Stochastic models of grassland community dynamics: a winter wind on inter-annual predictions.

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Abstract: Stochastic models of population and community dynamics constitute major tools in modern ecology (Lande et al. 2003). They have been mainly used for the analysis of animal populations, but much less for plant communities, with the notable exception of tree communities (e.g., Hubbell 2001). Recently, a stochastic model of community dynamics has been proposed to analyze some famous grassland experiments using species biomass as a measure of population size (De Mazancourt et al. 2013). This approach consists in analyzing inter-annual variations in plant biomass using an annual time step in the model. However, herbaceous plants face a drastic decrease of biomass during winter in temperate areas, which may alter inter-annual temporal autocorrelations in plant biomass, even for perennial species. We here explore whether increasing the temporal resolution of this stochastic model of plant growth (down to a daily resolution) changes the inference one can make on plant community dynamics, by enabling to take into account the effect of biomass decrease during winter. We compare the two temporal resolutions (annual and daily) based on their predictive accuracy of inter-annual biomass temporal stability as in De Mazancourt et al. (2013), using both simulated data and real data from a biodiversity experiment in Jena (Weigelt et al. 2010). We evidence that our approach with daily resolution outperforms the former approach based on an annual resolution of community dynamics, whereas it is based on the same inter-annual data. We hence point out that not taking into account biomass decrease during winter in analyses of plant community dynamics in temperate areas may substantially limit the inference power and predictive accuracy of process-based approaches, even for inter-annual predictions. We further provide efficient computational routines to calibrate the new model with inter-annual data.

References

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