A closer look at physical climate risk assessments: existing approaches, challenges and opportunities

Sophie Dejonckheere - Senior Adviser, Climate Finance - CICERO

Today's topics

- Physical climate risk and the financial sector
- Calculating climate risk & the ClimINVEST project
- Challenges to providing services in the financial sector
- Climate hazards and asset exposure
- Asset vulnerability: sensitivity and adaptive capacity

Pacific Gas and Electric is a company that was just bankrupted by climate change. It won't be the last.

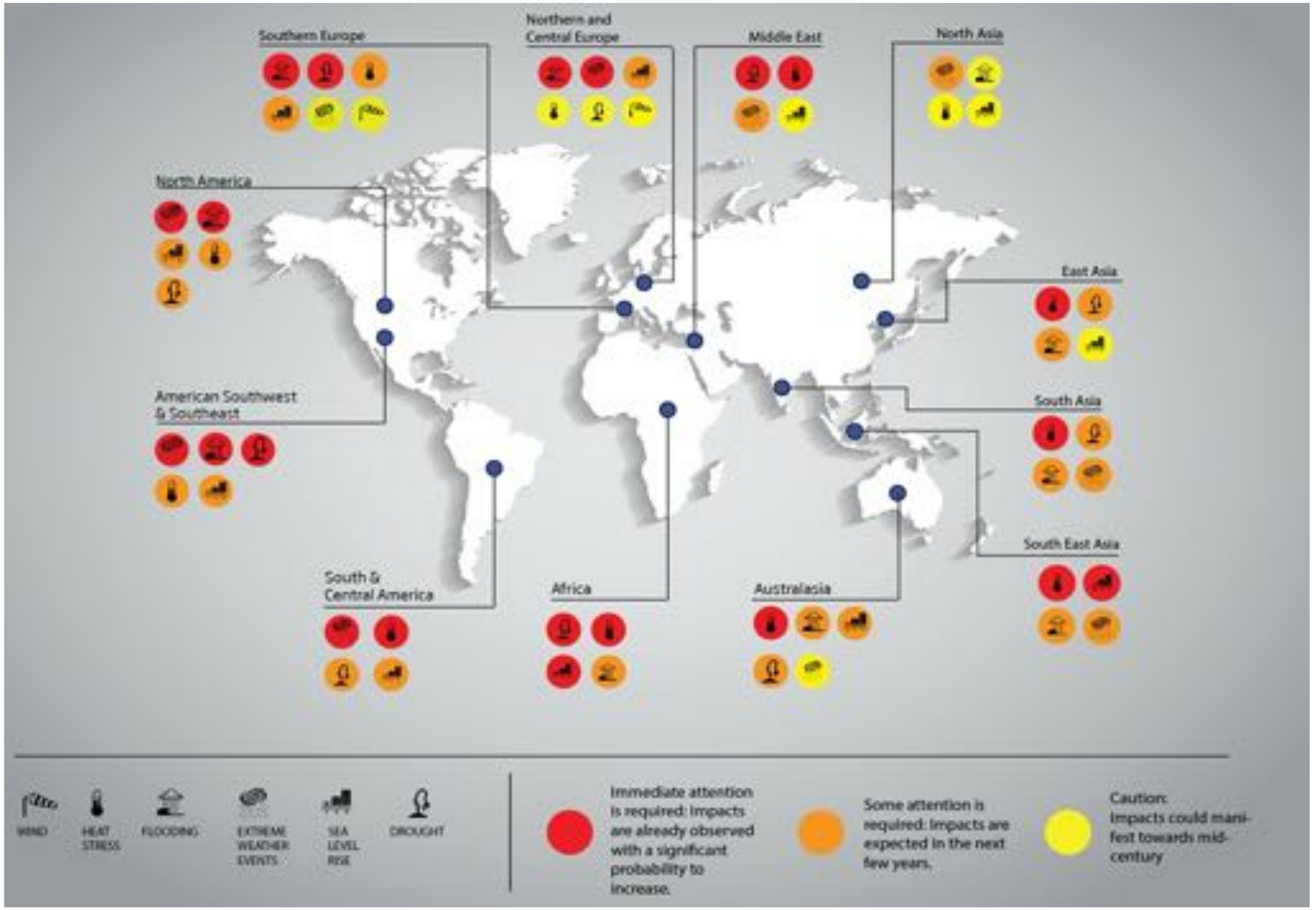
Washington Post, January 2019

Climate change poses new threat to Panama Canal

Upgrade to vital waterway may be required to cope with impact of more extreme weather

Financial Times, June 2019

Physical risk observed in all regions



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Source: Shades of Climate Risk (2017)

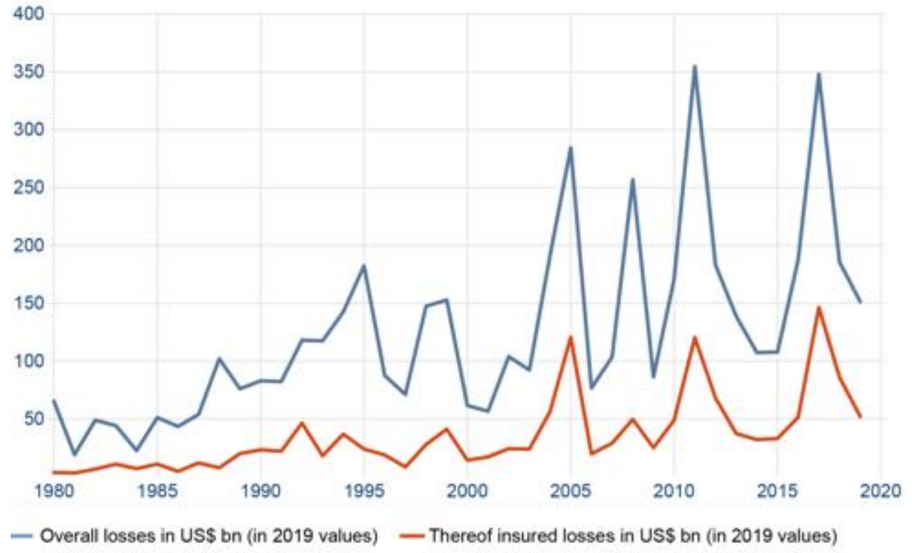
Climate risks are now financial risks

Investors expect increased losses from physical impacts of climate change

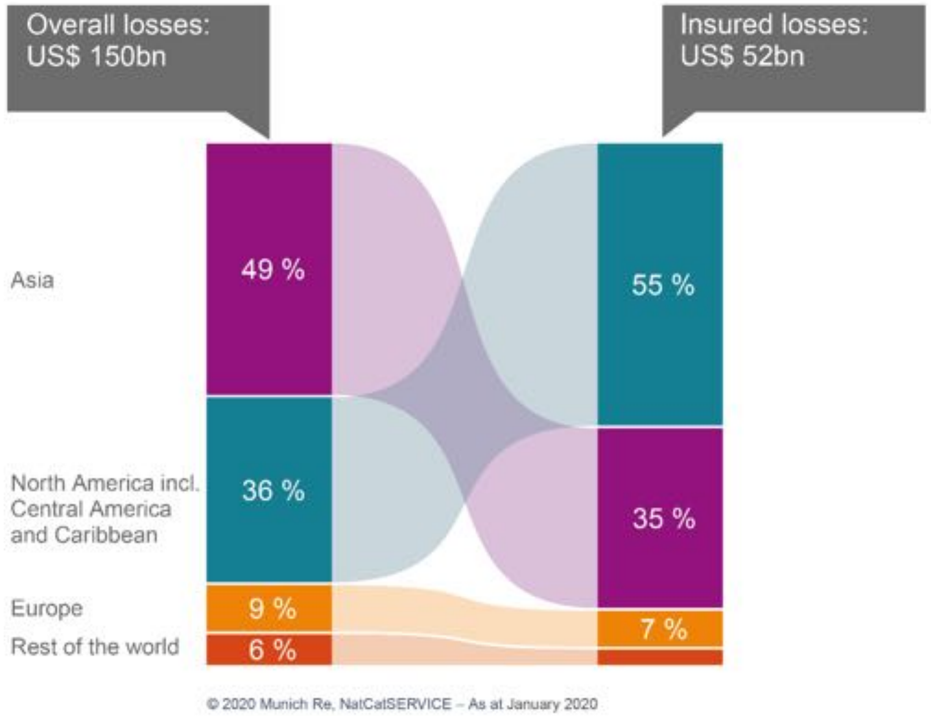
→ Global losses from natural disasters rose by 86% from 2007 to 2017
(EU Commission)

→ US $5,000bn in total losses since 1980; over 70% not insured

→Overall losses from natural disasters in 2019 came to $150bn, $52bn of which were insured.
(MunichRe Natural Disasters of 2019)



Source: MunichRe *Natural Disasters of 2019*



Source: MunichRe *Natural Disasters of 2019*

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TCFD recommends disclosure

Disclosure by Company Size: 2018 Reporting

Recommendation	Recommended Disclosure	<$4B Annual Revenue (620)	$4-10B Annual Revenue (184)	>$10B Annual Revenue (322)
Governance	a. Board Oversight	19%	27%	34%
	b. Management's Role	18%	32%	43%
Strategy	a. Risks and Opportunities	31%	45%	56%
	b. Impact on Organization	30%	53%	65%
	c. Resilience of Strategy	3%	7%	14%
Risk Management	a. Risk ID & Assessment Processes	17%	33%	42%
	b. Risk Management Processes	17%	34%	44%
	c. Integration into Overall Risk Management	9%	14%	19%
Metrics and Targets	a. Climate-Related Metrics	28%	47%	63%
	b. Scope 1,2,3 GHG Emissions	19%	38%	51%
	c. Climate-Related Targets	22%	48%	55%

The numbers in parentheses represent the size of the review population

Legend:

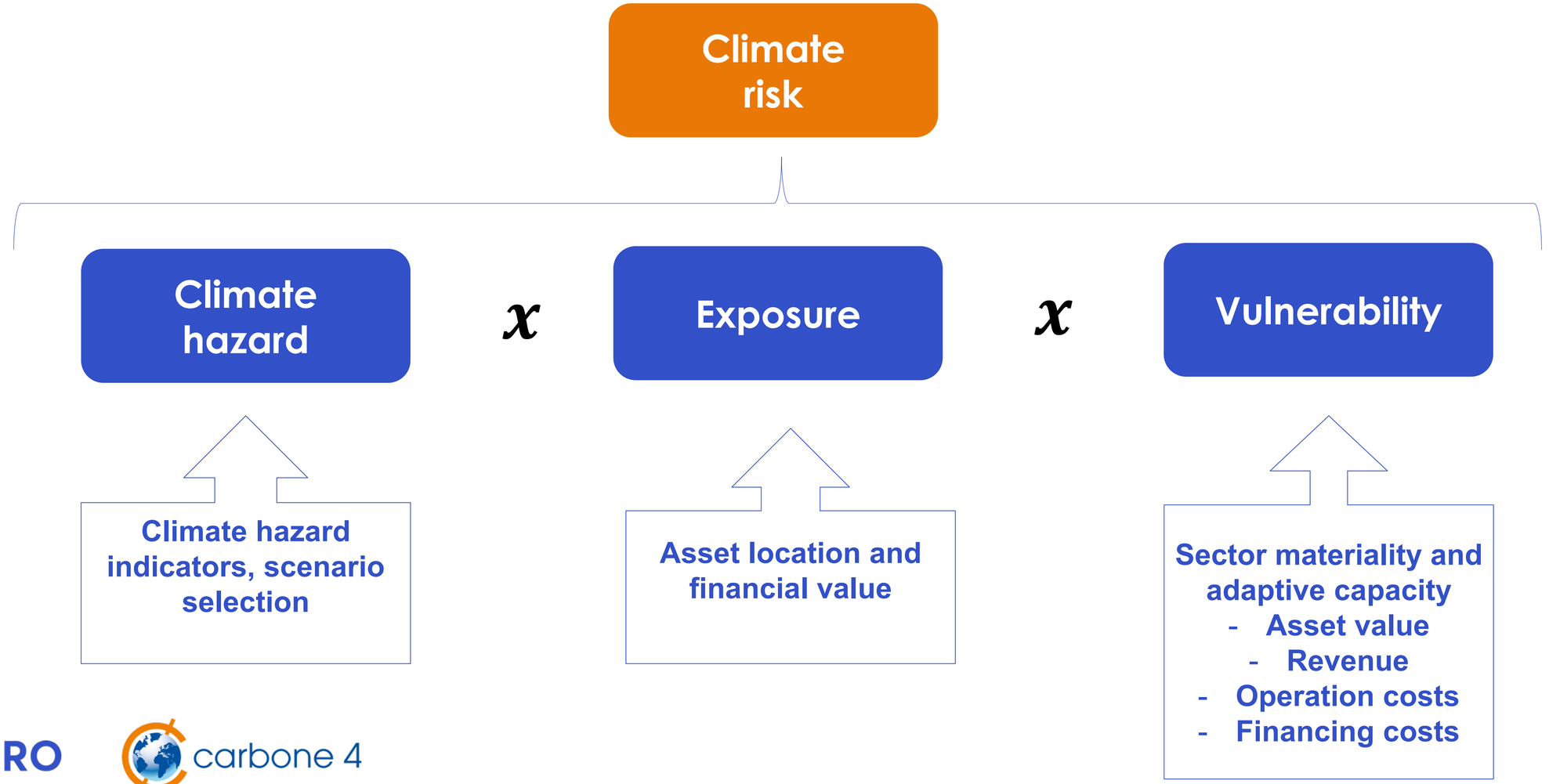
Low to high percentage of disclosure

Markets need information to assess which companies can seize the opportunities in a low carbon economy and which are strategically resilient to the physical and transition risks associated with climate change.

- Mark Carney, Governor of the Bank of England

Physical climate risk =

$$f(hazard\ x\ exposure\ x\ vulnerability)$$



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ClimINVEST objectives

Shed light on climate risk assessment services.

- Transparent methodologies
- Publicly available data
- Disclosure of uncertainties and constraints

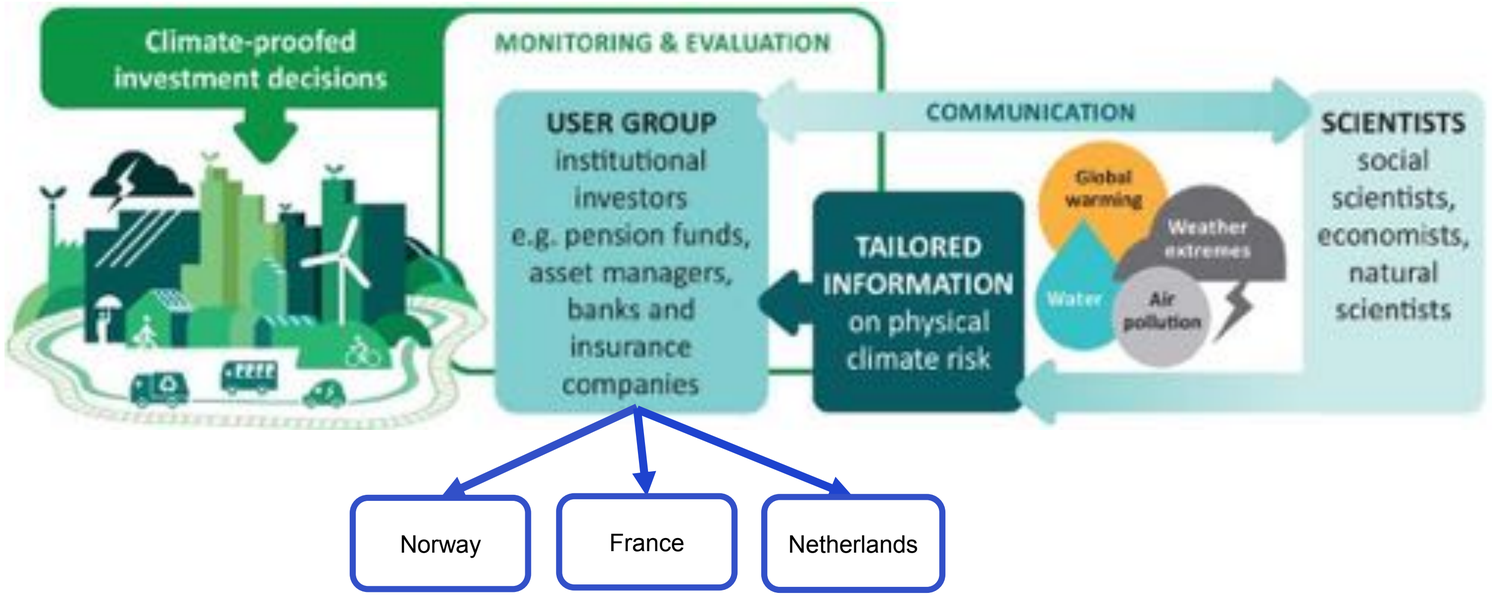
TCFD | TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

Help investors responding to TCFD – physical risk.

- Business-relevant climate indicators
- Sector materiality and impact chains

ClimINVEST approach

Better tools for climate-proofed investments



Research consortium

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Center for International Climate Research

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WAGENINGEN
UNIVERSITY & RESEARCH

Climate Adaptation Services

I4CE
INSTITUTE FOR CLIMATE ECONOMICS

METEO FRANCE

2017 — Understanding user needs and identifying gaps

2018 — Co-design relevant indicators on climate risk

2019 — Mapping and visualizing risk for investors

2020 — Evaluate, synthesize and raise awareness

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Phase 1 results: user needs and existing approaches

Elements reviewed:

Qualitative versus quantitative scores

Assessment coverage: project-level, sector-level, portfolios

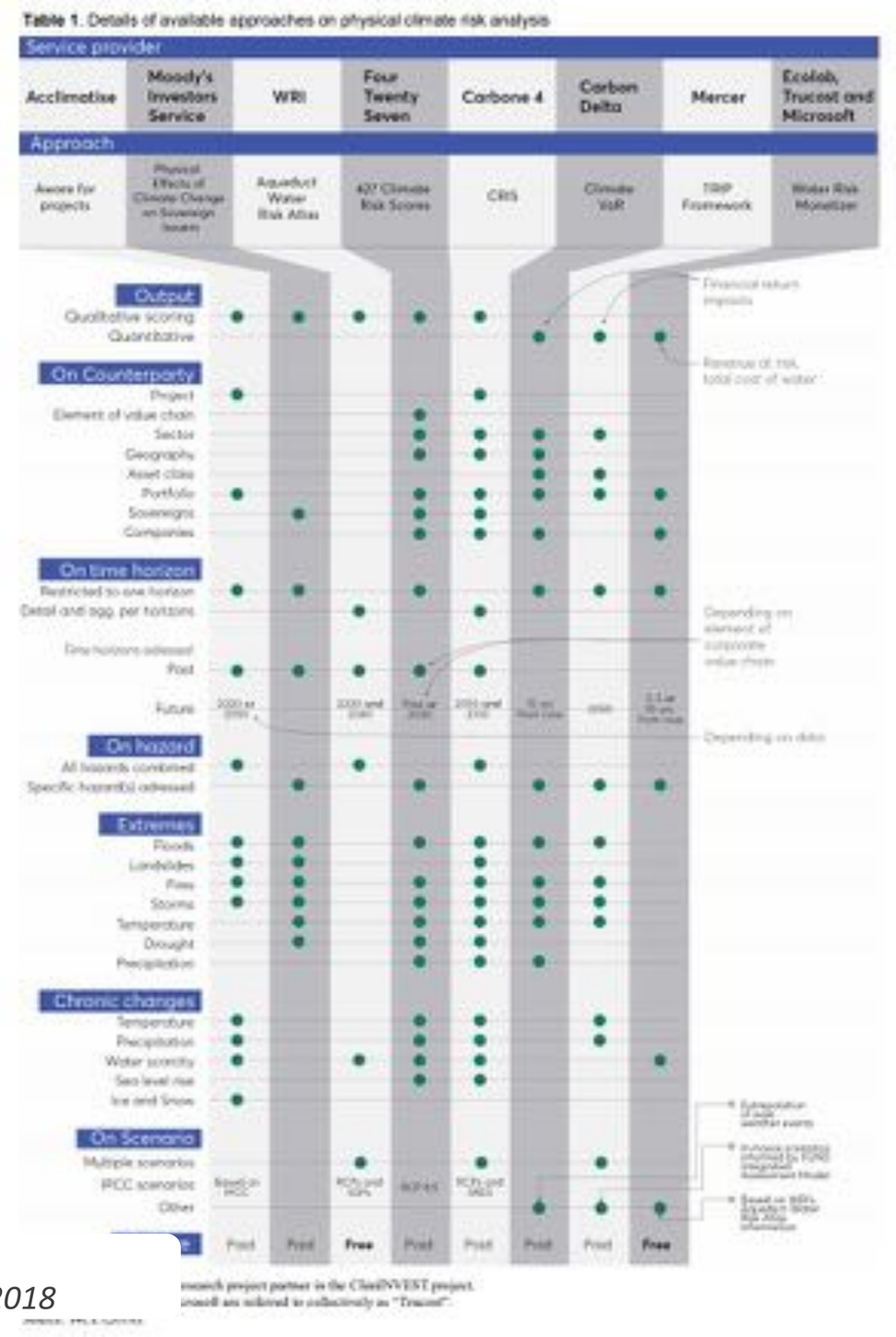
Time horizons: gap in climate versus finance timelines

Hazard coverage: combined or separate, weighting

Scenario selection

Take-aways:

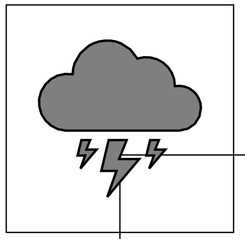
- Translation services between scientists and investors are needed.
- Investors want decision support and user friendly tools.
- Climate hazards should be weighted according to regional sector materiality.
- Data on asset sensitivity or adaptive capacity is lacking.



Source: *Physical Climate Risk: Investor Needs and Information Gaps, 2019*

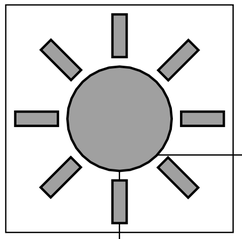
**Note: graphic on right created based on publicly available information in 2018*

Phase 2: codesign relevant climate risk indicators



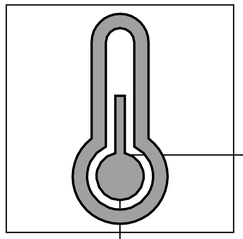
Floods

- Frequency of extremely wet days
- Consecutive number of extremely wet days
- Maximum daily rainfall
- Maximum daily rainfall over 5 consecutive days
- Total precipitation



Drought

- Consecutive dry days
- Total precipitation



Heat stress

- Average temperature in summer
- Daily heat wave magnitude index
- Warm spell duration index
- Cooling degree days
- Wet bulb globe temperature

Phase 3: visualizing risk for investors

Europe - RCP 8.5 – 1981 to 2050

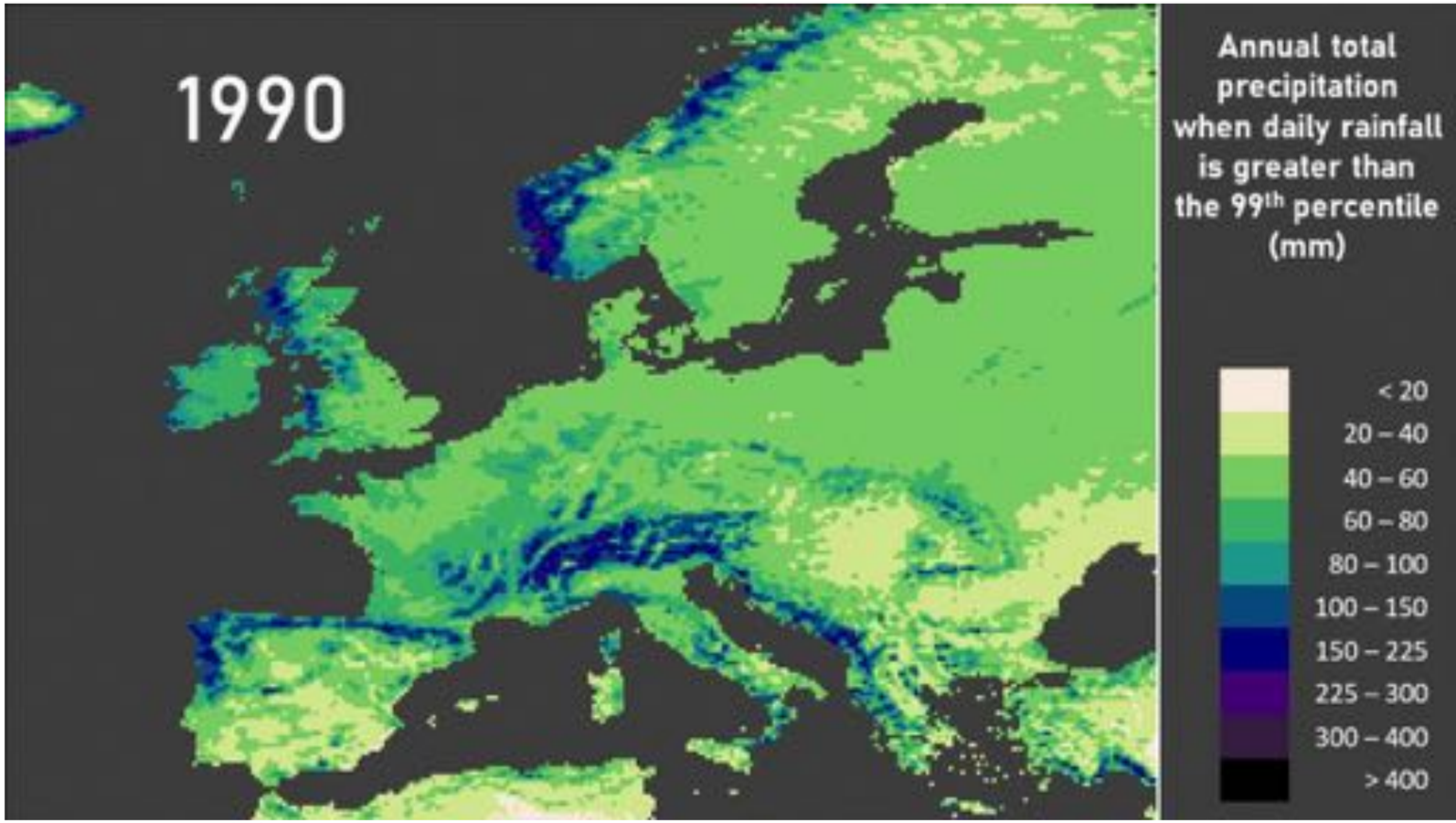
✓ **Climate hazard:** extreme rain bursts

✓ **Probability:** high

e.g. Norway - summer seasons will be drier overall, but have more very intense short bursts of rain

✓ **Exposure:** (depending on asset location)

❑ **Vulnerability:** X



Source: CICERO and Climate Adaptation Services
**Year is the middle of the 20 year span, so 1990 = 1981-2000, 2020=2011-2030, 2040=2031-2050*

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Visualizing vulnerability: heatwave impacts

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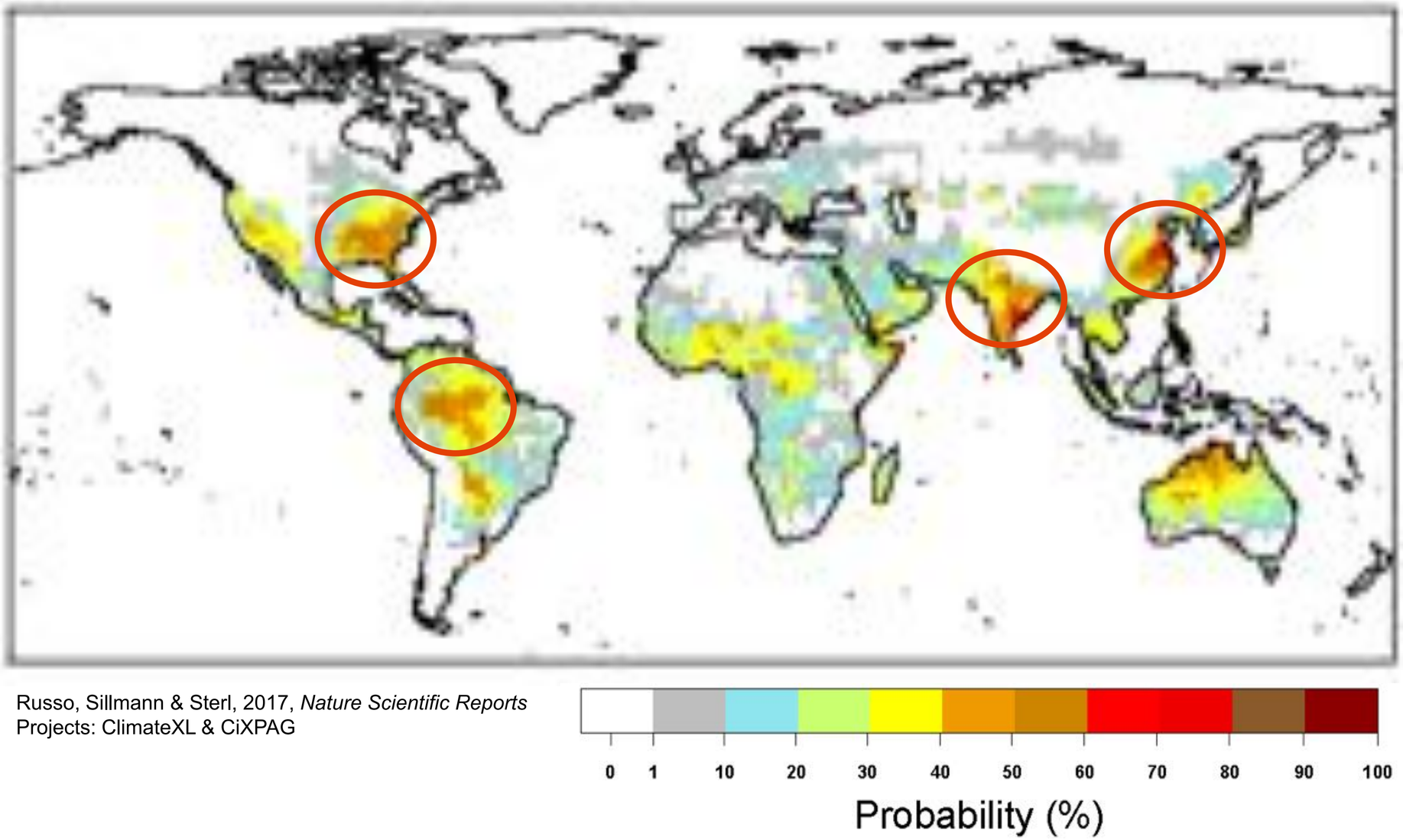
Hot spot regions



Russo, Sillmann & Sterl, 2017, *Nature Scientific Reports*
Projects: ClimateXL & CiXPAG

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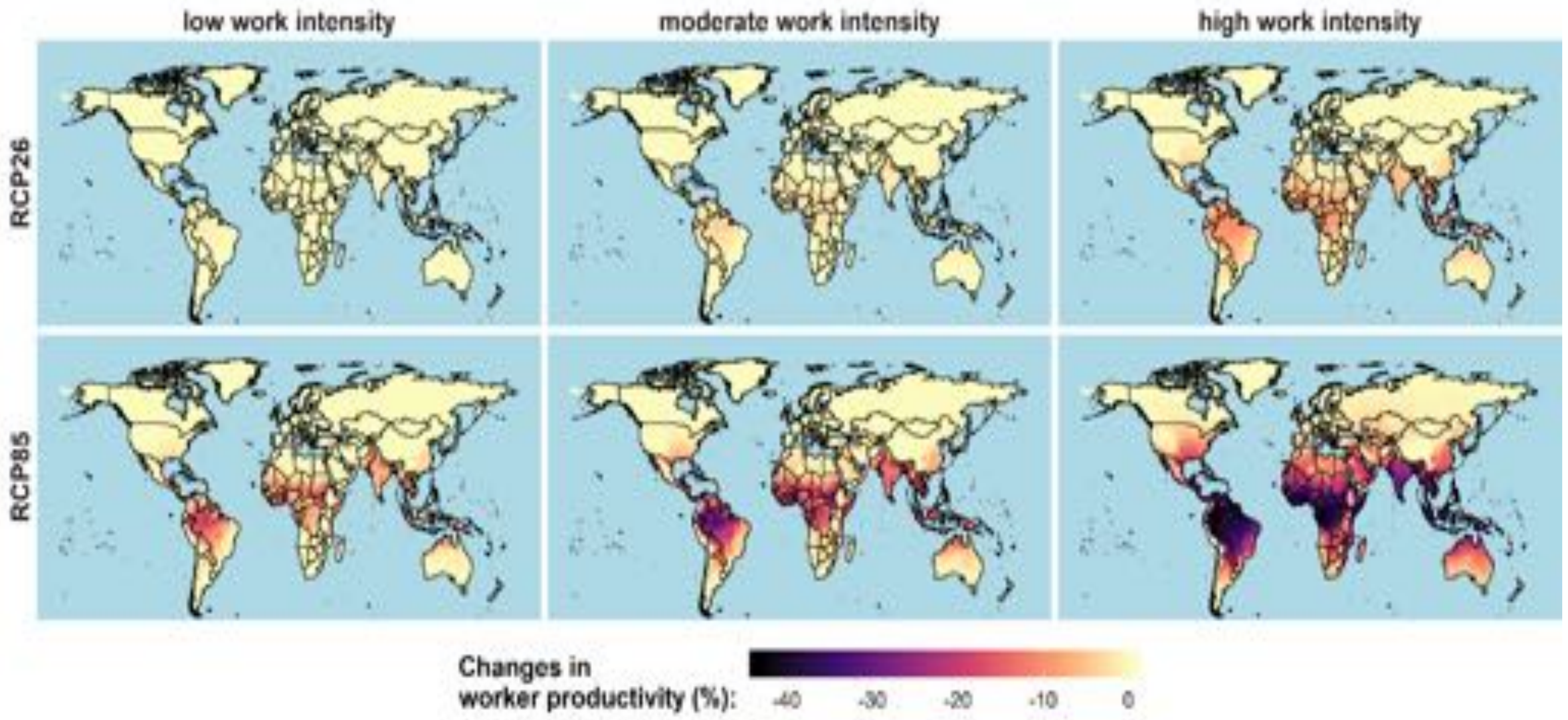
e.g. Heat impacts on worker productivity



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Orlov, Sillmann, Aunan, Aaheim etc. 2019 (sub. in *GEC*)
Project: ClimINVEST & EXHAUSTION

Impact chains for vulnerability assessment

Climate hazard	Physical impacts	Financial impacts for counterparties	Financial impacts for investors/AM
Changes in hazard indicators	Physical impacts on markets, operations or suppliers	Financial impacts on sales, OPEX or CAPEX	Impact on credit risk rating or other financial performance indicators

Example for "increased storm surges"

Agriculture	Storm surge and flooding	**Soil erosion, lost crops**	**Decreased income, cost of repair**	**Lower credit rating, reduced dividends**
Energy (hydropower)		Higher water level in reservoir	None	None
Transportation		**Runways / rails inundated service disrupted**	**Decreased revenue, cost of repair**	**Lower credit rating, reduced dividends**

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Source: Carbone 4 and CICERO

What factors affect asset sensitivity?

- **Construction materials and design.**
- **Land use around the asset.**
- **The age of the asset.**
- **The connectivity of the asset.** i.e. energy, water, financial services, transportation and ICT sectors
- **Alternative options/dependency.** E.g. infrastructure such as ports, train lines and roads.
- **Time horizons of the asset.**

Sector vulnerability, e.g. energy and floods

Asset sensitivity: Damages to plant structures and power lines, transmission and distribution networks, including due to sediments and debris (hydropower). Ruptured flow lines and storage tanks, flooded wells, and overflow of contaminated water from fracking.

Revenue. Lost revenue due to low production capacity and high demand

Operation costs. High repair costs and potentially higher insurance premiums.

Financing costs may increase with increased risk.

Adaptive capacity: hard. Reinforce power line networks, flow lines, and well casings; seal “produced water” tanks and storage tanks. If possible, run powerlines underground to avoid tampering and damage. Develop upstream sediment control facilities, install variable speed turbines for a wider range of discharge. Replace wooden utility poles with steel. Improve vegetation management around lines. Waterproof pipelines and substations, seal manhole covers, incorporate submergible transformers, switches and pumps.

Adaptive capacity: soft. Review proximity of well pads, compressor stations and flow lines to rivers and flood zones in the environmental review and risk assessments to help drill around flood plains. Develop an emergency response plan to prevent release of oil and gas into water supply. Design plants with alternative water sources like grey water and sea water. Improve hurricane and winter storm forecasting. Enhance design to withstand higher winds and ice loading.

Case study: Rhine River and 2018/2019 drought

- Rhine River major commercial artery connecting Rotterdam to Switzerland

- Shrinking alpine glaciers (-35%) + severe drought dropped the river to half its normal level, affecting commercial traffic

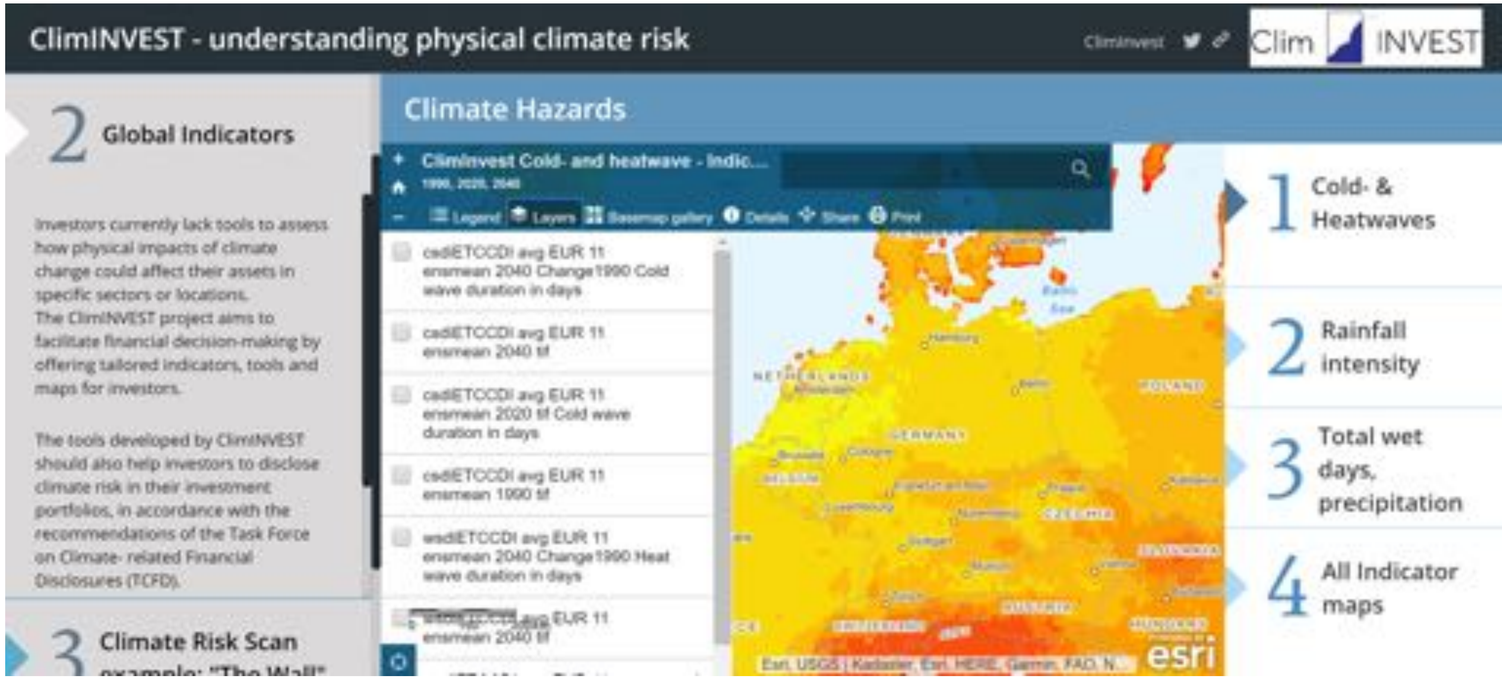
→Delayed shipments, high costs of storage and alternative transport (rail, road and shallow water barges)

ClimINVEST tools: public-facing arcGIS-based website

- Interactive climate indicator data base

- Case studies:
  - Dutch commercial real estate and flood risk screening
  - French real estate portfolios and climate risk screening
  - Norwegian railways and resilience investments

- Factsheets and webinar presentations on:
  - Climate modeling 101
  - Calculating climate risk
  - Droughts
  - Floods
  - Heat stress



Thank you

For more information see:
https://www.arcgis.com/apps/MapSeries/index.html?appid=24aa80957be242a794114cd4c9054518