# HOW TO CHOOSE, USE, AND BETTER UNDERSTAND CLIMATE-RISK ANALYTICS

Urban Land Institute

LaSalle®

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The Urban Land Institute is a global, member-driven organisation comprising more than 45,000 real estate and urban development professionals dedicated to advancing the Institute's mission of shaping the future of the built environment for transformative impact in communities worldwide.

ULI's interdisciplinary membership represents all aspects of the industry, including developers, property owners, investors, architects, urban planners, public officials, real estate brokers, appraisers, attorneys, engineers, financiers, and academics. Established in 1936, the Institute has a presence in the Americas, Europe, and Asia Pacific regions, with members in 80 countries. Drawing on the work of its members, the Institute recognizes and shares best practices in urban design and development for the benefit of communities around the globe.

More information is available at uli.org. Follow ULI on Twitter, Facebook, LinkedIn, and Instagram.

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ULI's Urban Resilience program is focused on how buildings, cities and communities can be more resilient to the impacts of climate change and other environmental vulnerabilities. The program works with ULI members to provide technical assistance, advance knowledge through research, and catalyse the adoption of transformative practices for real estate and land use policy. For more information, visit americas.uli.org/resilience.

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# Preface

Given the scope and magnitude of climate change's long-term impact on real estate value, the business of assessing and mitigating the effects of climate risk in real estate has the potential to be a trillion-dollar opportunity.

Over the past few years, a wide array of software companies, consultants, and risk analytics firms have developed assessment tools and models to better assess and price long-term climate risk. While many of these climate-risk analytics firms are using similar data sets and looking at similar climate risks in the same markets, their assessments of long-term climate risk vary considerably—even when evaluating the exact same assets. This presents the real estate industry with significant challenges and opportunities that require us to evolve our current approach. Establishing a shared understanding of climate risks and opportunities is a foundational step to ensuring investment performance now and into the future.

ULI has been at the forefront of helping the real estate industry understand and address climate risk. From practicable research to cross-disciplinary convenings to on-the-ground technical assistance, the Institute is committed to raising awareness of the risks and costs of climate change as well as the needs and opportunities for climate action. As climate risk continues to heighten, ULI's Urban Resilience program, and Randall Lewis Center for Sustainability in Real Estate, will continue to develop resources in collaboration with ULI members and partners that better prepare our buildings, our communities, and our industry for the impacts of climate change.

This report is the result of collaboration with LaSalle Investment Management. LaSalle recognizes that climate change has a material impact on the built environment that will only increase over time. LaSalle's global reach provides visibility into the reality of assessing physical climate risk across diverse asset types and geographies, illuminating new challenges that face the industry and the need to drive enhanced transparency and consistency of climate-risk analysis. By creating a shared conversation on how to tackle these challenges, we can proceed thoughtfully together.

To better assess, price, and mitigate long-term climate risk in real estate, the industry needs better models and better tools. This report provides insight to our industry on how to interpret climate-risk analytics, identify risks effectively, and incorporate them in our decision-making throughout the investment life cycle.

We believe collaboration is necessary to move forward and accelerate change to successfully adapt to, mitigate, and ultimately prevent further climate change risks. The next generation of real estate must be more sustainable and resilient to create value for everyone. Let's work together to achieve our goals.

**W. Edward Walter**
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# Executive Summary

The Intergovernmental Panel on Climate Change (IPCC) has confirmed that human activity has increased the global temperature approximately 1.0°C (1.8°F) above its pre-industrial level. Without meaningful intervention, the IPCC projects that the planet will likely reach 1.5°C (2.7°F) above pre-industrial levels between 2030 and 2050. It is clear that real estate investors and developers can no longer avoid risk related to climate change; in 2021 alone, the U.S. National Oceanic and Atmospheric Administration (NOAA) identified 18 separate billion-dollar disasters in the United States.[1]

Rising sea levels and the increasing frequency and severity of extreme weather events illustrate the consequences of a changing climate. The increasing probability of these physical hazards creates novel and dynamic threats to the real estate industry. How should institutional real estate managers evaluate current and future physical risk and integrate it into investment decisions? At present, the answer is opaque.

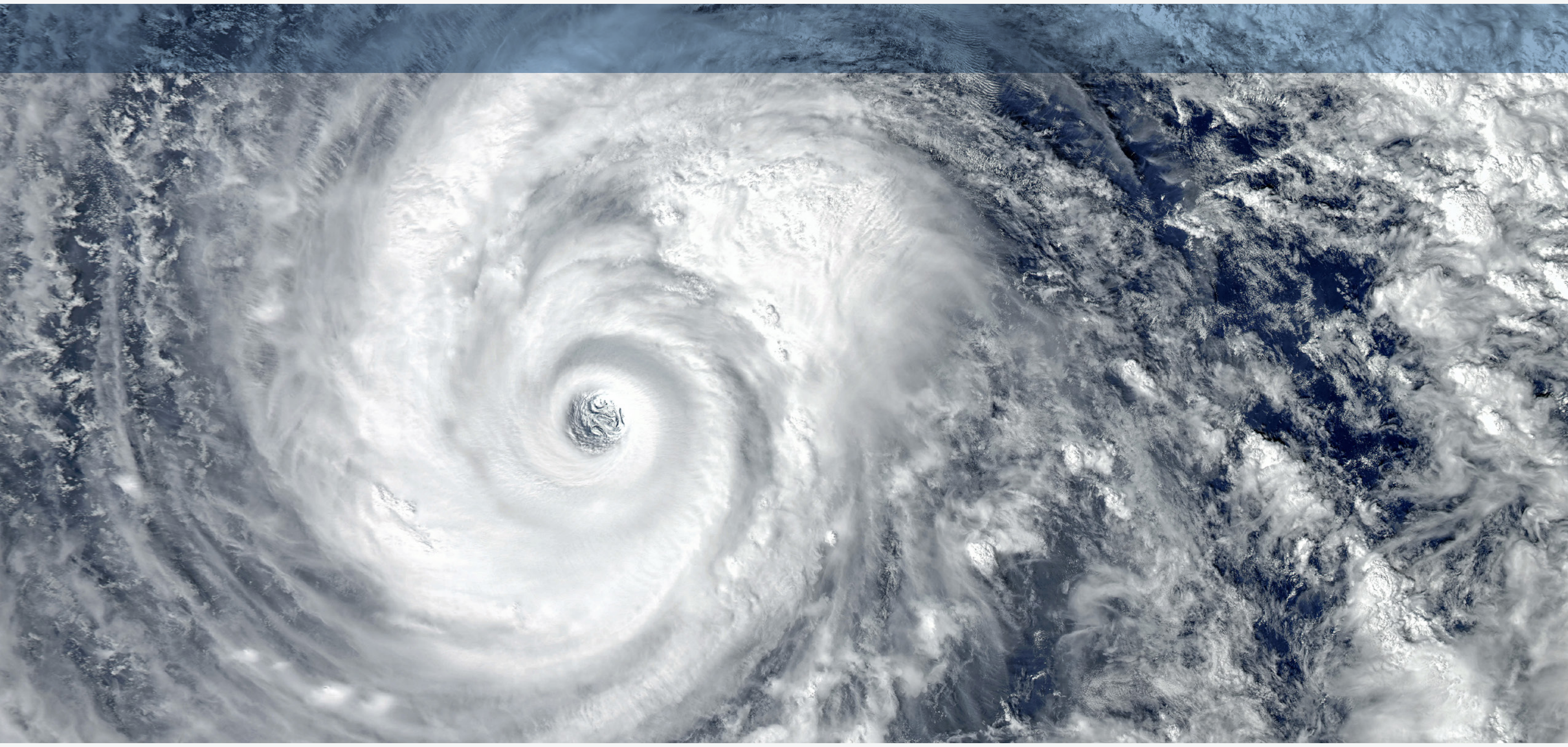
An array of climate analytics data, software, and consulting services have emerged in response to the changing climate and the attendant shifts in policy frameworks, regulatory environment, and growth in investor focus on environmental, social, and governance (ESG) issues. These data providers offer a wide range of commercialized science applications designed to help institutional real estate managers identify, measure, and describe physical risk at the asset and portfolio scales.

Investors today face a number of challenges related to physical risk, including a lack of clear industry norms or guidance relating to the following:

- Selecting physical-risk climate science data providers that are aligned to business needs;
- Evaluating the products and the complex science underpinning them; and
- Integrating this information into real estate life-cycle decisions.

As a result, institutional real estate managers face the substantial challenge of translating complex climate models into real estate investment decisions on their own—especially given the rapidly evolving nature of climate science and its natural levels of uncertainty.

Motivated by this science-business translation problem, this report provides high-level description and guidance for the real estate industry to evaluate the utility of physical-risk data analytics products. In addition, the report helps establish an important dialogue between institutional real estate and physical-risk data analytics firms that can help advance the interests of both parties and the industry as a whole around the globe.



This report is based on in-depth interviews with institutional real estate managers who are evaluating and using physical climate-risk analytics software, along with the data providers themselves. It addresses four questions:

1. How do physical risk analytics firms measure climate change, and what do they measure?
2. How are real estate investment firms assessing and addressing physical risk data in their business today?
3. To what extent, if any, is current physical risk priced into commercial real estate?
4. How can real estate investors and climate-risk analytics providers improve decision-making?

To the first question, physical risks include acute and chronic risks. Acute physical risks refer to increased frequency and severity of extreme weather events, such as cyclones, hurricanes, or floods. Chronic physical risks refer to longer-term shifts in climate patterns (e.g., sustained higher temperatures) that may cause sea-level rise or chronic heat waves. In both cases, physical risk arises from systematic, nonstationary, nonlinear changes in weather patterns. Data providers tend to measure physical risk across multiple typologies of extreme weather hazards. These hazards include drought, earthquake, storm surge, flooding, hail, heat, hurricane/typhoon, landslide, tornado, tsunami, wildfire, wind, and extreme weather.

Climate-risk models vary in nature and composition. They tend to use various types of base data (event, weather) from different sources, including the IPCC, various national databases, and private databases. These different types of data are cleaned, focused (hazards included/excluded), and processed using a variety of geospatial techniques—many proprietary. In addition to different base data and geospatial processing techniques, data providers tend to integrate expectations about the future by including representative concentration pathways (RCPs) in their climate models. RCPs represent scenarios of global warming that each have different potential impacts on future likelihood of a climate peril.

“The size of differences between risk scores for the same building can range from small to great orders of magnitude.”

The second question reveals a significant challenge for the real estate investment industry. The interviews revealed that when evaluating data providers, investors observed limited consistency in risk assessments or risk scores for the same asset relative to the same hazard type (e.g., tropical cyclone or pluvial flooding—flooding from rain). Differences in modeling approaches and data pose challenges to investors in property acquisitions and dispositions, valuation, and understanding value at risk. The important takeaway here is that the size of differences between risk scores for the same building can range from small to great orders of magnitude.

Although limited consistency is scientifically plausible, given variation in data and modeling methodologies, and a reality of scenario analysis, while trying to predict an uncertain future, institutional real estate managers need to be able to understand differences in approaches so they can articulate outcomes clearly to internal and external stakeholders as well as to regulators. This report outlines a set of questions investors can ask to better understand some causes of these differences.

To the third question, the interviews indicated that institutional real estate managers did not believe that physical risk is currently priced into commercial real estate assets. However, the interviews also indicated active attempts to integrate physical risk into the acquisition, management, and disposition process from these same firms. Some managers argued that as a forward-looking risk, physical risk influences discount rates, exit cap rates, and expectations about future buyers. Others reported that physical risk should be integrated into capital expense budgets for resilience or hazard mitigation measures.

At present, there does not appear to be consensus on when or how this integration should occur in valuation methods. Pricing and value-at-risk models are further complicated by the limited alignment between risk scores and the broader challenges related to dealing with risk (known variance) and scientific uncertainty (unknown variance).

Fourth, speaking to how real estate investors and climate-risk analytics providers might improve decision-making, the interviews make clear that the heart of this issue is the difficulty of translating complex science about probabilistic future outcomes into investment decision-making. Understanding and growing comfortable with scientific and model uncertainty regarding a novel risk is important. Users and providers of climate data alike acknowledge the need for continued conversation to better understand the nuances of one another’s business processes.

Institutional real estate managers would do well to carefully articulate their use case needs—specifically regarding valuation and value at risk. The data provider community might benefit from sharing more about their approaches and the strengths and limits of models and physical risk data. To the extent these conversations can be continuous and earnest, they will help guide both industries forward.

In this spirit, this report shines a light on the information investors might require and what climate-risk analytics providers currently offer. Mutual collaboration and understanding between these two sides should continue to improve this evolving space, potentially improving both financial and climate-risk outcomes.

# Motivation and Key Takeaways

Creation of this report has been motivated by the challenges of integrating physical risk into real estate life-cycle decisions with climate data. Given the importance of and increased attention to physical risk in commercial real estate, software companies, consultants, and risk analytics firms have developed an assortment of physical-risk assessment tools and models. Naturally, in a competitive market, commercialized science products should be expected to have variation that reflects differences in expertise, data, modeling approaches, scientific uncertainty, and future climate scenarios or pathways. However, many models of physical risk have limited alignment or consistency when evaluating the same asset—sometimes as different as orders of magnitude (e.g., a low versus high risk).

Paraphrasing a comment from a climate-risk data provider, "while everyone starts with similar flour, eggs, and sugar, we're all making different dishes." Indeed, at this stage, some are making biscotti while others are making birthday cake. In some instances, this diversity could have positive implications. Managers may find precisely the products they need. It may also have negative implications including shopping for desired outcomes or the inability to communicate clearly about risk and value to important stakeholders.

This report is based on in-depth interviews with both institutional real estate managers that use physical climate-risk analytics software and physical risk data providers. It addresses four central questions:

1. How do physical risk analytics firms measure climate change, and what do they measure?
2. How are real estate investment firms assessing and addressing physical risk in their business today?
3. To what extent, if any, is current physical risk priced into commercial real estate?
4. How can real estate investors and climate-risk analytics providers improve decision-making?

This report focuses on evaluating physical climate risk at the asset level. Naturally, portfolio construction dimensions and decisions as well as geographic investment considerations are relevant. Future work may examine portfolio construction to extend the foundation provided herein.

**KEY TAKEAWAYS**

- Physical risk scores for the same asset show limited alignment. Scores can sometimes differ by orders of magnitude.
- Translating the complexity of climate science into applied real estate industry practices is in its nascent phase, further complicated by limited alignment and scientific uncertainty.
- The impact of climate risk on current asset prices is difficult to measure, but institutional real estate managers believe it will be present soon. Many managers already incorporate physical risk into components of pricing tools—though with limited consistency of approach.
- Improved understanding and increased disclosure of physical risk in pricing and value-at-risk models will urge the industry closer to uniform practice and standards.

# What Is Physical Climate Risk?

Real estate is a business of assessing, mitigating, and managing risk. Investors and developers have long managed risks related to concentration, construction, environmental, financial, policy, tenants, and a host of related factors that are drivers of returns and values.

According to the IPCC, human activities have already caused approximately 1.0°C (1.8°F) of global warming above pre-industrial levels and, without meaningful intervention, the planet is likely to reach 1.5°C (2.7°F) above pre-industrial levels between 2030 and 2050.[2] Clearly real estate investors and developers can no longer avoid risk related to climate change.

Risks related to climate change are typically categorized into two types: physical risks and transition risks. Physical risks include extreme weather events, sea-level rise, and changing weather patterns. Transition risks are the economic impacts to an asset that result from a shift to a lower-carbon economy and the resulting changes in regulatory standards and market trends. Although this report focuses on physical-risk data sources, transition risk measures are equally important.

To borrow definitions from the Task Force on Climate-Related Financial Disclosure (TCFD), physical risks include both acute and chronic risks. Acute physical risks refer to increased frequency and severity of extreme weather events, such as cyclones, hurricanes, or floods. Chronic physical risks refer to longer-term shifts in climate patterns (e.g., sustained higher temperatures) that may cause sea-level rise or chronic heat waves. In both cases, physical risk arises from systematic, nonstationary, nonlinear changes in weather patterns.

Importantly, physical climate risk is an anticipatory or forward-looking risk. It seeks to account for expectations centered on changing patterns of extreme weather and climate.

While the underlying nature of the problem is more pressing, the contours of ambiguity for physical risk resemble those of other risks when they emerged, such as terrorism risk in the 2000s or the environmental and legal risk in the post-Superfund era of the 1980s—a sentiment echoed by numerous interviewees.[3] In both cases, the industry struggled to understand risk related to both event and long-term uncertainty. In response, firms focused on measurement and management and developed the tools that underpin due diligence today (e.g., the Environmental Phase I and II reports) as they likely will here.

# How Do Physical Risk Analytics Firms Measure Climate, and What Do They Measure?

Data providers tend to measure physical risk across multiple typologies of extreme weather events. These events include drought, earthquake, storm surge, flooding, hail, heat, hurricane/typhoon, landslide, tornado, tsunami, wildfire, wind, and extreme winter weather. Physical climate risk is a forward-looking risk that extends beyond historic insurability concerns. As a result, understanding more about catastrophic risk insurance provides a helpful history and learning framework for physical risk.

Physical risk analysis and assessment first began with the quantitative risk analysis associated with catastrophe insurance. For many years insurance firms have offered catastrophe or catastrophic risk protection against extreme weather events. Catastrophic risk coverage is typically informed by backward looking or historical data. Insurers use patterns in existing data to make short-term, frequently one year, insurance estimates against loss related to extreme weather hazard events. This is known as event-based modeling, and while it is now reasonably advanced in methodology, predicting actual damage to a structure remains a fluid process.

Hurricanes were the focus of the earliest event-based modeling and measurement techniques. Following Hurricane Andrew (1992), a storm that pushed a substantial number of insurance firms out of business, it was clear that failure to understand and predict event-driven risks was not an option. Today, building on the success of event-driven models, catastrophic risk modeling encompasses virtually all significant physical hazards using advanced scientific techniques. One data provider noted that "understanding catastrophic risk, *risk today*, is one of the keys to understanding physical risk—*risk tomorrow*."

"Understanding catastrophic risk, *risk today*, is one of the keys to understanding physical risk—*risk tomorrow*."

Since property insurers pass on the risk of insuring structures to property owners, the ongoing cost of property insurance represents a material risk. Much as interest rate uncertainty five years in the future is difficult to reasonably estimate, a property owner may have difficulty predicting its insurance costs in five years. Moreover, little prevents insurance providers from ceasing to underwrite certain hazards altogether, so the availability of insurance is also a material risk.

Climate-risk models vary from the insurance industry's catastrophic event models in nature and construction. They tend to use various types of base data (event, weather) from different sources, including the IPCC, various national databases, and proprietary private databases. These different

types of data are cleaned, focused (hazards included/excluded), and processed using a variety of geospatial techniques—many proprietary. In addition to using different base data and geospatial processing techniques, data providers tend to integrate expectations about the future by including RCPs in their climate models. RCPs represent scenarios of global warming that each have different potential impacts on future likelihood of a climate peril. In short, physical risk models describe and anticipate different versions of future climates and the attendant hazard risks those might pose for a specific location.

It is important to note that forward-looking physical risk models contain greater uncertainty and less consensus than backward-looking catastrophic risk modeling. As climate modeling advances, climate-risk analytics firms will likely develop more convergent models and views. However, today substantial variation in climate models exists that is material to real estate investment industry.

## Wide Variation in Reported Asset Risk

As physical climate-risk analytics firms work toward improved models and industry standards, the current landscape presents challenges to real estate owners, investors, and managers. Wide variation in prediction patterns remains prevalent across providers.

**Variations across Providers among Overall Physical Risk**

| Asset | State | Vendor A | Vendor B | Vendor C |
|---|---|---|---|---|
| A | CA | High | Very low | Low |
| B | DC | Medium | Very low | Low |
| C | FL | Low | Medium | Very low |
| D | IL | Medium | Very low | High |
| E | NY | Very high | Low | Medium |
| F | TX | Medium | Very low | Low |
| G | VA | Medium | Very low | None |

This figure was shared by one institutional real estate manager. It depicts a set of aggregate risk scores generated by three different providers (vendors A, B, and C) for assets (A to G). Clearly, consistency between the physical risk assessments for each asset is limited. The figure echoes statements made by many interviewees describing their data evaluation processes.

The overall physical risk score typically represents an aggregate of specific hazard risks. While the results were placed onto a Likert scale for demonstration and privacy purposes, this investor reported that in several instances, the difference between risk scores for the same asset was an order of magnitude. Consequently, the figure illustrates a central challenge faced by all institutional real estate managers—that of understanding complex climate science and translating it into financial models that inform investment decisions.

One sustainability manager commented, “When we were testing providers, for the most part they were consistent in identifying higher-risk assets, even if the estimated level of severity varied. But in a notable portion of the assets, we saw totally inconsistent results, both in terms of which hazards were flagged as well as the severity of risk. One provider would say the asset had no risk, and another would project it being totally wiped out within a few decades.”

Scientifically, more is known about some hazards than others—making it easier to develop consensus on some predictive modeling. For example, coastal-flooding risk predictions have lower variance and greater accuracy relative to other perils, whereas pluvial (rain) flooding and wildfire have higher variance based on existing data and models.

In addition to the wide variation in risk scores, institutional real estate managers identified the challenge of receiving single point estimates to describe physical risk. They acknowledged the benefits of simplicity in a single score but also wanted to understand the degree of confidence in the estimate.

### WHAT IS A CONFIDENCE INTERVAL?

Virtually all predictive analytics, including financial econometrics, physical climate risk, and many valuation metrics, involve estimating the future. Typically, end users of these models see a point estimate. But how certain are we that the point estimate is accurate?

Assuming a normal statistical distribution, 2 standard deviations (SD) represent a 95 percent confidence interval (CI). This means the probability of some event is X percent, but we are 95 percent sure it is between X percent and ± 2 SD.

For example, perhaps we wanted to understand the mean per square foot (PSF) sale price of a city’s office market. We might estimate $350 PSF with a SD of $75 PSF, meaning 95 percent of the sample should be between $200 PSF ($350 – 2*$75) and $500 PSF ($350 + 2*$75). That is quite a big range!

Although we know that some hazards have larger ranges (wider CI) and some have smaller ranges (lower CI), many climate-risk analytics providers do not disclose that information.

"When we were testing providers, for the most part they were consistent in identifying higher-risk assets, even if the estimated level of severity varied. But in a notable portion of the assets, we saw totally inconsistent results, both in terms of which hazards were flagged as well as the severity of risk. One provider would say the asset had no risk, and another would project it being totally wiped out within a few decades."
—Sustainability manager

Many institutional real estate managers indicated that their providers did not disclose confidence intervals for predictive models. Some providers offer multiple modeling frameworks, such as IPCC scenarios for users to choose from, without always providing guidance on the probabilities associated with each scenario.

Naturally, climate analytics firms are using different base data, proprietary data processing techniques, and different expectations about the future to generate physical risk predictive models. Some firms use government data sets whereas others rely on proprietary data sets from insurance firms or use machine-learning techniques to simulate data. Each firm believes it is using the best available data, modeling techniques, and metrics to make the most accurate predictions. However, at present these differences create significant friction for users.

## Sources of Variation in Climate-Risk Scores

The following section consolidates additional feedback from the interviews of climate providers, institutional real estate managers, and an online review of about 30 climate-risk analytics providers. It is important to note that this section is not a detailed description of individual commercialized science products or brands. Instead, it describes the attributes of these products and how variation illustrates the continuum of approaches.

### Methodology and Transparency

Nearly all data providers offer summary technical reports that shed light on some of the data and methods they use to generate risk assessments. Others offer a more comprehensive view of how each model component works. Most are willing to engage users who request more information. Inherently, variation in transparency is to be expected as data analytics firms work to create differentiated products for the market.

While typical technology adoption pathways involve standardization later in the process, one investment manager expressed frustration, saying, "Vendors [seem to] want to prevent standardization, each needing their value proposition to be unique. Metrics are different, units are different; it's not necessarily helping anyone's cause."

Within their product offerings, analytics firms often create summary metrics that aggregate the risk of multiple individual hazards. They also produce individual hazard assessments. For the aggregated measures, weighting of factors varies, and different hazards are included by different providers.

**PHYSICAL RISK VERSUS VALUE AT RISK**

Physical risk represents the likelihood that a physical asset (e.g., building) suffers damage from an acute weather event or is subject to gradual stress of chronic weather conditions like heat stress. This is a separate step from understanding the potential financial impact of that event, or the value at risk (VaR). VaR is a probabilistic estimate of the financial loss suffered if an event occurs. For a simplified example, if a flood occurs, do we need to merely dry the carpets or replace every ground-floor HVAC unit?

To put it in banking terms, physical risk parallels the likelihood of default. VaR mirrors the expected loss given default.

### Value at Risk (VaR)

Some providers offer value-at-risk measures, and some provide only physical-risk assessments. Both approaches have merit.

As one investment manager said, "I don't want [climate-risk assessment software providers] to tell me my building value and VaR. I want them to tell me risk! I will figure out what it means." On the other hand, several other investment managers suggested they just want "a number" they can use for decision-making because the climate science felt somewhat overwhelming.

"I don't want [climate-risk assessment software providers] to tell me my building value and VaR. I want them to tell me risk! I will figure out what it means." —Investment manager

VaR itself is a common metric used for risk management across a variety of financially oriented firms. Generally, the approaches to calculating VaR are bundled into three statistical methods for a portfolio of securities or financial instruments: (1) historical, (2) variance-covariance, and (3) Monte Carlo simulation. In each of these, the model estimates the maximum potential loss given a period of time and the probability of realizing losses.

Most *statistical* approaches are well defined and used by a wide swath of regulatory bodies. However, the key input to make all these approaches work is *value*. But what value should be used to estimate value at risk for a real asset or portfolio of real assets?

Some data providers consider the following:

- Market value;
- Assumed percentage change in value;
- Capital repair estimates;
- Replacement cost;
- Assumed business interruption loss; or
- Assumed mitigation costs.

As an illustration of potential confusion, some data providers estimate value at risk using market values, which may or may not necessarily reflect damage estimates. An identical physical structure in Dallas or New York will likely have drastically different market value and more closely related, albeit not identical, replacement costs. This report does not make specific recommendations beyond stressing the importance of clarity and disclosure to end-users.

Some data providers also include indirect considerations, such as the following:

- Ownership structure;
- Structure of the capital stack;
- Lease considerations (e.g., triple net);
- Insured amount; and
- Related intangible considerations to determine which parties may bear any costs.

The selection of value represents one area of differentiation between data providers. The estimation of VaR, when given the physical risk from climate providers, likely falls within the skill set of institutional real estate managers. Thus, users of the data do have a choice on whether to use provider or internally estimated VaR measures. Leading institutional real estate managers expressed strong concern about confusion here. Their comments on VaR reinforce the challenge of integrating the climate-risk metrics into financial models and decisions—especially in the dynamic policy landscape surrounding climate and ESG.

A sustainability lead in a real estate asset management firm expressed concern that "investors, voluntary reporting frameworks, and regulatory bodies are all starting to ask for 'Climate Value at Risk' but CVaR is not yet a standard term with a commonly accepted definition such as cap rate, NPV [net present value], or IRR [internal rate of return]."

"Investors, voluntary reporting frameworks, and regulatory bodies are all starting to ask for 'Climate Value at Risk' but CVaR is not yet a standard term with a commonly accepted definition such as cap rate, NPV, or IRR." —Sustainability lead

As briefly described earlier, VaR has two critical input components: (1) the value of the asset, as previously discussed, and (2) risk of a climate hazard to that asset. In addition to variation in value, the physical climate-risk assessment component also has wide variation in estimation techniques used to arrive at the baseline risk. The following sidebar lists key areas of variation across physical climate-risk analytics providers. They are described in detail in the next section,"Considerations When Choosing a Provider." Given variation in the inputs, variation in outputs for VaR and annualized loss estimates could result.

### KEY AREAS OF VARIATION ACROSS PHYSICAL CLIMATE-RISK ANALYTICS PROVIDERS

- Identification of hazards included or excluded
- Data description and source(s)
- Nature of model
- Inclusion of property-level information: physical and financial
- Government, municipal, and asset-level risk mitigation considerations
- Scenario analyses, time, and baseline assumptions

*These are described in detail in "Areas to Consider When Comparing Providers" on page 18.

## Considerations When Choosing a Provider

Physical risk should be considered as part of the overall portfolio or asset investment, hold, and disposition process. Choosing a provider that meets the strategic needs of your firm and/or fund involves several key considerations.

### Service Offerings

Across the platforms reviewed, analytics firms tend to offer two broad types of services: consulting services and web-based applications. Consulting services allow users to share information about their properties and portfolios with the data provider, who returns a slate of requested information. As one provider with consulting services indicated, "All really good [provider] data are hard to understand; we think part of our job is helping implement the data."

Web-based applications allow the users to identify and extract information about their properties and portfolios. In some cases, analytics firms will merge these offerings and build customized web applications for users as a service. Many analytics firms also appear willing to create bespoke information packages for clients depending on their needs and budget.

Climate-risk analytics providers reviewed offer a selection of products spanning a variety of use cases and client types. Some providers offer real estate–specific applications as well as other tools that align with or facilitate reporting for frameworks such as TCFD, Global Risk Institute (GRI), United Nations Principles for Responsible Investment (UNPRI), or the Global Real Estate Sustainability Benchmark (GRESB). These tools provide users with outputs and key performance indicators for real estate assets that can be used to convey physical-risk analysis to internal and external audiences.

As policy change occurs across global regions, physical-risk metrics will become increasingly important for reporting to TCFD and UNPRI as well as for regulatory disclosure. For example, in the United States, public firms may soon be required to disclose their carbon and climate-related activities. Firms making misleading or false statements could be subject to civil penalties and other legal action.[4]

As part of their service offerings, analytics firms provide an array of data to users. They tend to identify physical risk exposure and severity. Relative to the hazards identified, many providers offer dashboards that display risk indexes for various climate hazards and categorize risk as "high," "medium," and "low." Other providers reference continuous measures (e.g., 1–100).

### Hazard Coverage

Across the service offerings, differences exist in the types of hazards covered by climate-risk analytics tools. Not all analytics tools assess all physical risk hazards. For example, some only assess flood risk, while others exclude extreme heat/cold. In addition, providers do not always disclose detailed definitions for the types of hazards covered. "Extreme temperatures," for example, may or may not include extreme cold. Similarly, "tropical cyclone" may cover only factors such as strong wind and precipitation, but not flooding and storm surge.

These differences in lexicon and inclusion reflect rapidly evolving science regarding some natural phenomena, a range of data sources, and the complicated dynamics of measuring risk related to some hazards. They also provide evidence attesting to the fact that the market for commercialized science is competitive and firms need to create differentiated products for the variety of potential customers.

The 2022 report by the U.N. Environment Program Finance Initiative lists the following physical hazard types in its review of physical risk tools: coastal flooding, inland flooding, extreme weather, extreme heat, extreme precipitation, landslide, drought, water scarcity, and wildfire. This same report notes that the characteristics of some hazard types tend to vary depending on the region of the globe in which they occur and that not all tools account for this variation. The report also contends that tools tend to omit from their assessment indirect hazards of climate change like losses caused by service interruptions.

Chronic risks such as rising temperatures and sea levels and the attendant risks such as subsidence, cooling costs, and water availability vary in detail and coverage across providers. Like the other areas above, this variation reflects the changing state of scientific knowledge, the desire of analytics firms to specialize, and the breadth of physical risk as an area of study and commercialized science.

### Geographic Coverage

Significant variation in the geographic coverage of each climate-risk service exists. Some providers specialize in services for specific geographic or global regions. Other providers claim to be able to measure climate risk on a global basis. Like the variation in transparency and the differentiated service offerings, variation in geographic coverage is natural and helps firms provide differentiated products to the market. Institutional real estate managers gravitated toward the service offerings that best aligned with their strategic needs.

Importantly, even identical geographic coverage from two providers does not mean identical results. Providers offer different focus on hazards, may use different grid sizes, or source data and methodologies. Grid sizes can differ between providers and hazards. For example, some models may provide block-by-block assessments for coastal flooding and more regionally based assessments of tropical cyclone paths. These differences in model scale reflect varying levels of scientific information availability as well as varying consensus on the accuracy of modeling of different hazards at different geographies and scales.

Related to geography and geographic data coverage is sensitivity to variation in building codes within and across regions. Some providers consider local or regional building codes while others use a single framework for assessment of structures worldwide. One provider said, "We know Japan has a better building code for tropical cyclones compared to other regions like the U.S. A building located in Australia or in Japan will have region-specific building codes." This means that the likelihood of damage for certain wind thresholds would be different depending on the localized building code and its enforcement.

Moreover, some data providers include information about connectivity between and across locations when estimating risk at the site level. This is largely a geospatial process contingent on data availability that provides insight into an asset's infrastructure connectivity (e.g., roads, IT, water/sewer). Many institutional real estate managers observed the decision-making value of these connectivity insights. They argued that knowing how a site was connected to its surroundings and region helped contextualize capital investment decisions anticipating physical risk including for climate adaptation, hardening, and resilience.

#### DATA AVAILABILITY WORLDWIDE

Real estate investment managers noted they largely implemented the same evaluation process for physical risk across different global regions. However, they observed differences in data availability and consistency across the globe. They made specific comments about how, "[data] thresholds in the U.S. aren't the same as in Europe" and remarked that "every country has different level [grid-size] data" and "OECD countries bound infrastructure risk better." While managers use a consistent analytical posture/approach across all global regions, variation across and between regional data warrants further attention by firms as they work to select physical risk data providers.

# How Are Institutional Real Estate Managers Assessing Physical Risk Data?

The interviews indicate that institutional real estate management firms are assessing physical risk data in a variety of ways. Their approaches reflect the diversity of physical risk data available, different strategic priorities within and among firms, and challenges related to translating complex science into real estate decisions. At present, firms report evaluating the diverse and complex science on their own, without a great deal of consistent external guidance or formal public discussion.

With ESG reporting frameworks, governmental and securities regulators, and limited partner investors all requesting or requiring reporting, institutional real estate managers face difficult decisions when selecting climate-risk analytics providers. With the wide variation in physical risk assessment, what type of financial, regulatory, or reputational risk might an institutional manager face if the provider it selects minimizes an event that actually occurs? If the physical, financial, and especially human potential losses could have been mitigated with different risk assessment, who bears responsibility for what? As one investment manager said, "My lender repeatedly called out that if the asset has a hazard score of *X*, we need to do A, B, and C. But the problem is *X* doesn't even mean the asset risk level. A low score might be red and a high score green. We need standards."

This section describes more about where firms are in selecting physical risk assessment data providers and the challenges they face in doing so. It also describes how firms are applying physical risk data in real estate analysis, including risk identification and asset valuation.

## Where Are Firms in the Journey of Adopting Physical Risk Data and Assessment Tools?

Changing regulation, investor demands, and firm ESG goals are driving institutional real estate managers (firms) to evaluate physical risk within their portfolios. Institutional real estate managers sit at different places on the journey to evaluate and integrate new climate change data analytics products and services into their businesses. The firms just beginning their journeys tend to be exploring different product options, working to identify a single provider that can help them ascribe levels of physical risk to their assets.

Institutional real estate managers in the more advanced stages tend to have evaluated a number of data providers and are refining how they process, integrate, and use physical risk analysis tools within their businesses. They are adapting to the state of the science and are, broadly speaking, more comfortable with the scientific uncertainty associated with climate change modeling. Although firms may inhabit any space along this continuum, the interview sample largely clustered into two cohorts.

### Earlier Stages of the Journey

Firms in the early stages of evaluating and adopting physical risk data and data providers tend to use a two-part evaluation process. First, they are working to convince senior management that physical climate risk is a novel and material risk to their businesses and portfolios. Second, they are concurrently working to evaluate the tools they wish to use and demonstrate the utility of those tools in practice. Although they often recognize the need for diversity of data input, as one investment manager said, "It took us six months to decide on our climate provider; now I can't spend another three years figuring more [applications to practice] out. We need to understand what we have to make actionable, meaningful decisions."

It is important to note that no relationships appear to exist between physical risk assessment stage and firm size or operating history as all interviewees represented institutional management firms with substantial volumes of assets under management (AUM) and with full-time ESG staff.

Earlier-stage adoption firms are working to identify where within acquisitions, valuation, and asset-level business planning processes physical risk assessment can add value. They struggle to integrate traditional real estate due diligence and value estimation techniques with physical risk measures. One investment manager expressed the sentiment that "Management is willing to underwrite value of Turkish stone in the lobby but not necessarily energy efficiency or resilience measures."

They also describe their evaluation of different physical risk data providers based on the alignment of the risk score output with their teams' decision-making styles and skill sets. Many firms simply wanted easy-to-understand data. As one highly sophisticated investment manager said, "I want data presented in a very simple way. Investment professionals are not [climate] scientists." Echoing this from the data provider side, one interviewee said, "Purchasers [clients] are smart, but not in climate science. The ability to build the best model and the ability to simplify it are not necessarily correlated. Some, perhaps inferior models, communicate results better. Providers need to understand it's better to tell a client how to use it."

Firms earlier in their journey tend to be asking “what do I do with all this data?” thereby illustrating the challenge of converting risk scores into financial assumptions.

### Leading Investors

Leading investors primarily evaluate physical risk data from various providers and embed it in firm decisions and processes. They often look at mitigating climate risk—physical and transition—as a shared social responsibility. As one investment manager said, “We are trying to build a process that allows us to make the *right* decision. Trying to comply with reporting frameworks is important, but our focus is impact.”

Some of these firms are identifying the array of hazards they can analyze with different data providers, trying to understand underlying data used in the tools they can purchase, and navigating how those tools incorporate time, forecasts, and RCPs into real estate analyses. Other firms have selected a single provider, preferring depth of knowledge about one provider’s strengths and weaknesses over survey knowledge of many.

“We are trying to build a process that allows us to make the *right* decision. Trying to comply with reporting frameworks is important, but our focus is impact.”—Investment manager

Leading investors tended to point out that while they often examined and used data from multiple providers, they did not consider that process to be superior in and of itself. Instead, they valued continuous curiosity about data available in the market and its ability to help answer physical risk questions. They provide training and guidance on physical risk to acquisition and asset-management teams. They are developing screening and due diligence tools across the value chain and making space for discussion of valuation related effects relative to physical risk. When compared to firms in the earlier stages of assessment and evaluation, leading firms are grappling with the results of experiments to convert physical risk analyses into financial models and investment frameworks. They also recognize the challenges of evaluating results in a time of substantial global policy change.

## Shared

- Frustration, but not surprise, on diversity of results from providers
- Uncertainty on best path to fulfill regulatory, reporting, and investor requirements
- Doubtful physical risk impacts pricing today (although institutional real estate managers are actually pricing it!)
- Difficulty translating complex climate science to real estate analysis

## Early-Stage Firms

- Lack active dialogue at investment decision level
- Still learning in-depth knowledge of the data, typically through working with one provider
- Frequently “check the box” mode
- Senior management often skeptical of climate as legitimate risk

## Leading Firms

- Comparing and contrasting multiple data sources
- Integrating climate risk across investment, asset management, and disposition strategies
- Frequently training staff across functional areas to understand risk
- Typically, climate-risk mitigation resides in mission/strategic objectives instead of fulfilling reporting requirements

## Physical Risk and CRE Prices

Regardless of whether institutional real estate management firms were early or more advanced in their journey to evaluate, adopt, and integrate physical risk data into firm processes, all interviewees agreed that physical risk was not measurable in current asset values. Each interviewee also believed that physical risk will become a material factor in commercial real estate prices in the not-too-distant future.

> "Each interviewee believed that physical risk will become a material factor in commercial real estate prices in the not-too-distant future."

Institutional real estate managers are working to integrate physical risks into future values. One investment manager reported, "I have been part of investment committees where we are making an investment in [a coastal state] and there are discussions on insurance, operational risk mitigation plans in place, physical building. We look broader—at both physical and transitional risks."

Many institutional real estate managers indicated they anticipate that prices will, in the near term, reflect increasing levels of understanding and a greater ability of researchers and investors to translate science into practice. Some investors, typically the more advanced in this process, indicated their exit prices would be influenced by assessments of 2040 or 2050 risks.

The discussion of pricing tended to be germane to core or stabilized long-term-hold asset strategy funds, An early-phase firm's investment manager noted, "I can't even convince management this is a real thing until there is more data!" However, the same individual later stated that relative to core fund assets, the firm tended to examine the worst-case physical risk scenario and plan some mitigation measures.

This vignette illustrated the lack of consensus about how or where physical risk is best included in value estimates. This could be due to differing views on where physical risk plays a role in discounted cash flow (DCF) valuation assumptions—where institutional real estate managers described translating physical risk into asset-level discount rates, reversion cap rates, and expectations about future buyers. Each of these three factors is related to time (or timing) and can be complicated by the limited consistency between risk scores for the same asset. Managers also signaled that they strongly consider resilience-oriented capital expenditures in value estimates, believing that future buyers will want to acquire hardened or adapted assets. It is clear that climate-risk metrics need to be converted into financial terms to be useful to investment managers. Moving from the metrics of meteorology, hydrology, and atmospheric science to the world of discounted cash flow analysis is not simple or obvious yet.

## Additional Lessons from Institutional Real Estate Managers

In addition to the preceding key takeaways, institutional real estate managers identified three topics that could be useful to others when evaluating physical risk data and data providers. First, they observed that making a decision about data involved accepting both uncertainty and tradeoffs. Second, they hoped that, in time, the potential for more standardized data could improve decision-making. Third, they noted the importance of integrating data on public infrastructure into physical risk assessments.

### Tradeoffs When Selecting a Data Provider

Translating complex science into business decisions is a problem that exists across industries, and sometimes the science-translation process involves accepting ambiguity, uncertainty, and the potential for tradeoffs. For instance, one investment manager's firm reportedly selected its climate-risk data provider primarily because data was "simplified and easy to understand." Another interviewee echoed the sentiment, saying, "We just needed to pick one and go with it. We chose our provider because they were easy to use." These responses demonstrate the importance of ease of use. However, they also point out the potential for tradeoffs with other attributes, including depth or comprehensiveness of coverage and the complexity that different types of data can reveal—especially about a multifaceted phenomenon like climate change.

Related to uncertainty and tradeoffs, a number of managers observed that scientific literacy can vary within management, acquisitions, and other teams. Many of the interviewees identify this as a key reason they selected their physical risk assessment providers. They argued that the provider(s) they selected made climate science the most approachable and digestible for teams engaged in the identification and management of a range of financial, process, and environmental risks.

### Moving toward Data Standards

Limited consistency in risk scores created significant challenges for decision-making, internal communication, and reporting to external stakeholders. Real estate investment managers reported challenges in explaining to an acquisitions team, investment committee, or investor why the same asset might have different physical risk scores from different data providers (and the significance of the difference).

A relevant analogy for these challenges, offered by an investment manager, was economic model forecasting. In that field, economists have generated definitional consensus across common, transparent, and accessible data sets, and rely on generally accepted notions of uncertainty regarding models and data. However, despite consistency in data inputs and fundamental models, differences in economic forecasts are both expected and important. They arise from the nuanced ways in which analysts generate expectations about common data or modeling techniques, along with strategies in applying the various models. This allows for discussion about differences in levels and trends as opposed to the fundamental definitions or measurement of concepts.

"We had an asset that got flagged for flood risk. The asset level appeared okay, but the levees failed inspection. We called the municipality, talked to local engineering experts, and relied on internal expertise relative to the risk score to understand the risk."—Investment manager

### Understanding Public Infrastructure

Some leading investors were concerned about the network and infrastructure connectivity between their buildings, and how hazards affecting the surrounding area might affect the asset. They were also concerned about the need to understand the public adaptation, resilience, and hazard mitigation work being done in the markets where they invest. Because leading investors work across multiple global regions, they have experience with U.S., Asian, and European city and national efforts to protect all property in a market or submarket and the relevant data used to guide those decisions. One investment manager said, "We had an asset that got flagged for flood risk. The asset level appeared okay, but the levees failed inspection. We called the municipality, talked to local engineering experts, and relied on internal expertise relative to the risk score to understand the risk."

## International Perspectives

All firms with international portfolios shared that they maintain the same analytical framework relative to physical risk across global regions. Whether based in Europe, Asia Pacific, or North America, this perspective was shared across firms. Each did, however, take care to mention the wide variation in data by region and risk type. For example, data on public infrastructure investment varied widely. This was one reason firms suggest that they have been examining data providers with a global reach. Using a single firm with global reach allowed them to use their common analytical framework and insert a similar risk score calculated similarly with comparable parameters though varying by place.

# How Can the Real Estate Community and Climate-Risk Data Providers Improve Decision-Making Using Physical Climate Risk?

Real estate professionals at diverse points in the adoption process use data for different purposes. In truth, many at the early phase primarily use data to "check the box" for various reporting frameworks. They have not fully embraced the potential risk and pricing impact of this variable. Those in the more advanced stage of adoption have begun to integrate this information across acquisition, disposition, and asset management value chains. Institutional real estate management likely represents a generally advanced sample relative to mid-tier developer/investors.

The areas described below are highlighted as parts of the data and modeling strategies that, if better understood, can help firms make more informed decisions. Of course, most real estate experts are not climate scientists and vice versa. The goal for real estate experts should be to understand the key inputs and how those might impact decision-making. Similarly, the goal for climate-risk analytics providers should be to communicate key inflection points and how they may impact real estate–related risks.

## A Climate-Risk Assessment Road Map for Real Estate Stakeholders

### STEP 1

**Does my provider's report meet my strategic objectives?**

- Do they satisfy my investment process and business decision-making needs?
- Do they satisfy my regulatory reporting requirements (SEC, SFDR, etc.)?
- Do they satisfy my voluntary reporting requirements (TCFD, UNPRI, etc.)?
  - Are all hazards I want to evaluate covered?
  - If no, specialty providers may still be useful for specific risks, but be sure to capture everything you need.

### STEP 2

**Do the provider's services meet my needs?**

- Does the selection of RCPs and time scenarios align with my strategic objectives, reporting, and risk assessment needs?
- Does my provider's risk assessment include municipal and governmental risk mitigation measures?
  - If so, what have they incorporated?
  - If not, how are you addressing this issue?

### STEP 3

**Does my provider generate my value at risk?**

- If so, how do they define VaR? Understand the assumptions, including property-level hazard mitigation, valuation metrics, and tail risk.
- Consider whether your real estate firm prefers to separate risk assessment and VaR. When using your provider's physical climate-risk data, make sure the assumptions are understood to model VaR internally.

### STEP 4

**Are risk assessments from multiple providers congruent (if multiple providers are used)?**

- Expect inconsistency, develop a plan to address it, and understand each provider's strengths/weaknesses.

### STEP 5

**Is physical risk assessment integrated with your acquisition, development, financial reporting, and asset and portfolio management teams?**

- Depending where on the continuum your firm is, consider an internal task force, educational content development, or external consultants.
- Physical risk should be considered on par with financial, tenant, and the host of risks firms mitigate every day. Treat physical risk assessment as a strategic risk, incorporate into real estate life cycle.

## Areas to Consider When Comparing Providers

Enhanced understanding of the specific objectives behind the risk analysis for the firm naturally leads to improved decision-making. Some climate-risk analytics providers offer enough transparency to guide the user through each step of the modeling strategy. Other providers, while potentially presenting compelling results, offer only opaque guidelines on the methodology behind them.

Each of the areas discussed represents information that users should understand and, optimally, providers should disclose. This report expressly makes no judgment on the right or wrong way to assess climate risk. Given the evolving state of climate-risk analytics, best practices may take some time to converge. Further, any science that predicts the future, like financial modeling in real estate, constantly evolves as understanding of new trends and behaviors progresses, creating a fluid evolution of new and best practices.

- **Identification of hazards included or excluded**—Each analysis is unique. In some geographic locations, providers may choose to omit certain risks. For example, an asset located at a high elevation may be designated by a provider as having no flood risk, resulting in omission of flood risk assessment. Alternatively, in some locations, especially outside the United States and Europe, data to reasonably predict risk for some potential climate hazards may be limited. Users should understand which specific hazards were included or excluded and the reasoning for that omission.

- **Data description and source(s)**—A wide range of data sources may be used in assessing climate risk. Some are generated from LiDAR (light detection and ranging)-based mapping; others were created with flood elevation maps. Some use publicly available government, nongovernmental organization, or nonprofit information. Some firms use proprietary data sets created through an algorithm (or algorithms), firm experience, or by combining data sets for purchase (which may include data for which nonprofit firms charge). Many firms use multiple data sets. Furthermore, different data sets use different resolution. Some analysis may be as granular as one-square-meter and others as broad as 100-square-meter grids. Every major firm seeks to use the best available data, which continually evolves in this fast-moving space. However, users can ask more informed questions about the degree to which they should rely on certain assumptions.

  Although users should not expect climate-risk analytics firms to reveal trade secrets, a level of disclosure and transparency on the data used would benefit all parties.

- **Nature of model**—When multiple listing services (MLS) data became publicly available to consumers through numerous residential listing sites, many realtors feared they would become obsolete. Contrary to that view, the use of professional realtors on a percentage basis increased as data became more freely available.[5] Model disclosure will inform users and provide tools to compare modeling strategies, but the public will still require the expertise of climate firms to understand and make decisions using the data.

  Certainly, climate-risk analytics firms should maintain ownership of proprietary models. However, many firms may base their models on public sources. Some firms use the CMIP6 models from the World Climate Research Program; peer-reviewed literature frequently provides other cutting-edge modeling strategies. Government programs often disclose the modeling strategies behind their outputs. Climate-risk analytics providers are service providers who offer interpretation and guidance based on these models. Reasonable disclosure of modeling strategies, limited to high-level overviews, should be common practice.

- **Inclusion of property-level information**—Some providers include property-level mitigation measures, while others do not. For example, some analyses integrate property-level information such as the location of HVAC equipment and the extent to which hazard mitigation measures have been implemented; others do not.

  Many asset managers and owners—especially in core funds—are making improvements to properties to increase resilience against climate change impacts, including increasing site-level stormwater detention and structure wind dynamics. For users of physical risk data, there is often an important connection between infrastructure and site-specific conditions and hazards that helps inform investment decisions.

- **Governmental and municipal risk mitigation considerations**—Climate-risk analytics tools generally do not incorporate impacts from existing risk mitigation policies. However, a small share does consider localized, or at least country level, building codes. The quality of a risk assessment may be affected by public and, as above, asset-level interventions.

  Government authorities may adopt new building codes or land development regulations that mitigate or exacerbate adverse impacts from climate change. Prospective users of risk analytics providers should be conscious of the limitations of risk analytics tools in this regard. If appropriate, investors may consider opportunities to complement data sets with additional information about infrastructure in the surrounding area.

  For assets in locations with minimal interventions, this may not hold sway over risk rating or valuation of risk, but as municipalities increasingly take mitigative action and upgrade infrastructure, risk to individual assets may decline (assuming adequate maintenance of new and existing infrastructure). Whether and how the provider quantifies that risk are important questions.

- **Scenario analyses, time, and baseline assumptions**—The IPCC provides scenarios based on RCPs, each making different assumptions regarding degrees of global warming. Many model providers describe potential risks for a variety of RCP scenarios whereas some may focus on a single one. While this report makes no recommendation on optimal modeling strategies, certainly firms should consider regulatory requirements (e.g., the proposed European Financial Reporting Advisory Group rules, under comment period at the time of this writing, recommends use of the 1.5-degree scenario[6]).

  Similarly, time horizon serves as a critical assumption in risk assessment. The likelihood of damage from certain risks increases over longer time periods, and the climate-risk assessment output may differ if the assumption is a 10-, 20-, or 50-year horizon.

  In addition, different providers make different baseline assumptions. Some focus more on historical data, which might be considered catastrophic (backward) risk assessment as opposed to forward. Some include the current risk and the forward risk, attempting to predict total risk. Others essentially assume that current risk is already priced in the market and focus on the delta, or change, in forward-looking risk. While each method has merit, one caution on the focus for forward risk is that percentages of small base risk may receive outsize attention because of larger relative changes, while potentially downplaying risk to assets that are presently at high risk.

"We have cold storage–focused logistics across the globe. But in places like Spain or Arizona, operational expenditure for heat stress needs to be factored in. What regulations do we have to meet, what energy reductions and capex costs do we have?"—Investment manager

- **Value at risk**—In addition, and related to measuring physical risk exposure and severity, firms are also using data from climate analytics providers to estimate VaR. The "Value at Risk" section details nuances across the VaR generated from climate-risk analytics providers. However, some real estate investment management firms use internal expertise to generate their VaR by applying the physical risk metrics to their own value estimations.

  Some real estate firms simply rely on the climate-risk analytics provider for calculation of VaR, which has strategic tradeoffs and uncertainty as discussed earlier. While interviewees who model VaR internally did not explain modeling strategies in depth, they did highlight several of the frictions or obstacles identified above. Wide variation in the time periods, probabilities, and assumptions embedded in physical risk models from data providers present longitudinal matching problems.

  However, internal modeling does present opportunities for real estate investment firms to create new value. One investment manager said, "We have cold storage–focused logistics across the globe. But in places like Spain or Arizona, operational expenditure for heat stress needs to be factored in. What regulations do we have to meet, what energy reductions and capex costs do we have?" Climate-risk assessment results vary by the underlying data and variation in the science. This variation represents a natural process in the maturation of an evolving science and its application to business. It simply means that firms must be deliberate in how they select a provider and understand how the provider's work integrates underlying asset, place-based information; and the math used to calculate vulnerability, intensity, and network nature of exposure, relative to different climate scenarios.

## The Role of Climate-Risk Analytics Providers

As users of climate-risk assessment tools, the real estate community serves as a key barometer in the discussion. Although no single type of firm or use-case exists for physical risk assessment or the tools and data supporting it, real estate firms buy, sell, and manage capital-intense assets with fixed locations. Their business-oriented needs help shape the demand patterns for commercialized science.

Climate analytics providers and users will benefit from earnest conversation with one another about the way their products can contribute to analyses of (1) physical risk identification at the site scale; (2) the probability of exposure to and severity of those physical risks; (3) asset and portfolio value and value at risk; and (4) communication with other users, investors, and/or regulators.

These conversations might focus on the evolving nature of climate science and its nuances as well as limits (e.g., scale, precision, complexity), and how these results are translated into value and value-at-risk metrics. Conversations may also provide insight into how real estate firms make investment choices and may illuminate how science can be translated for reliable decision-making.

### Risk Identification, Assessment of Exposure, and Severity

The interviews indicate that having detailed information at the building, site, property, neighborhood, and regional scales will allow real estate developers and investors to identify adaptation, hardening, and hazard mitigation strategies that might defend against specific types of physical risk as well as the extent to which investors need to work within larger networks for planning and policy advocacy.

### Value and Value at Risk

With the varied methods of value estimation including choice of asset valuation, selection of damage responsibility, time horizon, and others described earlier, VaR can be challenging to understand. Given the levels of uncertainty in climate-risk models themselves, perhaps some consensus on appropriate value metrics can be reached.

Where providers estimate VaR, clearly disclosed methodology would benefit users.

### Stakeholder Communications

Measurement and valuation of physical risk must be communicated to a wide array of stakeholders for a variety of reasons. For example, investors need to report to their shareholders about how investment actions are aligned with investor priorities relating to ESG and climate. Many institutional investors require firms taking investment capital to clearly and precisely report risks and manage differences in signals across their portfolios.

Stakeholders may wish to report voluntarily to organizations such TCFD or the United Nations' Principles for Responsible Investment (UNPRI) or GRESB. They may also be required to comply with SEC regulations, Sustainable Finance Disclosure Regulation (SFDR), or other regional requirements given their investment geographies.

# Next Steps

Motivated by the numerous challenges involved in integrating physical risk into commercial real estate decision-making across its life cycle, this report discussed how physical risk analytics firms measure climate risk, described how different real estate investment firms currently use the data, demonstrated that the capitalization of climate risk into asset pricing has already begun, and provided a road map for improved decision-making with climate risk in commercial real estate.

Among the key issues discussed were limited alignment of physical risk scores for the same asset and competing methods to calculate value and value at risk. Difficulties translating the complex climate science into applied financial econometrics contribute to these concerns, further compounded by the fact that climate science is rapidly evolving as a science.

The good news is that this hurdle parallels similar introductions of newly assessed risks, such as environmental risk, terrorism insurance, and a host of other new issues over the history of real estate. The dedicated and resourceful professionals in both real estate and climate science will continue to work together toward a solution.

The next steps include the development of industry standards. Organizations like ASTM International, which is developing a Property Resilience Assessment standard, will aid in this process. As the Securities Exchange Commission in the United States and the European Commission in the European Union likely move from proposed to actual climate rules, some level of standardization should soon follow—regionally if not internationally.

During the period when the real estate industry develops standardized and industry-accepted practices, tools like the climate-risk assessment road map described on page 17 should help should help guide users on their journey to make more informed decisions. That series of questions, designed as a starting point, can aid in the process of evaluating, integrating, and using physical climate-risk data.

An important point for the real estate industry to consider is that regulators intend to create a framework for physical climate risk (and transition) for *all* industries, not just real estate. While the built environment is certainly dominated by traditional, investable asset classes, it also includes infrastructure, energy generation structures, specialty manufacturing, and transportation infrastructure, among other elements. The real estate industry can be a leader in this discussion, and in so doing needs to consider the broader goals.

Regulatory constraints aside, the next step is for continued and ideally public discussion between the providers of risk analytics and the real estate investment community. Increased transparency leads to meaningful conversations. Through collaborative efforts of real estate owners/investors/managers, service providers, and government partners, stakeholders can reach tenable solutions.

# Notes

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