UNIVERSITE DE LIÈGE
Gembloux Agro-Bio Tech

Agriculture Is Life.be

Can we use ERT to measure root zone competition in fields with multiple crops?

S. Garré, I. Coteur, C. Wongleecharoen, K. Hussain, W. Omsunrarn, T. Kongkaew, T. Hilger, J. Diels, J. Vanderborght

A collaboration of

KULeuven, Hohenheim University, Kasetsart University, FZJülich

Can we use ERT to measure root zone competition in fields with multiple crops?

YES

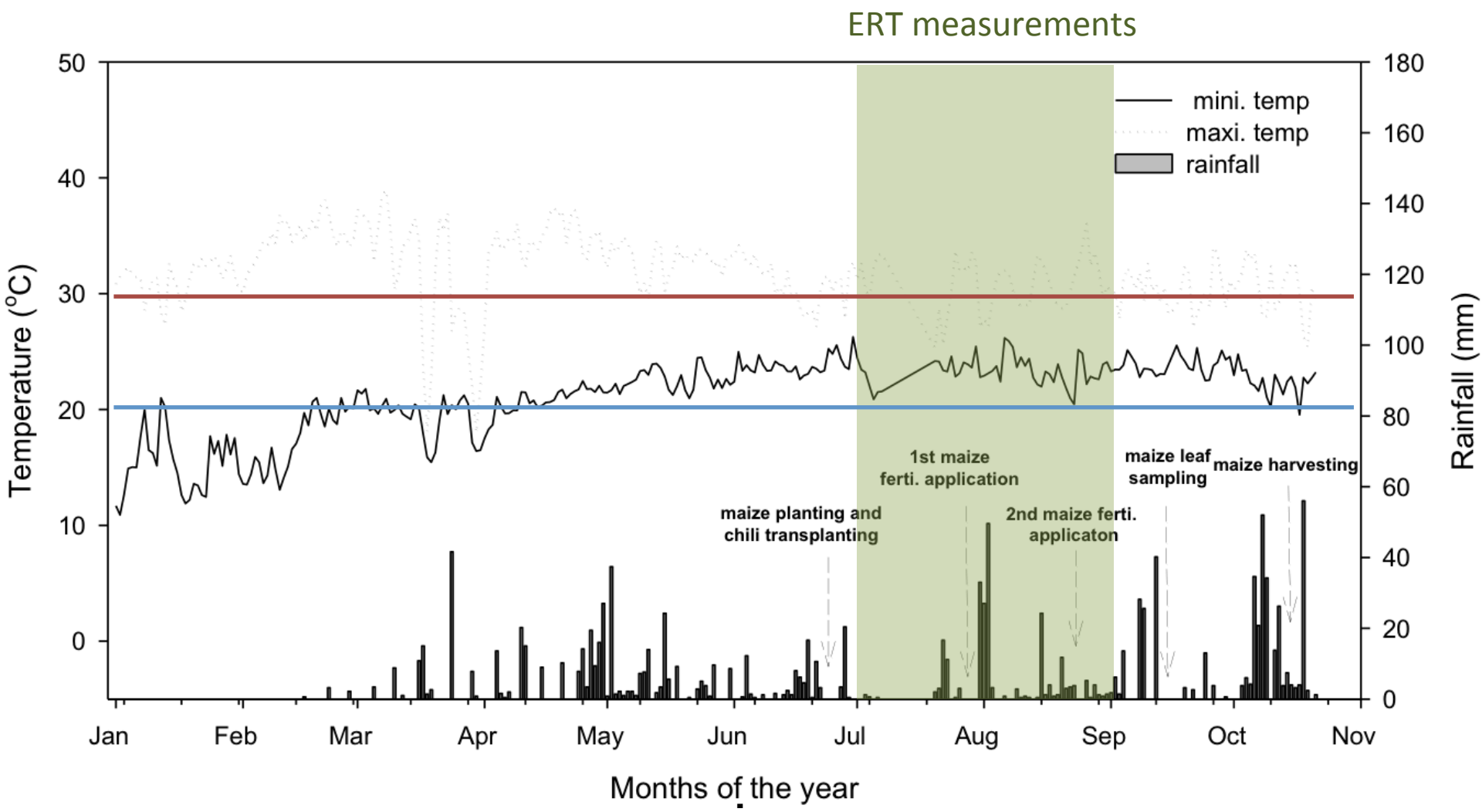
Can we use ERT to measure root zone competition in fields with multiple crops?

YES BUT...

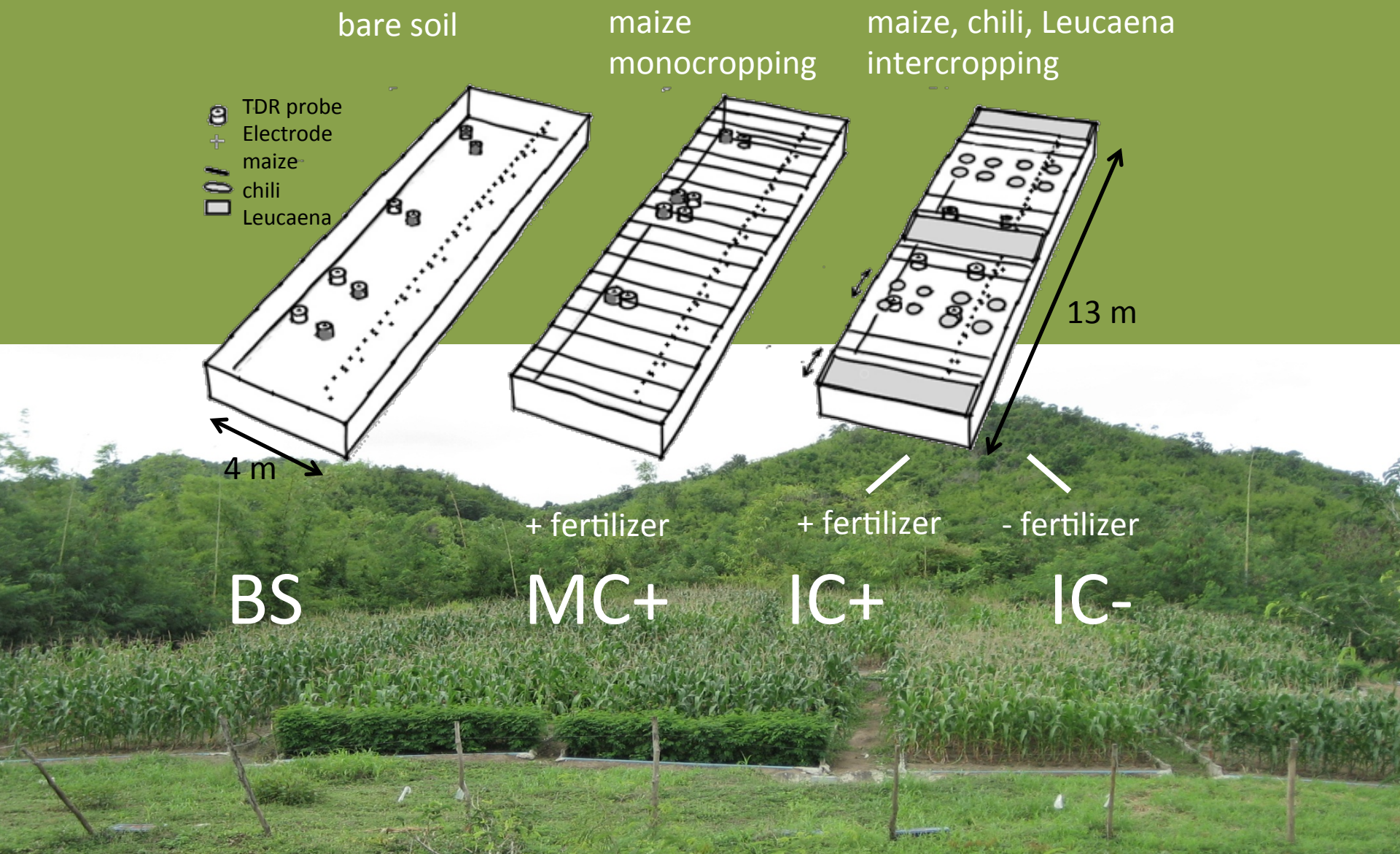
YES


Chiang Rai
Mae Hong Son
Laos
Phayao
Chiang Mai
Doi Phu Kha National Park
Lampang
Vientiane
Bueng Kan
Udon Thani
Thaton
Phitsanulok
Sakon Nakhon
Savannakhet
Khon Kaen
Mawlamyine
Nakhon Sawan
Roi Et
Thailand
Ubon Ratchathani
Nakhon Ratchasima
Si Sa Ket
Suphan Buri
Ta Phraya National Park
Dawei
Kanchanaburi
Siem Reap
Pattaya
Myeik
Rayong
Cambodia
Phnom Penh
Ratchaburi Province
Chumphon
Long Xuyen
Gulf of Thailand
Rach Gia
Ranong
Ko Samui
Surat Thani
Ca Mau
Nakhon Si Thammarat
Phang-nga
Phuket

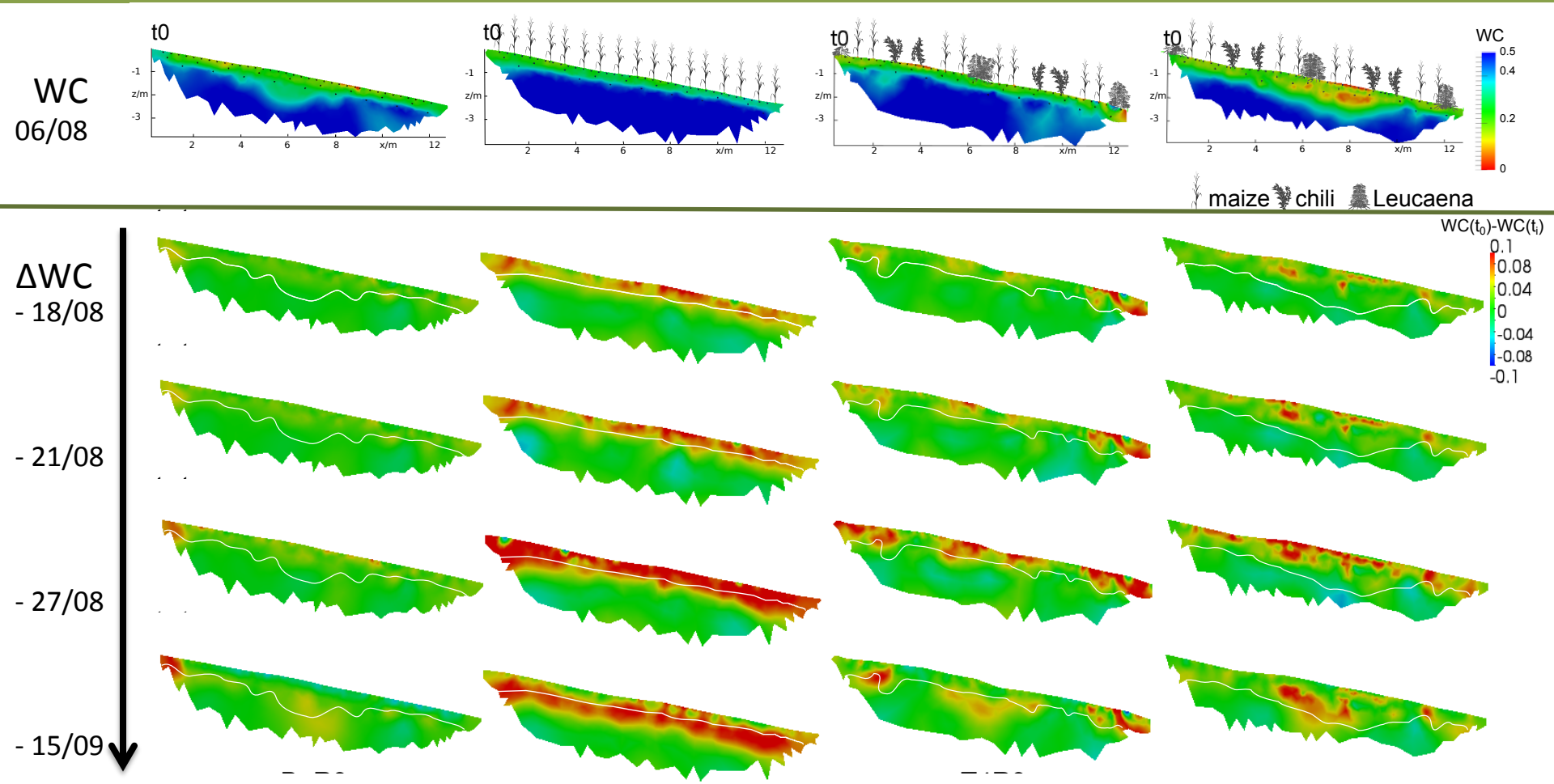
Climate


ERT measurements
mini. temp
maxi. temp
rainfall
1st maize ferti. application
maize leaf sampling
maize harvesting
maize planting and chili transplanting
2nd maize ferti. applicaton
Temperature (°C)
Rainfall (mm)
50
40
30
20
10
0
180
160
140
120
100
80
60
40
20
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Months of the year

4 contrasted cases

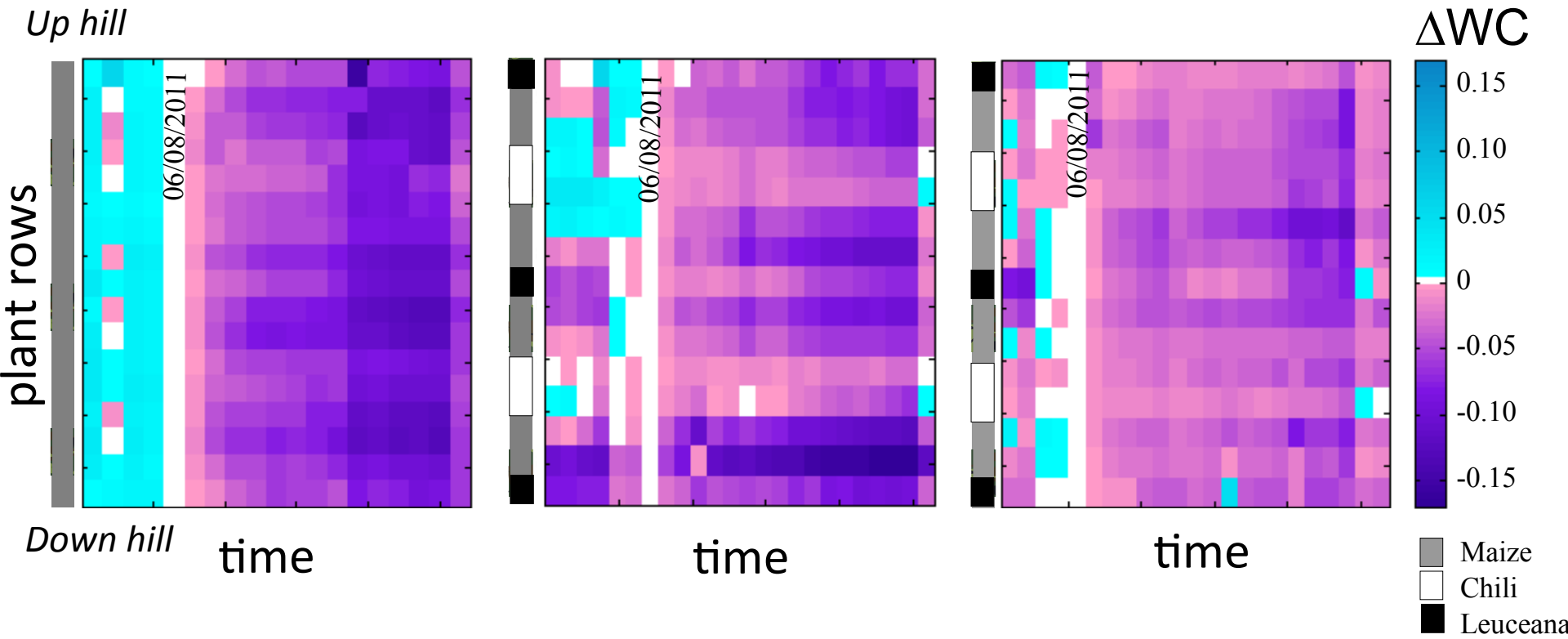


Soil moisture depletion



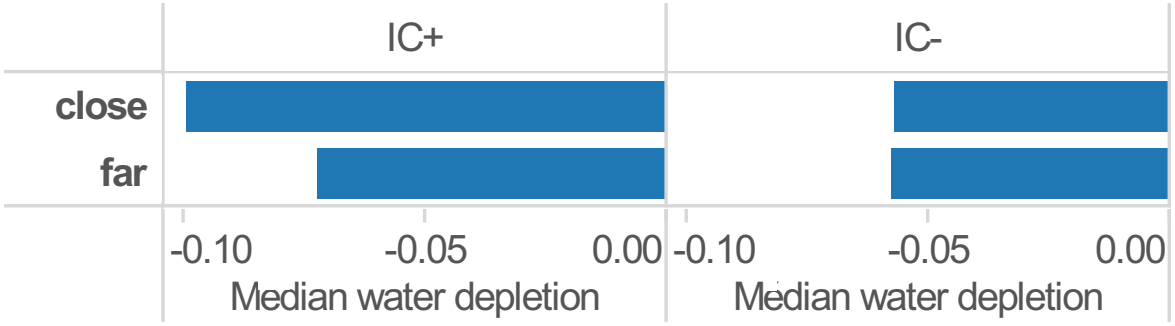
BS MC+ IC+ IC-

Water depletion during growing season

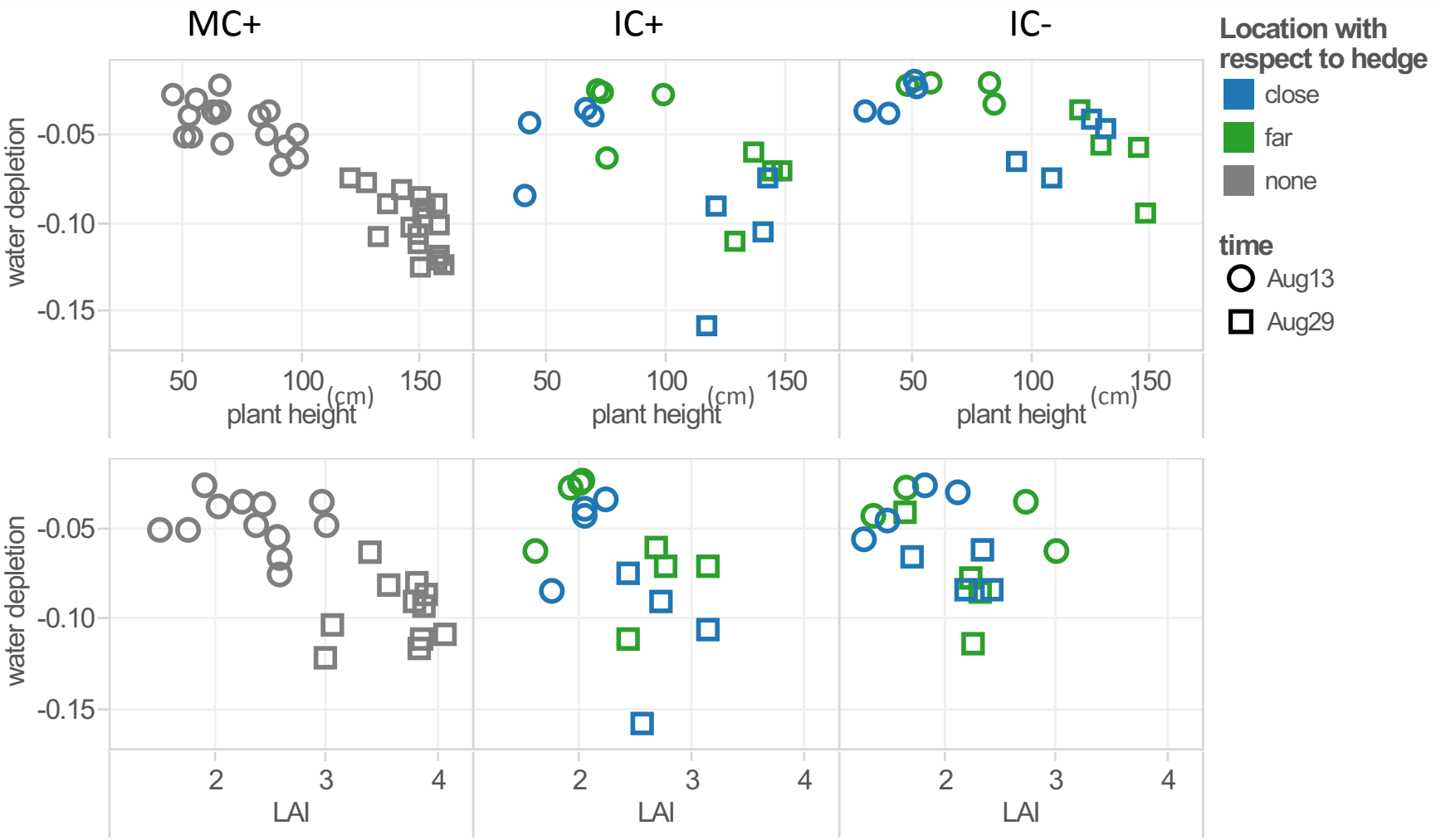


MC+ IC+ IC-

Water depletion f(distance to hedge)?



Water depletion vs. plant performance



Carbon isotopic ratio of C4 plants

Air: constant ratio of carbon isotopes (R)

$$\partial^{13}C = \left(\frac{R_{sample}}{R_{PDB}} - 1 \right) x1000 \quad with \quad R = \frac{^{13}C}{^{12}C}$$

No stress: same ratio $^{13}C/^{12}C$ in plant cells } $\delta^{13}C \cong -13$

Water stress: stomata close

-> fractionation by diffusion

-> discrimination against ^{13}C by enzyme RuBisCo

-> leaky bundle sheath cells

} $\delta^{13}C \searrow$

N stress: photosynthesis is shut down

-> less discrimination against ^{13}C

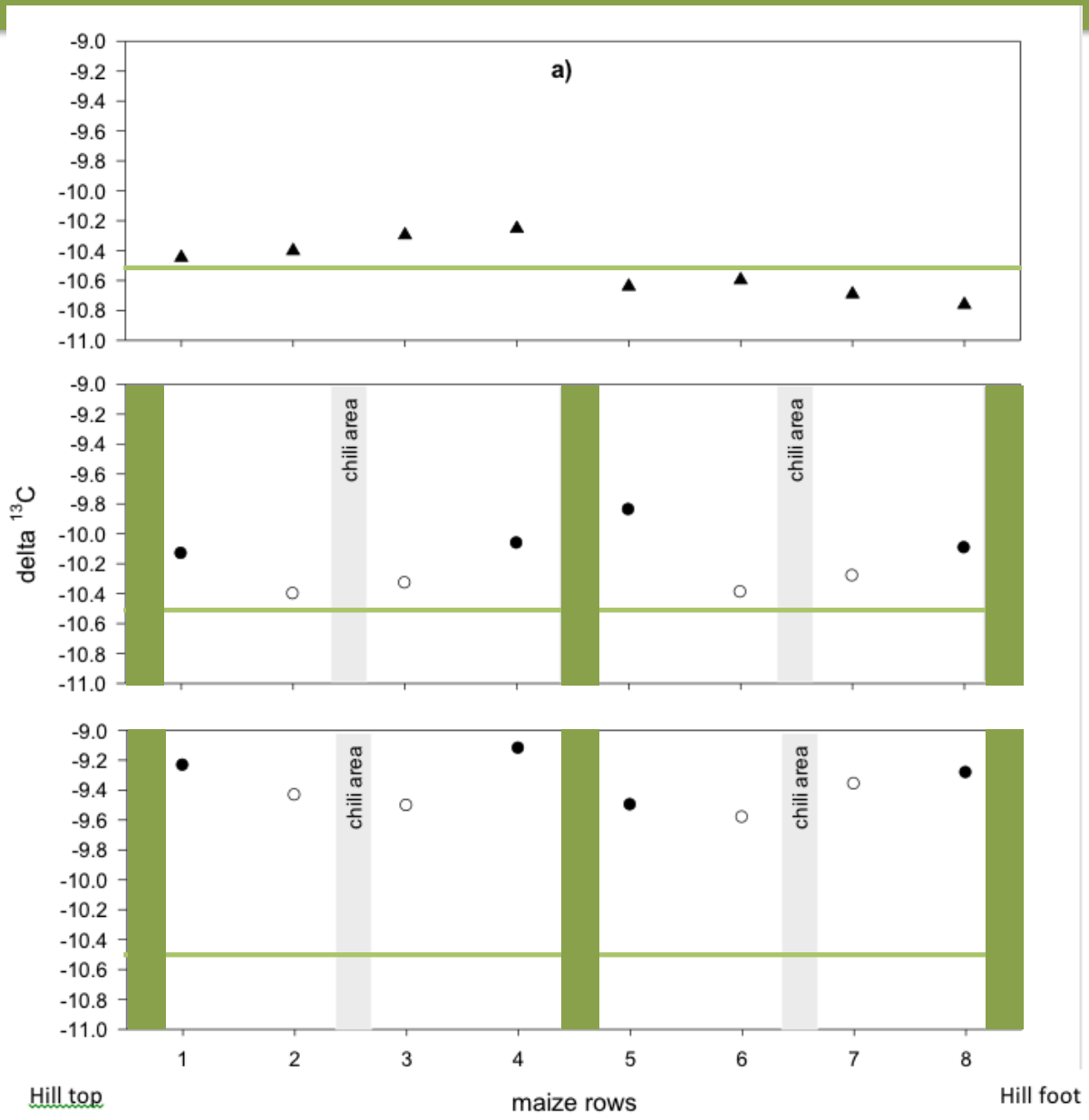
} $\delta^{13}C \nearrow$

Grain carbon isotopic ratio ($\delta^{13}C$)

MC +

IC+

IC-



$\delta^{13}C$ increase -> competition for N!

YES

… we can retrieve patterns of water depletion
… we can quantify differences between cropping systems
… combination with $\delta^{13}C$ techniques: nature of competition can be identified

YES

… we can retrieve patterns of water depletion

… we can quantify differences between cropping systems

… combination with $\delta^{13}C$ techniques: nature of competition can be identified

BUT…

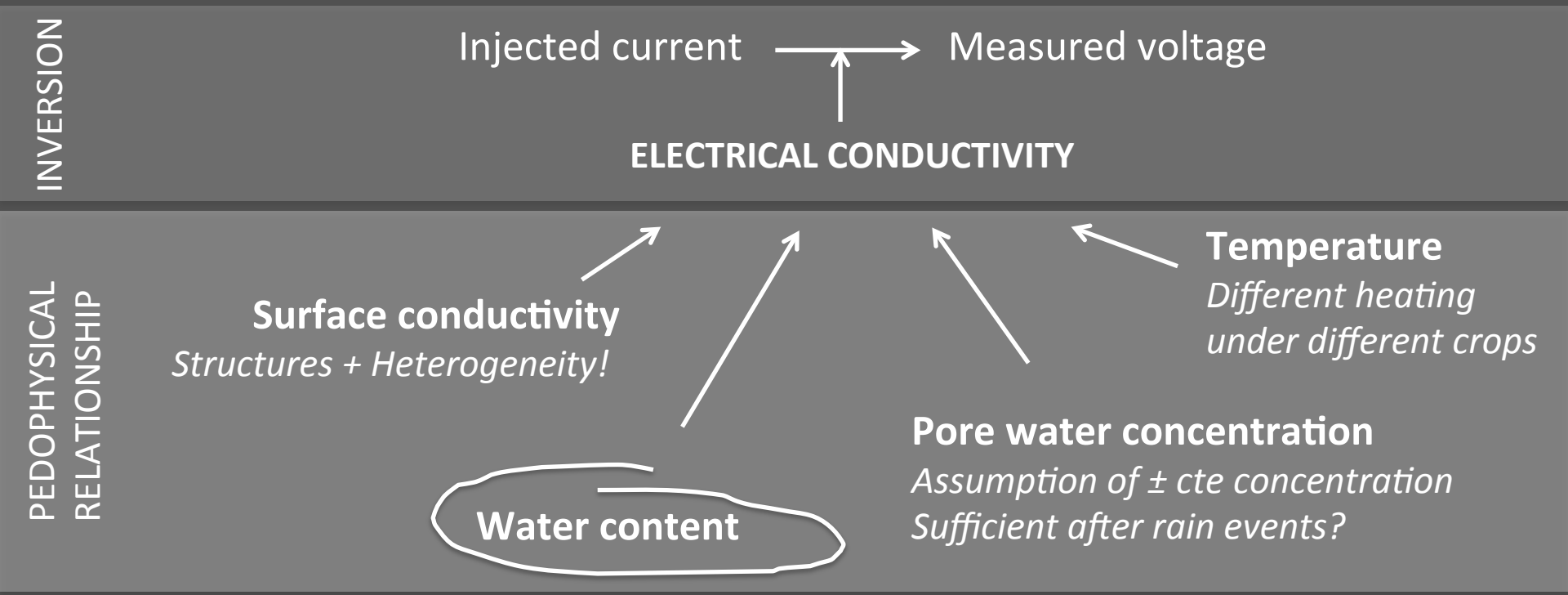
BUT...

- Detailed experimental design is necessary.
  Garré et al. (2012) VZJ 11 (4)

- Uncertainties in conversion WC = f(EC, ...)
  Garré et al. (2013) VZJ 12 (2)

BUT...

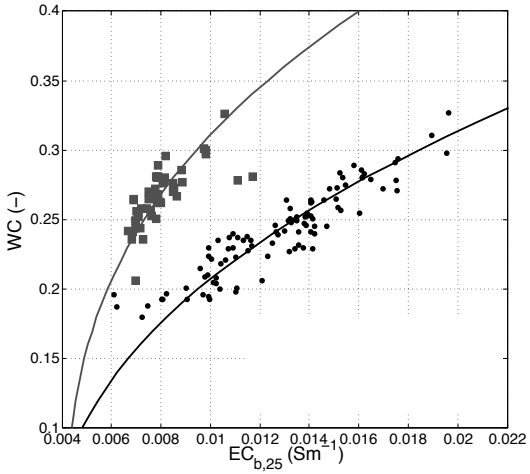
Uncertainties in conversion WC = f(EC, ...)



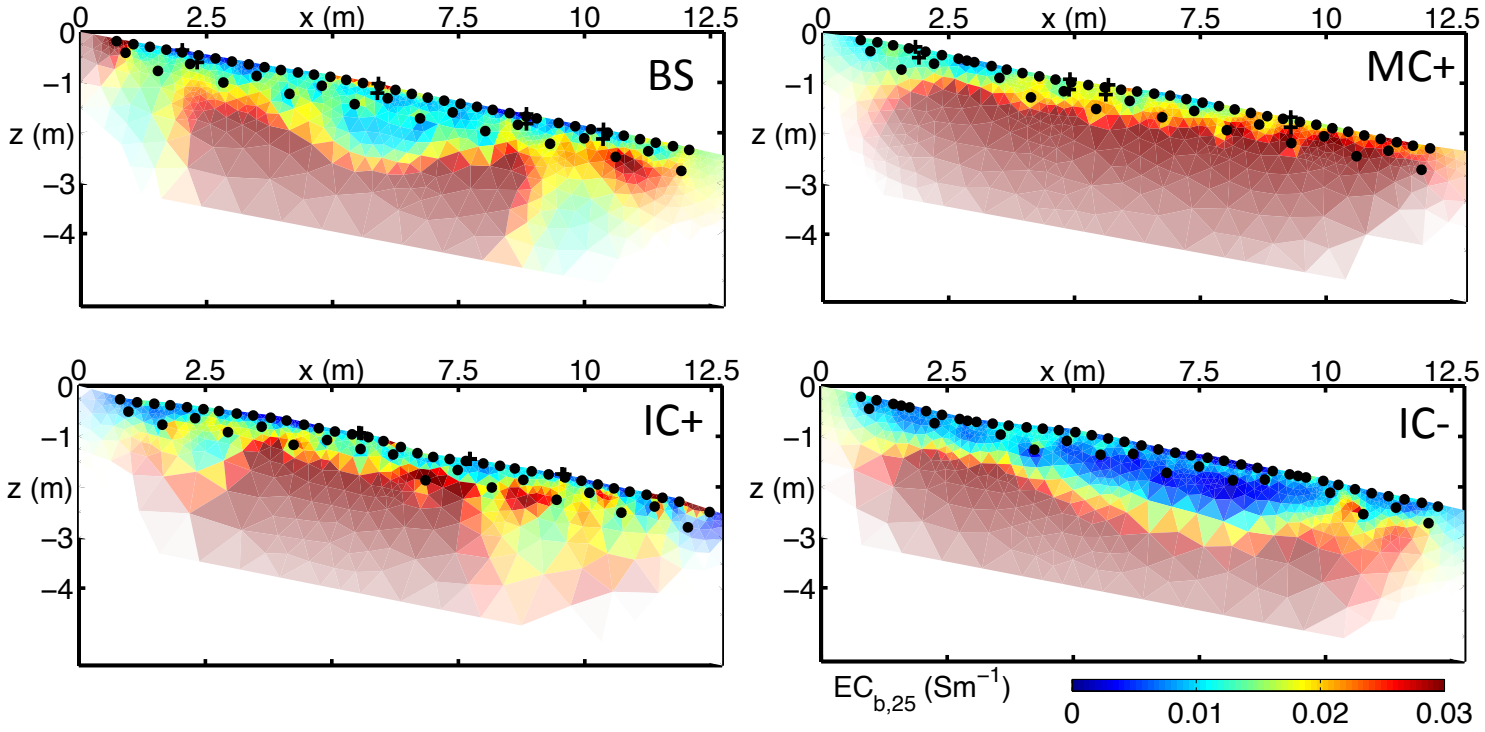
Garré et al. (2013) VZJ 12 (2)

Example: Heterogeneous profiles

Pedophysical functions
for 2 horizons



Not so easy to delineate horizons in the profile



Conclusion

Can we use ERT to measure root zone competition in fields with multiple crops?

YES!

©Seth, street art Paris

BUT...
further research!

My sincere thanks to

Ine Coteur
Prof. Jan Diels

Prof. Jan Vanderborght

Prof. Thanuchai Kongkaew+
Wattanai Omsunrarn
Channarong Khetdan

Khalid Hussain
Thomas Hilger
Chalemchart Wongleecharoen
Marc-André Sparke