Residential property evaluation and climate change modelling

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Abstract

Climate change poses a first-order threat to human civilisation and governments across the world, their agencies and big and small corporations have announced climate emergencies and made commitments towards net zero emissions across a range of target dates. Regulators have tasked financial institutions in the insurance and banking sectors to expose their existing portfolios and lending practices to scrutiny as to resilience levels, preparedness and knowledge base relating to property risk level impacts from existing and emerging climate-driven property perils. The scope of these investigations has mobilised a range of consultancies and emerging climate service providers (CSPs) to support regulatory oversight and provide modelling input relative to expertise in a range of environmental issues driven by climate change. The combination of global emission scenarios and general circulation models (GCMs) with existing expertise in modelling real-world problems such as flooding, coastal erosion, storm and subsidence has produced forward-facing forecasts across the natural physical and societal risks. The regulatory results at portfolio levels have necessitated financial institutions scenario planning down to property address levels to assess overall scale of impacts and the possible provisioning requirements against multiple probabilities over decadal horizons out to 2100. These high-level assessments will in the next few years feed directly into valuation and property investigation for origination loans and the cash buyer. CSPs will inevitably seek to monetise a return on their investment in modelling for financial institutions and their unique exposure to portfolio-level provisioning as consultants to these organisations reporting to the regulator. How this data at a property level is interpreted spatially and temporally will be a unique new challenge for chartered surveyors and other property professionals within lending institutions and within the conveyancing sector. This paper looks at the development of portfolio-level climate change reporting, the scientific basis for decisioning and the real risks of assuming that scenario precision produces accurate climate outcomes at the property level. A range of evolving rule sets are proposed for lenders, valuation specialists and conveyancers to ensure reporting is fit for intended purpose.

Keywords: data, property risk, climate change, data curation, data storage, data vendors, climate service providers, general circulation models, precision, accuracy, triage, lending

INTRODUCTION

Anthropogenic-driven climate change is now acknowledged almost universally as the most important global threat to human civilisation and the natural world. The impacts of climate change can destroy interdependencies between people and their physical environment and the natural capital of biodiversity that we depend upon.[1]

Across the world commitments are being made from transboundary organisations, through governments, agencies, corporations, businesses and citizens towards a goal of rapidly reducing carbon dioxide and other greenhouse emissions to a net zero target.[2]

In delivering a measurable roadmap towards targeted reductions in emissions, regulators have begun to interrogate sectors and to require disclosure of their exposure to risk and responses in mitigation in support of published targets.

In the UK the Prudential Regulatory Authority (PRA) has the statutory power to order disclosure of portfolio-level impacts across a range of future scenarios and to demand of large financial institutions action in improving their understanding of risk exposure at a property level over decadal horizons.[3]

In delivering the financial institutions reporting to the regulator, an emerging consultative sector of climate service providers (CSPs) has mobilised, based on varied skill sets and experience in supporting the basic physical assumptions driven by increasing greenhouse gases.

The basic assumptions of the interrelationships at a global scale of anthropogenic-driven temperature increases are modelled within a variety of general circulation models and at the most visible level within the rolling Coupled Modelled Intercomparison Project (CMIP), with data stored via the Earth System Grid Federation (ESGF). These climate-forcing calculations form the basis of mid- to late-century climate change scenarios now being utilised to forecast typically low, medium or future high emissions and the subsequent impacts on regional scale perils over the next century.[4]

The models, when integrated with regional environmental modelling, can across multiple scenarios produce highly precise outcomes for any likelihood of increased flooding, storms, hurricanes, drought and concomitant soil dehydration. Taken at face value, any future low, medium or high emission scenario results can be remarkably precise at national level all the way down to an address at any point in the UK.

Projecting this precision for property perils can indicate temperature change, increased or decreased rainfall, flooding, storms, subsidence or coastal erosion impacts over and under any title boundary in the UK. But what are the challenges, realities and risks of doing this and how should the data be used?

PRECISION VERSUS ACCURACY

The terms 'precision' and 'accuracy' seek to convey a concept of validity, reliability and trust. It has been argued that 'Precision and accuracy are two terms that are neither'.[5] A model or scenario might be extremely precise yet entirely wrong, while a highly accurate set of forecasts may repeatedly fail to inform sensible decision making.

To be useful, a model's outputs must not only have high precision — for instance, in allowing all financial institutions to submit their homework off a common precise outcome for the regulator — but must also be accurate at a particular level if they are

to drive good local decision making considering how they can support a well-informed drive towards net zero.

As Streiner and Norman caution,

> 'Scales can demonstrate high test–retest or interrater reliability (i.e., they are "precise") but still be unreliable in certain circumstances; and "imprecise' 'scales can still show good reliability. Further, "accuracy" as a synonym for validity reflects an outdated conceptualization of validity, which has been superseded by one that emphasizes that validity tells us what conclusions can be drawn.'[6]

On this basis, precision is simply a function of being able to replicate a chosen or targeted outcome, while accuracy may help inform us how close something is to being true (see Figure 1).

THE STATE OF THE ART

Financial institutions have only recently begun to take a consistent interest in real-world property data, its triage and deployment.[7] Equally, the assessment and integration of climate change impacts on large-scale portfolios is in its infancy.[8]

In understanding how these risks are modelled and the relative alleged precision and suggested accuracy, we need to understand the various UK perils of interest to lenders and insurers and then how the specialist CSPs utilise data relevant to that peril and the model outputs they supply at a regional, local, partial and full address level.

UK ENVIRONMENTAL RESIDENTIAL PROPERTY PERILS

For the UK the key environmental perils being reported are:

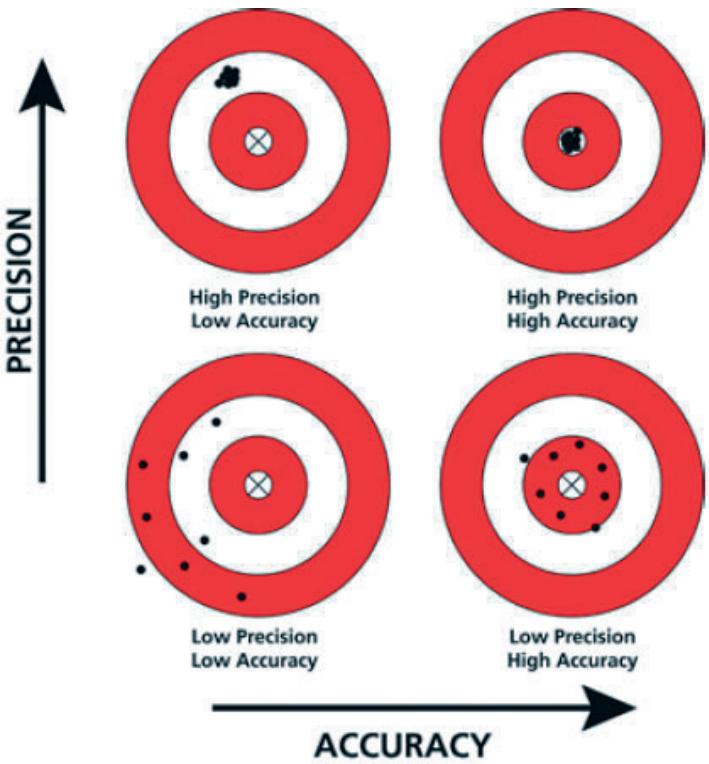

Figure 1: Precision versus accuracy
Source: Edvotek

- Flooding (riverine, surface and coastal);
- Coastal erosion;
- Ground subsidence;
- Windstorm.

As these perils were chosen as being reportable and measurable in a UK context (for instance, hurricanes are not a class of modelled peril of interest in northwest Europe), one would expect that they have a historical basis for property insured losses that can be reflected at portfolio and property level.

All the above risks are insurable under general or specialist insurance policies in the UK and the presence of any ongoing claim for flooding, coastal erosion or subsidence would usually preclude sale under mortgaged terms.

Once we have chosen any peril to subject to the low, medium or high future scenarios for temperature increase, the CSPs can offer modelling services against a portfolio of addresses such as to allow a lender or insurer to have the baseline data to prepare their internal regulatory reporting to the PRA.

It might be assumed that the peril data for a given environmental risk would show high levels of precision with which to match the scenario planning of the global circulation models. Unfortunately, before we even get to accurate reporting, we have to look at the matter of precision.

Here we have the issue of multiple models, varying granularity and assumptions to be able to deliver large-scale models.

In Figure 2 we assume that the forced emission climate modelling can deliver high precision (allowing for the fact that natural variability makes this precision of little value in the first decades of its application). We also note that this precision is an illusion if what we want to do is accurately forecast impacts on any given address.

We begin to consider accuracy at address level with the data, combination of data and the technical skill and resources applied to the assessment of impacts against a given model's performance.

When choosing any emissions scenario, we can match the purpose and need with

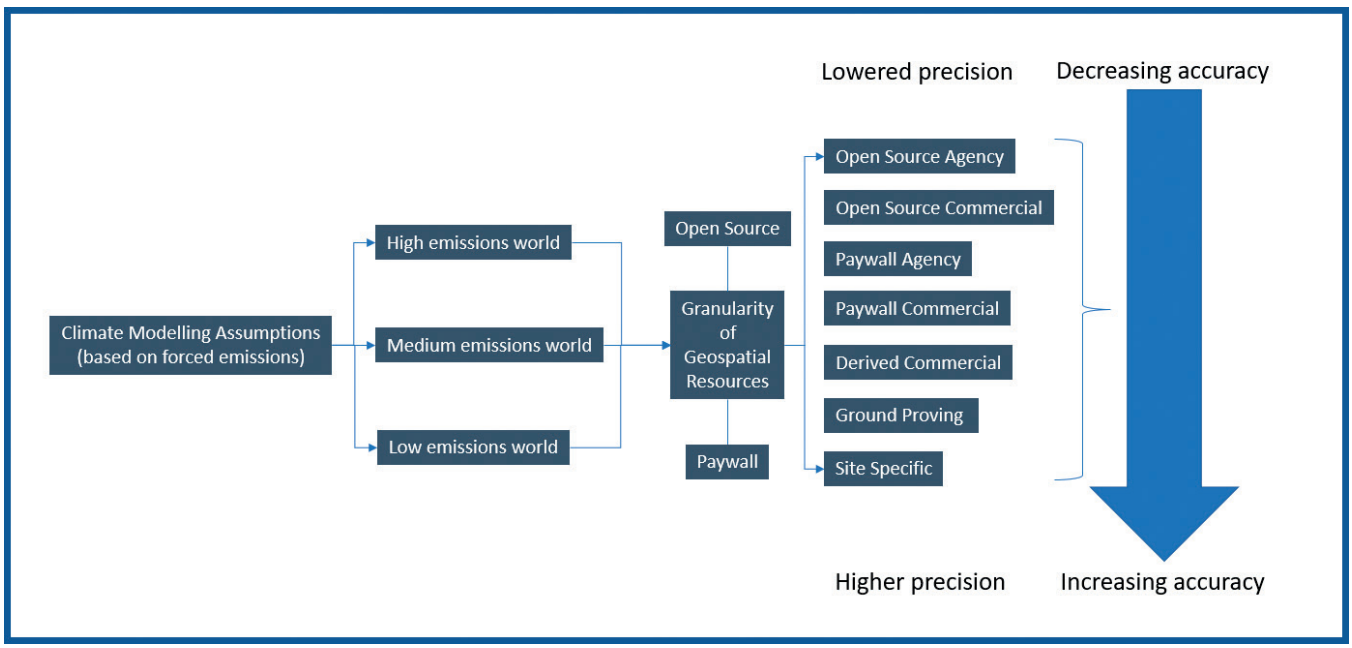

Figure 2: Sources of perils information

readily available open-source mapping and open-source perils data to then handpick paywall components in areas of doubt.

This approach may not be as 'precise' or 'accurate' as using paywall resources and ground proving, but it informs financial institutions and the regulator about key trends and builds experience and confidence in the methods employed. The issue of cost and scale across portfolios containing millions of addresses and accounts means some pragmatic decisioning must be made for forecasts that are essentially speculation at a regional level.

The lenders and their CSP advisers must therefore sensibly compromise in quality, cost and accuracy at letterbox level if ongoing assessments are not to become hugely expensive, time-consuming and subject to site uncertainty for millions of addresses. In this sense, at portfolio less is in this case more, if the intended purpose is to learn and inform as to trends.

MODELLING OUTCOMES AND USE CASES

We would suggest a framework for considering how data outputs from combination climate projections might be safely deployed.

Regulatory reporting

Reporting to the regulator on portfolio-level assumptions has a range of 'safe' applications within a secure and mature setting:

(1) The data is privately reported to the regulator and informs from a baseline an improving knowledge environment;
(2) The data is not used in origination cases for commercial purposes;
(3) The precision and accuracy component of the modelling is less important than the insights even if wrong;
(4) Property is not compromised or negatively selectively or listed as unsuitable for products.

Origination effort

Generating methods of supporting triage effort by lenders and insurers has a range of 'safe' applications within the evolving secure and mature setting of a lender's commercial-facing activities:

(1) More paywall resource can be called upon from geospatial and historic records as well as increasingly sophisticated paywall perils solutions;
(2) Concern can be escalated;
(3) Site-specific physical effort can be ordered;
(4) Overtime experience of the CSPs and the lender clients will refine approaches to be transparent and fit for purpose in treating customers fairly.

Conveyancing effort to sale completion

At the point at which a consumer is proceeding with the financial resources to complete a sale, the likelihood of exposing future-facing climate risks begins to take on a less 'safe' character with the current levels of sophistication:

(1) The overall complexities of multiple emission scenarios, allied to the multitude of complexities of what modelling resource was applied and what effort, sophistication and insight are utilised makes consumer products extremely difficult to deliver transparently;
(2) Climate change modelling can show precision but that might produce wildly inaccurate or misleading results to be considered by the public without the tools to comprehend the implications — the errors and unreliability will be legion.

THE DEVIL IS IN THE DETAIL

As an example of the complexities inherent in environmental perils and the application

of models at letterbox level, we illustrate a matrix of issues for a single property moving through the alleged precision of scenarios and the alleged accuracy of specific modelling.

No. 1 Acacia Avenue

A detached 1970s property in North London.

Neither open-source nor paywall geo-referenced soils data from the major providers can resolve without doubt that a given property is on a shrinkable clay soil (see Table 1). The improved granularity of the paywall resources can certainly flag the property, but only excavations on site will resolve the issue of foundation depths, soil material and drainage systems sufficiently for a definitive answer to these key attributes.

As already discussed, forced emission calculations have an inverse accuracy with proximity to the present. This is because natural variability of climate overwhelms forced emission projections in the near term, making them worthless.

Therefore, if we were to advise a homeowner that the risk of subsidence increases in a high emission scenario, this would be between three and five decades from the present and therefore beyond any normal mortgage period or typical ownership cycles and with no knowledge of any tree-planting priorities (urban shading) or the condition of the property or its services decades hence.

We could certainly improve our accuracy at address level by knowing about high concentrations (a relative term) of claims locally and we could then certainly triage to target any history of claim on site, any part of the structure with poor or sub-standard foundations, or presence of large trees.

These 'clues' may or may not have high precision at the address level, but they have a more likely high accuracy measure in ensuring we target sites of real interest.

The reality is that with all the data available it remains theoretically difficult to accurately forecast the possibility of future subsidence given the inherent variability in tree species and intra-species genetic variability which has been poorly researched.[9]

All the above complexities plague flood assessments, coastal erosion questions and storm; the implied accuracy of the predictions based on the false promise of the

Table 1: Subsidence factors matrix

Are the soils locally capable of suffering downward subsidence events?	**Yes**
Is this property constructed on shrinkable material?	Unknown
Do low, medium or high emission scenarios lead to enhanced risk of subsidence?	Yes
Would open source soils data inform this risk?	Possibly
Would paywall soils data inform this risk?	Possibly
Would derived and aggregated data (ie claims locally) inform this risk?	Yes
Would property data attributes inform this risk?	Yes
Would a physical risk survey inform this risk?	Yes
Would factors causing or contributing to this risk (presence of trees/leaking drains) inform this risk?	Yes
If a high emissions scenario is chosen has the risk automatically increased?	Not necessarily
Would any tests available (including physical and invasive) confirm or remove the risk of this peril occurring over decadal horizons?	No

NB: All scenarios see subsidence risk increase because some near-term impacts on the UK now appear inevitable regardless of late-century emission effort.

precision of climate change modelling makes forward-facing property level assessment fraught with challenges.

The current 'state of the art' is at risk of over-reaching itself in a classic Dunning-Kruger effort on top of Mount Stupid to the detriment of vendors, buyers, lenders and the surveying and conveyancing professions (see Figure 3).[10]

LENDERS MUST LEAD

In the current and emerging paradigms, CSPs are leading the charge in modelling effort towards regulatory oversight of property and future climate change impacts over decadal horizons.

Consultative support is then dependent on the lending institutions' resources, skill sets, appetite to further refine, test and amend modelled inputs as provisioning and planning outputs. They complete the homework set by the regulator.

The authors feel that this is a situation fraught with difficulties in determining the most effective strategies for lenders in support of net zero targets. We need lenders engaged with regulatory requirements at the technical level, because these models represent a potential 'drag' on delivery of effective lending.

If data from CSPs is black box provisioning, without uncertainty visible against every measure, with little or no corporate or consumer understanding, then we are left with lenders serving consumers products 'blind' to property-level forecasts at mortgage-length delivery decades.

Worse, we have an origination system in lending with products unreflective of the modelling scenarios of the CSPs; when these same CSPs service downstream valuation and conveyancing solutions, we have completely mixed messages on impacts and solutions at portfolio level, over time and for individual address level.

This is all complicated because the scale and granularity of modelling when mixed with open-source, paywall and derived products can mean a single letterbox having multiple answers to the same question depending on who pays and when they pay. The property may be green at portfolio, amber at regulatory level and red in

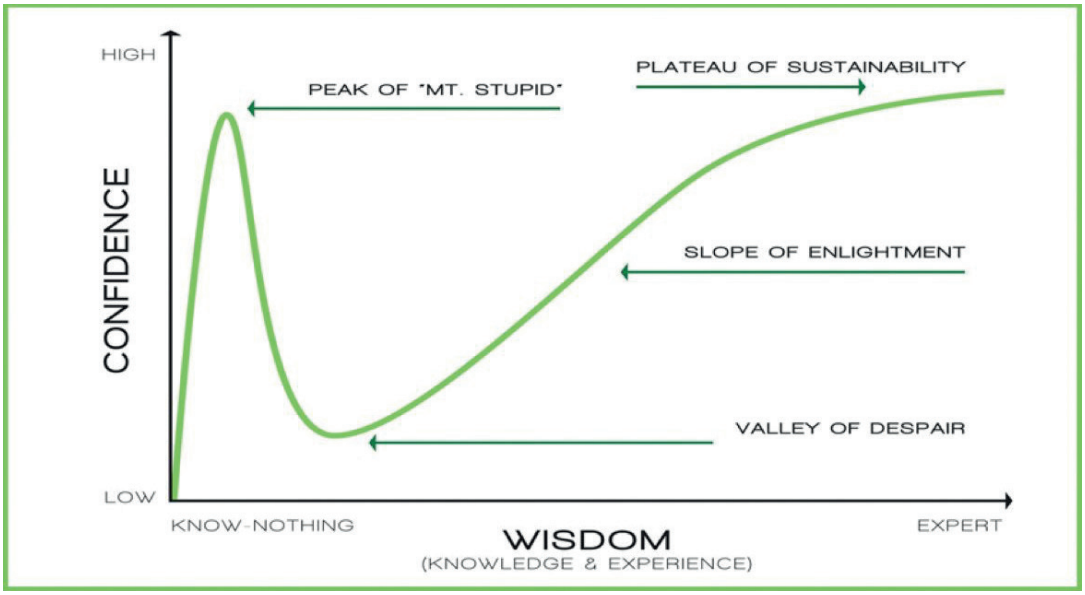

Figure 3: Dunning-Kruger

conveyancing or consumer reporting, all because of a mixed and misuse of the data.

Lenders need to demonstrate leadership in data, curation, modelled outputs and application or we have consumers poorly served, products badly designed, and climate change and net zero targets compromised.

We believe that data utilised in portfolio management, in regulatory reporting, in valuation property risk, in conveyancing and in consumer reporting should be from an authoritative source, with complete transparency, standards imposed and with full propagation of uncertainty disclosed in the creation of information regardless of open-source, paywall and derived solutions applied. Lenders must lead and the suppliers and CSPs must follow, inputting their expertise transparently and only in a manner consistent with the targets set to lower all of our emissions.

The existing approach will see potential profiteering by certain CSPs designing products ignorant of lender objectives, without real uncertainty transparent, and this will undermine confidence.

CONCLUSIONS

There is no doubt that property professionals will need to grapple with impacts from climate change and utilise data resources and modelling with which they will be inexperienced in the face of conflicting priorities. Rather than support prospective fearmongering and gloomy outlooks at address level, however, we should perhaps focus on the obvious imperative of net zero: a low emissions world.

There is a real risk that the data is seen purely as a tool to satisfy globally sponsored regulatory requirements as opposed to being utilised for sustainability considerations that genuinely drive business strategy. Risk teams may therefore adopt the path of least resistance by confirming that they have satisfied the regulatory hurdles and then filing the papers as 'project completed'.

Property assessment can, within the safe envelope of mature lender decisioning, lead the way in triage and accurate property reporting of the facts. Establishing a standard across all perils is an urgent priority, however, or we run the risk of propagating misguided precision that is essentially wholly inaccurate and inappropriate for its intended audience.

Once they have a clear line of sight on a lender's or client's appetite, property professionals can focus on the use of their core skill set: how do we improve this property to lower its contribution to climate change and achieve net zero?

A balanced scorecard for energy, electrification, electric vehicles, insulation, solar panels, air and other heat sources and using the currently illiquid power of equity in UK housing can help us lead the world in a net zero target and one property professionals can become expert in delivering.

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