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

The Clay Research Group
www.theclayresearchgroup.org

December 2008

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Last Edition

Lots of feedback from the last months edition, and hopefully copies of the E-mail exchanges have reached everyone.

Giles Biddle re-affirmed his belief in the value of precise levelling above all other forms of investigations – a view we support. When we do need to investigate, levels provide the most compelling evidence. Whereas soil testing can deliver ambiguous results at the best of times, and possibly no results at all in the winter months, levels are rarely ambiguous. Recovery in the winter is as positive an indicator of subsidence as downward movement in the summer. In addition, they find acceptance by all parties – arborists, tree officers, geotechnical engineers' insurers and homeowners.

Jim Smith, the London Trees & Woodlands Framework Manager reiterated the aim of the JMP – a vehicle for people to talk to one another.

Andy Tipping of the **LTOA** Executive has agreed to review the intervention technique and we will publish the outcome.

Jon Heuch expressed concerns about risk modelling and pointed out that any data relating to trees will inevitably be flawed because of inaccuracies with site measurements and understanding which trees are actually involved as opposed to which that are simply nearby. To summarise his view, he reiterates the adage 'bad data in, bad data out'. A sentiment that we share. Good data is extremely hard to find.

The biggest area of disagreement is the suggestion we can model the risk prior to damage occurring. Our differences – if we have any – are the recognition of risk, rather than a predictive function. Not everyone crossing the road is run down, but some are. It is a risky business.

Finally, thanks to **Paul Thompson** for his comments in support of the CRG research program.

Feedback

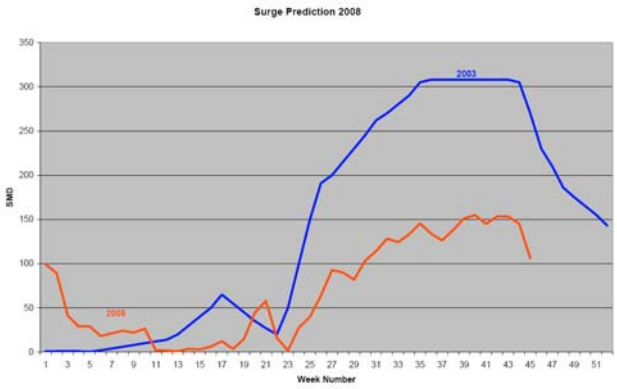
In the E-mail exchanges, **Giles Biddle** referred to a study in Maida Vale where several houses situated behind clonally identical trees were monitored for a period of time. The houses did not move uniformly even though the trees were, for all intents and purposes, identical.

This answers one of the questions posed in last months edition. It isn't the case that all of the houses were moving but one failed. The house that failed was moving, and the others were not.

In short, the suggestion is that the tree 'took its victim as it found it' rather than any inference of the buildings response due to the location of openings - the concept of building vulnerabililty.

We recollect a case where the **BRE** and **OCA** were involved showing that when trees were pruned, building movement slowed, but a few years after, the building moved again, and more. This opened the door to the suggestion that pruning was not a suitable response. Perhaps **OCA** will re-visit this study in a future newsletter.

They have kindly provided 'tree cover' SMD data for 2008 (red line) and 2003 (blue line).



2003 was an event year with high claim numbers, and 2008 is, in contrast, wet, with low claim numbers. This data, provided by the **Meteorological Office** reinforces the link between weather patterns and claim numbers, using tree values rather than grass cover.

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Arboricultural Research

Arboriculturalists have shown themselves to be alert to the need for change, and possibly more likely to undertake research than structural engineers, adjusters, surveyors or members of the geotechnical community.

Marishal Thompson are installing root barriers and below is an extract from their web site at …

http://marishalthompson.co.uk

Mike Lawson from OCA has also pointed out their own research unit which can be accessed at …

http://www.oca-arb.co.uk/research_unit.htm

Both have useful downloads and provide guidance on the various aspects of root induced clay shrinkage.

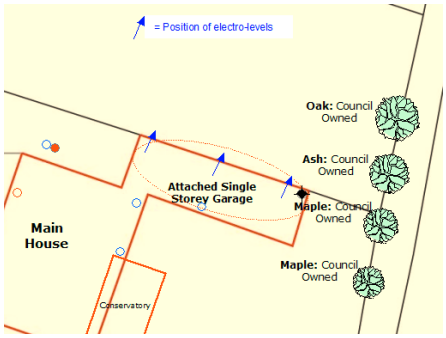
Intervention Case Study

Dr Allan Tew has identified another site for the intervention technique – see below. A Council tree is causing damage to the front wall of a terraced property, and we hope to receive approval to try the technique, which will be installed immediately behind the front garden wall.

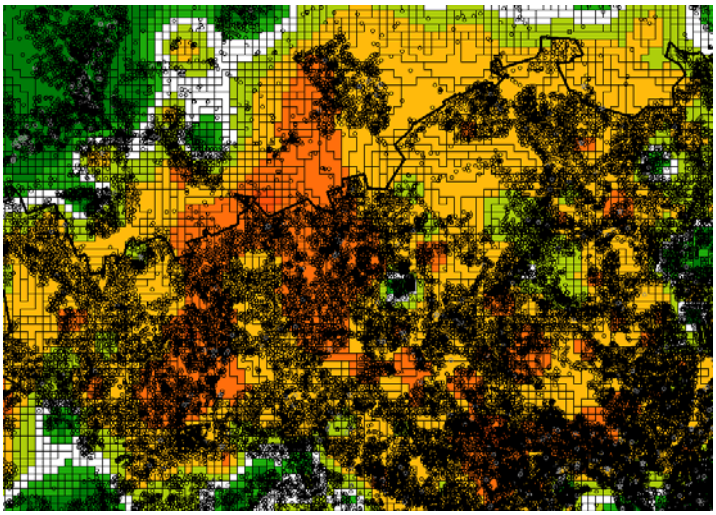
Electrolevels

Jonathan Gray from Crawford & Company has provided an example of an electrolevel installation in Essex, on London clay.

Jon has installed 3 sensors along a 9m long garage wall at 2.5mtr ctrs. The first is about 5mtrs away from a row of Council trees.



Claim Frequency



Some idea of why parts of London are more risky than others is illustrated above. Each of the dots is a full postcode - "NW2 2RW" – superimposed onto the geology map to show concentrations in North West London revealing why frequency is important. There are more claims where there are more houses - frequencies are fairly constant.

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TRIAGE – A CASE STUDY

Cyril Nazareth is currently testing the Triage system, and has examined several claims where visits had been arranged, but the site inspection had not yet been undertaken.

This is an example of the Triage exercise.

Top (Picture 1) is the geology – the basis of our virtual investigations. The property (red dot, centre of image), shows the average P.I. at 2mtrs bGL – the area of maximum root activity - to be around 42%.

Picture 2 shows the building, the tree canopy in height grids, the building footprint and an estimate of the root zone.

The canopy grids show the maximum tree height to be 9mtrs. The footprint of the building is 64 sq mtrs (Picture 3) and the estimated root overlap is 39%.

The bottom picture relates the root overlap zone to the height of the tree producing it. The figure '9' indicates we are dealing with the root zone from a tree 9mtrs tall.

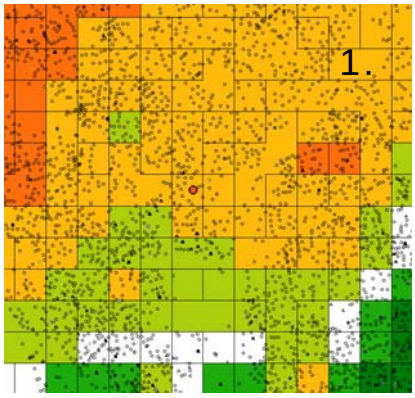
A highly shrinkable clay soil and roots within influencing distance leads to a more meaningful conversation with the homeowner. If they relate damage as the flank wall, or the front bay window, there will be a high confidence of this being a valid root induced clay shrinkage claim. Particularly so if the claim is notified in the summer. The trees appear to belong to the Council.

We can see that the crown of the street tree a few doors away overlaps the building. Perhaps too close to apply the intervention technique. The others are further away and in a group. Our 'virtual slices' through the canopy confirm this as we see from several overlapping root zones.

The claims database tells us it is an area of high claims frequency, with a high number of valid claims. This probability varies throughout the year depending on when damage was first noticed, and who reported it.

We might ask the homeowner for the number of floors. The BCSI tables can provide a rebuilding cost and we will have some idea of the Sum Insured prior to carrying out our inspection.

The images can be used in the engineers report and distributed amongst the suppliers to describe where investigations will be needed etc. See Page 6.



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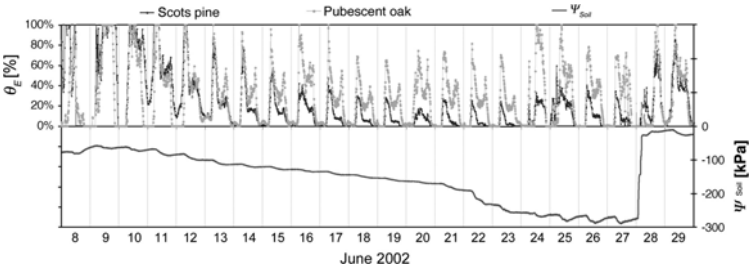
Stomatal Activity

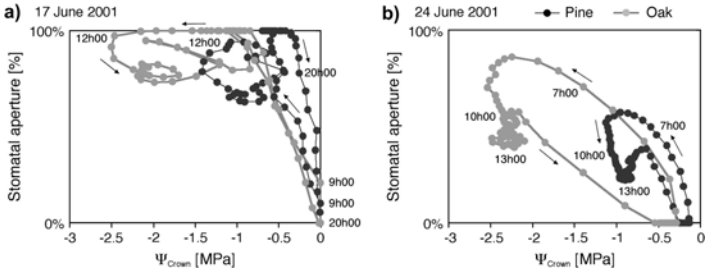
We re-visit the work of Zweifel et al in the Journal of Experimental Biology showing stomatal activity of a pubescent oak and scots pine over a short period of time in which the water deficit in the soil changed, revealing the link between them. See Edition 29.



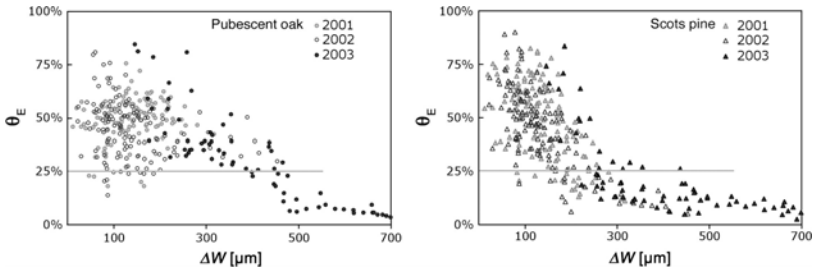
"Measurements in a drought period over 20 days in June 2002: the stomata of both species open less with the ongoing drought, however, the stomatal aperture ({theta}E) of Scots pine is much more affected than {theta}E of Pubescent oak."

There appears to be active control on an hour by hour basis revealing a prompt response to climate change and soil drying. Stomatal reduction in the pine is around 90%. The Oak is less at around 40%.

Modelled Hysteresis Patterns



In wetter weather (above, left) the hysteresis patterns show that the stoma of both species open to 100% very quickly, and the Oak produces larger canopy suctions (2,500kPa) responding to the water availability. Right, even in dry weather the Oak shows itself to be an efficient pump, with the stoma opening quickly and producing similar suctions to a dry day but, we assume, transpiring less as a result of the reduced opening of the stoma.



Mean Daily Stomatal Aperture Values ({theta}E) Corresponding to Tree Water Deficits ({Delta}W) over Three Years

Although there is a wide dispersal of data the trends confirm closure of the stoma at times of drought with the black dots from 2003 appearing more to the right of both graphs revealing the link between water deficit and stomatal aperture.

Stomatal Regulation by Microclimate and Tree Water Relations: Interpreting Ecophysiological Field Data with a Hydraulic Plant Model

Roman Zweifel[1,4,*], Kathy Steppe[2] and Frank J. Sterck[3]

Journal of Experimental Botany

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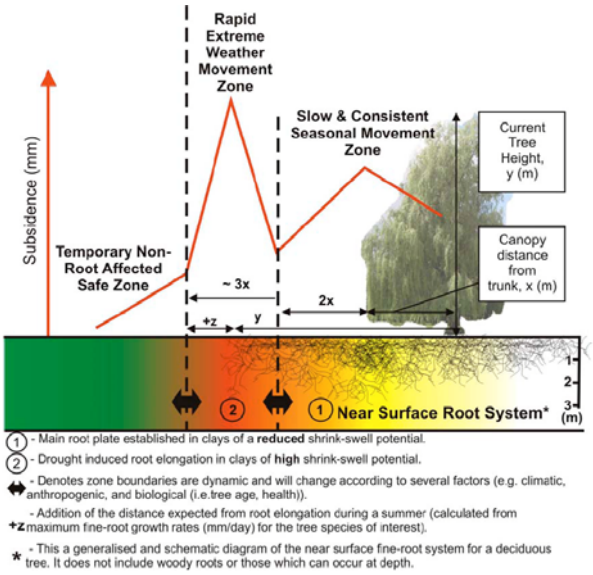
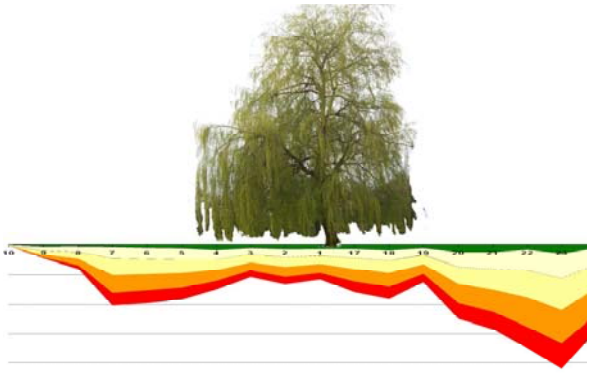
Glenda Jones

Glenda has submitted her paper for publication in the journal "Near Surface Geophysics" including the illustration below of the estimated distribution – and activity – of the rooting system of the Aldenham Willow.

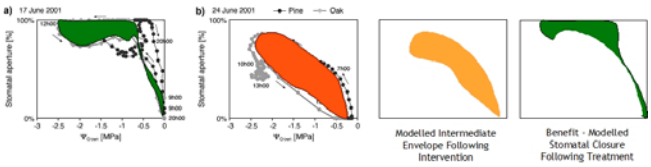


Glenda's work supports the view that the Willow has a dry zone beneath the canopy that produces less movement than at the periphery, where there is enhanced seasonal movement as we see below from precise level survey shown below with an exaggerated 'y' scale.



This form appears to apply predominantly to mature trees with a persistent or recurring deficit. Otherwise the pattern remains as a 'bowl shaped' curve.

Stomatal Aperture



We have attempted to model the benefits of the Intervention Technique based on the work of Zweifel el al - see previous page.

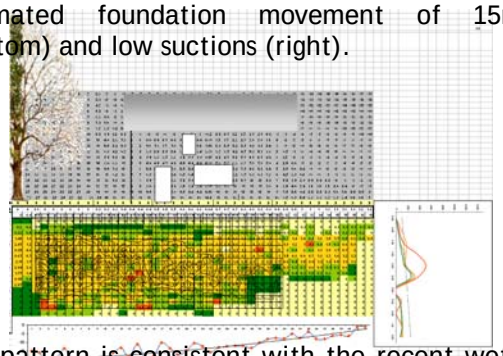
Based on the pubescent Oak we have subtracted the stoma opening envelope of a dry day (red) from that of a wet day (green), leaving the 'benefit envelope' to the extreme right. This is the amount of closure we might see in similar climatic conditions.

The orange envelope is the intermediate condition. The profile we are aiming for. This is the envelope that we assume reflects the treatment.

There are no absolute values and it will vary significantly but this at least provides a qualitative view of our objective.

Triage – Disorder Model

Although the Triage model estimated the root zones to extend beneath the building (Page 4) the output from the Disorder Model suggests very minor movement this year. Below we see estimated foundation movement of 15mm (bottom) and low suctions (right).



The pattern is consistent with the recent wetter weather and we can model 'what if' scenario in a long, dry summer when the risk would increase. This year we expect 1- 2mm cracks at most.