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# Aleppo pines installed on coal mine waste dumps grow much better than expected

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► **To cite this version:**

Frédéric Guibal, Cécile Miramont. Aleppo pines installed on coal mine waste dumps grow much better than expected. International Conference on Ecological Sciences, Oct 2016, Marseille, France. hal-04484224

**HAL Id: hal-04484224**

**<https://hal.science/hal-04484224>**

Submitted on 29 Feb 2024

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## Introduction

The landscape of the former SW Provence mining area around Gardanne city (Bouches-du-Rhône, SE France) was shaped during more than 5 centuries by lignite exploitation. This industrial activity led to coal mine waste dumps which now occupy a large surface area.

As soon as the waste deposition ceased mining wastes were rapidly colonized by a local pioneer species, Aleppo pine (*Pinus halepensis*).

Coring of some of these pines in a preliminary study addressing their age showed a particularly high radial growth rate which incited us to further analyze pines growth.



Les Molx mine waste dumps



Aleppo pines colonizing Biver mine waste dump



Core collected on a pine growing on a dump; slice collected on a control site

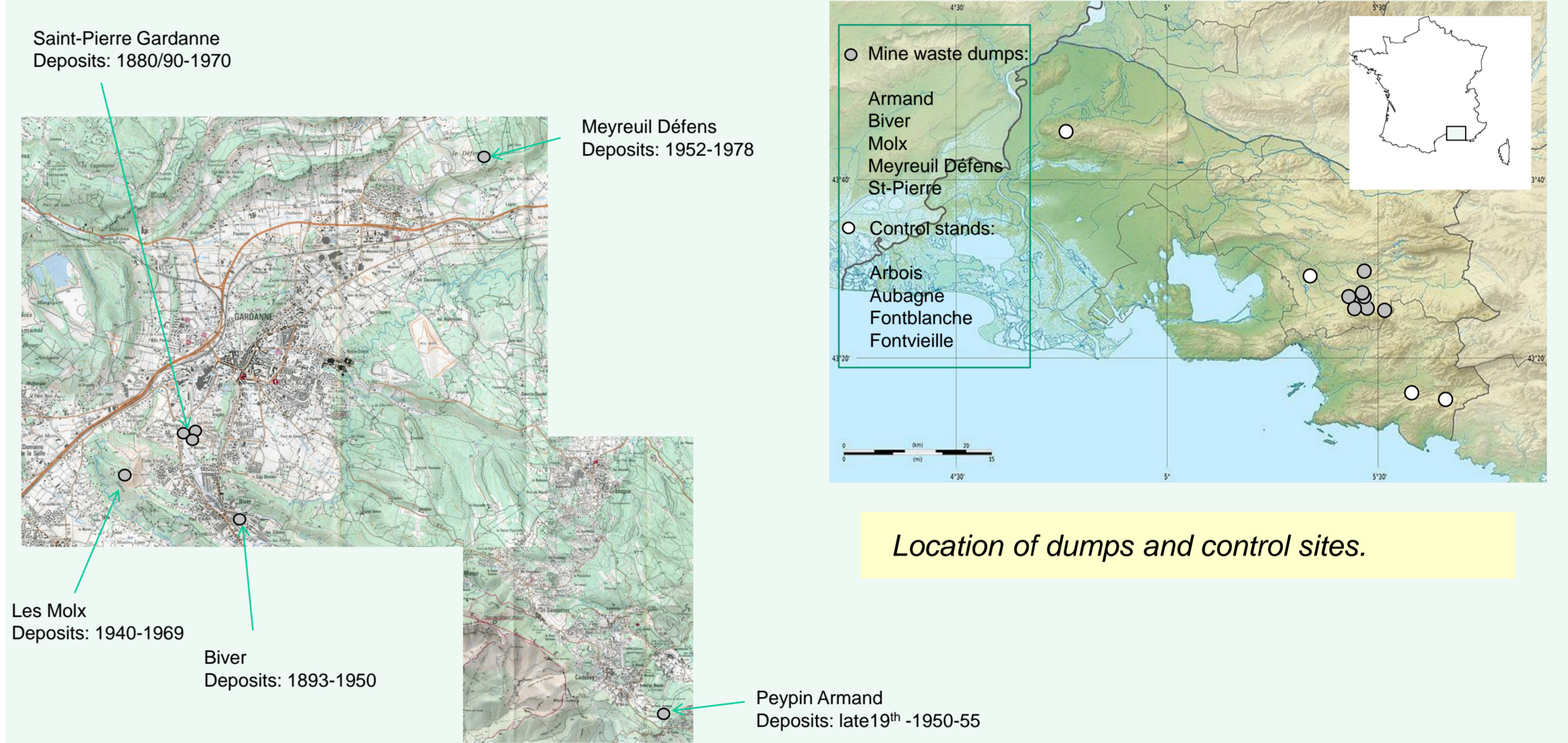
## Materials & Methods

A retrospective analysis of the ring-width series of pines growing on mining waste dumps compared to those of pines growing on brown calcareous soils (control trees) in SW Provence was carried out on 5 mine waste dumps and 4 control stands exposed to similar bioclimate conditions and similar tree densities. At each site, 15 dominant pines were cored.

Once the age of the dominant trees was established, ring-widths series were smoothed according to cambial age to compare wood production among the sites.

In order to assess climate-growth relationships a statistical model (response function) in which local climate is the predictor and tree-ring variation is the predictand was used. Magnitude and sign of the coefficients of the statistical model indicate the importance and signs of the tree-ring response to the climate variables.

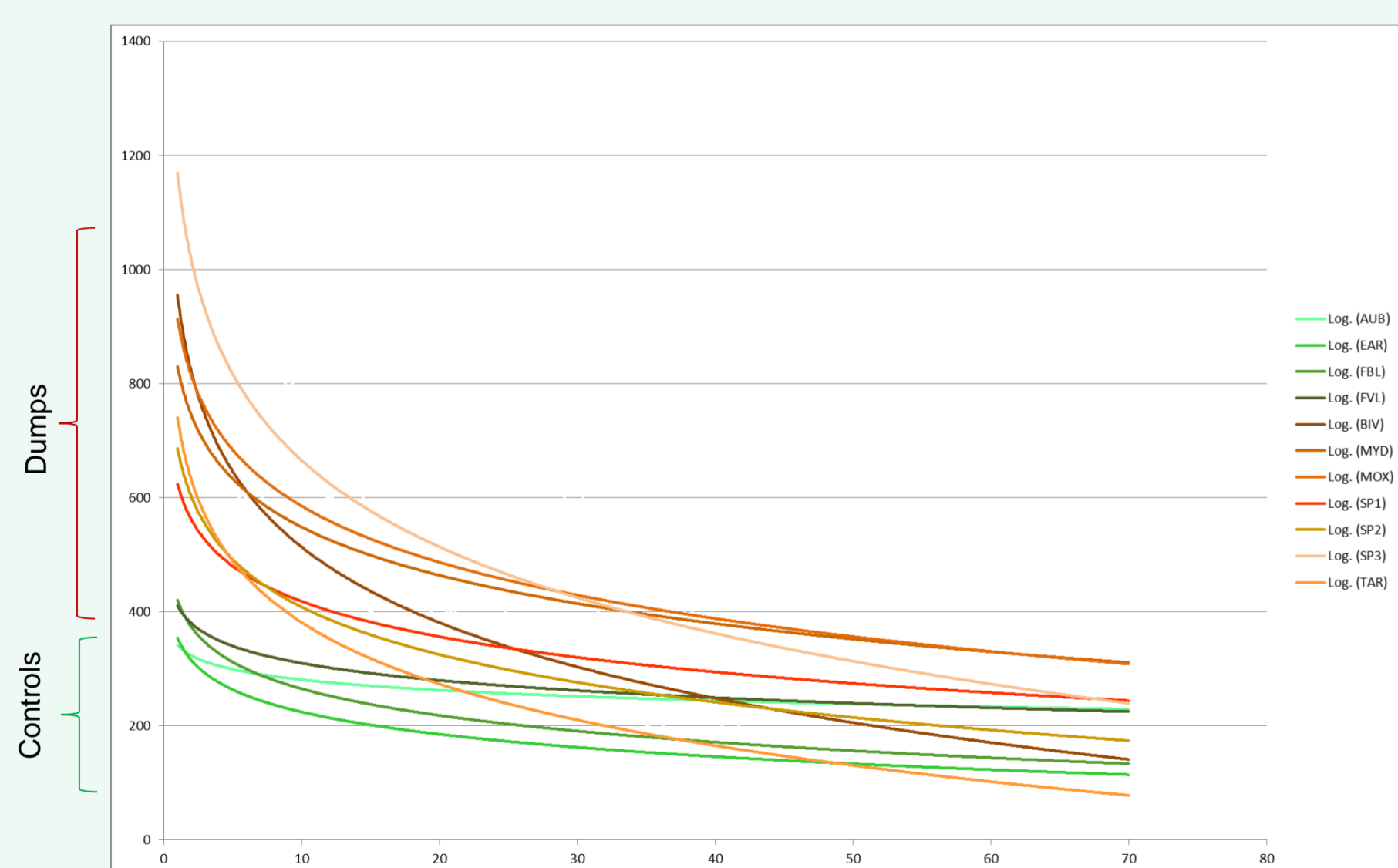
Last, once the climate factors which limit tree radial growth were identified, tree recovery was assessed through the number of years during which the effect of a stressing meteorological event was discernible in tree-rings.



Location of dumps in the Gardanne area with period of waste deposits.

Location of dumps and control sites.

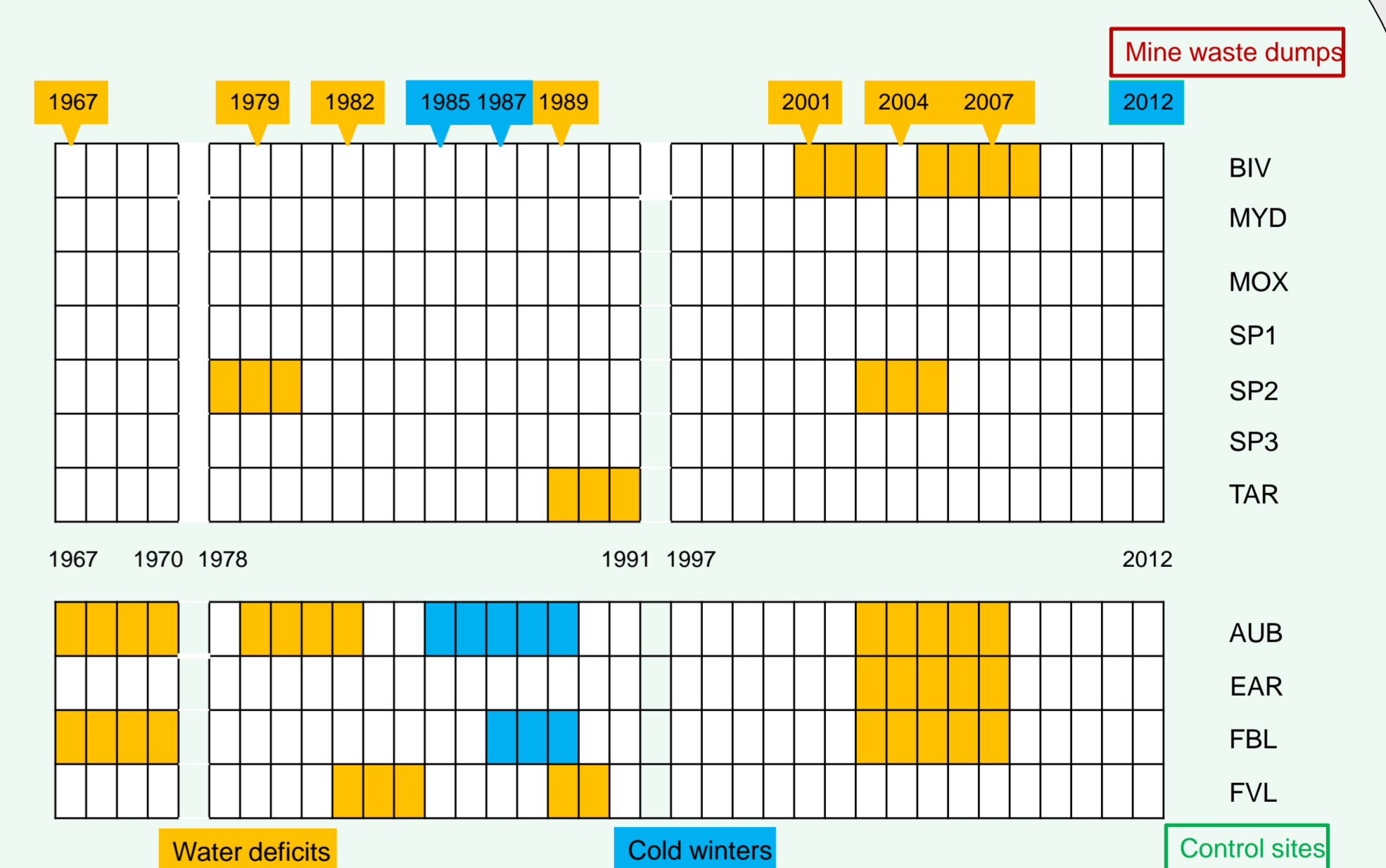
## Results & Discussion



At same cambial age, radial growth is higher on waste dumps than on control sites.



Response function coefficients for precipitation amount from nov-dec<sub>t-1</sub> to sep<sub>t</sub> (green: control sites ; blue : dumps).



The table represents the average negative growth reaction discernible in tree-rings following a stressing meteorological event.

Pines growing on dumps reveal a much higher radial growth than those on control soils as shown by annual growth curves according to cambial age. The relationship between climate and annual pine radial growth by means of response functions shows differences between dumps and control soils. On dumps, no significant relationship appears between temperature and radial growth. As regards relationship with precipitation, control pine growth is positively correlated with winter and early spring precipitation; meanwhile dump pine growth is positively correlated with precipitation of November/December of the previous year.

These results suggest that water supply better suits the needs of pine growth on dumps than on control calcareous soils. In addition to that the duration of recovery times of dump pines is shorter after a stressing meteorological event than that of control trees.

Temperatures rise in a dump as the result of slow oxidation process of coal substance as a part of the deposited material. Following these results experiments on saplings are under progress in order to differentiate the role of soil physicochemical properties and temperature on growth rate.