Carbon sequestration in soils

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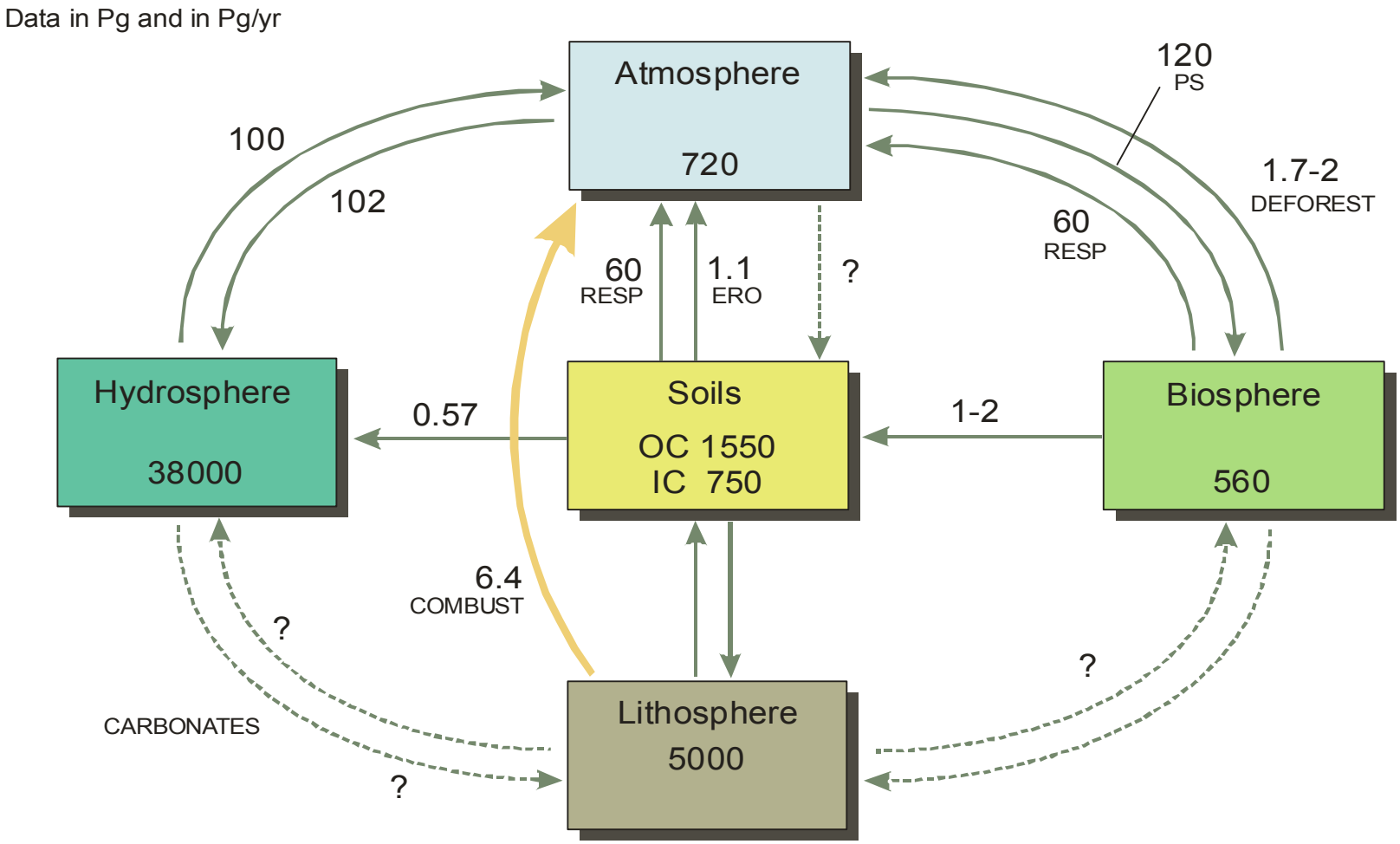
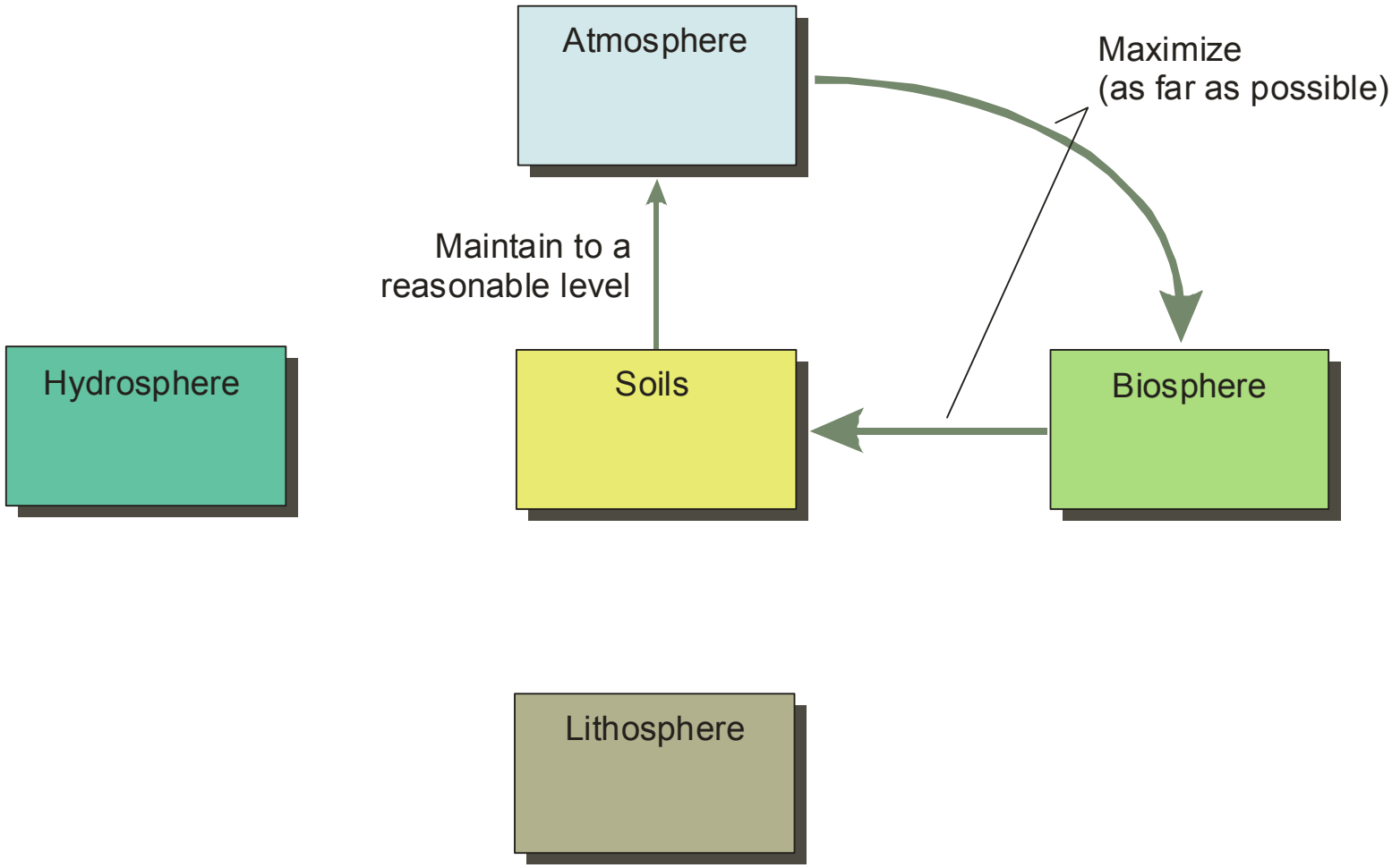
Carbon cycle: an overall view

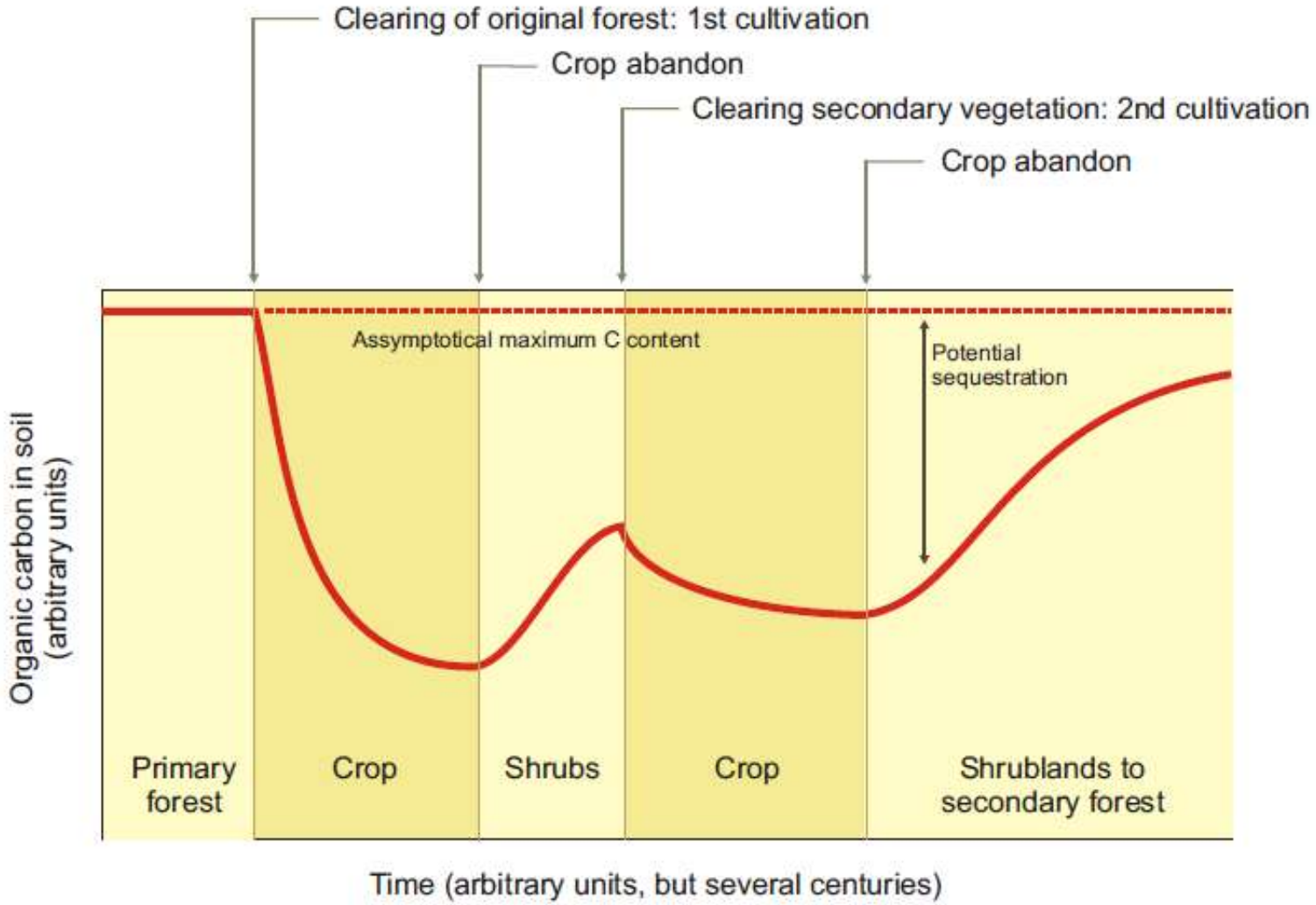


Lal R. 2001 Soils and the Greenhouse Effect. SSSA Special Publ 57.

Carbon sequestration: defining the concept



Carbon sequestration: an historical perspective



The 4 per mille initiative

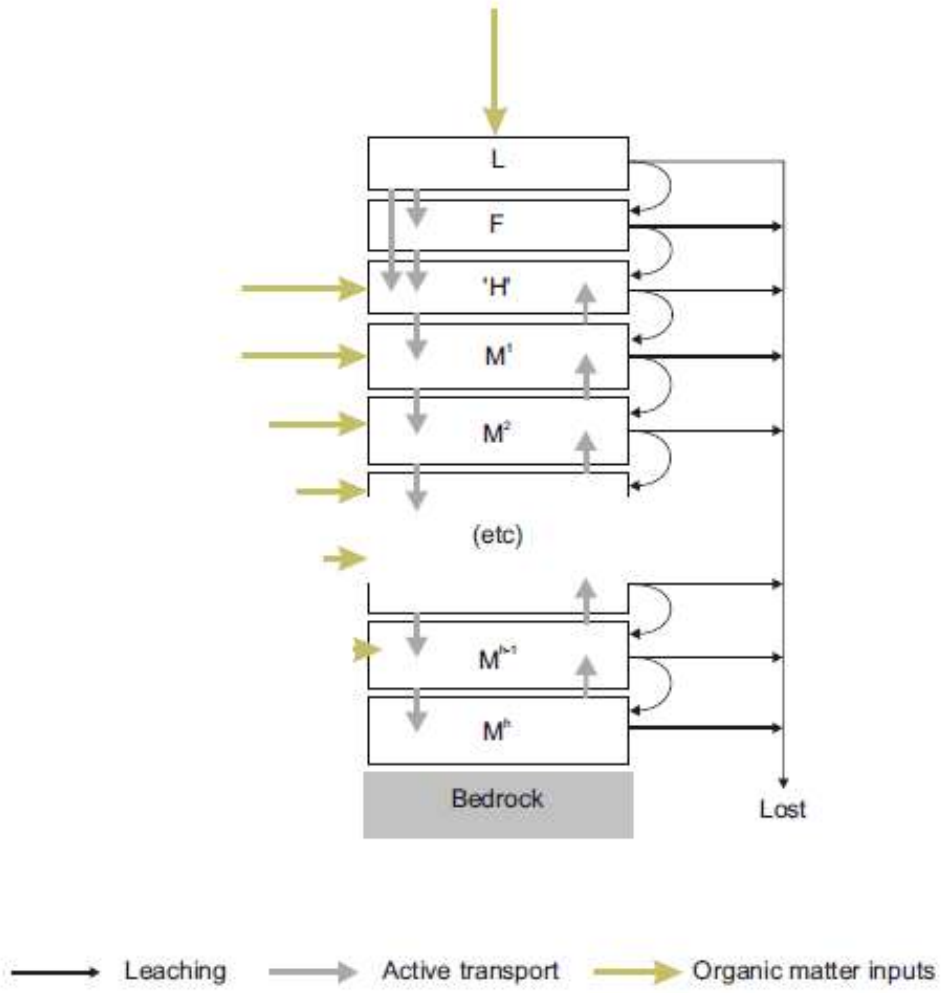
Dr. Abad Chabbi

Plant ecologist, soil biogeochemist, Research Director at the INRA

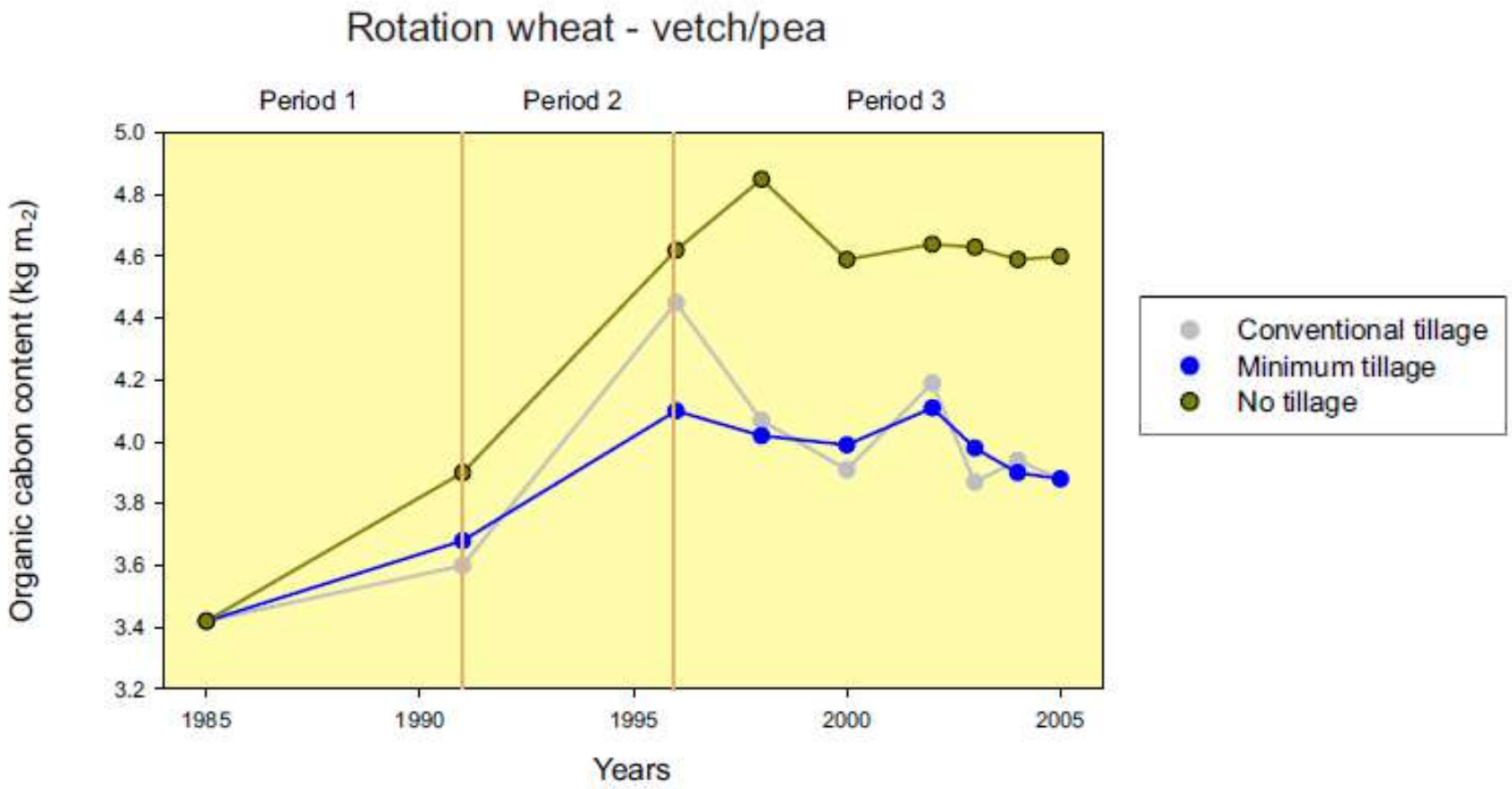
Carbon in Soils: 1550 Pg
Fossil carbon emissions: 6,4 Pg / year
Quotient:
6,4 / 1550 = 0,00413

Approx: 4 per mil

The soil is a complex machine

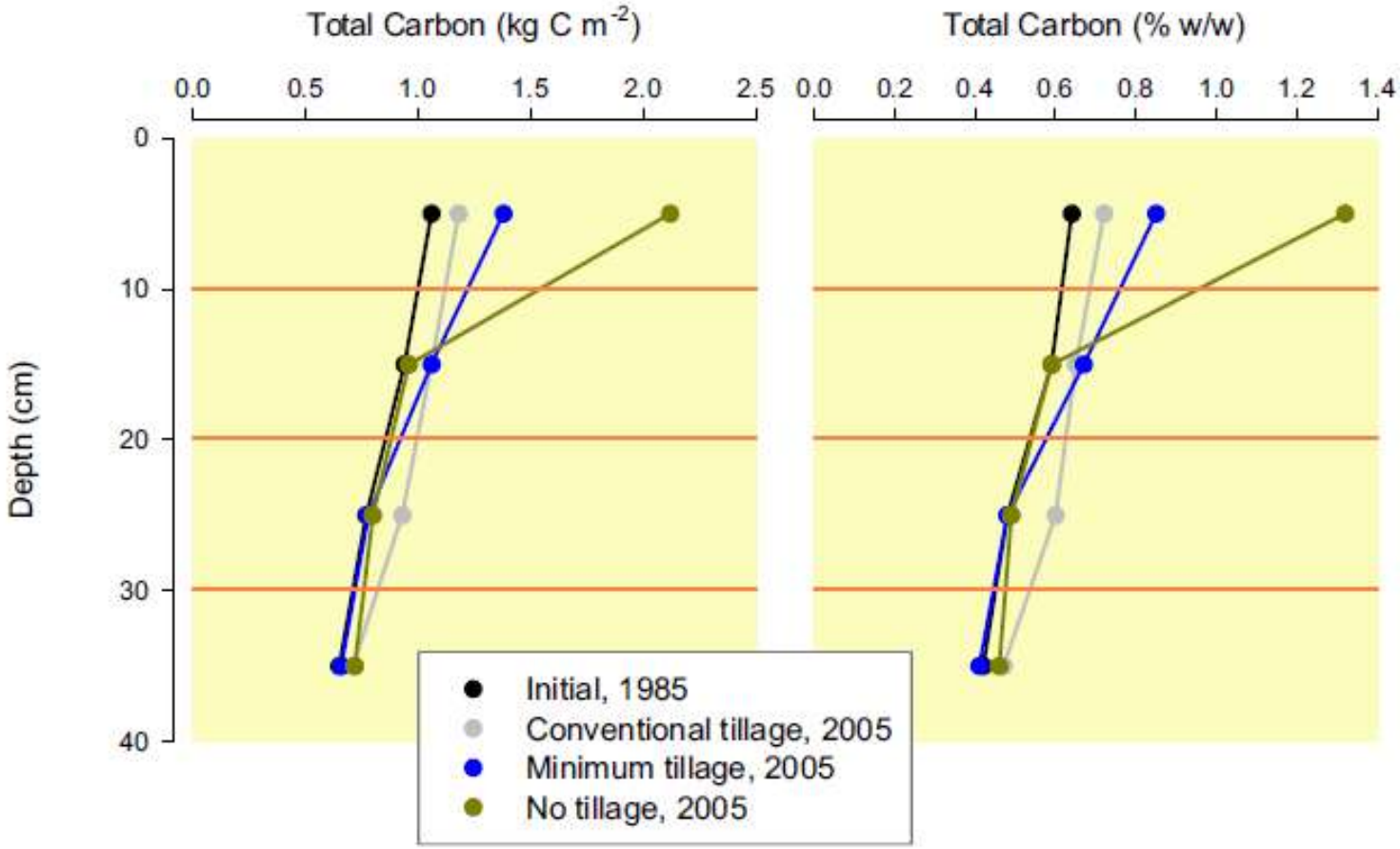


Carbon sequestration in agricultural soils (I)



Hernanz et al (2009). Agriculture, Ecosystems and Environment 133, 114-122.

Carbon sequestration in agricultural soils (II)

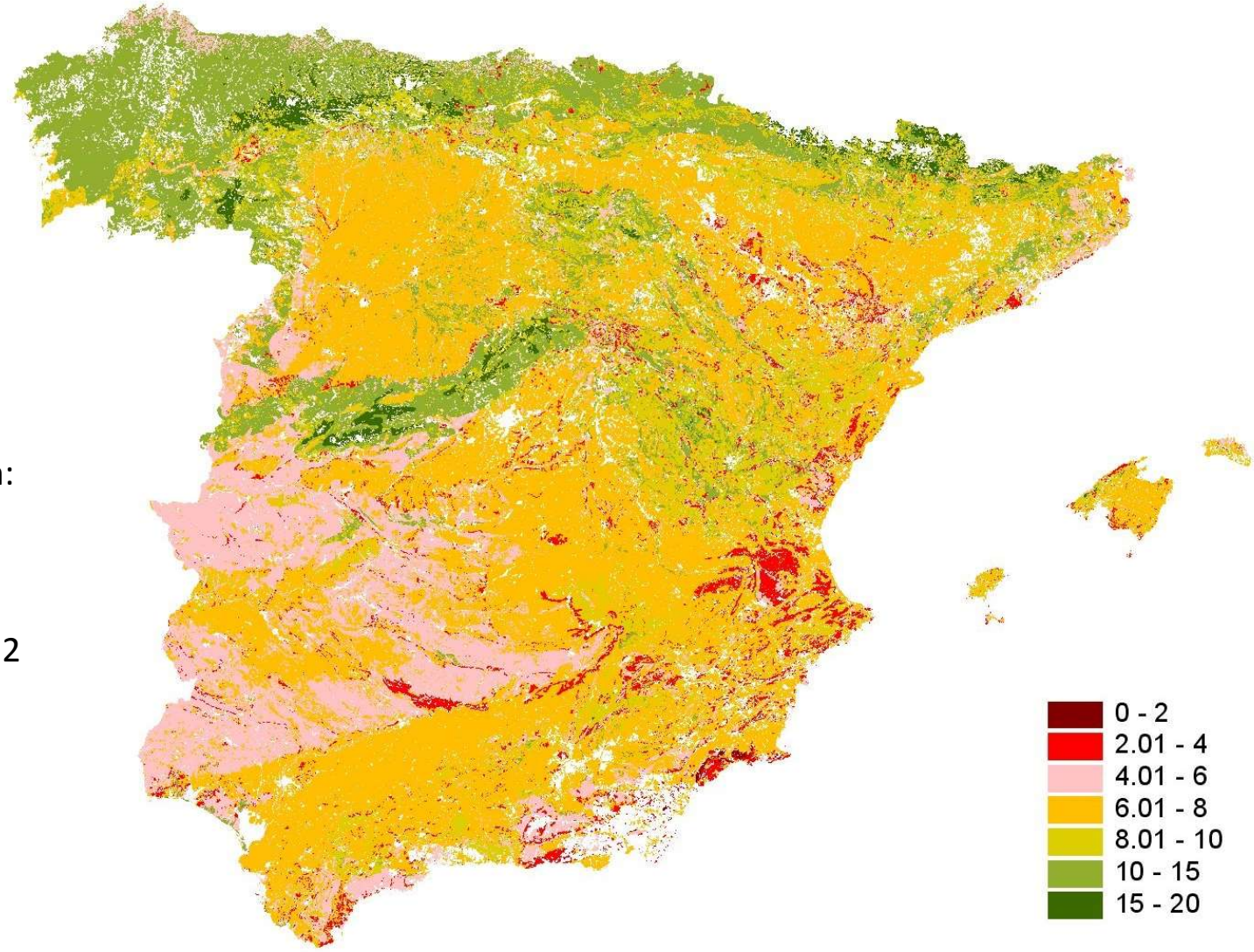


Hernanz et al (2009). Agriculture, Ecosystems and Environment 133, 114-122.

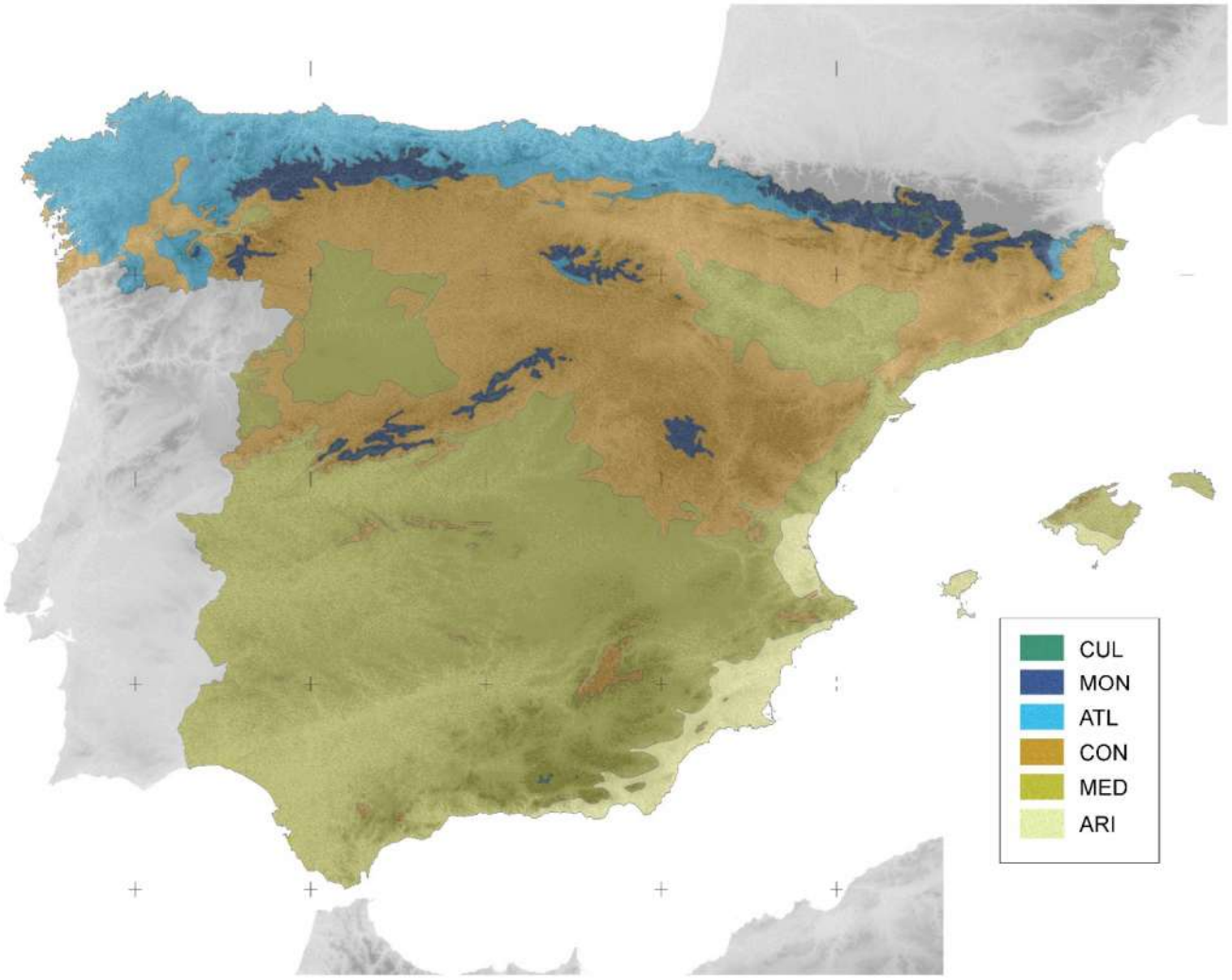
Soil carbon stocks: an overall view

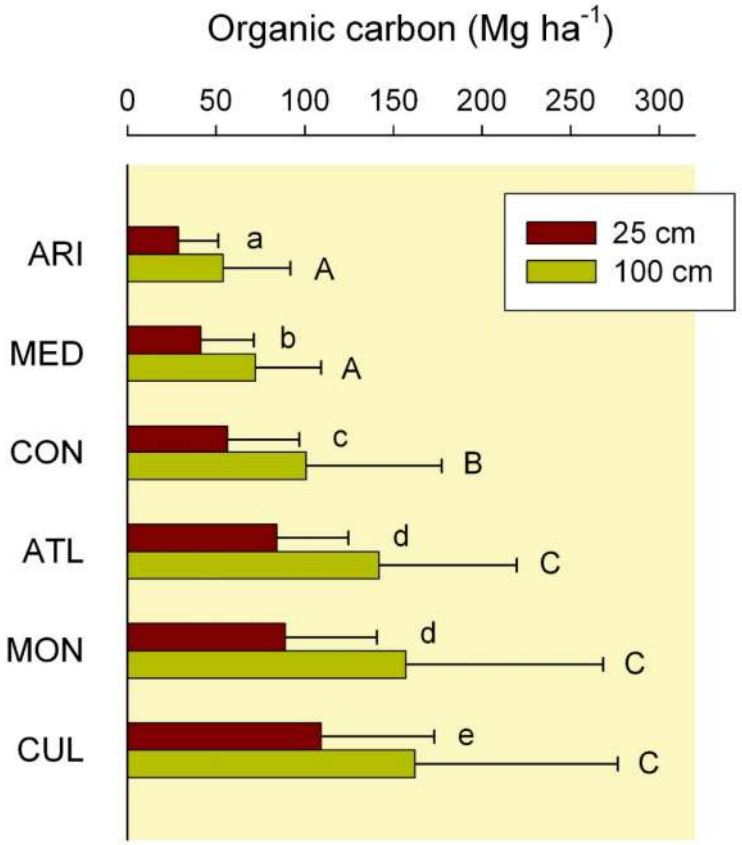
Total C stock,
down to a 1 m depth:
3.49 Pg
(1 Pg = 1 Gigaton)

Average: 8.3 kg C / m2

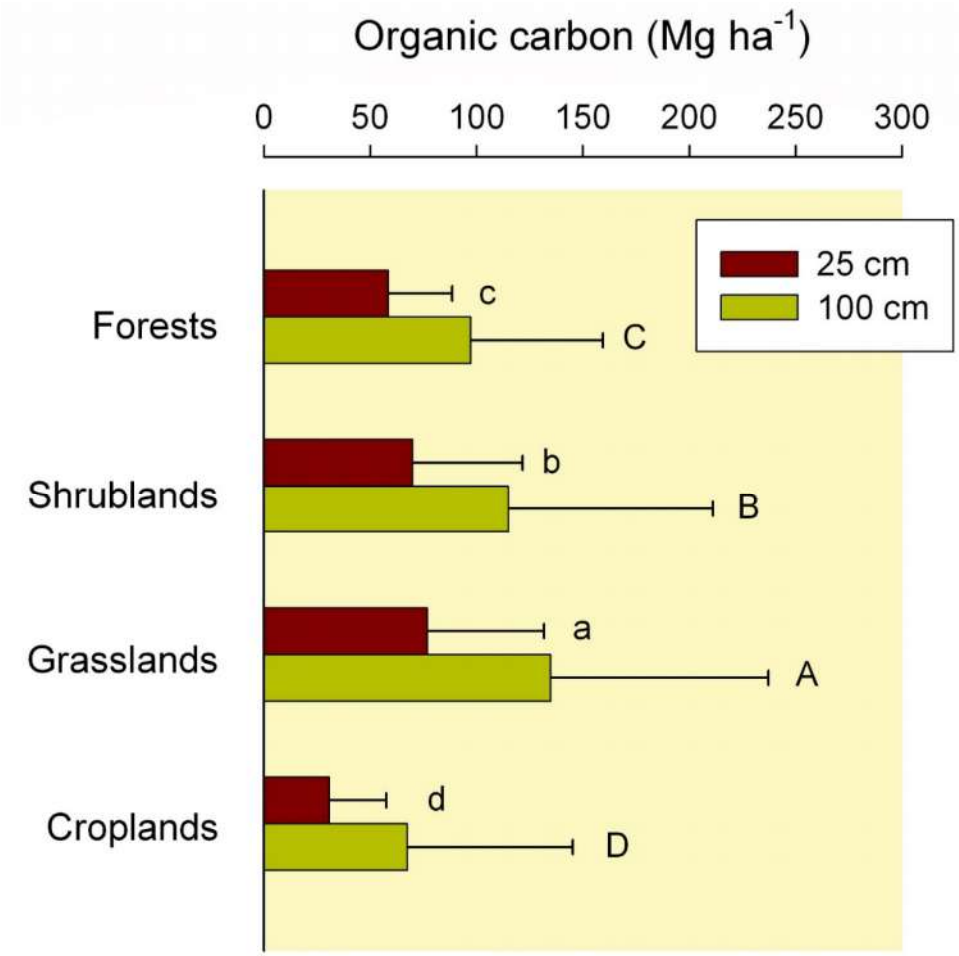


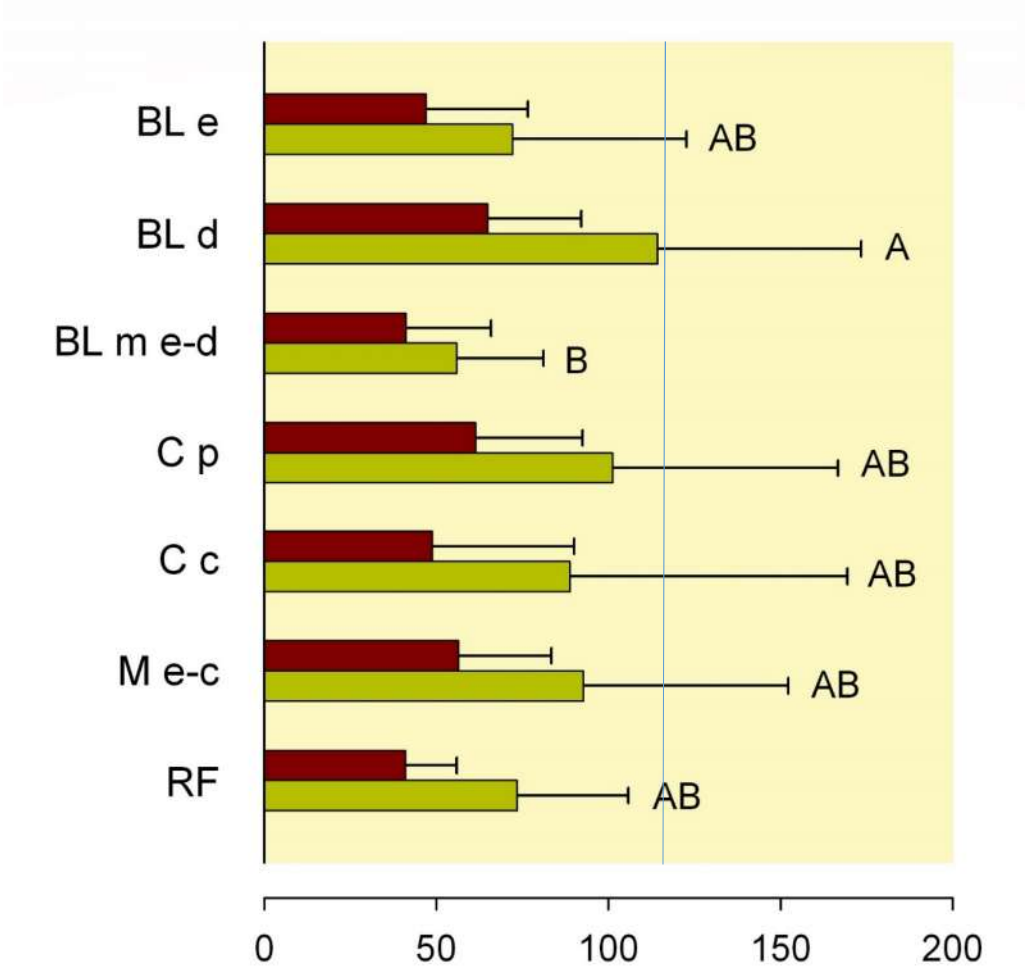
Soil carbon stocks and climàtic areas





Soil carbon stocks depend on vegetation types



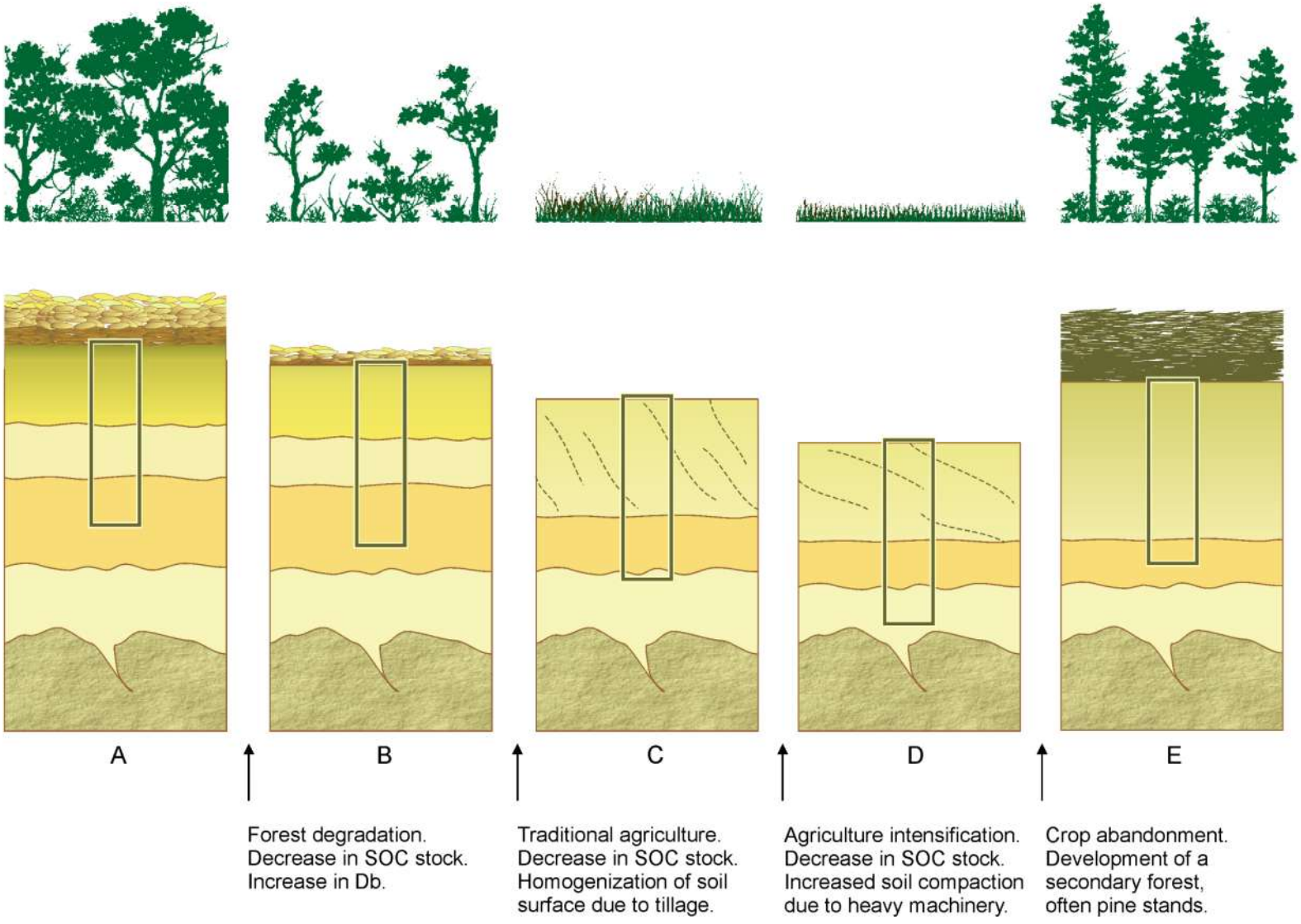


Soil carbon stocks: an overall view

Plant cover	ARI	MED	CON	ATL	MON	CUL
a) Down to –25 cm						
Forests	57.5 ± 30.2 abA	51.5 ± 28.7 bA	58.7 ± 29.7 abA	70.9 ± 31.3 aB	62.7 ± 27.3 abC	N.A.
Shrublands	24.0 ± 12.8 dB	49.3 ± 35.4 cdA	65.8 ± 48.9 bcA	107.0 ± 46.1 abA	126.2 ± 58.8 aA	120.2 ± 69.6 a
Grasslands	33.2 ± 35.4 bB	40.9 ± 32.0 bB	76.4 ± 63.6 aA	81.4 ± 35.4 aB	101.7 ± 58.8 aB	108.3 ± 65.0 a
Crops	24.7 ± 19.9 cB	27.1 ± 20.3 bcC	37.7 ± 36.7 bB	68.2 ± 23.4 aB	n.d.	N.A.
b) Down to –100 cm						
Forests	87.7 ± 43.4 bA	81.9 ± 58.1 bA	98.8 ± 64.1 abAB	122.8 ± 64.8 aB	105.4 ± 48.9 abB	N.A.
Shrublands	42.5 ± 31.5 bB	78.6 ± 58.8 bA	113.0 ± 100.9 abAB	174.3 ± 91.5 aA	209.6 ± 131.0 aA	255.5 ± 247.9 a
Grasslands	45.3 ± 42.3 cB	73.3 ± 48.4 bcAB	136.7 ± 101.3 abA	133.1 ± 58.5 aAB	189.1 ± 127.2 aA	153.0 ± 101.2 a
Crops	57.4 ± 36.8 bAB	59.2 ± 37.2 bB	83.0 ± 69.7 bB	139.7 ± 85.7 aAB	n.d.	N.A.

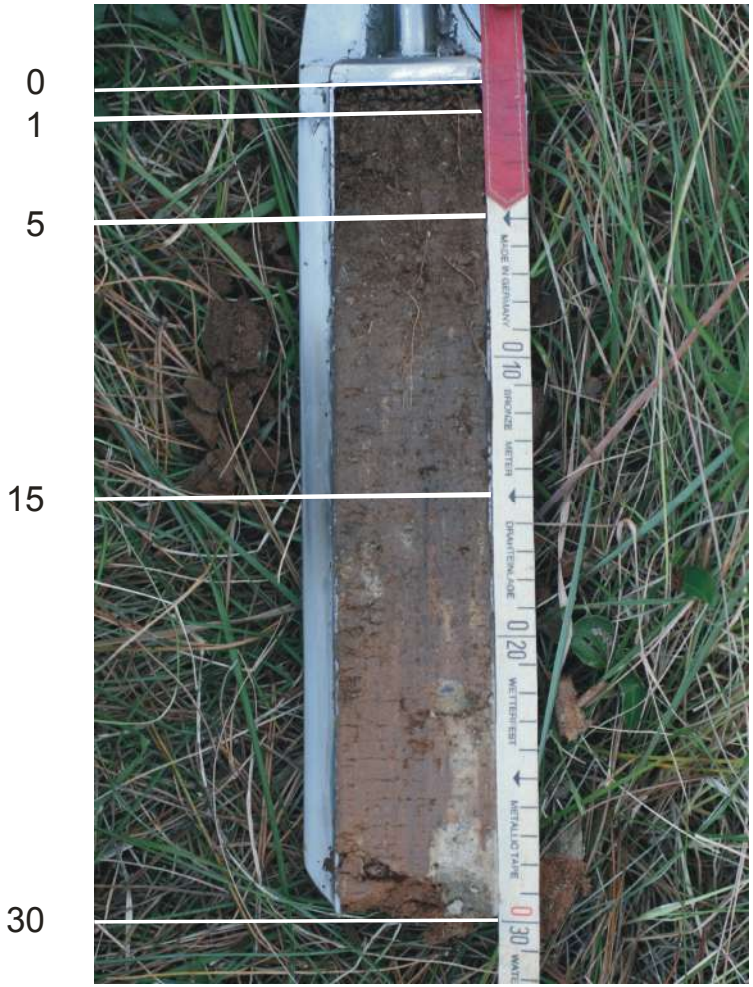
Changing land use: the key for carbon sequestration in soils?

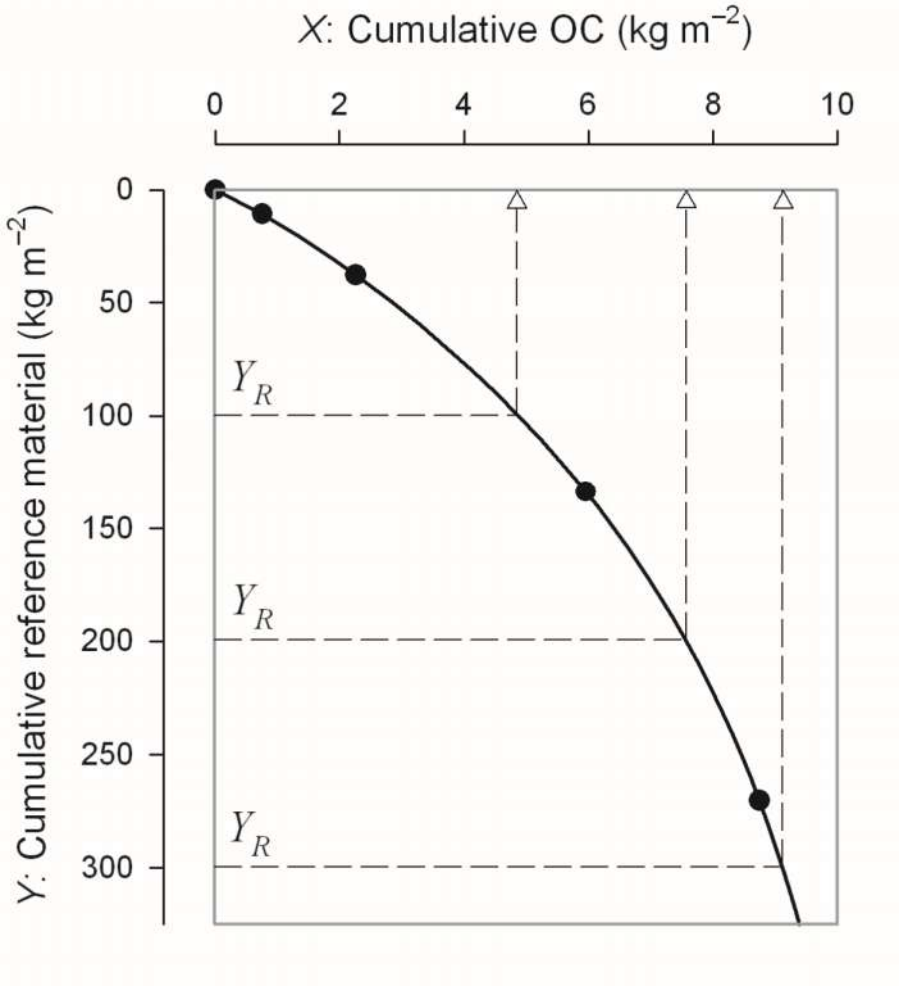
Quantifying changes: not so easy



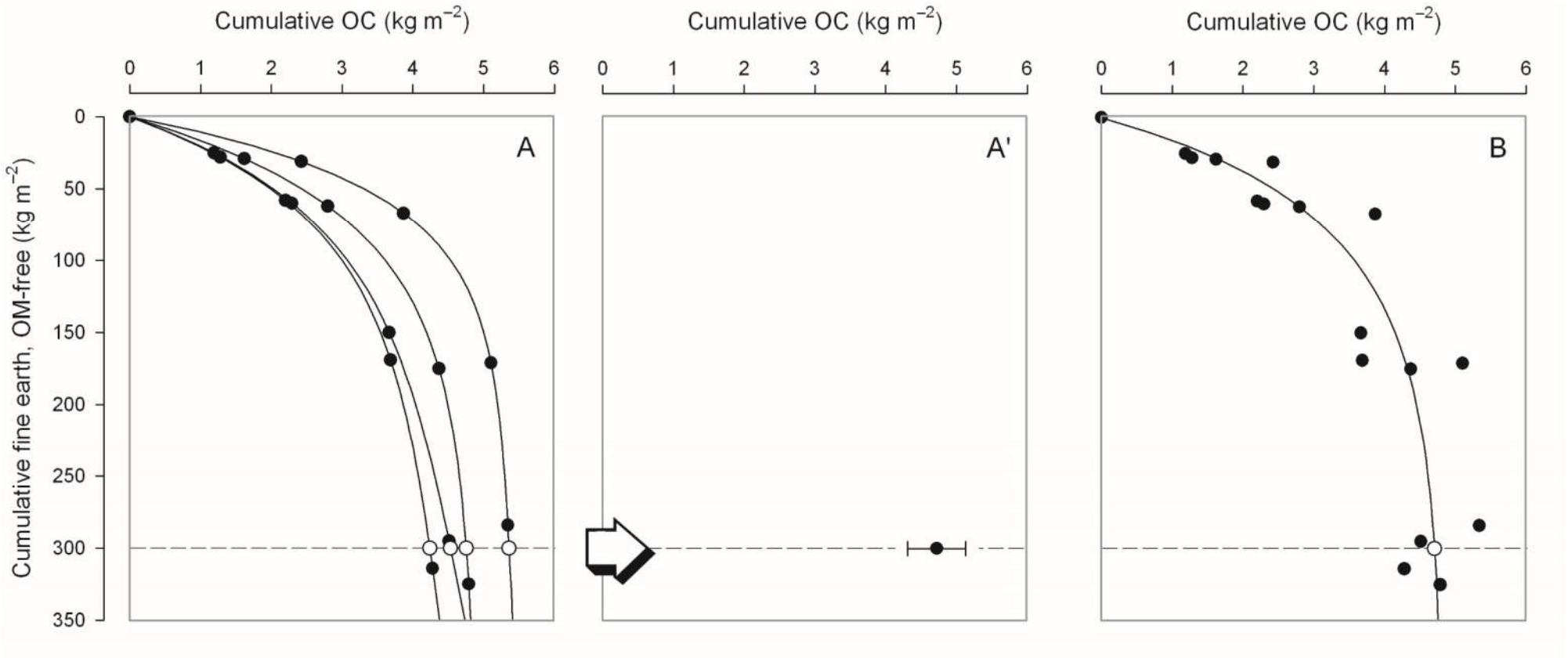
Soil sampling for monitoring changes in carbon stocks

Depth, cm



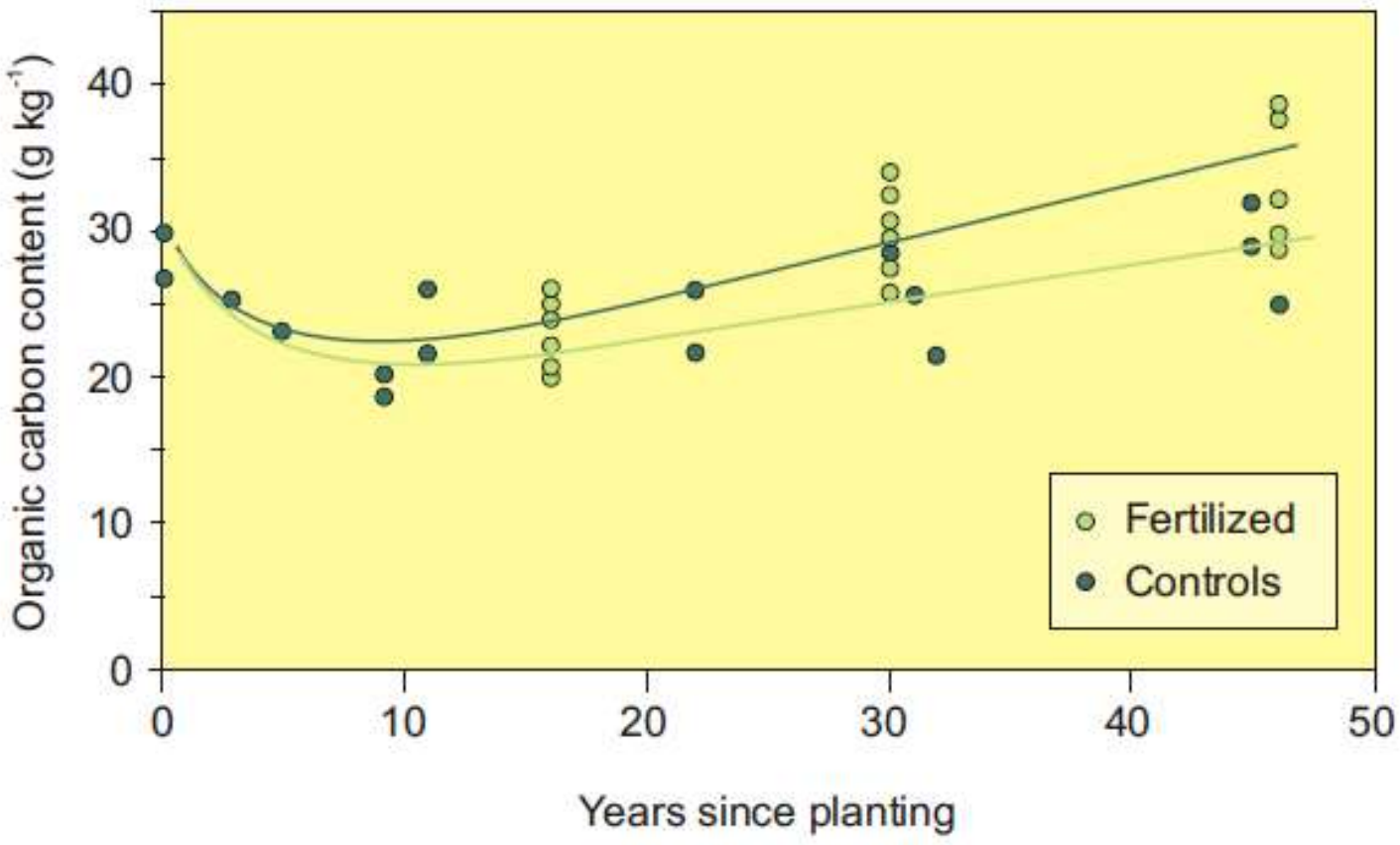


Cumulative coordinates approach



Net gains in C may be not immediate

Belanglo forest trials: *Pinus radiata* stands

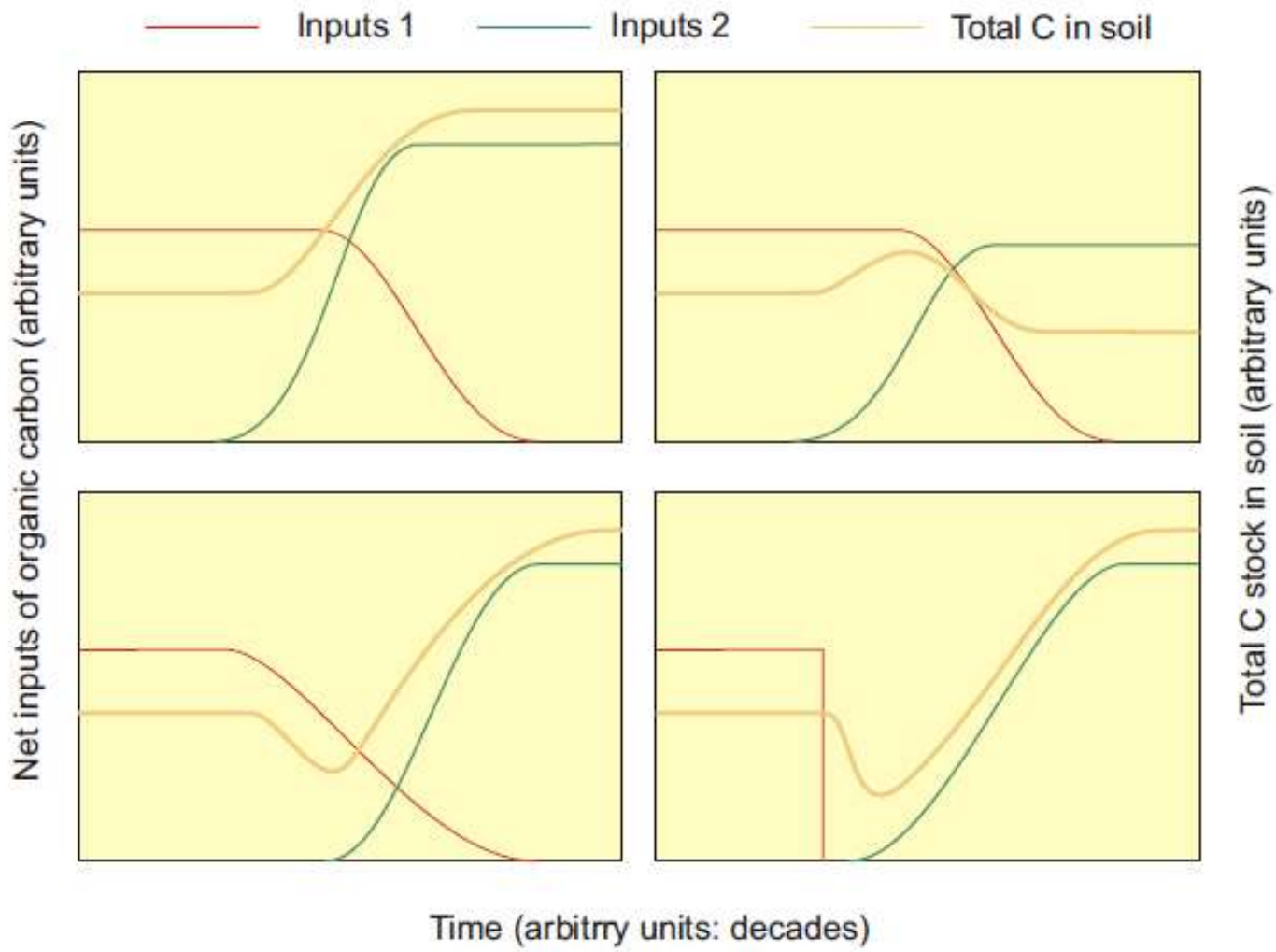


Turner et al (2005). Forest Ecology and Management 220, 259-269

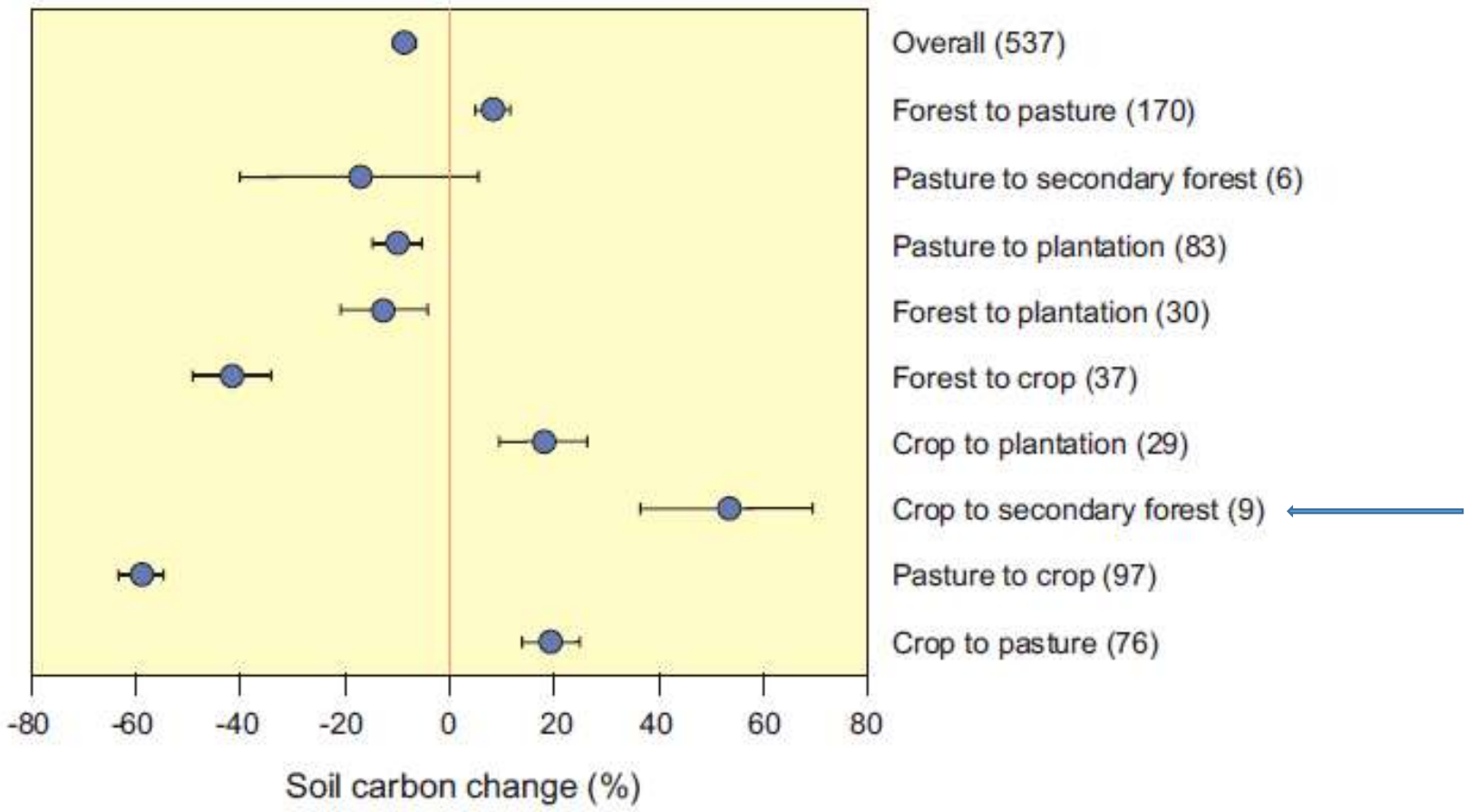
Forest Works may affect soil C stocks

Forest works: Soil organic carbon losses

Changing vegetation types



Each change has its own consequences



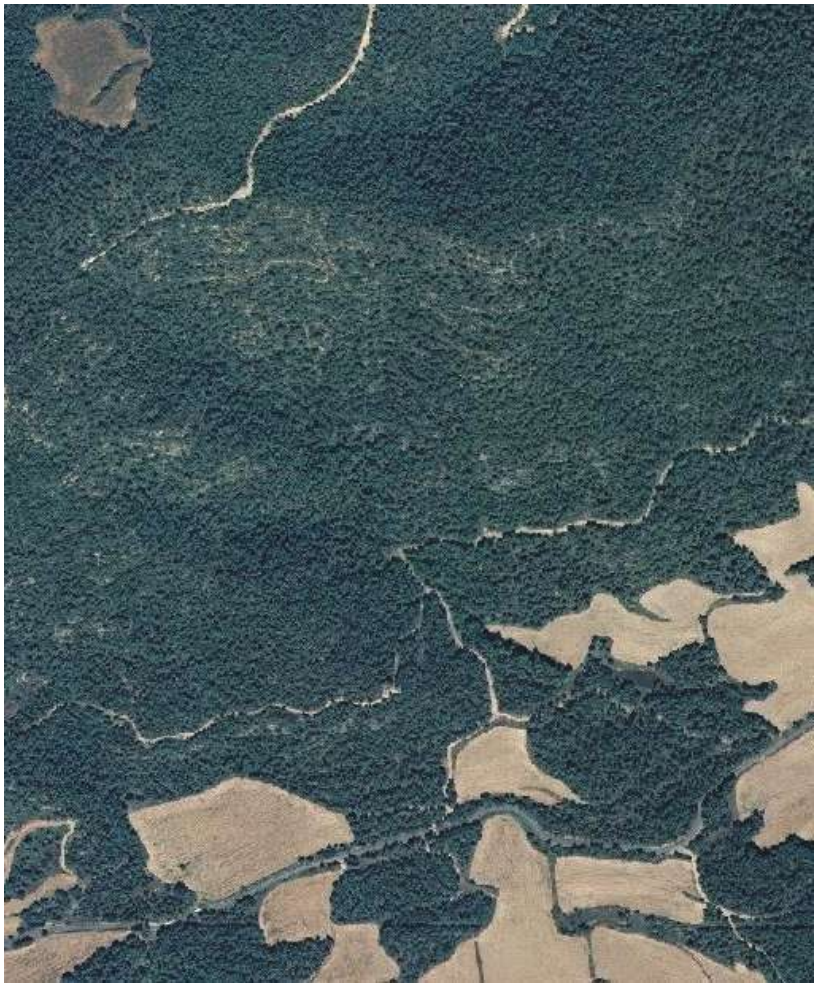
Guo L.B. & Gifford R.M. (2002). Global Change Biology 8, 345-360.

Agriculture abandonment, forest recovery

Comparison of historical aerial images with current ones

1956

2009

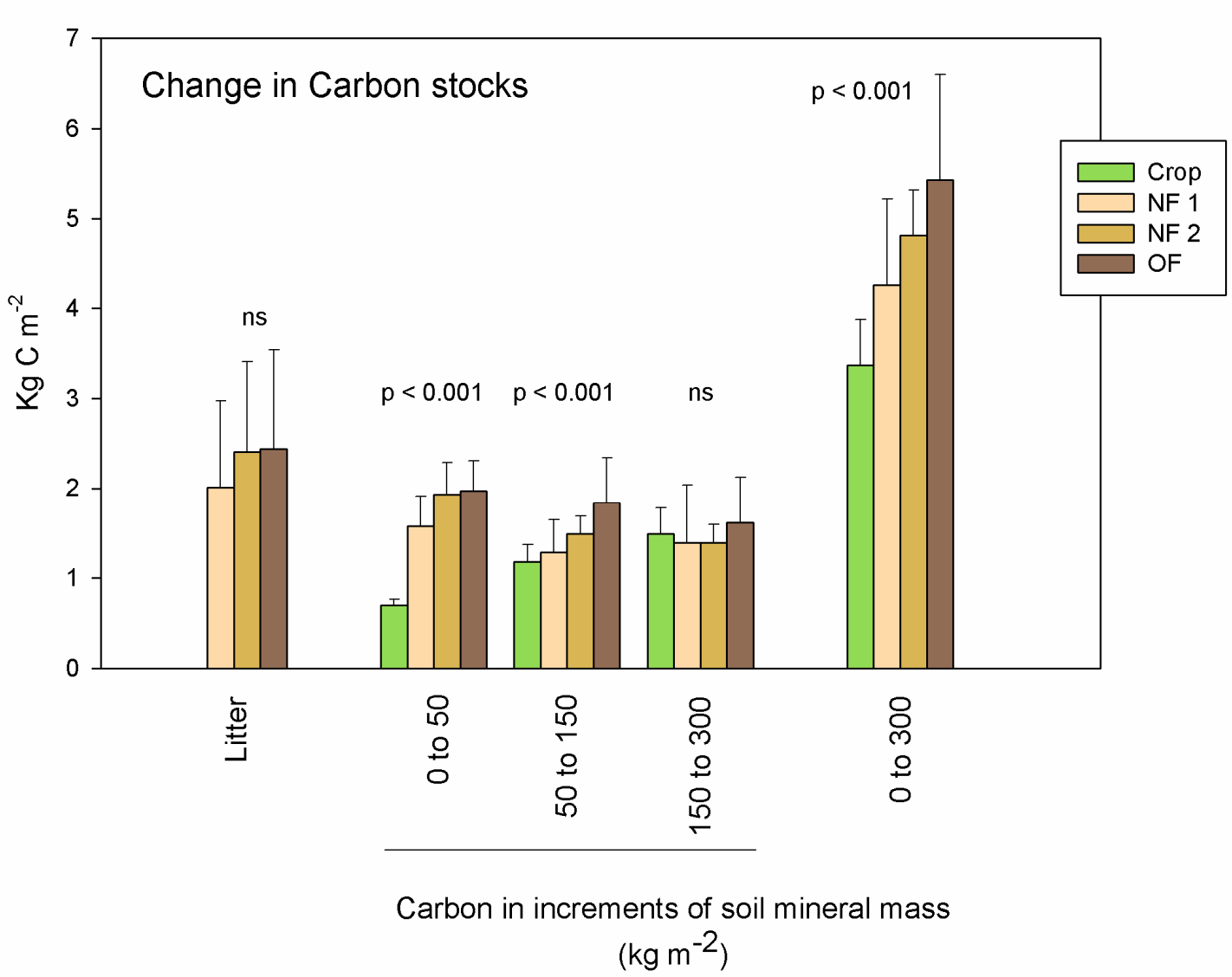


Site: Cardona
El Bages (Barcelona)
Tree species: *Pinus nigra*

Field work in Cardona: four diferent situations

Group	Acronym	Nr. Plots	Use in 1956	Current use	Agr signs*
Crops	CR	3	Crop	Crop	Y
New Forest 1	NF 1	5	Crop	Forest	Y
New Forest 2	NF 2	2	Forest	Forest	Y
Old forest	OF	3	Forest	Forest	N

Carbon sequestration



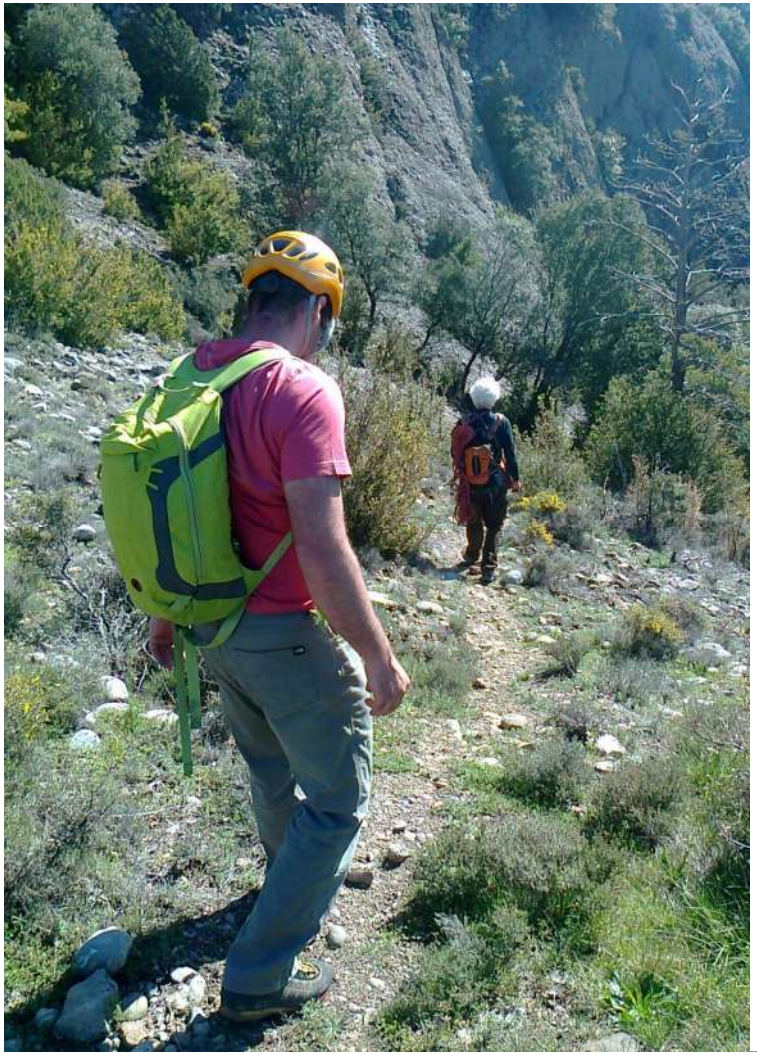
Not that optimistic

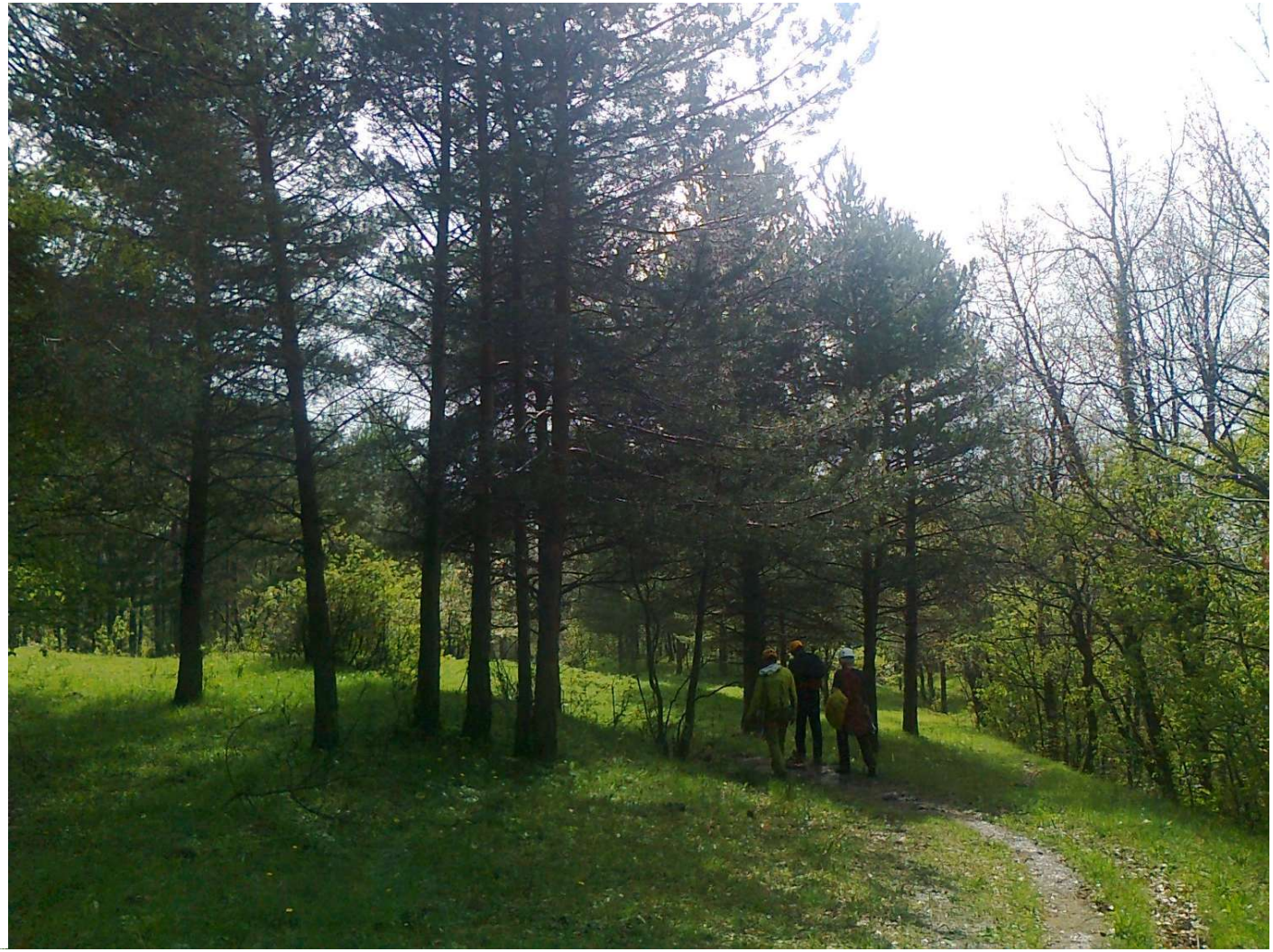
Citizen Kane (1941)

Not that optimistic

‘Increasing soil C stock 4 per mil each year is not so difficult,
Provided we manage our soils only for sequestering carbon’

Public uses *versus* carbon sequestration





Gràcies per la vostra atenció

Thanks for your attention