Spatial variation in vegetation height as an indicator of aboveground carbon stocks in grazed grasslands

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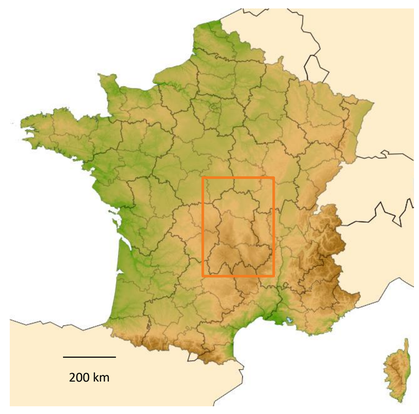
Background

Spatial heterogeneity in plant and soil properties is known to influence ecosystem functions, but the linkages between spatial variation and ecosystem services in grasslands are unclear. **Here we examine within-field variation in sward structure (vegetation height) and test whether indices of spatial heterogeneity can be used as a simple indicator of aboveground production services or carbon stocks over time in upland grasslands.**



Left : Study location in the Massif Central region of France ; Right : On-site grazing.

Grid measurements at the study site. Photos: C.Schmidt

Experimental approach

- Measurements were carried over 6 years at a **long-term research platform** in France (SOERE-ACBB: Laqueuille) on **two grazed grasslands** (high stocking rate and N inputs, intensive; low stocking rate and no N inputs, extensive).
- **Field-scale standing biomass** and potential productivity was assessed across each paddock at five dates per year during the growing season.
- Maximum height of both green and senescent shoots were determined at the end of each grazing season on **30m x 20m grids** using a sward stick (117 points per grid, 2.5m distances). Standard deviation (SD) and coefficients of variation (CV) were used to assess the variation in plant height.

Results

- Mean annual productivity was greater in the 'Intensive' treatment compared to the 'Extensive' grazing treatment ($F_{1,11}$ = 54.5, P < 0.001), but standing biomass showed no significant difference between grazing treatments during the study (Figure 1A/B).
- Absolute variation in **green vegetation height** at the end of the growing season (green height SD) showed a **positive relationship** with mean annual **field-scale standing biomass** in both grazing treatments (Figure 1C).
- Metrics of **green height** were **unrelated to field-level productivity**, and no significant relationship was found between metrics of variation in senescent height and either field-level productivity or standing biomass (P > 0.05).

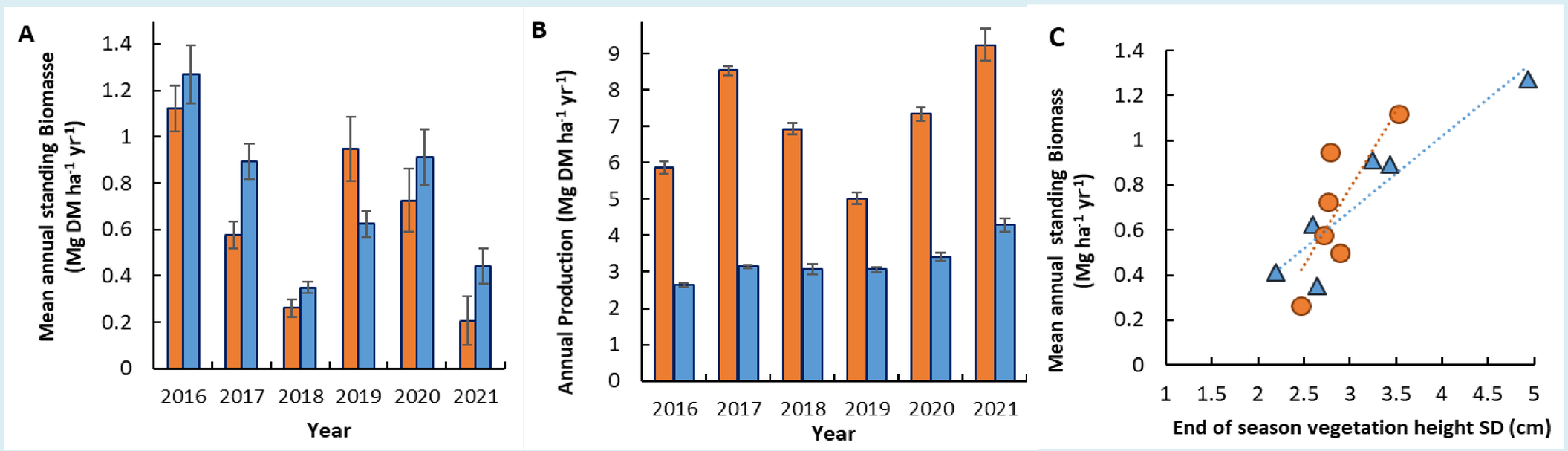


Fig. 1. Interannual variation in field-scale annual biomass production (A) and mean standing biomass (B); data are means ± SE. Relationship between within-field variation in green vegetation height (standard deviation) and estimations of mean annual field-scale standing biomass during the study (C). Grazing treatments are given by: Intensive, organe-filled bars/circles; Extensive, blue-filled bars/triangles.

Take-home Message

Our results suggest that within-field variation in end-of-season **green vegetation height** may provide an integrated **indicator of biomass state** during the year (i.e. quantity of standing biomass available for ingestion over time), with implications for the estimation of **aboveground carbon stocks and carbon input into the soil**. However, simple metrics of within-field variation do not appear to provide useful proxies of biomass fluxes in this grassland system.

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