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Stronger legacy effects of cropland than of meadows or pastures on soil conditions and plant communities in French mountain forests.

Introduction

- Forest with long temporal continuity (here more than 150 years) are called "ancient forests", in opposition with "recent forests" which have known land-use change during the same period.
- **Dispersal and recruitment limitations** constrain the colonization, establishment and persistence of some forest plants in **recent forests**.
- In former cropland, the **more intense agricultural practices** (tillage and fertilization) compared to former pastures or meadows may conduct to **stronger legacy effects on soil conditions and understory plant communities**.



Fig. 1. Historical map drawn during the mid-19th century (sector of Bourg-Saint-Maurice, Savoie) ©IGN remonterletemps.ign.fr

Objectives

- We aimed to compare soil conditions, taxonomic and functional composition of understory plant communities in **recent forests** located on **former pastures (RF_Pastu)**, **former hay meadows (RF_Mead)** or **former cropland (RF_Crop)**, using **ancient forests (AF)** as a reference.

Method

- We selected 82 forest sites with different past land uses based on **historical maps** surveyed between **1862 and 1864** (Fig.1).
- We carried out **soil sampling** and **botanical surveys** in summer 2020 in mountain forests of Vanoise National Park (Savoie, France).
- Soil conditions were analyzed by linear models, plant taxonomic composition by CCA and functional composition by generalized multilevel linear models taking into account elevation, stand composition, canopy cover and distance to forest edge as potential confounding factors.

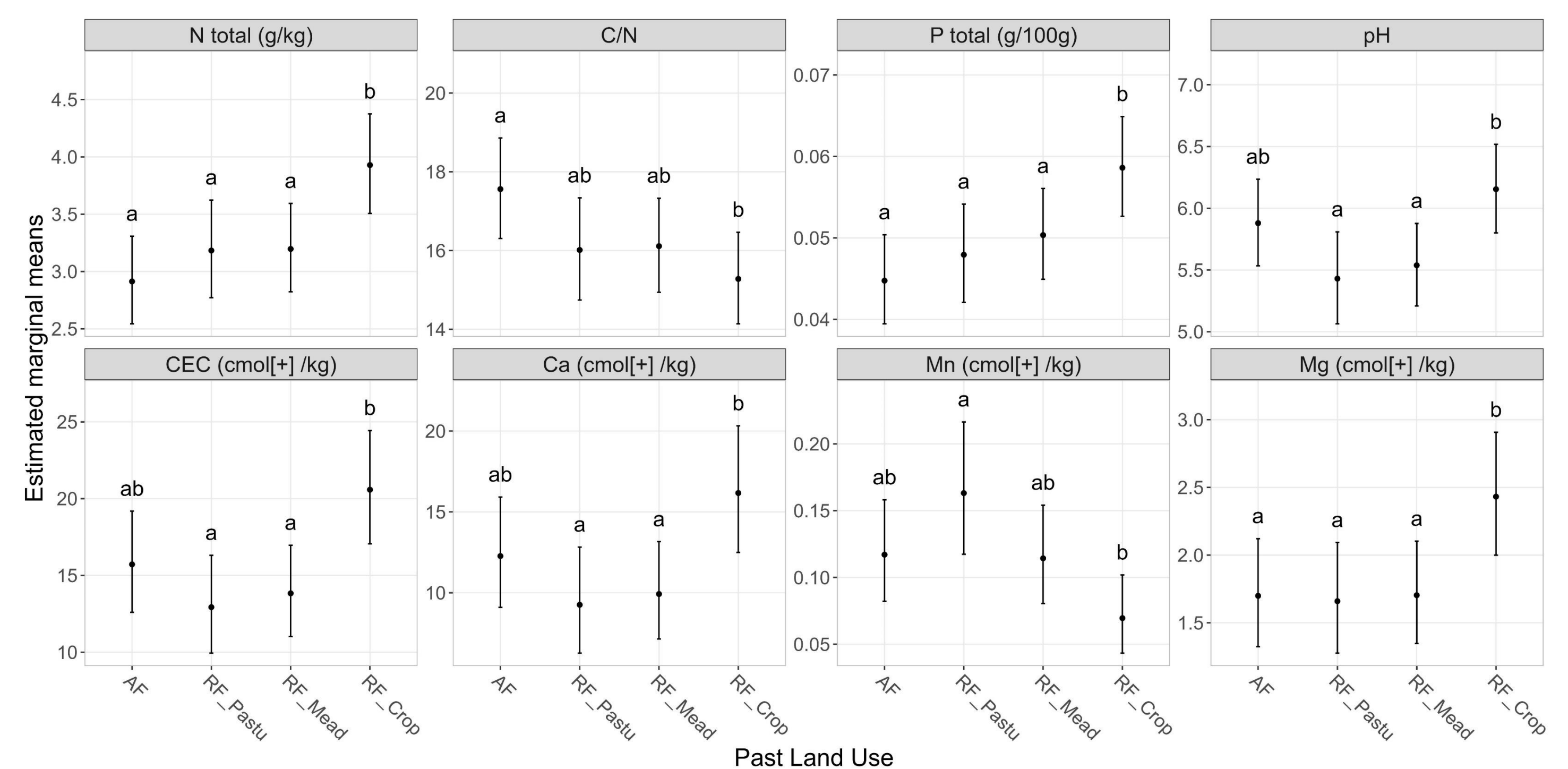


Fig. 2. Estimated means (\pm CI_{95%}) of the chemical soil properties according to past land use at the average value of the other predictors. Groups sharing the same letters were not significantly different.

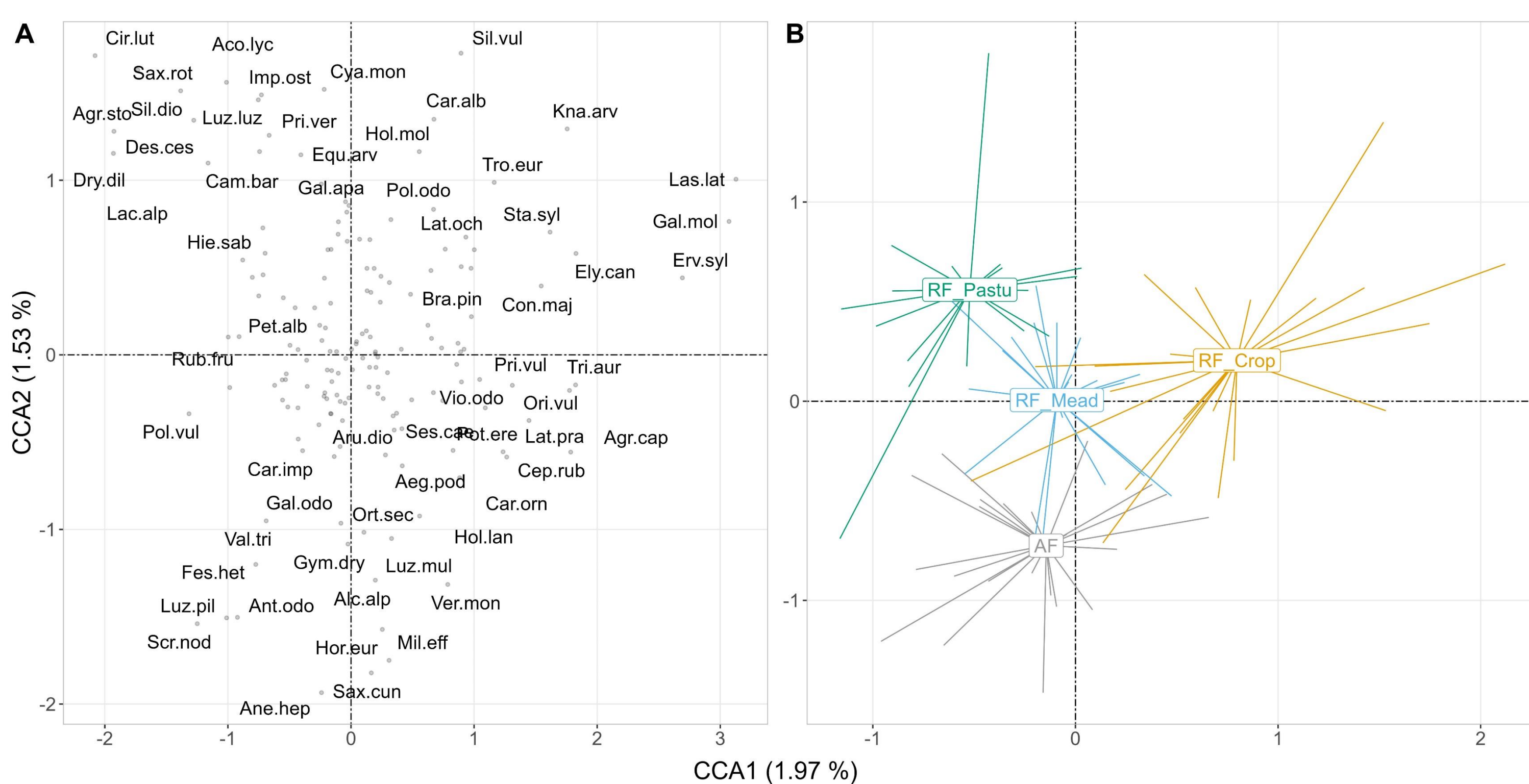


Fig. 3. Factorial maps (1, 2) of the partial canonical correspondence analysis for species (A, abbreviated species names) and sites (B, AF= ancient forests, RF_Mead= former meadows, RF_Crop= former cropland, RF_Pastu= former pastures).

Discussion

- Over than 150 year, cultivation has stronger legacy effects on soil chemical properties and plant communities compared to grazing or mowing.
- Dispersal limitation may partly explain the differences between ancient and recent forests while **recruitment limitation** may explain differences among past land uses in recent forests, **due to differences in soil properties**.

Conclusion

- Former human activities have a **long-term effect** on ecosystems.
- **The nature of the agricultural practice** preceding afforestation is an important source of **variability in current soil properties** of recent forests and conduct to **distinct understory vegetation communities**.

Results

- Former cropland displayed **richer and more alkaline soils** compared to other past land uses, while soils in **former pastures and meadows only slightly differed from ancient forests** (Fig.2).
- The four types of past land uses displayed **distinct taxonomic composition** (Fig.3).
- Ancient forests were characterized by **small, acidophilic, shade-tolerant and forest-dependent species**
- Former cropland was characterized by **basophilic and non-forest species**.
- Former pasture and meadow communities displayed a **distinct taxonomic composition** compared to other past land uses, but a **functional composition closer to AF** than to former cropland.

