cascades

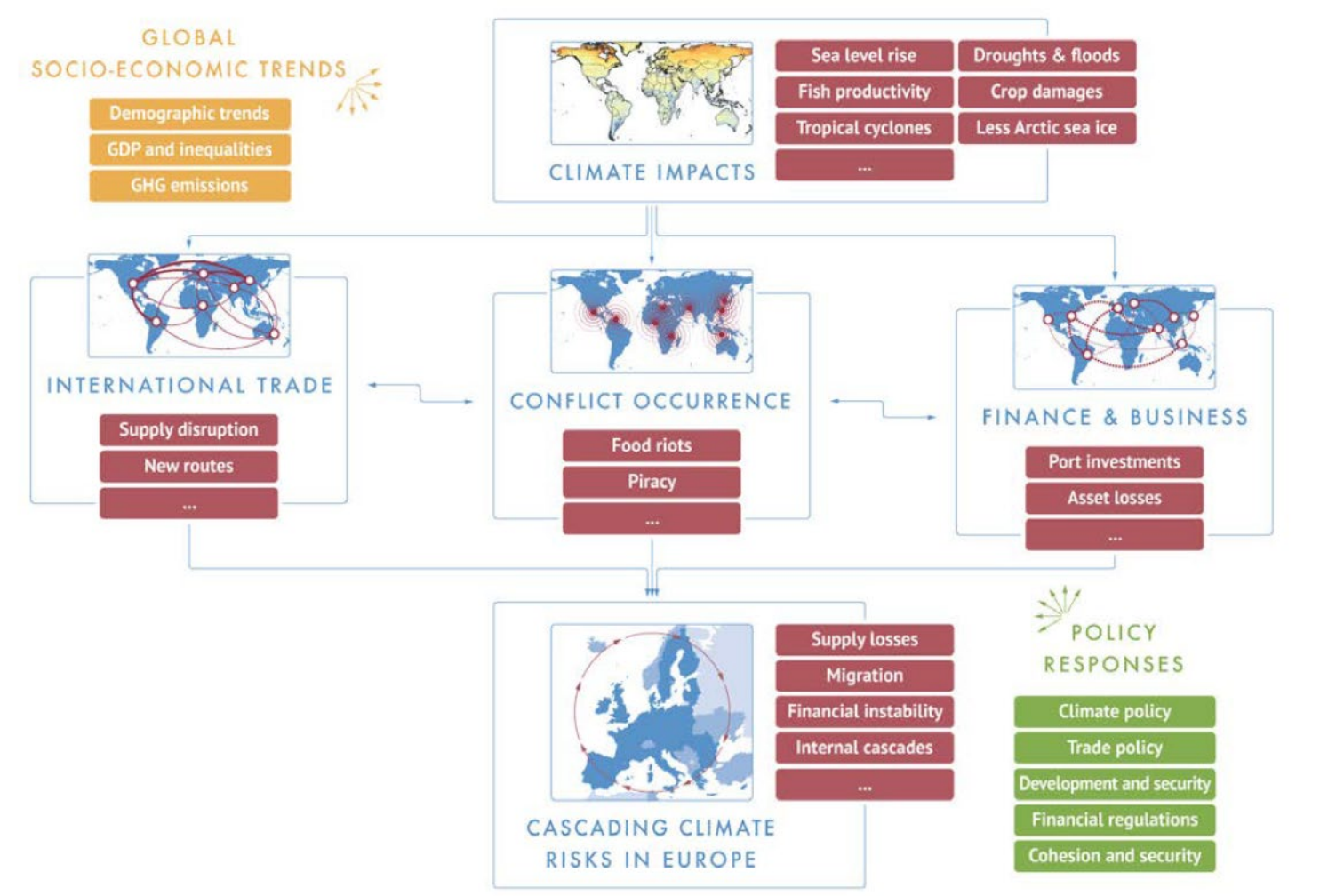
Cascading climate risks:
Towards adaptive and
resilient European Societies

Klimafolgen Kaskaden - Erkenntnisse aus dem CASCADES Projekt

13 Juni 2024

Cornelia Auer, PIK Potsdam

Die CASCADES Perspektive

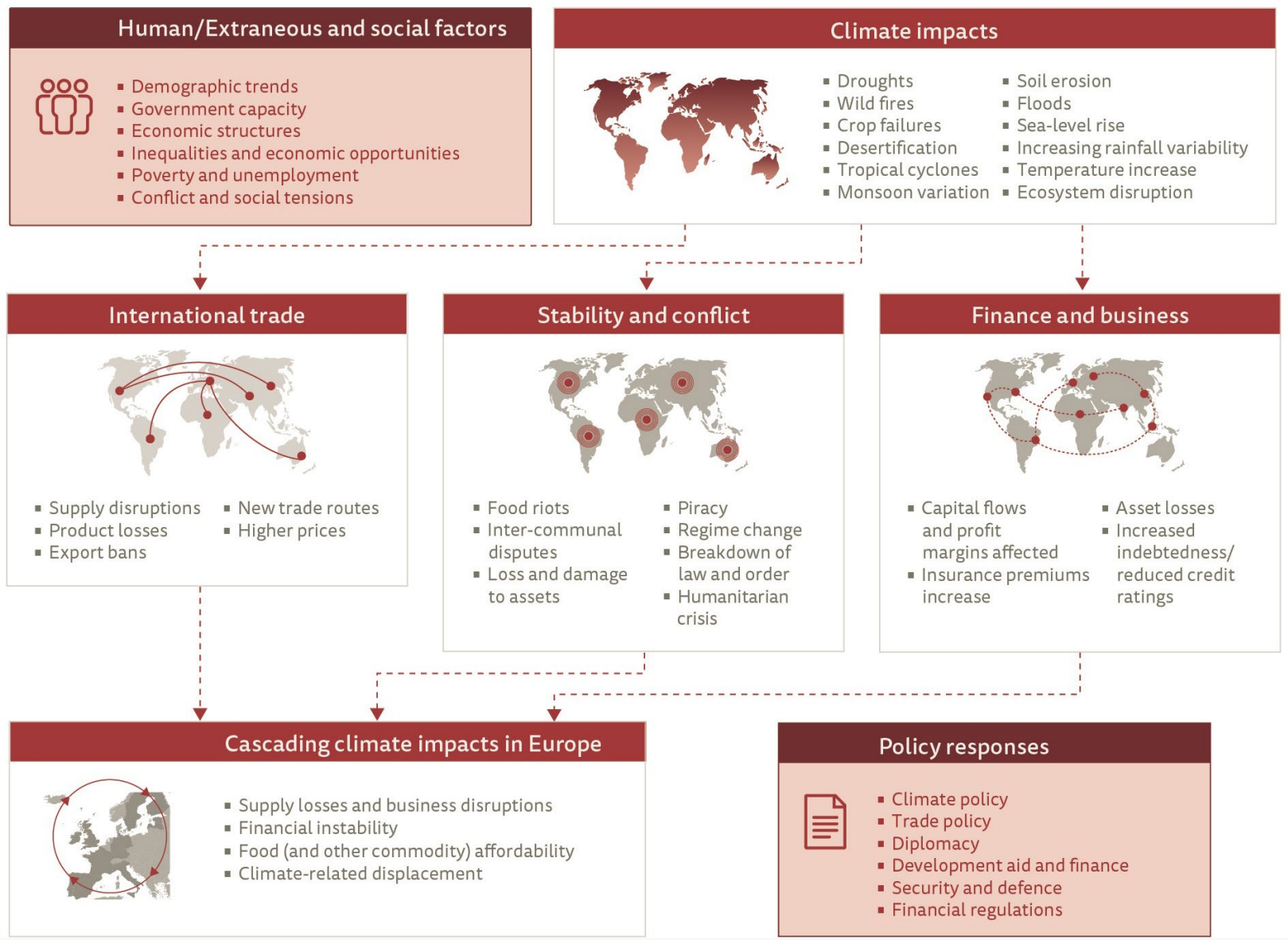


3 Säulen

- Wirtschaft & Handelsketten
- Außenpolitik, Sicherheit & Entwicklung
- Finanzen

Europäische Resilienz gegenüber Kaskadeneffekten durch den Klimawandel

Die CASCADES Perspektive



Centre for Systems Solutions

SYKE

SEI

CHATHAM HOUSE
The Royal Institute of International Affairs

CIDOB
BARCELONA CENTRE FOR INTERNATIONAL AFFAIRS

cmcc
Centro Euro-Mediterraneo sui Cambiamenti Climatici

European Centre for Development Policy Management
ecdpm

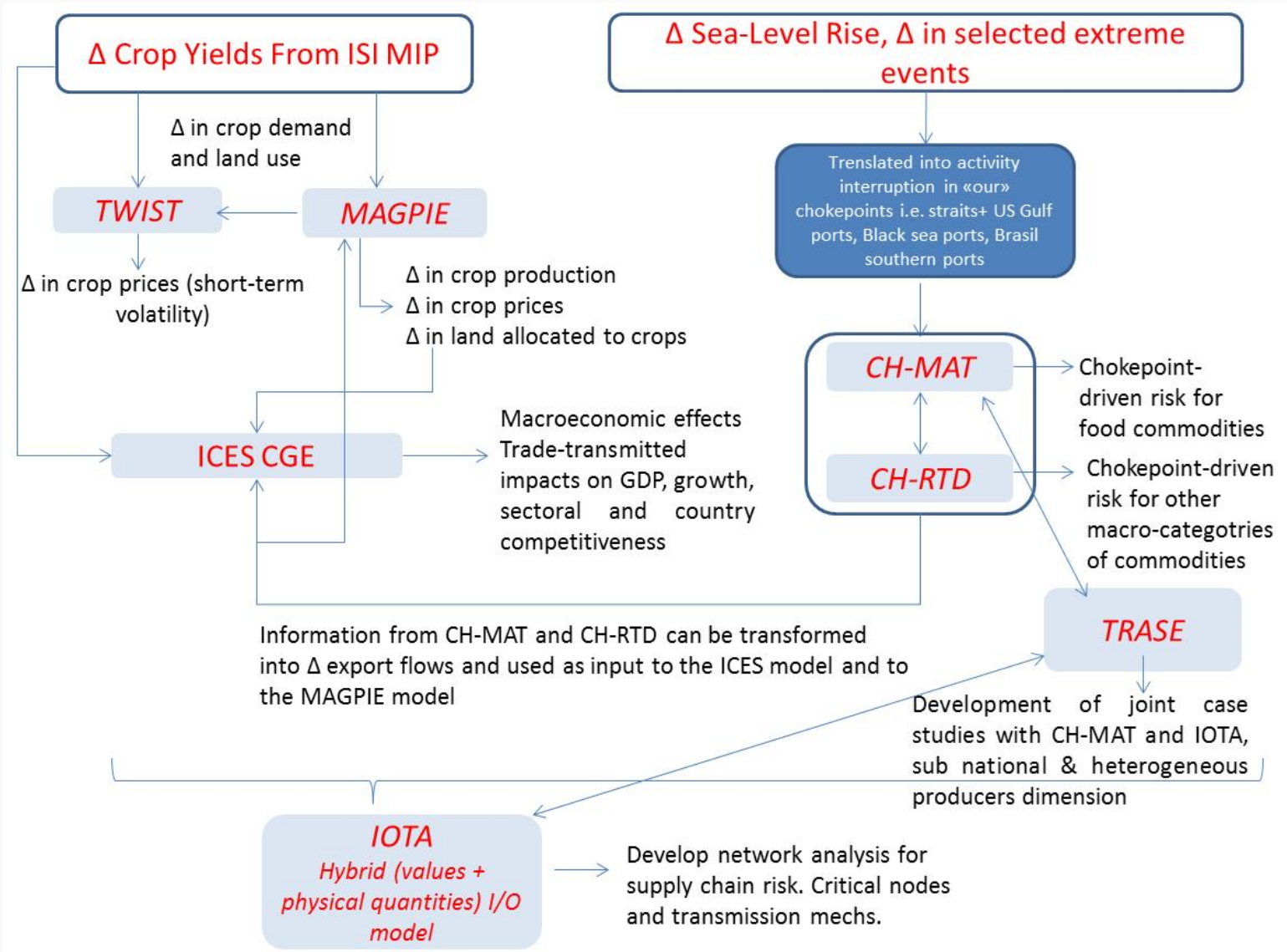
WU
WIRTSCHAFTS UNIVERSITÄT WIEN VIENNA UNIVERSITY OF ECONOMICS AND BUSINESS

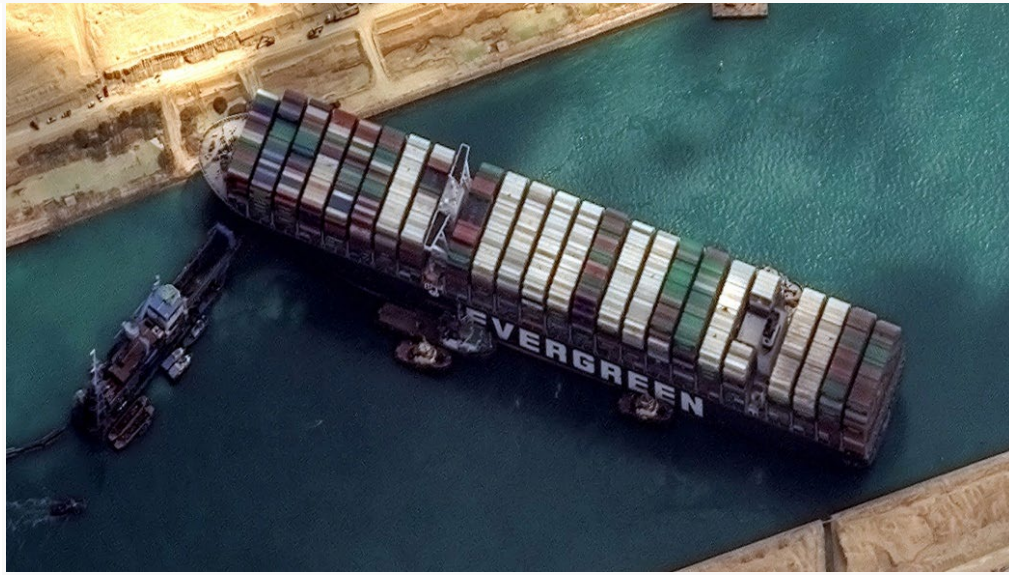
UNIVERSITY of York

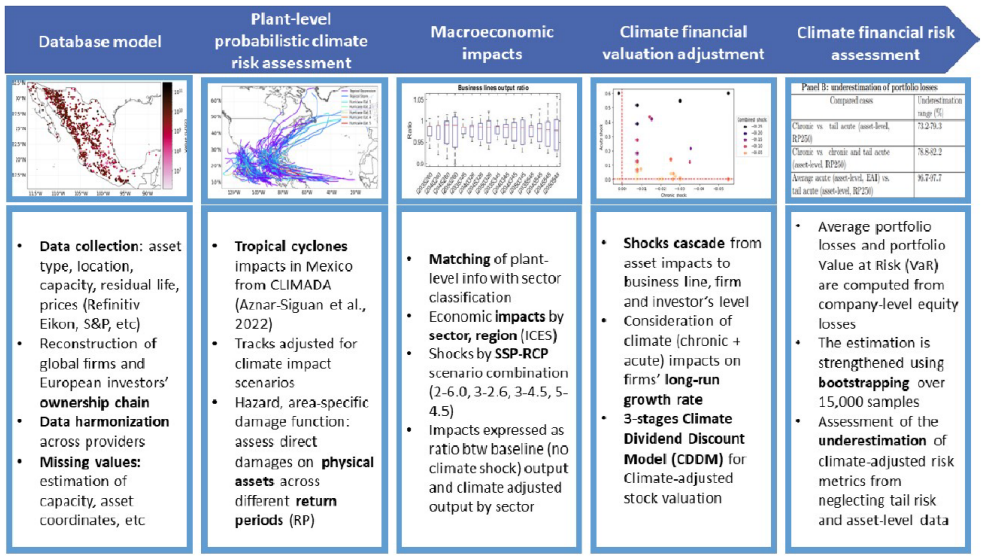
adelphi

ETH zürich

Modellierungskette für breite Palette von Szenarien



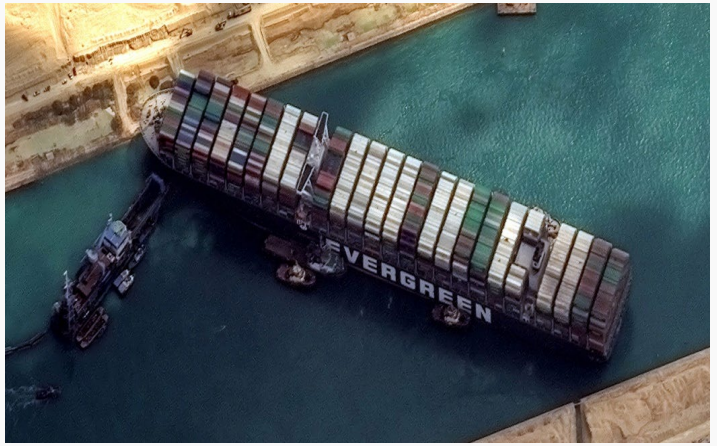


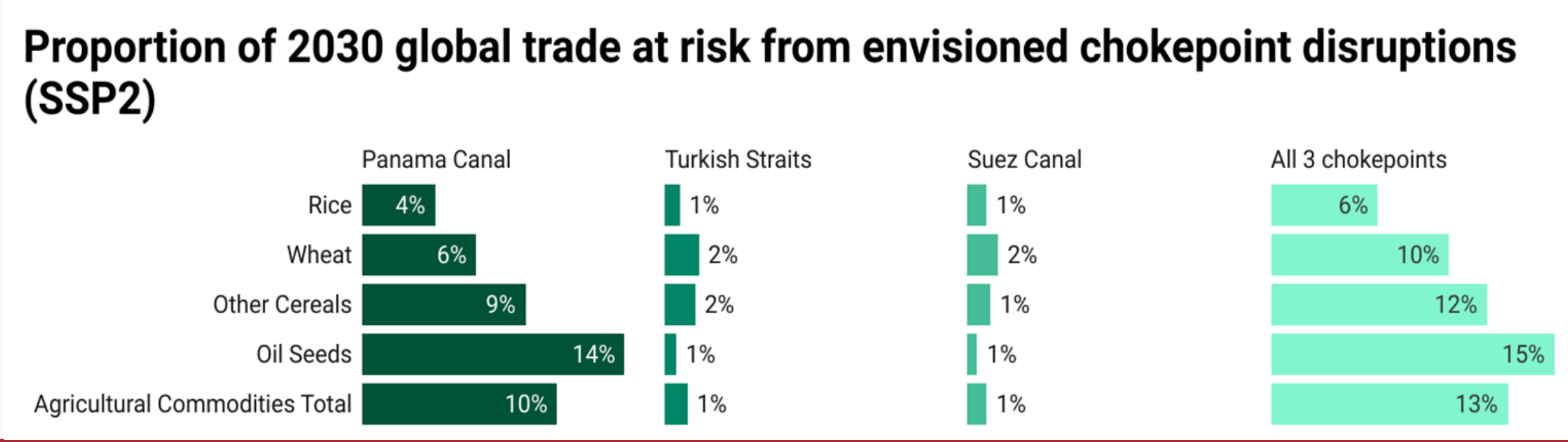


Bodirski et al. 2020, Bressan et al. 2022, SSRN, King et al. 2022 on resourcetrade.earth

Auswirkungen auf Handelsengpässe

- Auswirkungen einer Blockade des Panamakanals dominieren
- Einige Länder (z.B. Ägypten, Somalia) sind stark auf Weizenimporte angewiesen, die durch die türkischen Meerengen verlaufen
- Das Beispiel der Evergreen zeigte stärkere nachgelagerte Effekte als gedacht



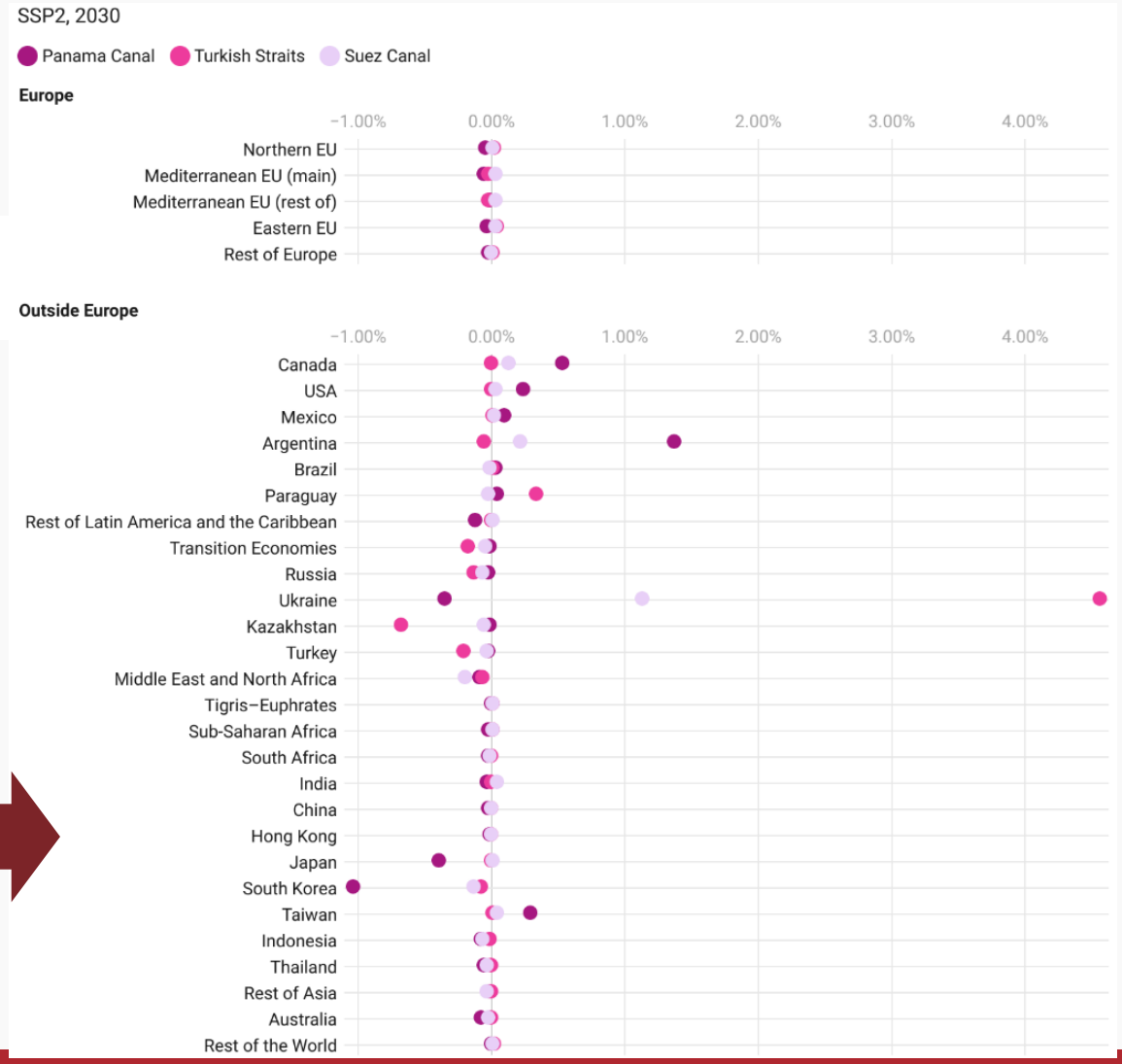


King et al. 2022 on resourcetrade.earth

Auswirkungen auf Handelsengpässe

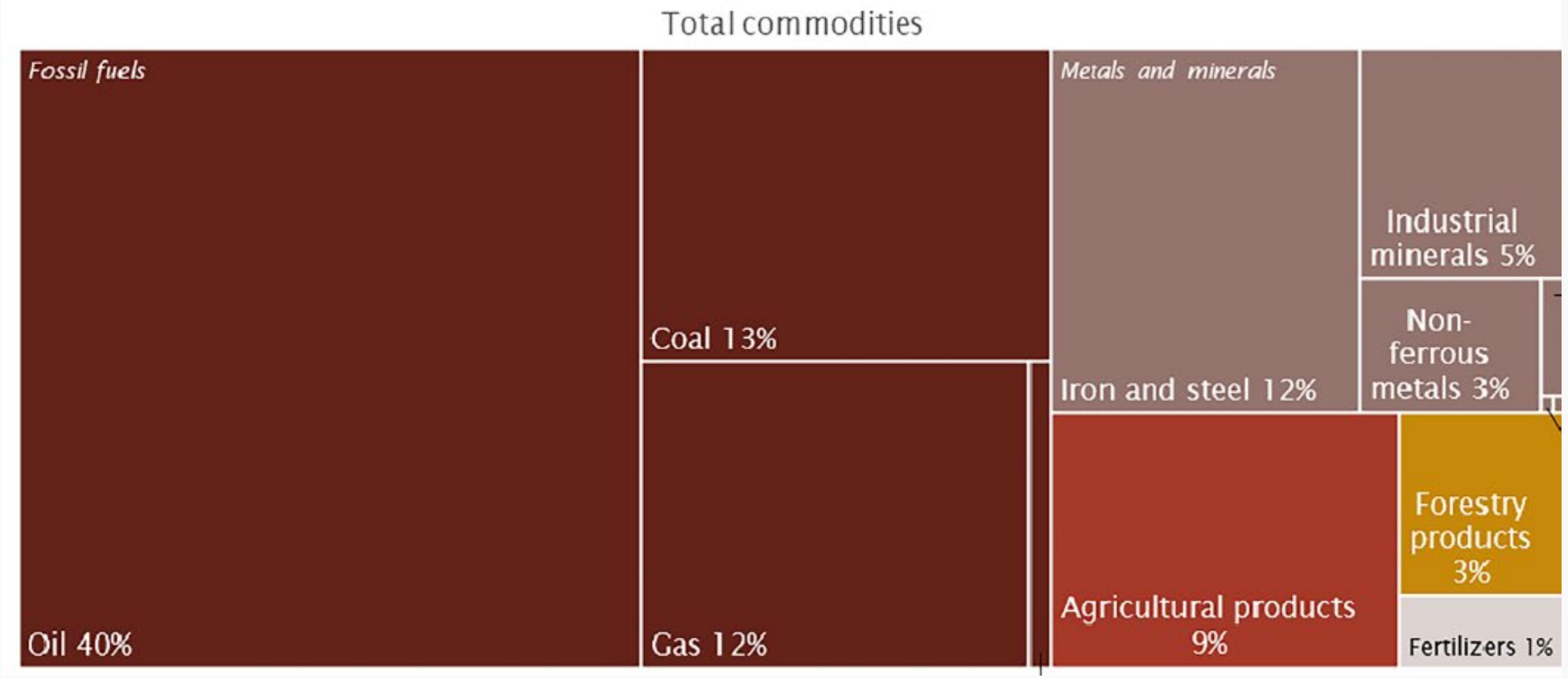
Änderung der Getreidepreise

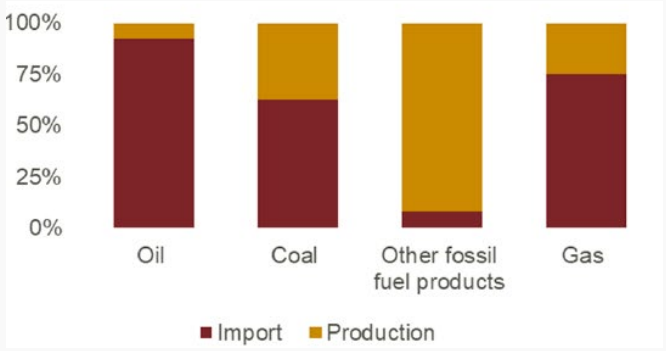
Änderung der Produktion in der Lebens-mittelindustrie

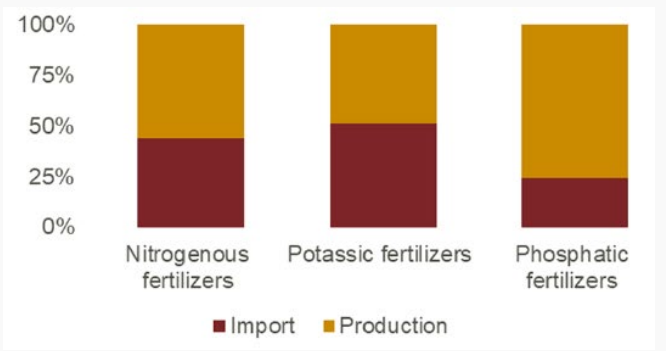


Source ICES model and CH data CMCC-CH

Starke Abhängigkeit bei fossiler Energie und Düngemittel



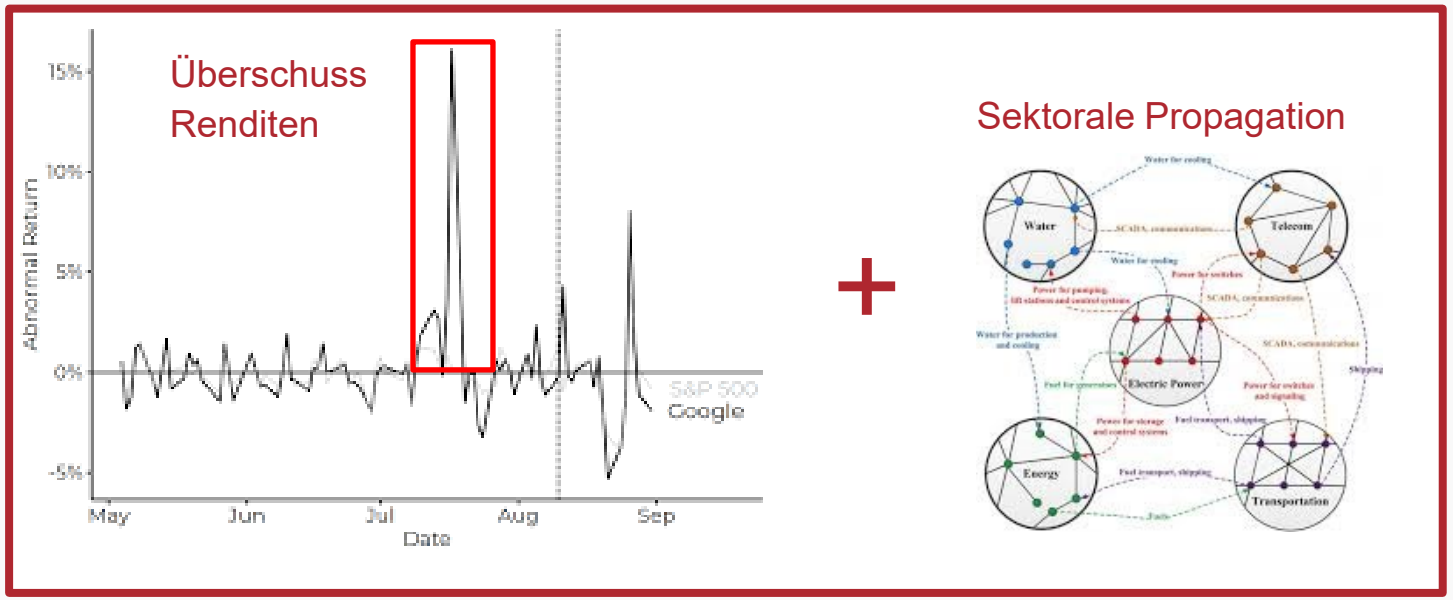


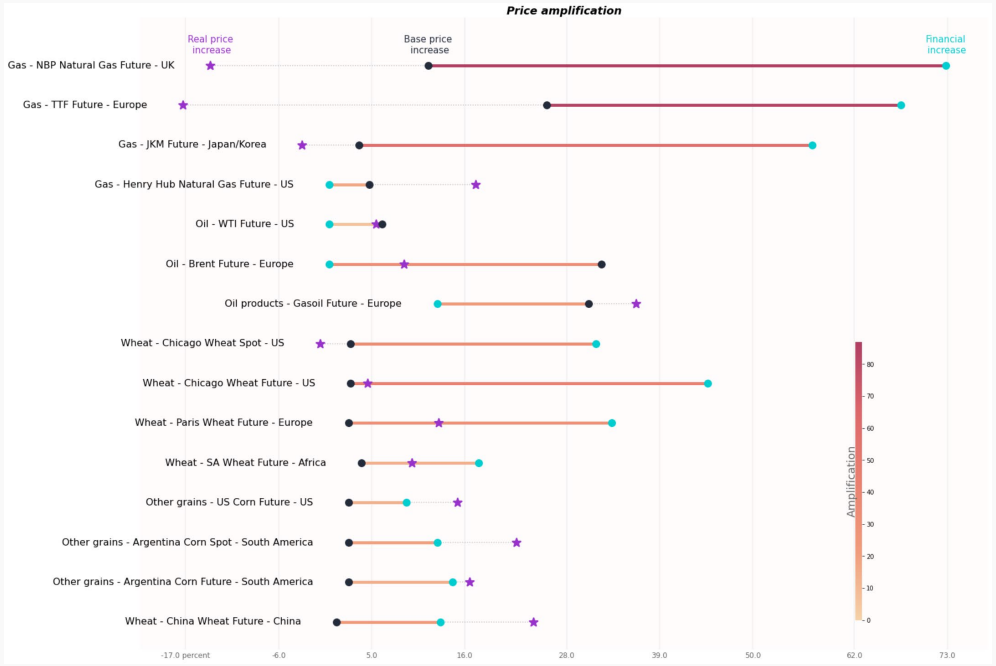


Betrachtet man Rohstoff Importe scheint die EU27 relativ selbstversorgend, aber bei Düngemitteln und fossilen Brennstoffen ist die EU27 stark importabhängig.

West et al. 2021, Climate Risk Management

Analyse des Krieges in der Ukraine: Schock Szenario für internationalen Handel von Energie und Getreide (Integration Finanzmarktanalyse zu CGE-Modell)

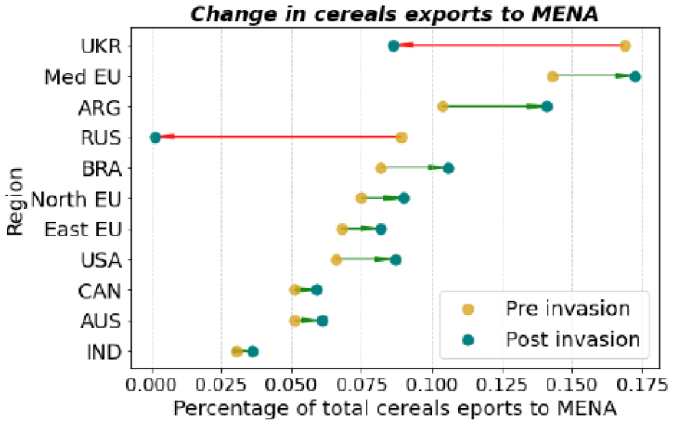


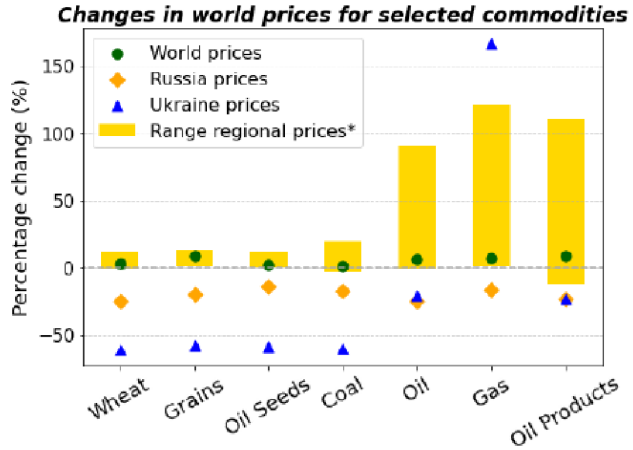


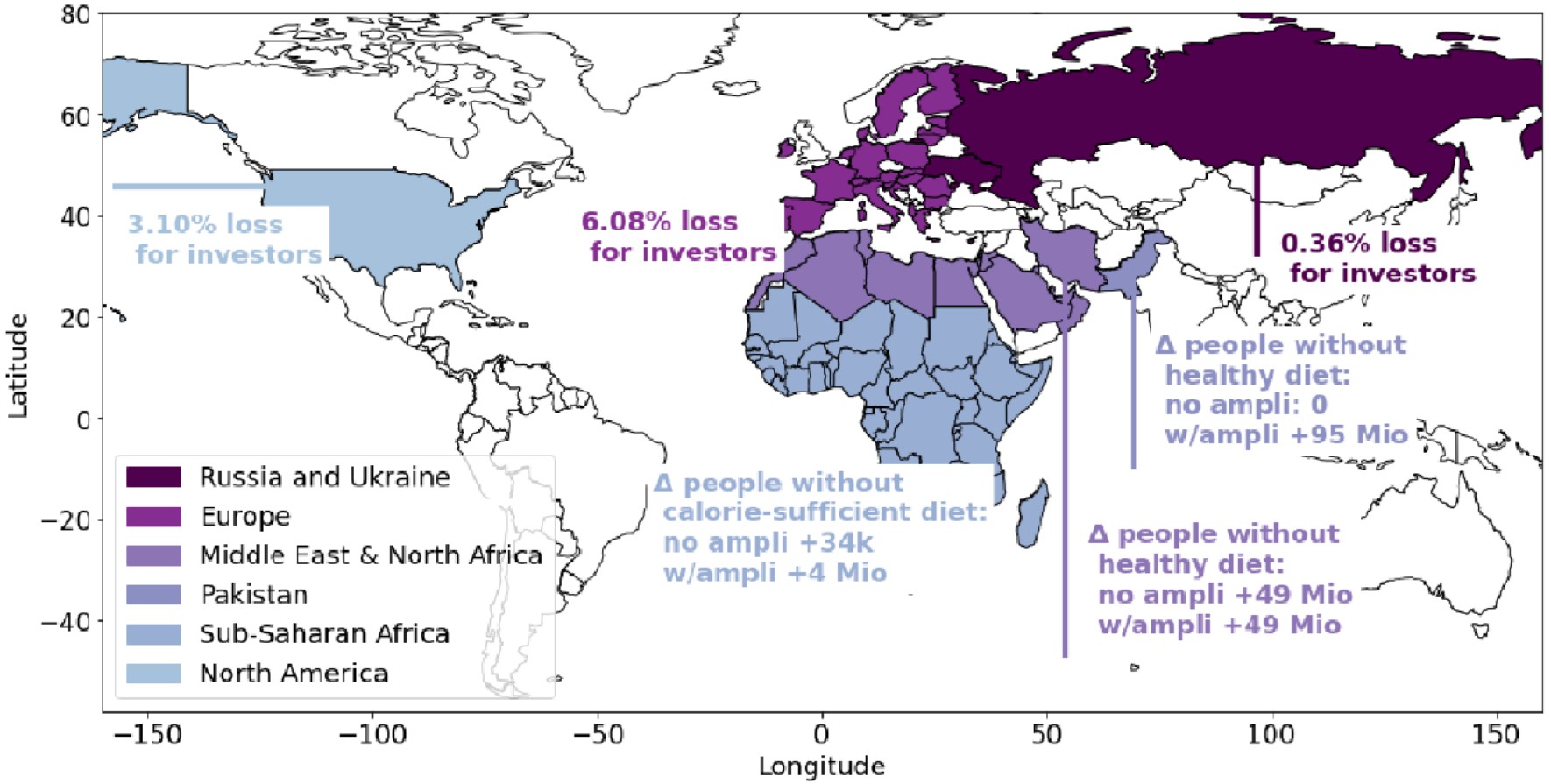
Basierend auf empirischen Daten:

- Quantifizierung: kurzfristiges ineffizientes Verhalten von Märkten
- Verstärkter Preisanstieg bei Rohstoffen (nicht sichtbar in klassischen Makroökonomischen Modellen)

Analyse des Krieges in der Ukraine: Amplifikation durch Integration Finanzsektor (Rohstoffhandel)







Szenarien: Exportverbot von fossilen Brennstoffen, Düngemitteln, Ölsaaten, Getreide, Forst- und Fischerei- produkten in die EU, die USA, JP, CAN, AUS, UKR; Produktions- und Exportreduktion in und aus der Ukraine; zusätzliche Handelshemmnisse.

Auer et al. in revision

Globale Netzwerkanalyse: Schlüsselpunkte zur Adaptation vor Kaskaden Effekten nach Europa

Netzwerkanalyse unter Einbeziehung von Kaskadeneffekten

"*Welche Systeme könnten Trigger für Kaskaden nach Europa sein*?"

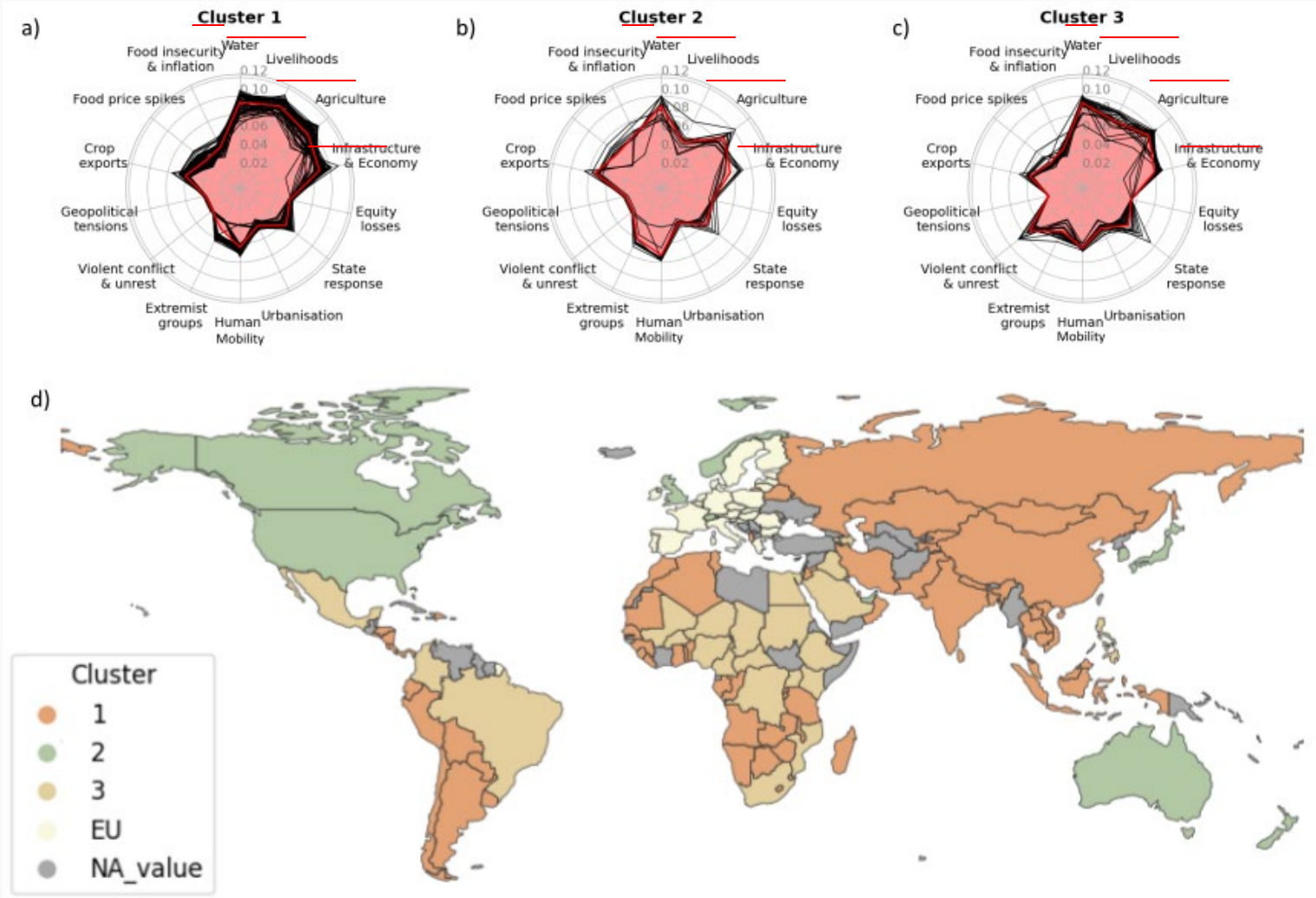
- Wasser und Landwirtschaft in fast allen Ländern
  → entweder hoher Anteil der Bevölkerung im Agrarsektor ODER
  → wichtiger Exporteur

- Individuelle Einkommen (besonders LMIC Länder)

- Lokale Wirtschaft (bes. LMIC Länder)

- [Konflikt: Sahel, Mexiko, Brasilien, Saudi Arabien]

➔ Anpassung unserer Lieferketten ohne Zerstörung Wirtschaft vor Ort
➔ Doppelte Belastung für LMIC



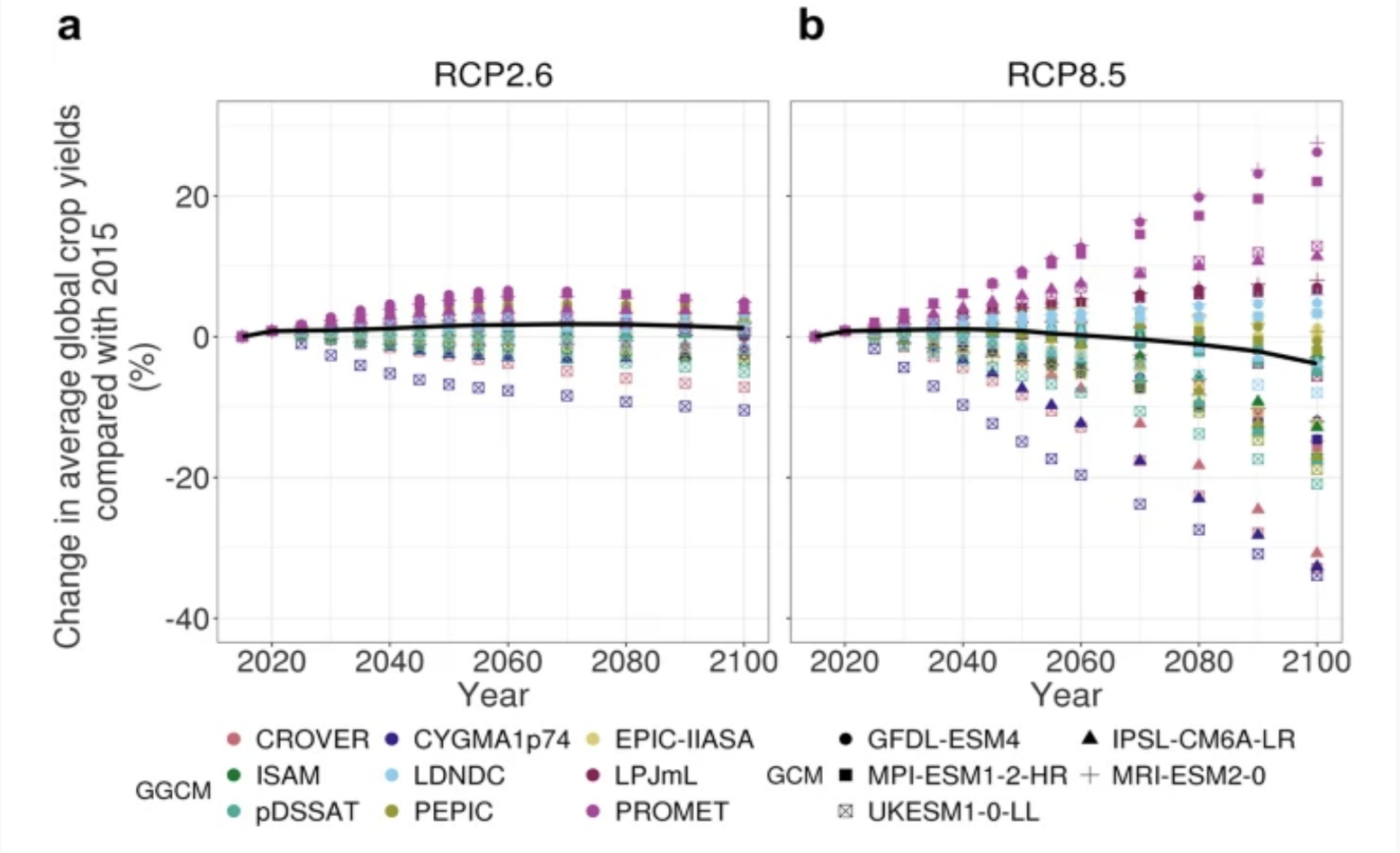
DANKE!

Questions and discussion

Why

› Strong divergence
› Hard to communicate
› Impression from median
→ nothing much to do

Fig. 1: Global climate change impacts on crop yields under two different emission scenarios.



Source: Bacca et al. 2023

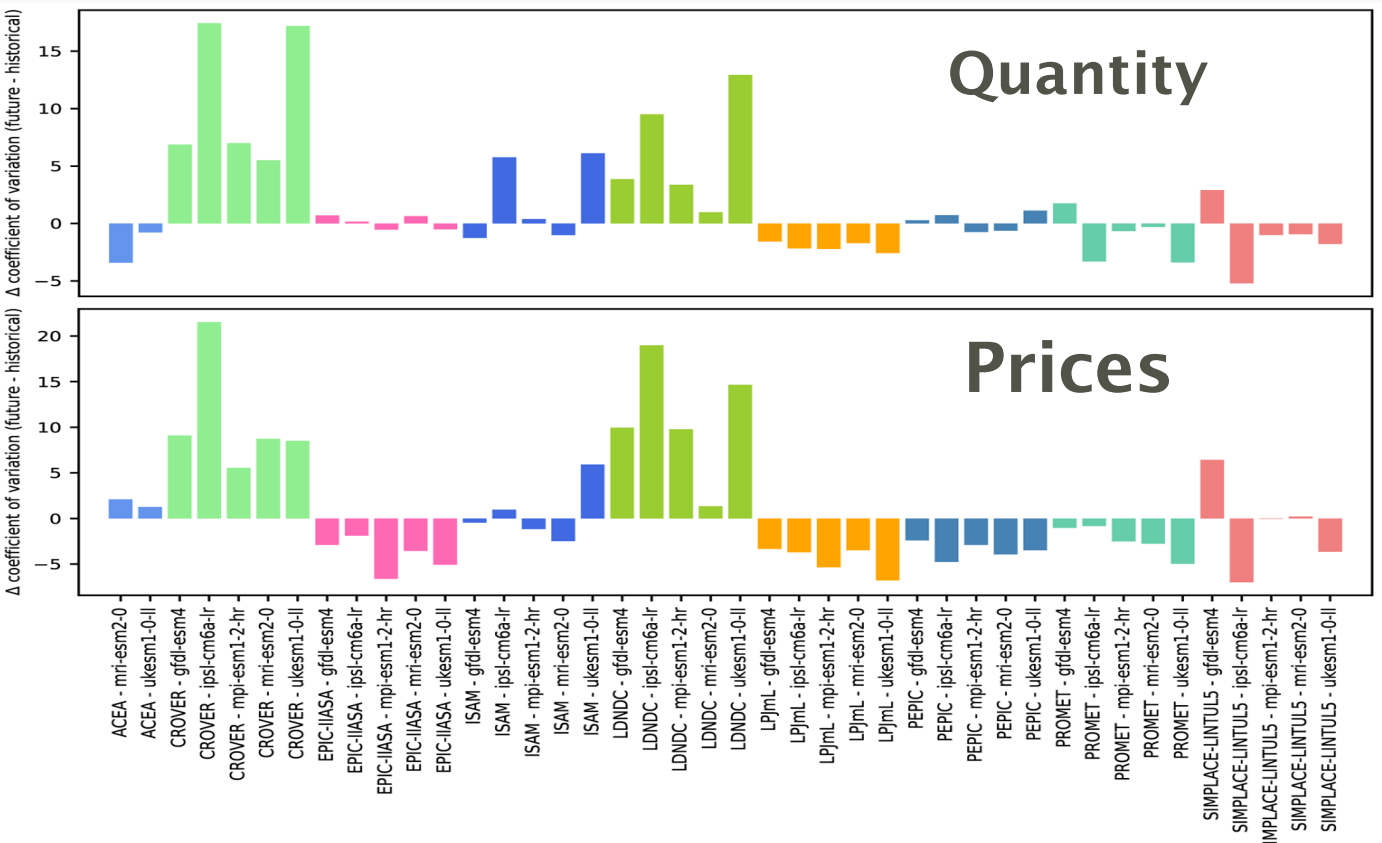
WP3: CC macroeconomic cascading effects

Macroeconomic effects can be «moderate», however cascading «extra EU» effects are huge in relative terms!

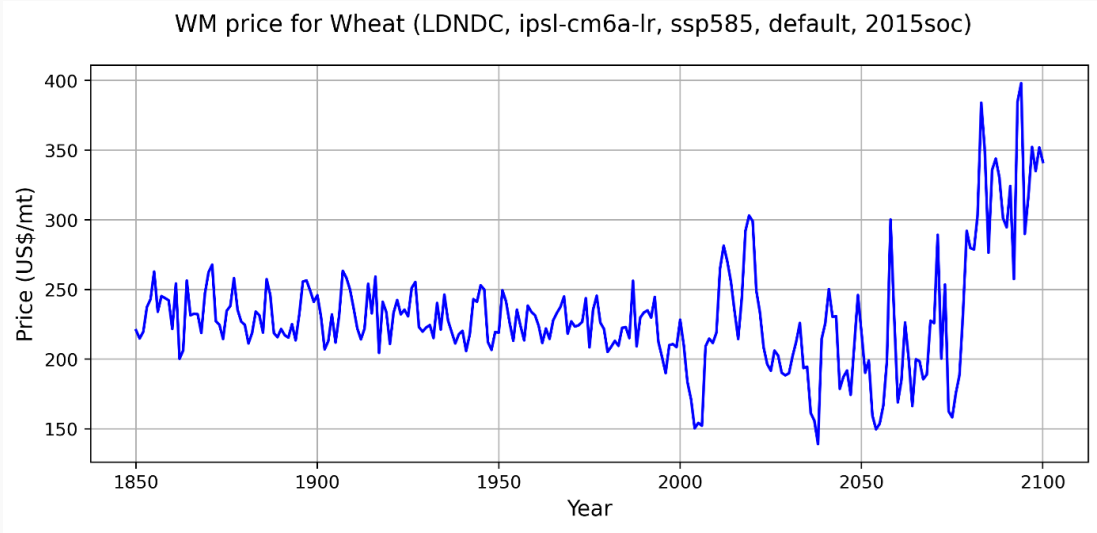
(Compare «red vs blue» bars var. % wrt baseline in 2050)

Source ICES model CMCC

WP3: CC impacts on agriculture



Difference in the coefficient of variation between future (2050-2099) and historical (1851-2015) production (top) and prices (bottom) using ISIMIP3b, RCP8.5 and the default sensitivity scenario.
Source TWIST model PIK



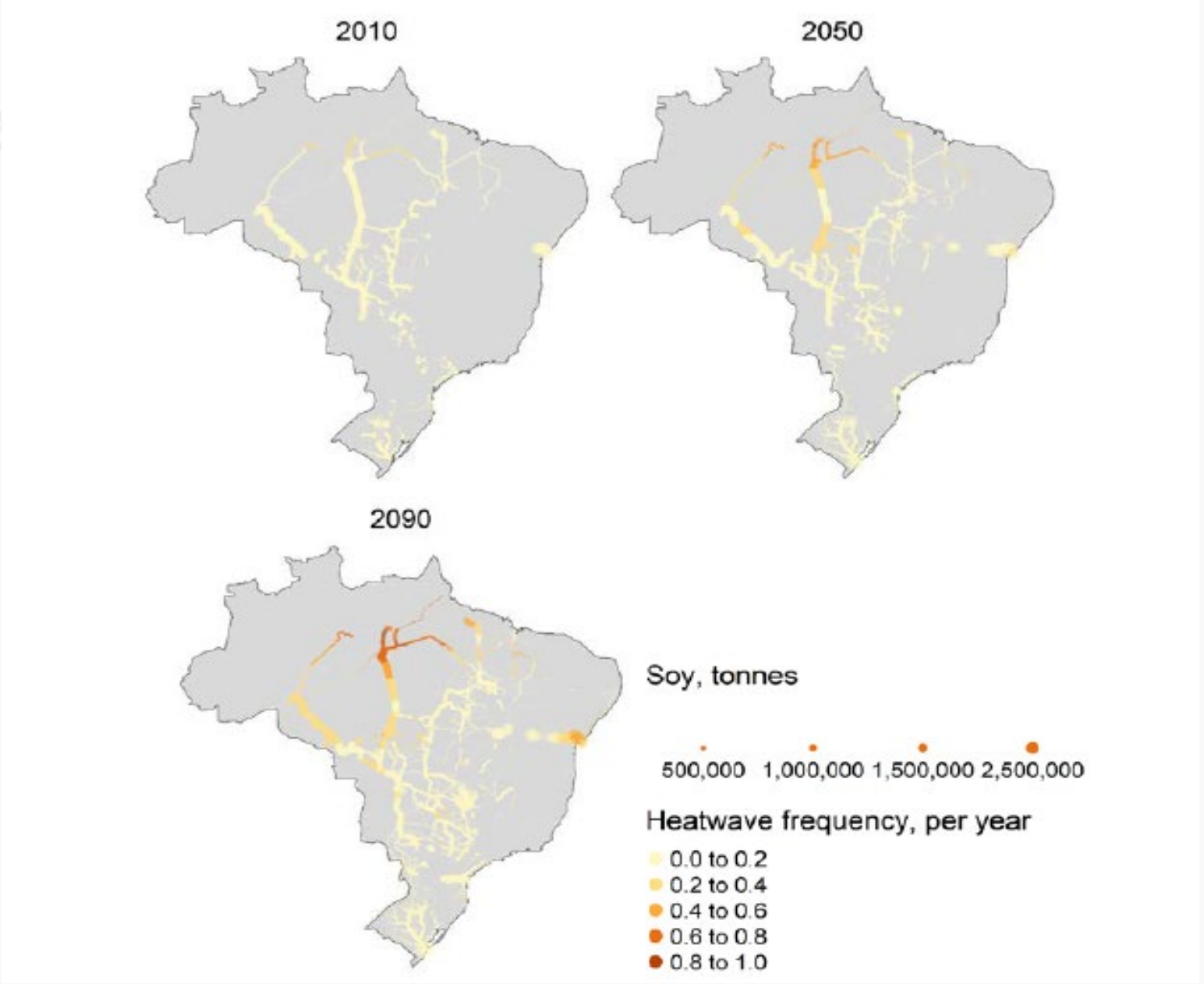
Simulated time series of annual wheat prices for a particular model combination with a very strong increase in price variability between historical and future periods.
Source TWIST model PIK

Huge uncertainty from crop model simulations. A precautionary approach is advisable!

WP3: the soy case

Frequency of heatwaves per decade along road routes for EU soy imports, 2010, 2050 and 2090. Year labels indicate the midpoint of an 11-year period, except 2010 which is a 9-year period. Size of each point indicates throughflow of soy, tonnes. RCP 6.0

Infrastructural stress on soy transport routes can increase…

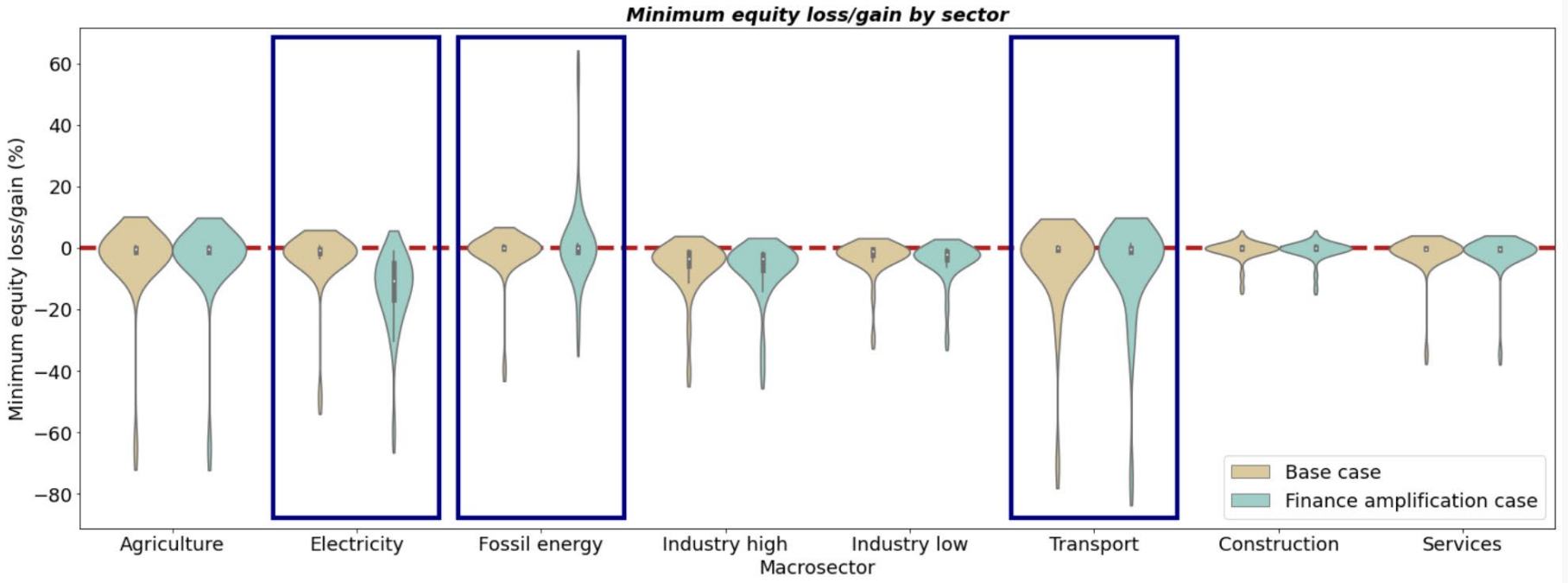


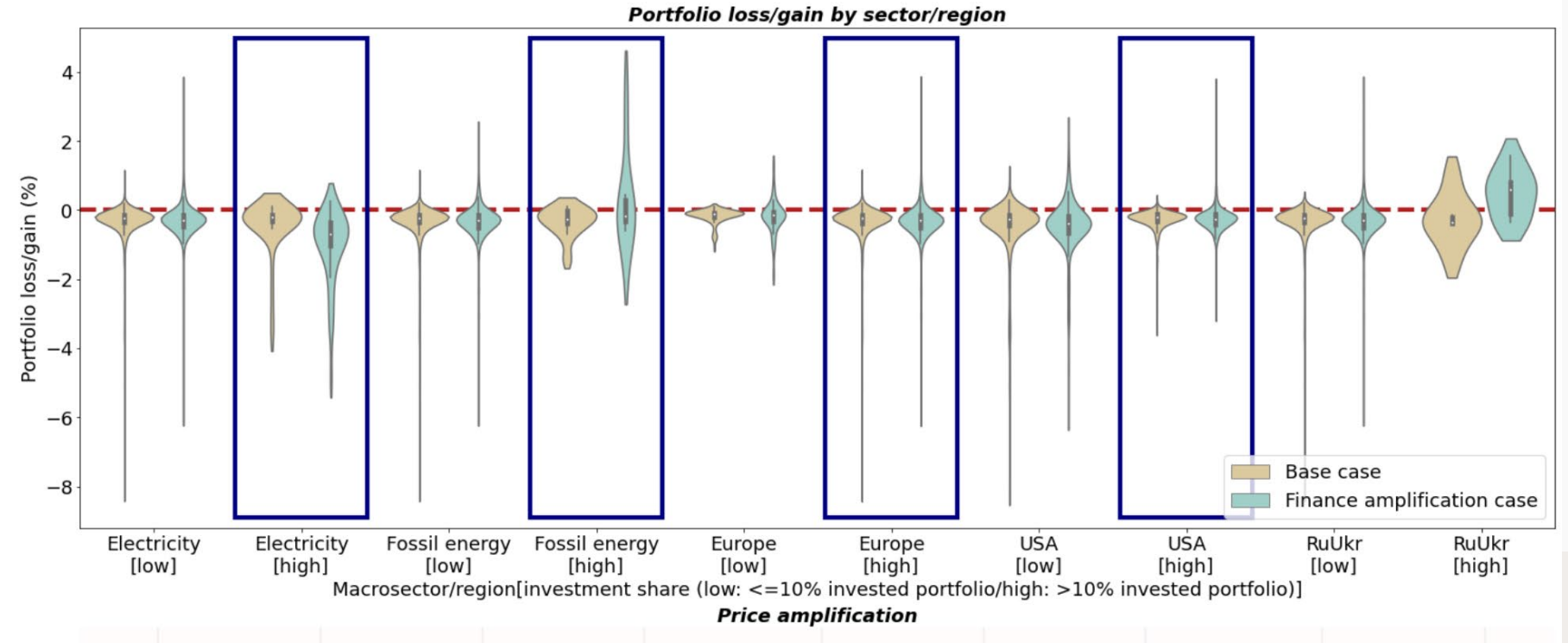
Source UoY

Finance results

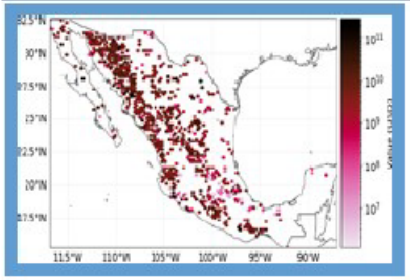
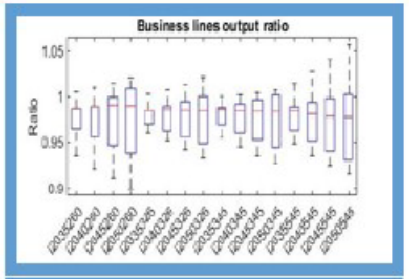
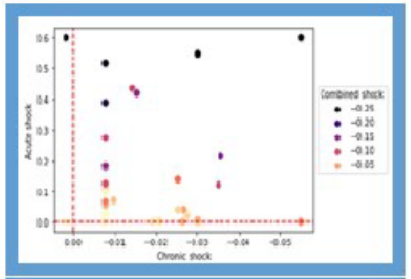
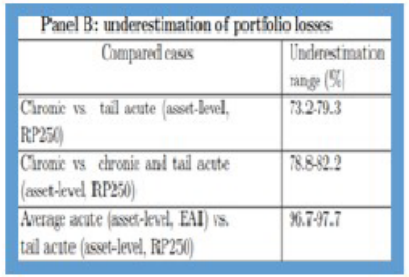
Portfolio benefit or loses from revaluation of stocks depend on sectoral and geographical composition Firms and portfolios in **Europe** emerge as main losers.

The **fossil energy** sector firms and portfolios (excluding oil products) emerge as the main winner





2. A database and workflow for financial risk assessment

Database model	Plant-level probabilistic climate risk assessment	Macroeconomic impacts	Climate financial valuation adjustment	Climate financial risk assessment
				
• **Data collection**: asset type, location, capacity, residual life, prices (Refinitiv Eikon, S&P, etc) • Reconstruction of global firms and European investors' **ownership chain** • **Data harmonization** across providers • **Missing values:** estimation of capacity, asset coordinates, etc	• **Tropical cyclones** impacts in Mexico from CLIMADA (Aznar-Siguan et al., 2022) • Tracks adjusted for climate impact scenarios • Hazard, area-specific damage function: assess direct damages on **physical assets** across different **return periods** (RP)	• **Matching** of plant-level info with sector classification • Economic **impacts** by **sector, region** (ICES) • Shocks by **SSP-RCP** scenario combination (2-6.0, 3-2.6, 3-4.5, 5-4.5) • Impacts expressed as ratio btw baseline (no climate shock) output and climate adjusted output by sector	• **Shocks cascade** from asset impacts to business line, firm and investor's level • Consideration of climate (chronic + acute) impacts on firms' **long-run growth rate** • **3-stages Climate Dividend Discount Model (CDDM)** for Climate-adjusted stock valuation	• Average portfolio losses and portfolio Value at Risk (VaR) are computed from company-level equity losses • The estimation is strengthened using **bootstrapping** over 15,000 samples • Assessment of the **underestimation** of climate-adjusted risk metrics from neglecting tail risk and asset-level data