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FONDATION POUR LA RECHERCHE SUR LA BIODIVERSITÉ

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CENTRE FOR THE SYNTHESIS AND ANALYSIS OF BIODIVERSITY

Project summary

DIVGRASS

Plant Functional DIVersity of GRASSlands – Assembling, analysing and sharing data on plant functional diversity to understand the effects of biodiversity on ecosystem functioning: a case study with French Permanent Grasslands

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Each grassland is unique. For instance, some contain more species than others, some are taller than others. Why do these differences exist? Are they due to different climatic conditions? Due to the way grasslands are managed by farmers? Due to different soils? What is the impact of these differences for the functioning of these grasslands (like fodder production for example)? DIVGRASS aimed to integrate and share existing knowledge on plant diversity in French grasslands to elucidate these puzzling questions.

Context and objectives

The importance of biodiversity on ecosystem functioning has been widely acknowledged, but only in recent years has it become feasible to incorporate plant functional diversity in biogeochemical modelling. In order to understand these relationships, considerable efforts have been made towards identifying plant traits that respond to environment and that impact ecosystem processes. However, we still lack a comprehensive study that links plant community aggregated traits to land surface modelling and this impedes the formulation of more general, widely applicable concept of biodiversity-functioning relationships across gradients of climate and land use.

Methods and approaches used for the project

The DIVGRASS project has integrated and shared existing knowledge on plant diversity in French Permanent Grasslands (FPGs). Permanent grasslands have been traditionally maintained through grazing or cutting and represent a hotspot of biodiversity. They are under threat worldwide and in France with an area declining by around 15 % in the last two decades.

The DIVGRASS consortium included experts in grassland functional ecology, soil science and ecosystem modelling. DIVGRASS has been a unique arena for academic and land-use managers to share data and knowledge on PG. Over the last three years, we have collated, integrated and processed an unprecedented database including vegetation readings, plant traits and environmental drivers **(i)** to characterize the determinants of community aggregated traits, and **(ii)** to improve the representation of the C3 permanent grasslands in Land Surface Models. More precisely, DIVGRASS has drawn upon the combined analysis of two large databases covering the diversity of permanent grasslands in France. The first one includes around 50 000 vegetation readings from FPGs. The second is the TRY database, recognized as the main source for plant functional traits worldwide.

Principal conclusions

Permanent grasslands cover about 10 millions of hectares in France, but, like in most of Europe, they have been receding over the last decades due to the combined effect of urbanization and changes in agricultural practices. These grasslands are remarkable areas for biodiversity and serve a large number of functions and ecosystem services. We assembled around 50 000 vegetation readings comprising 3 800 species and covering the main beta-diversity gradient of French grasslands. These readings were combined to the global functional trait database, TRY. Main moments of functional diversity were calculated at the community level (Community Weighted Mean [CWM], Community Weighted Variance [CWV]) and the relationships with the main climatic and soil variables were examined. Our main findings showed that CWM of the Specific Leaf Area (SLA) was significantly dependent on annual sum of Growing Degree Day (GDD) and soil water availability. This study provides the first comprehensive overview of the large-scale trait environment relationships and paves the way to the mapping of CWMs at a kilometric scale.

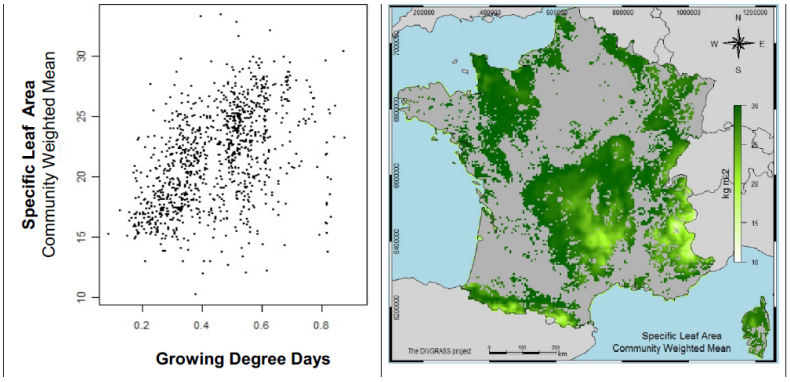

Figure: *On the left panel: positive relationship between Growing Degree Days (GDD - normalized scale) and Community-Weighted Mean (CWM) of the Specific Leaf Area (SLA) in the French Permanent Grasslands. On the right panel: spatial distribution model of CWM SLA based on a regression model using GDD and soil water availability as explanatory variables.*

Anticipated (or actual) impact of these results for science, society, and public and private decision making

Understanding, modelling and predicting the impact of global change on ecosystem functioning across biogeographical gradients can benefit from enhanced capacity to represent biota as a continuous distribution of traits. However, this is a challenge for the field of biogeography historically grounded on t he species concept. Functional biogeography - the study of the geographic distribution of trait diversity across organizational levels - is a newly emergent field that bridges species-based biogeography and earth science to provide ideas and tools to help explain gradients in multifaceted diversity (including species, functional and phylogenetic diversities), predict ecosystem functioning and services worldwide, and infuse regional and global conservation programs with a functional basis. The DIVGRASS project has been an exemplar exercise of functional biogeography with permanent grasslands as a case study. It provided both methodological and conceptual advancements to the emergent field of functional biogeography.

The DIVGRASS project and results have been presented to the network of Conservatoires Botaniques Nationaux that is missioned to assess the floristic diversity and the conservation status of FPGs and to the Ministère de l'Ecologie et du Développement Durable in the framework of the CARHAB project dedicated to vegetation mapping of French natural and semi-natural ecosystems.

In the NETGRASS project (following the project DIGRASS and funded by the French Research Agency), further dissemination of DIVGRASS results have been planned to the livestock sector through a partnership with IDELE, the French zootechnical institute with a strong expertise on grassland-farming systems and involved in knowledge transfer to agricultural technicians, practitioners and farmers.

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