

Compound Events: The COST Action DAMOCLES



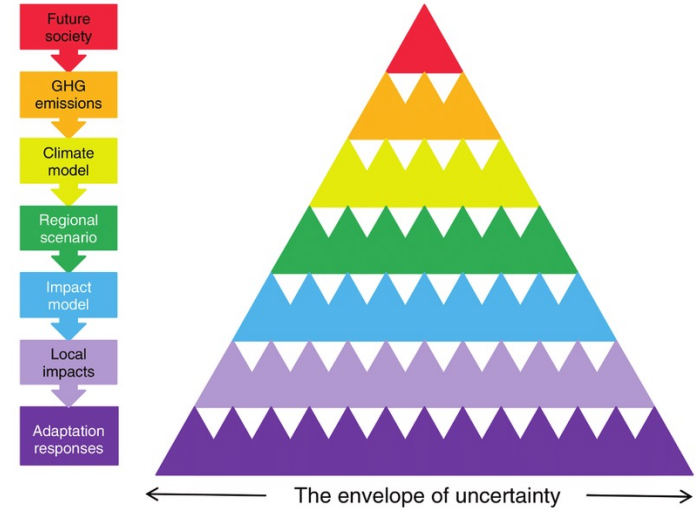
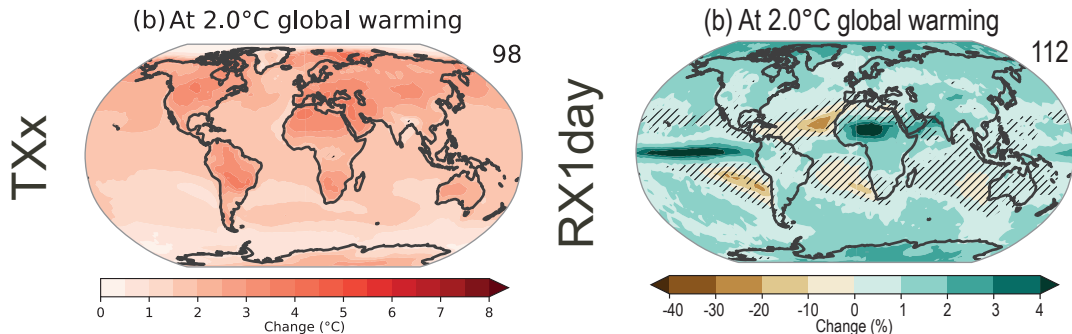
Jakob Zscheischler

Department of Computational Hydrosystems
Helmholtz Centre for Environmental Research (UFZ) Leipzig, Germany
EDORA Drought Workshop, 16-17 June 2022, JRC, Ispra

Traditional approaches to climate risk

Projection of extremes

- Warmest day of the year (TXx)
- Maximum daily precipitation (RX1day)
- Maximum length of dry spell
- Frequency of heat waves
- Intensity of droughts
- ...



Top-down modelling chain

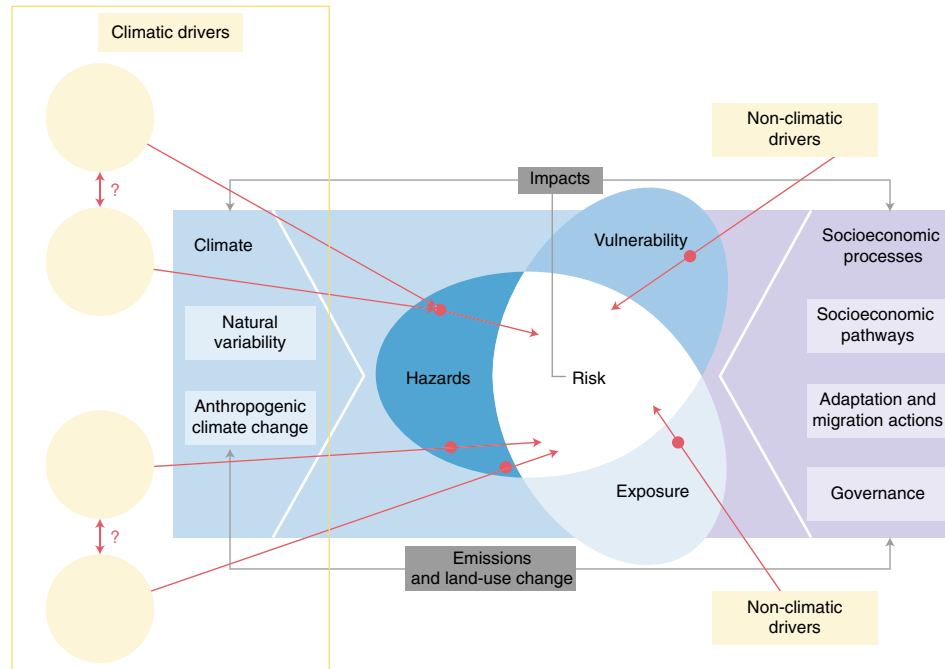
Limitations of the traditional approach

- Impacts are rarely driven by a single climate extreme
- Limited knowledge on
 - which weather conditions lead to impacts
 - dependence between climate impact drivers
 - whether climate models simulate climate impact drivers well
 - whether impact models simulate (multivariate) climate-impact relationships well



What is a compound event?

“Compound weather and climate events refer to the combination of multiple drivers and/or hazards that contributes to societal or environmental risk.”



Definition
used in the
IPCC AR6

What is a COST Action?

- Bottom-up network funded by the European **C**ooperation in **S**cience and **T**echnology (COST)
- Many different purposes, e.g. create new connections between previously unconnected actors across Europe (e.g. scientific disciplines, industry, governance)
- Funds workshops, training schools and short-term scientific visits
- COST Action DAMOCLES: *Understanding and modeling compound climate and weather events*, running from 9/2018-9/2022

COST Action DAMOCLES

Understanding and modeling compound climate and weather events

Benefit of a scientific approach
Way of interaction

Criteria for usefulness
Event-impact relationships

Classification of events
Compendium of methods

Criteria for usefulness
Applied to what kind of hypothesis?

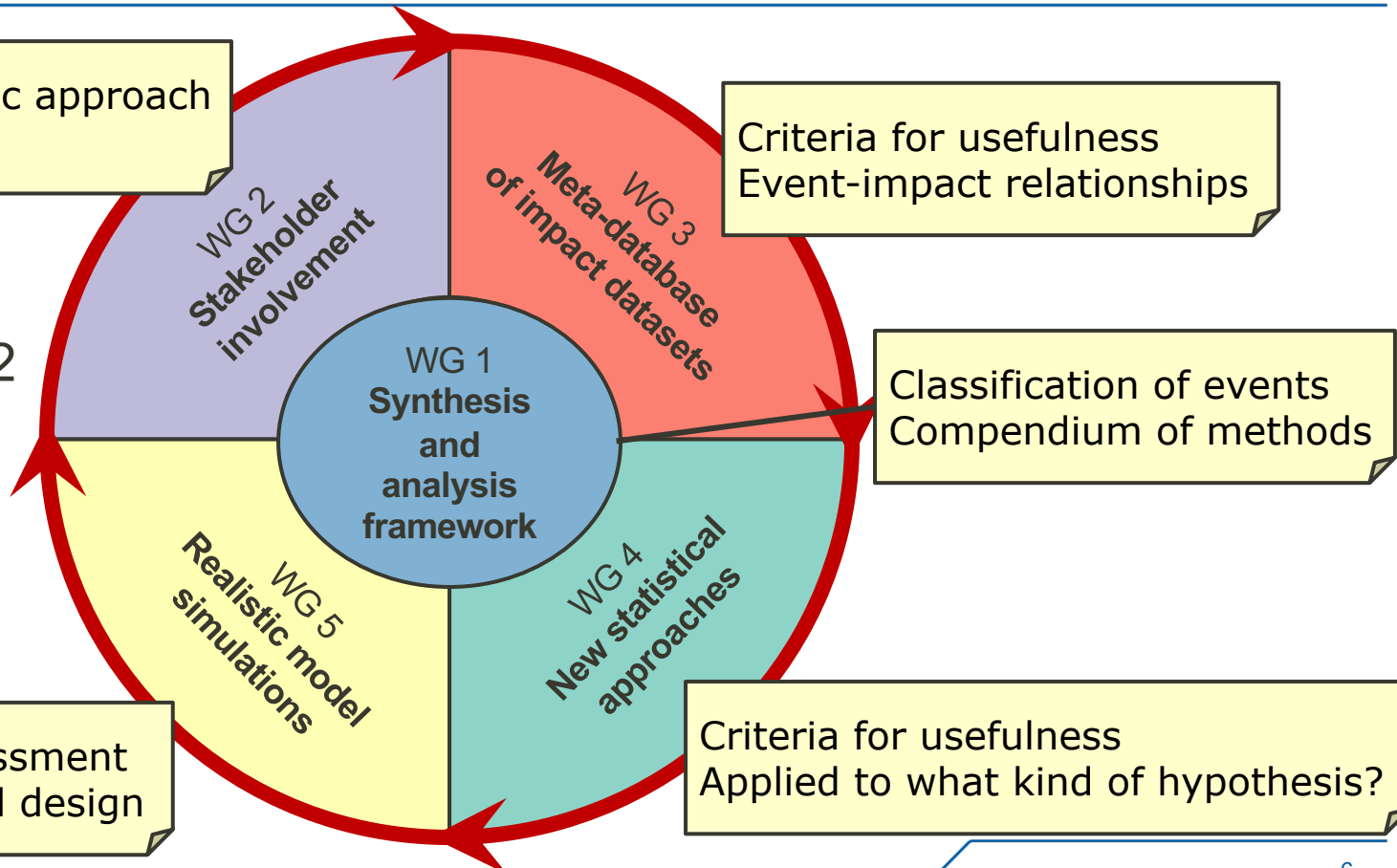
Quality assessment
Experimental design

9/2018 – 9/2022



38 countries

Chair: J.Z.



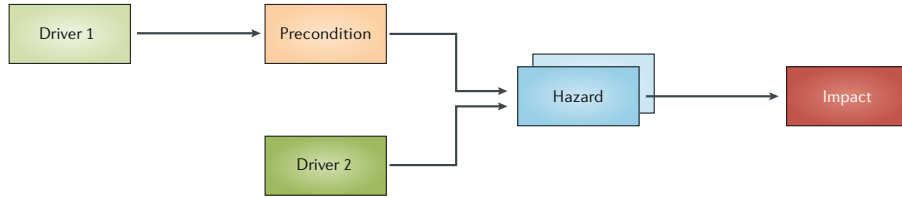
A typology of compound events

Why?

- Can help structure our thinking on high-impact events
- Can help select/develop appropriate analysis tools for a given event type
- Can trigger synergies between different impact communities for which similar event types are relevant

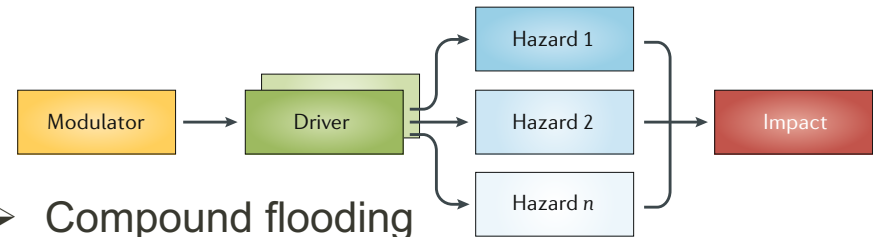
A typology of compound events

Preconditioned events



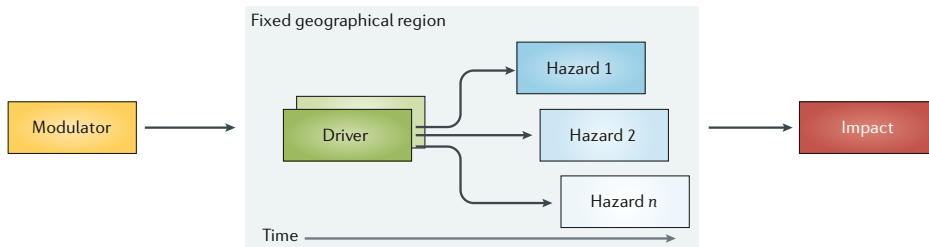
- False spring
- Rain-on-snow flood

Multivariate events



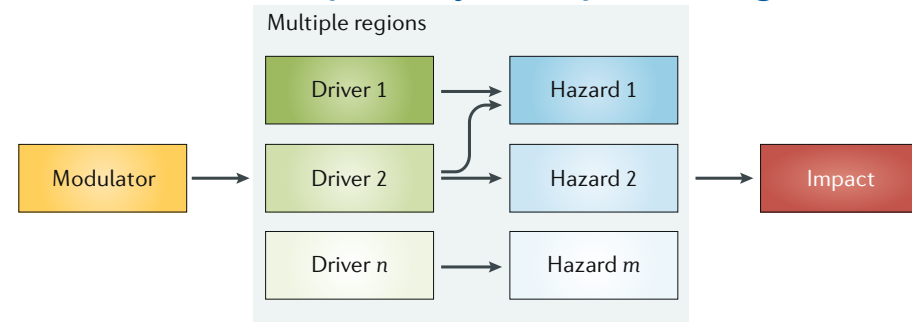
- Compound flooding
- Concurrent drought & heat
- Concurrent wind & precipitation extremes

Temporally compounding events



- Sequence of storms/heavy precip. events
- Cyclone followed by a heatwave

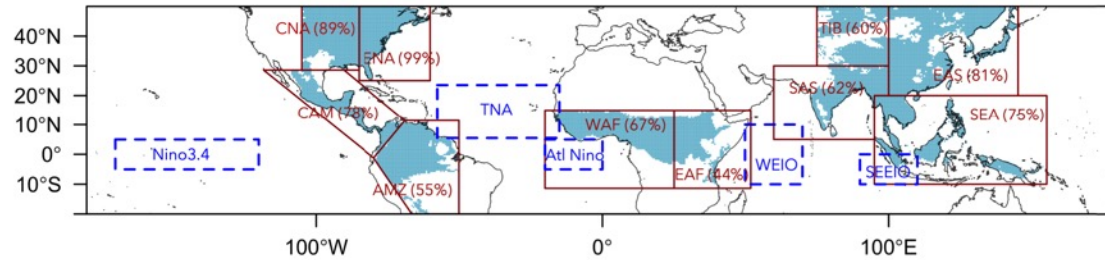
Spatially compounding events



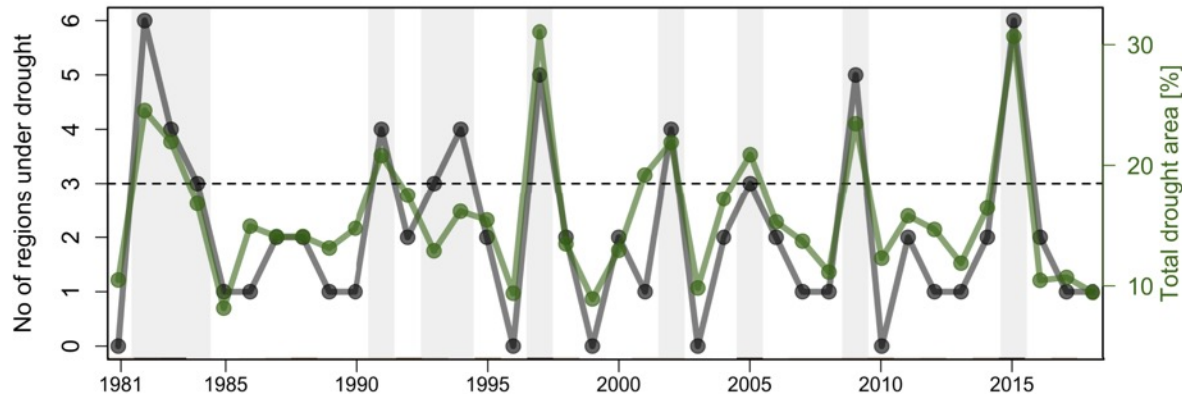
- Global crop failure

Spatially co-occurring droughts

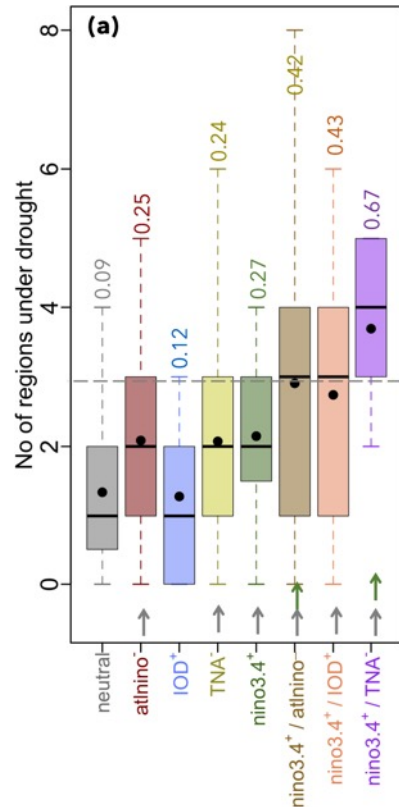
(a) SREX regions



(b) Compound drought characteristics



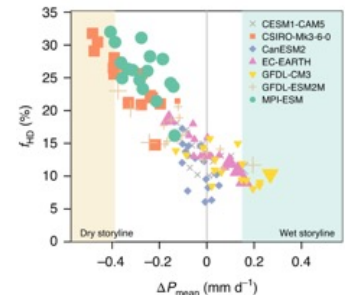
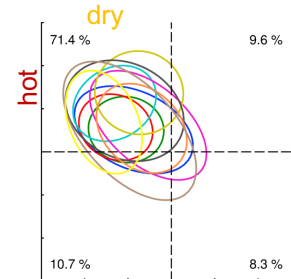
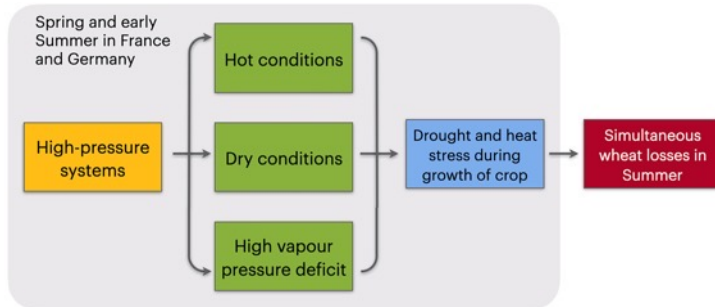
...associated with concurrent modes of climate variability



Concurrent El Niño and cold phases of the Tropical North Atlantic lead to many concurrent droughts

Guidelines for compound event analysis

- Causal diagrams allow communication between fields
- Employ impact-centric perspective to identify potential drivers, e.g. via composites
- Use physically-based modelling for future projections and disentangling complex driver contributions
- Event-based storylines to explore plausible worst-case scenarios
- Soft boundaries between types, depending somewhat on the research question



Conclusions

- Viewing climate impacts through a "compound event" lens leads to new research questions relevant for climate risk assessment
- Compound event research aims to develop a new paradigm to better understand and project climate risk
- The compound event typology can help select and develop suitable analysis techniques to better understand complex high-impact events