Transitioning Cereal Systems to Adapt to Climate Change

November 13-14, 2015

Funded through Award #2011-68002-30191 from USDA National Institute of Food and Agriculture

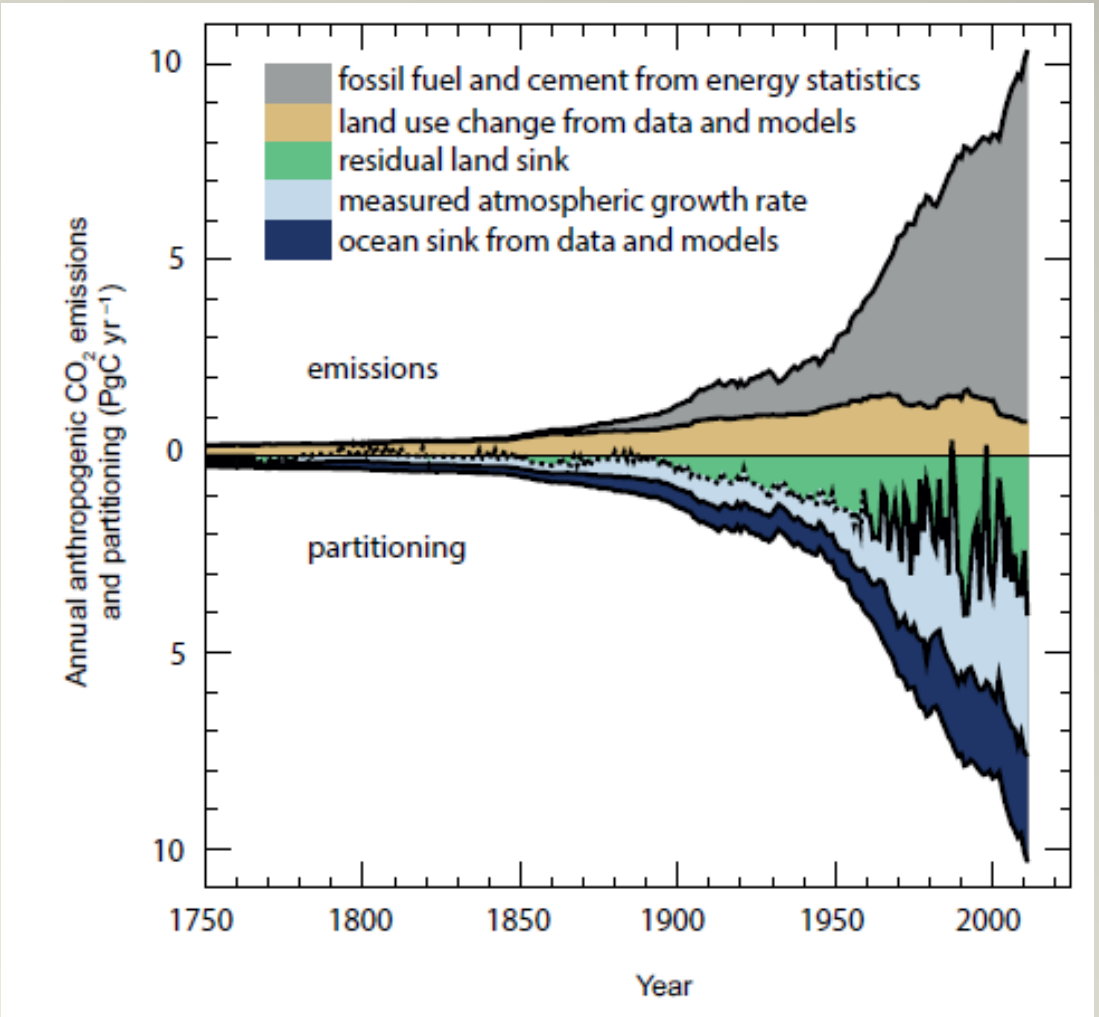
Is eddy covariance a suitable tool to establish greenhouse gas balance of cereals?

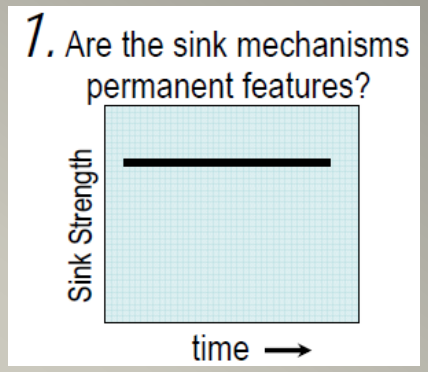
Marc Aubinet
Professor
University of Liege, Belgium

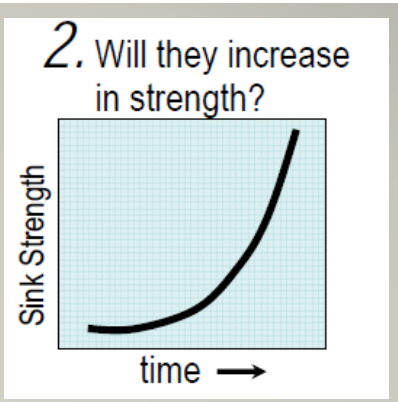
Is eddy covariance a suitable tool to establish greenhouse gas balance of cereals?

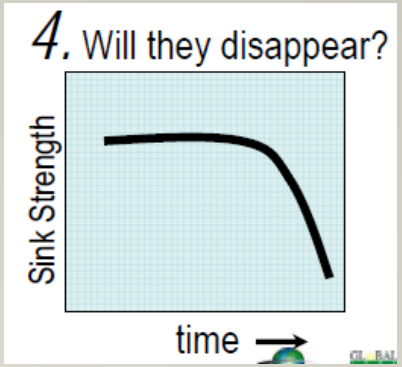
Marc Aubinet, Christine Moureaux
University of Liege,
Gembloux Agro-Bio Tech
Belgium

Gembloux Agro-Bio Tech
Université de Liège





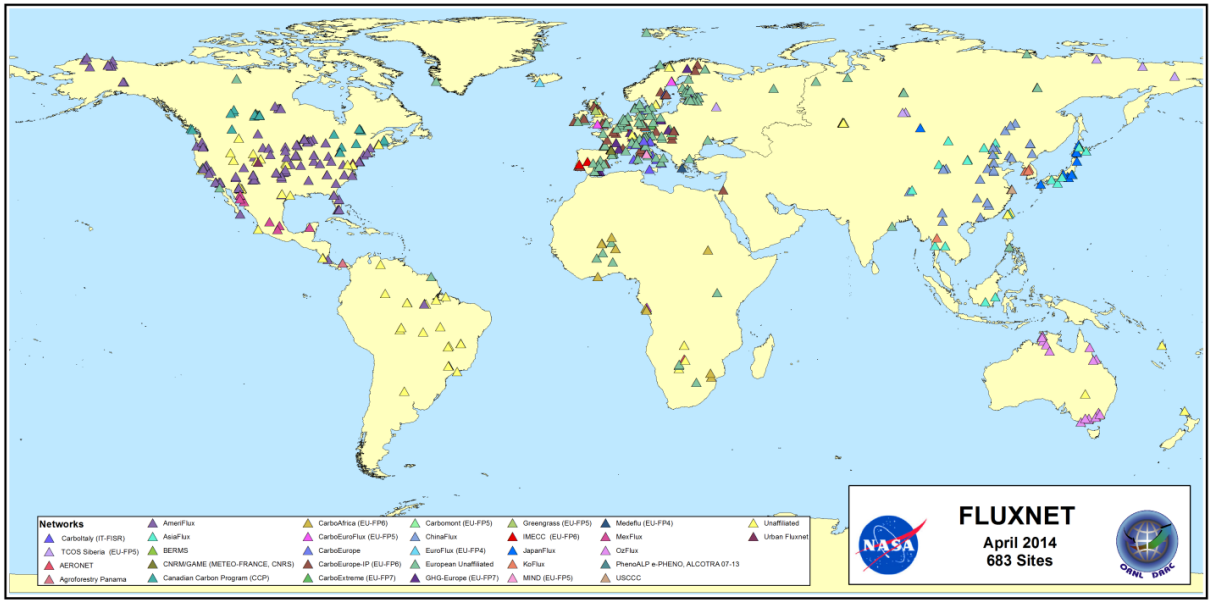


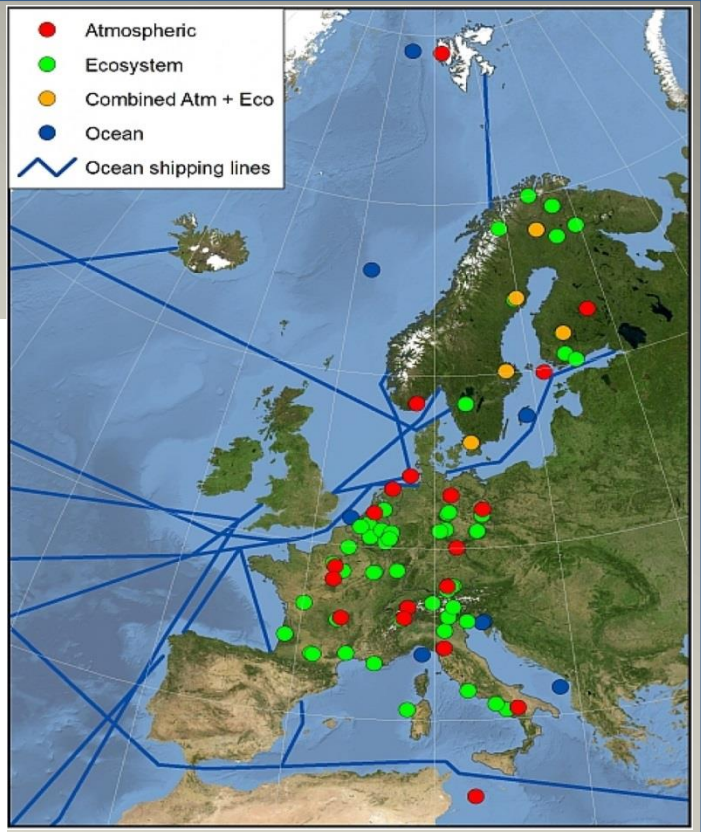


Le Quéré et al., 2014

ICOS
INTEGRATED CARBON OBSERVATION SYSTEM

Measurement networks CO_2 exchanges by terrestrial ecosystems





FLUXNET
A Global Network

Integrating Worldwide CO_2, Water and Energy Flux Measurements

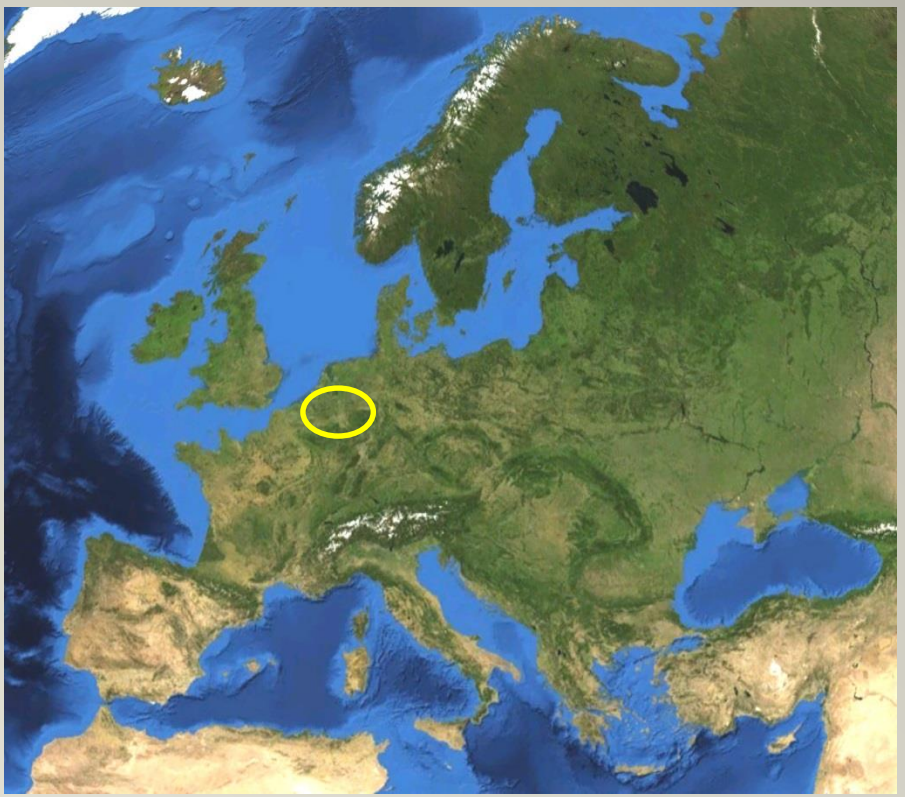


Eddy covariance

- Based on turbulence analysis $\overline{w'c'}$
- High temporal resolution (hour)
- Long term measurements (> 20 years)
- Integrated at ecosystem scale (~ 1 ha)

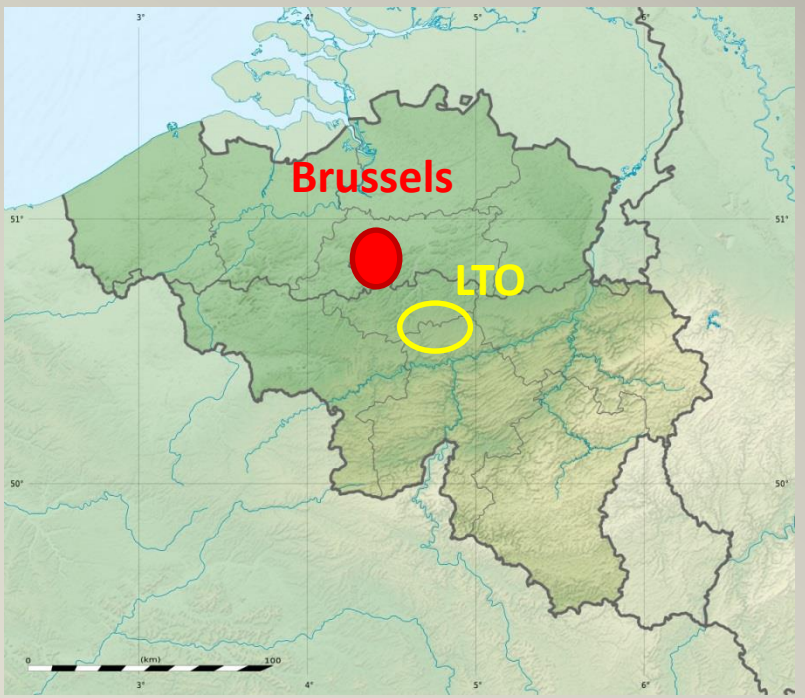
Belgium

- North Western Europe
- 49 - 51 ° N
- Avg Temp = 10°C
- Precipitation = 800 mm
- Temperate maritime



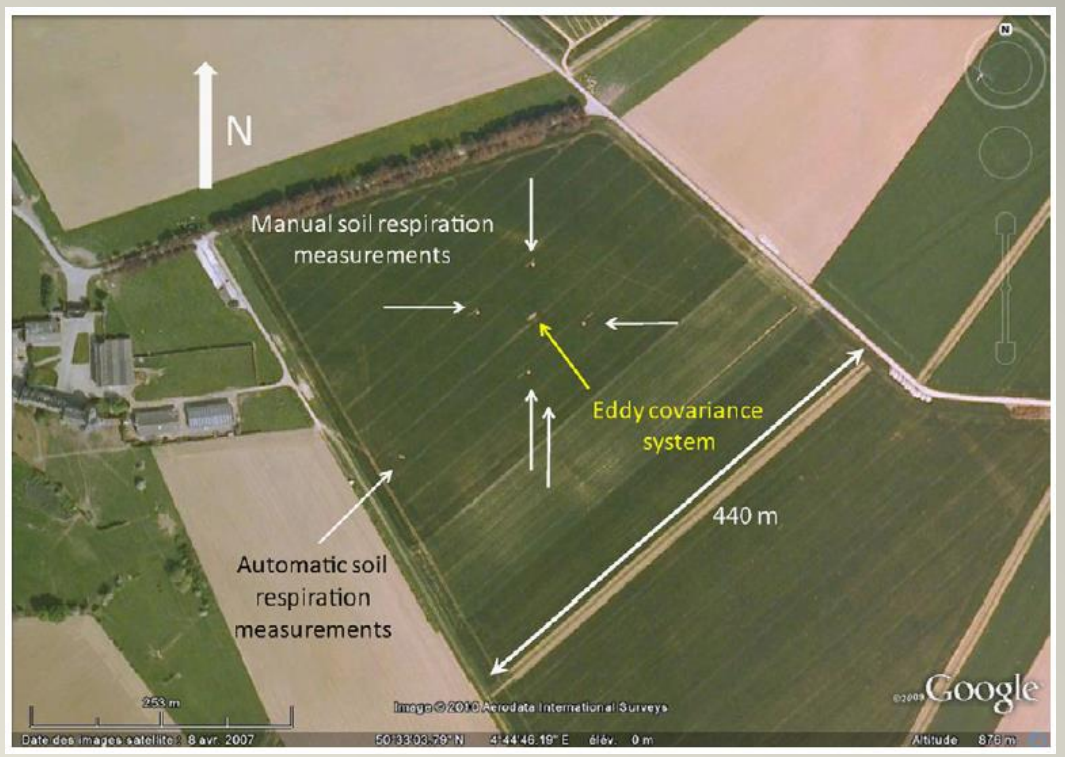
The silty area

- Cultivated since several centuries
- 4 year rotations (sugar beet, potato, winter wheat)
- Winter wheat production : 9000 kg ha^{-1}

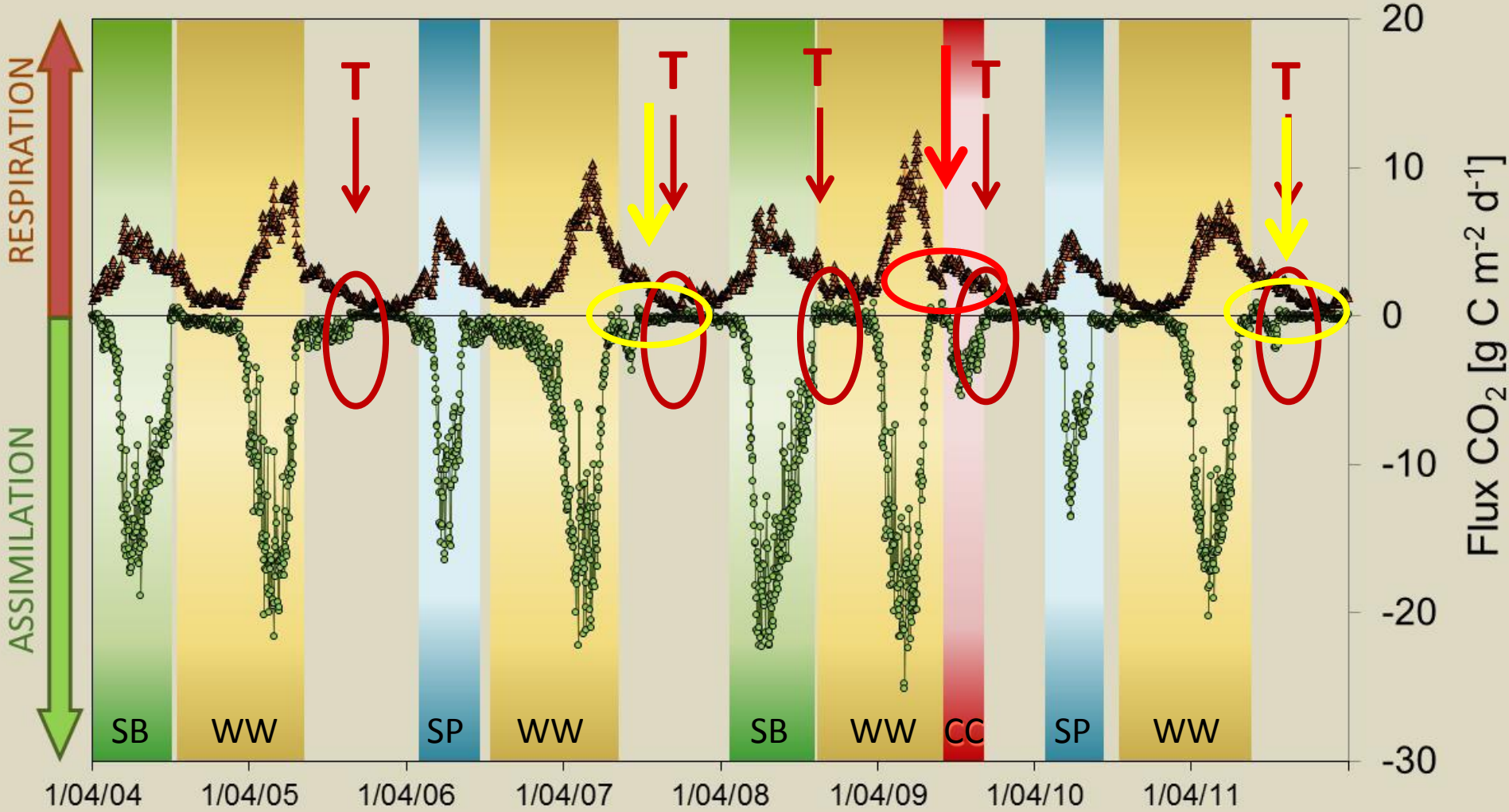


Lonzée Terrestrial Observatory

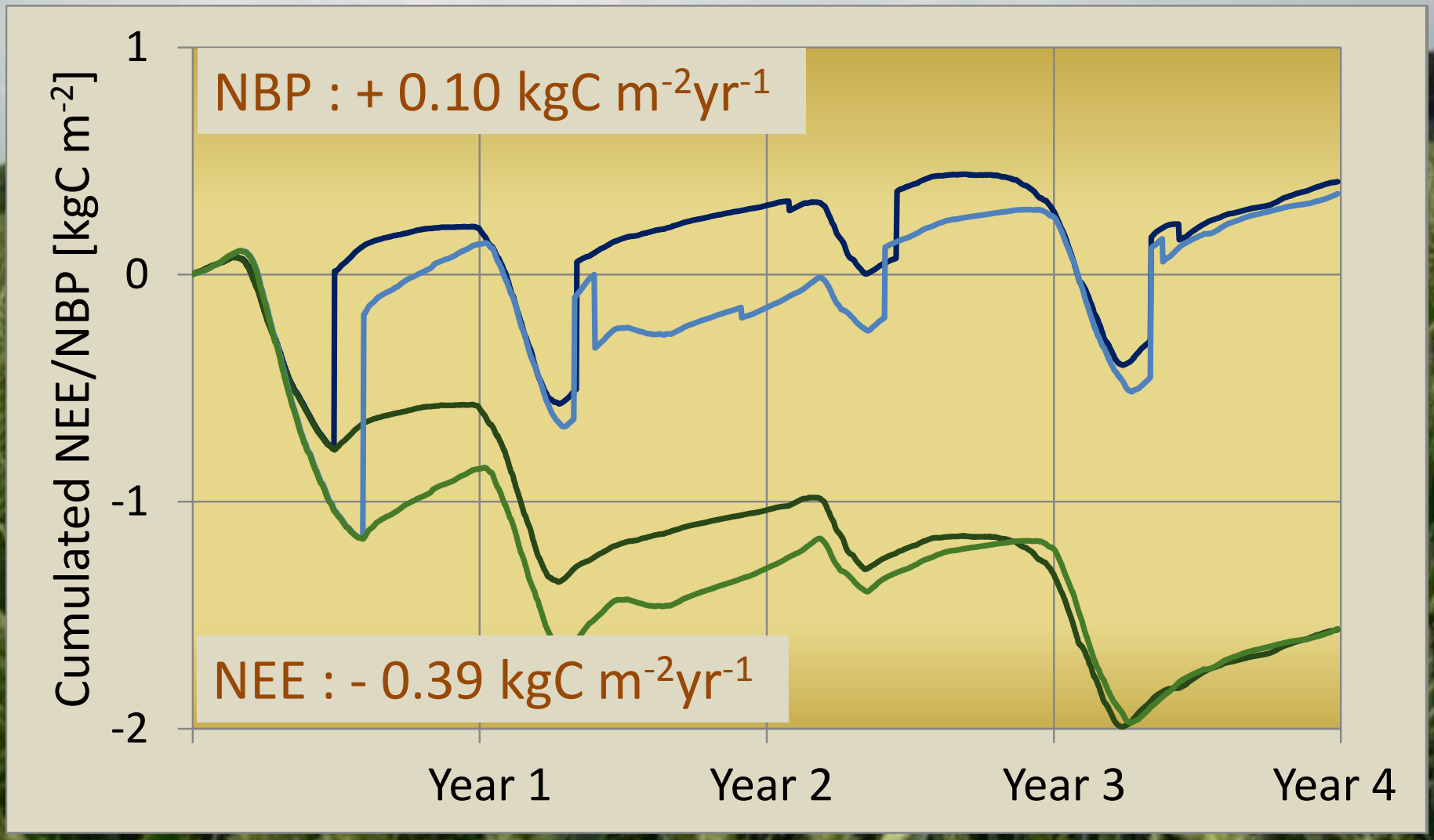
- 12 ha (~250 x 500 m)
- Fairly flat field
- Eddy flux since 2004



8 Years of CO_2 exchange

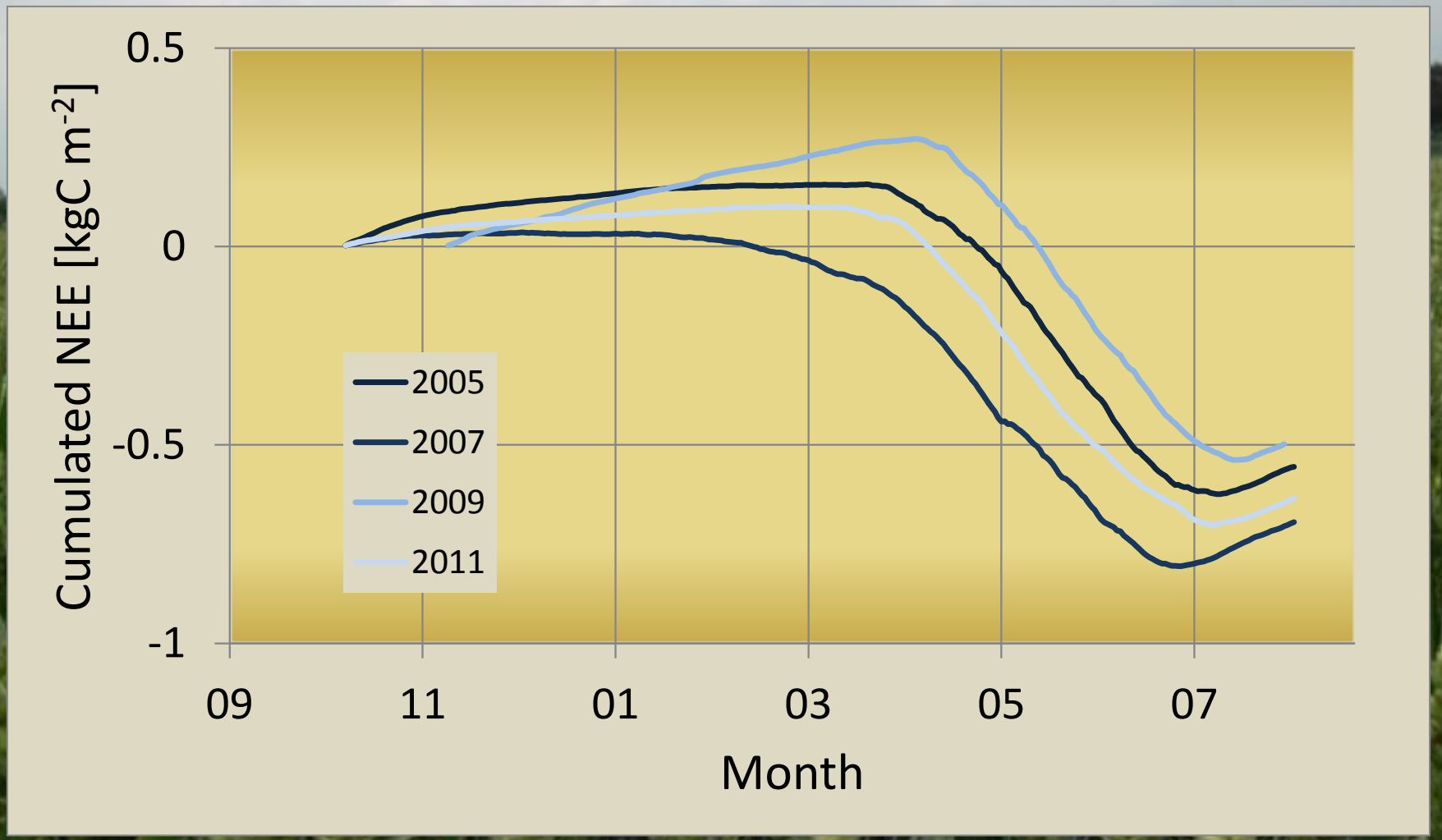


4 Year rotation : Cumulated carbon sequestration



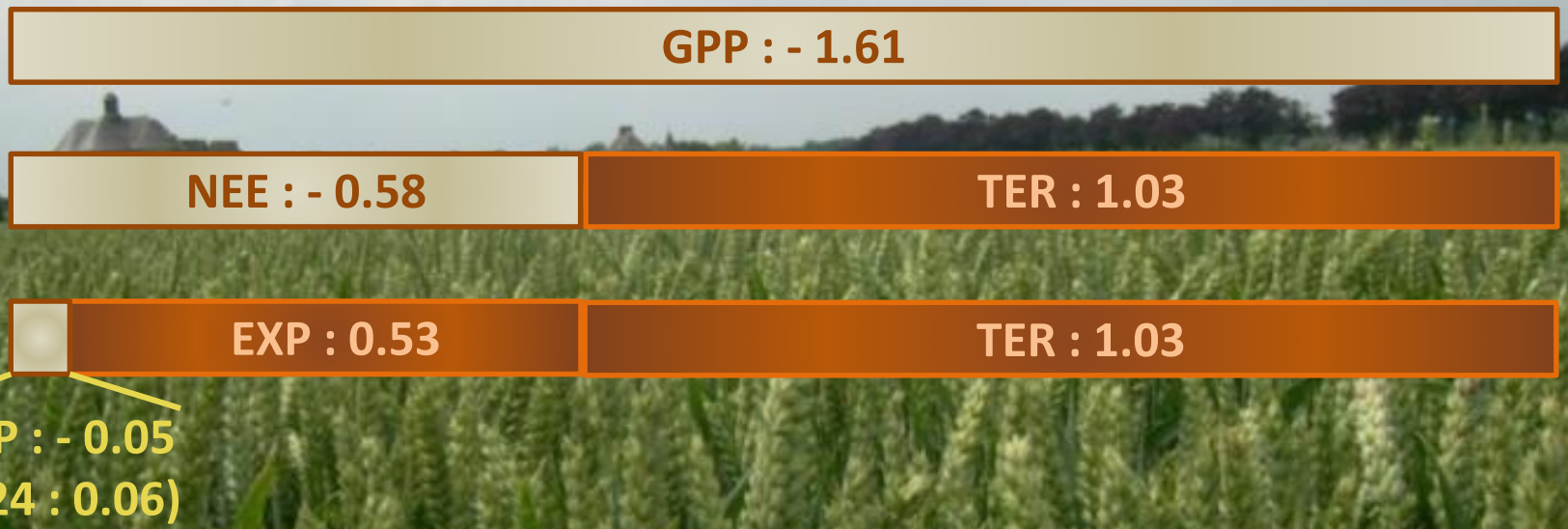
4 Year Carbon sequestration : focus on wheat

4 Year Carbon sequestration : focus on wheat

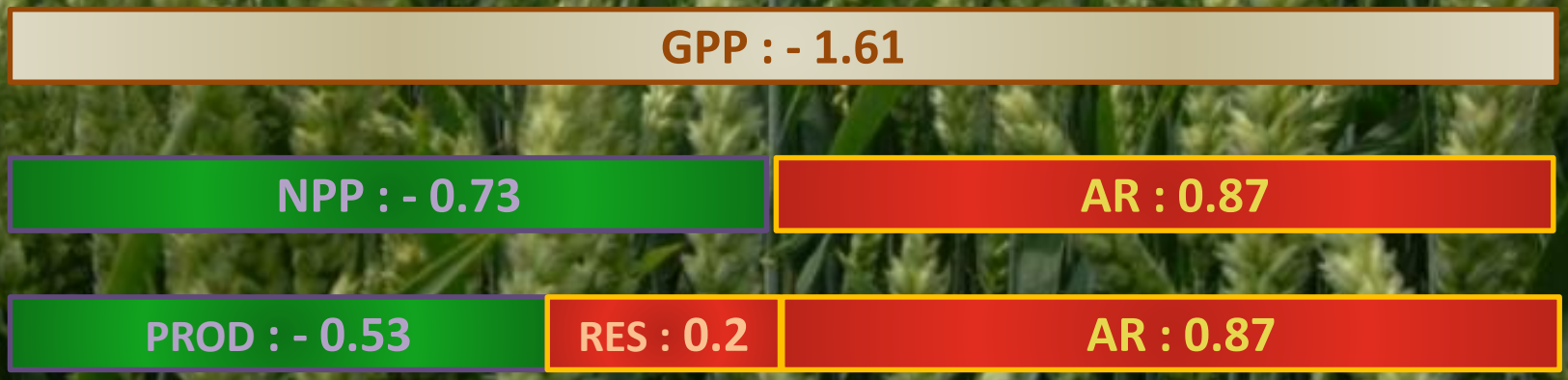


Winter wheat carbon balance (kg C m^{-2} yr^{-1})

Carbon sequestration perspective



Production perspective



LTO : Rotation carbon balance (kg C m^{-2} yr^{-1})

kg C m^{-2}	NEE	NBP
Year 1 (Sugar beet)	- 0.94 (0.30)	-0.05 (0.15)
Year 2 – 4 (Winter wheat)	-0.27 (0.09)	+0.14 (0.11)
Year 3 (Potato)	-0.09 (0.11)	+0.16 (0.12)
Mean 4 years	-0.39 (0.09)	+0.10 (0.06)

Conclusions

At LTO, NEE is negative in average (-0.39 kg C m^{-2} yr^{-1})

But, in the whole (NBP), it is a source (0.10 kg C m^{-2} yr^{-1})

Large interannual variability for one given crop

The budget is sensitive to cropping activities

Other GHG fluxes (N_2O) should be investigated

Thank you !

Papers on LTO:

CO2 fluxes over a sugar beet crop:
*Moureaux et al., **AgForMet 139**, 2006*

Carbon balance of winter wheat:
*Moureaux et al., **GlobChBiol 14**, 2008*

Carbon budget of a first 4-year rotation
*Aubinet et al., **AgForMet 149**, 2009*

Discrimination between heterotrophic and autotrophic respiration
*Suleau et al., **AgForMet 151**, 2011*

Comparison between three winter wheat years
*Dufranne et al., **AgEcos&Env 141**, 2012*

Carbo Europe Papers on crops :

Special issue : The carbon balance of croplands in Europe, ***AgEcos&Env 139**, 2010*

Cesschia et al.,
Kutsch et al.,
Eugster et al.,
….

On eddy covariance :

Aubinet, Vesala, Papale (Eds) (2012) Eddy Covariance : A Practical Guide to Measurement and Data Analysis
Springer Atmospheric Series

Transitioning Cereal Systems to Adapt to Climate Change

REACCH
Regional Approaches to Climate Change –
PACIFIC NORTHWEST AGRICULTURE

Thank you!

University of Idaho

Washington State University

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

Oregon State University OSU

Pacific Northwest Farmers Cooperative

CHS

Monsanto