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# Nitrogen cycle regulation in temperate agroforestry. A case study assessing the impact of trees on nitrification stability in grasslands in Brittany (France)

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## Introduction:

- Nitrogen losses are of great concern as they threaten ecosystems.
- Due to extreme climate events, nitrogen losses are expected to increase in the future.<sup>1</sup>
- Through direct and indirect impacts, agroforestry is considered as a lever to address this threat.<sup>2,3</sup>
- This PhD aims at depicting the impact of different agroforestry designs on the regulation of nitrogen cycle and associated ecosystem services in temporary grasslands in the Brittany region, France.

## Experimental design:

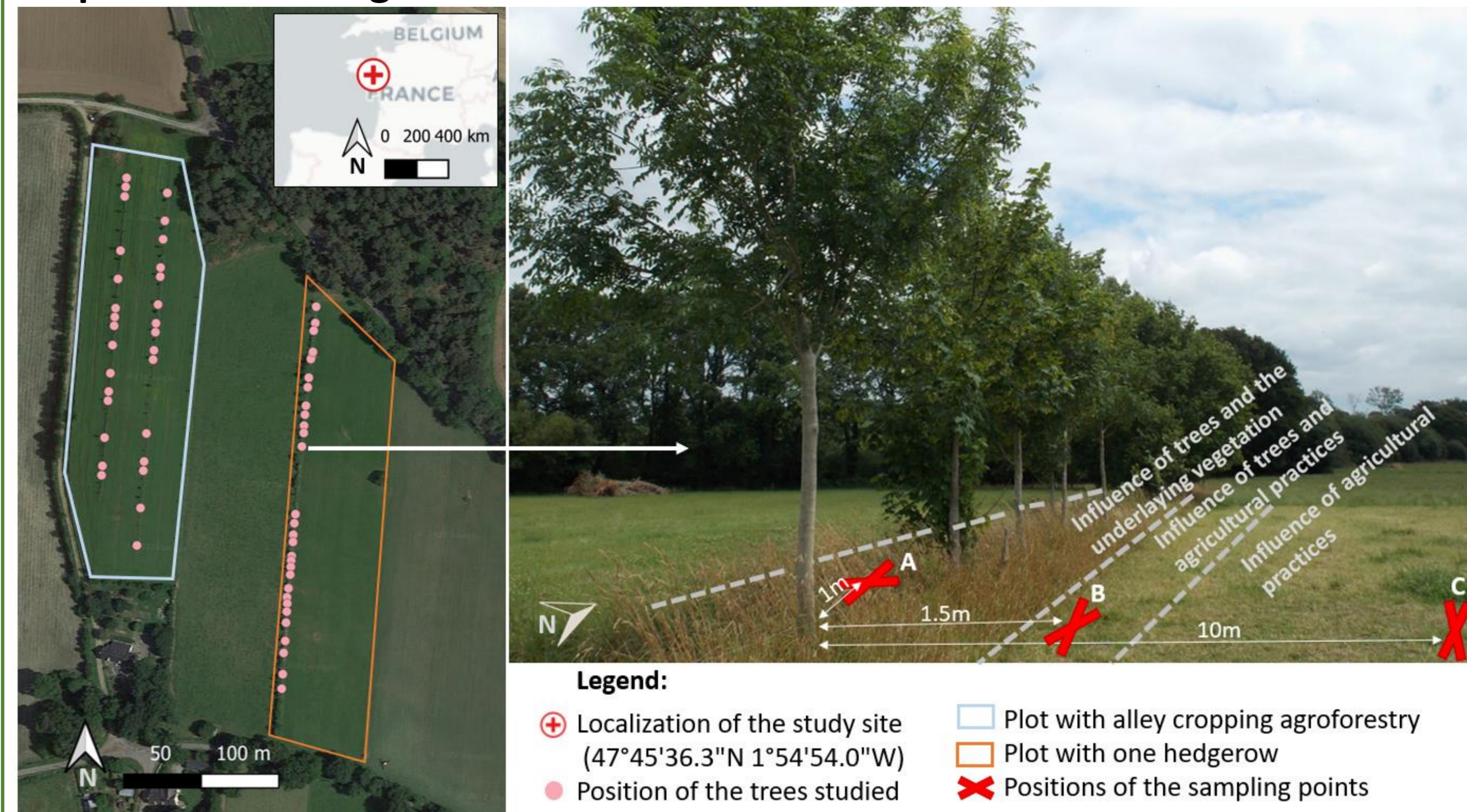


Figure 1: Experimental design that enabled us to test two explaining factors of soil properties: (i) the agroforestry design and (ii) the distance to the tree row.

## Measured soil properties:

### On soil microclimate:

- Soil temperature (°C)
- Soil humidity (%)

### On soil porosity:

- Soil density (g.cm<sup>-3</sup>)
- Earthworm abundance (nb.m<sup>-2</sup>)

### On soil nutrient availability:

- Mineral nitrogen (mg.kg<sup>-1</sup>)
- pH

### On the vegetation cover:

- Ground cover (%)
- Vegetation biomass (g.m<sup>-2</sup>)

Distance to trees and agroforestry designs explain soil properties variability, and may alter nitrification resistance and resilience to extreme climate events.

## Results :

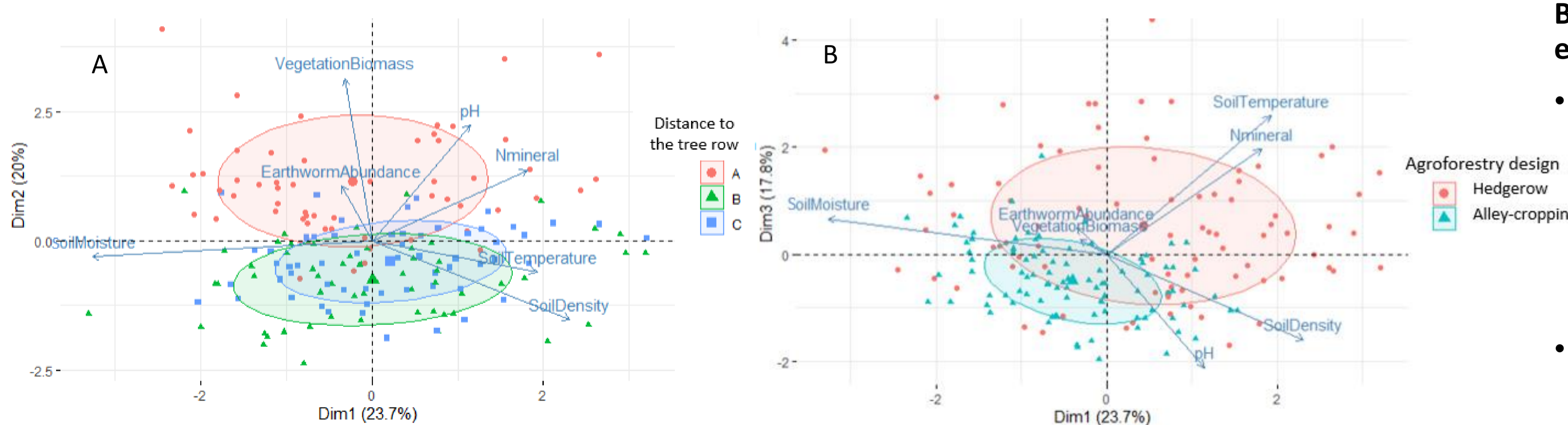


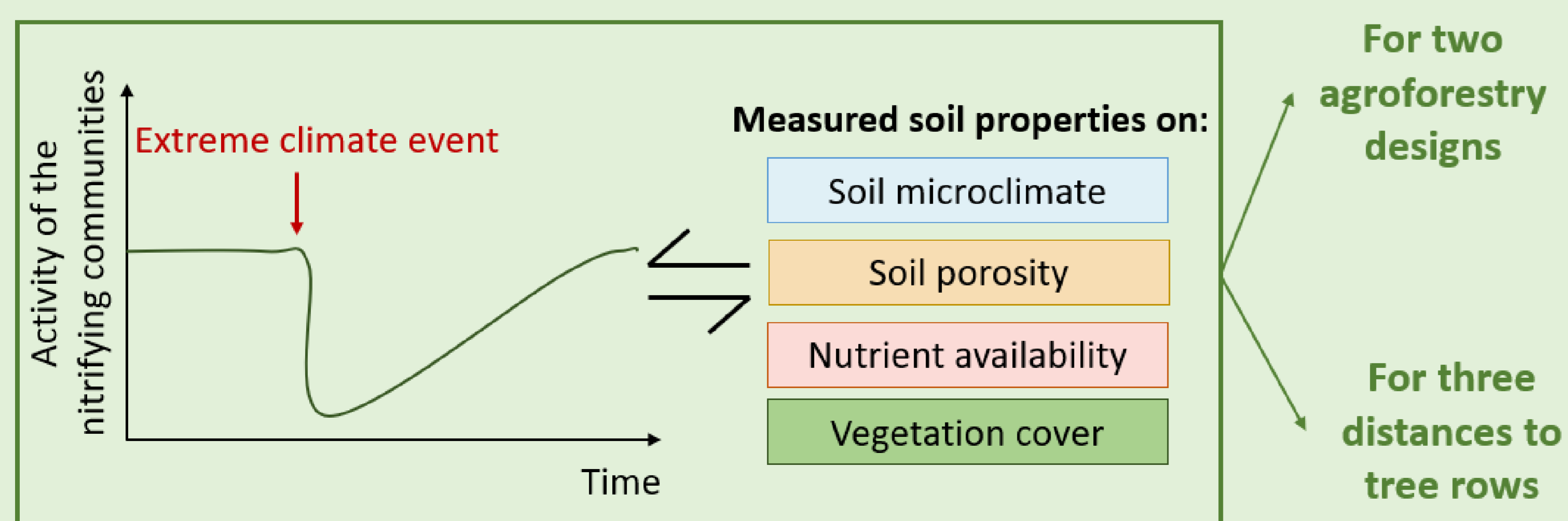
Figure 2: Principal component analysis performed on the measured soil properties. Graph A shows the individuals and the variables on dimensions 1 and 2 according to the distance to the tree row. Graph B shows the individuals and the variables on dimensions 1 and 3 according to the agroforestry design.

Both distance to trees and agroforestry design explained variability of soil properties\*.

- **Impact of the distance to trees:**
  - Higher **vegetation biomass** in the tree rows (A) than in the grassland (B and C), inversely higher **soil density** in the grassland (B and C) than in the tree rows.
  - More acidic **pH** at distance B.
- **Impact of the agroforestry design:**
  - Higher **soil temperature** and **mineral nitrogen** soil concentration, and lower **soil moisture** and **pH** near the hedgerow.

\* Anovas or Kruskal-Wallis statistical tests

## Perspectives : Linking soil properties and nitrification resistance and resilience



Keep in touch !

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## Bibliography:

<sup>1</sup>Greaver, T.L., C.M. Clark, J.E. Compton, D. Vallano, A.F. Talhelm, C.P. Weaver, L.E. Band, et al. « Key ecological responses to nitrogen are altered by climate change | Nature Climate Change ». *Nature Climate Change* 6 (2016): 836-43. <https://doi.org/10.1038/nclimate3088>.

<sup>2</sup>Caubel, Virginie. « Influence de la Haie de ceinture de fond de vallée sur les transfert d'eau et de nitrate ». Ecole nationale supérieure agronomique de Rennes, 2001.

<sup>3</sup>Beule, Lukas, Marife D. Corre, Marcus Schmidt, Leonie Göbel, Edzo Veldkamp, et Petr Karlovsky. « Conversion of Monoculture Cropland and Open Grassland to Agroforestry Alters the Abundance of Soil Bacteria, Fungi and Soil-N-Cycling Genes ». *PLOS ONE* 14, n° 6 (2019): e0218779. <https://doi.org/10.1371/journal.pone.0218779>