EUROPEAN FOREST INSTITUTE

Climate Impact Analysis for Europe

How to adapt? To what?
What are challenges for specific regions?

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EFI network - FORMASAM kick-off meeting

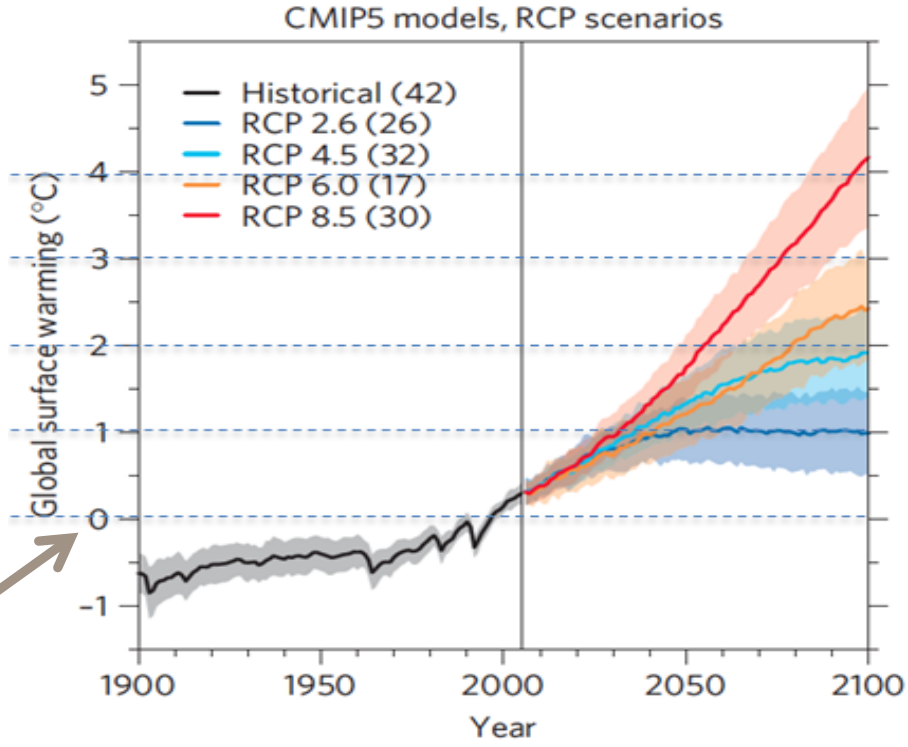
12th of November 2018

Potential impacts - Our future climate remains uncertain

- everything between +1.5 °C and +5 °C human induced climate warming is still possible

RCP: Representative Concentration Pathways (IPCC 2013)

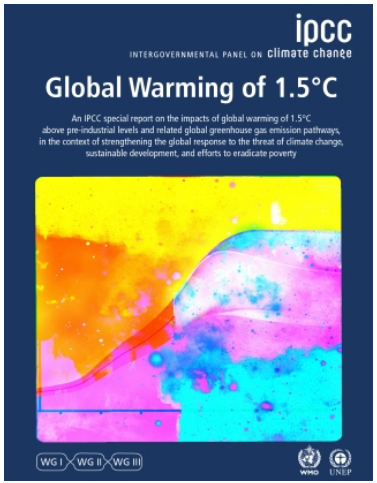
Scenario data relative to the observed 1986 – 2005 climate

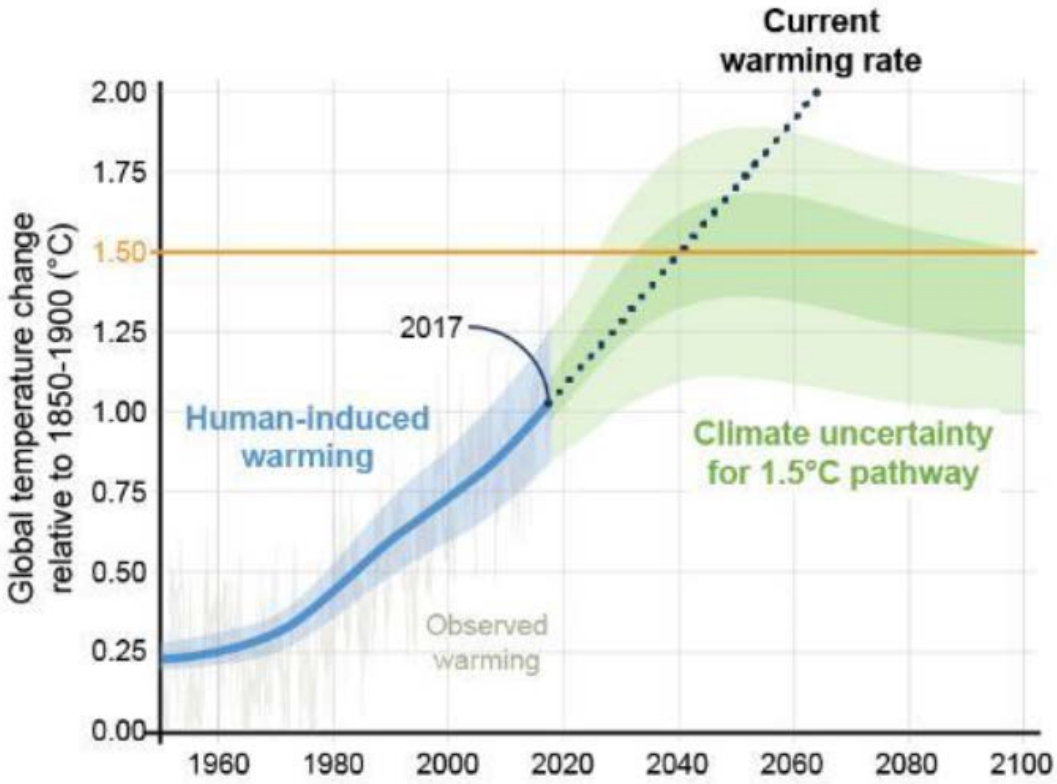


Knutti & Sedlacek, 2013, *Nature Climate Change*

IPCC Special report 2018:

GLOBAL WARMING OF 1.5 °C



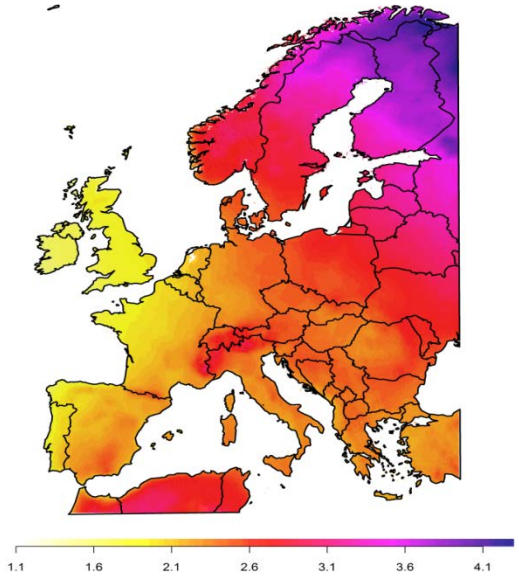


FAQ1.2, Figure 1: Human-induced warming reached approximately 1°C above pre-industrial levels in 2017. At the present rate, global temperatures would reach 1.5°C around 2040.

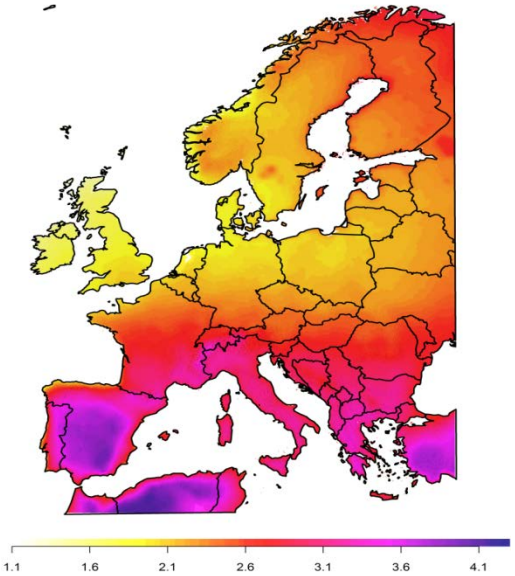
Trends and Uncertainty in Temperatures

Mean and St.dev among 6 RCM's used in MOTIVE for A1B

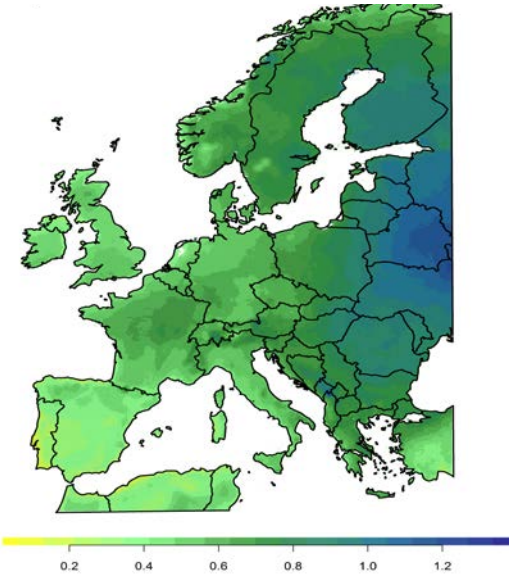
Winter 2051-2080 T-anomaly



Summer 2051-2080 T-anomaly



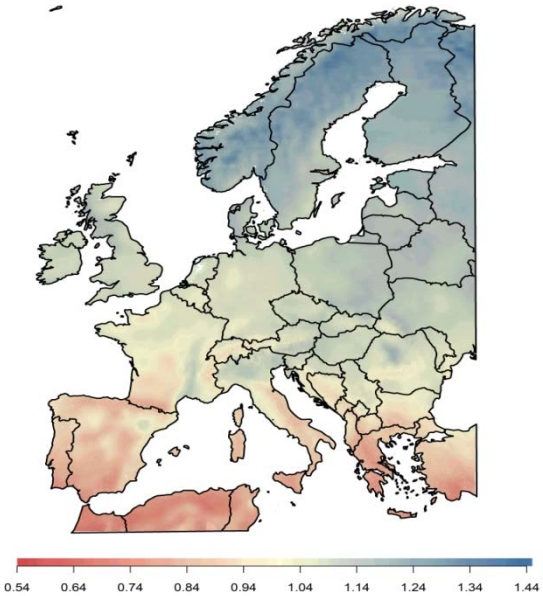
Uncertainty in summer T-anomaly



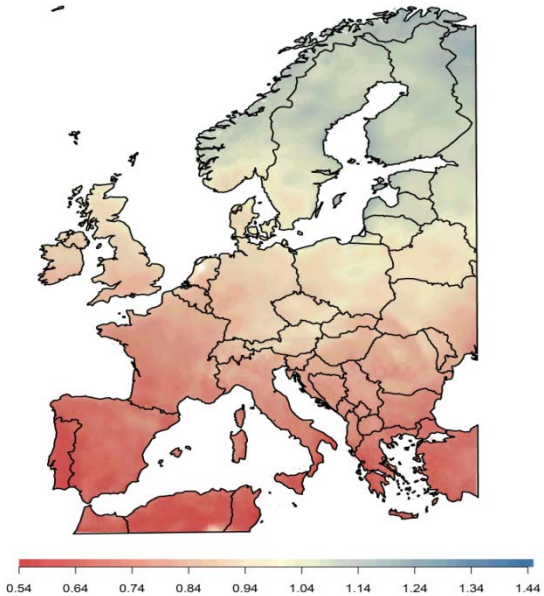
Trends and Uncertainty in Precipitation

Mean and St.dev among 6 RCM's used in MOTIVE for A1B

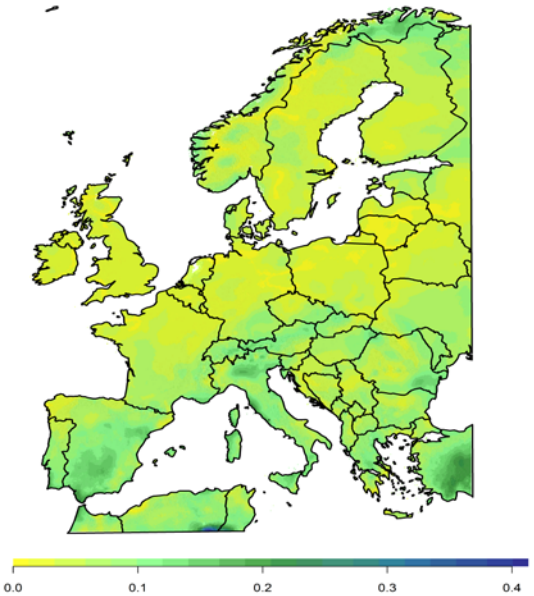
Winter 2051-2080 P-anomaly



Summer 2051-2080 P-anomaly

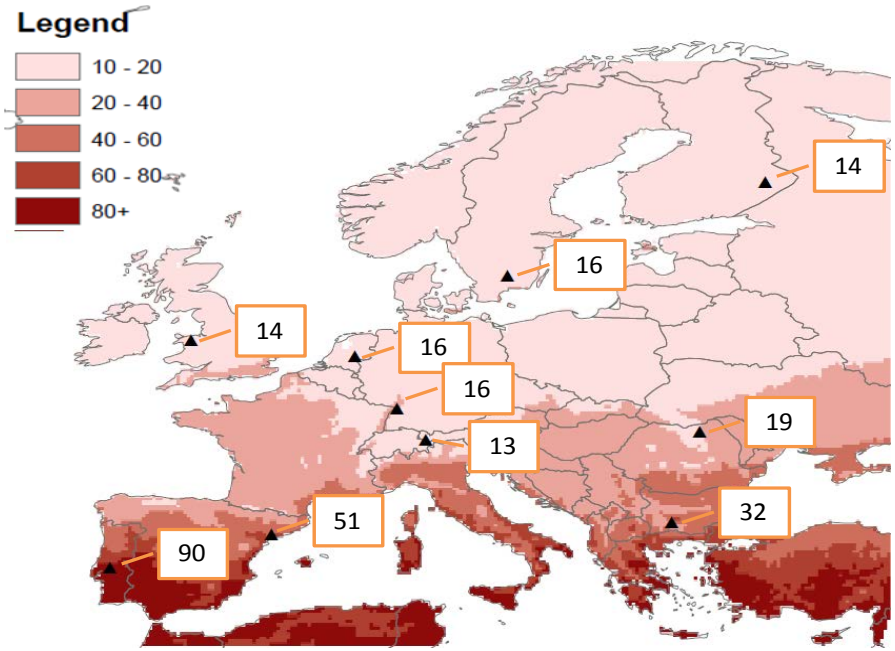


Uncertainty in summer P-anomaly

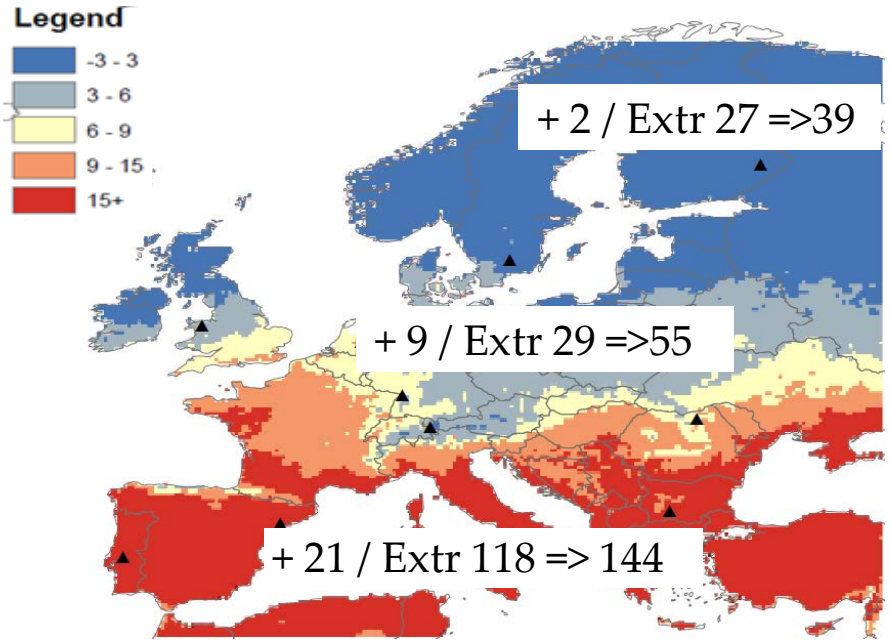


Abiotic risk - Drought

Annual Maximum Number of Continuous Dry Days (Mean 1961-1990)

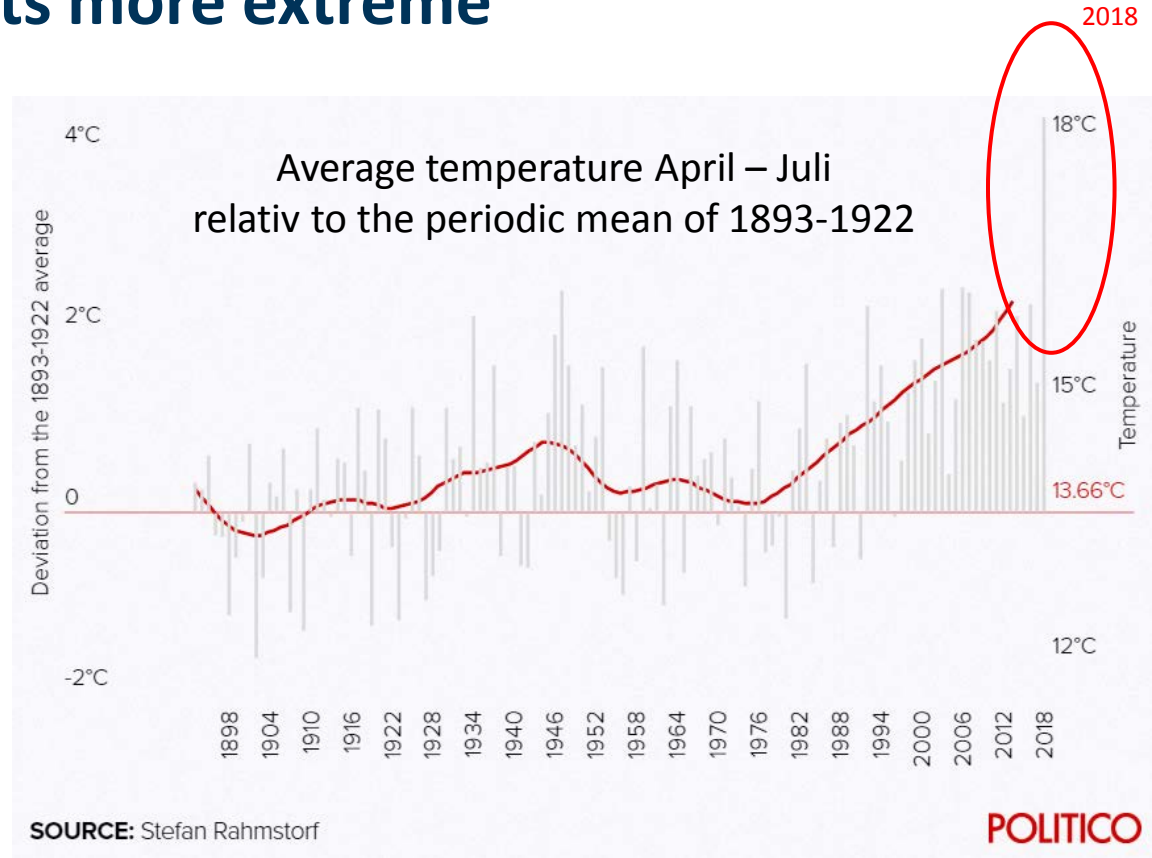


Change (2070-2099 vs. 1961-1990)



Climate variability gets more extreme

- Observed climate:
  2018 sets new record in April – Juli temperatures in Potsdam, Germany



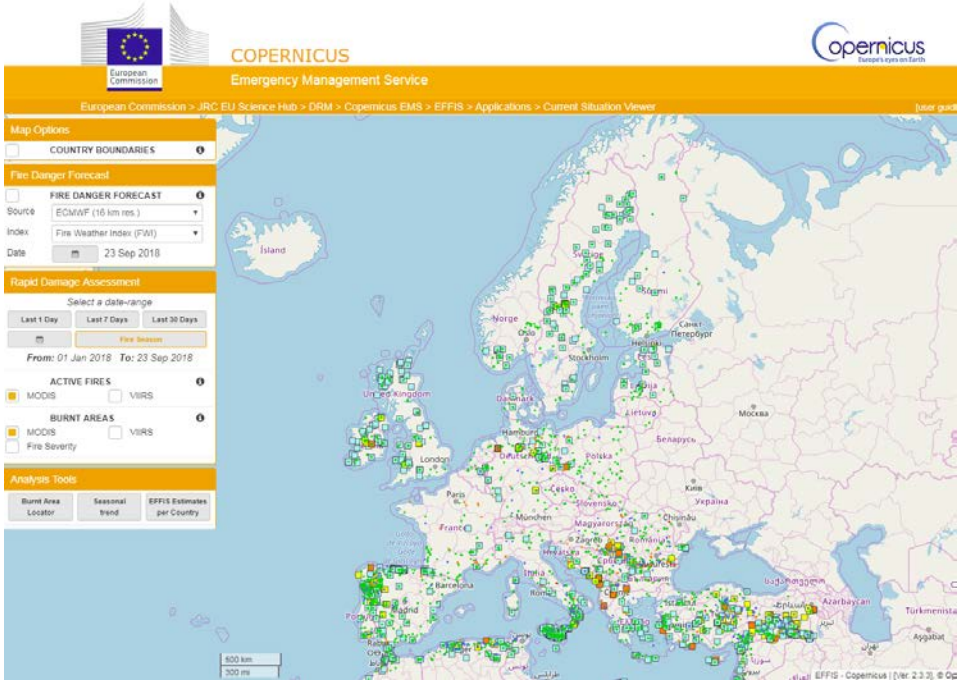
Abiotic risk - Change in fire regimes

Climate change affects on fire risk

- Air humidity, temperature, precipitation & wind speed all change towards higher risks
- Drought = dry fuel + more flammable biomass
- Thunderstorms with more lightnings (ignition)
- Fast fire spread under extreme temperature & locally very strong wind
- Forest fire risk increases in all of Europe – not only in summer

➢**Strongly enhanced risk of mega fires**

Copernicus Forest Fire Data 2018



Forests will have to adapt

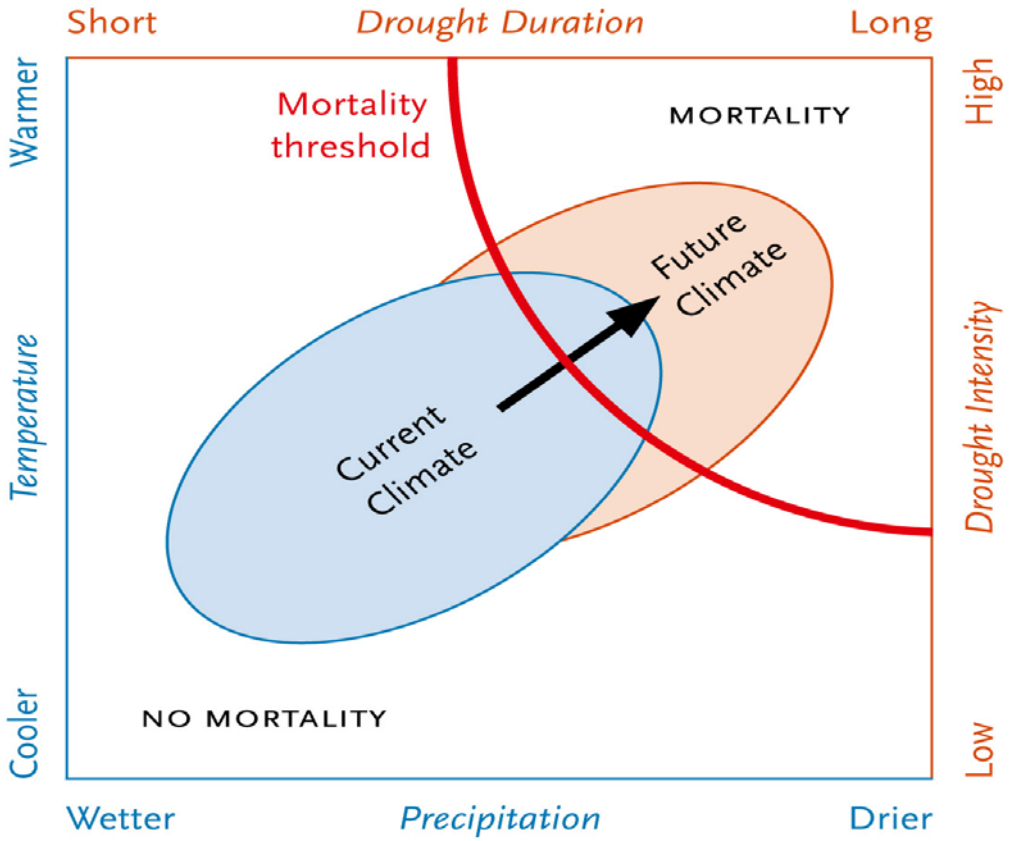
- to long-term changes in climate
- to shifting seasonal water availability
  - in most regions winter precipitation is projected to increase
  - summer precipitation is likely to decline especially in central and southern Europe
- to increased variability with more extreme weather events
  (e.g. prolonged drought, storms and floods)
- to more severe disturbances (fire, wind, bark beetles and other biotic threats)

Impact of climate change on European forests

Drought

Increasing average temperature & decreasing summer precipitation
=> increased duration of drought periods

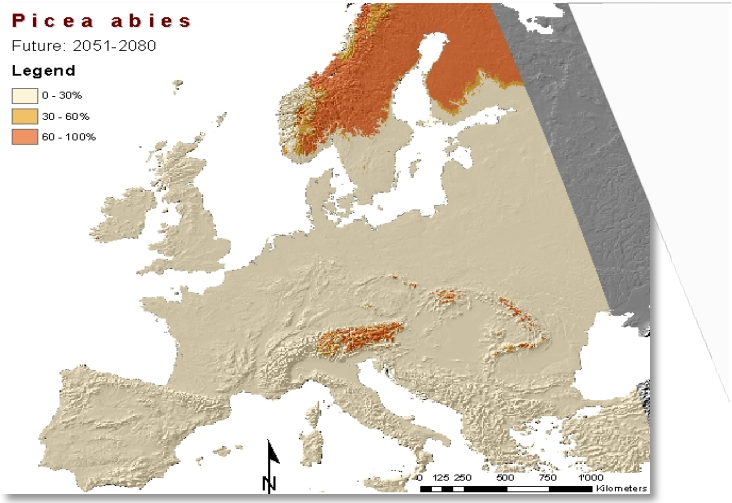
(Allen et al. 2010. Forest Ecology and Management 259:666-684)

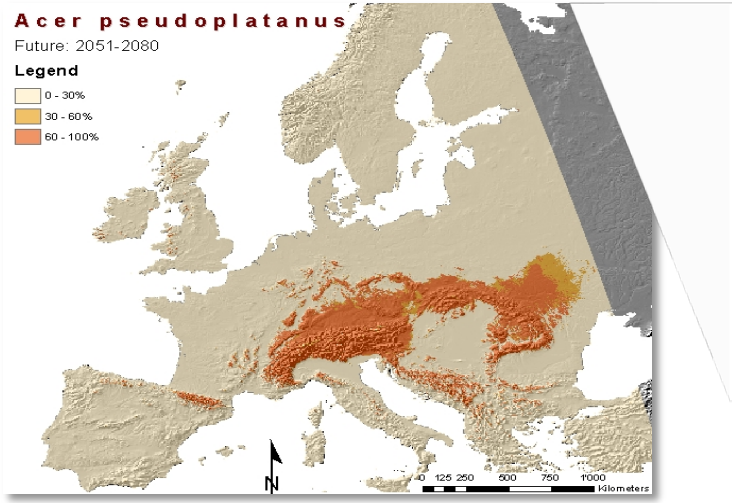


Impact on forest composition

- Montane/Subalpine species
- Ensemble predictions from multiple SDMs and RCMs

Suitable habitats in: 0-30% I 30-60% I 60-100% of all model/climate combinations





The challenges are diverse!

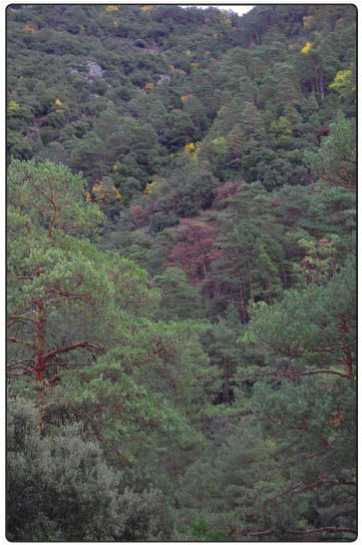


Photo: Joanne Fitzgerald.

Photo: Heli Viiri.

Photo: Manfred J. Lexer

Photo: Juan Guerra.

Photo: Olivier Bouriaud.

Evidence-based decision support on resilience and climate change adaptation in European forests

Adaptive forest management will be key for future sustainable forest management

- Lots of research exists on climate change impacts and climate change mitigation, less on resilience and adaptation to climate change
  - How to adapt forest management to the changes in climate, extreme events, and disturbance regimes in practice?
  - How to communicate often complex scientific knowledge to practice?

The implementation of climate change adaptation lacks sufficient ‘climate intelligence’ in forest management decision making processes

Rodney Keenan (2015). Climate change impacts and adaptation in forest management: a review. Annals of Forest Science, 72, 145-167.

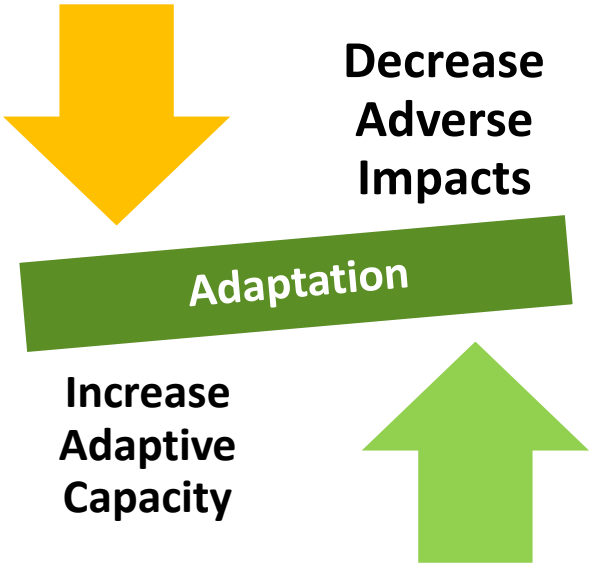
Planning adaptation to climate change

- As of July 2018, 25 EU Member States had adopted a national adaptation strategy and 15 have developed a national adaptation plan (EEA 2018)
- Role of forestry in national climate change adaptation policy: adaptation in the forest sector has mainly been reactive in Sweden, Germany, France and Italy. Extreme events drive adaptation policy (Keskitalo et al. 2015)

Countries adopting a strategy/programme dealing with adaptation of forests to climate change (19 Countries; ongoing Forest Europe survey)

First adoption	Signatory (revision)	Adopted cumulatively
2003	SE	1
2004	LU	2
2005	FI	3
2006	ES	4
2007		4
2008	DE	5
2009	(ES, SE)	5
2010	PT	6
2011	BU, CH, TR	9
2012		9
2013	EU, GE, PL (ES)	12
2014	SK (FI)	13
2015	CZ	14
2016	HU, UA	16
2017	CY	17
2018	(LU)	17

Adaptation for reduced CC vulnerability



Potential climate change impacts on the capacity of forest to provide goods and services

Adaptive capacity of forests/forestry

Vulnerability to climate change

Preliminary Analysis of Forest Europe Adaptation Measures Survey - Forest related problems

- A current forest composition of tree species maladapted to projected future climatic conditions and extremes. (12)
- Loss or underuse of carbon sequestration function of forests. (12)
- Degraded or fragmented landscapes and forest ecosystems as a result of increasing disturbances. (9)
- Low diversity or maladaptation of the current genetic material. (5)
- A low tree species diversity and a lack of structural diversity. (3)

Preliminary Analysis of Forest Europe Adaptation Measures Survey - Climate related problems

- Extreme climatic events such as storms and droughts. (14)
- Susceptability to the consequences of extreme climatic events such as floods, fires, erosion and desertification. (18)
- Frequent outbreaks of plague insects and other pathogens. (11)

Insufficient Information / Others

- Problems regarding innsufficient information, knowledge or monitoring (6)

- Others:
  - Barrieres for increased use of timber as a construction material.
  - General vulnerability of natural resource related sectors.
  - Insufficient road networks for quick response to beetle attacks and fires.
  - Mismatch between current land use and future climate.
  - Showcasing best adaptive management practices.
  - Forced land use change due to increased disturbances.
  - Lack of management.
  - Higher game pressure, because of higher winter survival rates.
  - Introduction of new pests or pathogens.

What type of adaptation measures?

The signatories identified 99 **climate adaptation measures**. They were grouped into five overall categories, which were further grouped into smaller clusters of corresponding measures.

- Forest management measures (8 clusters)
- Forest ecosystem restoration (4 clusters)
- Abiotic restoration (2 clusters)
- Knowledge dissemination/information (1 cluster)
- Others

Half of responding countries indicated that they prefer Close-to-Nature Forestry (natural regeneration and use of native tree species)

Improved climate intelligence for adaptive forest management relies on

- Knowledge on past and future climate conditions including climate variability, extreme events and changing disturbance risks
- Understanding changing species suitability and susceptibility to disturbance risks
- Assessing forest resilience and understanding how it can be supported
- Knowledge on adaptation strategies tailored to the local forest conditions

Conclusions

- Climate change scenarios remain uncertain and this is unlikely to change anytime soon!
- Extreme events are driving forest responses to climate change through disturbances and these get more and more devastating
- In many regions the current focus of adaptive forest management lies on Close-to-Nature-Forestry. This may not be sufficient in the future
- Better understanding physiological limits of species and disturbance interactions will be crucial to plan adaptive forest management

Thank you for your attention!

Lindner et al. 2014. Climate Change and European Forests: What do we know, what are the uncertainties, and what are the implications for forest management? Journal of Environmental Management 146, 69-83.