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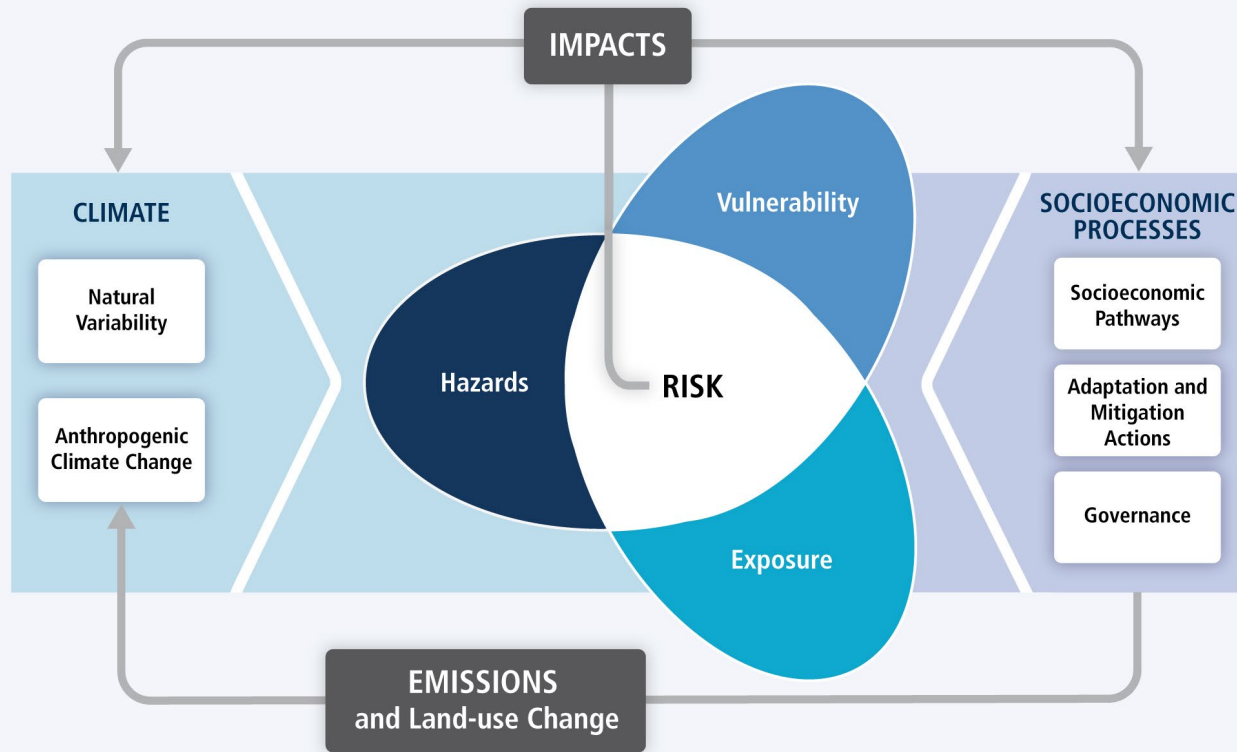
Framing complex, compound and cascading risks



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Simple component risk framing

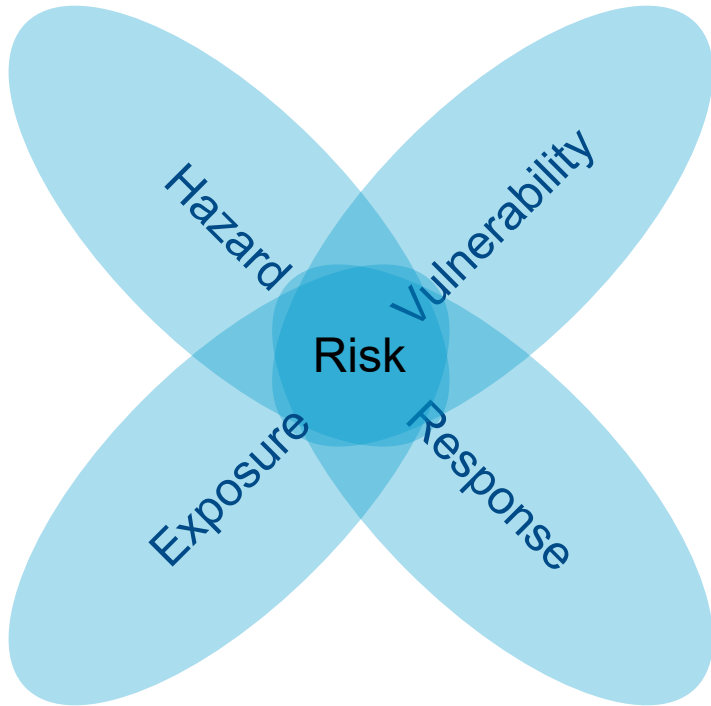


- *Hazard* – A situation that poses a threat
- *Exposure* – Presence in places that could be adversely affected
- *Vulnerability* – The propensity to be adversely affected

- The potential for adverse consequences for human or ecological systems (*i.e. combination of probability and consequence/impact*)
- **Impacts:** risks result from dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system to the hazards
- **Responses:** risks result from potential for responses not achieving the intended objective(s), or from potential trade-offs with, or negative side-effects on, other societal objectives (e.g. SDG's). Risks arise from uncertainty in implementation, effectiveness or outcomes of climate policy, climate-related investments, technology development or adoption and system transitions

- Physical
 - operational
 - strategic
 - insurance liability and asset value
- Transition (disclosure)
 - emission reduction process
 - risk management implementation
- Liability
 - compensation from affected parties (slow burn)
 - negligence, or for misleading and/or deceptive conduct
 - misleading disclosure
- Reputational, political and technological risks too

Revised framing: complex risk



Single-hazard assessments may underestimate risks

Increasingly drivers of risk interact, as do the pre-disposing conditions, as do the responses, creating new risks or amplifying existing ones

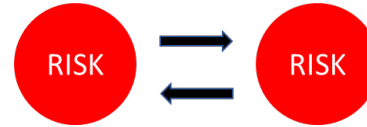
So there should be a bunch of arrows between and with these components

Various categories of complex risk

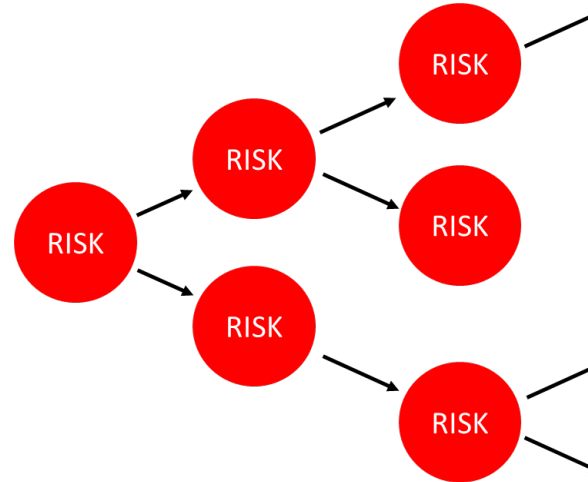
- **Compound Risk:** arise from the interaction of hazards (single extreme events or multiple coincident or sequential events) that interact with exposed systems or sectors
- **Cascading Risk:** One event triggering other events. Interactions can be uni-directional or may also have feedbacks. Often associated with the vulnerability component of risk, such as critical infrastructure
- **Aggregate Risk:** The accumulation of independent determinants of risk

Risk categories: figures

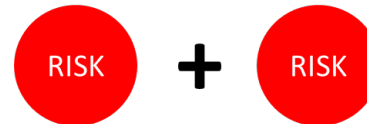
Compound risk



Cascading risk



Aggregated risk



More complexity

- Other typologies: preconditioned, multivariate, temporally compounding and spatially compounding
- Complexity also arises from inter alia:
 - sectoral interactions
 - temporal separation
 - spatial separation
 - multiple responses each with their own risk profiles
- Changes in operating environments, options and societal expectations

Compound risk examples

- Droughts: low rainfall, high vapour pressure deficit and evaporation, low soil and water storage levels, heat stress, increased fire danger
- Hurricane Harvey (USA, 2017): warm waters, stalling over land and storm surge
- High temperatures, humidity and air pollution
- Warmer temperatures, dry conditions and late frost
- Can be reductions in risk: e.g. drought and cyclones in NE Australia tend to be negatively related

Cascading risk examples

- UK floods 2013/2014 and La Niña years in Australia: sequential storms that fill up soil, dams and watercourses leading to increased flood and erosion risk
- Hurricane Harvey drew down FEMA aid so when Maria hit Puerto Rico (already vulnerable) aid resources were depleted
- Flooding and landslides after large fires
- Tohoku earthquake, tsunami and radioactive contamination

Aggregate risk examples

- Floods, cyclones and fires where evacuations made more complex by COVID-19 based social distancing or lockdown orders in place
- Armed conflict or political change interacting with climate extremes
- Herbicide tolerance and increasing drought
- Infrastructure aging and increasing extreme events
- Age profile of volunteer fire-fighters and increased fire risk



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Thankyou

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