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# SPATIAL VARIATION IN SOIL CO<sub>2</sub> EFFLUX IN FRENCH AND BELGIAN TEMPERATE FORESTS

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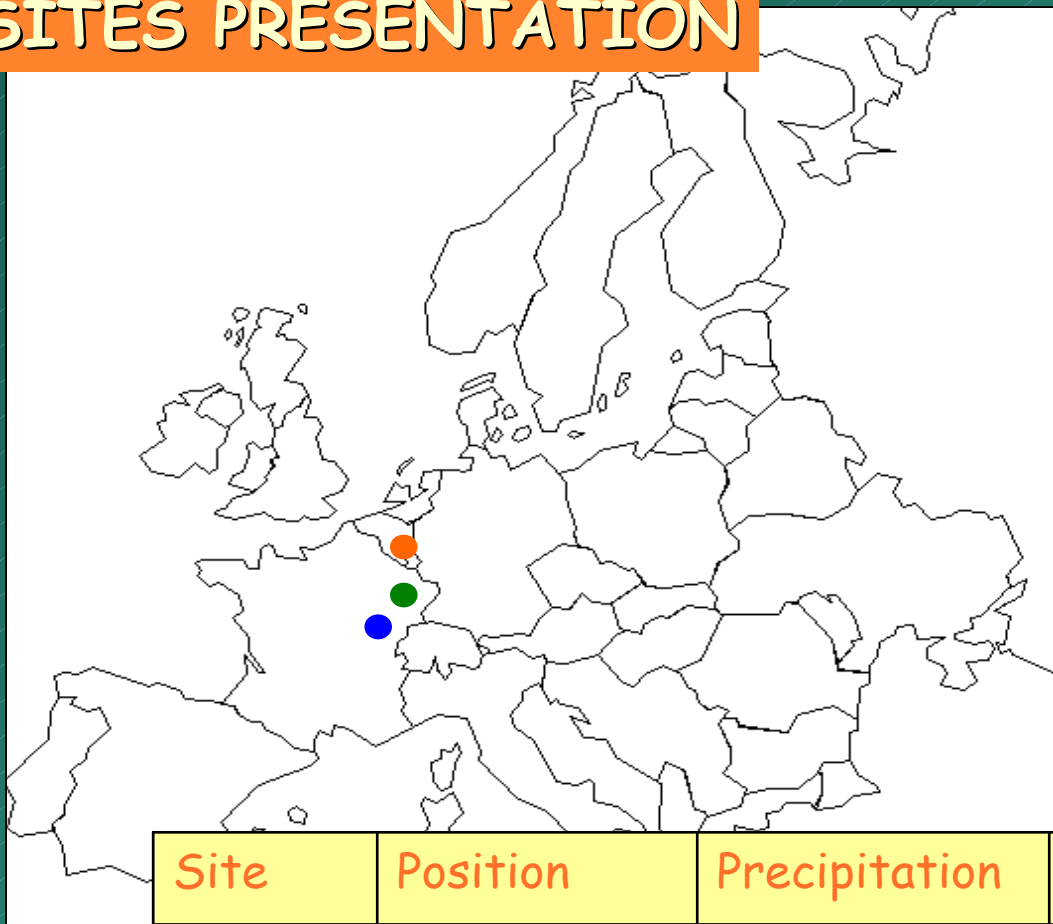
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## MAIN OBJECTIVE

Quantification of the relative importance of climatic factors and ecosystem properties on the spatial variability of soil CO<sub>2</sub> efflux (SR) from different ecosystems (plots).

1. System comparison and set up of a common protocol.
2. Quantification of climatic influences on SR for each plots.
3. Identification of the main ecosystem properties influencing SR<sub>plot</sub> variability

## SITES PRESENTATION



- Vielsalm, University of agricultural science, Gembloux, Belgium
- Hesse, National Institute of the Agronomic Research, Nancy, France
- Chaux, University of Franche-Comté, Besançon, France

Site	Position	Precipitation	Air temperature	Elevation
Chaux	47°07'N 05°42'E	950 mm	10,3°C	250 m
Hesse	48°40'N 7°05'E	1150 mm	10.5°C	300 m
Vielsalm	50°18'N 6°00'E	800 mm	8,5°C	450 m

Sites plots	Hesse			Chaux			Vielsalm	
	H1	H2	H3	C1	C2	C3	V1	V2
Tree species	Beech	Beech/Spruce		Mixed broadleaves			Beech	Douglas fir
LAI	6.3	5.5 - 8	4 - 8	7.2	7.9	7.4	3.3	5.0
Age (years)	35	35	35	Stratified forest			95	68
Ground area (m <sup>2</sup> .ha)	20.7	19.7	22.7				129	112
Soil class	Luvisol/Stagnic luvisol			Gleyic Luvisol			Dystric Cambisol	
Texture	7%(S <sub>a</sub> ); 64%(S <sub>i</sub> ); 29%(C)			20%(S <sub>a</sub> ); 50%(S <sub>i</sub> ); 30%(C)			27%(S <sub>a</sub> ); 55%(S <sub>i</sub> ); 18%(C)	
Soil density	1.078	1.103	1.108	1.024	0.978	0.997	1.038	1.044
Litter height (cm)				0.78	1.09	1.12	1.07	1.75
[C] g.kg <sup>-1</sup> (0-8 cm)	29.61	27.44	29.67				43.7	57.3
[N] g.kg <sup>-1</sup> (0-8 cm)	1.84	1.41	1.90				2.9	4.8
pH H <sub>2</sub> O	4.43	4.49	4.53	4.5	4.5	5	4.46	4.26
pH KCl	3.68	3.61	3.59				3.79	3.46

# MATERIAL AND METHODOLOGY

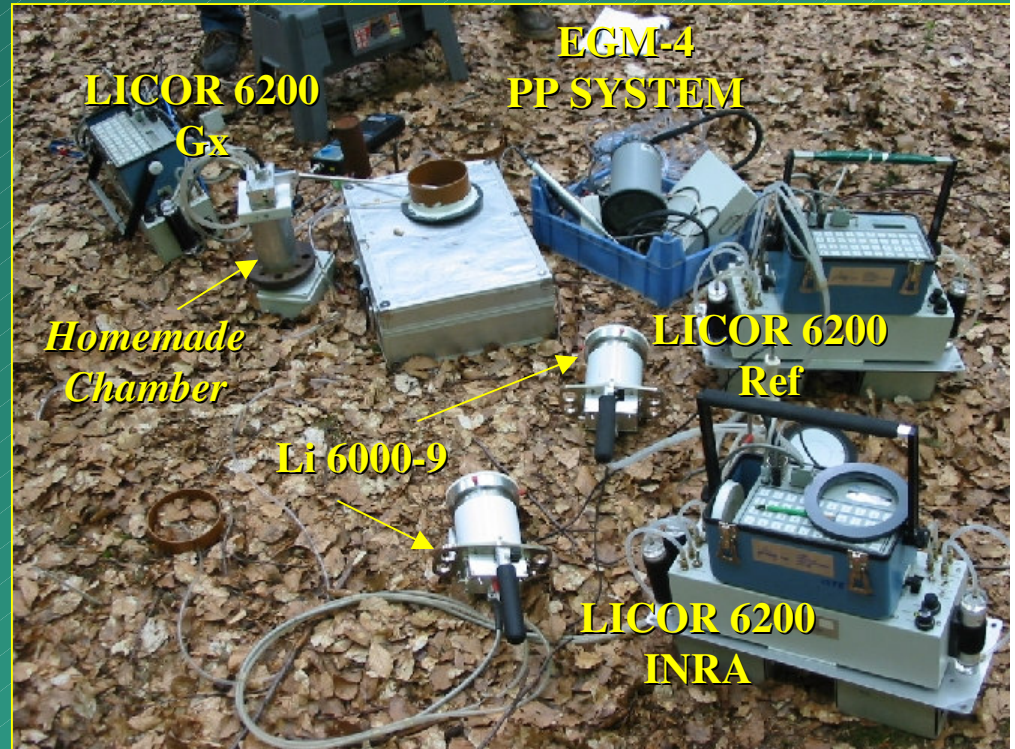
## 1. Four SR measurement systems

## 2. Soil Temperature ( $T_s$ )

- Thermocouple
- 10 cm depth
- Fixed (climatic station) or mobile (inserted near the measurement point)

## 3. Soil Water Content (SWC)

- Thetaprobe
- 0-20 cm depth
- Fixed or mobile



## COMPARISON

Two campaigns of measurements with the four systems :

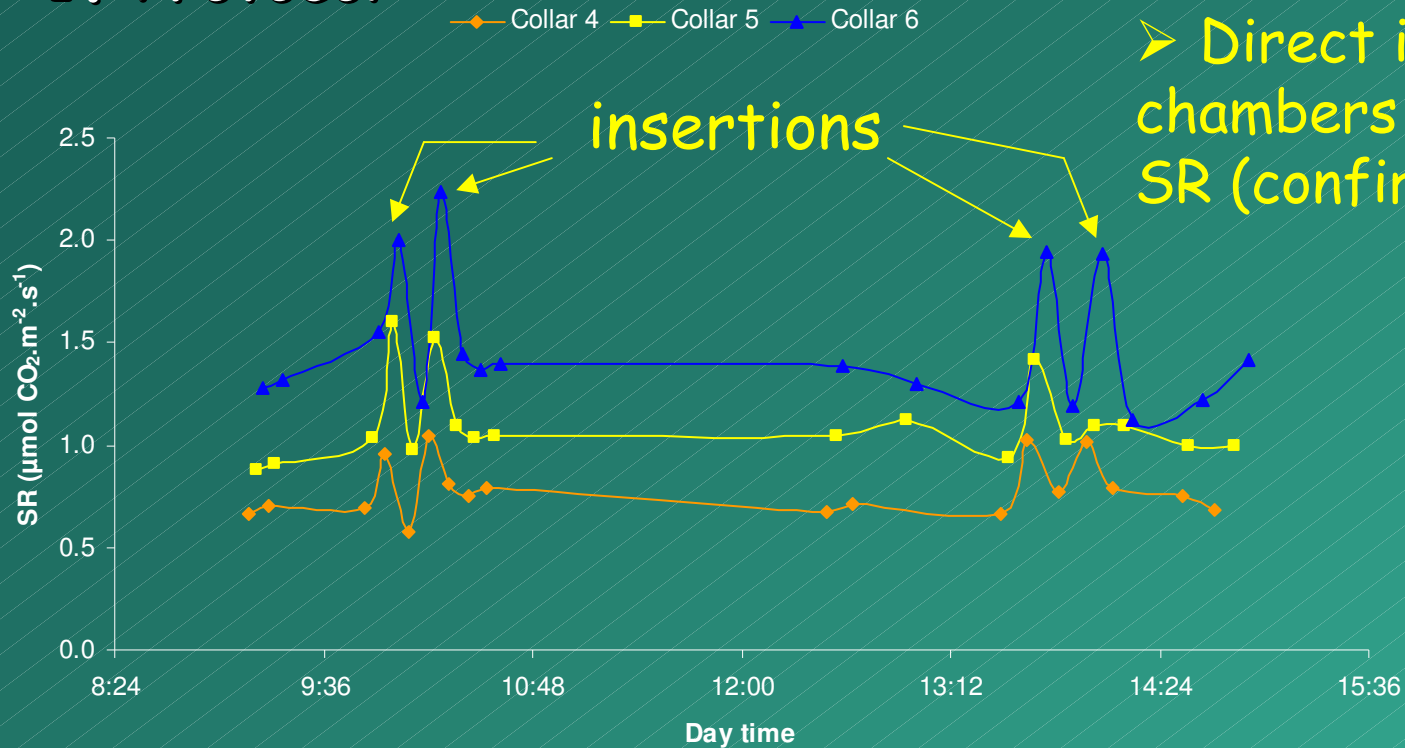
- ✓ 05/03 Vielsam (12 collars)
- ✓ 09/03 Hesse (20 collars)

One campaign in each plots with the reference and the « local » system



1. Protocol
2. Fluxes
3. SWC
4. Ts

# 1. Protocol

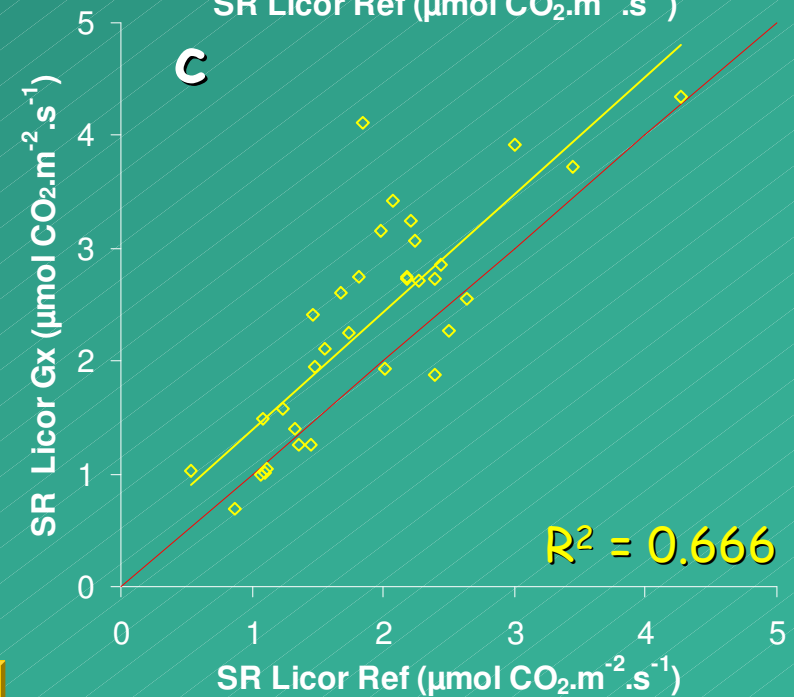
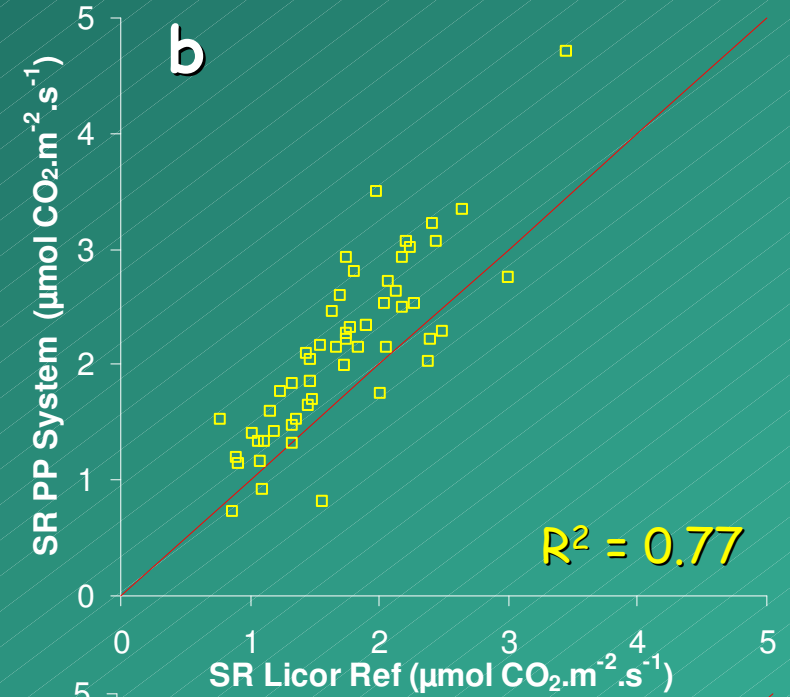
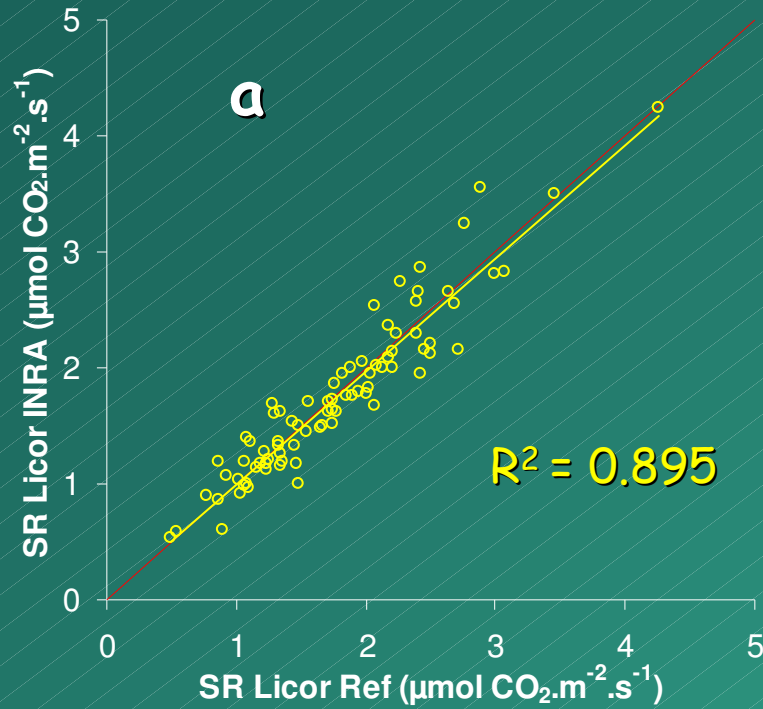


➤ Direct insertion of chambers generates higher SR (confirmation)

- $P_{ch} - P_{air} \leq 0.1 \text{ Pa}$  (Fang & Moncrieff, 98; Longdoz & al. 2000)
- 60 s are sufficient between two measurements on the same point
- No impact of the duration of measurement (up to 75 s)



## 2. Fluxes



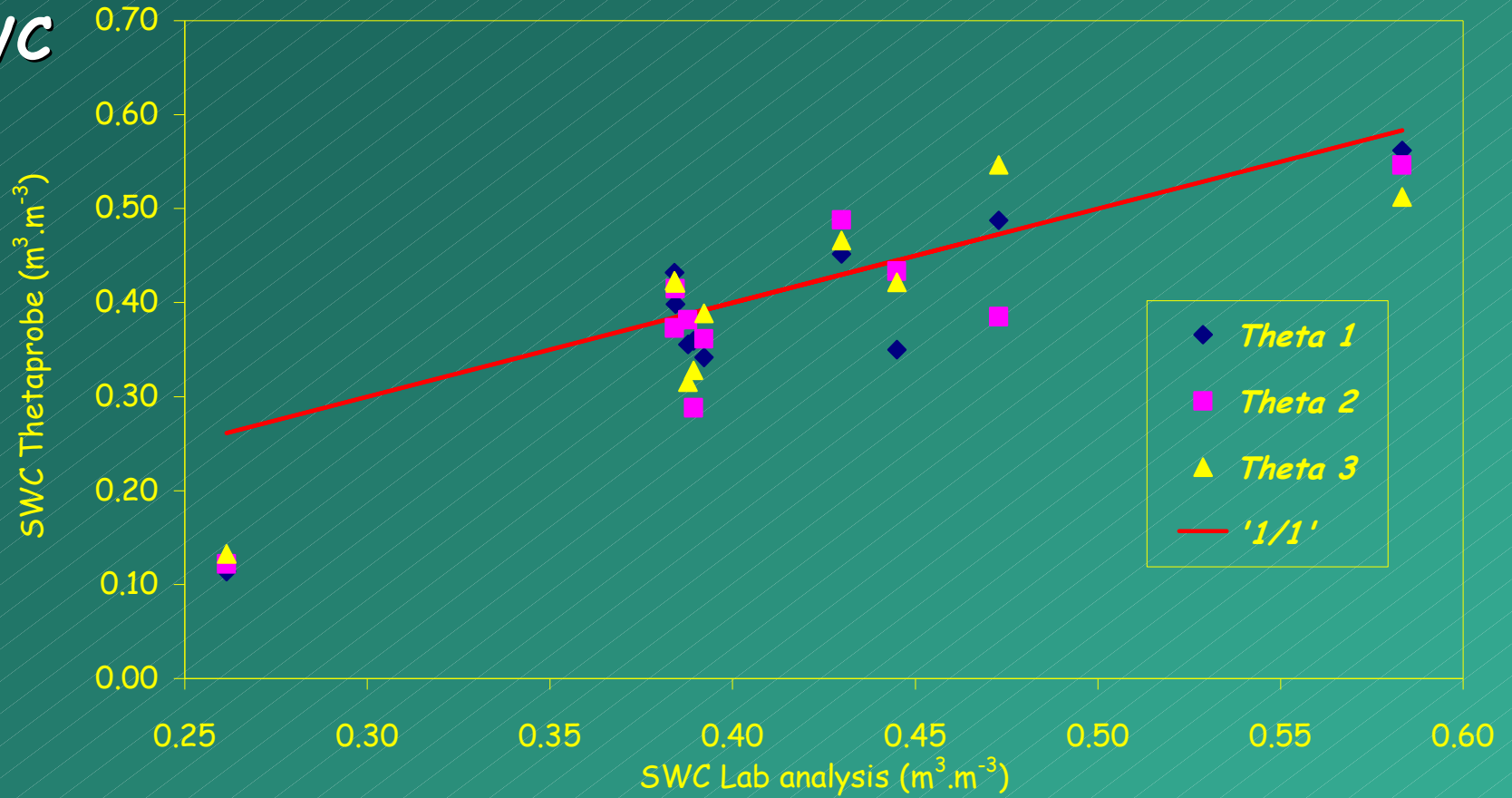
« Systems » equations :

**a**  $SR_{\text{Licor INRA}} = 0.9733 \cdot SR_{\text{Licor Ref}} + 0.0291$

**b**  $SR_{\text{PP System}} = 1.1472 \cdot SR_{\text{Licor Ref}} + 0.1392$

**c**  $SR_{\text{Licor Gx}} = 1.044 \cdot SR_{\text{Licor Ref}} + 0.3496$

### 3. SWC



### 4. Ts

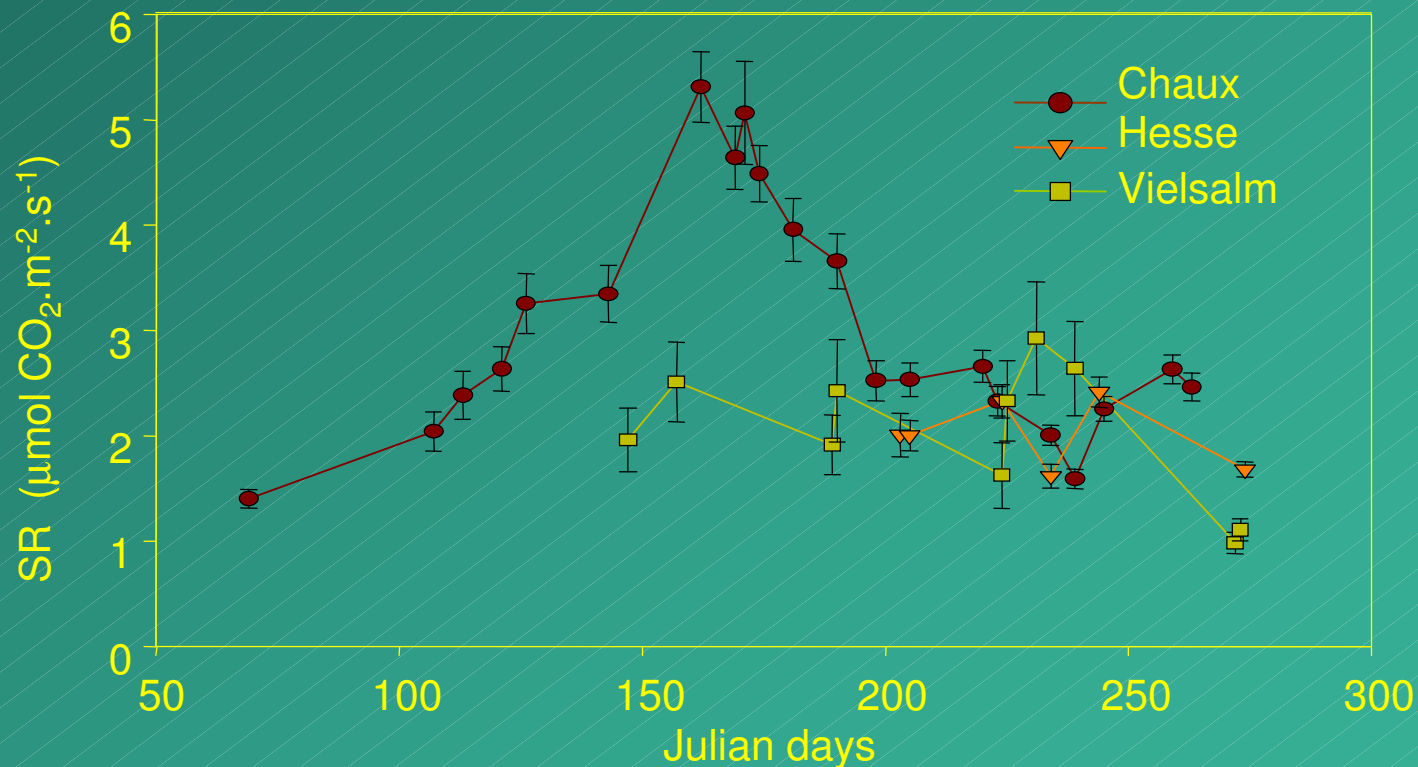
- This year : measurements with fixed probes
- Future : new probes (0 - 5 cm, 10 cm)



# CLIMATIC IMPACTS

For each plots :

1. measurements on minimum 12 collars, at several dates
2. conversion to  $SR_{ref}$  using the "systems" equations
3. one average value of  $SR_{ref}$  ,  $T_s$  ,  $SWC$  , by measurement dates

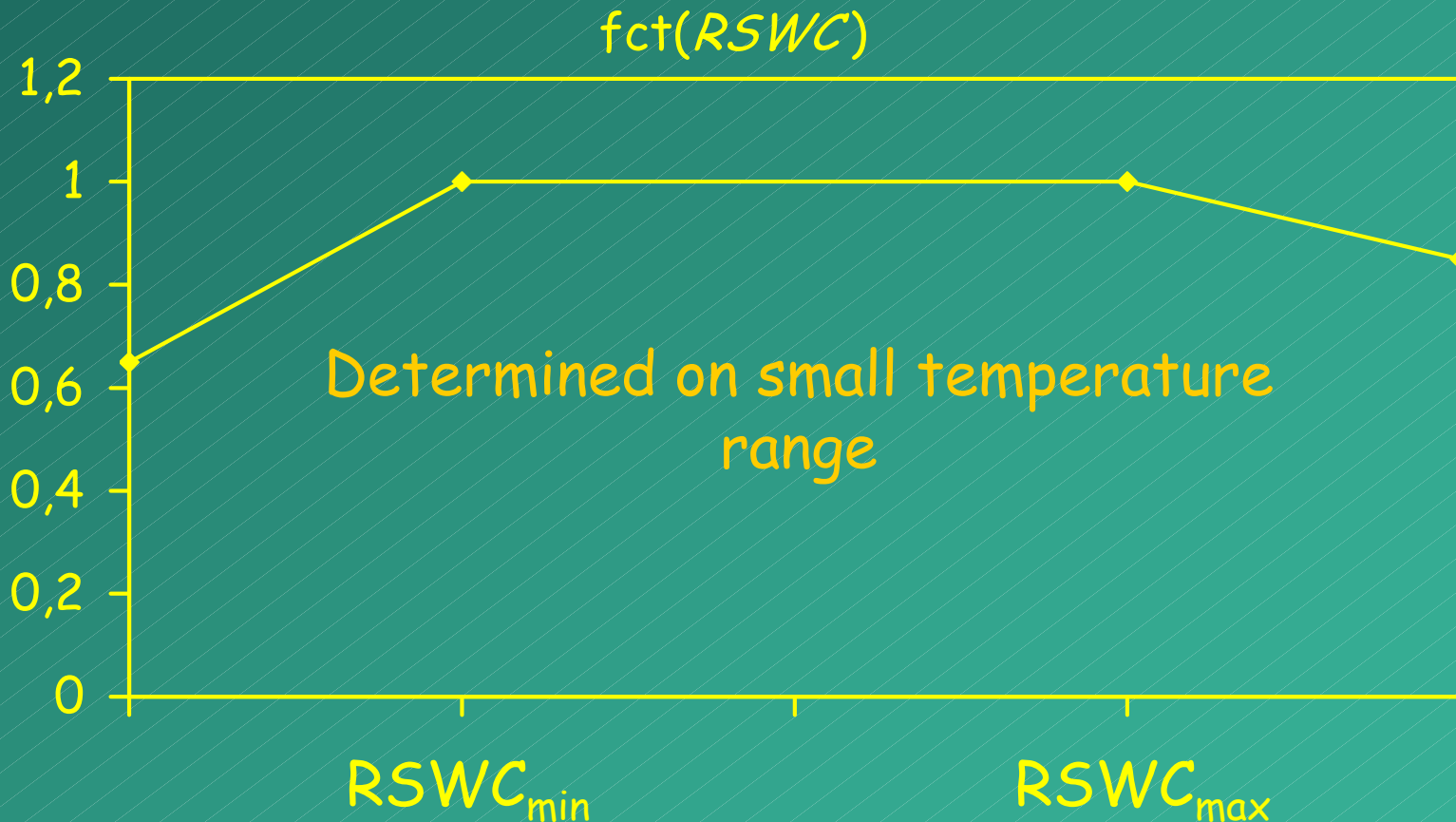


## Model

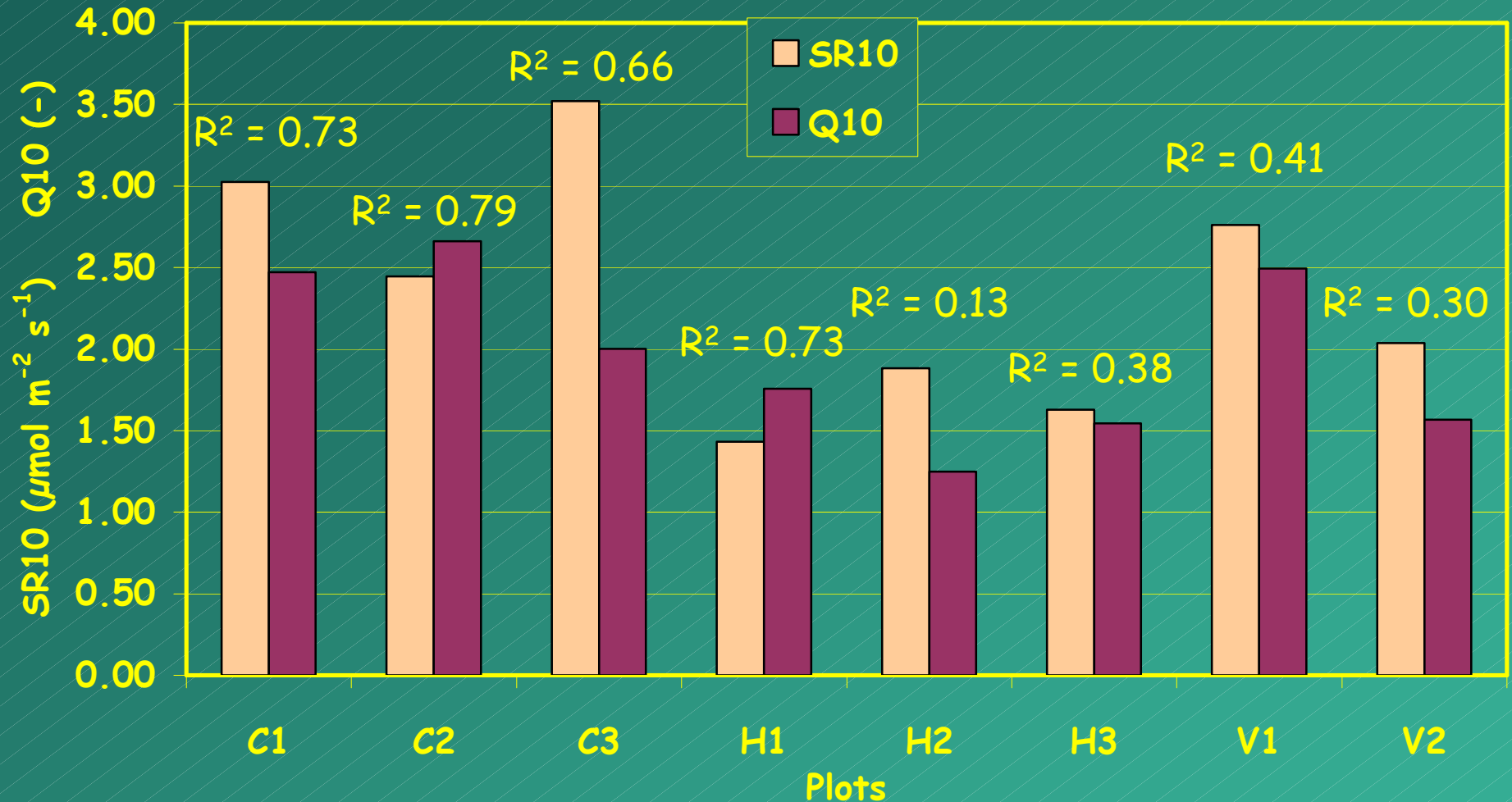
Multiplicative model : separation of SWC and Ts impacts

$$SR = SR_{10} * Q_{10} \left( \frac{T-10}{10} \right) * fct(RSWC)$$

where  
 $RSWC = SWC / SWC_{sat}$



# INTERPLOTS VARIABILITY



- Ts range to small during measurement periods for Hesse and Vielsalm
- Tendency : small  $SR_{10}$  and  $Q_{10}$  for young and coniferous plots (to be confirmed)

## CONCLUSIONS AND PERSPECTIVES

- Relatively good accuracy between systems → inter-plots variability consistent
- Work still in progress (more data to improve climatic impact)
- Small  $SR_{10}$  and  $Q_{10}$  for young and coniferous plots ?
- More plots with contrasted environmental conditions and properties

OTHERS TEAMS ARE WELCOME