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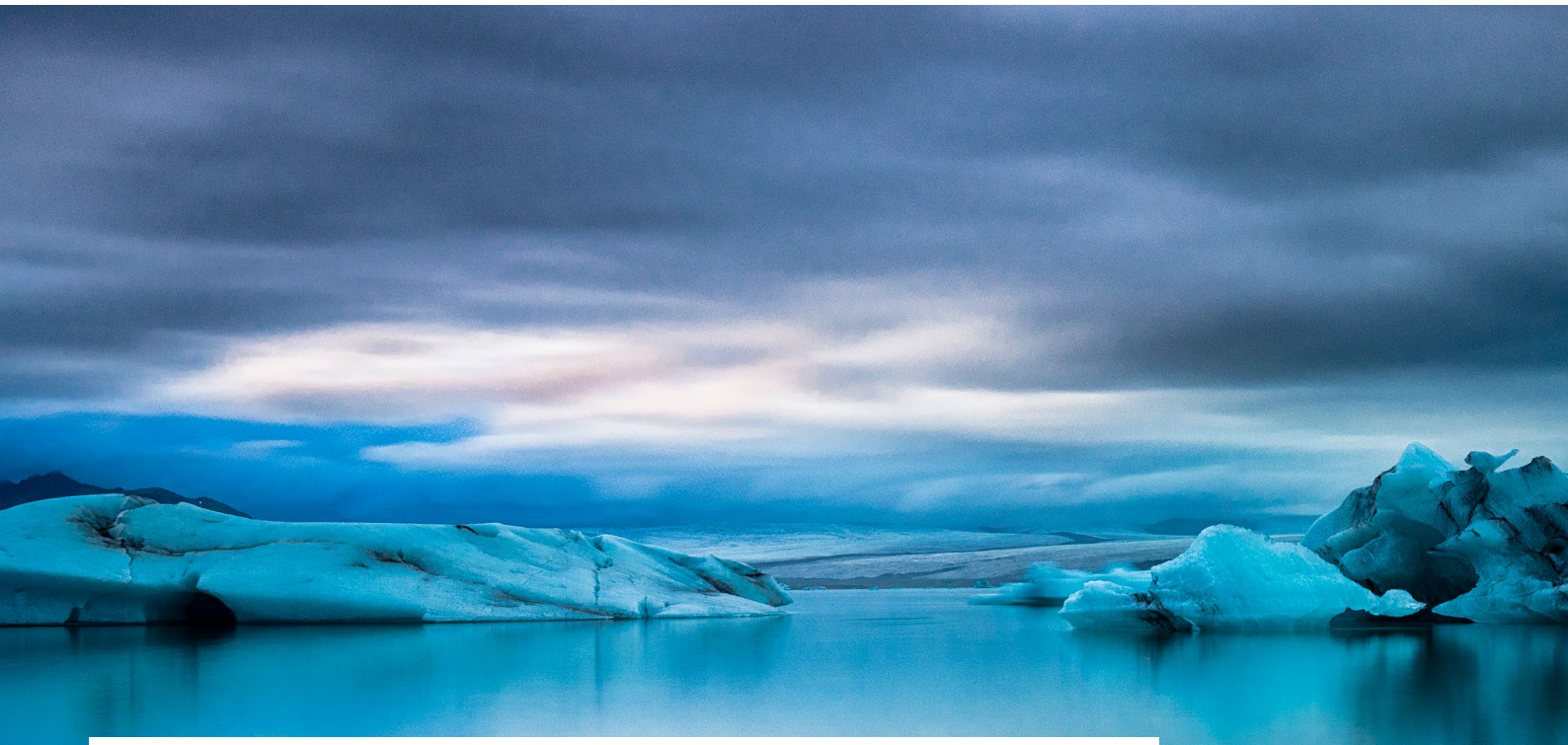

ESG VIEWPOINT

The challenges of assessing physical climate risk

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At a glance

- As the real-world impacts of the climate crisis become more apparent, attention is being directed to the physical risks posed to investors and the need to appraise the resilience of issuers to these risks.
- The data available to investors is, however, often opaque, and uncertain, putting the onus on users to understand the limitations of applying this type of data to managing issuer-level risks.
- In this ESG Viewpoint we assess four limitations of physical risk data and suggest ways in which qualitative and quantitative analysis can be combined to develop a deeper understanding of this critical issue.

Engagement and voting efforts as well as expectations outlined in this Viewpoint reflect the assets of a group of legal entities whose parent company is Columbia Threadneedle Investments UK International Limited and that formerly traded as BMO Global Asset Management EMEA. These entities are now part of Columbia Threadneedle Investments which is the asset management business of Ameriprise Financial, Inc.

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Introduction

Much of the investor focus on climate risk to date has been on managing 'transition risk', defined as the financial risk associated with changes in areas such as regulation, sentiment, or technology on the route to decarbonisation.

However, emphasis on the physical risks that arise from changes in weather and climate is ramping up, particularly after another summer of extremes.

This year alone, China saw its most severe heatwave on record, leading to a power crunch and factories being shut. In the UK and Europe droughts were affecting ~60% of the landmass by August, placing agriculture at risk. Major rivers that serve as crucial transport and trade routes, like the Rhine, Po and Thames, experienced abnormally low water leading to severe restrictions of cargo ships. Wildfires caused thousands of evacuations, as an area across Europe equivalent to about one-fifth of Belgium was engulfed, with experts warning that this will be a record year of wildfire destruction. The forest fires also released millions of tonnes of CO_2 into the atmosphere, reflecting the often exacerbating and circular nature of climate change and its impacts.[1]

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Why managing physical climate risk matters

Learn about the limitations of physical climate data

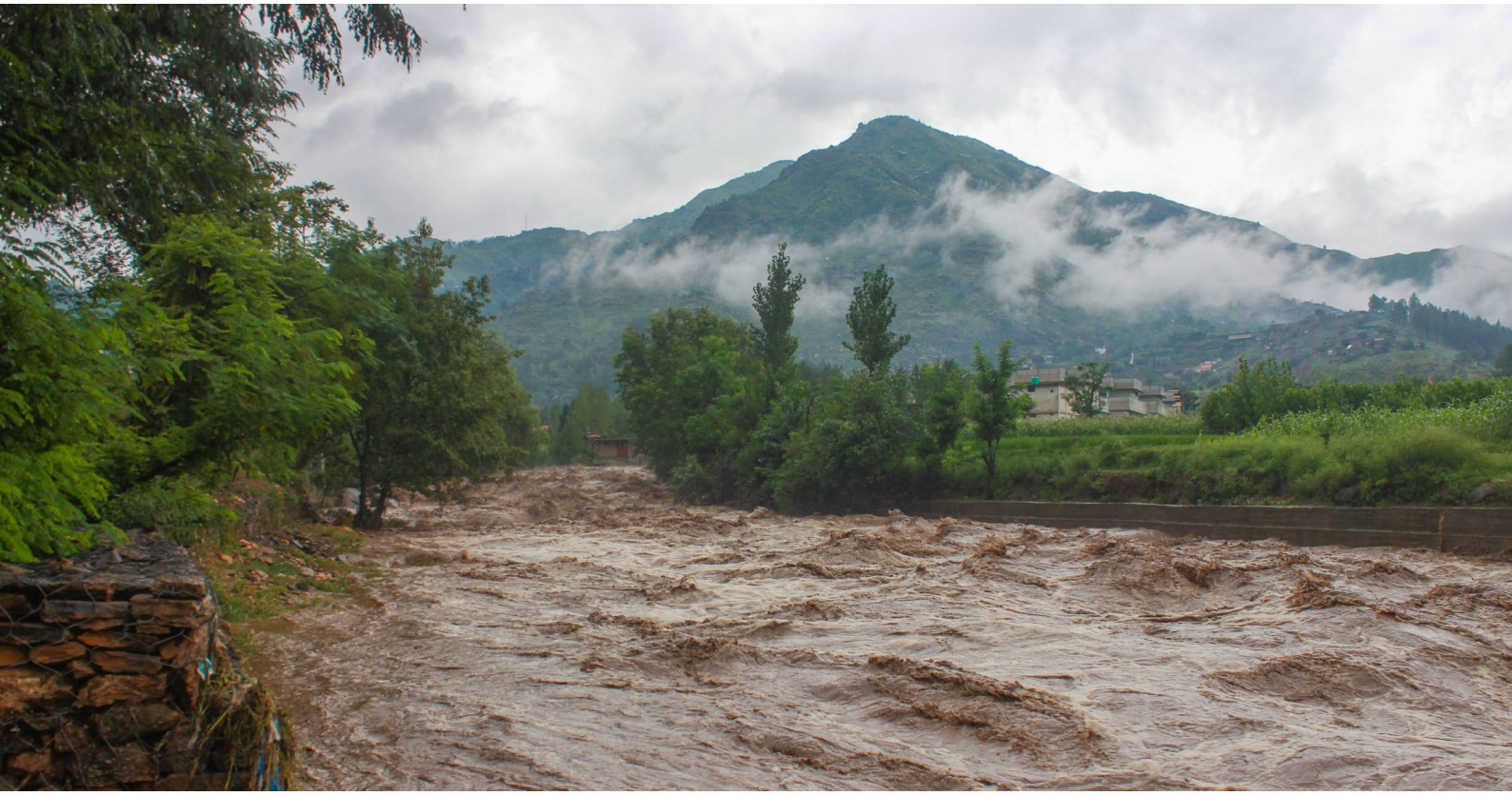
How can we respond to limitations in data?

Case study – monitoring wildfire risk in California

Thanks to Professor Andy Pitman, Director of the ARC Centre of Excellence for Climate Extremes, at the UNSW Sydney, for reviewing this piece. Professor Pitman and colleagues research on the risks of climate projections in finance and business[2] have been essential resources in outlining the limits and suggestions summarised here.

[1] Severe heatwave in six decades

[2] Pitman AJ; Fiedler T; Ranger N; Jakob C; Ridder N; Perkins-Kirkpatrick S; Wood N; Abramowitz G, 2022, 'Acute climate risks in the financial system: examining the utility of climate model projections', Environmental Research: Climate, vol. 1, pp. 025002 – 025002, http://dx.doi.org/10.1088/2752-5295/ac856f And Fiedler T; Pitman AJ; Mackenzie K; Wood N; Jakob C; Perkins-Kirkpatrick SE, 2021, 'Business risk and the emergence of climate analytics', Nature Climate Change, vol. 11, pp. 87 – 94, http://dx.doi.org/10.1038/s41558-020-00984-6



The materiality of managing physical risk

Managing physical climate risk is material to investors and will only become more so as we continue to experience the accelerated (and likely irreversible) impacts of climate change.

Efforts to assess physical climate risk across the financial system are expanding. Investors are demanding better reporting – for example, key frameworks such as guidance from the Task Force on Climate-related Financial Disclosures (TCFD) recommend that physical climate risks should be assessed and disclosed, ideally as part of a company's annual reporting. Regulators are also calling for clarity, with the TCFD becoming mandatory in the UK, whilst in the US, the SEC has put forward a draft proposal to enhance climate-related disclosures.

The need for good climate data that can be integrated into financial decision-making is key, and as a result new datasets and approaches to physical risk are rapidly emerging. These approaches typically start with at least one scenario for how the earth's climate will evolve, disaggregates this by country and region and maps it to an issuer's assets. Investors can then aggregate issuer level data up to a portfolio level to assess risks across full holdings. However, many challenges related to using this data prevail. Common criticisms include the 'black-box' approach to modelling, leaving users unsure of how results were arrived at and what they mean; the false level of precision in the results; and a lack of clear communication on data uncertainties and limits.

In this ESG Viewpoint we assess four challenges of using physical risk data in appraising issuers' climate resilience, and suggest ways in which narratives and numbers can be combined to achieve better disclosure.

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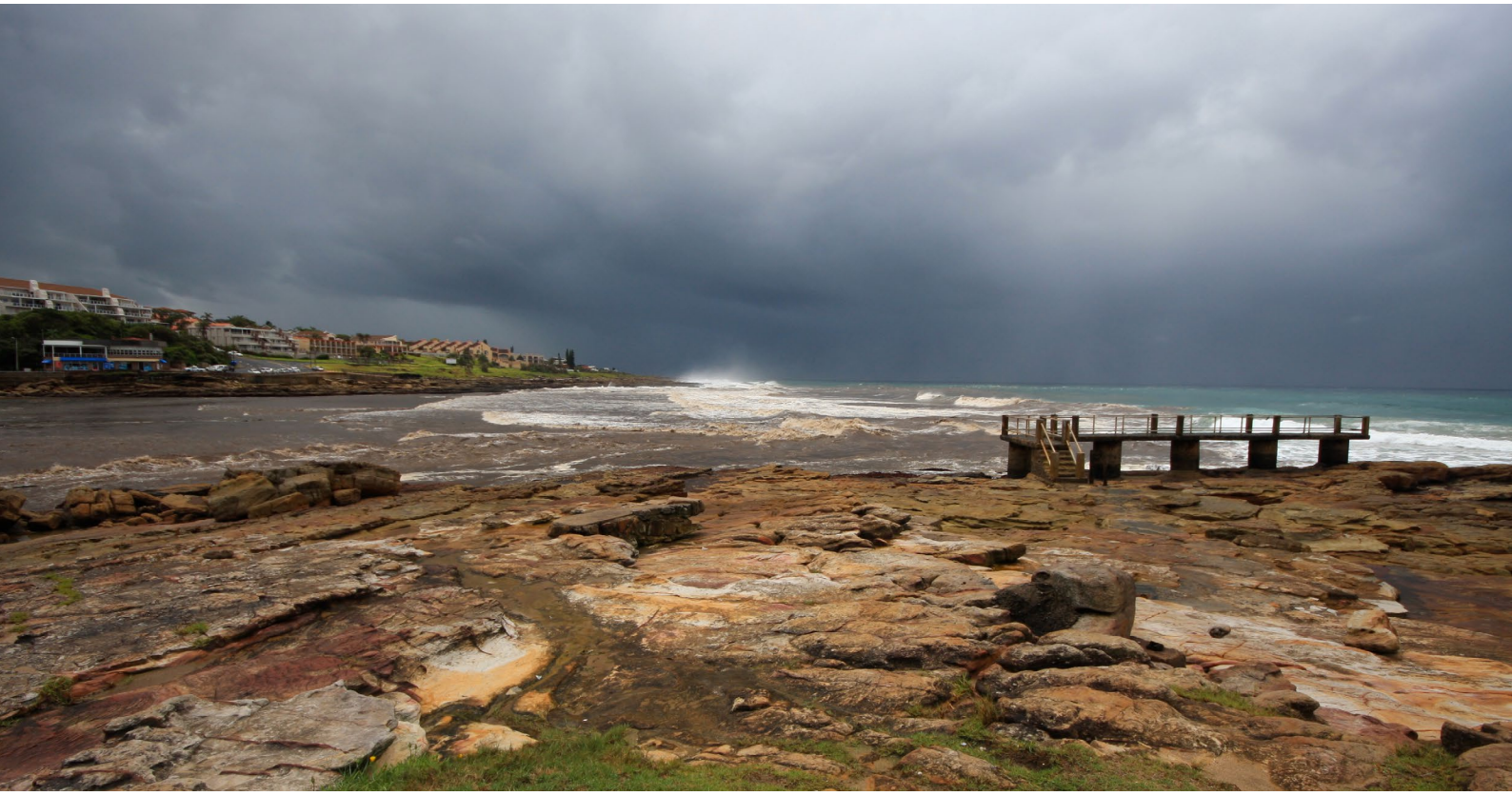

Four limitations of physical climate data in managing risk

1 The intertwined macroeconomic impacts and supply chain shocks

Typically, physical risk estimates at the company level are measured by assessing exposure of the location of that company's assets to a particular climate peril. Results do not account for the reverberating macroeconomic shocks of a physical risk event, both on the supply and demand side. As most commodities are traded on global markets, there is a high degree of interconnectedness which will result in cross-asset and cross-border climate risk. Even though results can be aggregated to portfolio level, this does not necessarily reflect the true nature of the threat.

To illustrate how a single extreme weather event can transmit risk across the world, the recent WG2 IPCC report explained how the 2011 Thailand floods resounded across Japan, the EU and North America. In Thailand, flooding caused USD 40 billion of economic damages and affected the production of cars, hard disk drives, air conditioners and refrigerators. Globally, the flooding resulted in significant delays in car manufacturing and a reduction in industrial production of 2.5%. Another example occurred April this year when flooding and landslides caused by heavy rainfall in South Africa displaced 40,000 people and damaged over 12,000 houses in the city of Durban. The port of Durban – through which 20% of total Africa-China trade passes – was also damaged. As a result, at least 826 companies were affected by these floods in KwaZulu-Natal, with the cost of the damage estimated at R 7 billion.[3]

Limitation 1: The fallout of a physical risk event has macroeconomic implications that are not accounted for in economic models. The interconnected nature of global supply chains means that looking at asset-level risks in isolation does not create a comprehensive picture of the real financial risks arising from physical climate impacts, and potentially misses some of the largest impacts of all.

[3] According to a survey by the South African Department of Trade, Industry and Competition, https://reliefweb.int/report/south-africa/damage-kzn-companies-estimated-r7-billion

2 Modelling the climate, not the weather

Most 'top-down' data of physical risk exposure rely on climate models. Climate models are built to represent the physical processes occurring on earth, based on a well-established understanding of the climate system, coupled with observations of the world around us. Like a 'computational twin' to our planet, these models project how the climate may evolve in response to changes in greenhouse gases and other drivers of climate, like changes in vegetation, over a defined period. There are many different types of models, varying in complexity and approach. Simulations often rely on hundreds of scientists working together to paint a full picture of planet Earth. Climate models have proven to be powerful allies at a global and regional scale, with most model projections predicting the actual changes in global surface temperature over the past five decades, according to one study taking a retrospective look at performance.[4]

However, to engage in any constructive conversation about climate risk in the financial sector it is crucial to recognise that climate models are not weather forecasts. Weather represents day-to-day variation, while climate refers to the average of day-to-day variation over several decades. Though climate models are good at estimating future climate changes at regional scales, particularly average changes, these models can not accurately represent where and when acute risks to a specific asset will occur. Hence, a reasonable question to ask a climate model would be something like: "how will the average characteristics of the weather look over a region", whilst an unreasonable question would be: "at what specific time will a specific climate peril influence X location at Y time".

This nuance matters. Material risks to businesses most often relate to the occurrence of weather-related phenomena like heatwaves, storms, or extreme rain; and although models are good at showing how weather-related threats will get worse globally (or regionally), this does not translate into accurate predictors of acute risks at an asset level. This introduced an uncertainty that must be acknowledged before any asset-level assessment: climate models are good at representing climate risks, however, the impacts that are the most material relate to weather-risk influenced by climate change, which are much less accurately modelled.[5]

Limitation 2: Asset-level risks should not be quantified solely on results from top-down climate models. Downscaling global climate models to asset level must be done with care, expert knowledge, and a full translation of uncertainty.

[4] https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019GL085378 and https://www.climate-x.com/articles/science/climate-101-for-people-in-finance-why-climate-models-aren-t-what-you-think
[5] https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019GL085378 and https://www.climate-x.com/articles/science/climate-101-for-people-in-finance-why-climate-models-aren-t-what-you-think

3 Compound events and tipping points

Asset-level physical risk assessments are unable to capture "compound climate events", which are concurrent climate 'perils' (like flooding, heatwaves, or sea level rise) occurring at the same place either at the same time or in close proximity. Often asset-level risk data looks at the impact of one peril to one asset at a time.

This, however, does not reflect the real world, where chronic and acute impacts are inevitably intertwined. For example, increasing sea temperature (chronic) is more likely to increase the intensity of tropical storms (acute), while heatwaves and droughts are often compounded.[6] As just one example of compounding risk, a toxic mix of high temperatures, drought, and strong winds in Eastern Australia led to unprecedented wildfires that transported smoke as far as South America during the southern hemisphere summer 2019-2020.[7]

Another aspect of the climate system which is not well captured in models are so-called 'tipping points'[8], such as the rapid loss of the West Antarctica ice sheet (leading to accelerated sea level rise) or the dieback of biodiverse biomes such as the Amazon rainforest. These events are low probability but would be (extremely) high impact and are generally not accounted for in climate models. This is a concern, as recent research has suggested that a global warming of 1C – a threshold we have already passed – puts us at risk of triggering some of these irreversible impacts.

Limitation 3: Financial risk models that do not account for compounded or tail risks (like tipping points) could lead to significant underestimates of real-world impacts and a false sense of security about management of risk.

4 Precise but uncertain data: underestimating the importance of uncertainty

Uncertainty is the product of imperfect knowledge, and as shown, the way in which we currently model physical climate risks relies on several assumptions and inputs that require some degree of imperfect knowledge. This does not disqualify modelling as a critical tool in financial risk estimation but underlines the importance of accurately communicating how uncertainties are translated into the portfolio-level results.

Economic models often take the estimated damage from specific events and then aggregate this to a national or global level. For example, we can estimate the financial impacts of a business for a defined extreme event by using historical data. Say we wanted to understand how flooding has financially impacted cement plants in a particular location in the UK we could combine past data of flooding in that location and the financial costs to cement plants, creating a so-called 'damage function'. However, we need to acknowledge that this is inherently uncertain for the specific cement plant, and that when this data is scaled, for example to flooding for all plants in the whole of the UK it introduces further uncertainty, even more so if it is extrapolated to a global level. Often data providers rely on only a few 'damage functions' to model risks for a large amount of assets.

This process of scaling up is of course to be expected and is part of the core process of modelling. But without disclosing how damage functions are calculated and how the value of an asset is estimated, we can end up with apparently very precise data points that hide a high degree of uncertainty. For example, what happens in areas where there is very little hazard data or where the value of a factory is undisclosed? Is the financial value of a factory to an issuer assumed, or are values based on real company input? These are the types of questions we need to be asking of data providers. Without attached uncertainties, data provided could lull decision makers into a false sense of security that the value at risk is fully captured for all assets, even in cases where estimates rely on heavy imputation (and not real data).

Limitation 4: Uncertainty is inherent in any climate and risk modelling process. Better communication of where the main sources of uncertainty are, and where data points are imputed rather than based on real values is crucial.

[6] https://openknowledge.worldbank.org/bitstream/handle/10986/37041/Assessing-Financial-Risks-from-Physical-Climate-Shocks-A-Framework-for-Scenario-Generation.pdf?sequence=1
[7] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8038035/; https://www.nature.com/articles/s41467-020-19639-3 ; https://www.nature.com/articles/s41612-021-00224-4
[8] https://www.nature.com/articles/d41586-019-03595-0;
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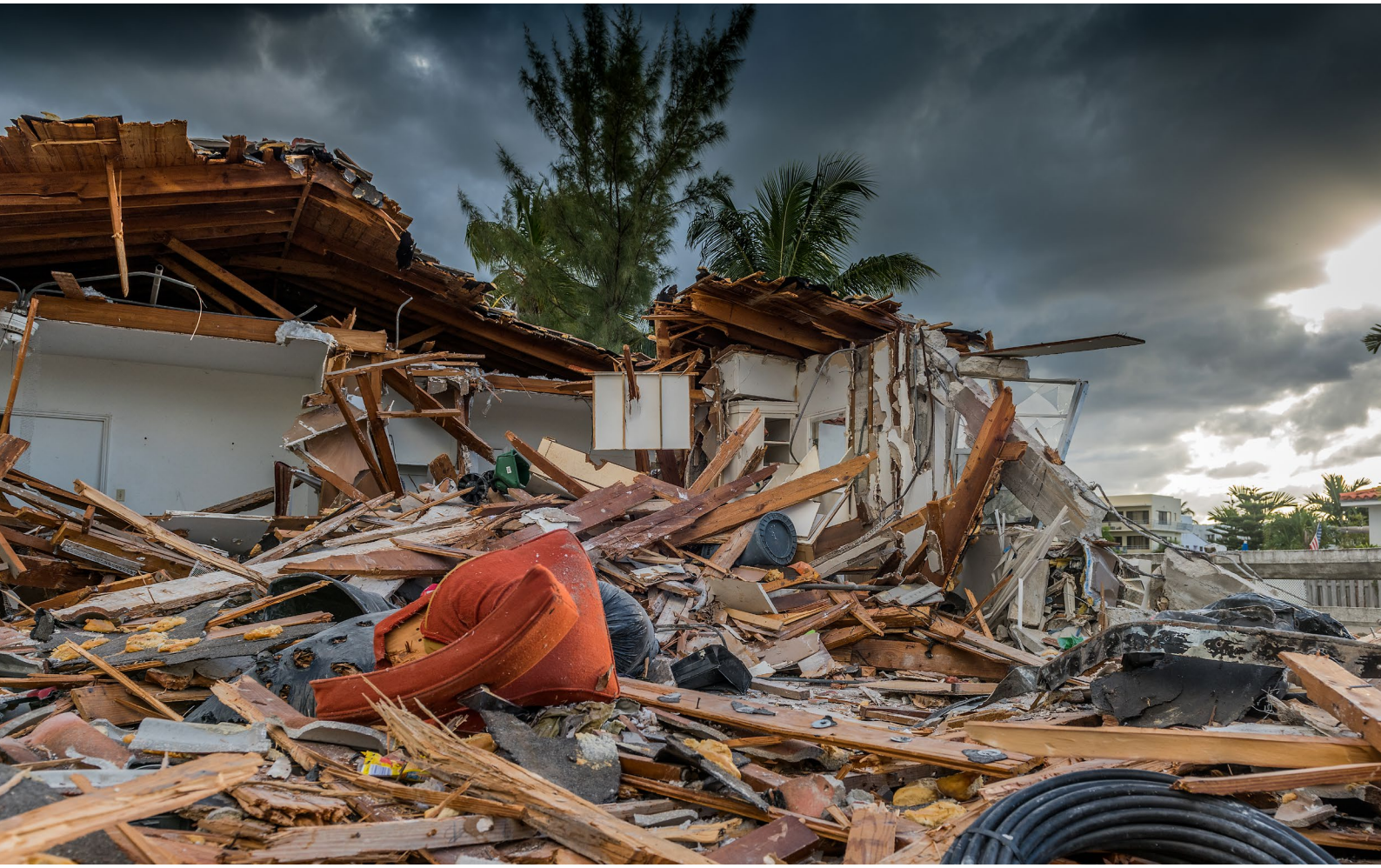


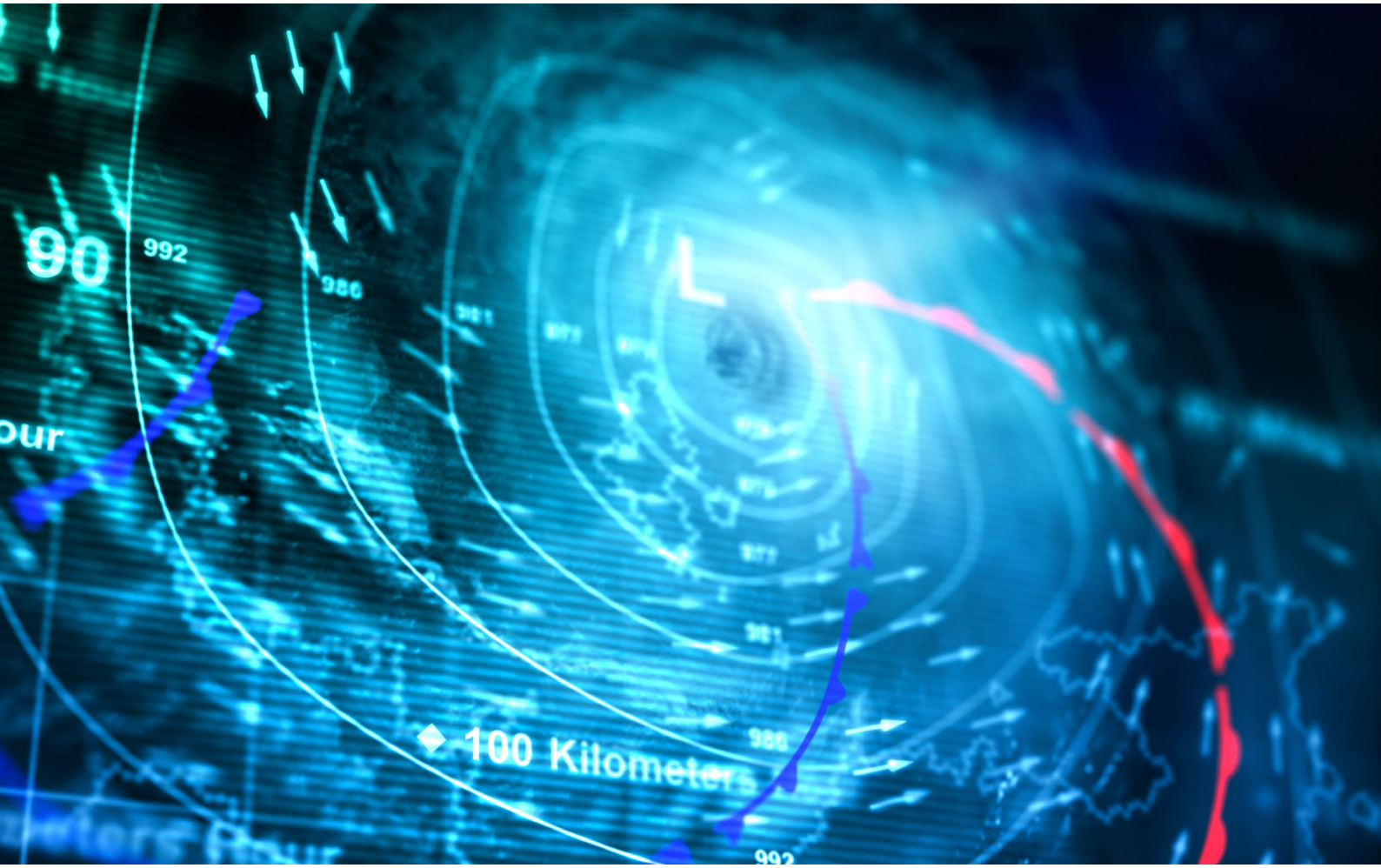
How will we use these insights to engage on physical climate risks?

How should investors respond to these limitations – do they mean that physical risk scenario analysis should be rejected?

Clearly the answer to that is no. Physical risk models are invaluable in understanding what our future will look like, and as models continue to improve, they will remain a crucial part of any sound climate resilience strategy. However, 'top-down' asset level data should be approached with a healthy sense of curiosity and scepticism, and we should learn to ask the right question of the right data.

The main threat is that the perceived precision of just looking at numerical climate data could lead to the assumption that investors are in possession of information that can insure against all future risk. In fact, without a better understanding of what climate data can (and cannot provide), unintended consequences, such as a false sense of security, could undermine financial security, according to a 2020 Nature study (Fielder et al., 2020). Here we suggest four ways in which investors can constructively engage with climate data and uncertainty.

Physical risk models will continue to improve and remain a crucial part of any sound climate resilience strategy.



1 Encourage the use of narratives and alternative data

Rather than just reporting numerical results, quantitative scenarios can be combined with good qualitative analyses. To be clear, this means investors and companies should be adding more detail not less to reporting, by combining numerical results with qualitative assessments.

Telling narratives about change and using these 'stories' to facilitate companywide (and board-level) discussion on ways to mitigate and create resilience to risks is a powerful (and often underestimated) tool for conceptualising change. For example, qualitative narratives allow different types of uncertainty to be presented, discussed, and dealt with – while also allowing a measured discussion of where the value of 'top-down' climate data stops, and where strong capabilities in articulating climate vulnerabilities by business executives needs to come in.[9]

Scenario planning begins with intelligence gathering to understand and define a strategic problem, bringing together quantitative and qualitative data teams can then create 'sketches' of potential futures. Research into this type of 'corporate foresight strategy' has shown that it can foster learning, creativity, innovation, and even improved performance.[10] Good scenarios analyses should lead top managers to acknowledge their susceptibility to bias and create an open environment that encourages dissent, according to Drew Erdman, principal at McKinsey & Co.[11] The IPCC also underlined this year the value of integrating alternative data such as from indigenous and local people into climate scenarios, something that is not frequently seen at issuer level.

Suggestion 1: Use a combination of qualitative and quantitative data to create storyline of the future, allowing for internal discussions that can foster innovation and strategic solutions.

[9] https://www.sciencedirect.com/science/article/pii/S2212096320300292?via%3Dihub https://research.monash.edu/en/publications/business-risk-and-the-emergence-of-climate-analytics
[10] https://www.sciencedirect.com/science/article/abs/pii/S0040162515003224
[11] https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/overcoming-obstacles-to-effective-scenario-planning

2 Busting the "black box"

Current available metrics of company-level climate risks diverge substantially from data provider to data provider, according to a 2022 paper from the University of Zurich.[12] The researchers assessed four different data providers rankings on physical risks, concluding that financial institutions should be aware that the "choice of one measure over another is very consequential for the outcome" [of a risk analysis]. The key issue they highlight is that the current competitive market discourages the sharing of underlying data between providers. This is the 'black box'.

Clearly, data users have a role in advocating for better disclosure of uncertainty. Due diligence for financial risk assessments should include assessing risk scores from different providers and datasets, as well as asking questions of how the data is modelled, and where the main assumptions are. Issuers can also support efforts to ask for more consistent, open-source data from issuers and policymakers. For example, the IIGCC released its first framework for climate resilient investing this year, calling for investors to contribute to the development of a more robust resilience framework, based on physical risk data. The Global Resilience Index Initiative (GRII) is another initiative which aims to provide reference data on climate risks – all open source – to protect populations and economies by providing data that can help implement more resilient decisions.

Suggestion 2: Always ask what data is being used and how calculations are done. Do not rely on results you can't explain. Use several different data sources, communicate results in ranges rather than absolutes and require a full disclosure of uncertainties.

3 Engaging for bottom-up due diligence

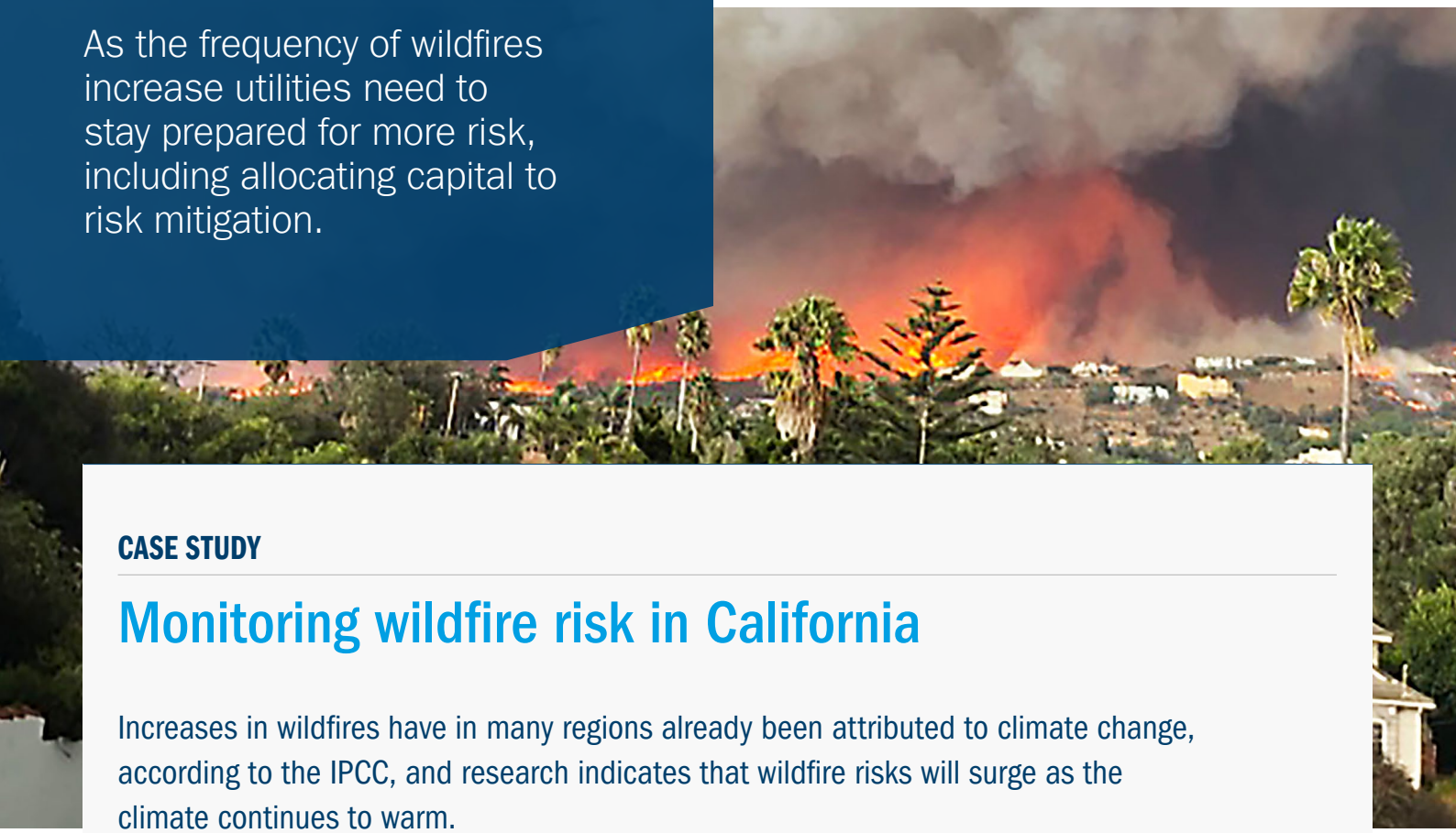
Companies who manage and own their asset are in possession of the best available information of physical risk. Many companies are already monitoring weather, climate, and values at risk for each of their assets over time. However, few companies are doing this type of due diligence (yet) at the scale needed. Part of our active ownership approach is to engage with companies in disclosing much clearer physical risk data, as well as better management of any risks that are located through this due diligence. 'Top-down' data combined with issuer level disclosure provides a much fuller risk picture, allowing for constructive conversations with companies about how to implement local mitigation, build resilience, and implement management strategies that consider these risks.

One promising approach is to use the 'top-down' data to locate companies and sectors that are seemingly at high risks from physical impacts. These 'heat maps' can be used to target constructive engagements with issuers about how they perceive and manage physical risks, encouraging better disclosure in line with expectations of the investors and the TCFD. A similar approach can be taken at issuer level, where 'top-down' climate data can be used to identify assets at risk, then prioritise these assets for forensic 'bottom-up' assessments.

Suggestion 3: Combine 'top-down' and 'bottom-up' data. Risk models should be combined with detailed examinations of aspects such as supply chain vulnerability, and past financial impacts of weather events.

[12] https://www.sciencedirect.com/science/article/pii/S1544612321004013# and https://journals.aom.org/doi/abs/10.5465/amp.2018.0178

As the frequency of wildfires increase utilities need to stay prepared for more risk, including allocating capital to risk mitigation.



CASE STUDY

Monitoring wildfire risk in California

Increases in wildfires have in many regions already been attributed to climate change, according to the IPCC, and research indicates that wildfire risks will surge as the climate continues to warm.

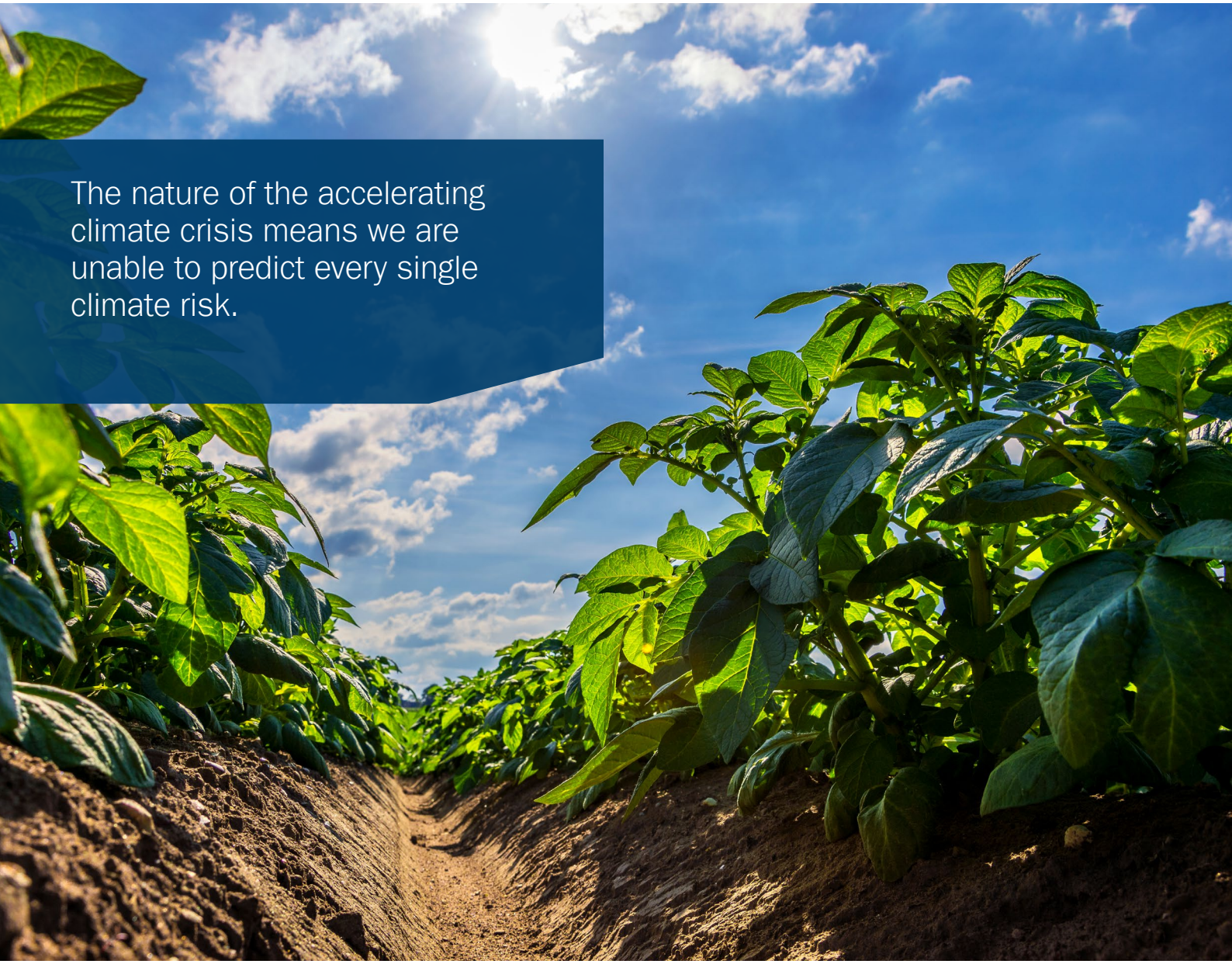
For example, a 2021 study by a group of University of California Irvine scientists suggest that increasing temperature extremes will lead to a ~50% rise in the number of fires in the Sierra Nevada by 2040, compared to a 2011-2020 baseline.[13]

Wildfires are increasingly material to Californian utilities who want to cut the frequency of Public Safety Power Shutoffs (PSPS) in fire-prone areas, but also because utilities have been implicated in sparking devastating wildfires in the past. PG&E's outdated equipment was blamed for triggering a series of fatal wildfires between 2017 and 2018, with the charges leading to the company filing for chapter 11 bankruptcy protection in 2019. In September this year a USD 117 million settlement was reached between former PG&E executives and directors, who were accused of lax oversight of the utility's safety measures.[14]

We have engaged with utilities in California on how they are managing these risks. Southern California Edison, for instance, told us how they are dealing with the increasing risk of wildfires by building models which combine data– including ignitions, faults, and wire down events – with satellite and camera data to live-monitor the risks of wildfires. These models help locate areas most prone to wildfires and concentrate mitigation efforts there and has also moved the company from entity level risk assessment to detailed asset level ones. The assessment method is made publicly available, and most crucially, a mitigation plan is published and updated as risks are continuously assessed.[15]

The continual assessment and risk modelling is crucial, but so is the need for forward planning. As the frequency of wildfires increase utilities need to stay prepared for more risk, including allocating capital to risk mitigation. This is crucial to avoiding litigation and the devastating, potentially life-threatening, impacts caused by lapses in oversight in an increasingly warming climate.

[13] https://www.science.org/doi/10.1126/sciadv.abe6417
[14] https://www.reuters.com/markets/commodities/pge-officials-reach-117-million-settlement-over-california-wildfires-2022-09-29/
[15] https://www.latimes.com/world-nation/story/2021-02-08/california-utilities-to-spend-billions-to-cut-wildfire-risk and https://www.sce.com/wildfire/wildfire-mitigation-efforts and https://www.sce.com/wildfire/situational-awareness and https://www.sce.com/sites/default/files/AEM/SCE%202020-2022%20Wildfire%20Mitigation%20Plan.pdf



4 Fair communications and uncertainty

Finally, all these points come down to honest and clear communication. The need for better communications is two-fold. First, people trained in how climate science can be operationalised at a business level should be consulted on how climate data should (and should not) be used. This involves helping financial decision makers understand how climate impacts will be experienced locally, as well as the uncertainties associated with taking global predictions to the asset level. In fact, Fielder et al., 2020 suggest a name for this new type of professional: "climate translators".

Second, and crucially, it also involves honest communication with clients and the market. Financial decision makers should be communicating how the combination of narratives, engagement, and reporting are feeding into physical risk assessments, as well as mitigation and resilience measures based on these findings. It also involves admitting that despite everything, the nature of the accelerating climate crisis is that we are left unable to predict every single climate risk – and that the best way to ward against the worst impacts is to decarbonise now, not later.

Suggestion 4: Bring climate experts into risk conversations. Communicate clearly to stakeholders where the greatest source of assumptions and uncertainty are in an assessment.

Get to know the author

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Albertine joined the Responsible Investment team in the summer of 2022, concentrating on climate change. Albertine's background is in climate science and before joining she worked as a researcher and adviser at a range of academic, third- and public-sector organisations. When not working she enjoys spending her time reading, running, and climbing.

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