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DGO 3

Rotational and continuous grazing does not affect the total net ecosystem exchange of a pasture grazed by cattle but modifies CO_2 exchange dynamics

Louis Gourlez de la Motte
Yves Beckers
Bernard Bodson
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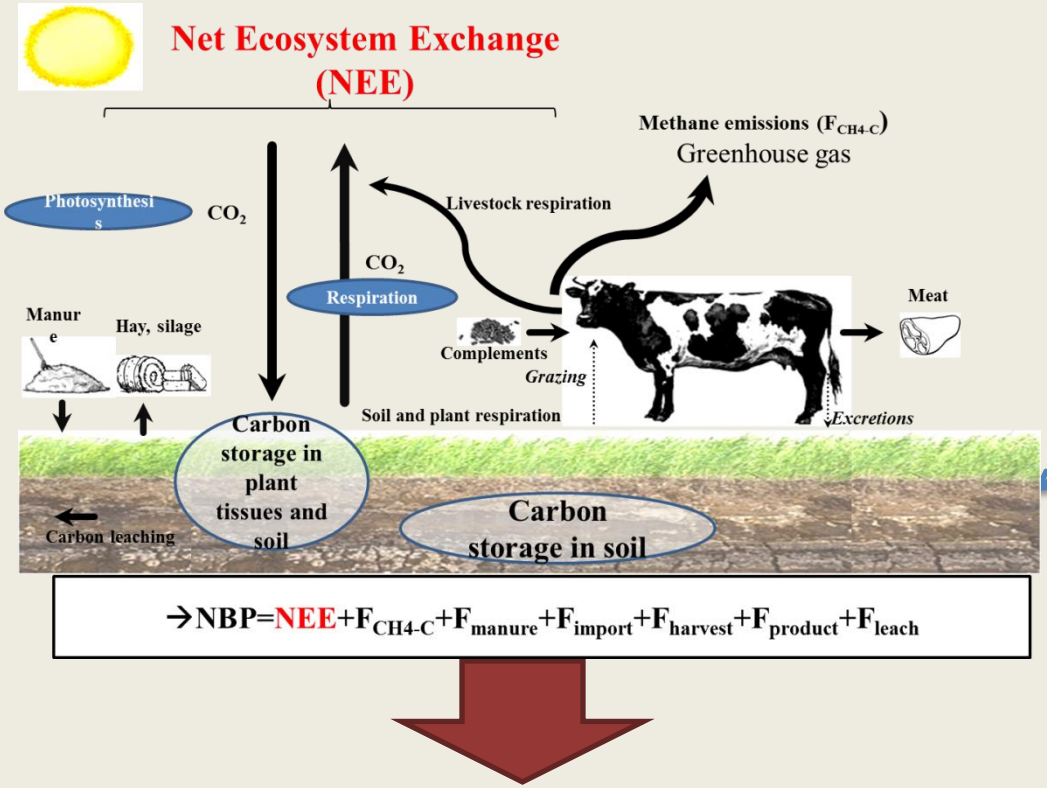
"While proponents of holistic, ***rotational*** *or adaptive grazing management have made large claims about the potential for carbon sequestration in grazing land, these rest on extrapolation from a small number of case-studies.* ***Peer-reviewed studies of these systems give mixed results, and where benefits are shown, the numbers are small."*** *(Garnett et al., 2017)*

Dorinne Terrestrial Observatory : Intensively managed pasture

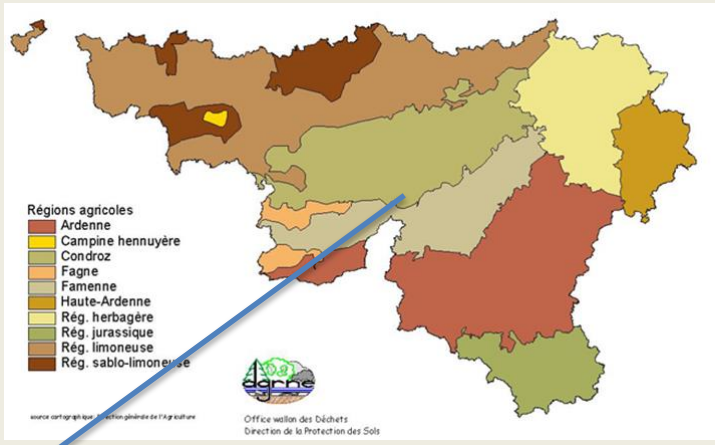
Candidate ICOS site



Average 5 year **Net Biome Productivity**

≈-160 g C m^{-2} yr^{-1}

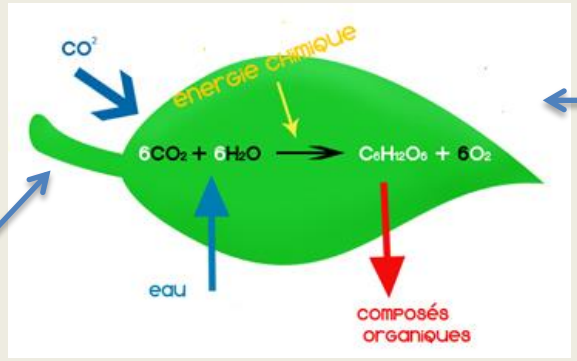
(Gourlez de la Motte et al., 2016)



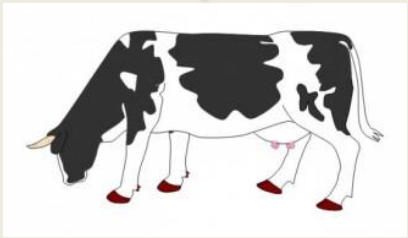
CO_2 fluxes and other variables measured since 2010

Grazing impact on CO_2 fluxes :

Photosynthesis



Biomass growth

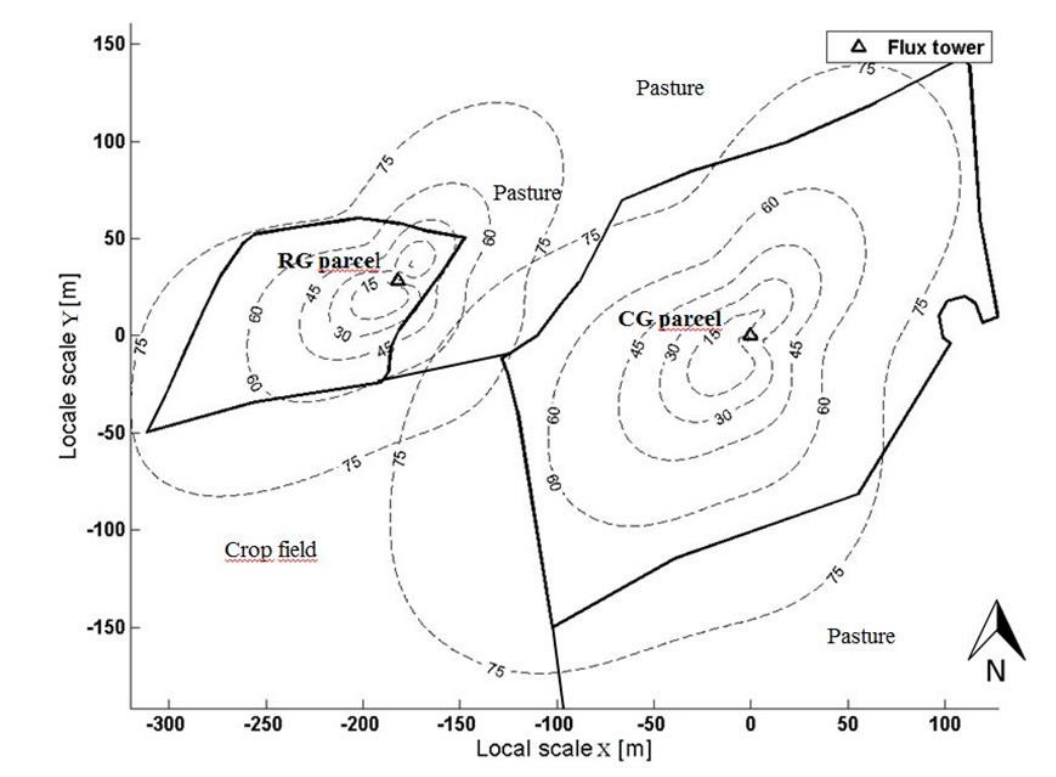


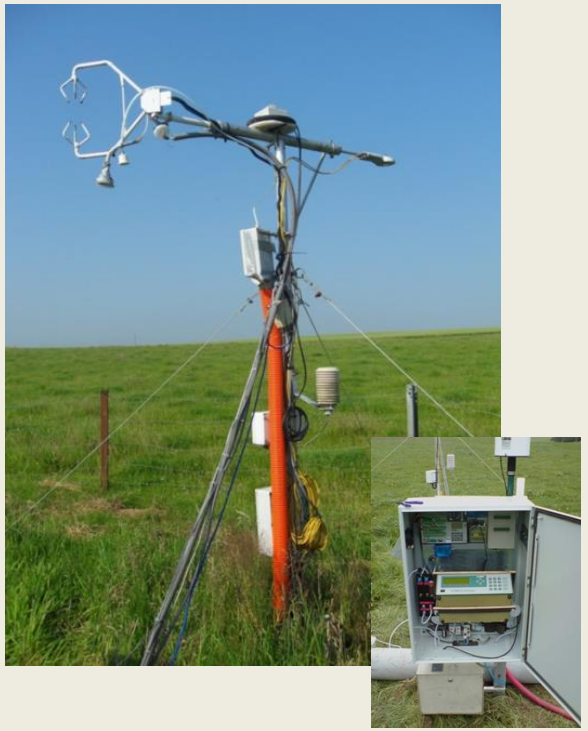
For more details : Jérôme et al., 2014

Impact of grazing timing-management ?

Rotational grazing ? **Continuous grazing** ?

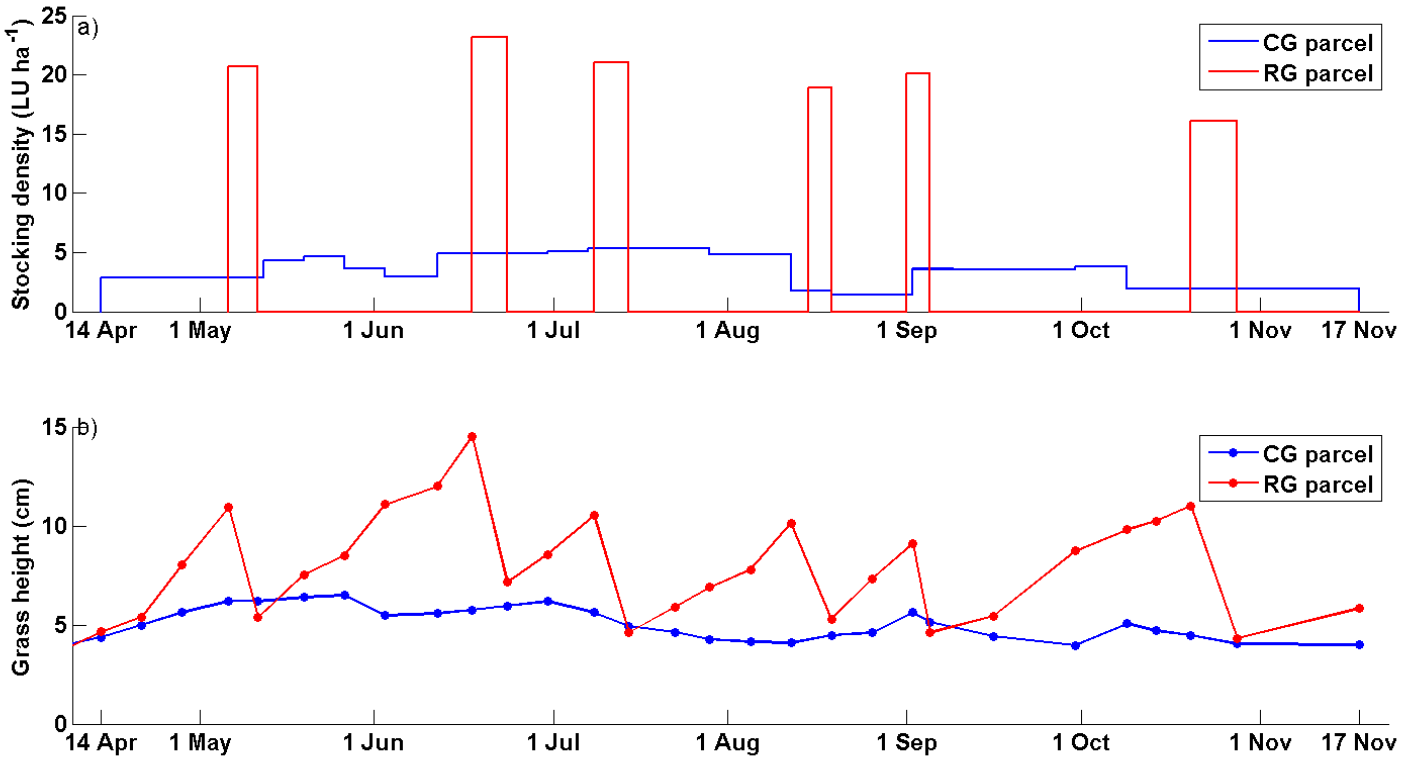
Rotational grazing vs continuous grazing





- Eddy covariance CO_2 flux measurements
- Same measurement systems
- Footprint filtering
- Biomass measurements
- Experiment from April 2015 to November 2015 (one grazing season)

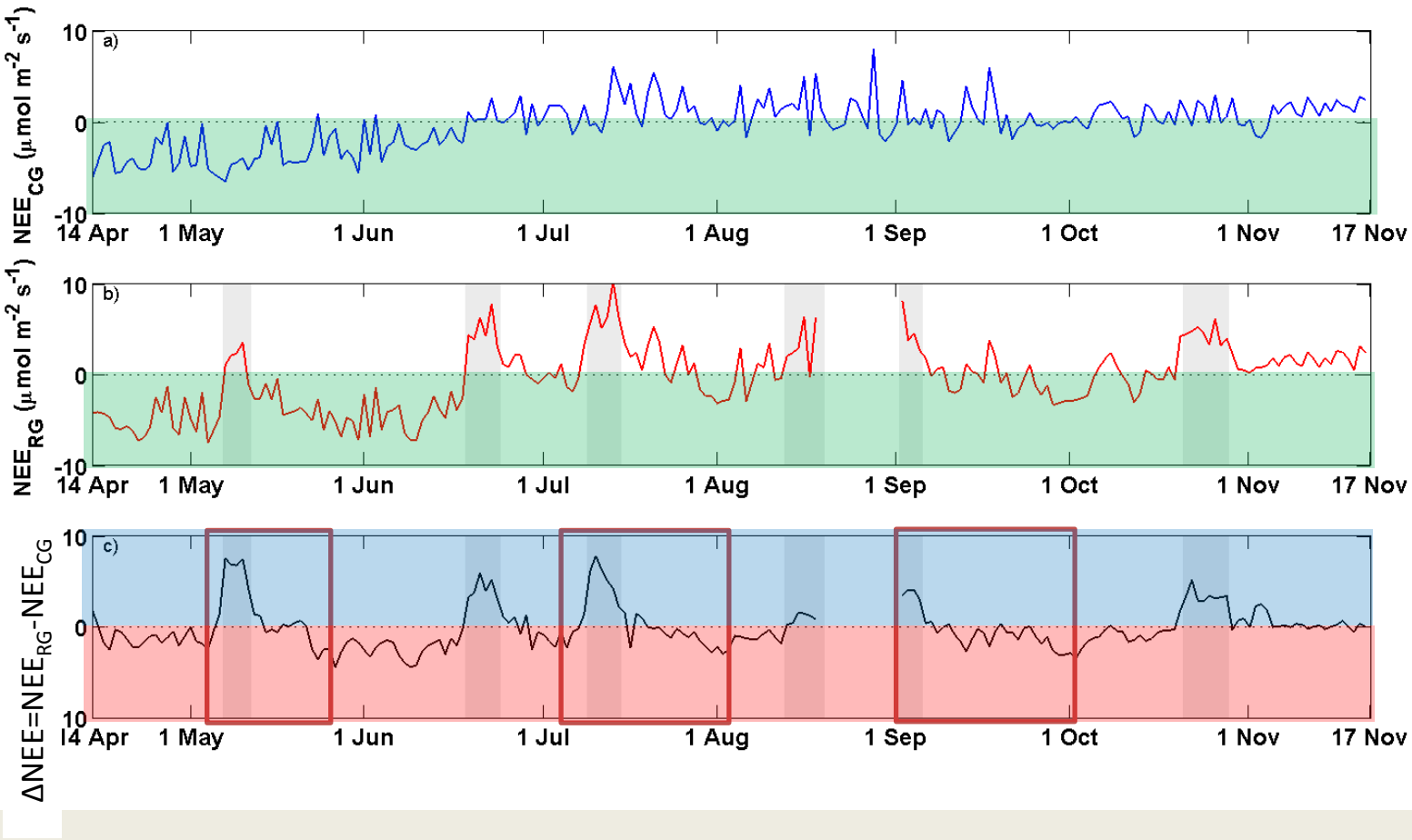
Rotational grazing vs continuous grazing



Rotational grazing : 6 rotations, 36 days of grazing, and **1.9 LU ha^{-1} yr^{-1}**

Continuous grazing : 220 days of grazing, **2.1 LU ha^{-1} yr^{-1}**

Grazing method impact on CO_2 flux dynamics (daily means)



Does grazing impact NEE dynamics through
photosynthesis, **ecosystem respiration** or **both** ?

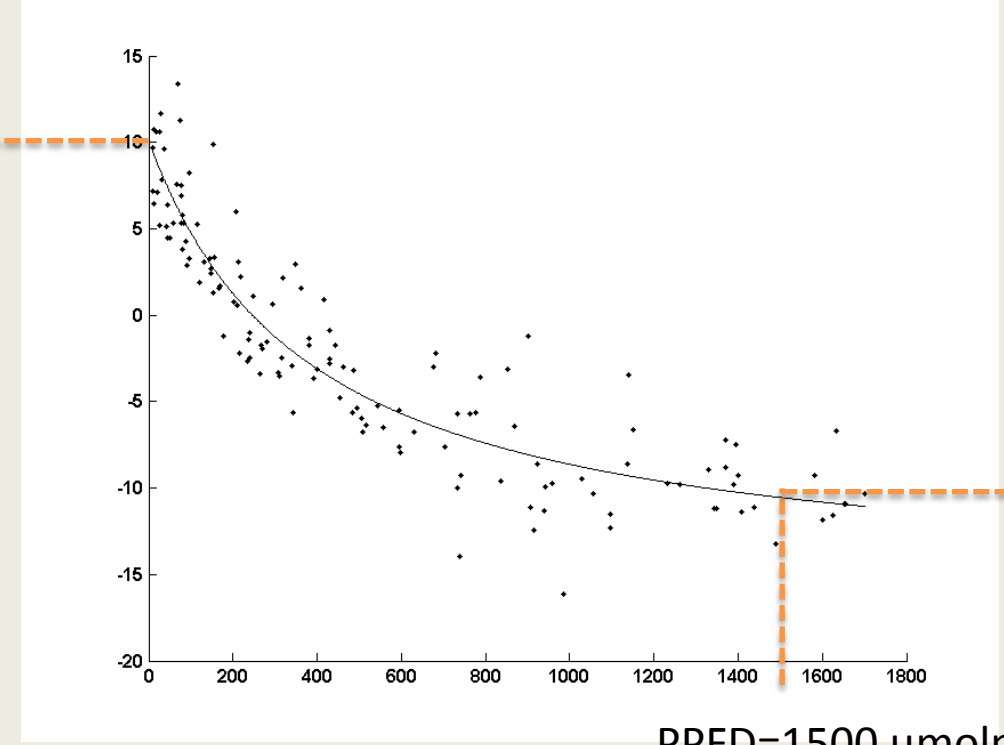
Grazing method impact on CO_2 flux dynamics : Daytime analysis

(cf Lasslop et al., 2010)

Who is responsible ?

Rd_{10}

Ecosystem respiration ?



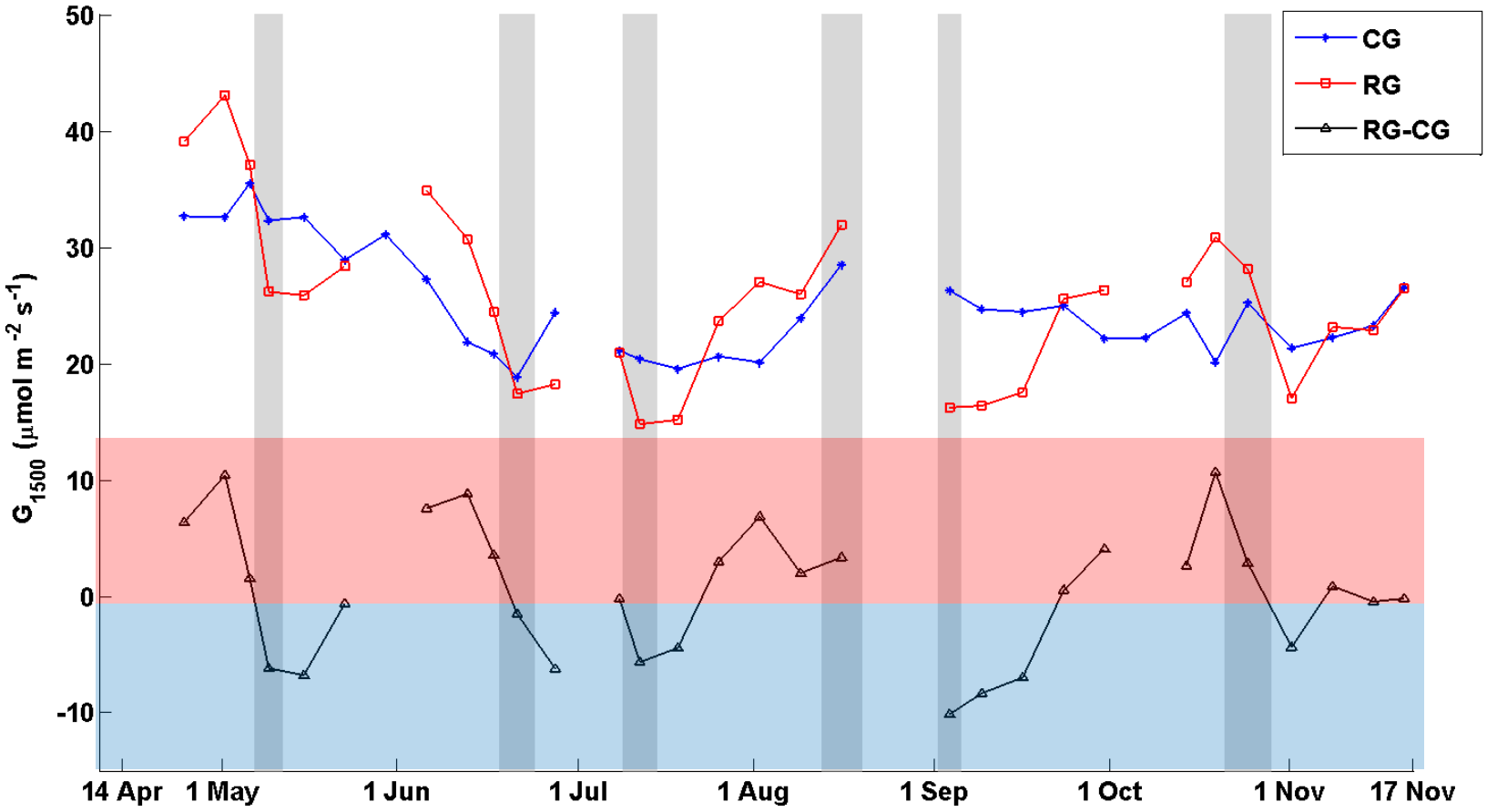
Gross primary productiviy ?

G_{1500}

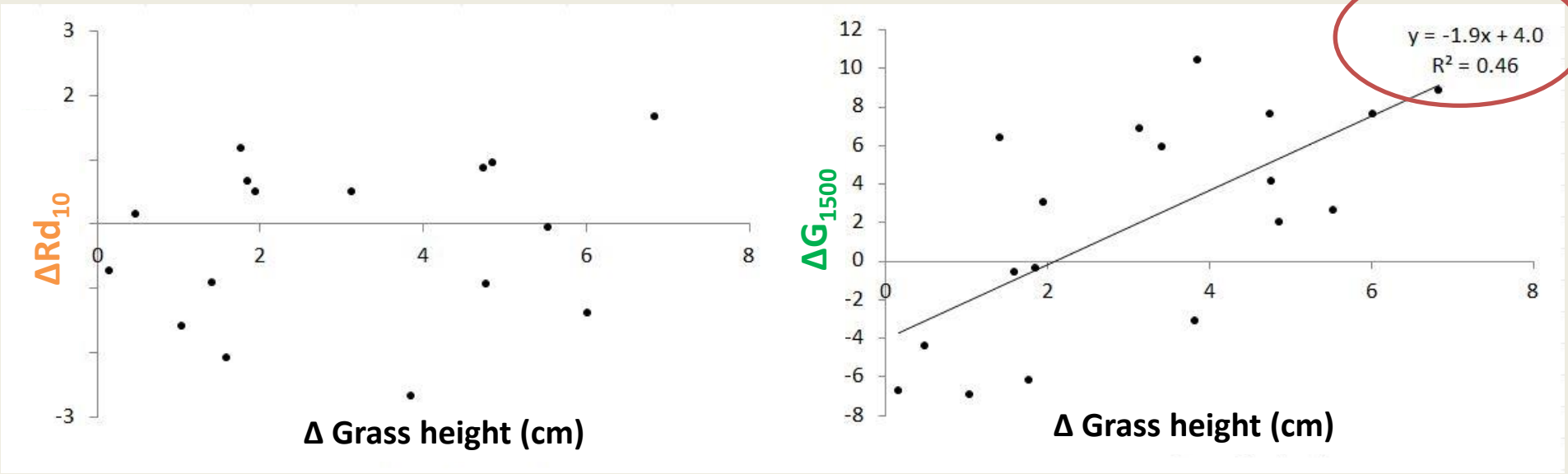
PPFD=1500 µmolm^{-2}s^{-1}

$$NEE_{day} = -\frac{\alpha \times PPFD \times G_{1500}}{\alpha \times PPFD + G_{1500}(1 - \frac{PPFD}{1500})} + Rd_{10} \times \exp\left\{E_0\left(\frac{1}{T_{ref} + 46.02} - \frac{1}{T_s + 46.02}\right)\right\}$$

Grazing method impact on CO_2 flux dynamics : G_{1500}



Grazing method impact on CO_2 flux dynamics : relation to biomass

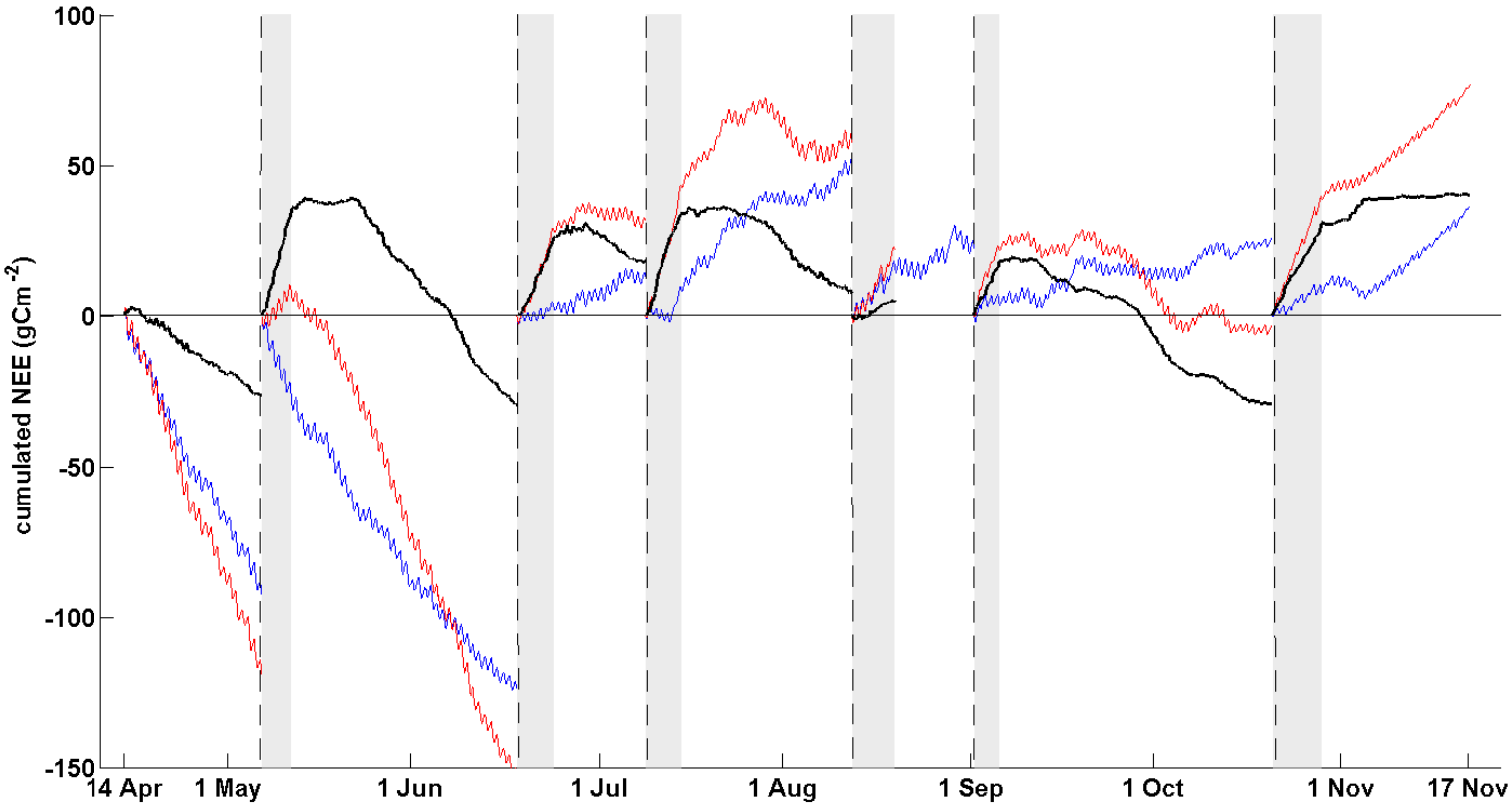


- Significant relationship between differences in standing biomass and vegetation photosynthetic capacity
- No such relationship for ecosystem respiration

→ **Photosynthesis seems to be the most impacted by grass heights/grazing timing**

What about total NEE ? Implications for the carbon budget ?

Grazing method impact on total NEE



Total NEE_{RG}= **-88** g C m^{-2}

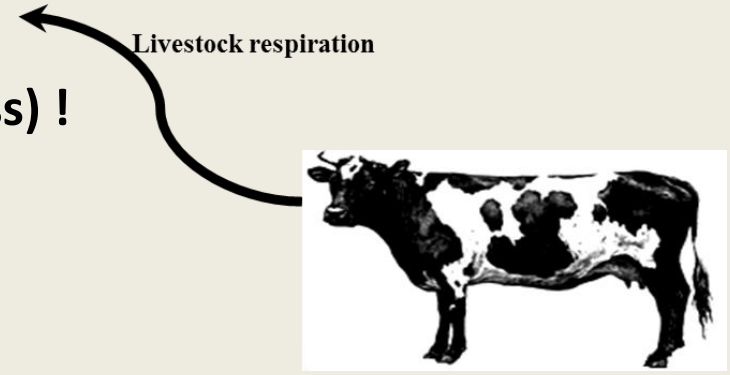
Total NEE_{CG}= **-74** g C m^{-2}

≠ Not significant when accounting for uncertainties

BUT…

- We assume that livestock CO_2 respiration is measured in a representative way on both parcels
- This is only the case if the cows are homogeneously distributed over the field at all time (Felber et al., 2016)
- This hypothesis more likely bo be met in the RG parcel as fluxes are filtered according to wind direction
- More problems on the CG parcel as the cows can or can not be in the measurement footprint
- This hypothesis is morel likely to be met when integrating fluxes over long periods (Dumortier et al., 2017)

This remains to be verified (work in progress) !



More details

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Research Paper

Rotational and continuous grazing does not affect the total net ecosystem exchange of a pasture grazed by cattle but modifies CO_2 exchange dynamics

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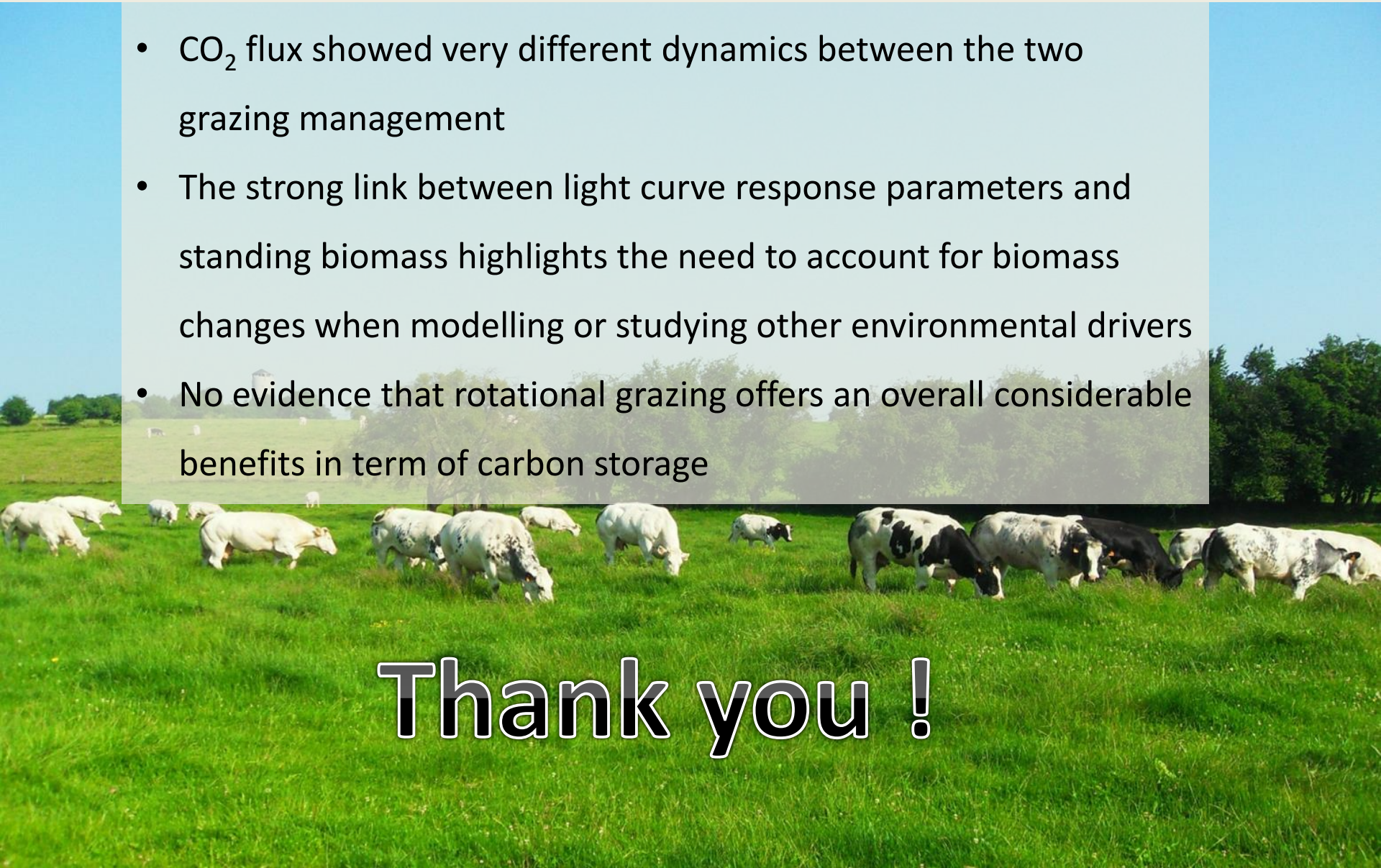
- CO_2 flux showed very different dynamics between the two grazing management
- The strong link between light curve response parameters and standing biomass highlights the need to account for biomass changes when modelling or studying other environmental drivers
- No evidence that rotational grazing offers an overall considerable benefits in term of carbon storage



Thank you !