



Natural Hazards in a Changing Climate

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Natural Hazards

Changing Weather Extremes

Changing Natural Hazards



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Natural Hazards

Natural phenomena that might have negative effects on humans or the environment

Geological

- ▶ (Earthquakes, volcanoes)
- ▶ Avalanches
- ▶ Landslides & Debris Flows
- ▶ Rock falls
- ▶ Floods
- ▶ (Meteorological extreme events)

Biological

- ▶ Epidemics & pandemics

National Risk Index, US Federal Emergency Management Agency

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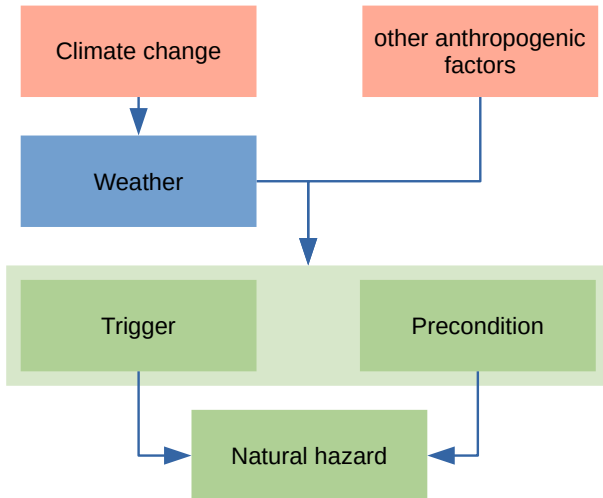
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Natural hazards and weather and climate



- ▶ How does weather precondition and trigger natural hazards?
- ▶ How does climate change alter these weather conditions?
- ▶ What is the relative role of climate change and other anthropogenic factors?



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Observed changes in hot and wet extremes

Since 1950; red/green: increase; grey: limited data; hatched: low agreement

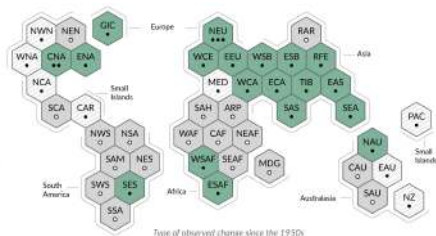
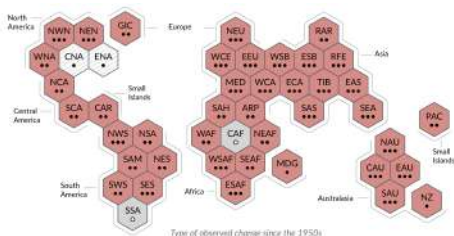


Fig SPM.3, Masson-Delmotte et al., IPCC, 2021; Seneviratne et al., IPCC, 2021

Projected changes in hot and wet extremes

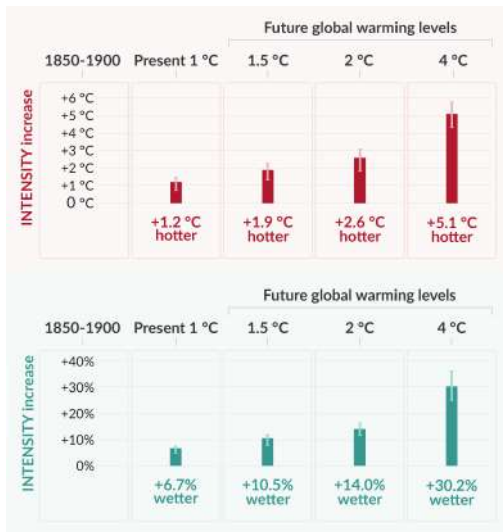
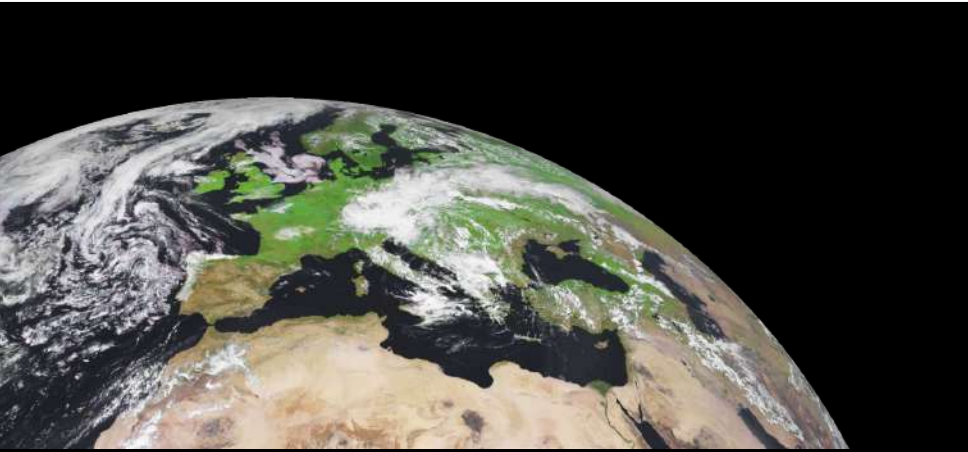


Fig SPM.3, Masson-Delmotte et al., IPCC, 2021; Seneviratne et al., IPCC, 2021

But regional changes are often still uncertain

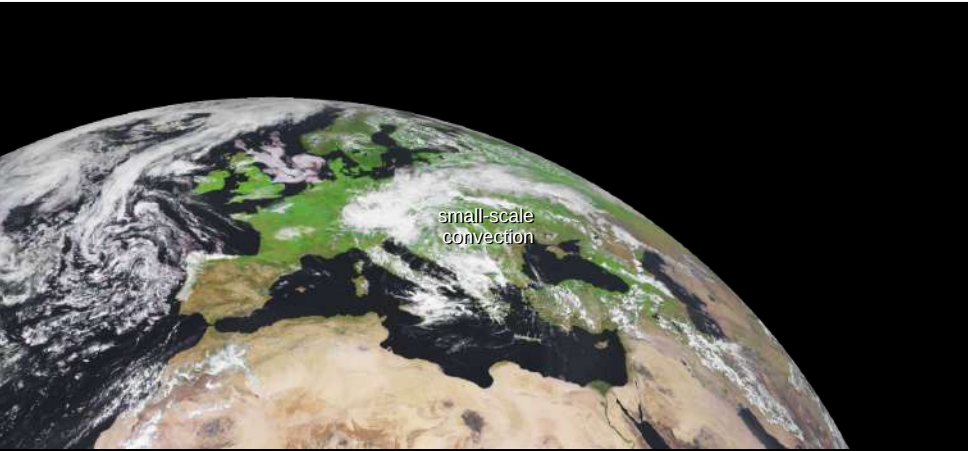
Processes governing extreme events in Europe - An incomplete sketch



EUMETSAT, inspired by Woollings, 2010

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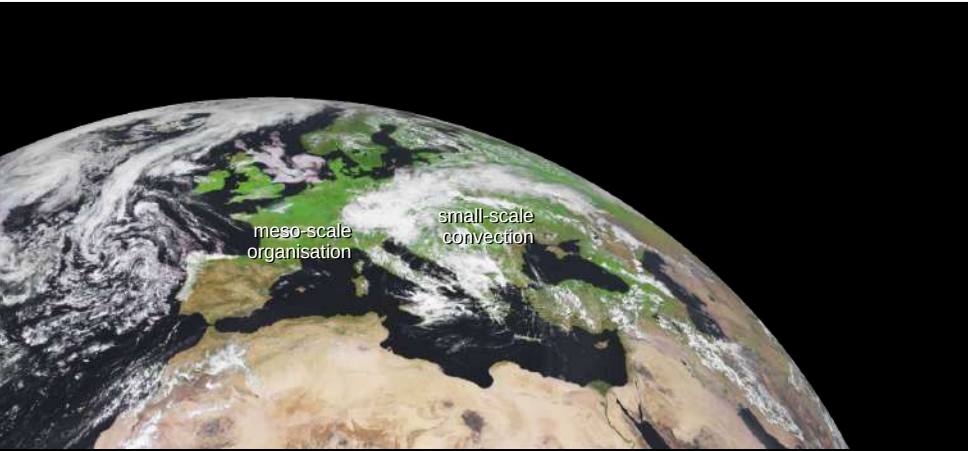
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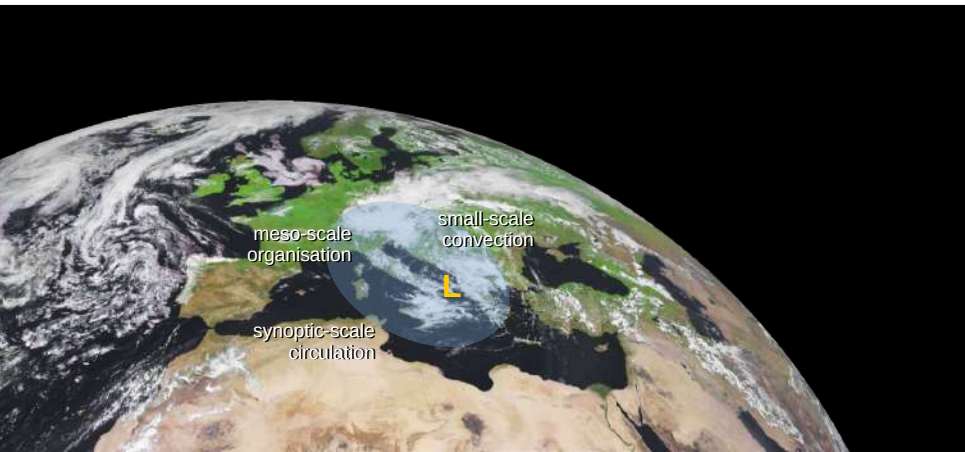
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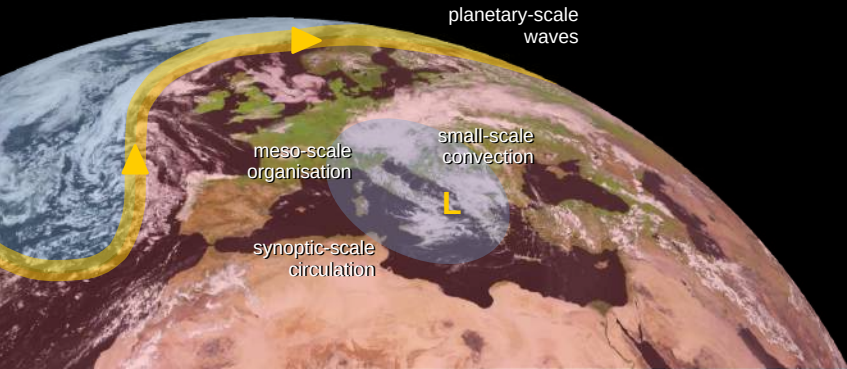
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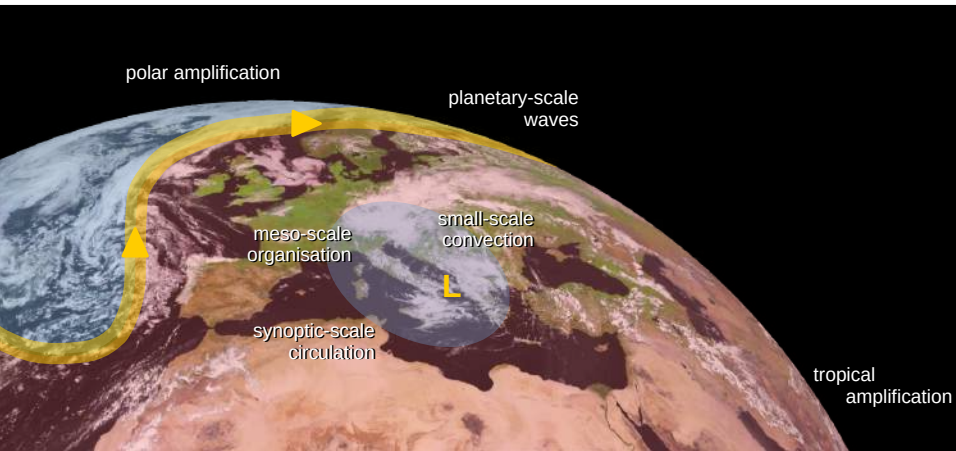
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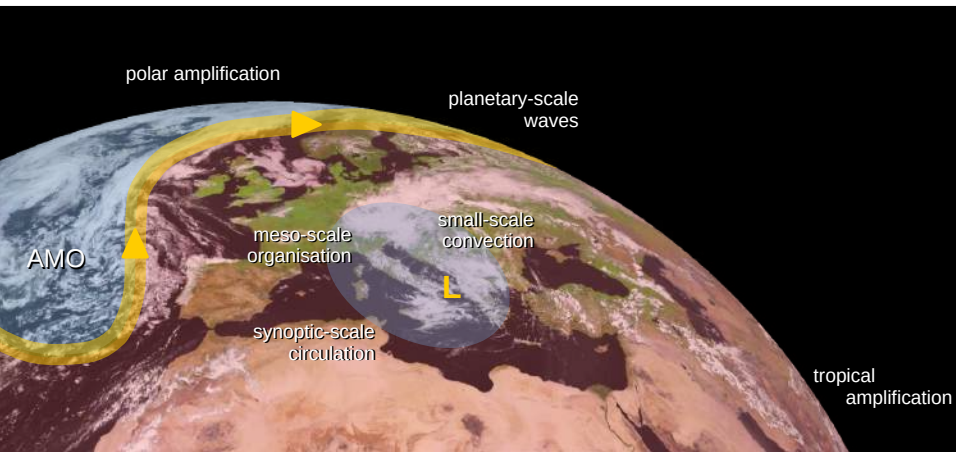
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Chapter 10

The spoil sports chapter

10

Linking Global to Regional Climate Change

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Francisco J. Doblas-Reyes (Spain), Anna A. Sörensson (Argentina)

Lead Authors:

Mansour Almazroui (Saudi Arabia), Alessandro Dosio (Italy), William J. Gutowski (United States of America), Rein Haarsma (The Netherlands), Rafiq Hamdi (Belgium), Bruce Hewitson (South Africa), Won-Tae Kwon (Republic of Korea), Benjamin L. Lampertey (Niger, Ghana/Ghana), Douglas Maraun (Austria/Germany), Tannecia S. Stephenson (Jamaica), Izuru Takayabu (Japan), Laurent Terray (France), Andrew Turner (United Kingdom), Zhiyan Zuo (China)

IPCC, Doblas-Reyes et al., 2021



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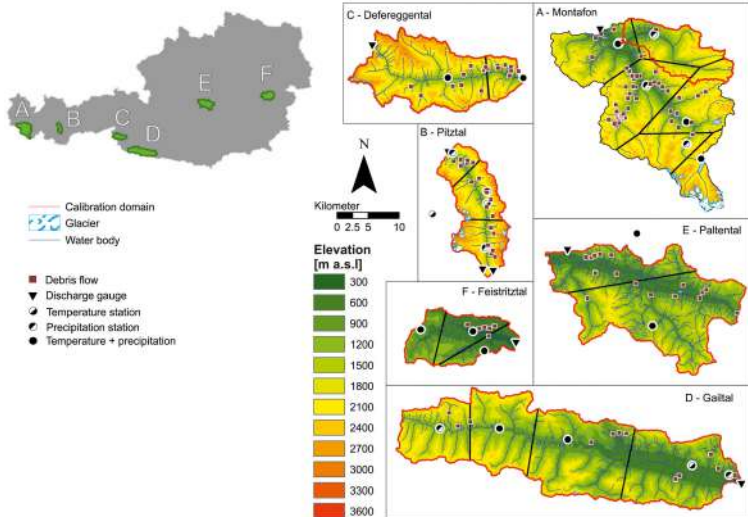


Changing Natural Hazards

Debris Flows

Debris flow in the Alps

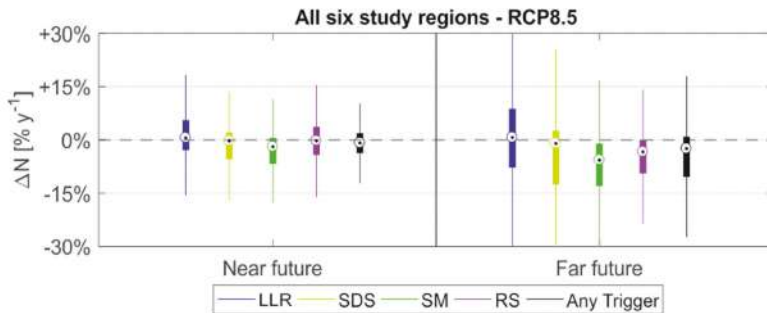
Assessment of changing triggering conditions



Kaitna et al., Science of the Total Environment, 2023

Debris flow in the Alps

Overall changes in triggering conditions, scenario RCP8.5, 2071-2100 vs. 1971-2000

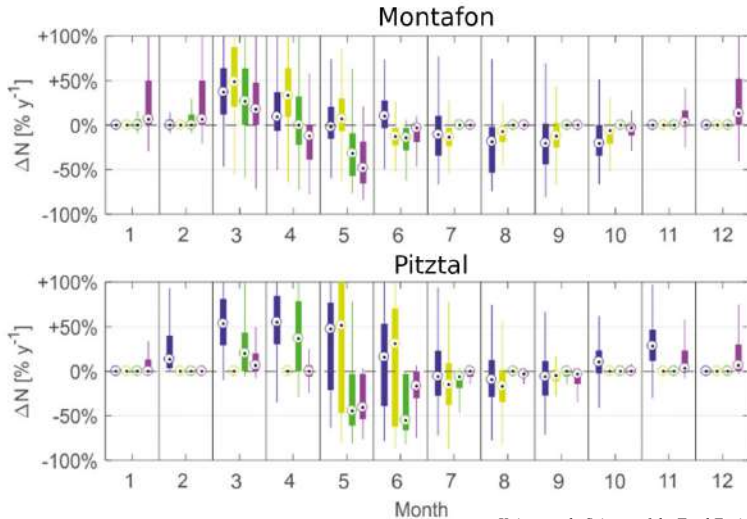


LLR: long lasting rain; SDS: short duration storms;
SM: snow melt; RS: rain on snow

Kaitna et al., Science of the Total Environment, 2023

Debris flow in the Alps

Seasonal changes in triggering conditions



Kaitna et al., Science of the Total Environment, 2023

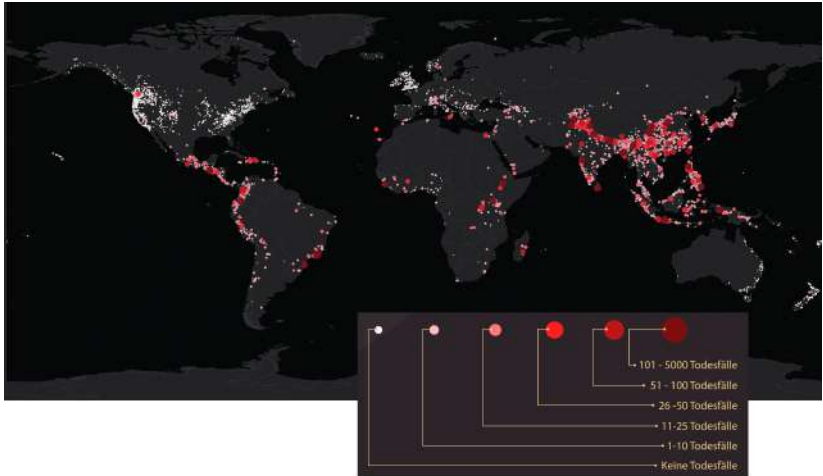


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Landslides

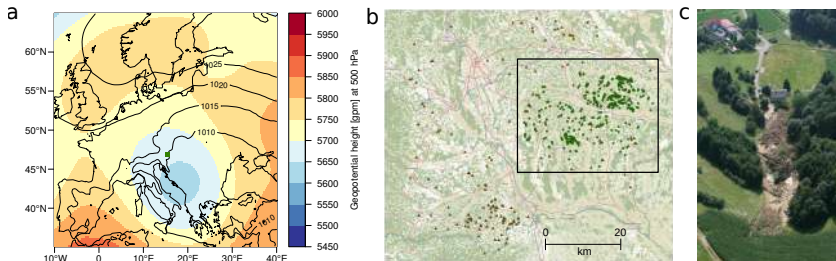
Fatalities from landslide events, 2007-2017

300 Mio people exposed, up to 18 BEUR per year damages



NASA's Scientific Visualization Studio

Feldbach region, Styria, June 2009



- Persistent cut-off low over the Adriatic;
- widespread heavy rain 22-25 June 2009 in Feldbach region;
- Some 3000 landslides triggered.

Research Questions



- ▶ What would be the hazard of a 2009 event in a warmer climate?
- ▶ What is the relative contribution of changes in rainfall and soil moisture to changes in the landslide hazard?
- ▶ What is the role of climate mitigation?
- ▶ How could land-use management reduce the hazard?

Maraun et al., Comms. Earth Env., 2022