Compounding risks and tipping points

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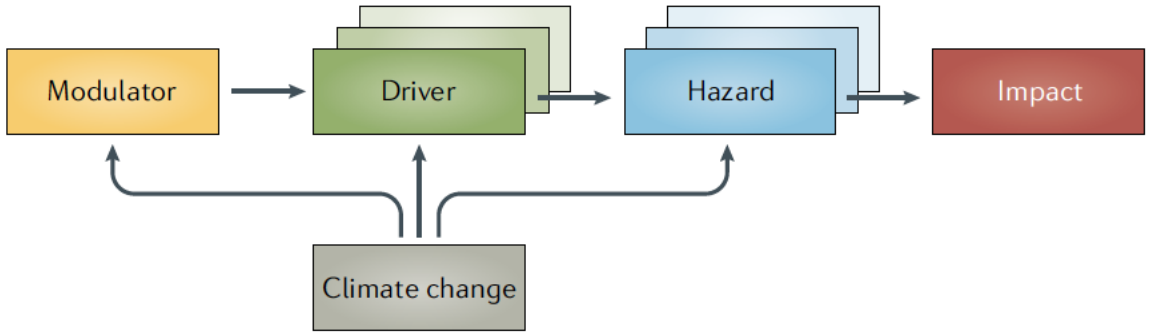
What are compound events

Compound events are a combination of multiple drivers and/or hazards that contribute to societal or environmental risk

Compound events are responsible for many of the most severe weather-related and climate- related impacts.



Modulators *change the frequency, magnitude and location of events –e.g. modes of variability*

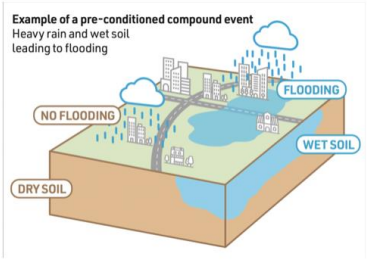
Drivers *include extreme rainfall, heat, storm surge, strong winds*

Hazards *include heatwaves, flood, fire*

Impacts *include failure of energy supply, structural damage to housing etc*

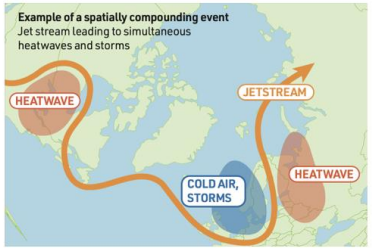
Zscheischler et al., 2020, Nature Earth and Environment, doi: 10.1038/s43017-020-0060- z

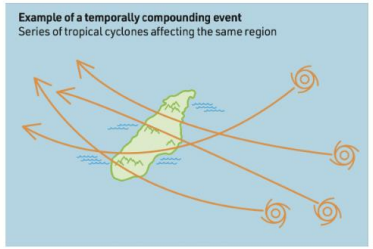
What are compound events



Preconditional – e.g. heavy rain on saturated soil

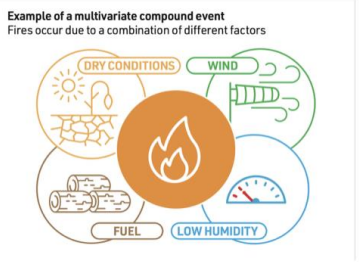
Spatially compounding - severe rainfall occurring in the same place





Temporally compounding – severe rainfall occurring in sequence

Multivariate – e.g. compounding precipitation and wind extremes



If you think about the Lismore event, it was all these types of compound event

Zscheischler et al., 2020, Nature Earth and Environment, doi: 10.1038/s43017-020-0060- z

Observations of compound events

nature COMMUNICATIONS

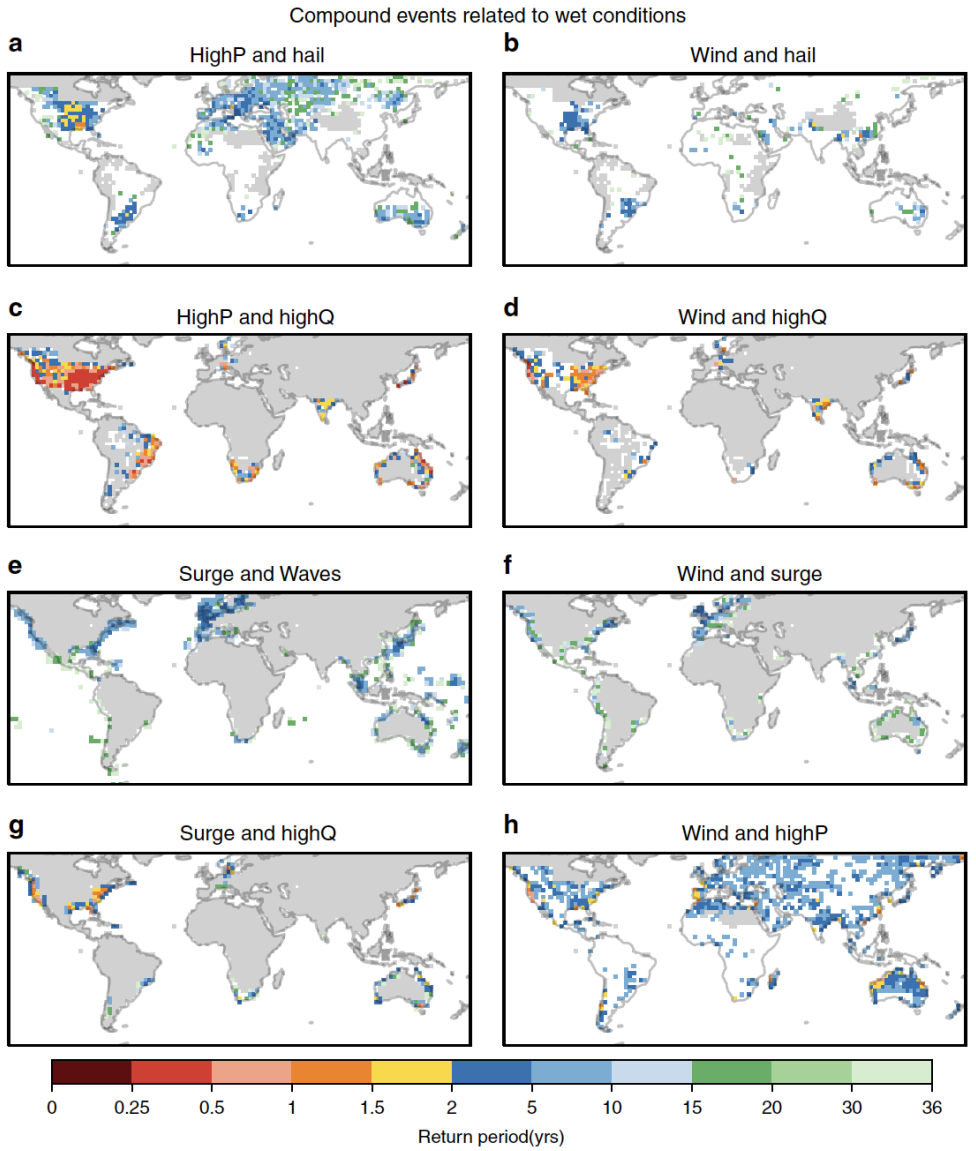
ARTICLE

https://doi.org/10.1038/s41467-020-19639-3 OPEN

Check for updates

Global hotspots for the occurrence of compound events

Nina N. Ridder[1✉], Andy J. Pitman[1], Seth Westra[2], Anna Ukkola[3], X. Do Hong[4,5], Margot Bador[1], Annette L. Hirsch[1], Jason P. Evans[1], Alejandro Di Luca[1] & Jakob Zscheischler[6,7]



Observations tell us about risks of compound events

- Limited to observationally rich regions
- Limited to how rare an event we can estimate well
- Multivariate risks very poorly observed
- Easily calculated risks (e.g. annual events) unlikely to be material

Remember, Australia has the most variable climate on Earth

Contents lists available at ScienceDirect

Weather and Climate Extremes

journal homepage: www.elsevier.com/locate/wace

High impact compound events in Australia

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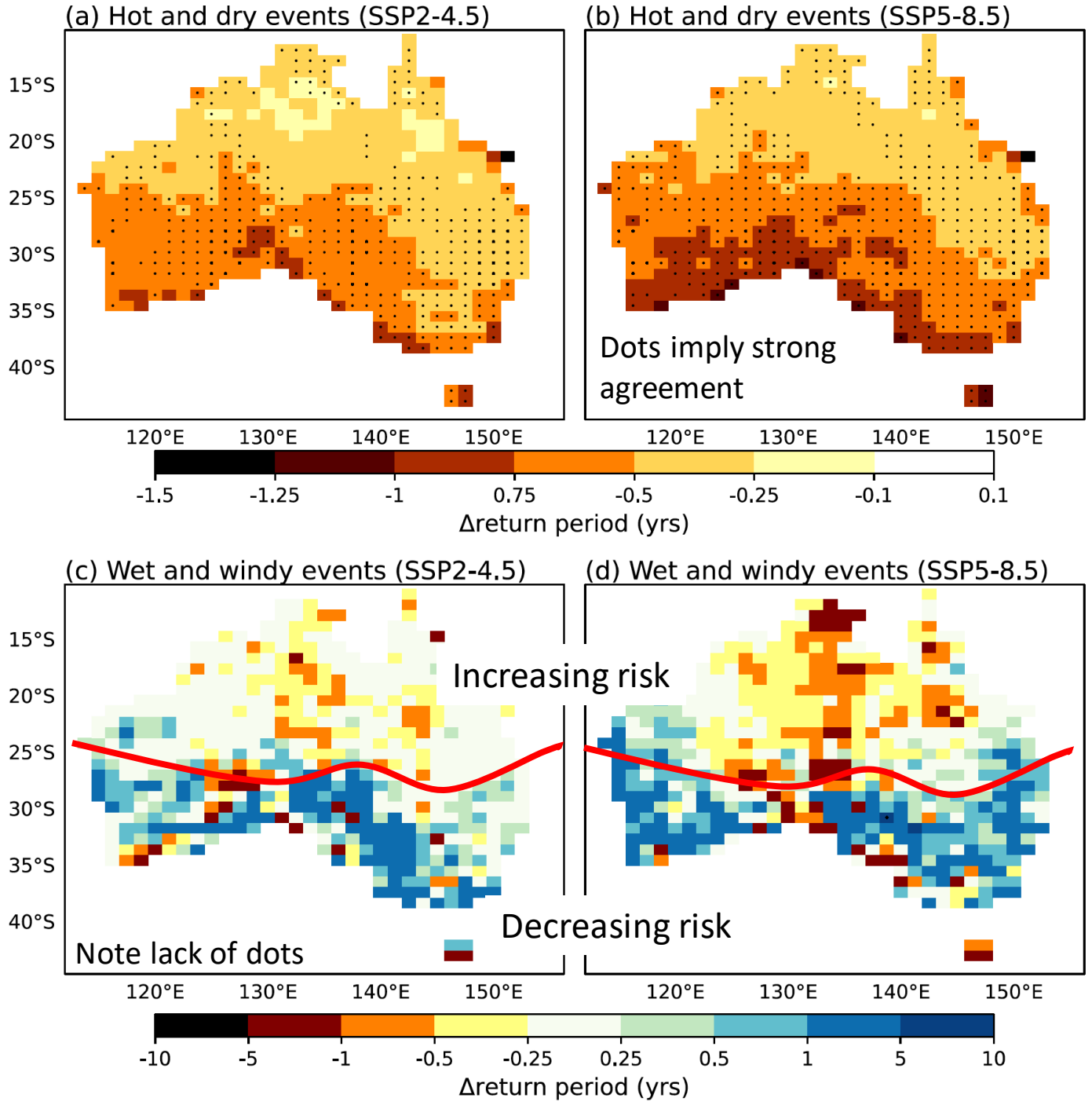
Clear increased risk of hot and dry events

Broad geographic patterns for wet and windy hinting at decreasing risk of wet and windy compound events in southern regions

Remember climate models do not really capture the weather-scale processes that lead to extreme rainfall

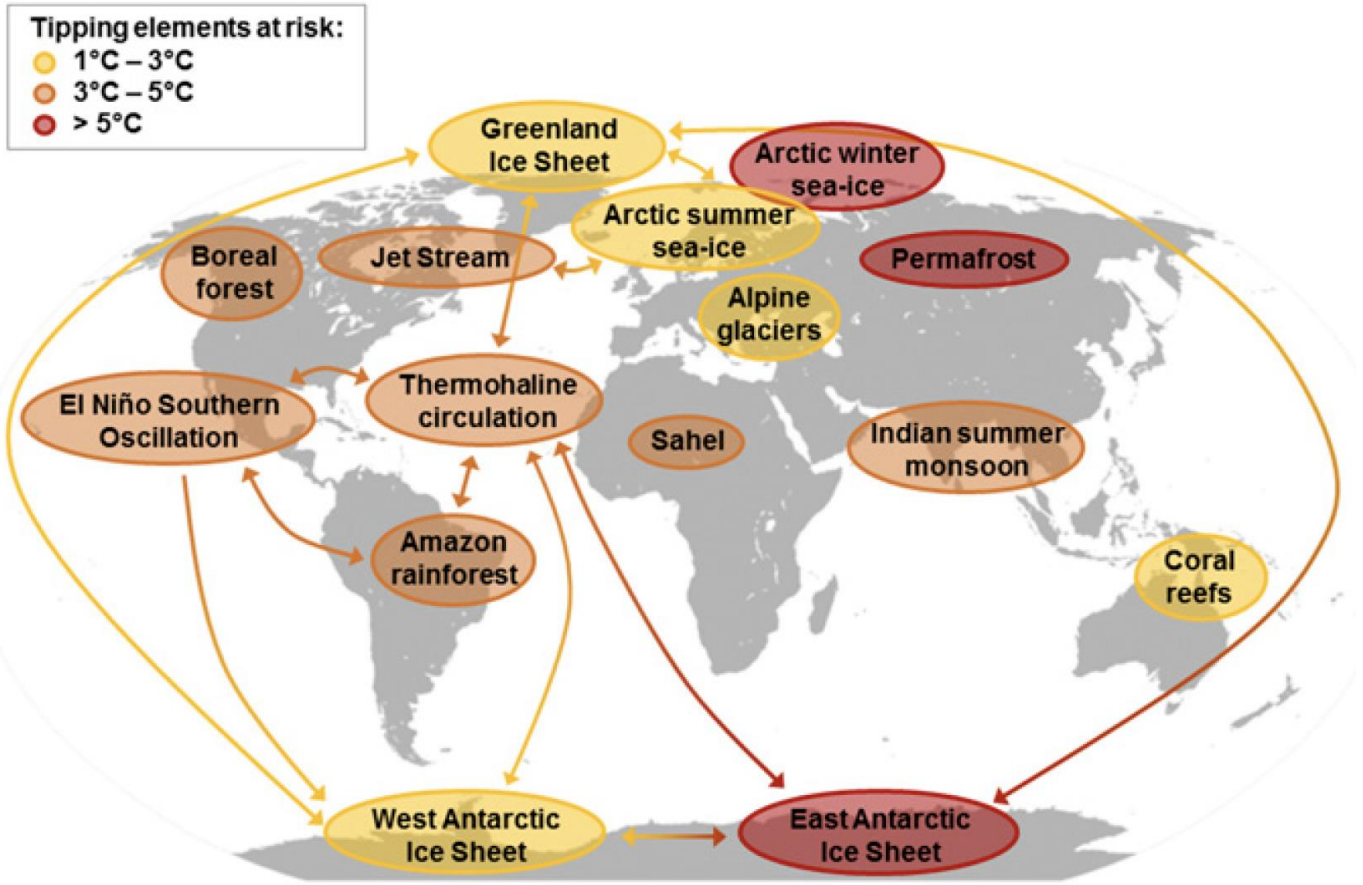
Climate models do not simulate most extremes that are material directly (e.g. floods, storm surge …

Note the size of the pixels



From Steffen et al., 2018

Tipping points and adaptation



- Real – apparent in observations
- Clear risks to systems
- Link with temperature based on limited modelling and expert judgment
- Not included in Physical Climate Models or regional downscaling (couple of exceptions)
- Can cascade
- Unlikely this century – timing unlikely predictable
- Impact on Australia not explored in detail

- Crucially, not feasible to adaptable to.

Tipping points exist at regional scales – but separating tipping points from variability or simply an extreme event is hard

Adaptation concerns

	Materiality for adaption	Level of understanding	Scale of change by 2030/2050
Compound events	Very High	Emerging	Uncertain, emerging understanding in some regions
Tipping points	Low	Emerging	Close to (but not exactly) zero

The appreciation that Compound Events tend to be associated with catastrophe points to a foci for adaptation.

Knowing where is vulnerable to these events in the present, and investing in resilience to these events is an excellent “no regrets” starting point to providing less vulnerable communities to longer-term climate change