Interreg Alpine Space

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Klimawandel + Auswirkungen auf den Wald

global bis lokal

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Klimawandel global

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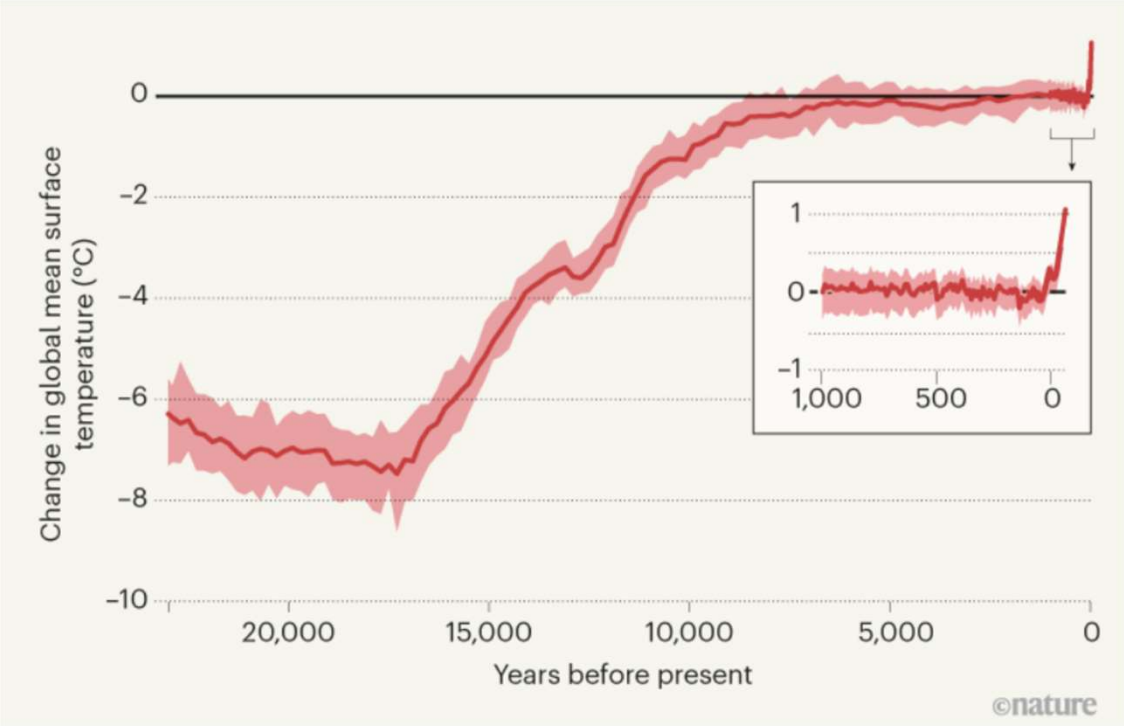

Figure 1 | Changes in the global mean surface temperature over the past 24,000 years. Osman *et al.*[2] combined proxy data — obtained indirectly through palaeoclimate records when direct data are unavailable — with climate models to compute the evolution of the difference in the global mean surface temperature relative to the average for the pre-industrial period of the past millennium (1000–1850). The shaded area represents a 95% confidence interval. (Adapted from Fig. 2 of ref. 2.)

Marcott & Shakun (2021) *Nature*

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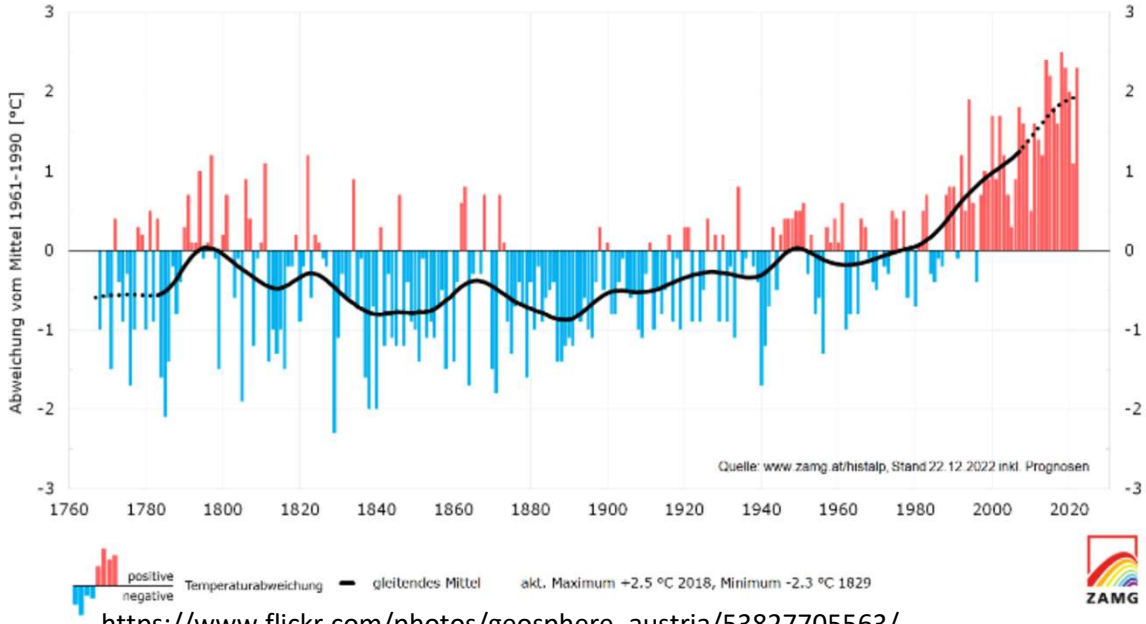
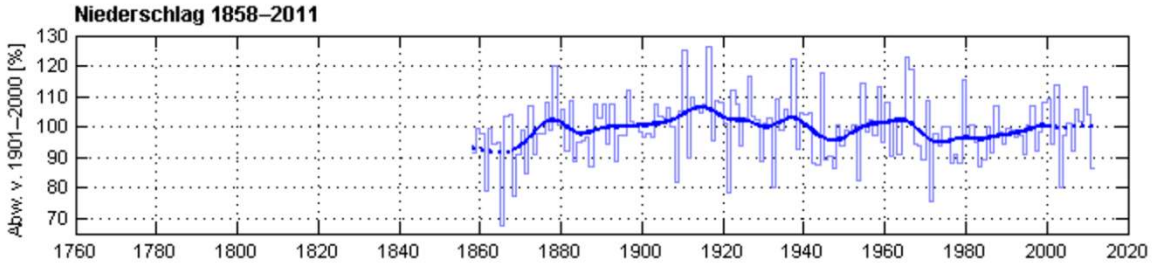
Klimawandel Alpen



https://www.flickr.com/photos/geosphere_austria/53827705563/



Auer (2007), *Int. Journal of Climatology*

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Mittelwerte vs Extreme

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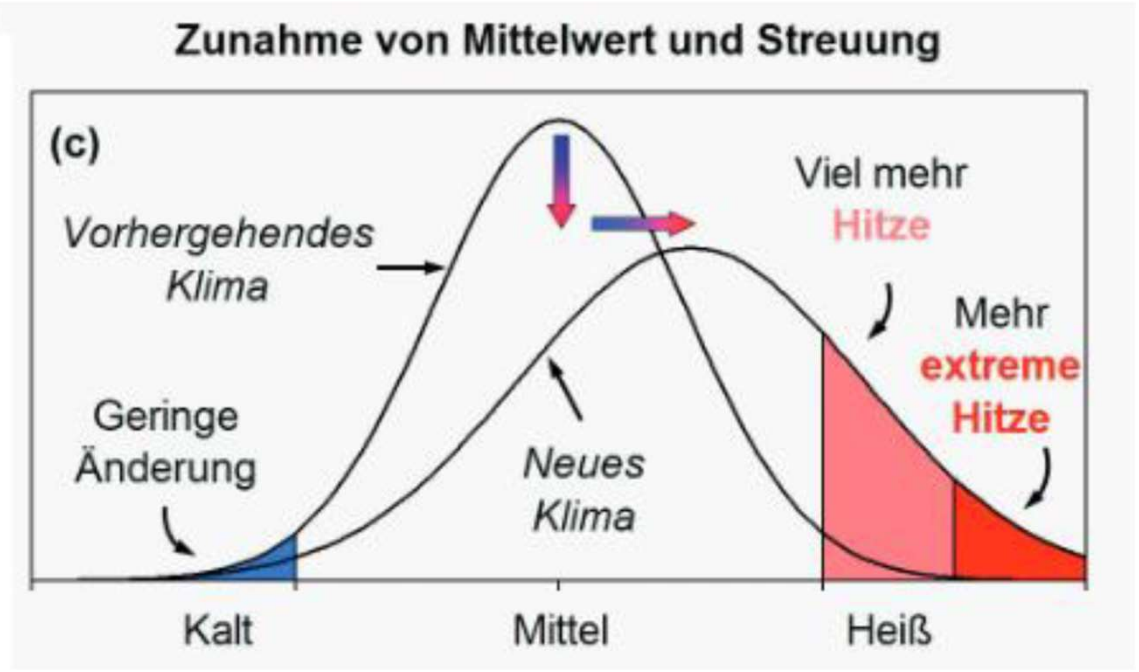
Auftreten von Klimaextremen

(Hitzewellen,Trockenperioden, Spätfröste,Starkniederschläge, Stürme)

Änderung von:

- ➢ Intensität
- ➢ Häufigkeit
- ➢ Dauer
- ➢ Zeitpunkt
- ➢ räumlichen Ausdehnung



Hupfer & Börngen (2004), *Naturwiss. Rdsch.*

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Klimarisiken Wald global

- Kohlenstoffsenke
- Biodiversität
- Waldschäden/-störungen
  - Waldbrände,
  - Dürre,
  - Schadinsekten/Krankheiten
  - Stürme

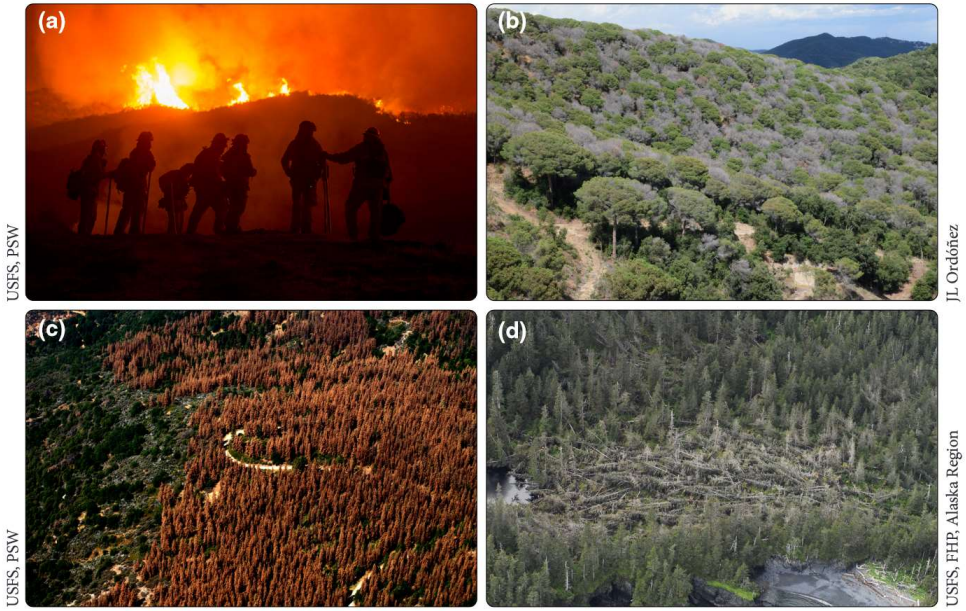

Figure 1. The primary climate-change-related hazards in forests are (a) wildfires, (b) drought, (c) insect outbreaks, and (d) windstorms.

Anderegg et al. (2022), *Science*,
Lecina-Diaz et al. (2021), *Front. Ecol. Environ.*

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Waldbrände

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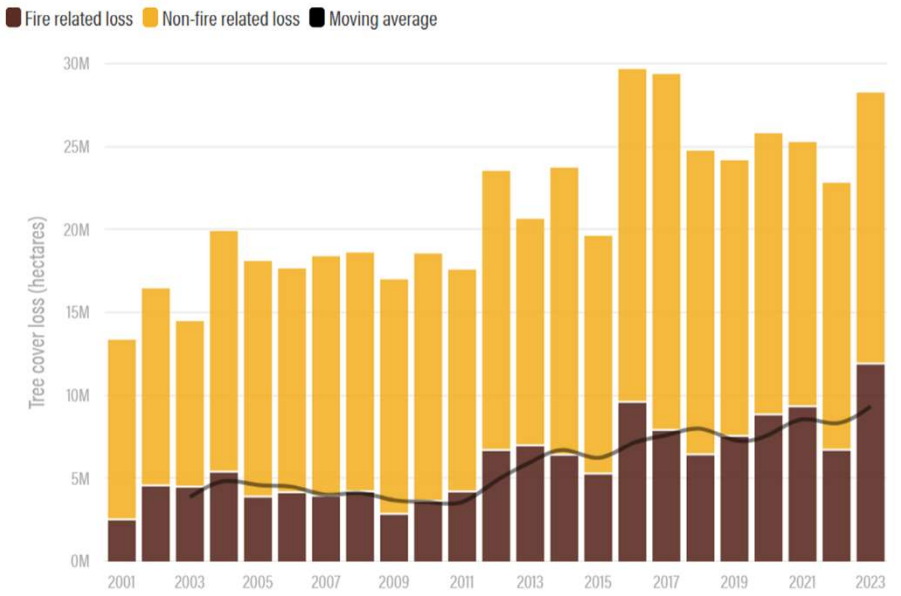
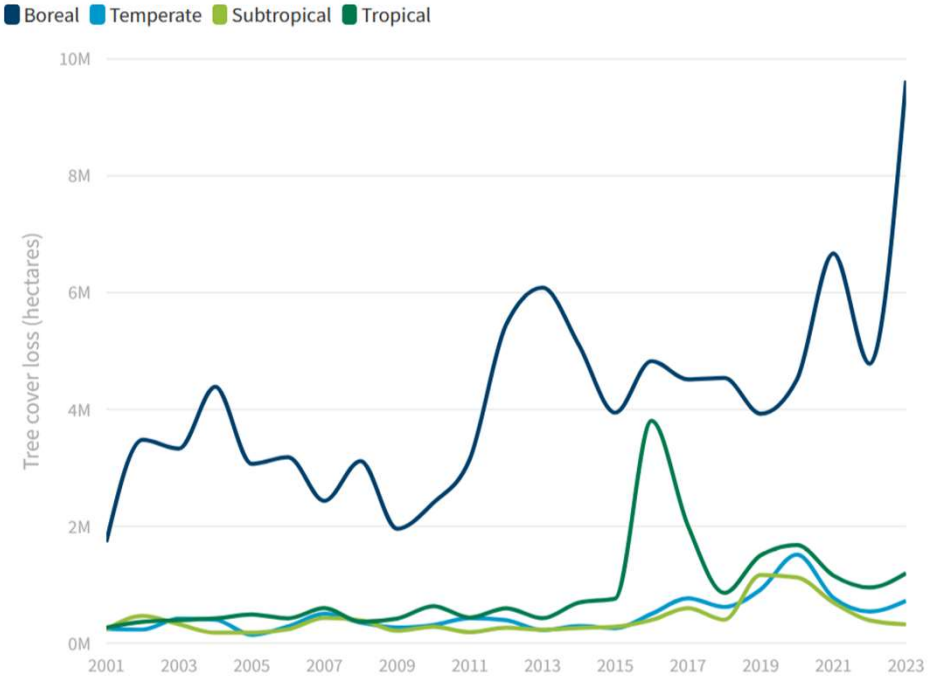
Tree cover loss due to fires compared to other drivers of loss, 2001-2023



Non-fire related loss can occur from mechanical clearing for agriculture and logging, as well as natural causes such as wind damage and river meandering. The three-year moving average may represent a more accurate picture of the data trends due to uncertainty in year-to-year comparisons. All figures calculated with a 30 percent minimum tree cover canopy density.

GLOBAL FOREST WATCH WORLD RESOURCES INSTITUTE

Annual tree cover loss due to fires by climate domain, 2001-2023



All figures calculated with a 30 percent minimum tree cover canopy density.

GLOBAL FOREST WATCH WORLD RESOURCES INSTITUTE

https://www.wri.org/insights/global-trends-forest-fires

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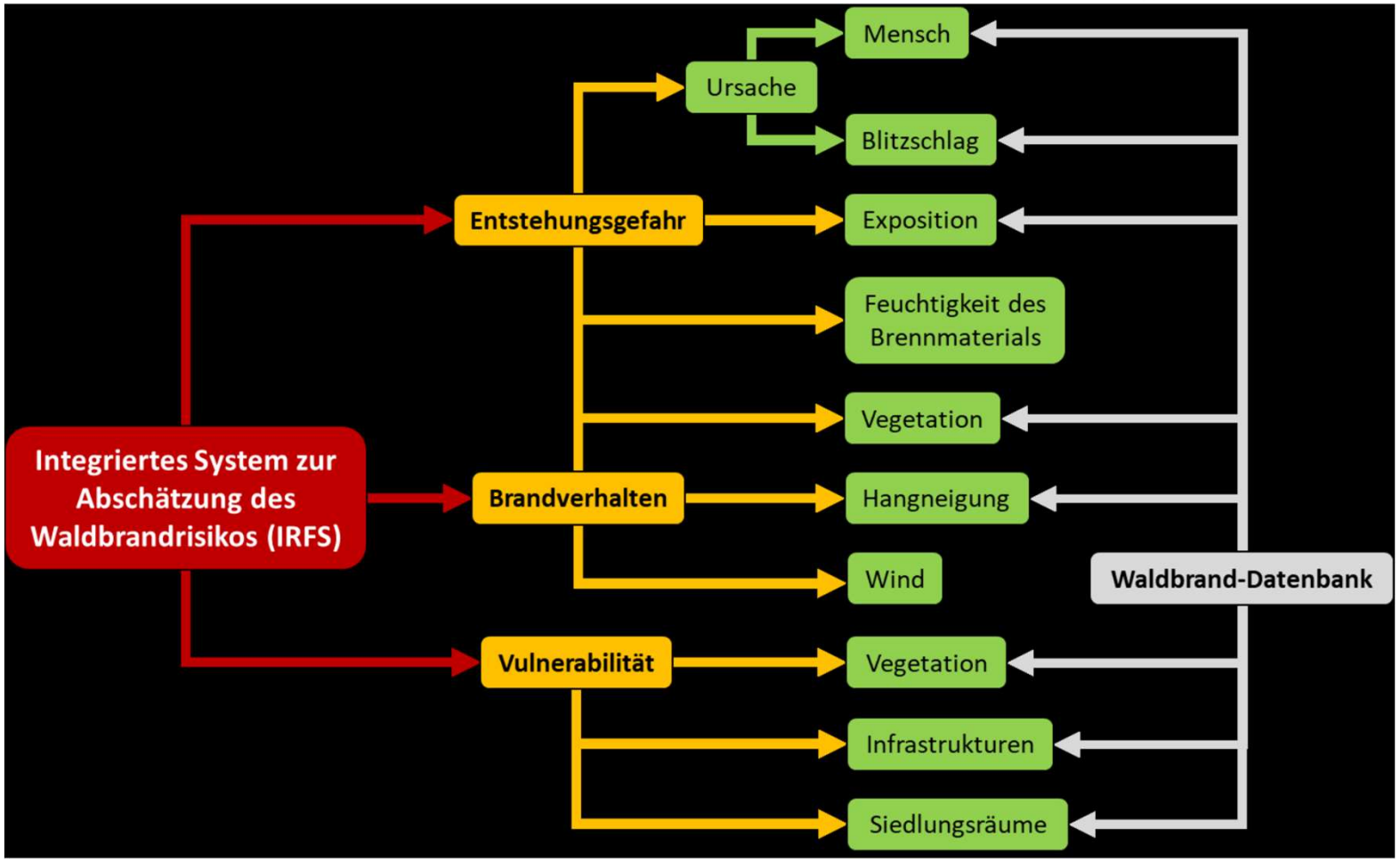
Waldbrand



https://fireblog.boku.ac.at/2020/12/28/waldbrand-risikokarte-oesterreich/

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Dürre

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Dürreschäden Fichte 2018-2020

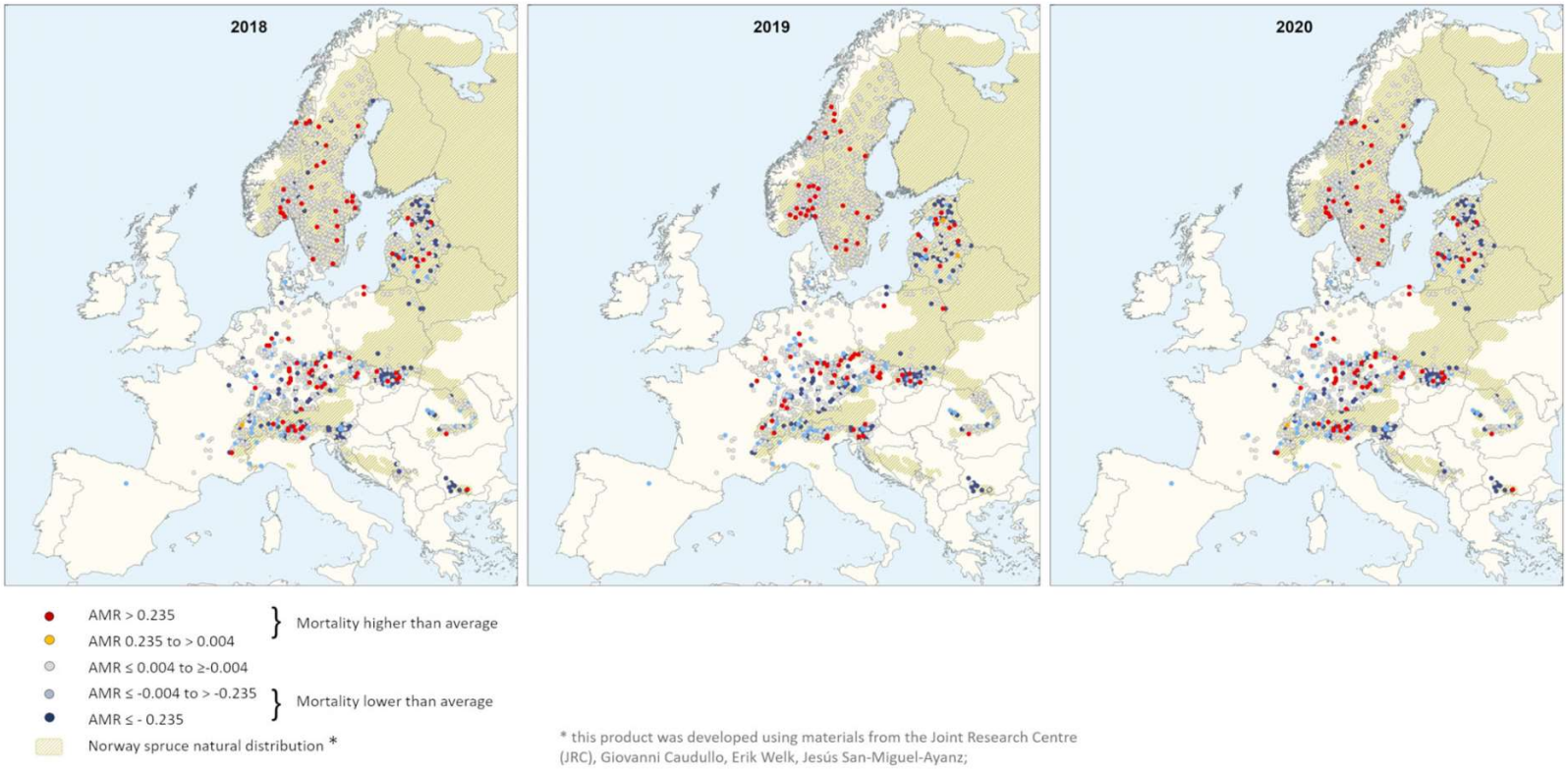

Fig. 4. Spatial variation of annual mortality from 2018–2020 for Norway spruce (*Picea abies*). Red and orange dots show plots with above-average mortality (referenced against average 1995–2020). Green area shows natural distribution of Norway spruce. Note that data were scaled for illustration and thresholds were chosen to enhance visibility across the entire range.

George et al. (2022), Plant Biology

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Stürme

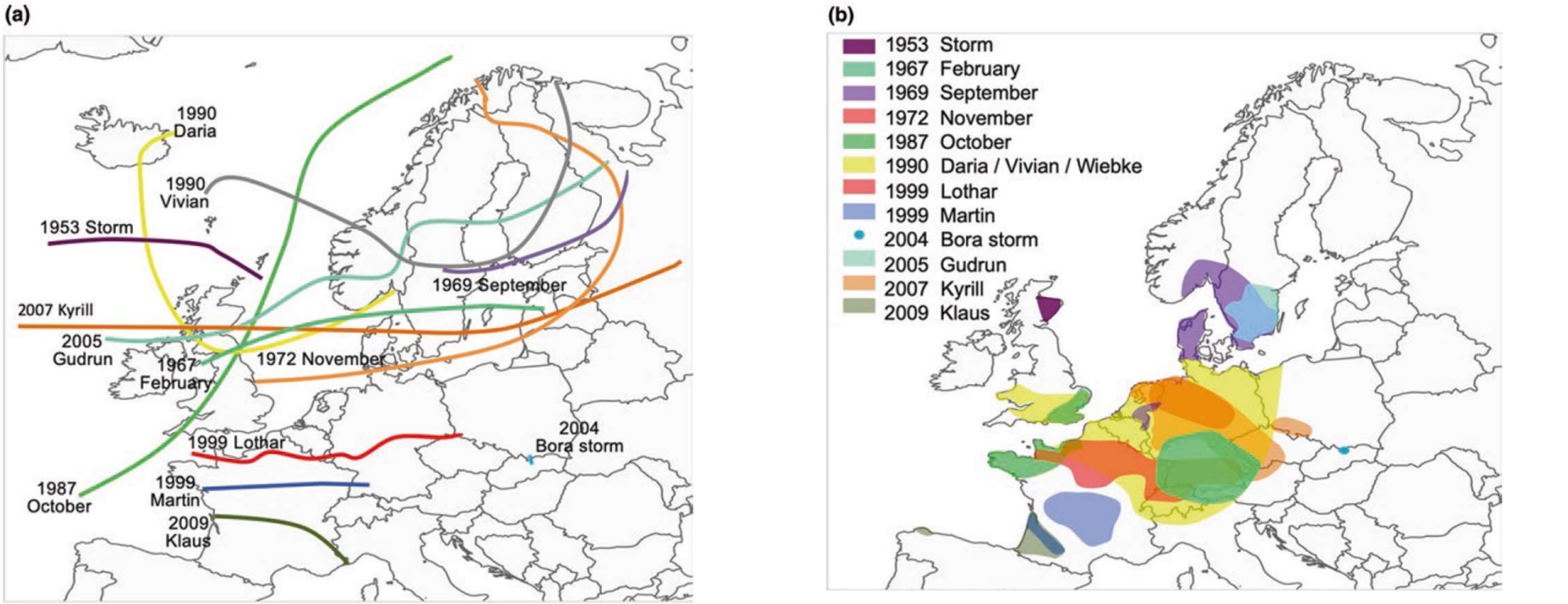

Fig. 8.3 (**a**) Paths of low-pressure systems (storms) in the winter months from 1961 to 2010. (**b**) Estimated areas affected by storms in the winter months from 1961 to 2010. (From Gardiner et al. 2010, modified)

Wohlgemuth et al. (2022), Disturbance Ecology, Springer

Stürmschäden

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Table 8.1 The 'most expensive' storms in Europe during the period 1980–2016. Country abbreviations according to ISO 3166-1

Date	Storm	Affected countries	Total losses in billion €[a]
26 December 1999	Lothar	AT, BE, CH, DE, FR	10.4
18–20 January 2007	Cyril	AT, BE, DE, DK, FR, NL, UK	9.0
25–26 January 1990	Daria	BE, DE, DK, FR, IE, LU, NL, PL, UK	6.2
26–28 February 2010	Xynthia (storm tide)	BE, CH, DE, ES, FR, LU, NL, PT	5.5
7–9 January 2005	Erwin (Gudrun)	DE, DK, EE, FI, LV, NO, SE, UK	5.4
15–16 October 1987	Not named	IT, FR, NO, UK	4.8
24–27 January2009	Klaus	ES, FR, IT	4.6
27 December 99	Martin	ES, CH, FR	3.7
25–27 February 1990	Vivian/Wiebke	AT, BE, CH, DE, FR, IT, NL, UK	2.8
3–4 December 1999	Anatol	DE, DK, LT, LV, RU, PL, SE, UK	2.8
27–30 October 2013	Christian	BE, DE, DK, FR, NL, SE	2.2

Source: Munich RE, http://natcatservice.munichre.com

[a]Exchange rate June 2014: $1 = €0.9

Wohlgemuth et al. (2022), Disturbance Ecology, Springer

Schadholz (m^3):
Lothar/Martin 240 Mio,
Viviane 60-70 Mio,
Gudrun 75 Mio,
Kyrill 66 Mio,
Vaia 6-8 Mio.

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Table 12.1 Major mass outbreaks of the European spruce bark beetle (*Ips typographus*) in Central and northern Europe. For comparison, information on the historic outbreak of the mountain pine beetle (*Dendroctonus ponderosae*) in North America is also provided

Region	Period	Trigger	Infested timber (million m³)	Infested area (km²)	Source
Ips typographus L.					
Central Europe	1942–1951	Heat, drought, storms, snow breakage, war effects, clear-cuts	25[a]		Wellenstein (1954)
Southern Norway	1971–1981	Storm, drought	5		Bakke (1989)
Sweden	1990–1996	Storm, drought	4.5		Kärvemo and Schroeder (2010)
NP Bavarian Forest (Germany)	1988–2010	Thunderstorms, drought		58	Lausch et al. (2013)
Switzerland	1990–1996	Storms Vivian/Wiebke	2		Stadelmann et al. (2014b)
Europe	1990–2001	Various storms	31.6		Grégoire and Evans (2004)
Austria	1992–1999	Storms Vivian/Wiebke	10.7[b]		Hoch et al. (2016)
Germany	1999–2005	Storm Lothar, drought	14.5		R. John (unpubl.)
Switzerland	2000–2007	Storm Lothar, drought	8		Stadelmann et al. (2014b)
France	2001–2008	Various storms	3.6		Nageleisen (2009)
Austria	2003–2012	Foehn storm, storm Kyrill	21.6[b]		Hoch et al. (2016)
Sweden	2006–2011	Storm Gudrun	3.2		Kärvemo and Schroeder (2010)
Germany	2009–2015	Storm Kyrill	9		R. John (unpubl.)
Czech Republic	2015–>2019	Heat, drought	>48		Hlásny et al. (2021)
Dendroctonus ponderosae Hopk.					
British Columbia (Canada)	1990–2015	Drought	700	183,000	Corbett et al. (2016)

[a]Total of bark beetles on spruce and fir
[b]Including *Pityogenes chalcographus*

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Borkenkäfer

Wohlgemuth et al. (2022), Disturbance Ecology, Springer

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Borkenkäfer Pustertal

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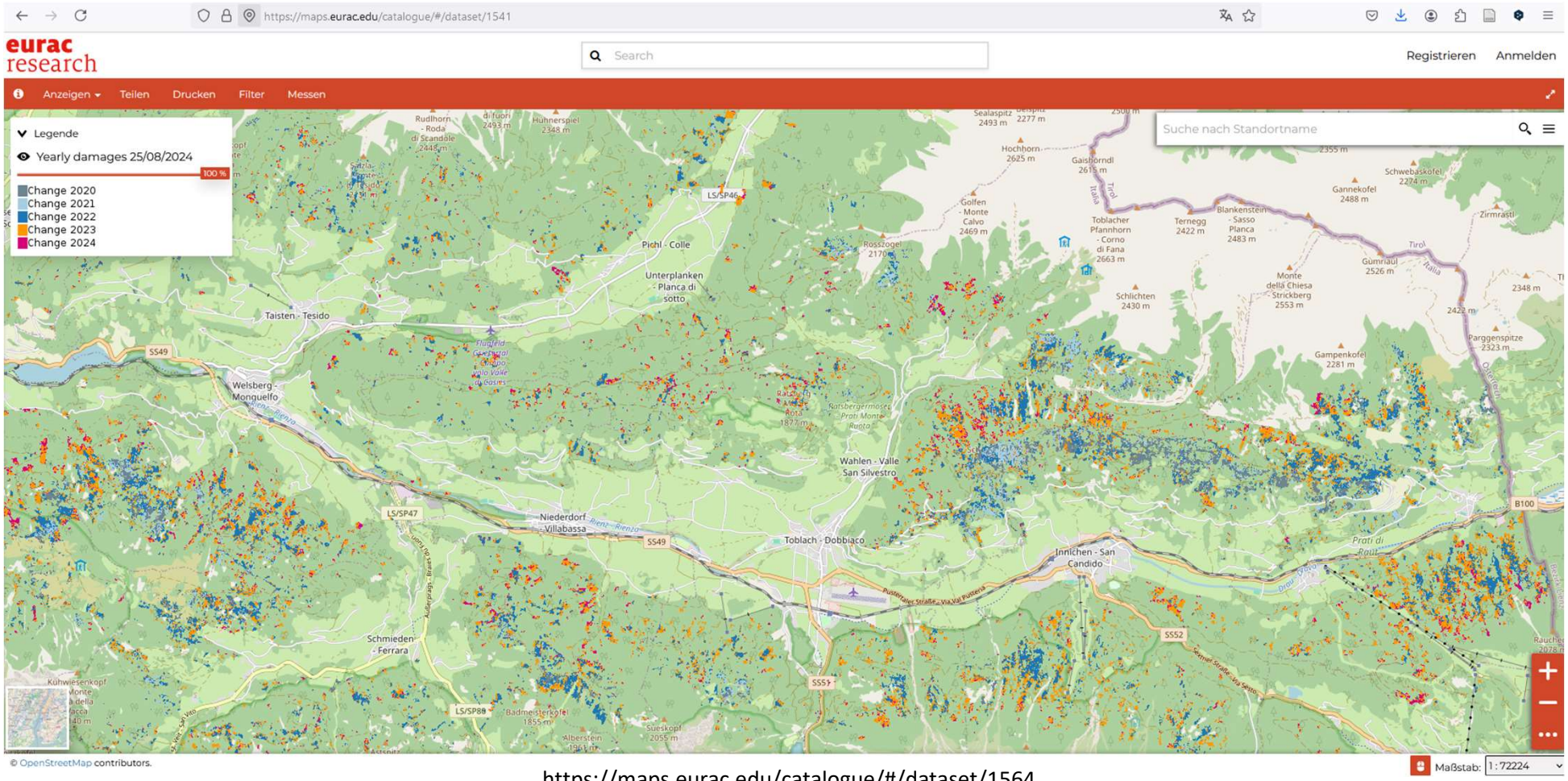

https://maps.eurac.edu/catalogue/#/dataset/1564

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Photo: Aymeric Voyez

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