Effects of long term soil organic matter restitution mode on soil heterotrophic respiration and soil biological properties.

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Francqui Chair 2011,
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Introduction

- Soil Heterotrophic Respiration (SHR): positive feedback to global change in the future?
- Agricultural soils = potentially important sources of CO_2.

  ➔Importance of crop management (e.g. Organic Matter Restitution Mode = « OM-RM »)

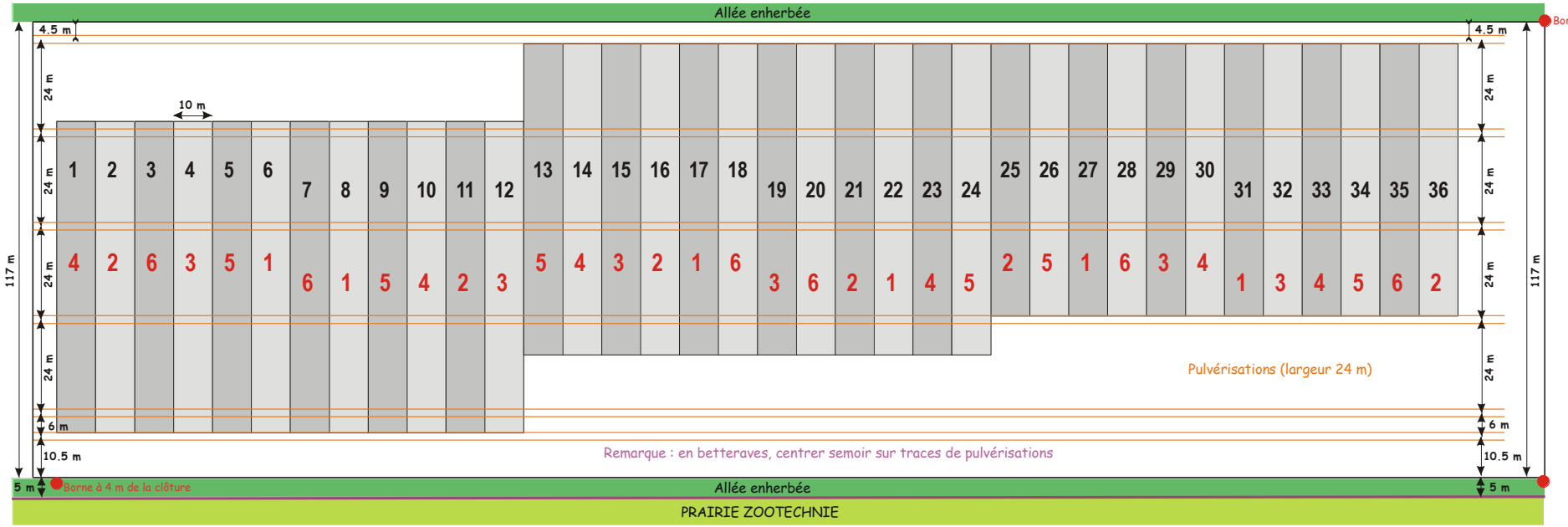
Scientific questions

1. Does long term (> 50 years) application of different OM-RM cause differences in SHR fluxes?
2. Do different OM-RM imply different responses of SHR to Temperature and Soil moisture content?
3. Is the experimental set-up suitable to answer these questions?

Material and Methods

Experimental design

- Situated in Liroux, near Gembloux
- 6 different OM-RM (RM1 ➔ RM6)
- 6 plots (repetitions) in each treatment: 10 by 70 (or 60) m
- All plots ploughed over 0-25 cm depth



Manual SHR flux measurements

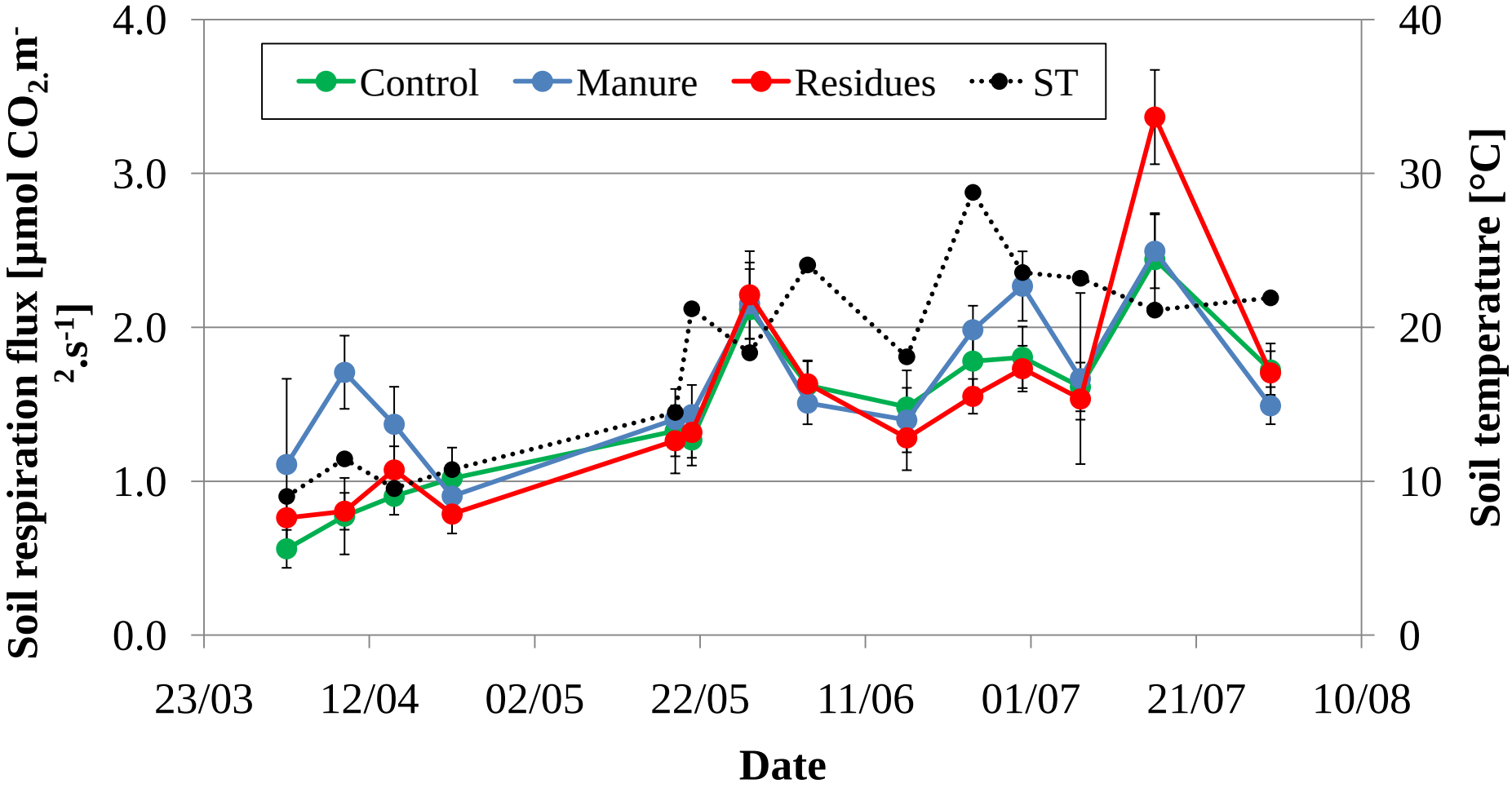
- Studied OM-RM (in 3 out of the 6 repetition plots):
  - RM 1: Control (exportation of all residues)
  - RM 4: Manure
  - RM 6: Restitution of residues
- **Weeded areas** (3 m by 3 m): **4 measurement points** ➔ 12 points/treatment

Manual SHR flux measurements

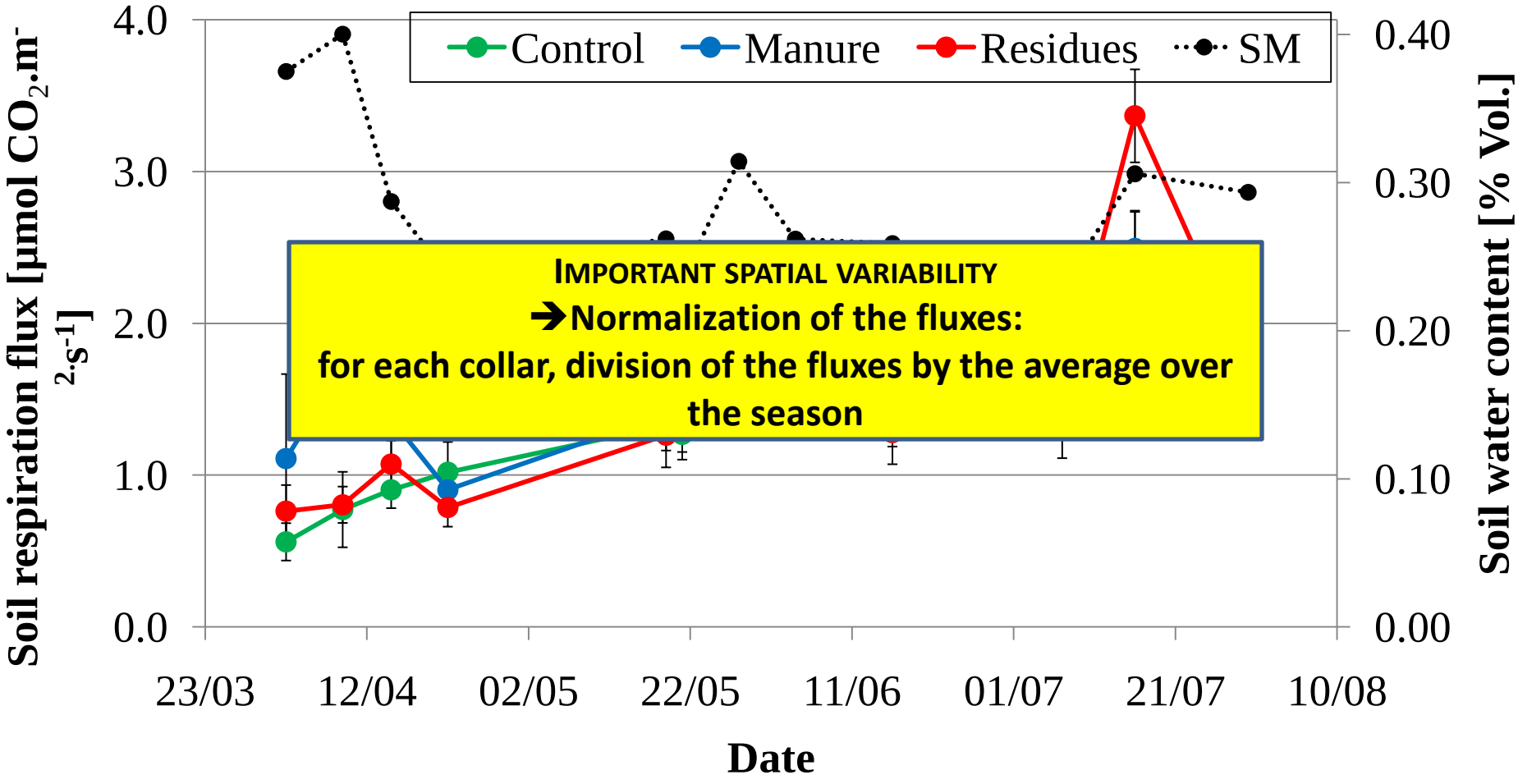
- From 2 April to 30 July 2010 (14 measurement dates).
- Dynamic closed chamber system ([CO_2] vs Time).
- Measurements of Temperature and Soil moisture content.

Main results

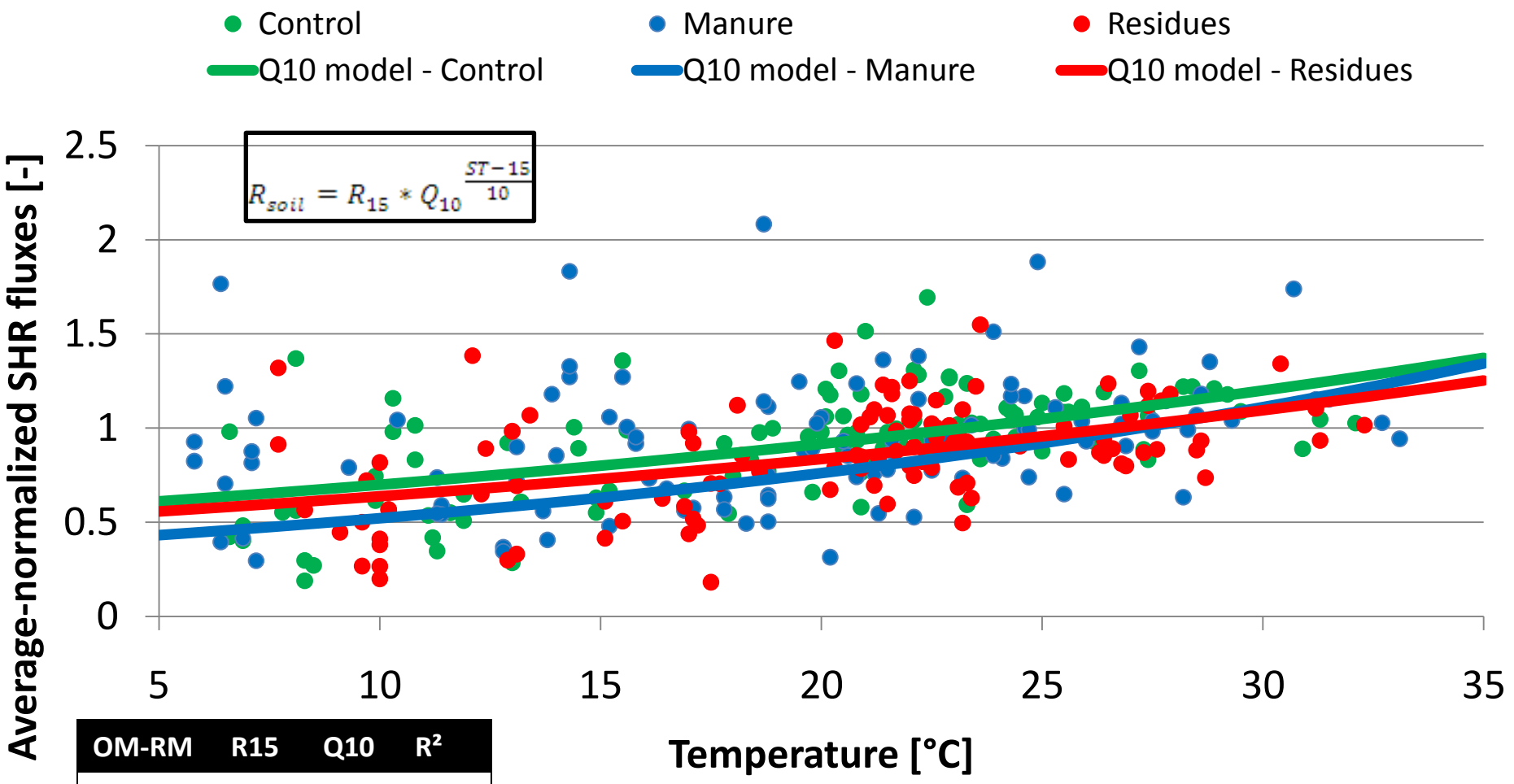
Temporal evolutions of SHR fluxes and Soil temperature



Temporal evolutions of SHR fluxes and Soil moisture content



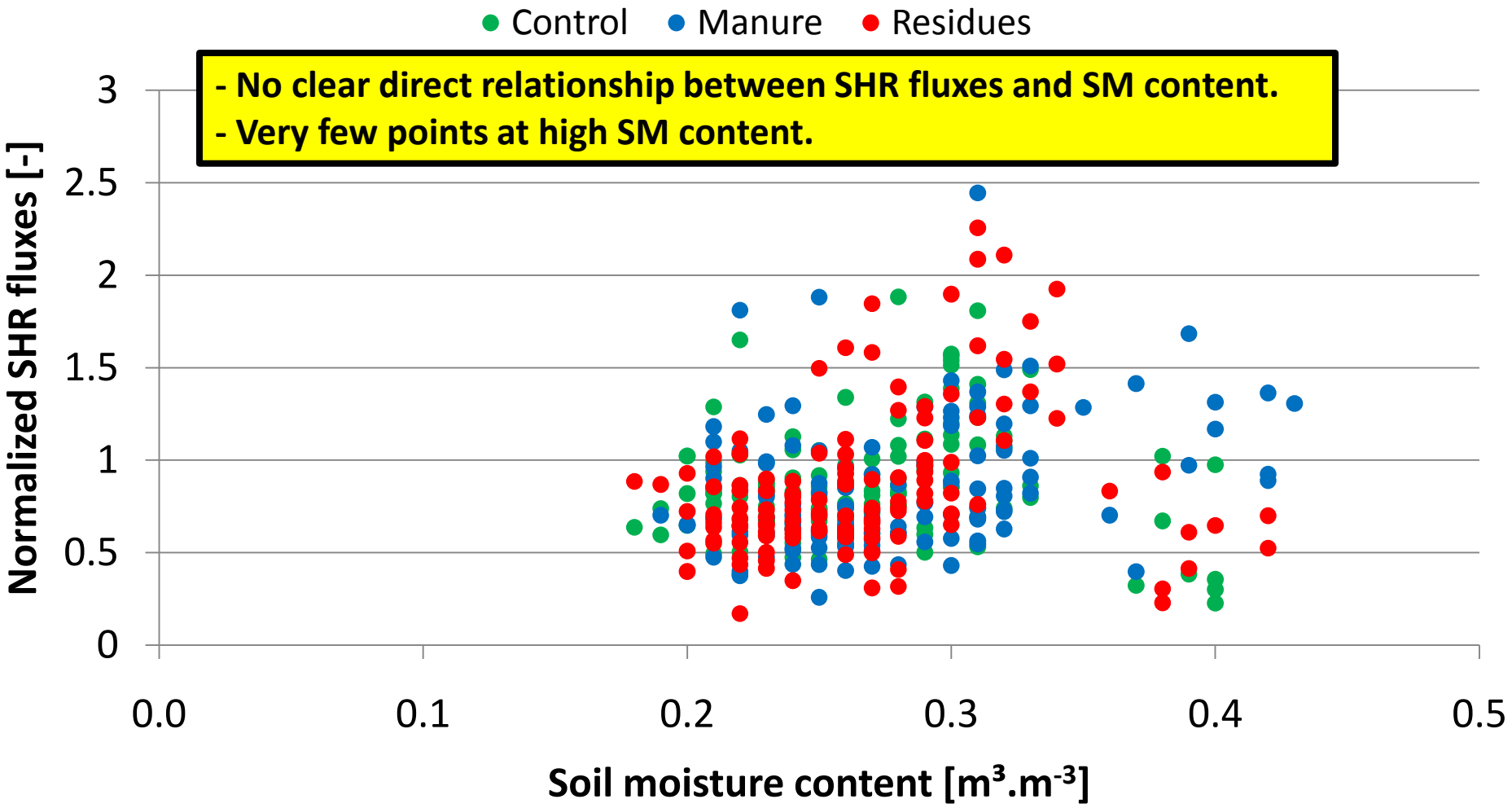
SHR fluxes vs Temperature



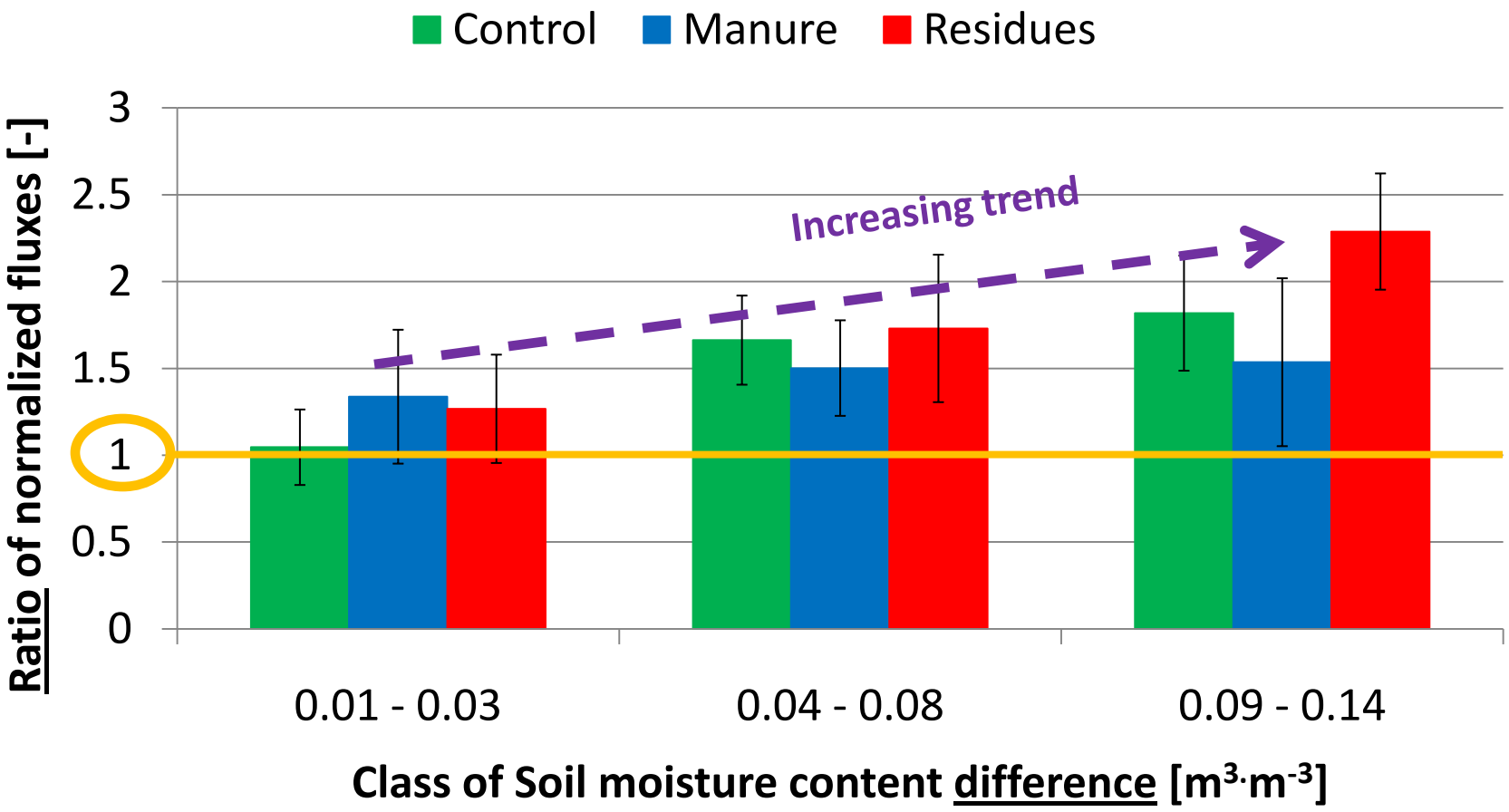
OM-RM	R15	Q10	R^2
1	0.8	1.31	0.32
2	0.63	1.46	0.15
3	0.73	1.31	0.24

➔ R15 and Q10 factors: No significant difference between treatments (ANOVA, $p > 0.05$)

SHR fluxes vs Soil moisture content



Increase of SHR fluxes after increase of SM content between two measurement dates.



Spatial variability issue

➔ Does spatial variability preclude the assessment of potential differences between treatments?

SOC content	Relative difference
Control vs Manure	25.6
Control vs Residues	15.8
Residues vs Manure	10

SHR Fluxes	Relative uncertainty (%)
Control	17.3
Manure	14.1
Residues	13.6

SHR fluxes	Relative difference (%)
Control vs Manure	22.4
Control vs Residues	22.0
Residues vs Manure	19.6

➔**Only differences between « Control » and « Manure »** could potentially be assessed.
➔**The amount of measurement points should be min. 9, 24 and 45** to assess differences between Control/Manure, Control/Residues and Residues/Manure respectively.

Main findings and discussion

- Question 1: SHR flux differences between the treatments?

➔No.

➔ Potential reasons:

  - Problem of spatial variability
  - Impact of drought ➔ low fluxes ➔ smaller differences

- Question 2: Different responses to T° and SM content?

➔ No.

➔ The study showed a strong SHR response to rewetting events.

➔ Birch effect? Solubilization of labile carbon?

- Question 3: Is the experimental set-up sufficient?

➔ Not totally. Because of the very important spatial variability more measurement points would be necessary.

Perspectives

- New flux measurement campaign in 2011
- Further investigation: « What are the effects of long term application of different OM-RM on soil biological properties (microbial biomass, metabolic activity, qCO_2, labile carbon)? »

Thank you!

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Types of OM-RM

	Description of treatment
RM 1	**Control (exportation of residues)**
RM 2	Straw + liquid manure
RM 3	Straw +liquid manure
RM 4	**Exportation of residues + Manure**
RM 5	Restitution of residues
RM 6	**Restitution of residues**

➔Today's situation.
➔RM 2, 3 and 5 changed before and after 1998.
➔RM 1, 4 and 6 were left unchanged since 1959.

SOC temporal evolution