Climate Risk Disclosure Considerations for the Municipal Bond Market

Harris Public Policy Students

May 27, 2021

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The Questions

1) How reliable are the third-party estimates of economic/financial damages for municipal issuers from climate change?
2) Are the data now available - from risQ and other data providers - finite enough that a single municipal issuer can use them to measure risk impacts across their entire debt portfolio?
3) With respect to climate change impact/adaptation, what is material from the reasonable investor's standpoint?
4) Can state or regional governments/councils of government (including any reports they publish) be a reliable and uniform data source for municipal issuers for climate change impact?
5) Is a disclosure model that emphasizes the categories of: physical risk, transition risk, and resiliency planning - a good model for municipal issuers to follow?
6) Is the SEC's disclosure guidance to public companies a good analogue for where municipal issuers should describe climate-change related risk and opportunities in their disclosure documents?

Project Overview

- Ten Harris students participated in the project - all volunteered their time and expertise
- Robust research effort:
  - Interviewed 25 muni market stakeholders - issuers, investors, councils of government, others
  - Evaluated products from six climate risk data providers
  - Reviewed more than 50 research reports and academic papers
  - Reviewed relevant legislation and regulatory guidance across multiple US states and three other countries
- Additional research support from other Harris and UChicago faculty
- Thanks to the U Chicago Center for Municipal Finance Advisory Board for connections and insights
- Special thanks to the SEC Office of Municipal Securities for the opportunity to share our findings!

Question 1 - June and Zayn

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Reliability of 3rd Party Climate Risk Estimates

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Current Climate Risk Data is Catastrophe-Focused

- Financial models focus on catastrophic climate hazards
  - Once-in-10 or 100 year events, such as severe hurricanes, wildfires, flooding
- Less focus on “climate trend” risks related to climate change processes[1]
  - Rainfall increases/decreases, cold snaps, heat waves, sea level rises
- Latter category carries serious consequences for issuers
  - Example: Municipalities with an agriculture-focused economic base and water authorities

- Climate Value-at-Risk Model
  - Used to assess financial sensitivities to climate risks
  - Data includes empirical quantifications, credit resilience, political risks
- Implications of tail-end focused financial models and estimates
  - Precision is stable (one-tenth basis point)
  - Reliability is difficult, partly due to dependence on historical data
- Data purveyors *aware*, but quantitative modeling lags

Tentative Theories of the Catastrophe Focus

- Data vendors and modelers responding to demand from investors and buy-side institutions
- Possible that issuer-focused services will emerge when the economics make sense

- Modeling catastrophic risk builds on methods from the insurance industry
- Other risks evolve from hypercomplex systems, models are sensitive to:
  - Size and accuracy of historical record
  - Simulation complexity[1]
  - Understanding of physical processes

Typology of Climate Risk

- Catastrophic Risks
  - Storm Surge
  - Hurricane Wind
  - Hurricane Floods
  - Inland Flooding
  - Coastal Flooding
  - Wildfire
  -

- Majority of climate risks that are accounted for in financial models are focused on or heavily emphasize left-tail catastrophic risks

- What about *trending* risks?
  - Drought
  - Sea level rise
  - Ecological change
  - Forced migrations

The Existing Data & Implications

- Climate Value at Risk (Climate VaR)
  - Public and third-party data are amassed and fed into familiar risk management framework like VaR
  - Model assesses financial sensitivity to climate risks
  -
- Historical Data vs. Future Projections
  - Historical data could underestimate the likelihood and/or severity of extreme events in the future[1]

- Precision and Reliability of Estimates
  - Precision is stable
    - Presented in finance/market based frameworks
    - Usually calculated out to within one-tenth of a basis point
  - Reliability is difficult to assess
    - Complicated interactions between atmospheric conditions, climate catastrophes, and trend risks[2]
    - Confidence intervals become wider as time goes on due to policy uncertainties, environmental complexities, and risk compounding

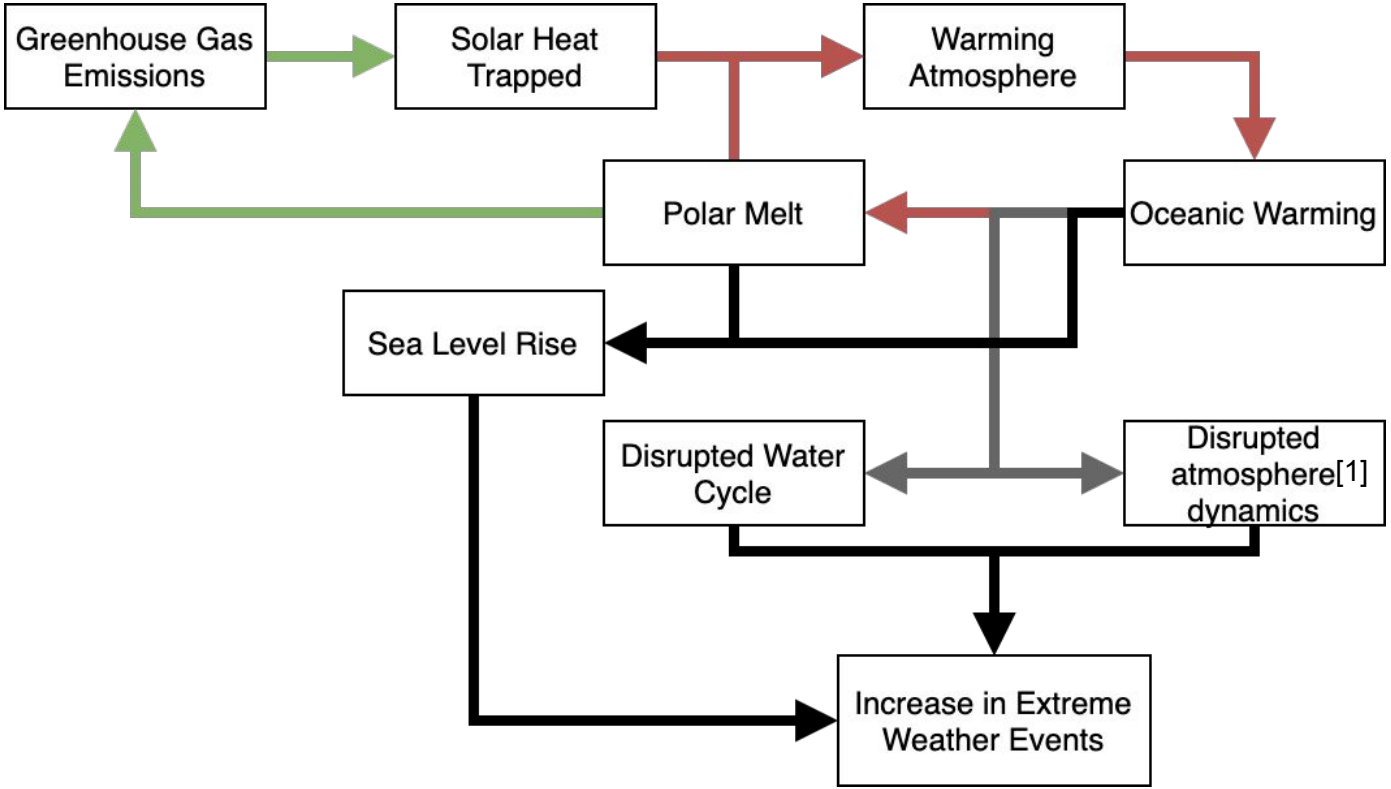
Data Used to Inform Estimates

- Empirical quantification of climate-related hazards
  - Economic disruption: Property loss, supply chain disruption, declining agricultural program
  - Physical damage: Loss of roads, utilities, buildings, communication networks, transportation assets
  - Health and public safety: Loss of life, jeopardization of critical emergency provisions such as medical care, food, water, power, shelter
  - Population displacement: Short-term forced displacements
- Credit resilience to climate change
  - Measures of Economic Strength: speed at which economy may recovery from climate-related hazards
  - Fiscal Flexibility: access to liquidity, ability to raise additional revenue, asset management and governance, debt affordability
- Political risks
  - The rise of political polarization effects disaster aid/climate change relief
  - As climate change effects become more prevalent, public support for costly bailouts weaken (example: Puerto Rico)

Data Purveyors & Audiences

Type	Examples	Municipal Bond Specific Resources
Bank	BlackRock	**X**
Credit Rating Agencies	Moody's, S&P Global, Fitch	**X**
Governmental Entities	National Science Foundation (NSF), U.S. Forest Service	**-**
Industry Associations	Insurance Information Inst., GFOA	**-**
Higher Education Institutions	University of Notre Dame (ND Global Adaptation Initiative)	**-**

How Climate Change Produces More Extreme†



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Question 3 - Henry and Darryl

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Assessing Climate Risk Across a Broad Muni Portfolio

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Data specificity & geospatial resolution
JUPITER
Predicting risk in a changing climate
risQ
AIR
risk Business
Trucost
ESG Analysis
S&P Global
FitchSolutions
Focus on municipal debt/issuers


Data specificity & geospatial resolution
JUPITER
Predicting risk in a changing climate
427
risQ
AIR
A Verisk Business
ESG Analysis
S&P Global
FitchSolutions
Focus on municipal debt/issuers


Data specificity & geospatial resolution
JUPITER 427
Predicting risk in a changing
risQ
AIR
A Verisk Business
ESG Analysis
S&P Global
FitchSolutions
Focus on municipal debt/issuers

Four Twenty Seven (Moody's)

Note that these scores, while robust, are still limited to cities and states

This limits the depth of analysis that can be done on specific CUSIPs and obligors

City Name	State	Total Score	Hurricane	SLR	Extreme Rainfall	Heat Stress	Water Stress
Miami Beach	Florida	76.17	84.73	92.37	37.48	98.92	67.34
Sarasota	Florida	73.25	71.01	72.38	81.31	83.24	58.30
Pompano Beach	Florida	72.73	86.14	72.17	48.57	96.05	60.73
St. Petersburg	Florida	72.06	63.21	77.45	76.10	84.86	58.67
Boca Raton	Florida	71.54	84.58	69.49	48.68	94.20	60.73
North Miami	Florida	71.39	83.48	75.90	37.48	98.92	61.17
Bradenton	Florida	71.21	65.86	66.36	82.18	83.37	58.30
Deerfield Beach	Florida	71.16	84.58	67.61	48.68	94.20	60.73
Fort Lauderdale	Florida	71.01	86.14	62.14	48.19	97.89	60.69
Boynton Beach	Florida	70.88	83.48	74.11	43.98	91.67	61.17
Galveston	Texas	70.69	84.58	89.28	64.99	48.49	66.15
Delray Beach	Florida	70.66	86.14	67.22	44.60	94.20	61.17
Miami	Florida	70.11	83.33	70.56	35.11	98.39	63.18
Jupiter	Florida	69.89	84.89	84.27	41.54	83.42	55.35
Largo	Florida	69.75	59.31	72.76	73.55	84.49	58.67
Clearwater	Florida	69.22	59.31	76.02	68.65	83.43	58.67
Melbourne	Florida	68.43	95.18	66.22	51.21	73.42	56.10
Coral Gables	Florida	68.23	80.68	73.43	35.11	98.39	53.57
Kenner	Louisiana	67.63	77.40	100.00	77.68	49.60	33.48
Port Arthur	Texas	67.62	91.13	71.60	62.68	49.75	62.93
Fort Myers	Florida	67.39	67.73	68.49	52.40	82.57	65.73

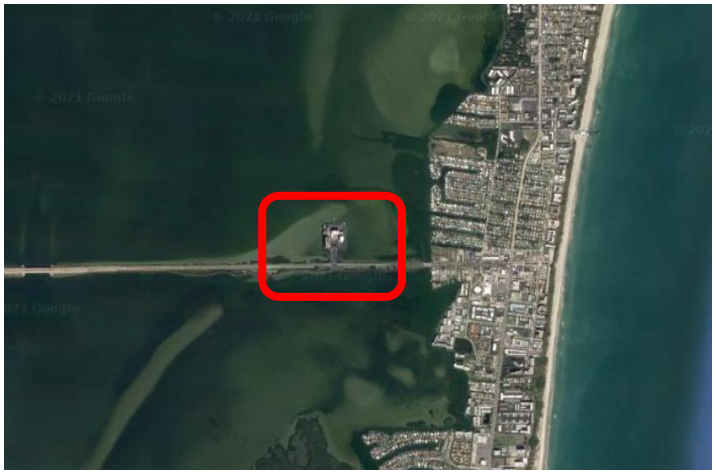
RisQ - two key differentiators

- Leading provider of an interactive data platform targeting the municipal debt ecosystem
- Explicit incorporation of climate change (not just catastrophe) into hazard models
  - Critical given the 10-30 year maturities of municipal bonds
  - This is a timespan in which material climate change risks will continue to intensify
  - Conventional data providers' time horizon is shorter
- Translation to municipal financial risk
  - Rather than focusing solely on a client-specified portfolio, RisQ models financial impacts to multiple layers of any given area's local economy (though custom, automated portfolio analysis is offered through RisQ's platform)
  - Generalizability of RisQ data means that 100x100m grids anywhere in the US can be directly compared to one another (contrast with other providers who offer high granularity in some areas and less elsewhere)

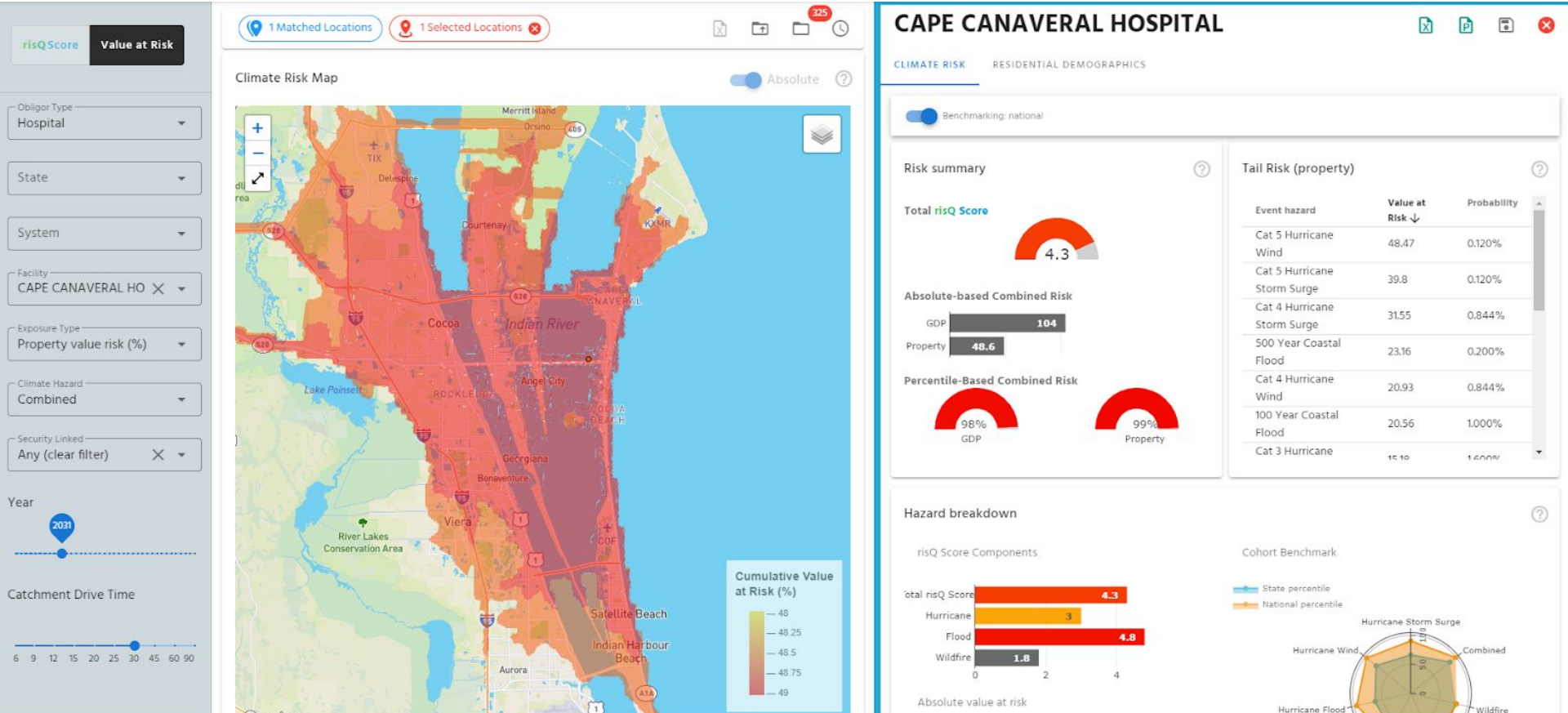
RisQ, continued

- RisQ does not generally work directly with issuers
  - Go-to-market strategy focuses on investors (especially on the buy-side), as well as investment banks that are investing directly off their own balance sheets
  - Also conducts consulting work for ratings agencies and bond insurers
- Like other data providers, RisQ addresses physical risk
  - Identifying transition risk,which is linked to the follow-on effects to a municipality/asset's catchment area, is more challenging
  - Analyzing acute risks like natural disasters is manageable but chronic risks like rising temperatures, expansion of tropical pests and diseases into temperate zones can be more challenging
  - One example: **Cape Canaveral Hospital, Northwest Florida - only accessible by causeway**

Cape Canaveral Hospital - Brevard County, FL



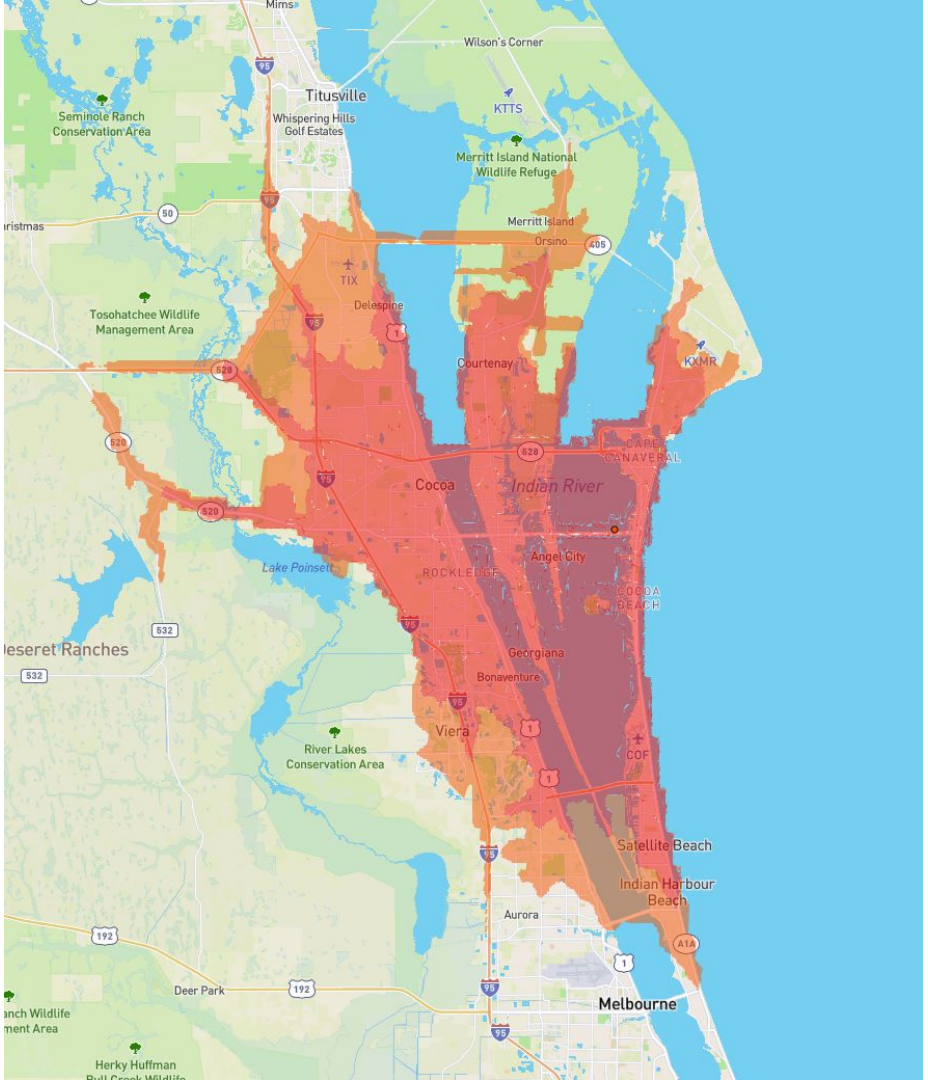
The RisQ perspective



Predictably, a hospital on a causeway is high-risk

- But exactly how high is that risk?
- Can it be mitigated?
- What does the risk come from?
- What are the secondary effects of diminished hospital capacity and GDP impairment?

- The hospital’s catchment area extends far beyond its immediate surroundings
- This map displays GDP impairment risk
    - Intuitively, anything that affects Cape Canaveral Hospital will also affect the highlighted communities within a 30 minute drive



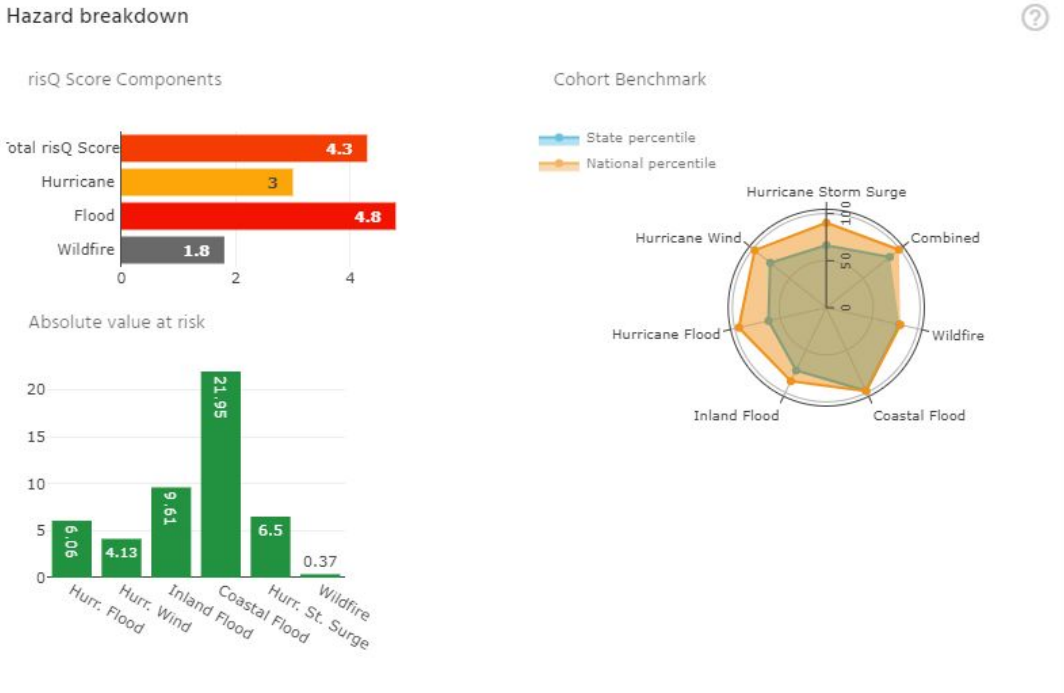
Disconnect between catastrophic and cumulative risk

Tail Risk (gdp)

Event hazard	Value at Risk ↓	Probability
Cat 5 Hurricane Wind	70.73	0.120%
Cat 5 Hurricane Storm Surge	69.52	0.120%
Cat 4 Hurricane Storm Surge	46.47	0.844%
500 Year Coastal Flood	44.03	0.200%
Hurricane Flood	43.84	3.451%
Cat 4 Hurricane Wind	41.23	0.844%
500 Year Inland Flood	39.44	0.200%

Breaking down specific hazards at Cape Canaveral Hospital

- Perhaps surprisingly, the greatest absolute property risk stems from coastal flooding, not extreme storms
- Important to consider the intersection of probability and magnitude



Wildfires (and inland flooding) pose a threat to property, too

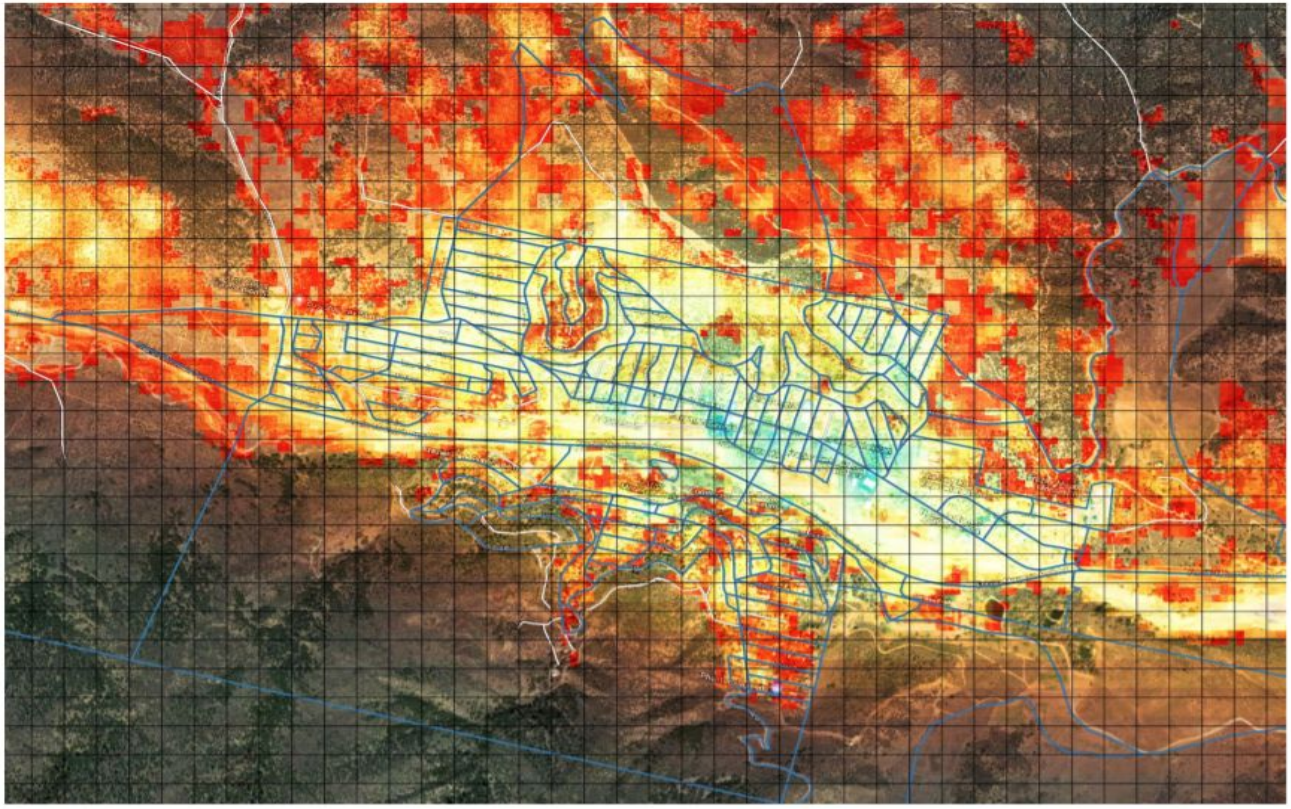


Figure 5: *Selected spatial data ingredients used in modeling exposure on risQ's 100-meter grid, shown for El Tejon School District in California. Black squares represent the 100-meter grid, white lines represent roads, blue lines represent census boundaries, and the red-to-blue gradient represents lower-to-higher built structure density. All of these features are used to disaggregate property values and GDP data to the 100-meter grid. This same data and grid structure is utilized over the entire contiguous U.S.*

So are the data finite enough to measure risk impact across an entire debt portfolio?

So are the data finite enough to measure risk impact across an entire debt portfolio?

Probably

Environmental Risk Factors

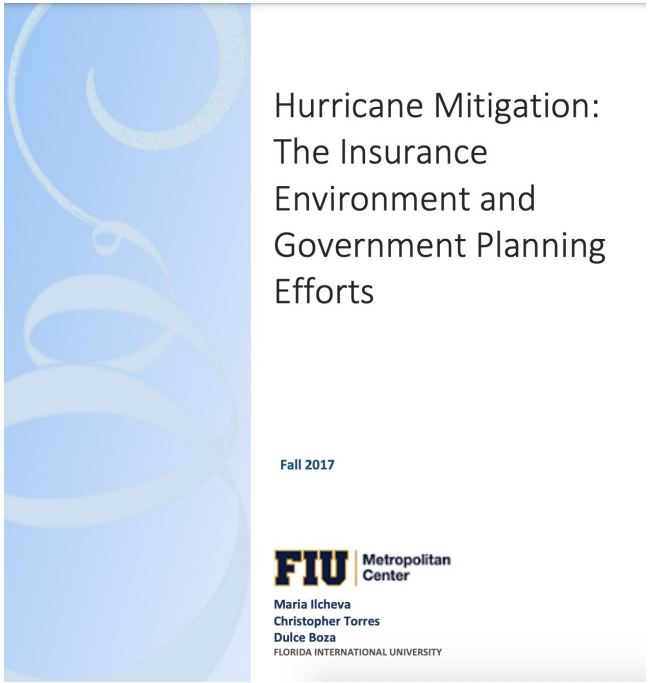
With more than 2,000 linear miles of coastline, Florida's weather and natural resources affect its economy in a variety of ways. Economic activity attributable to in-migration and tourism represents a significant part of the State's economy, and the State's warm weather and beaches are responsible for attracting seasonal and permanent residents and tourists to the State. Because of the State's reliance on its natural resources to generate business and sustain in-migration, its economy and financial condition may be vulnerable to the impacts of environmental events, especially hurricanes. The State has mitigated its vulnerability to the impacts of hurricanes with a robust emergency response system, hardened infrastructure through building codes and coastal setbacks, and the establishment of the Florida Hurricane Catastrophe Fund and the Citizens Property Insurance Corporation to stabilize the property insurance market in the State. Notwithstanding multiple hurricanes, State finances and the economy have only experienced temporary economic disruption.

The State has effectively responded to past environmental events, such as multiple hurricanes and the 2010 oil spill in the Gulf of Mexico from the Deepwater Horizon oil drilling rig, and has a variety of resources available to respond to damage caused by such events. The State has financial reserves available to cover response-related expenditures, and, in most cases, the State can request reimbursement from federal relief funds to pay for a portion of such expenditures. In addition, upon a declaration of a state of emergency, Florida law provides the Governor broad spending authority to meet financial needs resulting from a disaster. The Division of Emergency Management ("DEM") was established as part of the State's structure to plan for and respond to both natural and manmade disasters. In addition to coordinating disaster response activities, DEM prepares and implements a statewide Comprehensive Emergency Management Plan and routinely conducts extensive exercises to test state and county emergency response capabilities.

In January 2019, the Governor created the Office of Environmental Accountability and Transparency, led by the State's Chief Science Officer, within the Department of Environmental Protection to, in part, conduct scientific research that focuses on current and emerging environmental concerns most pressing to Floridians. In 2019, the Governor created the position of Chief Resilience Officer to work with state agencies to, in part, develop and coordinate the implementation of a comprehensive statewide resilience plan with goals designed to mitigate and adapt to the environmental challenges facing Florida's communities.

The magnitude of the impact on the State's operations, economy, or financial condition from environmental risks is indeterminate and is unpredictable for future natural disasters like hurricanes, tropical storms, and naturally-occurring phenomena like red tide. There can be no assurance that such risks will not adversely affect the operations, economy, or financial condition of the State.

Florida International University
Dormitory Revenue Bonds, Series 2020A Official Statement



Florida International University Metropolitan Center
Hurricane Mitigation: The Insurance Environment and Government Planning Efforts (2017)

The problem is twofold

Issuers must have the proactiveness to simulate scenarios where physical climate risk exists within their debt portfolio and be able to disclose that information in order to provide context to the more transitional risk.

But there also needs to be encouragement from the buy-side and regulators in order drive standardization for climate risk disclosure. The industry faces an S-curve for adoption, and momentum appears to be building.

There are **other data sources** that provide analysis on climate risk to their respective locations that provide issuers the opportunity to explore how climate change can affect their debt portfolios.

There needs to be a way to push issuers to make a greater effort to provide better risk disclosures. Issuers have intimate knowledge to their areas, and with combination of climate analytics, can provide better context to their investors and credit agencies among others.

There isn't going to be a standardization of the uses and limitations of the climate model information given by data providers until there is a concerted desire and effort from governments, regulators, standard-setters, and businesses to assess climate risk

Unintentional ways in which climate risk projections can be used incorrectly

- Climate models and guidance can lead internal players to believe that financial reports are densible and documents are completely trustworthy
- Auditors can form opinions of the information in the climate analytics that if interpreted incorrectly, can be hard to prove without consensus on any set benchmarks
- Overprojection might encourage investors to pull out of a project entirely if the models assess the environment to be too risky.
- Inaccurate information can lead to lowering creditworthiness as well as loss in capital, that can affect investments to even tackle the issue.

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RisQ - https://www.risq.io/

Question 3 - Paulina

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Materiality of Climate Risk Disclosures

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"There must be a substantial likelihood that the **disclosure of the omitted fact** would have been viewed by the reasonable **investor** as having significantly **altered the 'total mix' of information** made available."

— Supreme Court, in TSC Industries, Inc. v. Northway Inc., 426 U.S. 438 (1976) ("TSC Industries")

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Interviews with Municipal Securities Industry Stakeholders

3rd party

HIP℠ INVESTOR
Human Impact + Profit

SUSTAINABILITY ACCOUNTING STANDARDS BOARD
SASB

Investor

Ivy INVESTMENTS℠

Foundation | CREDIT

Issuer

Hawkins
DELAFIELD & WOOD LLP

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Interviewees were concerned about

Local Govt

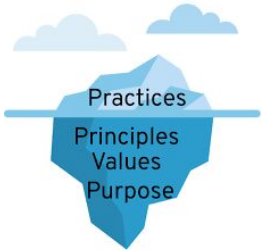
City Hall

3rd Party Data

Specific vs Generic Information

Revenue Stream

Principles-based vs Rules-based



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Question 4 - Ryan and Junaid

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Role of Regional Governments / Councils of Governments

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Project Overview

- Motivating question: “Can state or regional governments/councils of government (including any reports they publish) be a reliable and uniform data source for municipal issuers for climate change impact?”

What We Did

- Created a survey containing a list of relevant questions
- Sent emails to a select number of COGs and MPOs based on relevant factors such as:
    1. Size of population,
    2. Geographical location,
    3. Expected climate change risks
- Replies received: 3
- Surveys completed: 2 (MARC & PSRC)

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List of Survey Questions

1. **What information does your organization collect on climate change and climate change risk?**

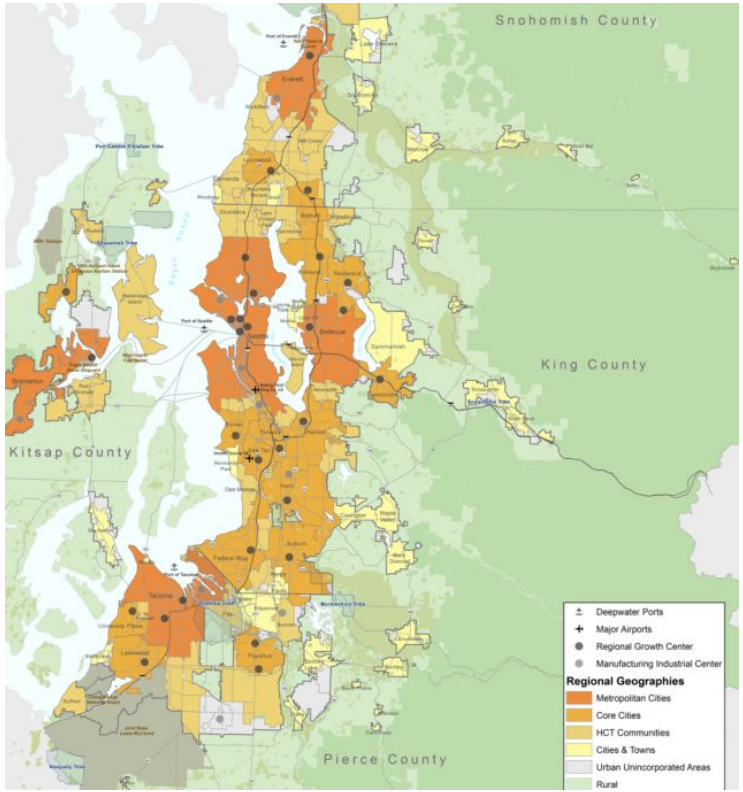
2. Does your organization provide a summary of your findings on climate change risk that municipal bond issuers could use? Would it be able to?

3. Would municipalities have undue difficulties if they were to reference your reports or summaries on climate risk when issuing their own bonds?

4. Does your organization communicate with other groups about climate risk?

5. **How do you analyze climate change risk?**

Puget Sound Regional Council (PSRC)



- PSRC is a Metropolitan Planning Organization (MPO) in greater Seattle
- PSRC focuses on regional growth, transportation and economic development planning within *King*, *Pierce*, *Snohomish* and *Kitsap* counties
- Has focused on climate change ***mitigation*** rather than climate change ***risk***

Mid-America Regional Council (MARC)

- MARC composition:
  - 10 counties
  - 123 municipalities
  - Population of 2.14 million
- Interviewed David Warm, Executive Director, and Tom Jacobs, Environmental Program Director
- In March, 2021, MARC released a **Regional Climate Action Plan**

Regional Climate Action Plan

The **Regional Climate Action Plan** contained a **Climate Risk and Vulnerability Assessment (CRVA)**

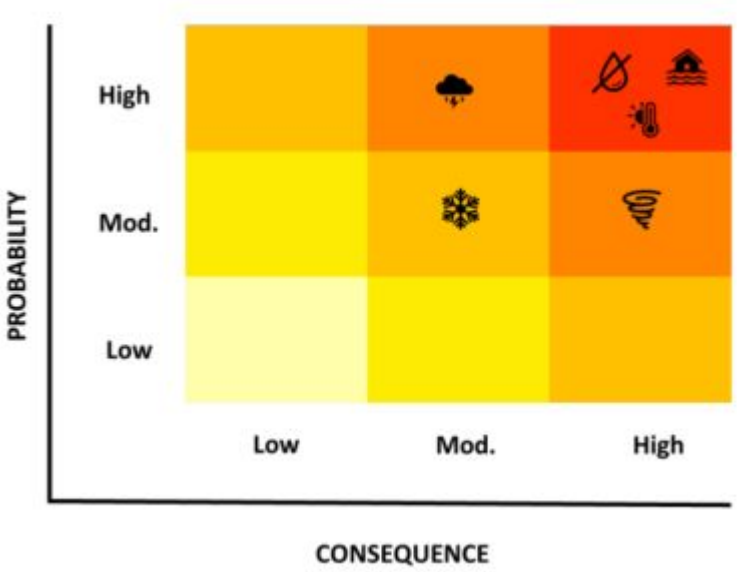
CRVA contains components including:

1. Community Profile
2. Climate Outlook
3. Natural Hazards
4. Social Vulnerability Assessment
5. Adaptive Capacity

- **Natural Hazards** include: flooding, heat, drought, severe thunderstorms, severe winter weather and tornadoes.
- [**Risk** = Probability of a hazard occurring x consequence of that hazard occurring]
- Flooding, heat, and drought considered greatest natural **hazard risks** in the region

Climate Change Risk & Natural Hazards

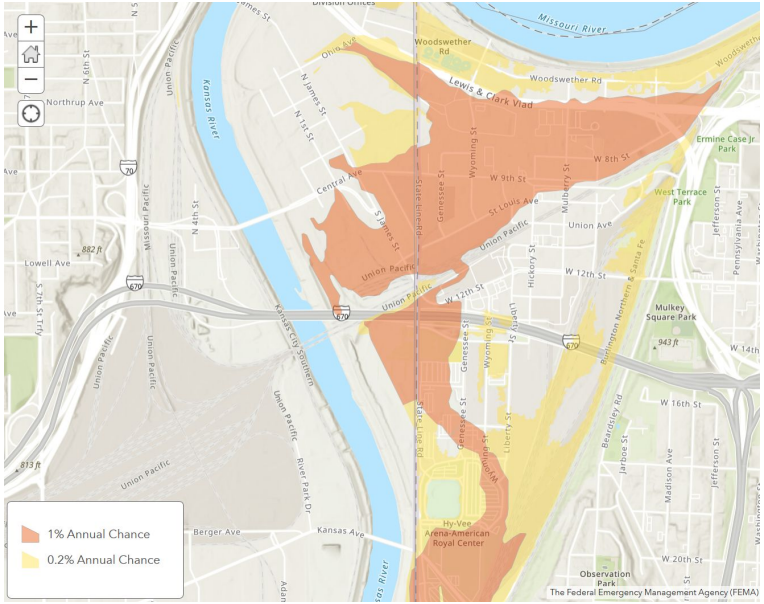
Risk Matrix

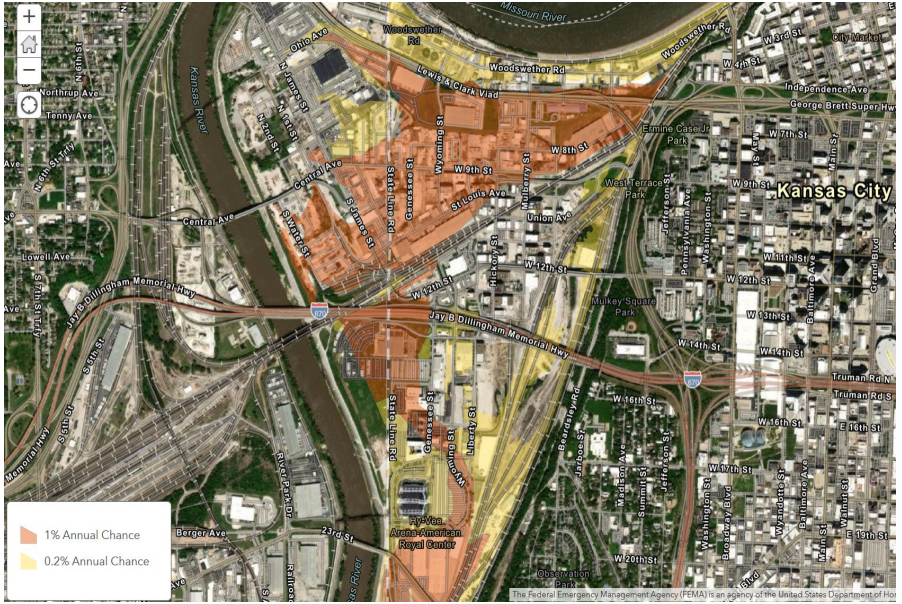


Natural hazard risk quantified by:

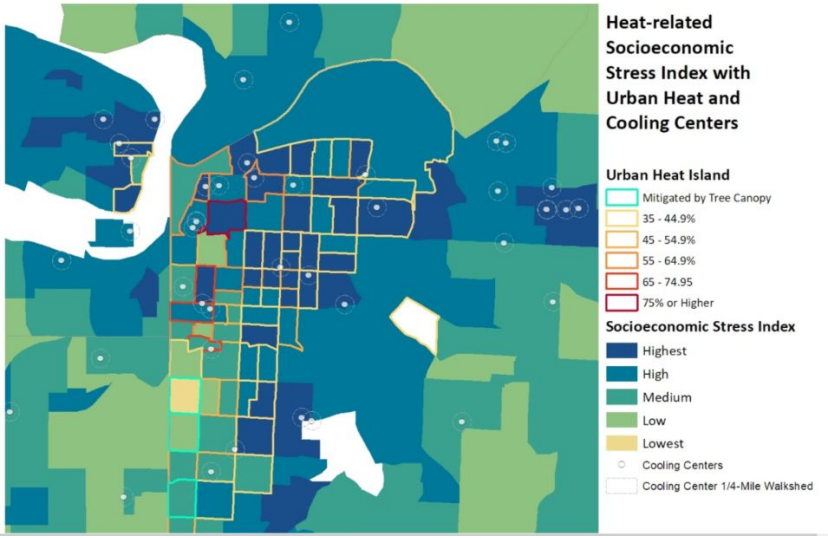
- Risk Level (risk matrix)
- Change in intensity
- Change in frequency
- Timescale: Immediate (2026-2050), Medium Term (by 2050), Long Term (after 2050)

Flooding Risk – where Kansas meets Missouri





Heat Risk



- Map shows Main Street corridor in Kansas City, Missouri.
- Risk of urban heat islands is seen as High Risk in the Medium Term (by 2050)
- “The corridor is the economic center of the region and used for recreation, shopping, medical services, transit connections, etc.”

NARC, COGs, Counties & Cities

National Association of Regional Councils (NARC)

- Members include COGs, regional planning and development agencies, MPOs, and other regional organizations.
- Oversees coordination among Regional Councils/Council of Governments
- Include members from all fifty states

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COGs and Cities

COGs, counties, and cities active in considering climate change risk and developing climate action plans

- California
  - SECOG, SCAG, SANDEG, ABAG, San Francisco
- Florida
  - Broward County, Orlando
- Boston
- Philadelphia

Global Covenant of Mayors for Climate & Energy

Facts

- Covenant includes mayors from around the world
- 179 city members in the United States, with MARC as recent member
- All participating cities in US oversee a total population of approximately 80 million people

- Share data related to climate change actions like mitigation, adaptation, and accessibility to energy
  - Data includes: emissions information from buildings, transportation, industry, and waste
  - 3 phases for each **action** listed above that are measured based on Assessment/Inventory, Goal, and a **Plan**
  - Uses same risk matrix as in previous slide

Summary: Promising Outlook

- David Warm confirmed that COGs have **enormous capacity** and **would be able to create a standardized resource** for municipal bond issuers to use for assessing climate change risk.
- NARC offers strong coordination structure to develop and employ construction of a uniform reference that COGs, MPOs, and municipalities could use.
- Ongoing developments in this space across many COGs, MPOs, and municipalities offer opportunity for greater coordination, information sharing, and development of standardized climate change risk assessment.

Question 5 - Kelsie

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Potential Muni Climate Risk Disclosure Models

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The Question

Is a disclosure model that emphasizes the categories of: physical risk, transition risk, and resiliency planning - a good model for municipal issuers to follow?

Are there other categories that should be included?

How Corporations are Disclosing Non-financial Risks

- Corporate Disclosures as a Benchmark for comparison to Understand how Municipalities can effectively disclose risks, specifically climate-related.
- Corporations are performing materiality assessments to understand which risks are critical to its business.
  - Risks are identified based on
    - “ESG”: Environmental, Social, Governance Initiatives
    - Companies taking accountability of their impact on environment, communities, and employees
    - Media attention on trending issues also forces corporations to identify more niche, non-financial risks
    - Improving transparency by reporting more metrics
      - Most report on Scope 1 and 2
      - Most have not reported on Scope 3 -more complicated to calculate and measure
    - Trend: Corporations Looking More at Risk and Performance Management in relation to ESG
      - corporations hiring Chief Risk Management/Sustainability Officers
- Large stakeholders are specifying to companies which risks are critical to identify, report, and mitigate
- IMPORTANT TO REMEMBER:
  - Corporations and stock market can react quicker to newer trends, social movements, etc and are more volatile while municipalities are slower, lag timely, lack more data, more stable

Disclosure model for Municipalities

PHYSICAL

- ENVIRONMENTAL
- RACIAL, EQUITY, JUSTICE CLIMATE

TRANSITIONAL

- MOVING TO A MORE CARBON FRIENDLY FUTURE
- AUTOMATION, DIGITALIZATION
- FOREIGN COMPETITION AND EXPORT CHANGES DUE TO CLIMATE CHANGES
- “CLIMATE REFUGEES”
- CRYPTOCURRENCY

RESILIENCY

- PREPARATION FOR NATURAL DISASTERS
- INCREASED TEMPERATURES → WATER CRISES
- WASTE MANAGEMENT
- PANDEMICS

Defining Physical Risks

What aligns:

- **Environmental**
  - **Physical Climate Changes**
    - Emissions
    - Water Access/Pollution
    - Food Access and Waste
    - Air Quality

- **Social**
  - Equity Climate
  - Justice Climate
  - Racial Climate

What does not align:

Uniquely Corporate
Social
EXs: Diverse Board
Employee Engagement
Representation throughout
Equal and Equitable Pay

Defining Transitional [Risks]

Municipalities cannot mitigate these risks

- **No opportunity to prevent these events from happening**
  - **Potential Value to acknowledge such events and disclose them**
- **We DO know that governments will lose tax revenues from all of these transitional changes**

What does not align:

Uniquely Corporate

- Transition to a more carbon-friendly economy
- Climate Refugees
- Automation and Digitalization
- Cryptocurrency
- Foreign Competition

Defining Resiliency Planning

- **What aligns:**
  - Natural Disasters
  - Pandemics, Public Health
  - Water scarcity
  - Deforestation
  - Waste Management
  - Political Risk
    - State and federal tensions
    - More problematic?
    - Barrier to climate adaptation & resilience

What does not align:

Uniquely Corporate

Regulatory Risk

Costly mitigation and preparational strategies for both Corporations and Municipalities

How Foreign Governments Categorized Non-Financial Risks for Publicly-Traded Companies

- Foreign Governments beginning to take action and require publicly-traded companies to disclose non-financial risks, ie. emissions and diversity
  - To mitigate “greenwashing” risk
    - But compliance issue rises
  - China and UK
- Muni Market lacks data and slower to change
- Foreign Governments not requiring governmental disclosures yet
  - But, Issuing More Green and Carbon Bonds
  - No generic climate-related governmental disclosures

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Question 6 - Haobin and Mike

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Muni Climate-Risk Disclosure Channels

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Research Question

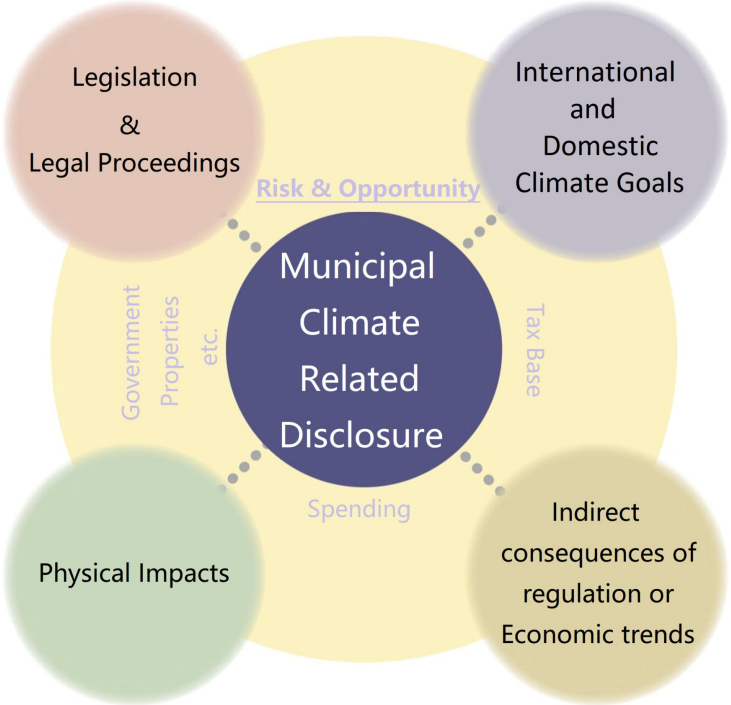
The SEC has provided guidance to public companies that, depending on the circumstances, information about climate change-related risk and opportunities might be required in disclosures related to its description of business, risk factors, legal proceedings, and management's discussion and analysis of financial condition and results of operations. **Would this guidance provide a good analogue for where municipal issuers should describe climate-change related risk and opportunities in their disclosure documents?**

SEC CR Disclosure Guideline for Business

Published by the SEC in 2010

- **Disclosure channels in reports:**
  - Description of business
  - Legal proceedings
  - Risk factors
  - Management's discussion and analysis. (MD & A)
  - Foreign private issuers
- **Aspects of current climate change related disclosures:**
  - Impact of legislation and regulation.
  - International accords.
  - Indirect consequences of regulation or business trends
  - Physical impacts of climate change

Updated Framework (Proposed)



Legislation and Legal Proceedings

Legal proceedings have very strict material impacts on investment. E.g., lawsuit against global warming.

Governments & Government-like Issuers:

- Currently rarely prosecuted for climate change or emission related issues.
- May change in the future as state legislation change. Example: state emission target, carbon neutral, paris accord.

Corporate-like & Other Issuers:

Example: Utilities such as water, electricity, waste, and other Issuers. May have similarity to corporations.

- Current SEC guidance pointed out that pursuant to Items 101, 103, 503(c) and 303 of Regulation S-K may trigger climate-related disclosure for corporates. May consider expansion to municipal issuers that have elements similar to corporates.

International and Domestic Climate Goals

Paris Accord and other international climate targets (1.5 Celsius)

Cooperation with foreign and domestic municipal governments.

New Trend in Legislation, at least for firms:

March 10, 2021, the Paris Climate Agreement Disclosure Act (H.R.1780) introduced.

- Disclose whether the issuer has set, or has committed to achieve the defined climate targets. What steps have been planned or taken?

January 26, 2021, the Climate Corporate Accountability Act (CA- SB 260) introduced.

- Require firms with revenue > $1,000,000,000 to disclose emission, emission estimates, and related targets and plans.
- Has details on category of emission and regulatory process on disclosure.

H.R.1780 May serve as a legal basis if passed and CA- SB 260 can serve as a template with details.

Physical Impacts of Climate Change

- **What is it?** Physical impacts that climate change may have on the issuers' ability to collect tax and secure the value for their assets and collaterals.
- Tax base revenue raising ability
  - Population growth trends
    - Heat-related illness, fog and smog, etc.
  - Long-term economic growth implication
    - Change of composition of local industry
    - Local business operations and supply chain disruption
      - Sea level rise, water availability and quality,
- Maintenance cost for existing infrastructure
  - Highways
  - high-speed railroads in the future

Indirect Consequences

- **New regulatory requirements**
  - Possible emission caps placed on issuers like the SF Public Utilities Commission in the future?
  - State-imposed target on municipalities' carbon emissions in the future?
  - Other possible regulatory requirements.
- **Economic Trends & New Opportunities**
  - Enterprises may choose to **relocate and restructure**:
    - Electric vehicles: Chrysler vs. Tesla
      - Changing Climate -> Changing economic conditions -> Changing demographics
      - Boomer Workers vs. Millennial Engineers
    - Pittsburgh: Rebirth of the steel city
      - Economic trends leading to lower emission of air and water pollutants
      - From a city of steel mills to a city of research centers and tech-enabled hospitals
  - Modernizing Tax Base
    - Pittsburgh Example: Uber Self-driving Lab, Google, UPMC etc.
    - Vibrant entrepreneur community

Comparison between Municipal vs. Corporate

Organizational and Operational Differences	Corporate	Governments & Government-like Corporate-like & Other
Disclosure Framework	1. Impact of legislation and regulation*	1. Legislation and legal proceedings†
	2. International accords*	2. International Accords and Cooperation†
	3. Indirect consequences of regulation or business trends*	3. Indirect Consequences of Regulation or Economic Trends†
	4. Physical Risks*	4. Physical Risks†
* Summarized based on the current SEC guidelines and the latest legislation progress pertaining to climate-related disclosure.		
† Proposed based on The Climate Risk Disclosure Initiative Steering Committee 2006 report.		

Further Investigation Directions

1. Study the leading disclosing issuers in the corporate realm on climate-related risks.
    a. Leading large cap in climate related disclosure: Apple and Chevron. Small cap: Smucker's.
2. Study if disclosure requirements need to be specified for different categories of municipal issuers.
3. Study how can the modified and updated guidelines (if developed) can be applied under the current disclosure-related law and regulations.
4. Track and study the latest regulations, federal and state, on climate-risk disclosure.
5. Analyze the administrative cost such disclosure requirements could add on smaller issuers.
6. How to centralize the decision making process and make this transition more systematic? How to standardize the climate-related disclosure process to facilitate "apple to apple" comparison between climate risk information disclosed?

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