SOLVENCY WORKSTREAM OF THE CLIMATE AND RESILIENCY (EX) TASK FORCE
Tuesday, Nov. 29, 2022
12:00 – 1:30 p.m. ET / 11:00 a.m. – 12:30 p.m. CT / 10:00 – 11:30 a.m. MT / 9:00 – 10:30 a.m. PT

ROLL CALL

Kathleen A. Birrane, Vice Chair	Maryland	Trey Hancock	Tennessee
George Bradner	Connecticut	Scott A. White	Virginia
David Altmaier	Florida	Mike Kreidler	Washington
Gary D. Anderson	Massachusetts	Amy Malm	Wisconsin
Rajesh Bhandula	New York		

NAIC Support Staff: Dan Daveline

AGENDA

1. Opening Comments - Commissioner Kathleen A. Birrane (MD)

2. Company Experience and Utilization of Climate Scenario Analysis

    - Liberty Mutual-Rakhi Kumar & Kelly Hereid
    - Equitable-Aaron Sarfatti

3. Any Other Matters

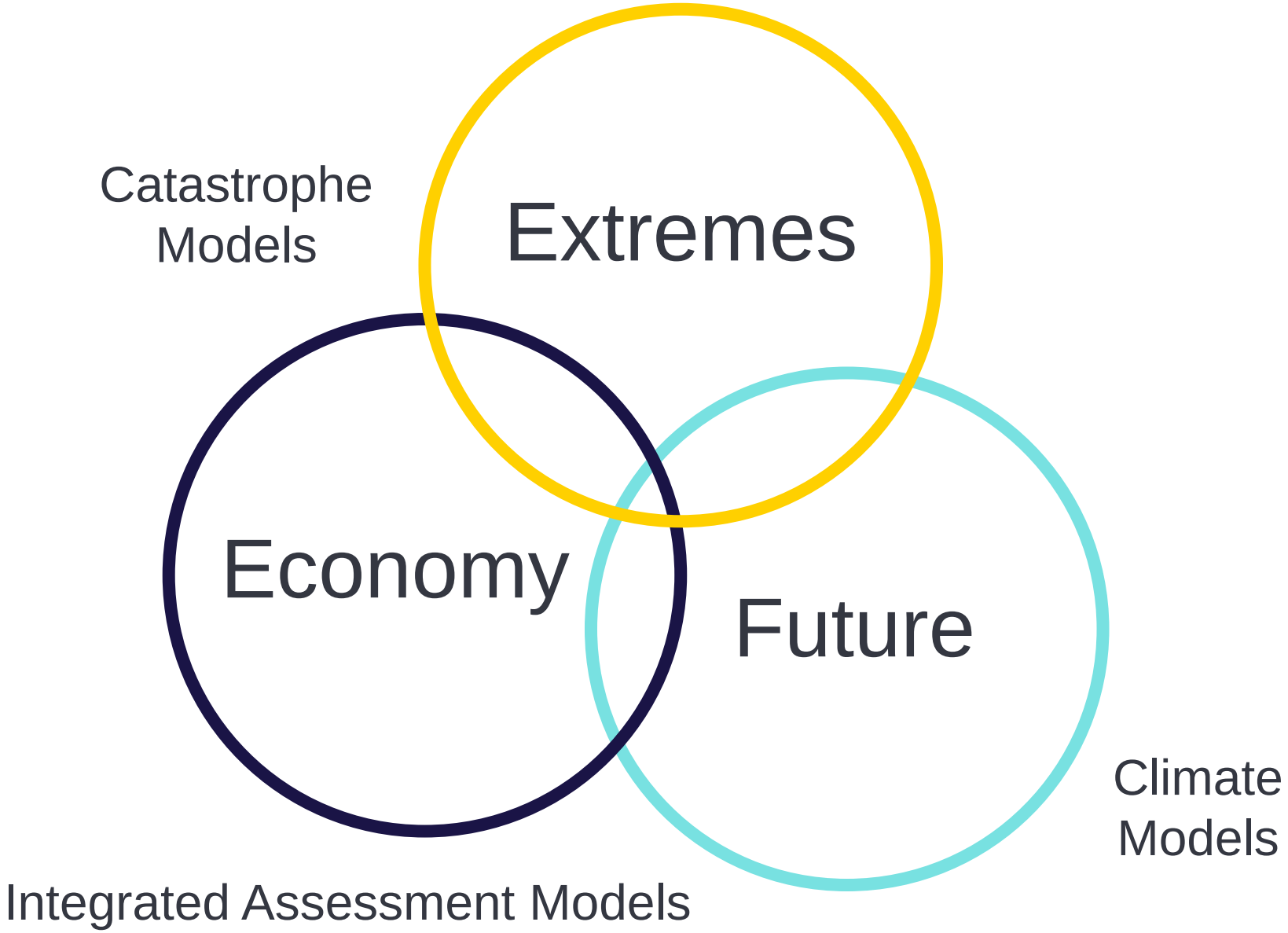
4. Adjournment

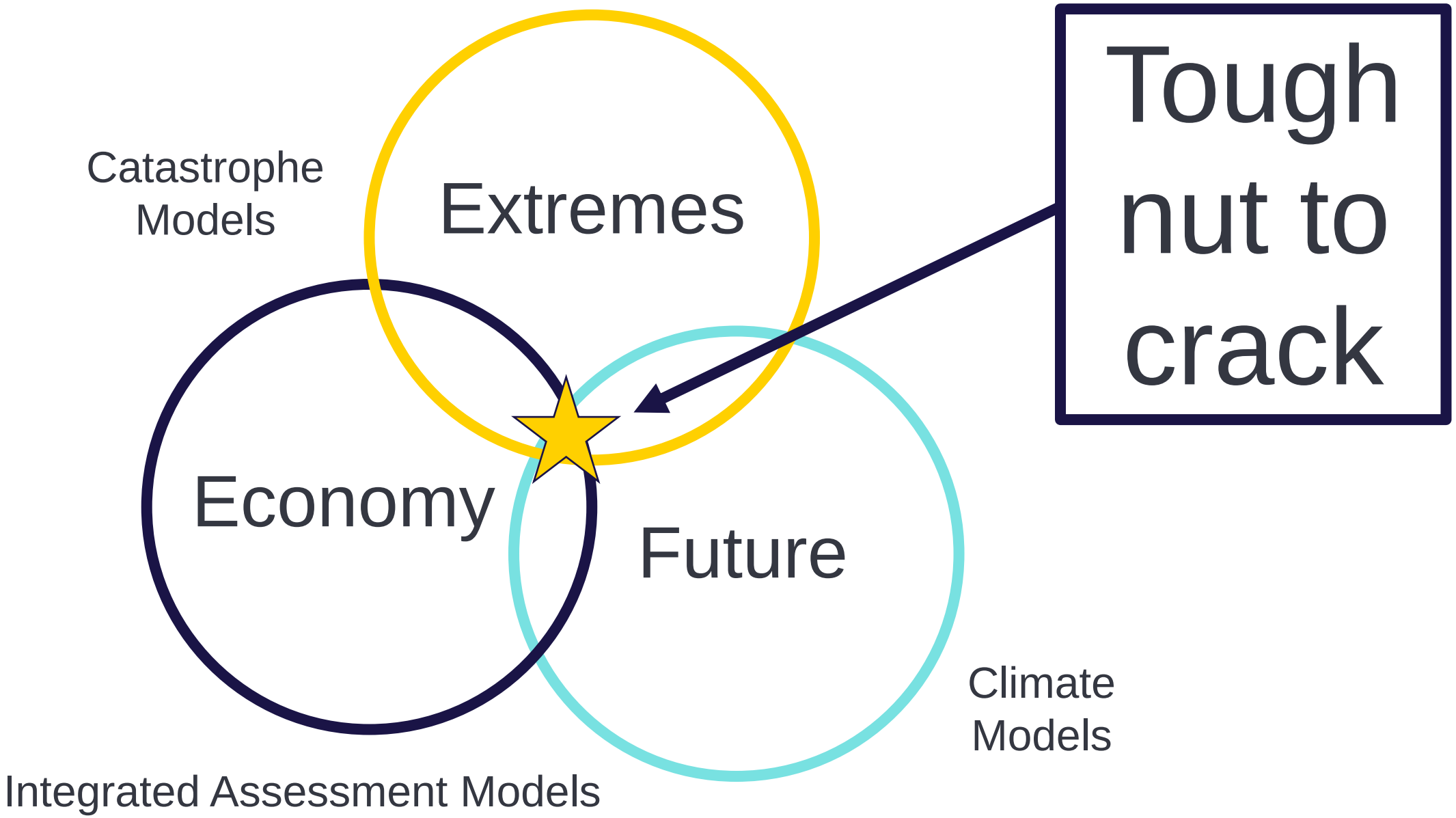
Liberty Mutual's Approach to Climate Risk

November 29, 2022

Rakhi Kumar, Senior Vice President, Sustainability Solutions & Business Integration, Office of Sustainability

Kelly Hereid, Ph.D., Director of Catastrophe R&D, Corporate ERM


Catastrophe Models
Extremes
Economy
Future
Climate Models
Integrated Assessment Models

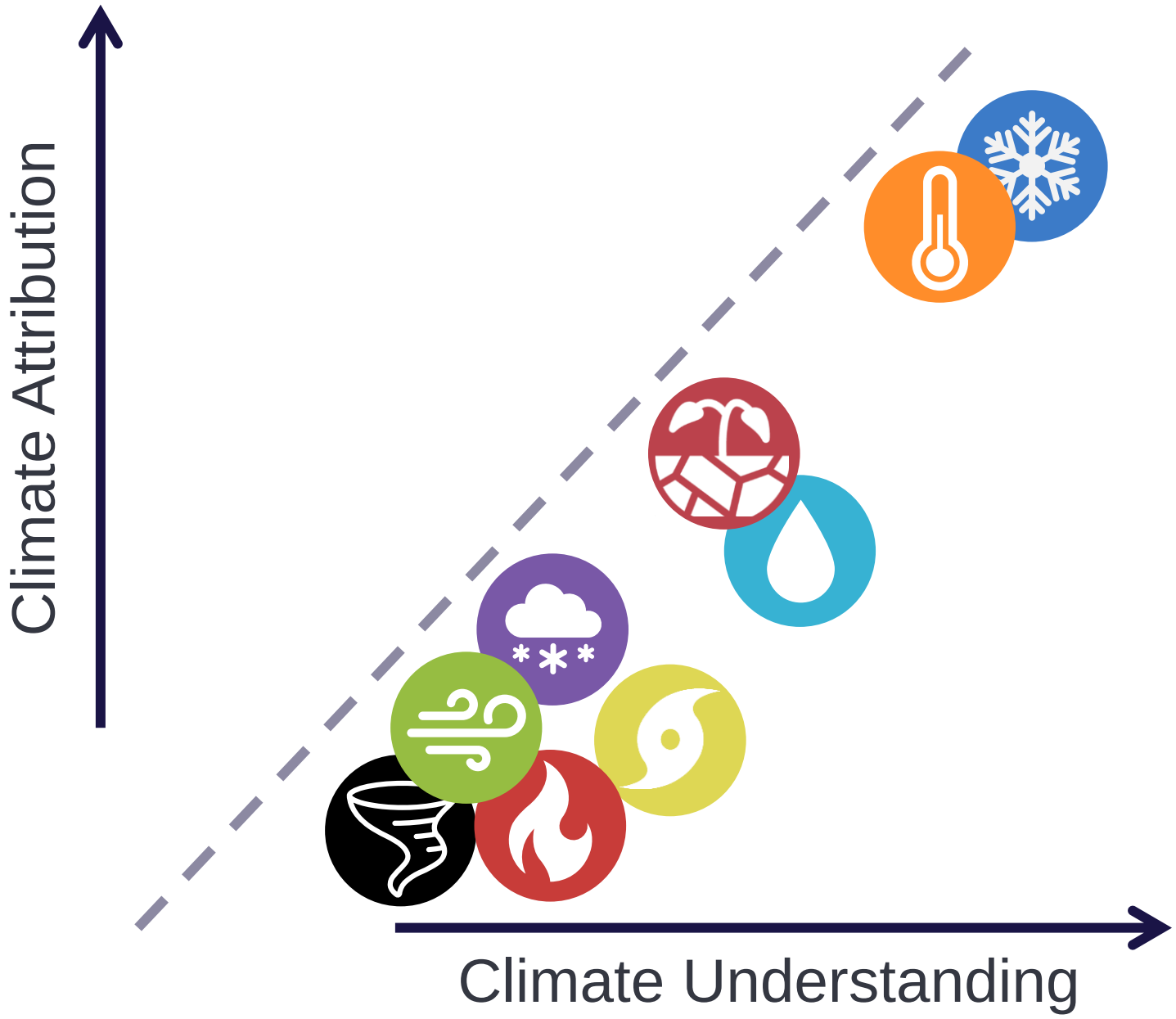

Catastrophe Models
Extremes
Tough nut to crack
Economy
Future
Climate Models
Integrated Assessment Models

The financial sector has discovered climate models

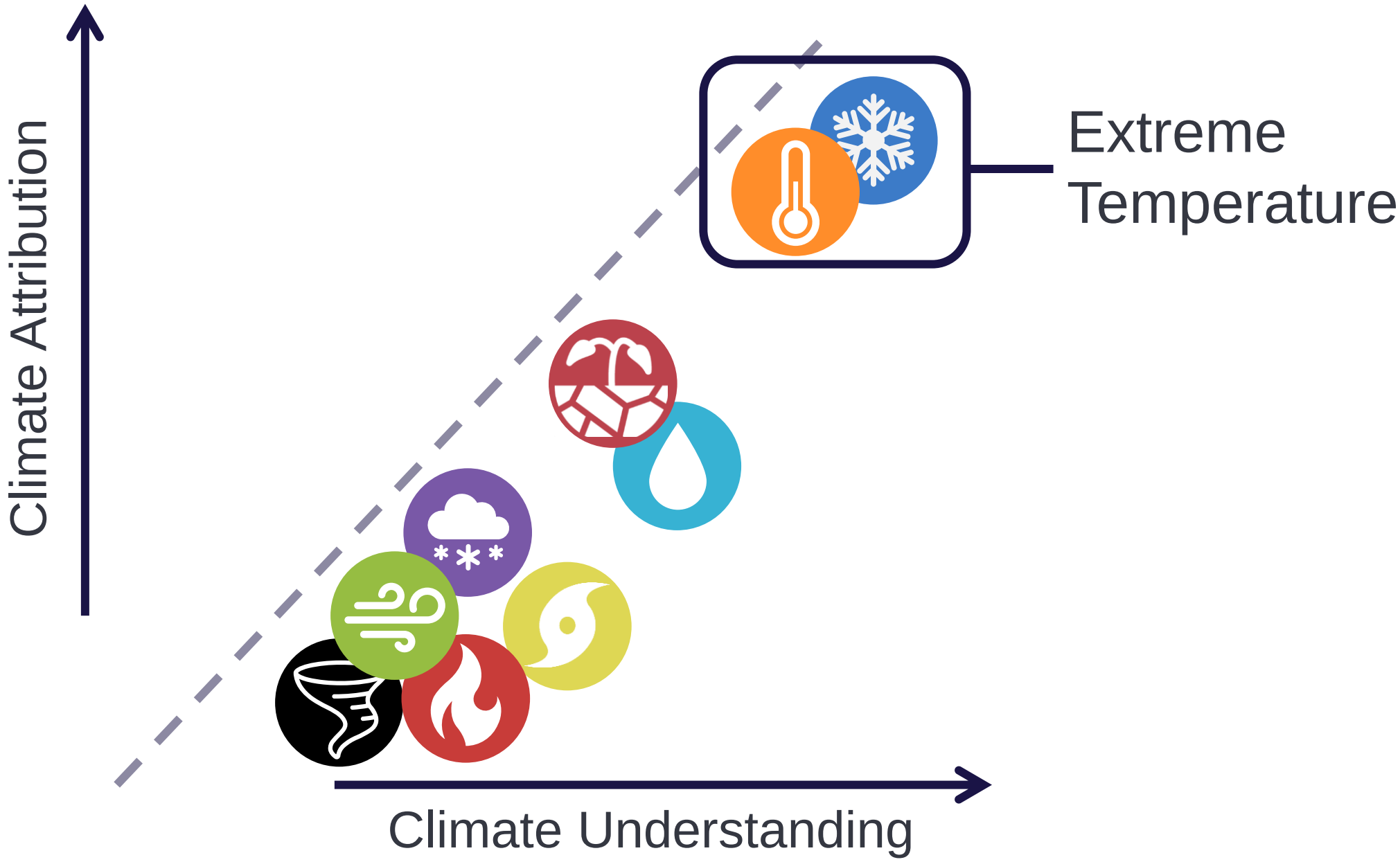
Calls for the integration of climate science into risk disclosure and decision-making across many levels of economic activity has leap-frogged the current capabilities of climate science and climate models by at least a decade.

Fiedler et al., Nature Clim Ch, 2021

Catastrophe Risk in a Changing Climate



After Carbon Brief



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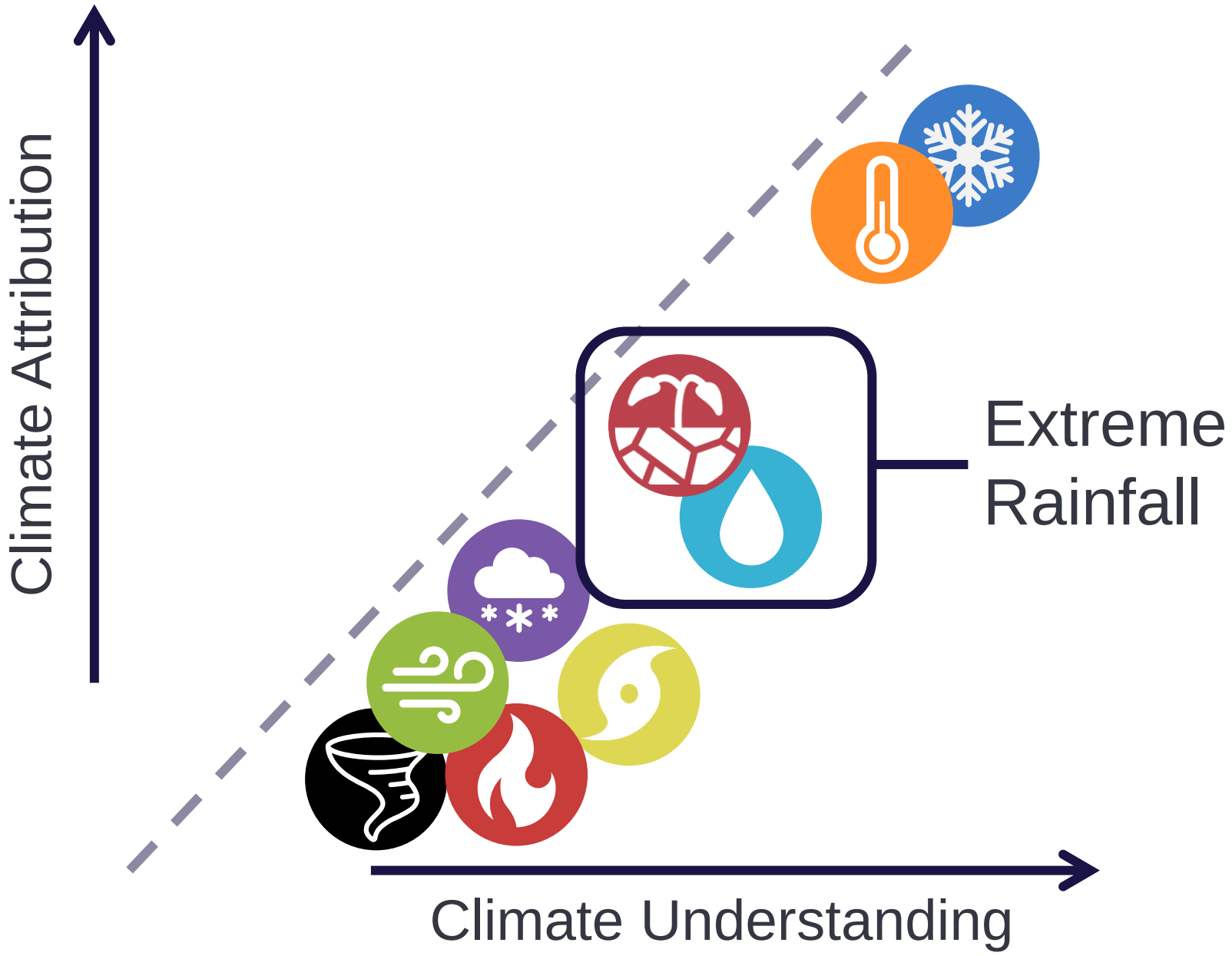

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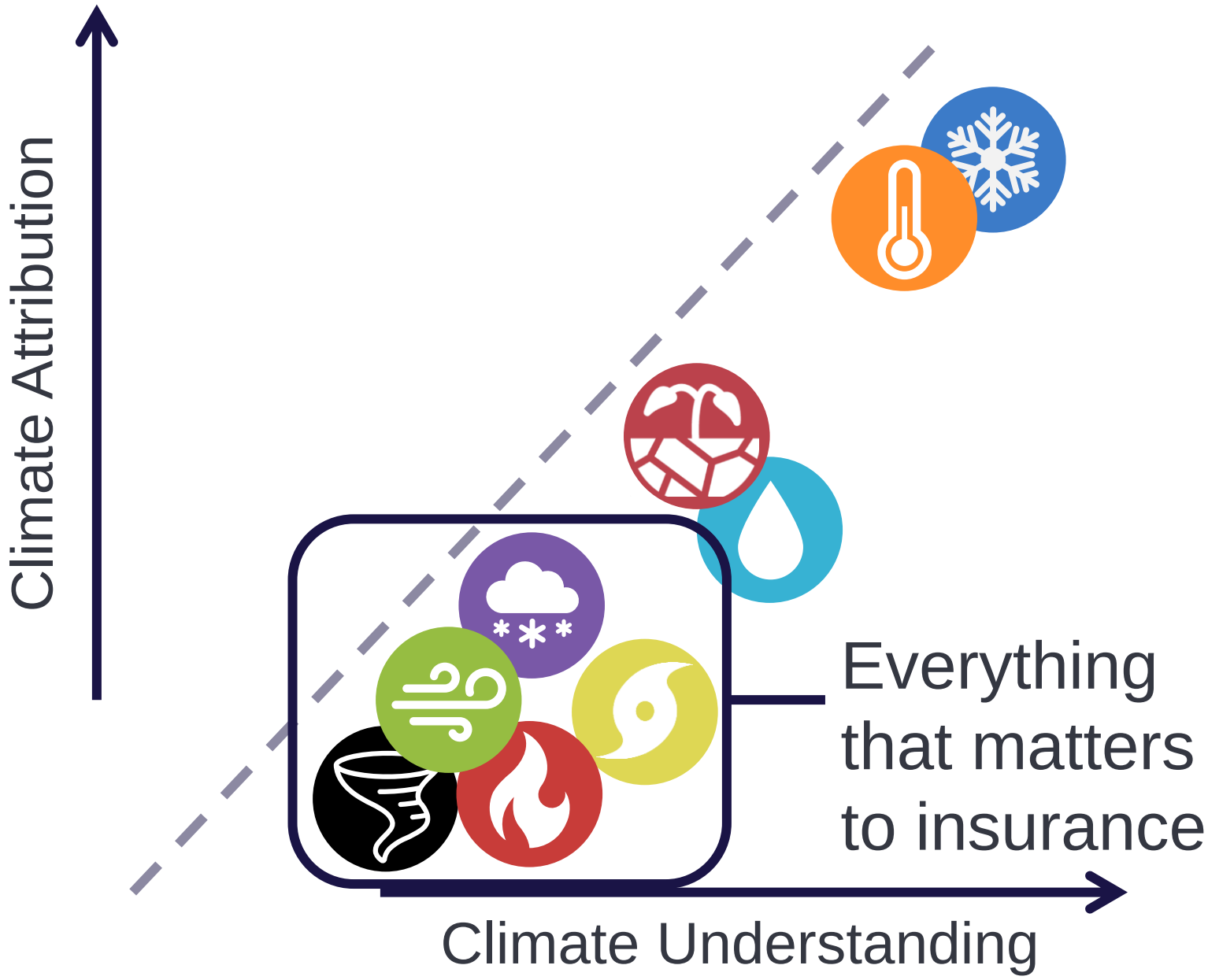

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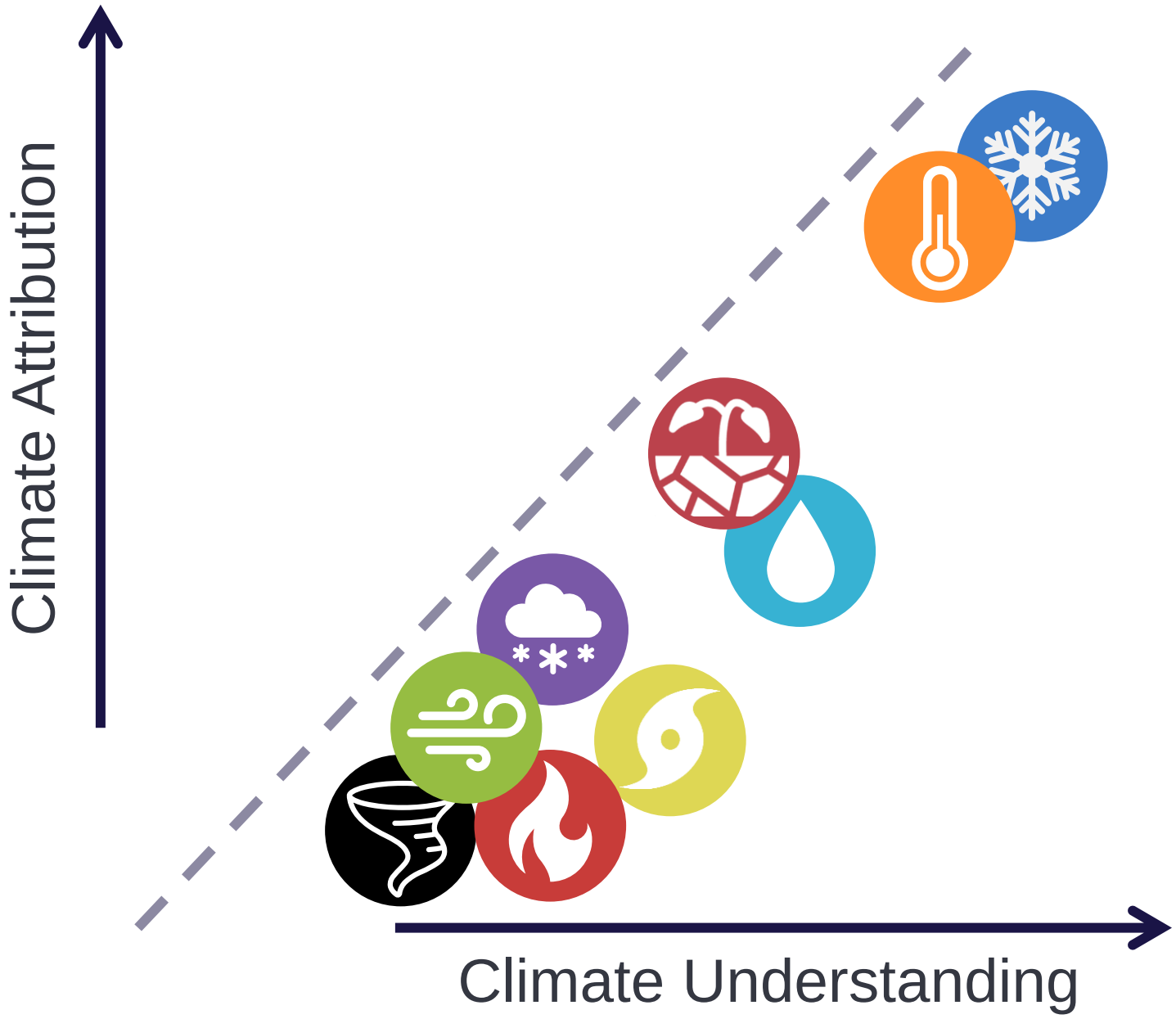

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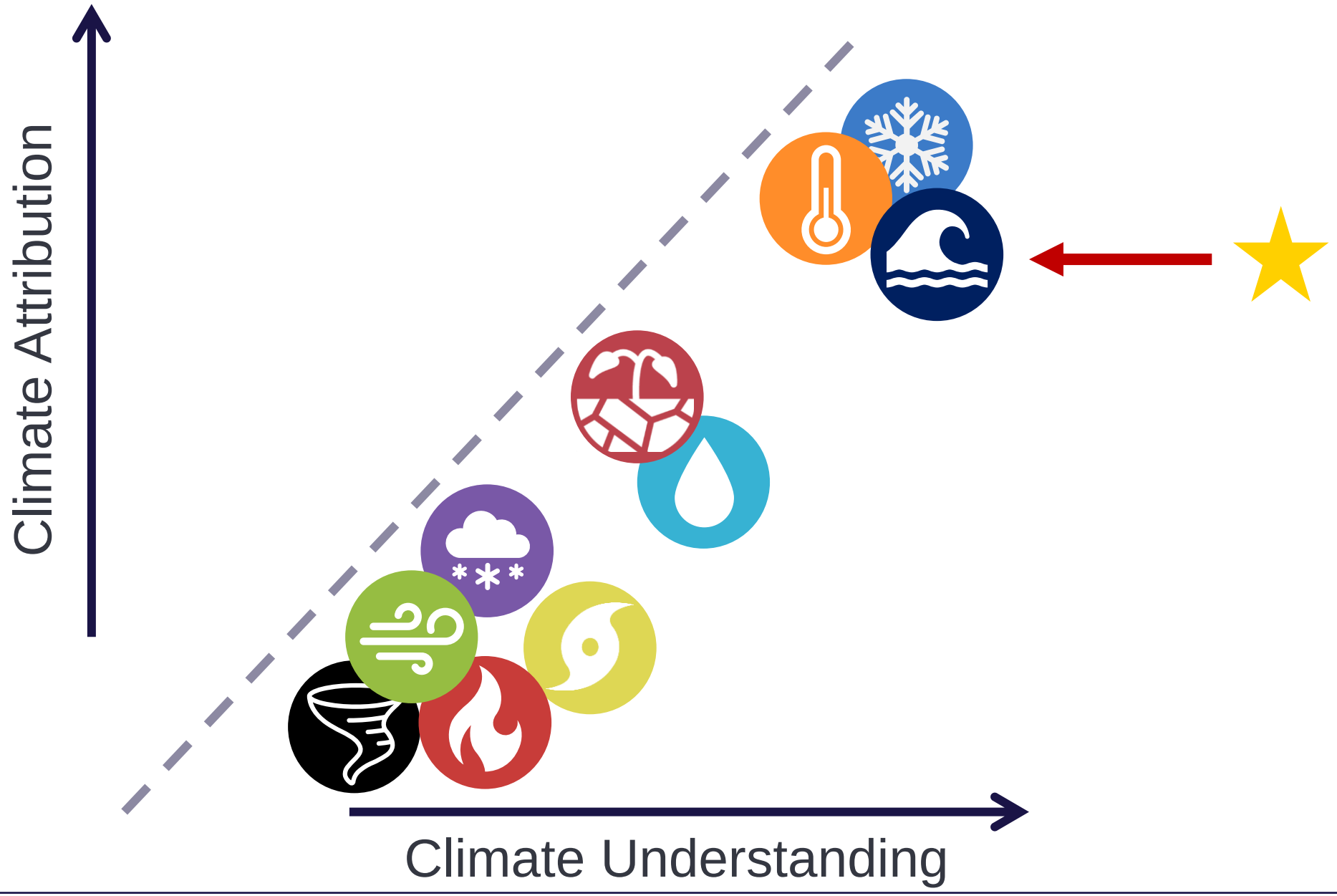

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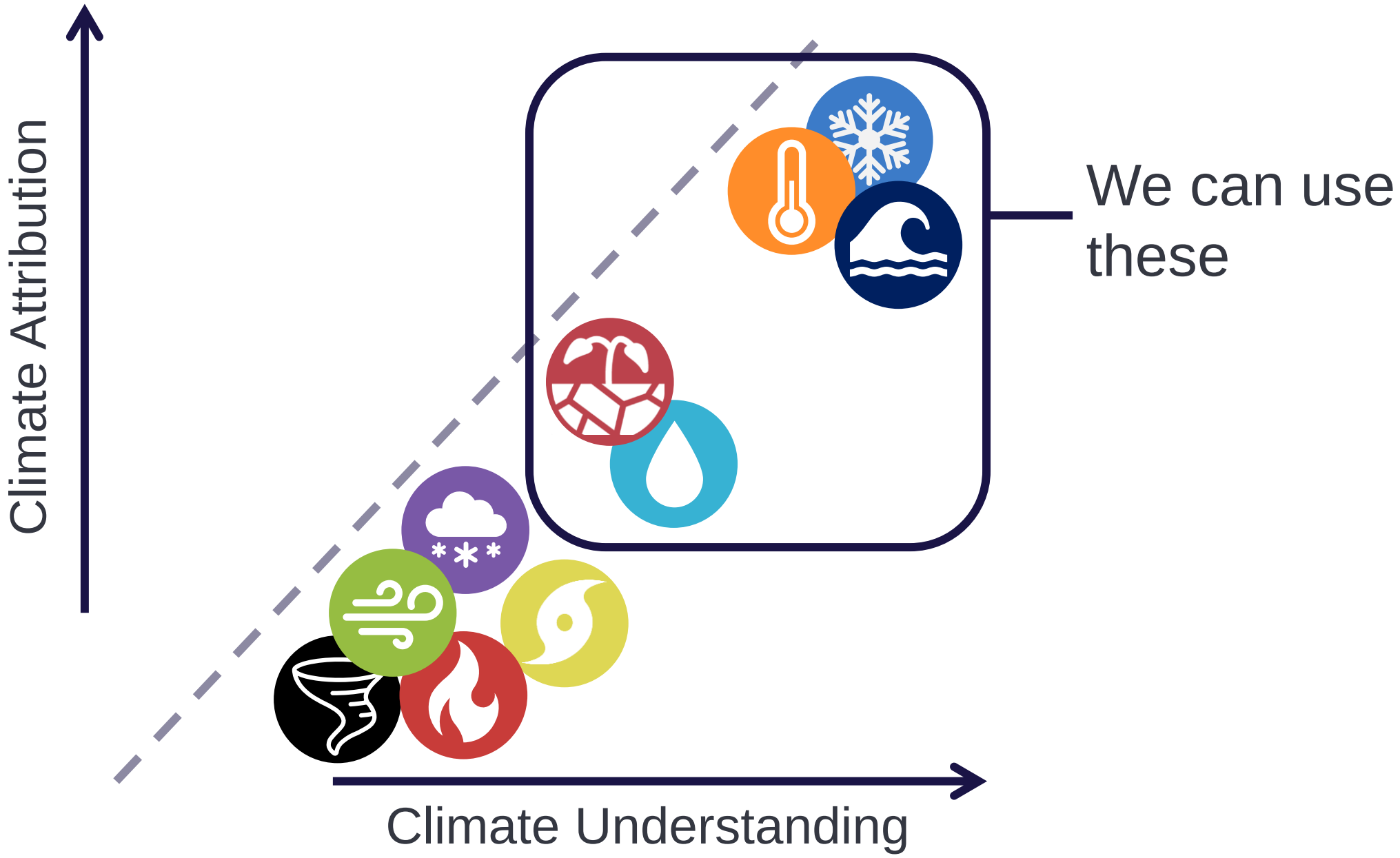
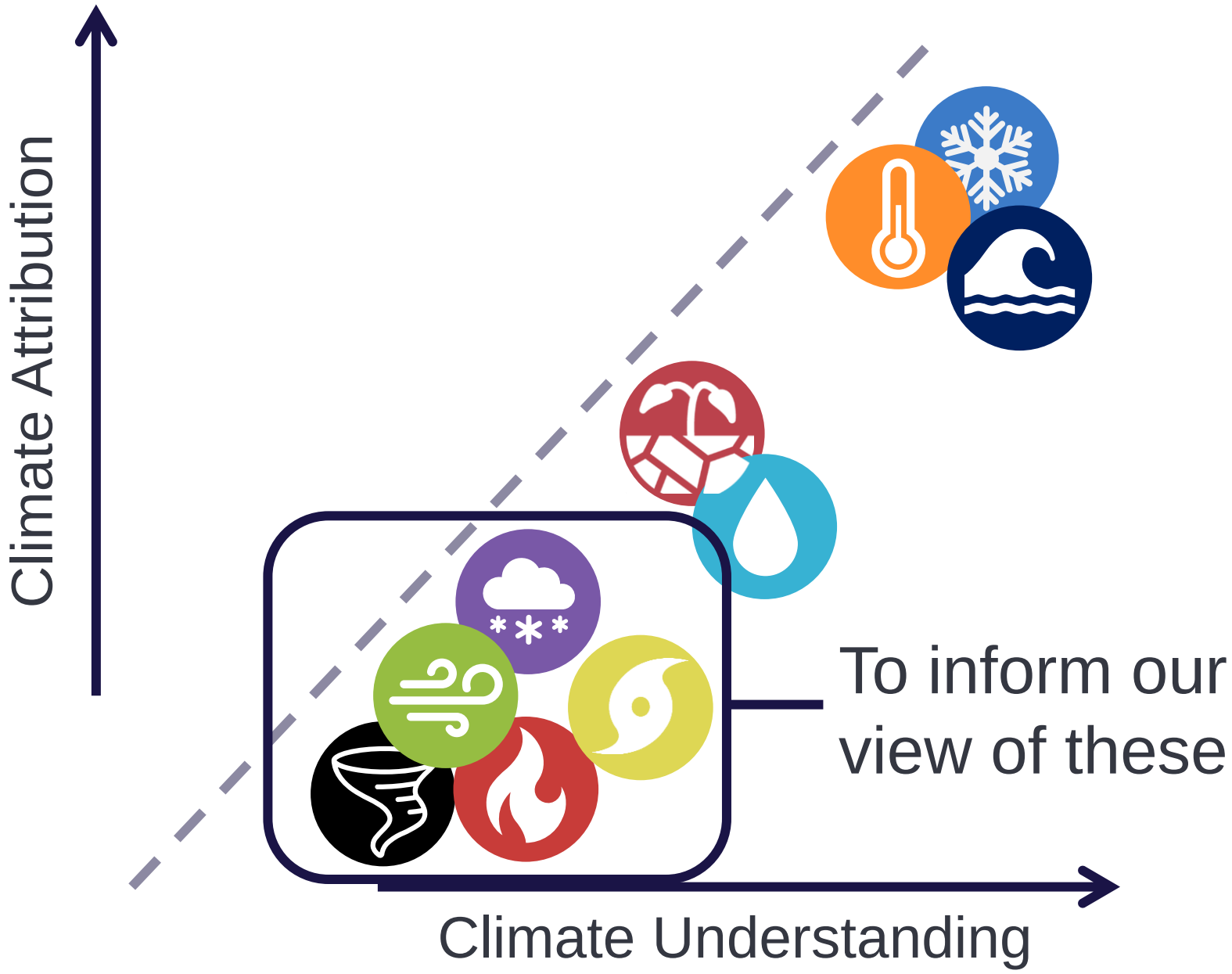

Climate Attribution
We can use these
Climate Understanding


Climate Attribution
To inform our view of these
Climate Understanding

Deploy a flexible toolbox for managing uncertainty

Direction + Magnitude ⟷ Neither Direction / Magnitude

Scenario

Sensitivity

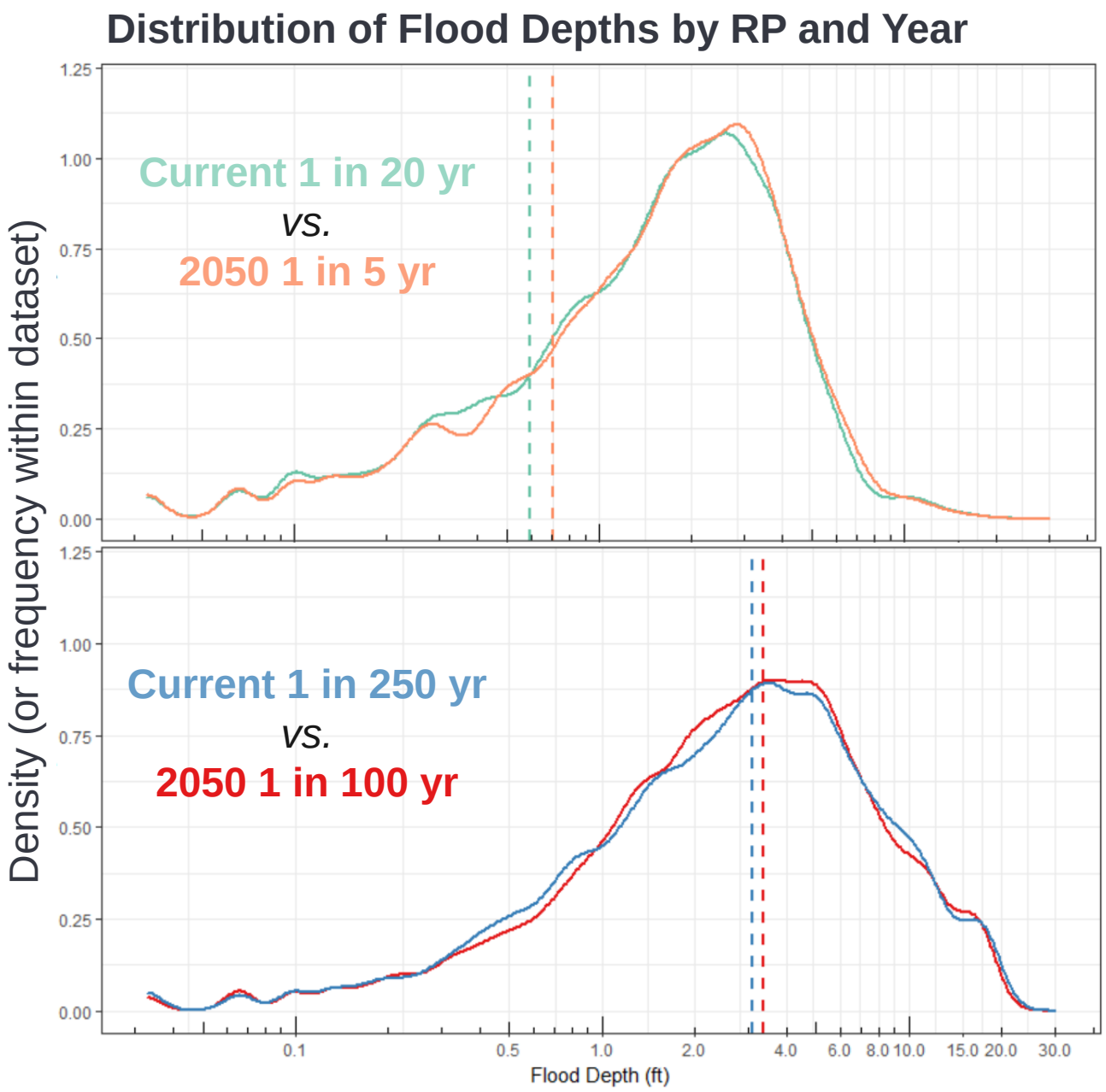
Normative

Sea level rise and surge

Hurricane rainfall

Hurricane frequency

Coastal Flood Return Periods will Shorten




NYT

Critical Thresholds

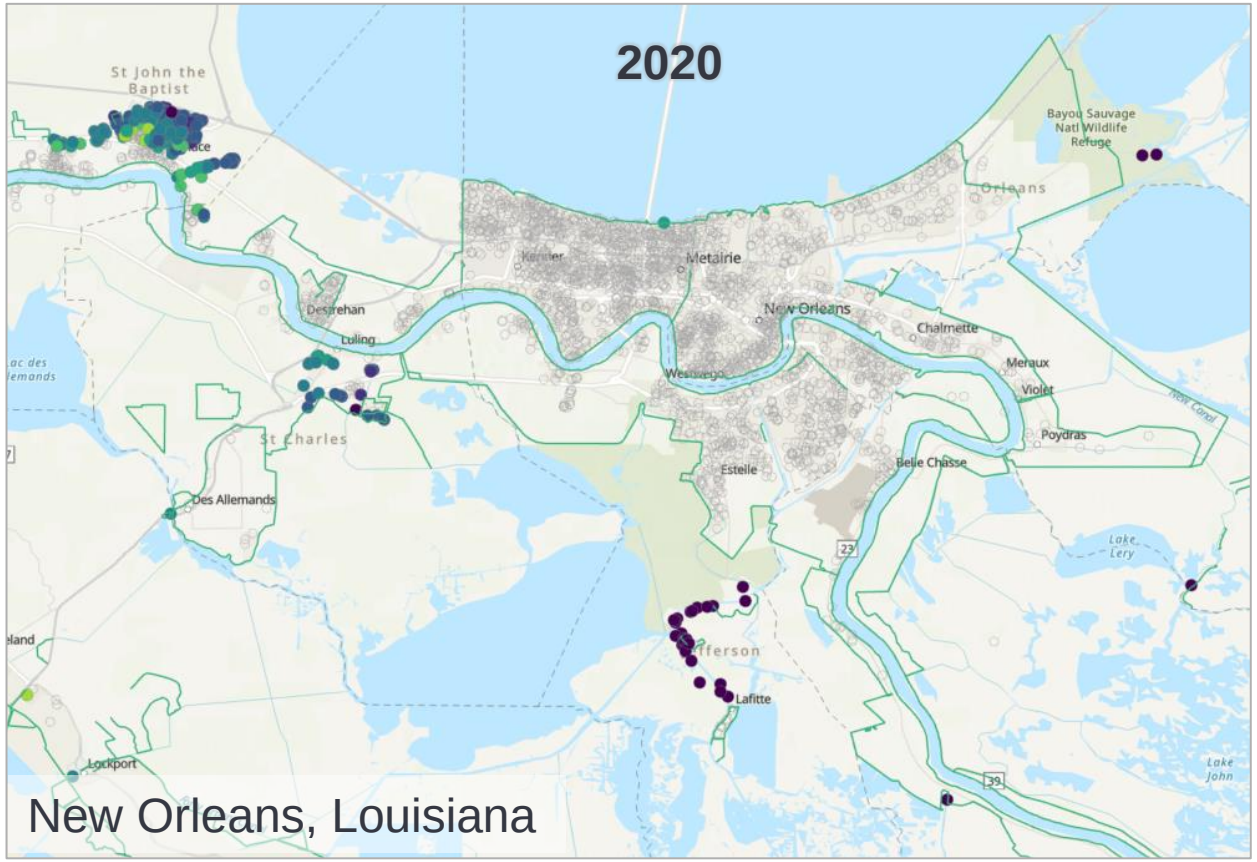
Levee Locations

Exposure Locations

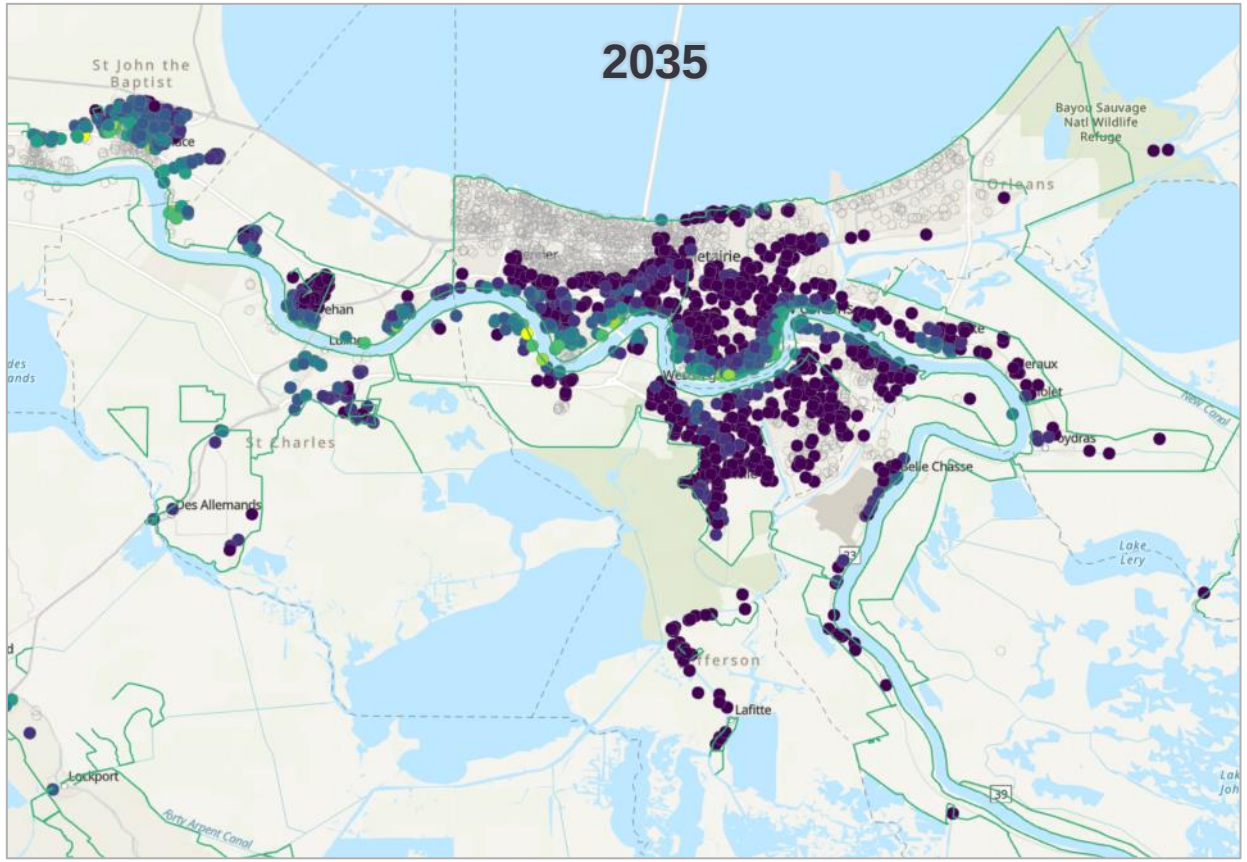
Flood Depth (ft)

- < 1 in
- 1 - 6 in
- 6 in - 1 ft
- 1 - 2- ft
- 2 - 4 ft
- 4 - 6 ft
- 6 - 8 ft
- > 8 ft

1 in 100 year Return Period Depths



New Orleans, Louisiana



In this paper, the authors review the state of the science regarding what is known about tropical cyclone frequency.

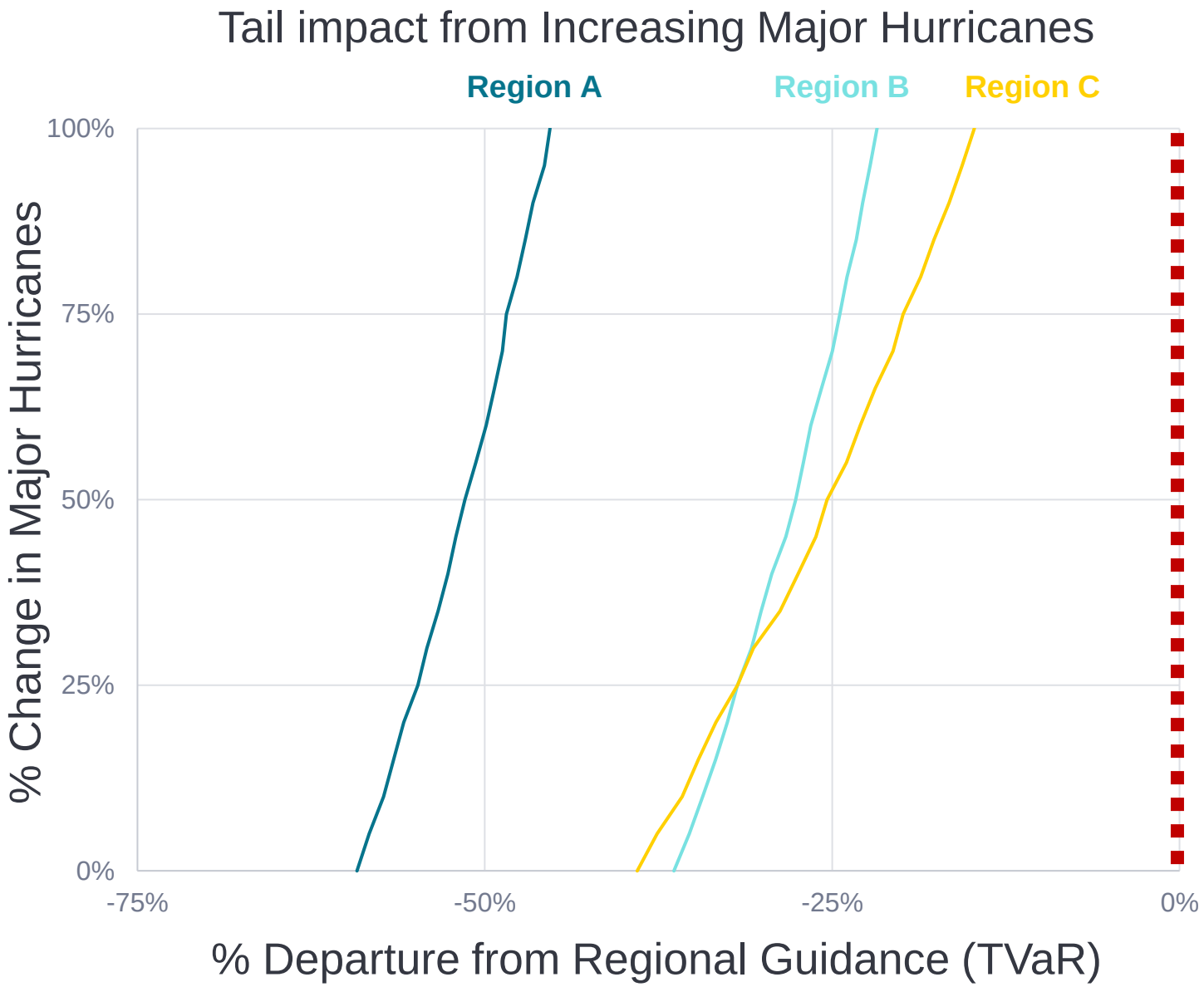
The state of the science is not great.

Sobel et al., 2021

Translate to actionable metrics for the business

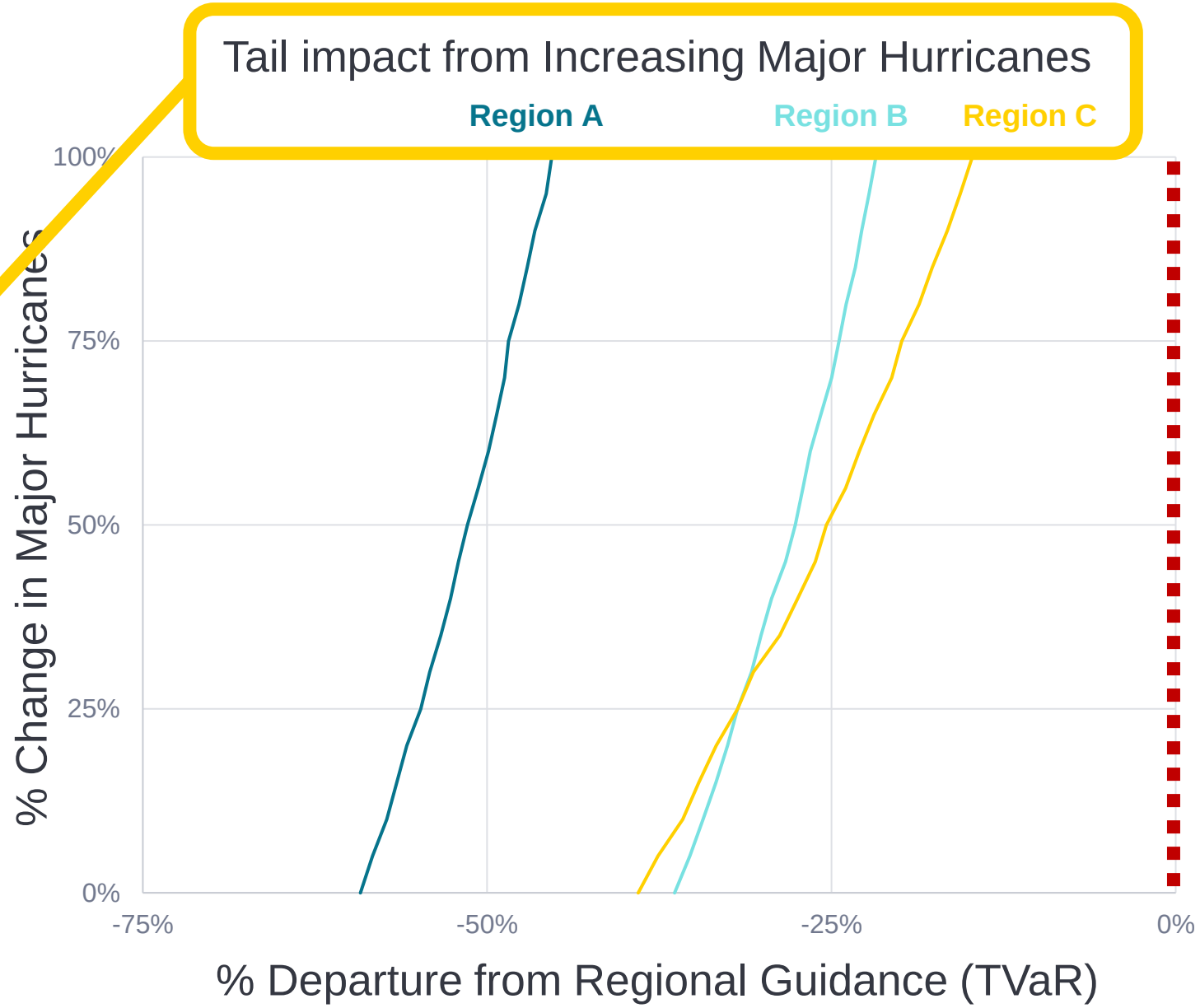
[A normative approach] allows individual insurers to define climate change risk appetites and estimate a point in time when they can expect 'unacceptable' levels of risk.

Rye et al., Nature Clim Ch, 2021



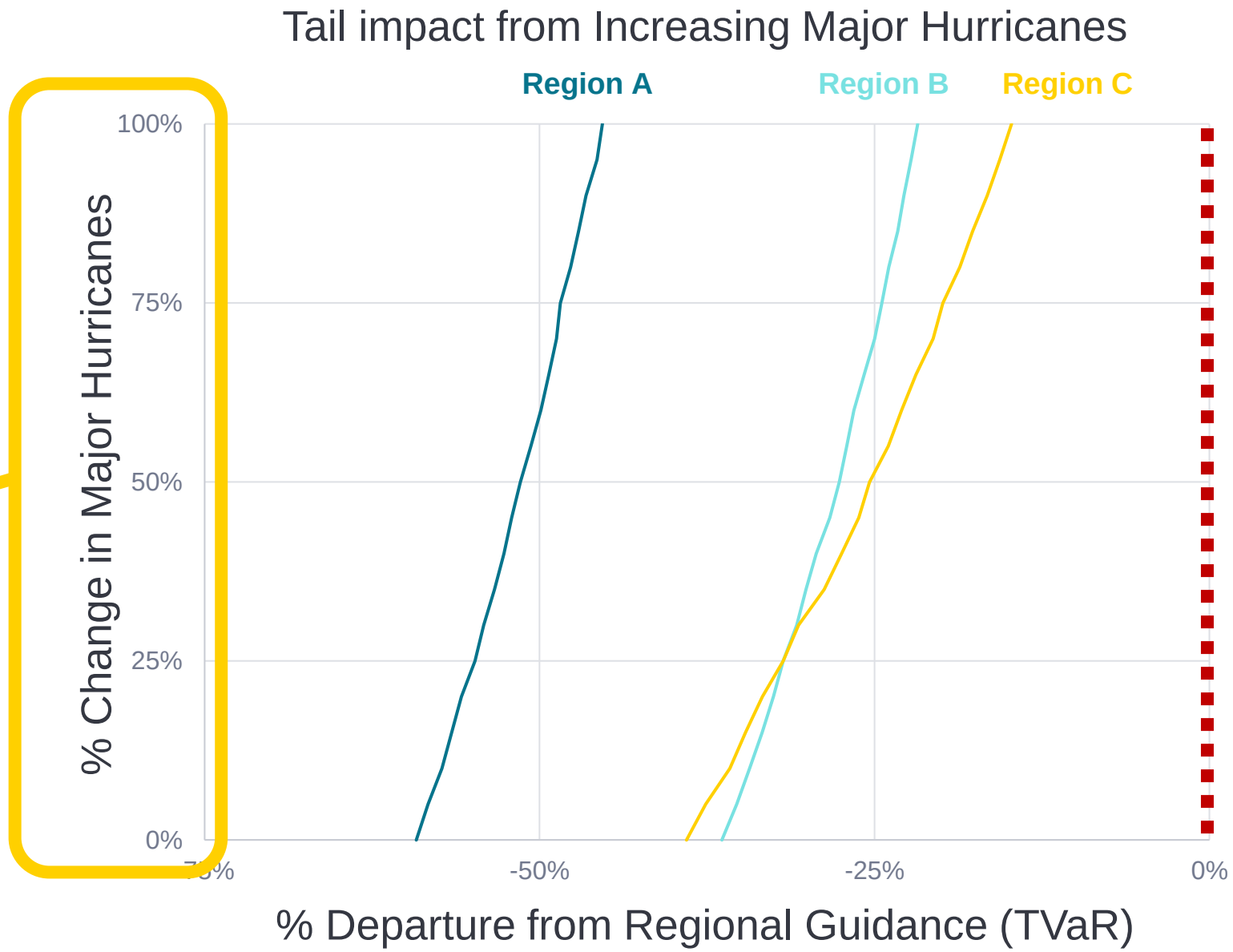
Translate to actionable metrics for the business

Focus on subperils that drive loss



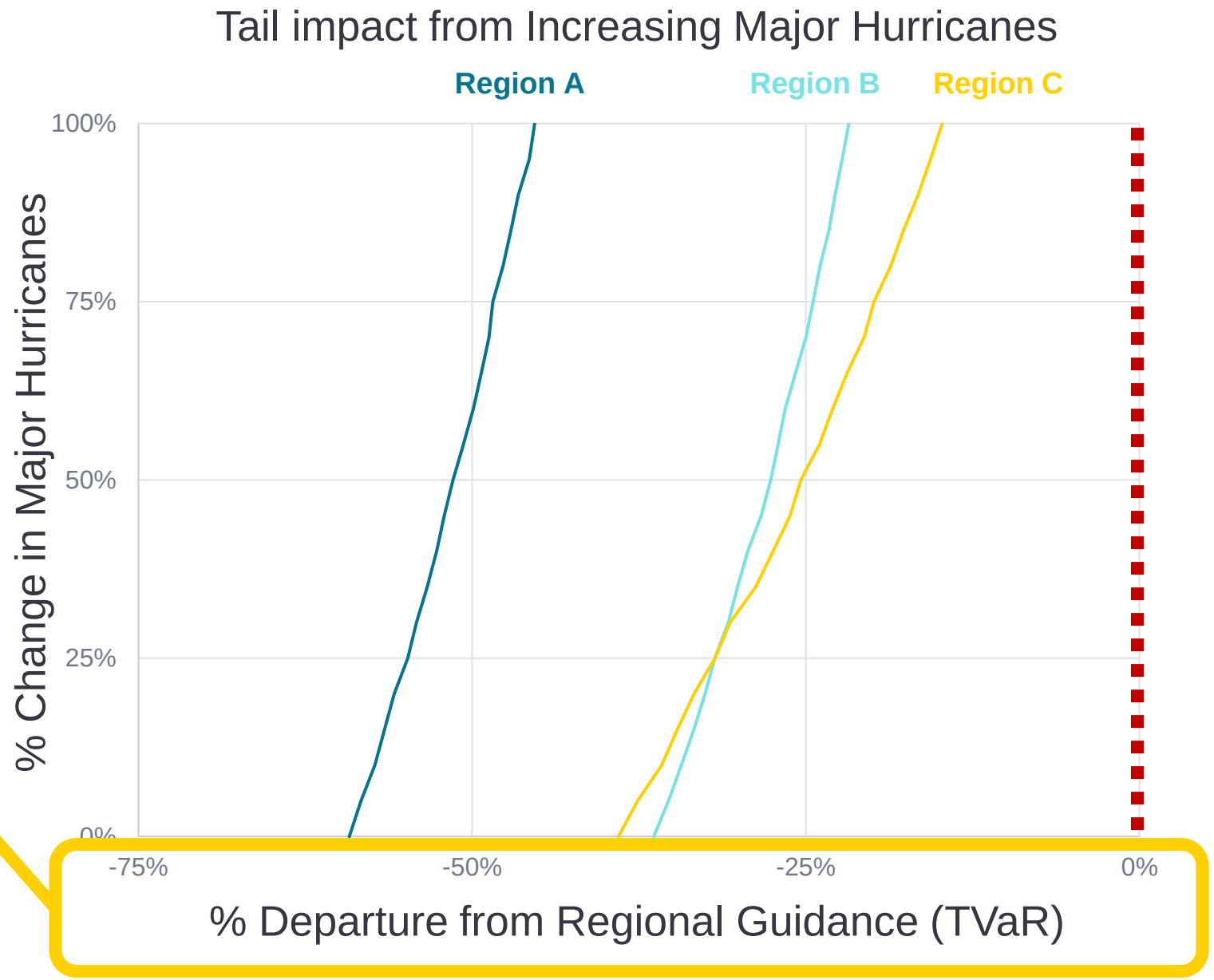
Translate to actionable metrics for the business

Not one scenario, but an exploratory range of possibilities, from likely to extreme



Translate to actionable metrics for the business

Assess risk appetite via [capital allocation, profitability, etc.] metrics



NASA Earth Observatory

NASA Earth Observatory


Justin Hobbs

Takeaways

Understand climate + built environment

Examine extreme hazards by scientific confidence + impact

Big risk handling

Translate science to action on the ground

Understanding the Drivers of Climate Transition Risk

Combining Systems Level (Top-Down) & Portfolio Level (Bottom-Up) Scenario Analysis Approaches

Time Horizons for Systems Level & Portfolio Level Scenario Analysis

As time horizons extend into the future, the analysis becomes increasingly exploratory in nature.

5 years (2025) | **10 years (2030)** | **15 years (2035)** | **30 years (2050)** | **50 years (2070)**

Enterprise-Level

- Systems Level Approach
- Global impact assessment with regional and sector assessment
- Agnostic of Liberty specific assets/liabilities/portfolios

Businesses can leverage insights from the 30- and 50-year enterprise level 'horizon scan' scenario impact assessments to help inform strategy.

Business-Level

- Portfolio Level Approach
- Analyzes portfolio level impact
- LMI to conduct climate scenario assessment on portfolios

Overview of Network for Greening of the Financial System (NGFS) Climate Scenarios

The Network for Greening the Financial System (NGFS) designed a set of hypothetical **Climate Scenarios** that explore a range of plausible outcomes. The Climate Scenarios provide a common reference point for understanding how **climate change** (physical risk) and **climate policy and technology trends** (transition risk) could evolve in different futures.

High Transition Risk ← Realistic Temperature Ambition → **High Physical Risk**

Divergent Net-Zero	Net-Zero 2050*	Delayed Transition	Below 2°C	Nationally Determined Contributions (NDCs)	Current Policies*
• Assumes net-zero CO_2 emissions by 2050 and limits warming to 1.5°C • Assumes **considerably high transition risks**, due to quickened energy transition pace and policy variation, but overall results in the lowest physical risks	• Assumes net-zero by 2050 and limits warming to 1.5°C • Assumes coordinated and stringent climate policies and innovation	• Assumes global annual emissions do not decrease until 2030 with strong policies needed to limit warming to below 2°C • Assumes new climate policies are not introduced until 2030 and the level of **policy action differs across countries and regions**	• Assumes net-zero CO_2 emissions by 2070 and limits warming to 1.7°C • Assumes that globally **coordinated climate policies** are introduced immediately, resulting in relatively low physical and transition risks	• Assumes continued progress towards a moderate climate ambition resulting in a steady decline in emissions and warming of ~2.5 – 3°C • Assumes **moderate to severe physical risks**	• Assumes emissions grow until 2080 resulting in ~3°C of warming and severe physical risks • Assumes existing climate policies remain in place with no additional strengthening

NGFS models are made up of 3 Integrated Assessment Models or IAMs (GCAM, MESSAGEix-GLOBIOM, and REMIND-MAgPIE) and 1 econometric model (NiGEM). The IAMs generate the general transition pathways per scenario, while the NiGEM model creates estimated macro-economic impacts

*Note: Net-Zero and Current Policies scenarios were not considered realistic options based on evidence from the 6th IPCC report and are therefore not being reviewed

Source: Network for Greening the Financial System

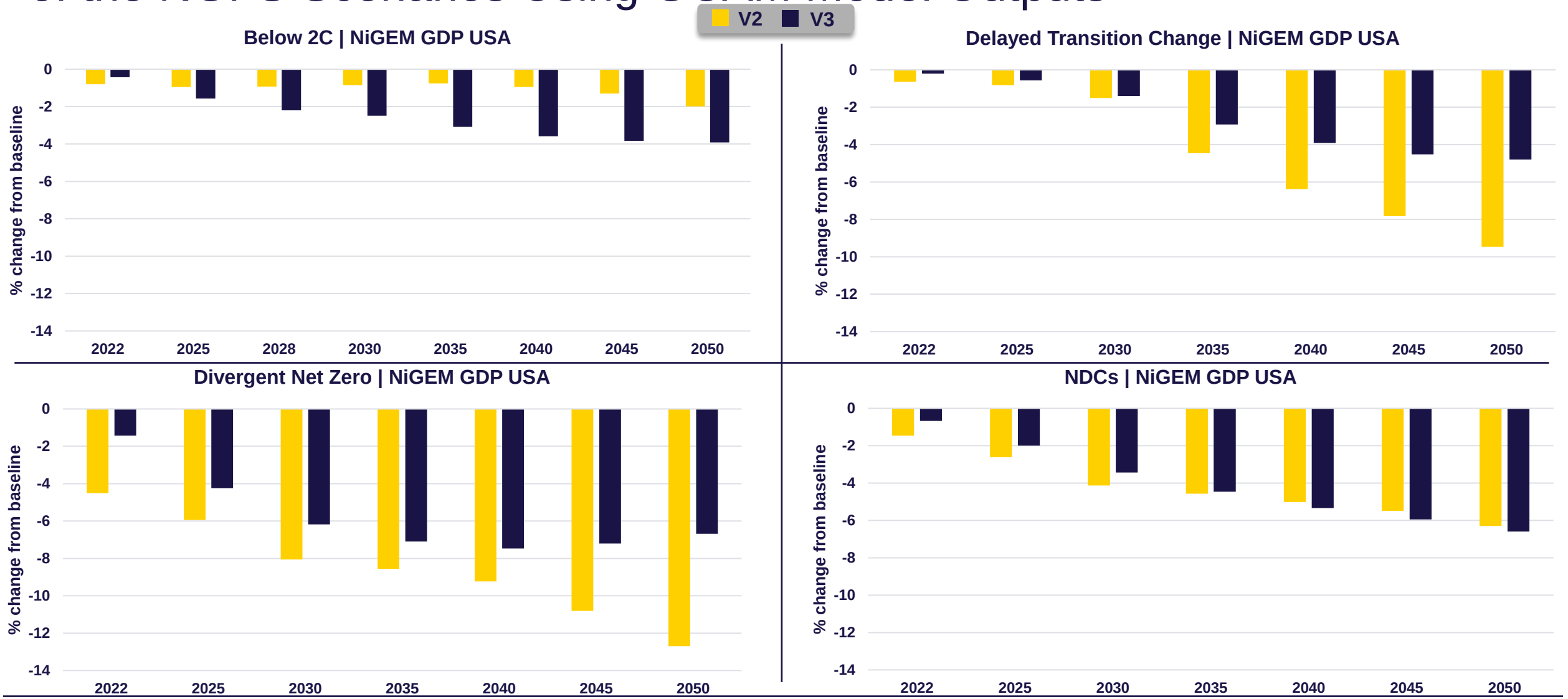
The Network for Greening the Financial System (NGFS) v3 Update

- In September of 2022, the NGFS published an updated version of their climate scenarios. The new version includes the following:
  - Fiscal and monetary policy modeling changes and increased sophistication in modelling, which significantly alter projected GDP impact vis-à-vis NGFS v2
  - Policy updates related to COP26 commitments and other climate related policies as of March 2022
  - Updates to GDP and population growth projections
  - Improved sectoral and technological models
  - Included a new methodology to integrate acute physical risk

- Observations based on analyzing results from v2 vs. v3:
  - Significant difference on GDP impact attributed largely to fiscal modeling changes – eg runaway inflation/ interest rates – based on feedback from Treasuries
  - Magnitude of year-on-year changes are further evidence that we are still in a learning and development phase when it comes to climate transition risk modelling – the information can be leveraged to set broad strategic direction but should not be relied upon to measure exact impact of transition on financial/ insurance portfolios

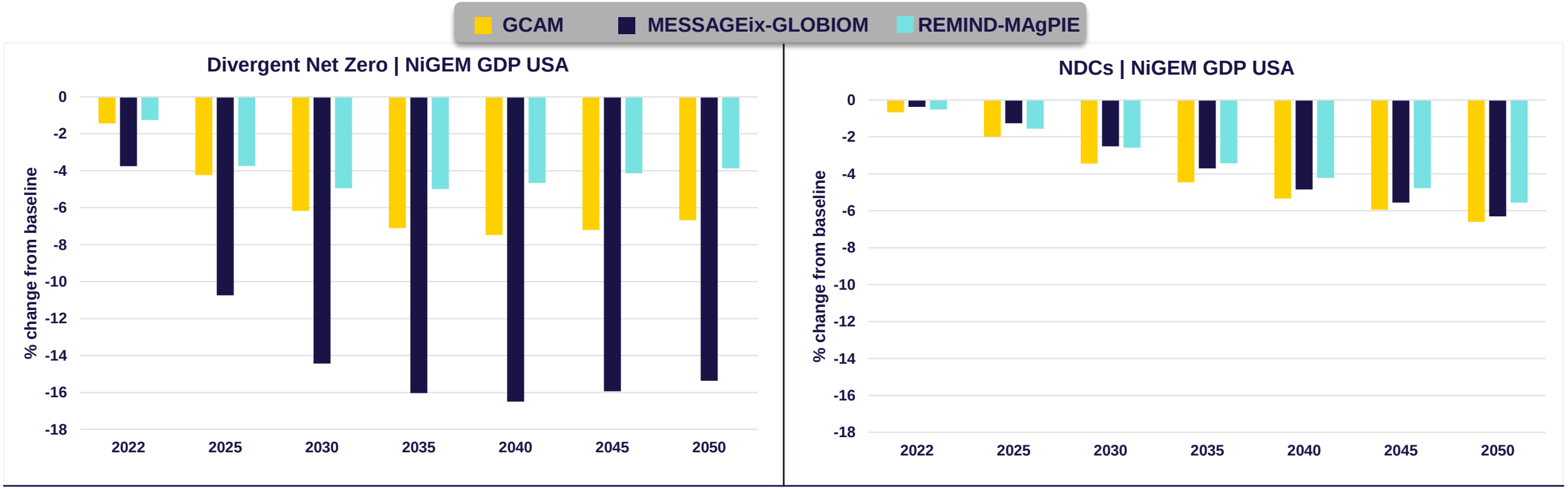
Climate Scenarios Sensitivity Analysis to Macroeconomic Policy Assumptions, Sept. 2022, NGFS

US GDP Impact from Climate Change - Comparison Between v2 and v3 of the NGFS Scenarios Using GCAM Model Outputs



Source: Office of Sustainability Scenario Analysis

Variance Between Integrated Assessment Models from V3



While the scenario parameters and model updates are important, these graphs illustrate that model choice is equally important.

Since the IAMs have different solutions methods, they can produce highly variant outputs for the same variable – as can be observed in the Divergent Net Zero scenario.

Insights from Our Scenario Analysis Exercise

Better understanding of transition risks impacting companies

- The most immediate source of climate-related transition risk facing companies is stemming from **Policy** changes followed by **Reputational** risk
- Policy change is also impacting **Market** related transition risk, but multiple models indicate market changes are still 5-10 years away
- **Technology** transition risk is evolving at a rapid pace but is not likely to disintermediate existing businesses in the short term; they provide areas of strategic opportunities that should be explored

Coordination not commonality is the way forward

- Time horizons of transition risks varies by region as they are based on different and sometimes divergent policy commitments made by countries (e.g., EU committed to net zero by 2050, China by 2060, India by 2070)
  - US policy approach supports innovation and brings a positive opportunity lens to strategic planning; The EU disclosure-based policy approach is seen as a 'stick', which focuses companies on measurement and disclosure and embeds a risk aversion approach to transition planning.

Energy dependency/ independence will influence policy design

- Pace and shape of policy transition is informed by economic dependencies on the primary energy sector (coal, oil, natural gas) from an infrastructure, production and export perspective
- Over the next decade all transition pathways rely on a combination of fossil fuels AND renewable technologies to power the global economy

Divergent, regional energy transition pathways should be expected

- Regional-specific energy transition pathways will impact preference for the type of renewable investment & strategy, further challenging a one-size-fits-all approach to decarbonization

Source: Office of Sustainability Scenario Analysis

Aggregate Portfolio Findings

- Among the different forms of climate risk, Liberty Mutual Investment's portfolio is most exposed to transition risk.
- Liberty Mutual's internal analysis was conducted by calculating market valuations at various points in time using NGFS climate scenario details.
- In addition to highlighting areas of elevated risk, a key takeaway is that Liberty's investment portfolios climate risk was muted largely due to portfolio concentration in highly rated fixed income instruments. Where Liberty does hold exposure to impacted asset classes, exposures are minimal.

Portfolio Impacts per Scenario

	5	10	15
Accelerated			
Orderly			
Disorderly			
No Action			

Key	Low Risk	Medium Low Risk	Medium Risk	Medium High Risk	High Risk

Assumptions

- Scenario analysis measures total mark-to-market losses over 5, 10, 15 years assuming no other change to portfolio positions.
- If needed, transition risk estimates were based on:
  - Public equivalents for private positions
  - Sector aggregates for Structured, PE, O&G, Non-IG Illiquid, and others
- Physical risk is considered negligible for 15-year (or less) horizons

Source: Liberty Mutual Investment Scenario Analysis

Asset Class Level Findings

- Not surprisingly, in all scenarios except No Action, Natural Resources is the most negatively impacted. Because there is relatively low exposure in Liberty's portfolio the total projected loss from this asset class is not significant.
- The second highest projected losses by asset class are in equities given.
- Leveraged Loans and High Yield bonds are also a potential areas of loss, carrying more climate risk than comparable Investment Grade exposures
- Losses in Investment Grade Corporate Bonds are small. However, where losses arise, they are driven by Oil & Gas, Airlines, and Electric Utilities.
- Liberty's aggregate investment exposure is relatively muted due to high concentrations in Investment Grade Fixed Income that are not particularly sensitive to climate risk.

Specific Asset Class Impacts per Scenario

	5				10				15			
Asset Class	Accelerated	Orderly	Disorderly	No Action	Accelerated	Orderly	Disorderly	No Action	Accelerated	Orderly	Disorderly	No Action
Investment Grade Bonds												
High Yield Bonds												
Public Equity												
Private Equity												
Structured Products (Non-Agency)												
Private Credit												
Natural Resources												
Leveraged Loans												

Key	Low Risk	Medium Low Risk	Medium Risk	Medium High Risk	High Risk

Source: Liberty Mutual Investment Scenario Analysis

EQH

NAIC Meeting – Climate Risk

November 29, 2022

Origins of Equitable Holdings climate risk analytical efforts

Background and objectives

- Financial sector stakeholders, including NY DFS, set expectations to integrate climate stress testing into risk management and business frameworks in the past years
- Our preliminary assessments from 2021 indicated that climate risk *standalone* is unlikely to constitute a material portion of our risk profile
- Consequently, our objective in 2022 was to incorporate climate risk within our risk policy with a minimalist implementation – albeit with an openness to expand should we find the risks to be more material or if industry analytics improve
- Outside of stress testing, climate impact remains a material commercial topic for our insurance and asset management businesses, both offensive and defensive

Guiding principles for 2022

- **Integrate climate risk into Risk Policy**
  - Establish process to managing our climate change risk
  - Conduct materiality assessment based upon stress testing
  - Integrated results into ORSA given regulatory prominence
- **Focus on major asset classes**
  - Focused on major asset classes and overall portfolio-level risk
  - Public corporate bonds (transition risk) and CMLs (physical)
  - Others risks deemed “too remote” or non-quantifiable, including US mortality
- **Stepwise build-out with “minimum viable product”**
  - Build analytics in step-wise fashion: “Start simple”
  - Minimum viable product status with pragmatic models

Key messages

1	**Climate-related initiatives are pervasive across the Equitable enterprise, though risk and capital management constitute only a narrow portion of the aggregate effort**
2	**Climate is a known but tertiary contributor to aggregate our Investment risk exposure, with traditional macroeconomic risks decidedly more prominent; we observe no data to support climate impact to mortality**
3	**Climate risk investment analytics remain immature with leading models reliant upon multiple layers of untested and uncalibrated assumptions**
4	**Equitable use of a “limits only” approach to mitigate climate-driven investment risk reflects the (a) limited maturity of climate analytics and (b) tertiary status of climate contribution to investment risk**
5	**Equitable GA investment decisions utilize our internal rating system and integrate measures of climate change including but are not limited to carbon intensity**
6	**We anticipate a gradual evolution of climate investment risk measures driven more by regulation than actual risk measures – and (aspirational) greater standardization of climate risk investment models**

1 Climate-related initiatives are pervasive across the Equitable enterprise, with risk and capital only a narrow portion of the aggregate effort

Considerations for climate risk at Equitable Holdings

An entire set of climate-related initiatives

What

ESG Disclosure Standards

- Published our first environmental, social and governance (ESG) report
- Aligned with the Sustainability Accounting Standards Board (SASB) and the Taskforce on Climate-related Financial Disclosures (TCFD)

Responsible Investing

- Issued an FABN to fund ESG projects (5bps cost save)
- Signed "The Principles for Responsible Investment (PRI)"
- Integrated ESG into our investment philosophy

AB's Climate Strategy

- Announced commitment to achieve net zero emissions
- Partnered with leading climate organization
- Built portfolios to pursue financial goals while also achieving ESG, including climate-related objectives

Risk Management

- Climate stress testing for certain investments in the General Account portfolio
- Limit framework based upon climate-related potential loss integrated in Risk Policy

Why

Defense

- Purpose to avoid sanctions from proxy advisors and other public shareholder groups

Commercial growth

- Desire to grow AuM by establishing presence in growing ESG investing wave

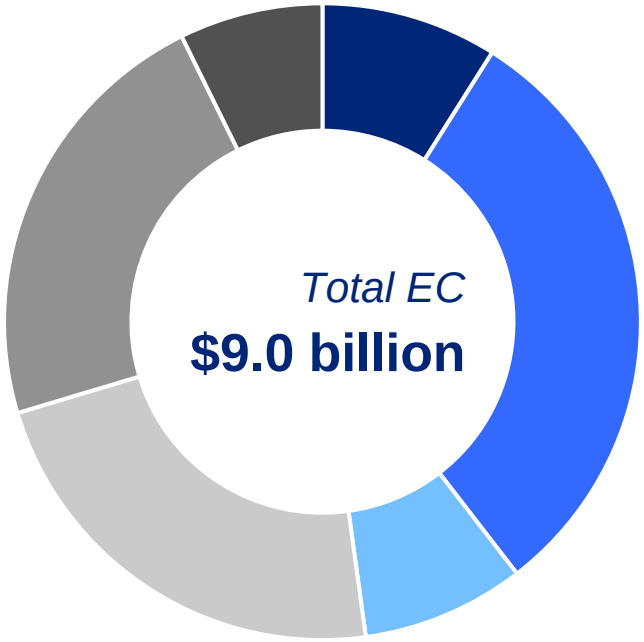
Regulator expectations

- Address NY DFS and other regulator expectations

Risk and capital efforts – <2% of total resources

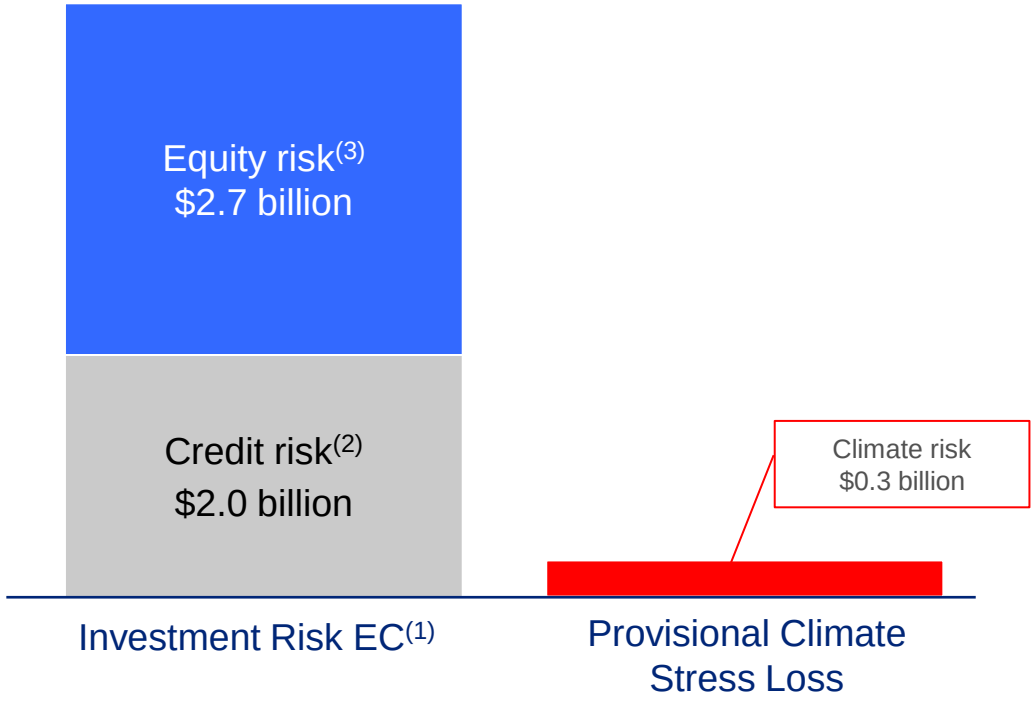
2 Climate is a known but tertiary contributor to aggregate our Investment risk exposure, with traditional macroeconomic risks decidedly more prominent

Composition of required Economic Capital
As of 12/31/2021; Ins Op



- Interest rate risk
- Equity risk
- Volatility risk
- Credit risk
- Insurance risk
- Operational risk

Illustrative comparison of Equitable's capitalization by risk factor
Investment Risk EC vs. Provisional Climate Stress Loss



(1) Based upon the post-diversified combined contribution of both credit risk and equity risk
(2) Credit risk comprises GA invested assets, reinsurance and derivative counterparties
(3) Equity risk includes open equity exposure and general account private equity

Our results indicate that the aggregate investment risk position within the insurance company is significantly greater than the provisional stress losses from climate risk realization

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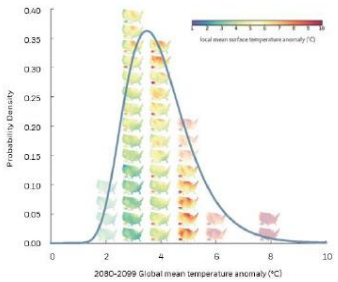
3 Climate risk investment analytics remain immature with leading vendor models reliant upon multiple layers of untested and uncalibrated assumptions

Equitable assessment of leading vendor climate risk model:

Climate Modeling

Assess expected risks under forward-looking climate scenarios

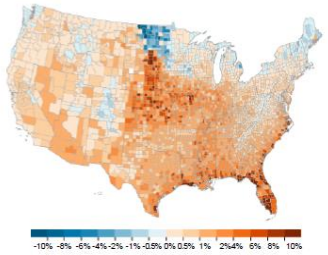


Acceptable

- Variable
- Academic-based

Economic Impacts

Convert climate projections into forecasts of economic impact



Unvetted

- Not backtested
- Heavily subjective

Company & Asset Analysis

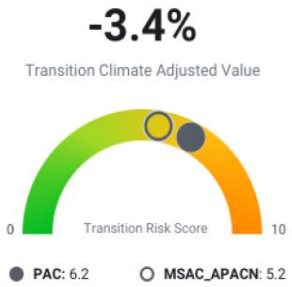
Map geolocations and sector impacts to individual counterparties and assets

Unvetted

- Not backtested
- Heavily subjective

Financial Risks

Translate into financial risks via security valuation model and portfolio risk models



Unvetted

- Product of two untested modules

Equitable conclusions of leading model:

- "Merton" model structure is sensible and intuitive
  - Link climate risk to credit risk by assessing probability of default (PD) impacts
  - Change in PD based upon a Merton-like framework relying on conditional climate variables[1]
- Calibration and documentation is inadequate
  - Statistical evidence for calibration is scant
  - Documentation "very light" or non-existent
- Preliminary results appear unusual
  - Examples: Singapore Airlines ("highly rated") set to 20% chance of default in 5 years due to climate alone

As industry experts remain at an early stage of translating climate-related risks into robustly quantifiable investment risk, our view is to leverage those results to aid in refining our internal stress tests

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(1) See appendix slide on adjusted probability of default for climate risk realization

4 Equitable uses a “limits only” approach to mitigate climate investment risk

Reflects limited maturity of climate analytics and tertiary risk status

GA assets

- Exposure confined to our GA investment portfolio
- Focused on major asset classes

X

% allocated to climate risk

- Based upon 19 climate relevant sectors for corporate bonds
- Granularity of flood risk using county level data

=

Corporate bond limit

- Limit compared against max stress loss across 3 climate scenarios
- Consider both transition risks and physical risks to climate change
- Assume transition risk to be bi-directional

CML Limit

- Limit compared against a probabilistic outcome (extreme value theory)
- Cover flood risk because flooding has historically been a major source of physical risk in the U.S.

“Transition risk” stress test(1)

- Shock parameters inferred from Bank of England estimates defined as a 1-in-100 Value-at-Risk
- Scenarios in sync with climate targets set by Paris Agreement for 2022-2050

“Physical risk” stress test

- Approach developed by the UN Environment Finance Initiative (“UNEP FI”) pilot group under guidance provided by Acclimatise, a leading climate software company

Limit approach is used for “difficult to quantify” risks to ensure such risks cannot destabilize company

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(1) Provisional climate stress loss dominated by a sudden disorderly transition scenario.

5 Our investment philosophy integrates climate risk to deliver value over an extended period, thereby enhancing the quality of our portfolio

Impact of climate risk factors into the investment process

Portfolio	Strategic Asset Allocation	Tactical Asset Allocation	Security selection
Equity (2% of GA) *Mostly private equity*	***Modest*** Industry/strategy allocation mostly reflects diversification goals	**De minimis *direct impact*** Investments managed predominantly by private equity managers or ABS managers; these managers likely integrate climate risks, among others, in investment decisions	
Fixed income / debt (98% of GA) *Mix of bonds, ABS, CMLs*	**De minimis *direct*** High level allocations driven by liability profile / ALM considerations, and general views of "fitness" of asset class for life insurer balance sheets	***Most significant*** Industry/strategy allocation mostly reflects diversification goals	***Modest*** • IG Corps and ABS: ESG reflected in AB (our asset manager) rating system • CML: LEED certification a factor in underwriting, and now flood risk

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Note: We have engaged a GHG emission vendor, Antea, to support measurement of the climate impact across our GA, starting with public corporate and sovereign bonds. The initial application is disclosure, not investment management, but applications pertinent to investment decision may evolve

Appendix

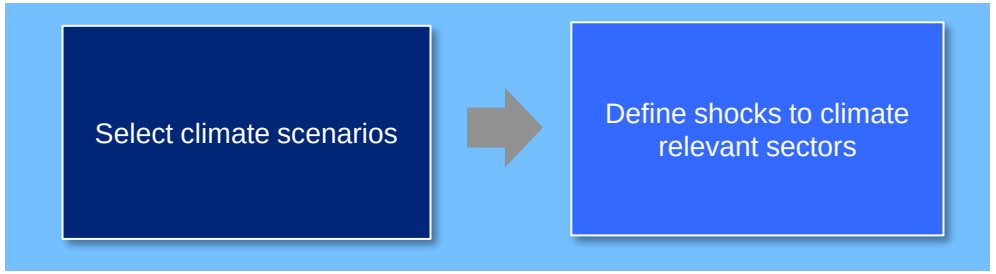
We completed the development of a stress testing and exposure limit framework as per our commitment disclosed in last year's ORSA

Key considerations	Description and purpose
Scope GA investment portfolio	• Confined to our investment portfolio because this is the only source of material exposure • Focused on investments in climate-sensitive companies
Asset Class Public Corps and CMLs	• Focused on major asset classes and based upon 19 climate relevant sectors / categories • Current scope covers more than half of our fixed income GA assets including public corporate bonds and CMLs • Granularity of flood risk assessment using county level data
Risk Factor Transition Risk & Physical Risk	• Consider both physical risks to climate change and transition risks • Assume transition risk to be bi-directional in order to reflect the risk of more rapid or more gradual transitions than markets anticipate to a low carbon economy • For physical risk, the scope of the stress tests to the CML portfolio covers flood risk because flooding has historically been a major source of physical risk in the U.S.

The stress loss on public corporates is based upon the product of the shock parameter for each climate relevant sector and the portfolio's exposure to that sector

Overview of the methodology for assessing changes in public corporates portfolio's MV:

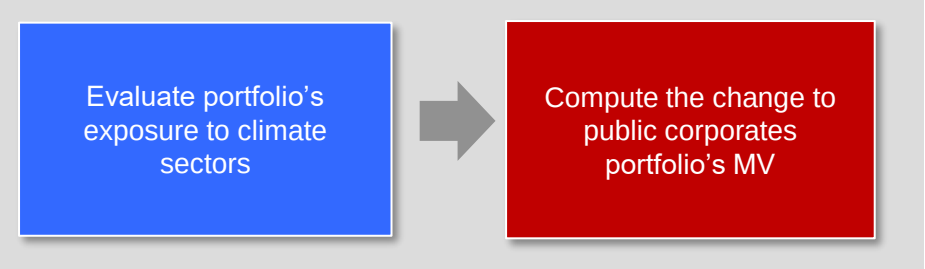
Climate scenarios



- Based on 3 scenarios including (a) a sudden, disorderly transition, (b) a long-term, orderly transition and (c) no transition
- In sync with climate targets set by Paris Agreement for 2022-2050

- Shock parameters in line with research and estimates published by Bank of England
- Translated into a simple equity and bond shock defined by scenario and capturing transition risk and physical risk realization
- Originally informed using a DCF-type analysis that captures the differences in future profits between baseline and the climate scenario

Portfolio of public corporate bonds



- Run holdings through the Paris Agreement Capital Transition Assessment ("PACTA") tool to determine portfolio's exposure to climate relevant sectors
- Broadly aligned with Bloomberg Industry Classification System (BICS) revenue data
- Overall, we elected 19 climate-relevant sectors that will undergo shocks under transition and physical risks

- Impacts based on a) the scenario-defined changes in the value of holdings in each sector and b) the portfolio's exposure to holdings in each climate relevant sector
- Shocks are applied consecutively, first for transition risks and then for physical risks

Recap of our climate stress tests
Public Corporate Bonds

Scenario Name	Key Assumptions	Temperature Rise	Year of Impact	Change to the Public Corp Portfolio's MV
Scenario A	*Sudden disorderly transition following rapid global action*	Below 2°C by 2100	2022	-0.66%
Scenario B	*Long-term orderly transition in line with Paris Agreement*	Well below 2°C by 2100	2050	-0.55%
Scenario C	*No transition and a continuation of current policy trends*	Exceeding 4°C by 2100	2100	-0.56%

- Climate scenarios defined based on interpretations of the climate targets set by the Paris Agreement
- Scenarios A and B assume that the Paris Agreement targets are broadly achieved
- Shocks parameters reflect the potential impact on the market valuations to the 1-in-100 Value-At-Risk ("VaR") measure under the climatic scenarios

Main results:

EQH GA well within risk limits for climate stress testing

- 19% of the GA corporate bonds portfolio's exposure subject to climate relevant sectors
- Potential overall loss is in the range of [0.5%; 0.7%]
- Potential loss in absolute terms no larger than $0.1bn across any climate relevant sub sector and less than $0.2bn in aggregate for the high-carbon split

Main caveats:

Industry modeling practices remain in infancy

- The stress tests will be further refined as novel approaches are available
- This analysis rests on several unvetted assumptions that affect results materially, reflecting the immaturity of climate analysis - these will be monitored

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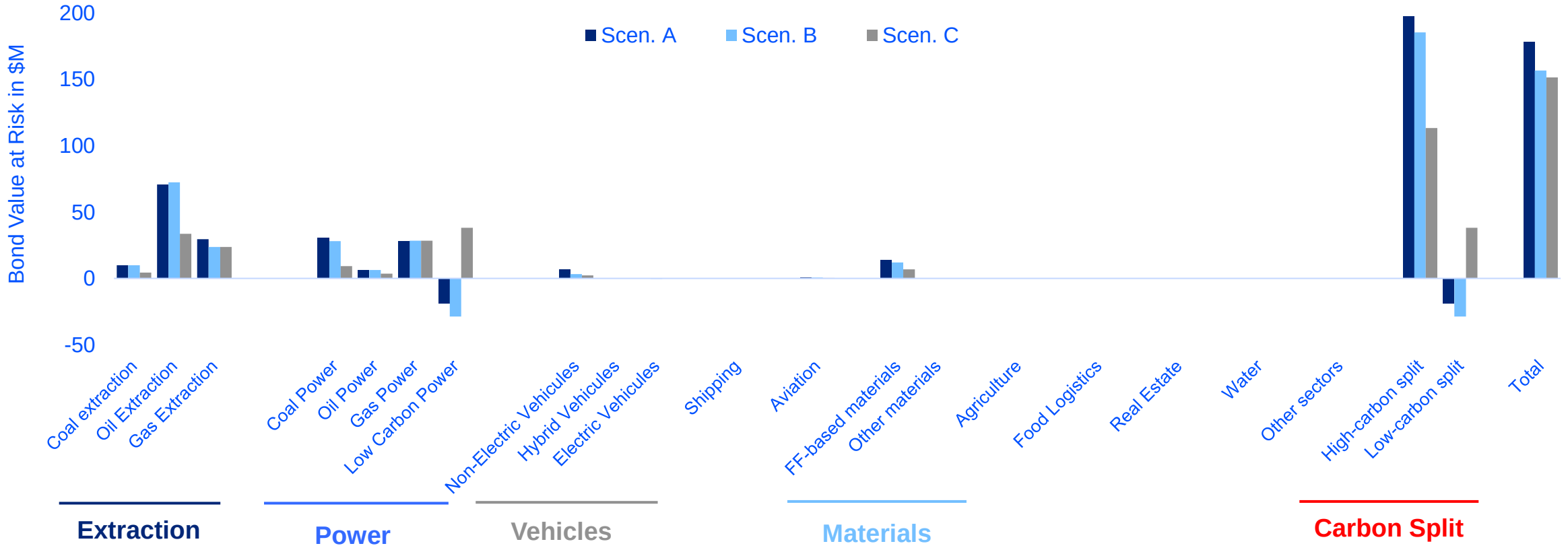
Our climate risk stress testing for public corporates show that the General Account is well within provisional investment risk limits

Assets by climate risk by climate-relevant sector and sub-sector - chart shows the climate sector level bond VaR under Scen. A, B and C
Alert / limits set at $250M / $350M per sub sector and $500M / $700M for the high/low carbon split



Note: Bond VaR under a given scenario can take negative values, as climate scenarios can be beneficial for some sectors

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Our methodology to assess climate-related risks to CMLs due to future flooding events was developed by the UN Environment Finance Initiative ("UNEP FI") pilot group

Overview of the methodology for assessing changes in CML fair values:

Physical Risk scenario

Changes in flooding events → Define shocks to property values

- We use a probabilistic approach using flood risk maps by county defined with a 1 in 500 year return period from First Street
- The output measures the 30-year cumulative flood likelihood of properties at risk of flooding per county in the U.S.
- Changes in environmental factors are captured based on guidance from the Intergovernmental Panel on Climate Change's (IPCC) Representative Concentration Pathway (RCP) curves

- The 30-year cumulative likelihood is mapped to a property value shock
- Empirical evidence indicates that experience of extreme events can reduce property values between 5% and 20%
- A direct relationship between the 30-yr probability and the property shock with guidance indicated in First Street technical documentation to define the 'medium' risk level

Portfolio of Commercial Mortgage Loans

Measure new LTVs and 'risk to property value' → Establish relationship between spread and LTV → Compute the potential change in CML fair value

- Data on future return periods for flooding events are converted into 'encounter probabilities'
- The encounter probabilities are multiplied by the estimates of changes in property values
- The results are aggregated, to calculate the 'risk to property value'

- We employ the AXA IM pricing relationship between spread and LTV ratios by property type
- We use a non-linear function to estimate the spread impact for each CML in the portfolio

- We use change in spreads and credit spread duration to obtain the change in CML fair value

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Recap of our climate stress tests
Commercial Mortgage Loans

Range of Stress Tests	Lower	Upper
Flood Return Period	1 in 500 years	
Change in Future Flood Frequency	11%	
Average Age to Maturity	10yr	
Encounter Probability	2.20%	
Property Shock ("Medium" Risk Level)	-10%	-20%
Risk to CML MV (%)	-0.09%	-0.18%

- Conservative stress test methodology assuming no insurance coverage
- Produced also a “worst case” version of the stress test estimated at -1.01%
  - using a higher flood return period of 1 in 100 years, and increased the change in future flood frequency to 25%
  - But we recognize that this outcome is an overestimation of the risk of flooding

Main results:

Analysis shows a limited impact from flooding events

- Potential credit losses in the range [0.09%; 0.18%]
- Utilizes flood risk map quantifying frequency of flooding events from river, rainfall, storm surge and coastal sources
- Reflects changes in flood risk over the next 30 years under the 4°C conservative climate change scenario (Scen. C)

Main caveats:

Assumptions are based on high level estimates

- Stress tests use high-level, albeit severe, estimates of potential changes in property values
- The low frequency of extreme flooding events plays a critical role in quantifying the overall impact
- Ignores other extreme events (cyclones, wildfire, heat)
- Flood risk maps defined by county, but individual counties can cover large areas with varied climate change effects

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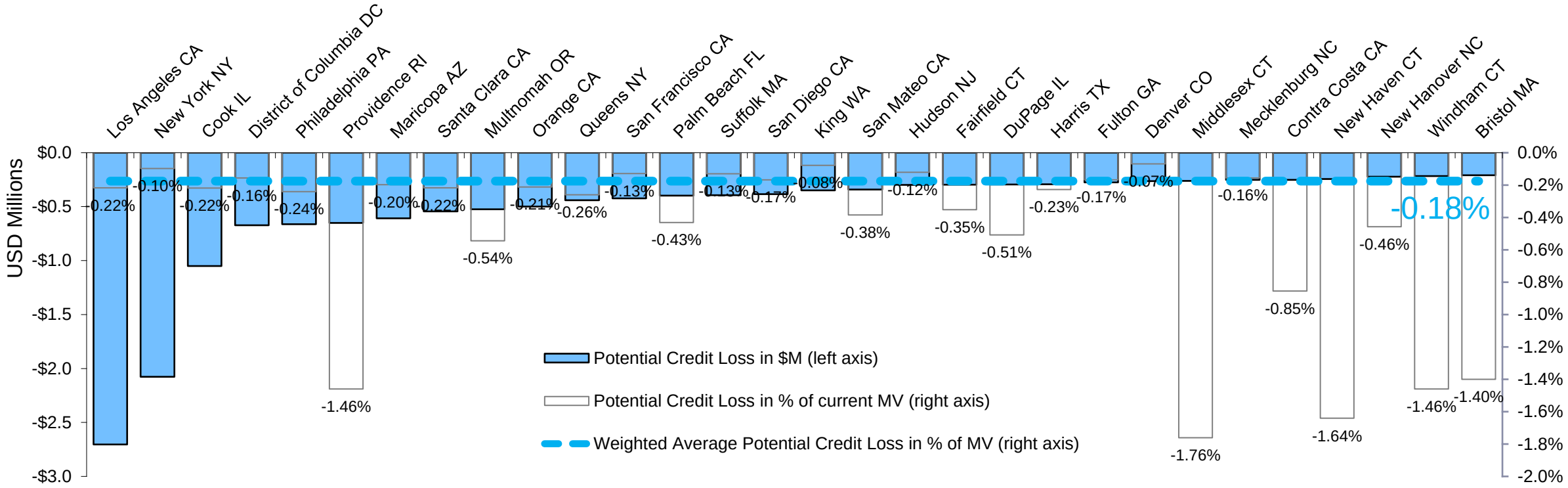
The low impact from flood risk on our CML portfolio is because our largest exposures are not concentrated in flood zones, and those in such zones are relatively disperse

Visual representation of the potential credit loss in both absolute and relative basis:

"Best Case Upper" Stress Test: Potential Credit Loss for the top 30 County in USD million (left axis) and % of MV (right axis)



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What are the major assumptions in our climate stress testing framework?

Assumptions	Description
Asset class coverage	• The current framework covers public corporate bonds and CMLs but does not provide portfolio exposure values associated with other financial instruments, such as sovereign bonds
Portfolio "runoff"	• To consider the impact under the climatic stress, we measure risk against the "runoff" of our investment portfolio remains constant i.e., we examine the instantaneous sensitivity analysis on today's investment portfolio with no adjustments thereto
New investments or reinvestments	• Any effects on new investments or reinvestments are not included in the analysis even under the climate scenarios that play out to 2050 or 2100
Equity to credit relationship	• The impact of climate change to corporate bonds is more complex than the impact it may have on equities, and that there are different views on how those impacts interplay
Extreme event modeling	• The approach to the CML portfolio is based upon low frequency events, where the occurrence of the extreme events can be significantly altered by climate change in the future
Flood risk map by county	• The geographical areas are limited by county, but some counties can cover a disproportionate amount of land, while climate change effects are not necessarily confined by those borders

We anticipate stress loss on risky assets due to the occurrence of defaults or climate effects to follow a different distribution profile

Credit risk

Inputs
- Probability of default
- Loss given default
- Correlation of defaults

Generic asset attributes (rating, duration) mapped to corresponding PD and LGD

Calculations
- Loss function based on instrument type
- Loss percentile

Credit loss distribution sensitive to the asset type, credit quality, maturity and seniority of the asset

Capital Charge
- Economic Capital
- Based on VaR or CTE

Economic capital requirements estimated using VaR or CTE risk measure

Risky assets can incur total losses after a certain level of defaults have occurred (e.g., case of subordinated CLOs)

Climate risk

Inputs
- Climate scenarios
- Climate risk exposure

Climate scenarios and forward-looking views of climate change

Calculations
- Economic impact
- Financial risk impact

Climate change quantified in financial risk terms (i.e., climate adjusted price, yield)

Capital Charge
- Climate stress loss

Climate risk aggregated with investment risk via security valuation model and/or adjustment

Realization of climate changes act primarily as a "shift" in valuation and haircut in prices[1]

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(1) See appendix slide on adjusted probability of default for climate risk realization – commonly modeled based upon a Merton-style framework that consists in a "shift" in the counterparty's asset values

Vendor models have developed a Merton-like framework to theoretically ground the calculation of climate scenarios to probability of default (PD) impacts

Climate risk is measured as the change in default loss under a climate scenario:

Stressed Loss = Stressed Probability of Default (PD) x Loss Given Default (LGD) x Exposure at Default

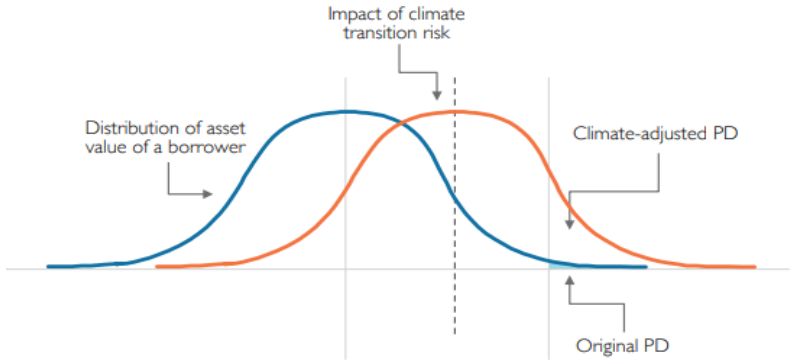
- Stressed loss is the amount expected to lose under a Very Severe event

- Probability of default of issuer under a Very Severe event

- Ultimate loss as a % of exposure at time of default

- Expected outstandings at the time of default

<u>Adjusted</u> for climate risk realization using a Merton-style framework that consists in a "shift" in the counterparty's asset values



Thank you

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