Climate Risk Assessment for Global Property Fund

Dr. Maarten Jennen
Strategist Private Real Estate
PGGM Private Real Estate Fund

Some characteristics:
- Indirect
- Diversified
- EUR 14 billion NAV
- > EUR 160 billion GAV underlying
- Approx 4,000 assets
- Outperforming
"We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten. Don't let yourself be lulled into inaction."

It’s certainly not just us …
World Economic Forum – Global Risk Landscape 2020

Top 10 risks in terms of Likelihood
1. Extreme weather
2. Climate action failure
3. Natural disasters
4. Biodiversity loss
5. Human-made environmental disasters
6. Data fraud or theft
7. Cyberattacks
8. Water crises
9. Global governance failure
10. Asset bubbles

Top 10 risks in terms of Impact
1. Climate action failure
2. Weapons of mass destruction
3. Biodiversity loss
4. Extreme weather
5. Water crises
6. Information infrastructure breakdown
7. Natural disasters
8. Cyberattacks
9. Human-made environmental disasters
10. Infectious diseases
From awareness to action!
Overview of climate change related risks

**Transition Risk**
Impacts all assets in a jurisdiction that align with government requirements

**Physical Risk**
Impacts all assets in different ways depending on location

**Asset Level Characteristics**
Potential mitigants driven by structural quality
Physical Risk
Step 1: Know where your assets are

Do not just know where you have assets but really where they are!
This has proven not to be an easy step for a global indirect investor

- Geocoding all assets
4,000 Assets Geocoded
Step 2: Find a partner for physical location risk

Some of our requirements:

- **Global** ➔ for globally diversified portfolio
- **Detailed** ➔ for meaningful analysis
- **Reputable** ➔ based on the best models and scientific research
- **Long-term** ➔ this is going to be a long-term project
- **Aligned** ➔ proper incentive to get it right; 2100 is still a very long time
Munich Re NATHAN analysis

NATHAN Single Risk Assessment Report

<table>
<thead>
<tr>
<th>Hazard Score Rating</th>
<th>low</th>
<th>high</th>
<th>hazard rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthquake</td>
<td></td>
<td></td>
<td>Zone 0</td>
</tr>
<tr>
<td>Volcanoes</td>
<td></td>
<td></td>
<td>No hazard</td>
</tr>
<tr>
<td>Tsunami</td>
<td></td>
<td></td>
<td>No hazard</td>
</tr>
<tr>
<td>Tropical cyclone</td>
<td></td>
<td></td>
<td>No hazard</td>
</tr>
<tr>
<td>Extratropical storm</td>
<td></td>
<td></td>
<td>Zone 2</td>
</tr>
<tr>
<td>Hail</td>
<td></td>
<td></td>
<td>Zone 2</td>
</tr>
<tr>
<td>Tornado</td>
<td></td>
<td></td>
<td>Zone 3</td>
</tr>
<tr>
<td>Lightning</td>
<td></td>
<td></td>
<td>Zone 2</td>
</tr>
<tr>
<td>Wildfire</td>
<td></td>
<td></td>
<td>Zone 1</td>
</tr>
<tr>
<td>River flood</td>
<td></td>
<td></td>
<td>Zone 0</td>
</tr>
<tr>
<td>Flash flood</td>
<td></td>
<td></td>
<td>Zone 2</td>
</tr>
<tr>
<td>Storm surge</td>
<td></td>
<td></td>
<td>100 year return period</td>
</tr>
</tbody>
</table>

Risk Score Rating

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Climate related risk</th>
<th>Real Estate Risk</th>
<th>Included In analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthquake</td>
<td>×</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Volcanoes</td>
<td>×</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Tsunami</td>
<td>×</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Tropical cyclone</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Extratropical storm</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hail</td>
<td>✓</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Tornado</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lightning</td>
<td>✓</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Wildfire</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>River flood</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Flash flood</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Storm surge</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Composite Natural Hazard Risk Scores
Zooming in: Tokyo

[Climate Risk Map]

Score (1-4)  ● 1  ● 3  ● 4

Score (1...  ● 1  ● 3  ● 4

MR_measure
- Composite Score Earthquake
- Composite Score Flooding
- Composite Score Storm

Region
- APAC

Land
- Japan

City/MSA
- Tokyo

[Map of Tokyo with color-coded risk assessments]
What’s in it for us: now and future?

- Even better informed decisions
  - Part of asset and portfolio level DD
  - Reason for additional questions and discussion
  - Input for hold/sell analysis – among many other factors
Another important aspect: potential mitigants

**Amagasaki Distribution Centre**

**Location**
- Suehirocho, Amagasaki City, Hyogo

**Features**
- 5.5m clear height
- 1.5ton/m² floor loading
- Truck berth: 418
- Cargo elevators, vertical lifters
- Amenities: relax lounge, retail shop and children’s day-care centre

**Structure**
- 6 storeys

<table>
<thead>
<tr>
<th>Land Area (m²)</th>
<th>195,157</th>
</tr>
</thead>
<tbody>
<tr>
<td>GFA (m²)</td>
<td>361,057</td>
</tr>
</tbody>
</table>

- **Seawall Tokyo Peil (TP) +6.0m**
- **First floor @ TP +4.55**
- **Highest history TP +3.5** (Typhoon no 21, 2018)
- **Hyogo Prefecture highest tide expected TP +4.5**
What’s in it for us: now and future?

- **Even better informed decisions**
  - *Part of asset and portfolio level DD*
  - *Reason for additional questions and discussion*
  - *Input for hold/sell analysis – among many other factors*

Future

- Further develop partnership with Munich Re
  - potentially expanding beyond private real estate
- Enhance the forward looking aspects of the analysis – sea level rise latest addition
Climate risk assessment in global real estate investing

Transition Risk
Asset Level Characteristics
Physical Risk