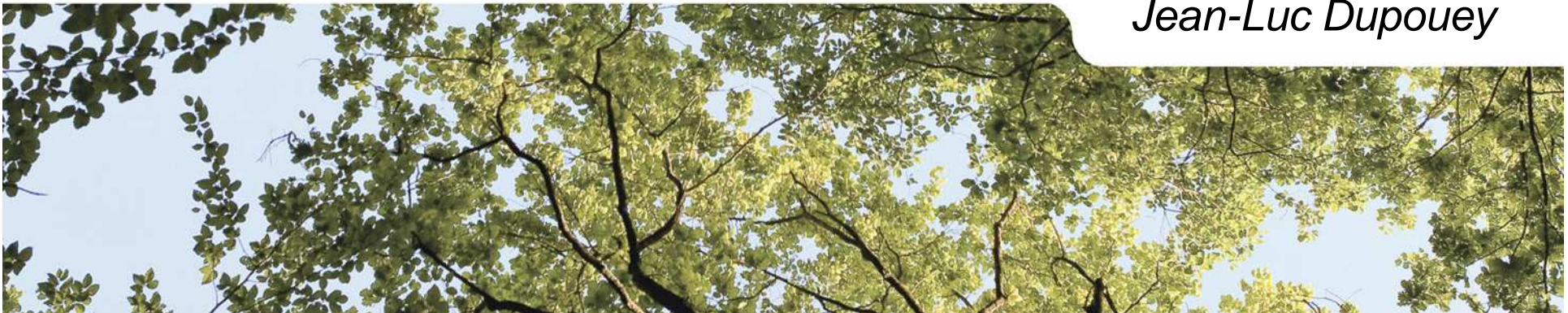


ICP Forests scientific conference, Ljubljana 2015

Plant bio-indicators do not reflect temporal changes measured in forest soil pH and C/N ratio over 15 years

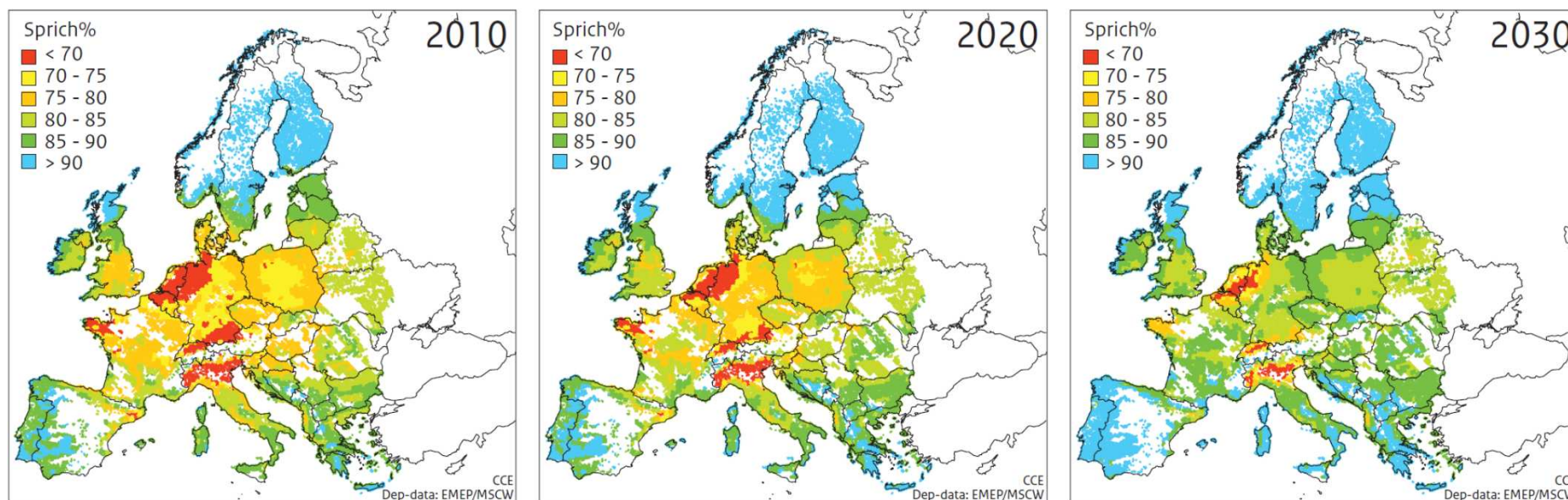
Manuel Nicolas, Iris Le Roncé, Vincent Boulanger, Noémie Pousse, Jean-Luc Dupouey



Introduction

Plant species are supposed to respond to environmental changes induced by atmospheric pollution (e.g. acidification, eutrophication).

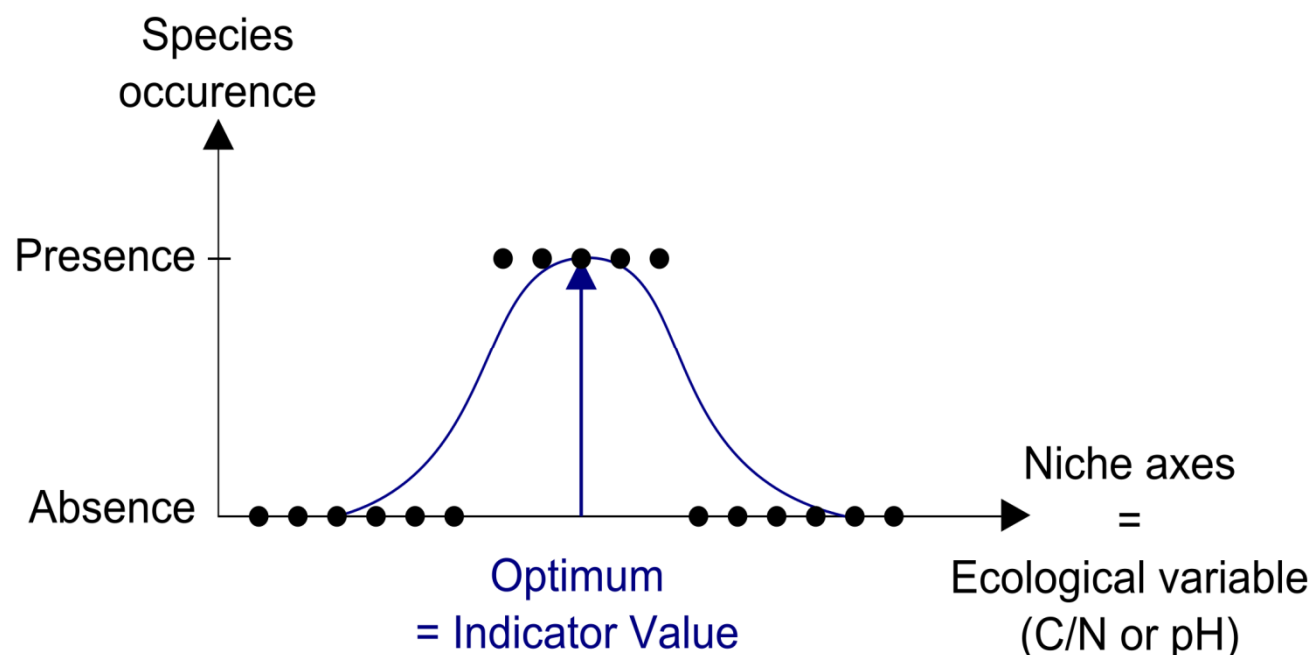
- E.g. Tentative estimation of the impact of N deposition onto plant species richness in grasslands (CCE report 2014)



Introduction

Indicator Values (e.g. Ellenberg) are commonly used to relate temporal changes in species composition to changes in environmental factors.

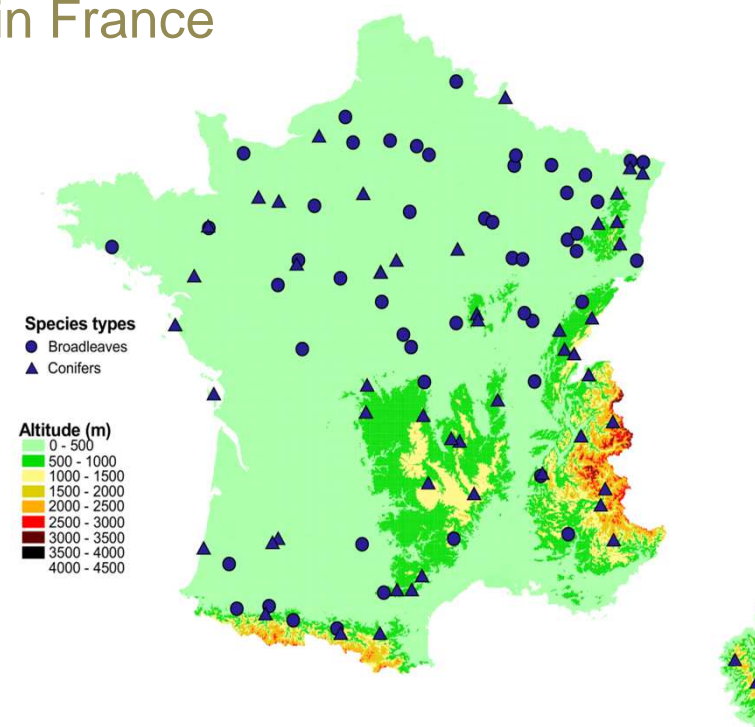
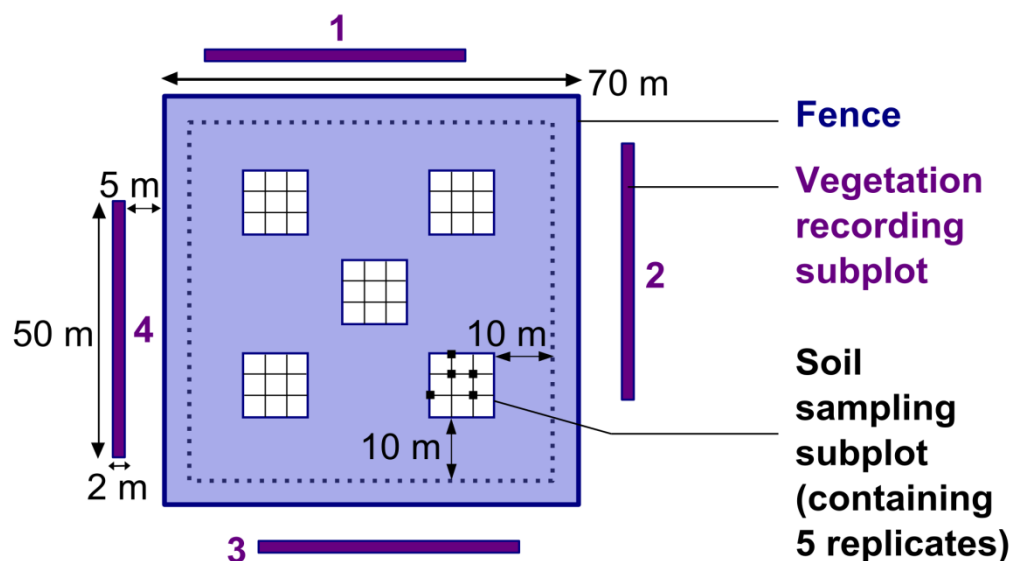
But they are based on variations observed over space. And their ability to depict temporal changes has been rarely tested and only in small-scale studies.



Objectives

Comparison of temporal changes measured in soil properties (pH, C/N) with changes in corresponding indicator values calculated from plant species composition.

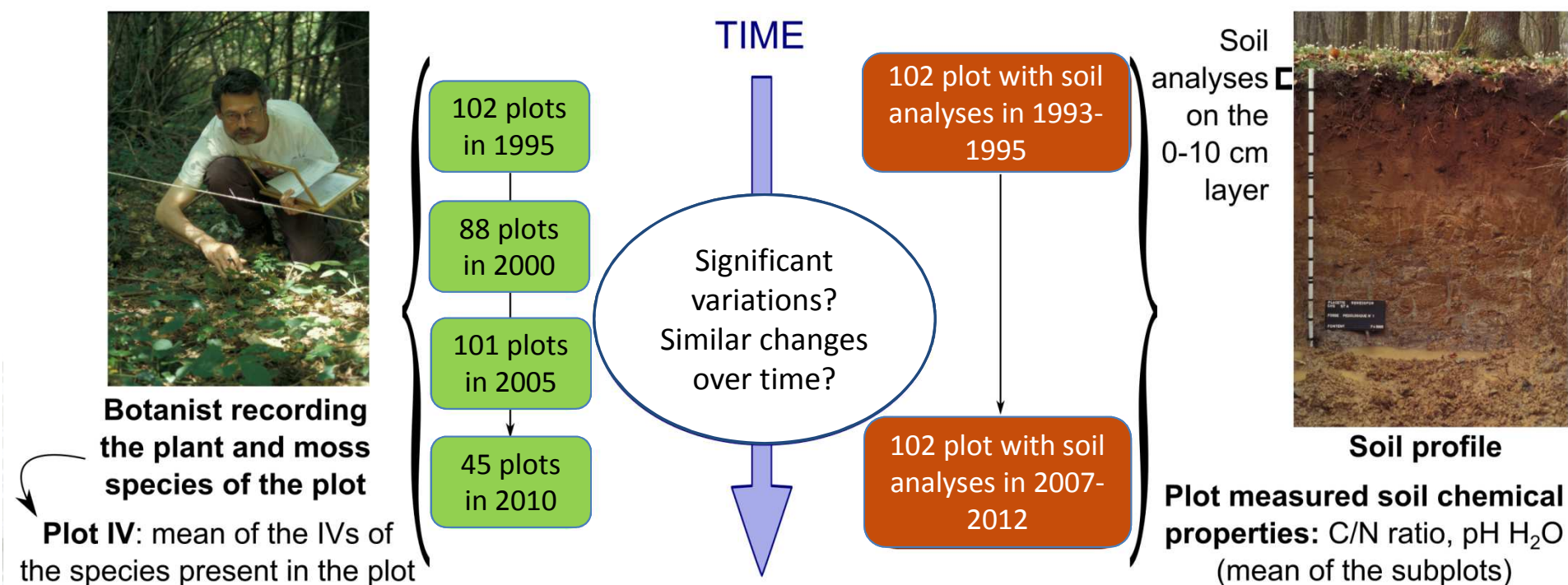
- High quality surveys repeated on level II permanent plots
- Large range of ecological conditions in France



Materials and Methods

Comparison of plotwise averaged values over 15 years (45 plots)

- Soil pH and C/N ratio of the 0-10 cm mineral layer
- Ellenberg (R, N) and Ecoplant (pH, C/N) indicator values from plant composition observed on 4x100 m²

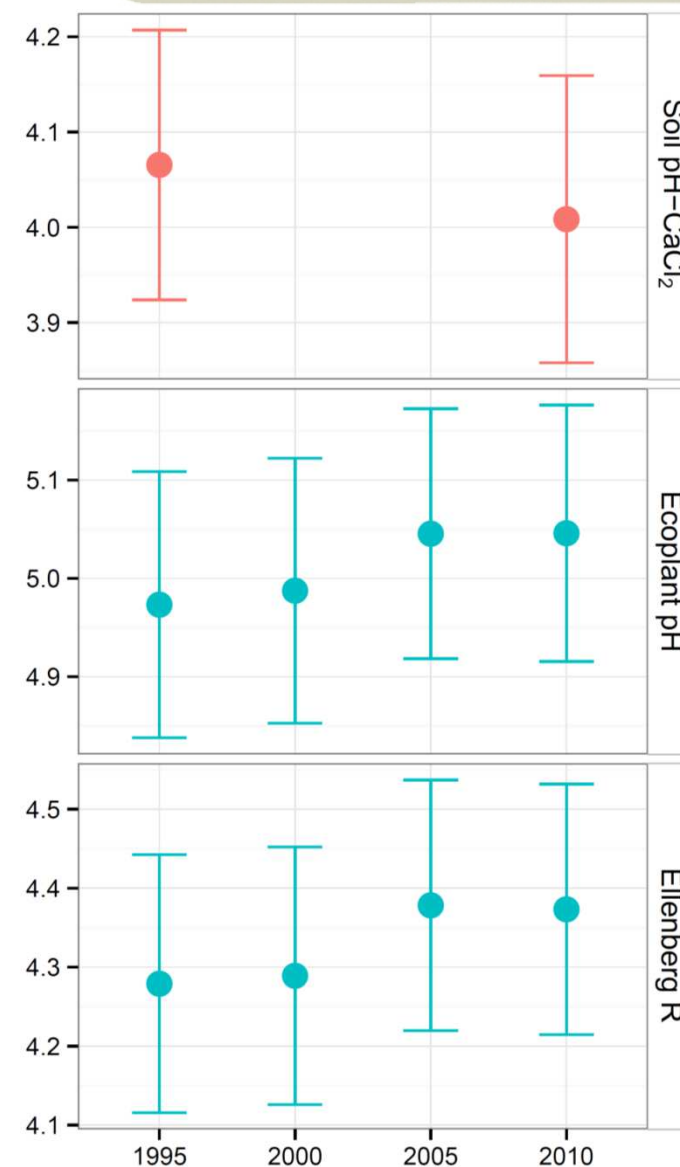


Results: overall trends

Overall temporal trends (for 45 plots over 15 years):

- Measured soil properties significantly changed over time
- But bio-indicated values changed in the opposite way
- Whatever the indicator values considered (Ellenberg or Ecoplant)

For soil pH



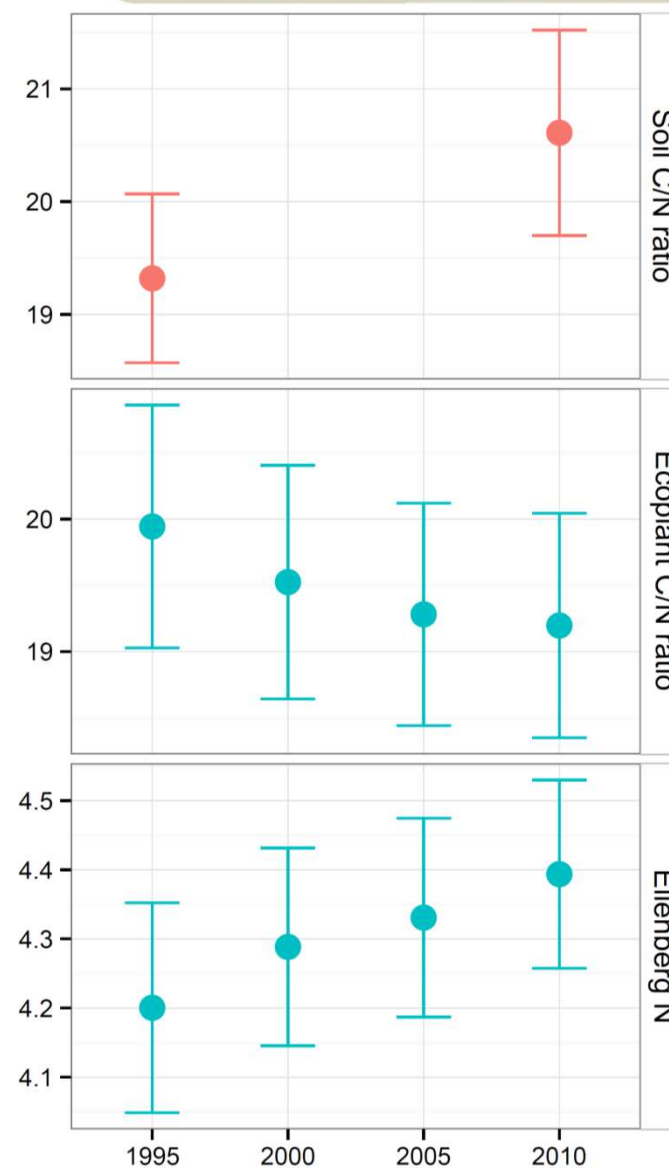
Results: overall trends

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For soil pH

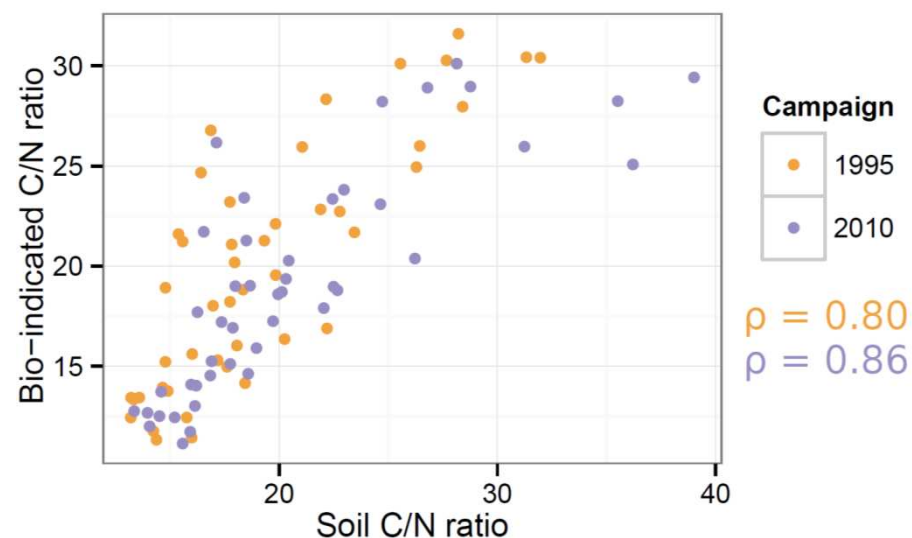
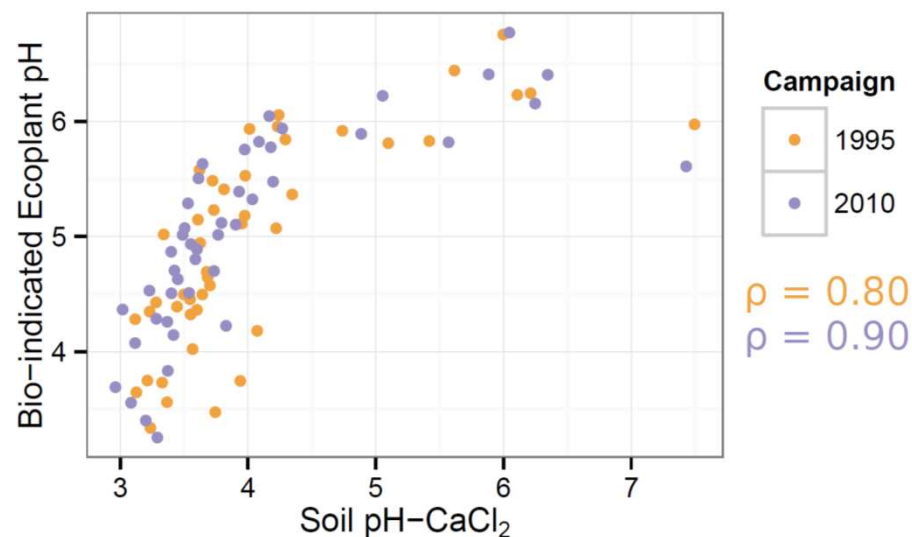
And also for soil C/N ratio



Results: among plots

Strong spatial correlations between bio-indicated and measured values:

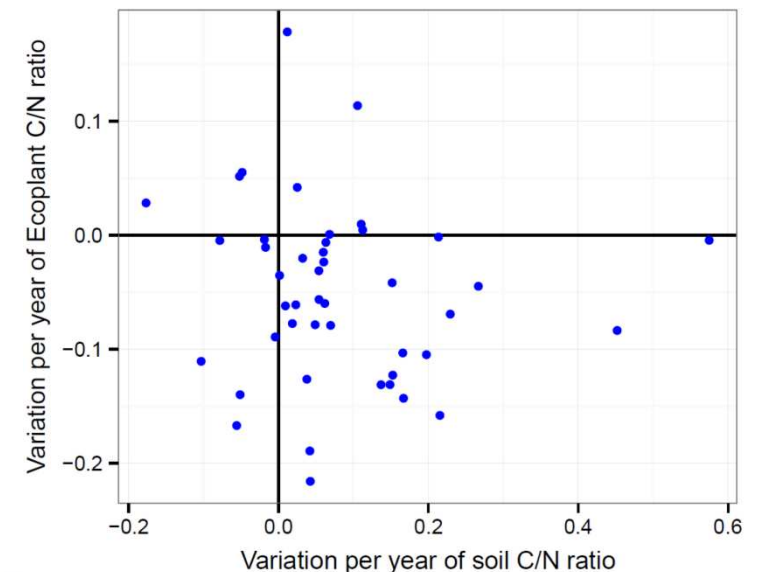
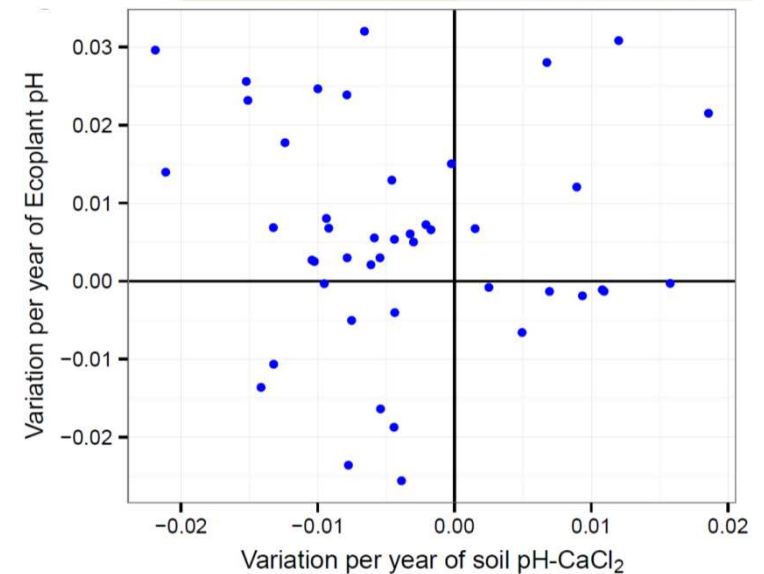
- Very significant Spearman rank correlation (non linear relationships)
- For both pH and C/N ratio
- Whatever the indicator values considered (Ellenberg or Ecoplant)
- For any time when both soil and plants were surveyed (1995 or 2010)



Results: among plots

But no correlations between temporal changes of bio-indicated and measured values:

- No significant Spearman rank correlation and even some negative relationships
- For any soil parameter (pH or C/N ratio)
- Whatever the indicator values considered (Ellenberg or Ecoplant)



Conclusion

Strong spatial correlations confirmed between soil properties (pH and C/N) and indicator values calculated from plant species composition.

However temporal changes in indicator values were unable to reflect the significant changes measured in soil pH and C/N over 15 years (neither in overall trends nor in correlations among plots).

The same results were obtained whatever the method for calculating the indicator values:

- Ellenberg or Ecoplant indicator values
- Considering presence/absence or abundance weighted values
- Considering all plant strata or only the herbaceous stratum
- Considering the plant composition of the 4 subplots inside or outside the fenced area



Conclusion

Different hypotheses can be drawn to explain these results.

- Plant species composition may respond late to temporal changes in soil condition.
- Or indicator values may not be accurate enough to reflect changes of small magnitude (even if significant) compared to spatial gradients.
- Or indicator values may not correspond to cause-effect relationships driving plant species composition over time.

Further monitoring and research are needed to understand actually how plant communities respond to environmental changes over time.



Aknowledgements

Many thanks:

- To all foresters, technicians and scientists who participated to soil sampling and analyses
- To the botanists who performed the plant surveys and shared their expertise for the long-term collection of high quality data

Thank you for your attention

