

How to better understand the adaptive capacity of Social-Ecological Systems to absorb climate extremes

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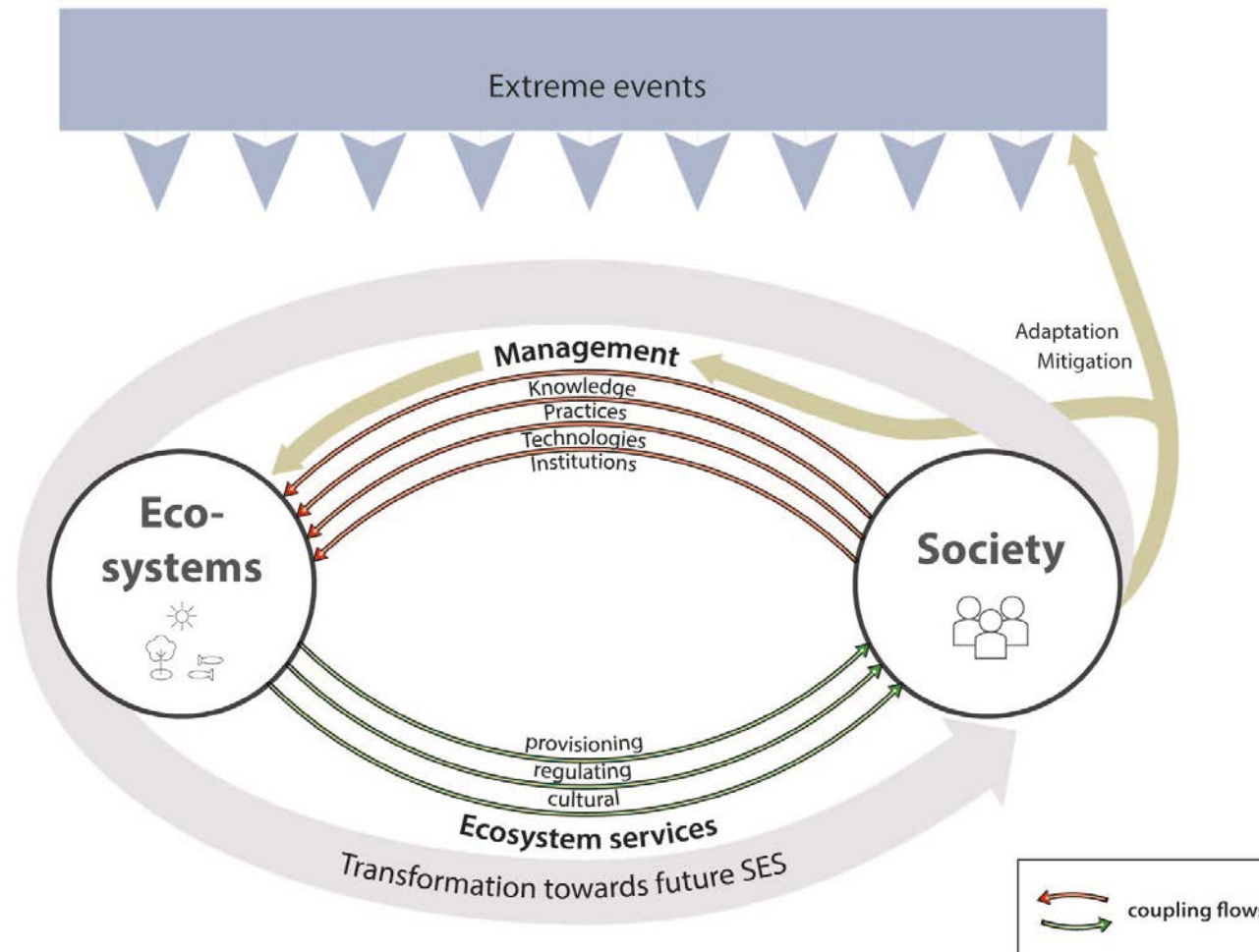
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Overview

- **Social-ecological systems (SES)**
- **Social-ecological resilience (SER) and climate extremes**
- **Understand more on adaptive capacity of SES**

Social-ecological systems (SES)

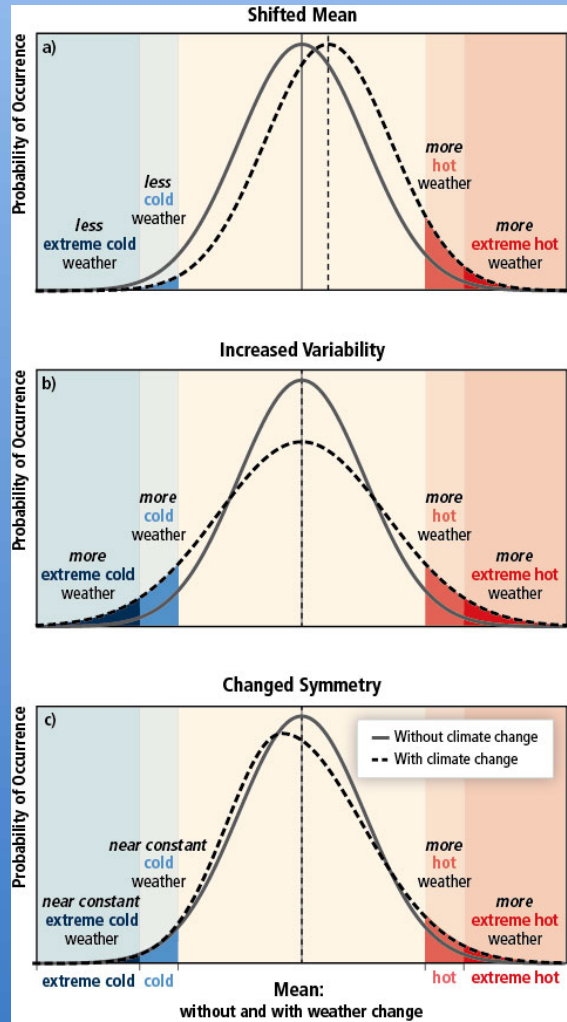


Social-ecological Resilience (SER)

- **Ecological resilience (from disturbance ecology)**
 - Definition: “Capacity of an ecosystem to persist and maintain its state and functions in the face of disturbance. It is determined by the capacity to reduce the impact (resistance) and the capacity to recover from the impact of disturbance (recovery).” (Ingrisch & Bahn 2018)
- **Social-ecological Resilience**
 - Definition: “The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.” (IPCC 2014)

Climate: Climate change

Climate extremes



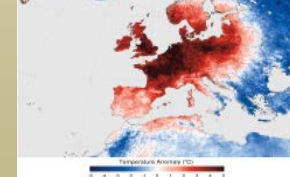
Social-ecological System (Ecosystems, Society)

Disturbances (f,I)

Drought



Heatwave



Pest



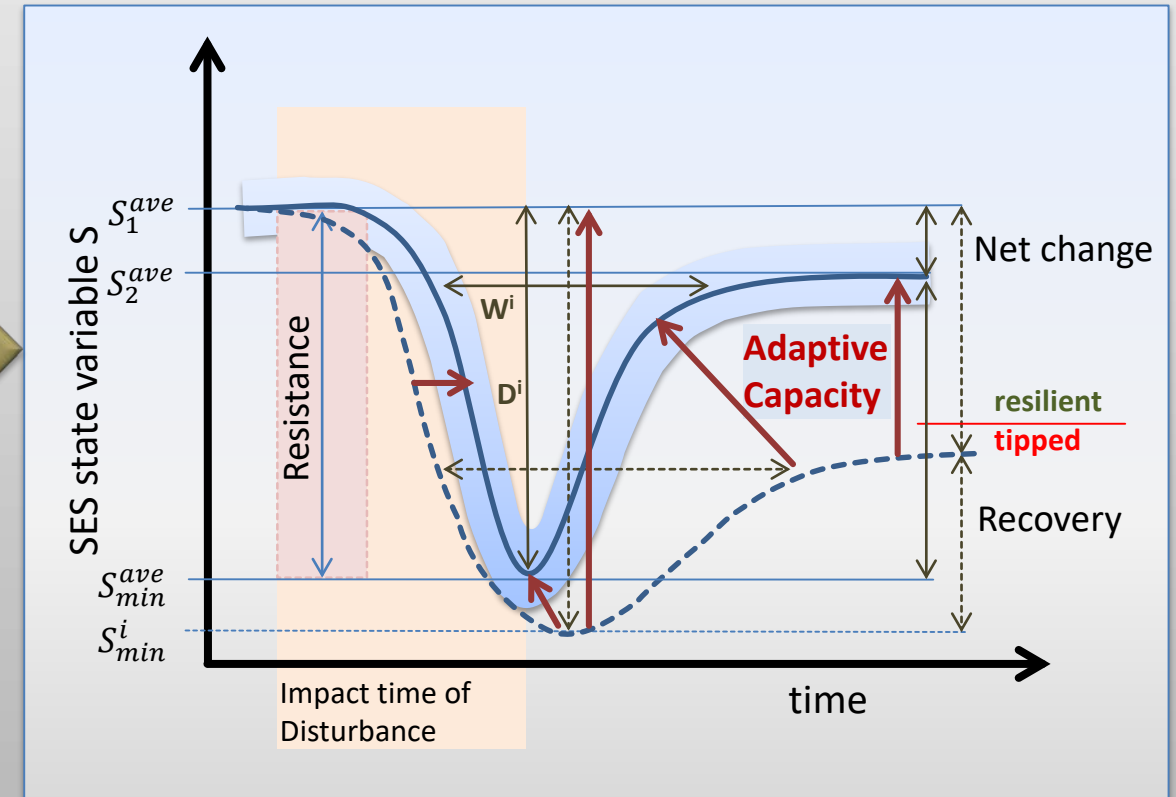
Wildfire



Storm



Resilience and Adaptive Capacity of SES state variables



Three Challenges for Operationalization of the SER concept

1. Identify and measure relevant driver and system variables in response to climate extremes
2. Quantify Climate Extreme Impacts on coupling flows in SES
3. Identify Management Options and Institutional Changes to maintain or enhance SER

1. Identify and measure relevant driver and system variables

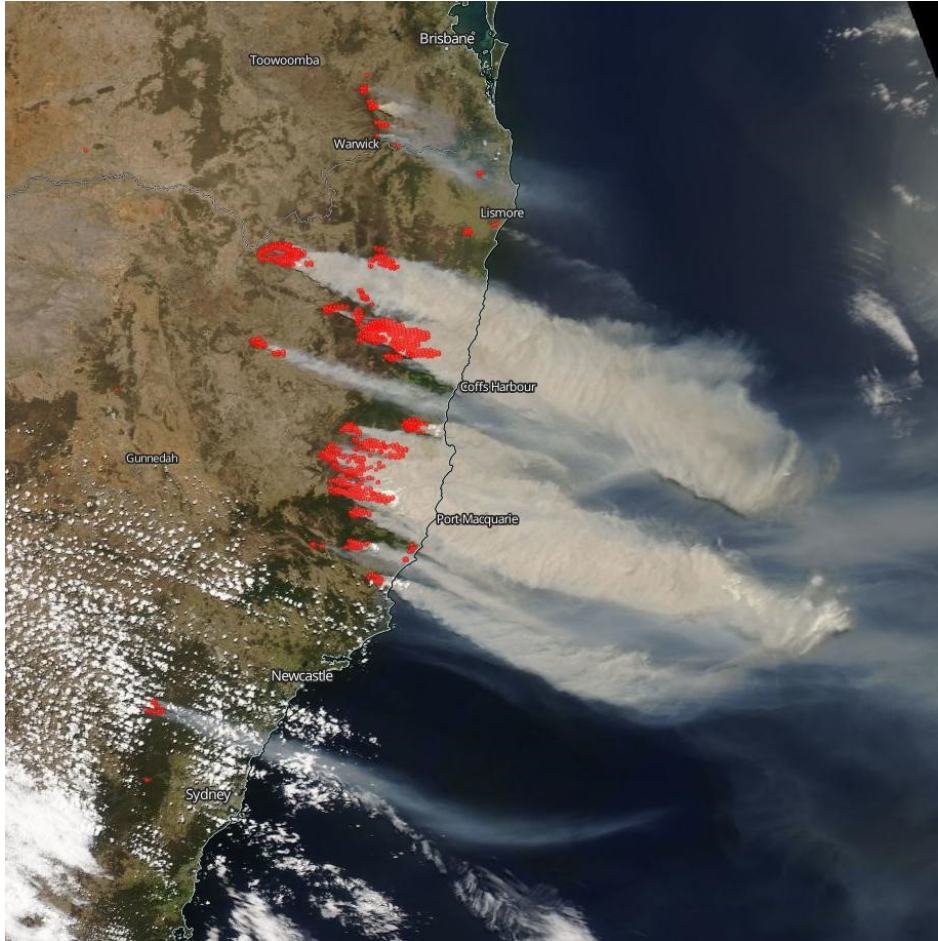
Extreme wildfire

- Ecosystem
 - ❖ Fire statistics (area, intensity, frequency)
 - ❖ Fire-related emissions (biomass burnt, layers affected: litter, duff, peat → soil carbon storage)
 - ❖ Vegetation regrowth: species composition and abundance, structural diversity
- Society
 - ❖ Infrastructure affected (communication infrastructure)
 - ❖ Settlements, houses affected
 - ❖ Casualties, injuries

Monitoring

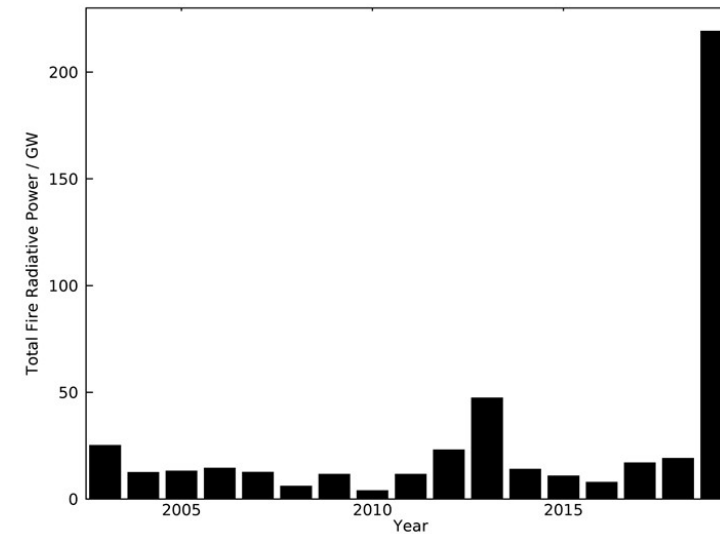
- Ecosystem
 - ❖ Fire statistics and RS-based monitoring (MODIS)
 - ❖ CAMS & modelling
 - ❖ In-situ, EBV, observatories, Fluxnet
- Society
 - ❖ Statistics and reports
 - ❖ Remote sensing (hazard)
 - ❖ Insurance

1. Identify and measure relevant driver and system variables



Extreme wildfire SE Australia 2019-2020

CAMS 1 Sept-12 Nov Total Fire Radiative Power (GFASv1.2) for New South Wales



<https://atmosphere.copernicus.eu/copernicus-tracks-catastrophic-effects-unprecedented-australian-bushfires>

2. Quantify Climate Extreme Impacts on coupling flows in SES

Extreme wildfire

- Ecosystem Service
 - ❖ Carbon sequestration, carbon storage (biomass & soil)
 - ❖ Water regulation (evapotranspiration, discharge, retention)
- Society
 - ❖ Money spent on
 - fire monitoring, information apps and training (educational programmes)
 - compensation and reforestation
 - insurance

3. Identify Management Options and Institutional Changes to maintain or enhance SER

Extreme wildfire

- Ecosystem:
 - ❖ Increase structural diversity (multiple canopy layers)
 - ❖ Prescribed burning (management of understorey)
- Society: improve hazard response system
 - ❖ Early Warning during event: online information systems, evacuation warnings (Apps)
 - ❖ Planning ahead: integrate knowledge of future projections and increase preparedness
 - ❖ Knowledge transfer to user groups
 - ❖ Revisit regulations (e.g. evacuation orders)

Highly context
dependent:
Australia vs.
Germany -
Exposure &
Experience

Expected impact

- **Improved understanding of sustainable management**
 - Survey techniques, modelling & monitoring
- **Integrate gained knowledge into decision-making**
 - Identify leverage points and relevant actors
- **Explore multiple pathways to enhance Adaptive capacity for mitigation and adaptation strategies to facilitate transformation**

More details and thoughts

Earth's Future

COMMENTARY

10.1029/2019EF001221

Key Points:

- Climate extremes impact the resilience of social-ecological systems; their adaptation requires knowledge on ecological and social mechanisms
- Relevant ecological and social variables document the impact of climate extremes on the coupling flows, enabling management options
- Three challenges remain to advance our understanding on adapting social-ecological systems for a resilient and sustainable future

Supporting Information:

- Supporting Information S1

Advancing the Understanding of Adaptive Capacity of Social-Ecological Systems to Absorb Climate Extremes

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