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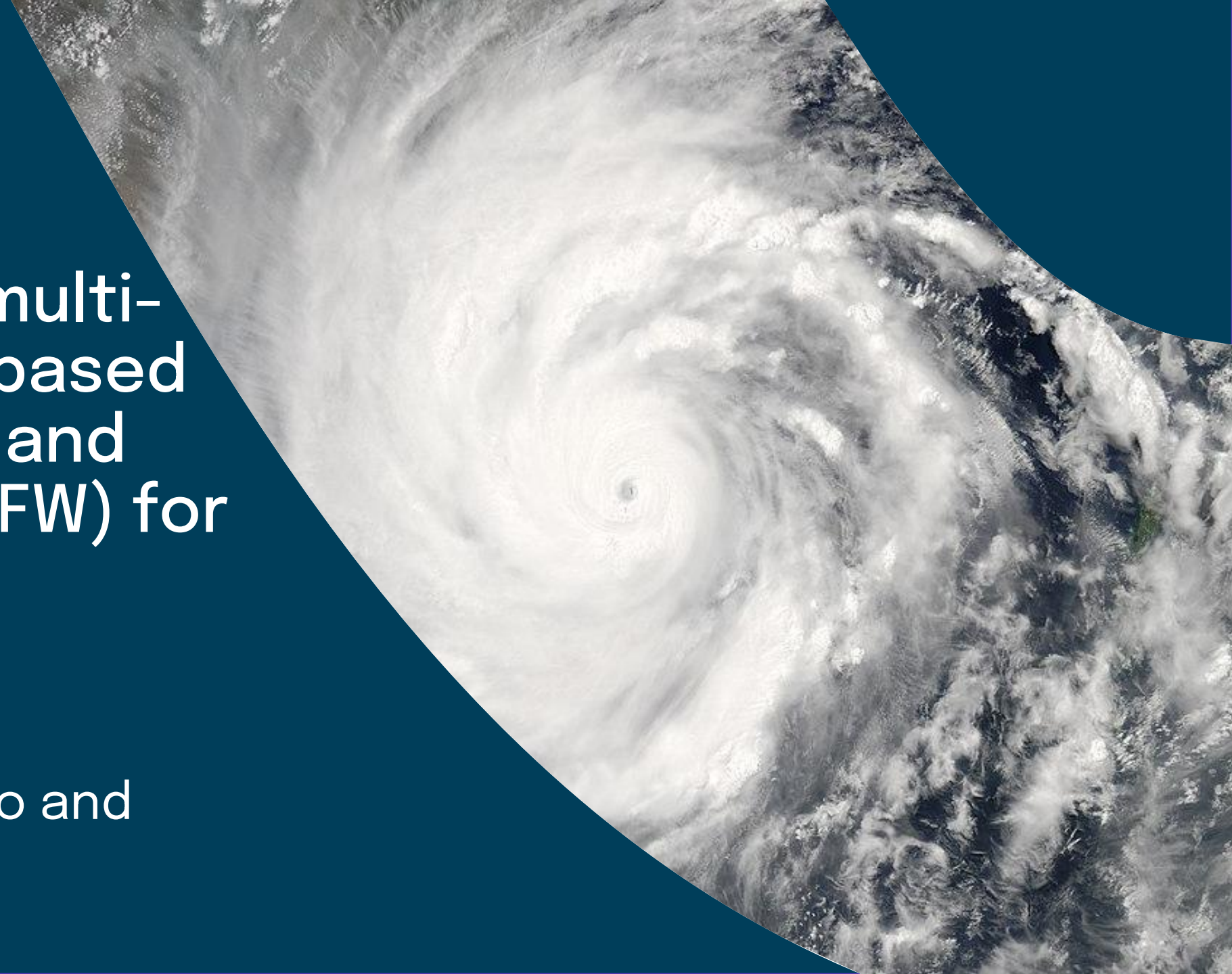
Developing multi-risk Impact-based Forecasting and Warnings (IbFW) for India

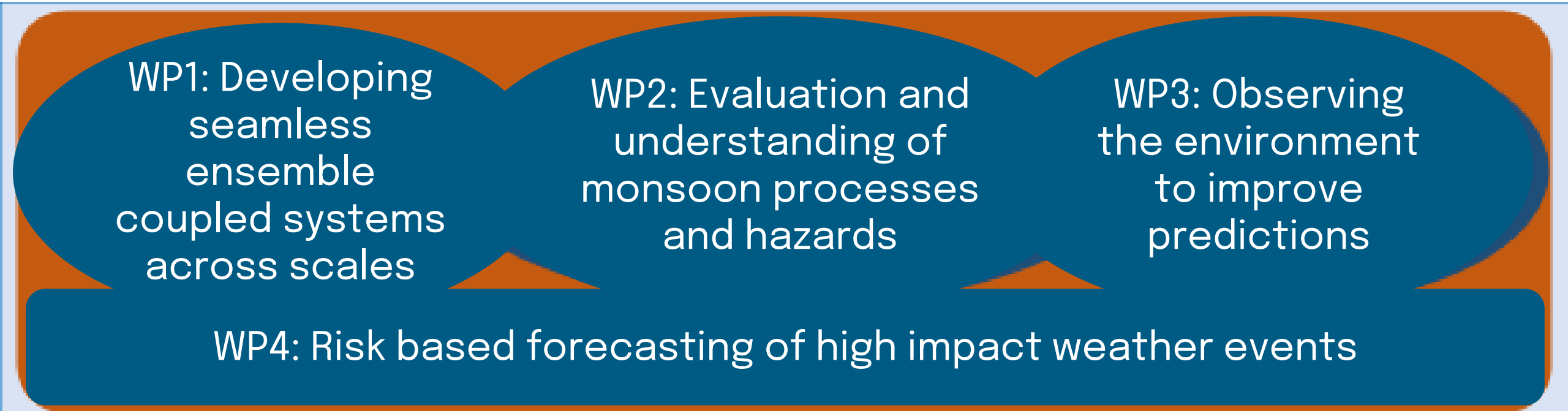


WCSSP India

Darren Lumbroso and
Emma Brown

21 March 2025

Weather and Climate Science for Service Partnership (WCSSP) India Work Package 4



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Multi-risk Impact-baseD forecasting (MIDAS)

Objectives of the research

- Identify appropriate approaches to adopt when **implementing multi-risk assessment** within the Impact-based Forecasts and Warnings space in India
- Identify methods and tools to describe the **interactions between multiple hazards** and the varying vulnerabilities and exposures in time and space for use in an Indian context
- How to **assess and validate approaches for multi- and cascading risks** within the context of Impact-based Forecasts and Warnings

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Terminology

Hazard: A physical event, phenomenon or human activity with the potential to result in harm. A hazard does not necessarily lead to harm

Receptor: An entity that may be harmed by a hazard (e.g. a person, building, habitat, agricultural land)

Exposure: The quantification of the receptors that may be affected by a hazard (e.g. number of people, number and types of buildings, area and types of agricultural land)

Vulnerability: The characteristics of a receptor that describes its potential to be harmed by a particular hazard

Risk: Risk is a function of the likelihood (or probability) of a hazard occurring together with the exposure and vulnerability of the receptors (the impact)

Risk = Likelihood of a hazard occurring x **Impact**

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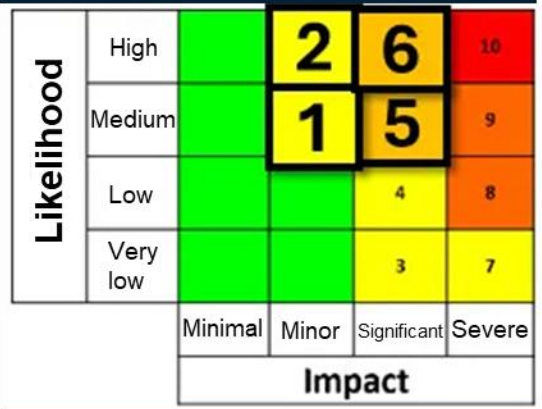
Terminology

Severe Weather Alerts for Wednesday, 19 February 2025

Issued: 19 February 2025 06:00SAST

South African Weather Service

Risk matrix

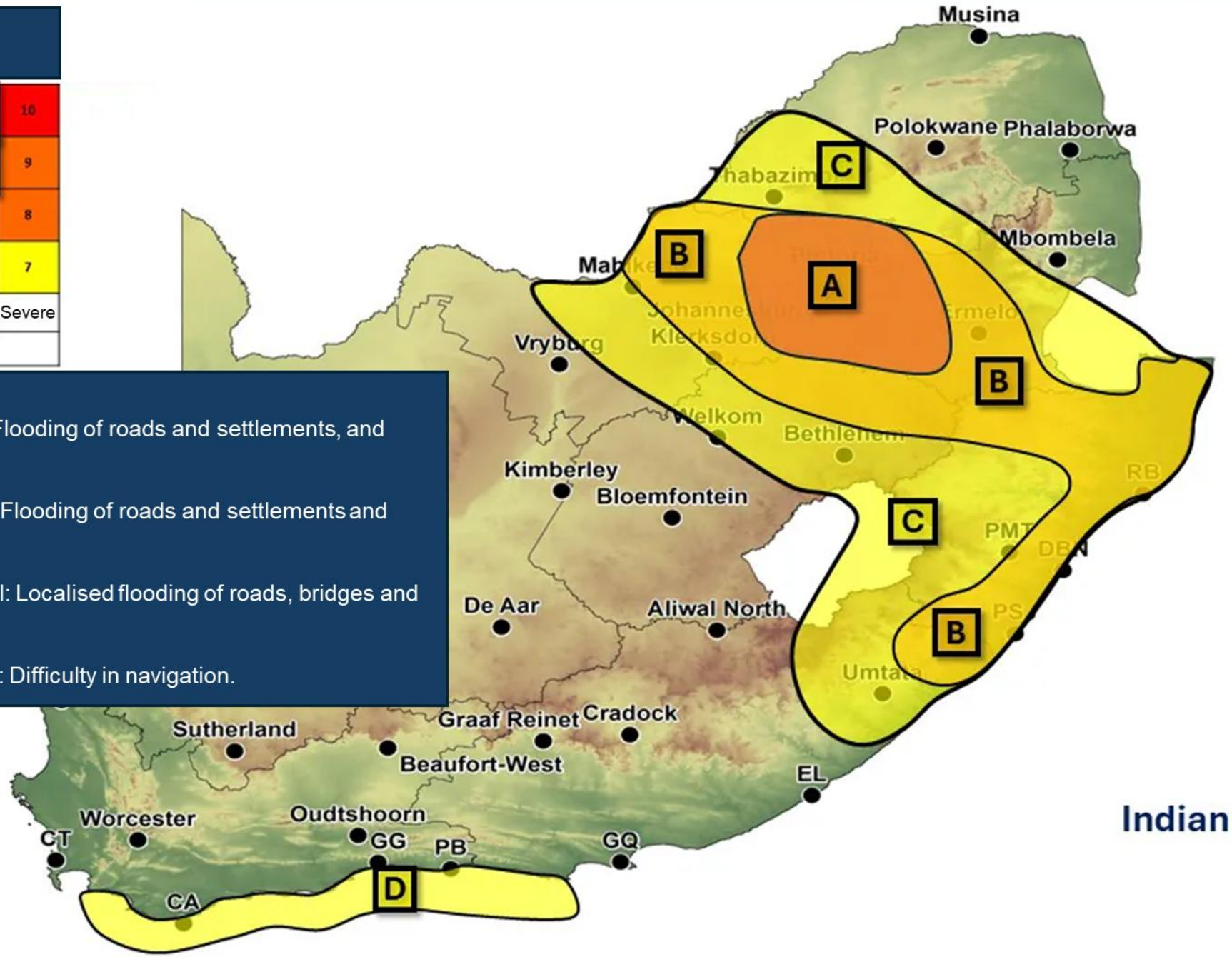


A. Orange level 6:
- Disruptive rainfall: Flooding of roads and settlements, and danger to life.

B. Orange level 5:
- Disruptive rainfall: Flooding of roads and settlements and danger to life.

C. Yellow level 2:
- Disruptive rainfall: Localised flooding of roads, bridges and settlements.

D. Yellow level 1:
- Damaging winds: Difficulty in navigation.



Atlantic Ocean

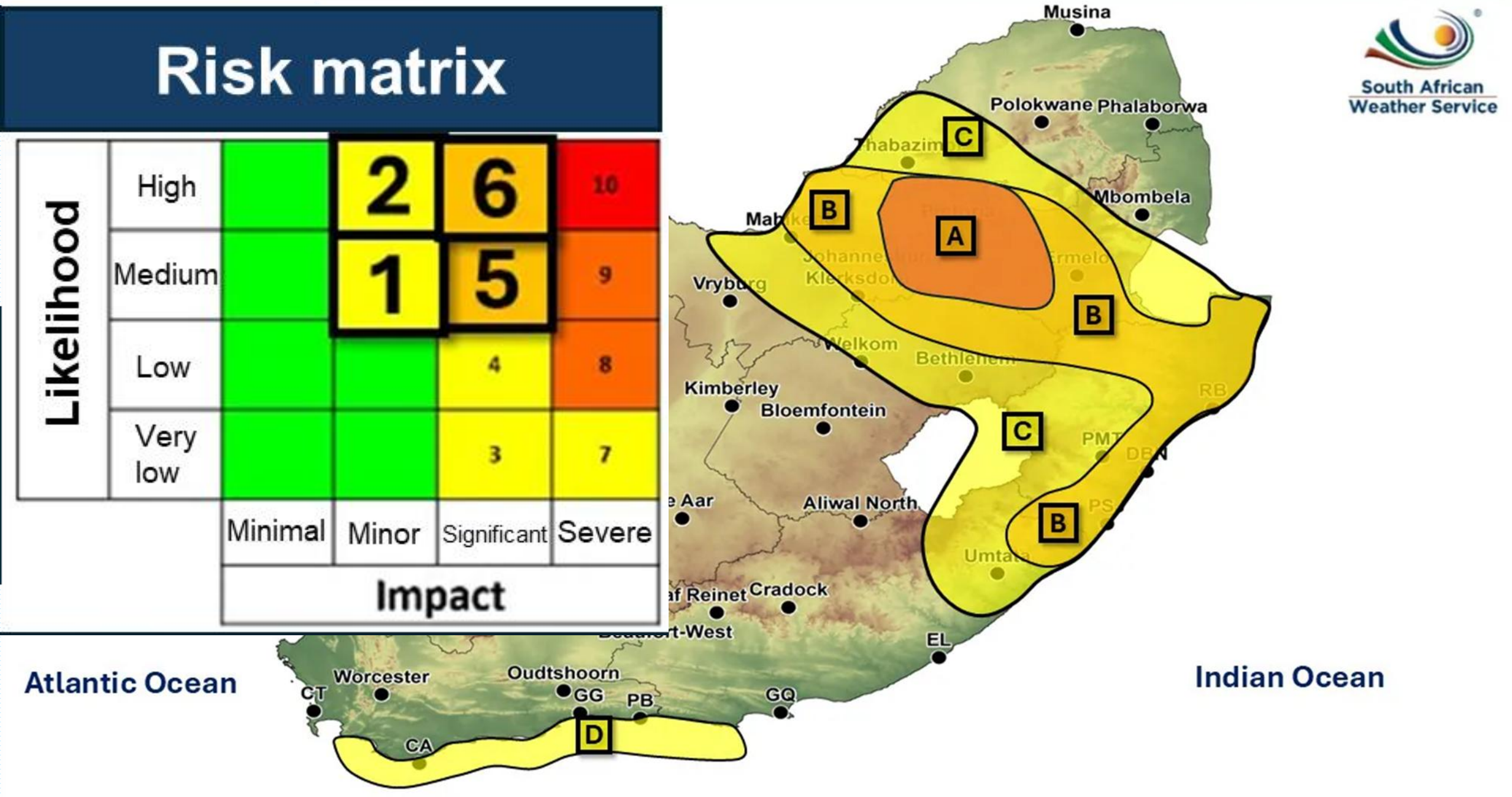
Indian Ocean

Severe Weather Alerts for Wednesday, 19 February 2025 Issued: 19 February 2025 06:00SAST

Risk matrix

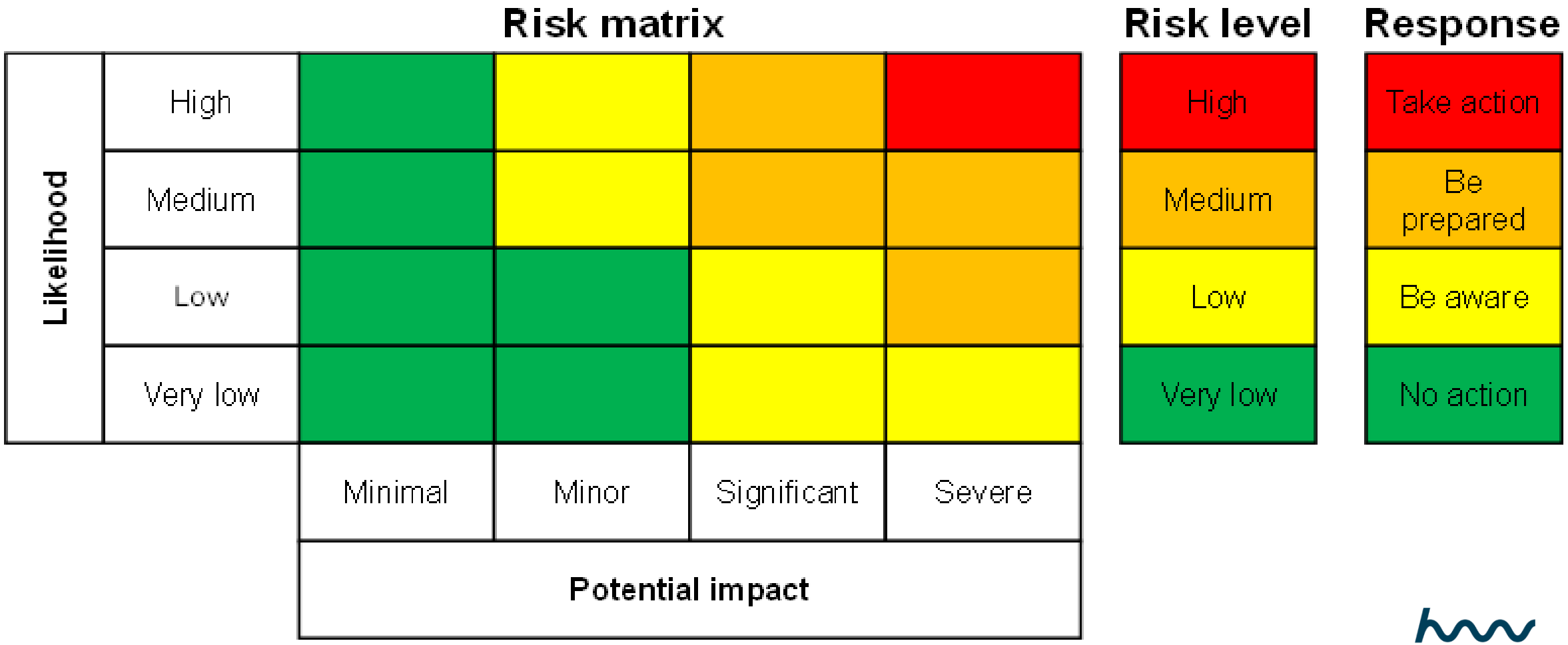
Likelihood	Minimal	Minor	Significant	Severe
High		2	6	10
Medium		1	5	9
Low			4	8
Very low			3	7

Impact

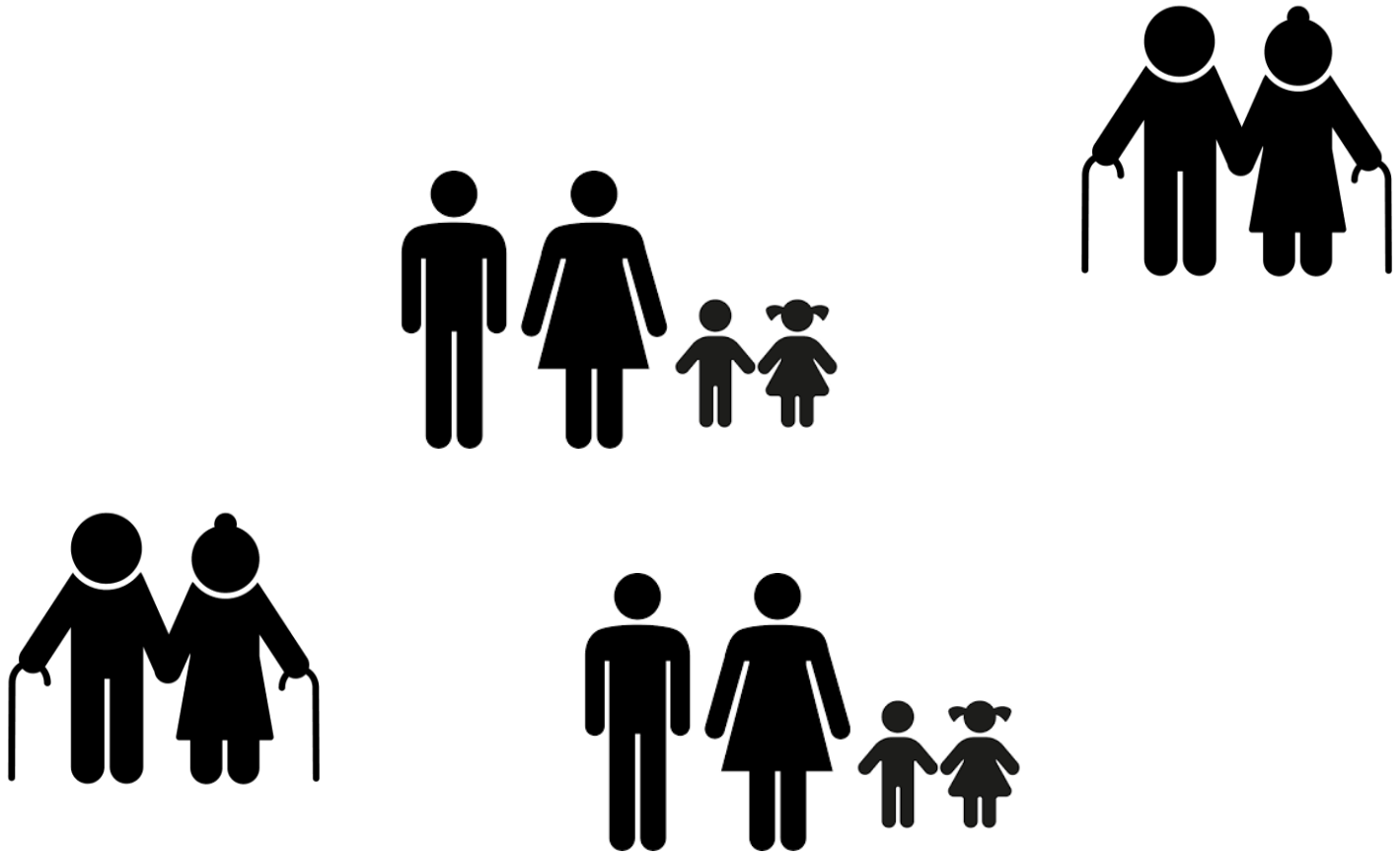


South African Weather Service

Impact-based Forecasting and Warnings in India



Multi-risk Impact-based Forecasting and Warning



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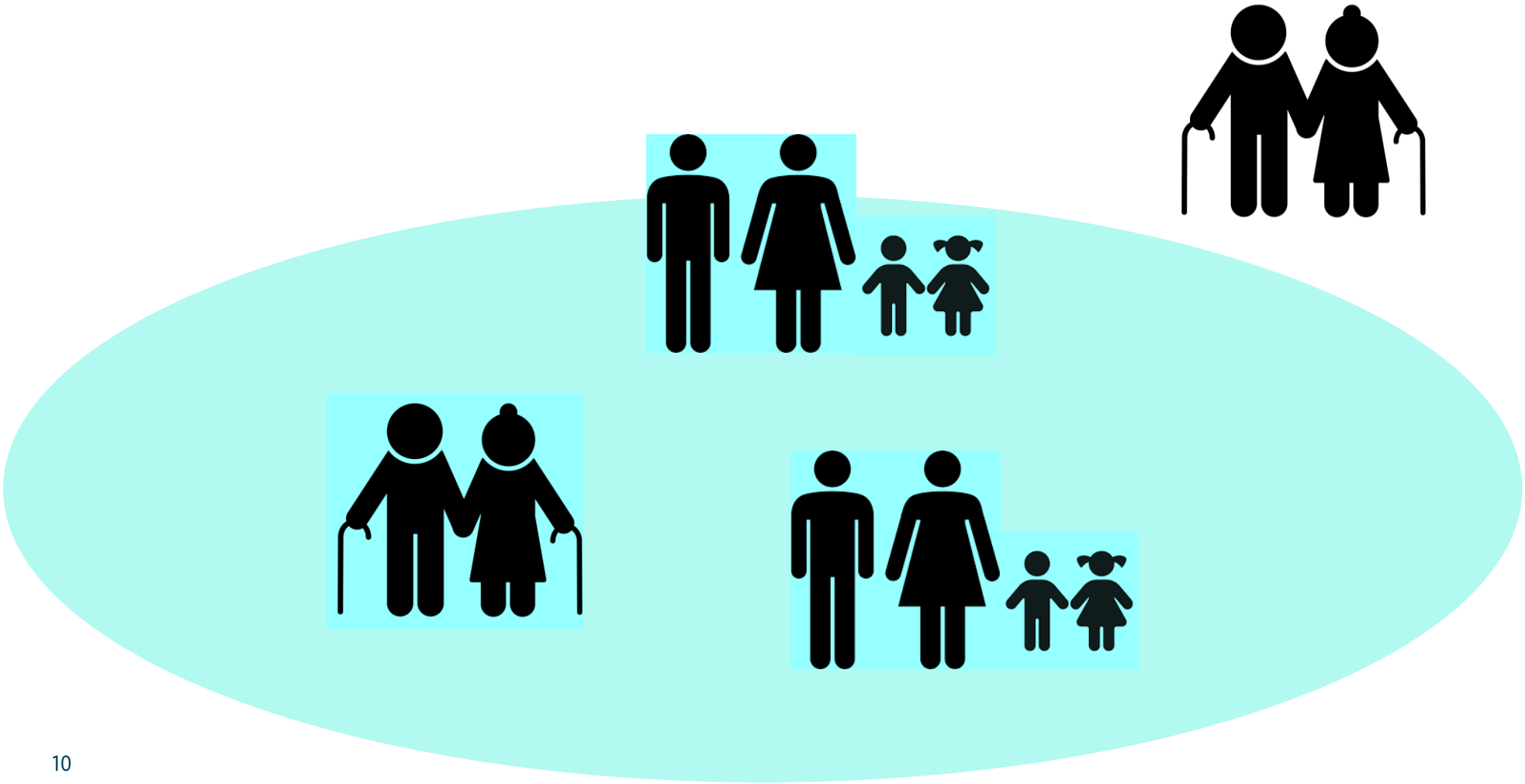
Multi-risk Impact-based forecasting and warning



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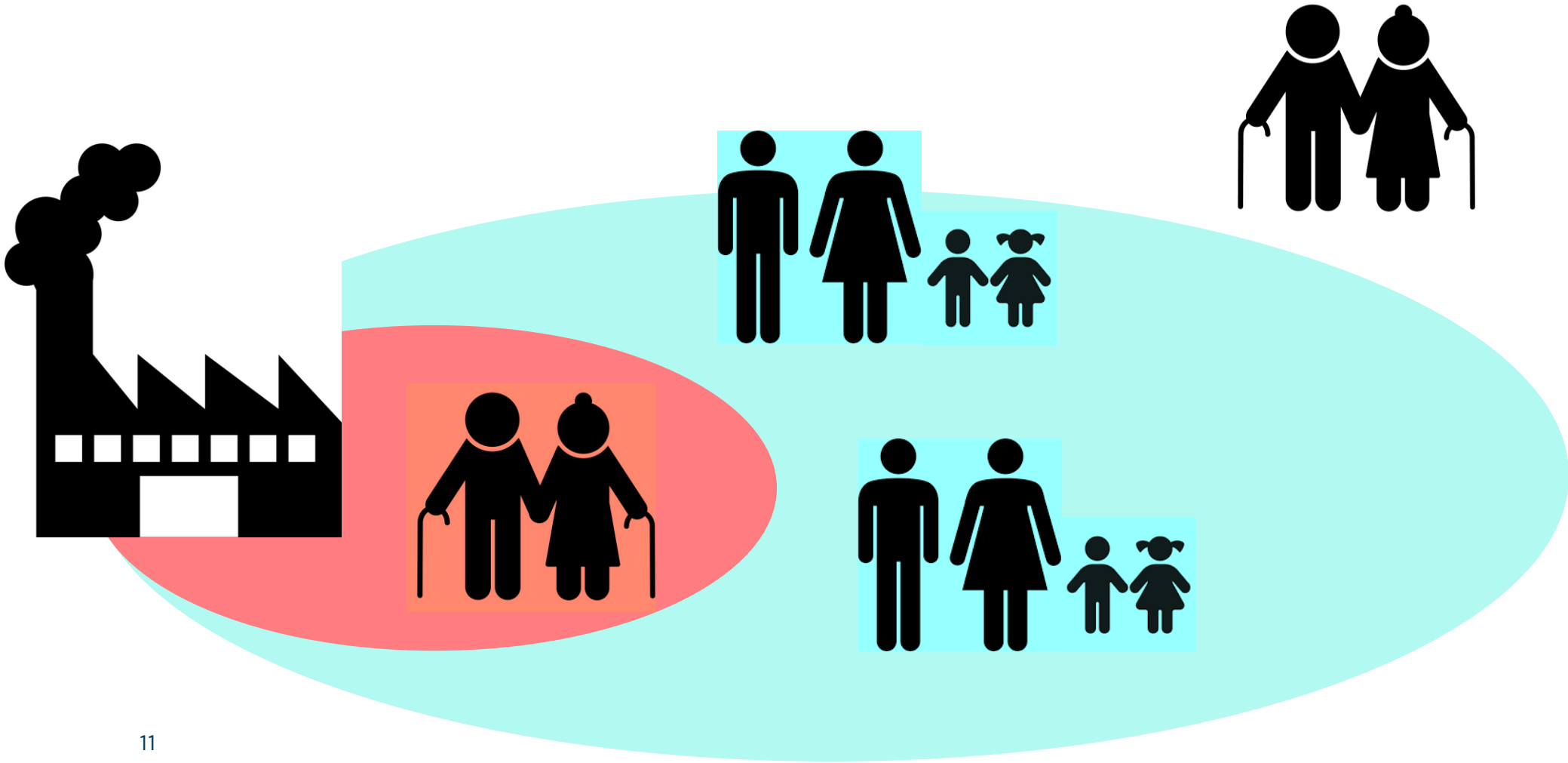
“Simple” example of multi-risk



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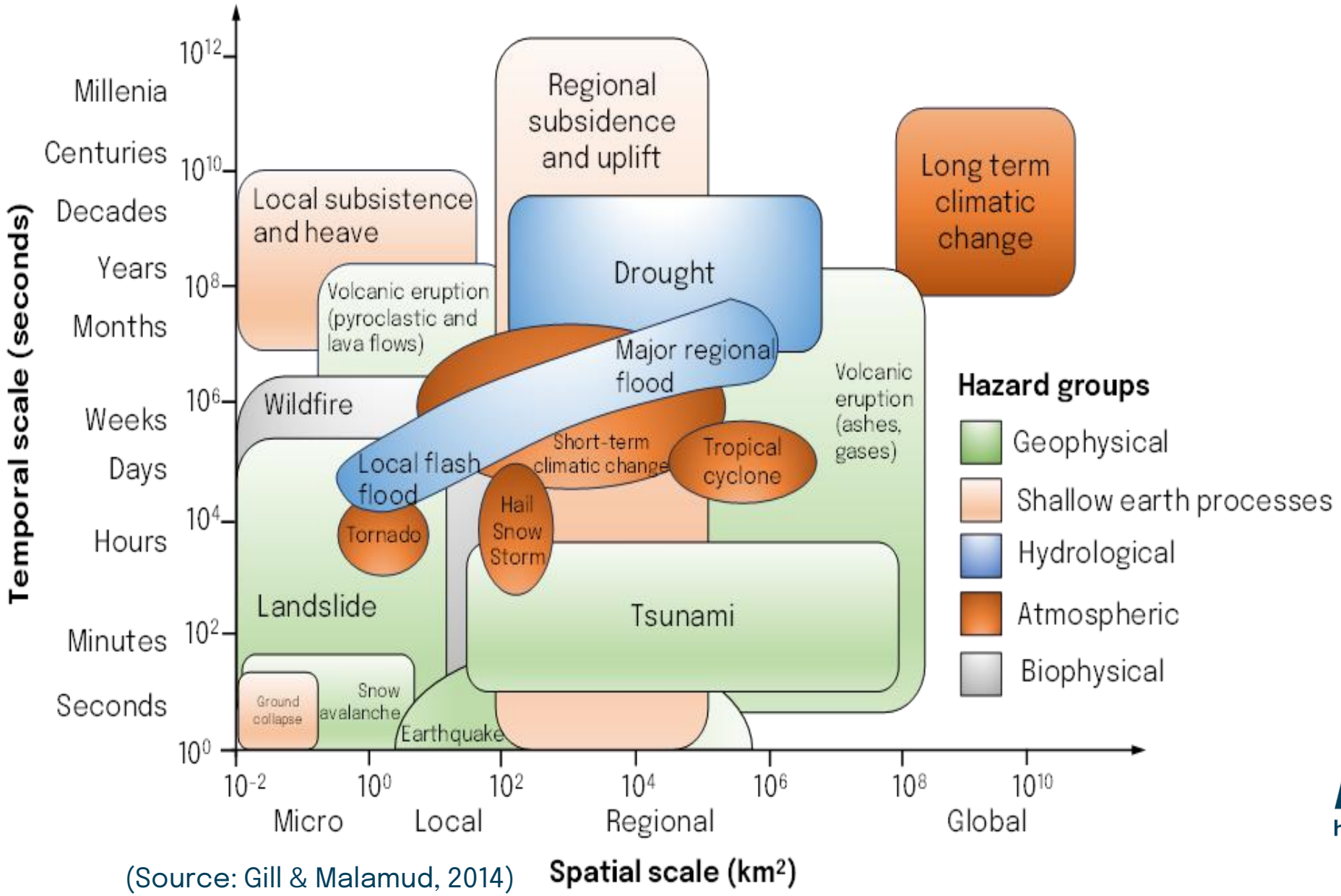
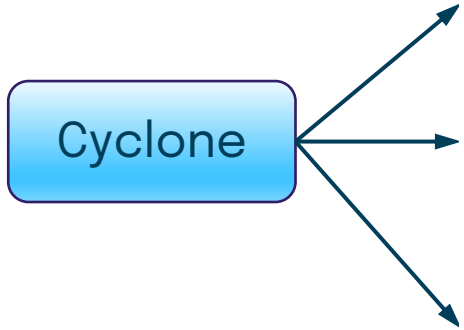
Spatial and temporal scales of hazards



(Source: Gill & Malamud, 2014)

Cascading hazards and risks



Based on Lei et al., 2015

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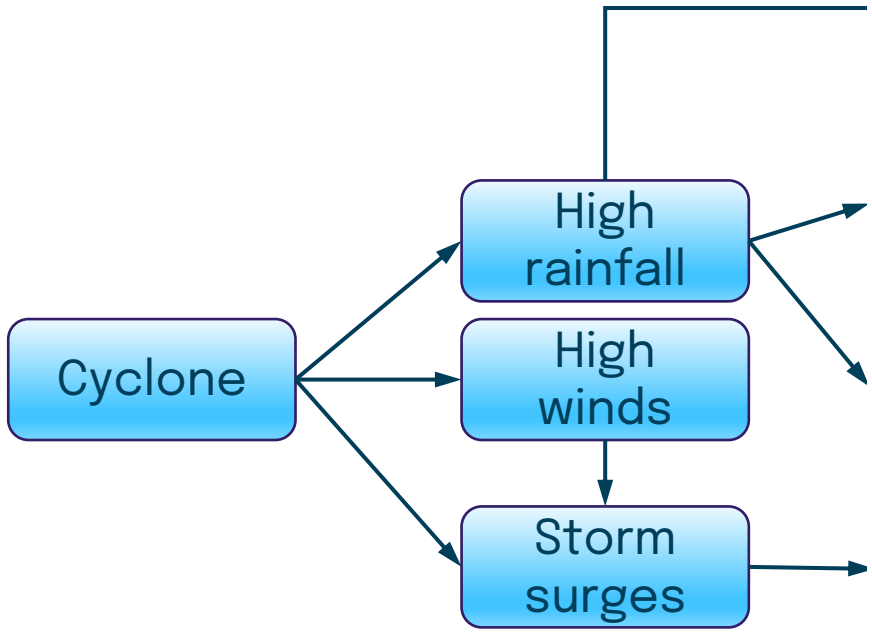
Cascading hazards and multi-risks



Based on Lei et al., 2015

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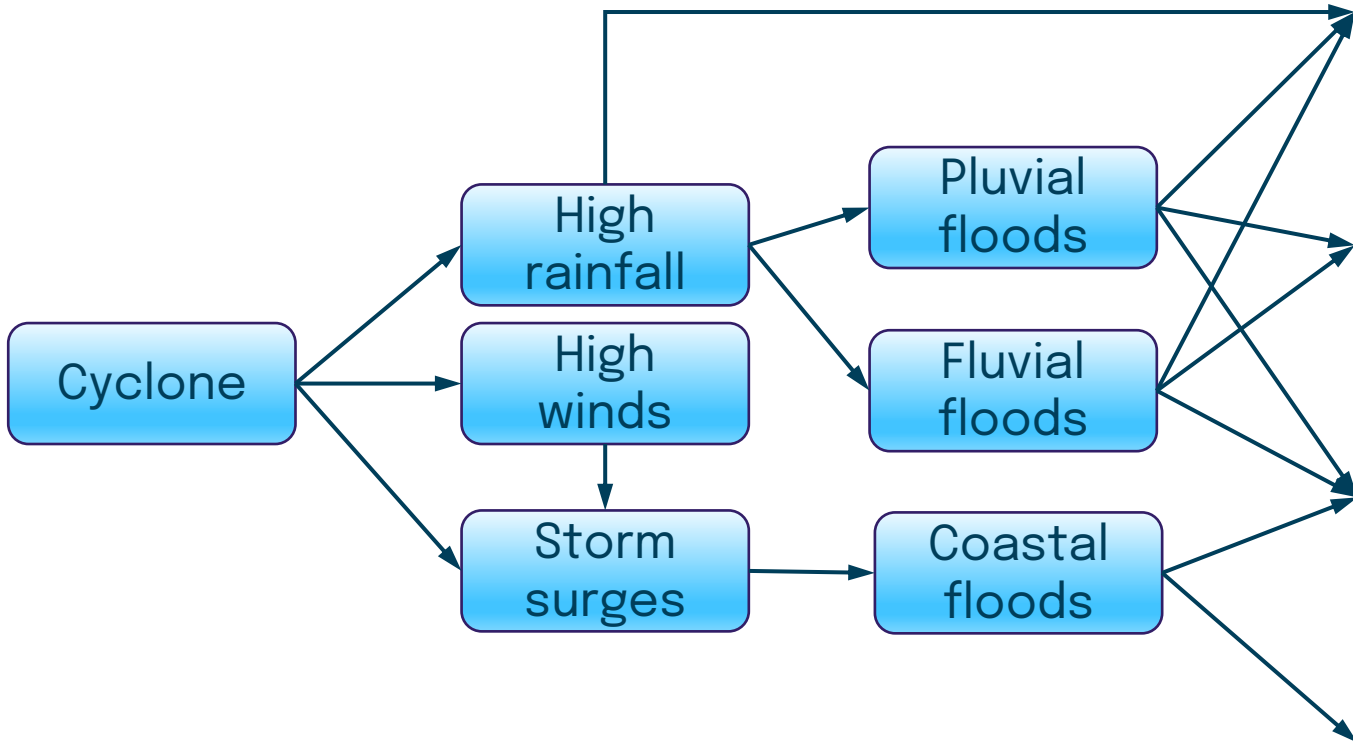
Cascading hazards and risks



Based on Lei et al., 2015

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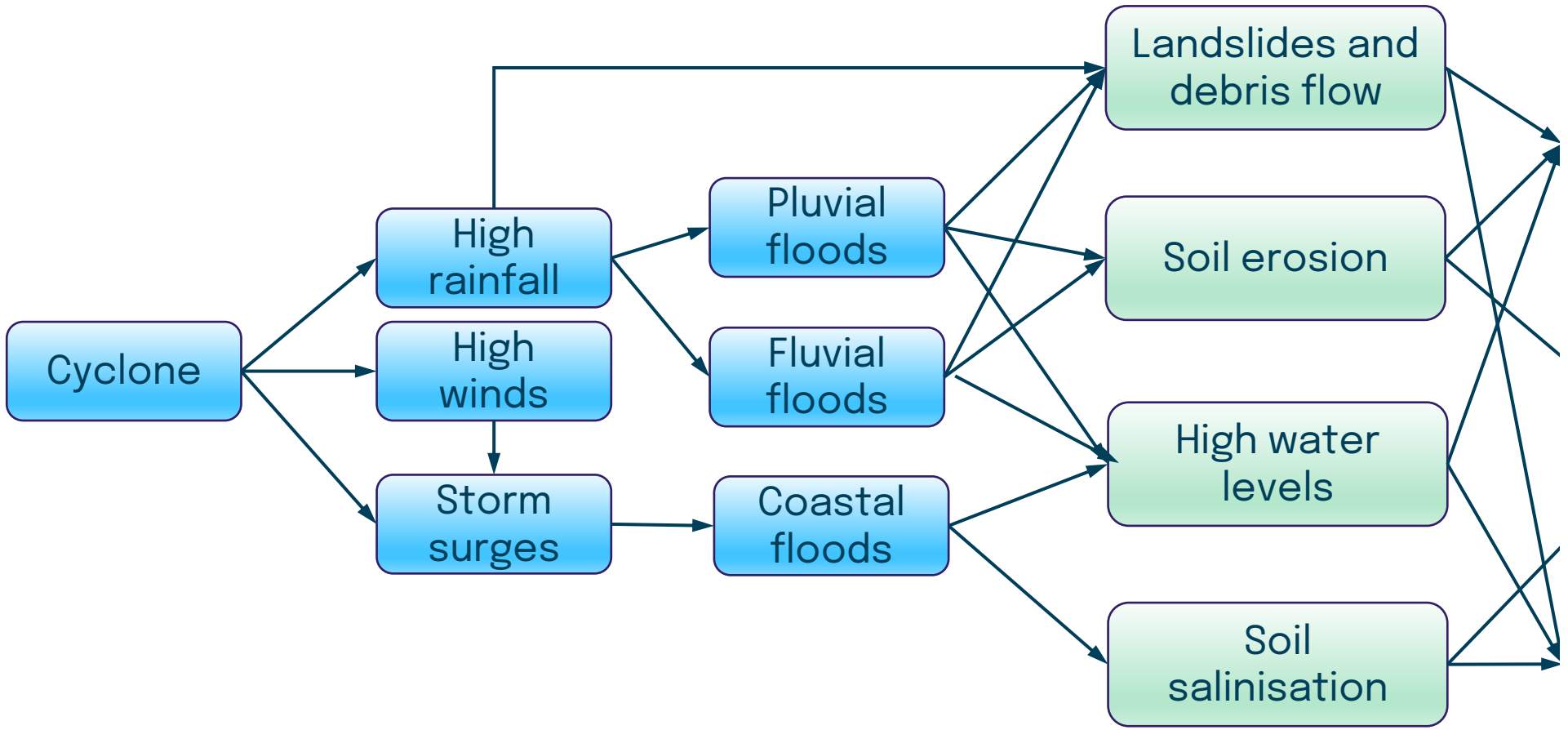
Cascading hazards and risks



Based on Lei et al., 2015

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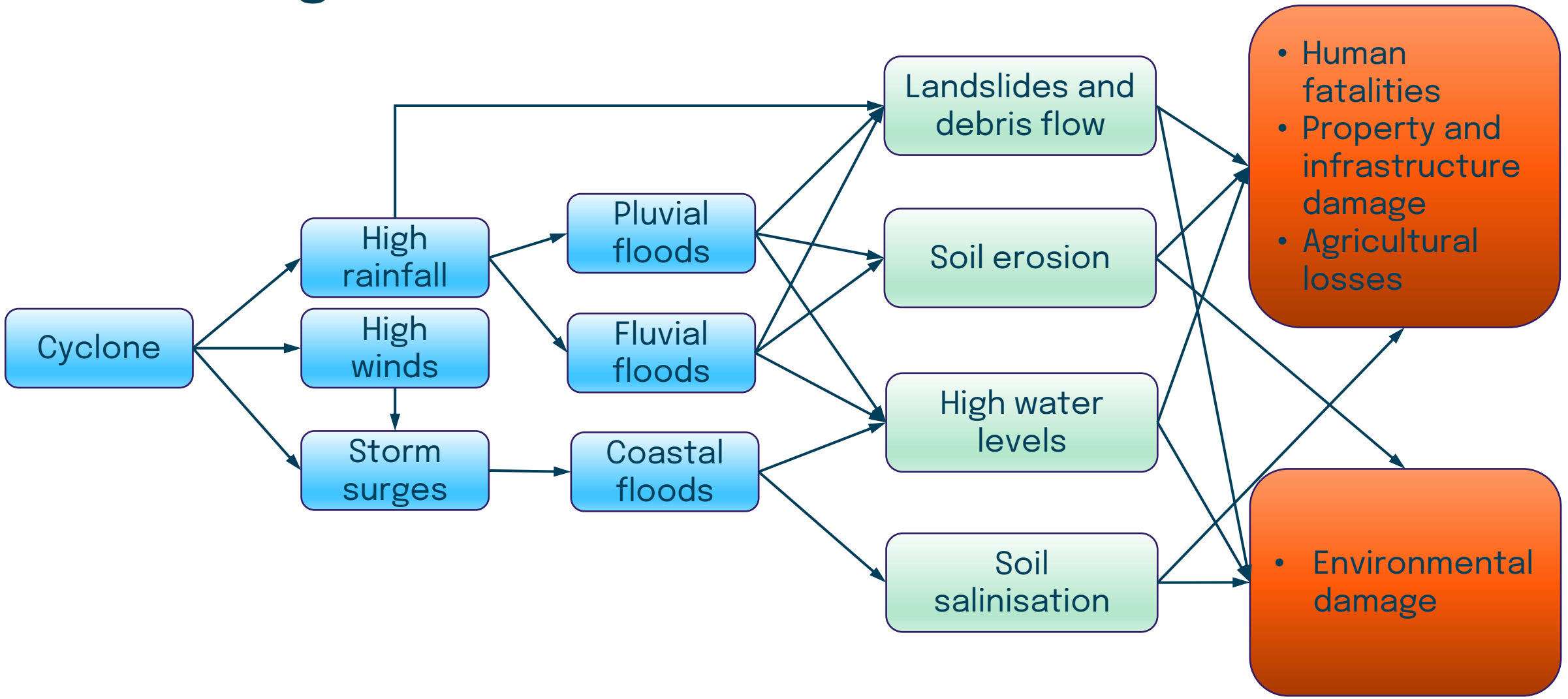
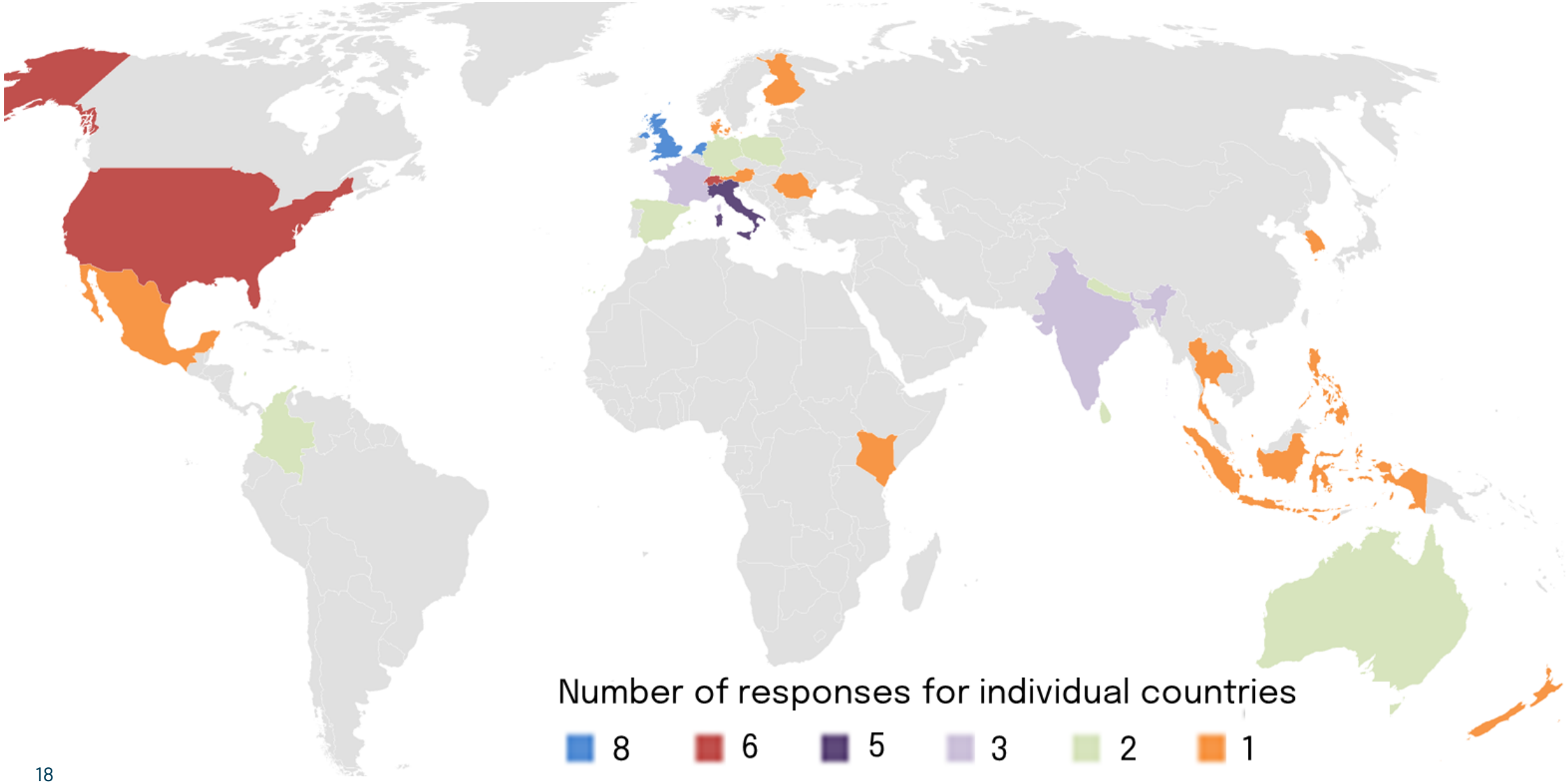
Cascading hazards and risks

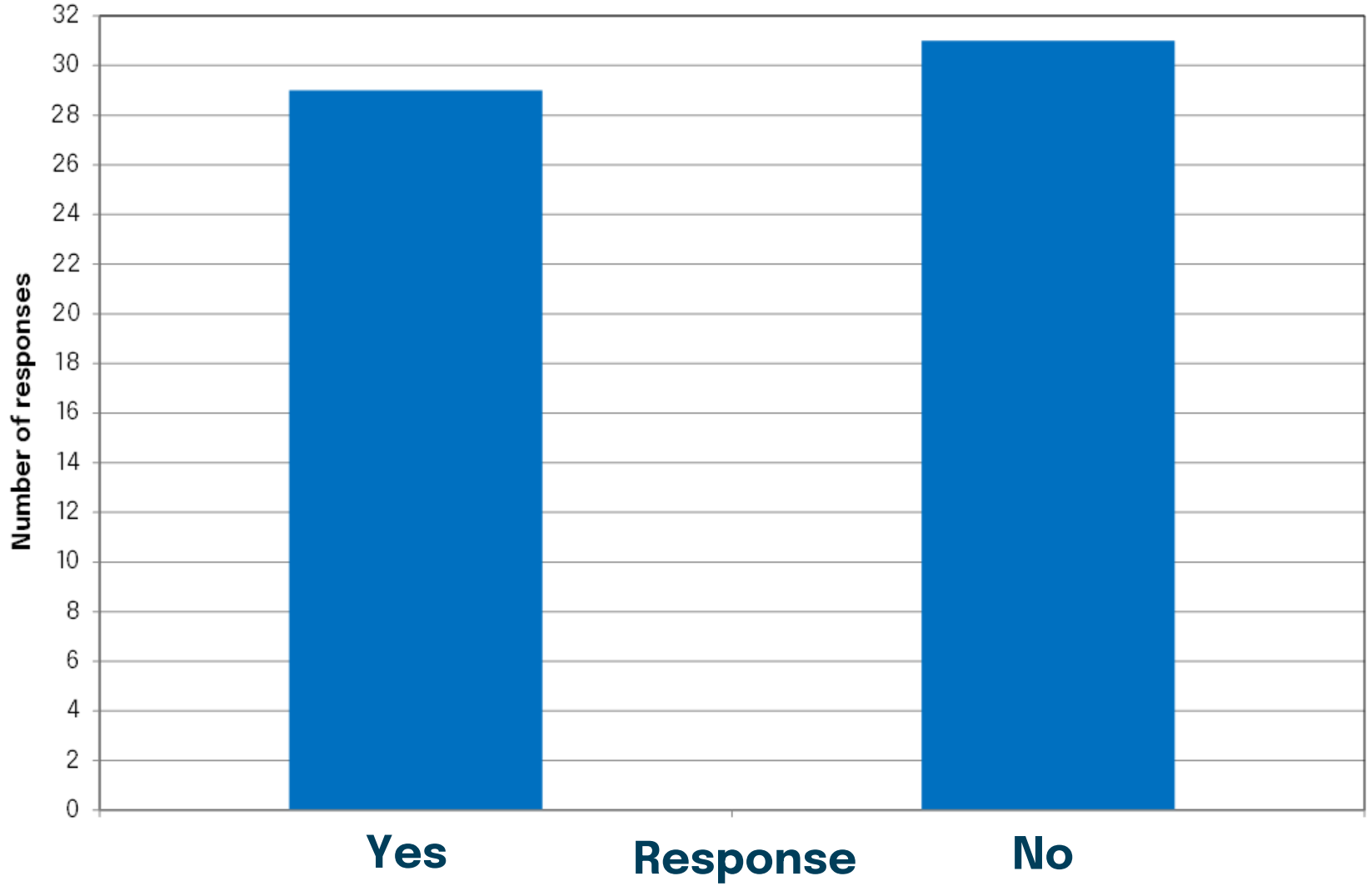


Adapted from Lei et al., 2015

Survey on Impact-based Forecasts and Warnings



Do you know of any examples of *operational Multi-risk Impact-based* Forecast and Warning systems for weather-related hazards



Does an operational multi-risk Impact-based Forecast and Warning systems for weather-related hazards really exist!?

"El Salvador has a truly multi-hazard early warning system in place. Covers geological, tsunami, and hydro-met hazards"

"There is the European Multi-Hazard Early Warning System (MHEWS) or the Global Disaster Alert and Coordination System (GDACS). Similar systems are run US NOAA and Chinese CMA"

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Does an operational multi-risk impact-based forecast and warning systems for weather-related hazards really exist!?

No!?

Why not?!

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Does an operational multi-risk impact-based forecast and warning systems for weather-related hazards really exist!?

- Complexity of development
- Incomplete data
- Funding issues
- Governance issues
- Research versus practical applications

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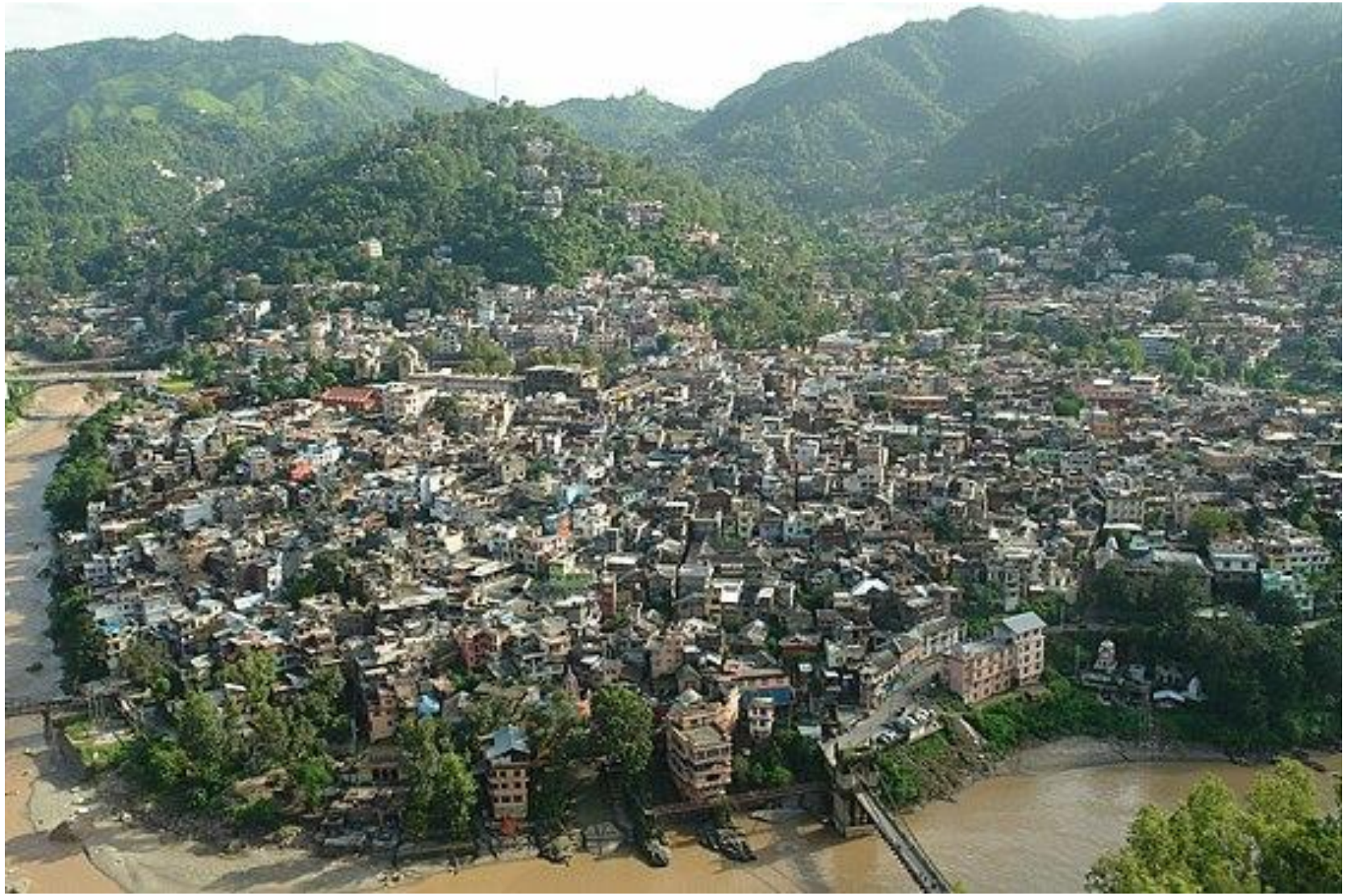
Interacting and compound hazards resulting in multiple risks

Approaches to multi-risk Impact-based Forecasts and Warnings - Mandi



Approaches to multi-risk Impact-based Forecasts and Warnings - Mandi

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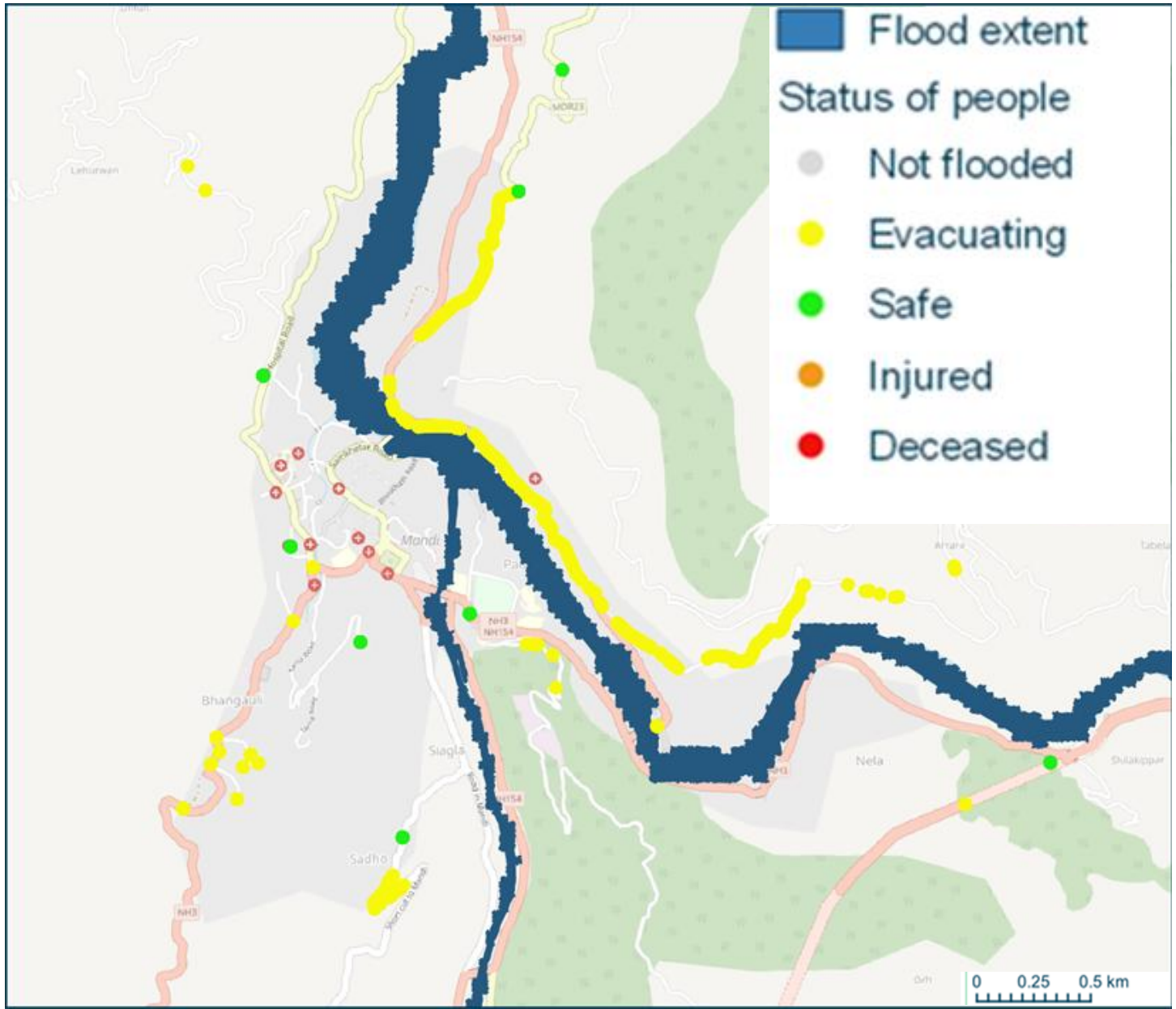
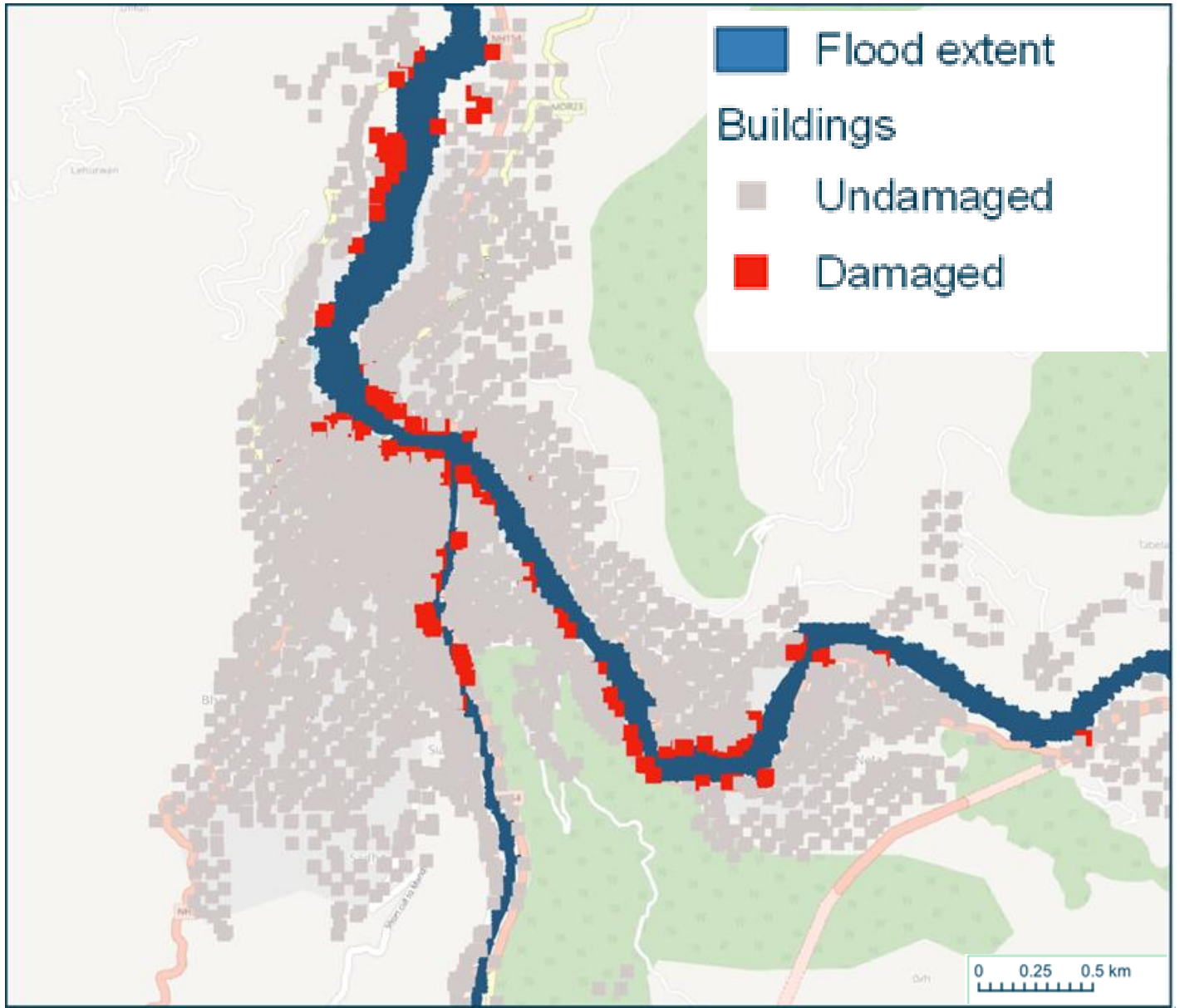
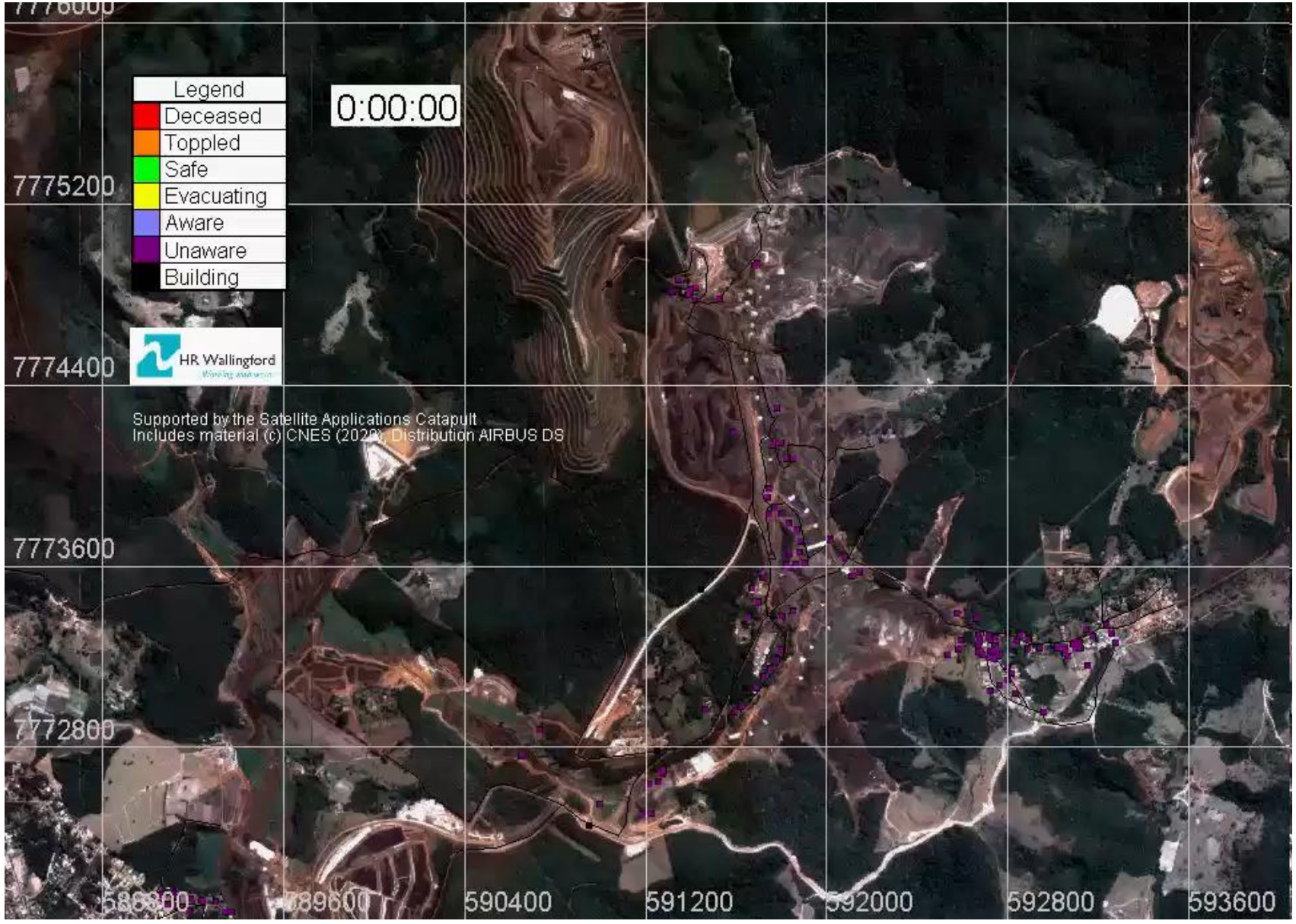
Agent-based modelling - Mandi



Agent-based modelling - Mandi



Risks to people



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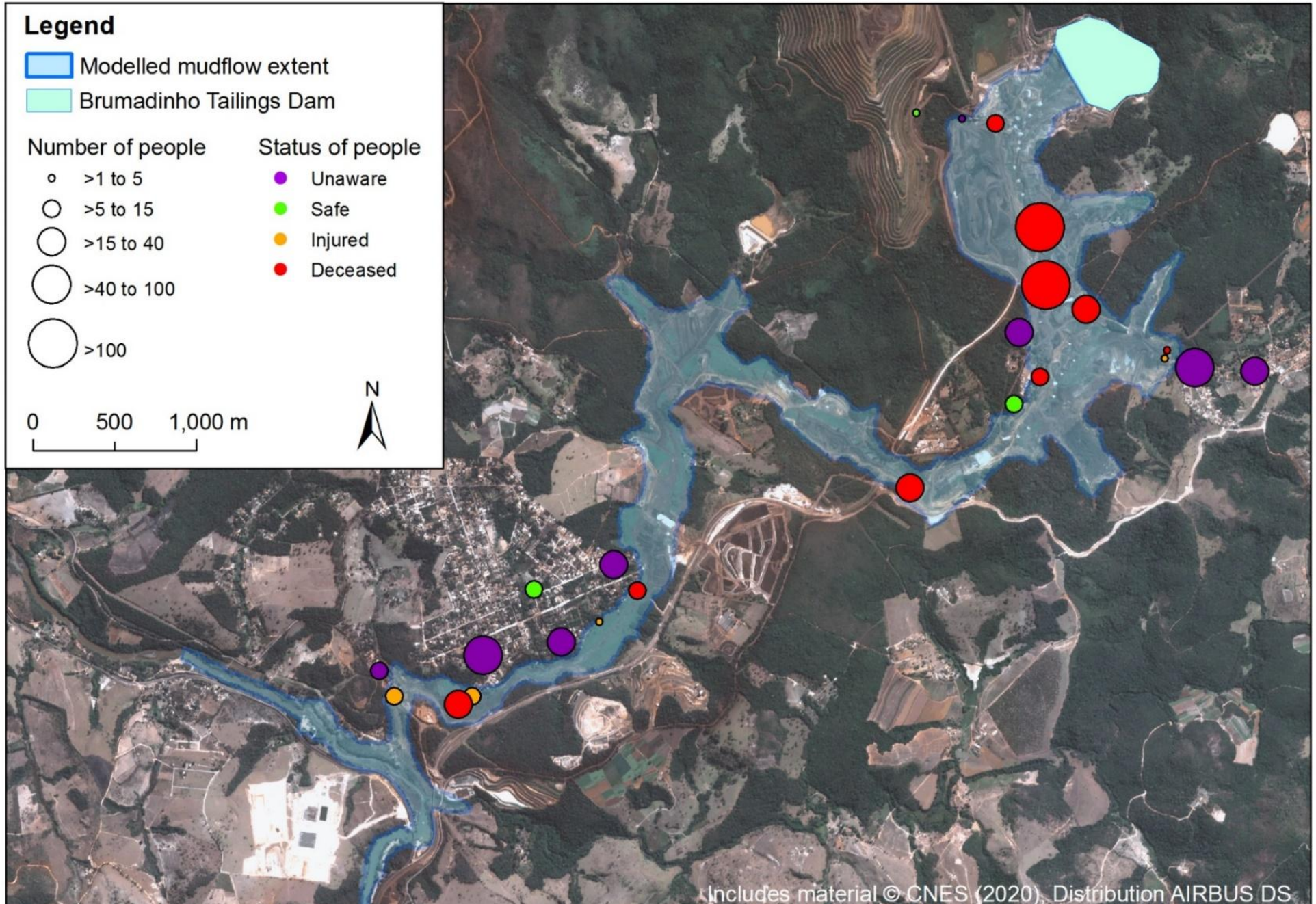
Risks to people



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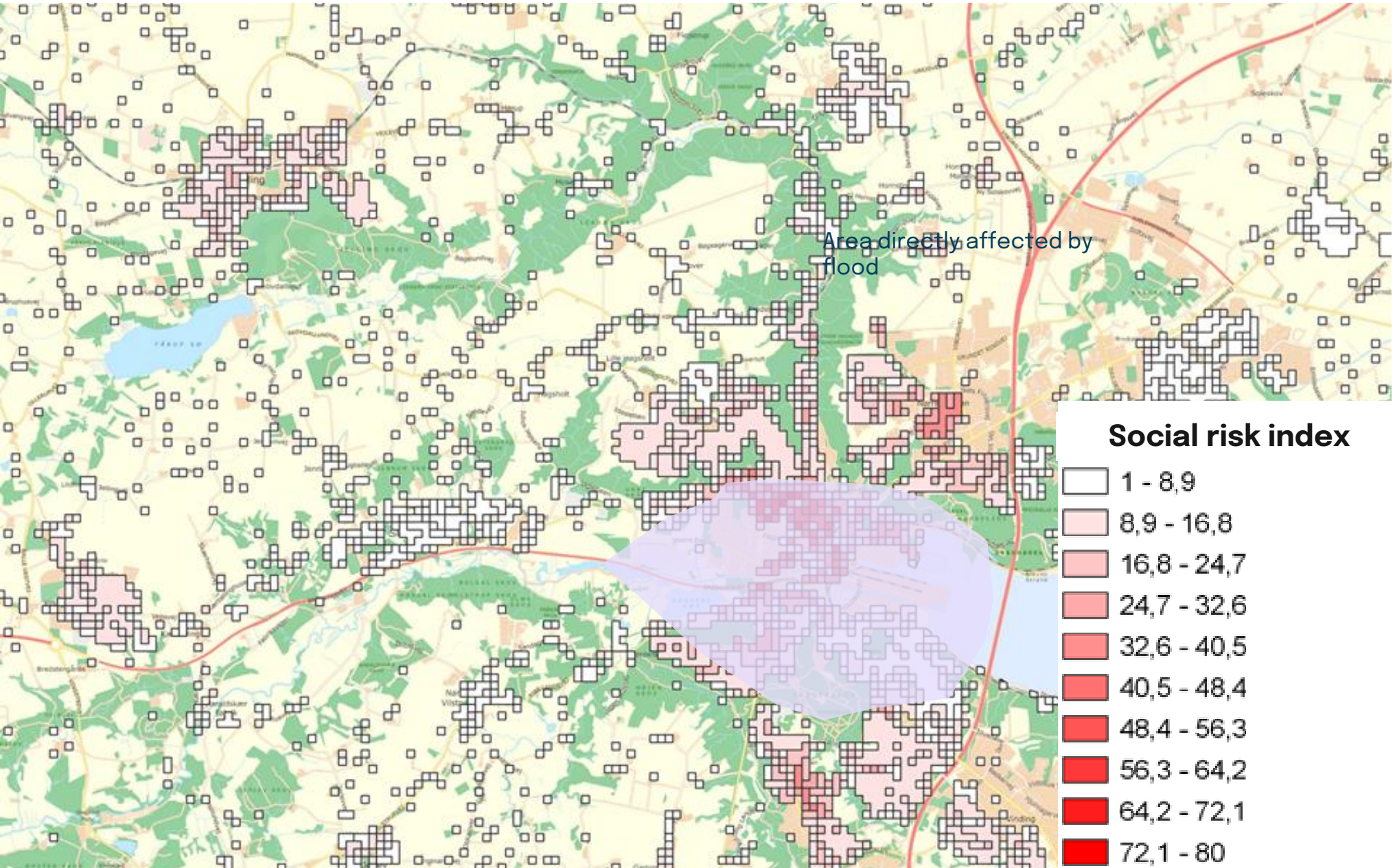
Vulnerability indices



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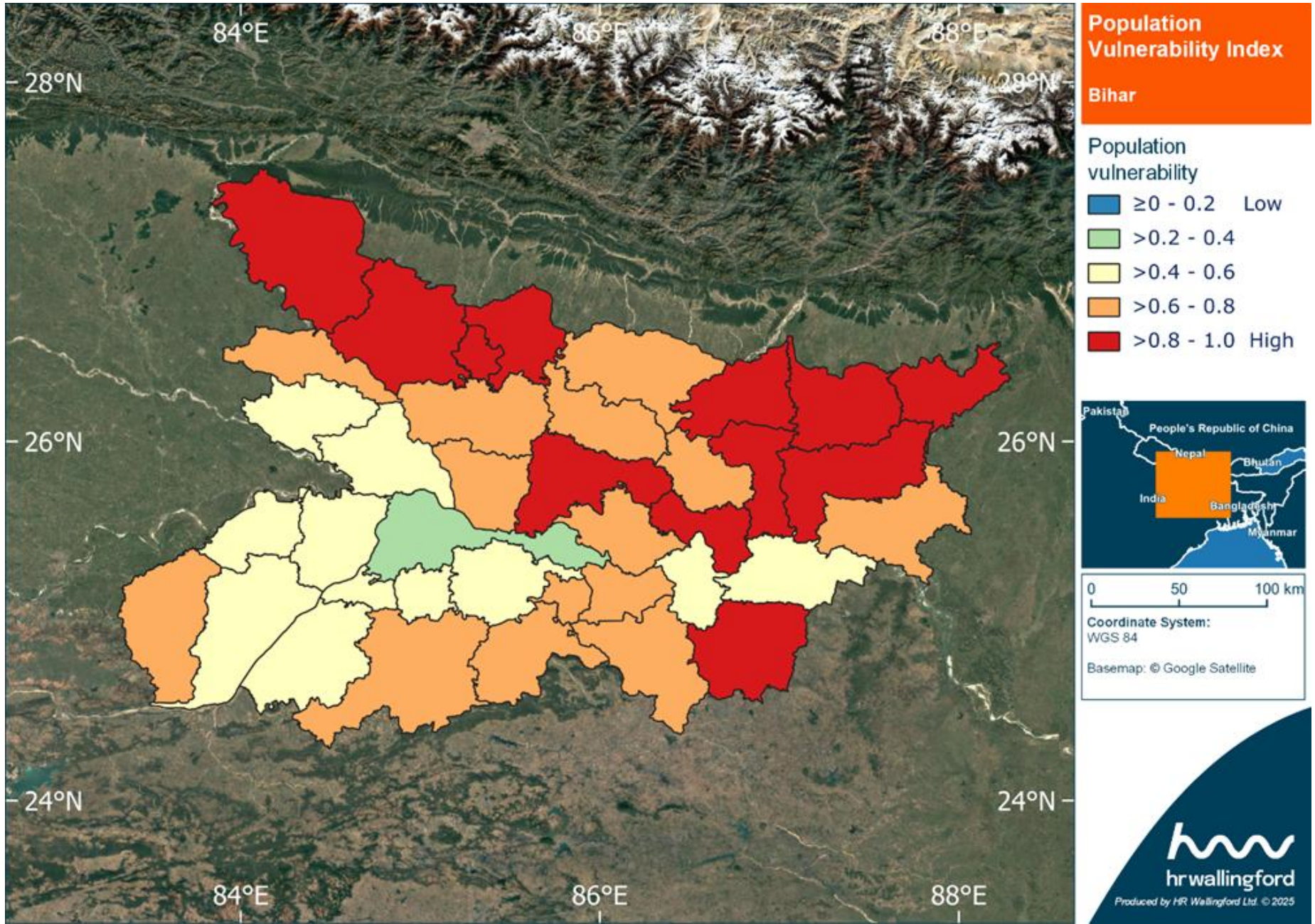
Vulnerability indices – Bihar



Population Vulnerability Index

Bihar

Population vulnerability

- ≥0 - 0.2 Low
- >0.2 - 0.4
- >0.4 - 0.6
- >0.6 - 0.8
- >0.8 - 1.0 High

0 50 100 km

Coordinate System:
WGS 84

Basemap: © Google Satellite

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Some final thoughts

- Do operational multi-risk impact-based forecast and warning systems exist?
- How to verify them?
- How to communicate multiple interrelated risks and to whom?

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Questions

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