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

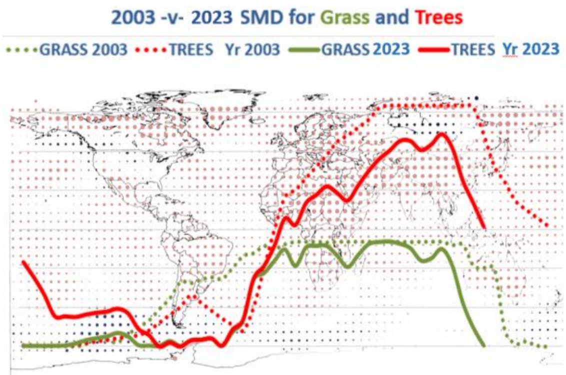
January 2024
Issue 224

The Clay Research Group

CONTENTS

SMD Update

Soil Moisture Deficit readings plotting variations in moisture content of the ground at tile 161 for 2023 compared with the surge year, 2003.



SMD Data provided by the Met office. Tile 161, Medium Available Water Capacity with grass and tree cover

Contributions Welcome

We welcome articles and comments from readers. If you have a contribution, please Email us at: *clayresearchgroup@gmail.com*

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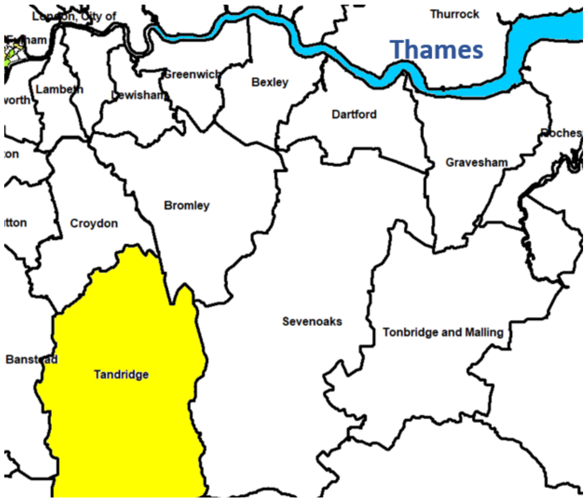
District and Sector Risk

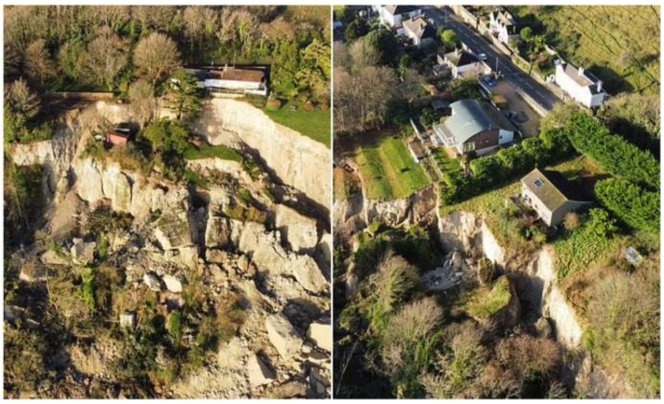
Mole Valley is the topic of the 'Risk by District' series in this month's edition. Situated in east Surrey, it has superficial deposits of clay with flints overlying variable bedrock deposits – see Page 6.

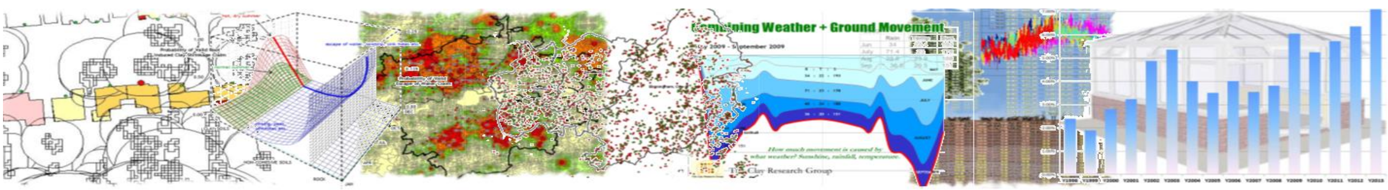


The risk maps are built from a data sample covering four claim years, including one surge and three 'normal' years.

Isle of White Cliff Collapse

Large cliff collapse at Ventnor, Isle of White in December resulted in 20 houses being evacuated. The cause is thought to be the unseasonably period of wet weather.





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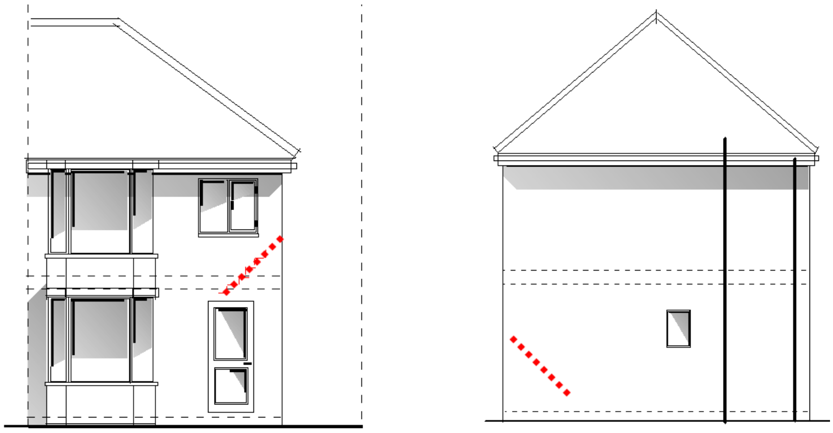
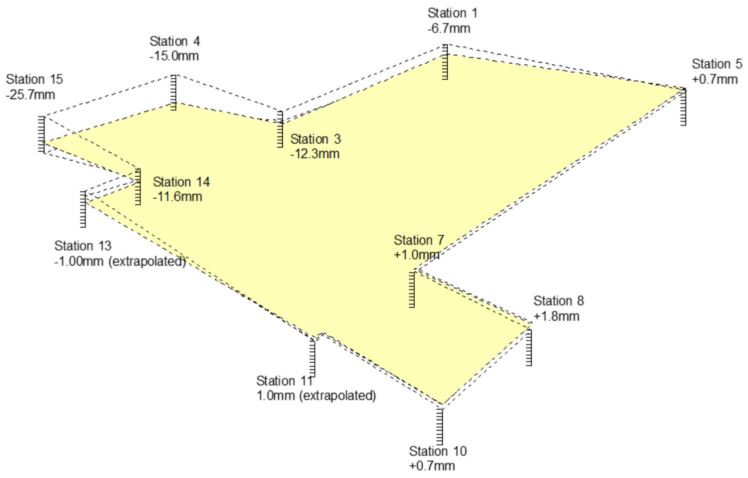
Satellite Monitoring - feedback

As anticipated, there has been quite a lot of interest in the article, 'Detecting Subsidence with Satellites' by Reijo Pold, the founder of Value.Space, in last month's edition. Cleary, if it is possible to detect movement and remotely monitor properties that are suffering subsidence at a reasonable cost and high resolution, it would provide a significant benefit. Readers have raised several queries.

First, as the sketch, right, illustrates, it is unusual to see significant differential movement to roofs other than in the most extreme cases



Can satellite data detect localised movement to the supporting brickwork in such circumstances, with damage of the sort shown? As far as we are aware, movement to the roof is rare.

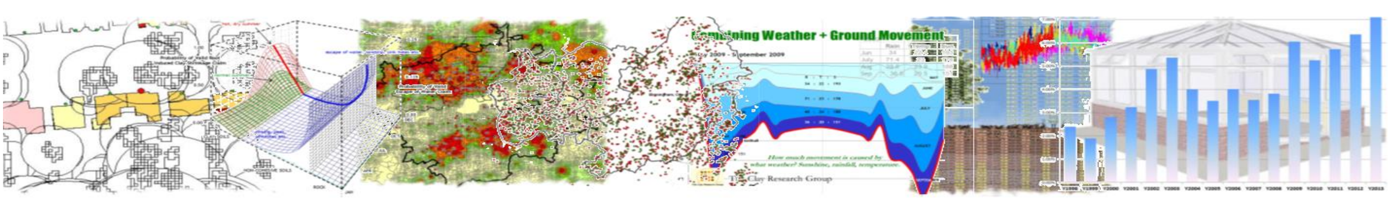


We understand that satellite data can detect ground movement but at what resolution?

Left, an example of precise levels using current methods, with vertical readings taken around the perimeter of the building at a resolution less than 1mm.

This traditional method is accepted by the various parties involved and can be verified if challenged.

Of particular interest is the issue of detecting localised subsidence using data gathered from sloping roofs, if that is in fact the process. From a practical point of view, producing a sketch of this nature using satellite imagery would, it is assumed, be difficult when movement of the roof (assuming the roof to be the source of data) is rare or a distortion of what might be happening. Precise levels to diagnose subsidence are based on readings taken along a brick course around the house. If radar delivers readings from roof distortions, the output could be misleading.



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It would also be necessary to clarify if readings are taken at exactly the same location at each pass and the horizontal and vertical resolution.

How is the data delivered? Is there a record of movement over time – by day, week or month? Will users have access to an application where location and movement are recorded on a screen or will the data be listed in a table by property address?

If Value.Space are willing, we would suggest comparing data from a number of valid and declined claims. A review of satellite data for these properties (assuming historic data is available) compared with traditional precise level data would resolve this query.

It would be an interesting exercise to see data relating to ground movement at the site of the Aldenham willow over a period of time, assuming past radar data is available. We have precise level data extending from 2006 through to 2022 and a comparison may be of value.

The final question is, what would be the cost? In terms of claims assessment, what would it cost to monitor a building on a bi-monthly basis over say a 12-month term? For underwriters, what would be the cost of (a) a 'per scan' assessment and (b) an annual update?

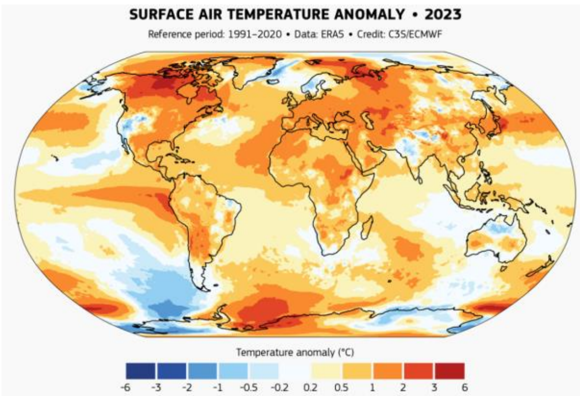
We have passed these queries to Reijo Pold for comment.

CLIMATE – UK -v- Global

2023 is confirmed as the warmest calendar year in global temperature data records going back to 1850. 2023 had a global average temperature of 14.98°C, 0.17°C higher than the previous highest annual recorded value in 2016.

According to the Meteorological Office, in the UK 2023 was the second warmest year after 2022 which had an average annual temperature 0.06C higher. That said, 2023 tied with 2006 for the highest September temperature on record for the UK with an average of 15.2C.

Right, a global view of the 2023 temperature anomaly from the Copernicus web site.



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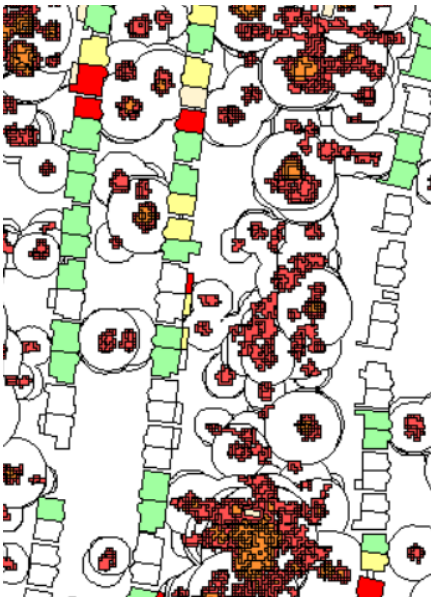
Modelling the Risk Posed by Trees on Clay Soil



Just how many houses in the street with a high risk profile have suffered damage since subsidence was added to the insurance policy at the beginning of 1970?

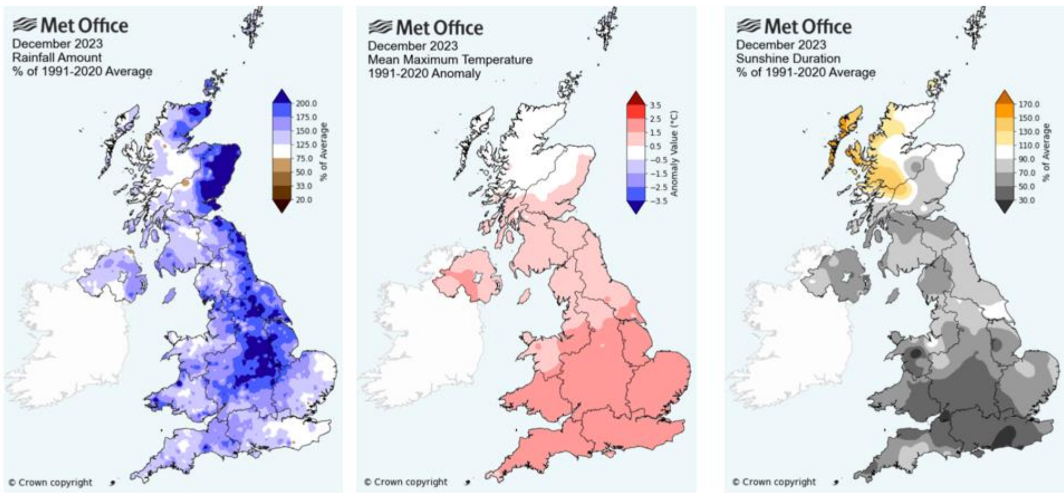
With the increasing threat of climate warming, how many houses will suffer damage in the future? Left, an extract from our model mapping the height of trees across the high-risk boroughs in London situated on clay soil.

Houses with no shading present low risk of subsidence, green a nominal risk, yellow greater and red the highest risk.

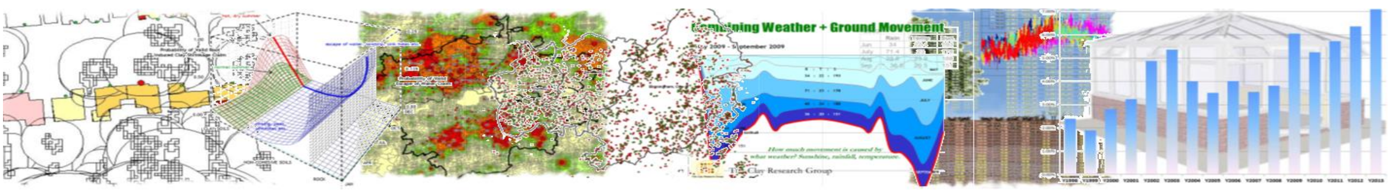
Understanding their exposure would deliver a benefit of course, along with some idea of the timeline over which claims might occur.

Met Office December 2023 Update. Anomaly Data, 1991 – 2020

Anomaly maps from the Met Office web site for the month of December 2023 reproduced below. The month was warmer than the 1991-2020 average, with increased rainfall and lower hours of sunshine for the south east, the area with the highest number of subsidence claims and vulnerability to surge.



htts://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps



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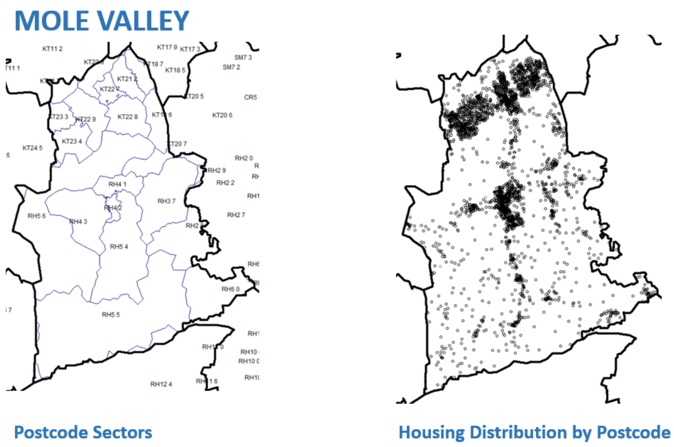
Subsidence Risk Analysis – MOLE VALLEY

Mole Valley is located in Surrey, occupying an area of 258km^2 with a population of around 87,500.



Distribution of housing stock using full postcode as a proxy. Each sector covers around 2,000 houses on average across the UK and full postcodes include around 15 – 20 houses on average, although there are large variations.

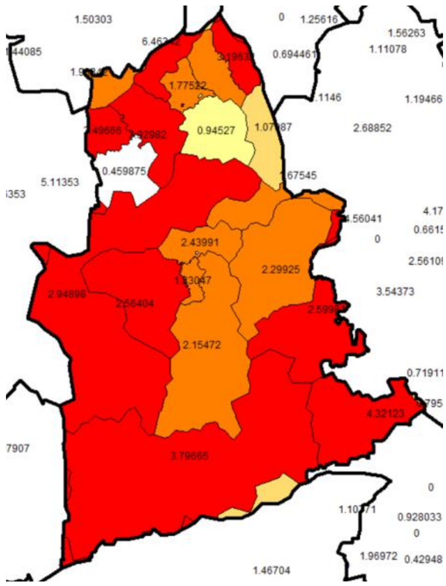
Sector and housing distribution across the district (left, using full postcode as a proxy) helps to clarify the significance of the risk maps on the following pages. Are there simply more claims in a sector because there are more houses?

Using a frequency calculation (number of claims divided by private housing population) the relative risk across the borough at postcode sector level is revealed, rather than a 'claim count' value.

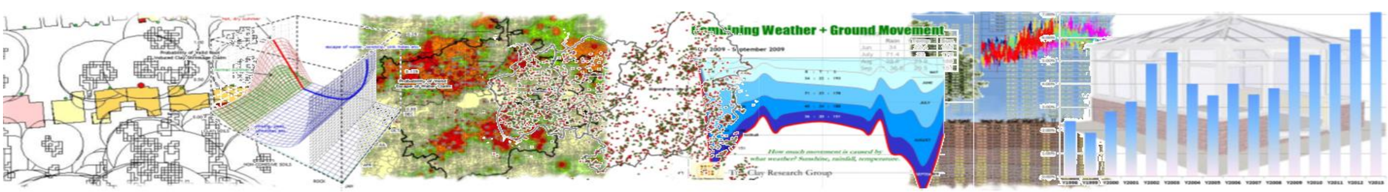
From the sample we hold, sectors are rated for the risk of domestic subsidence compared with the UK average – see map, right.

Mole Valley is rated 19th out of 413 districts in the UK from the sample analysed and is around 2.28x the risk of the UK average, or 0.59 on a normalised 0 - 1 scale.

There is a varied risk across the borough as can be seen from the sector map, right, which reflects the varied geology with non-cohesive drift deposits overlying London clay.



Sector risk compared to UK average from the sample analysed including all properties by ownership.



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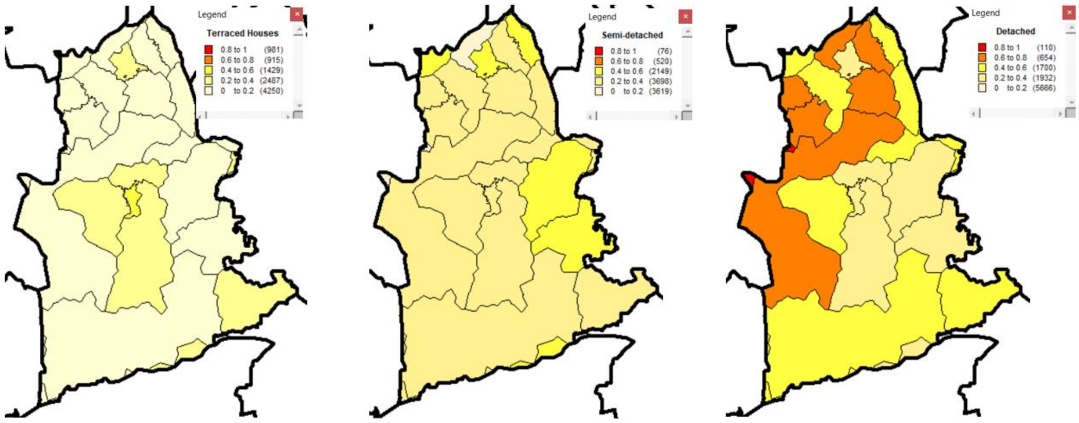
MOLE VALLEY - Properties by Style and Ownership

Below, the general distribution of properties by style of construction, distinguishing between terraced, semi-detached and detached. Unfortunately, the more useful data is missing at sector level – property age. Risk increases with age of property and the model can be further refined if this information is provided by the homeowner at the time of taking out the policy.

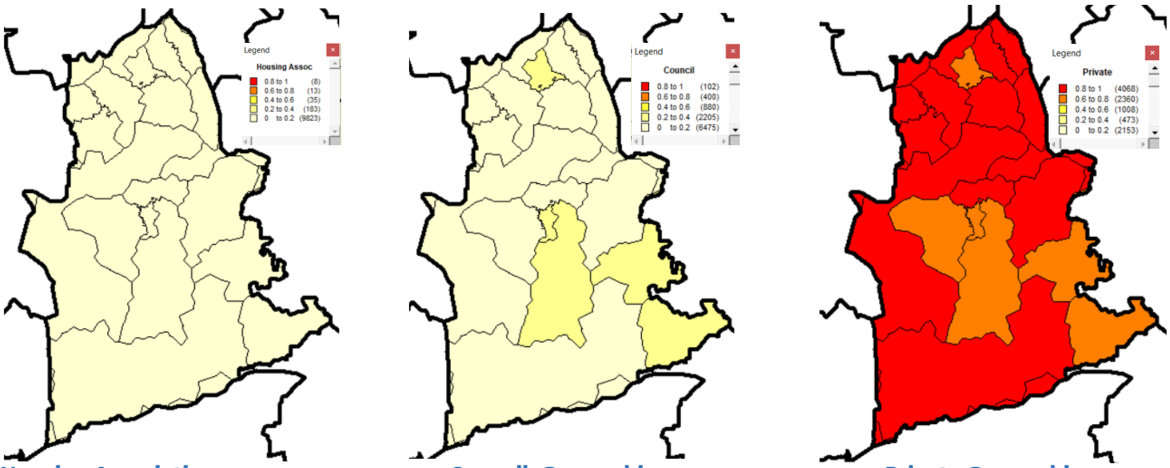
MOLE VALLEY - Distribution by House Type



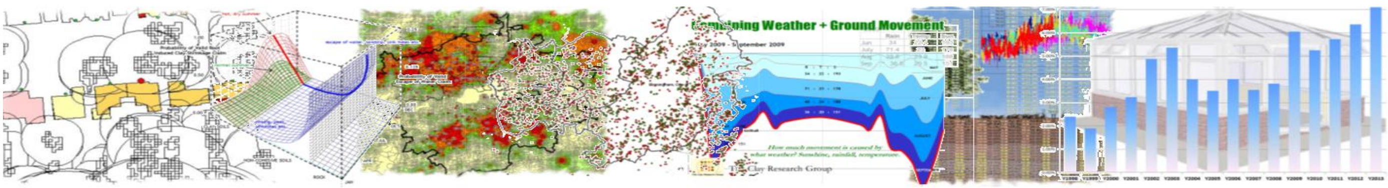
Terraced **Semi-Detached** **Detached**

Distribution by ownership is shown below. Detached, private properties are the dominant class ownership across the borough.

MOLE VALLEY - Distribution by Ownership



Housing Association **Council Ownership** **Private Ownership**



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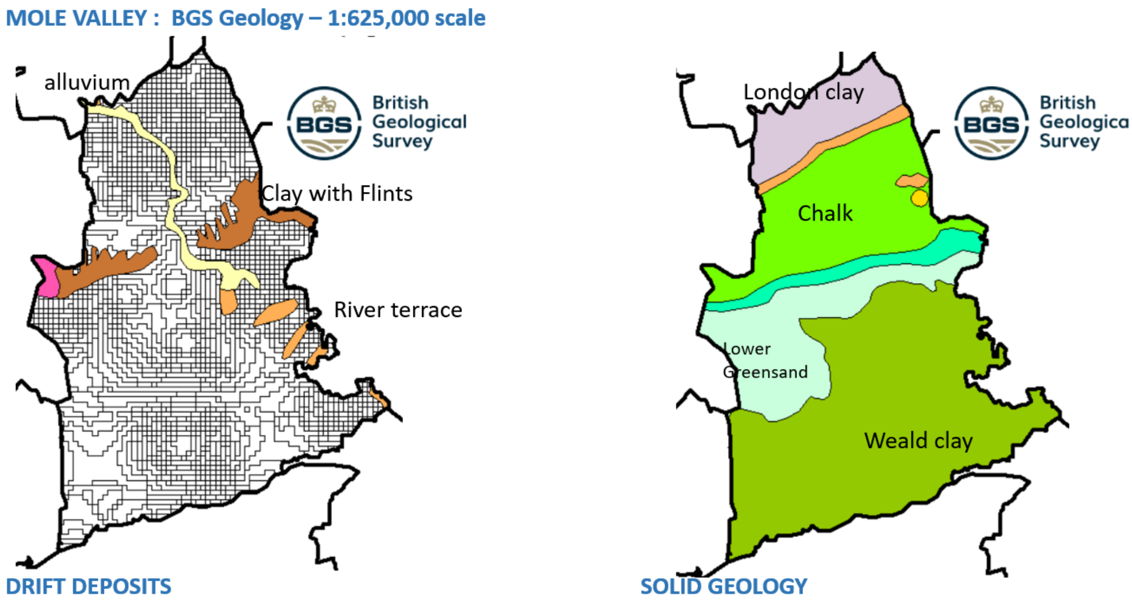
Subsidence Risk Analysis – MOLE VALLEY

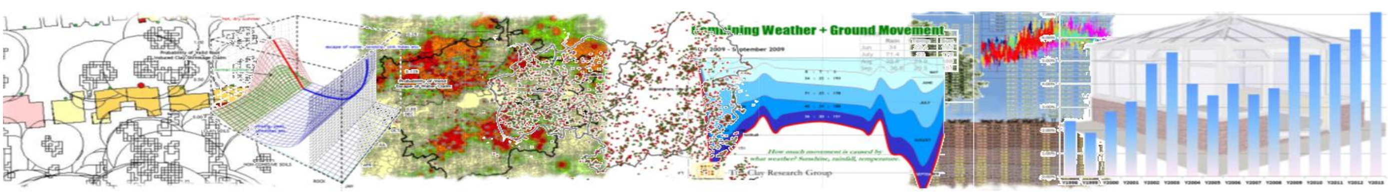
Below, extracts from the British Geological Survey low resolution 1:625,000 scale geological maps showing the solid and drift series. View at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html for more detail.

See page 10 for a seasonal analysis of the sample which reveals that, at district level, there is around a 70% probability of a claim being valid in the summer and, of the valid claims, there is around a 68% chance that the damage will have been caused by clay shrinkage, with escape of water accounting for the remaining 32%. In the winter the likelihood of a claim being valid is higher at around 60%. Of the valid claims there is a 30% chance of the cause being clay shrinkage and 70% chance of the cause being an escape of water.

Maps at the foot of the following page plot the seasonal distribution with shrinkable deposits encountered following investigations associated with claims.



Above, extracts from the 1:625,000 series British Geological Survey maps. Working at postcode sector level and referring to the 1:50,000 series delivers far greater benefit when assessing risk.



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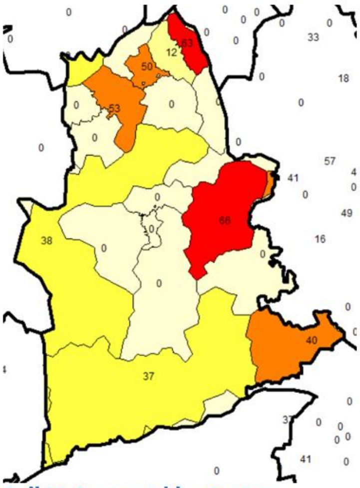
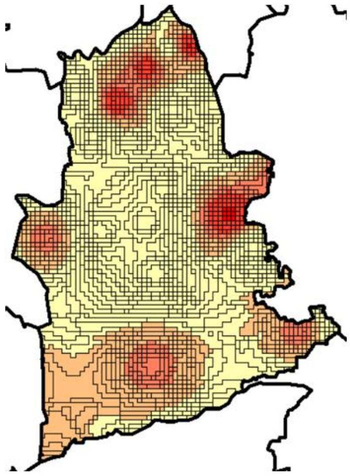
Liability by Geology and Season

Below, the average PI by postcode sector (left) derived from site investigations and interpolated to develop the CRG 250m grid (right). The higher the PI values, the darker red the CRG grid.

MOLE VALLEY – Soil Plasticity Index



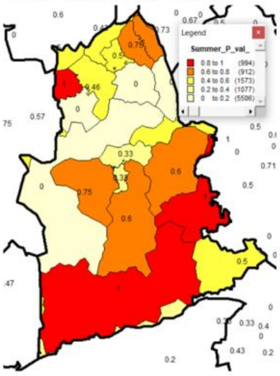
Soil PI Averaged by Sector



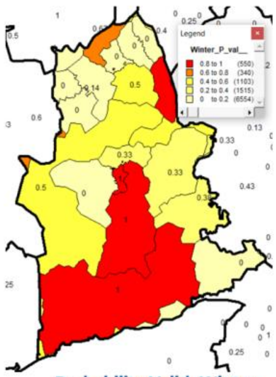
PI Interpolated on 250m CRG grid

Zero values for PI in some sectors may reflect the absence of site investigation data - not necessarily the absence of shrinkable clay. A single claim in an area with low population can raise the risk as a result of using frequency estimates.

MOLE VALLEY – by season



Probability Valid, Summer



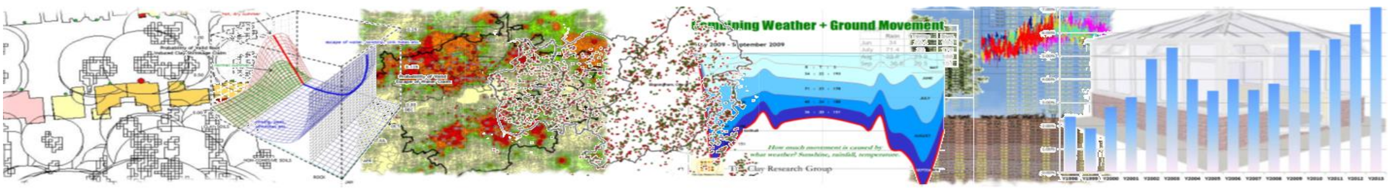
Probability Valid, Winter

The maps, left, show the seasonal difference from the sample used.

Combining the risk maps by season and reviewing the table on page 10 is perhaps the most useful way of assessing the potential liability, likely cause and geology using the values listed.

Clay is recorded as a significant cause of subsidence in the summer months which reflects the distribution of the housing population relative to the London and Weald clay series.

The ‘claim by cause’ distribution and the risk posed by the soil types is illustrated at the foot of the following page. A high frequency risk can be the product of just a few claims in an area with a low housing density of course and claim count should be used to identify such anomalies.



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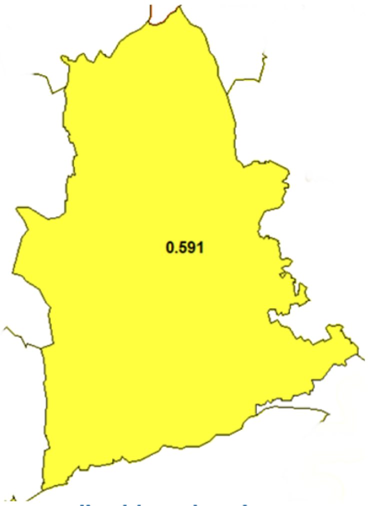
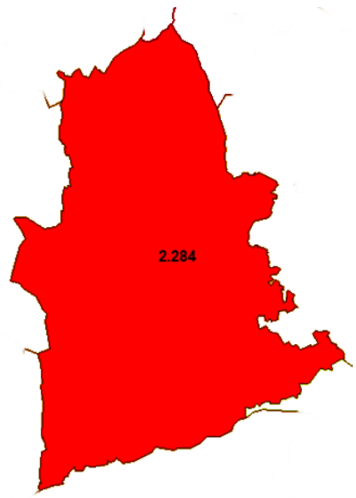
District Risk -v- UK Average. EoW and Council Tree Risk.

MOLE VALLEY - Subsidence Risk Relative to UK Values



Normalised (0 – 1) Scale



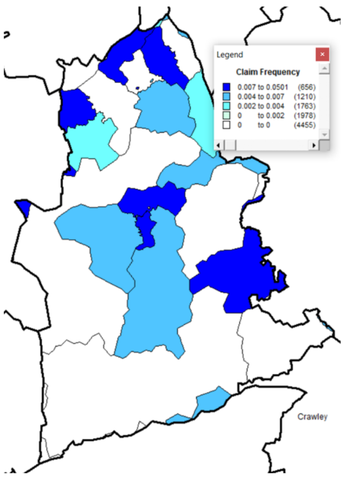
Relative to UK Average

Below, left, mapping the frequency of escape of water claims confirms the presence of non-cohesive soils. As we would expect, the 50,000 scale BGS map provides a more detailed picture.

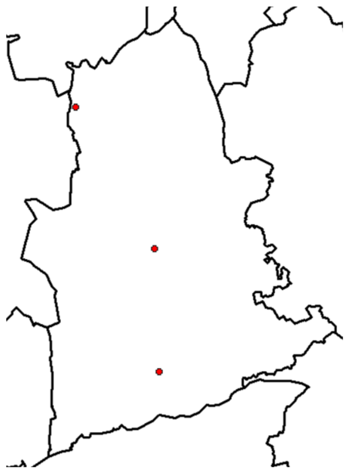
The CRG 1:250 grid reflects claims experience.

Below right, map plotting claims where damage has been attributable to vegetation in the ownership of the local authority from a sample of around 2,858 UK claims. The low numbers are attributable to the superficial geology being largely non-cohesive.

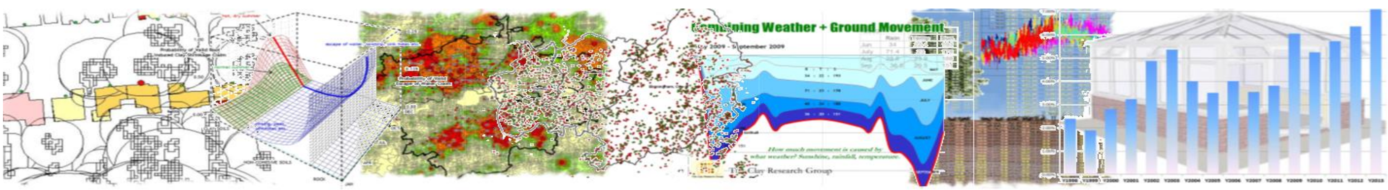
MOLE VALLEY



Higher Risk Escape of Water



Claims Involving Council Tree
(2,858 UK claim sample)



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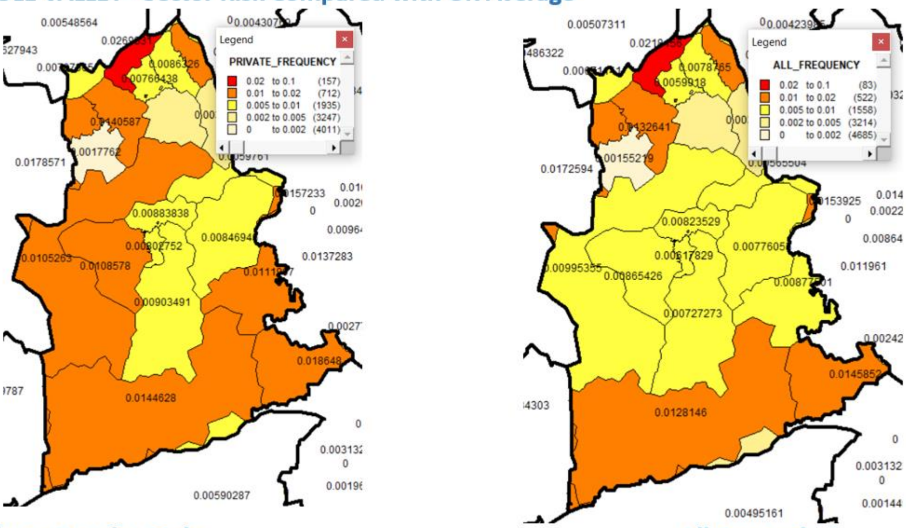
MOLE VALLEY - Frequencies & Probabilities

Below, mapping the risk of subsidence by ownership. Claims frequency including council and housing association properties delivers a misleading value of risk as they tend to self-insure. The following show the normalised risk, taking account of the private housing population – that is, the rating compared with the average value for each category.

MOLE VALLEY - Sector Risk Compared with UK Average



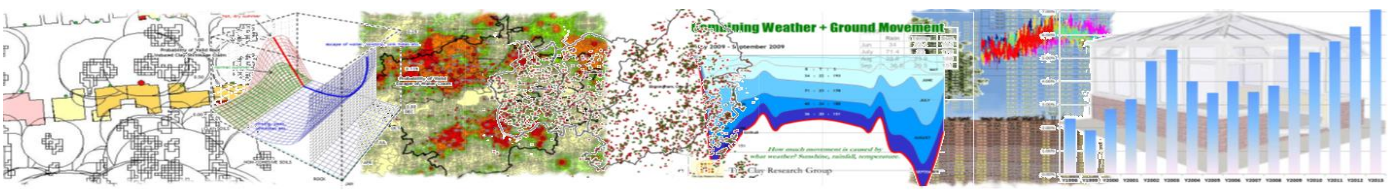
Private Housing Only **All Properties**

On a general note, a reversal of rates for valid-v-declined by season is a characteristic of the underlying geology. For clay soils, the probability of a claim being declined in the summer is usually low, and in the winter, it is high.

Valid claims in the summer are likely to be due to clay shrinkage, and in the winter, escape of water. For non-cohesive soils, sands, gravels etc., the numbers tend to be fairly steady throughout the year.

Liability by Season - MOLE VALLEY

District	valid summer clay	valid summer EoW	Repudiation Rate (summer)	valid winter clay	valid winter EoW	Repudiation Rate (winter)
Mole Valley	0.476	0.222	0.302	0.19	0.41	0.401



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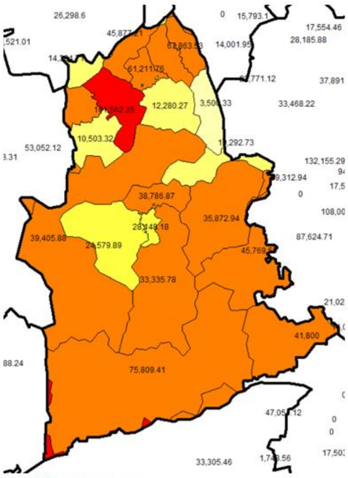
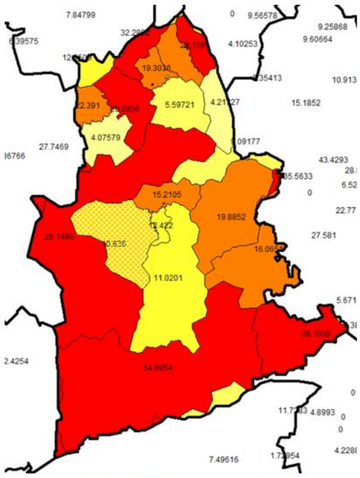
Aggregate Subsidence Claim Spend by Postcode Sector and Household in Surge & Normal Years

The maps below show the aggregated claim cost from the sample per postcode sector for both normal (top) and surge (bottom) years. The figures will vary by the insurer's exposure, claim sample and distribution of course.

NORMAL YEAR SPEND – MOLE VALLEY



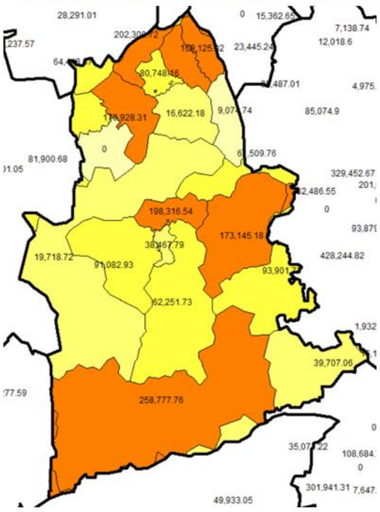
Spend by Sector



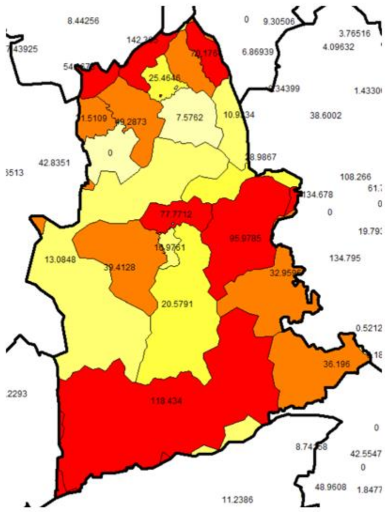
Spend Averaged Over Housing Population

It will also be a function of the distribution of vegetation and age and style of construction of the housing stock. The images to the left in both examples (above and below) represent gross sector spend and those to the right, sector spend averaged across housing population to derive a notional premium per house for the subsidence peril. The figures can be distorted by a small number of high value claims.

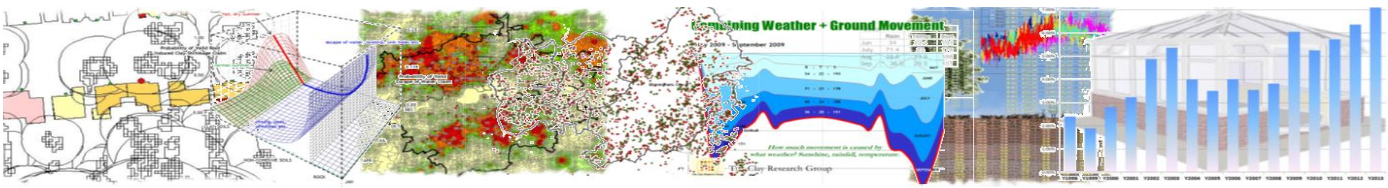
SPEND in SURGE – MOLE VALLEY



Spend by Sector



Spend Averaged over Housing Population



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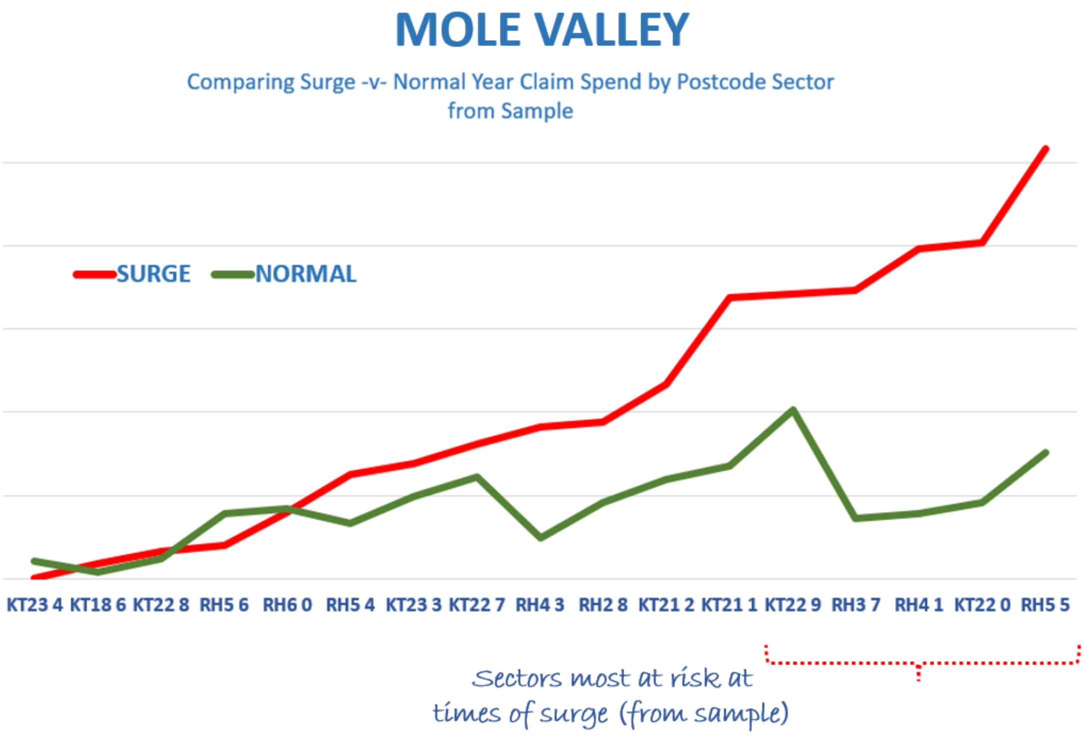

The above graph identifies the variable risk across the district at postcode sector level from the sample, distinguishing between normal and surge years. Divergence between the plots indicates those sectors most at risk at times of surge (red line).

It is of course the case that a single expensive claim (a sinkhole for example) can distort the outcome using the above approach. With sufficient data it would be possible to build a street level model.

In making an assessment of risk, housing distribution and count by postcode sector play a significant role. One sector may appear to be a higher risk than another based on frequency, whereas basing the assessment on count may deliver a different outcome. This can also skew the assessment of risk related to the geology, making what appears to be a high-risk series less or more of a threat than it actually is.

The models comparing the cost of surge and normal years are based on losses for surge of just over £400m, and for normal years, £200m.