

Testing stochastic community models with long-term spatiotemporal data in grasslands

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Background & Aims

Models of plant community assembly have specific assumptions (e.g. local saturation of species richness, functional equivalence or assumption of equilibrium dynamics) that hard to test in the field. In our study we developed and applied a specific field sampling protocol for observing spatiotemporal patterns in different grasslands and old fields and for testing contrasting community models.

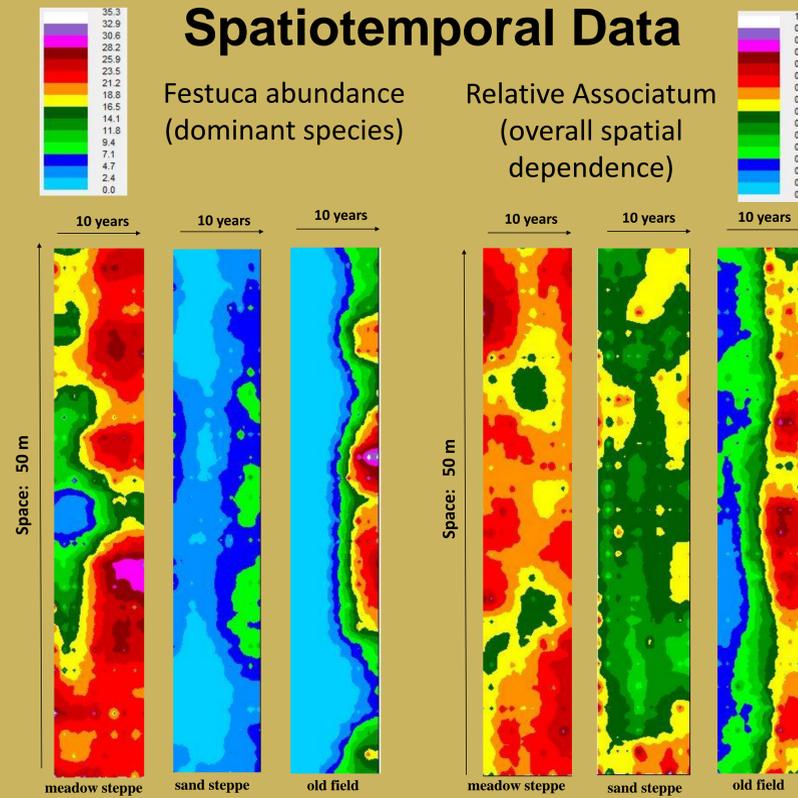
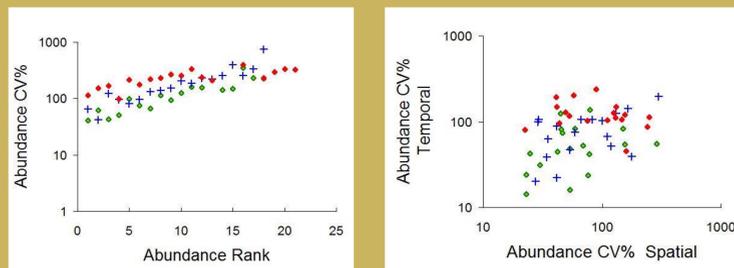
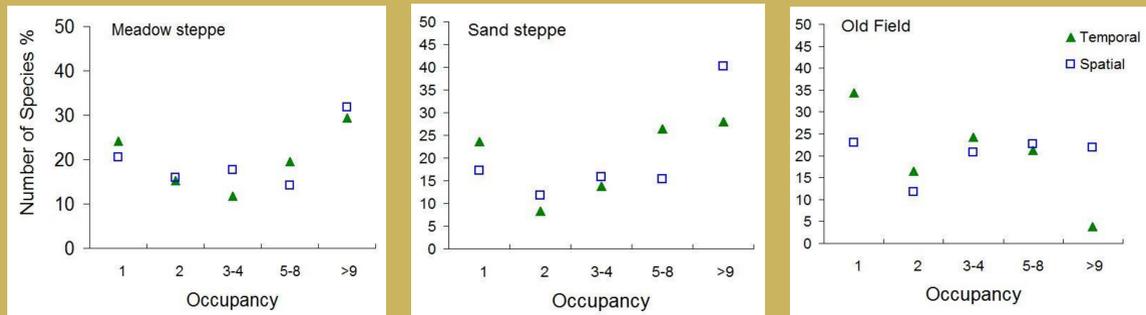
Materials & Methods



Presence of plant individuals (ramets) were annually mapped in transects and grids with 5x5 cm resolution. The spatial extent was up to 25 m while the temporal extent varied between 9 and 25 years. Data were analyzed by information theory models.

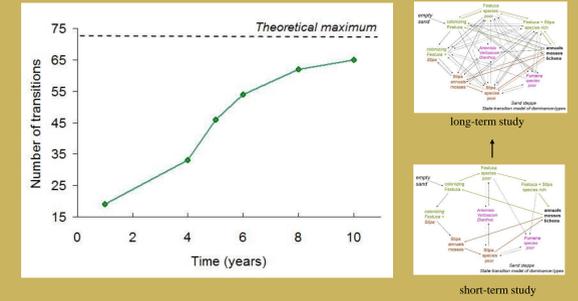
Results I. Patch-scale dynamics

Spatiotemporal dynamics of species in natural grasslands (meadow steppe and sand steppe) fitted well to the core-satellite model (stochastic patch dynamics). Old fields showed different patterns (due to strong spatial and temporal contingencies and non-stationary dynamics).

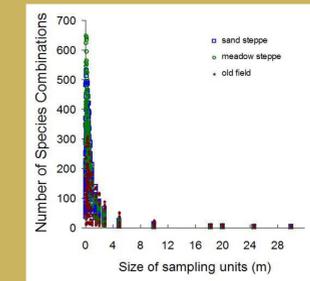


Importance of scaling

maximizing temporal extent ...

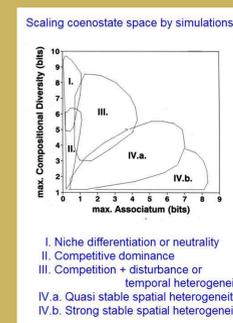
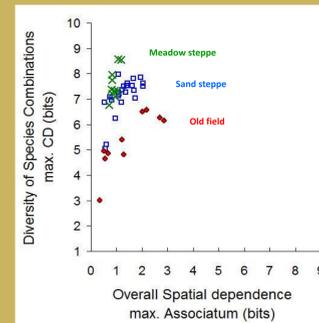


and maximizing spatial resolution

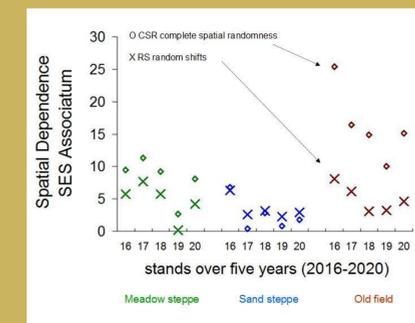


Results II. Within-patch dynamics

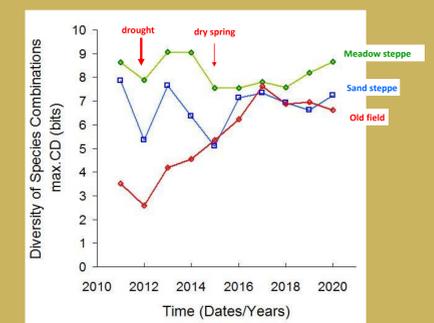
Hypotheses about mechanisms using spatially explicit individual-based simulations



Disentangling aggregations and associations by nullmodels



Effects of weather fluctuations



Simulations suggest emergent neutrality and niche differentiation for meadow steppe. Competition and gap dynamics hypothesized for sand steppe. Old fields are organized similarly to sand steppe with stronger spatial heterogeneity in elder stages.

Strongest spatial dependence appeared in old fields (using CSR randomizations). However, after removing intraspecific spatial dependence (by RS randomizations), the overall degree of interspecific associations in mid-succession seems to be similar to the natural grasslands.

Diversity temporary collapsed in dry years (with the largest effect in sand grassland). Mid-successional old fields did not respond to weather fluctuations due to strong temporal contingencies of inherent population dynamics.