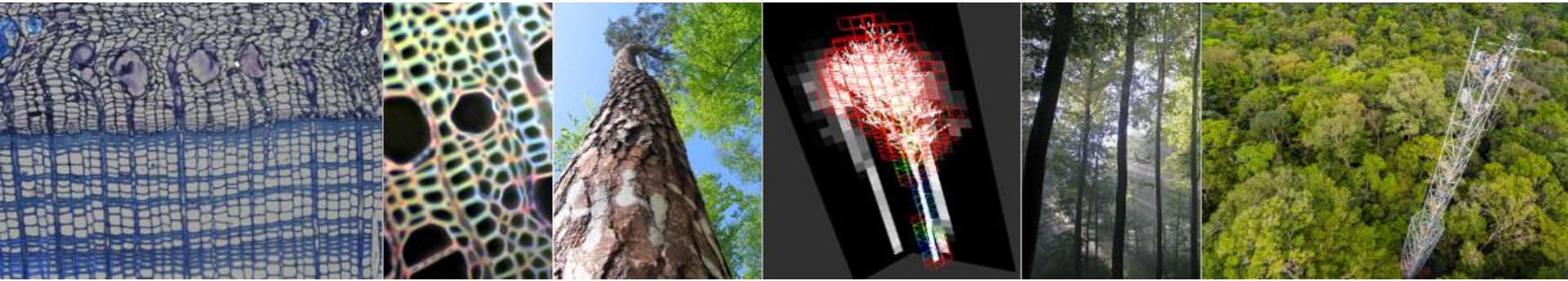
INRAE

Impact of Climate Change on European Forests

Dr. Damien BONAL

UMR Silva



Dr. Damien BONAL Annabel BONAL

Research Scientist in forest ecology



Dr. Damien BONAL

Research Scientist in forest ecology

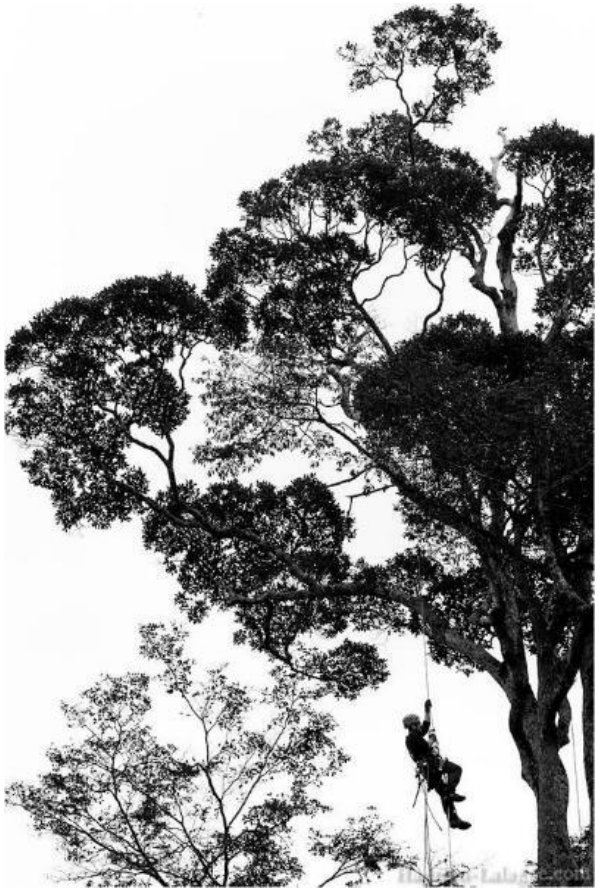


What is my job?

I am doing research in forests (Tropical and Europe) to understand how climate change impacts trees and forest ecosystems

Dr. Damien BONAL

Research Scientist in forest ecology



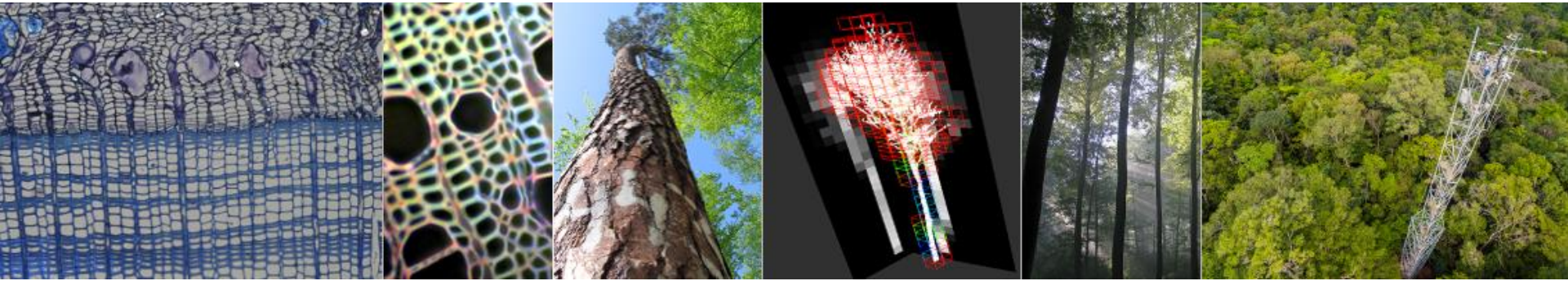
What is my job?

Making measurements and observations on young and old trees in forests across the world, and using these data to answer questions



OUTLINE

- INRAE
- Climate Change
- Impact of Climate Change on Trees and Forests





Objectives: To produce and share scientific knowledge contributing to solve major challenges in Europe and in the world concerning agriculture, food and the environment

INRAE

science for people, life & earth

Key figures

SCIENCE DEDICATED TO LIFE, HUMANS AND THE EARTH

Agriculture

Environment

Food

Global challenges

Climate change and risks,
One health, agrifood systems

Our staff in 2020:

11,000+ people

Our people

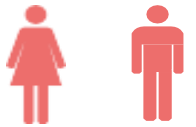
2,005 researchers

3,179 engineers

3,045 technicians

1,850 PhD candidates

2,029 interns



50,5% 49,5%

Budget in 2021:

€ 1045,44 million



public service subsidy
own resources

INRAE: 18 research centers



INRAE: 14 scientific divisions

- Agronomy & Environment
- Plant Biology & Breeding
- Plant Health & Environment

- Animal Genetics
- Animal Physiology & Livestock System
- Animal Health

- Human Nutrition & Food Safety
- Food & Bioproducts Sciences
- Microbiology of Food Chain

- Ecology of Forests and Terrestrial Ecosystems
- Water Resources & Uses

- Mathematics, Computer Sciences & AI
- Sciences for Action & Sustainable Development
- Economic & Social Sciences

202 Research units

22 Service units

43 Experimental units

10 Metaprogrammes

Si vous ne savez pas répondre en anglais, répondez dans votre langue à vos professeurs, qui traduiront en anglais !





If you don't know how to answer in English, answer in your language to your teachers, who will translate into English!

Kui te ei tea, kuidas inglise keeles vastata, vastake oma keeles oma õpetajatele, kes tõlgivad inglise keelde!





Se non sai rispondere in inglese, rispondi nella tua lingua ai tuoi insegnanti, che tradurranno in inglese!

Ak neviete, ako odpovedať v angličtine, odpovedzte vo svojom jazyku svojim učiteľom, ktorí vám preložia do angličtiny!





Pokud nevíte, jak odpovědět v angličtině, odpovězte ve svém jazyce svým učitelům, kteří vám přeloží do angličtiny!

When we say "**Climate Change**", what does it mean for you?



Climate Change



Slow increase in mean earth temperatures

Heatwaves, Extreme temperatures, Fires



Increase in sea level



Melting of glaciers and ice floe at the poles



Change in rainfall events (droughts, floodings)



Change in the frequency and intensity of extreme events (hurricanes, …)



Acidification of oceans

Climate Change

How do we know that these changes are going on?

What **Tools/Equipment/measurements** do we use to monitor climate change?

Climate Change

Earth Observation Satellites



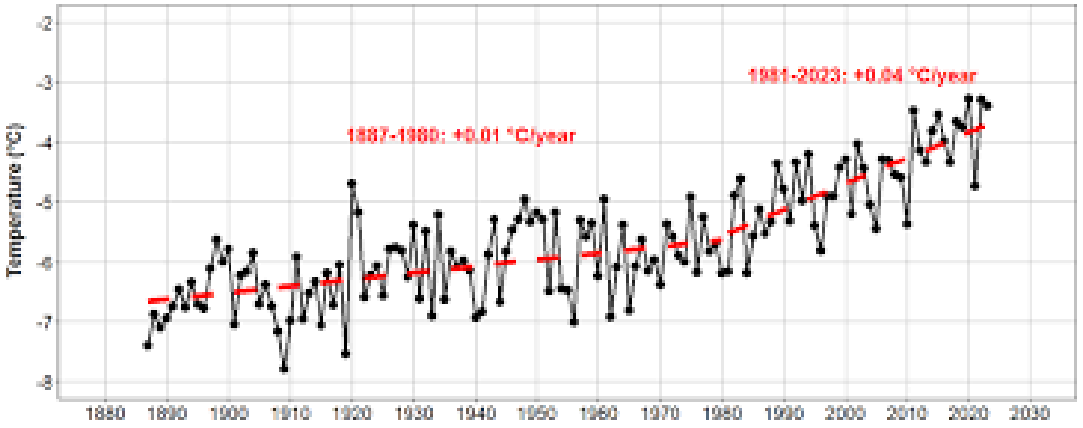
But information available only since 1980's

Climate Change

Weather stations
on the ground or in the ocean



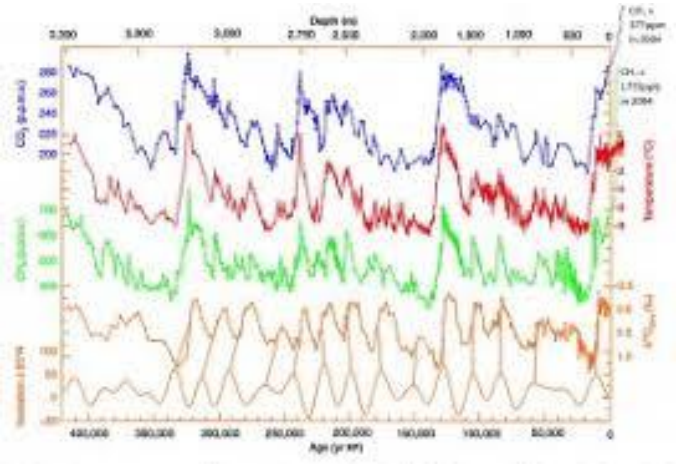


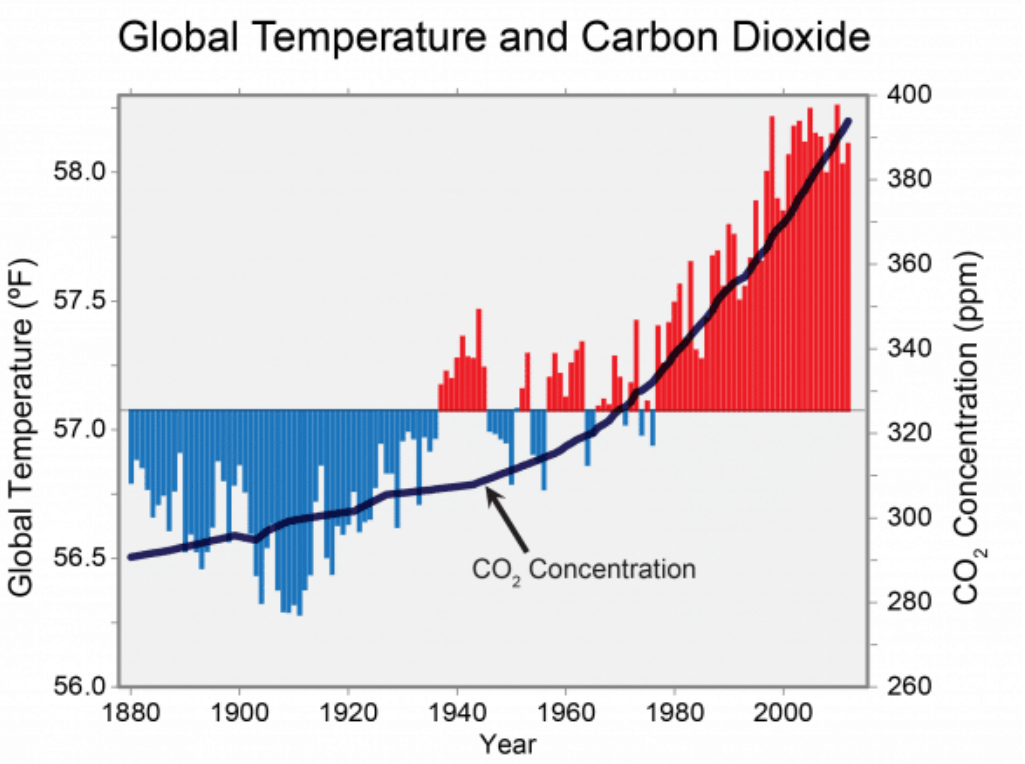


Climate Change

Ice cores







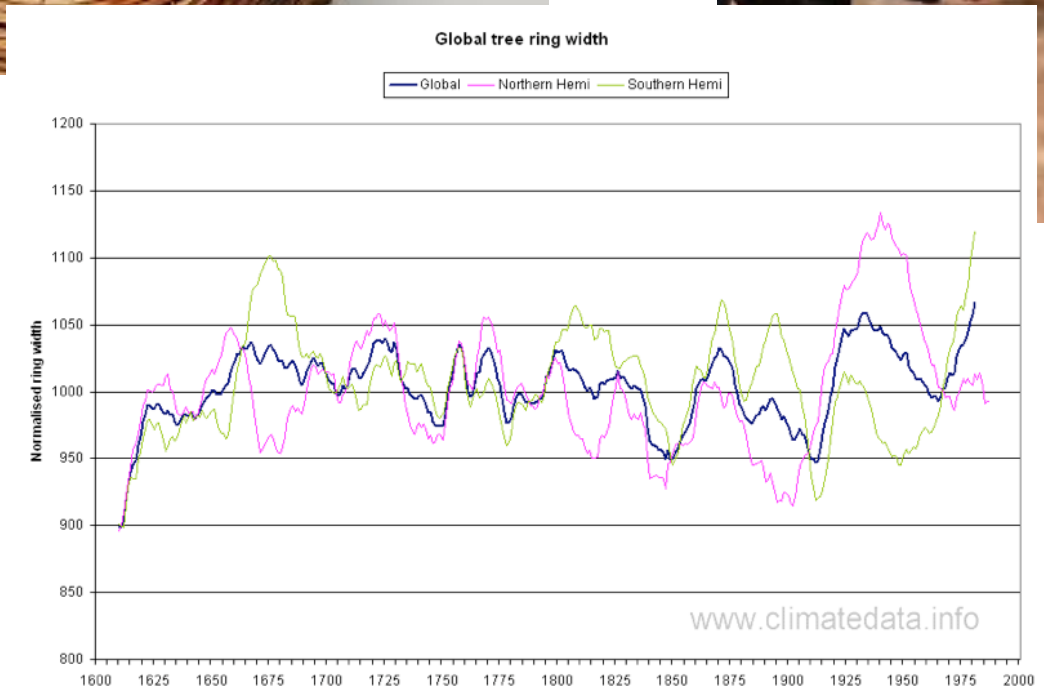
Climate Change

Wood cores

Tree ring
1 ring = 1 year





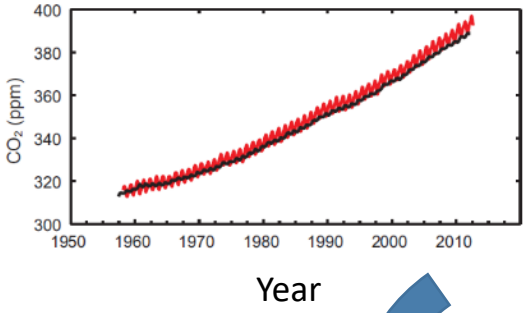


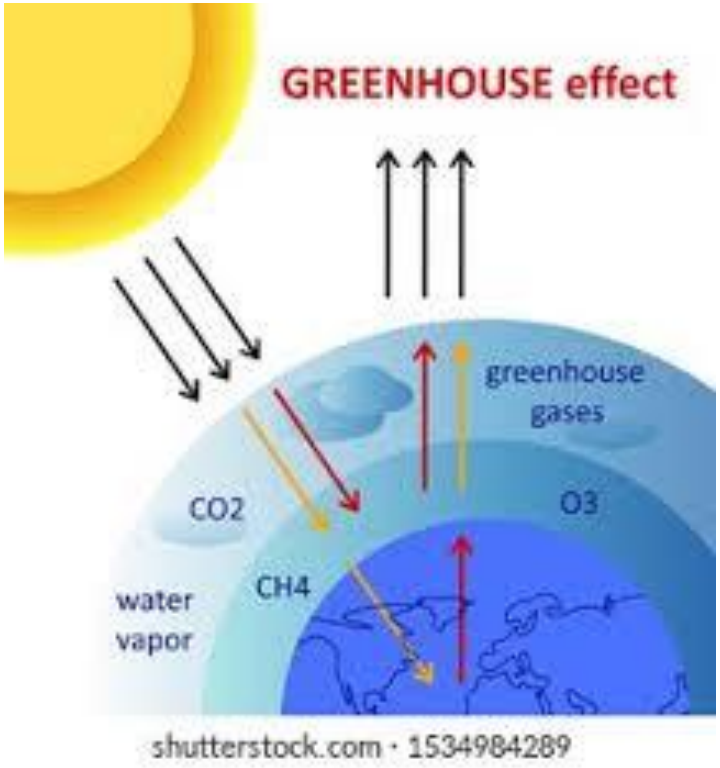
Climate Change

Causes

Increase in greenhouse gas concentration in the atmosphere related to human activities

CO2, CH4, …



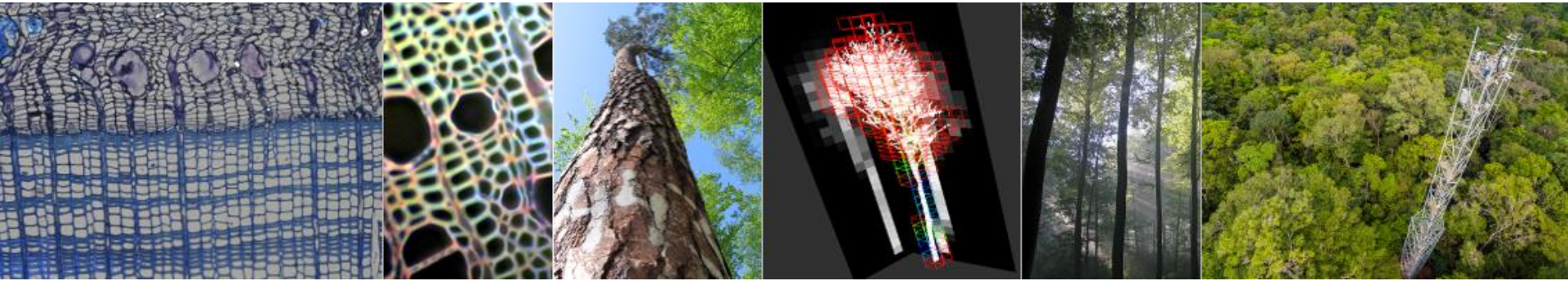


GIEC Report 2023

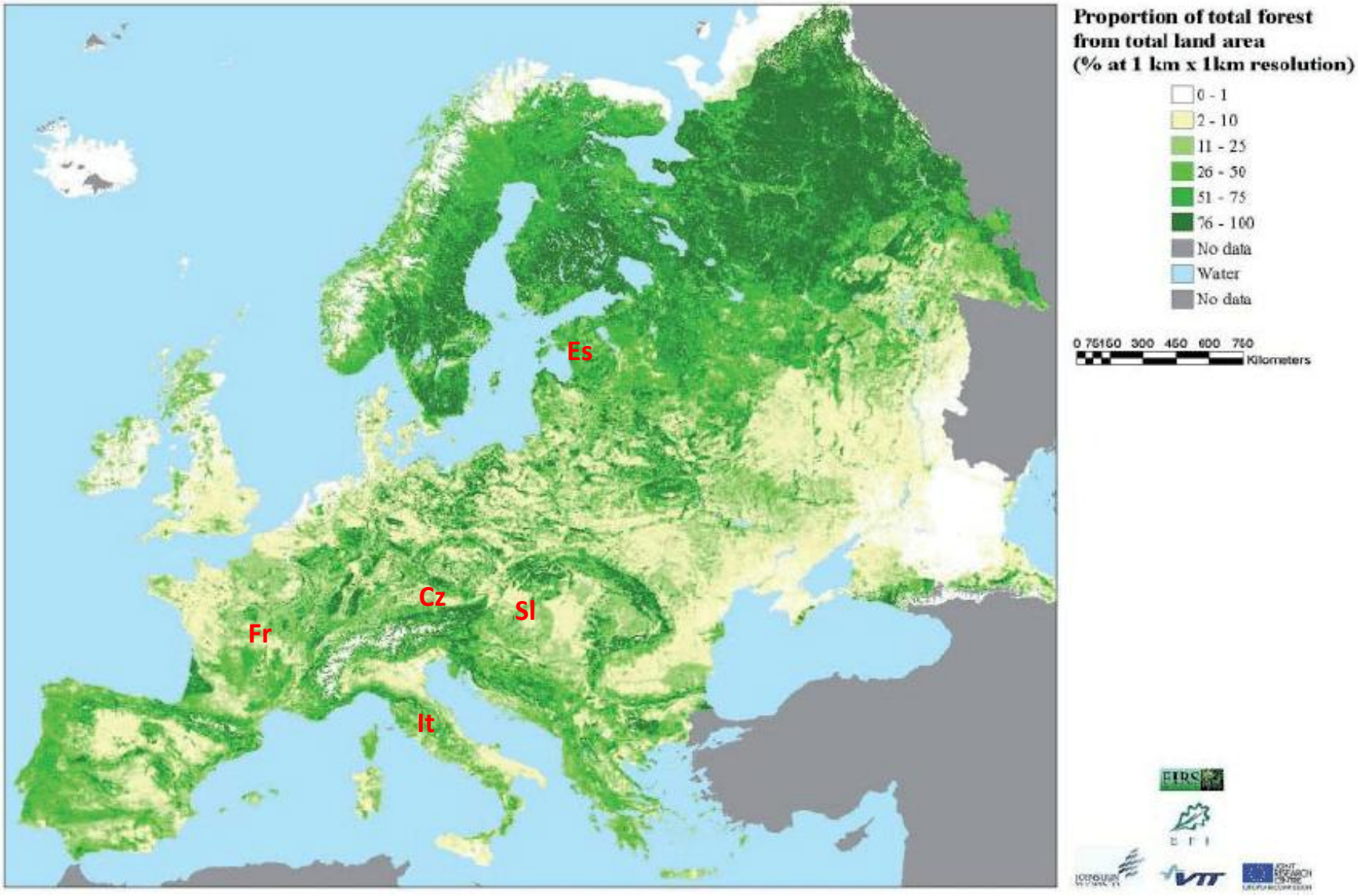
INRAE

Impact of Climate Change on Trees and Forests

UMR Silva



Distribution of forests in Europe



Will these **Climate Changes** impact forests?



Impact of Climate Change on Forests



Slow increase in mean earth temperatures

Heatwaves, Extreme temperatures, Fires



Increase in sea level



Melting of glaciers and ice floe at the poles



Change in rainfall events (droughts, floodings)



Change in the frequency and intensity of extreme events (hurricanes, …)



Acidification of oceans

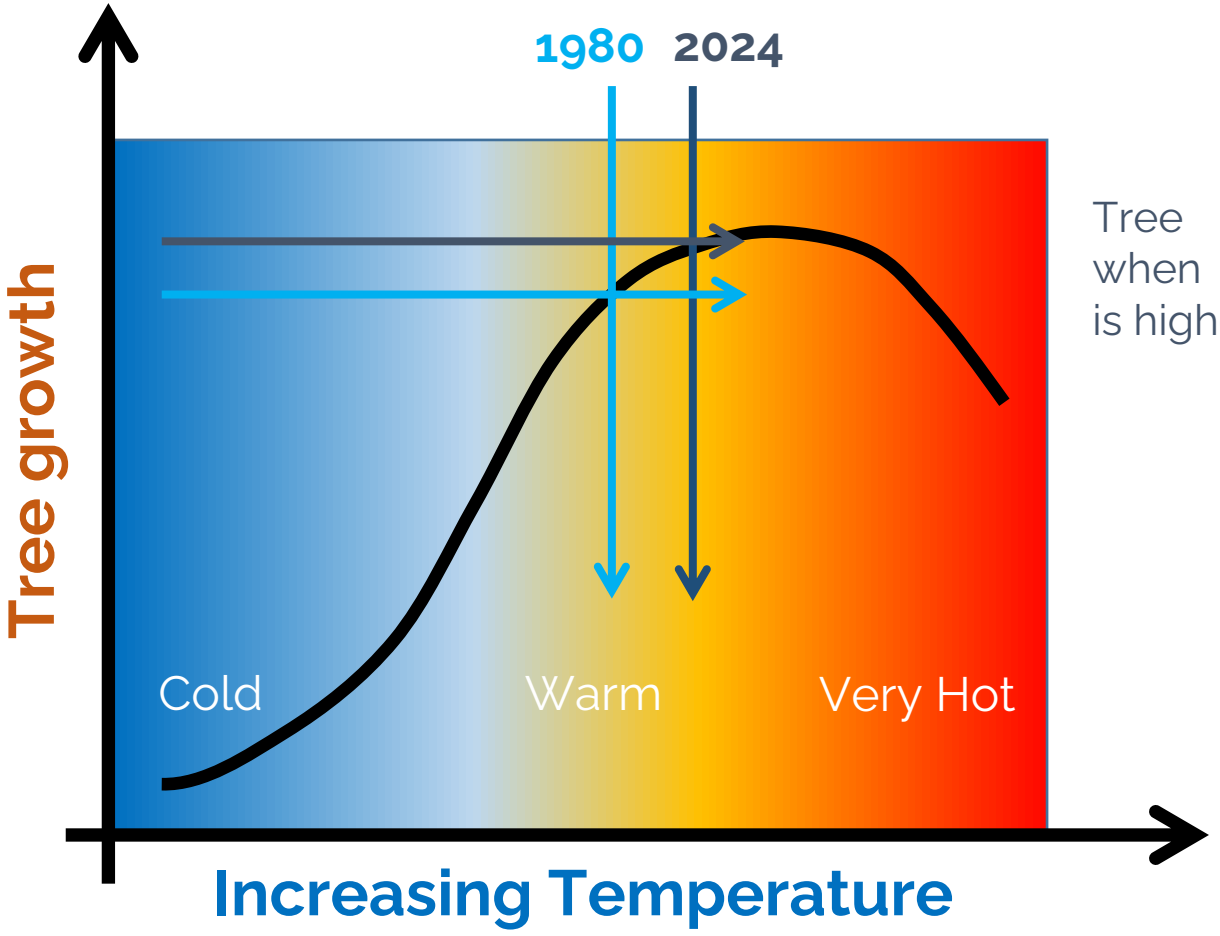
What is the impact on trees and forests?

Slow increase in mean earth temperatures



Increased growth

Mean Air Temperature



Tree growth is higher when mean temperature is higher

What is the impact on trees and forests?

Slow increase in mean earth temperatures



Increased growth

Heatwaves, Extreme temperatures

Attacks of Insects and pathogens

Too hot for the trees



What is the impact on trees and forests?



Change in rainfall events (more droughts and floodings)



Reduced growth
Higher mortality



What is the impact on trees and forests?



Change in the frequency and intensity of extreme events (hurricanes, …)

Destruction of forests



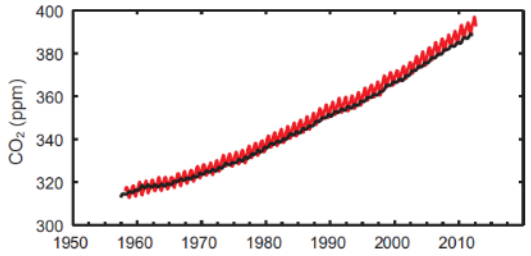
What can we do now to **save our forests**?

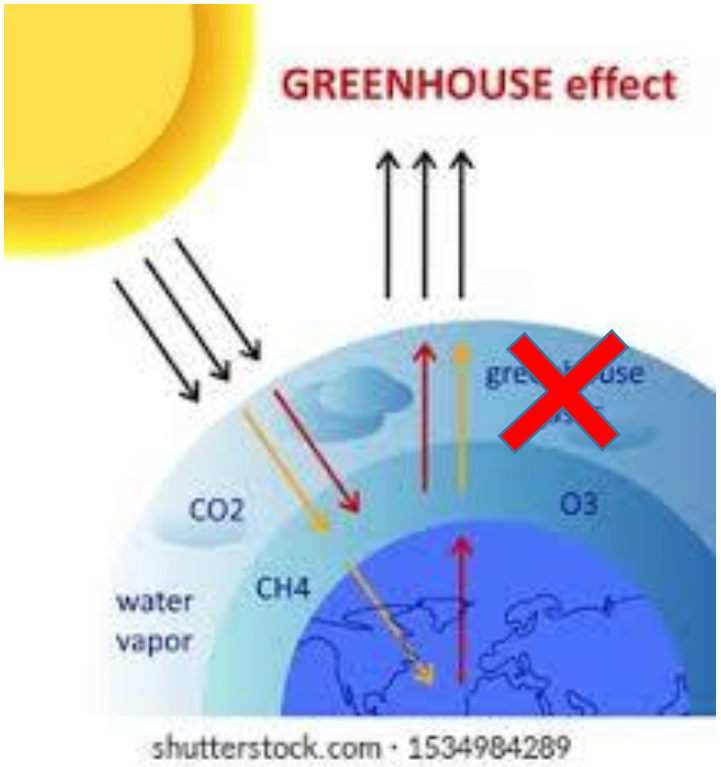


What can we do now to **save our forests**?

Reduce the use of greenhouse gases to limit earth global warming

Increase in greenhouse gases in the atmosphere related to human activities



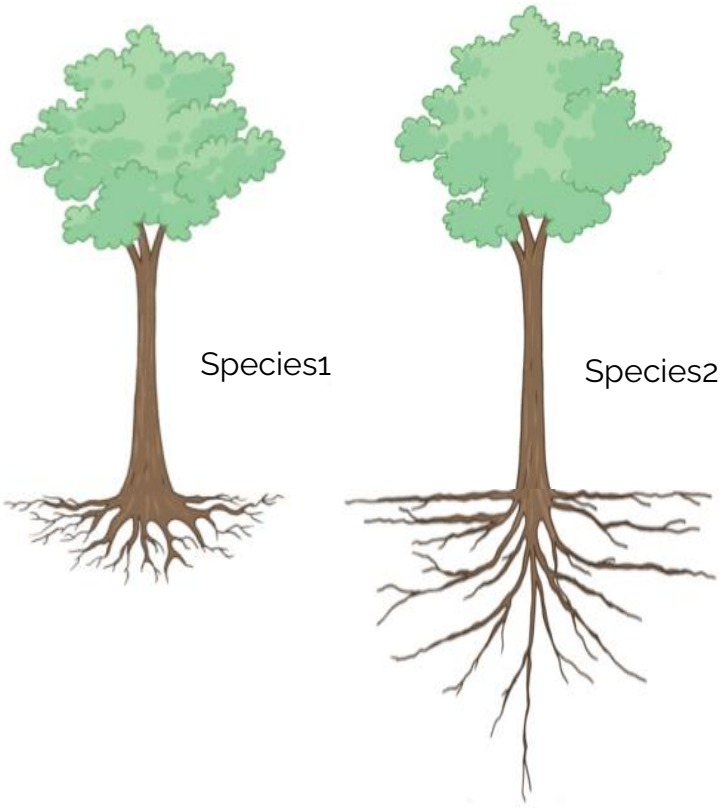


What can we do now to **save our forests**?

Research scientists in forest ecology like me are trying to find solutions …

What can we do now to **save our forests**?

Favor tree species which are resistant to drought and heat



Deep root systems



Quercus cerris
Quercus pubescent
(cf. Italy)

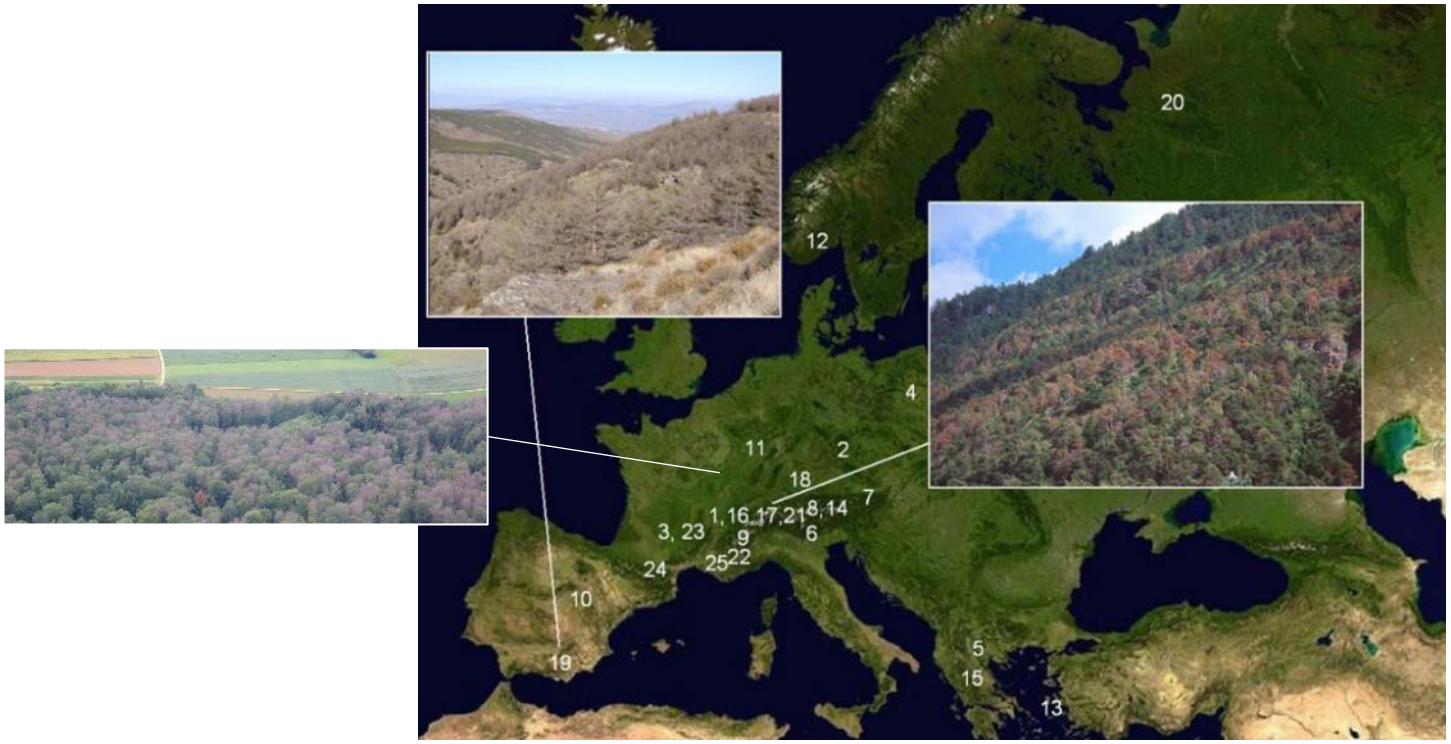


Black Pine, sub Laricio

Leaf characteristics adapted to drought and heat

What can we do now to **save our forests**?

Favor tree species which are well-adapted to local soil type

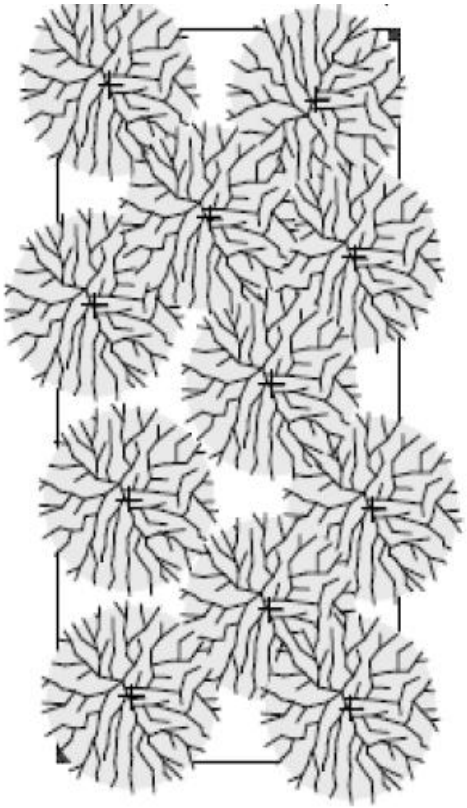


Adapted from Allen et al. 2010

Above : Pinus sylvestris mortality, Valais, Switzerland; 1999, by B. Wermelinger.
Right: Pinus sylvestris die-off, Sierra de los Filabres, Spain; 2006, by R. Navarro-Cerrillo
Left: Beech in Swiss Jura: https://www.letemps.ch/suisse/jura-situation-catastrophe-forestiere

What can we do now to **save our forests**?

Adapt forest management methods



Today: Dense forest

Tomorrow: more opened forest

What can we do now to **save our forests**?

Plant tree species which are resistant to drought and heat (« assisted migration »)



End of this talk

Thanks for your participation!

