biogeografie
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Linking Earth Observation with Emerging Risks of Wildfires in European Temperate Forests

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University of Bayreuth, Germany

LifeWatch ERIC

Thematic Service Workshop - Biogeography
4.-5. April 2024 Bologna, Italy

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
A.D. 1088

Structure

- Aim and scope
- Wildfires in forests as natural disturbances
- Defining the temperate forest biome in Europe
- Biodiversity and functioning of the temperate forest
- Detecting wildfires in the European temperate forest
- Impact of climate change on wildfires
- Alternatives ?
- Diversity and resilience
- Management options

Aim and Scope

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Aim and Scope

Biodiversity loss and **climate change**

cannot be seen in isolation.

Emerging economic societal losses and risks!

Unused options to counteract!

Knowledge needs to be translated into action!

Aim and Scope

Investigate the **biogeographical background** for

emerging risks of forest fires in

European **temperate deciduous broadleaved forest**.

Protect **human beings, economy, infrastructure**

and **nature**.

Provide **adaptation strategies to a changing environment**.

Aim and Scope

Biogeography can:

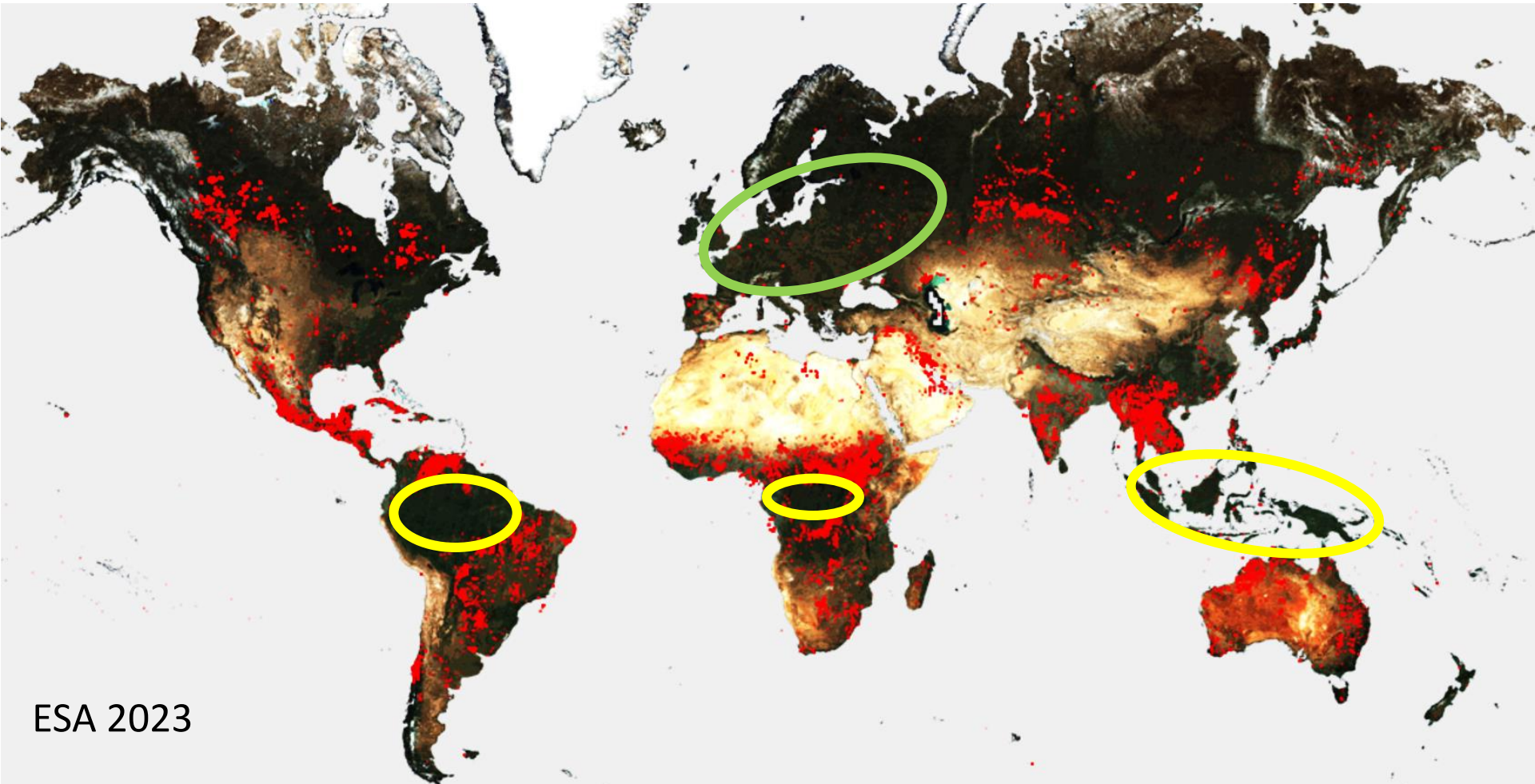
- *Illustrate* the need for **continental perspectives**
- *Condense* **spatial patterns** from **biodiversity data bases**
- *Understand* temperate **forest history and ecology**
- *Link* **remote sensing** on ecosystems with fire incidents
- *Conclude* on **future novel risks** to society

Wildfires

Wildfires

Wildfires in forests are a global phenomenon

Wildfires between May 2016 and June 2023 recorded by the Sea and Land Surface Temperature Radiometer (SLSTR) on board the Copernicus Sentinel-3A satellite.



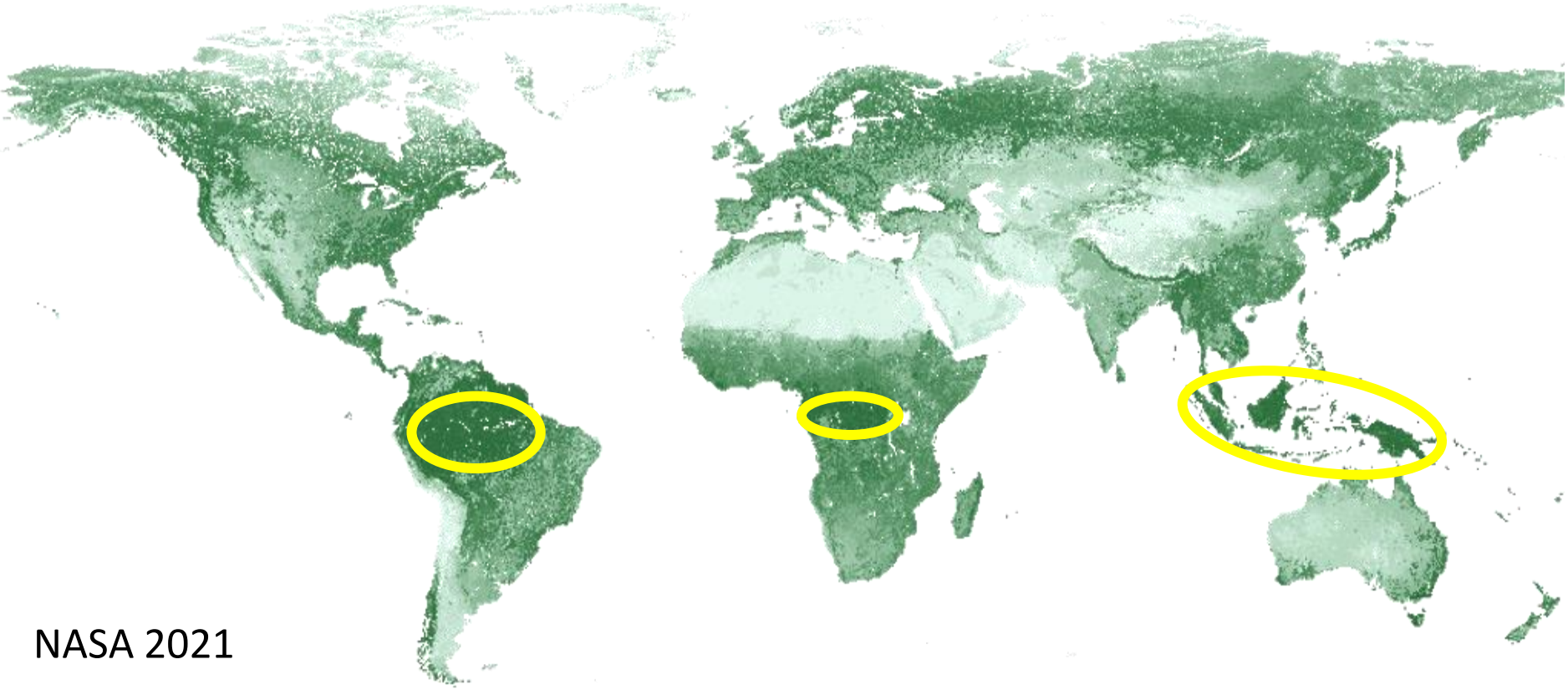
ESA 2023

Biomass

Fires are dependent on fuel

Above ground biomass indicated by carbon density (ORNL DAAC).

Mismatch in the **tropical rain forest**



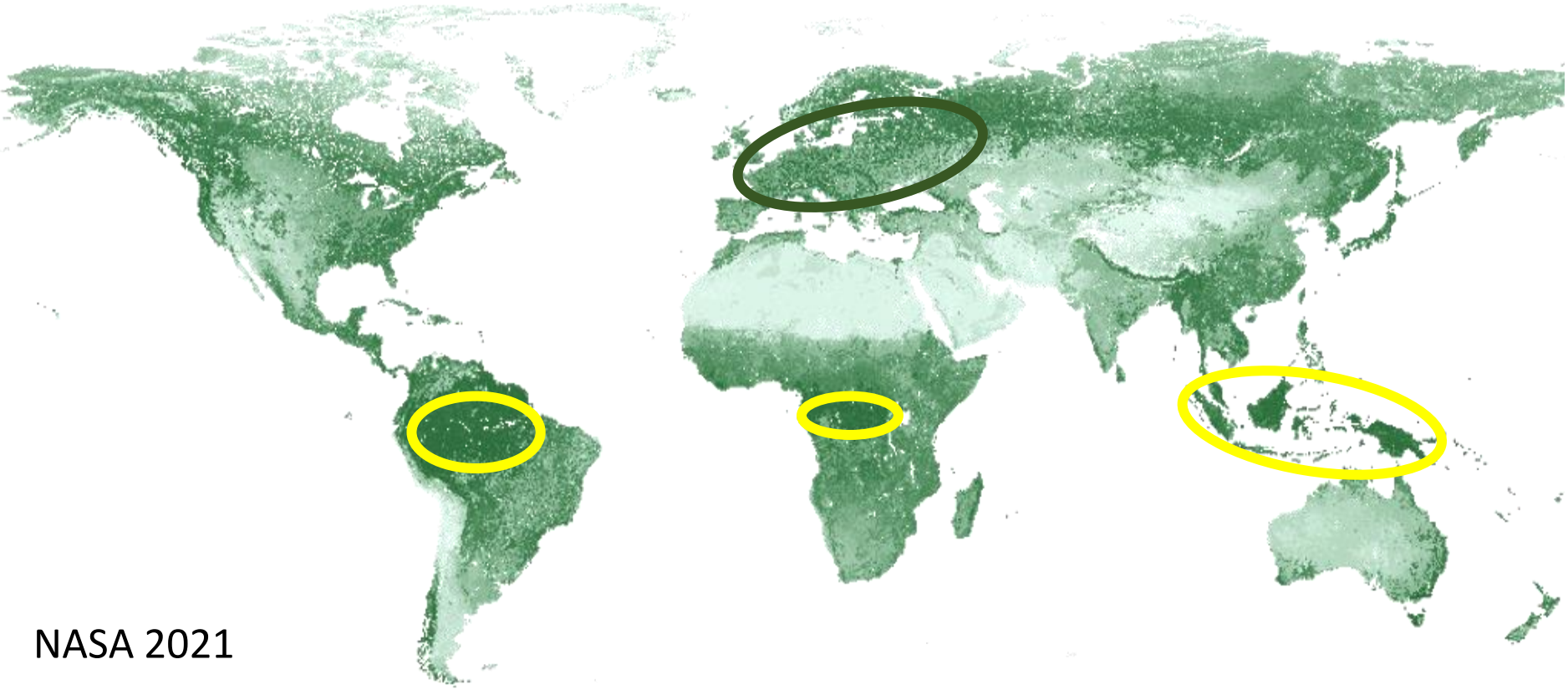
NASA 2021

Biomass

Fires are dependent on fuel

Above ground biomass indicated by carbon density (ORNL DAAC).

Mismatch in the **tropical rain forest** and in the **European temperate forest**.



NASA 2021

Wildfires

Many forest ecosystems in global biomes are adapted to fire.

In Europe, this applies mostly to Mediterranean forests.

European deciduous broadleaved forests exhibit low flammability.

Dated Holocene charcoal appears in these soils not before human land use (slash and burn) (e.g. Robin et al. 2013).

Wildfires

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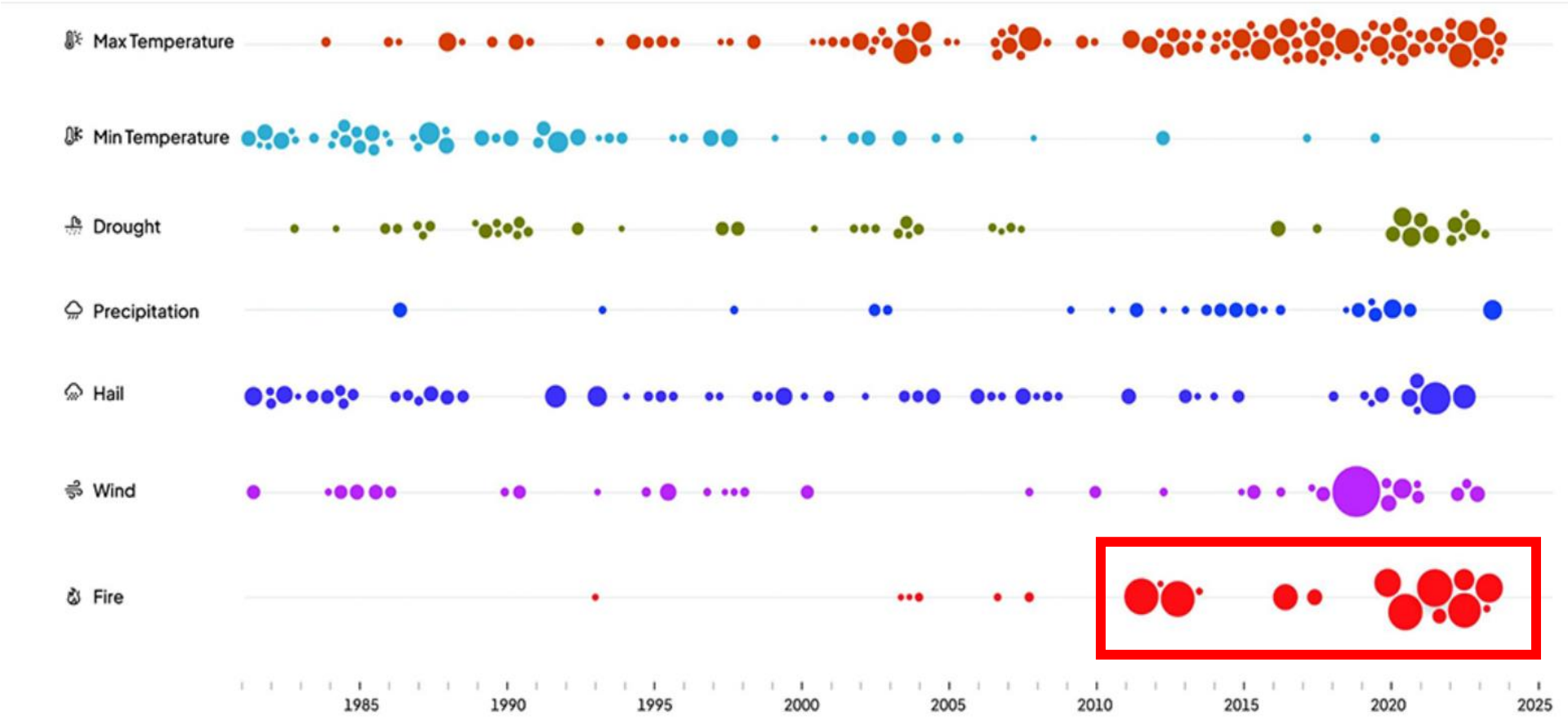
Trends in European Extreme Events Climate Index –> **Fires**



https://www.ifabfoundation.org/e3ci/

Recent increase !

Temperate Biome

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Temperate Biome

Defining the **scope of global biomes** such as boreal forest, tropical rain forest, etc. is dependent on products / maps!

The temperate biome is differentiated into **temperate forest (oceanic climate)** and **steppe (continental climate).**

Temperate Biome

Received: 15 March 2022 | Revised: 4 July 2022 | Accepted: 8 July 2022

DOI: 10.1111/geb.13574

Global Ecology and Biogeography | A Journal of Macroecology

WILEY

DATA ARTICLE

The biome inventory – Standardizing global biogeographical land units

Jan-Christopher Fischer | Anna Walentowitz | Carl Beierkuhnlein

Fischer, J.C., Walentowitz, A., Beierkuhnlein, C. 2022. The biome inventory – Standardizing global biogeographical land units. Global Ecology and Biogeography, 31, 2172-2183.

Temperate Biome

Defining the **scope of global biomes** such as boreal forest, tropical rain forest, etc. is dependent on products / maps!

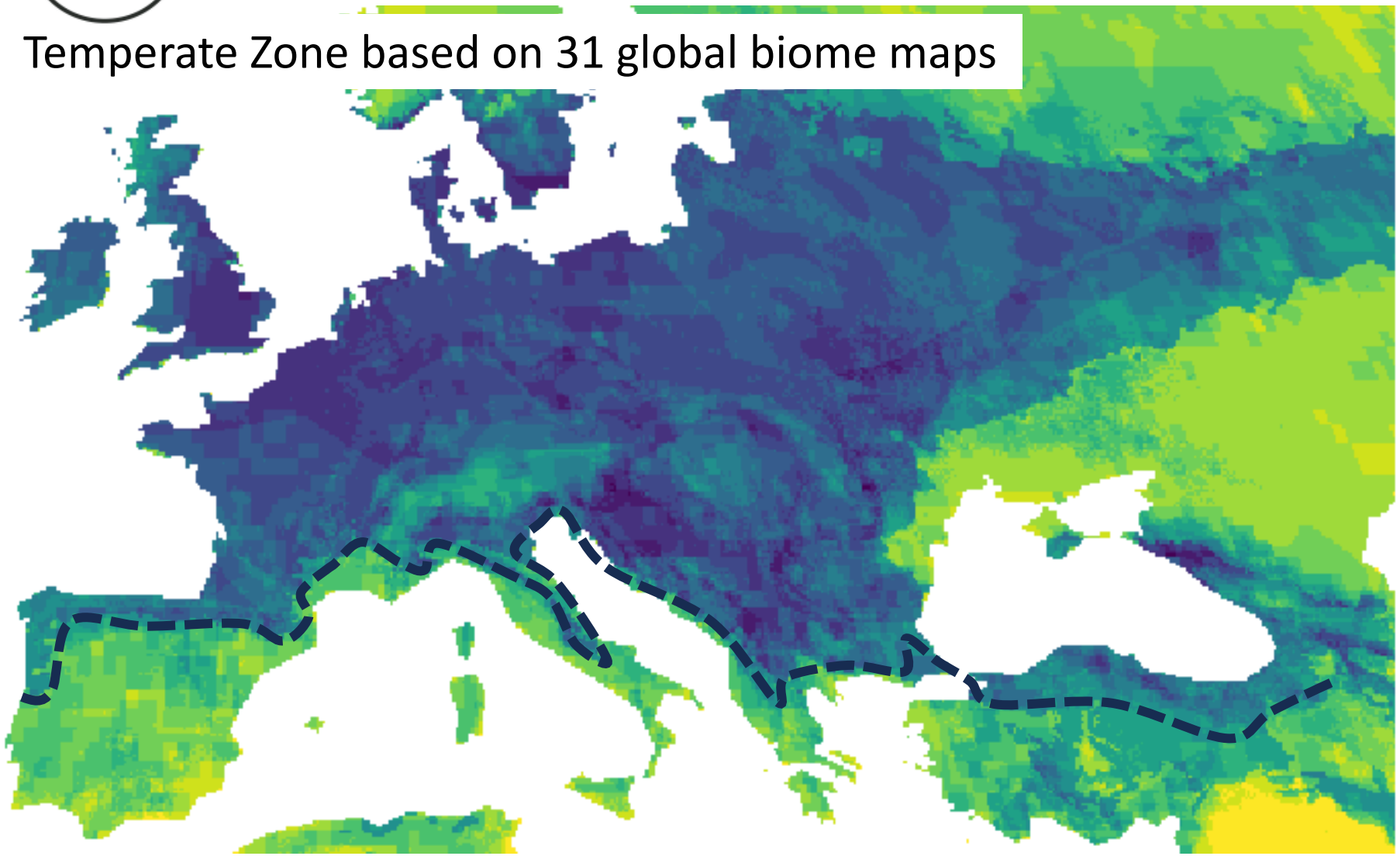
The temperate biome is differentiated into **temperate forest (oceanic climate)** and **steppe (continental climate).**

Here, we focus on **zonal temperate forest, i.e. broadleaved deciduous forest.**

Within this biome, also **non-natural conifer plantations** and forests with **non-native species** occur (e.g *Eucalyptus*).

Temperate Biome

Temperate Zone based on 31 global biome maps



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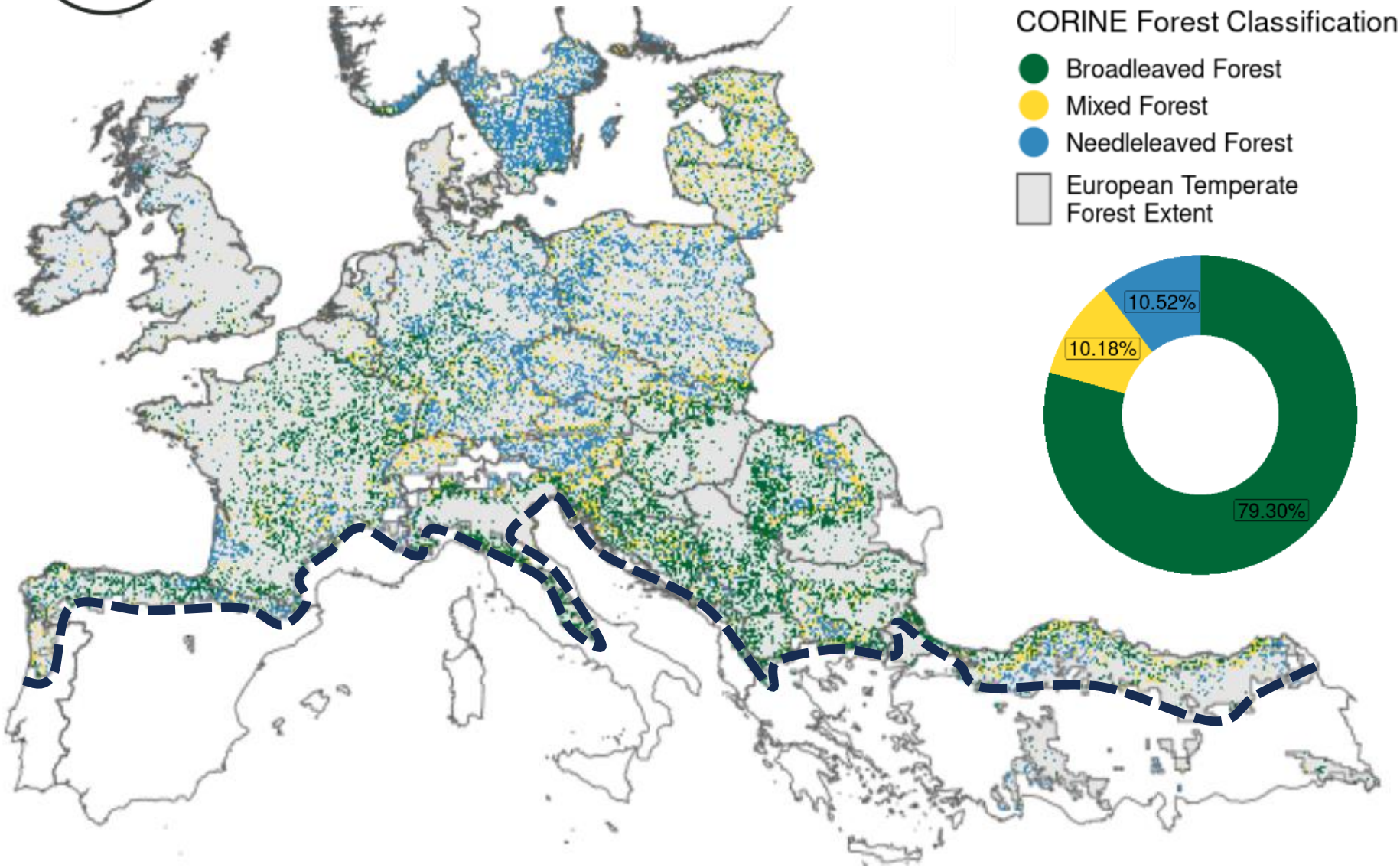
Temperate Biome



Biodiversity

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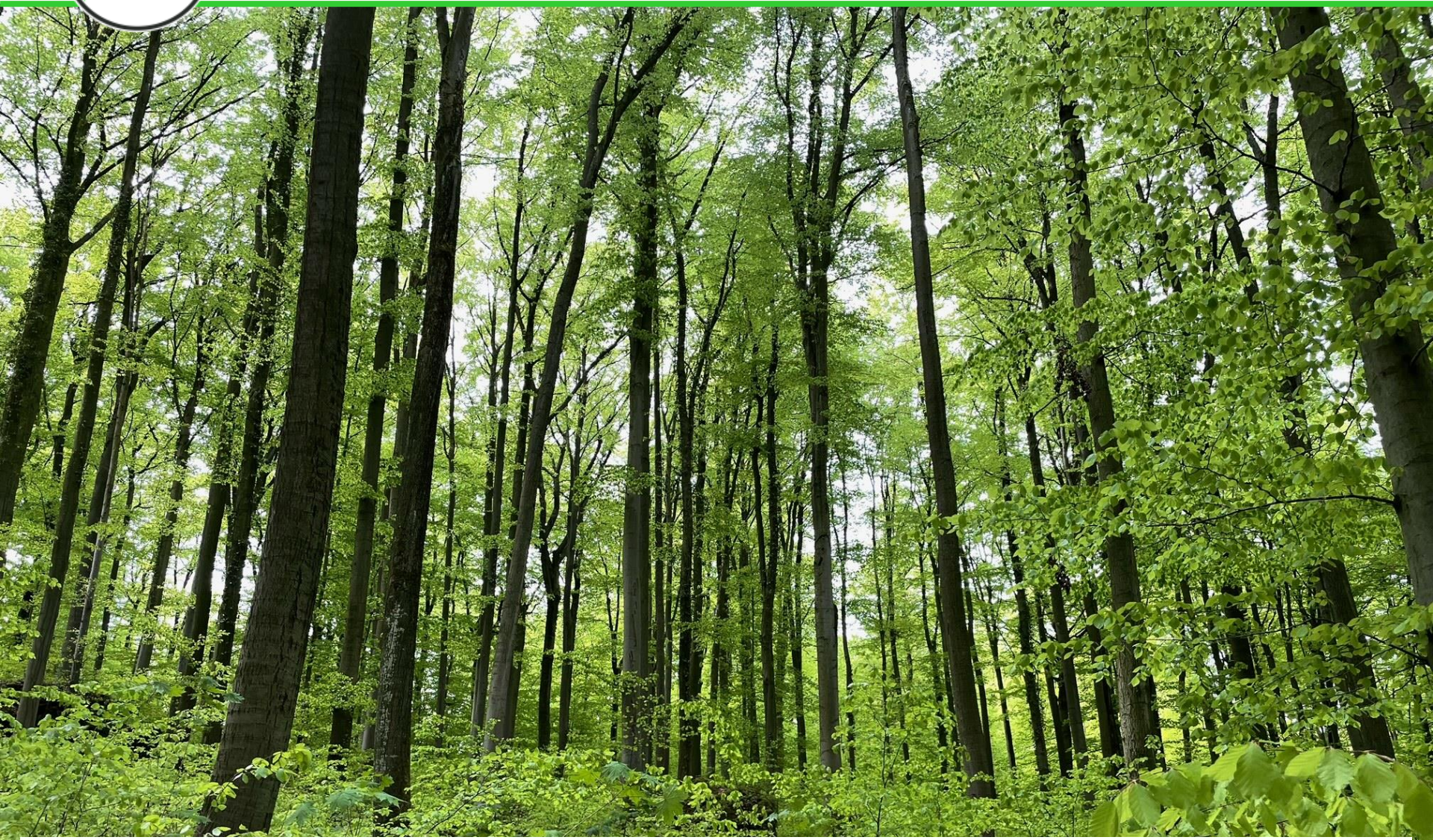
Biodiversity



Species-poor temperate deciduous beech forest, Franconia, Germany

Biodiversity

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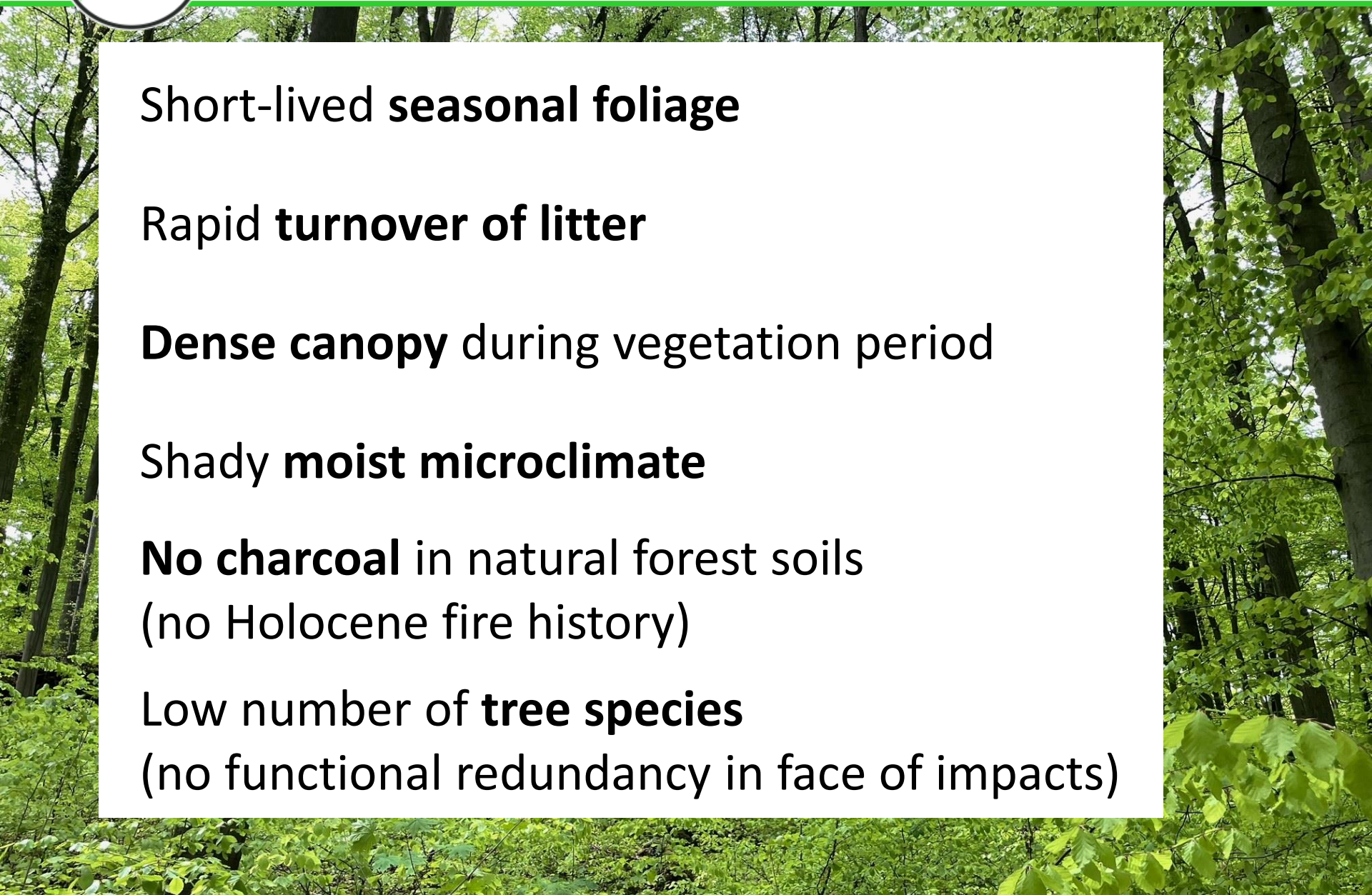


Short-lived **seasonal foliage**

Rapid **turnover of litter**

Dense canopy during vegetation period

Shady **moist microclimate**

No charcoal in natural forest soils
(no Holocene fire history)

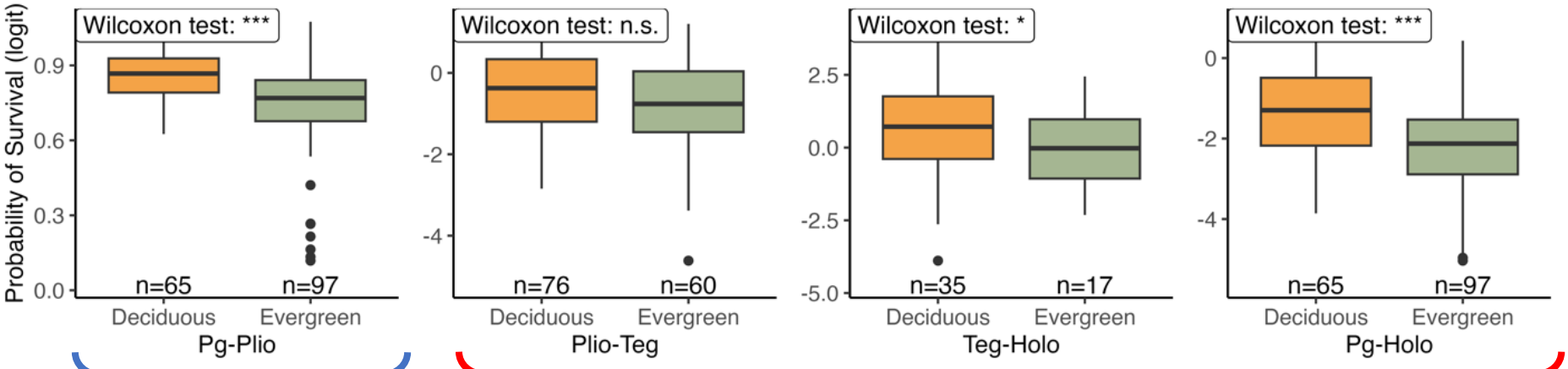
Low number of **tree species**
(no functional redundancy in face of impacts)

Biodiversity

Cenozoic (66 mya - today) **probability of survival for European tree genera**.

Macrofossil and pollen records are collected from PBDB, Fossilworks and Neotoma databases (1127 records for 274 tree genera).

Many tree genera were lost in Europe during the Pleistocene.
But **deciduous tree genera had a higher likelihood to survive** Pleistocene climatic fluctuations.



High likelihood to survive during the Tertiary period

Extinctions of tree genera during the Pleistocene period

Wilkens V … Beierkuhnlein C (in prep). Traits to Live or Traits to Die? – Tracing the Development of Functional Diversity in Trees During Cenozoic Climate Change.

Biodiversity

Numbers of **tree taxa** of temperate forests in the Northern Hemisphere

	Northern, Central & Eastern Europe	**East-Central Asia**	**Western North America**	**Eastern North America**	**Northern Hemisphere (total)**
Orders	16	37	14	26	39
Families	21	67	19	46	74
Genera	43	177	37	90	213
Species	**124**	**729**	68	**253**	1166

European temperate forest is comparably tree species-poor

Latham & Ricklefs 1993 Continental comparisons of temperate-zone tree species diversity. In: Ricklefs & Schluter: Species diversity in ecological communities – Historical and geographical perspectives. 294-317

Forest Fires

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Forest Fires

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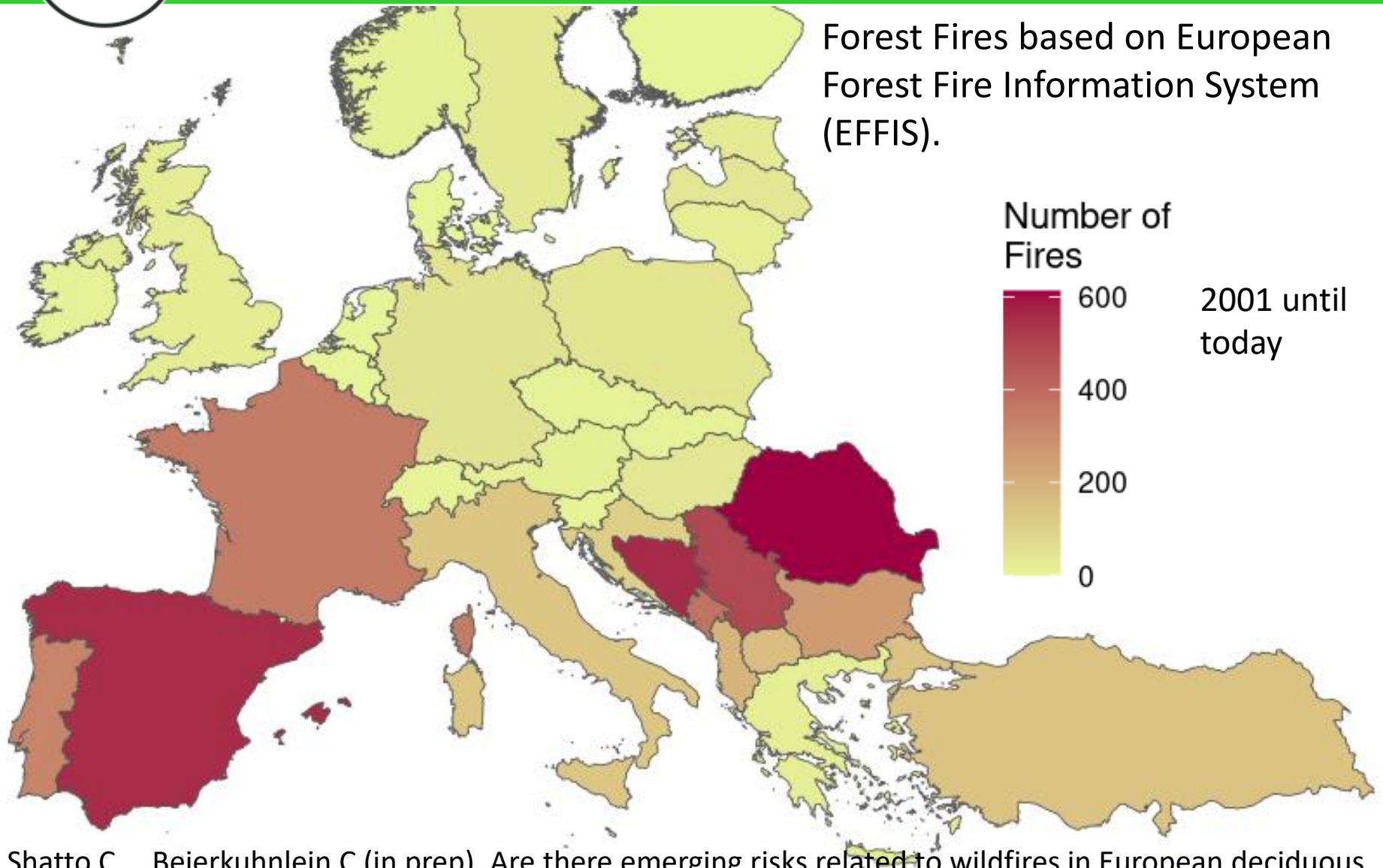
Forest Fires based on European Forest Fire Information System (EFFIS).



Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?

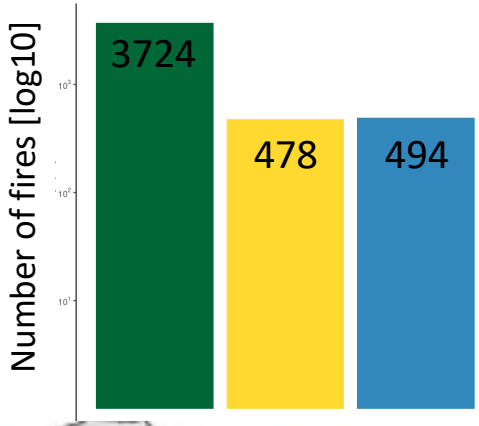
Forest Fires

2001 until today

Forest Fires based on European Forest Fire Information System (EFFIS).

- Broadleaved Forest
- Mixed Forest
- Needleleaved Forest

For >50% forest cover within 1km^2 pixels



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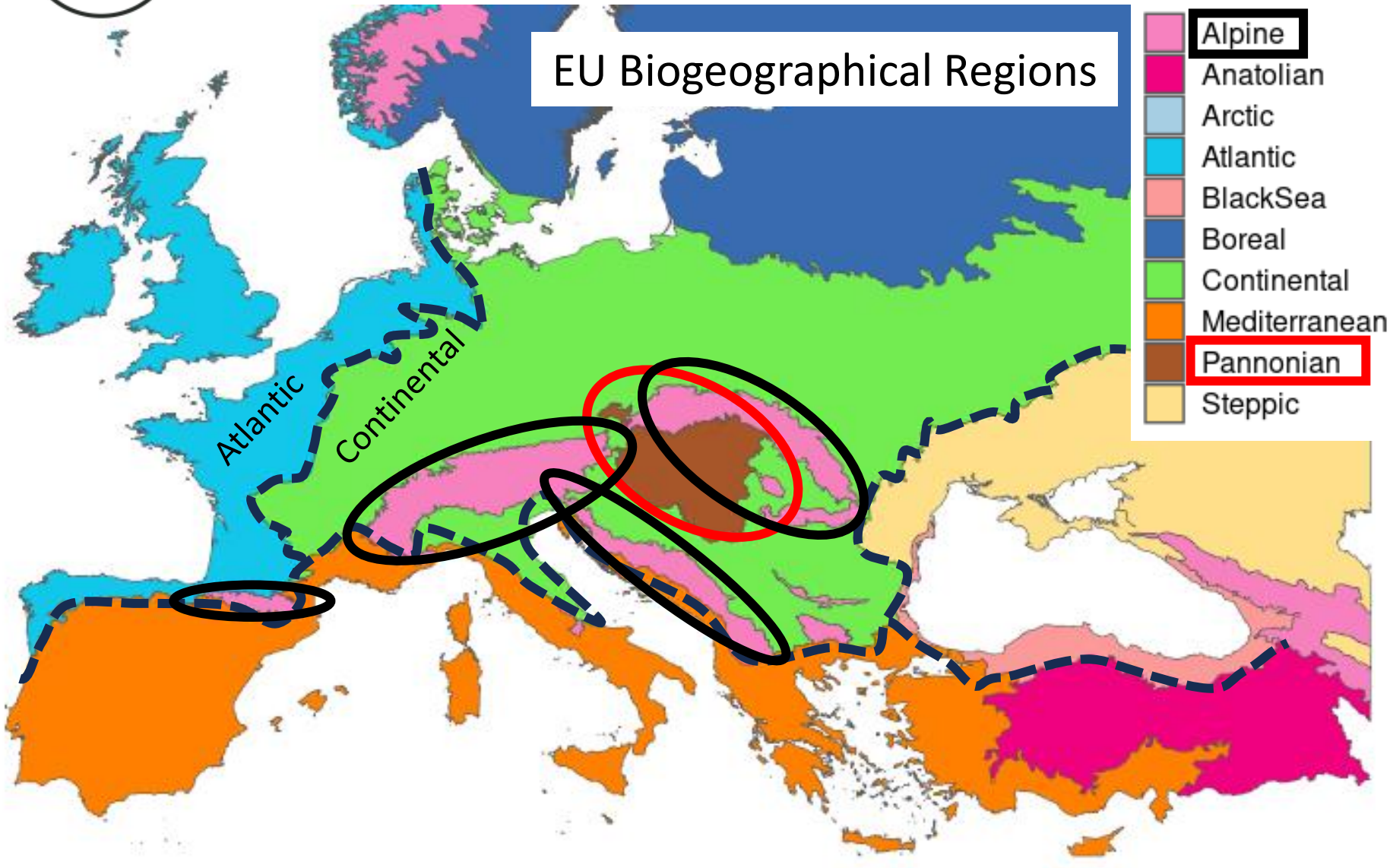
Eucalyptus

Occurrence of *E. gomphocephalus*, *E. camaldulensis*, *E. globulus*

European Atlas of Forest Tree Species, European Union, 2017

Temperate Biome



https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-1/

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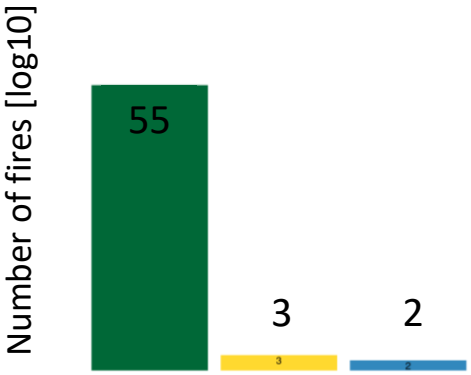

"**Pannonian**" region
(EU map of biogeographical regions)

Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?

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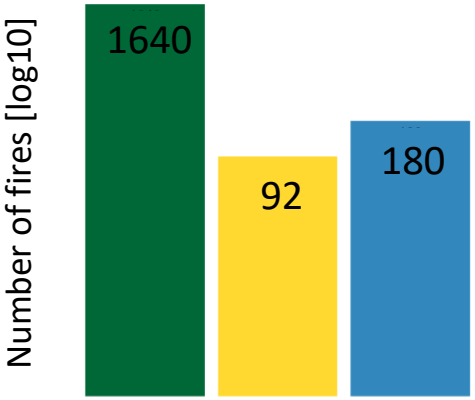


Eucalyptus, Pannonian, Alpine, Anatolian, and Black Sea filtered out

Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?

Phytogeography

Frey & Lösch 2010 Geobotanik. 3rd ed. Springer, Berlin

Phytogeographical regions

Phytogeography

Crops have been supported to fill their ecological niche completely (e.g. olive trees).

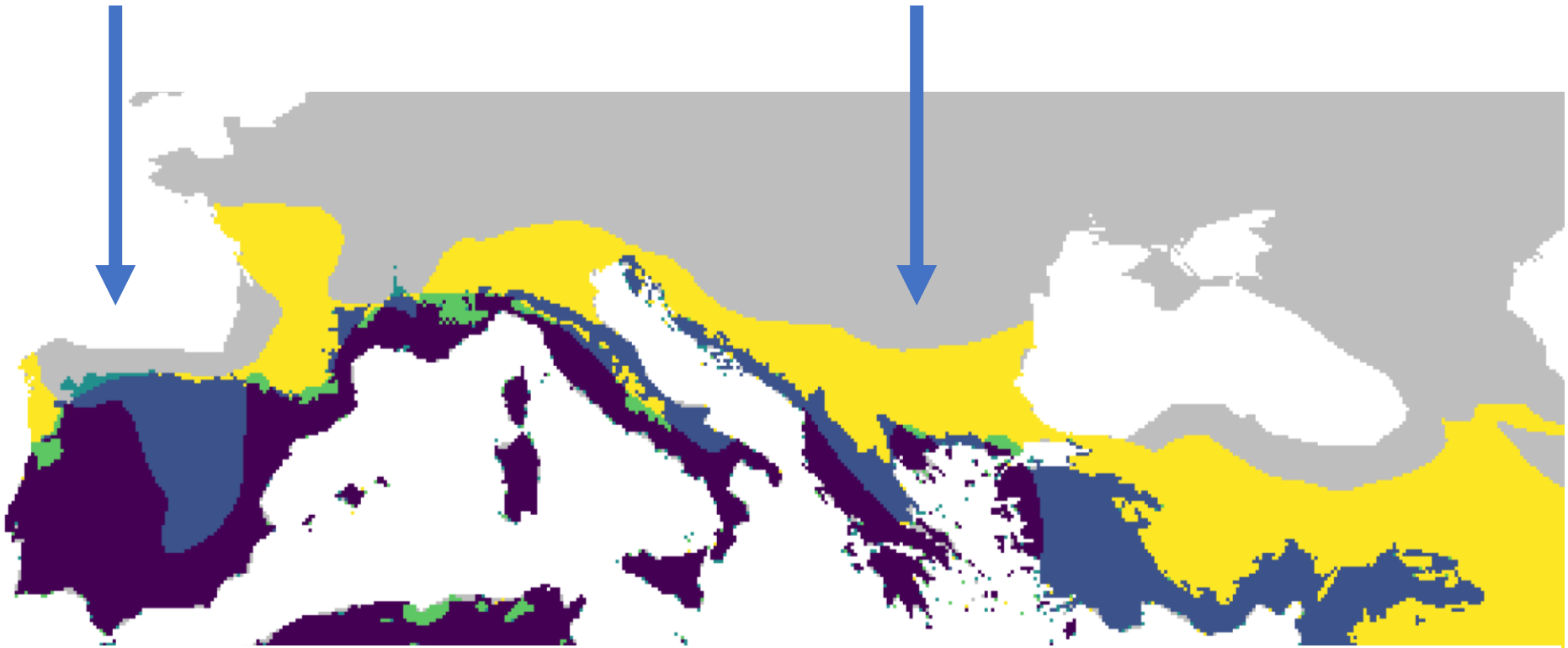
Olea europaea L.

Mediterranean Biome

Transition between the Temperate and the Mediterranean Biome

Clear limits

Unclear limits



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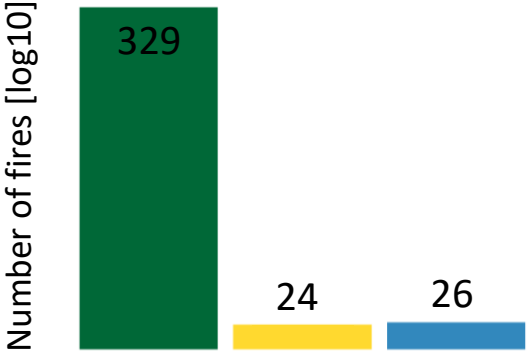

Mountains !

"**Mediterranean**" region overlap
(EU map of biogeographical regions) with temperate biome

Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?

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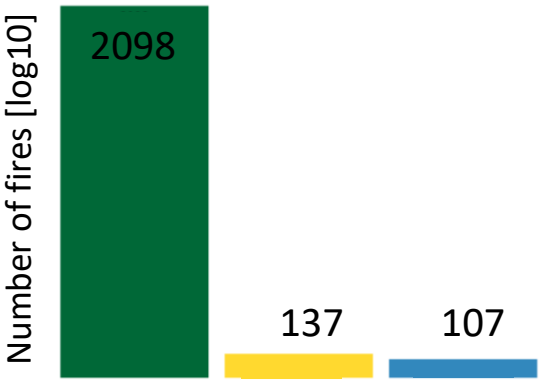

Submediterranean region

Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?

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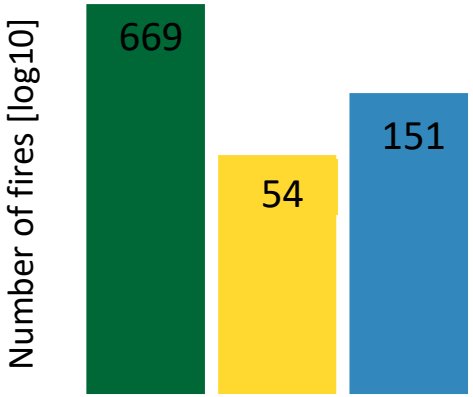

Submediterranean region filtered out

Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?

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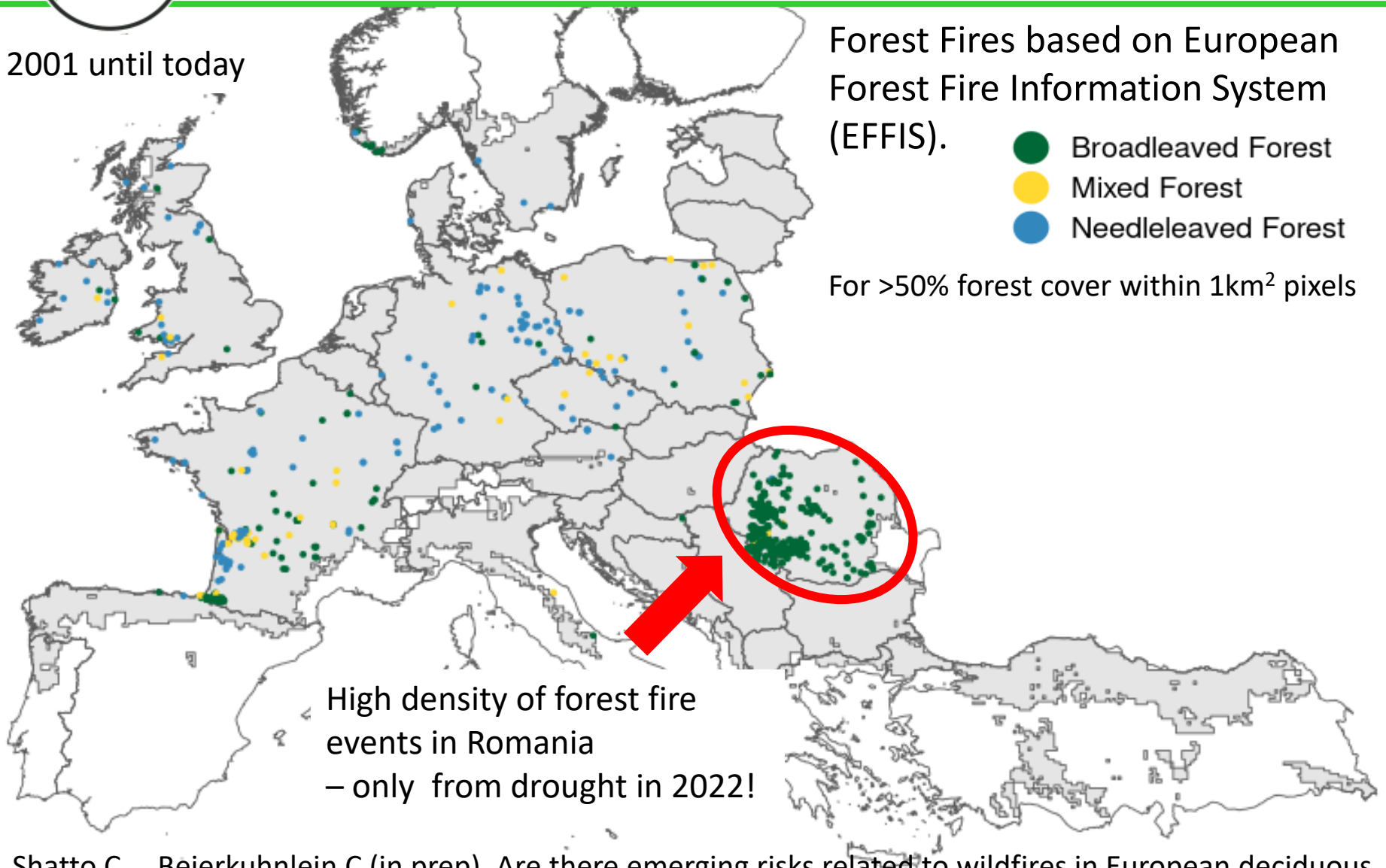

High density of forest fire events in Romania – only from drought in 2022!

Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?

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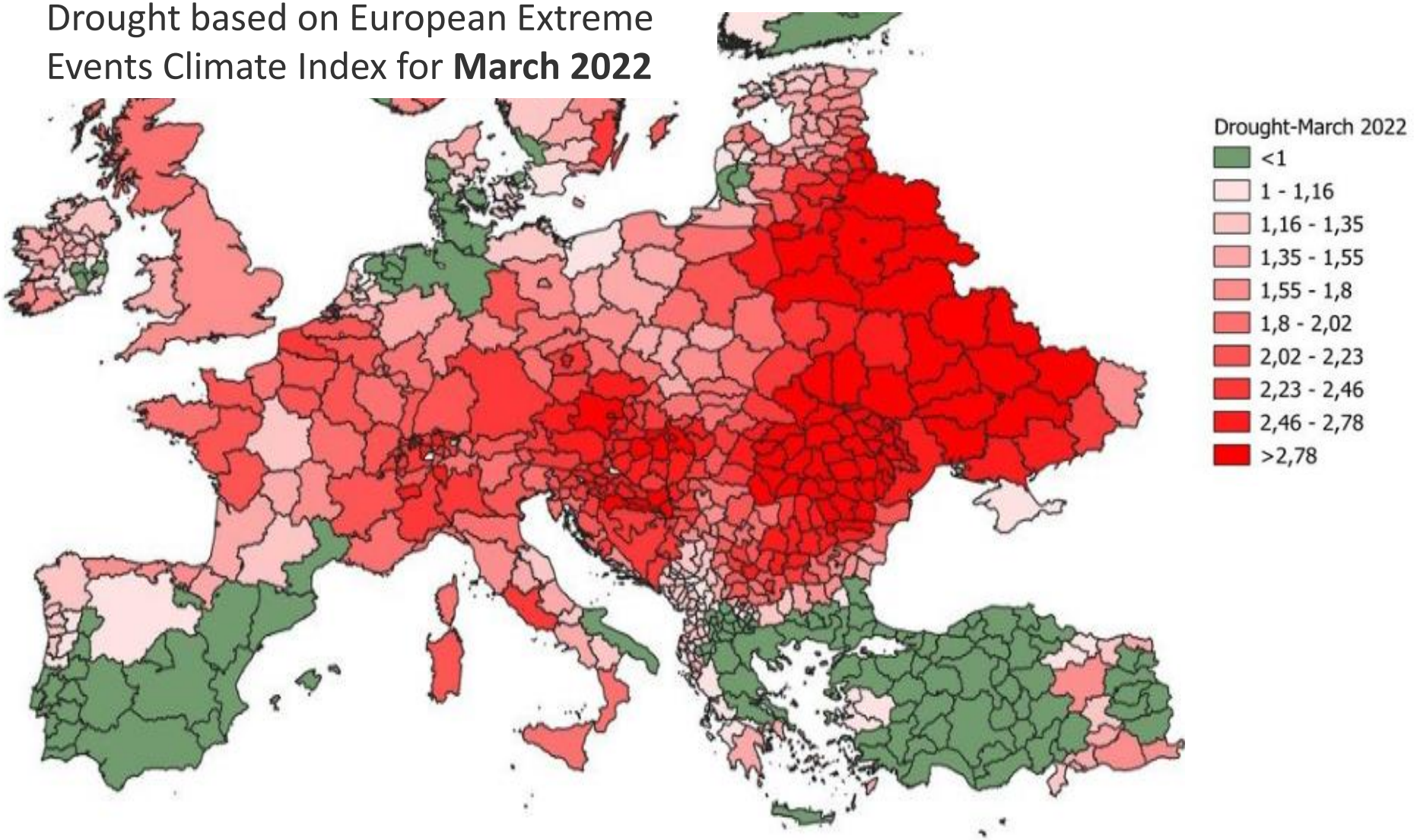
Drought based on European Extreme Events Climate Index for **March 2022**



https://www.ifabfoundation.org/it/2022/06/10/2022-european-drought/

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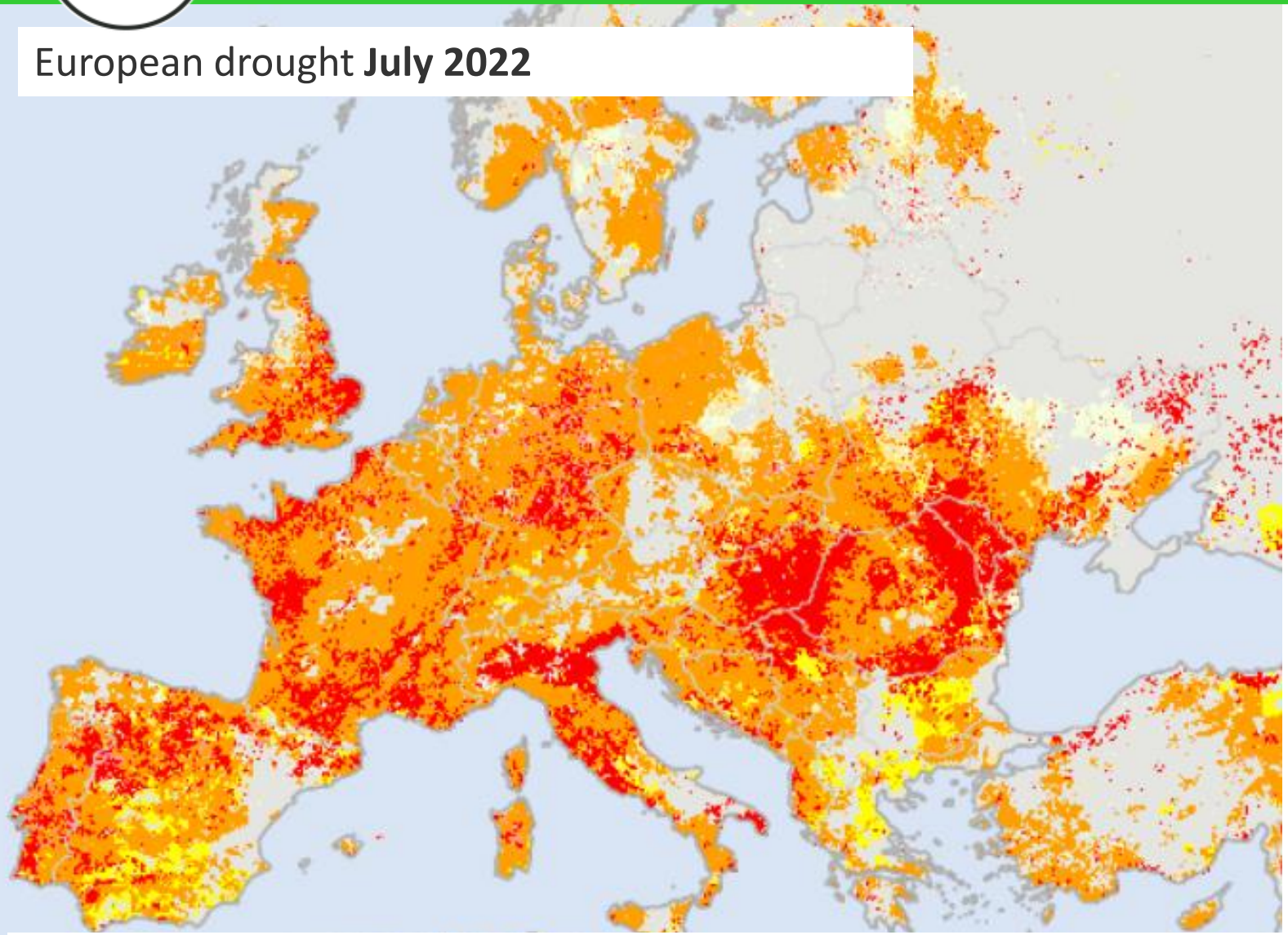
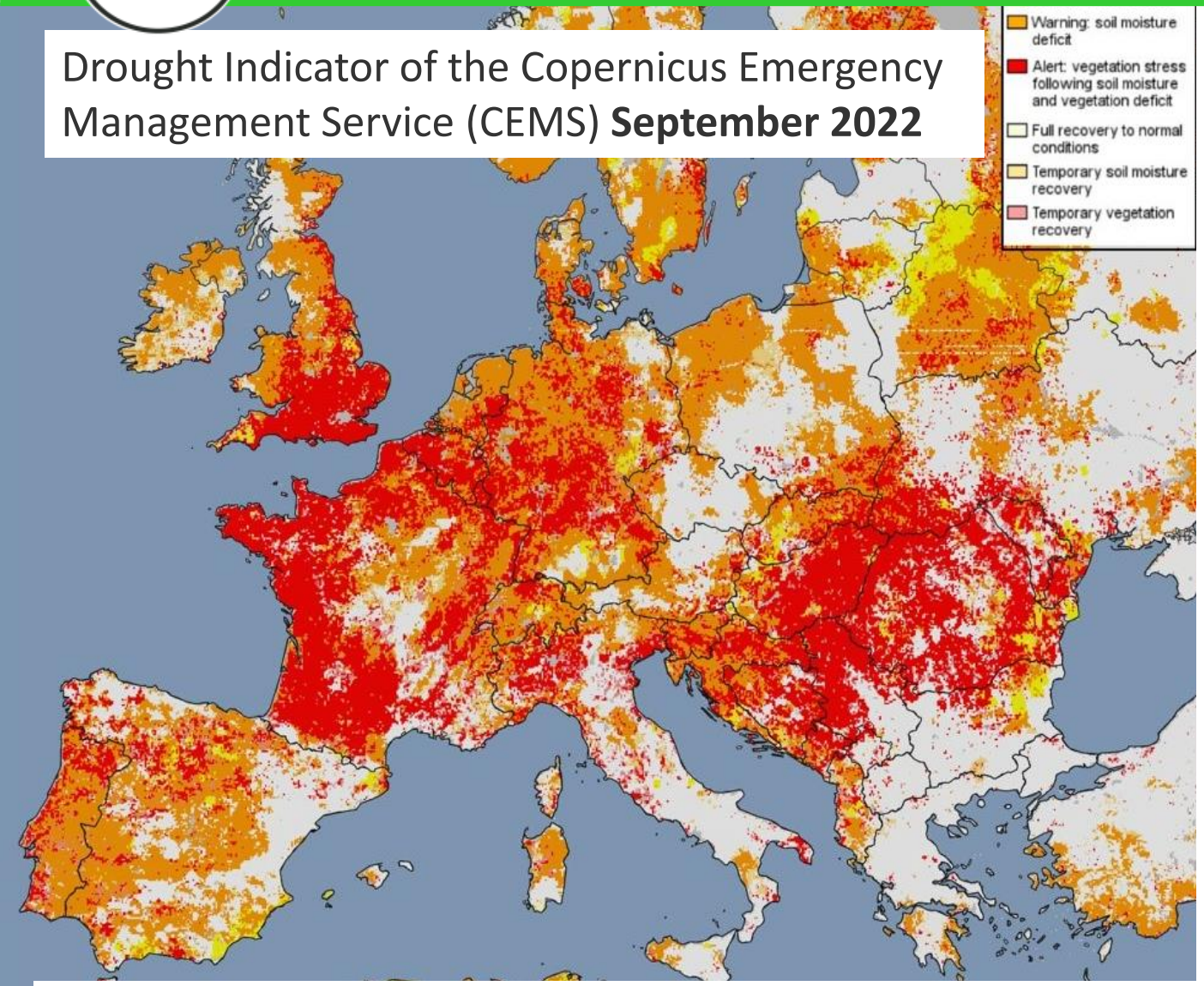
European drought **July 2022**



European Drought Observatory (EDO)

Climate Change

Drought Indicator of the Copernicus Emergency Management Service (CEMS) **September 2022**



https://www.copernicus.eu/en/news/news/observer-2022-year-extremes

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In Romania with the outstanding record in 2022, "*99 percent of forest fires are caused by human activities, such as the uncontrolled burning of pasture in spring and the burning of stubble after the harvesting of crops directly adjacent to forests*".

Marin Drăcea Forestry Research and Development Institute (INCDS)

However, **increasing drought** allows these fires now to spread into the forest.

2022 was third hottest year on record in Romania, official data says

Romania Insider
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Almost €34 million in European Solidarity Funds awarded to Romania to repair damages caused by severe drought in 2022

04 December 2023

Climate Change

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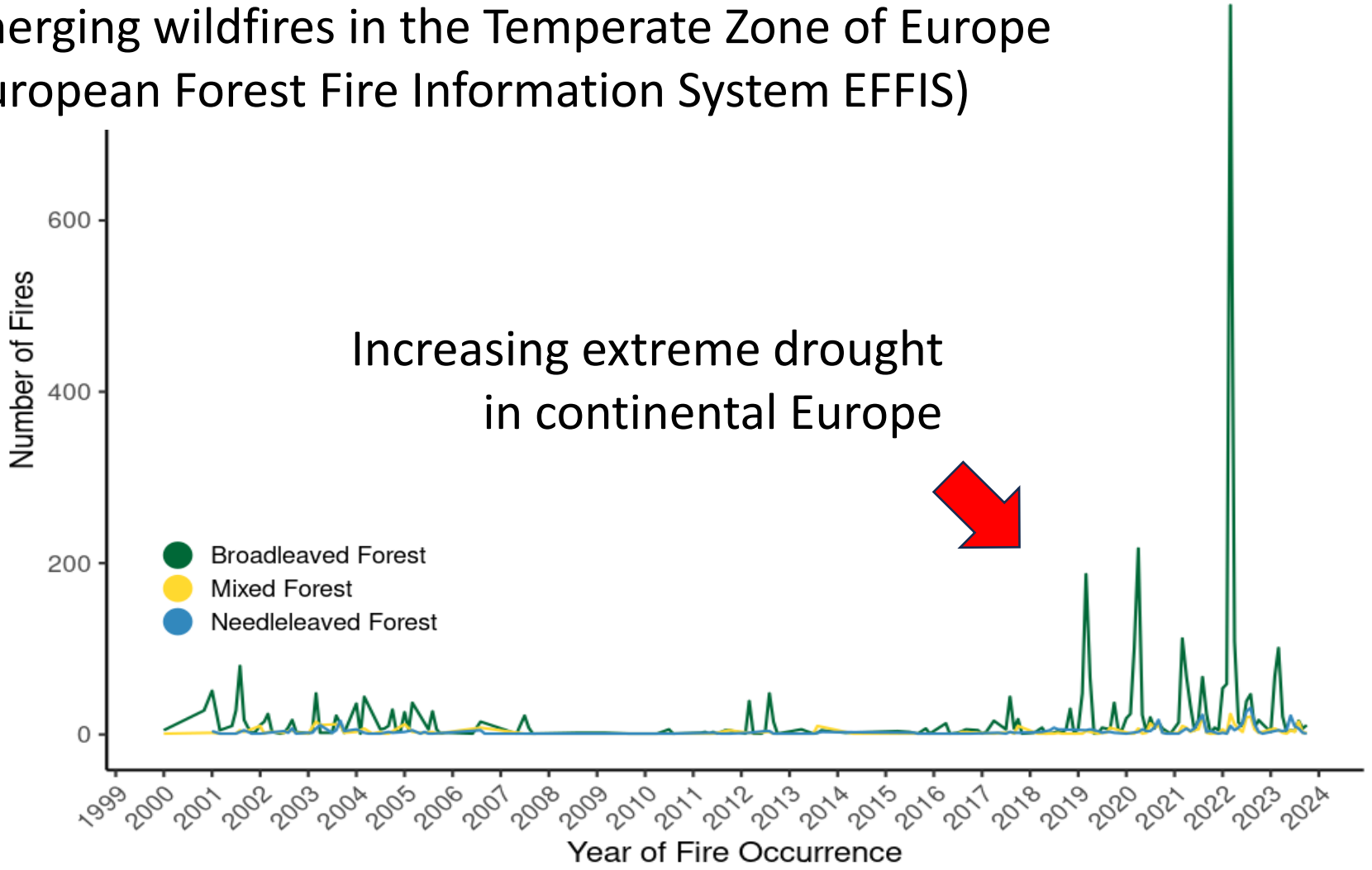
Emerging wildfires in the Temperate Zone of Europe
(European Forest Fire Information System EFFIS)



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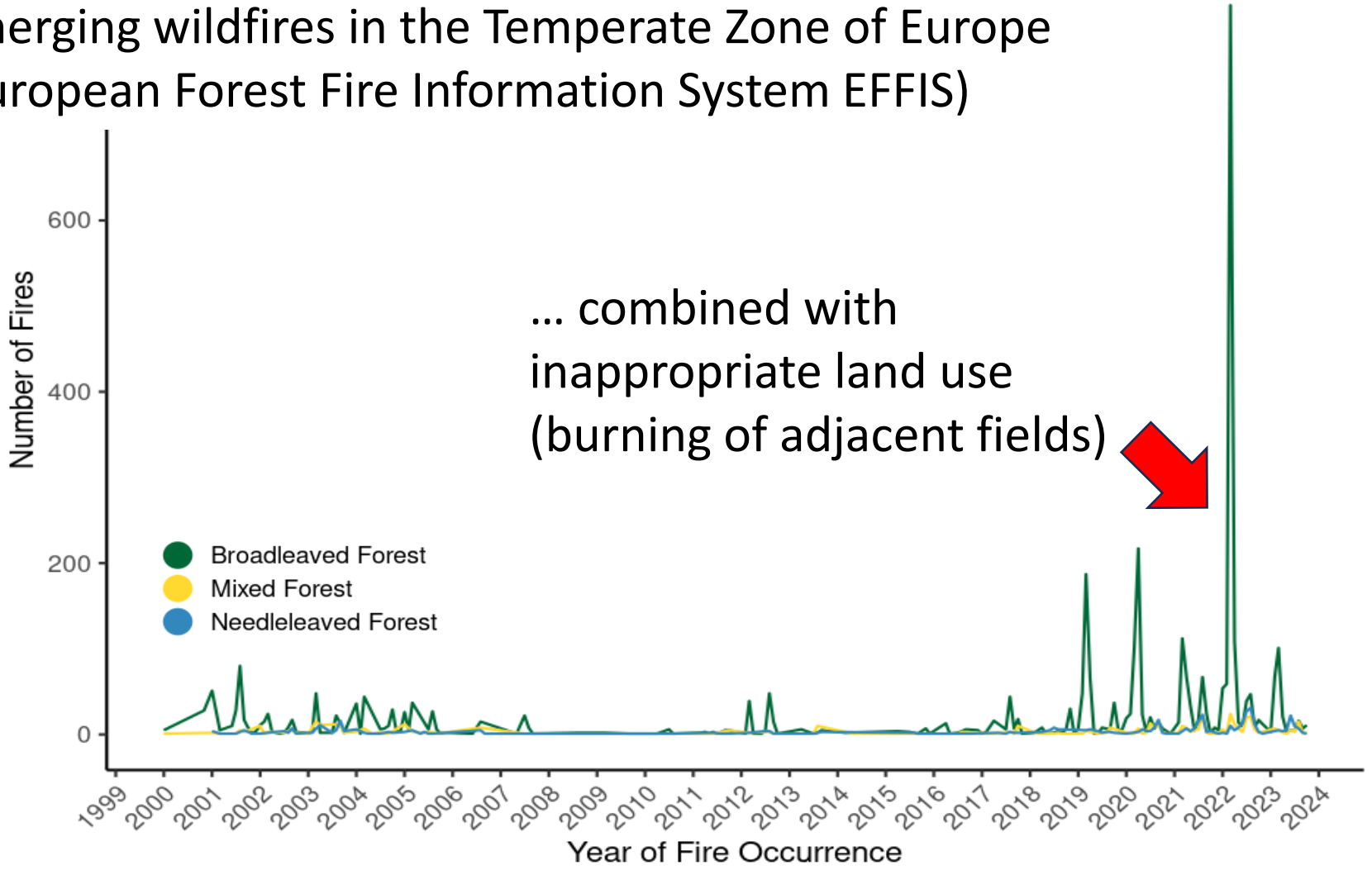

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Biomass = Fuel ?

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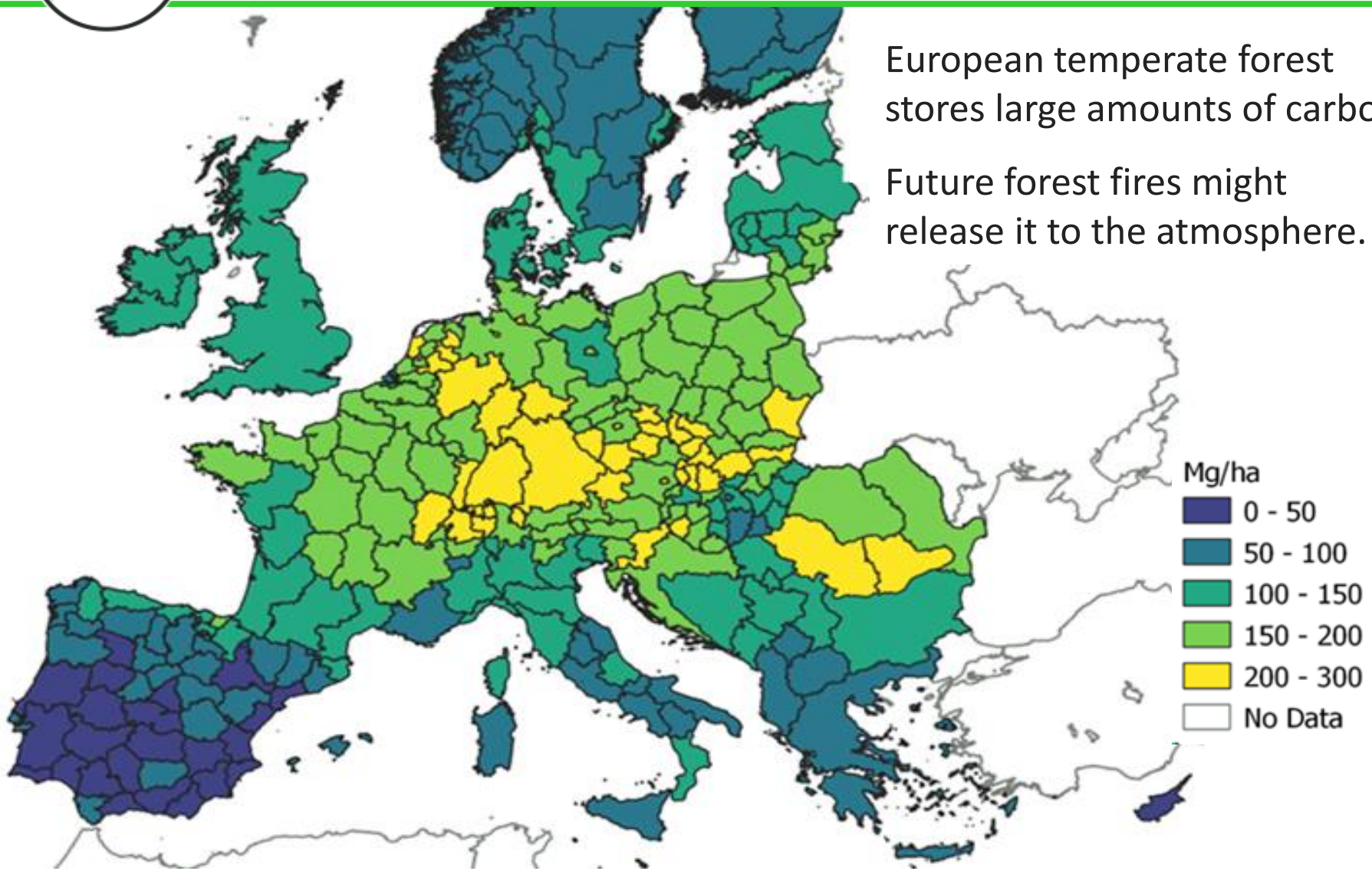
European temperate forest stores large amounts of carbon.

Future forest fires might release it to the atmosphere.



Avitabile V et al. 2024. Harmonised statistics and maps of forest biomass and increment in Europe. Sci Data 11, 274.

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Central European Beech forest in Summer 2018

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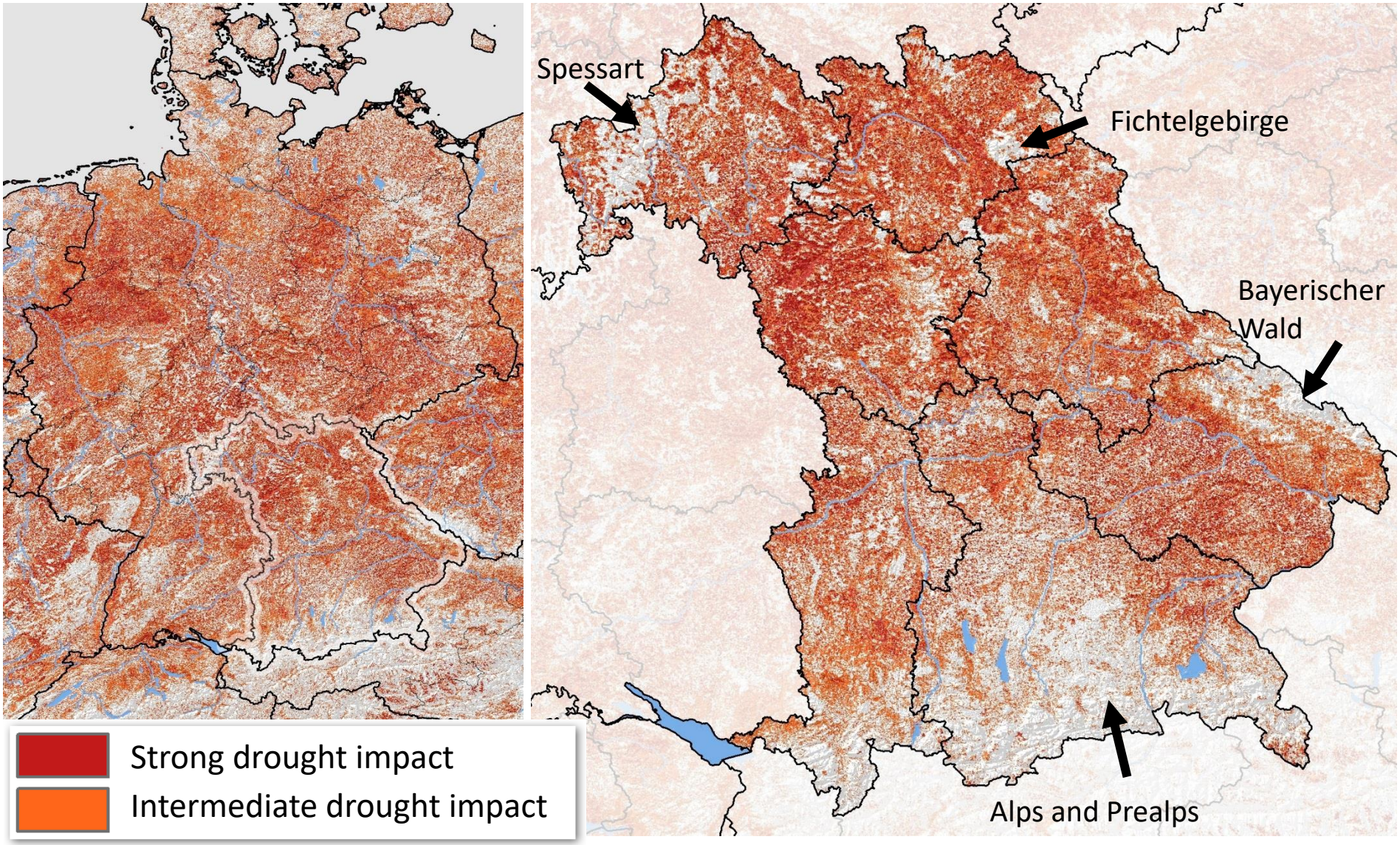
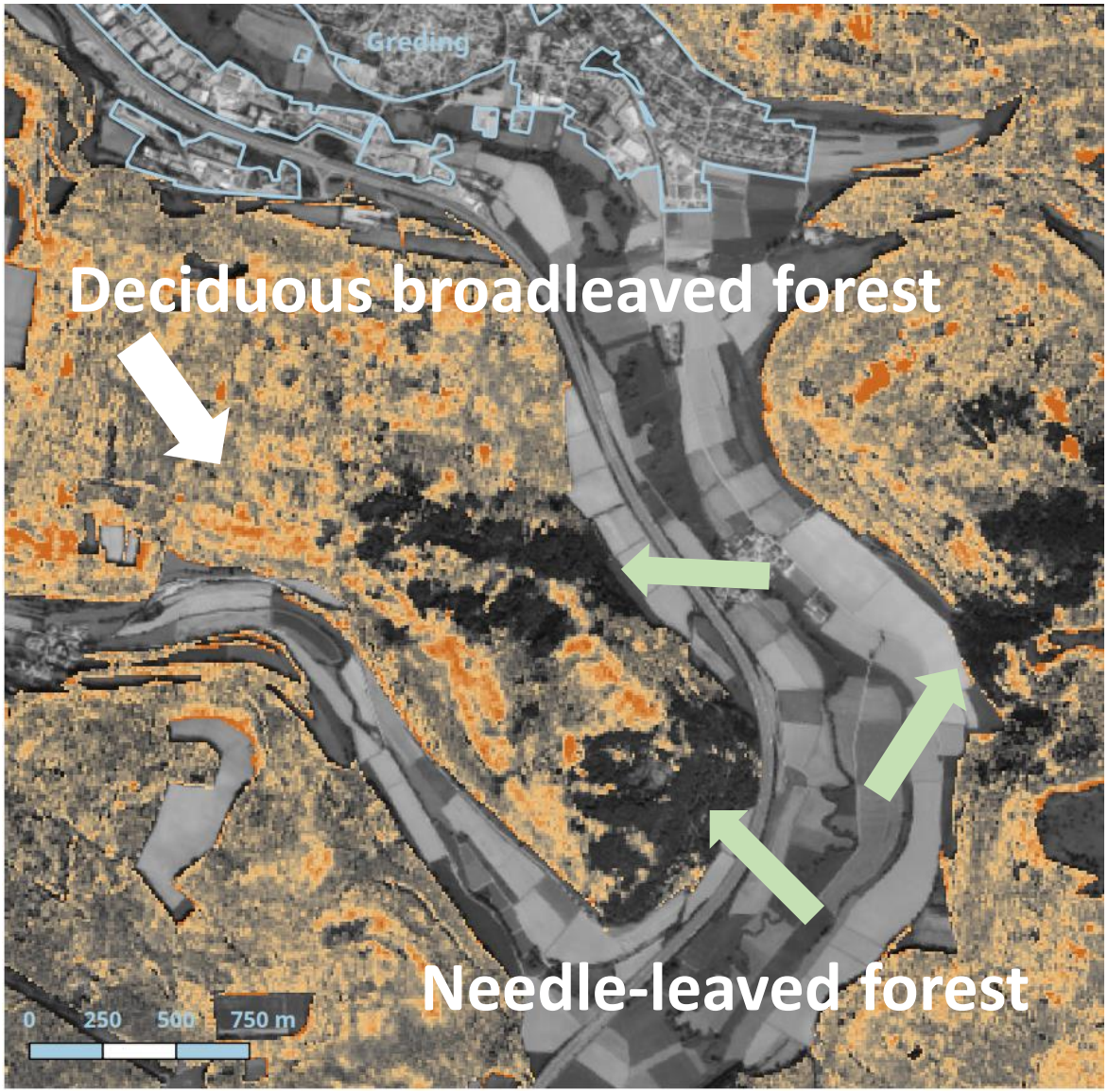
NDVI comparison Period **13. to 28. August in 2017 and 2018**, Sensor MODIS



Climate Change



NDVI Difference in Sentinel 2 scenes from **15th August 2017** and **20th August 2018**

Greding

Intermediate drought impact

Slight drought impact

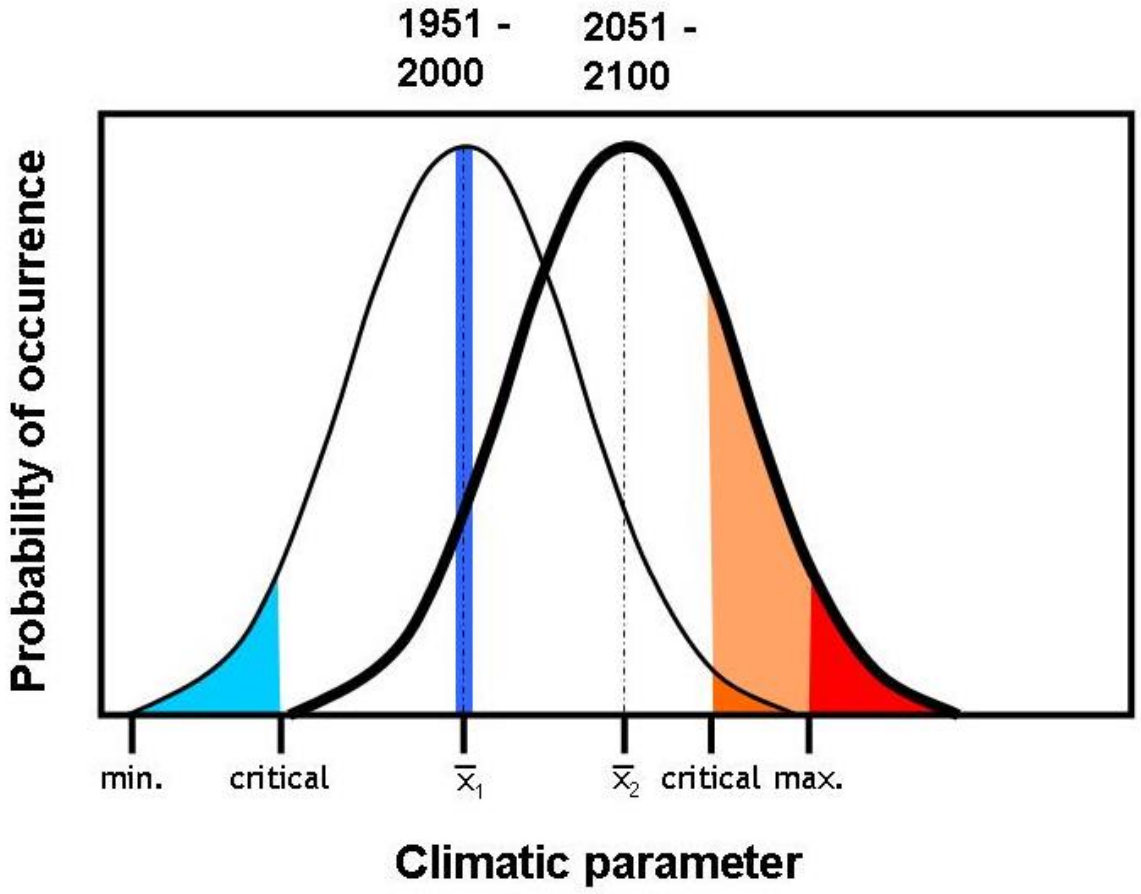
Climate Change

"An ***extreme weather event*** is an event that is rare at a particular place and time of year. […] an extreme weather event would normally be as rare as or rarer than the 10th or 90th *percentile* of the observed *probability density function*.
By definition, the characteristics of what is called *extreme weather* may vary from place to place in an absolute sense.
[…]
When a pattern of extreme weather persists for some time, such as a season, it may be classed as an ***extreme climate event***, especially if it yields an average or total that is itself extreme (e.g., *drought* or *heavy rainfall* over a season)."

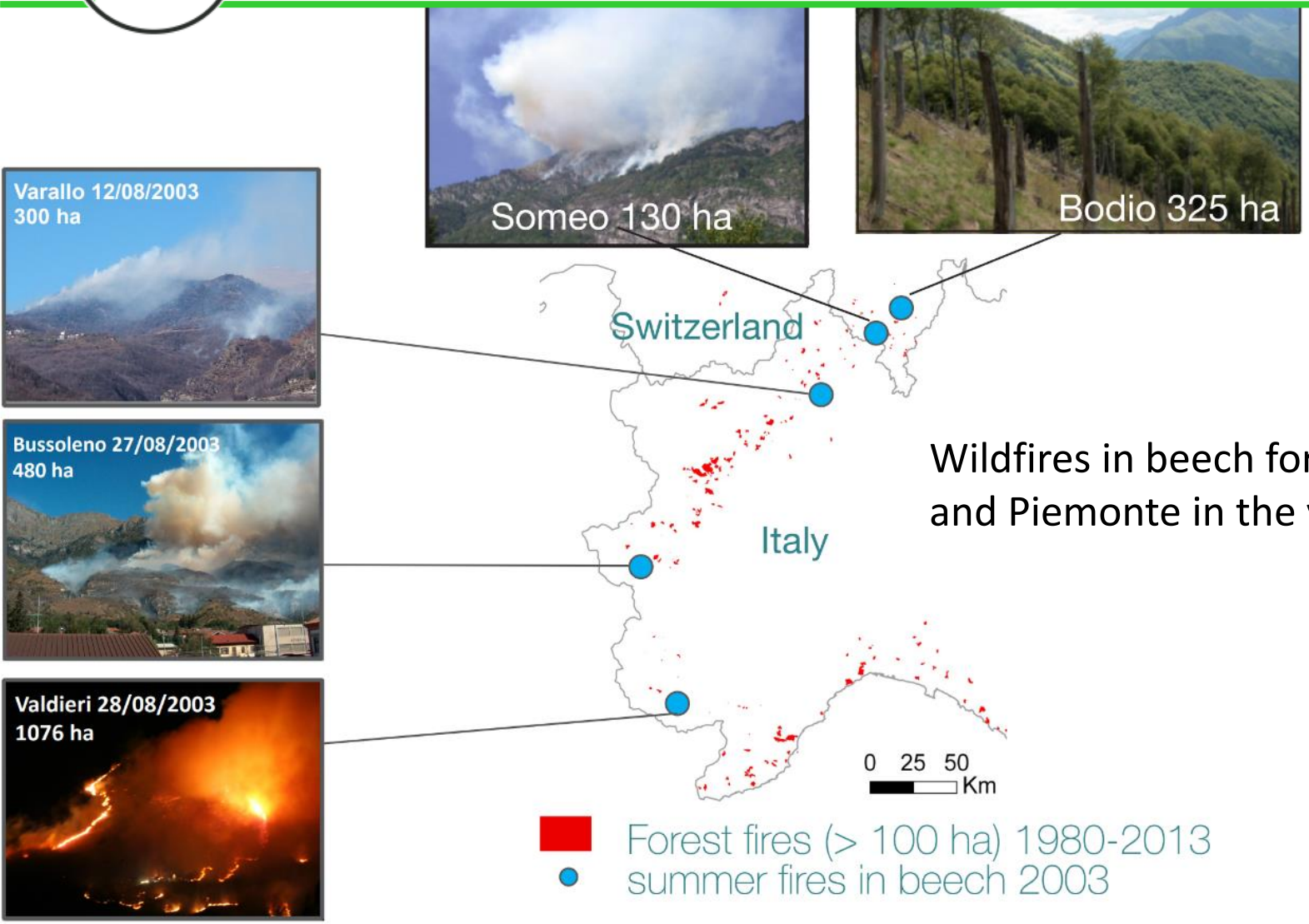
IPCC 2007: Climate Change **2007**: The Physical Science Basis Annex I, Glossary.

Climate Change

An event that used to be “normal” in the past may become “extreme” in the future! – and vice versa!



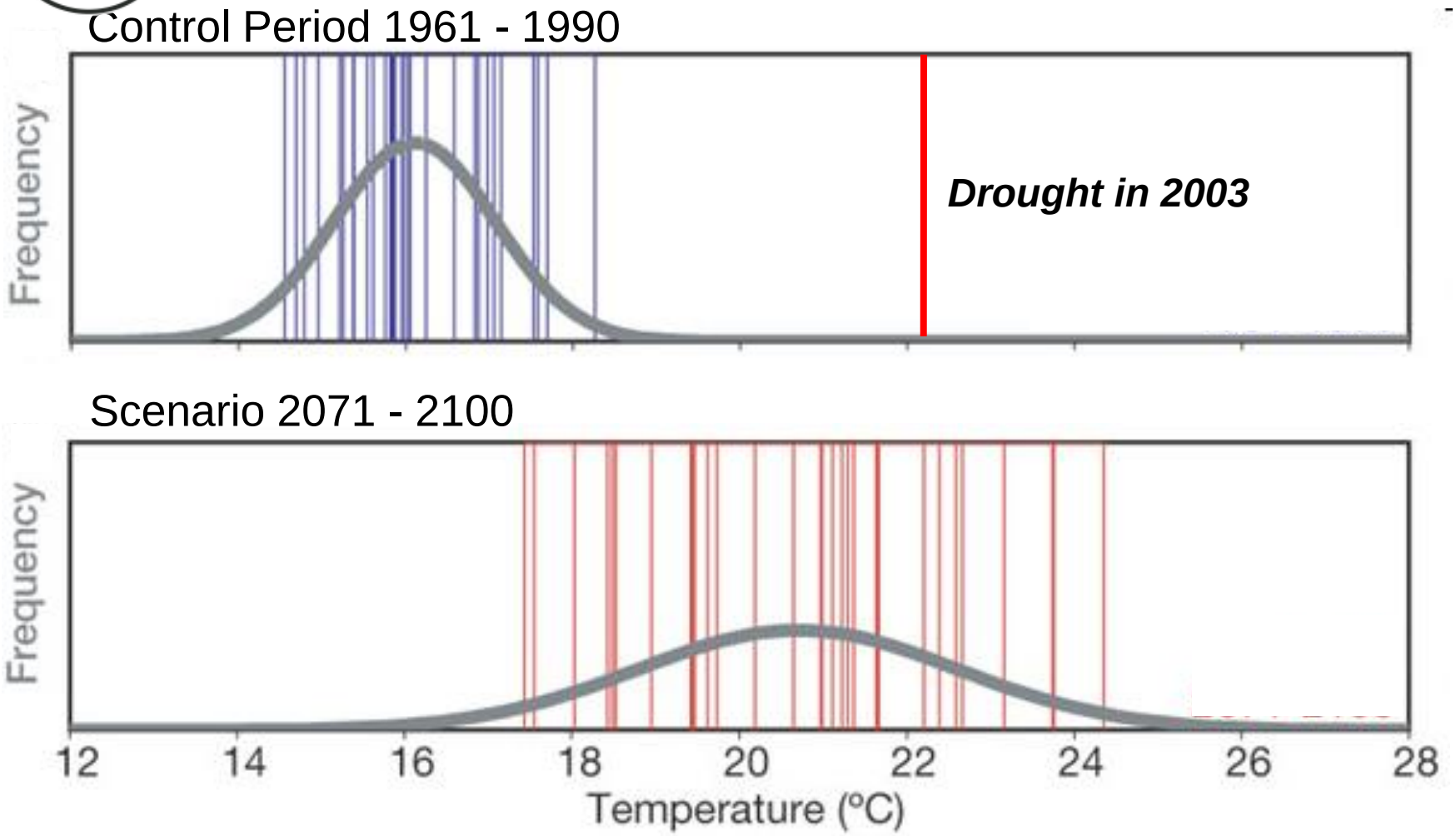
Climate Change



Wildfires in beech forests in Ticino and Piemonte in the year 2003.

Maringer J, Ascoli D, Conedera M (presentation). General assumption: Beech forests do not burn. Evidence from recent years: Yes they do!

Climate Change



Historical probability of a „2003“ event in Switzerland.

Schär et al. 2004, Nature

CLIMATE SCIENCE

Elusive extremes

Extreme climate events can cause widespread damage and have been projected to become more frequent as the world warms. Yet as discussed at an interdisciplinary workshop, it is often not clear which extremes matter the most, and how and why they are changing.

Gabriele C. Hegerl, Helen Hanlon and Carl Beierkuhnlein

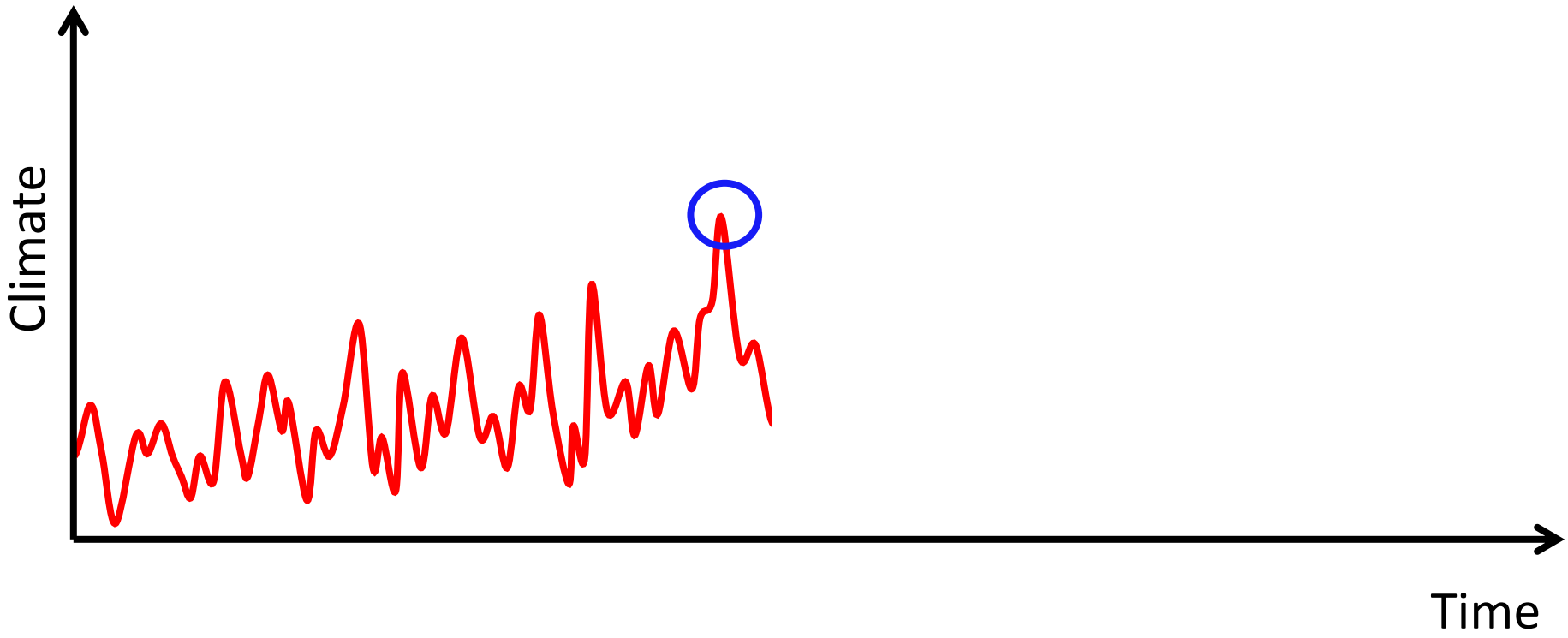
Changes in the frequency, intensity and timing of climate extremes matter to ecosystems and society. Characterizing such changes and their impacts is a challenge, not only for climate scientists but also for statisticians, ecologists and medical scientists. The impacts of rare climate events can be difficult to detect, for example when they arrive with significant delay. To complicate matters further, combinations of extreme climate events — such as heatwaves coinciding with droughts or air quality problems — could cause more severe consequences for humans and ecosystems. At a conference in Cambridge on 'Extreme Environmental Events' in December 2010[1] that brought together climate scientists, statisticians and ecologists, the conclusion evolved that useful prediction of climate change impacts hinges on understanding the right types of extremes, and then producing reliable projections for their changes.

Weather and climate extremes are usually defined as rare events in the context of historical climate data. Alternatively, weather events can be classified as extreme according to the amplitude of their impacts on society or ecosystems. The Russian heatwave of 2010 and the European heatwave of 2003 fulfilled both criteria: they were climatically highly unusual[2], and at the same time had substantial consequences for human health and ecosystems.

Extreme events can span a wide range of spatial and temporal scales. For example, storms are usually short-lived and occur over only a few hours, whereas a drought can extend over months. In the spatial domain, they can range from an anomalously warm summer or cold winter diagnosed on a continental scale, to events such as a hail storm that affect only a small region. When defining extremes, it is therefore easy to drown in choices. It is not obvious whether it is the frequency, intensity or duration of an extreme event that matters — or a combination of all three. Impact researchers may be able to guide the choice of characteristics that matter for society and ecosystems.

Hegerl H, Hanlon H, Beierkuhnlein C **2011** Elusive Extremes. ***Nature Geoscience*** 4, 143-143

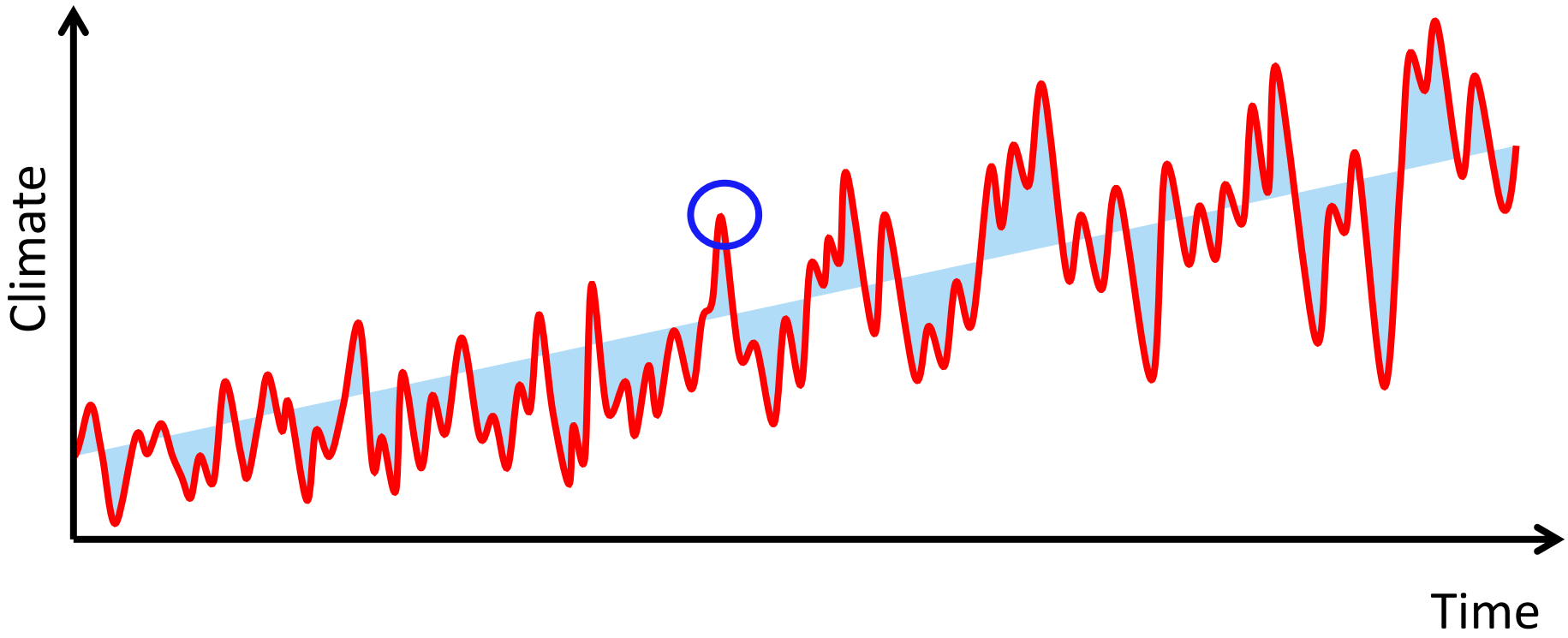
Climate Change



„Extremeness“ of climatic conditions is a relative term, depending on the time sequence before ...

Hegerl H, Hanlon H, Beierkuhnlein C **2011** Elusive Extremes. ***Nature Geoscience*** 4, 143-143

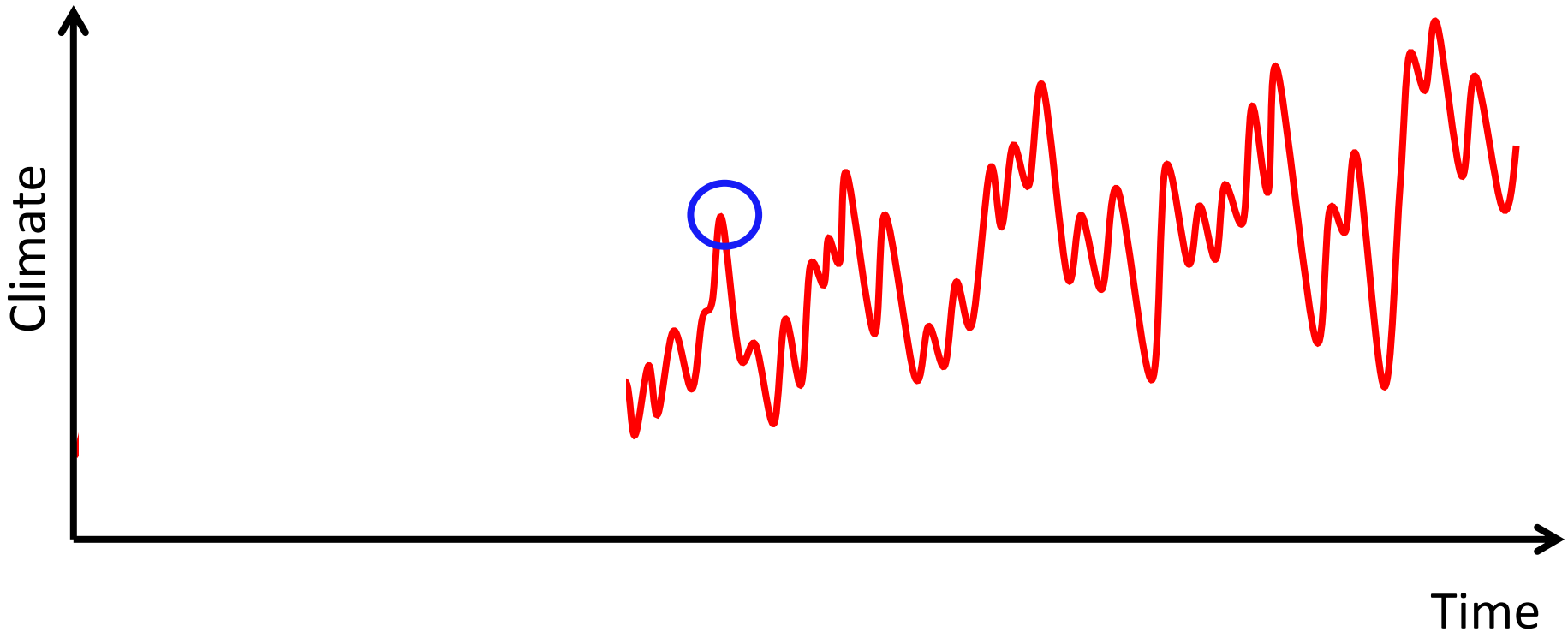
Climate Change



„Extremeness“ of climatic conditions is a relative term, depending on the time sequence before and after the event.

Hegerl H, Hanlon H, Beierkuhnlein C **2011** Elusive Extremes. ***Nature Geoscience*** 4, 143-143

Climate Change



„Extremeness“ of climatic conditions is a relative term, depending on the time sequence before and after the event.

Hegerl H, Hanlon H, Beierkuhnlein C **2011** Elusive Extremes. ***Nature Geoscience*** 4, 143-143

Climate Change

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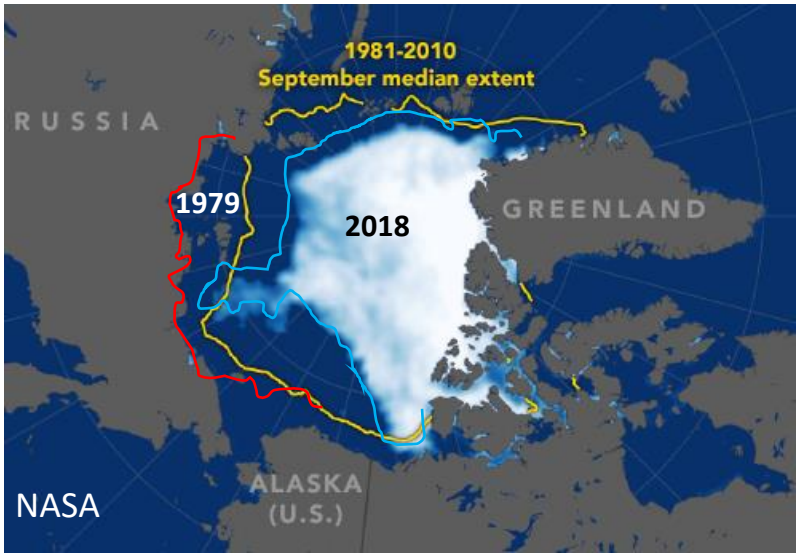
There is no clear understanding of „extreme“ conditions.

Extreme value **statistics** is influenced by the **duration** of the time series of a weather station (e.g. 50 vs. 150 y). Extreme values of today are no longer statistically „extreme“ in the future - just by the underlying trend.

Climate **models** are projecting long-term **average values** but are unable to precisely predict extreme conditions for the future.

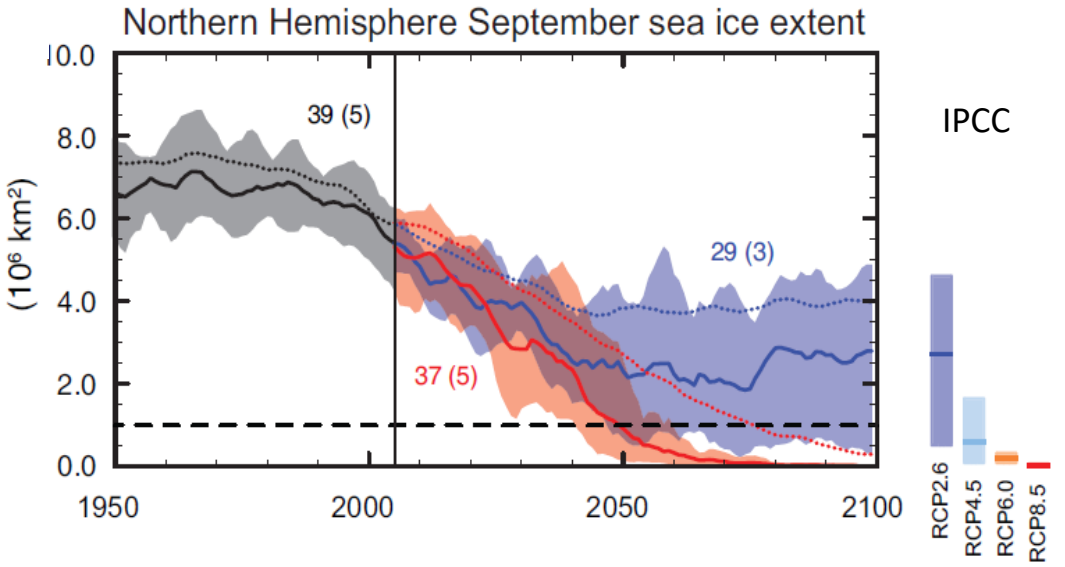
Biologically there are no absolute extremes. Conditions that are extreme for one species are not extreme for another!

Climate Change



Reduced sea ice extent reduces the albedo of the Arctic Ocean
=> **enhances global warming**!

Only in optimistic scenarios, a part of the polar sea ice is maintained.



IPCC

Climate Change

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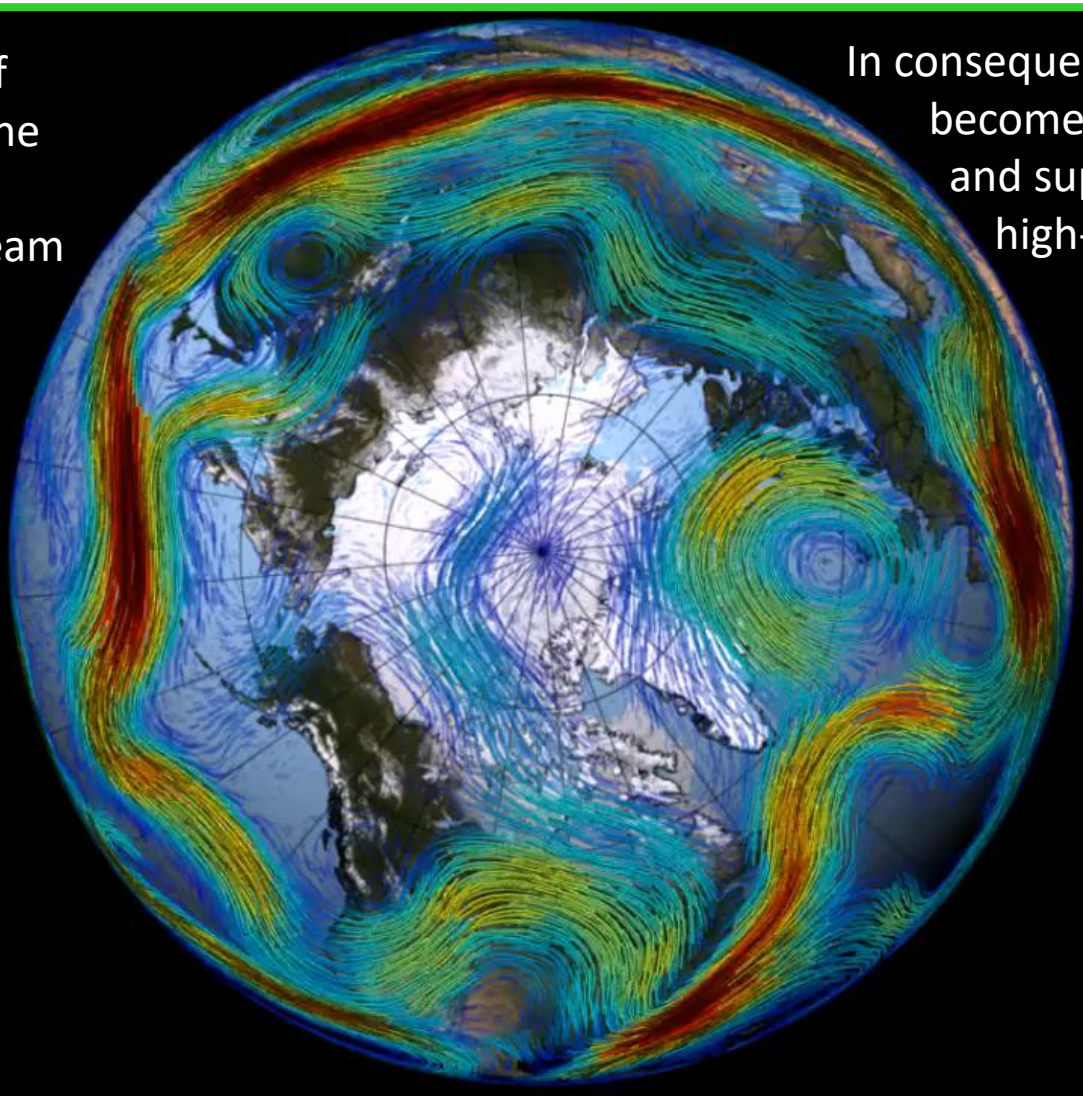
With the warming of the north pole cap the energy gradient is reduced and Jet Stream is slowed down.

In consequence, **Rossby Waves** become increasingly stable and support sequences of high- or low pressure in the same region.



Animation NASA's Goddard Space Flight Center

Climate Change

There is a clear linkage between **Rossby Wave packets** and **temperature extremes** in the **Northern Hemisphere**.

The presence of large-amplitude Rossby Wave packets in the upper troposphere is associated with a considerably **increased probability of lower-tropospheric temperature extremes**.

Fragkoulidis G, Wirth V, Bossmann P, Fink AH 2018. Linking Northern Hemisphere temperature extremes to Rossby wave packets. Q.J.R. Meteorol. Soc., 144: 553-566.

Climate Change

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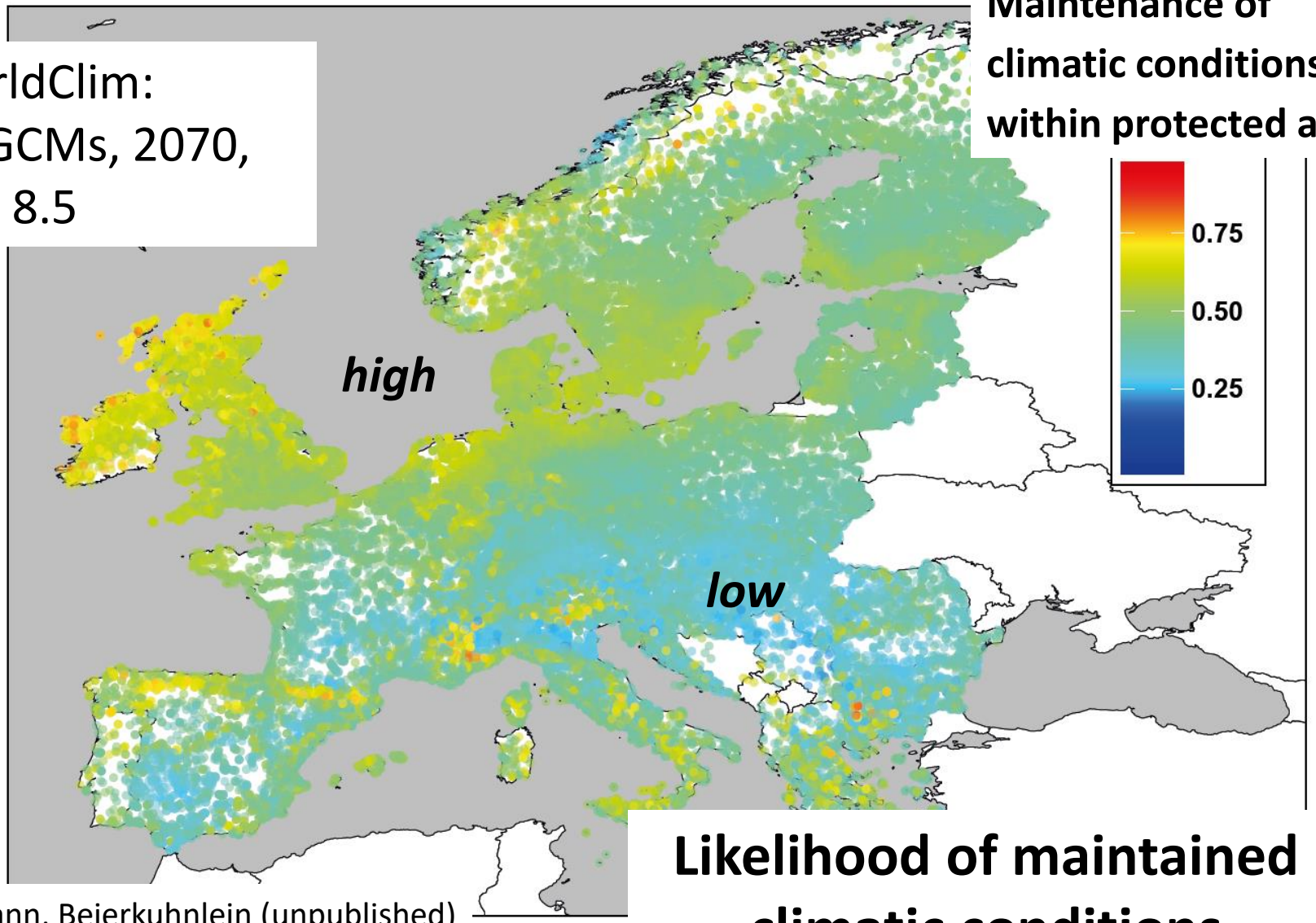
WorldClim:
10 GCMs, 2070,
RCP 8.5

Maintenance of climatic conditions within protected areas



Likelihood of maintained climatic conditions

Hoffmann, Beierkuhnlein (unpublished)

Alternatives ?

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Douglas Fir

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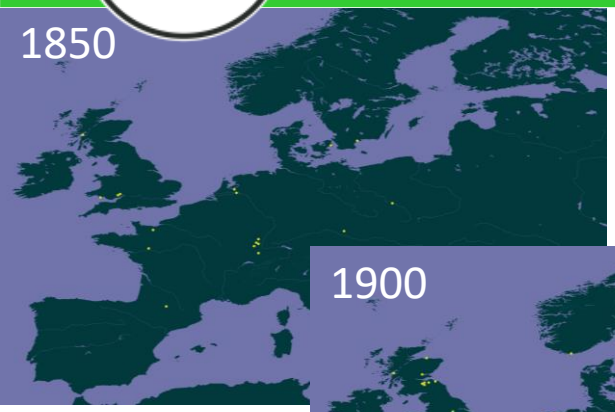
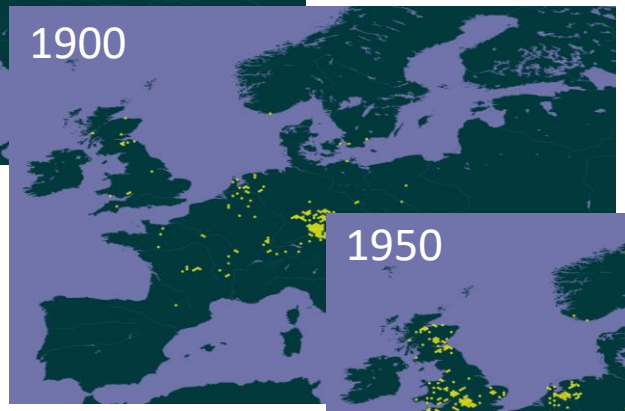
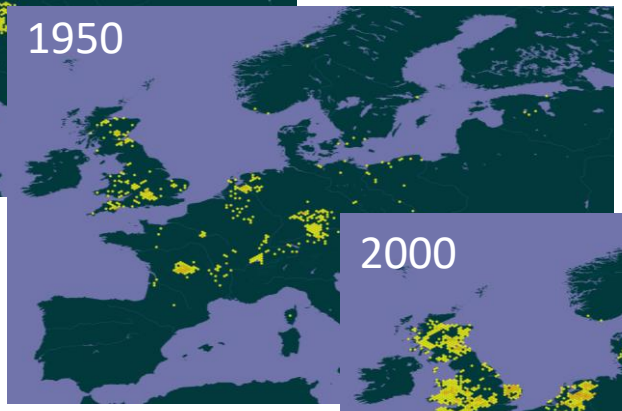
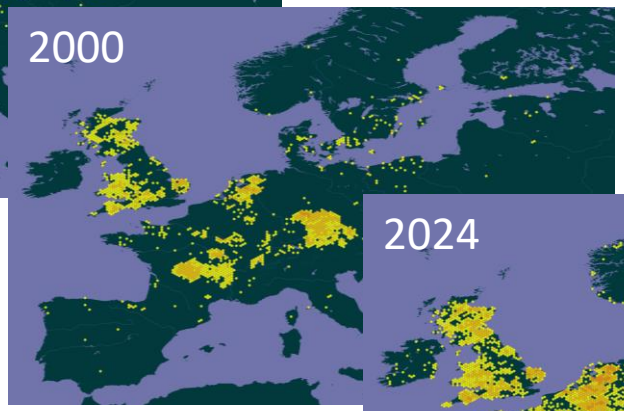
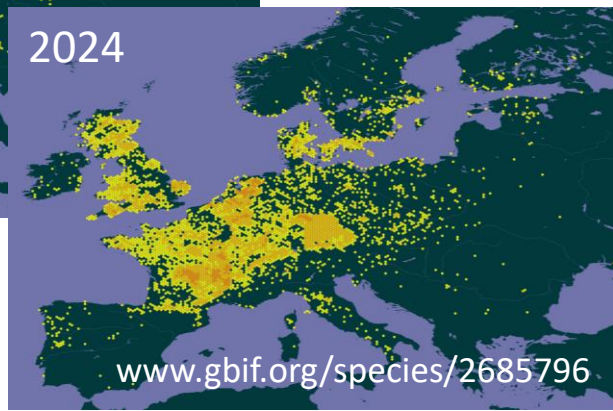






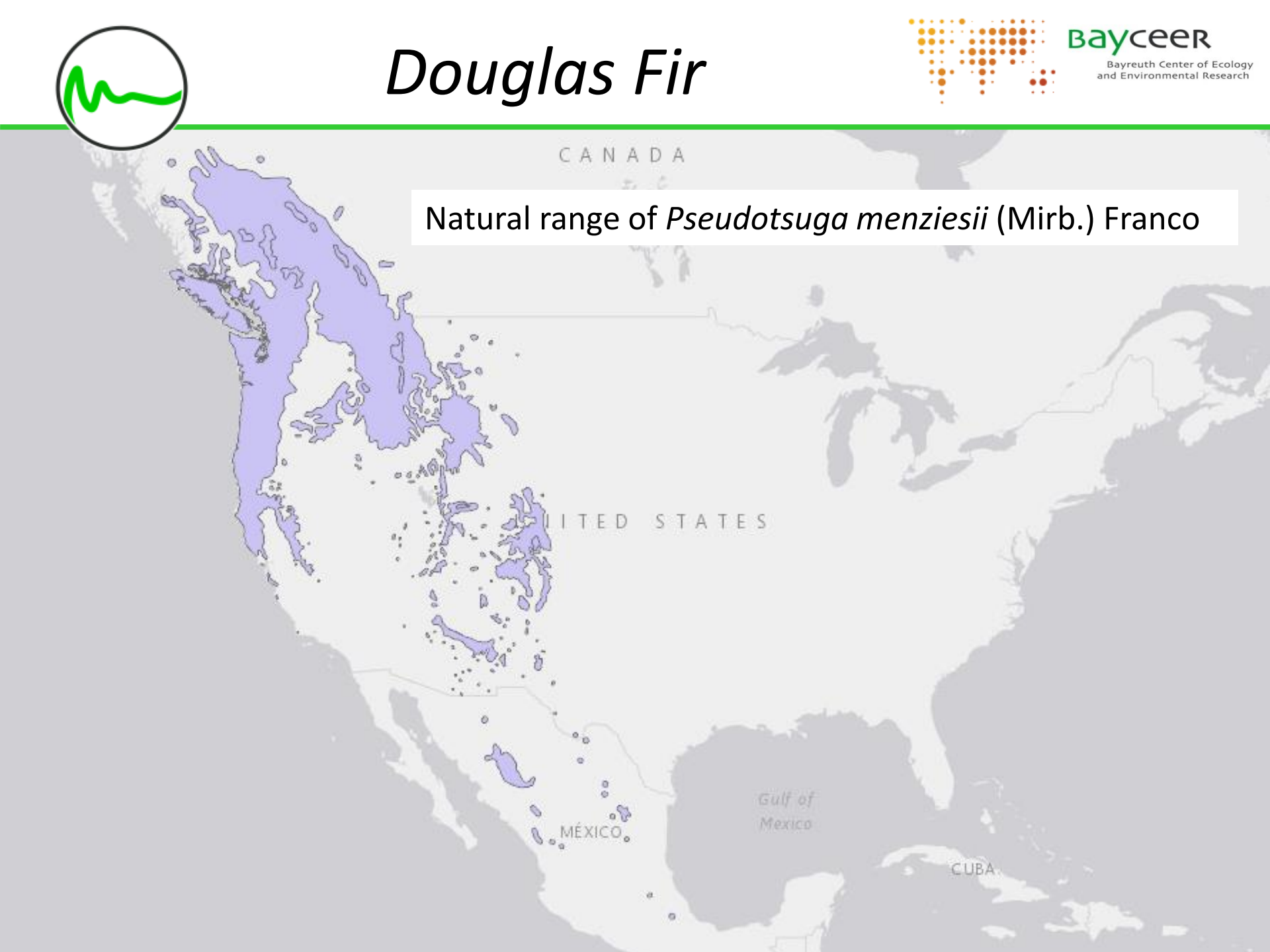




Development of European GBIF georeferenced records of introduced *Pseudotsuga menziesii* (Mirb.) Franco

Native European *Pseudotsuga* populations became extinct in the Waal Interglacial (1.6 – 1.4 mya)

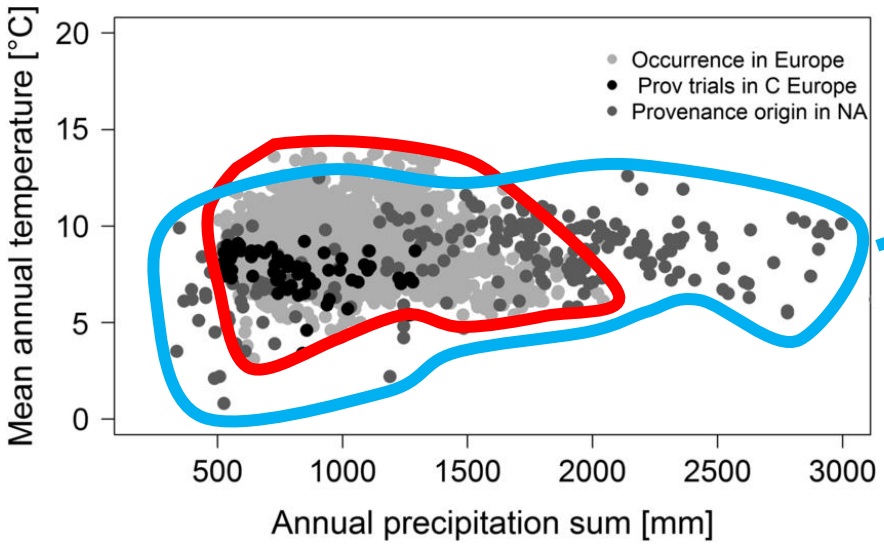
Douglas Fir



Natural range of *Pseudotsuga menziesii* (Mirb.) Franco

Douglas Fir

Natural and European bioclimatic niche of *Pseudotsuga menziesii*



SDM based on European records of *Pseudotsuga menziesii*

Observed natural records of *Pseudotsuga menziesii*

Neither continental climate with seasonal fluctuations nor regions with high amount of precipitation are represented!

Chakraborty D et al. 2019. Genetic trials improve the transfer of Douglas-fir distribution models across continents. Ecography 42: 88-101.

Douglas Fir

In Oregon, currently large forests of Douglas fir are dying (> 4000 km2).

Drought combined with high temperatures are seen as the main drivers of douglas fir decline (USDA Forest Service).

USDA Forest Service 2015. Predicting Douglas-Fir's response to a warming climate. Science Findings 179, https://www.fs.usda.gov/pnw/sciencef/scifi179.pdf

Douglas Fir

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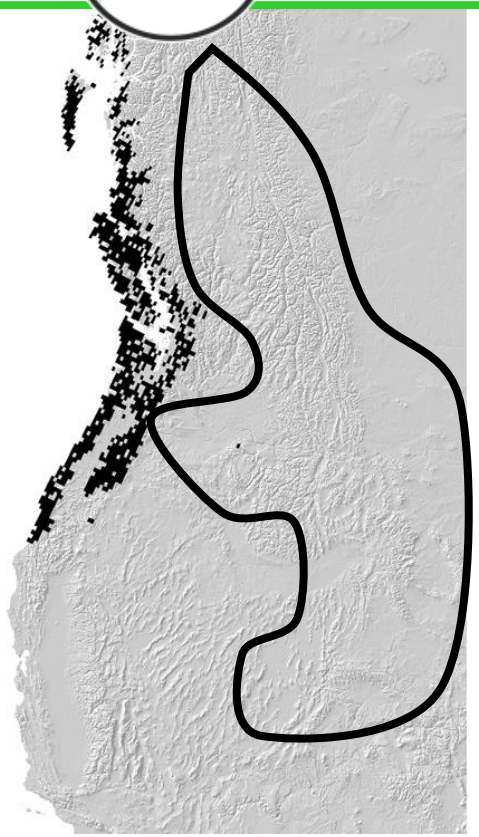

Populations which exhibited the highest level of drought tolerance originated in **climates with cold winters and dry summers**.

These conditions are not represented in the current European Douglas fir populations.

SDM based on European records of *Pseudotsuga menziesii*

Observed natural records of *Pseudotsuga menziesii*

USDA Forest Service 2015. Predicting Douglas-Fir's response to a warming climate. Science Findings 179, https://www.fs.usda.gov/pnw/sciencef/scifi179.pdf

Douglas Fir

Douglas fir ecosystems are naturally exposed to wildfires.

The species can survive with and without fire. It is not dependent on it.

However, within days wildfires can **release** a huge amount of **sequestered carbon** that has been accumulated over decades.

Pseudotsuga menziesii regenerates well after fire, but it does not regenerate well in the understory of an established canopy (US National Park Service).

The species is adapted to wildfires, but not appropriate to reduce fire risks.

Foto USDI National Park Service

https://www.nps.gov/articles/wildland-fire-in-douglas-fir.htm

Diversity and Resilience

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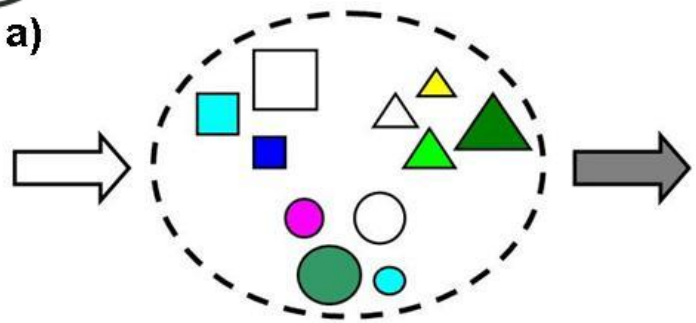
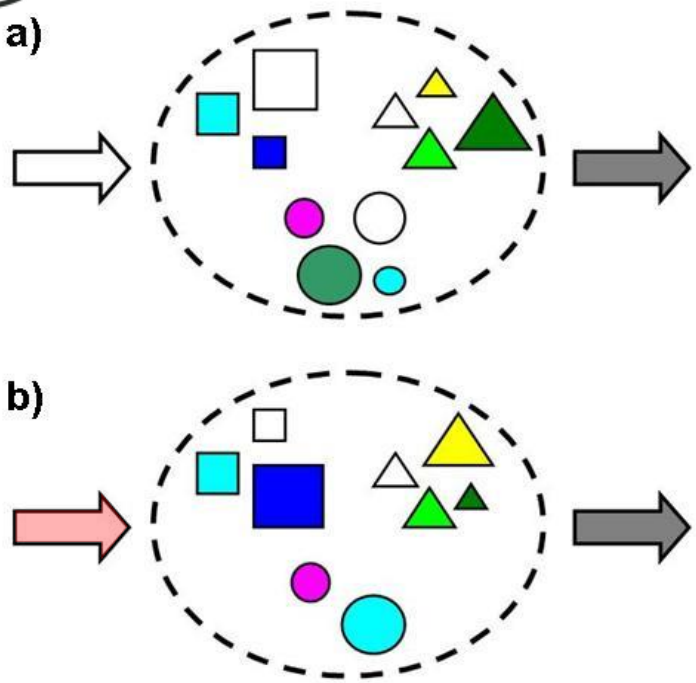
Diversity and Resilience



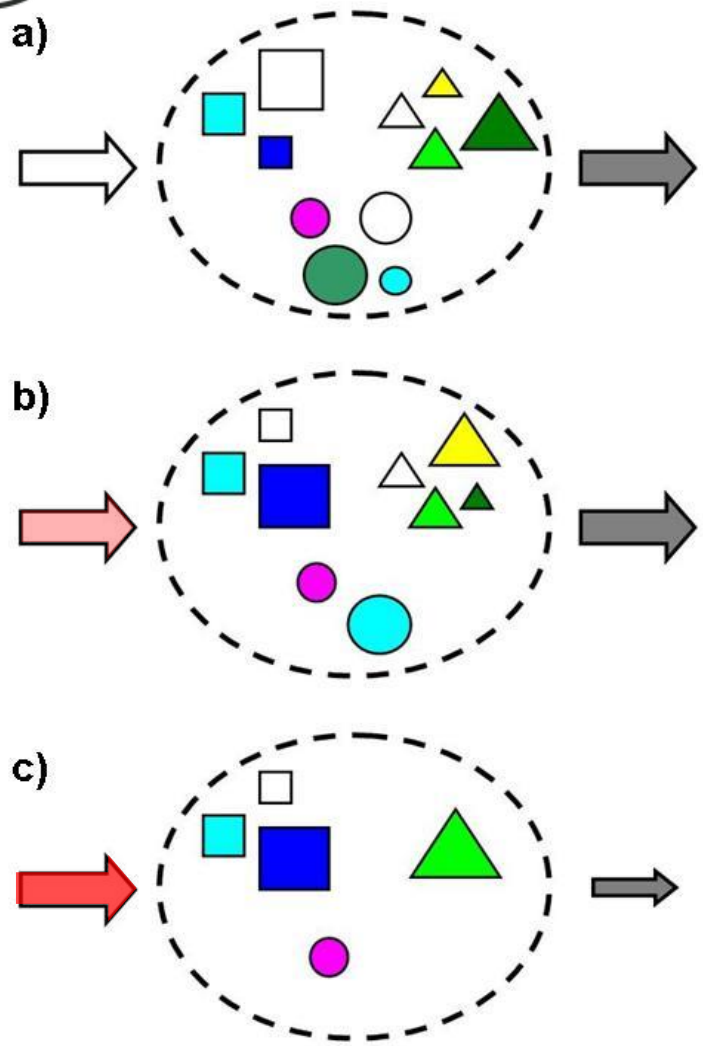
Beierkuhnlein, C. & Jentsch, A. (2004) Ecological importance of species diversity. A review on the ecological implications of species diversity in plant communities. In: Henry, R. (ed.): Diversity and Evolution of Plants. CAB International, 249-285

Diversity and Resilience



Beierkuhnlein, C. & Jentsch, A. (2004) Ecological importance of species diversity. A review on the ecological implications of species diversity in plant communities. In: Henry, R. (ed.): Diversity and Evolution of Plants. CAB International, 249-285

Diversity and Resilience



Species diversity buffers the effects of climate change

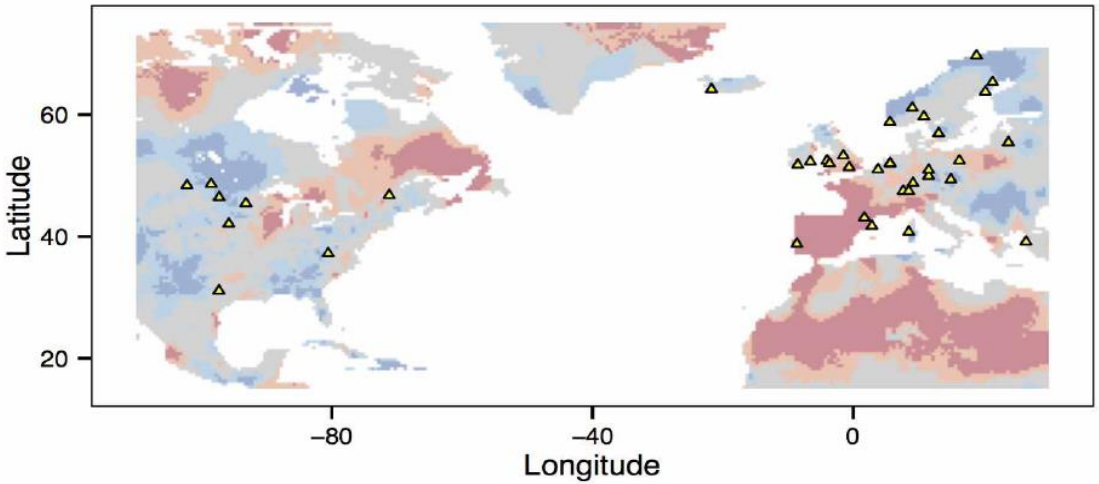
Beierkuhnlein, C. & Jentsch, A. (2004) Ecological importance of species diversity. A review on the ecological implications of species diversity in plant communities. In: Henry, R. (ed.): Diversity and Evolution of Plants. CAB International, 249-285

LETTER

doi:10.1038/nature15374

Biodiversity increases the resistance of ecosystem productivity to climate extremes

Forest Isbell[1], Dylan Craven[2,3], John Connolly[4], Michel Loreau[5], Bernhard Schmid[6], Carl Beierkuhnlein[7], T. Martijn Bezemer[8], Catherine Bonin[9], Helge Bruelheide[2,10], Enrica de Luca[6], Anne Ebeling[11], John N. Griffin[12], Qinfeng Guo[13], Yann Hautier[14], Andy Hector[15], Anke Jentsch[16], Jürgen Kreyling[17], Vojtěch Lanta[18], Pete Manning[19], Sebastian T. Meyer[20], Akira S. Mori[21], Shahid Naeem[22], Pascal A. Niklaus[6], H. Wayne Polley[23], Peter B. Reich[24,25], Christiane Roscher[2,26], Eric W. Seabloom[1], Melinda D. Smith[27], Madhav P. Thakur[2,3], David Tilman[1,28], Benjamin F. Tracy[29], Wim H. van der Putten[8,30], Jasper van Ruijven[31], Alexandra Weigelt[2,3], Wolfgang W. Weisser[20], Brian Wilsey[32] & Nico Eisenhauer[2,3]

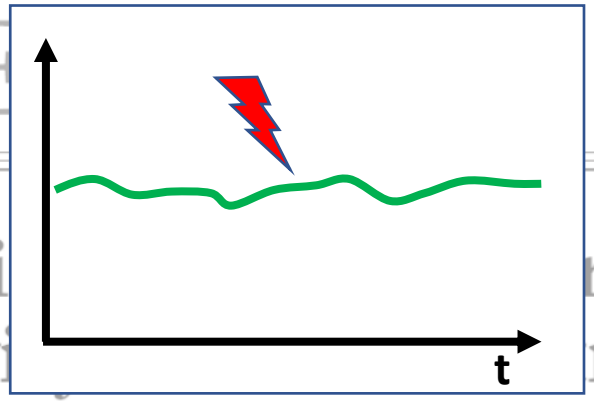


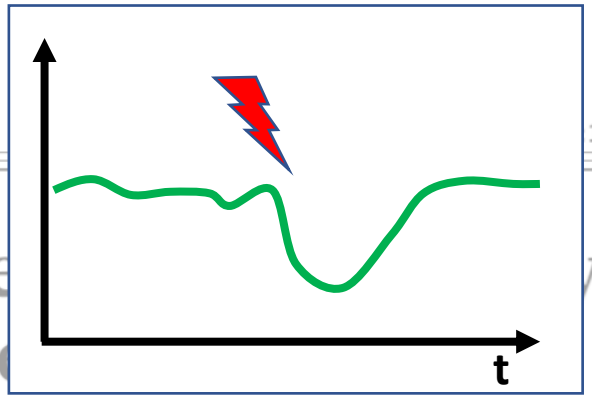
46 Biodiversitätsexperimente im Grünland

Diversity and Resilience

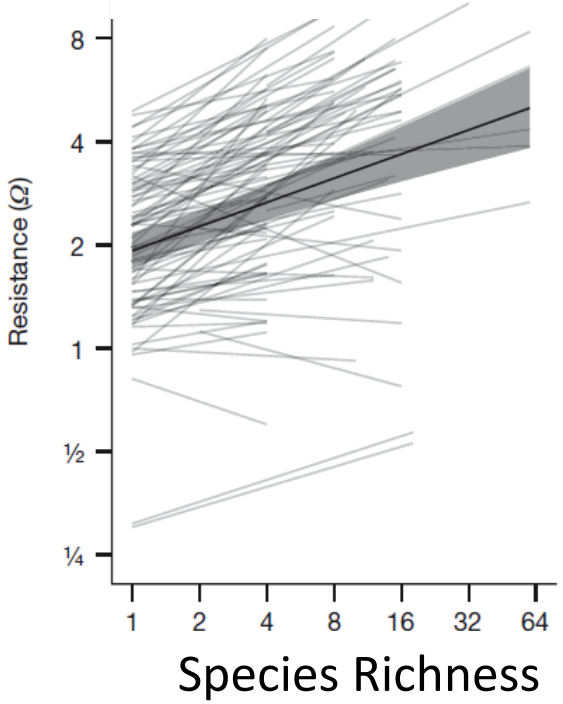
LETTE
10.1038/nature15374

Biodiversi re ystem
productivi re

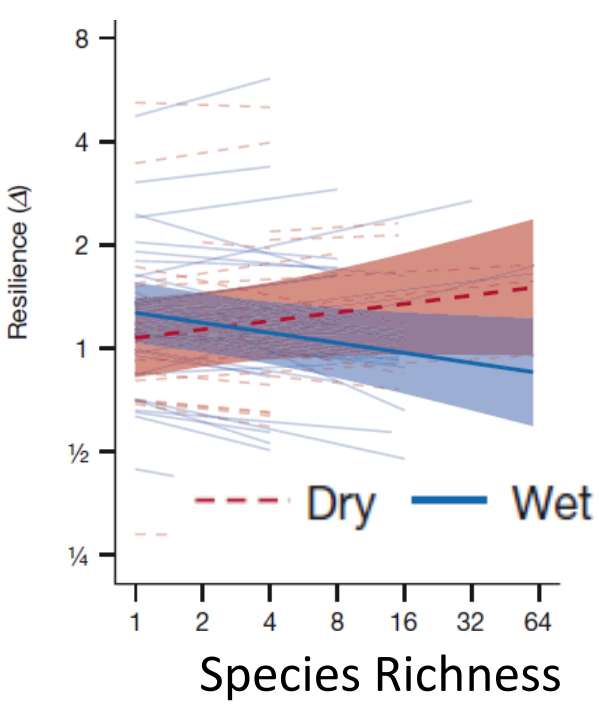




Resistance



Resilience



Management Options

Maintaining and promoting **deciduous forest stands reduces the risk of wildfires** in the temperate forest.

In the temperate zone, conifer plantations and **exotic** tree species (*Eucalyptus*) must be **replaced** by deciduous forests.

Ban on intentional burning of agricultural land close to forests.

Diversity is an **insurance to maintain the functioning** of forests.

Tree **species respond individually** to climatic extremes. The **native tree species pool** must be maintained!

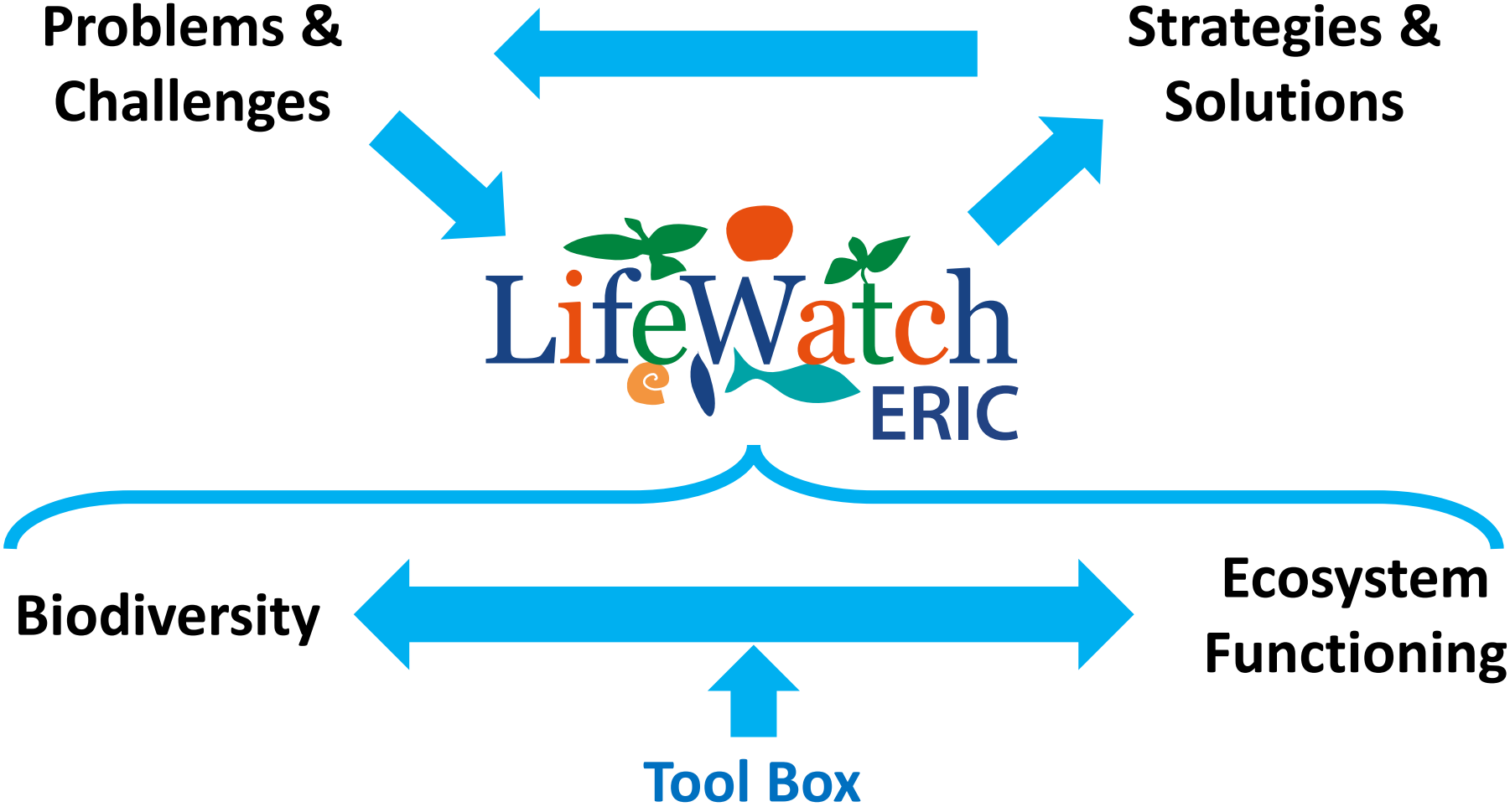
My View

Problems & Challenges

Strategies & Solutions

LifeWatch ERIC

My View


Problems & Challenges
Strategies & Solutions
LifeWatch ERIC
Biodiversity
Ecosystem Functioning
Tool Box
Monitoring
Algorithms
Databases
Models
Experiments

My View

Problems & Challenges

Decision Making

Strategies & Solutions

Policy Calls

LifeWatch ERIC

Research Projects

Biodiversity

Ecosystem Functioning

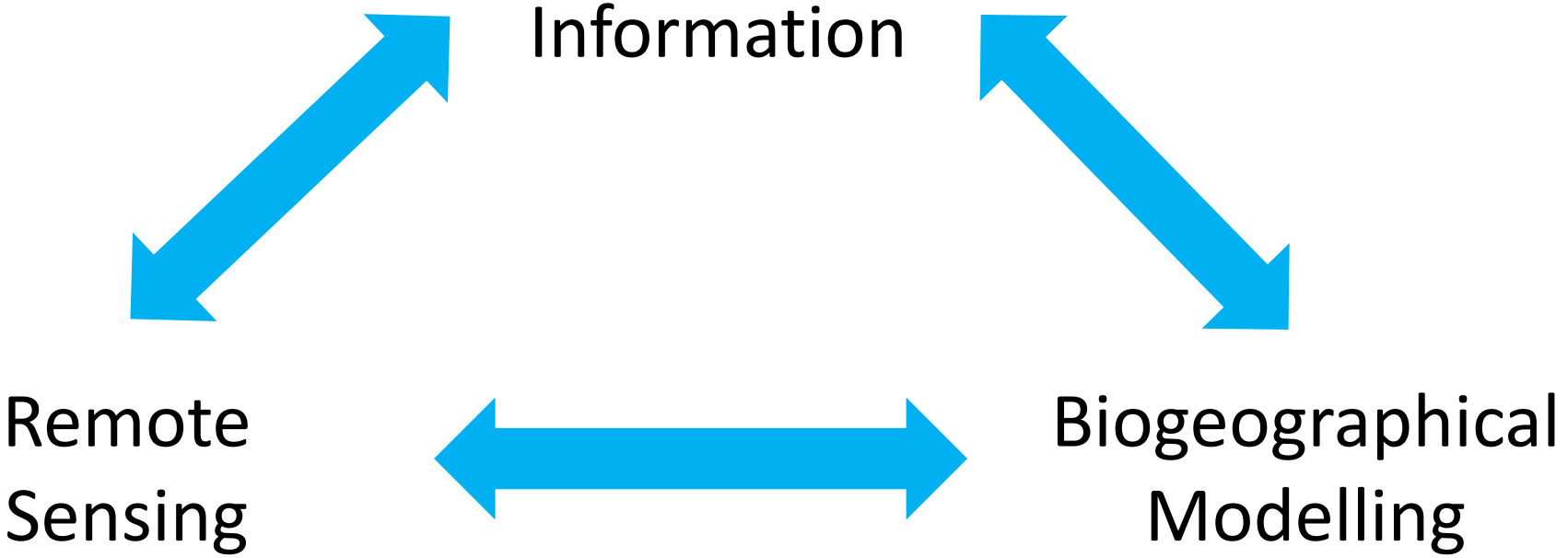
Tool Box

Monitoring *Algorithms* *Databases* *Models* *Experiments*

LifeWatch ERIC

In-situ Information

Biogeography & Lifewatch



Biogeography & Lifewatch

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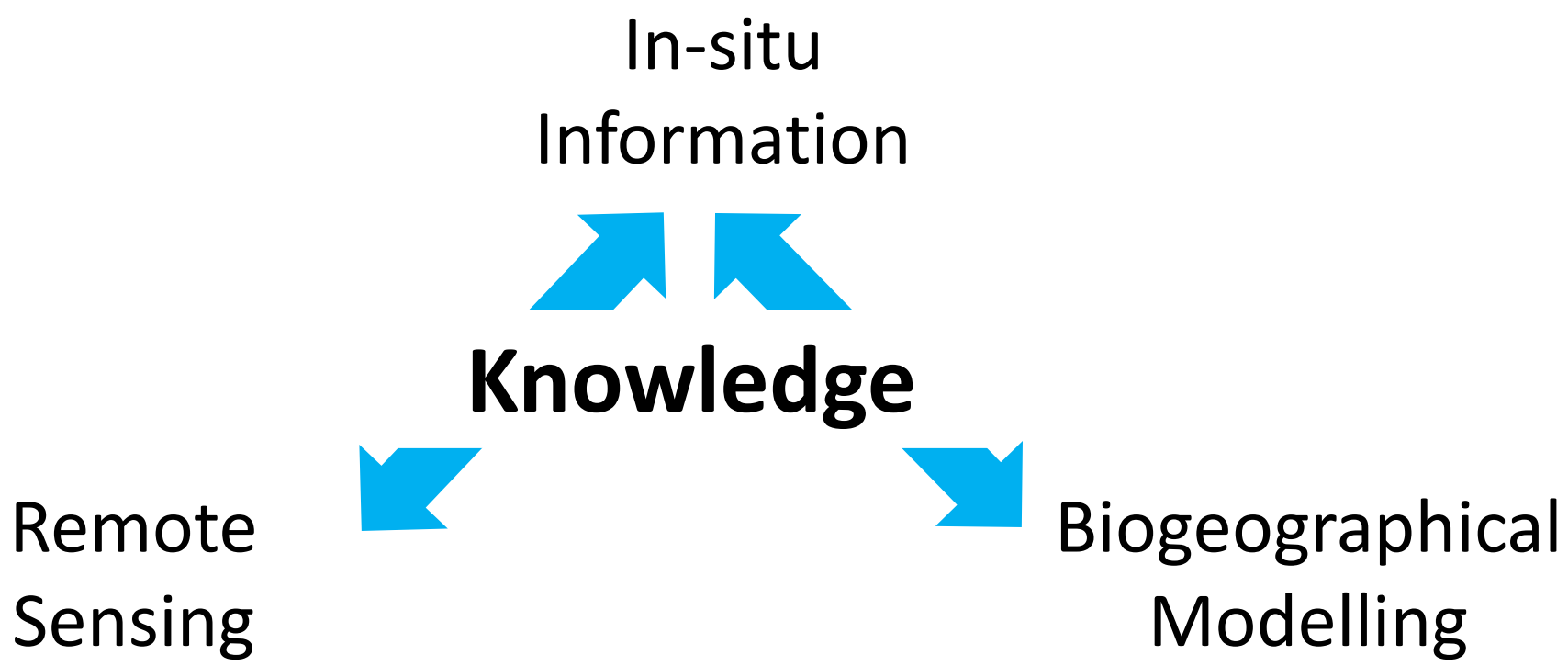
LifeWatch ERIC



Thanks

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Conceptual art installation “Green Desert” by Isaac Cordal in Galician Eucalypt forest, Pontevedra, Spain

photo by Isaac Cordal

Climate Change

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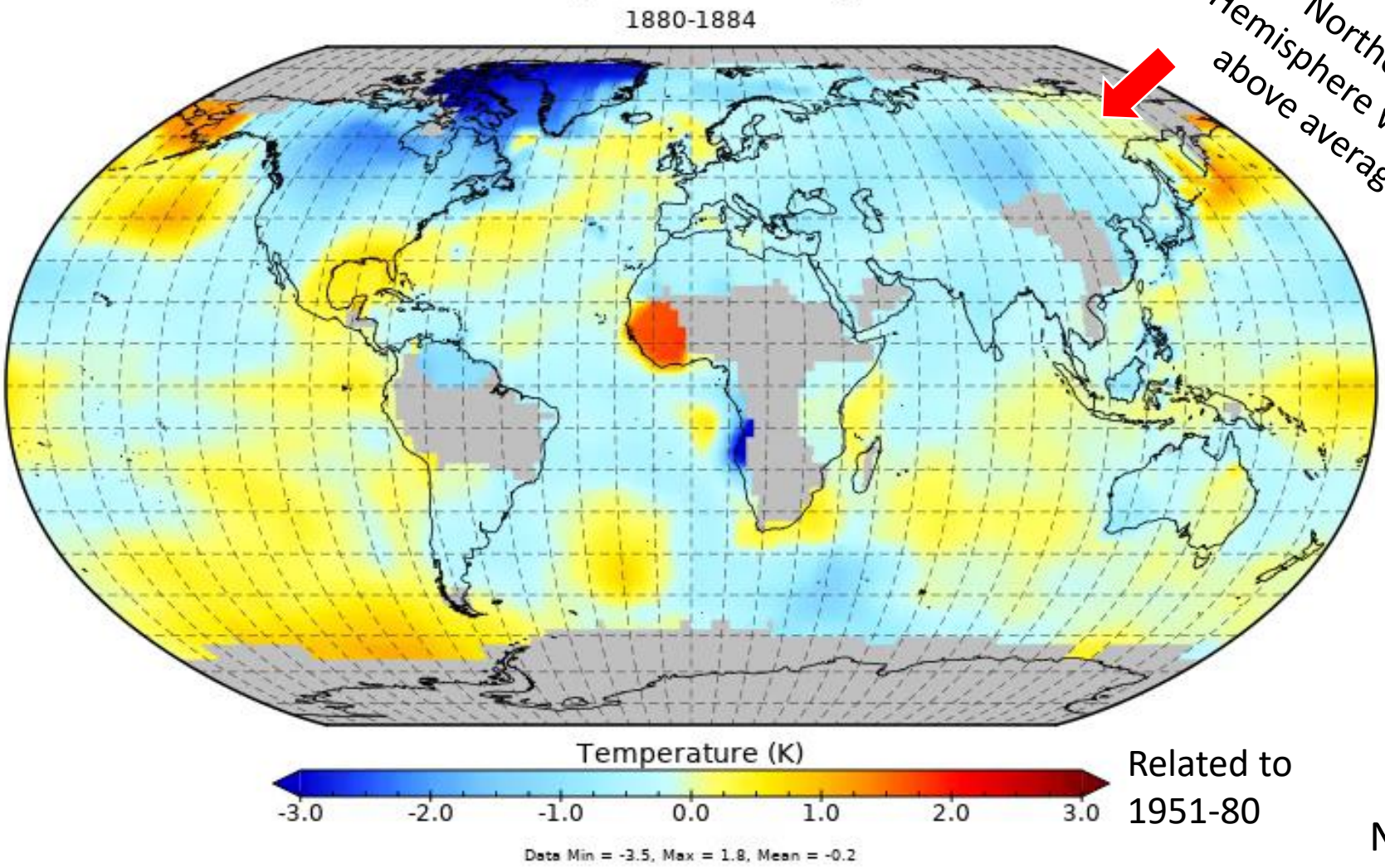
5-year temperature anomaly 1880-2018

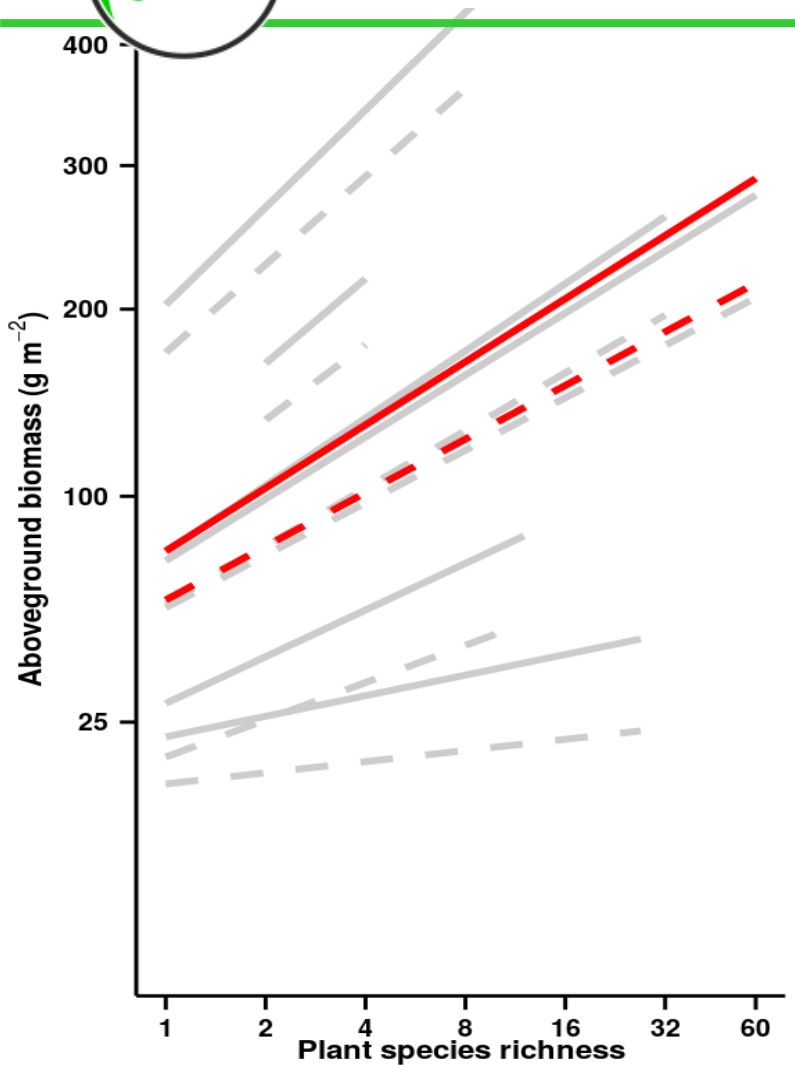
Spatial interpolation of recorded data



Related to 1951-80

NASA

Ökosystem-Funktionen



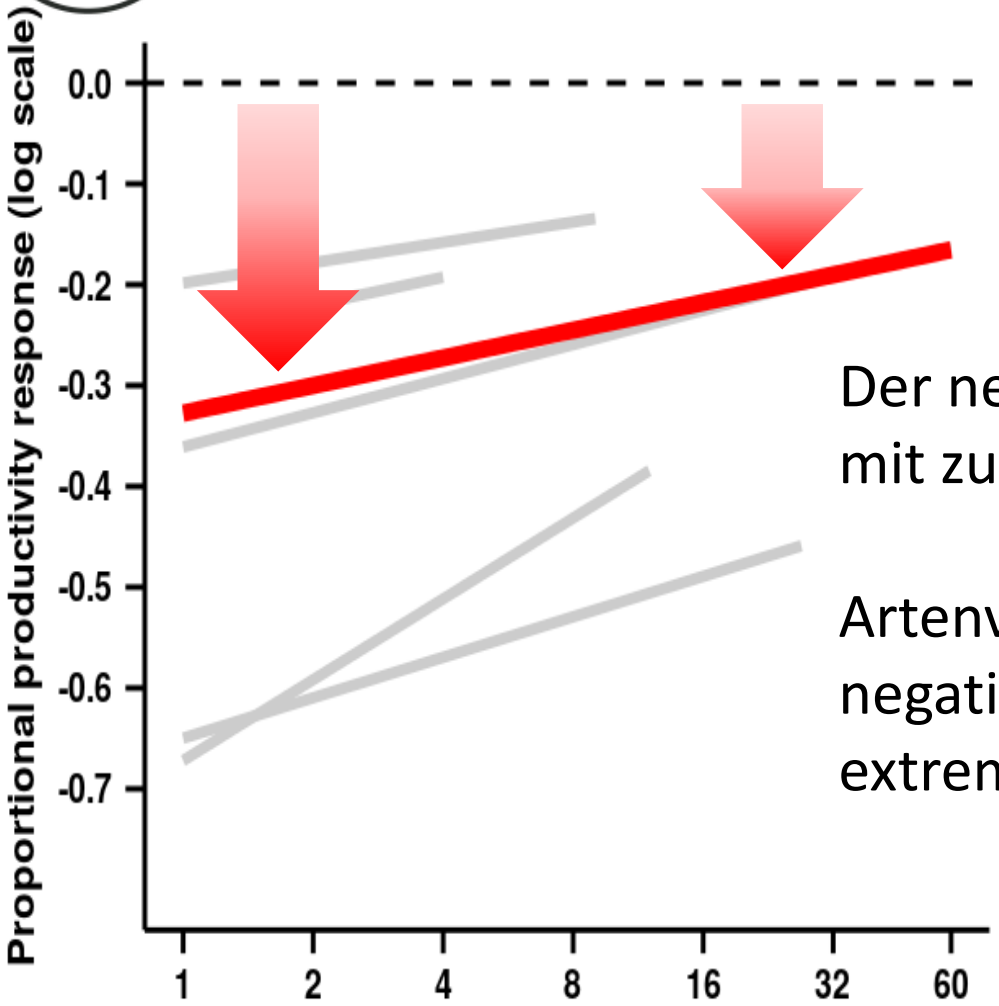
Zwar nimmt durch Dürre die Produktivität von Ökosystemen ab, doch zeigt sich nach wie vor ein Biodiversitätseffekt.

Artenreiche Graslandbestände wachsen auch unter Dürre besser als artenarme. Auswertung von 16 Experimenten in Grasland weltweit.

Dürre
Kontrolle

Craven, Isbell, Manning, Conolly, Bruelheide, Ebeling, Roscher, van Ruijven, Weigelt, Wilsey, Beierkuhnlein et al. (2016) Plant diversity effects on grassland productivity are robust to both nutrient enrichment and drought. Philos Trans R Soc Lond B Biol Sci. 19; 20150277. doi: 10.1098/rstb.2015.0277

Ökosystem-Funktionen

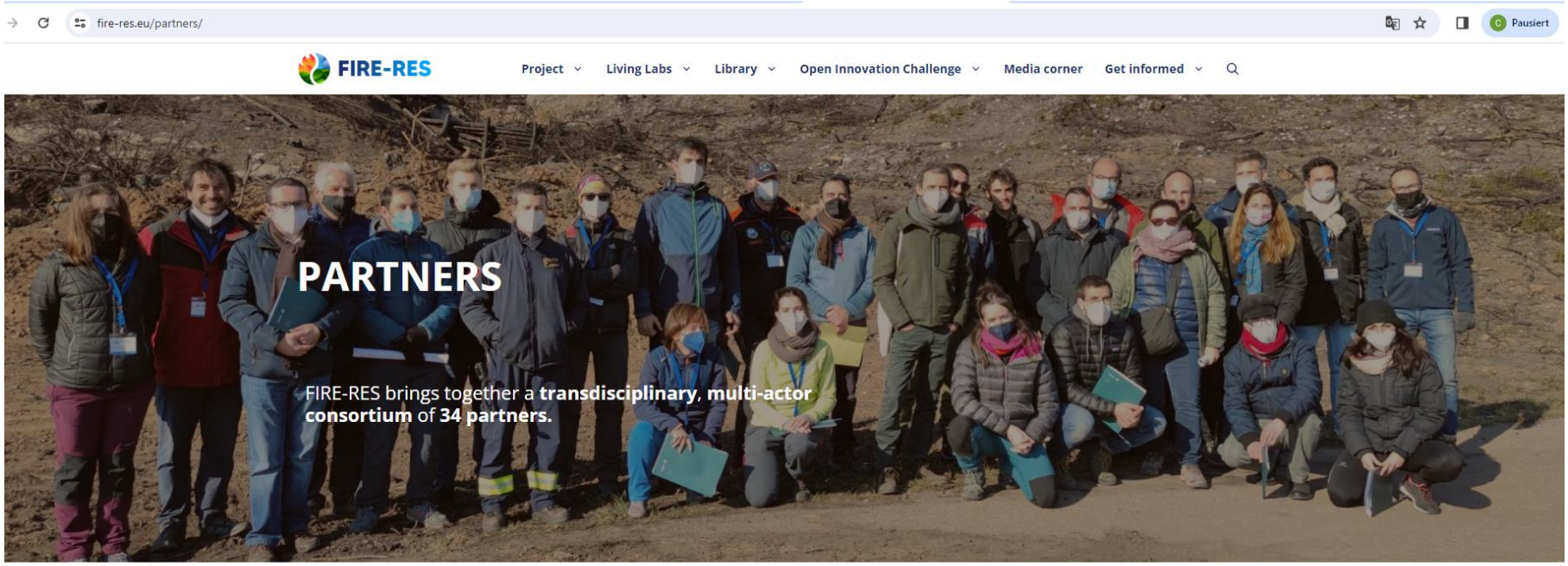


Der negative Effekt von Dürre nimmt mit zunehmender Artenzahl ab.

Artenvielfalt mildert folglich die negative Auswirkungen von extremen Klimabedingungen.

Craven, Isbell, Manning, Conolly, Bruelheide, Ebeling, Roscher, van Ruijven, Weigelt, Wilsey, Beierkuhnlein et al. (2016) Plant diversity effects on grassland productivity are robust to both nutrient enrichment and drought. Philos Trans R Soc Lond B Biol Sci. 19; 20150277. doi: 10.1098/rstb.2015.0277

Horizon2020 FIRE-RES



FIRE-RES Consortium is formed by researchers, emergency-response bodies, technological companies, industry and civil society from **13 countries**, linking to broader networks in science and disaster reduction management.

The **Forest Science and Technology Centre of Catalonia**, Spain, coordinates the FIRE-RES project.

CTFC

fire regimes are bringing in new wildfires. As a result, these countries are now reinventing the wheel of fire management while they could benefit from learning from other countries and experiences in other fields, such as water management.

FIRE MANAGEMENT IN GERMANY-THE NETHERLANDS

Fire management in the Netherlands and Germany has a long tradition. However, because of their fire history, fire services are mostly trained to deal with urban fires while they have **little preparedness** to respond in case of non-urban fires.

The intensity and frequency of ongoing wildfires are a relative new phenomenon. However, the region has a **little forest management** tailored to forest fire and **limited policy for wildfires**.

Therefore, systematic registration, innovative fire management practices and learning from other countries is central. In particular, the region urge to develop its fire management practices as relative small fires can have huge impact due to the high population density, intensive use of space and large areas of Wildland Urban Interfaces.

CHALLENGES

- To foster knowledge exchange between Netherlands and Germany and with traditional fire prone countries
- To increase awareness among wider public, in governance and decision-making processes among stakeholders involved
- To make integrated fire management an essential part of landscape management

Habitat Fragmentation and La | Habitat fragmentation and lan | Dryad | Data -- The biome inve | Why are forest fires such a seri | Germany-The Netherlands - Fl | JanetMaringer_forestfireimpac
pik-potsdam.de/en/institute/departments/climate-resilience/projects/project-pages/formasam/meetings/4/JanetMaringer_forestfireimpactsbeechforest_day1_shareYes.pdf
JanetMaringer_forestfireimpactsbeechforest_day1_shareYes.pdf 1 / 58 100%

General assumption: Beech forests do not burn. Evidence from recent years: Yes they do!

Janet Maringer[1], Davide Ascoli[2], Marco Conedera[1]

[1]Swiss Federal Institut for Forest, Snow and Landscape Research
[2]University of Turin, Italy

Fire in beech forests

Beech forests rarely burn due to ...
... compact litter layer with low oxygen content
... a lack of understory vegetation
... typical forest structure („Hallenwälder“)

Wildfires

In 2023 until July 234 516 hectares of land burned

European Forest Fire Information System (EFFIS)

ESA 2023

Climate Change

With climate change, an increase in wildfires is expected for the near future.

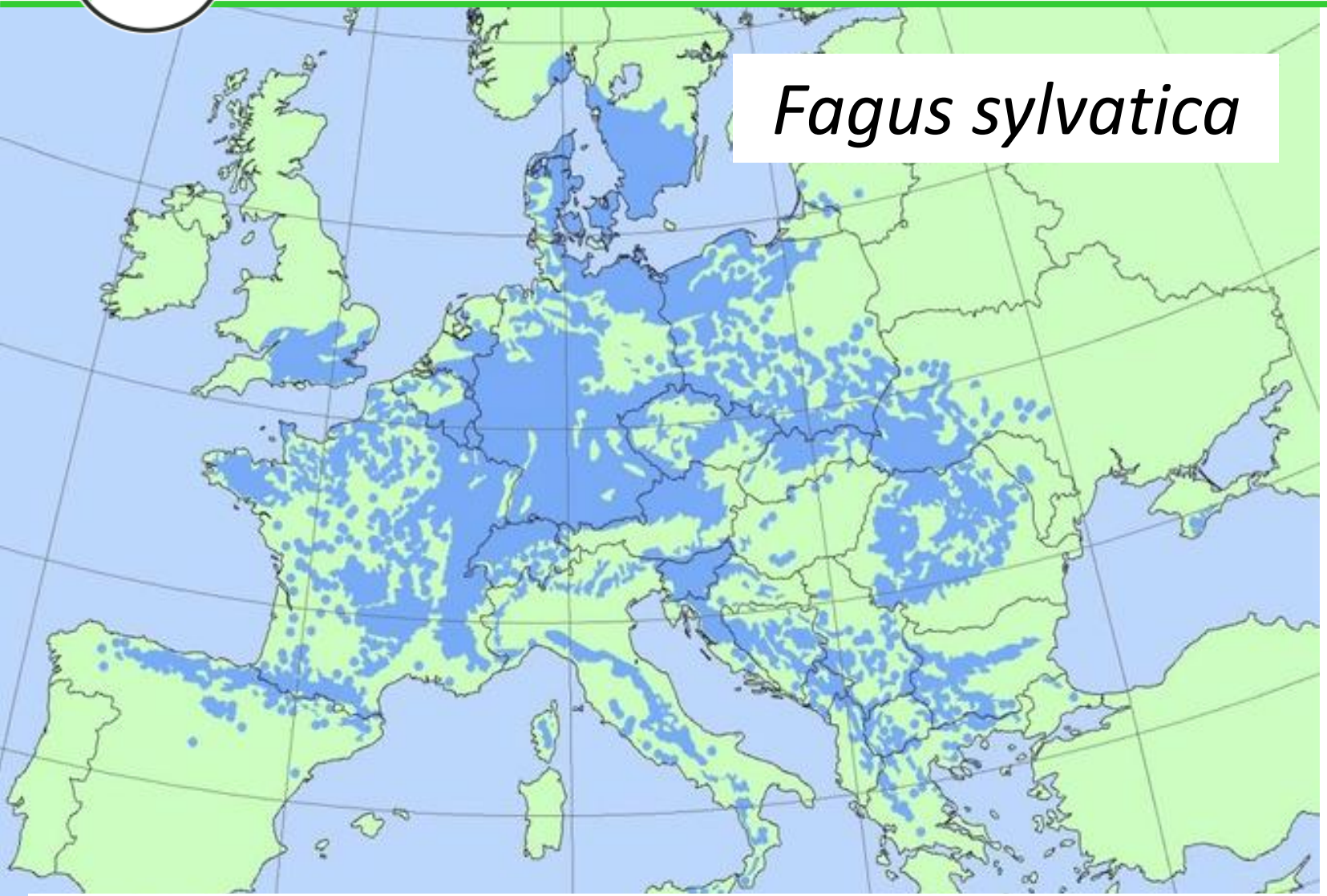
Climate Change

In 2022 in Romania, 1,019 fires forest fires consumed 13,141 hectares.

2022 was the year with the largest area of forest burned since records began in 1956.

Marin Drăcea Institute

Biodiversity



EUFORGEN based on Pott R 2000. Paleoclimate and vegetation – long-term vegetation dynamics in Central Europe with particular reference to beech. Phytocoenologia 20, 265-333.

Climate Change

Data from the European Union indicate even larger burned areas of broadleaf forest in 2022 for Romania.

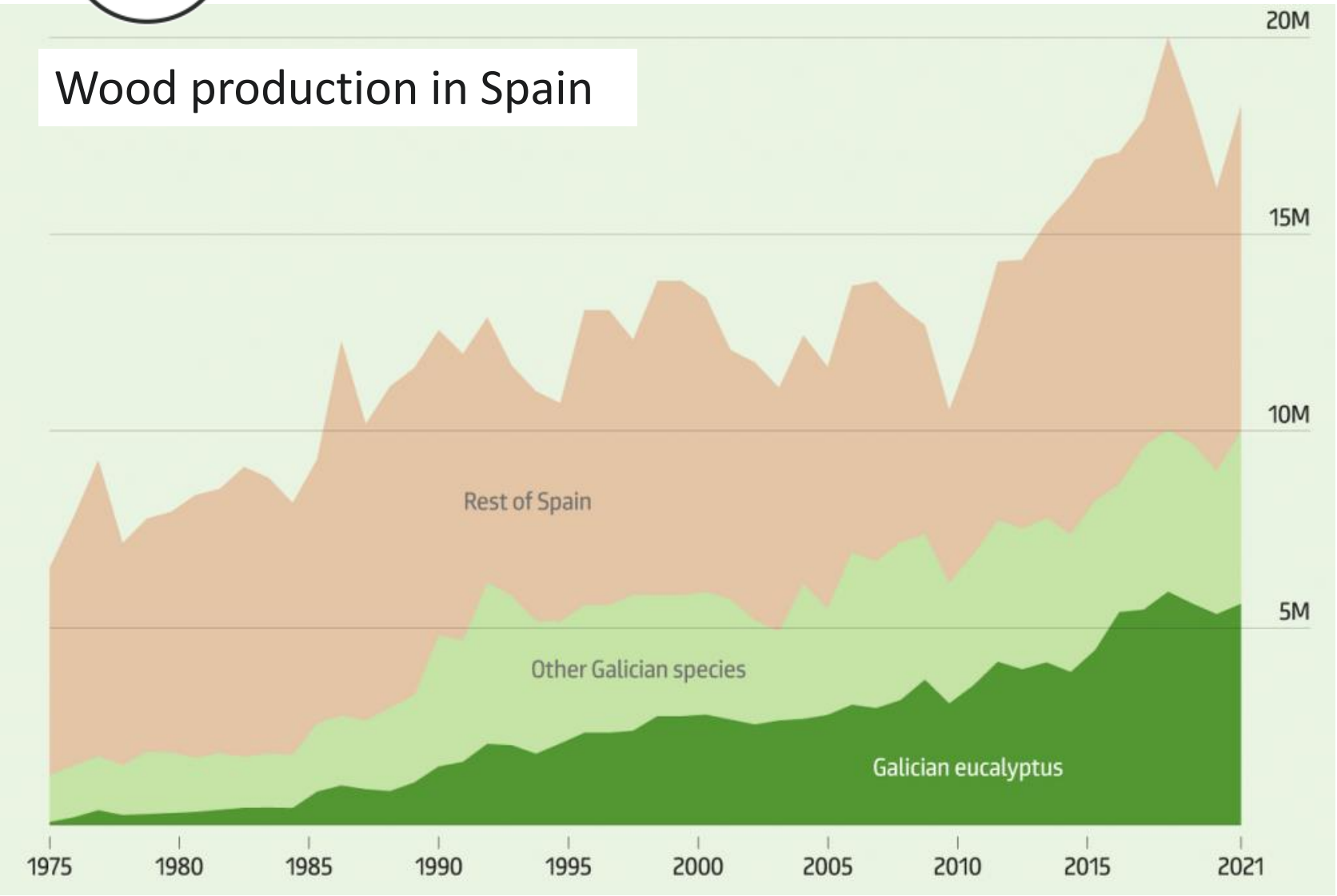
Land cover	*Area burned*		*% of total*
Broadleaf forest	34892		21.5
Coniferous forest	15		0.0
Mixed forest	238		0.1
Other Natural Land	95038		58.5
Transitional	4752		2.9
Agriculture	26729		16.4
Artificial Surfaces	83		0.1
Other Land Cover	771		0.5
TOTAL	162518	ha	100

San-Miguel-Ayanz, J., et al. 2022. Forest Fires in Europe, Middle East and North Africa 2022, Publications Office of the European Union, Luxembourg.

Eucalyptus

Bayceer
Bayreuth Center of Ecology and Environmental Research

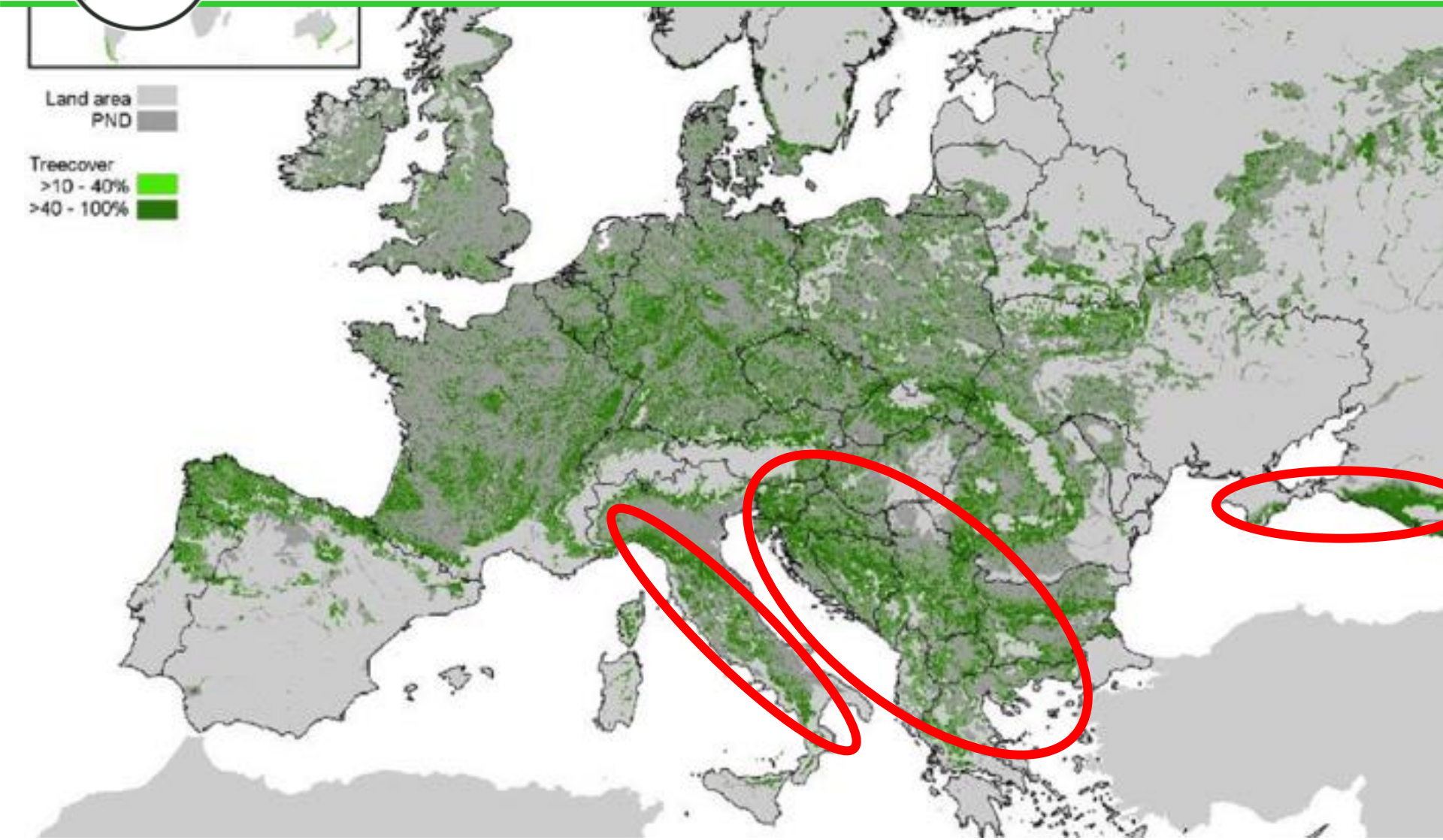
Wood production in Spain



m^3

www.europeandatajournalism.eu/cp_data_news/eucalyptus-fever-speculation-and-wildfire-in-galicia/

Temperate Biome

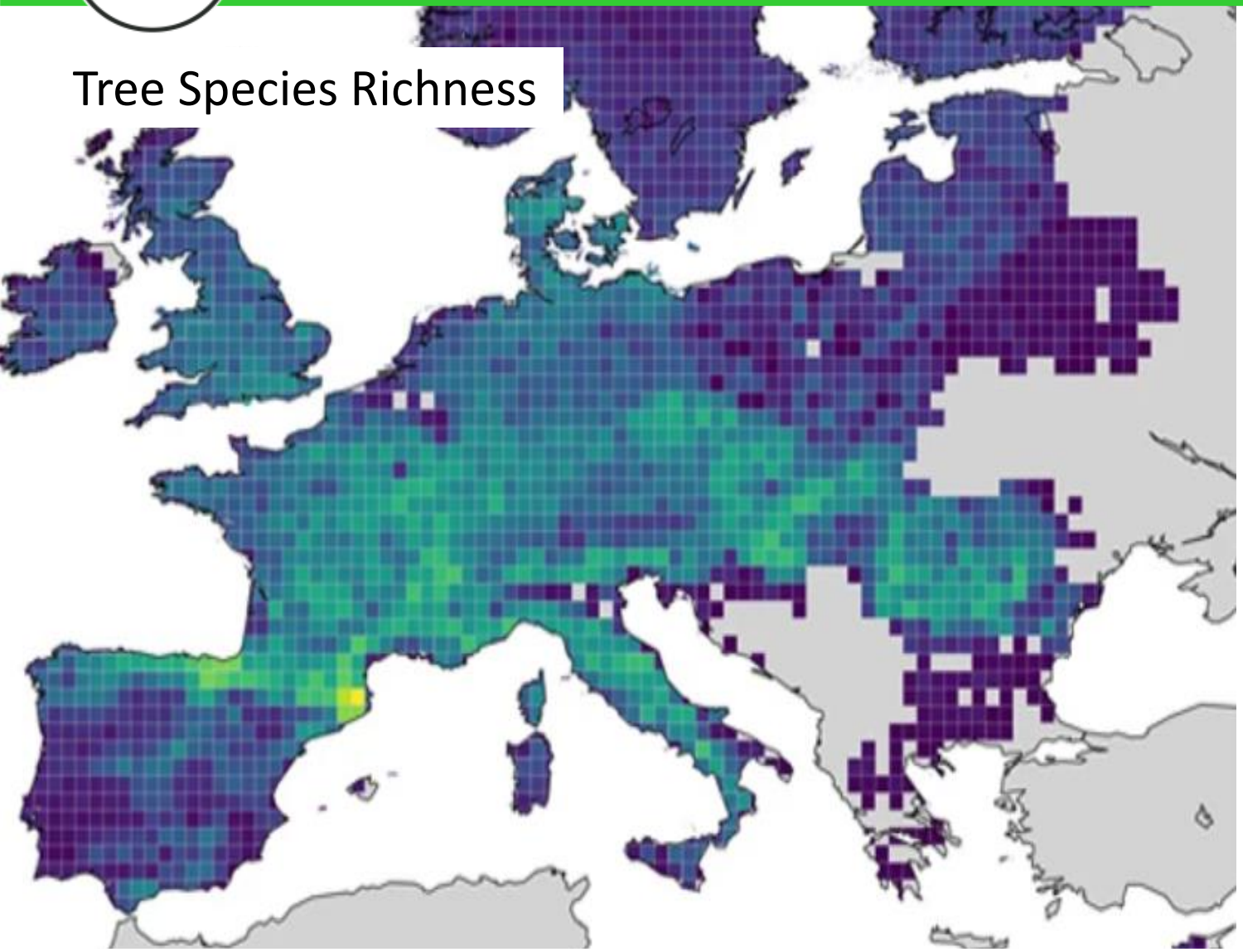


Gustafsson et al 2020 Retention as an integrated biodiversity conservation approach for continuous-cover forestry in Europe. Ambio 49(1):85-97.

Biodiversity

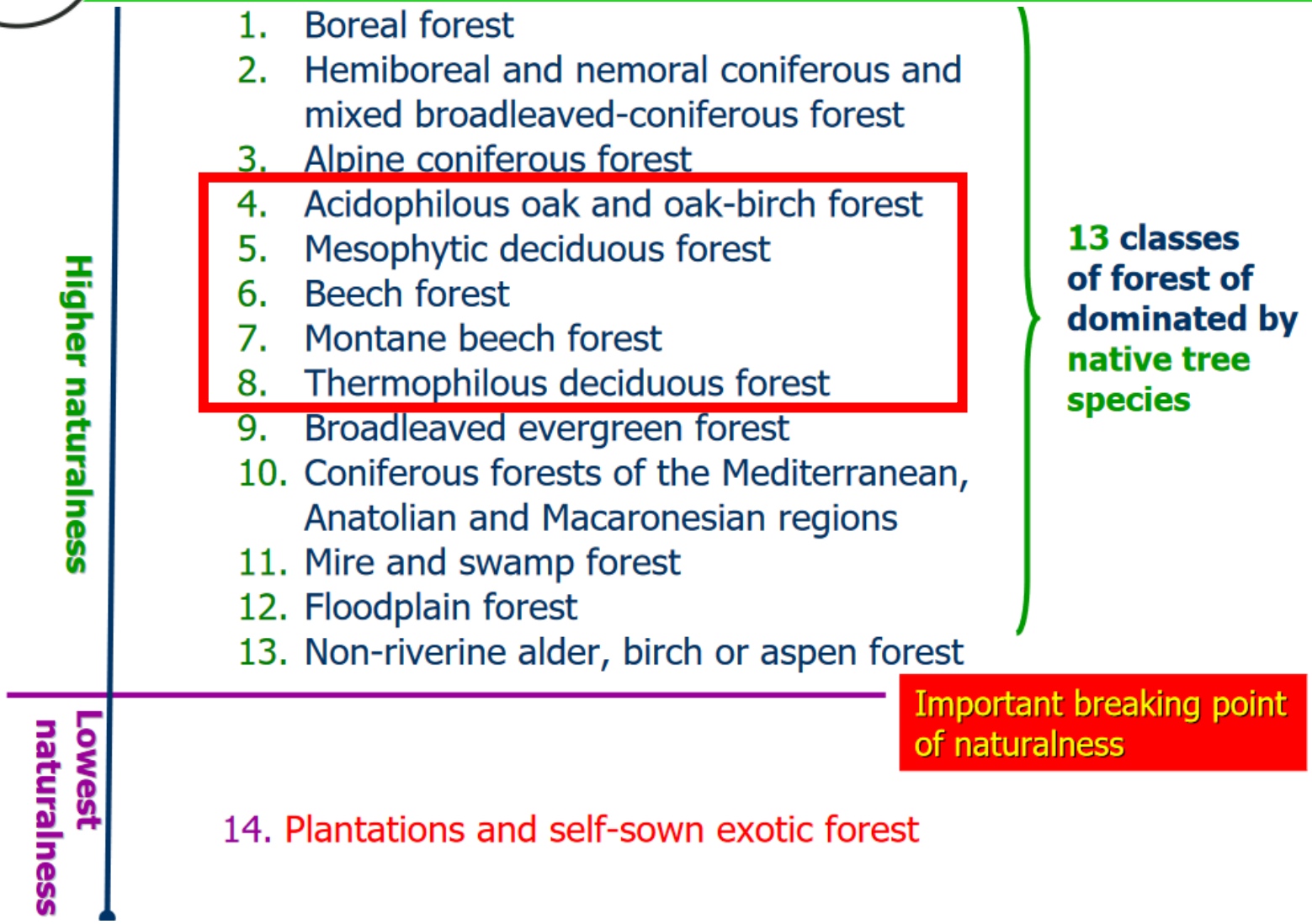
Bayceer
Bayreuth Center of Ecology and Environmental Research

Tree Species Richness



Mauri, A. et al. 2017. EU-Forest, a high-resolution tree occurrence dataset for Europe. *Sci Data* **4**, 160123.

Biodiversity



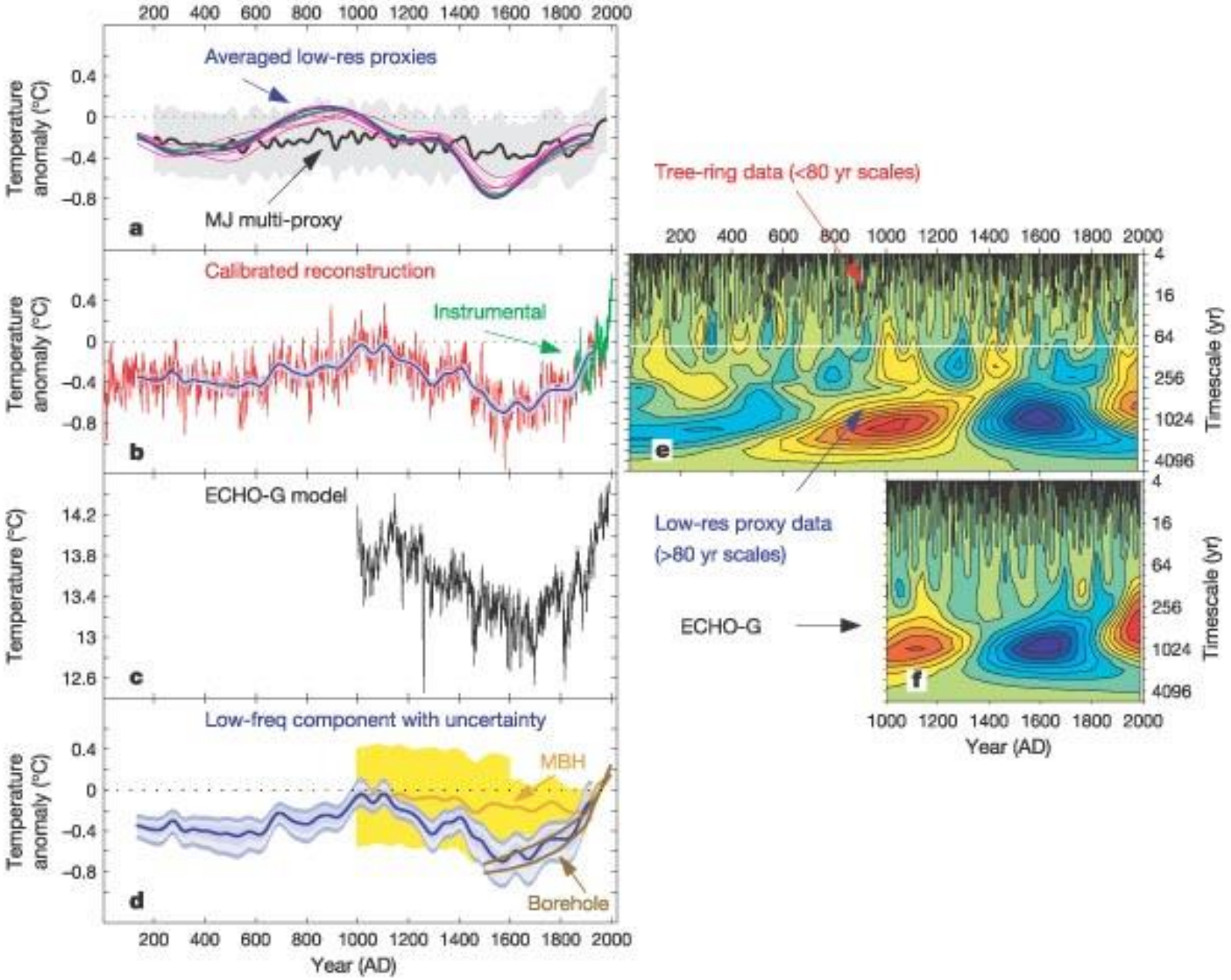
Marchetti European Forest Types

What is Extreme?

Climatic trends are occurring in space and in time.

This implies that extremeness necessarily refers to

- period of recent conditions (reference, time)
- specific spatial location (relatedness, place)



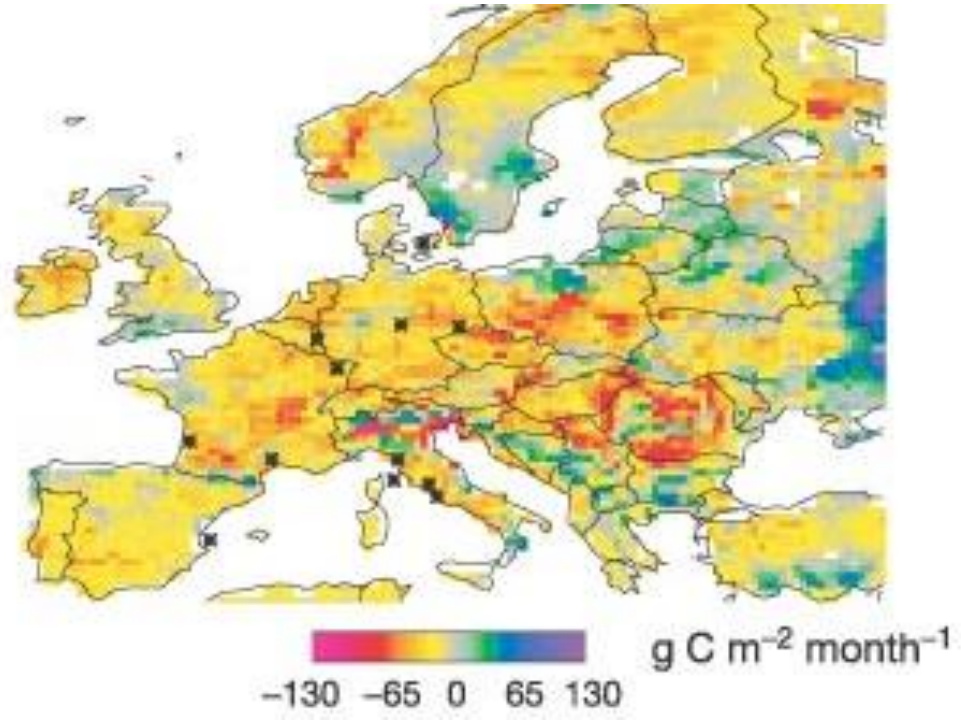
Moberg A et al. 2005 Highly variable Northern Hemisphere temperatures reconstructed from low- and high-resolution proxy data. Nature 433, 613-617

Extreme Events

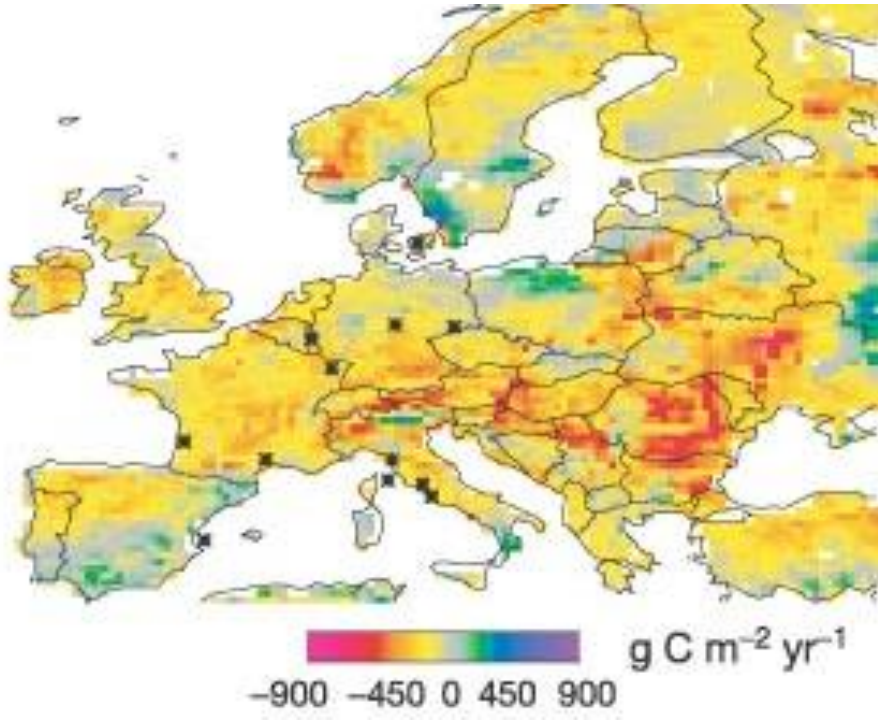
Carbon Biogeography

Reduced Net Primary Production in Europe after 2003 drought

July-Sept. 2003 / 5 years before



Whole year 2003 / 5 years before



Ciais et al., Nature 437, 539-533, 2005

PAs & Climate Change

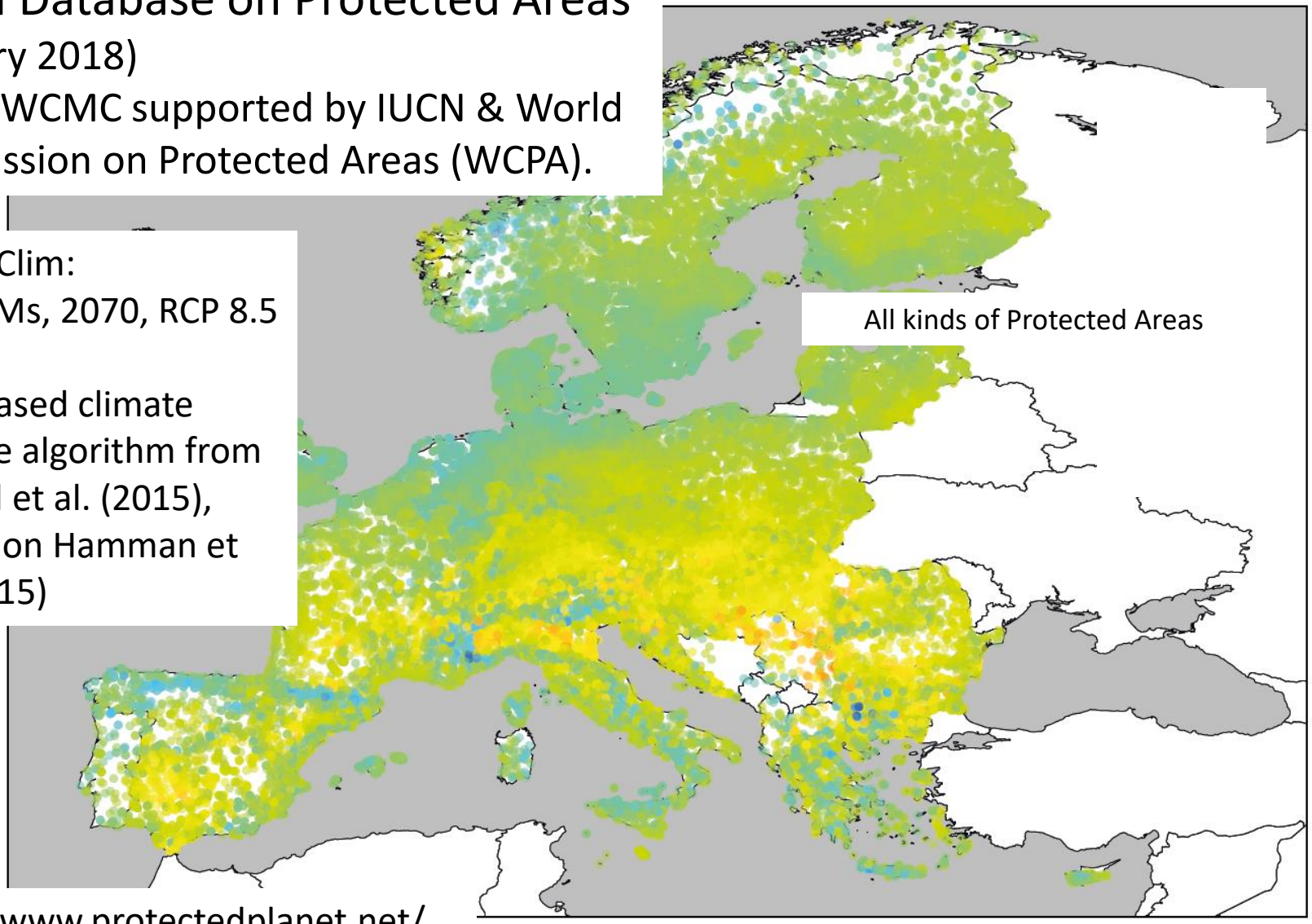
www.ecopotential-project.eu

World Database on Protected Areas (January 2018)

UNEP-WCMC supported by IUCN & World Commission on Protected Areas (WCPA).

WorldClim:
10 GCMs, 2070, RCP 8.5

PCA-based climate change algorithm from Carroll et al. (2015), based on Hamman et al. (2015)

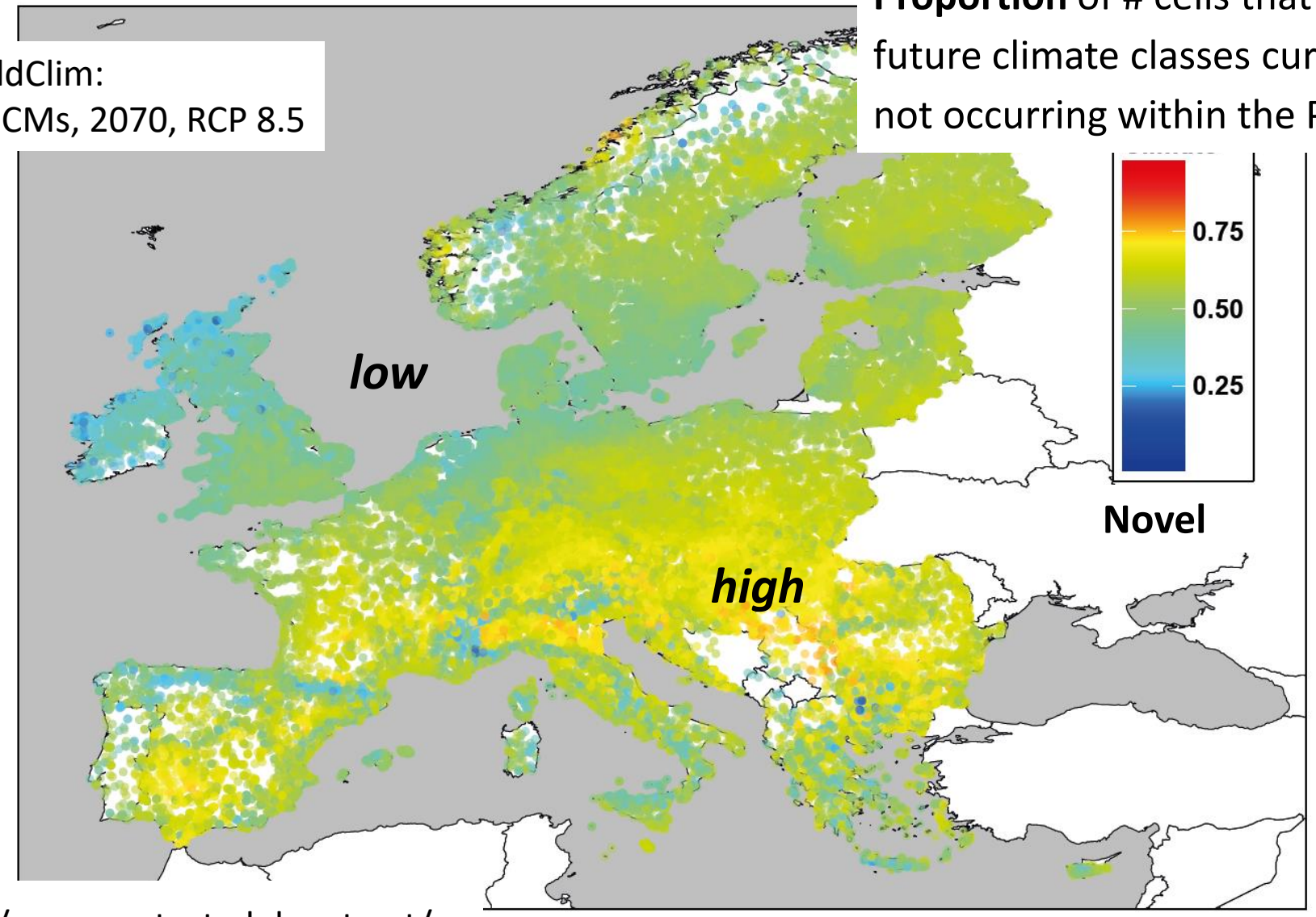


https://www.protectedplanet.net/

PAs & Climate Change

Proportion of # cells that imply future climate classes currently not occurring within the PA

WorldClim:
10 GCMs, 2070, RCP 8.5

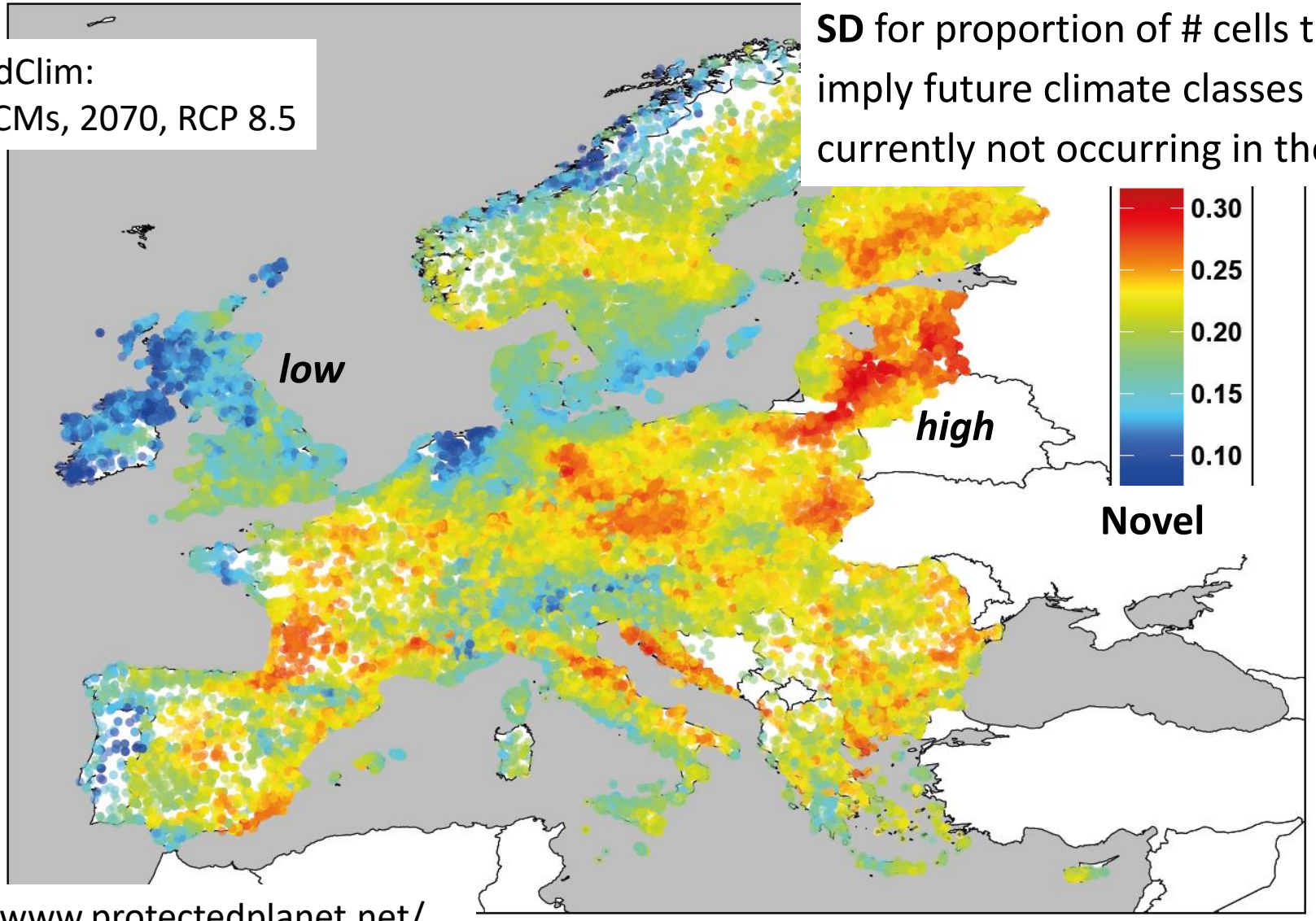


https://www.protectedplanet.net/

PAs & Climate Change

WorldClim:
10 GCMs, 2070, RCP 8.5

SD for proportion of # cells that imply future climate classes currently not occurring in the PA



https://www.protectedplanet.net/

PAs & Climate Change

Proportion of # cells that imply future climate classes currently occurring in the PA

WorldClim:
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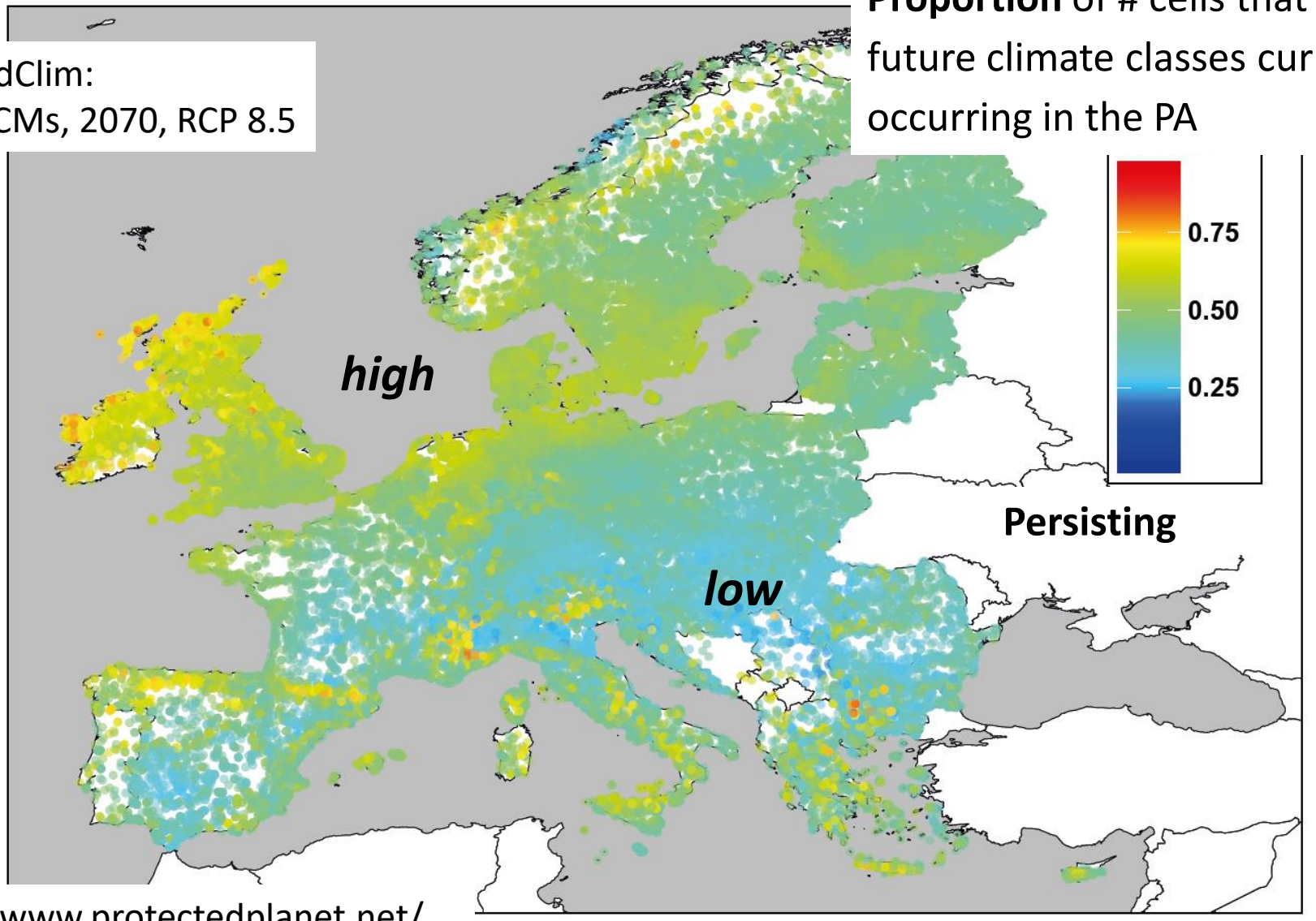
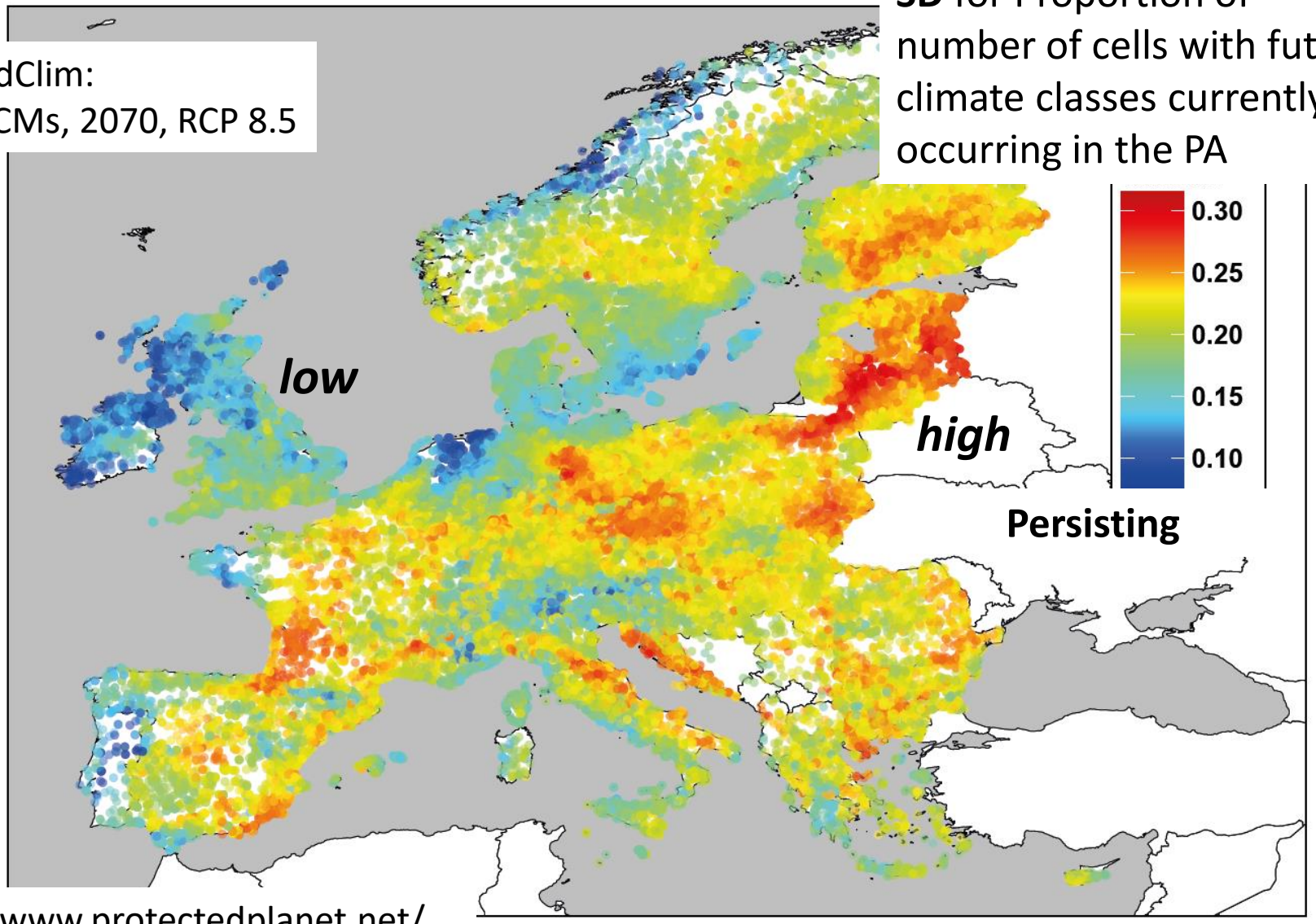


https://www.protectedplanet.net/

PAs & Climate Change

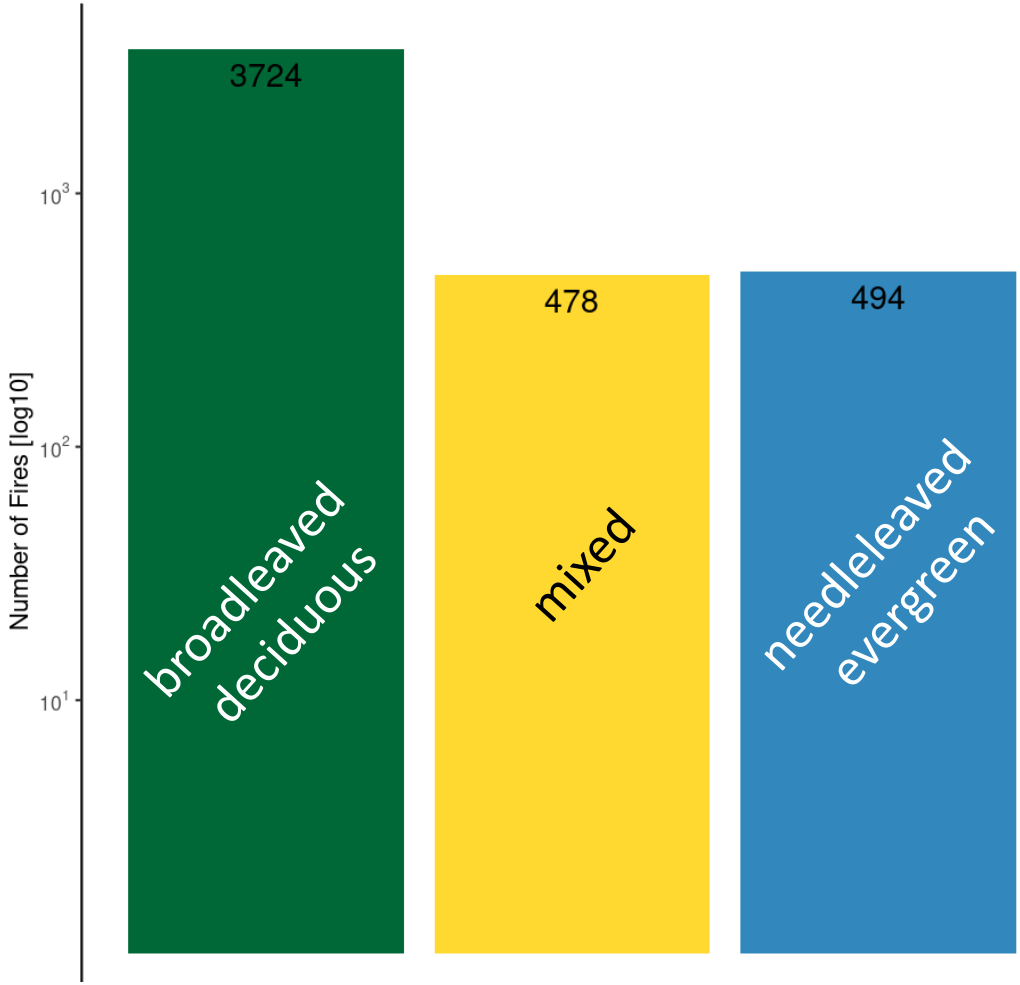
WorldClim:
10 GCMs, 2070, RCP 8.5

SD for Proportion of number of cells with future climate classes currently occurring in the PA



https://www.protectedplanet.net/

Forest Fires



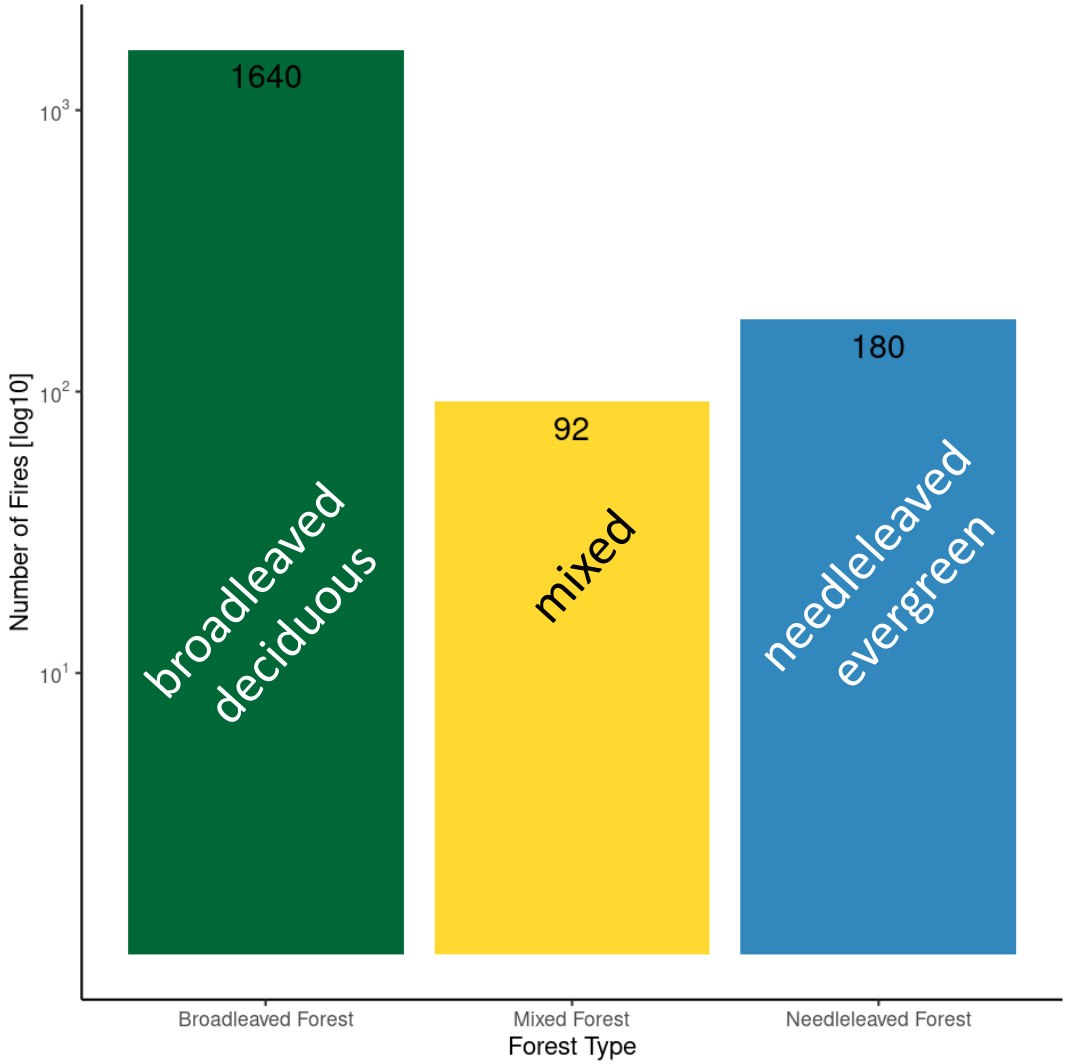
Forest Fires based on European Forest Fire Information System (EFFIS).

- Broadleaved Forest
- Mixed Forest
- Needleleaved Forest

*Number of fire occurrences displayed in black.

Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?

Forest Fires



Forest Fires based on European Forest Fire Information System (EFFIS).

- Broadleaved Forest
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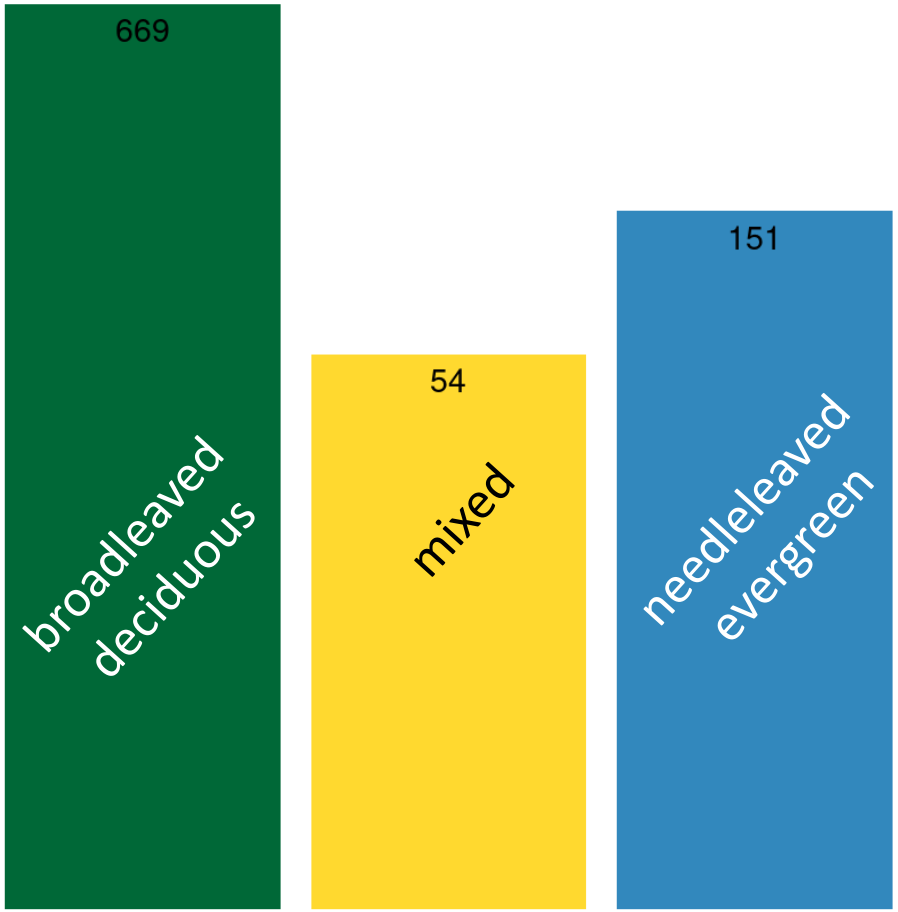
- Needleleaved Forest

*Number of fire occurrences displayed in black.

Eucalyptus, Pannonian, Alpine, Anatolian, and Black Sea filtered out

Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?

Forest Fires



Forest Fires based on European Forest Fire Information System (EFFIS).

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- Mixed Forest
- Needleleaved Forest

*Number of fire occurrences displayed in black.

Submediterranean region filtered out

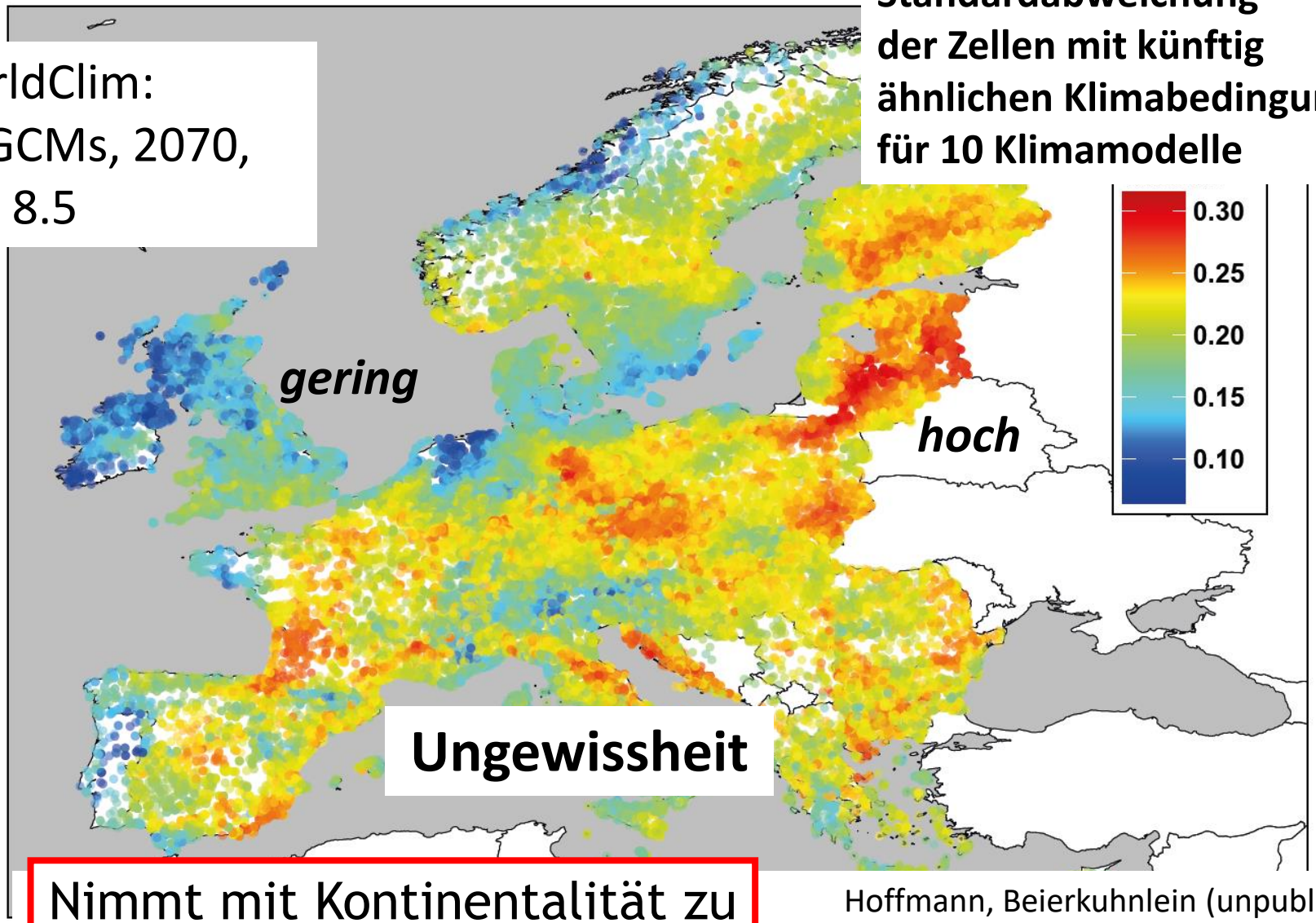
Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?

Climate Change

Bayceer
Bayreuth Center of Ecology and Environmental Research

WorldClim:
10 GCMs, 2070,
RCP 8.5

Standardabweichung der Zellen mit künftig ähnlichen Klimabedingungen für 10 Klimamodelle



Ungewissheit

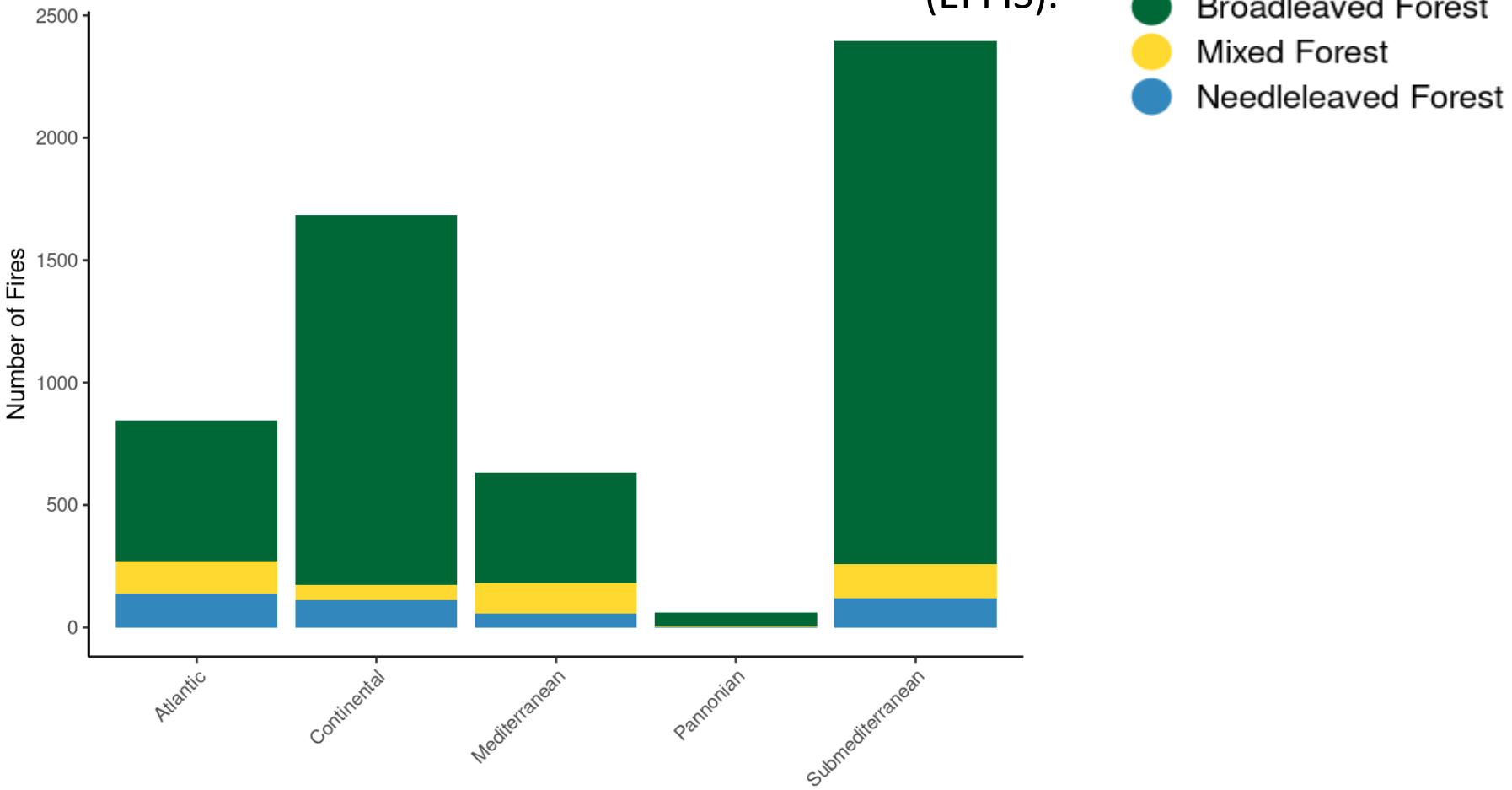
Nimmt mit Kontinentalität zu

Hoffmann, Beierkuhnlein (unpublished)

Forest Fires

2001 until today

Forest Fires based on European Forest Fire Information System (EFFIS).



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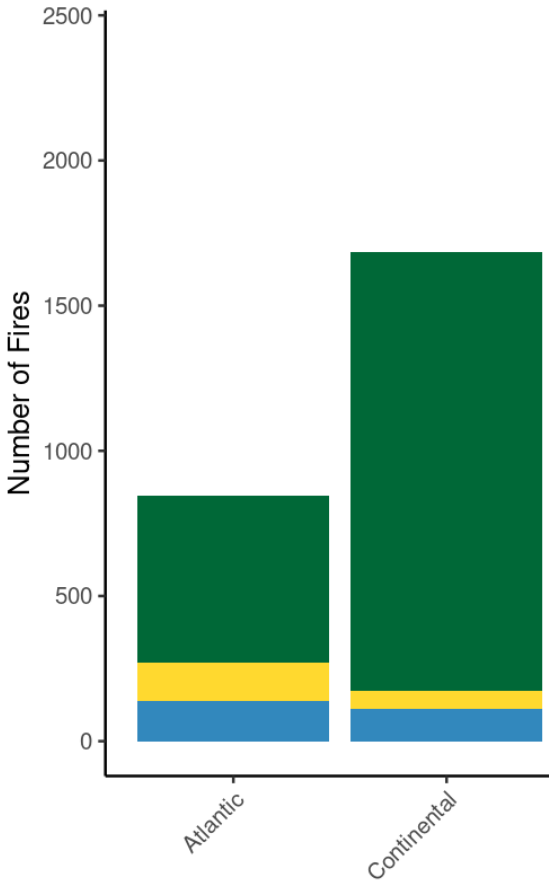
Forest Fires

2001 until today



Forest Fires based on European Forest Fire Information System (EFFIS).

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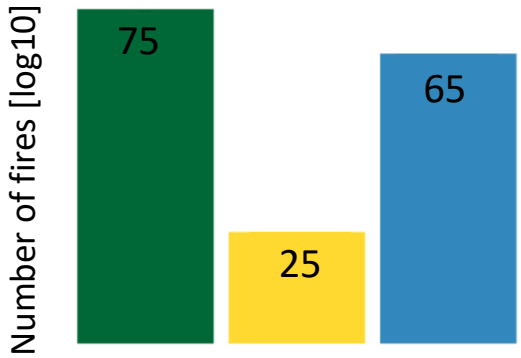
Forest Fires

2001 until today

Forest Fires based on European Forest Fire Information System (EFFIS).

- Broadleaved Forest
- Mixed Forest
- Needleleaved Forest

For >50% forest cover within 1km^2 pixels



Eucalyptus

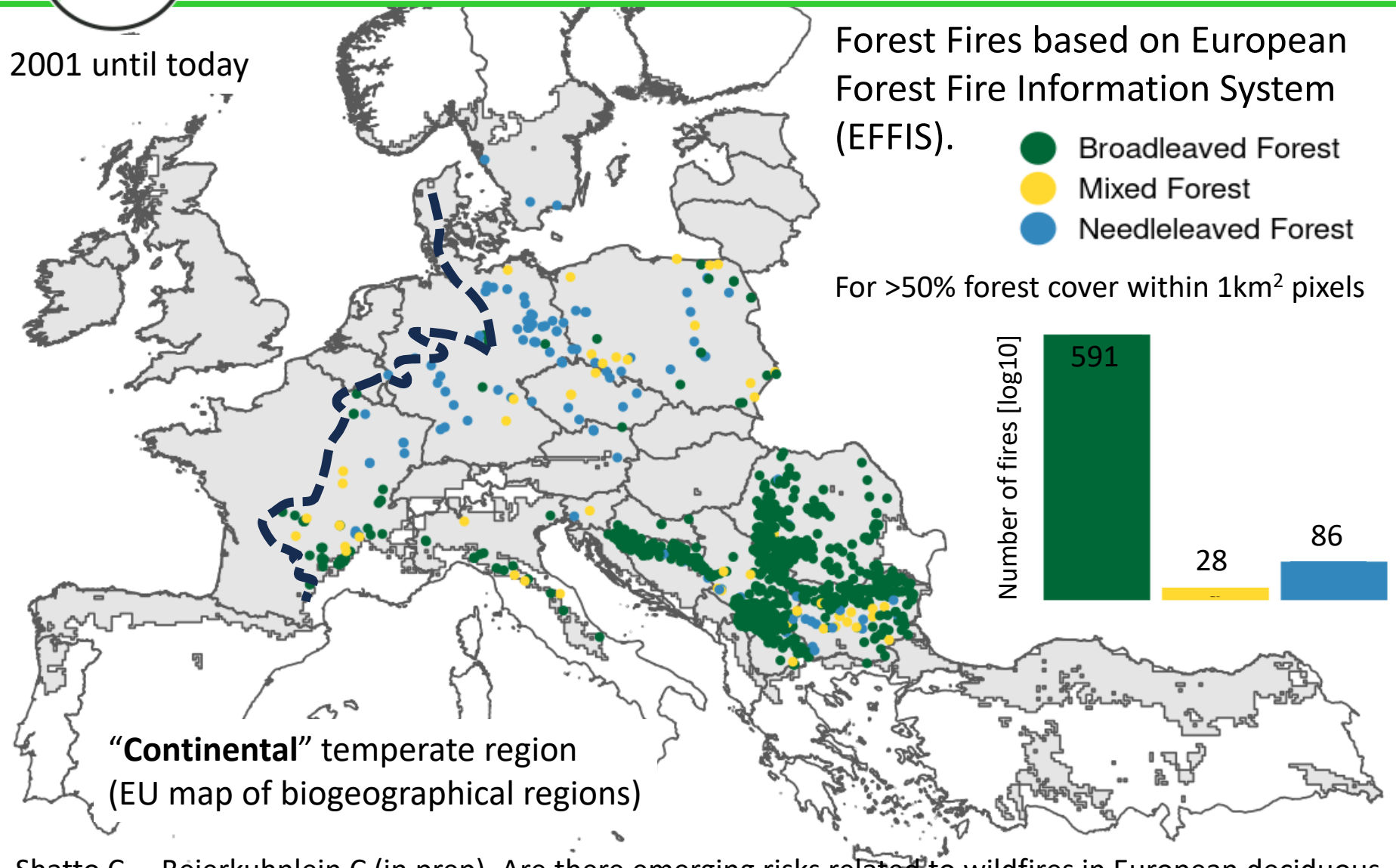
"**Atlantic**" temperate region
(EU map of biogeographical regions)

Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?

Forest Fires

2001 until today

Forest Fires based on European Forest Fire Information System (EFFIS).



Shatto C … Beierkuhnlein C (in prep). Are there emerging risks related to wildfires in European deciduous temperate forests in the face of climate change?