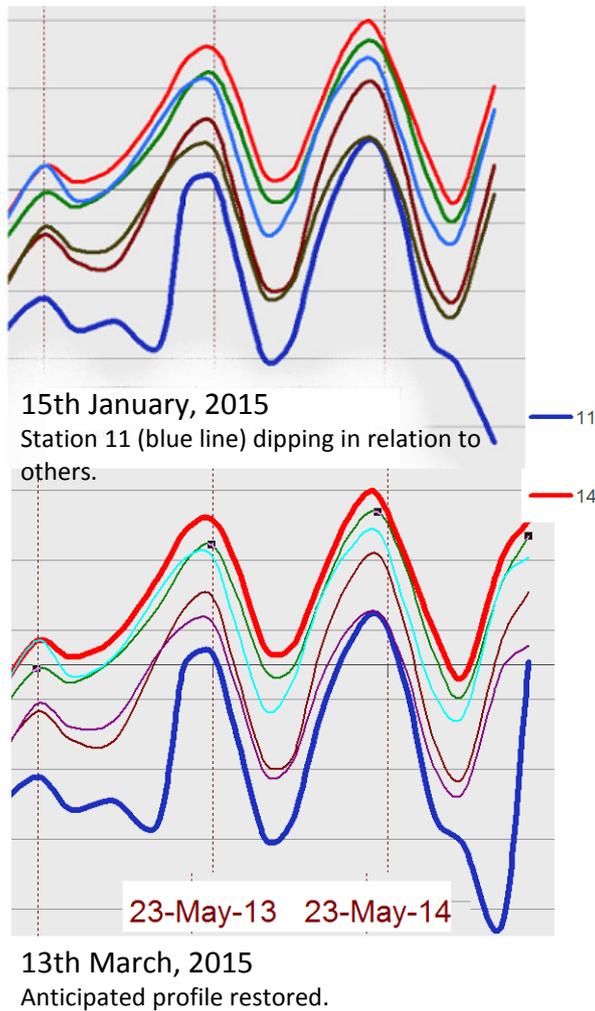
Clearly therefore, $w < 0.4w_L$ should be used only as a rough guide and it is unwise to use an assessment of desiccation solely on this criterion, particularly if desiccation is slight. The 'rule' should be applied with caution and should always be supported by other evidence.

1 Driscoll, R (1983). The influence of vegetation on the swelling and shrinking of clay soils in Britain. *Géotechnique*, Vol. 33, pp 93–105.

2 BRE (1996). Desiccation in clay soils. Digest 412. CRC Ltd.



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Precise Level Update

Station 11 Anomaly

The latest precise level readings, taken on 13th March 2015, may have clarified the issue of whether the EKO treatment (see last edition for background and site plan) had caused consolidation at Station 11.

The top picture plots the levels on 15th January 2015. Around 20mm of recovery was expected, but instead the station subsided by about 15mm and was 35mm lower than anticipated.

Was this related to consolidation following the EKO soil treatment?

Apparently not.

The latest readings position the station where we would anticipate, suggesting that the anomaly may have been due to one false reading.

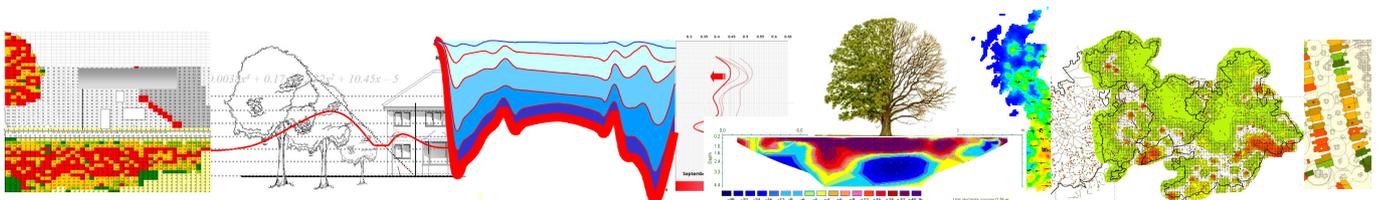
Factoids ...

Did you know that a house built in the 1950s is twice as risky as a modern house, but only half as risky (at least, in terms of subsidence) as one built around 1900? More semi-detached houses are damaged by subsidence than any other style, but not because of any inherent weakness. There are simply more of them on clay soil. It's the soil that makes them riskier.

Also, oak trees are twice as risky as the cherry or sycamore and three times riskier than the apple or birch but conifers are riskiest of all.

Did you know that London clay is nearly (but not quite) twice as risky as the Lias? Clay with flints is twice as risky as Hasting beds - and the Oxford and Kellaway series.

Most important of all if you have an interest in systems and probability, that a claim notified on London clay, in the summer and with vegetation nearby has a greater than 80% probability of being valid?



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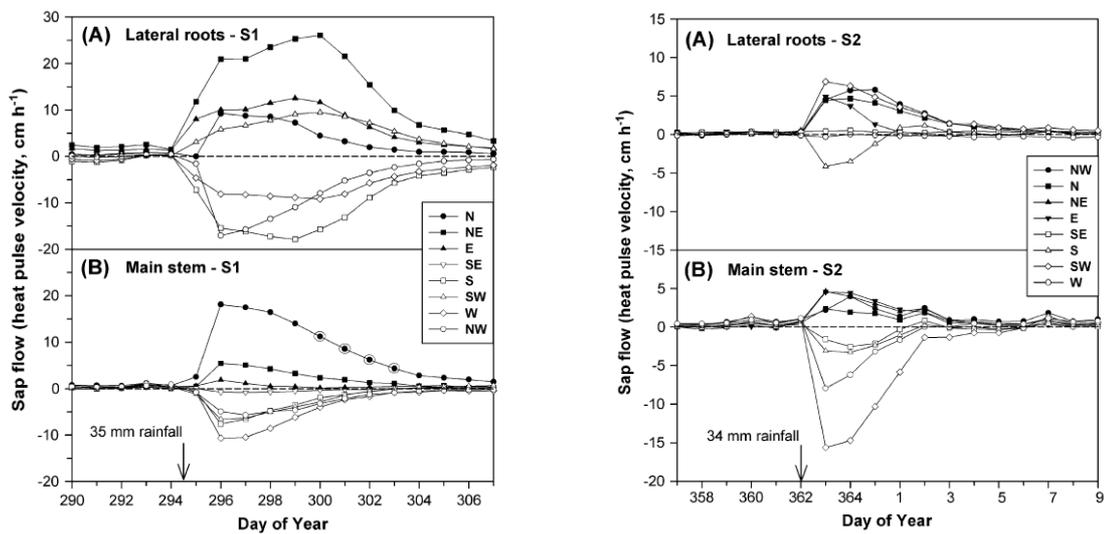
Overnight Equilibration of Water across the Root Zone

Redistribution of soil water by lateral roots mediated by stem tissues
 Burgess and Bleby, (2006) Journal of Experimental Botany, Vol. 57, No. 12, pp. 3283–3291

Overnight water redistribution in root systems leading to equilibration between dry and wetter zones is an important component of the Partial Root Drying (PRD) mechanism that we take advantage of in the InterTeQ system.

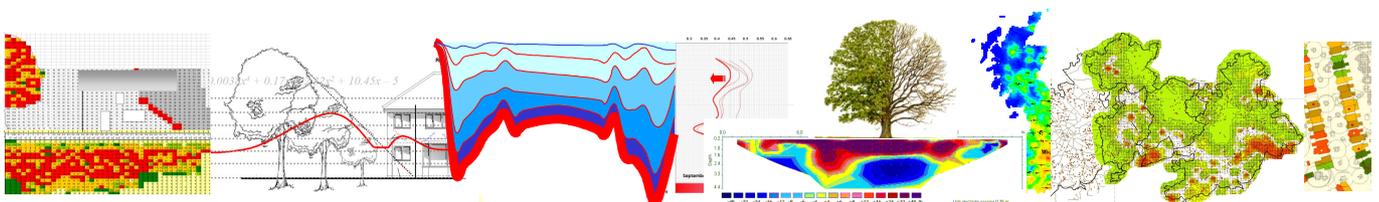
PRD allows vegetation to survive healthily on reduced water availability and this paper provides evidence by measuring sap flow. In this paper, researchers explore the mechanism of overnight equilibration.

“Patterns of sap flow among lateral roots on opposing sides of the salmon gum trees following rain showed a donor–recipient pattern similar to hydraulic redistribution between taproots and lateral roots ...Our simple survey of soil moisture contents on different sides of a single tree demonstrated that considerable variability in water contents (and by inference soil water potentials) of the upper soil layers is possible”



Extract from Paper

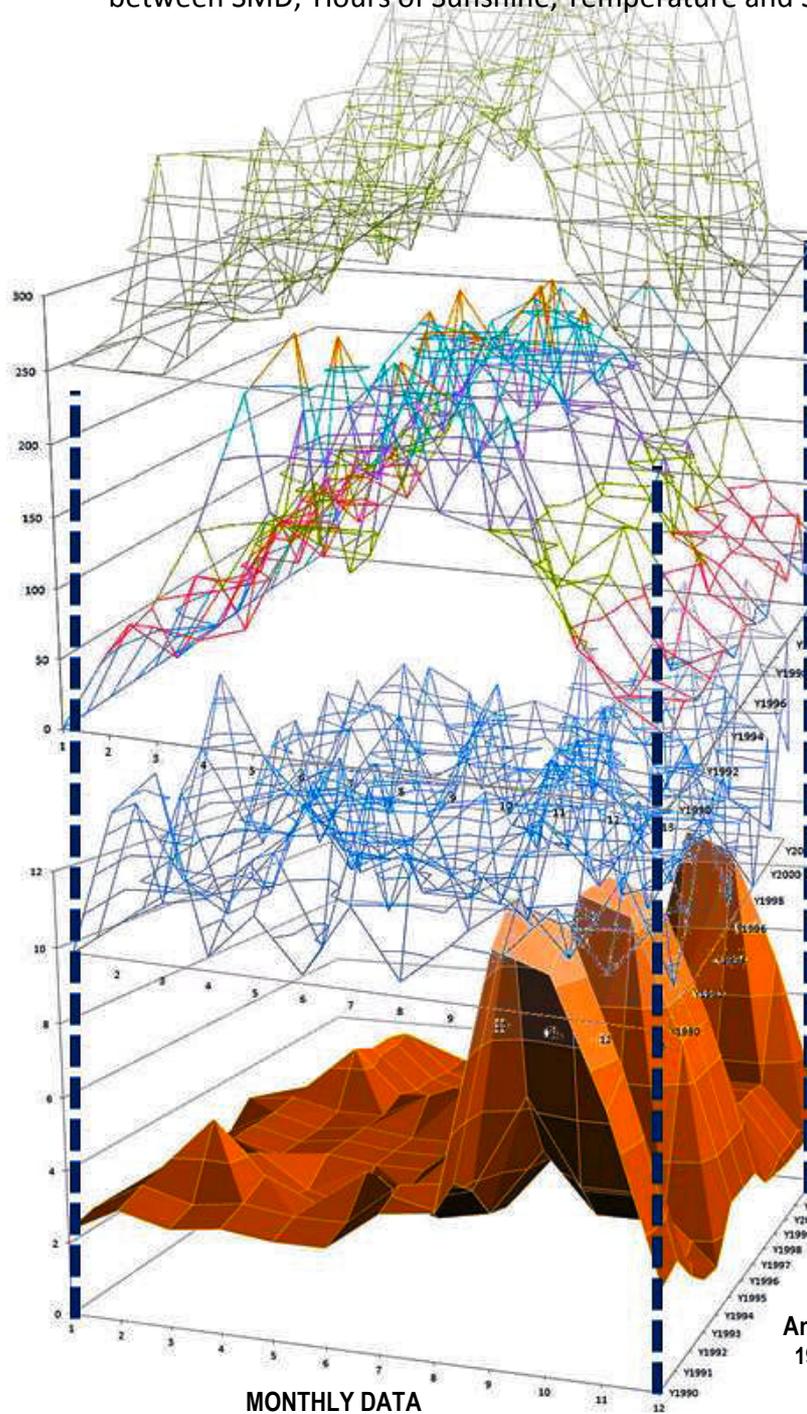
Fig. 2. (A) Night-time rates of sap flow (averages of midnight to 4.00 h) in seven lateral roots radiating out in different directions from the base of a single *Eucalyptus salmonophloia* tree ‘S2’, growing at Corrigin Western Australia. Thirty-four mm of rain fell over day 362/day 363 (summer, 2004). (B) Night-time rates of sap flow measured at eight positions around the stem of the same tree at 1 m height.



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Correlating Weather Elements

Elaborating on the article in Issue 118, the following is an extract showing relationship between SMD, Hours of Sunshine, Temperature and Subsidence Claim Numbers.



Soil Moisture Deficit

Combined values taking into account hours of sunshine, temperature, ground cover and wind etc.

Hours of Sunshine

Influencing plant growth and transpiration, hours of sunshine are an important factor in determining likely surge years in terms of subsidence claim numbers.

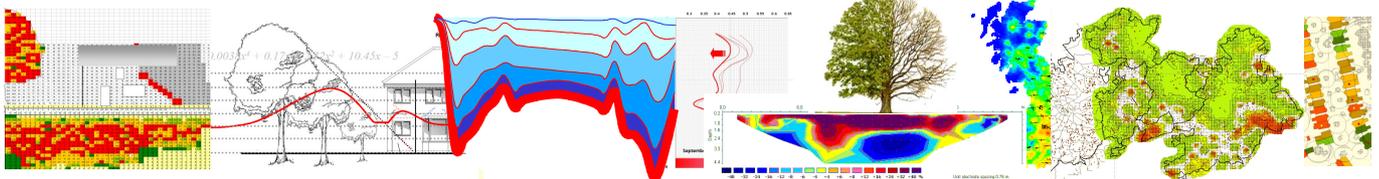
Rainfall

Intermittent rainfall breaking up the summer months and reducing the influence of the temperature and hours of sunshine components.

Subsidence Claims Numbers

Seasonal changes with surge years represented by the summer peaks in 1990, 1995 and 2003.

Annual Data
1990 - 2003



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The Annual Aston Subsidence Conference 16th June 2015



Running in its present form since 2003, the conference is a well attended event that aims to cover the disparate topics that combine to form a typical subsidence claim. Attendees include lawyers, adjusters, engineers, arboriculturalists, geotechnical specialists and surveyors.

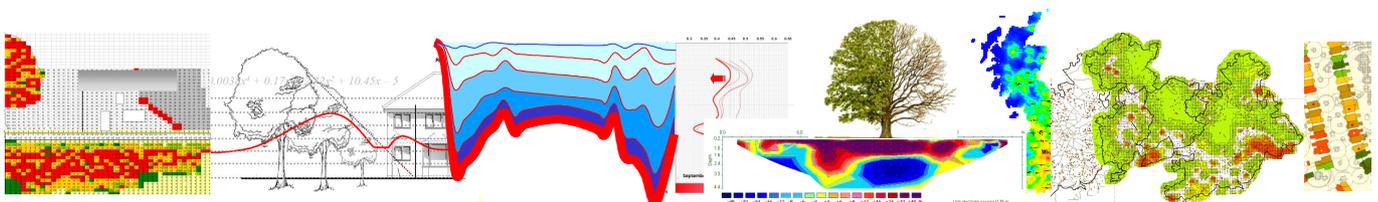
More latterly, the business method has attracted interest. Profession or business? Is there a difference? Introducing new systems and approaches is a good way to attract disparaging responses from colleagues, staff and clients alike but are there tangible benefits for the homeowner in terms of service delivery? What role has procurement played over the last ten years or so in shaping the way we handle claims?

The Big Data debate has led us to widen the coverage of the conference still further. Last year Tony Boobier outlined the increasing value of social networking. Paul Stanley, who was already using this approach to handle general claims for a major insurer, explained the practical benefits.

Richard Rollit and Mike Mortished give their view on the practical issues that they face in terms of ensuring customer satisfaction. Any change impacts on day to day handling but what are those challenges and how do we deal with them? This links in with Tim Freeman’s suggestion that we remove the personal opinion from disputes, and stick to the facts. How do we manage to waste so much money on claims with what may appear – in the main – to have obvious outcomes? The JMP was a good idea in principle but some might say it would benefit from being refined.

Then we move on to the evidence and how we might resolve a certain category of claim quicker and with certainty. The research on soil stabilisation is progressing at Aldenham. Will we see the day when we can receive a claim on Tuesday and fix it on Wednesday, cheaply and efficiently with nominal disruption to the homeowner? Can we verify the treatment has reached the target when that could be 2 or even 3 mtrs below ground? If so, can it be done quickly and cheaply without the need for disruptive site investigations, soil testing, monitoring and arborist's reports?

Have procurement driven new practices to improve the process? Come along to Aston to find out.



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Richard Rollit

MD of Subsidence Management Services

“Treating the Customer Fairly. Aligning the Policy and Claim.”

Richard Rollit is the chairperson for the event, introducing the speakers, ensuring that things run smoothly and keeping the day on schedule. Richard also considers potential conflicts between our over-riding objective of treating the customer fairly, balanced with strict interpretation of policy wording and some recent FOS decisions.

He may also have the time to bring us up to date with developments at The Clay Research Group.

Tony Boobier

WW Executive for Insurance at IBM

“The Future of Subsidence Claims Handling”.

Tony will explain how the 'digital customer' is set to transform subsidence claims handling and how changing customer behaviours and expectations will require insurers to rethink their claims processes to remain relevant.

Tony is well placed to bring us up to date given his position at IBM and experience working in insurance.

Professor Ian Jefferson

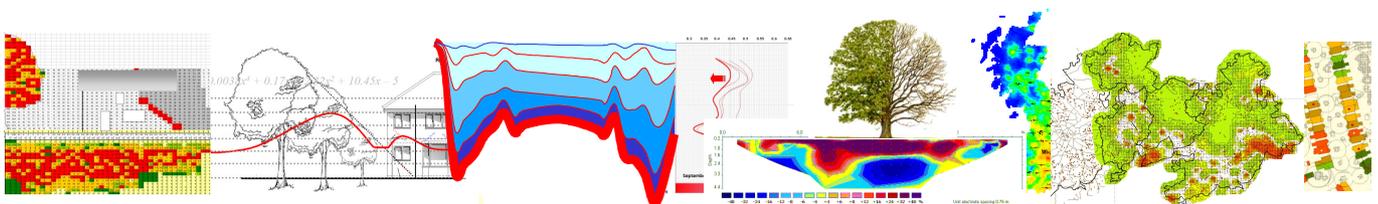
Professor of Geotechnical Engineering, School of Civil Engineering,
University of Birmingham

Professor Jefferson will outline the results of the elektrokinesis osmosis (EKO) soil stabilisation research at Aldenham. A new approach to stabilisation under houses suffering departmental swell-shrink problems has been developed following detailed laboratory studies.

The work involves the use of conditioner driven into a soil to a specified target zone via electro-kinetic (electrical) mobilisation.

Recent field trials have just been completed and data from this, together with laboratory data show the potential the approach has to alter and stabilise potentially challenging expansive soils under shallow residential buildings.

A suite of data have been gathered to understand the processes involved and these will be presented along with monitoring results gained during the treatment process.



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Dr. Nigel Cassidy

Reader in Applied and Environmental Geophysics, Keele University.

“Clay stabilisation and subsidence: Imaging and monitoring using time-lapse, azimuthal 3D Electrical Resistivity Imaging”.

Nigel explains “*stabilisation methods that utilise fluid injection through electro-kinetics to mitigate against the effects of tree-induced subsidence are at the forefront of clay & soils research. But can we be sure that the fluids are reaching the target area of subsidence? How do we check that electro-kinetics mechanism is operating correctly in the sub-surface? These are all part of the real-world problems associated with such techniques and in my presentation I will show how novel, time-lapse, azimuthal 3D Electrical Resistivity Imaging (ERI) can be used to effectively monitor the movement, emplacement and reactivity of the fluid injection process.*”

Mike Mortished

Claims Team Controller, Ageas Insurance

Mike looks at the issues related to customer service, i.e. expectations, complaints/feedback & their analysis, shift in culture & looking to the future. Whilst subsidence claims are declining, complaints are actually going in the opposite direction. Exploring the reasons for the increase. How we seek, obtain and analyse customer feedback, & exploring the reasons for the rise in expectations generally. (culture, communication, FCA/FOS etc). Suggestions as to how we can reduce complaints and meet rising customer expectations going forward.

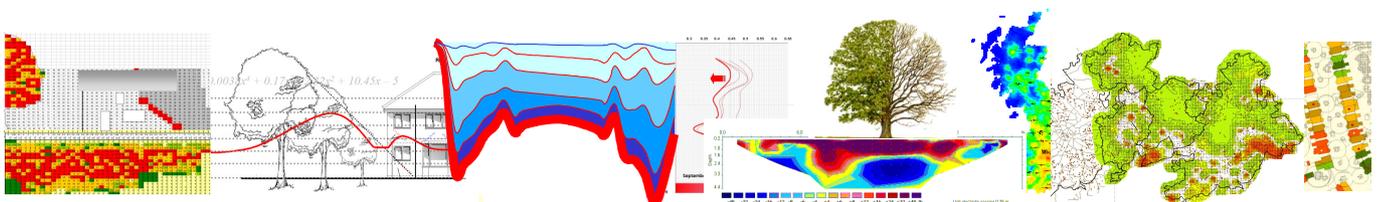
Tim Freeman

MD of GeoServ Limited

“Time to let the evidence do the talking”

Tim outlines a fresh approach to mitigation and 3rd party tree claims in his talk. He suggests that we might replace the existing protocol of prolonged exchanges of challenges & denial that usually leads to an unsatisfactory “OK we’ll reduce the tree by 25%”, with a fixed duration “attend to the tree or pay for the underpinning” approach.

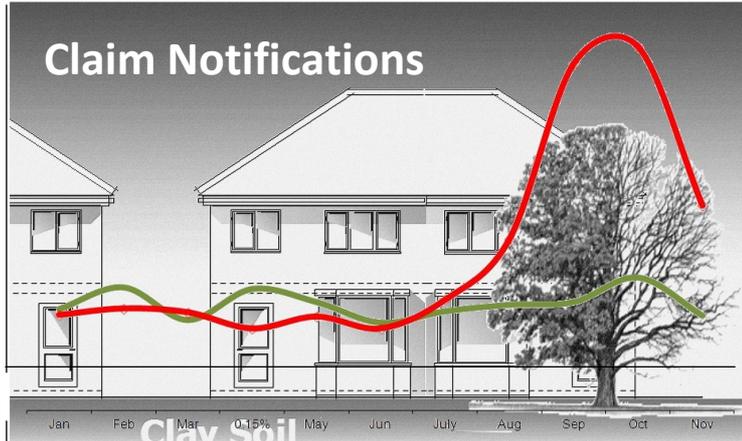
The talk will describe an approach that hopefully satisfies all parties The objective will be to streamline the process and reduce friction between parties, reducing the need for litigation and the involvement of solicitors where possible. Tim feels an evidential approach with specific requirements, supported by a factual report could ease cases that otherwise result in litigation and increased costs.



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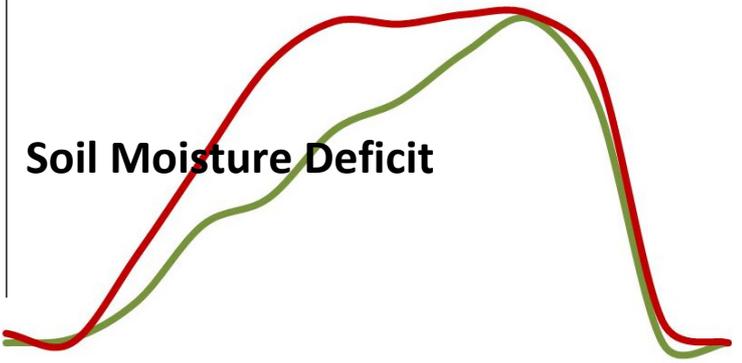
Comparison Weather Data

What factors influence the difference in claim numbers and can we use any to help predict an event year earlier? Similar exercises for different years have appeared in earlier issues. Here, data for the event year 2003 is plotted against data for 2002 – a relatively normal year for subsidence claims.



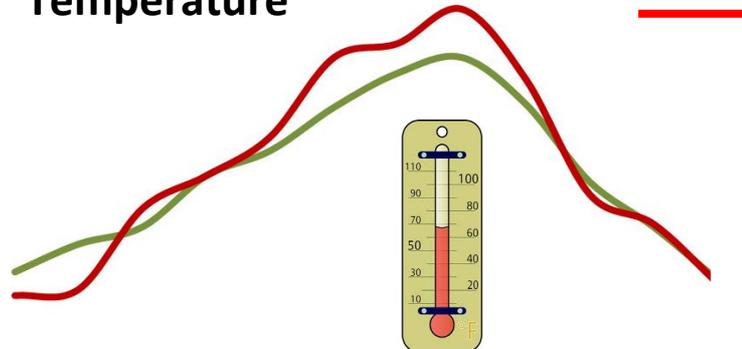
The top graph plots claims notifications for 2002 and 2003. The ABI recorded 36,500 subsidence claims notified in 2002 and 55,400 in 2003.

Immediately below this is the graph of the Soil Moisture Deficit (SMD) data followed by temperature and rainfall.



The SMD comes from tile 161, medium AWAC with grass cover. Amongst the datasets, the SMD provides the only potential forewarning of a busy year, which is helped by the fact it combines values of sunshine, temperature and rainfall.

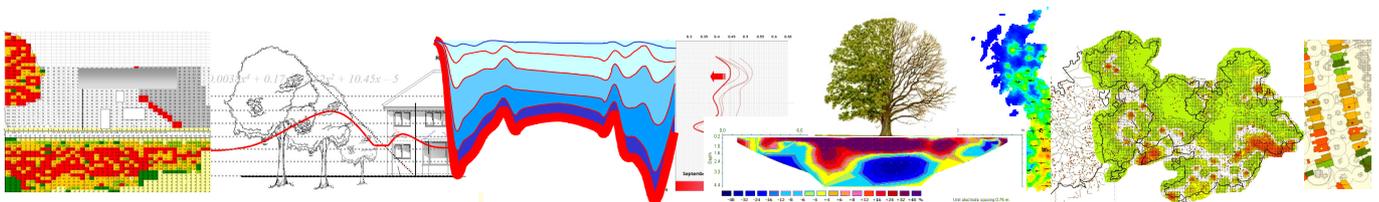
Temperature



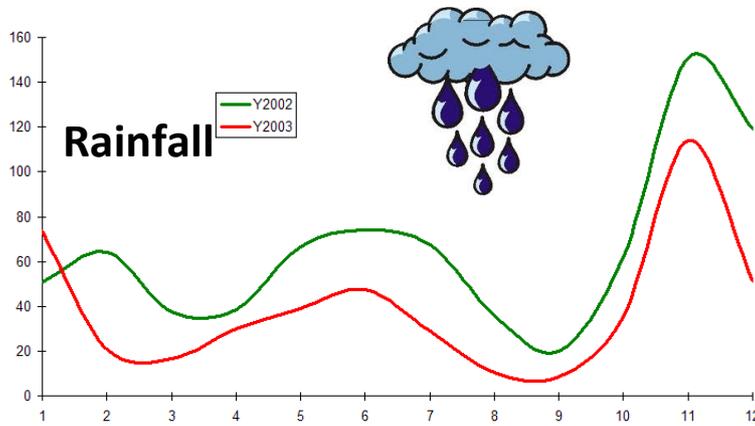
2002

2003

Relatively small changes in temperature of two or three degrees, when combined with reduced rainfall, drive summer claim numbers although they lack any predictive element.

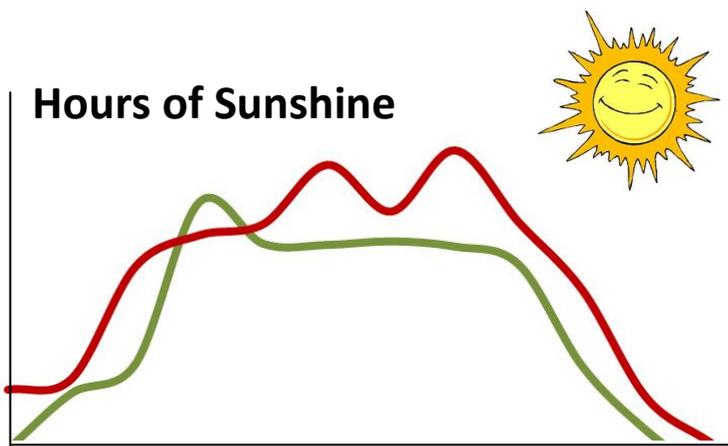


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Rainfall for the two years followed similar contours but a marked difference in amount with 2003 being far drier. The deficit was greater in June and July – periods of peak uptake for most trees.

The difference between 2002 and 2003 in terms of hours of sunshine is shown left.



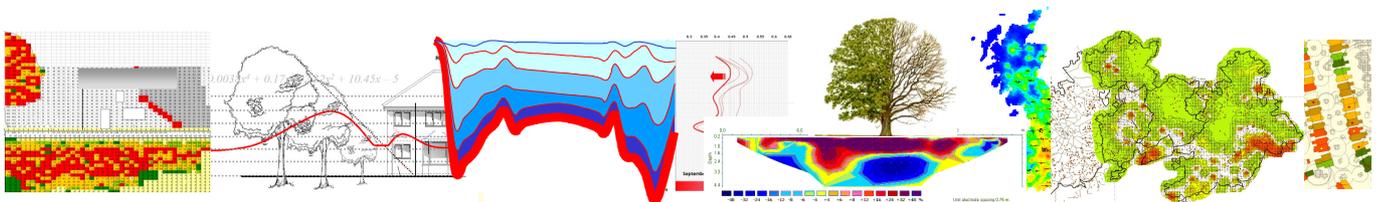
In summary, the summer of 2003 was characterised by more sunshine, less rainfall, higher temperatures and a greater soil moisture deficit – as we would expect.

In terms of predictive potential, there is little to distinguish between them. In more stable climatic conditions, the SMD has shown some benefit but this has diminished over recent years with more changeable weather conditions and periods of intermittent rainfall in the summer months.



Bottom graph shows the dynamic nature of the soil moisture changes that tree roots have to contend with and the early drying in the surge year of 2003.

SMD - Difference by Month



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High Risk Postcode Sector in North London Compared with UK average

Or ,,,“It’s just a matter of time”

More often than not we use averages to describe the UK risk of subsidence. For example, the number of houses damaged in an average year is around 1.2 per 1,000. But what is the situation in a high risk, north London postcode sector?

The risk increases by a factor of around 5. Instead of 1.2 houses being damaged, it might be nearer 6. In surge, that figure could double.

If the average sector has say 1,800 private houses (discounting council houses), it would take around 300 years for every house with a tree nearby to suffer subsidence damage, assuming that every house with a tree nearby is at risk of course.

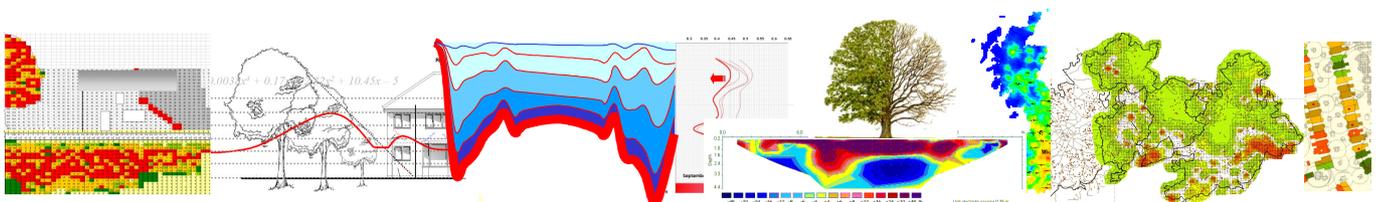
There is a school of thought that suggests that the number will diminish over time. Houses that are at risk have already been damaged. Those that have not are less vulnerable.

The alternative is that every house within influencing distance of a tree is at risk, and it is just a matter of time. The Sidcup Road study posed this problem. Why, out of a road of identical trees in terms of species, height and distance from similar properties, do some cause damage whilst others do not? And yet every year we see fresh claims.

Is it really the case that one day no further claims will be notified?

We shall see but at the current rate it could take between 200 – 300 years for every tree to cause damage in a higher risk north London postcode sector – assuming of course that they will. And that every tree causes damage only once, and no further trees are planted.

Or will the claims suddenly stop? Will there come a time in say 20 – 30 years when we will only be dealing with leaking drain type claims? If not we are drawn to the inevitable conclusion that trees are in fact ‘ticking time-bombs’, just waiting to strike. It doesn’t matter that we can identify which tree will strike when and where at a point in time.



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Agrochemical Control of Plant Water Use using Engineered Abscisic Acid Receptors.

Sang-Youl Park *et al*, Nature, 2015

Plant physiologists researching drought responses of crops are looking at ‘ABA mimics’ to emulate the role of the hormone, abscisic acid (ABA). The obvious answer would be to simply spray leaves with the naturally produced hormone but the problems are twofold. First it is costly to produce and second it doesn’t last long when applied – probably a matter of hours.

A team of scientists at the University of California are researching an agrochemical called mandipropamid. This is already widely used in agricultural production to control late blight of fruit and vegetable crops. The researchers are exploring whether it might act as an ABA mimic, helping plants to conserve water by triggering closure of the stomata in periods of drought.

Vegetation produces ABA readily but the problem is much of it simply circulates around the plant and is lost to the soil. It needs specific receptors to be activated before it becomes effective.

The team from The University of California are working with *Arabidopsis*, a model plant used widely in laboratories, and the tomato plant. In the lab, they used synthetic biological methods to develop a new version of these plants' abscisic acid receptors, engineered to be activated by mandipropamid instead of ABA. When the modified plants were sprayed with mandipropamid, the plants survived drought conditions by turning on the abscisic acid pathway, which closed the stomata on their leaves to prevent water loss.

Although only tested on plants and crops at this stage, it may be useful in the conservation of moisture in trees. The product was developed by Syngenta Crop Protection inc., and the release document issued by the United States Environmental Protection Agency, dated January 2008, describes the product as “a new chemical”. Its use at that time (2008) was listed as providing protection against specific pathogens and mould.

Their “Residential Exposure and Risk” comments were as follows: “Residential exposures were not assessed because the proposed uses of mandipropamid do not involve applications by homeowners or by commercial applicators in residential settings.”

Clearly any application relating to domestic subsidence caused by root induced clay shrinkage would be in a residential setting and more detail is needed but a long lasting, sensibly priced anti-transpirant spray would be worth considering as an the alternative to felling or regular and disfiguring crown reduction.

