



Crisis and Disaster Risk Finance Executive Education Program

Climate analytics informing
sovereign credit ratings

Dr Mark Bernhofen

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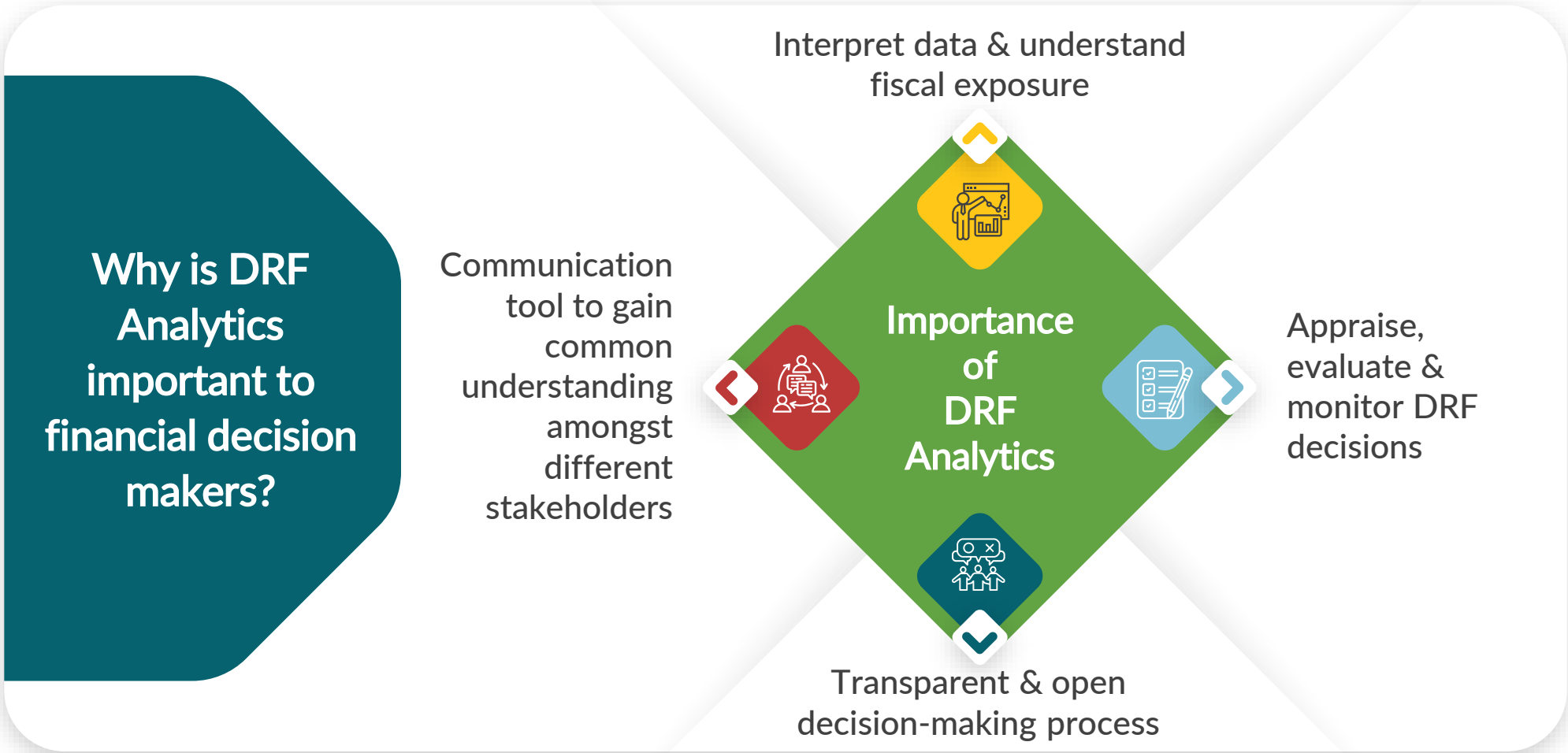
Environmental Change Institute



Disaster Risk Financing
& Insurance Program



DRF Analytics Empowers Stakeholders to Take Risk-Informed Financial Protection Decisions



Climate Change and Sovereign Risk



Fiscal Impacts of Disasters

- Economic disruption impacting tax revenue
- Cost of reconstruction and recovery
- Public insurance payouts



Fiscal Impacts of Climate Policies

- Adaptation costs in developing countries 10-18x higher than adaptation finance
- Many large national adaptation projects will be publicly financed



Macroeconomic Impacts

- Recent estimates show global income losses of 19% are already *baked in*
- Long-run growth effects due to lost labour productivity, agriculture production, and increased frequency and severity of extreme events.



International Trade

- Disruption to supply chains and international trade by extreme events
- Long term impacts of climate change on production and output



Financial Sector Risk

- Climate risks pose a material risk to financial institutions and financial stability
- This has knock on effects on real economy and government finances



Political Instability

- Politically unstable countries have higher default rates and pay higher risk premiums
- Climate change can impact political instability due to increased inequality, migration, and conflict

Sovereign Credit Ratings and Climate Risk – Current Approach



Ex-Ante – Qualitative and Implicit

None of the rating agencies explicitly incorporate climate risk into their methodologies – although they are **beginning to be incorporated implicitly** through other variables.

The big three rating agencies consider climate risk either through **ESG variables** that inform their core assessment or through **qualitative judgements** of how climate risk may impact economic and fiscal performance.

Ratings agencies argue that the barriers for incorporating quantitative *ex-ante* assessments of climate risk into ratings are due to the **uncertainty** around such assessments and the long **time-horizon** over which many of these risks will materialize

Credit Ratings & Climate Risks



Ex-Post – Ratings Changes

Rating agencies do incorporate climate risk into ratings considerations in an *ex-post* manner through **rating changes following climate disasters**.

Moody's downgraded Sint Maarten's credit rating in 2017 following the **economic and fiscal impact of Hurricane Irma**.

Fitch Ratings downgraded Pakistan's credit rating in 2022 due to **reduced foreign exchange reserves and worsened external liquidity as a result of the catastrophic flooding**. This event was made **50% more intense due to climate change**

RATING ACTION COMMENTARY

Fitch Downgrades Pakistan to 'CCC+'

Fri 21 Oct, 2022 - 06:14 ET

The First “Climate-Smart” Sovereign Credit Ratings

A study published last year developed a model, trained on historical rating movements, to predict sovereign credit ratings

By integrating the model with macroeconomic loss estimates of **chronic** climate impacts, they provide the first **climate-smart** credit ratings for 109 countries.

In a high-emission scenario, **59 sovereigns** could experience downgrades by 2030

By the end of the century, this rises to **81 sovereigns** with an average downgrade of **2.18 notches**

However, questions remain...

What about acute (extreme) events?

How can adaptation reduce the risk?

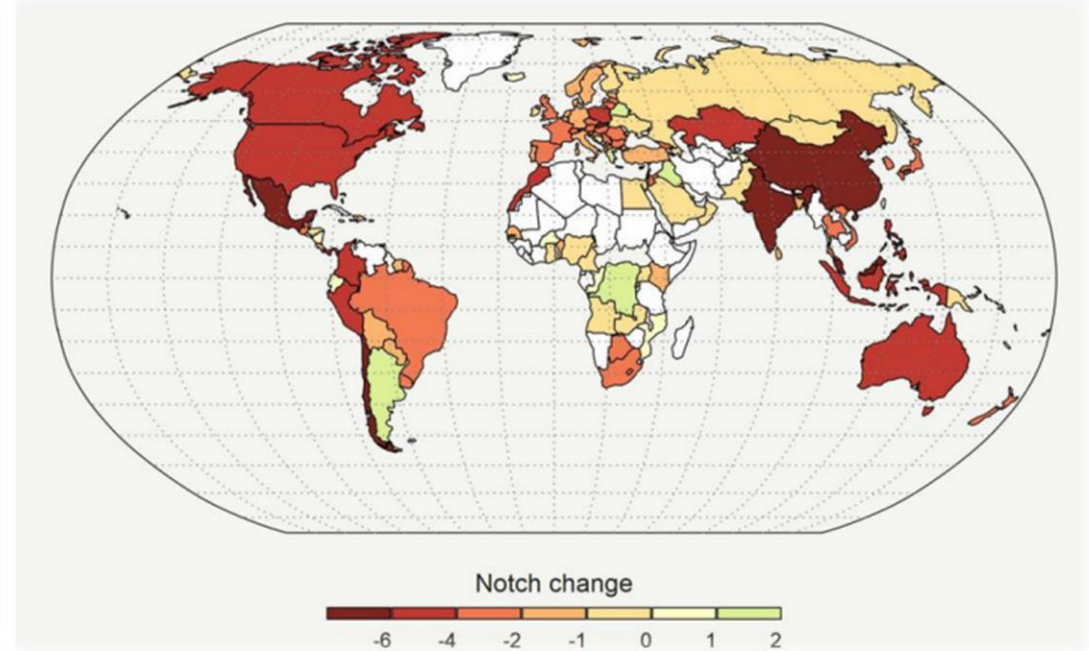
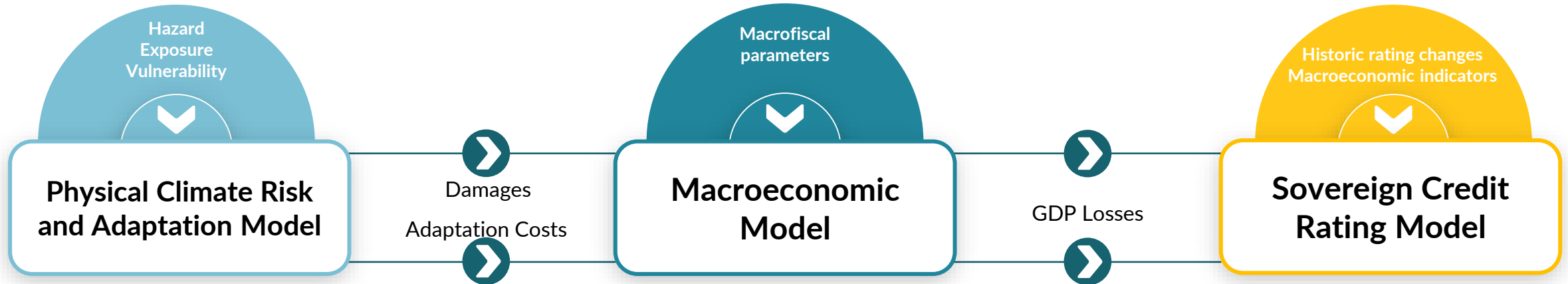


Figure. Global Climate Induced Sovereign Ratings Changes (2100, RCP8.5)

Klusak, P., Agarwala, M., Burke, M., Kraemer, M., Mohaddes, K. (2023). Rising Temperatures, Falling Ratings: The Effect of Climate Change on Sovereign Creditworthiness. *Management Science* 69 12



The First “Climate-Smart” Sovereign Credit Ratings



We test the model in **Thailand** for **river flood risk**

1. Floods

Adaptation Scenario 1

Current levels of adaptation in a **baseline climate** as well as a **future (2075) high emission (RCP8.5) climate**

FLOPROS Flood Protection Level

Return Period	Color
0 - 2	Red
2 - 10	Orange
10 - 20	Yellow
20 - 30	Light Green
30 - 40	Green
40 - 50	Dark Green

Adaptation Scenario 2

Urban area flood protection improved to 1 in 100-year flood. Tested in a **future high emission climate**

Urban Classification

Urban Classification	Color
City	Red
Dense Town	Orange
Semi-Dense Town	Yellow
Suburban Area	Light Green
Village	Green
Dispersed Rural Area	Light Green
Mostly Uninhabited Area	Dark Green
Water	Blue

Results for Thailand

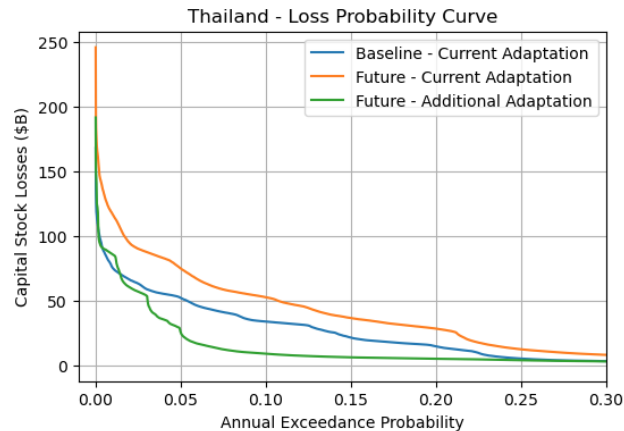


Simulated Losses

With our model, we can simulate **thousands of years of losses** in Thailand

We find that in the future, without additional adaptation, **average annual losses will increase by 65%**

Investing in adaptation **reduces losses by 41% compared to baseline**



Symbol	Numerical	Grade
AAA	20	Prime high grade
AA+	19	
AA	18	High grade
AA-	17	
A+	16	
A	15	Upper medium grade
A-	14	
BBB+	13	
BBB	12	Lower medium grade
BBB-	11	
BB+	10	
BB	9	Speculative
BB-	8	
B+	7	
B	6	Highly speculative
B-	5	
CCC+	4	
CCC	3	Substantial risks
CCC-	2	
CC	1	Extremely speculative
C	1	
D/SD	1	In default

But what does it mean for Thailand's sovereign rating?

100-year flood loss year

A 100-year loss year would lead to a **1.35 notch** downgrade **today**. This increases to **2.25 notches** in a **future with no additional adaptation**. **Adaptation** can limit it to **1.54 notches**

Scenario	Downgrade	Δ PoD (%)	Δ CoD (\$B)
Baseline	1.35	1.27	0.91
Future	2.25	4.7	2.15
Adaptation	1.54	1.44	1.02

Non-investment grade downgrade

The probability a flood-loss year would shift Thailand's credit rating to **non-investment grade?**

In addition to direct capital stock damages of **160 \$B**, such an event would increase the 10-year cost of debt by **38 \$B**

Scenario	Annual Probability	10-year probability
Baseline	0.02%	0.2%
Future	0.66%	6.43%
Adaptation	0.09%	0.9%

Concluding Thoughts and Next Steps



Three Concluding Thoughts

1. Ratings agencies can build climate risk and adaptation into credit ratings, in a scientific way

Why not have ultra-long-term ratings?

2. Such analyses can be used as evidence for financing adaptation

Developing countries can build a case for concessionary loans for adaptation and resilience

3. Banks can incorporate these scenarios into their climate stress tests

Sovereign debt is world's largest asset class. High correlation between sovereign risk and other asset classes



What's Next?

1. Quantification and communication of uncertainty throughout the modelling chain

By properly quantifying uncertainty, can we overcome key barrier identified by rating agencies?

2. Extend analysis globally

A woman wearing a blue cap and a plaid shirt is holding a tablet. A man in a light blue button-down shirt is looking at the tablet. They are standing in a field with trees in the background. The image is overlaid with a semi-transparent dark grey filter. A thick yellow curved line separates the image from the white background below.

Q&A