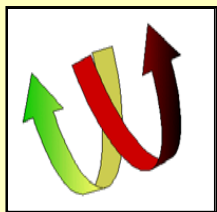


**Simulation of biomass production
and soil water dynamics
on highly weathered, acidic Acrisols
with the EPICSEAR model**

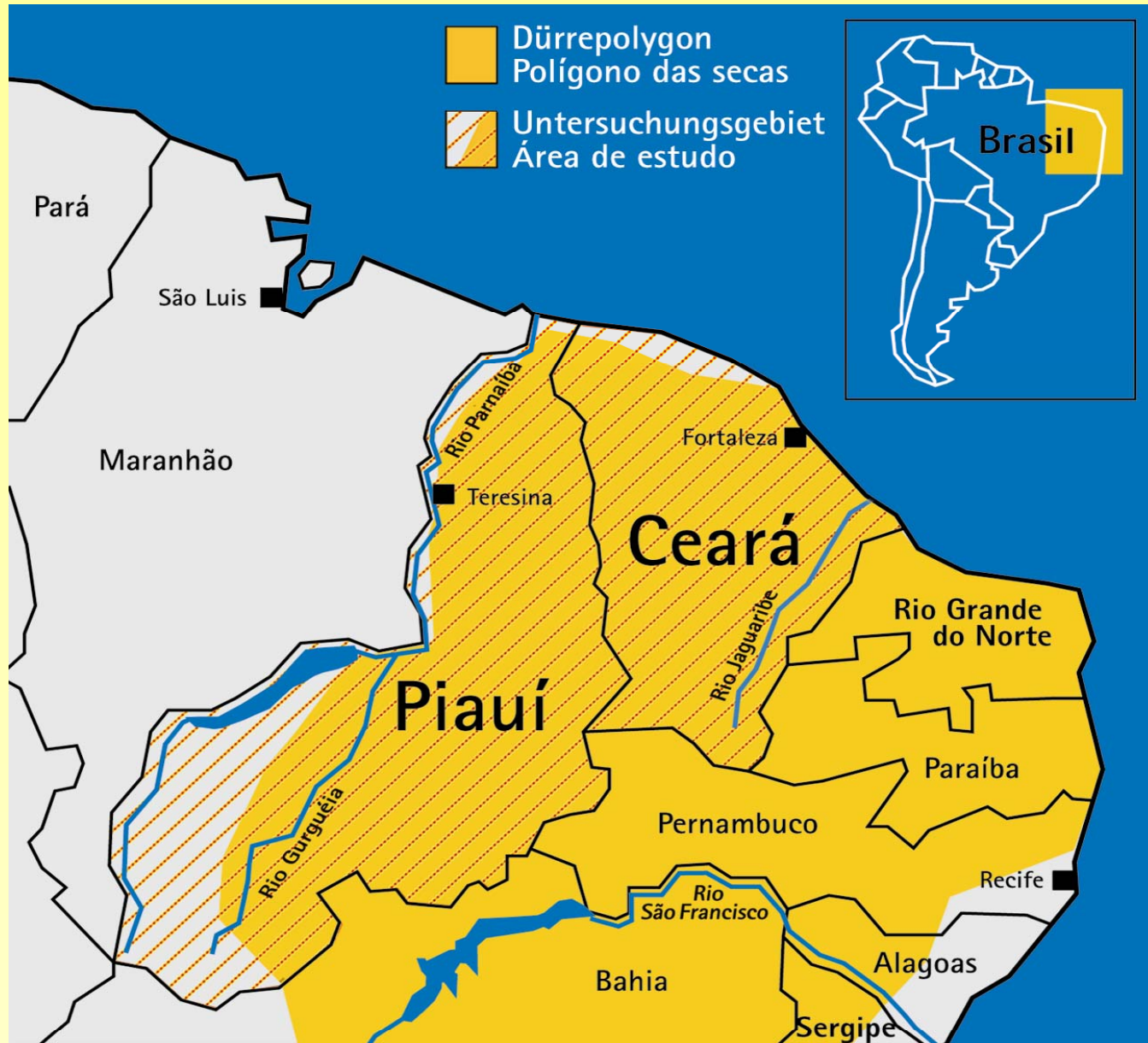


WAVES

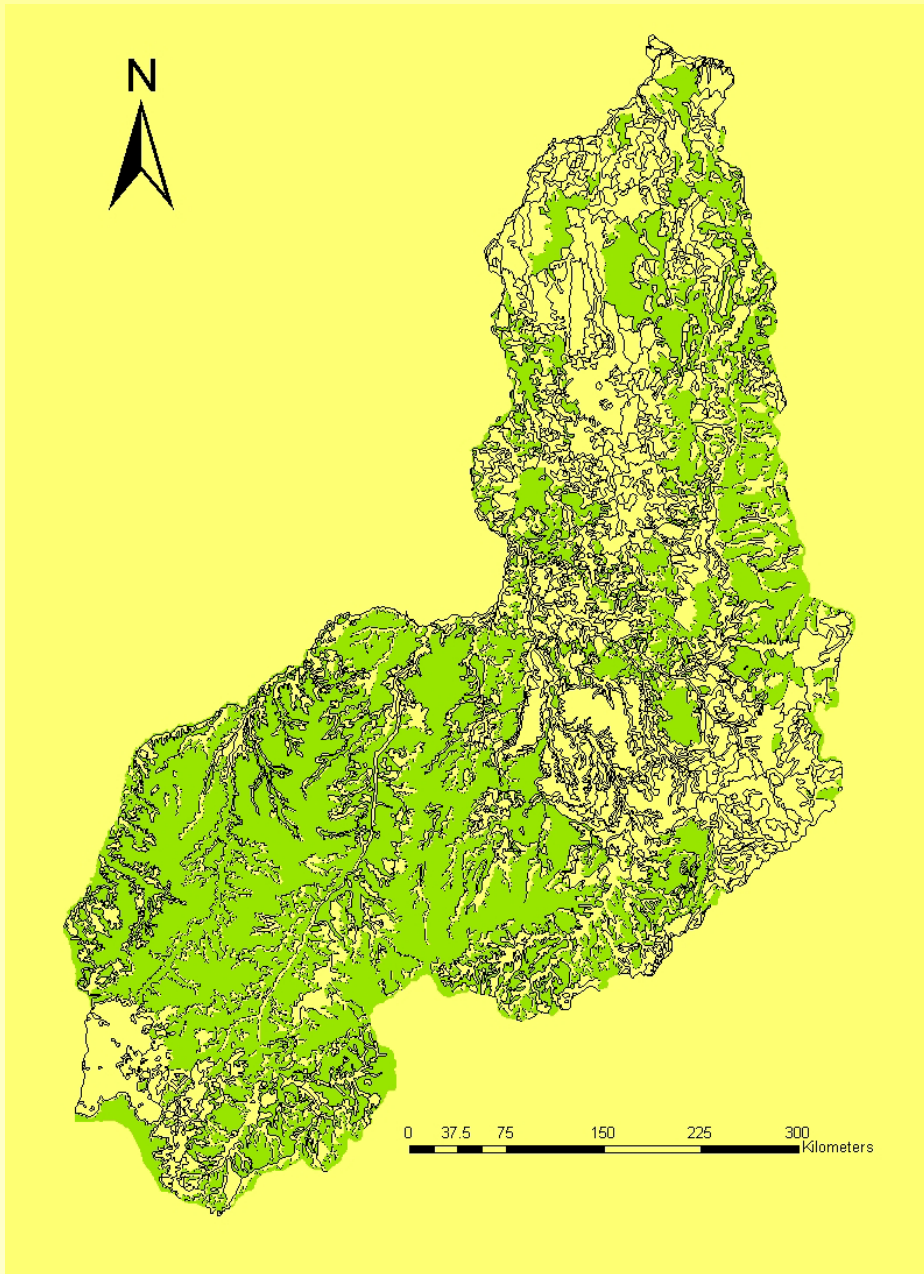


**Thomas Gaiser
Frank-Michael Lange
Inacio de Barros**

Simulation of biomass production and soil water dynamics



Distribution of Alumi-Haplic Acrisols in the state of Piauí





**Typical
Alumi-Haplic Acrisol
developed from
coversand**

Range of soil characteristics in the topsoils of Alumi-Haplic Acrisols developed from coversands in Piauí

	0-20 cm	20-40 cm
	Range	Range
pH (H₂O)	4.2 – 4.4	4.0 – 4.1
Texture	S L	S L
CEC_{ef} (cmol _c .kg ⁻¹)	1.5 – 1.8	1.3 – 1.4
Al (cmol _c .kg ⁻¹)	0.7 – 1.0	0.9 – 1.2
Al saturation (%)	50 – 61	67 – 88
P (mg.kg ⁻¹)	1 – 4	1 – 2
C (g.kg ⁻¹)	6.9 – 9.0	3.5 – 6.0

Field experiment

⊗ RCB Design with five treatments and four replications:

(1) Control

(2) Complete fertilization (N, P, K) with lime (Complete)
30N/18P/50K kg ha⁻¹a⁻¹, 3000 kg ha⁻¹Lime once

(3) *Complete without nitrogen*

(4) *Complete without phosphorous*

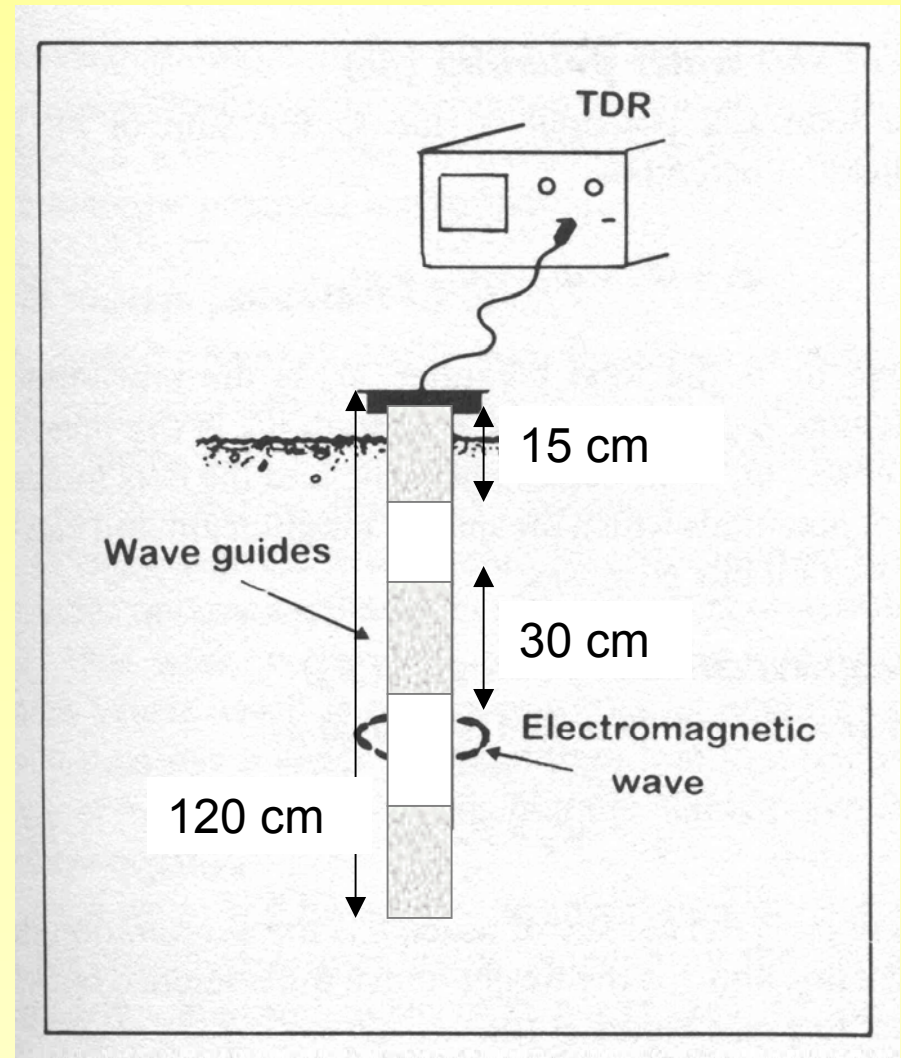
(5) *Complete without potassium*

(6) *Complete without lime*

⊗ Maize/Cowpea intercrop with 4.5/9 plants m⁻²

Soil water measurements

- Treatments:
 - (1) Complete
 - (2) Control
- Three TDR probes per treatment



Applied simulation models:

HILLFLOW

- soil water balance model
- physically based (elementwise solution of Richards equation)

Problems:

- interaction soil acidity / root water uptake not considered

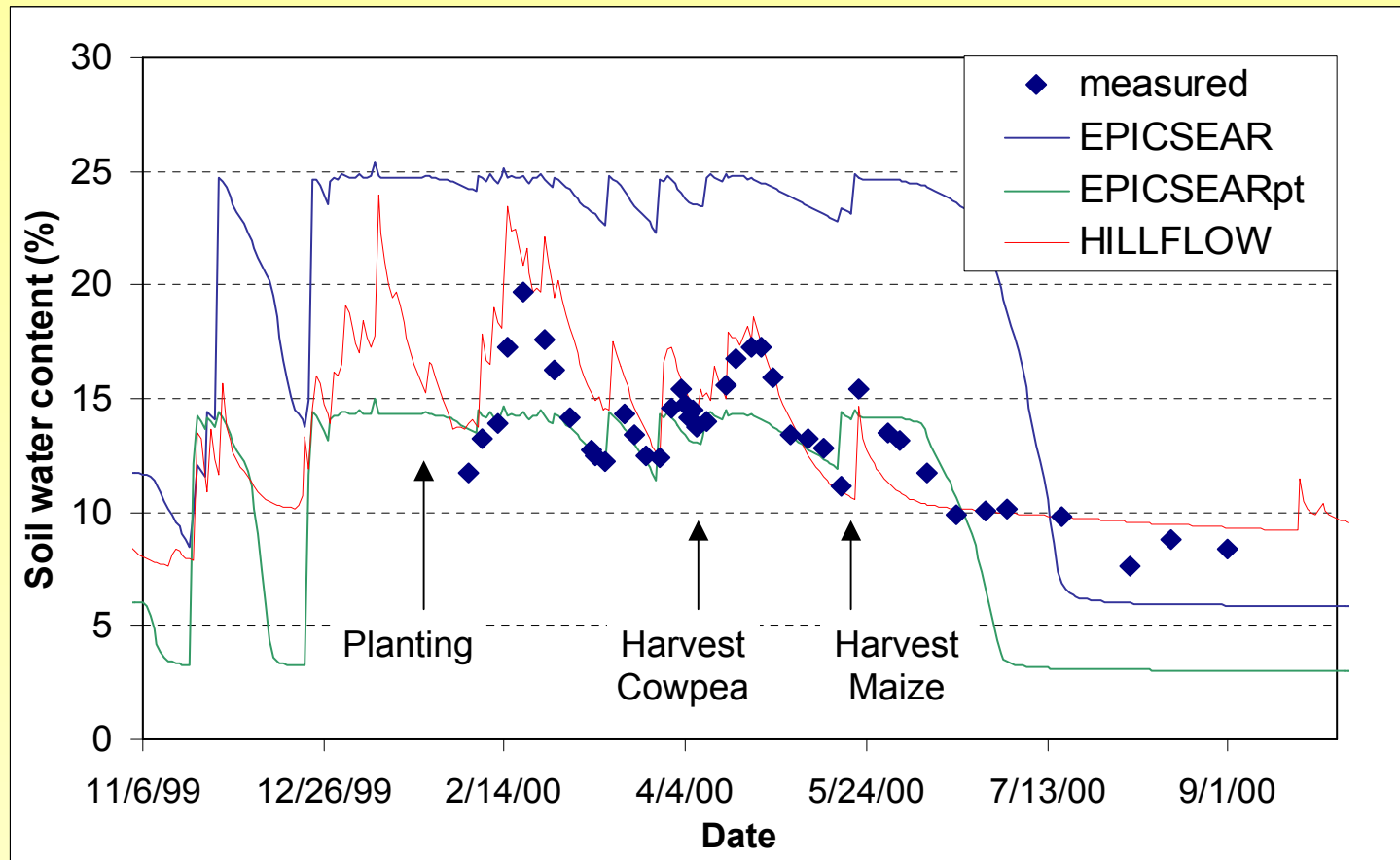
EPICSEAR („EPIC Semiarid“)

- agroecosystems model (considers all „relevant“ processes)

Problems:

- bucket approach, FC = maximum storage volume
- no upward movement of water
- interception by crops not considered

Measured versus simulated soil water content (15-30 cm depth)



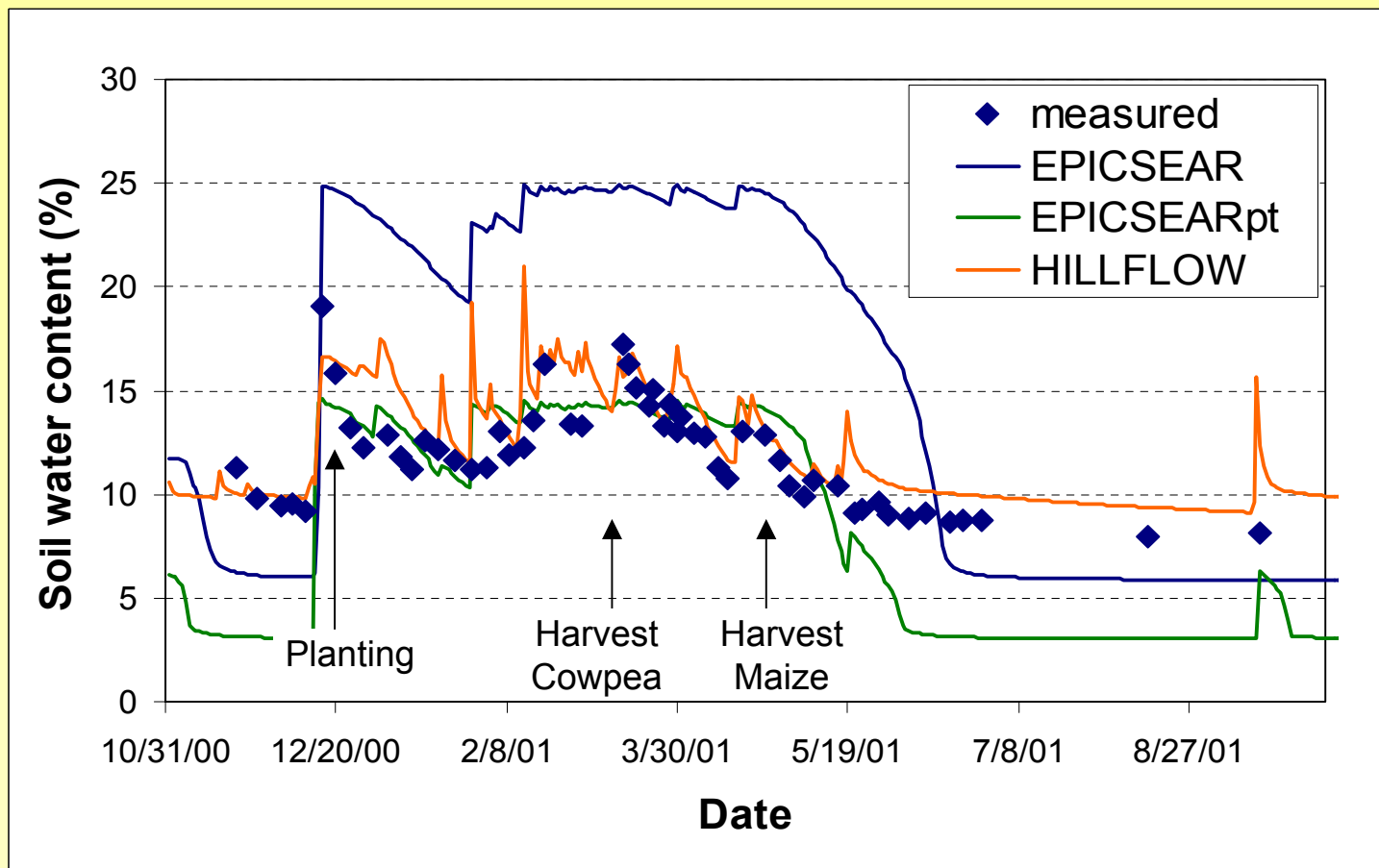
control treatment in 1999/2000

Different methods for calculation of soil hydrological properties

Volumetric water content at	EPICSEAR	EPICSEARpt [*]
Field Capacity	24	14
Wilting Point	10	6

* Calculated from pedotransfer functions given by Gaiser et al. 2000

Measured versus simulated soil water content (15-30 cm depth)



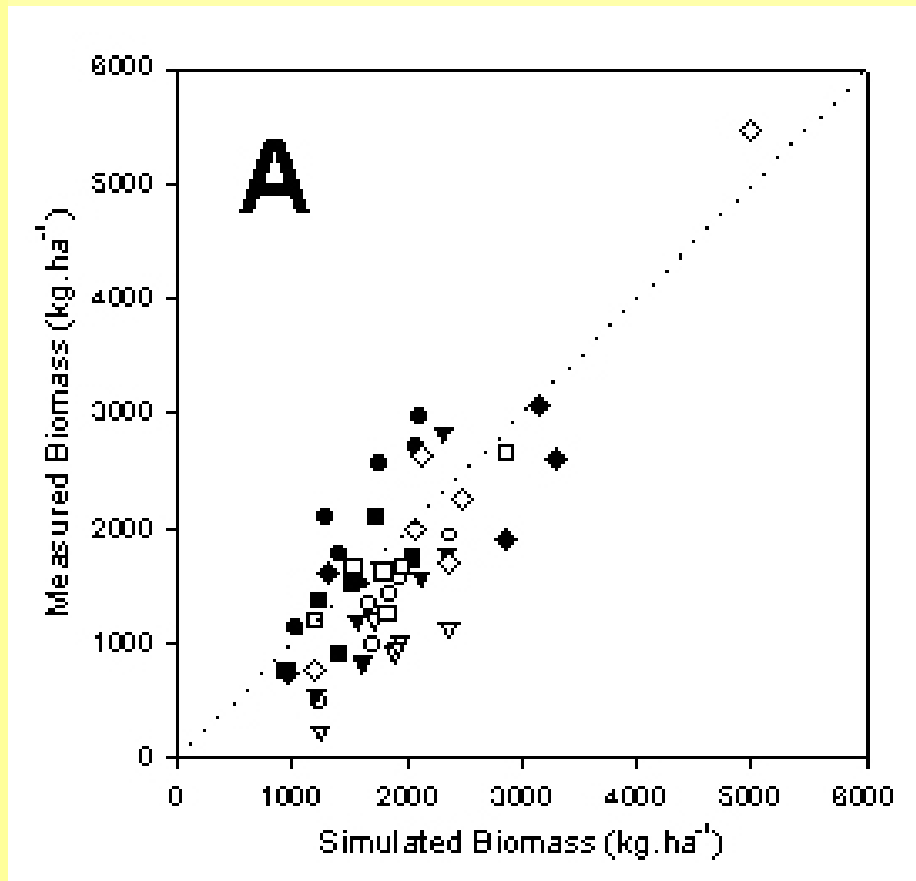
control treatment in 2000/01

Mean absolute error of simulated water content within 15-30 cm

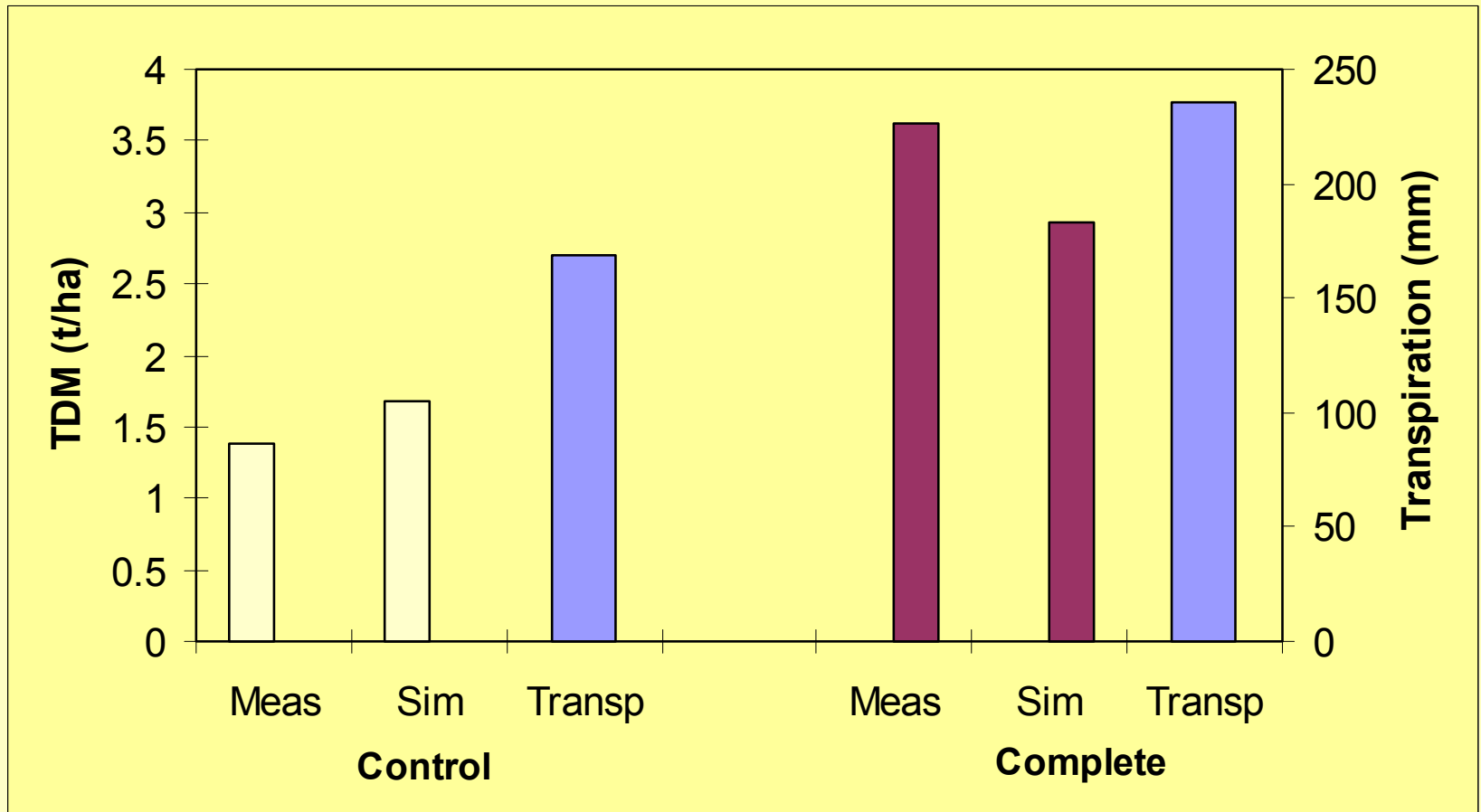
Year	Control		
	EPICSEAR	EPICSEAR _{pt}	HILLFLOW
1999/00	9.5	2.7	2.1
2000/01	9.5	3.2	2.4

Year	Complete with lime		
	EPICSEAR	EPICSEAR _{pt}	HILLFLOW
1999/00	8.1	4.1	2.5
2000/01	8.2	4.2	1.8

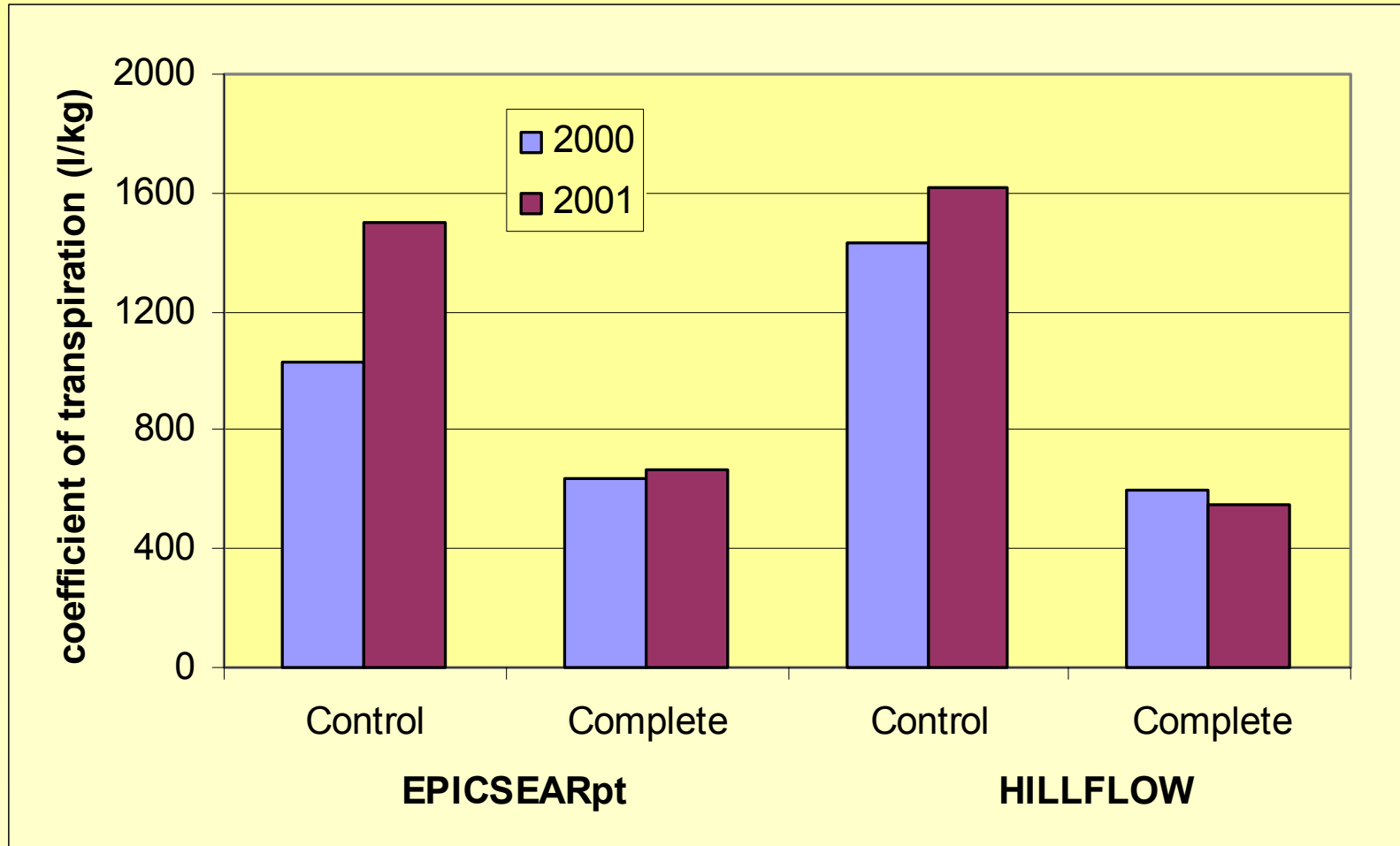
Measured versus simulated total dry matter production (all treatments)



Mean total dry matter production and transpiration



Coefficients of transpiration in relation to fertilization



Conclusions

for sandy-loamy, highly acidic Acrisols

- HILLFLOW reflects soil water changes more accurately compared to EPICSEAR
- EPICSEAR produces comparable results when field capacity and permanent wilting point are estimated by other PTFs
- EPICSEAR is sensitive to the effects of liming and fertilization on soil water balance and dry matter production
- Productivity of water in a maize/cowpea intercropping system can be increased by more than 100% through the application of lime and NPK fertilizer.

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