

A whole farm approach based on farm management practices data coupled with crop and grassland mechanistic models

Fiorelli J.-L.¹, Drouet J.-L.², Duret S.², Gabrielle B.², Cellier P.², Blanfort V.^{3,4}, Capitaine M.⁵, Boisdon I.⁵, Soussana J.-F.³

¹ INRA, UR 055, F-88500 Mirecourt, France. fiorelli@mirecourt.inra.fr

² INRA, UMR 1091 INRA Environnement et Grandes Cultures AgroParisTech, F- 78850 Thiverval-Grignon, France

³ INRA, UR 874, F-63100 Clermont-Ferrand, France

⁴ CIRAD, UR 18, F-34398 Montpellier, France

⁵ ENITA, AFOS, F-63370 Lempdes, France

Context

Agriculture is a large source of emissions of greenhouse gases (GHG, nitrous oxide N_2O , methane CH_4 , carbon dioxide CO_2) in Europe. A lot of mitigation options have been reported, but they have mainly focused on a single gas and have generally dealt with source-oriented processes.

Organic farming is considered as a possible strategy for reducing GHG emissions: these systems are characterised by low inputs and frequently aim for being self-sufficient. They are often mixed farming systems and combine grassland and crops. Organic farming presents a real opportunity to enhance soil carbon storage through grass-crop rotations with a special concern to grass-legume leys, intercrops and tillage techniques.

Methodology

Crop-livestock farming systems use fields, animals, buildings, machinery and stores generating energy and matter exchanges. Interactions between the different fluxes are especially strong in the organic mixed crop-livestock farms.

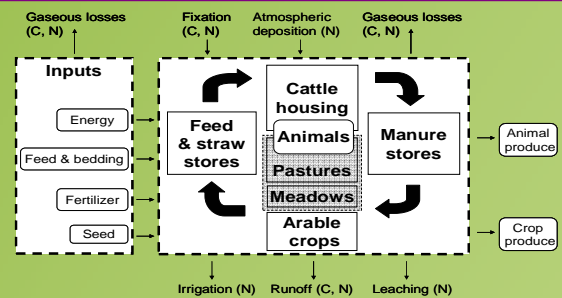
Emissions of GHG are related to carbon and nitrogen flows and environmental conditions. We consider carbon and nitrogen cycling through a whole farm system approach extended to the inputs used.

Objectives

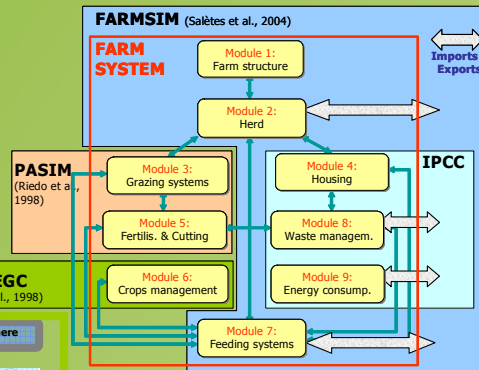
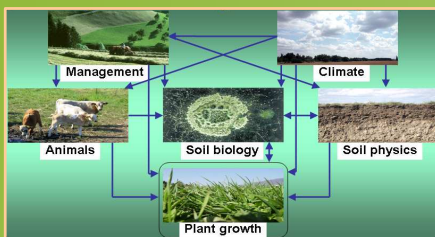
→ To develop a simulation tool to assess the effect of farmers practices on the GHG balance and carbon sequestration at the whole farm level

→ To assess the contribution of a mechanistic crop model instead of crop emission factors to simulate GHG balance

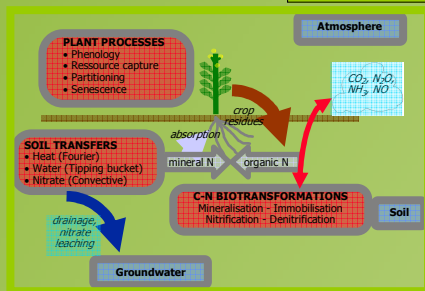
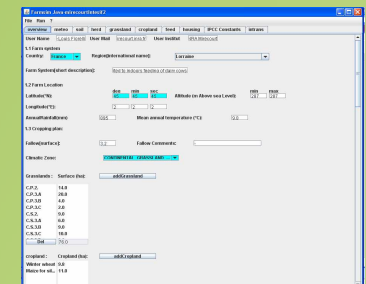
→ To assess the effect of mitigation options on farm GHG balance



Coupling FarmSim / PaSim / CERES-EGC models



Java interface



Perspectives

Using FarmSim for assessing GHG emissions from different organic farming systems requires to:

- further assess the capability of FarmSim / PaSim / CERES-EGC model to predict nitrogen and carbon fluxes at the farm level
- analyse the sensitivity of model outputs to parameters (soils, climatic conditions...)
- assess the impact of mitigation options related to grassland and crops practices
- compare GHG balance of different crop-livestock farming systems, including a network of organic farms from different french areas

Mirecourt Farm (North-Eastern France)

(A) Re-building of a crop-livestock system from description of land use and farming practices in an intensive dairy farm

(B) Designing of a mitigated farming system (conventional):

- strong reducing fertiliser spreading (-50%)
- changing the cropping system for animal feeds self-sufficiency
- increasing white clover rate in pasture composition
- reducing stocking rate (0.9 LU / ha)

