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Regulatory Physical Climate Stress Tests in Southeast Asia

Considerations and Challenges from a Singapore Reinsurer's Perspective

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Background

Possible Permutations of Physical Climate Stress Tests

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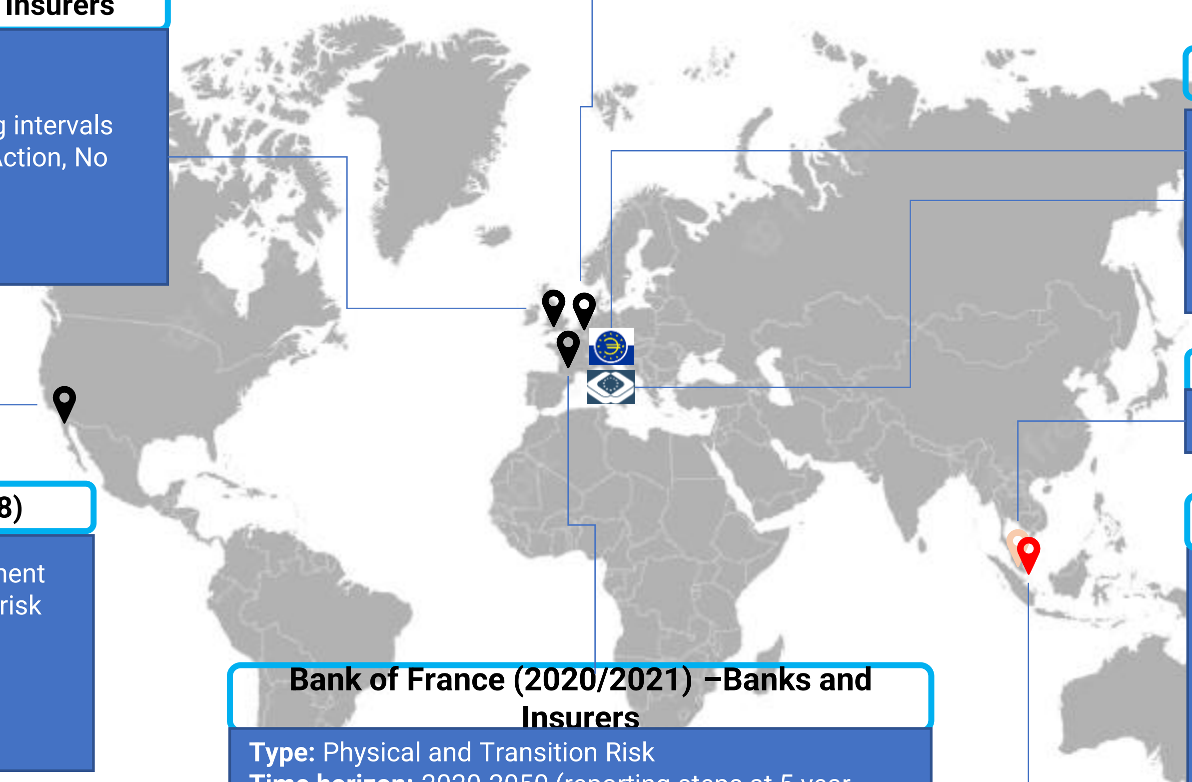

De Nederlandsche Bank(2018) – Banks Insurers Pension Funds

Type: Energy Transition Risk
Time horizon: 5 year
Scenarios: Policy shock, technology shock, double shock, confidence shock
Impact: Assets (bond and loan values) and supervisory ratios

ECB (2022)- Banks

Risk
Time horizon: 1 yr for physical, 3 and 30 for transition risk
Scenarios: Physical/Transition ST (Baseline vs stress); Transition LT: Orderly, Disorderly, Hothouse

Bank of England (2021) – Banks and Insurers

Type: Physical and Transition Risk
Time horizon: 30 years with 5 year reporting intervals
Scenarios: Early Policy Action, Late Policy Action, No Additional Action
Impact: Assets and liabilities

EIOPA (2020) - Insurers

Time horizon: 2019 - 2030
Scenarios: A late and sudden policy shock, a supplementary scenario based on the IEA "Beyond 2 degrees scenario"
Impact: Price sensitivity of equity, corporate bonds and govt holdings

BNM (2024) – Financial Institutions

Type: Discussion paper for stress test in 2024

California Insurance Commissioner (2018)

Type: Physical and Transition Risk (2° scenario analysis) – evaluation of existing exposure, alignment to 2° alignment, exposure to high/low carbon and risk exposure to environmental risk such as flood and wildfire
Time horizon: Point in time
Scenarios: 2° scenario analysis
Impact: Assets (corporate and municipal bonds)

MAS (2021 and 2022) –Financial Institutions

Type:
2018 – Physical (flooding)- insurers only
2022: Physical (1/200 yr flood, prescribed parameters)
2021: Transition Risk (2021, prescribed parameters) with insured Co_2 emission
Time horizon: 3 consecutive years for transition risk, 30 years with 5 year reporting intervals except for the No additional where initial consecutive 5 years also required
Scenarios: Physical - Orderly, Disorderly, no additional policies
Impact:
2022: Asset and Liabilities (Unexpired risk reserves), gross claims incurred
2021: Asset by sector, liabilities, CAR

Bank of France (2020/2021) –Banks and Insurers

Type: Physical and Transition Risk
Time horizon: 2020-2050 (reporting steps at 5 year intervals)
Scenarios: Transition – orderly, delayed, no transition
Physical: RCP 8.5
Impact: Assets and claims/loss ratios.

Source: *European Central Bank.* https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.climate_stress_test_report.20220708~2e3cc0999f.en.pdf (July 2022)
EIOPA. https://www.eiopa.europa.eu/document-library/methodology/methodological-principles-of-insurance-stress-testing-climate-change_en (Jan 2022)
BNM. https://www.bnm.gov.my/documents/20124/3770663/DP_2024_CRST.pdf *(Jun 2022)*
California Insurance Commissioner/2° degree Initiative https://interactive.web.insurance.ca.gov/apex_extprd/cdi_apps/r/250/files/static/v54/2018_full_report.pdf *(2018)*
There may be other regulators which have issued stress tests on physical climate risks but not covered here.

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Parameters Provided (Examples)

Scenario Narrative	**Key assumptions about transition and timing of shocks**	Yes	• Orderly • Disorderly • No Additional Policies
Climate Factors	**Pathway for temperature, emission, carbon price climate perils**	Yes	• Max daily air temp, annual windspeed, annual precipitation, soil moisture, land area exposed to wildfire, frequency of Cat 4/5 typhoons, intensity of cyclones
Broad Economic Factors	**Pathway for GDP, inflation, interest rates**	Yes	• Real GDP levels, unemployment rate, CPI, Property Price • Equity price, credit spreads, exchange rates, yield curve *
Economic Sector Implications	**Disaggregated implications for specific economic sectors and countries**	Yes	
Firm Level Implications	**Disaggregated implications for individual assets**	No	
Activity Level Implications	**Disaggregated implications for specific economic activities**	No	

Source: Adapted from *EIOPA*. https://www.eiopa.europa.eu/document-library/methodology/methodological-principles-of-insurance-stress-testing-climate-change_en (Jan 2022)

*The MAS stress test included exposures to market value of debt and equity securities. These are not discussed in this presentation.

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Risk Type	Timing of Effects	Selected Design
Physical Risk	Short to Medium Term	2022 – 2050 (5 year intervals): Orderly, Disorderly 2022, 2023, 2024, 2025 – 2050 (5 year intervals): No Additional Policies - 1 in 200 year shock in 2022
	Medium to Long Term	Not selected

Frequency of Calculation	Timing of Effects	Design
At end of modelling horizon only	Fixed, impact on reference date balance sheet	Not selected
	Dynamic, balance sheet allowed to change	Not selected
At intermittent intervals (for instance 1 year or 5 year intervals)	Fixed, impact on reference date balance sheet	• Static balance sheet as of 2021 • Management actions can be stated qualitatively/quantitatively
	Dynamic, balance sheet allowed to change	Not selected

<u>Required Output</u>

- **By Scenario**
  - **By Term**
    - **By Country and Business Line**
      - **By Gross and Net**
        - **Impact of 1/200 yr flood in 2022 in urban centres**

- **Unexpired Risk Reserves**
- **Gross incurred claims (No additional policy scenario only)**
- **Management Actions**
- **Data Scenario**
- **Scenario expansion if any**
- **Key Drivers**
- **Risk identification and assessment**
- **Methodology**

Source: Adapted from *EIOPA*. https://www.eiopa.europa.eu/document-library/methodology/methodological-principles-of-insurance-stress-testing-climate-change_en (Jan 2022)

Modelling Assumptions

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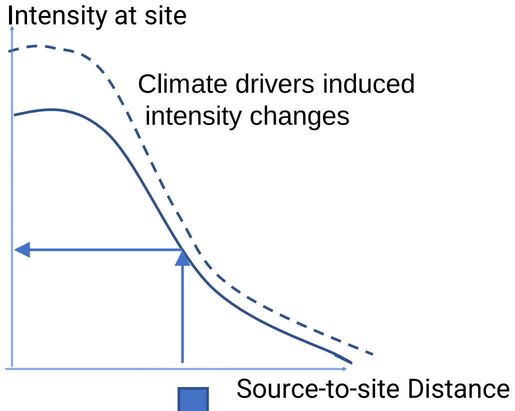
Event Definition

Locations?
Magnitude?
Hazard type?
Probabilities?
Combinations

Severity Estimation



Details

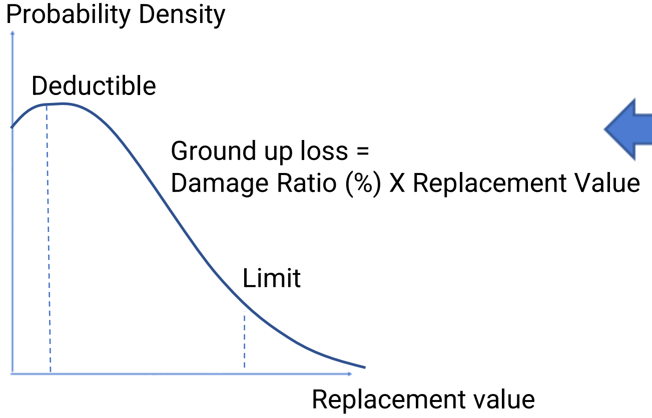
Address/Geolocations
Primary Modifiers:

- Occupancy
- Construction
- Year of Construction
- Number of stories, etc

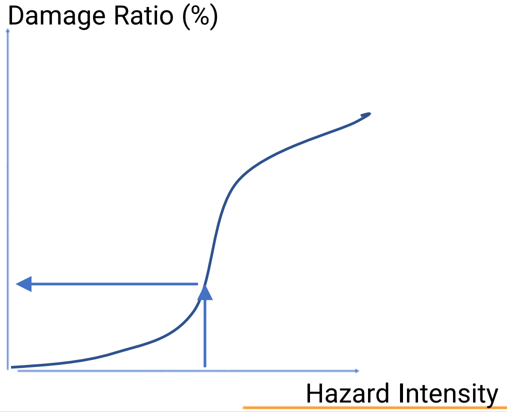
Coverage: Building/Content/BI
Sum Insured
Attachment Point
Deductibles/limits
Secondary Modifiers:

- Foundation
- Cladding
- Set backs etc

Impact Estimation



Damage Estimation



Assumption: One event, one location, one coverage

Modelling Challenges

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Challenges: Hazard Module (Frequency)

Feedback loops affecting casual dependencies/clustering or tail correlations across hazards that has to be ignored

For some lines of business, e.g casualty, fin lines, minimal information on climate change
Impacts

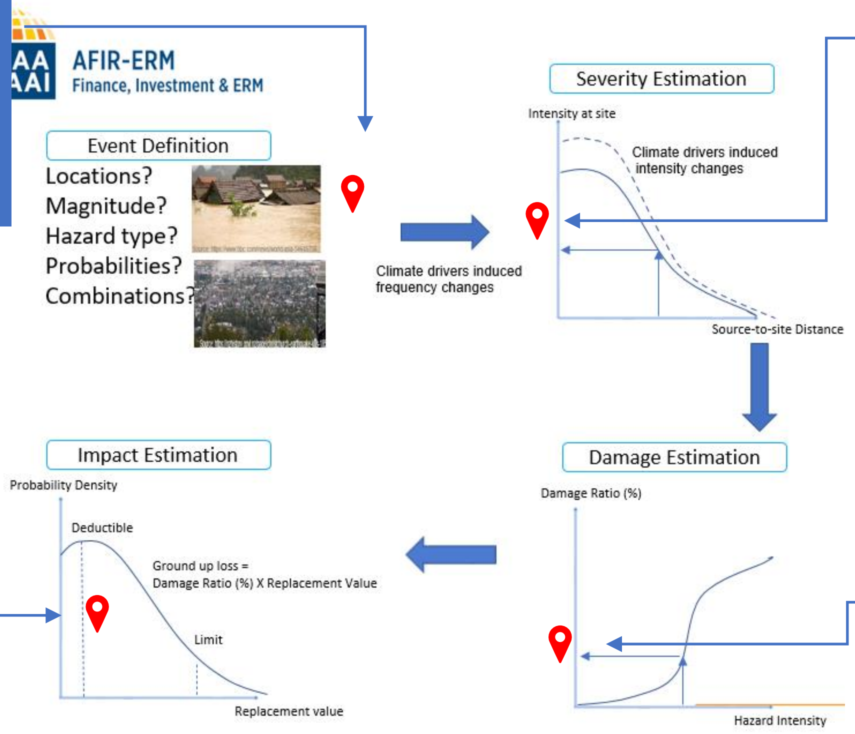
Challenges: Hazard Module (Severity)

No geolocations for some lines (mostly treaty) business

Computational power to re-estimate for every property even with geolocations

Nat Cat internal/vendor expertise/resources may be unavailable at time of the stress test

Uncertainty if the physical risk parameters provided by regulator as inputs suffice to adjust nat cat models appropriately



Challenges: Financial Module

Some reinsurers' cat models are not oriented by country as required by regulator and impact had to be attributed outside of model

Challenges: Vulnerability Module

Chronic risk parameters such as changes in surface temperature on a standalone basis, etc are not directly relevant to damage estimation*

The relation of damage estimates to such changes are also not clear

Climate driven inflation is challenging if parameters not provided for specific country

*For e.g., changes in soil subsidence are affected not only by changes in temperature but also the combination of precipitation and soil mostiure. The same applies to heat waves – which are not affected only by air temperature but droughts and dry days etc.

Heuristics

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Level	Description	Provided	Parameters Provided (Examples)
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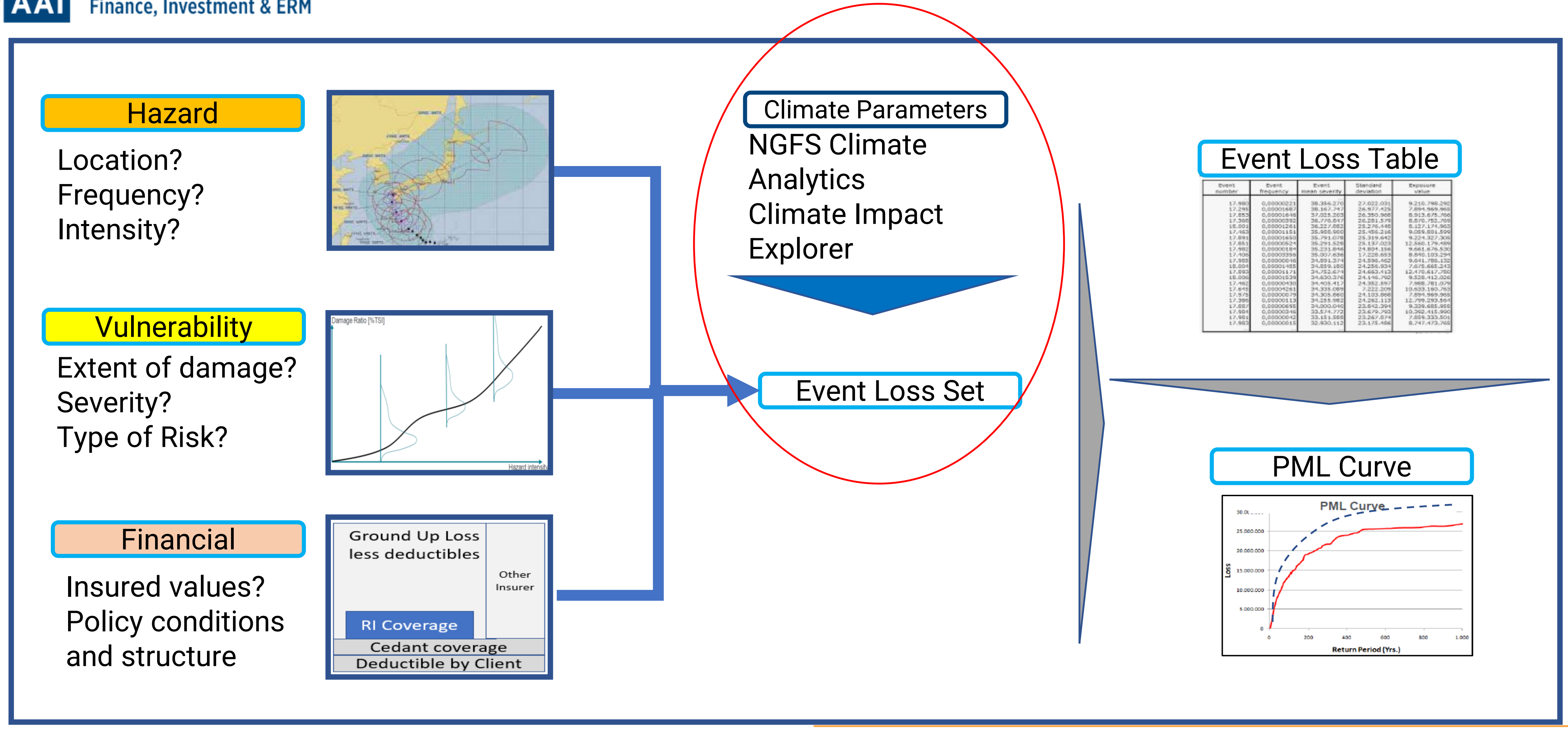

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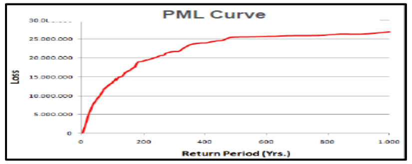
Conduct risk Identification to focus on most material climate risks

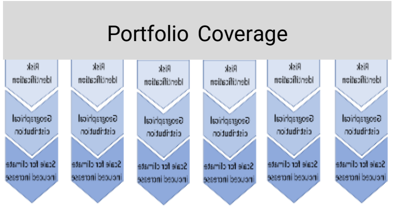
- Considering also availability of climate change data – for e.g., v little for life data, for casualty lines of business vs property

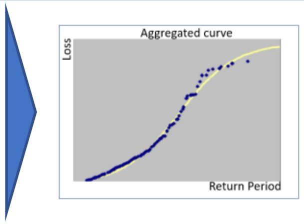
Lines of Business*	Tropical Cyclone	Flood	Wildfire	Sea Level	Heat Stress	Precipitation Stress	Drought
Property/Engineering	H	H	M	M	L	M[1]	N
Casualty(Motor)	M	M	M	N	N	N	N
Cyber	N	N	N	N	N	N	N
Marine (Hull+Cargo)	M	N	N	N	N	N	N
Personal Accident	L	M	M	L	N	M	N
Life & Health	L	L	L	L	L	L	L

Obtain event loss tables for each treaty by cedant, country and hazard produced by nat cat models used in pricing



Aggregate individual treaty event loss tables to one portfolio net of financial structures into a PML curve

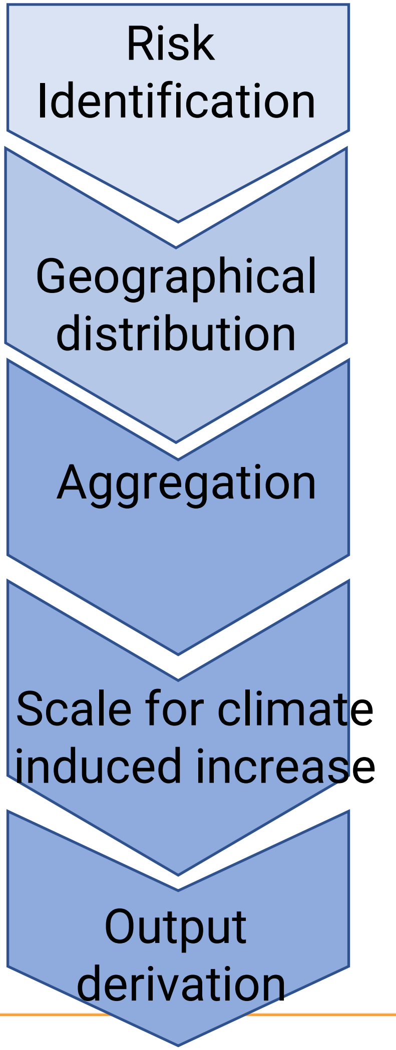




Scale the event losses using the relative change factors from NGFS Climate Explorer

- Process the financial structure (attachment points, limits, share)*
- Derive a rescaled event loss table

Calculated expected loss, adjust nat cat loss ratio, re-add to basic and large loss, expense and other ratios (assume unchanged), calculate unexpired risk reserves.



*If financial structure is not available, then scale the frequency instead. Work with nat cat modellers on aggregation across if the models used are dissimilar.

Results

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Impact of climate change on nat cat loss ratios requested was obviously driven by the NGFS factors

- There was wide variability in factors that could be selected (median and various percentiles were available)

Underestimation in unexpired risk reserves affected by climate change because of lack of information to adjust basic / large losses* for climate change (Only nat cat portion adjusted)

While we observed a significant increase in loss ratios of hazards in certain countries, in absolute terms, these were not material as they were outweighed by existing hazards.

* In theory, the damage curves will be changed by climate change as a wetter climate may drive increase in soil subsidence, concrete cancer, increased expansion and contraction of materials, among other effects. However, it was challenging to derive the extent

Alternatives

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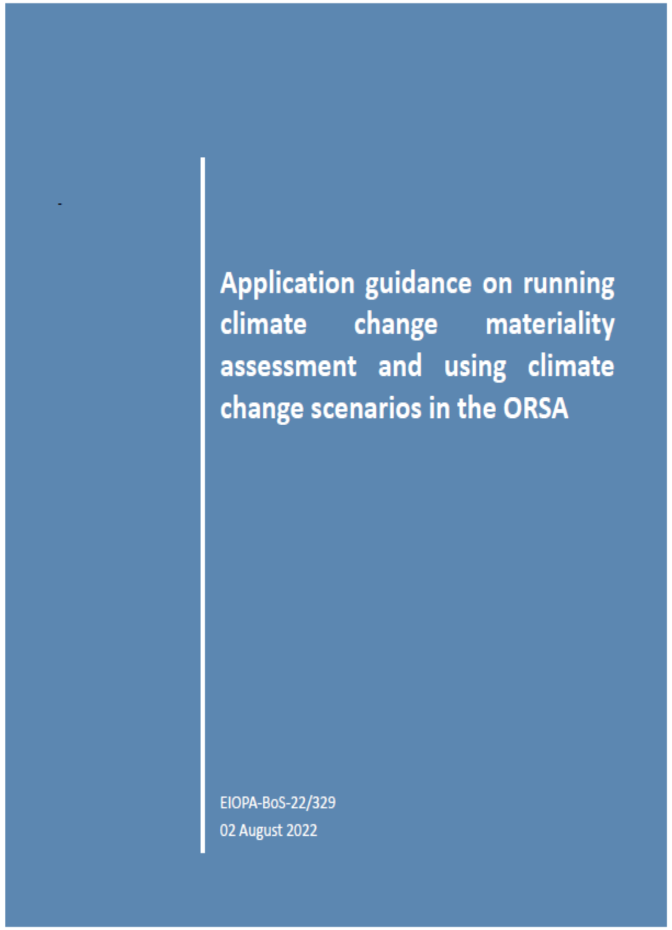
Application guidance on running climate change materiality assessment and using climate change scenarios in the ORSA

EIOPA-BoS-22/329
02 August 2022

Input: SCR by location per peril **Tool:** NGFS Climate Explorer
Method: Use of relative change in annual expected damage to scale the hazard SCR

Input: SCR by location per peril **Tool:** PESETA IV
Method: Use of relative change in expected damage for baseline and warning scenarios to scale SCR

Input: SCR by location/asset per peril **Tool:** Proprietary CAT Models
Method: Use of change in loss for scenarios for the occurrence exceedance probability curve

Input: SCR by location/asset per peril **Tool:** Existing stress test (for e.g., P.R.A of UK)
Method: Use of factors provided in stress tests to allow approximation of losses

eiopa
European Insurance and Occupational Pensions Authority

Source: Adapted from *EIOPA*. https://www.eiopa.europa.eu/document-library/other-documents/application-guidance-climate-change-materiality-assessments-and_en (Aug 2022)

Conclusion

Objective of a climate stress test will need to be made clear – otherwise, mindshare is reduced as compared to 1-3 financial projections in a business plan which has more vividity in the minds of senior business leaders

Climate stress testing is nascent and techniques could be evolved.

- Data availability and resource constraints are real issues.
- Not a complete reflection because of the absence of ability to model many drivers such as impact of post loss amplification into the medium term etc.
- Inability to consider feedback loops and tipping points may also lead to significant under-estimates

Multi-disciplinary approach required – many consultations with climatologists as well as nat cat modellers required but their extensive inputs would also be required in future