Grasslands for soil organic matter storage in crop-livestock systems.

Francoise Vertès, Valérie Viaud, Hugues Clivot, Nouraya Akkal-Corfini, Fabien Ferchaud

GRASSLANDS FOR SOIL ORGANIC MATTER STORAGE IN CROP-LIVESTOCK SYSTEMS

Vertès F.[1], Viaud V.[1], Clivot H.[2], Akkal-Corfini N.[1], Ferchaud F.[3]

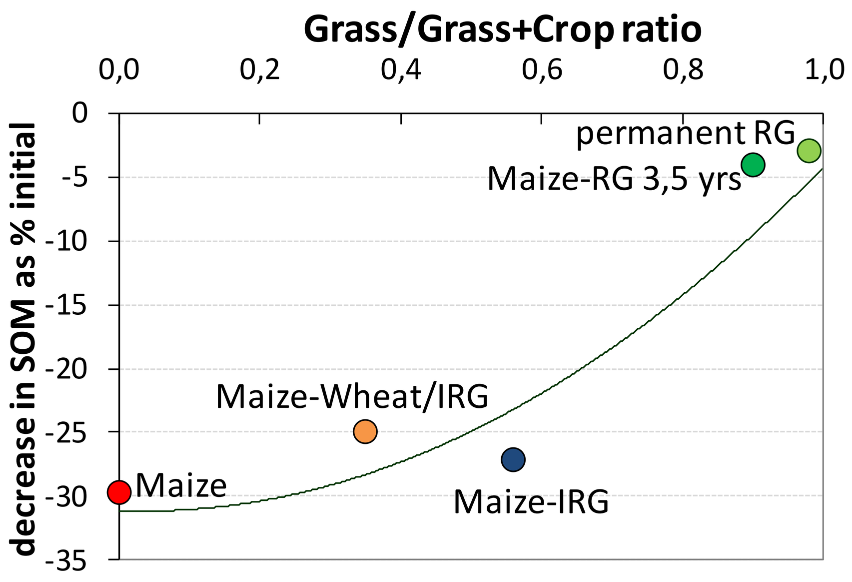
[1]UMR SAS, INRA, Agrocampus Ouest, [2]UMR LAE, Université de Lorraine, INRA, [3]AgroImpact, INRA, France

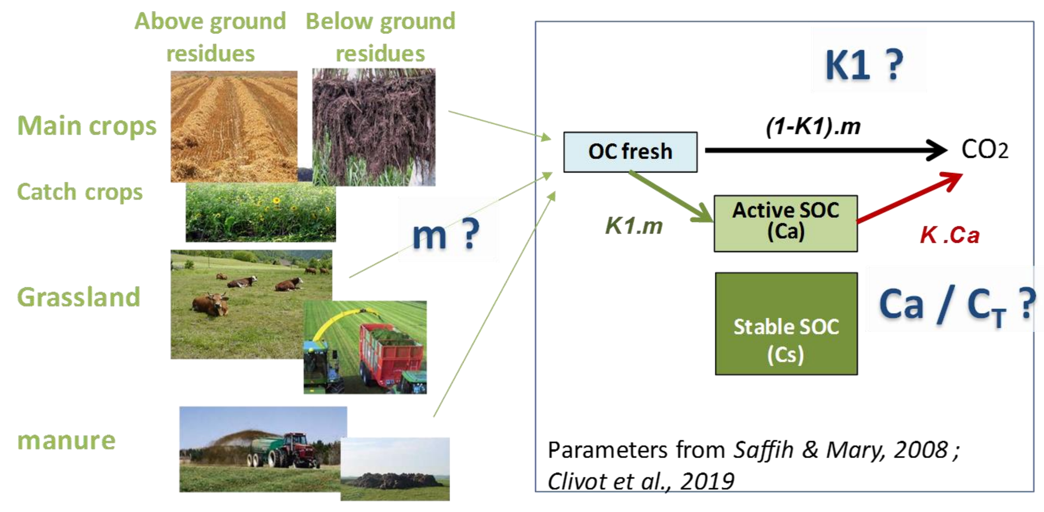
Intensively managed crop-livestock systems combine a diversity of cropping systems differing in i) grass proportion and duration in ley-arable rotations, ii) carbon and nitrogen inputs to soil via plant residues + manure, iii) local soil and climate conditions.

We aimed to identify main drivers of SOC stocks, storage or release comparing 3 types of crop rotations

- Crops : Maize monoculture with or without Italian Ryegrass as catch crop, Maize-Wheat+IRG as cc
- Ley-arable : Maize – (cereals) – grasslands
- Permanent grasslands

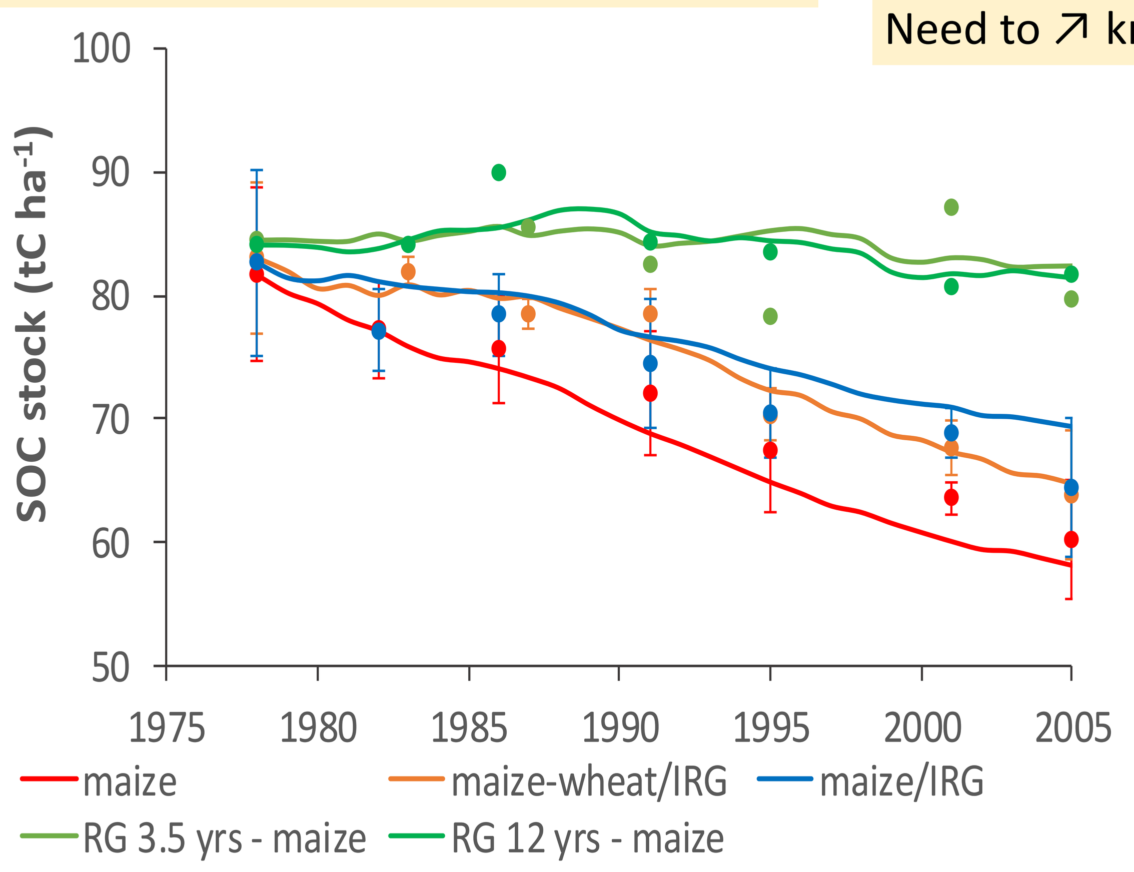
In a long term experiment (Western Brittany, 27 years, initial C stock (0-25 cm) ≈ 89 tC.ha^{-1} → measurements + simulation of SOC storage/release with AMG Model *(Clivot et al., 2019, Envir. Model. & Software, 118, 99-113)*

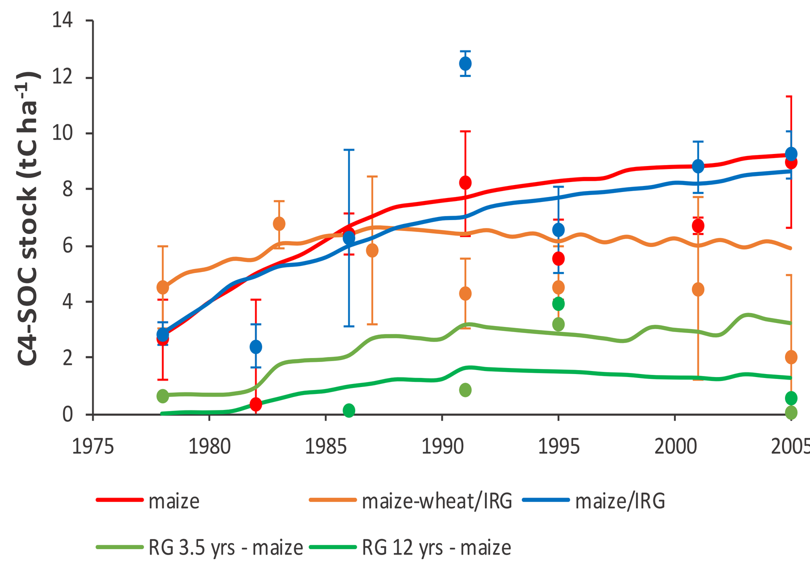




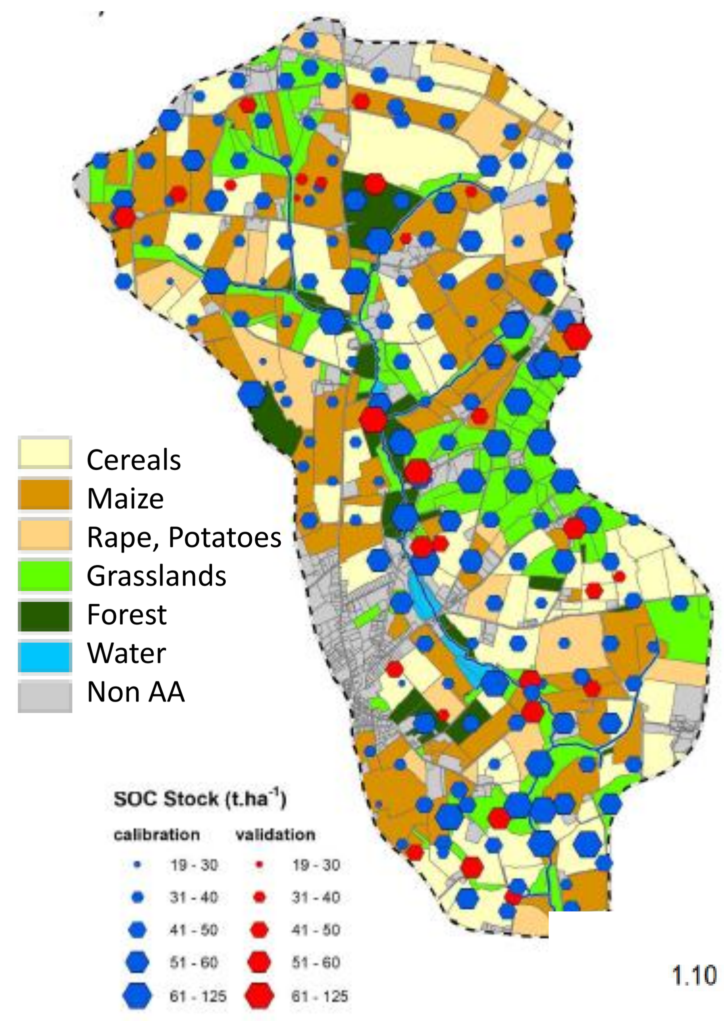
Proportion of grassland ≈ good proxy to predict long term SOC evolution

AMG model simulates correct SOC evolution and part of new organized SOC from maize and slurry inputs (C4).
Need to ↗ knowledge on C inputs in grassland soils





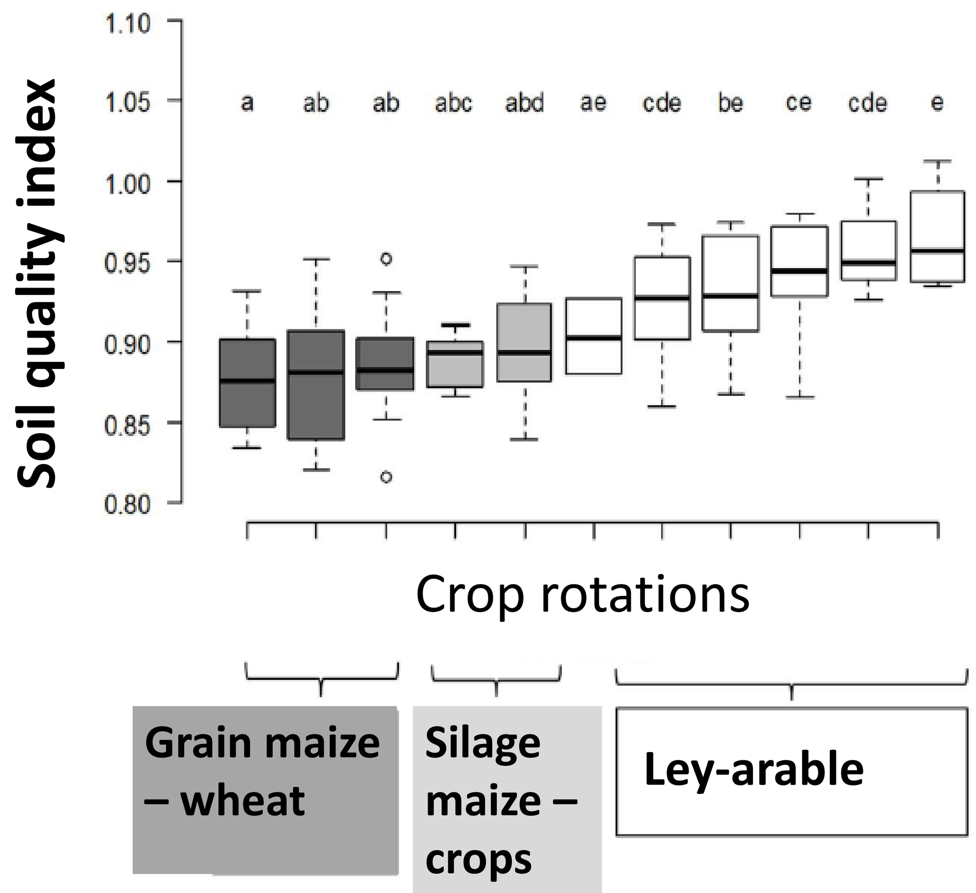
In a fields network (Centre-Brittany, SOERE Agrhys, C stocks ≈ 40-60 tC.ha^{-1} (0-25 cm) → measurements + soil quality index *(Viaud et al., 2018, AGEE, 265, 166-177)*



Mean C stocks 47,7 t.ha^{-1} (20-125)

Influenced by crop rotations and management, then silt rate and location along slopes

Soil Quality Index integrates physical, chemical and microbiological components
(Viaud et al., 2018)



Proportion and duration of grasslands in rotations appeared as the first factor explaining SOC stocks and their evolution in crop-livestock systems. Grasslands also favored **higher soil biological diversity** (macro-fauna, microorganisms) **and activity**.

Increased SOC stocks with increasing grassland proportion can be explained by higher C inputs to soil compared to annual crops with straw usually exported. **According to AMG simulations, total humified C inputs were more than two fold higher in long-term grassland compared to silage maize monoculture** (2 vs. 0.8 t C ha^{-1}.yr^{-1}).

These results highlight the interest of grasslands for agro-ecological mixed crop-livestock areas.

Further development in