Carbon balance of an intensively grazed permanent grassland in southern Belgium

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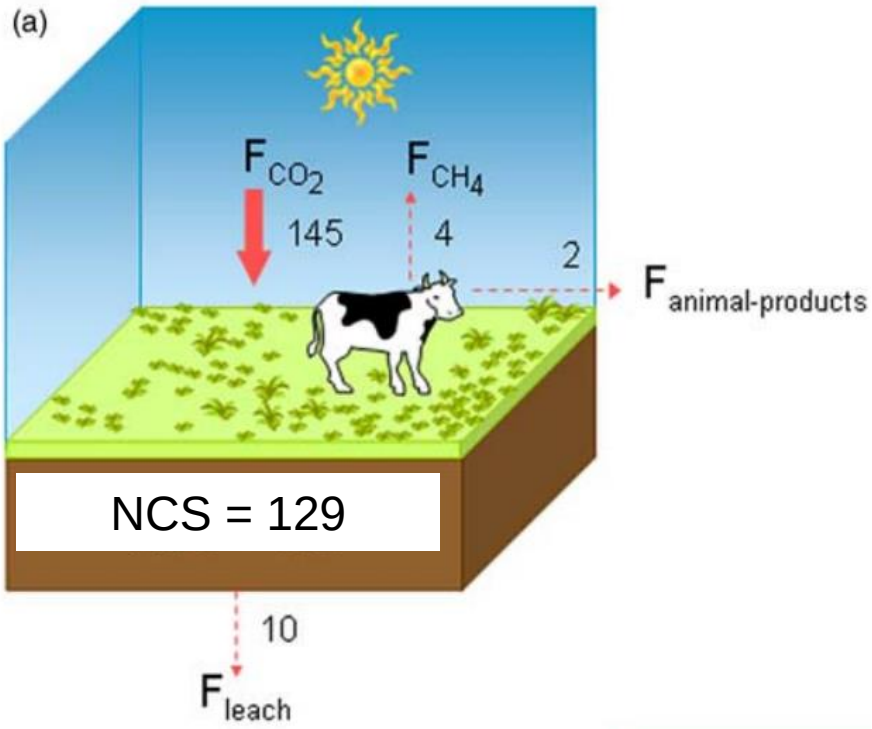
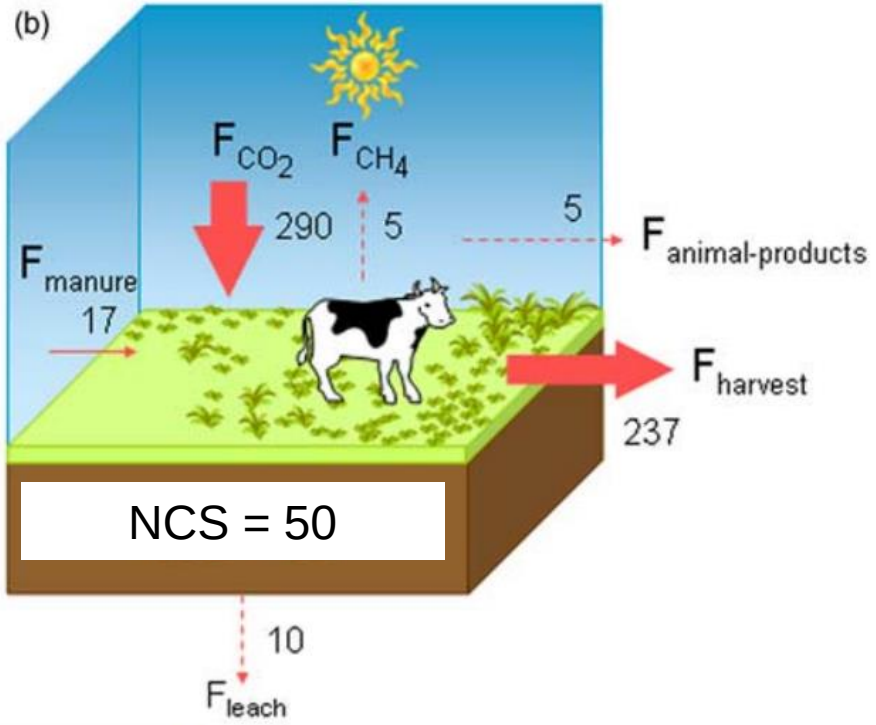
Pasture greenhouse gas budget

European grasslands carbon balance *(Soussana et al., 2007,2010)*

Grazing only



Grazing and harvest



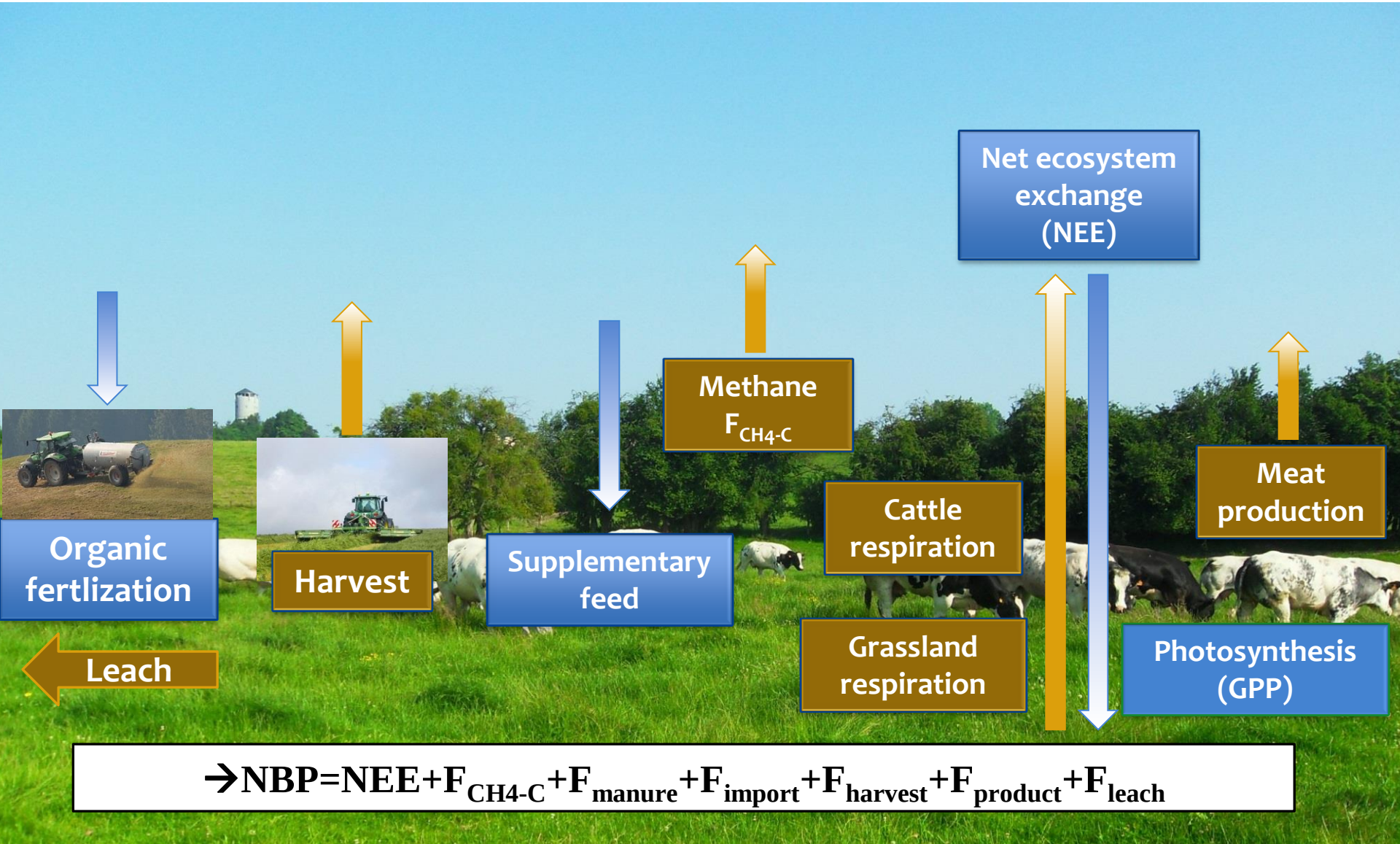
- ✓ Global mean of diversed exploitation (milky cows, goats etc…)
- ✓ Average stocking rate from **0.3 to 1.3 LU ha^{-1}** when grazed
- ✓ Necessity to study a grazing system representative of southern Belgium

Dorinne: A permanent temperate grassland

- Climate: Oceanic temperate
- Average air temperature: 10°C
- Annual precipitation: 630 mm
- Measurements: May 2010-2015
- Altitude: 250m

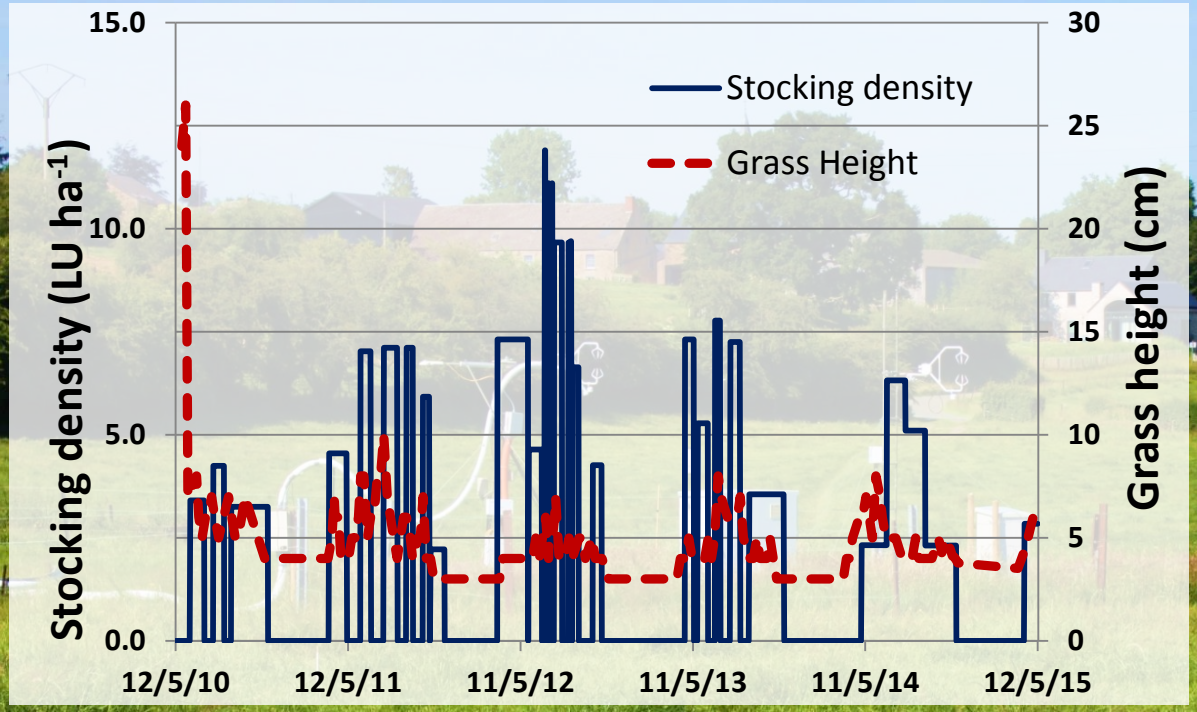
- Highly productive **(≈ 8-10 t ms ha^{-1})**
- Organic and mineral fertilization
- **(120 kg N ha^{-1} yr^{-1})**
- Permanent grassland **>100 years**
- Intensively managed for **> 40 years**

Carbon budget of the pasture



$$\rightarrow NBP = NEE + F_{CH4\text{-}C} + F_{manure} + F_{import} + F_{harvest} + F_{product} + F_{leach}$$

Grazing management



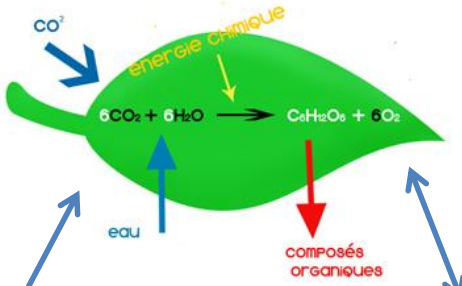
- Average stocking rate = **2.3 LU ha^{-1}**
- **Belgian Blue (meaty cows)**
- Organic and mineral fertlization (120 kg N ha^{-1})

Sink or source ?

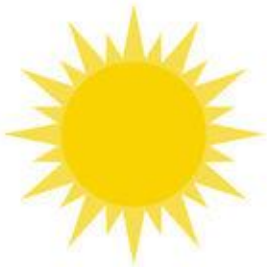
Sink : - 161 gC m^{-2} yr^{-1} on average

Carbon balance: grazing impact (Jérôme et al., 2014)

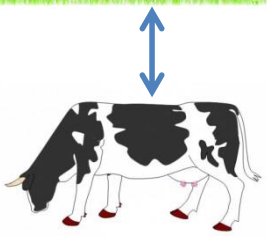
Photosynthesis

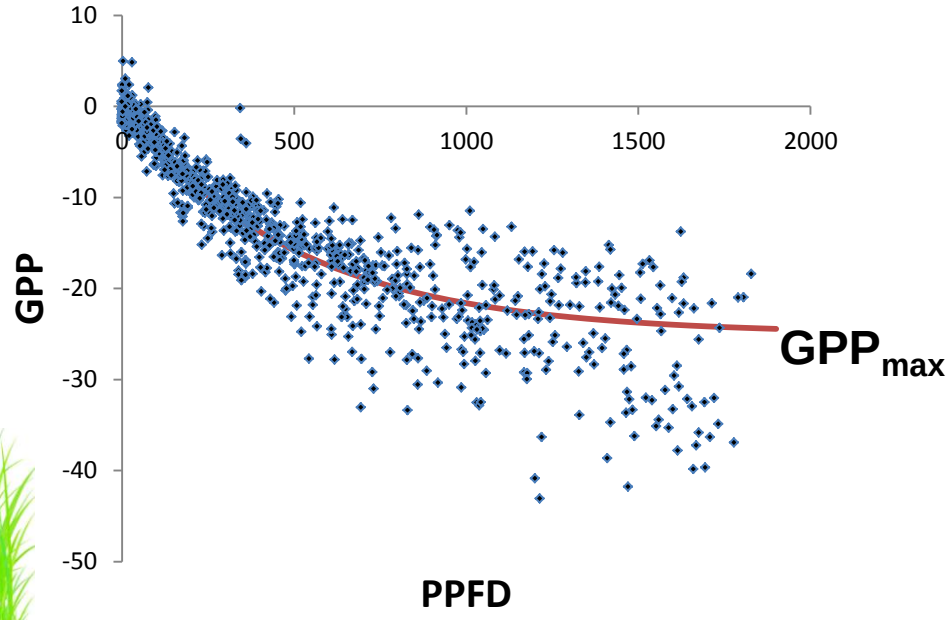


Biomass



Weather conditions

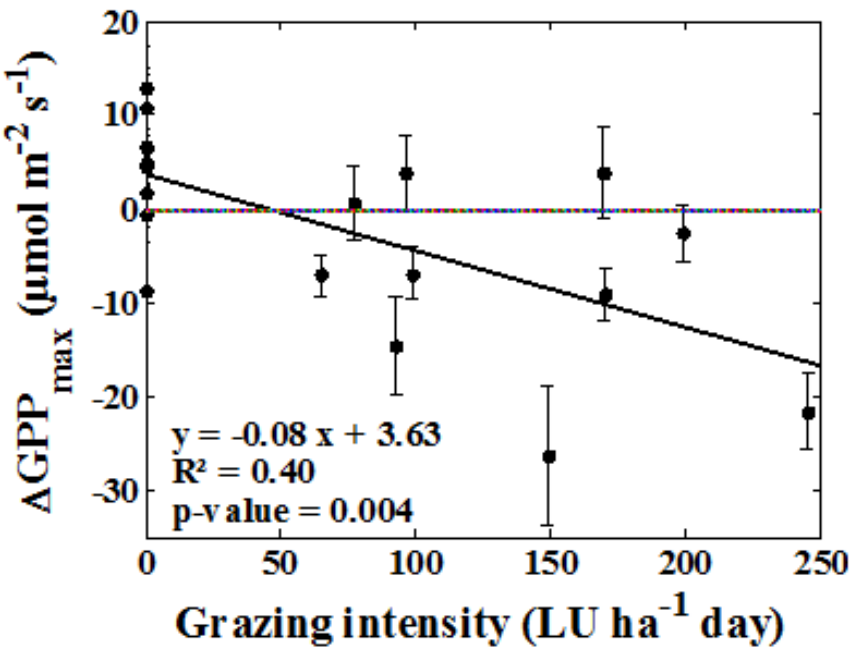




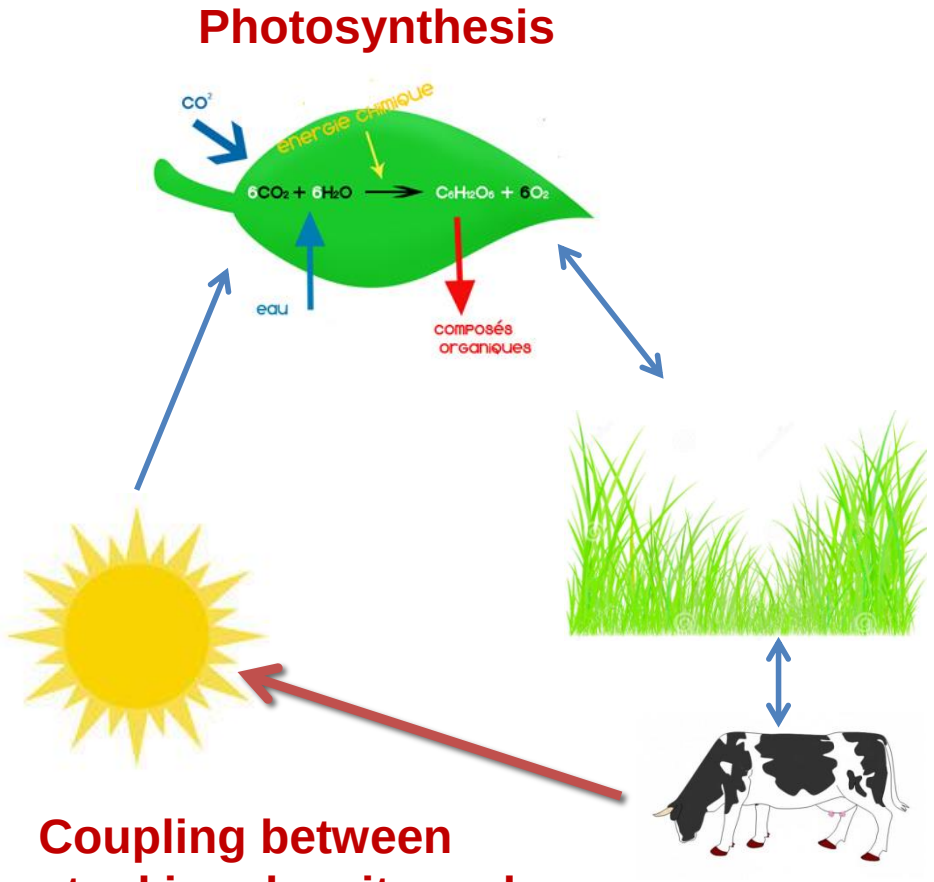
$$GPP = GPP_{max}(1 - \exp(\frac{\alpha.PPFD}{GPP\,max}))$$

→ Relationship between GPP_{max} and grazing intensity ?

Carbon balance: grazing impact (Jérôme et al., 2014)



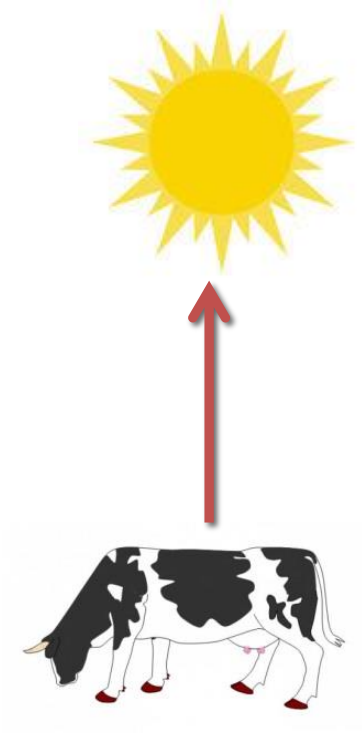
- The decrease of GPP_{max} is negatively correlated to grazing intensity because of defoliation
- No similar impact was observed on total ecosystem respiration

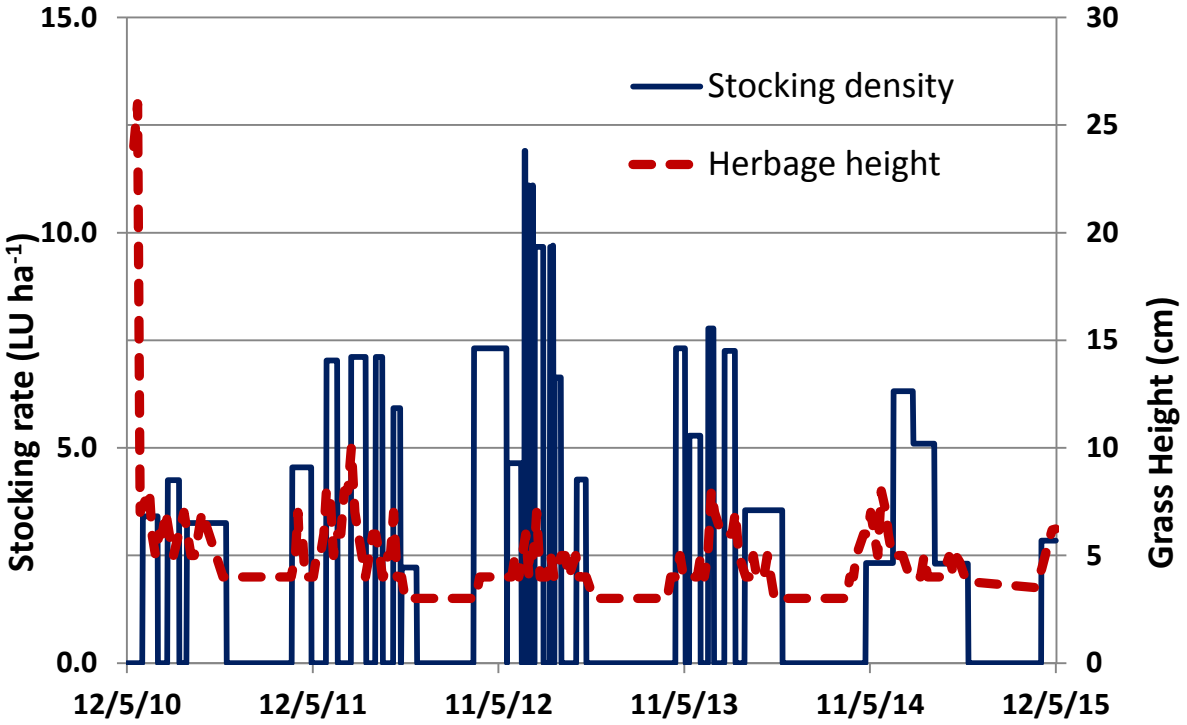


Coupling between stocking density and weather conditions

Carbon budget : weather conditions impact

- No significant relationship between monthly NEE anomalies and weather variables anomalies were observed
- Behavior at least partially due to the coupling between grazing management and weather conditions
- This coupling is necessary to maintain a steady meat production

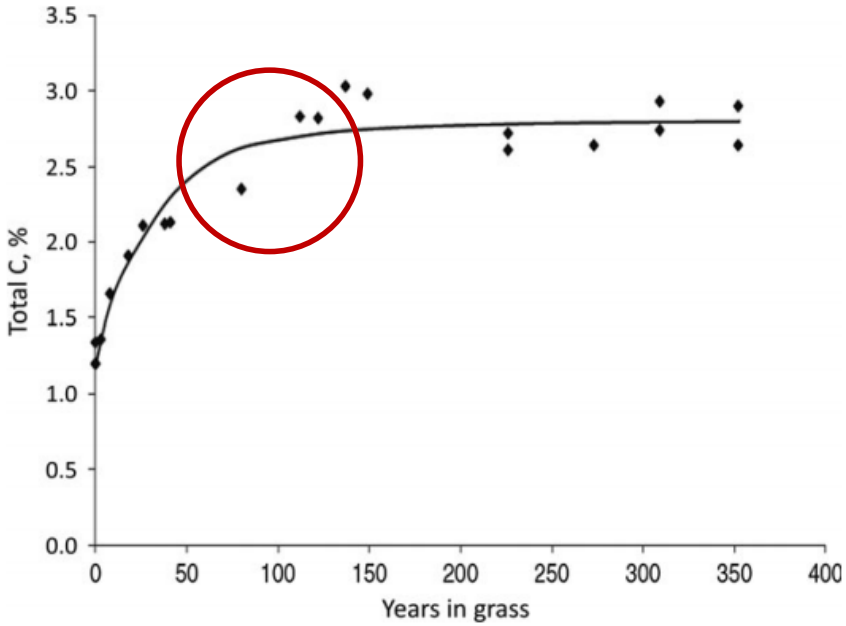




Carbon storage? How long ?

Dorinne grassland

- Permanent grassland, never cultivated since it is used as a pasture (more than one century)
- Intensively managed with organic and mineral fertilizers since around 40 years



- Carbon stocks stablizes only after **around a century**
- In agreement with our observations
- There is a strong need to correlate carbon balance observations to carbon stocks

Figure adapted from Johnson et al, 2009 used by Smith et al., 2014

Conclusions

- Carbon sink observed every year despite a high stocking rate and the old age of the pasture
- C exports in form of meat were low compared to C exports in dairy pastures
- Probable coupling between weather conditions and grazing management
- Carbon storage that must taken into account in livestock GHG budgets

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References :

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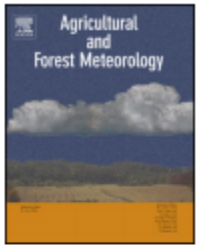

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Agriculture, Ecosystems and Environment

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Impact of grazing on carbon dioxide exchanges in an intensively managed Belgian grassland

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Pr. Yves Beckers, Pr. Bernard Bodson

Pr. Bernard Heinesch, Pr. Marc Aubinet