ETH zürich

Exploring the efficient frontier in physical risk reporting

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“La finance sera verte - ou elle ne sera pas.”

Bruno Le Maire
Ministre de l'Economie et des Finances
Décembre 2017

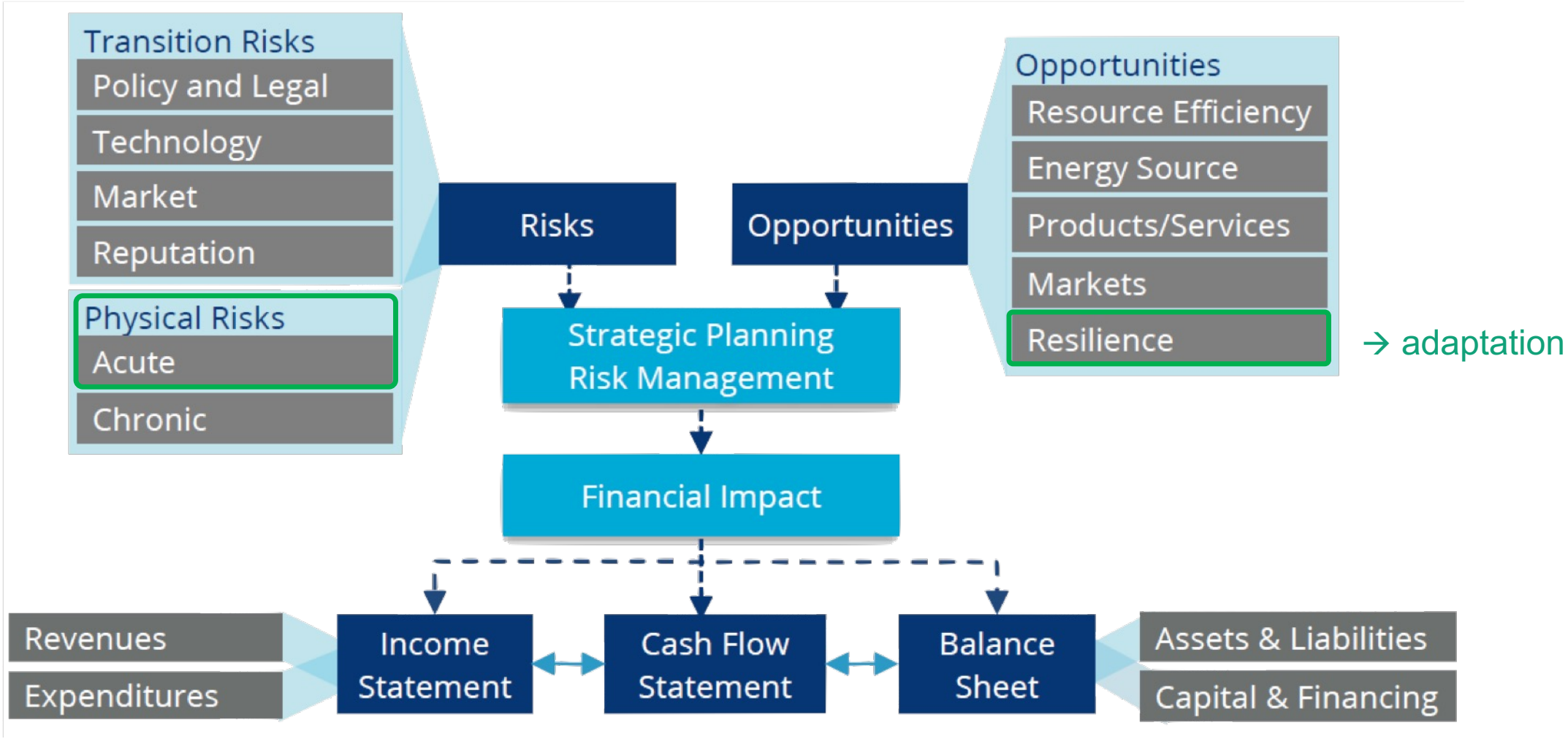
Financial Stability Board
Task Force on Climate-related Financial Disclosures (TCFD) [1]

"Climate change is the Tragedy of the Horizon."

Mark Carney, Governor of the Bank of England, 29 Sep 2015, speech at Lloyd's of London

[1] established 4 Dec 2015: https://www.fsb-tcfd.org, Speech: https://www.bis.org/review/r151009a.pdf, Video: https://www.youtube.com/watch?v=V5c-eqNxeSQ

TCFD: Climate-related risks, opportunities, and financial impact

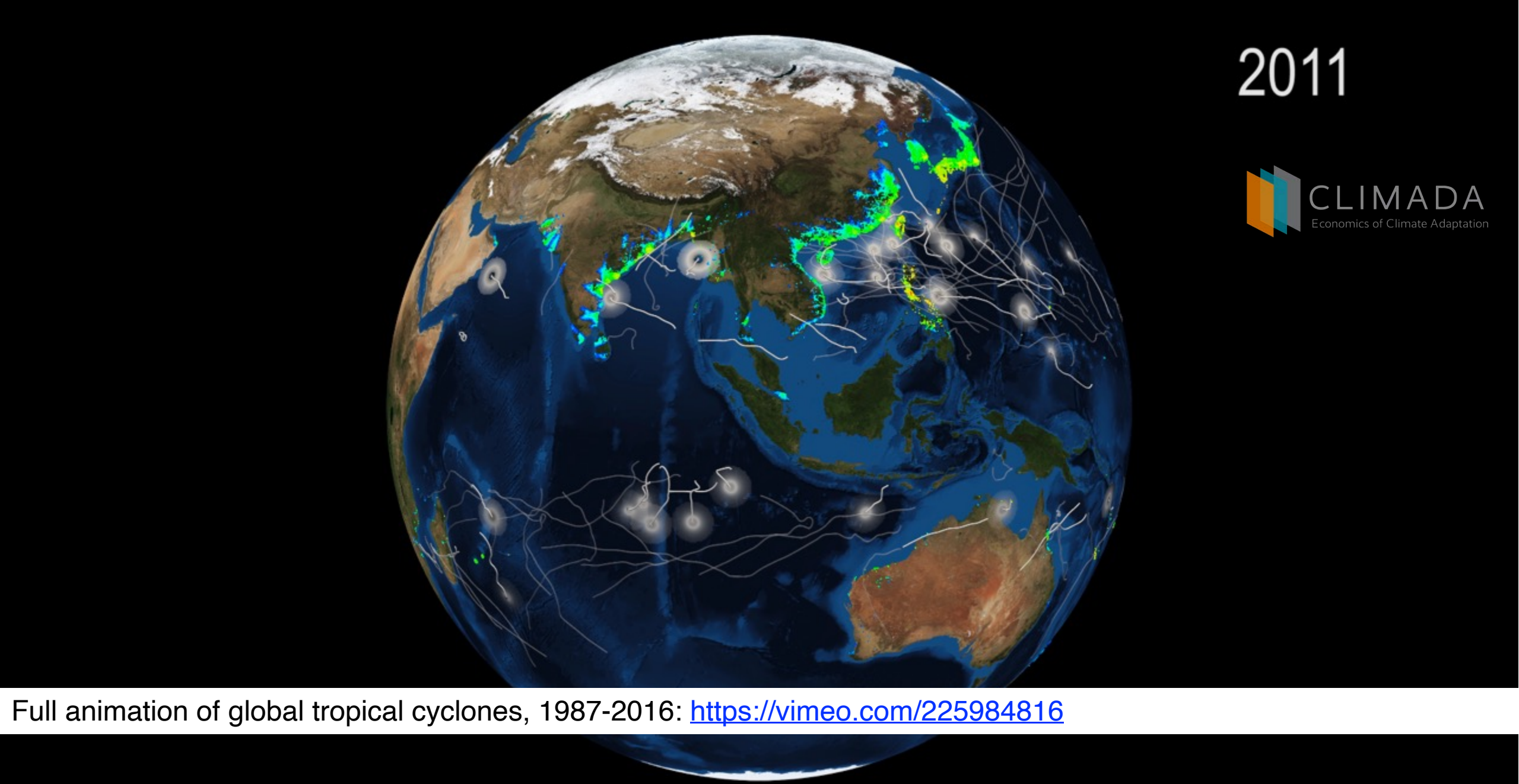


Source: Final Report – Recommendations of Task Force on Climate-related Financial Disclosures (TCFD), https://www.fsb-tcfd.org

Physical climate risks disclosure – state of play[1]

- An increasing number of consultancies, financial technology firms, data providers, and investment advisory groups now **offer information about localized physical climate risks**, entering a technology arms race among climate services providers (Keenan, 2019; Condon, 2023)
- The physical-risk scores produced by various commercial providers, each developing their own firm-level indicators of physical climate risk, **diverge substantially** (Hain et al., 2022).
- The proprietary nature of their products introduces significant challenges, including a lack of transparency and accessibility, for **comparison** and evaluation (Arribas et al., 2022).
- The efforts of regulatory bodies to establish **standards for measuring and reporting are still developing** (Fiedler et al., 2021)

[1] some of the text taken from Meiler, S., PhD thesis, outlook, to be defended 20 Nov 2023



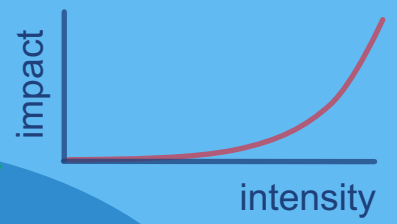
Full animation of global tropical cyclones, 1987-2016: https://vimeo.com/225984816

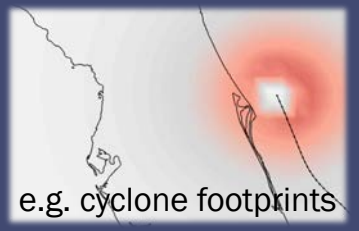
CLIMADA impact model (10km), C2SM, Chadha & Bresch, 2017. Zyklonen: IBTrACS, NOAA. Hintergrundbild: Stöckli (MeteoSwiss), NASA Earth Observatory (NASA Goddard Space Flight Center).

CLIMADA
Economics of Climate Adaptation

Resilience measures
(for example:
prevention, spatial planning,
building codes ...)

vulnerability



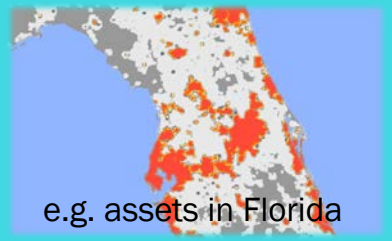


weather
→ hazard

CLIMADA
probabilistic
event-based
simulation
open-source[1]

climate scenarios

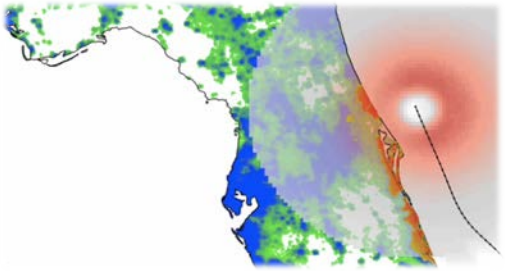
development scenarios



exposure

Outputs:
Risk analysis, -mapping
+ (impact-oriented)
warnings ...

example: direct economic impact

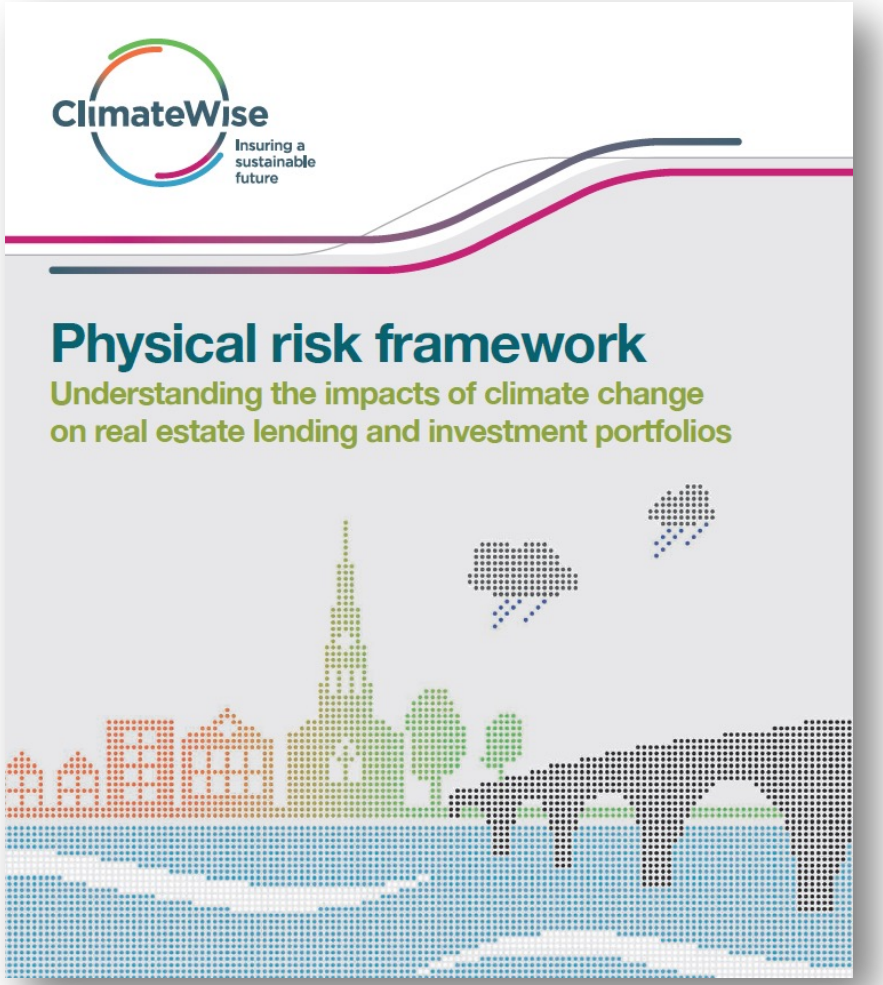


impact animation:
https://vimeo.com/202068551

+ appraisal of resilience measures / options (effectiveness of options, cost/benefit …)
+ Quantification of uncertainty

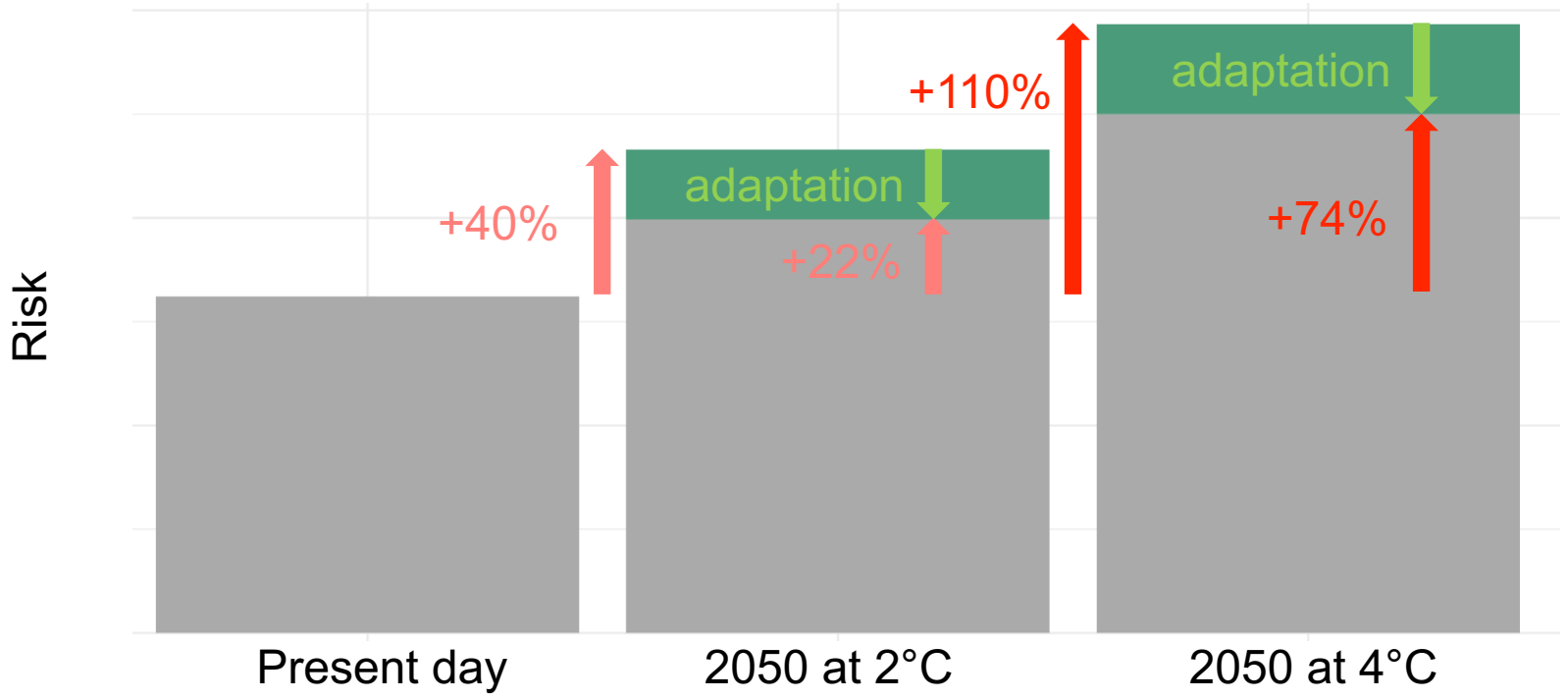
[1] https://wcr.ethz.ch/research/climada.html und Aznar-Siguan & Bresch, 2019: CLIMADA ... weather and climate risk assessment ..., https://doi.org/10.5194/gmd-12-3085-2019

Physical Risk Framework



https://www.cisl.cam.ac.uk/resources/sustainable-finance-publications/physical-risk-framework-understanding-the-impact-of-climate-change-on-real-estate-lending-and-investment-portfolios

UK banks – physical tropical cyclone risk on loan portfolios



Expected damages to assets[1] exposed to tropical cyclones increase by 40% with 2 degrees of warming and 110% with 4 degrees of warming. Adaptation could limit these to 22% and 74% increase.

[1] Westcott, M., Ward, J., Surminski, S., Sayers, P., Bresch, D.N. and Claire, B., 2020. Be prepared: Exploring future climate-related risk for residential and commercial real estate portfolios. *The Journal of Alternative Investments*, **23**(1), pp. 24-34. https://jai.pm-research.com/content/early/2020/05/09/jai.2020.1.100.abstract
https://www.cisl.cam.ac.uk/resources/sustainable-finance-publications/physical-risk-framework-understanding-the-impact-of-climate-change-on-real-estate-lending-and-investment-portfolios

[2] asset base: global exposure of leading 9 UK banks' loan portfolios.

Challenges

Availability
Natural catastrophe models mainly exist for (top) OECD countries for select hazards
→ Need for a globally consistent framework ✓ and worldwide coverage of main hazards

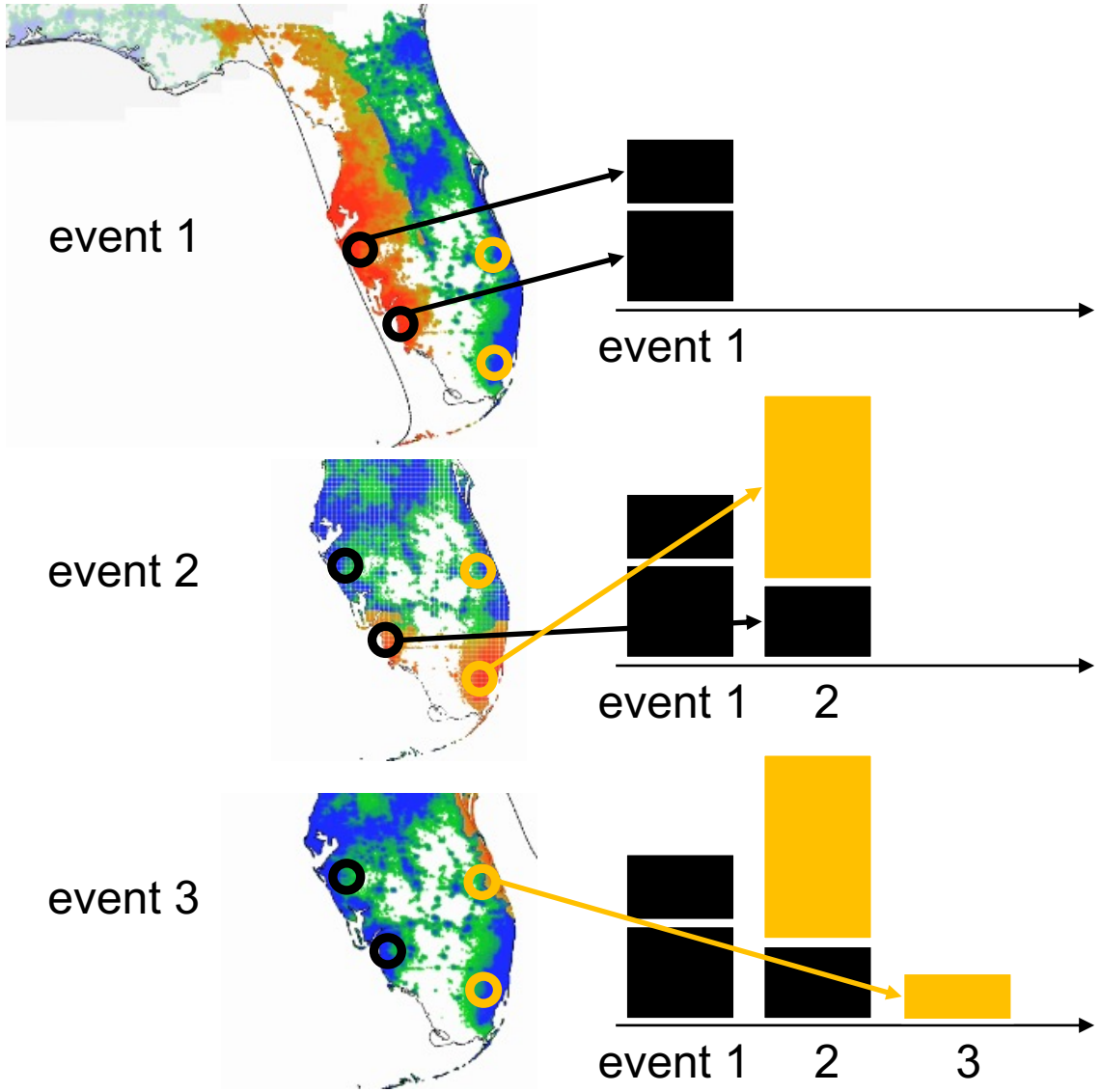
Accessibility
Natural catastrophe models are proprietary either to (re)insurance companies or so-called model vendors
→ Need for open-source and -access models with full transparency (and APIs to open-data sources) ✓

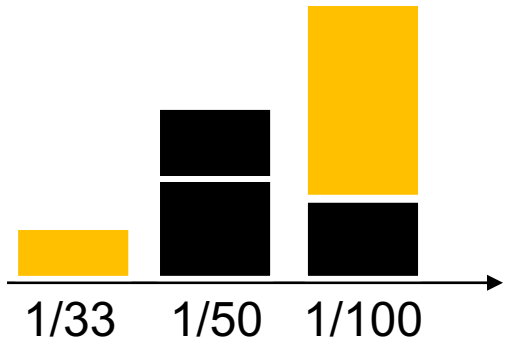
Applicability
Proprietary natural catastrophe models are myopic – ready to assess risk today, but not under future climate yet
→ Need for integration of climate impacts in a transparent scenario fashion (as in open-source models ✓)

Aggregate-ability
Physical risk disclosures today are company-specific, no established methodology for inter-comparison
→ Need not only for consistent approaches (scenarios, risk metrics …), but even more so for appropriate aggregation method (e.g. event-based)

Event-based risk assessment – risk differentiation

company A
company B





→ 1/100 event dominated by company B

→ Invest less in B

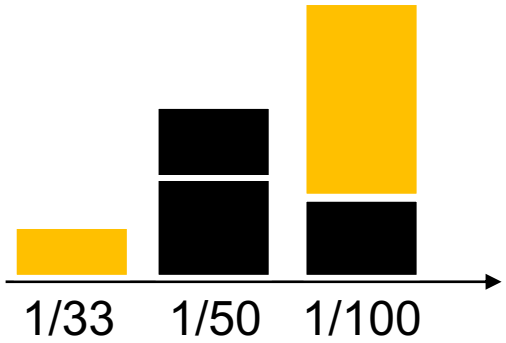
→ both companies equal

→ invest equally

based on https://wcr.ethz.ch/research/climada.html und Aznar-Siguan & Bresch, 2019: CLIMADA ... weather and climate risk assessment ..., https://doi.org/10.5194/gmd-12-3085-2019

Event-based risk assessment – risk differentiation (cntd)

company A
company B



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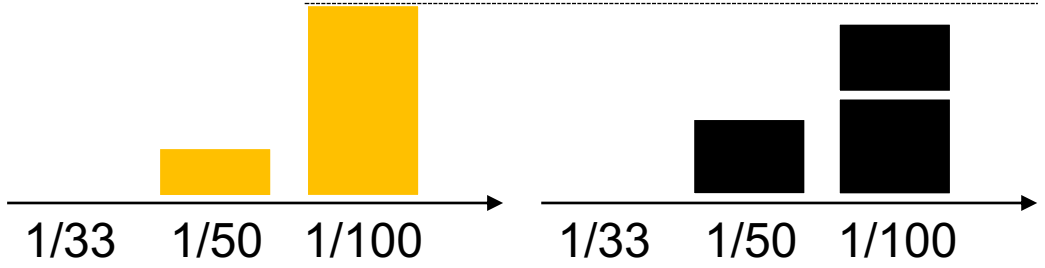
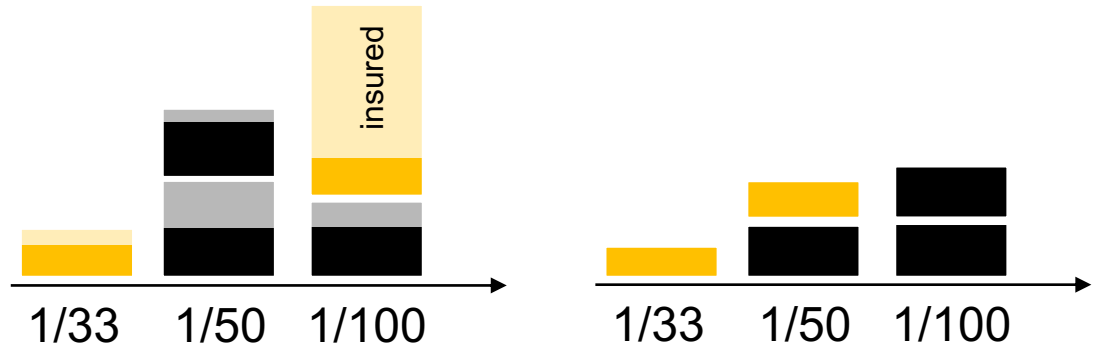


→ Almost no differentiation on stand-alone 1/100 event

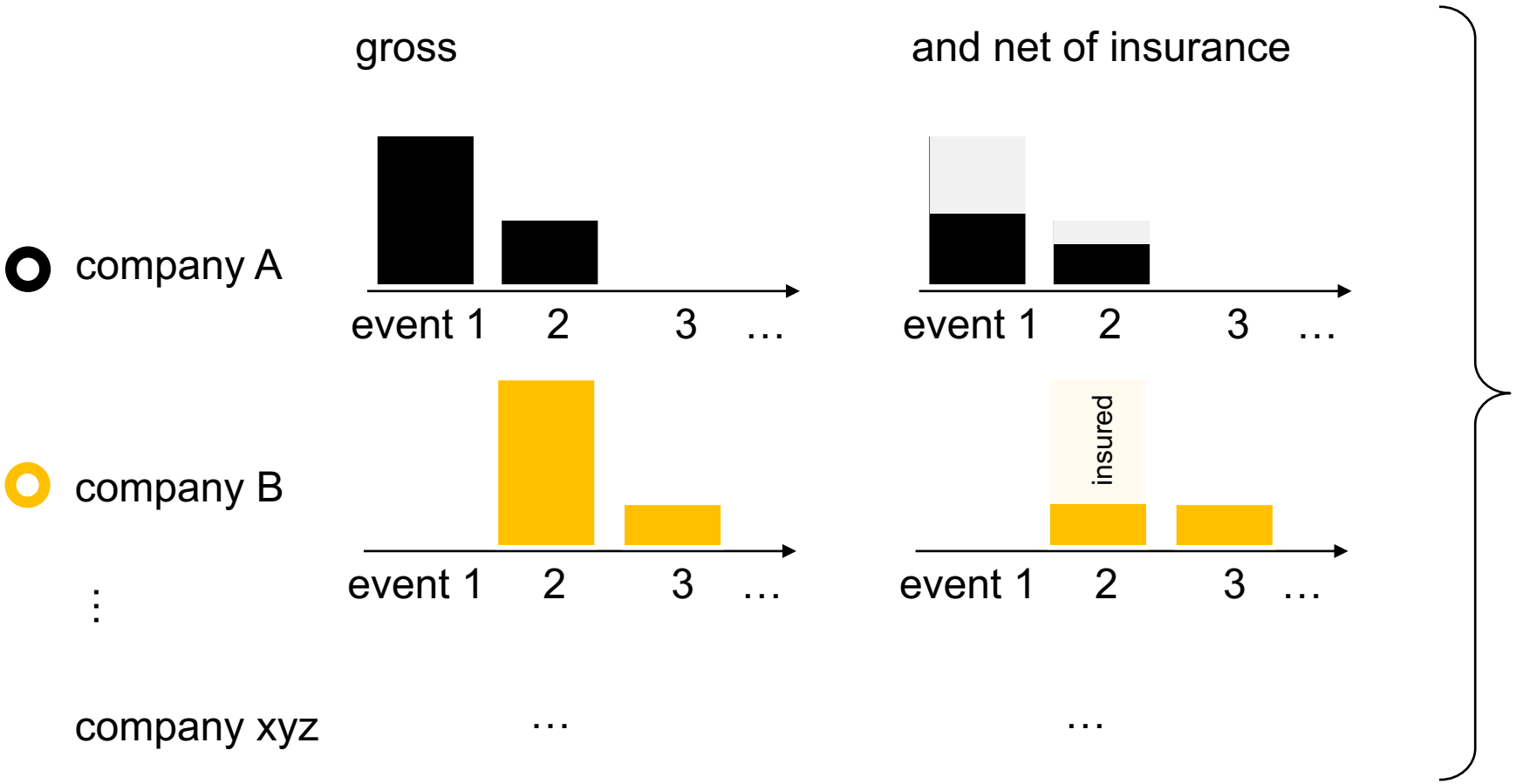


Net of insurance → invest less an A

based on https://wcr.ethz.ch/research/climada.html und Aznar-Siguan & Bresch, 2019: CLIMADA ... weather and climate risk assessment ..., https://doi.org/10.5194/gmd-12-3085-2019

Aggregate-ability – a suggested methodology for inter-comparison

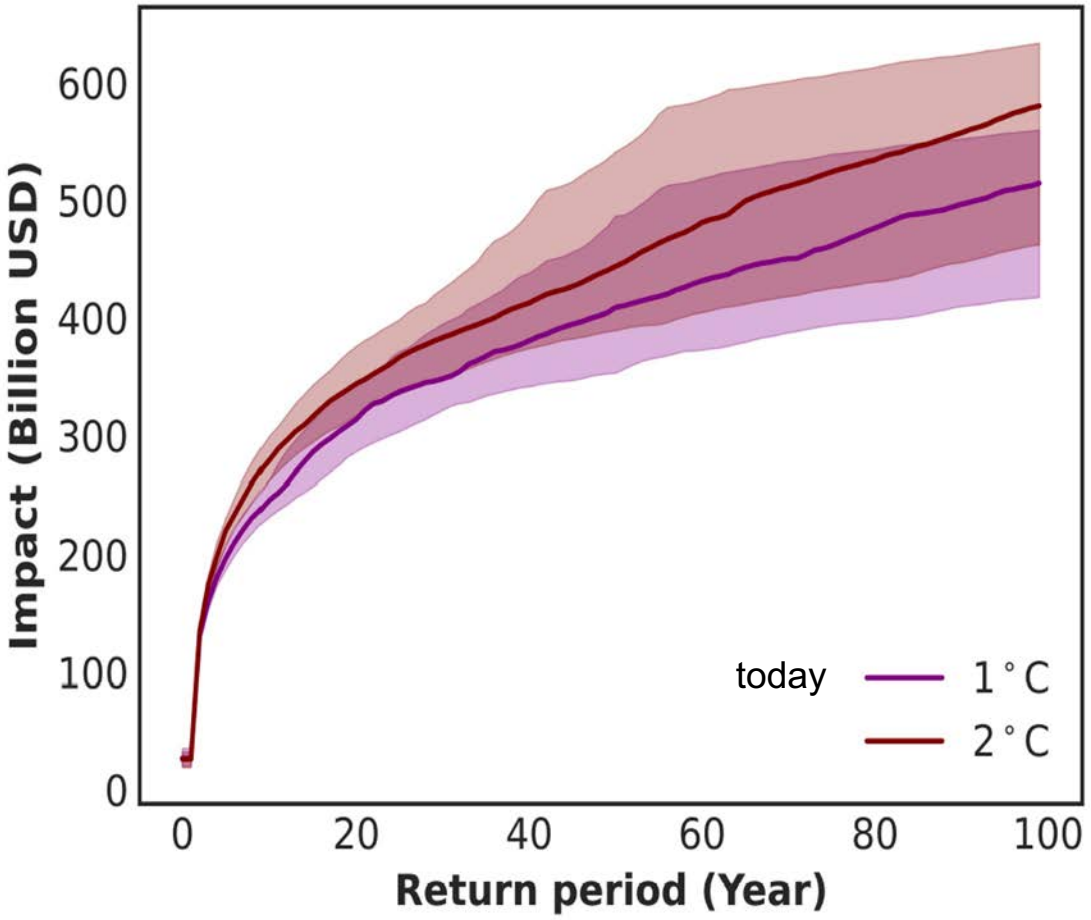
Each company to report modeled impact on a per-event basis of a reference hazard set, gross and net



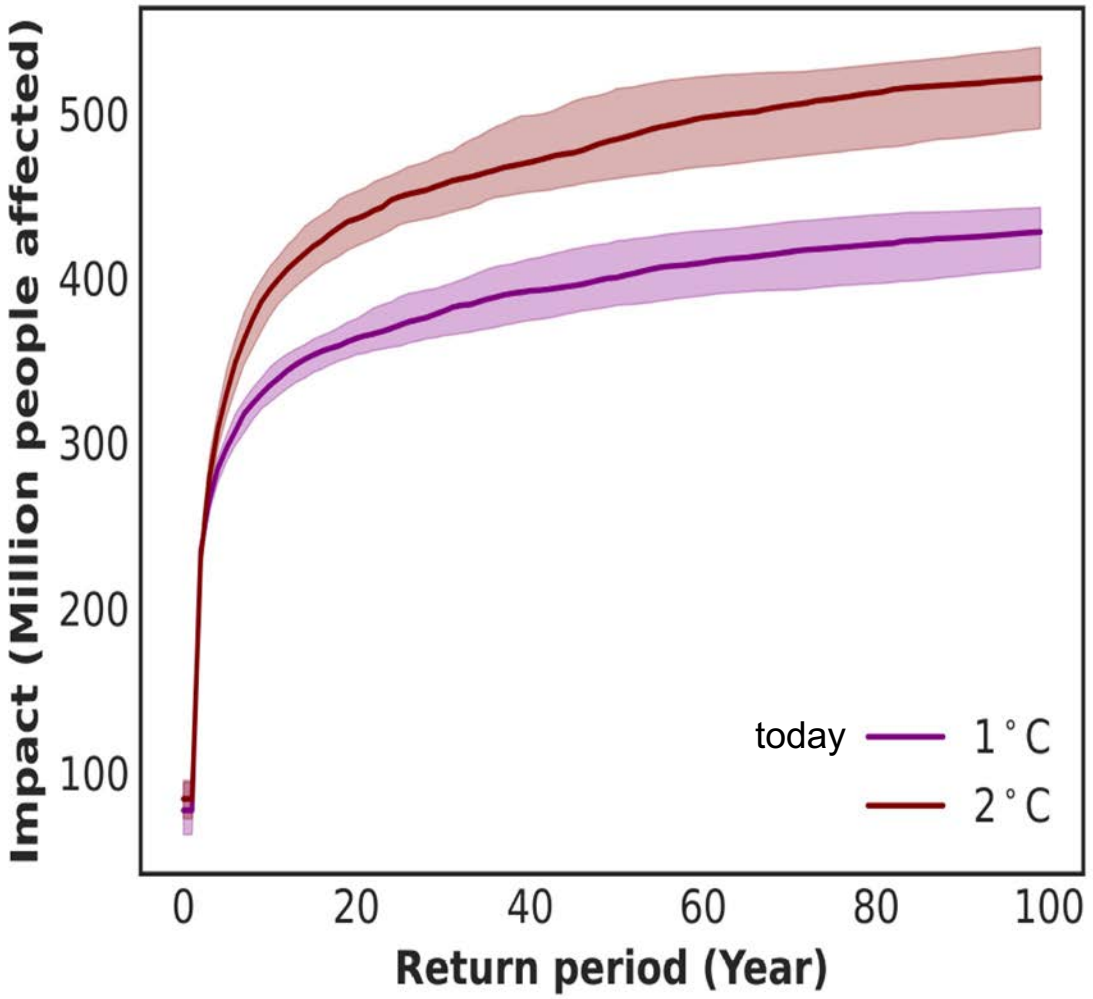
serves as a comprehensive basis for many risks metrics (including risk-return profiling) to be applied

based on https://wcr.ethz.ch/research/climada.html und Aznar-Siguan & Bresch, 2019: CLIMADA ... weather and climate risk assessment ..., https://doi.org/10.5194/gmd-12-3085-2019

Global multi-hazard risk assessment



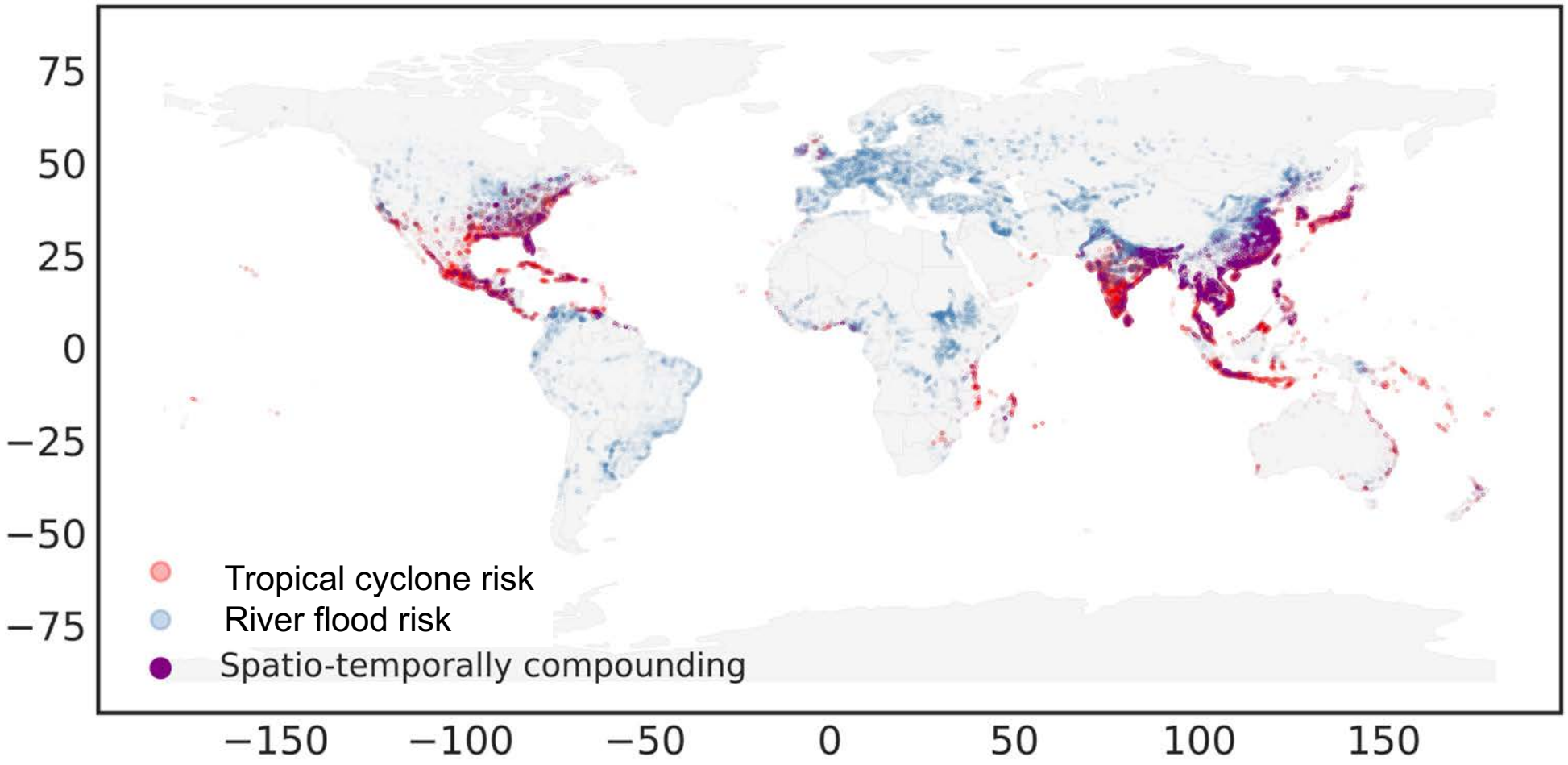
Physical assets



Population

Stalhandske, Z., Steinmann, C. B., Meiler, S., Sauer, I., Vogt, T., David N. Bresch, D. N., Kropf, C. M.: Global [event based] multi-hazard risk assessment in a changing climate. https://eartharxiv.org/repository/view/5286/

Global multi-hazard risk assessment – physical assets



Stalhandske, Z., Steinmann, C. B., Meiler, S., Sauer, I., Vogt, T., David N. Bresch, D. N., Kropf, C. M.: Global multi-hazard risk assessment in a changing climate. https://eartharxiv.org/repository/view/5286/

Event-based physical climate risk reporting

Prerequisites

- globally consistent **reference hazard event sets** for main perils both under current and future climate conditions (tropical cyclones, floods, droughts, wildfires to start with)
- globally consistent, **interoperable open-source and -access models**

Pros

- modeled impact on a per-event basis of a reference hazard set, gross and net
  serves as a comprehensive basis for many risks metrics (including risk-return profiling) to be applied
- companies need to to disclose neither asset locations, nor supply chain structure, nor vulnerabilities
- allows for true transparency and enables risk-aware long-term investment strategies to be enacted

Cons

- Looks like quite some data volume, but a ridiculous argument in the era of big data

This presents a tremendous opportunity for the academic community to work towards **interoperable models** and **reference hazard event sets** both under current and future climate conditions.

CLIMADA – Collaborations (logo style, size arbitrary)

CLIMADA
Economics of Climate Adaptation

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology
MeteoSwiss

cascades
Cascading climate risks:
Towards adaptive and
resilient European Societies

MSCI | CARBON DELTA
An MSCI Company

KFW

eiopa 2011–2021
European Insurance and
Occupational Pensions Authority

b
UNIVERSITÄT
BERN

DWD
Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Receipt

oasis LOSS MODELLING FRAMEWORK

ADB
ASIAN DEVELOPMENT BANK

NCAR UCAR
National Center for Atmospheric
Research

THE WORLD BANK

The Nature Conservancy

"La Ciencia sin Moral es Vana"

iDMC internal displacement monitoring centre

POTSDAM-INSTITUT FÜR KLIMAFOLGENFORSCHUNG
PIK

Frankfurt School
of Finance & Management

InsuResilience
Solutions Fund

United Nations University

THE GLOBAL GOALS
For Sustainable Development

ISIMIP
Inter-Sectoral Impact Model
Intercomparison Project

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

NGFS
Central Banks and Supervisors
Network for Greening the Financial System

CCRIF
The Caribbean Catastrophe Risk Insurance Facility

THE ROCKEFELLER FOUNDATION

Atlantic Council

Adrienne Arsht-Rockefeller Foundation
Resilience Center

CelsiusPro

CLIMADA Technologies

Accelerating the global mindset towards anticipating climate impact and adaptation

Supporting a global client base in climate adaptation and resilience with decision-critical insights

THE CLIMATE ADAPTATION TECHNLOGY COMPANY