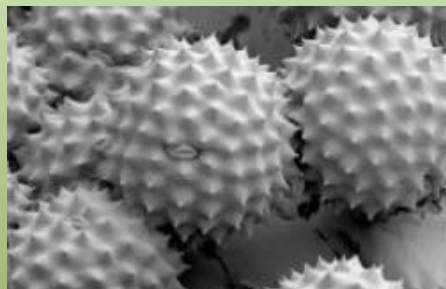




Tree pollination and its impact on human health as indicators of air pollution and climate change

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IUFRO



Tokyo 2017

Pollen transport

Anemogamy: by the wind



Entomogamy: by insects



Aerobiology: a multidisciplinary approach



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Dispersion
&
Transportation

Emission

Deposition

Source

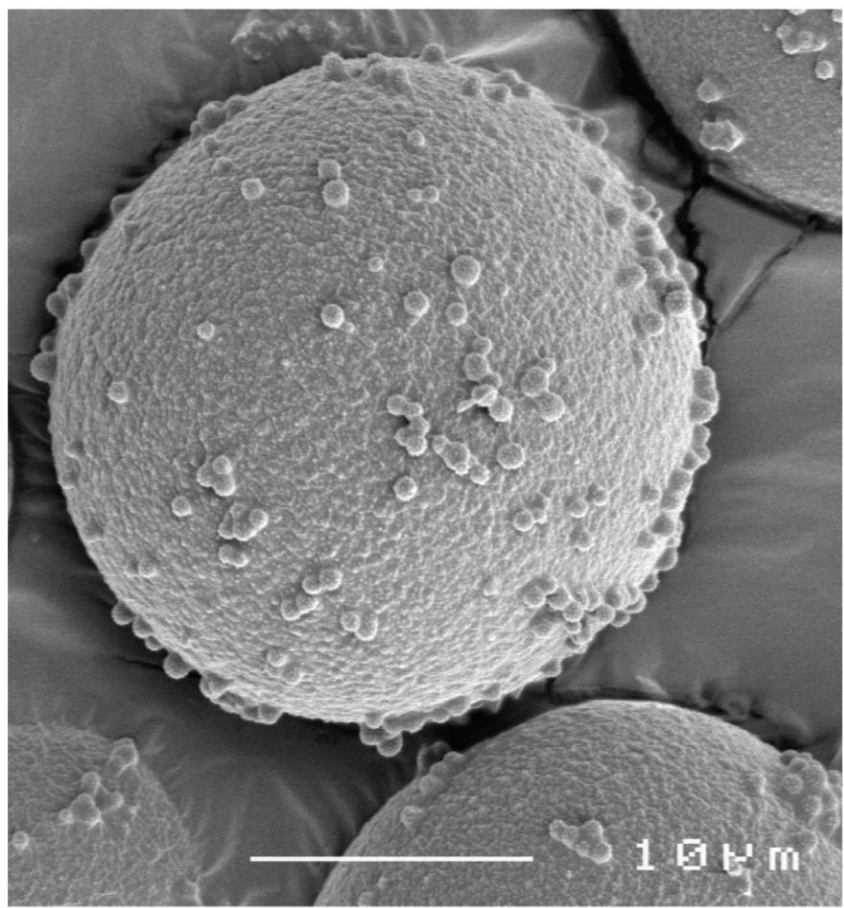


Impact

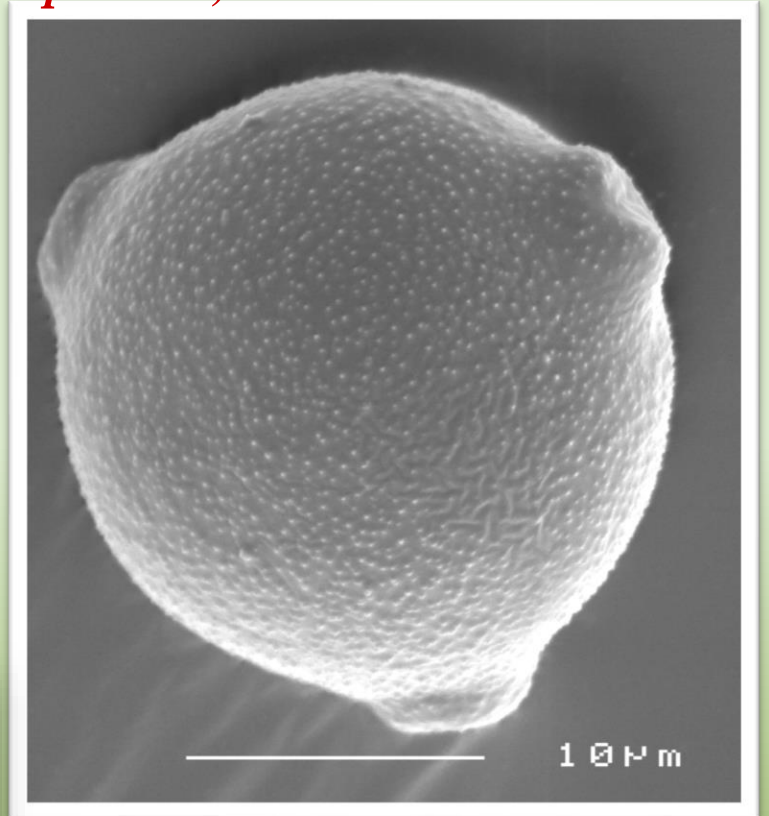
Atchoum!

Receiver





Cypress
(Cupressus)

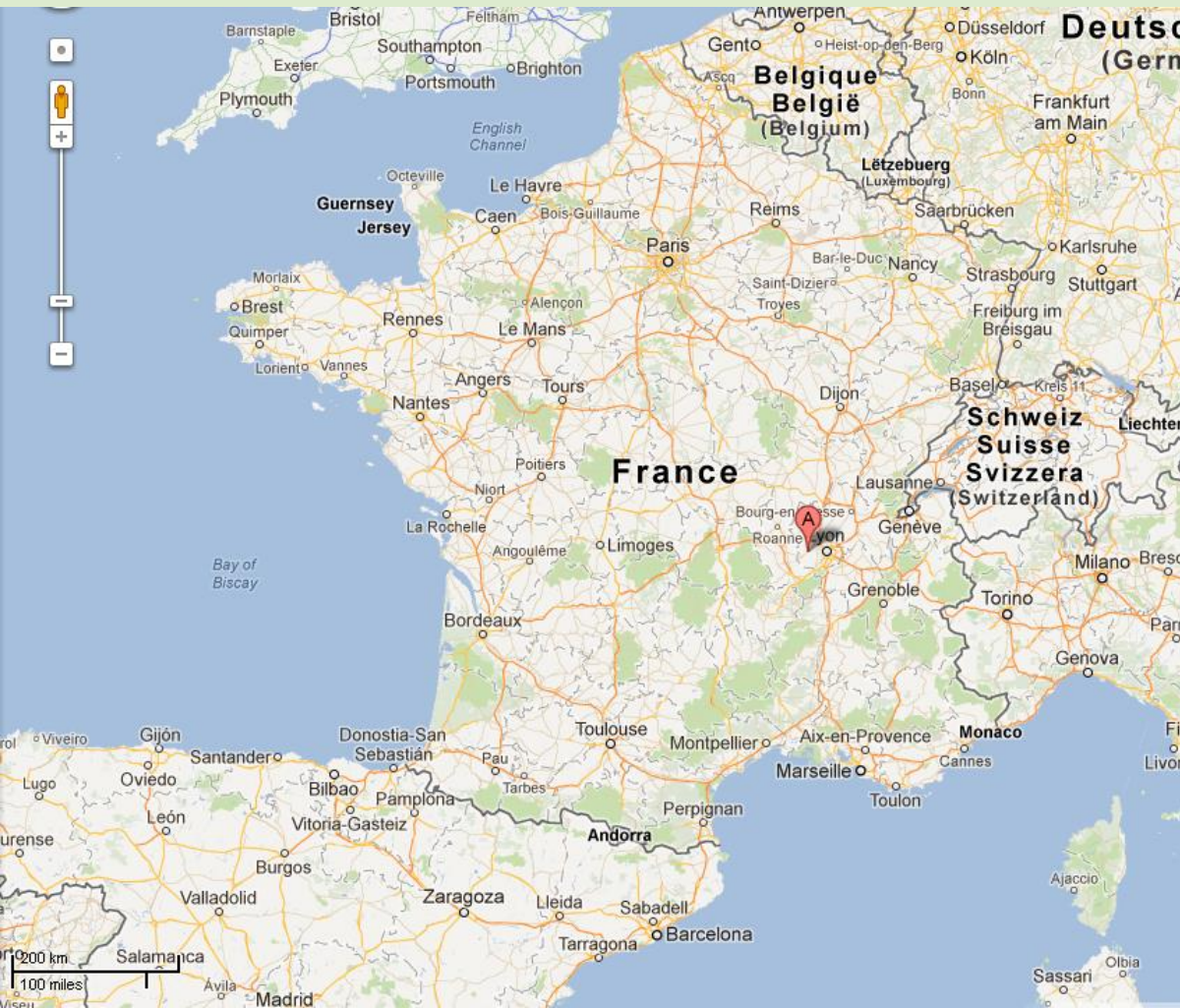


Birch
(Betula)



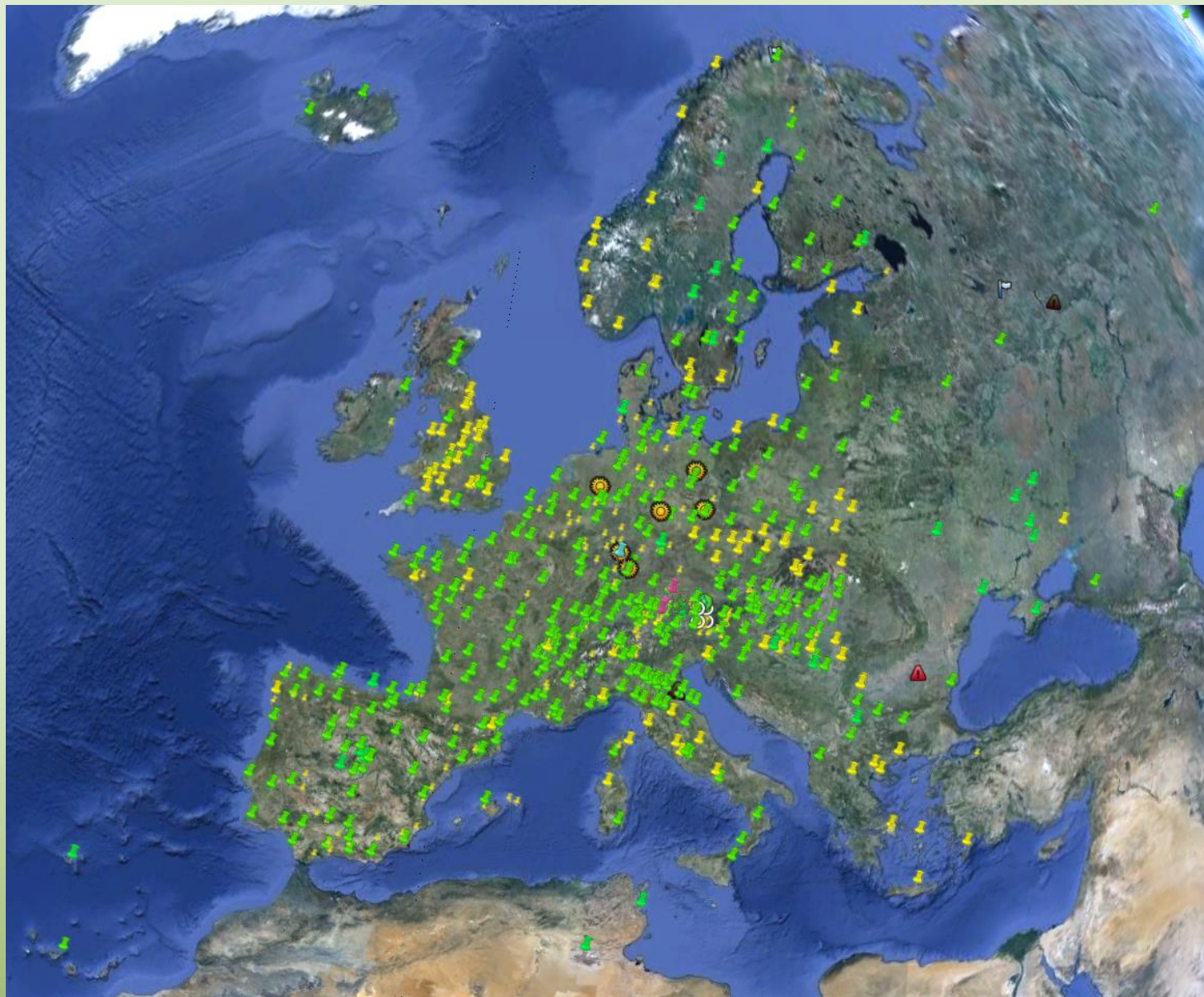
RNSA presentation

RNSA is the French aerobiology network responsible for analyzing biological particles in the air, and giving some information about their health impact.



The coordination center and training RNSA is located at Brussieu (69) in the heart of the Monts du Lyonnais, 40 km west of Lyon.

Pollens stations in Europe in 2017



Pollen exposure measurement : pollen trap

Current standard method in Europe

Breathing orifice
(10 L air/min)



Horizontal
reading



Adhesive band on the drum

1h = 2mm

Measurements were made
with Hirst-type pollen traps.

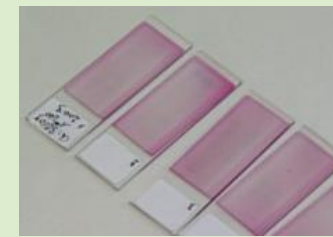
Pollen exposure measurement : analysis



Collection of the drum band



Dividing the band into daily sections



1 slide by day



Counting with a vocal recognition system



Daily amounts (grains/m³)

Difference between allergy potency and allergy risk

The **allergy potency** is specific to a pollen grain whatever the location while the **allergy risk** is a measure of health impact and depends on several factors such as the amount of pollen, the weather, the phenology, the symptoms observed by doctors...

Allergy potency of plants

- The allergy potency of a plant species is the ability of its pollen to cause an allergy to a significant part of the population
- The allergy potency can be:
 - **Low or negligible** : This means that a very large amount of pollen is needed to trigger an allergy and this applies only to the most sensitive people
 - **Moderate** : These species may be present locally to bring diversity into plantations, but they should not represent the majority of planted species
 - **High** : A few number of pollen is enough to cause an allergic reaction

Allergy potency of trees



Birch



**LIFE13
ENV/IT/001107**

TREES

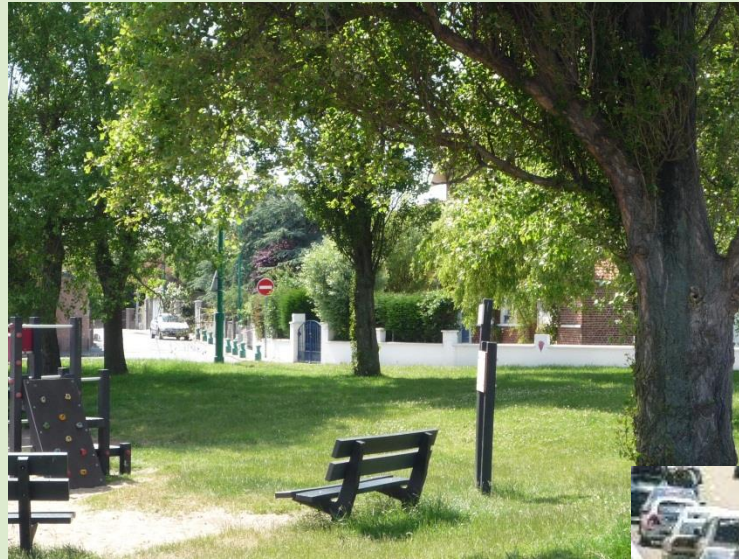
<u>Species</u>	<u>Family</u>	<u>Allergy potency</u>
maple*	Aceraceae	Moderate
alder*	Betulaceae	High
birch*		High
hornbeam*		High
hop hornbeam		Low or negligible
hazel*		High
baccharis		Asteraceae
cade	Cupressaceae	High
common cypress		High
Arizona cypress		High
juniper		Low or negligible
thuja*		Low or negligible
locust*		Fabaceae
chestnut-tree	Fagaceae	Low or negligible
oak*		Moderate
beech*		Moderate
walnut*	Juglandaceae	Low or negligible
paper mulberry	Moraceae	High
white mulberry		Low or negligible
ash*	Oleaceae	High
olive-tree		High
privet*		Moderate
pine*		Pinaceae
plane-tree**	Platanaceae	Moderate **
poplar*	Salicaceae	Low or negligible
willow*		Moderate
yew	Taxaceae	Low or negligible
Japanese red-cedar	Taxodiaceae	High
linden*	Tiliaceae	Moderate
elm*	Ulmaceae	Low or negligible

* several species

** The pollen of the plane trees is weakly allergenic. On the other hand, the microneedles contained in the waders resulting from the degradation of the female heads of the previous year are very irritating.

Urban Vegetation & Air Quality

Absorption of pollutants



Absorption of particulate pollutants



Effect on well-being
Fight against stress



Trees and pollution

Advantage :

Planting trees in the city would have a protective effect because they reduce the presence of pollutants in the air by filtering and absorbing pollutants, small fine dust and aerosols suspended in the air.

Disadvantages :

Urban pollution aggravates allergenicity of pollens by weakening the surface of the grains and allowing the exit of granules containing allergenic proteins. It also causes an increase in bronchial, nasal and ocular hyperresponsiveness, altering the threshold of sensitivity to pollens. Moreover, the introduction of trees in the city (cypress, birch, plane tree ...) contributes to the increase of respiratory allergies.



Moreover...

Other environmental aspects related to vegetation should be taken into account

Urban climate - greenhouse effect

Energy expenditure in buildings

We must also consider the health aspects linked to urban vegetation.

😊 *Physical and psychological well-being*

☹️ *Allergies*

Vegetation has a cost :

In France, the average cost for a planted tree is 1250 euros

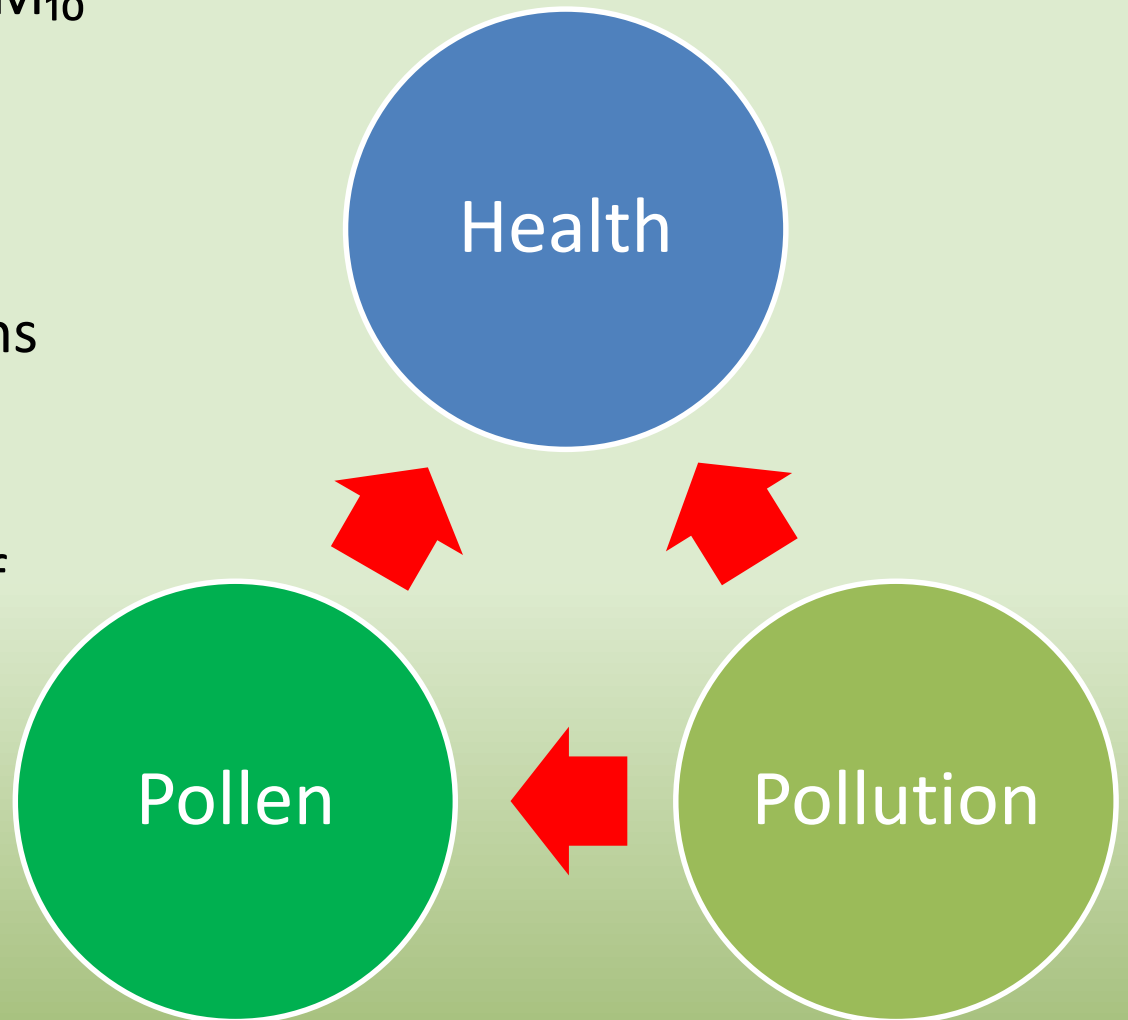
(Soil preparation, planting, maintenance)

Pauleit and al. (2002) Tree establishment practice in towns and cities. Urban Forestry & Urban Greening 1 : 83-96



Pollution and pollen

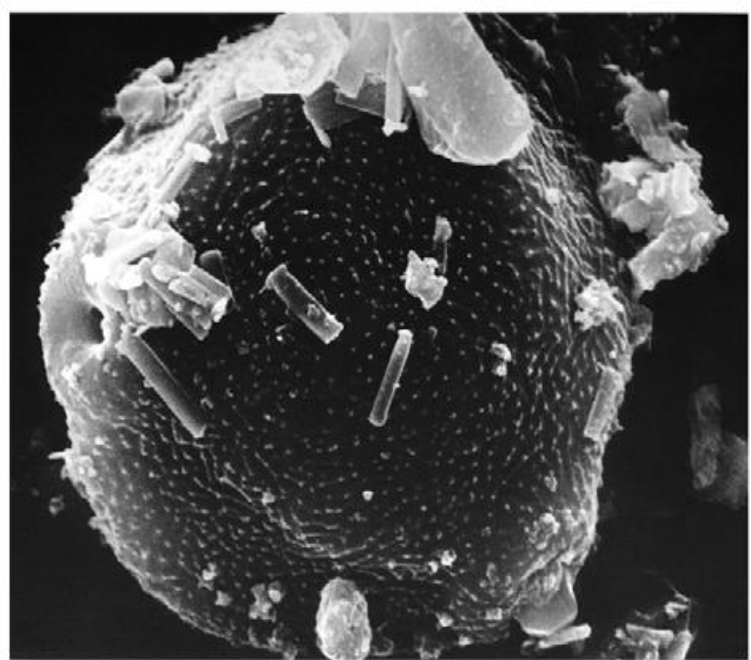
- Pollutants (NO_2 , O_3 , PM_{10} et $\text{PM}_{2.5}$) act:
 - By weakening the respiratory system
 - On the aeroallergens contained in the pollen grains
 - On the structure of the pollen grains
 - On allergenicity of the pollen grains



Pollution and pollen



Birch pollen in the countryside

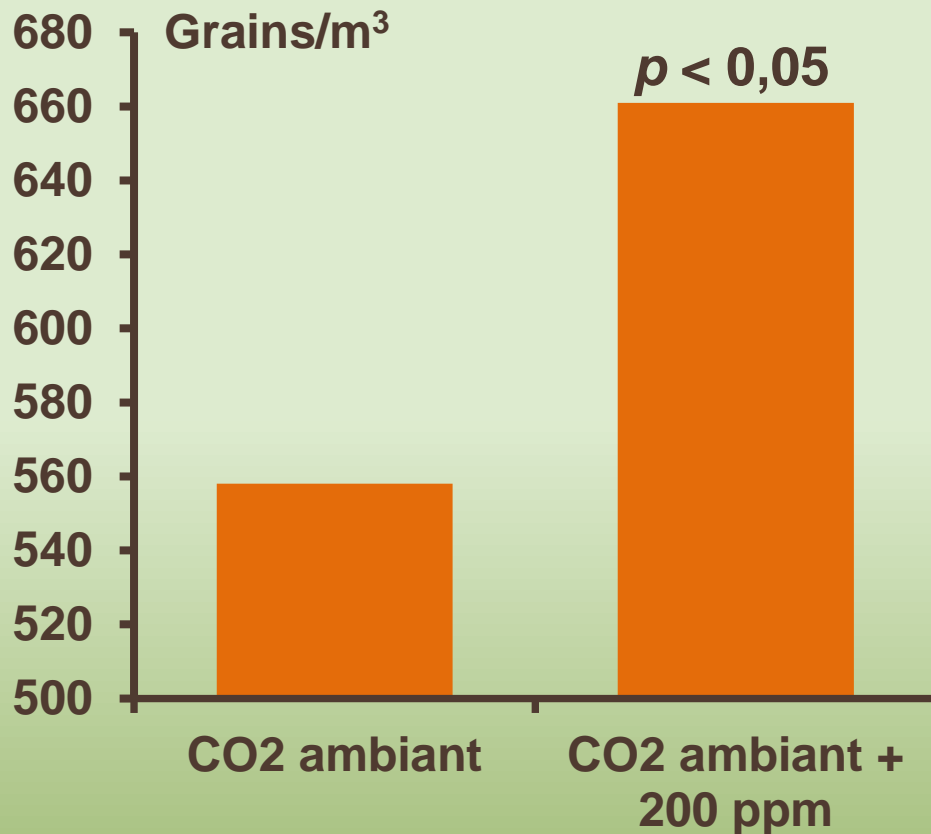


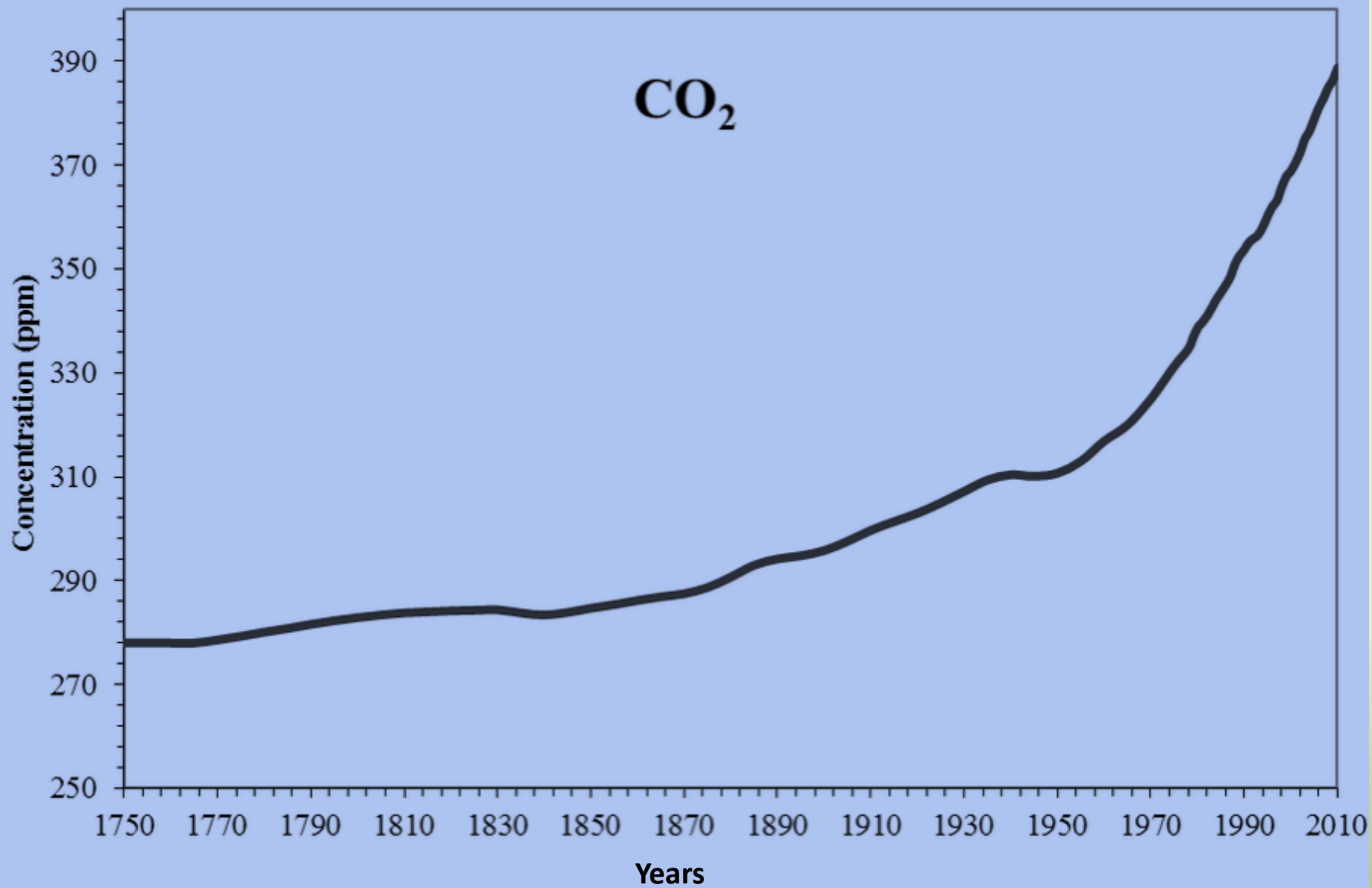
Birch pollen in town

H. BEHRENDT & W.M. BECKER, 2001 : *Curr Opin Immunol* 13, 709-715

Pollution and pollen

➤ CO₂ and *Pinus taeda* :



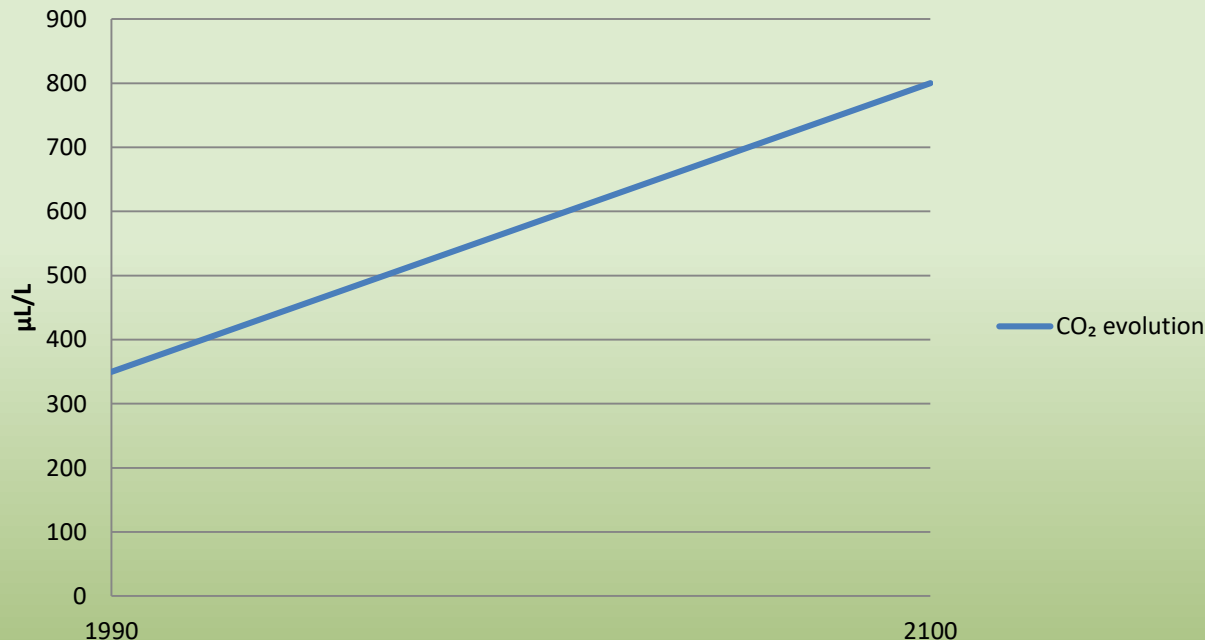


CO₂

The report of the Intergovernmental Panel on Climate Change edited by Houghton *and al.* (1990) projects CO₂ increasing from present day concentrations of about 350 μ L/L (1) to over 800 μ L/L by the end of the present century if no steps are taken to limit emissions.

(1) 1 μ L/L = 1 microliter CO₂ per liter of air = 1 ppmv = 1 part per million by volume = 1 μ mol/mol

CO₂ evolution



Effects of increasing atmospheric CO₂ on vegetation

B. A. Kimball and all - Environmental and Plant Dynamics Research Unit,

Photosynthesis and CO₂

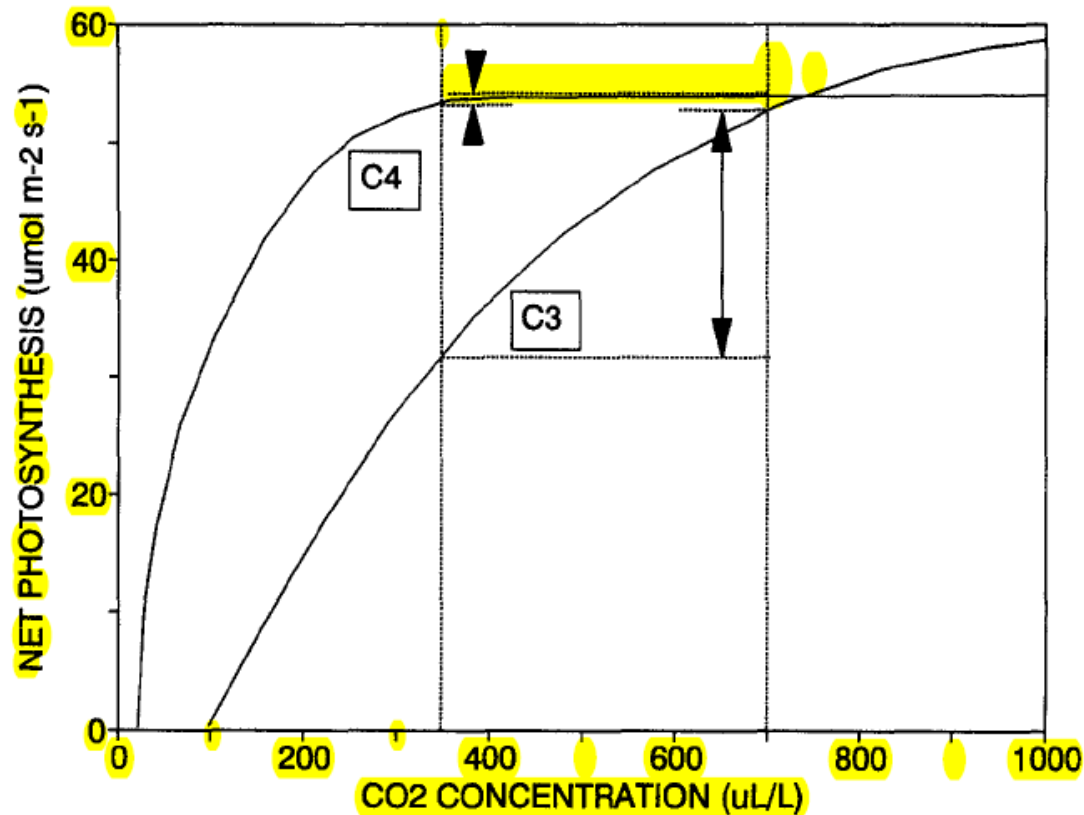
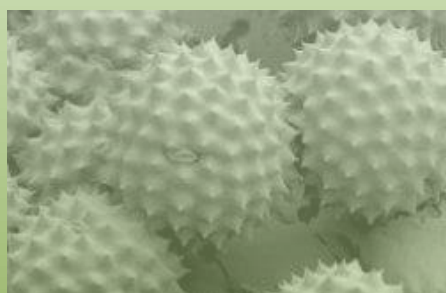


Fig. 1. Net photosynthesis of typical C₃ and C₄ plants versus CO₂ concentration, adapted from Taiz and Zeiger (1991). The vertical dotted lines at 350 and 700 μL/L indicate the present-day CO₂ concentration and the doubled concentration projected to occur sometime near the end of the next century (Houghton *et al.* 1990), respectively. The double arrows indicate the amounts of increase in photosynthesis due to the CO₂ doubling.

Pollen : Health indicator of climate change



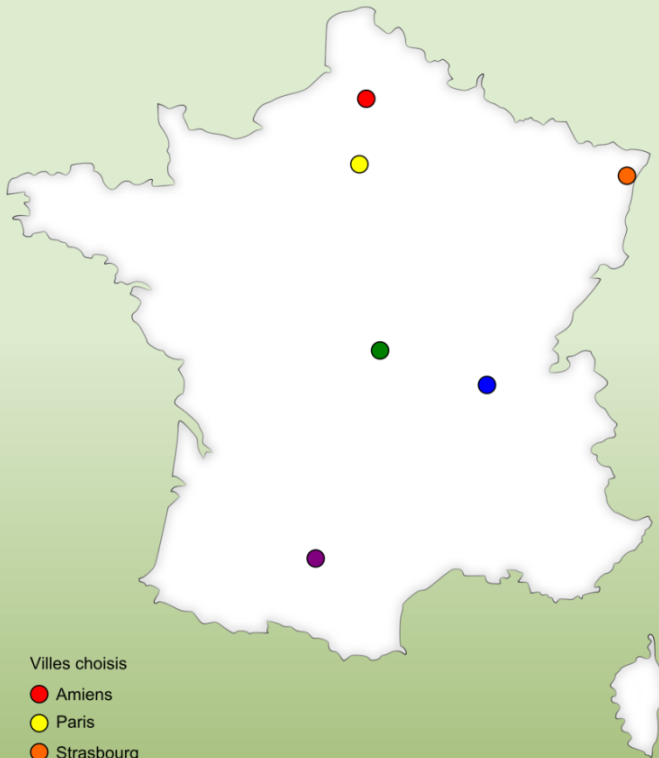
Phenological phases of trees

Source : GLOBE Suisse

Study ONERC-RNSA : Pollen : Health indicator of climate change

First phase of the study → taxon choice:

- ✓ Tree
- ✓ High allergenic potential
- ✓ Representation on a large part of the territory

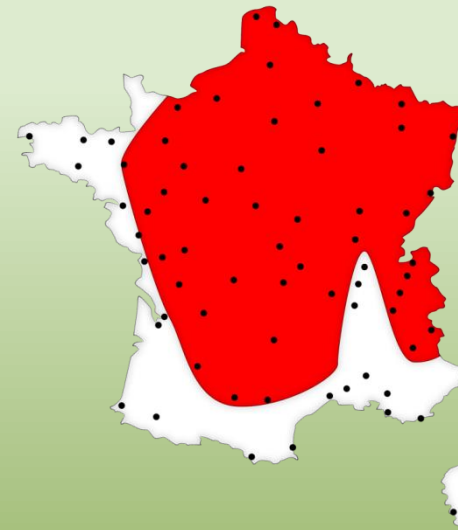


Villes choisies

- Amiens
- Paris
- Strasbourg
- Montluçon
- Lyon
- Toulouse

Second phase of the study → cities choice:

- ✓ Representation of different climates
- ✓ Areas of birch presence
- ✓ Reliable data



Map of the distribution of birch pollen in France

Study ONERC-RNSA : Pollen : Health indicator of climate change

Third phase of the study → period choice :

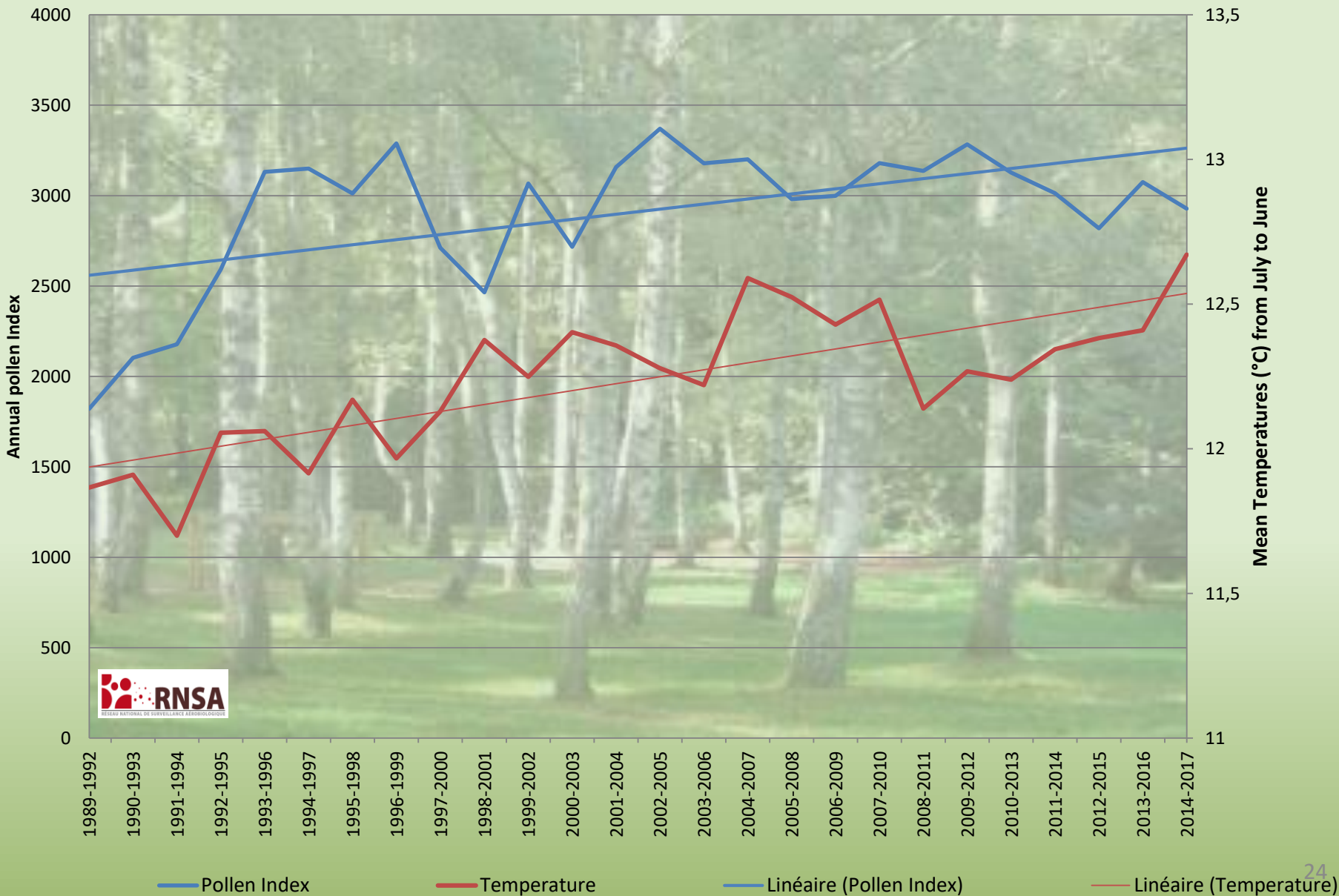
The phenological year for birch is from July to June.

The birch pollen quantity which is released in March-April depends on the temperatures and weather he has done before, since july of last year.

The period July-June (year N+1) has been chosen.

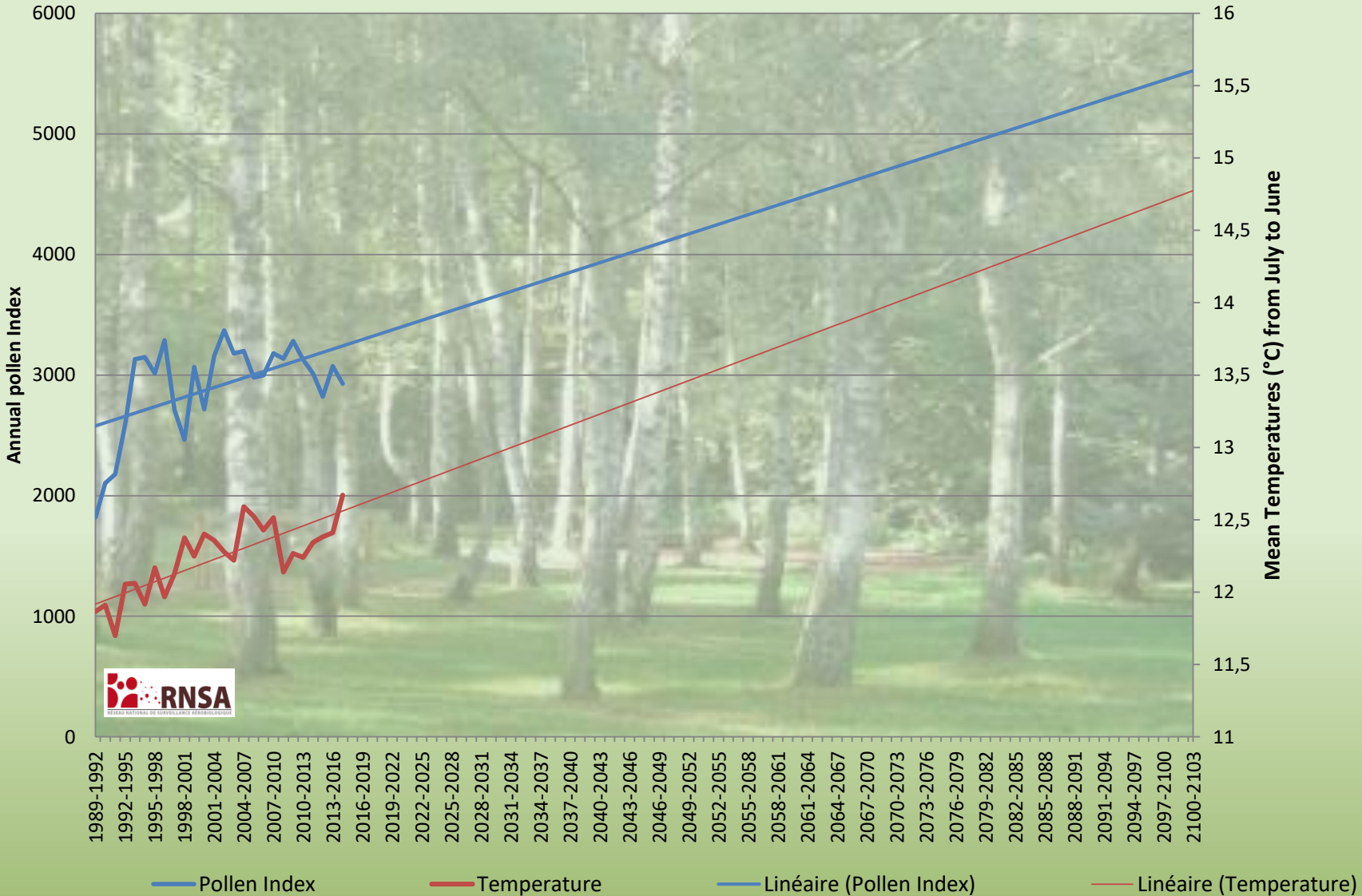


Moving average(-4 years) birch pollen quantity and annual T° for 6 cities across France from 1989 to 2017

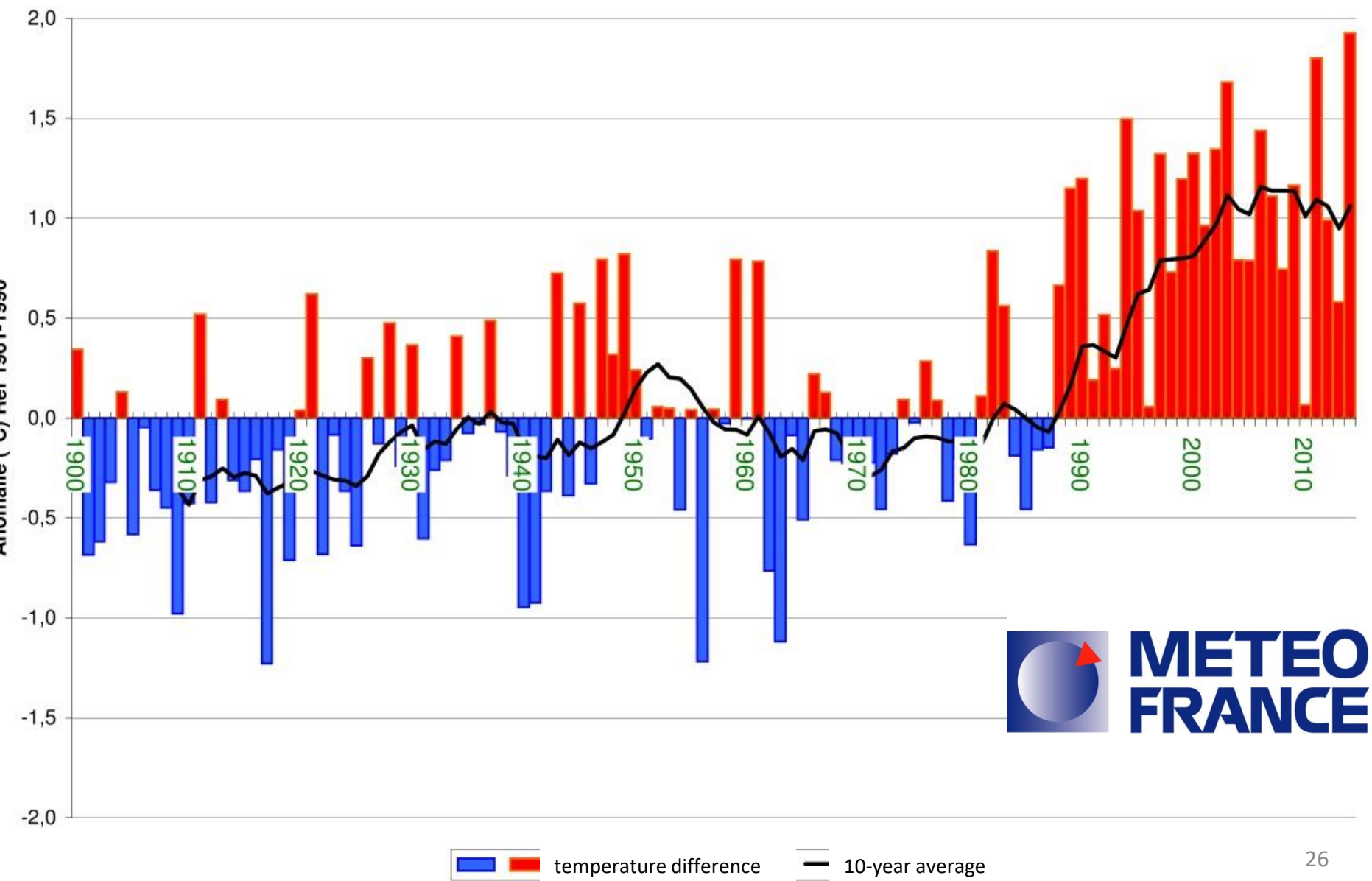


Simulation/Projection

Moving average(-4 years) birch pollen quantity and annual T° for 6 cities across France from 1989 to 2100

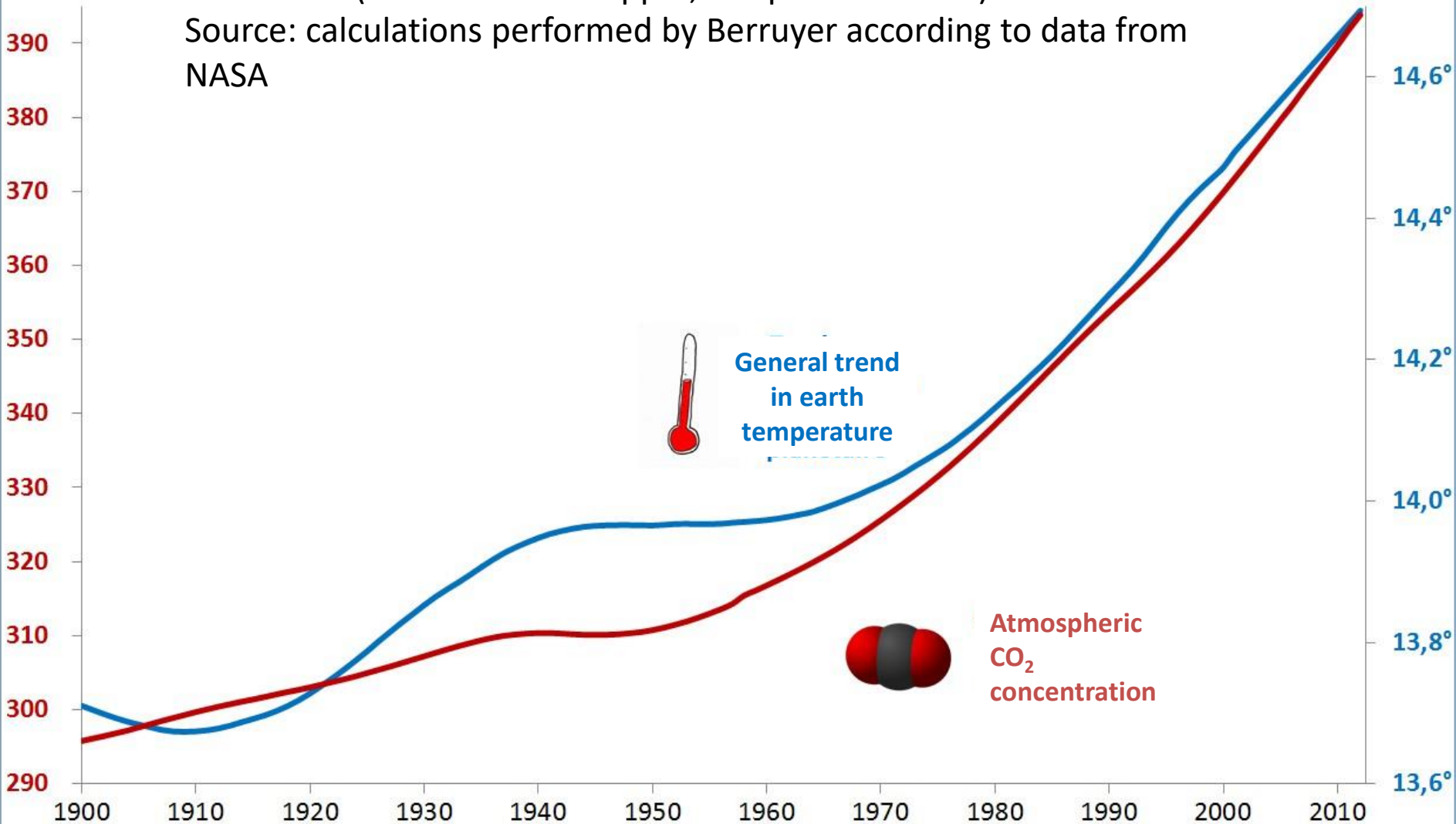


Evolution of the average temperature in metropolitan France from 1900 to 2015

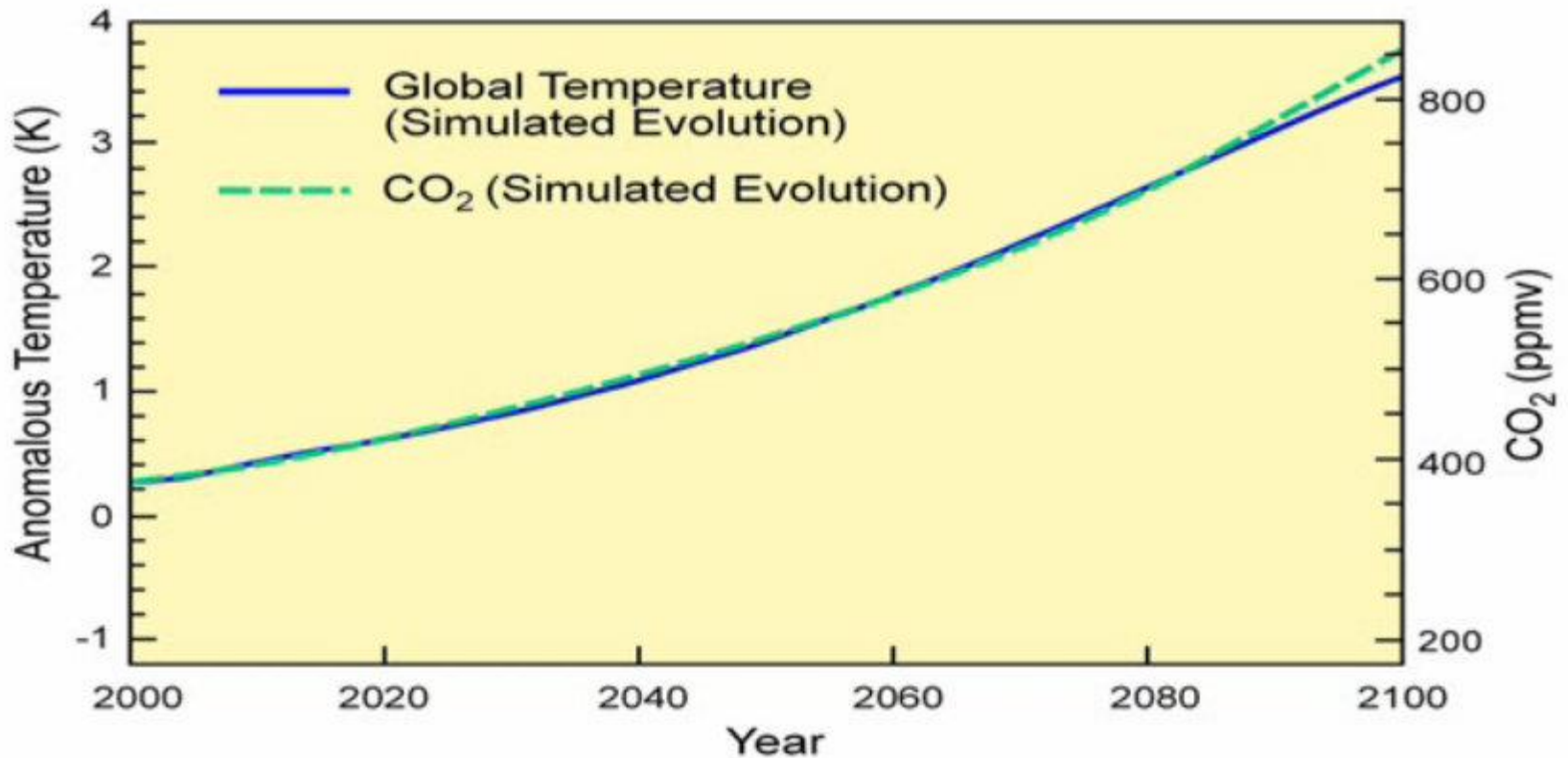


Atmospheric CO₂ concentration and trend in earth temperature, 1900-2012 (concentration in ppm; temperature in °C)

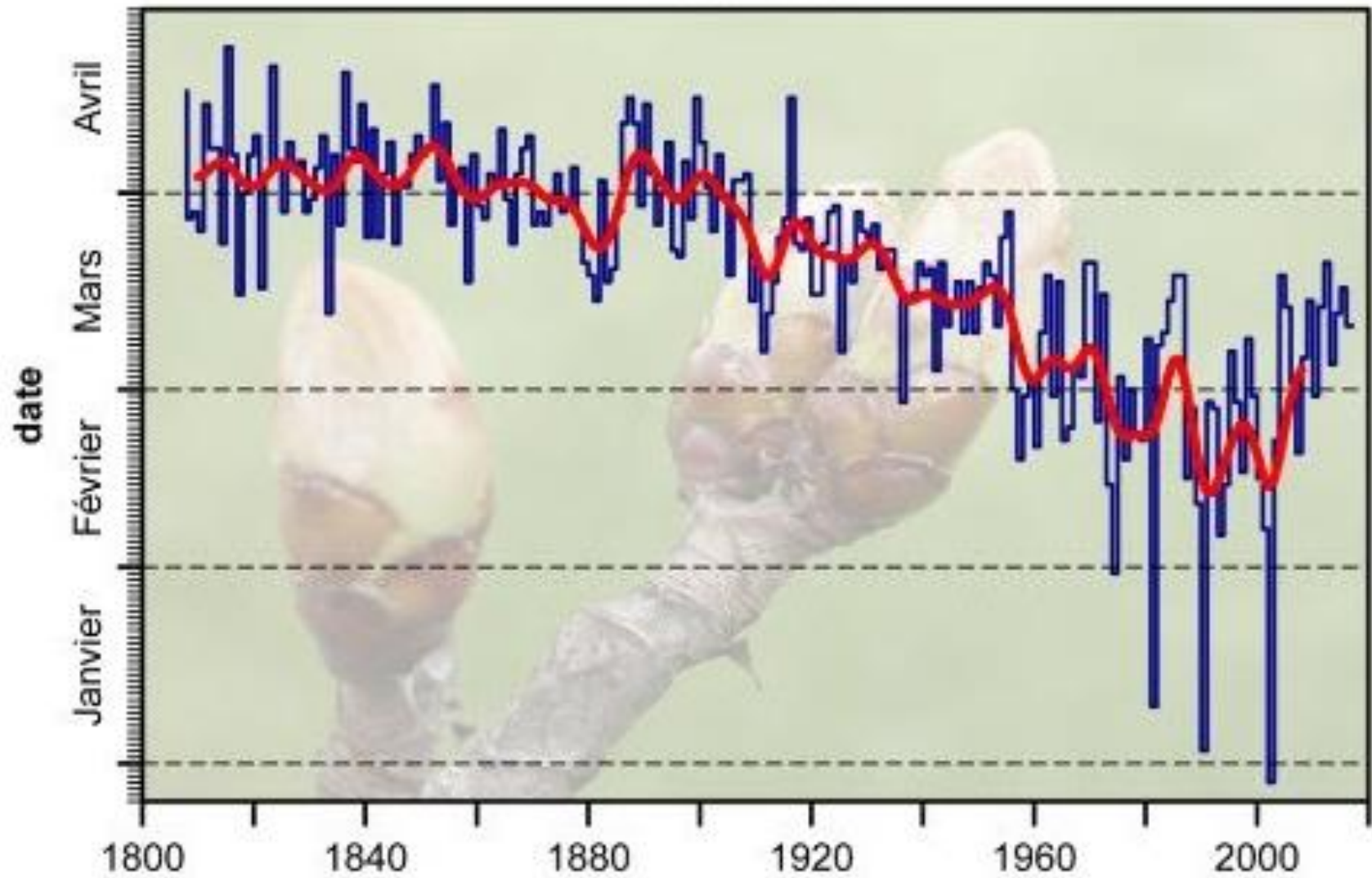
Source: calculations performed by Berruyer according to data from NASA



Theories/Projection



Eclosion du premier bourgeon du marronnier à Genève 1808-2017

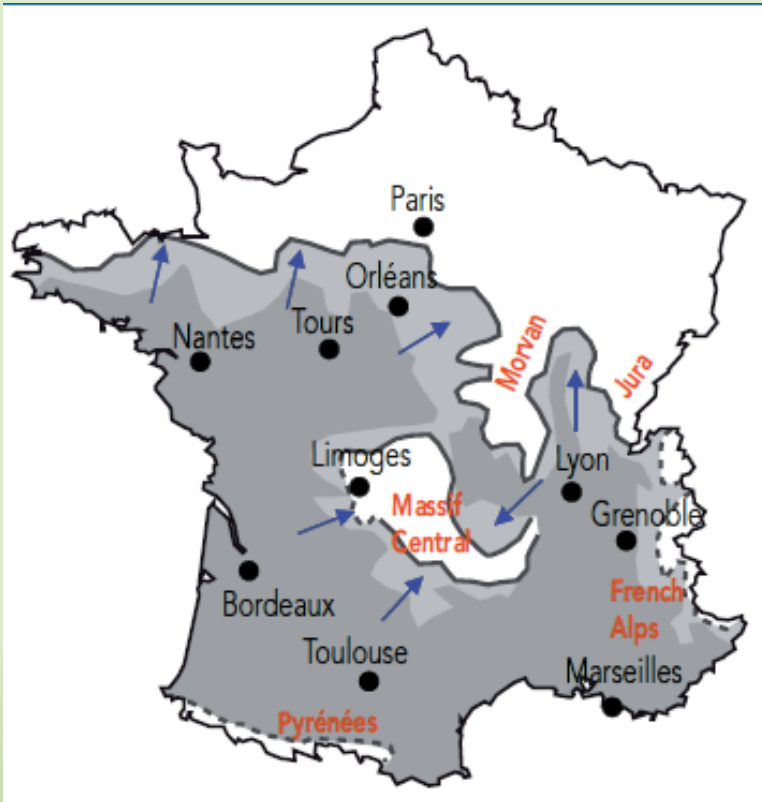


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pheno.longts 0.38 / 15.03.2017, 06:08

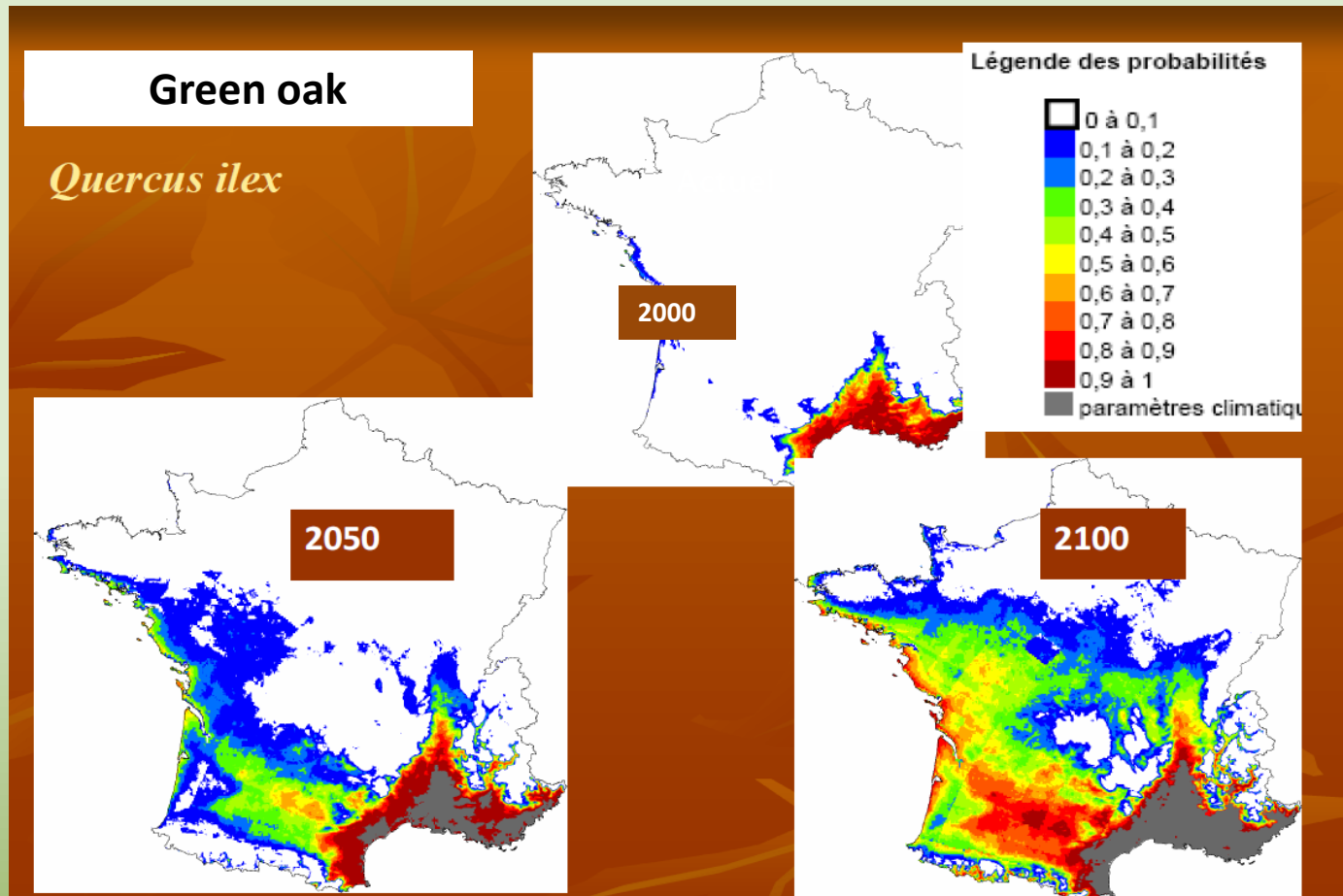
The appearance dates of horse-chestnut bud burst in Geneva from 1808

Theories/Projection



**According to the biologists:
The increase of 1 °C in mean annual temperature is equivalent to a translation of plant species 200 km to the north or to a rise up of about 150 m in altitude.
Source : Science & Vie, 2003**

- Species migration from South to North (ragweed, trees, grasses, cypress and oak. ...).
- Forecast: warming of 3.5 °C by 2100.
- The area of green oak by 2050 could exceed a line Bordeaux-Saint-Etienne and cross the Loire by 2100.

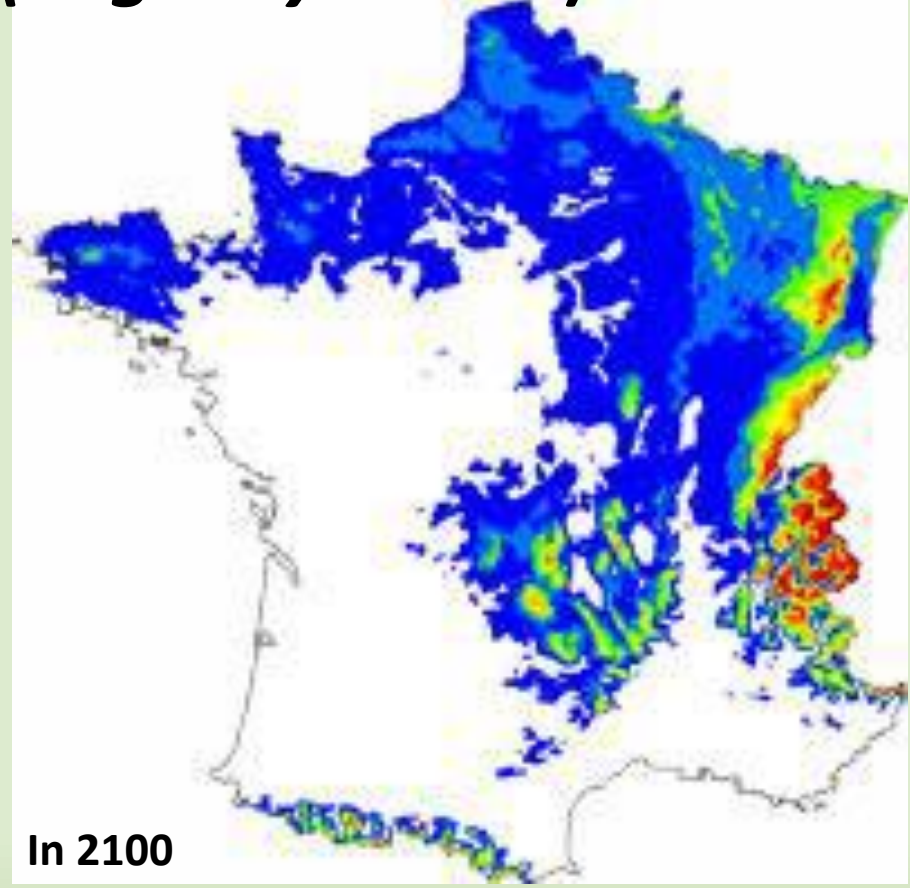
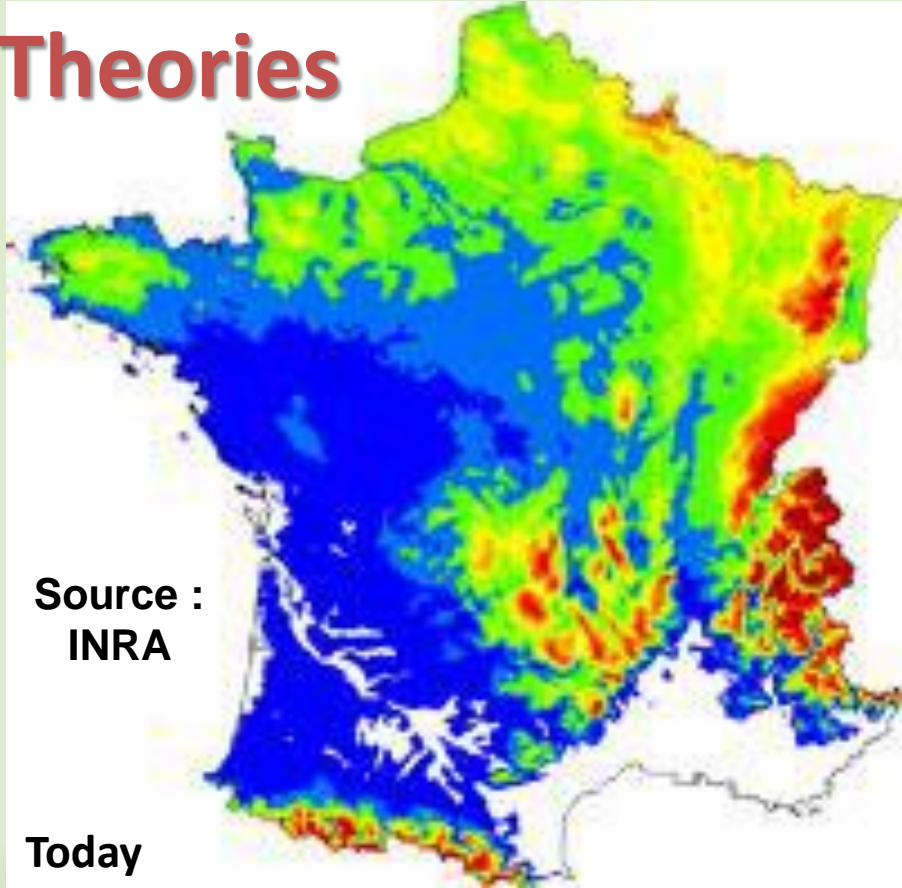


Source :
INRA

Projet carbofor , Tâche D1 : modélisation et cartographie de l'aire climatique potentielle des grandes essences forestières françaises, Badeau et al .

Common beech (*Fagus sylvatica*)

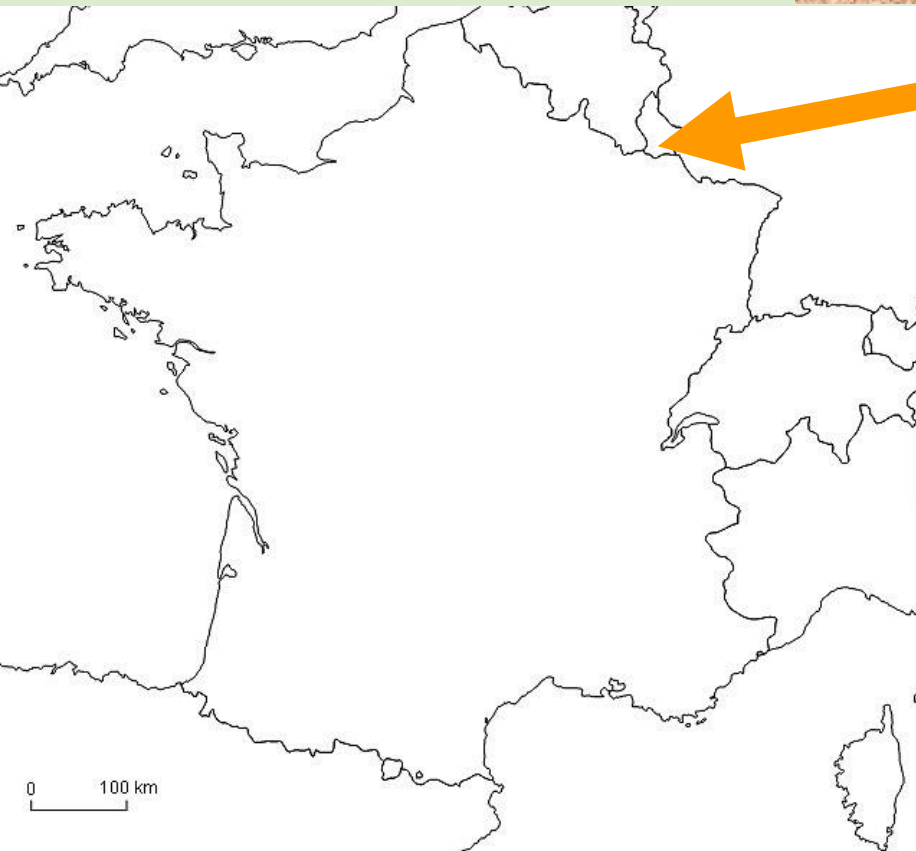
Theories



The range of beech, by a hundred years, could significantly decrease due to higher summer temperatures and lower rainfall. The same phenomenon could be observed for mountain species: Larix, Abies, Picea ...

Theories

Olive tree



With a warming of 3.5°C by 2100 the Olive tree could go back to the gates of Luxembourg.

Because of the Photoperiod which is an essential element for plants it will certainly never happen

Pollen allergy

Asthma

Rhinitis 90%

Urticaria and
eczema 20%

I am itchy



Conjunctivitis

*I weep
for
its prick*

Conjunctivitis 75%

I cough

Tracheitis, asthma
50%



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Thank you for your attention

www.pollens.fr

<http://www.vegetation-en-ville.org/>