# Understanding and Managing Cascading Disasters

## A Framework for Analysis

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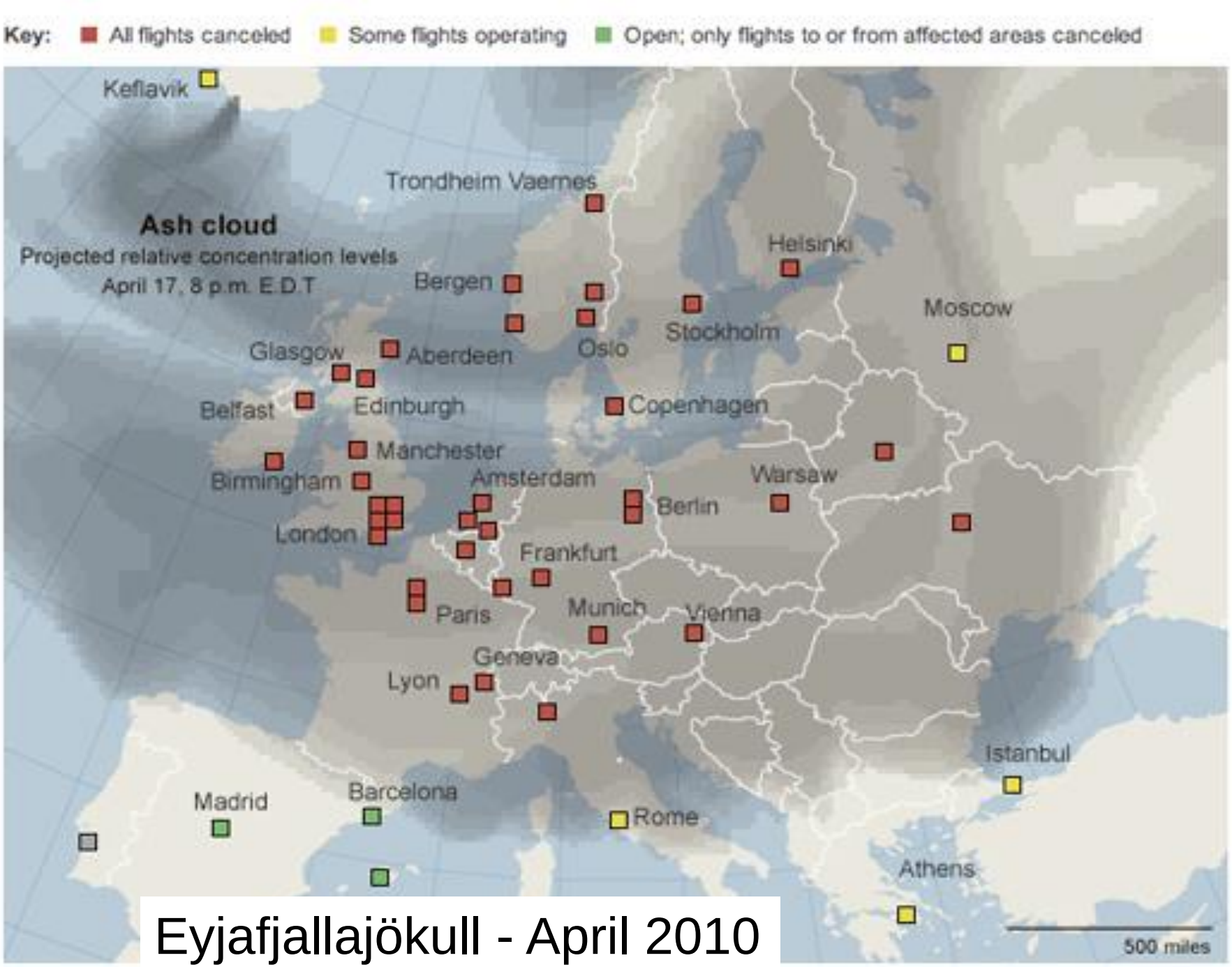
Rigopiano, 18 Jan. 2017

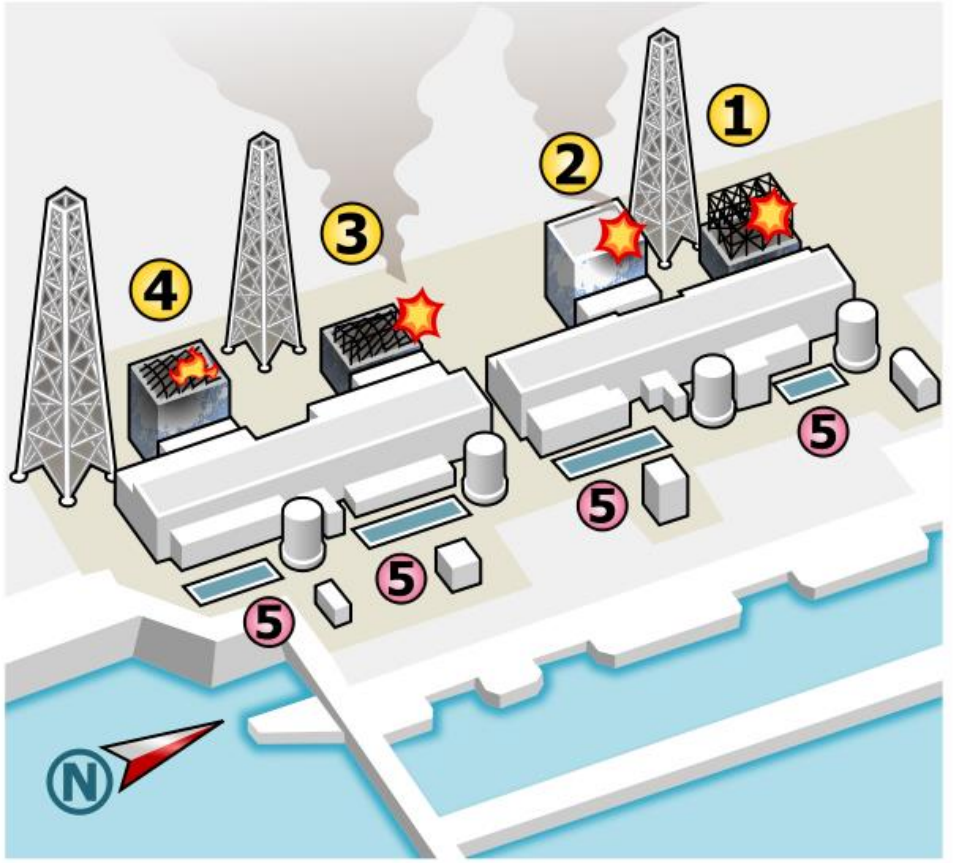
# Central Italy, January 2017: Connected Events


Campo Felice, 24 Jan. 2017


Power outage after Superstorm Sandy 2012




Eyjafjallajökull - April 2010

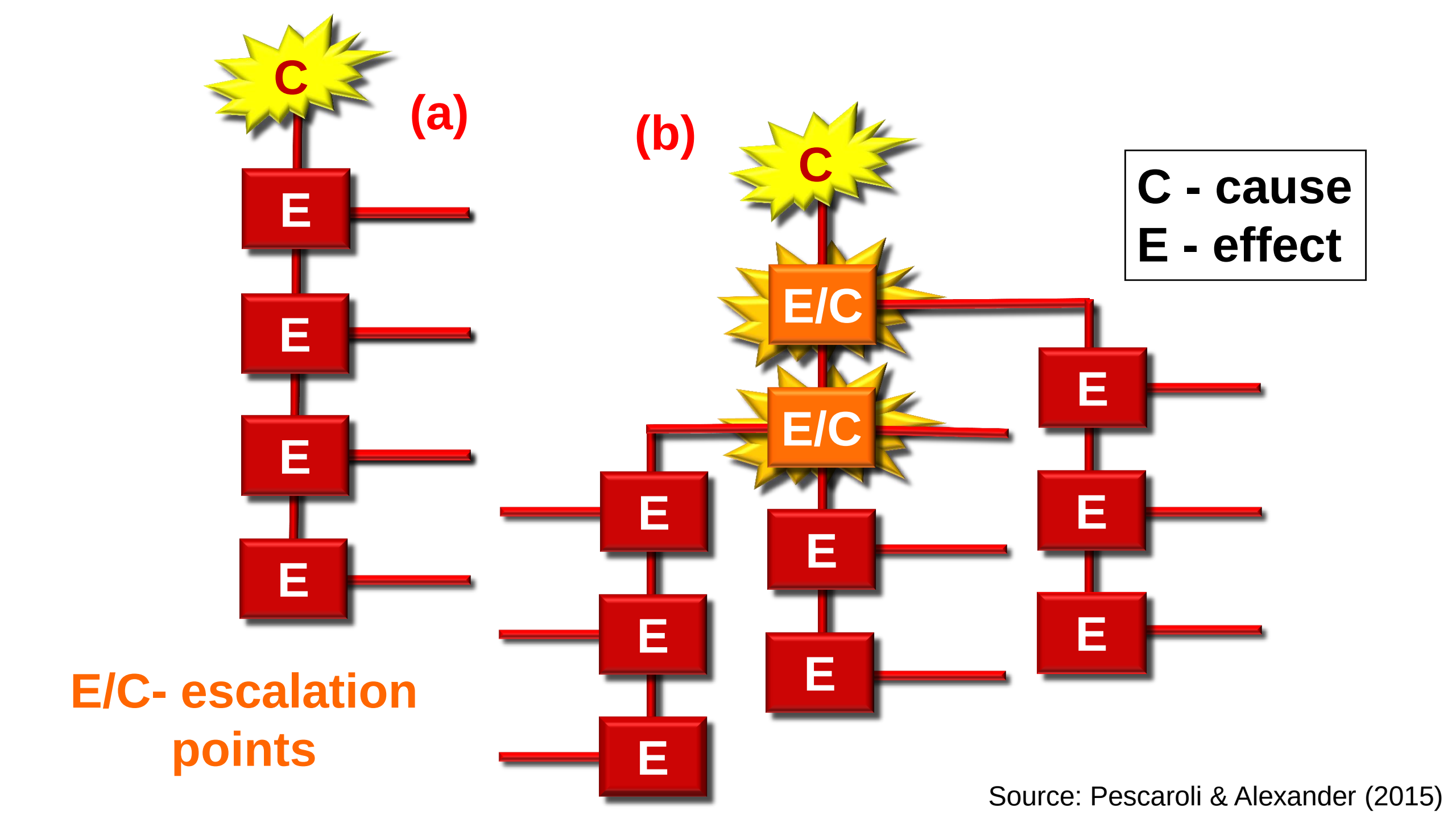



# Triple disaster in Japan March 2011

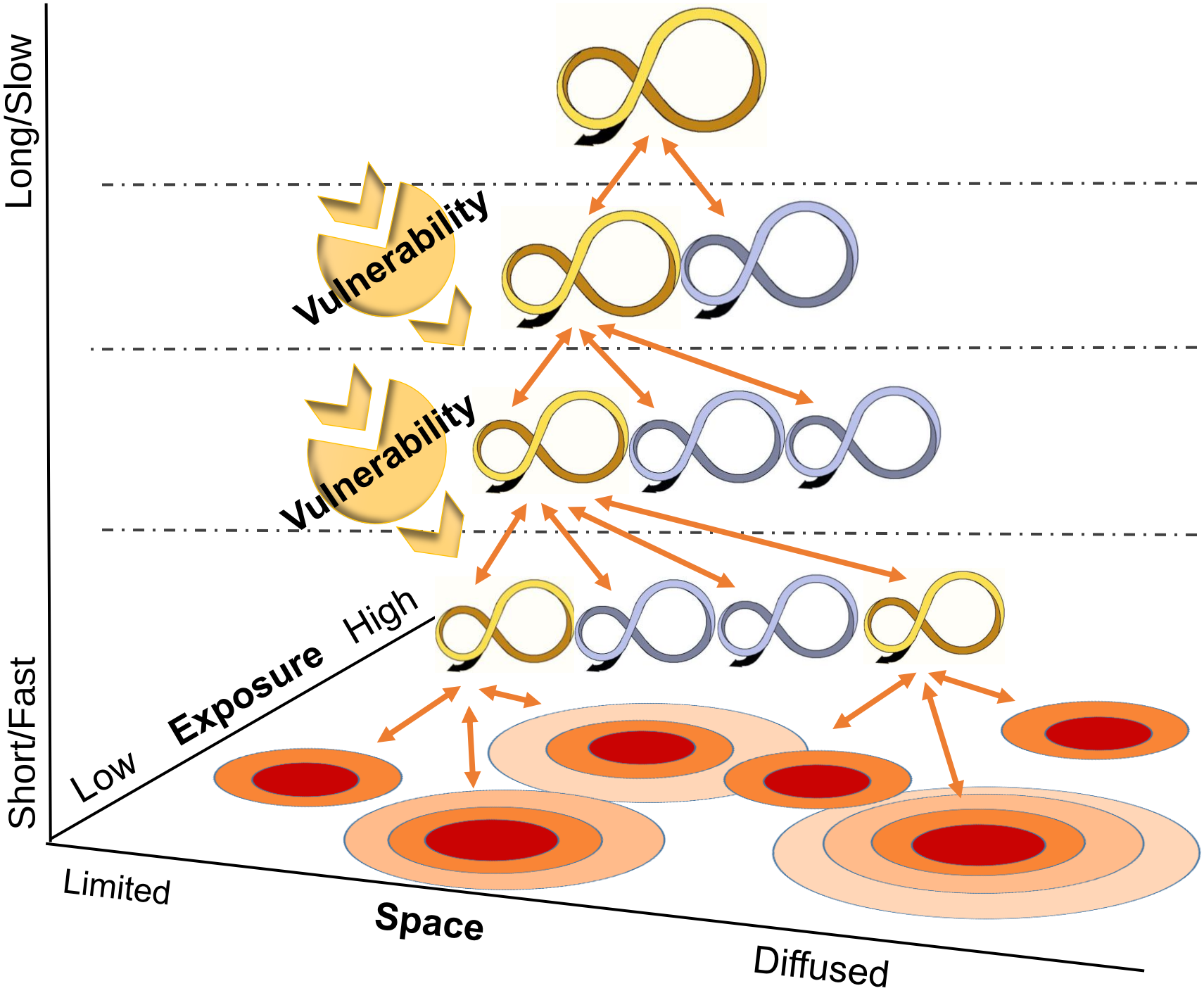
# Cascading disasters

**[crises, emergencies]**
**are negative events that involve:-**

- a primary impact (the trigger)
- chains or networks of consequences
- secondary impacts
- complex vulnerabilities interacting
- escalation points
- (usually) complex impacts upon critical infrastructure.




Source: Pescaroli & Alexander (2015)

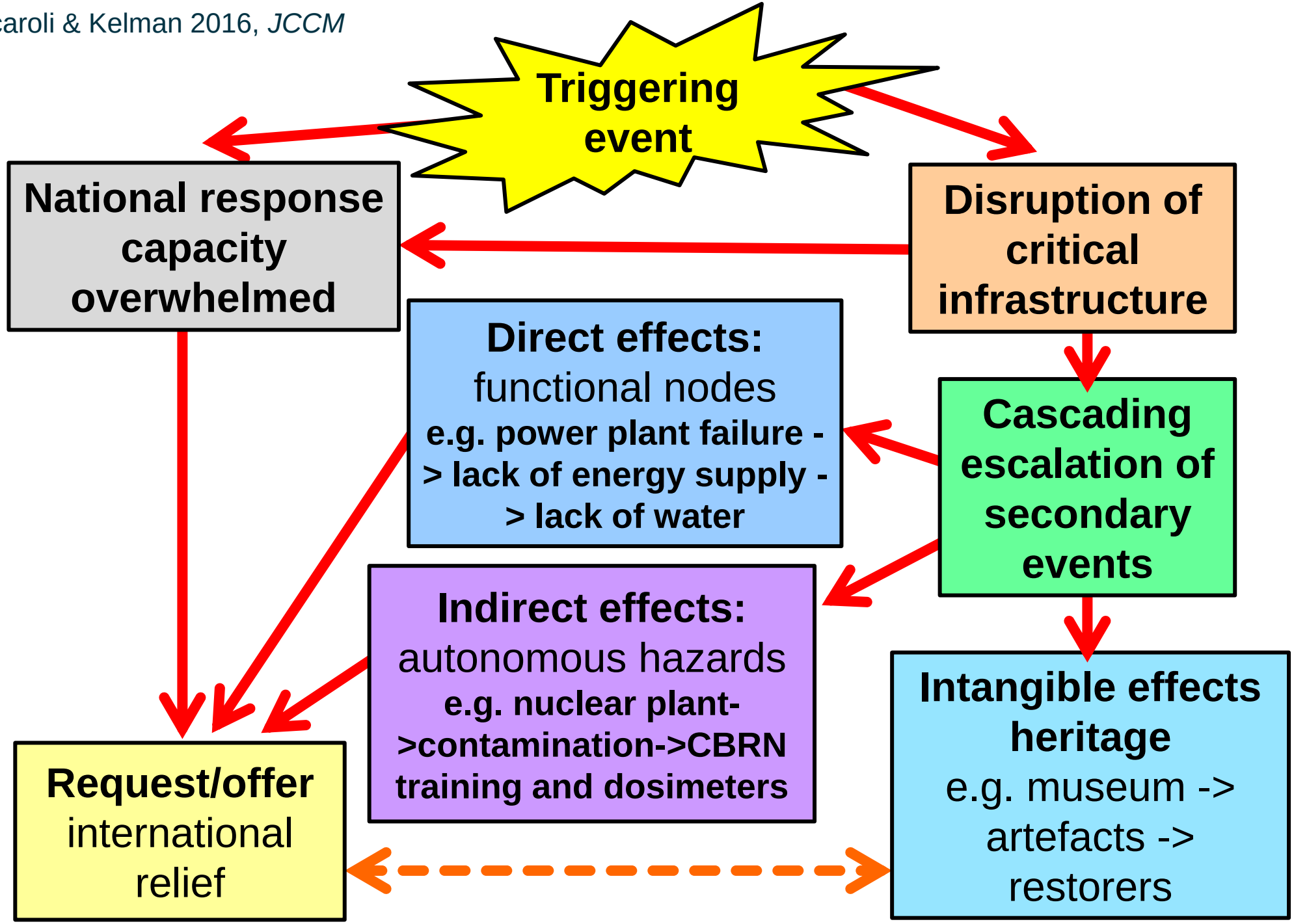



Source: Pescaroli & Alexander (2016)

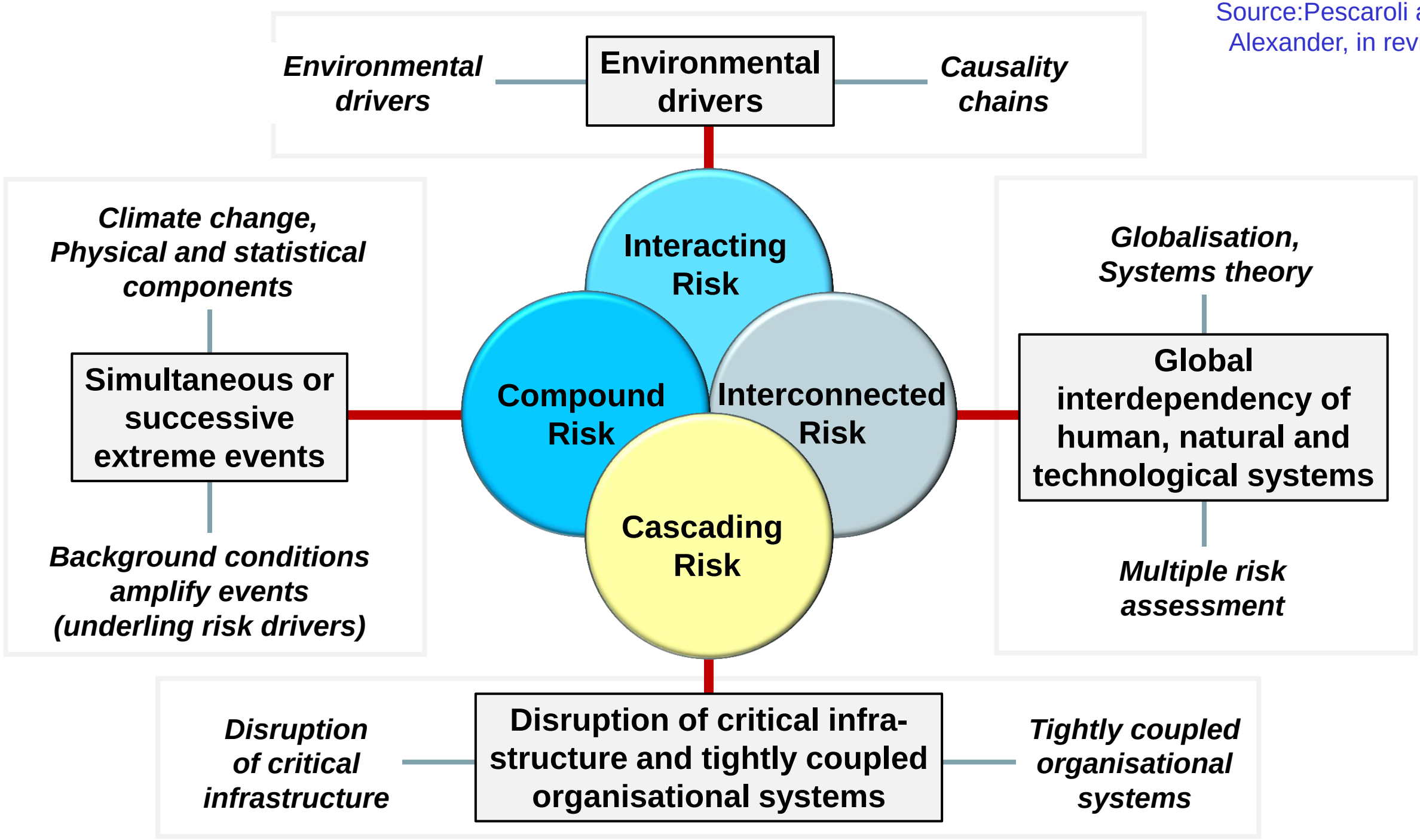
# Balancing vulnerability and resilience

- current knowledge about the concepts of vulnerability, threat and risk
- current knowledge about the concept of resilience
- human organisation in crisis situations
- gap analysis and resilience matrix
- interactions between resilience and vulnerability: theoretical model.

Source: Pescaroli & Kelman 2016, *JCCM*



Source:Pescaroli and Alexander, in review



# Magnitude classification of cascading incidents, crises and disasters

**Level 0 - Simple incident or major incident.**
No significant cascades or escalation points.

**Level 1 - Major incident of limited complexity.**
Simple, short cascades as secondary effects of the starting impact.

**Level 2 - Major incident or small disaster, some complex consequences.**
Limited cascade chains propagate to tertiary levels.

**Level 3 - Disaster, with complex consequences.**
Significant cascade chains with at least one escalation point.

**Level 4 - Disaster, with substantially complex consequences.**
Easily identifiable cascades with escalation points.

**Level 5 - Catastrophe, with overwhelmingly complex consequences.**
Major initial impact sets off long causal chains of cascading consequences, some of which through escalation points generate secondary causal chains.

# Improving strategic level awareness of cascading risk

- from theory to practice: collaboration with London Resilience
- objectives: coordination of prevention; management and recovery of disruption
- two key areas: critical infrastructure interdependencies and power failures
- use of ANYTOWN model

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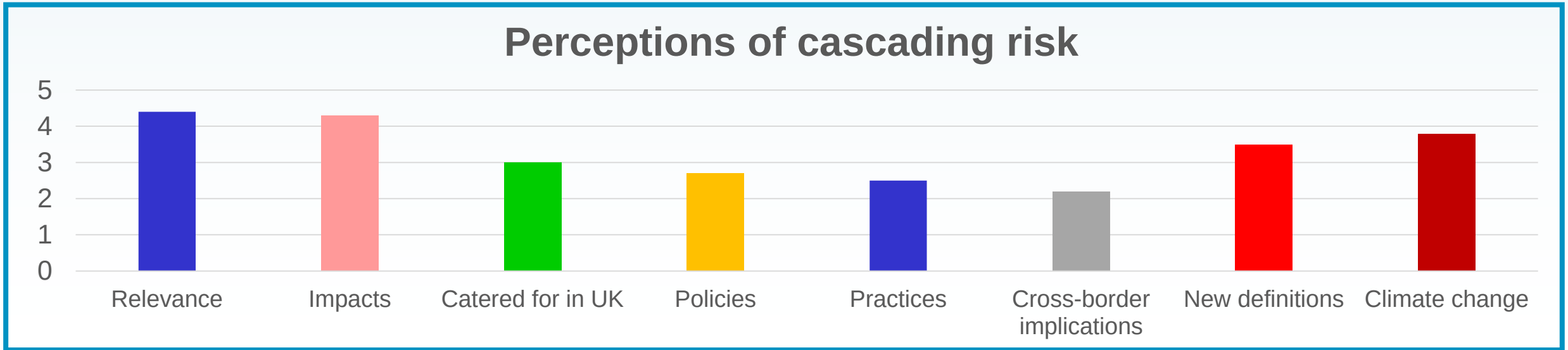
# Aims of the study

- to support the actions of policy makers with better data
- to identify gaps and priorities
- to verify whether cascading risks and critical infrastructure interdependencies are sufficiently well addressed in multi-agency planning
- to increase awareness among senior stakeholders.

# Preliminary results of a questionnaire survey (n=54)

- risk of cascading events perceived to be high
- could be connected to climate change
- cascading events involve significant risk of loss of life
- not sufficiently prioritised in policy and practice
- good levels of trust in contingency planning
- need to define thresholds ('tipping points') for decision making.

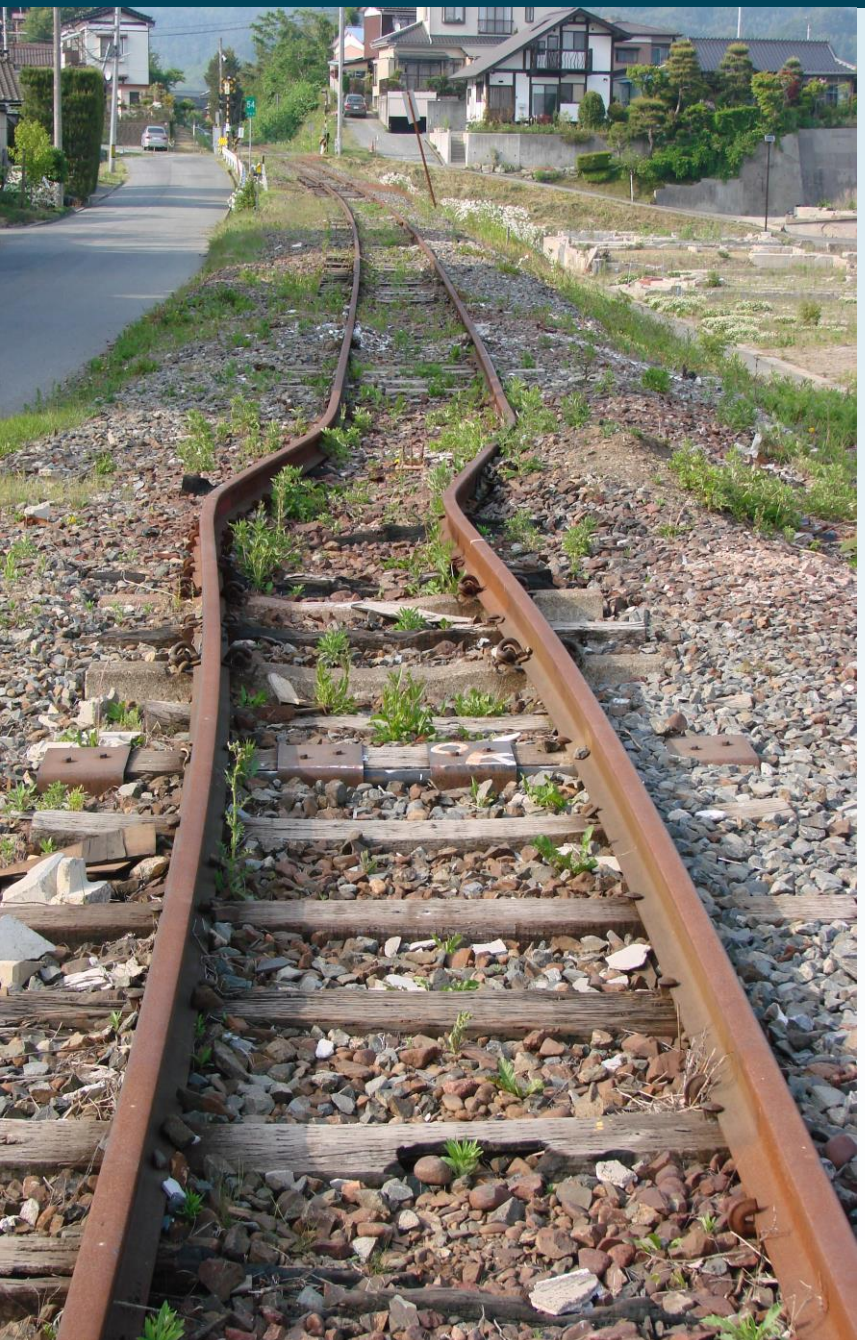


# Mitigation

- mitigation needs integration of maps and strong inter-modal cooperation
- big questions remain about major issues (e.g. energy supply failure)
- some scepticism encountered about decision support systems (DSS)

# Training

- training levels are better than expected, but need to be improved
- the best tools may be guidelines and table-top exercises.



# Conclusions

- society is complex: all disasters of a certain size will involve cascades
- more investigation of operational components is needed
- in preparation: *operational guidelines on cascading effects of power failures*
- we need to understand how people behave in cascading crises
- inter-institutional dialogue needs to be increased
- we need to investigate more case studies.

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# Thank you for listening!

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