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

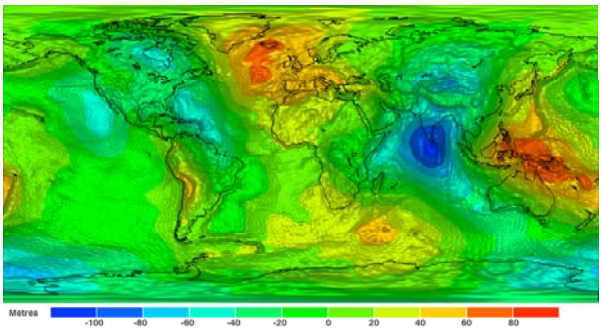
July 2010

The Clay Research Group

CONTENTS

Goce Gravity Map

An amazing map of gravity, supplied by Europe's Goce satellite. The BBC web site reports *"Scientists say the data gathered by the spacecraft will have numerous applications. One key beneficiary will be climate studies because the geoid can help researchers understand better how the great mass of ocean water is moving heat around the world."*



They add, *"this colourful new map traces the subtle but all pervasive influence the pull of gravity has across the globe".*

The Clay Research Group
www.theclayresearchgroup.org
splante@hotmail.co.uk

Challenges Ahead

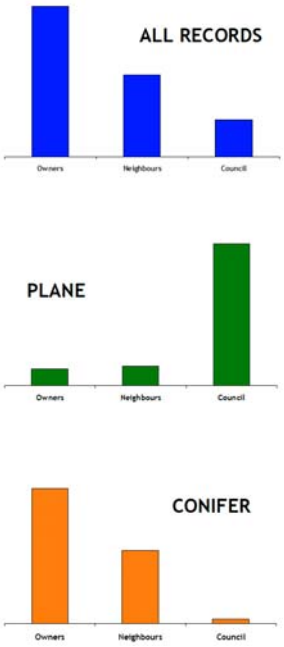
Several speakers at the recent subsidence conferences – Aston and The Post – have commented on the apparent absence of 'new blood' coming through. Gary Strong, John Parvin and Geoff Davies all highlighted the problems we face in terms of a decreasing workload, but also how do we encourage younger people into our profession and develop those that we already have?

London Boroughs

This month we discuss the advantages of the London Boroughs providing limited information from their claims data to help them reduce their annual spend on tree maintenance. Although subsidence accounts for a relatively small number of trees being felled, reduction of the entire population every few years costs, on average, £220k p.a., per Borough and leaves many trees looking disfigured. By comparing the characteristics of trees implicated with damage with our database of the tree stock it may be possible to target a much smaller number.

Tree Data

Our tree database has just been updated and now holds in excess of 43,000 records of trees close to houses that have suffered subsidence damage – although not all have been proven to have been implicated in causing the damage. Just one of the complications of undertaking any analysis is shown right. Categories of ownership vary with species and Plane trees have a very different ownership profile to Conifers. An updated analysis follows next month.

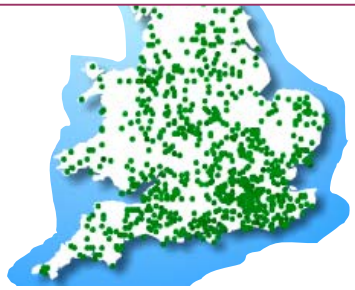


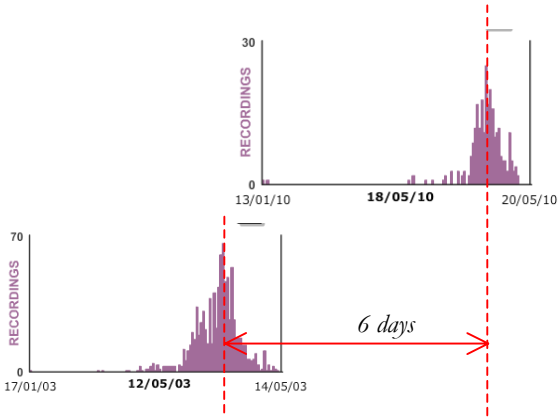
The Clay Research Group

Pedunculate Oak

Visit http://www.naturescalendar.org.uk/ to see some amazing data on trees and the environment. Below we reproduce data on "Pedunculate Oak coming into leaf", which graphs reported sightings by date, and maps them at the same time. In the case of this species, most sightings occur around the 19th May 2010, and slightly earlier in 2003 – an event year. The number of sightings isn't high – fewer than 30 in 20910 and 70 in 2003, but nonetheless, a very useful site, well presented.

Map of the "Pedunculate Oak" coming into leaf across the UK, by the date of the reported sightings from 70 observations.





The date of reported sightings for the "Pedunculate Oak" coming into leaf. The web site suggests the reason for the delay in 2010 is the colder weather through the more recent winter.

SUBSIDENCE 2010

POST EVENTS Management Briefings

SUBSIDENCE CONFERENCE

Less interest this year due to low claim numbers. The format was a day of talks delivered by individuals, rather than stands showcasing suppliers' products.

Gary Strong opened the day by outlining the problems we face with fluctuating workloads and explained some initiatives by the RICS to improve standards.

Geoff Davies reiterated the problems suppliers face with increasing pressure on cost, and asked who would fund the innovation that most speakers acknowledged was required.

A panel including representatives from the Met Office, Zurich and the ABI continued the theme and questions were asked about the ability of the Met Office to reliably predict weather patterns accurately enough for adjusters and engineers to recruit several months ahead of the warm weather.

The CRG were represented by Steve Plante who opened with a brief outline of the value of the BGS maps in terms of risk, and then extended the topic to The Joint Mitigation Protocol.

This was followed by Jim Smith explaining where the London Government and related bodies were headed and recent political initiatives.

Much debate followed on the topic of the JMP.

Bill Jeffrey and Jon Hall from GAB Robins concluded by asking what the future held. Where will technology take us and what might our world look like in 2020?

The Clay Research Group

WEATHER WATCH 2010

Predicting weather patterns with any sort of certainty more than a week ahead is quite simply impossible, as we heard from the Met Office at The Post conference. Attempting to predict several months ahead is just guessing.

Climate Change has added a degree of complexity with long sunny spells interrupted by heavy rainfall. Trends can very quickly be reversed and climatologists predicted wide fluctuations lasting for a period of 10 years about four years ago. Recent years have supported their prediction.

We still hold the view that Soil Moisture Deficit (SMD) at the end of May has value in providing a clue about summer claims frequency.

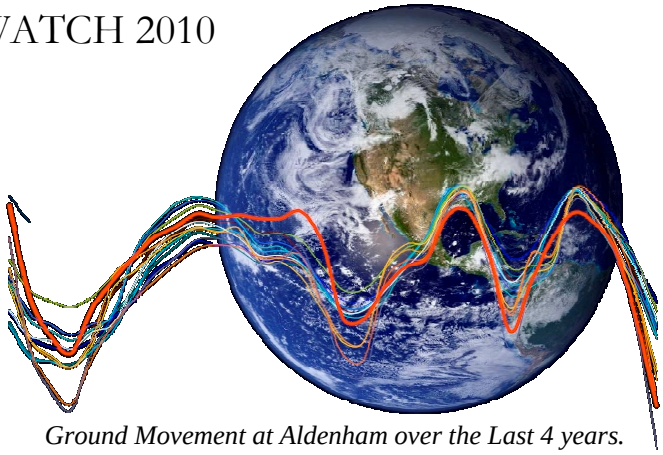
SMD values take account of hours of sunshine, wind, temperature etc., and by using the Met Office data from Tile 161, grass cover and medium AWAC we can build background climate data that has proven to be quite accurate over the last 20 years.

Our model seeks to factor in the response of the tree to the climate at the time of coming into leaf. The model uses the idea that tree water uptake is governed by hormone regulation that is, in turn, driven by stress.

It is the energy scenario that we described last year. Producing ground subsidence of say 50 – 100mm requires a significant amount of energy.

The gradient of the line plotting the SMD is material to the response of the root and in turn, the water uptake of the tree.

Simply being dry – for example, carrying over a deficit from the previous year – seems to pose less of a trigger than moving very quickly from a zero deficit (the soil at field capacity) to a 100mm deficit in the space of a month or so.

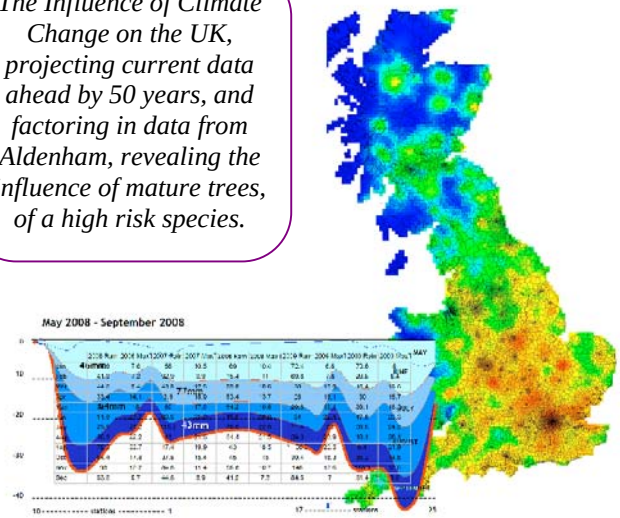


Ground Movement at Aldenham over the Last 4 years.

If this is so, active drying of the soil surrounding tree roots produces a different response to the soil being simply dry, even at the same suction. Perhaps actively increasing suctions trigger a larger hormonal response to 'static' ones.

Combining climate with geology and then vegetation (see articles elsewhere in the newsletter) delivers the image below.

The Influence of Climate Change on the UK, projecting current data ahead by 50 years, and factoring in data from Aldenham, revealing the influence of mature trees, of a high risk species.



Linking Climate to Geology to Vegetation.

If the model proves to be correct, the prediction for 2010 would be a normal year with higher claim numbers, but not an Event although June has tested our confidence somewhat!

The Clay Research Group

SIDCUP ROAD PROJECT

The Subsidence Risk Model correctly identified all subsidence claims from the tile below. Two fell into the 'high risk' band, 5 were medium and 1 low. In one instance, conifers from the rear garden had been removed in 2004. Perhaps more interesting is the number of houses that do not pose a risk – those with no colour coding. The model has a 'reverse rating', with lower percentage modelled root overlap presenting a higher risk.

Medium Risk Identified

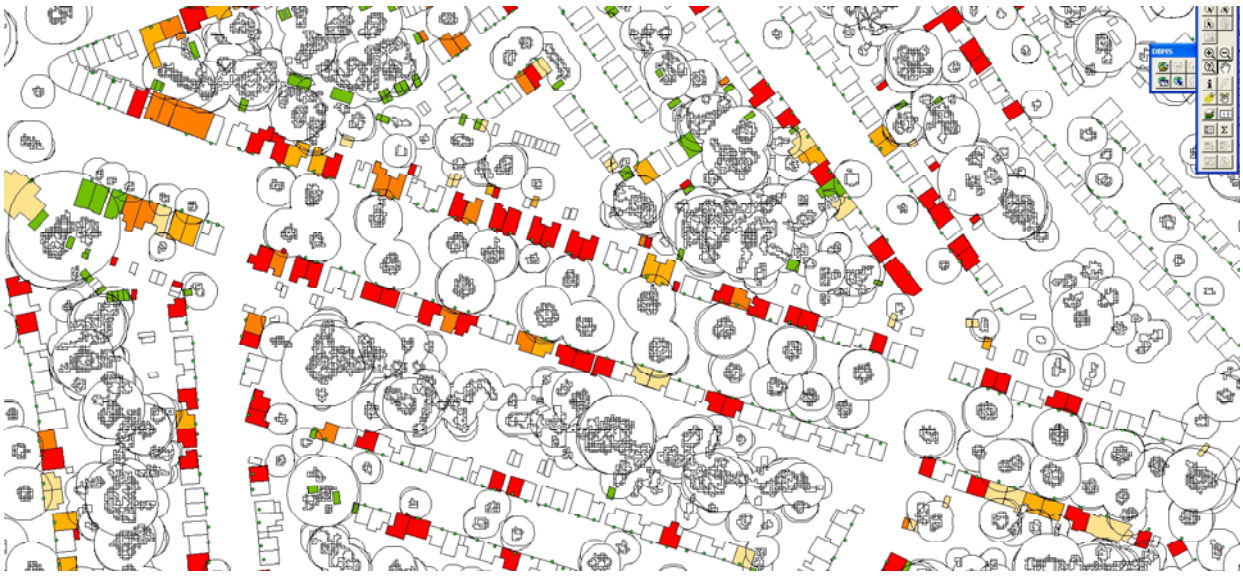
Low Risk Identified

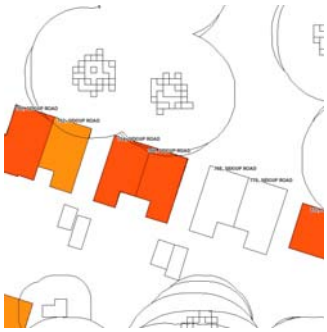
Risk Table

60 to 100 (508)
30 to 60 (225)
20 to 30 (124)
10 to 20 (205)
0 to 10 (418)

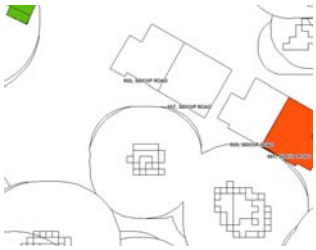
"% Overlap"

Medium/Low Risk Identified





2 Tree Removed Prior to LiDAR Survey in 2005.



2 Properties Identified – Medium/High Risk

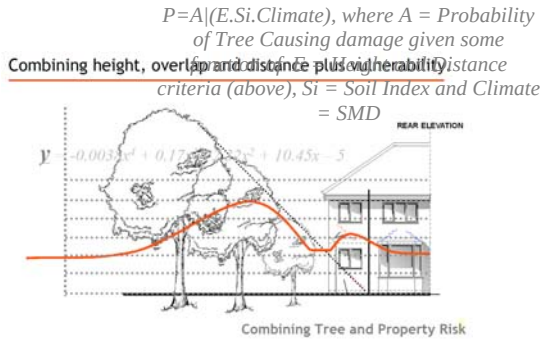
2 Properties Identified – Medium/High Risk

The Clay Research Group

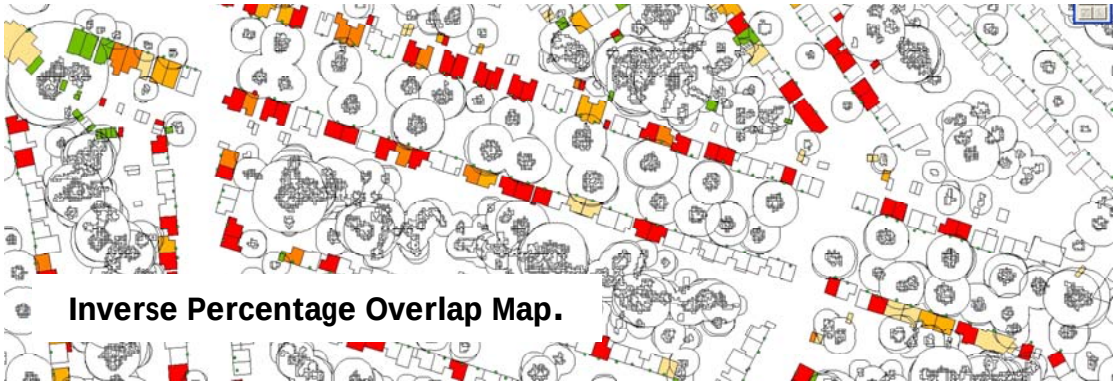
BUILDING the MODEL

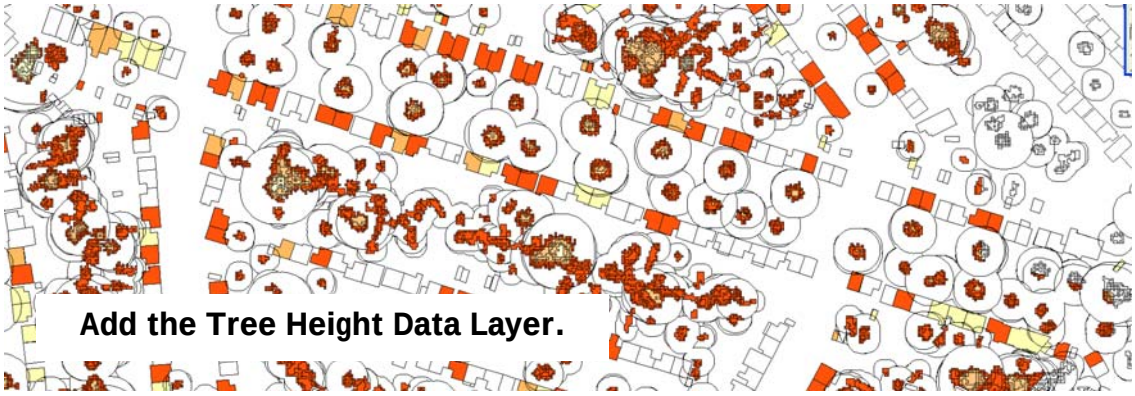
Taking the street view image from the previous page, we can estimate the notional root zone that appears to pose the highest risk. To refine this further, we can model various scenarios relating to tree heights.

Using a GIS system, trees of a certain height and buildings at a certain distance can be combined to deliver the map at the bottom.



A formula for expressing the risk posed by trees in relation to buildings, taking account of height, distance and building vulnerability – but not tree species.





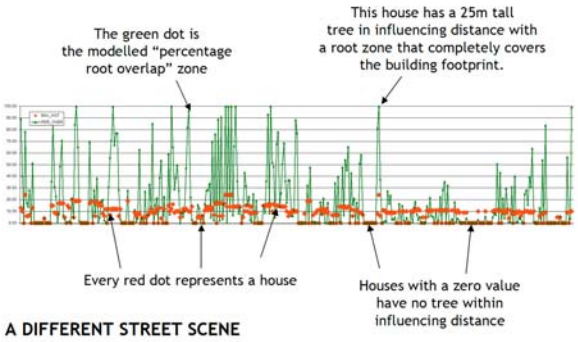
These images plot a sample from Sidcup Road with many trees planted around the same time. The risk rating is determined by matching colour coded houses with shaded trees nearby, the modelled root zones of which 'touch' the building, but do not cover the building footprint.

Where colour is absent in one, but not the other, means the risk is reduced. It is the coincidence of both that distinguishes categories of risk. Trying to refine the model to distinguish which trees will cause damage is explored on the following page.

The Clay Research Group

A GRAPHIC STREET SCENE

Below is the scene expressed graphically as if we were walking along Sidcup Road with each house represented by a red dot. If the house has no tree nearby (within modelled influencing distance) it has a zero value. This is from a sample of 378 houses in Sidcup Road.



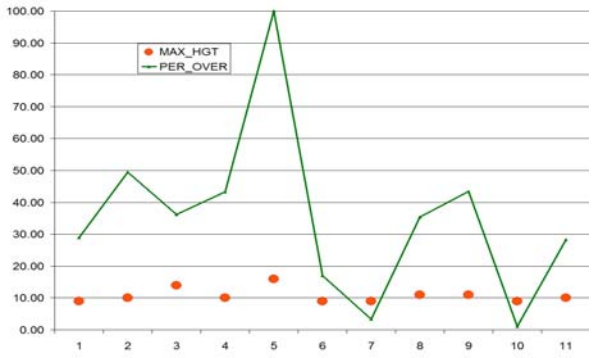
A DIFFERENT STREET SCENE

The green dot represents the modelled root zone - the zone where we estimate roots may exert an influence sufficient to cause damage to a low rise structure – it has little (if anything) to do with actual root zones.

Houses to the left of the graph (at the western end of the road) are either closer to the buildings, or taller. Quite a few have root zones that could extend beneath the entire footprint of the house.

As we proceed down the street, houses to the right of the graph have smaller trees with root zones that 'touch' the building, delivering 'percentage overlap' figures of between 20 – 50%. What would the graph look like if we extracted houses that have suffered damage from the industry figures contributed?

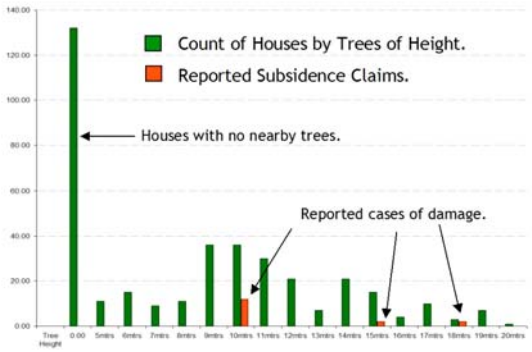
The graph below plots the same data for houses that have had valid root induced clay shrinkage claims.



What can we see from the data? Is there a particular combination that presents a greater risk? How do damaged houses compare with undamaged houses? Of the 11 claims notified, 9 have trees of a height of around 10mtrs and 10 have root zones less than 50%. Only 1 has a root zone of 100%.

81% of the sample have a height of 10mtrs (because there are more trees of this height) combined with a root overlap of 50% or less. If we include 'missing' data from one of the larger insurers, we might extrapolate the above to say, 14 claims.

Turning now to the issue of probability and foreseeability, what can we learn from this? Well, from the sample of 378 houses, we think 14 have been damaged which gives a 3.7% probability of spotting the risk.



If we only include those houses with trees estimated to be within influencing distance, there are 246 houses notionally 'at risk' providing an improved chance of spotting which trees could be implicated over a five year term of 5.7%.

Of those we may target only trees 10m high and with a root zone < 50% = 36 trees from this sample.

That reduces the odds still further. Looking at our data (and including the missing set), we have 14 claims against 36 higher risk houses/trees that meet our criteria. This delivers a 38% opportunity of "spotting the tree".

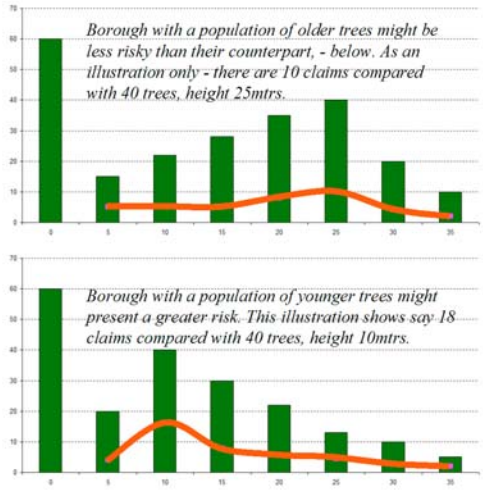
Factoring in species – and this is where we hope to gather further information from our industry colleagues – we may be able to help Local Authorities spend their limited resources in a better, more targeted way and reduce risk for all at the same time.

A claim frequency of say 0.6% would deliver 0.006 x 378 (including all of the houses in the sample) = 2.2 claims p.a., or 11 claims over the five year term of our study.

The Clay Research Group

Explanatory Note

Whilst we talk of trees of a certain height presenting a higher than average risk, much has to do with distribution, and we saw on the previous page high claim numbers from trees of a particular height simply because there were more of them.



TREE DISTRIBUTION & RISK

To summarise, we believe that a population of trees that are all 10mtrs tall would deliver more claims (all other circumstances being equal) than a Borough with a population of trees that were all say, 25mtrs tall.

Current SMD Values

Below are the latest SMD readings for grass cover plotted against both Normal and Event profiles. They exceed those for an Event year, making this an interesting opportunity to test the model.

Up until the end of May 2010 we were reasonably confident that it would be a normal year. In June, the gradient of the line (a proxy for energy) increased steeply.

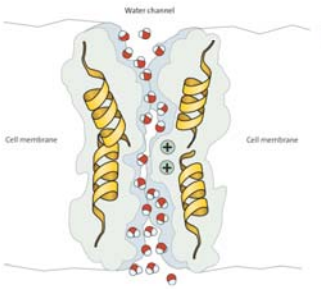
SMD for 2010, compared with profiles of Event and Normal years. It has started late but has a very steep gradient following a wet winter.

2010 may improve our understanding and determine whether the value at the end of May is a determining factor, or the steepness of the incline.

Or of course, weather patterns have simply become too complex to act as a predictive tool going forward.

Electro-osmosis and Ion Channels

We were struck by the remarkable similarity between the mechanism by which cell walls allow certain chemicals to pass, whilst others are repelled, and the mechanism associated with electrokinesis, as we see below.

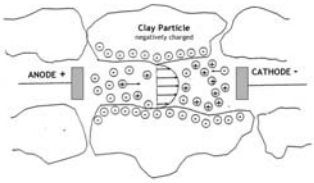


Ion Channel

Cell walls 'allow' the passage of selected molecules using what are termed 'ion channels'. The charge along the wall of the channel either draws the required molecule into the cell, or repels it.

Electrokinesis

Electrokinesis operates in a very similar way. The externally applied charge pushes or pulls electrically charged particles - water or soil - along.



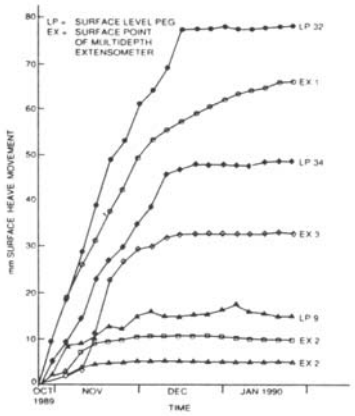
The two images are almost interchangeable, although they come from different sciences and deal with different topics.

The Clay Research Group

REHYDRATION

Our current work on water harvesting and rehydration (or more correctly, water supply) goes back to a literature review undertaken on our behalf by Professor Richard Chandler at Imperial College in 1992.

Professor Chandler uncovered a wide range of published trials and case studies, many of which related to rehydrating areas of desiccated land prior to construction.



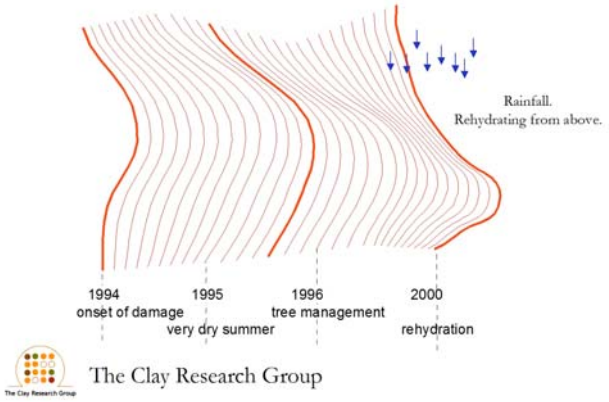
Time – Surface Heave Relationship Following Flooding. Blight et al, (1992)

The example above illustrates the speed of recovery achieved in one particular study - swell of 80mm in just under two months followed by stability.

We tested this at a site in Chislehurt, Kent on behalf of Direct Line Insurance. Two mature Oak trees had built up a persistent deficit and were causing damage to a detached property.

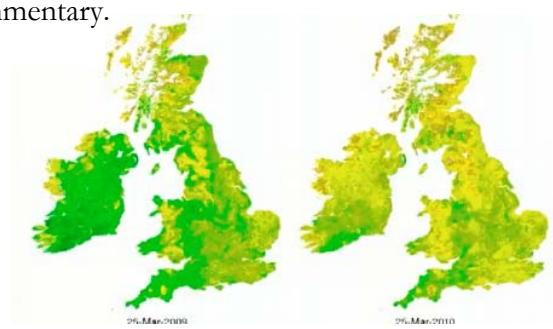
By sinking bores and wetting the ground, we were able to rehydrate the soil to field capacity and fell the Oaks.

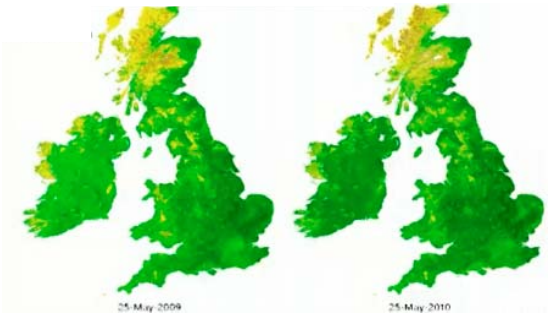
THE ENVELOPE OF A SUCTION CURVE PLOTTED OVER A 6 YEAR TERM.



Chlorophyll Production in the UK

The Woodlands Trust web site (see Page 2 for address) also has a video of chlorophyll production across the UK. See maps below and their commentary.





"Look for the dramatic difference in timing when the UK 'greens up'. If you compare the maps in mid-April for instance, the 2010 greening had still not caught up with 2009. This is hardly surprising as we've just had the coldest Dec - Feb period for 30 years."