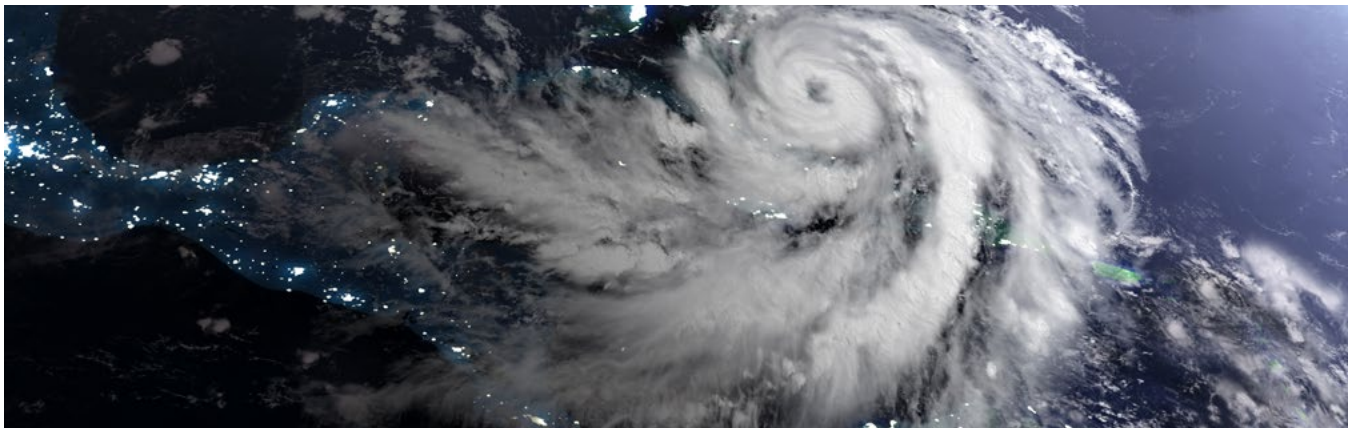


MEASURING CLIMATE RISK

How Banks and Asset Managers can Accurately Understand Future Climate Risk Now with Agent Based Modeling

14%

Asset managers that wait until 2025 will have to cut emissions by 14% a year to limit warming.[3]

Scenario testing is used by the Bank of England as part of their latest stress testing approach to assess the resilience of the UK banking sector.[4]

Financial institutions and asset managers need to plan and execute global strategies in a highly connected and complex world. Among the most complex and pressing problems being confronted is the need to quantify and evaluate the impact of climate change on balance sheets, profitability and cash flow. Such assessments are highly likely to drive demand for new capital to comply with evolving regulations. In addition to regulatory requirements, clients, investors, and employees are expecting transparent progress through disclosure reports that identify gaps and progress of efforts related to climate change.

The EU has defined a sustainable finance framework[1] to provide guidance and oversight in the goal of becoming the first climate-neutral continent. As part of these efforts, disclosure requirements will mandate that firms provide "the impact of a company's activities on the environment and society, as well as the business and financial risks faced by a company due to its sustainability exposures." The Bank of England[2] has taken a leadership position in publishing disclosures related to its own progress on climate-related initiatives. At the same time, regulators around the globe are moving towards increasingly stringent rules, including explicit public disclosures on climate initiatives.

As pressure mounts for firms to provide disclosures on progress towards climate goals, it is critical that institutions have an effective and flexible approach to understand their climate risk. Insurance companies have always been acutely aware of climate-related risks, but until more recently the financial and asset management sectors have not needed to consider the potential impact of such exposures. With the increased interest from corporates and scrutiny by regulators, there is now a need for all firms, but banking institutions in particular, to better model, measure and manage the economic and financial effects of climate change. Central to this requirement is the need to generate scenarios to improve insight into the range of impact and potential strategies available to address the inherent commercial risks and opportunities in the years ahead.

Variables in Measuring Climate Risk

Climate risk is extremely difficult to measure due to the complexities of the climate and financial systems. Familiar metrics such as value at risk, potential exposure and scenario analysis provide a straightforward approach for institutions to begin to understand relevant risk factors, model a realistic range of scenarios and plot an effective risk mitigation strategy.

Climate Risk Categories

PHYSICAL	TRANSITION
Temperature	Carbon Tax Credits
Precipitation	Carbon Penalties
Sea level	Property Damages

ALIGNMENT
Corporate Strategy
Portfolio Adjustments

The variables that affect the exposure to climate change can broadly be grouped into three categories of risk:

- Physical: the physical impacts, including upstream and downstream impacts (i.e. rising temperatures that cause lower productivity in labor forces affected by the heat, coastal properties or agricultural insurance)
- Transition: the changes in asset values, business models, etc. (i.e. the taxes and penalties associated with "dirty energy", the cost of clean energy innovation, supply chain insurance)
- Alignment: the steps needed to adjust and determine next steps (i.e. corporate strategy and investment changes)

Quantifying and evaluating climate risk will require risk and finance teams to model behavior, evolve new metrics and generate scenarios using rising sea levels, emissions, etc. to anticipate emergent, potentially catastrophic climate-related events. They must be able to accommodate a dynamic and complex set of highly variable data. However, financial institutions have limited experience in forecasting the dynamics and quantitative impact of climate change (physical, economic, and societal). It is uncharted territory; yet there is an increasingly urgent need for both accuracy and precision to deal with both the micro and macro effects of climate change.

Developing the required insight into climate risk demands that the problem be analyzed from the bottom up to capture the aggregate impact of the enormous range of interacting and interconnected micro effects. Models that can incorporate the uncertain interactions of micro variables can help predict the impact on a bank's balance sheet, enabling better risk management and improved identification of potential business opportunities.

Current methods and tools have proven inadequate even though they remain strongly embedded into the current measurement and decision-making process. However, there is a more effective and accurate way to model and simulate the complex and evolving processes and thereby gain the foresight institutions need today to meet their climate objectives more rapidly, namely, agent-based modeling and simulation.

Agent-Based Models

Agent-based Models (ABMs) are computer models for simulating the actions and interactions of autonomous elements (such as organizations, groups, or individual people). It is widely used in science to search for explanatory insight into the collective future behavior of elements who obey (or may disobey) rules. Each element (or agent) is an entity which may be modified to assess its resulting impact on a complex system, such as a financial market or the planet's climate. These individual elements might include temperature, coal powered energy facilities, emission rates, barometric pressure, sea level, etc. When modelled and run in a simulation, the interaction of the agents helps us to better understand potential outcomes for not only the agents and groups of agents but for the whole system.

ABMs link together a disparate group of factors across the natural sciences, economics, societies, financial markets, governments, and industries. It captures uncertainty and emergent behavior while generating and incorporating realistic feedback. The simulations help create scenarios that institutions can use to gain better predictive capability and insight.

Technology advancements in the last ten years, such as improved processors, faster and cheaper storage, and cloud computing, have made feasible the widespread institutional use of agent-based modeling and simulation. These developments are particularly relevant for larger and more complex ABMs that combine climate and economic interactions to measure climate risk at the balance sheet and portfolio levels for banks and asset managers. These comprehensive models are increasingly critical for estimating exposure for banks and damage functions for insurers. The added benefit is that the models can also be used to evaluate scenarios that explore the potential feedback effects of mitigation strategies and regulatory policy variation. The ABM approach makes possible climate–macroeconomic models

Cloudera Data Platform offers the tools to help financial services embrace both the present opportunity around data, as well as the emerging sources of new information to manage risk and compliance more effectively.

To learn more about how Cloudera enables climate risk scenarios, visit cloudera.com/solutions/financial-services

calibrated on stylized facts, future scenarios, and climate impact functions for use in measuring climate risk, the first step in transitioning to an appropriate risk level and identifying new business opportunities for the future.

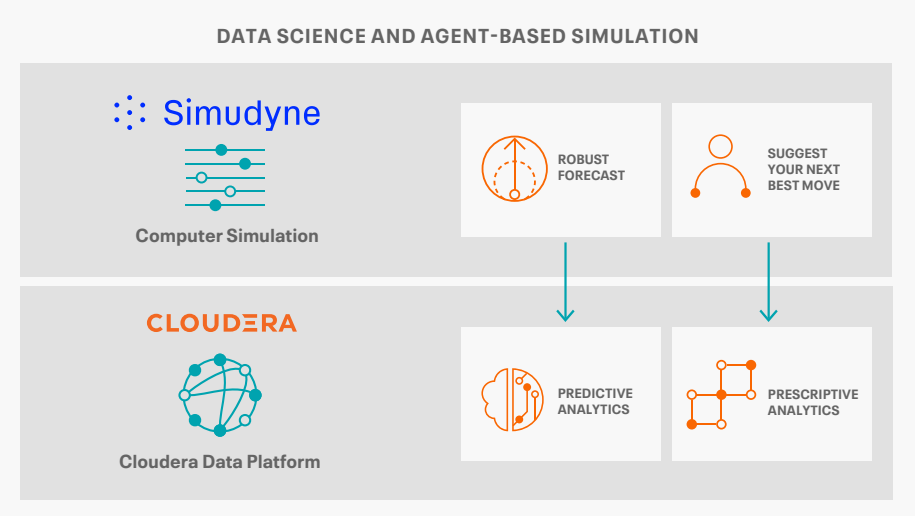
Scenarios (for stress and reverse stress environments) generated using ABM provide the insights banks and asset managers need to measure and manage risk. With an ABM approach, banks and asset managers are able to measure climate risk including measuring a firm's own carbon footprint, investment valuations, customer loan portfolios and the corresponding capital adequacy. In the wake of the 2007/8 credit crisis, scenarios are the principal means financial institutions use to gain the insight required to guide the transition and alignment to a lower carbon future for an institution, its clients, investors, and stakeholders.

A Partnership in Climate Risk Modeling

Simudyne, a simulation technology company has built an agent-based model to accurately measure climate risk. Simudyne runs on the Cloudera Data Platform and can use OpenShift containers from Red Hat to run anywhere on the open hybrid cloud. Deloitte provides extensive experience and consultation in the climate model inputs and analysis.

This partnership offers expertise in ABM used in areas such as central counterparty risk modeling, trade execution performance and asset pricing. The modeling approach has been applied to climate change to more accurately assess and measure the associated risks. The solution makes robust scenarios possible with a minimal amount of data and yields actionable insights to help a firm quantify their disclosures.

With a realistic climate risk simulation, institutions can quickly test their strategic decisions to understand the best path forward before committing people and resources. Institutions will better understand how to transition their investors and their portfolios to a properly mitigated level of climate risk for the future.



To Learn more, visit cloudera.com/solutions/gallery/simudyne

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At Cloudera, we believe that data can make what is impossible today, possible tomorrow. We empower people to transform complex data into clear and actionable insights. Cloudera delivers an enterprise data cloud for any data, anywhere, from the Edge to AI. Powered by the relentless innovation of the open source community, Cloudera advances digital transformation for the world's largest enterprises.

Learn more at cloudera.com

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Simudyne

Deloitte.

Red Hat

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