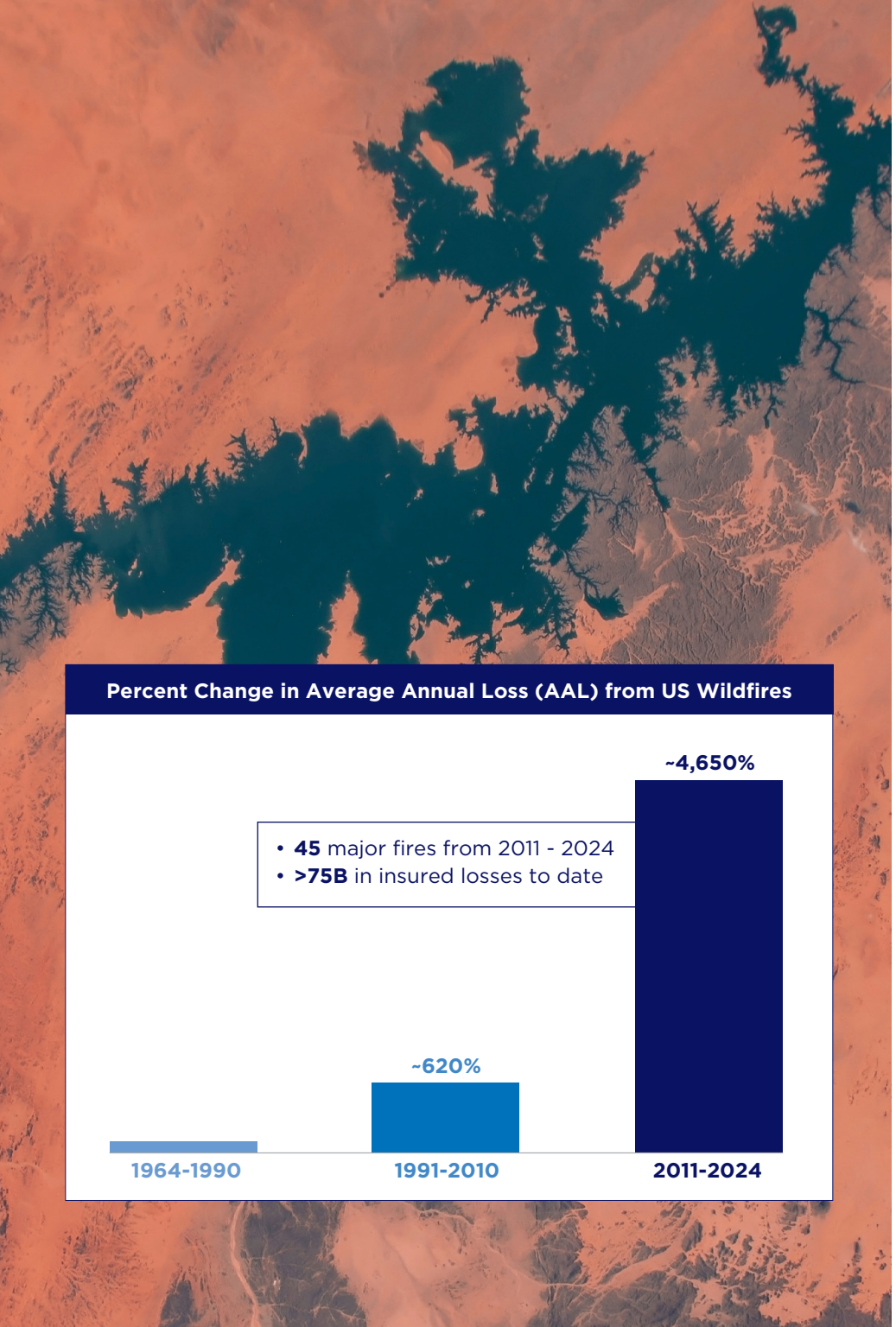
MOODY'S

Mitigating Wildfire Risk in a Changing Climate:

How adaptation investments can help reduce the escalating financial impacts of wildfires



Navigating Wildfire Risk Adaptation

Wildfire risk is increasingly influenced by the effects of climate change. Rising temperatures, changing precipitation patterns, and prolonged droughts create conditions that facilitate the spread of wildfires. As a result, the frequency, severity, and duration of wildfires are on the rise, posing significant threats to communities, ecosystems, and economies.

The relationship between climate change and wildfires presents unique challenges for a wide spectrum of stakeholders, especially insurance companies. The increased risk and unpredictability associated with wildfires make it difficult to accurately assess and price insurance coverage. Insurers face challenges in providing comprehensive and affordable wildfire insurance, leading to coverage gaps and potential financial vulnerabilities for homeowners, businesses, and communities. The limited historical data and the evolving nature of wildfire risk due to climate change and social inflation adds another dimension of complexity to risk management strategies.

Addressing these insurance challenges requires collaboration among insurers, policymakers, and stakeholders. It involves implementing next generation risk assessment models to account for climate change impacts, enhancing data collection on wildfire risk, and developing innovative insurance products that accurately price the evolving risk landscape. Additionally, investing in community-level mitigation efforts, promoting resilient building practices, and implementing effective land management strategies can all help reduce the overall risk and therefore make insurance coverage more accessible and affordable for those living in wildfire-prone areas.

Adaptation investments property owners can consider:

Roof:

- Choose fire-resistant roofing materials such as metal, clay tiles, or asphalt shingles treated with fire-retardant chemicals.
- Keep the roof and gutters clear of debris like dry leaves and twigs that can easily catch fire.
- Install spark arresters on chimneys to prevent embers from igniting the roof.

Vents:

- Cover attic, eave, and foundation vents with fine mesh screens to prevent ember penetration.
- Use ember-resistant vent covers or dampers to protect against ember intrusion.

Exterior Walls:

- Use non-combustible materials for the exterior walls like brick, stone, concrete, or stucco.
- Avoid using wood siding or other flammable materials.
- Seal any gaps or cracks in the walls to prevent ember intrusion.

Windows and Doors:

- Install dual-pane or tempered glass windows to reduce the risk of breakage during a fire.
- Consider using fire-resistant shutters or coverings for windows.
- Ensure that doors have a tight seal to prevent ember entry.

Landscaping:

- Create a defensible space around

Community wildfire risk reduction strategies and planning options:

Fuel Management:

- Conduct regular fuel-reduction activities such as clearing vegetation, thinning trees, and removing dead or diseased plants in common areas and open spaces.
- Establish fuel breaks or firebreaks between communities and wildland areas to slow down or stop the spread of wildfires.

Road and Access:

- Ensure that roads leading to and within the community are wide enough for emergency vehicles to access easily.
- Maintain clear and well-maintained driveways and roadways to facilitate evacuations and firefighting operations.

Emergency Planning and Communication:

- Develop and regularly update emergency plans that include evacuation routes, assembly points, and communication channels.
- Conduct community-wide drills and exercises to practice emergency response and evacuation procedures.

Water Supply and Fire Hydrants:

- Ensure that communities have adequate water supply for firefighting purposes.
- Install and maintain fire hydrants in strategic locations throughout the community.

Education and Awareness:

- Provide education and awareness programs to residents on fire safety, evacuation procedures, and the importance of individual and community-level mitigation efforts

Modeling Wildfire Risk Financial Impacts

Moody's offers comprehensive climate models that are uniquely well-suited to assist stakeholders in addressing wildfire risk, including insurers, utilities, policy makers, and asset managers. These models cover insurance pricing, loan underwriting, portfolio management, community and investment planning for adaptation, and regulatory workflows. Additionally, and the focus of this chapter, Moody's provides specialized modeling that enables cost benefit analysis for structural hardening and defensible space management, whether for an individual property all the way up to community scale planning, offering valuable insights for effective decision-making in mitigating wildfire risks.

Moody's wildfire climate-conditioned catastrophe model is designed to assess and project future time horizons, with analyses conducted in five-year increments up to the year 2100. The model considers key factors such as topography, fuel type, climate patterns, vegetation, ignition sources, community layout and urban conflagration potential to provide a comprehensive analysis of wildfire risk. In addition, the model can include individual property vulnerabilities to heat, ember, and smoke damage based on specific building and property characteristics.

The model utilizes high resolution climate data and projections to simulate the forward-looking behavior of wildfires in different regions considering how variables like temperature, humidity, and precipitation influence the likelihood and severity of wildfires. By incorporating climate change projections, the model can assess the changing risk landscape and provide insights into future wildfire scenarios identifying areas with increasing burn probability.

Unpacking Burn Probability

Burn probability refers to the likelihood of an area being affected by a wildfire within a specific timeframe. The model assesses burn probability by analyzing a range of variables such as historical fire data, fuel load, topography, and weather conditions. The inclusion of burn probability in the model allows insurers, policymakers, and other stakeholders to better understand the spatial distribution of wildfire risk. It helps identify high-risk areas where preventative measures, such as fuel management and community-level mitigation efforts, should be prioritized. Additionally, burn probability analysis aids in determining insurance pricing and coverage decisions, allowing insurers to assess the potential losses associated with wildfires in specific locations.

Upper Deerwood Case Study

Applying the Moody's wildfire climate-conditioned catastrophe model to a high wildfire risk California suburb, Upper Deerwood (pictured below), the analysis explores present-day and future exposure to wildfire using loss cost and average annual loss (AAL) metrics under various Representative Concentration Pathways (RCPs). AAL, representing the average of potential losses in a given year, is a key metric in this analysis complemented by loss cost, which is defined as the average annual loss per $1,000 insured coverage. In addition to exploring alternate RCPs and time horizons, different scenarios are considered, including the hardening of building structures and community expansion of defensible space to reduce proximal fuel and local burn probabilities. The climate change scenarios shown for the Upper Deerwood community are not necessarily representative of broader climate change impact estimates for Northern California or the United States. Variations in wildfire behavior, local and regional responses to climate change, and property vulnerability, including adherence to local building codes, can lead to differing climate risk outlooks depending on the location of an individual property or portfolio of properties.

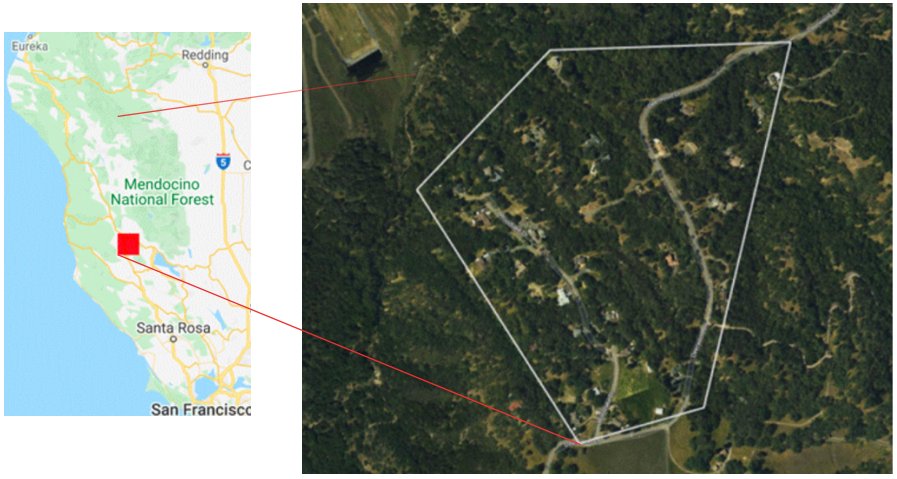


Figure 1. Upper Deerwood suburb pictured on the left in map view and aerial on the right reflects a moderately dense neighborhood in a wooded area.

The analytics reveal a significant reduction in loss cost at the portfolio level, both in the near term and under aggressive climate change scenarios later in the century when mitigation actions are applied, as shown in Figure 2. The initial AAL without mitigation measures is measured for the present-day climate and building conditions. This is followed by calculating the benefits of structural, and then combined structural and vegetation, mitigation. Figure 2 shows the percent difference in AAL relative to present day wildfire risk between each set of conditions, RCP, and time horizon.

Notably, present-day and even end-of-century risks under aggressive RCP 8.5 are significantly reduced compared to present-day AAL when both structural hardening and vegetation mitigation are implemented. When only structural adaptations are applied, AAL is significantly reduced early to mid-century, but outlooks to the end of the century show increased risk relative to present day for RCP 8.5.

Upper Deerwood Percent Difference in AAL Compared to Present Day Wildfire Risk[1]

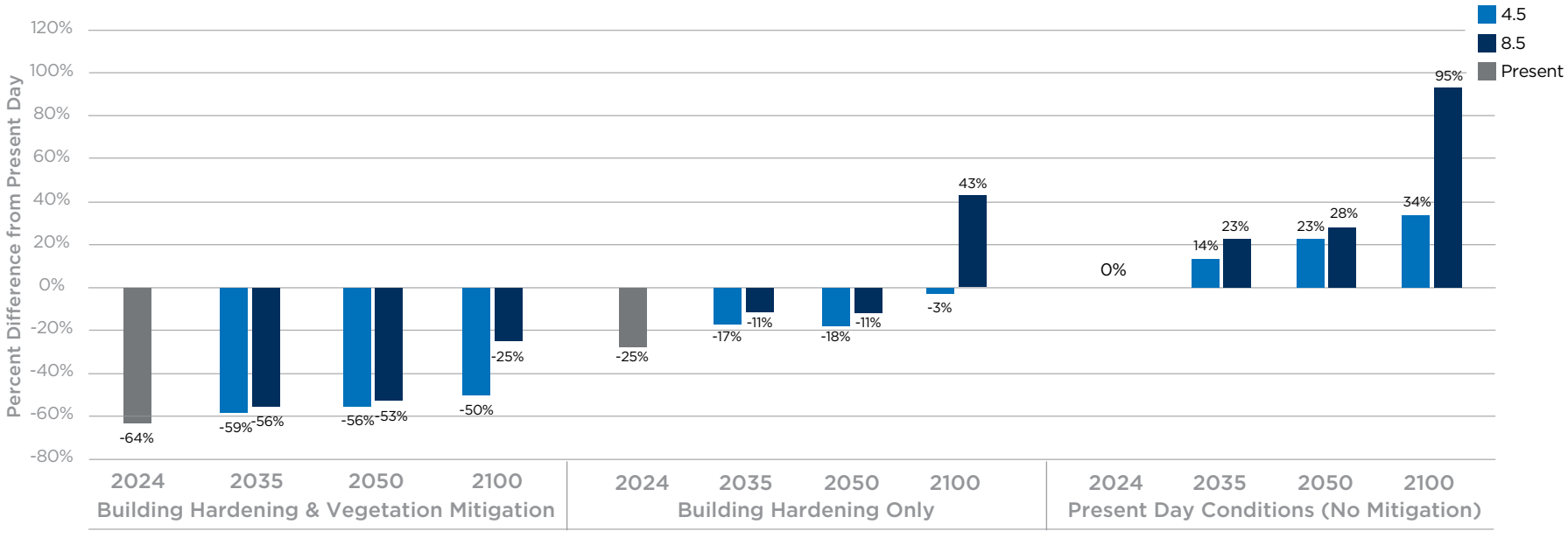


Figure 2: Shown left to right are increasingly less mitigated scenarios in terms of the percent difference in average annual loss (AAL) calculated relative to present day vegetation and building construction. RCP 4.5 is considered a moderate climate change pathway, while RCP 8.5 is considered a more extreme one.

[1] The climate risk metrics shown for the Upper Deerwood community are not necessarily representative of broader estimates for Northern California or the United States.

Figure 3 shows, in dollar terms, the loss cost per $1000 of insured value, across present-day and mitigation scenarios under RCP 4.5 and 8.5 at near-term, mid-term, and end-of-century time horizons. Notional property values are assumed to be $789,000 based on RMS Wildfire study 2020.[1] The loss cost results reflect those of the percent change in AAL previously discussed and provide additional financial risk quantification.

Notably, under present day building structure and vegetation conditions loss costs are estimated to rise at least 23% by mid-century and nearly double by 2100 under extreme climate change pathways. Experts observe that even a mere 10% increase in AAL could result in significant insurance gaps, leaving many homeowners and businesses vulnerable to financial losses. These results highlight the significant need for communities to invest in adaptation measures to reduce financial impacts from wildfires and maintain affordable insurance. The Upper Deerwood results show that structural hardening and vegetation mitigation can successfully reduce AAL and maintain lower loss costs relative to present day even under aggressive climate pathways.

Upper Deerwood Loss Cost per $1,000 Insured Value[3]

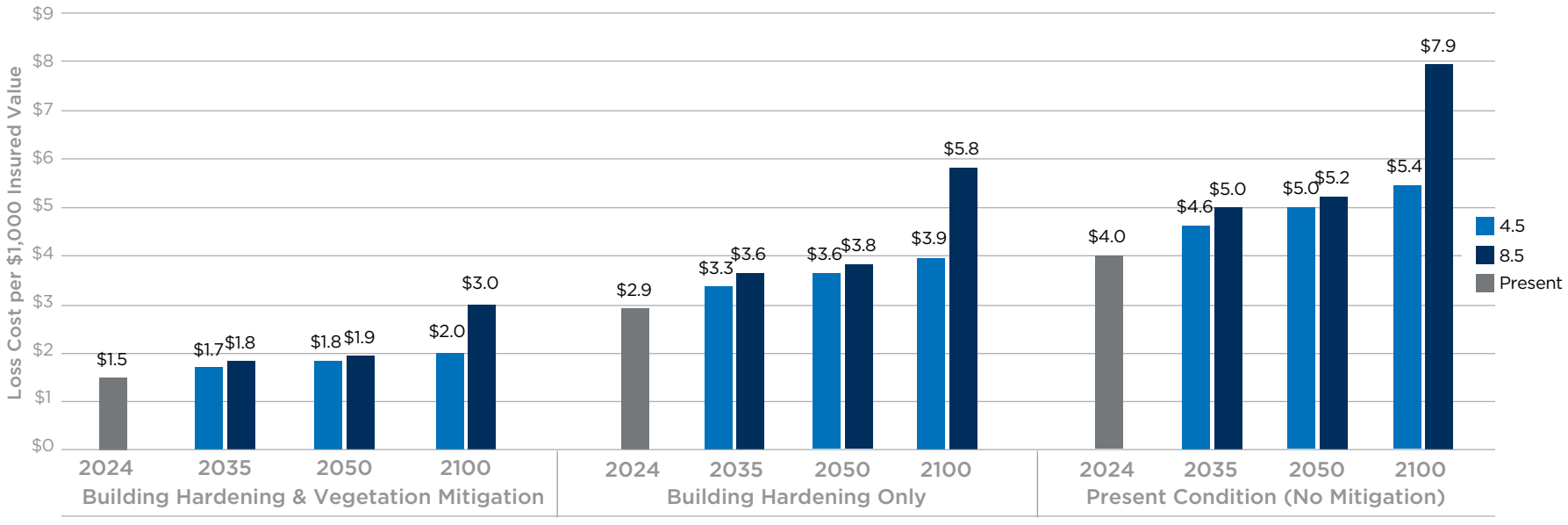


Figure 3: Shown left to right are increasingly less mitigated scenarios' plotted in terms of their loss cost per insured $1000. Notional property values are assumed to be $789,000 per property, with present day AAL under 2100 RCP 8.5 calculated to be $10,931 per property.

[2] https://www.rms.com/offer/wildfire-mitigation

[3] The climate risk metrics shown for the Upper Deerwood community are not necessarily representative of broader estimates for Northern California or the United States.

Wildfire Risk is Business Risk

As the frequency and severity of wildfires continue to rise, there is growing concern about potential insurance gaps and rising premiums. The unavailability of wildfire insurance can also have significant impacts on businesses, particularly corporations and commercial real estate (CRE) owners. Wildfires pose not only a threat to residential properties but also to commercial structures, industrial facilities, and business operations in fire-prone areas.

For corporations, the lack of affordable and comprehensive wildfire insurance coverage can result in increased financial vulnerability. Many businesses rely on insurance to protect their assets, including buildings, equipment, and inventory. Without adequate coverage or with unaffordable premiums, corporations may face significant financial losses in the event of a wildfire. This can impact their ability to recover, rebuild, and continue operations, leading to potential business disruptions, layoffs, and economic downturns in affected areas.

Similarly, CRE owners and operators face challenges in obtaining affordable wildfire insurance for their properties. CRE properties, such as office buildings, shopping centers, and warehouses, often have higher values and more complex risk profiles compared to residential properties. Insurance companies may be reluctant to provide coverage or charge higher premiums due to the increased risk and potential for substantial losses. This can deter CRE investment in fire-prone areas, limit development, and impact local economies, including job creation and tax revenues.

Addressing insurance gaps for businesses requires collaboration between insurance companies, policymakers, and stakeholders. It involves improving risk assessment models, enhancing data collection on wildfire risk, and developing innovative insurance products that accurately price the risk while remaining affordable. However as demonstrated in this report, investing in community-level mitigation efforts and promoting resilient building practices can help reduce the overall risk and make insurance coverage more accessible and affordable for both businesses and homeowners in wildfire-prone areas.

MOODY'S

Climate Risk is Business Risk

The foundation of Moody's value is market insight defining our approach to financial quantification of risk and the capabilities to deliver consistent and complete perspective on the interconnected risks impacting your business.

Moody's encompasses market-tested analytical tools designed for identifying and quantifying the impact of climate risk on global debt markets, credit performance, and financial outcomes.

Our solutions enable understanding of physical climate risks by leveraging decades of real-world data on damages and costs from climate events to inform transparent and robust solutions for modeling risk to real assets and translating it to company and entry-level impacts. We cover transition risk with comprehensive and continuously improving datasets, analytics, and assessments of policy, macroeconomic trends, and company-specific profiles to analyze the impacts of potential future climate scenarios.

Our solutions are developed to seamlessly integrate into the workflows your teams manage across the organization, in which climate data, analytics, and insights should inform strategy and decision-making to future-proof your competitive position in the market.

Learn more at **https://climate.moodys.com/**

Our physical risk capabilities are developed on the foundation of Moody's RMS climate science and modeling expertise. For more than 20 years, Moody's RMS has worked with partners and stakeholders to understand the complexity of modeling physical risks and financial impacts on P&C insurance portfolios and assets. We have extended our understanding of the interconnected and complex dimensions of current risk with globally recognized, forward-looking climate change models and best-available climate science to develop consistent frameworks for assessing future scenarios of risk applicable to enterprise risk management across sectors.

Learn more at **https://www.rms.com/climate-change**

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