Interacting abiotic, biochemical and management factors explain soil organic carbon in Pyrenean grasslands

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Please visit our app https://antonio-rodrguez.shinyapps.io/Soil_organic_carbon_Pyrenees/

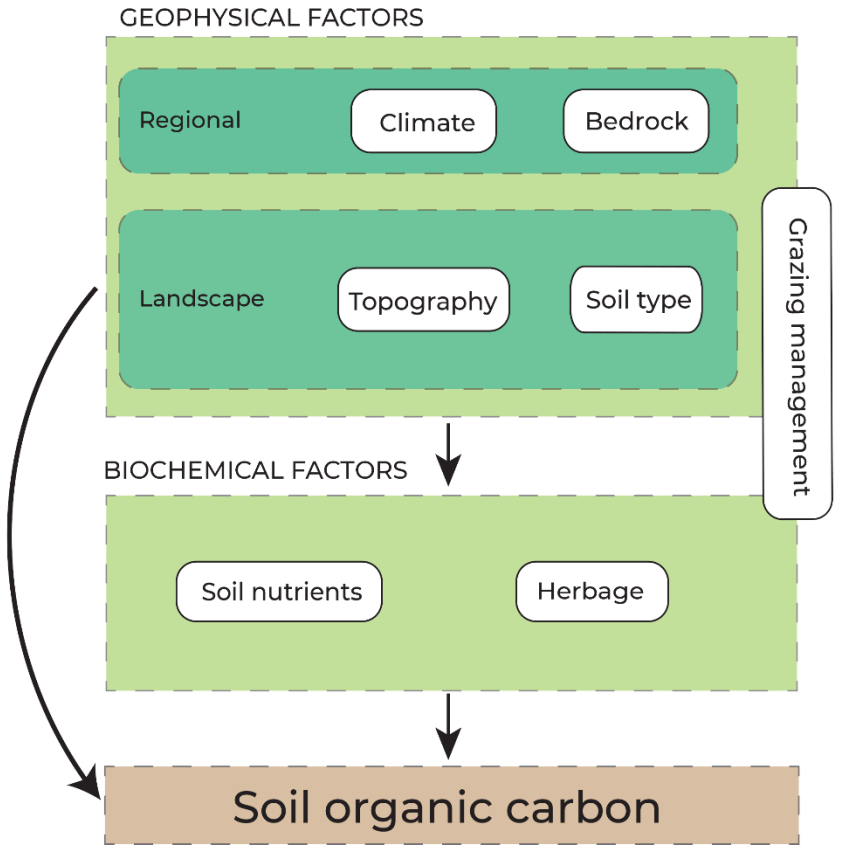
Introduction

SOC accumulation depends on multiple environmental factors such as climate, soil texture and nutrients, and land management. Understanding how these factors drive SOC is challenging because they are scale-dependent and on a hierarchy of controls over SOC, so large scale also drivers affect those at fine spatial scales.

1) How are the effects of the geophysical, widely used predictors located at the top of the hierarchy of controls on SOC?

2) How are the effects of the biochemical, unfrequently used (soil nutrient and herbage), predictors on SOC?

3) Can grazing management regulate the effects of other SOC drivers located at different levels of the hierarchy of controls?



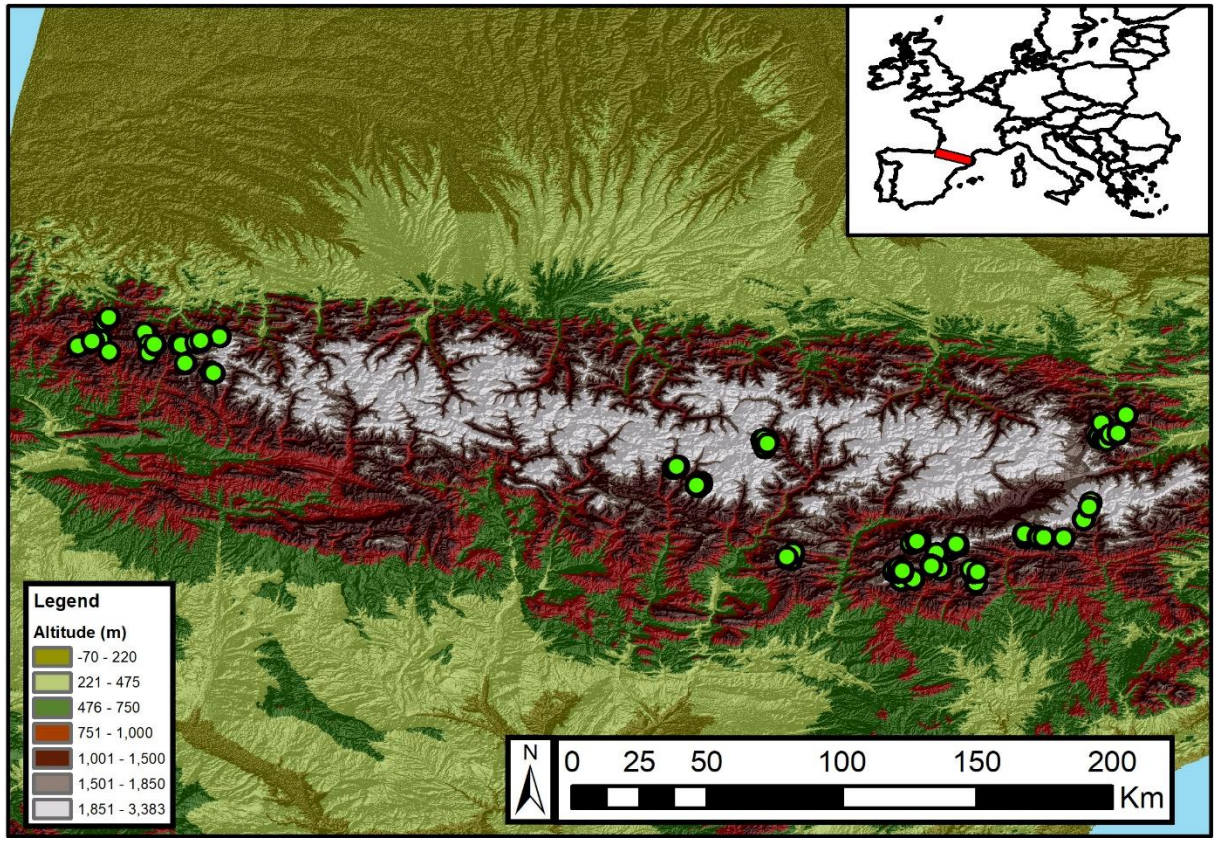
Conceptual scheme used in this work to relate potential environmental drivers with SOC.

Material and methods

The PASTUS database:

128 grassland patches distributed across the Pyrenees, including topographical, climatological, soil, herbage and management variables.

The sampled area encompasses a wide variety of temperate and cold-temperate climates, with different precipitation conditions, depending on altitude and geographical location from Mediterranean to Continental and Boreo-Alpine.



Map of the study area. Points indicate sampling locations.

Material and methods

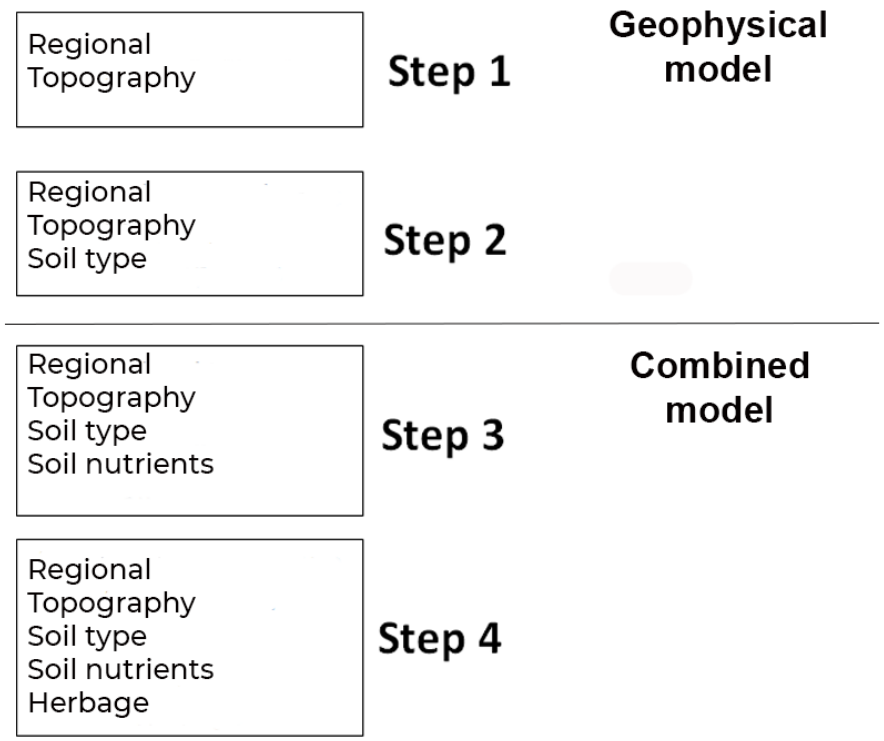
Statistical analyses:

- Boosted Regression Trees: to identify the most important variables affecting SOC.
- General linear models:

  Based on hierarchy of controls over function hypothesis. Terms were added sequentially.

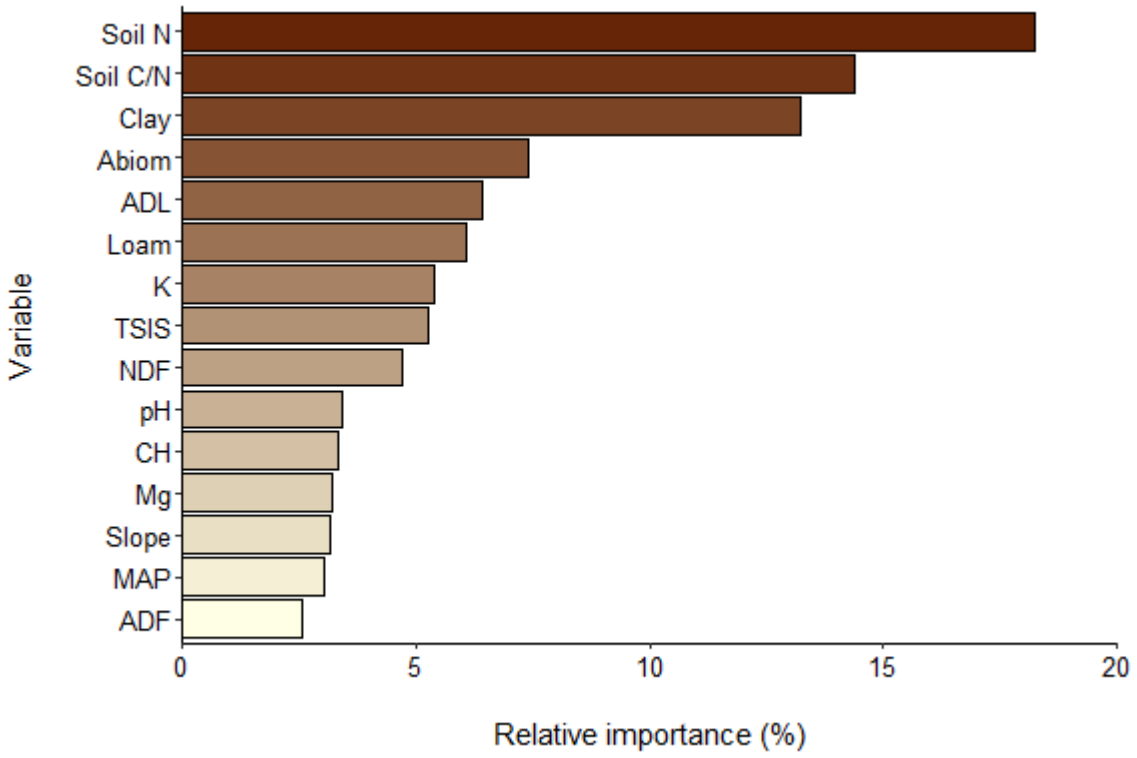
  Two models: Geophysical model and Combined model.

  … identify the primary sources of variation and important interaction effects.



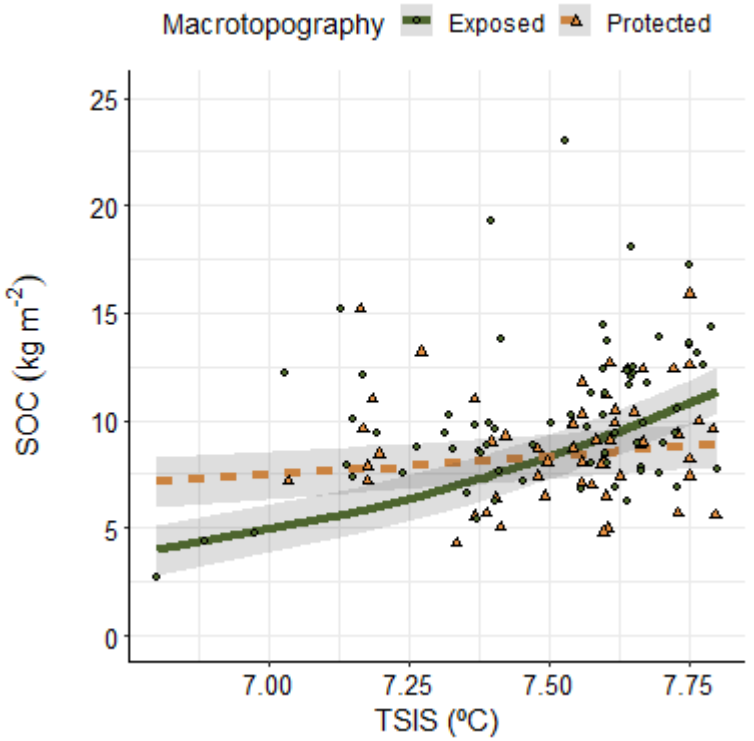
Linear modelling based on hierarchy of controls over function hypothesis.

Results: BTR model

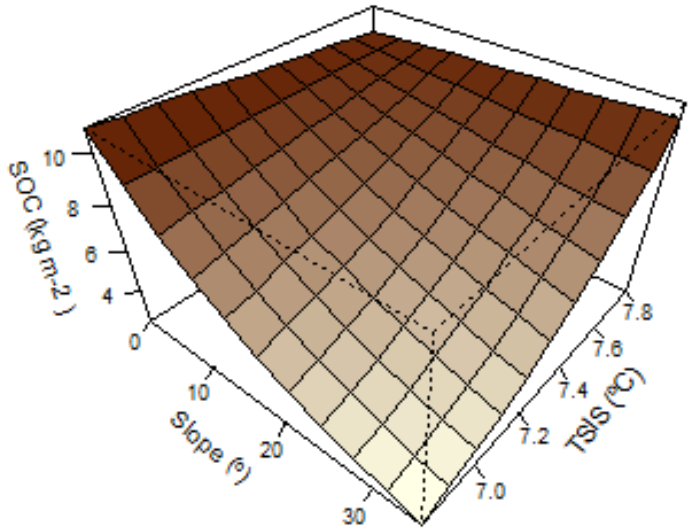


Relative contributions (%) of predictor variables in the final BRT model obtained.

Results: Geophysical model

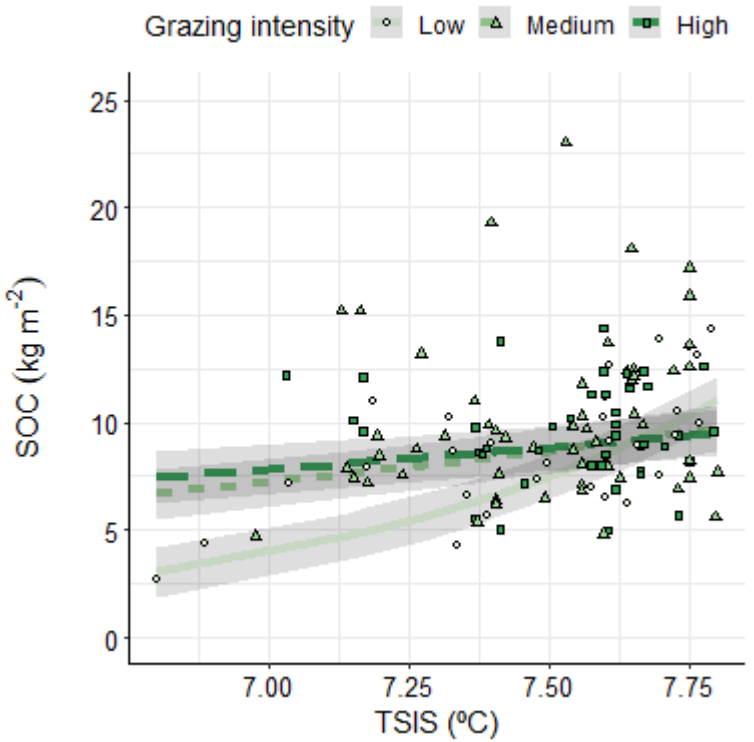


The relationship between SOC and temperature seasonality (TSIS) depending on macrotopography in the Geophysical model.

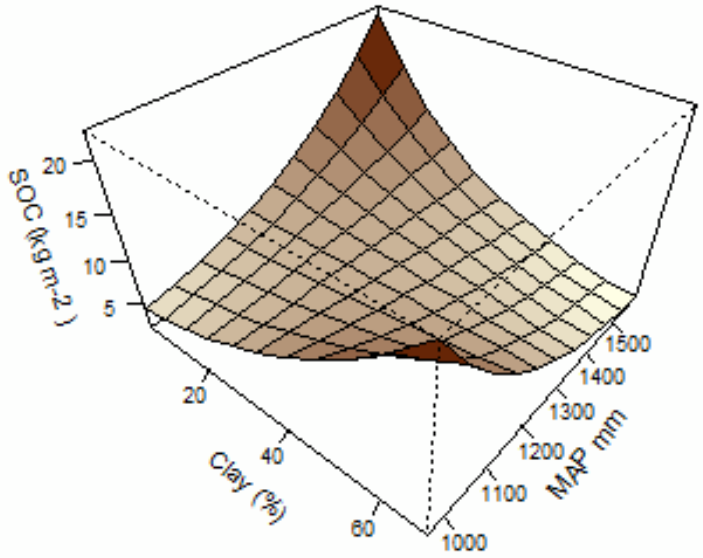


The relationship between SOC and temperature seasonality (TSIS) depending on slope in the Geophysical model.

Results: Geophysical model

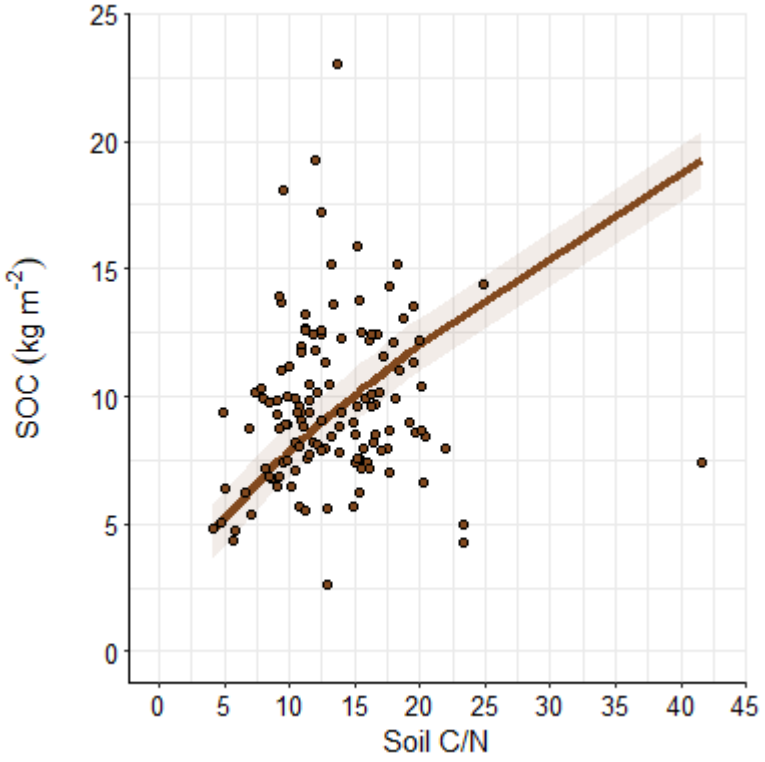


The relationship between SOC and temperature seasonality (TSIS) depending on grazing intensity in the Geophysical model.

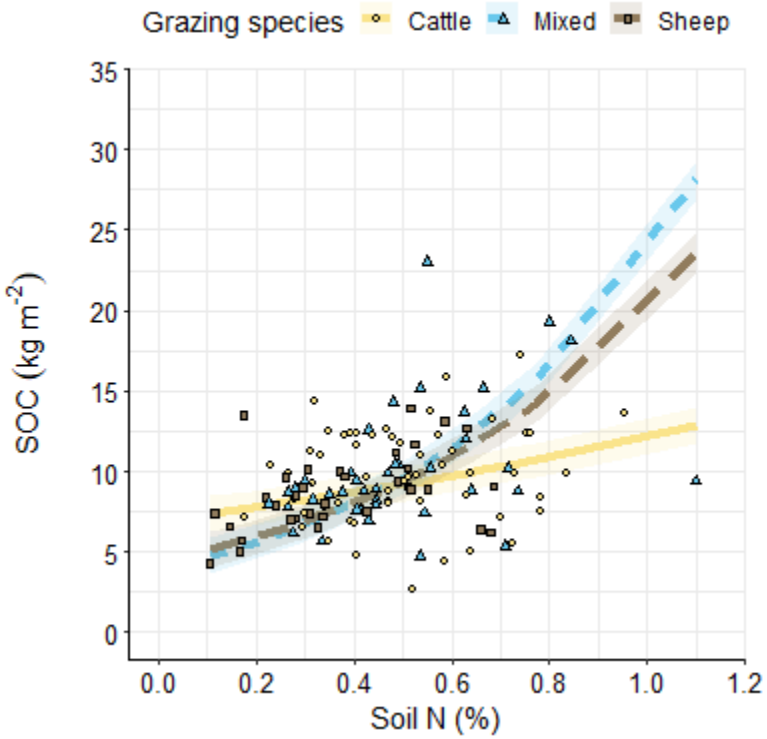


The relationship between SOC and clay content depending on mean annual precipitation (MAP) in the Geophysical model.

Results: Combined model

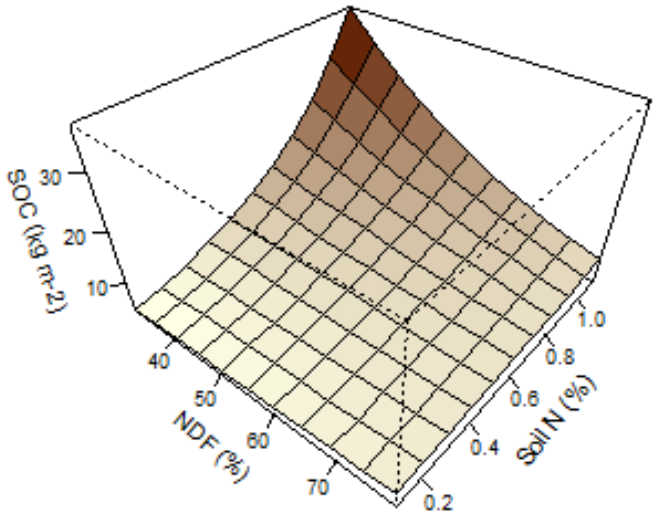


The relationship between SOC and soil C/N ratio in the Combined model.

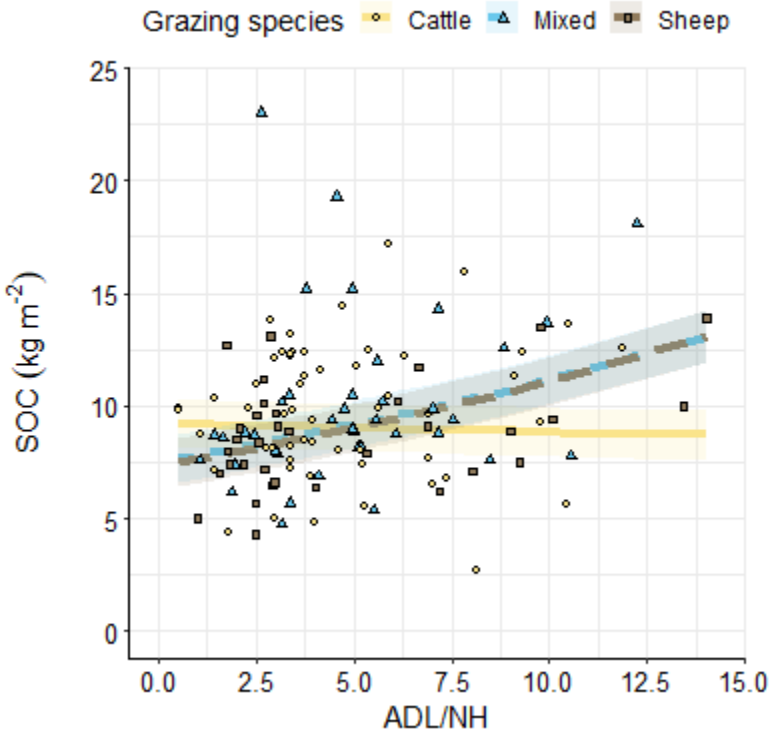


The relationship between SOC and soil nitrogen depending on grazing species in the Combined model.

Results: Combined model



The relationship between SOC and Neutro-detergent fiber (NDF) depending on soil N in the Combined model.



The relationship between SOC and herbage acid-detergent lignin (ADL)/Nitrogen ratio depending on grazing species in the Combined model.

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