ETH zürich

Weather and Climate Risks

CIRED

Compound impacts of extreme weather events on European supply chains

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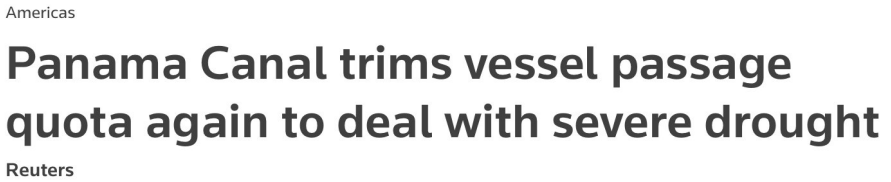
Image source: https://www.esri.com/about/newsroom/arcnews/the-eye-after-the-hurricane/

Supply chain disruptions



Research questions

- Which events cause most indirect impacts to Europe?
- Can seemingly unrelated events lead to compounding impacts in Europe through supply chain?
- What characteristics do these events have?
- Can modelling tools be used to increase our understanding of these systems?

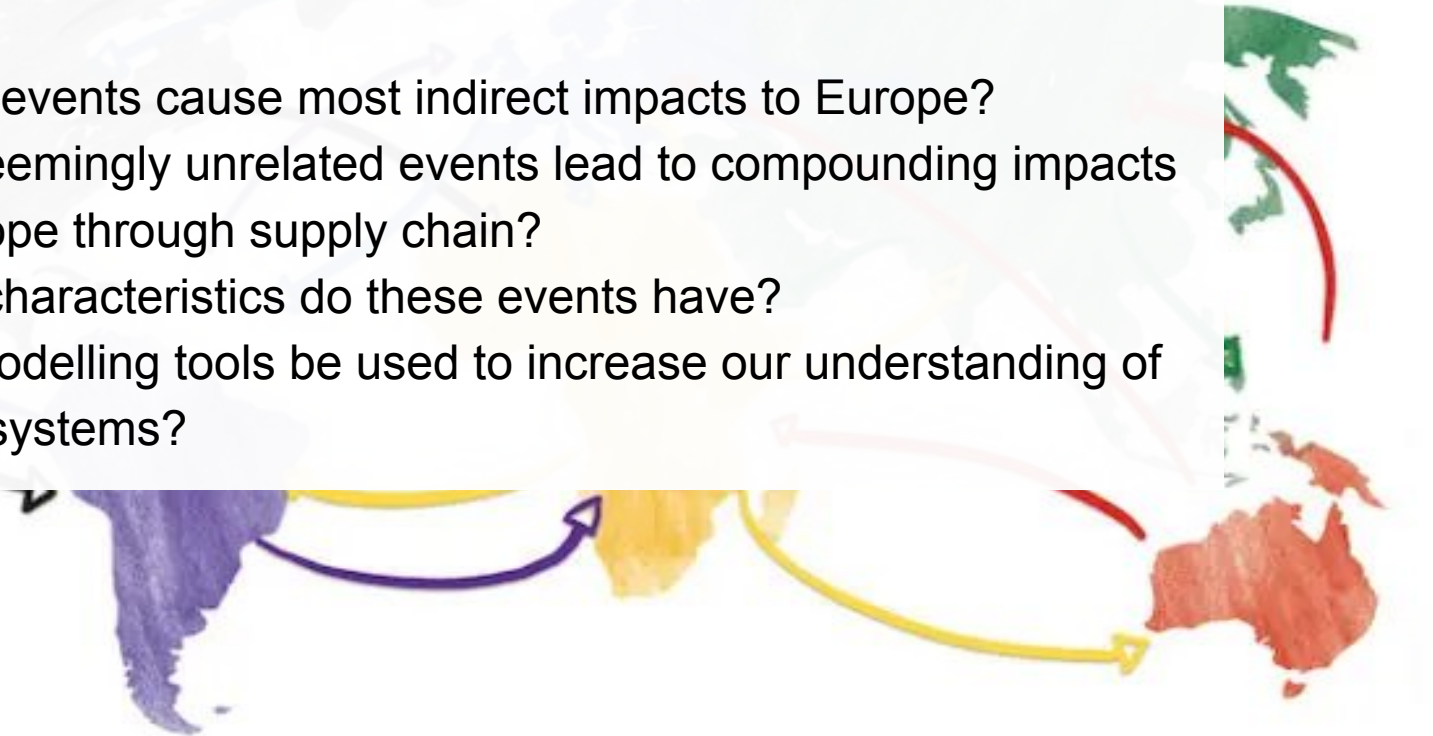


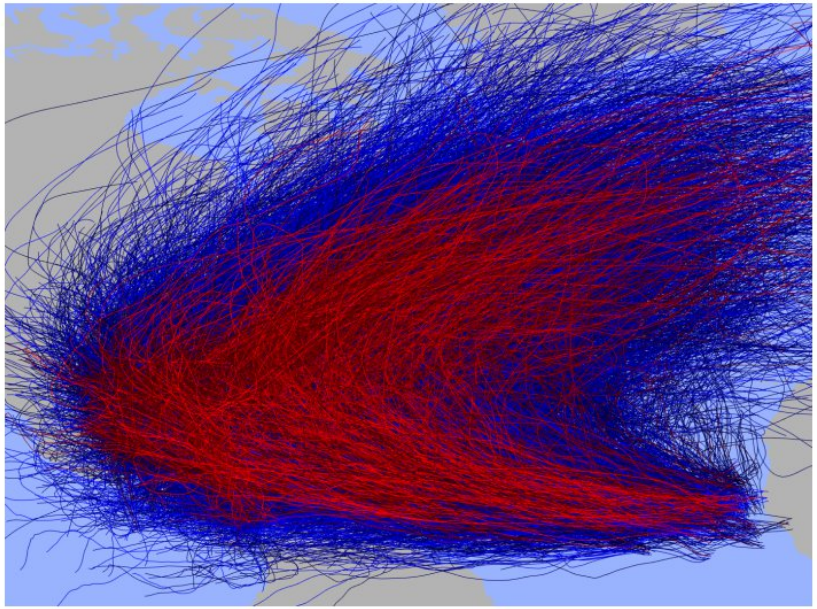
Image source: https://cepr.org/voxeu/blogs-and-reviews/globalisation-doomed

Methods

Tropical cyclone modeling

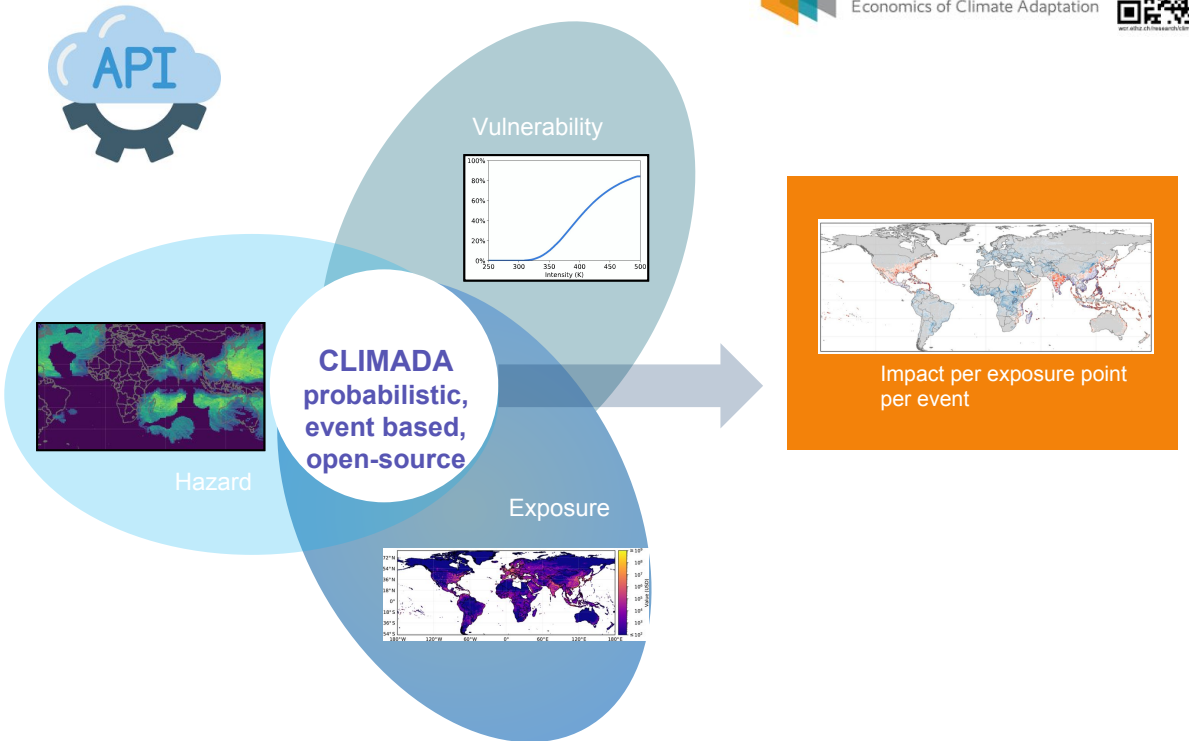
historic
~100 years

probabilistic
~10‘000 years



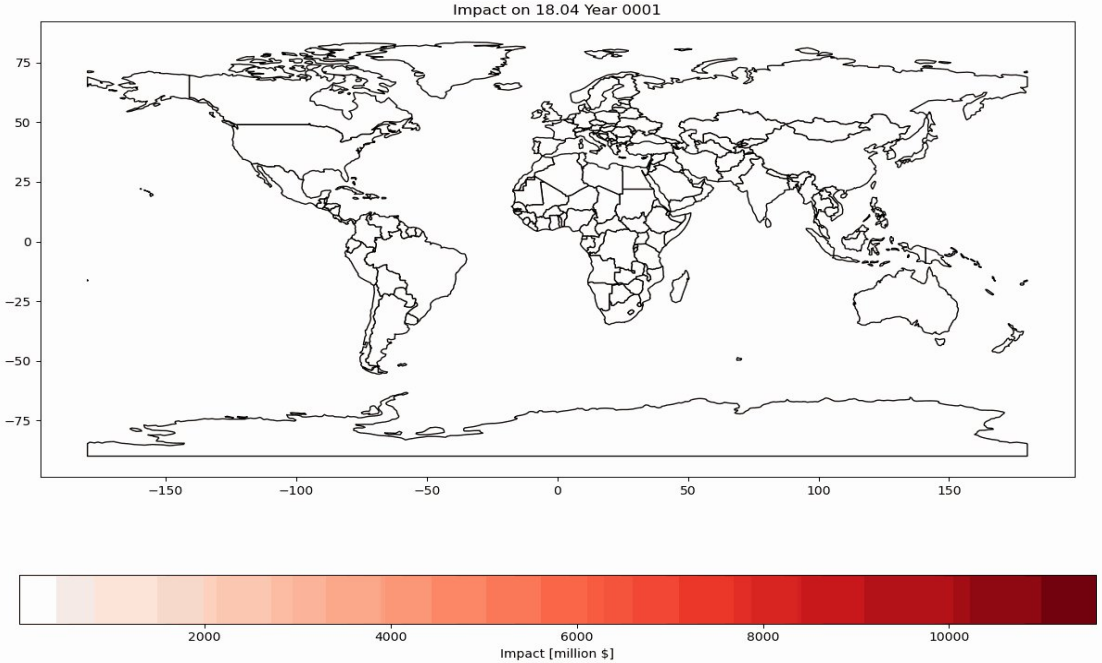
100 samples of 5 years
Focus only on North Atlantic and West Pacific (most exchanges with Europe)

CLIMADA framework

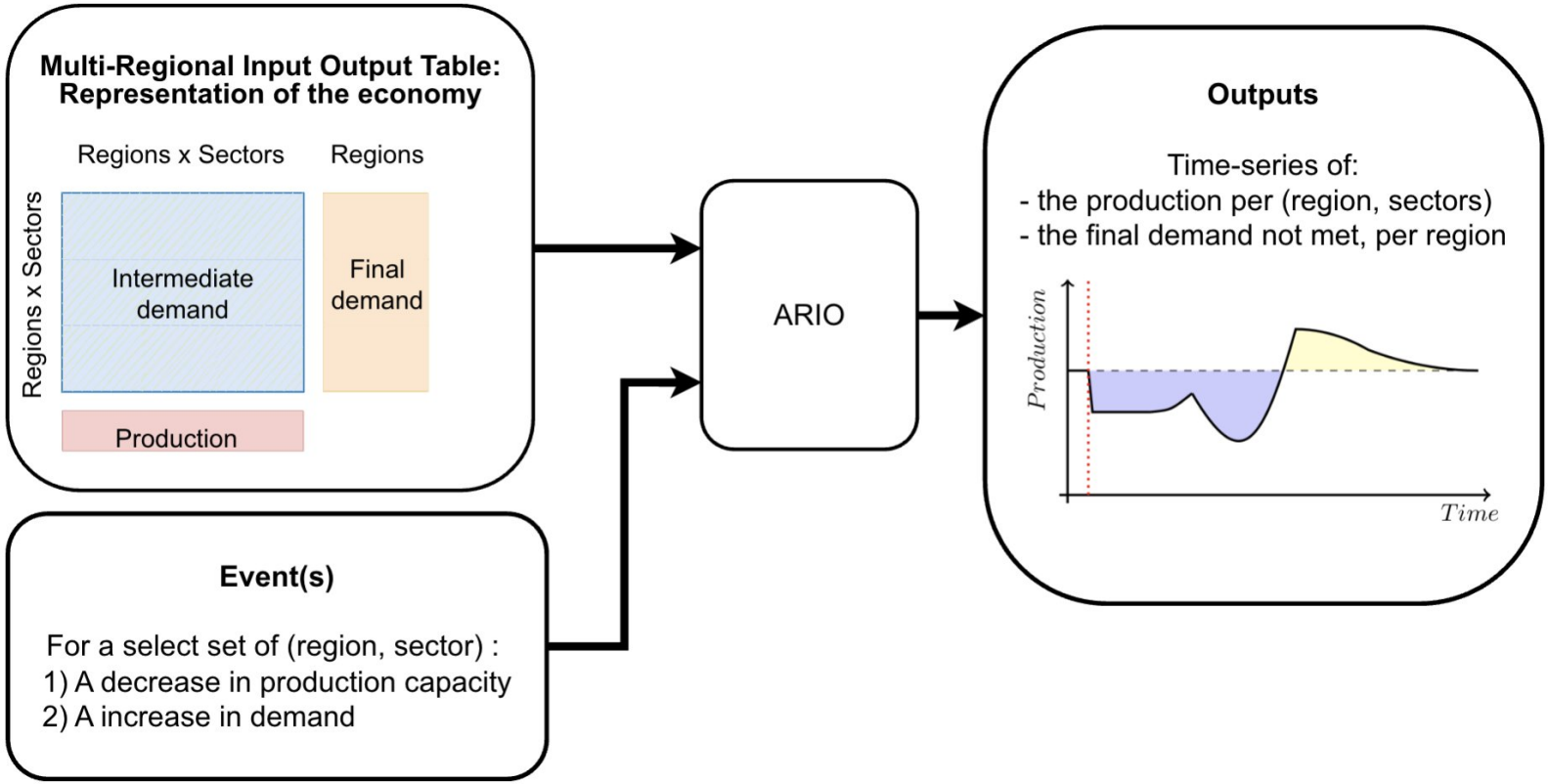


Eberenz, S., Stocker, D., Röösli, T., and Bresch, D. N.: Asset exposure data for global physical risk assessment, Earth Syst. Sci. Data, 12, 817–833, https://doi.org/10.5194/essd-12-817-2020, 2020.
Eberenz, S., Lüthi, S., and Bresch, D. N.: Regional tropical cyclone impact functions for globally consistent risk assessments, Nat. Hazards Earth Syst. Sci., 21, 393–415, https://doi.org/10.5194/nhess-21-393-2021, 2021

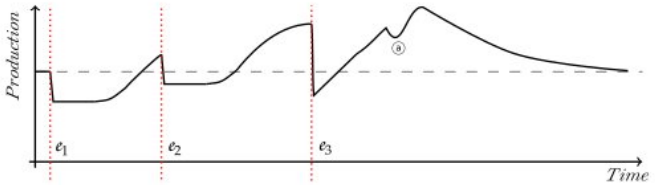
Direct impacts by country - BoARIO input for one sample



BoARIO

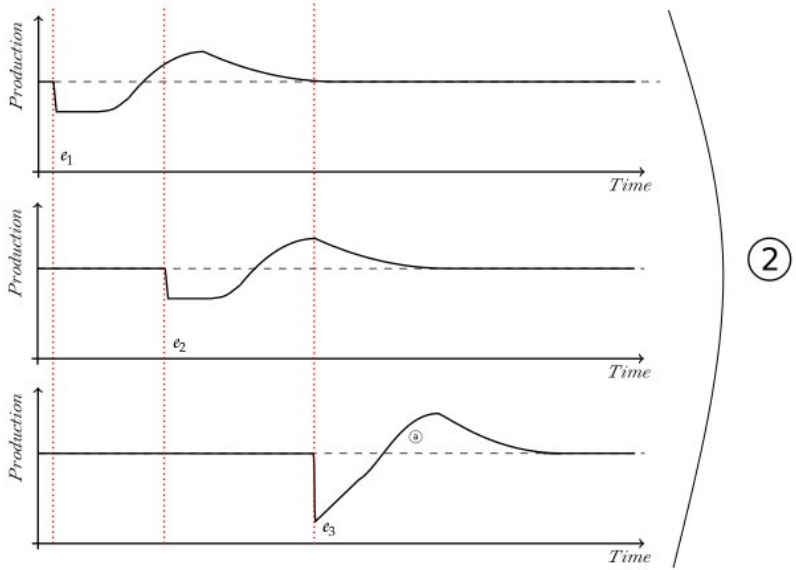

Multi-Regional Input Output Table:
Representation of the economy
Regions x Sectors
Regions
Regions x Sectors
Intermediate demand
Final demand
Production
Event(s)
For a select set of (region, sector) :
1) A decrease in production capacity
2) A increase in demand
ARIO
Outputs
Time-series of:
- the production per (region, sectors)
- the final demand not met, per region
Production
Time

Analysing the interaction of events



1

1) Indirect impacts of events are calculated together → interaction between events is considered

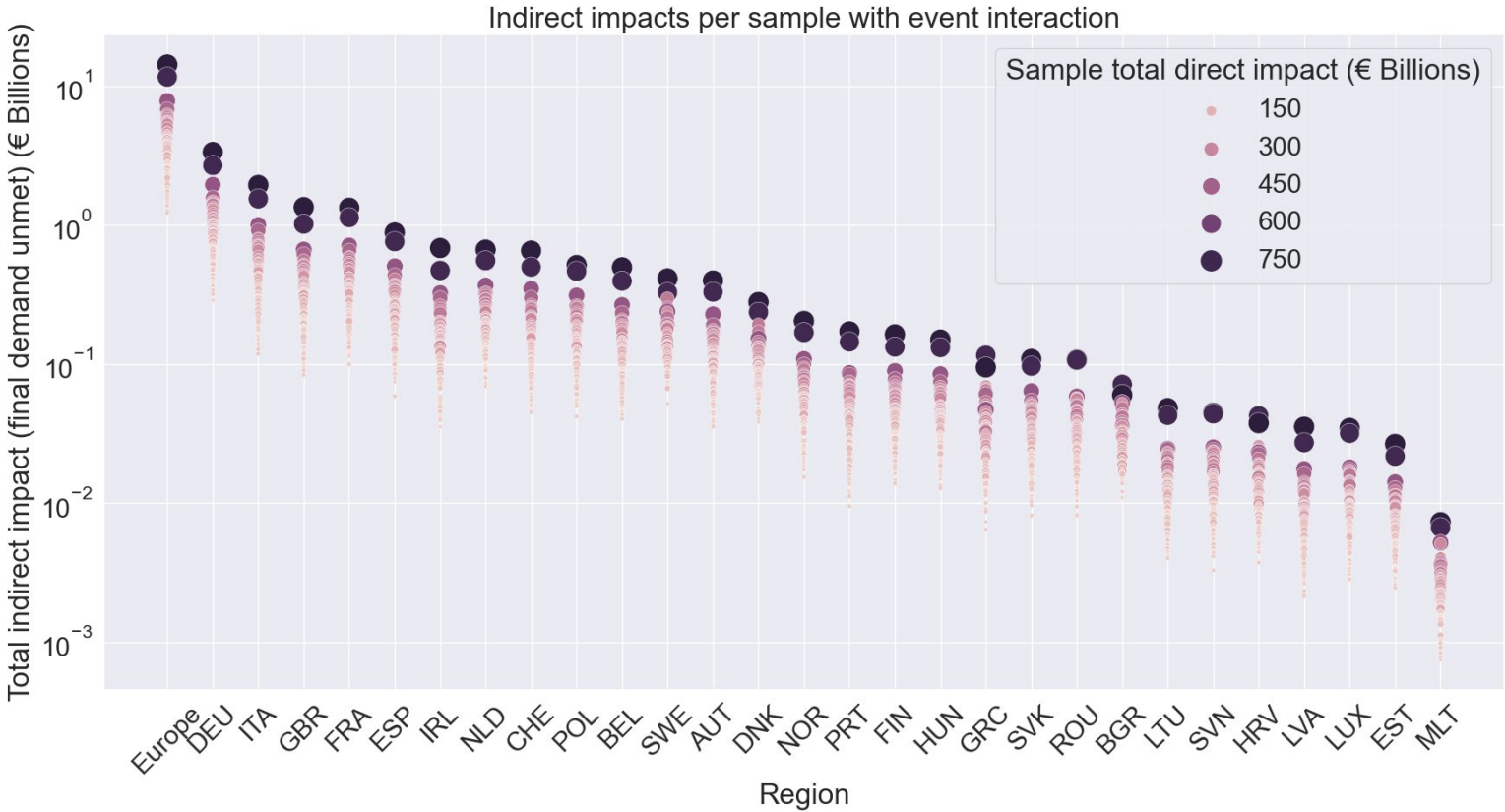


2

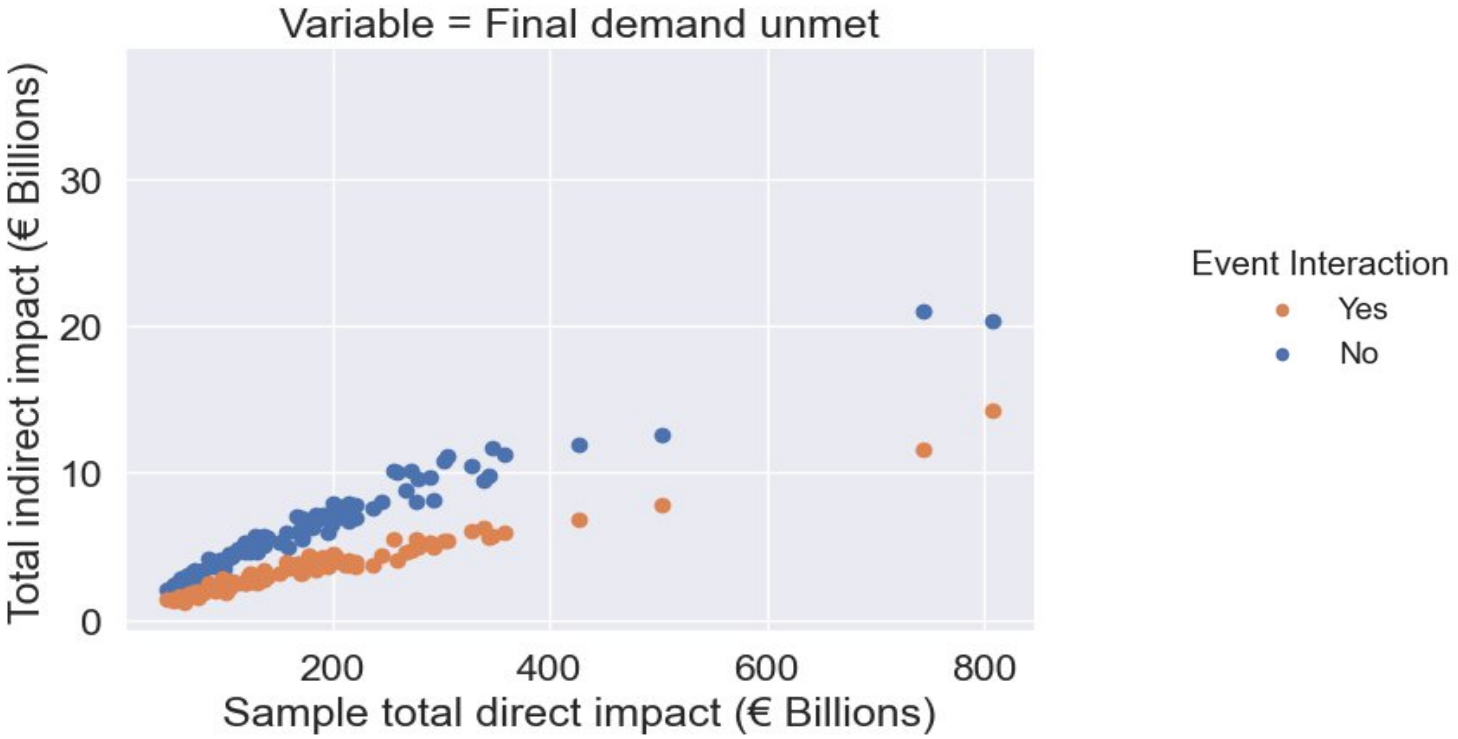
2) Indirect impacts of events are calculated separately

Results

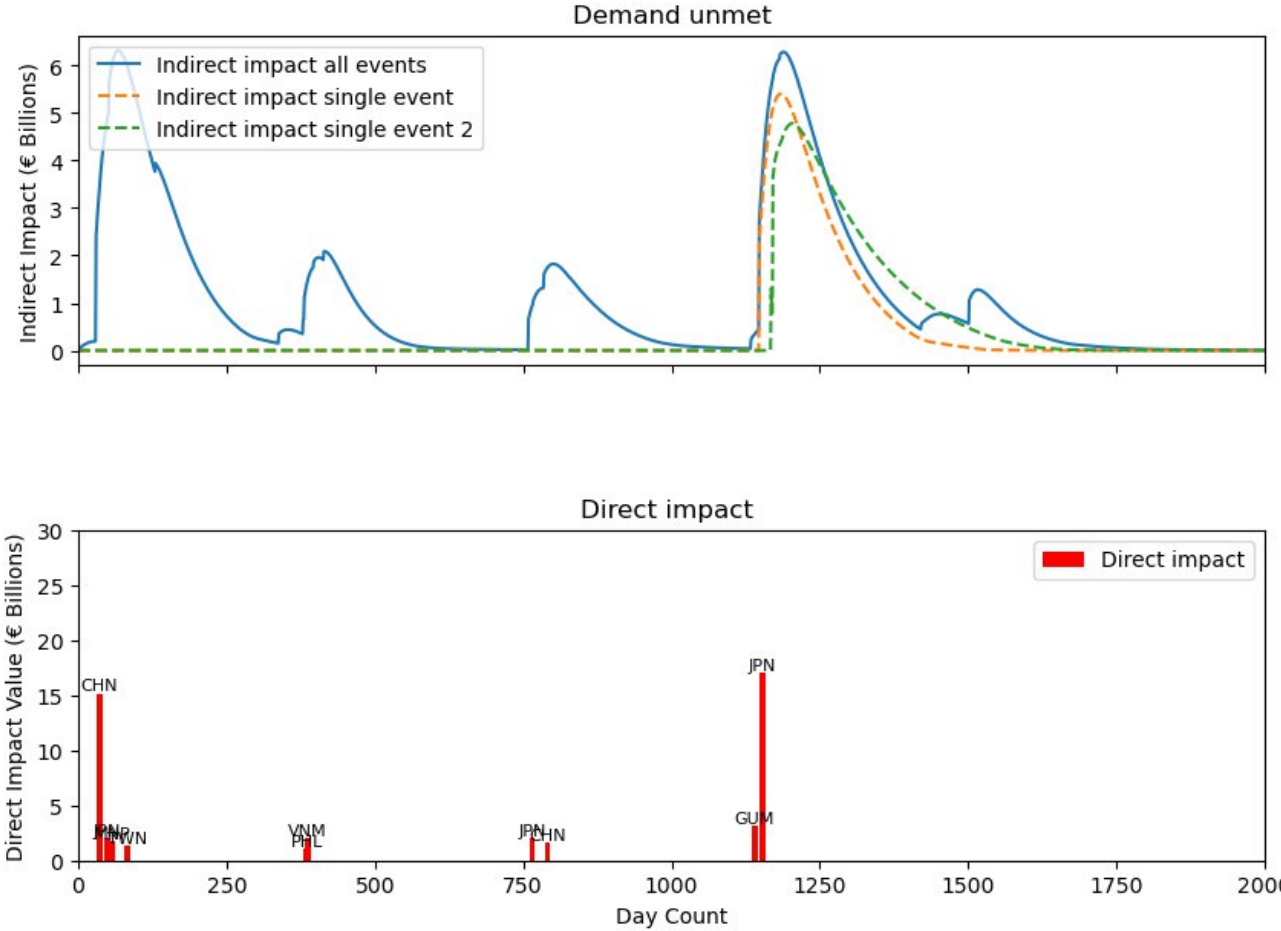
Direct vs indirect impacts per sample



Effect of considering event interaction



Effects of all events together vs one event



Conclusion and outlook

- Coupling of open source impact model and supply chain model
- Interactions of events can be observed
- Interactions mainly lead to positive effects in Europe
- Limitation: only macro-economic effects
  - Impacts are very small relative to the economy of large countries
    → Some bottlenecks may not be represented
- Opportunity:
  - improve representations of critical supply chains and economic sub-regions affected
  - Effect of climate change & multi-hazards

Contacts

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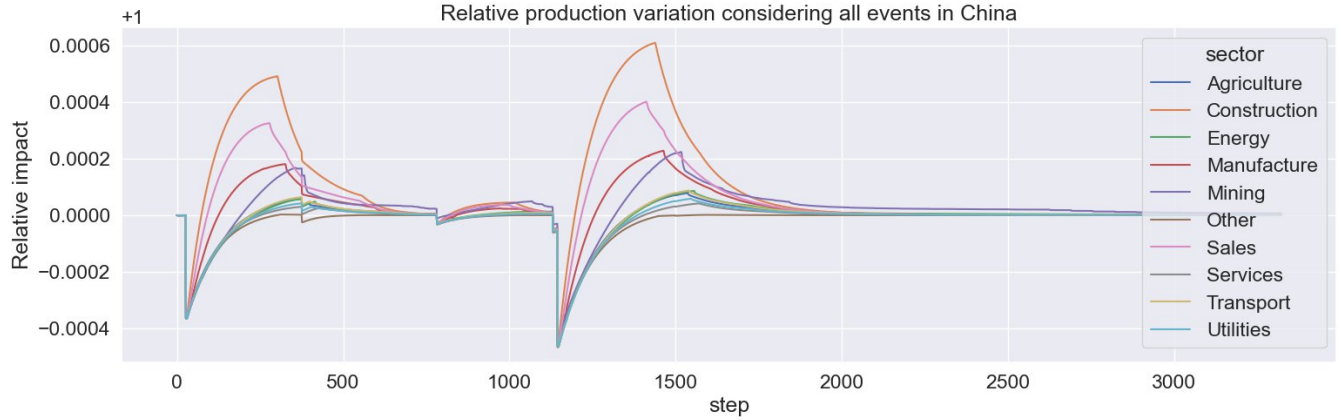
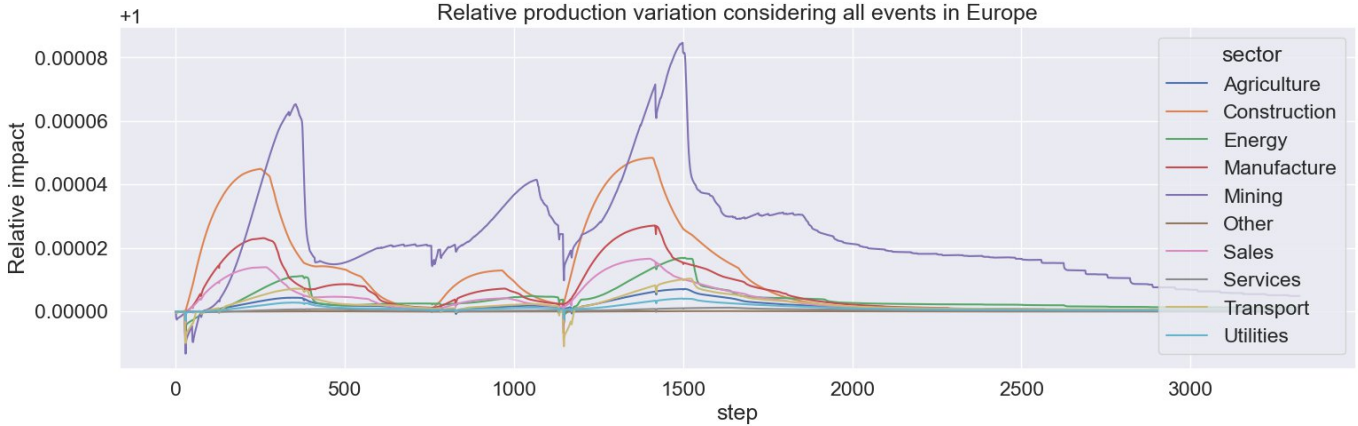
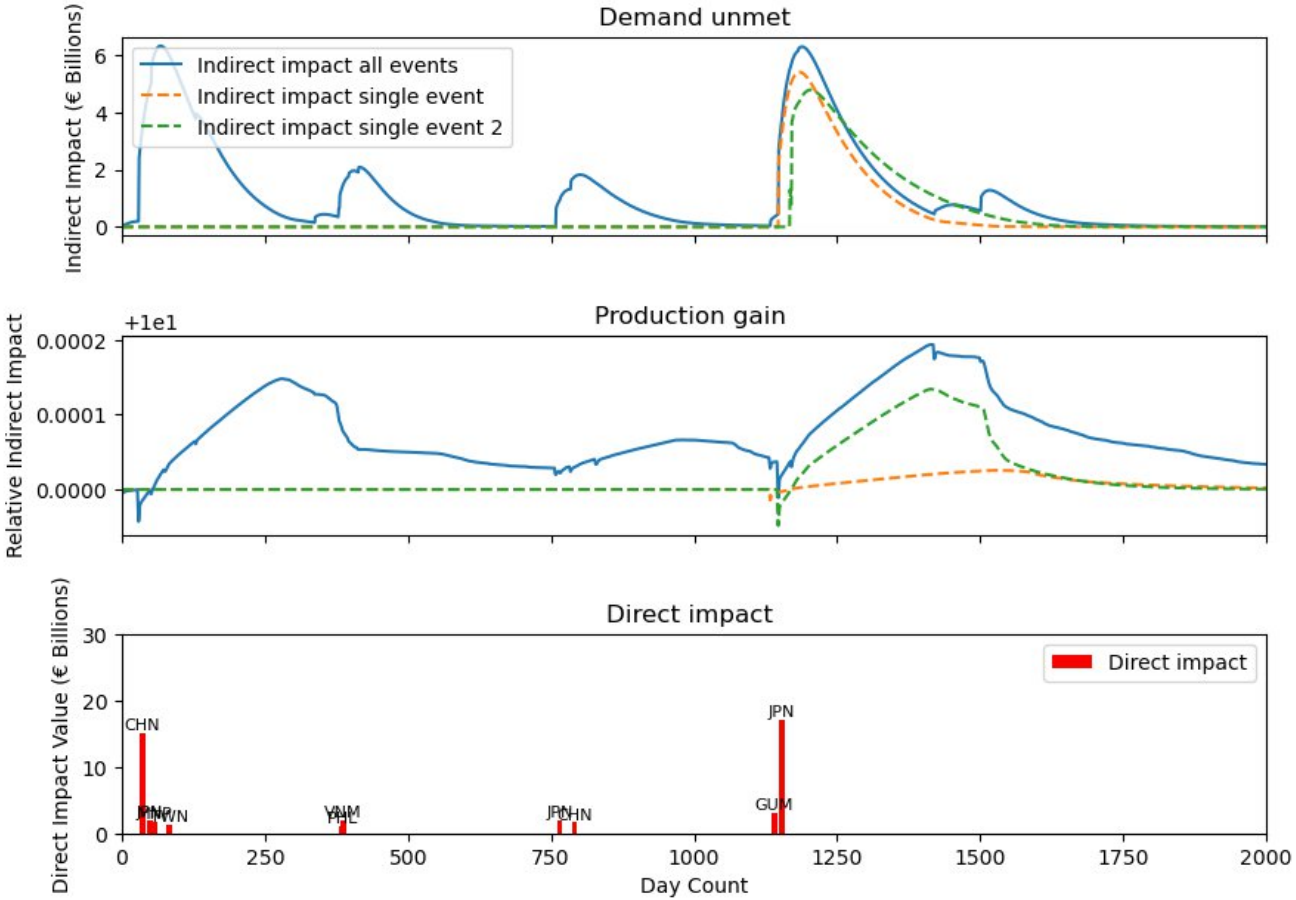
Indirect impacts China

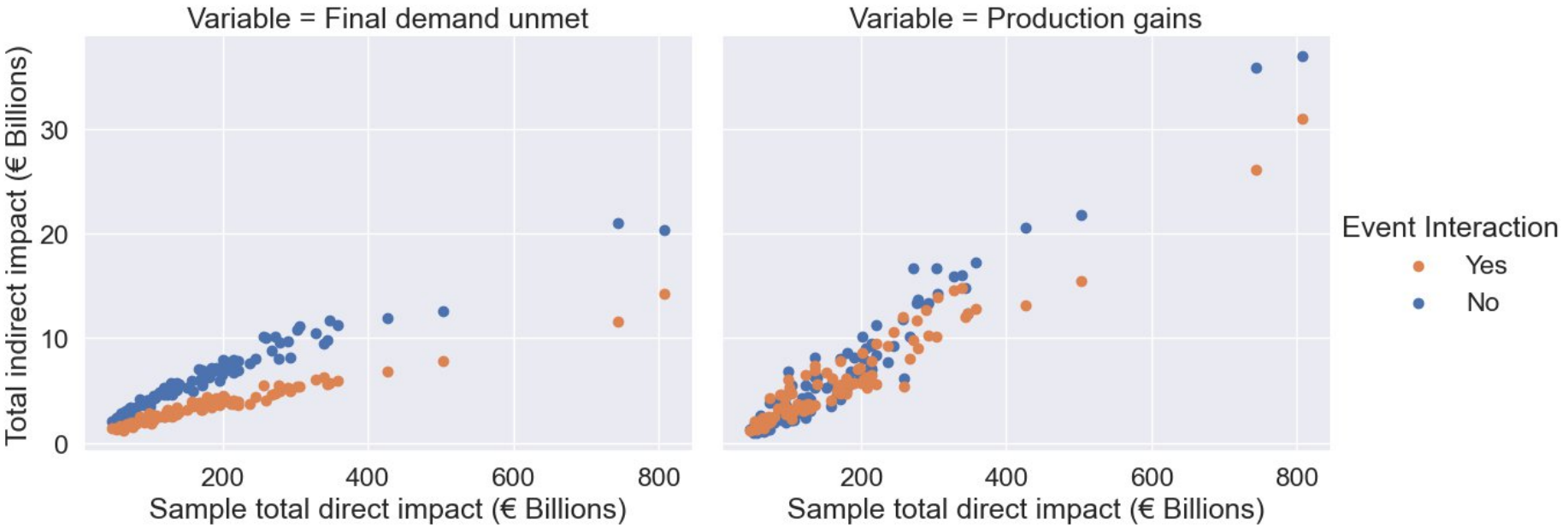




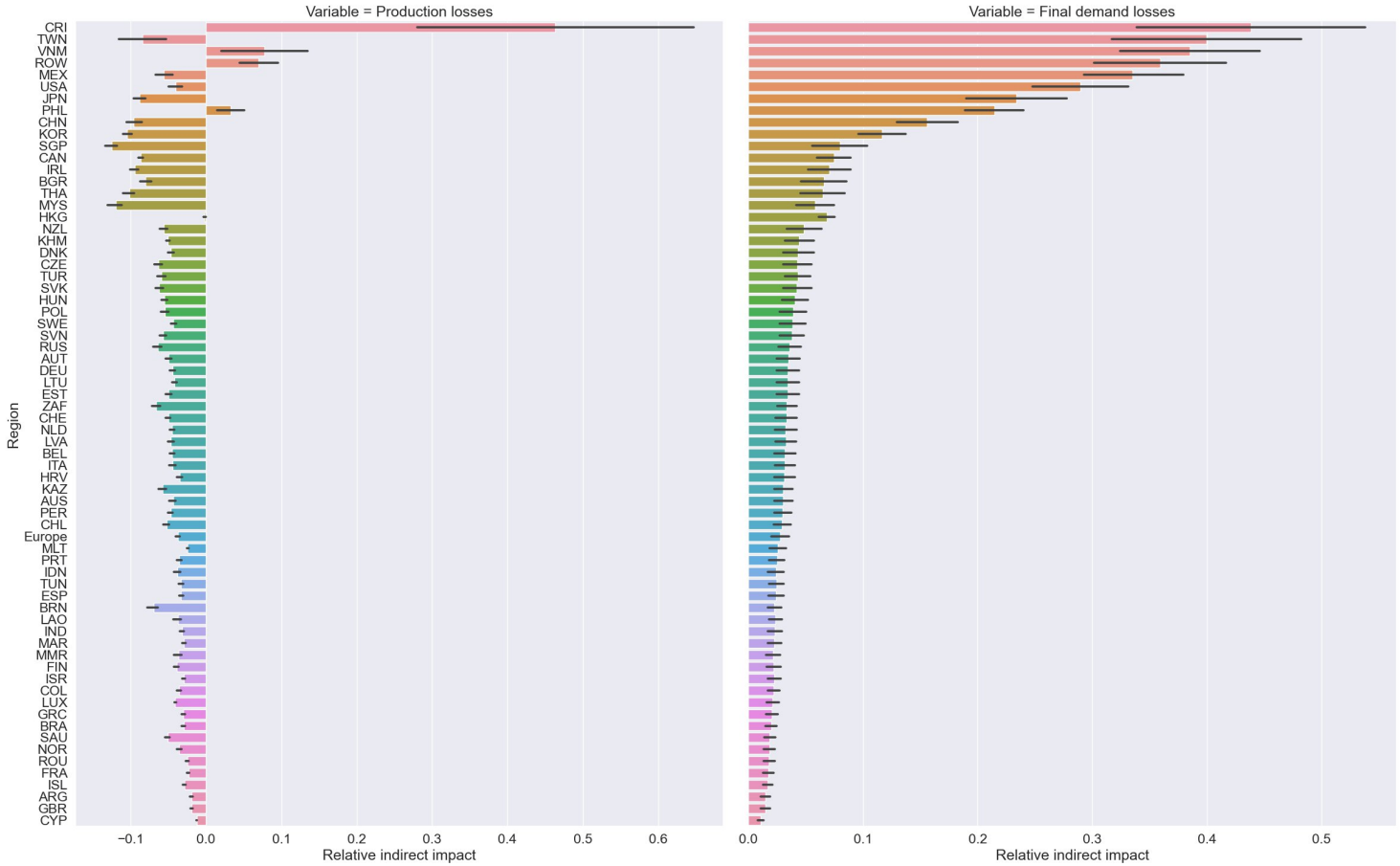
Effects of all events together vs one event



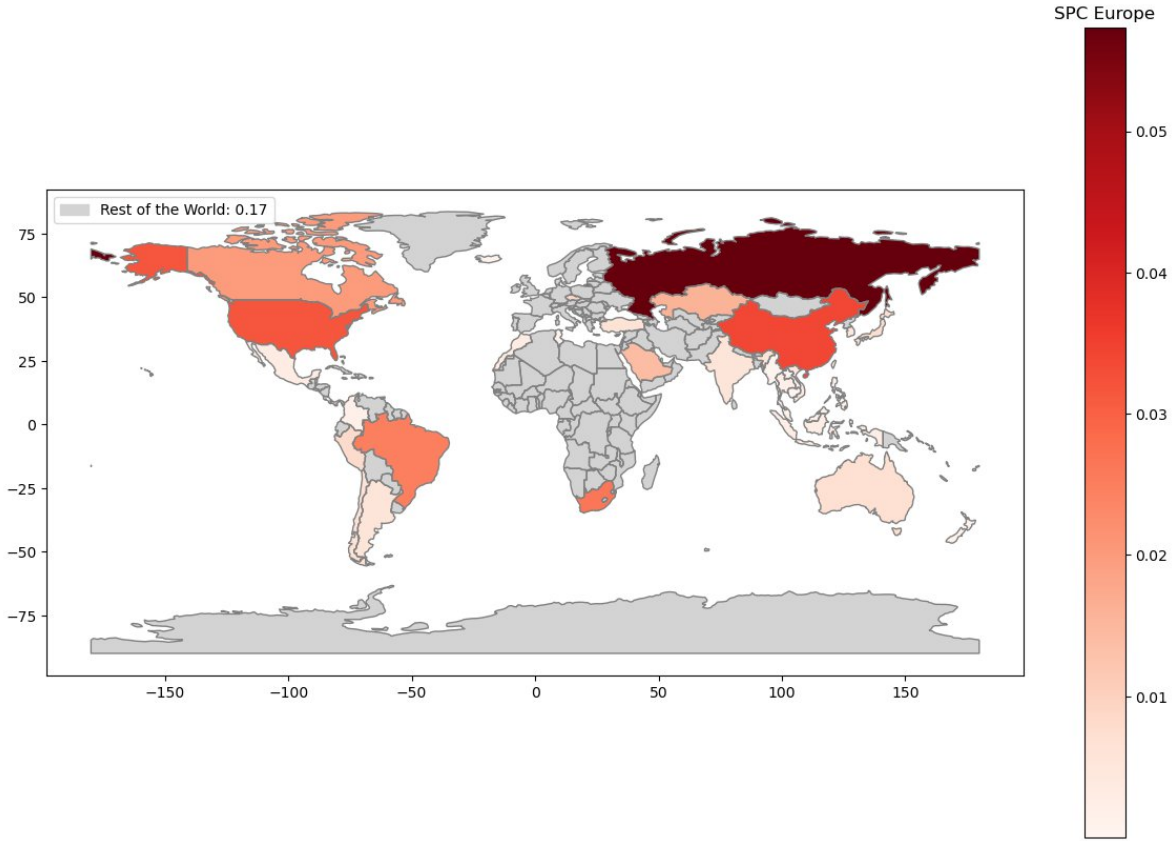
Effect of considering event interaction



Indirect impacts by region



SPC Europe


SPC Europe
Rest of the World: 0.17
75
50
25
0
−25
−50
−75
−150
−100
−50
0
50
100
150
0.05
0.04
0.03
0.02
0.01