Session **SSS6.1:** Soil carbon sequestration and greenhouse gas emissions: sources, mechanisms, processes and management practices effects (co-organized)

Effect of climate change on soil carbon dynamics under three wheat based rotation in a Mediterranean semiarid site

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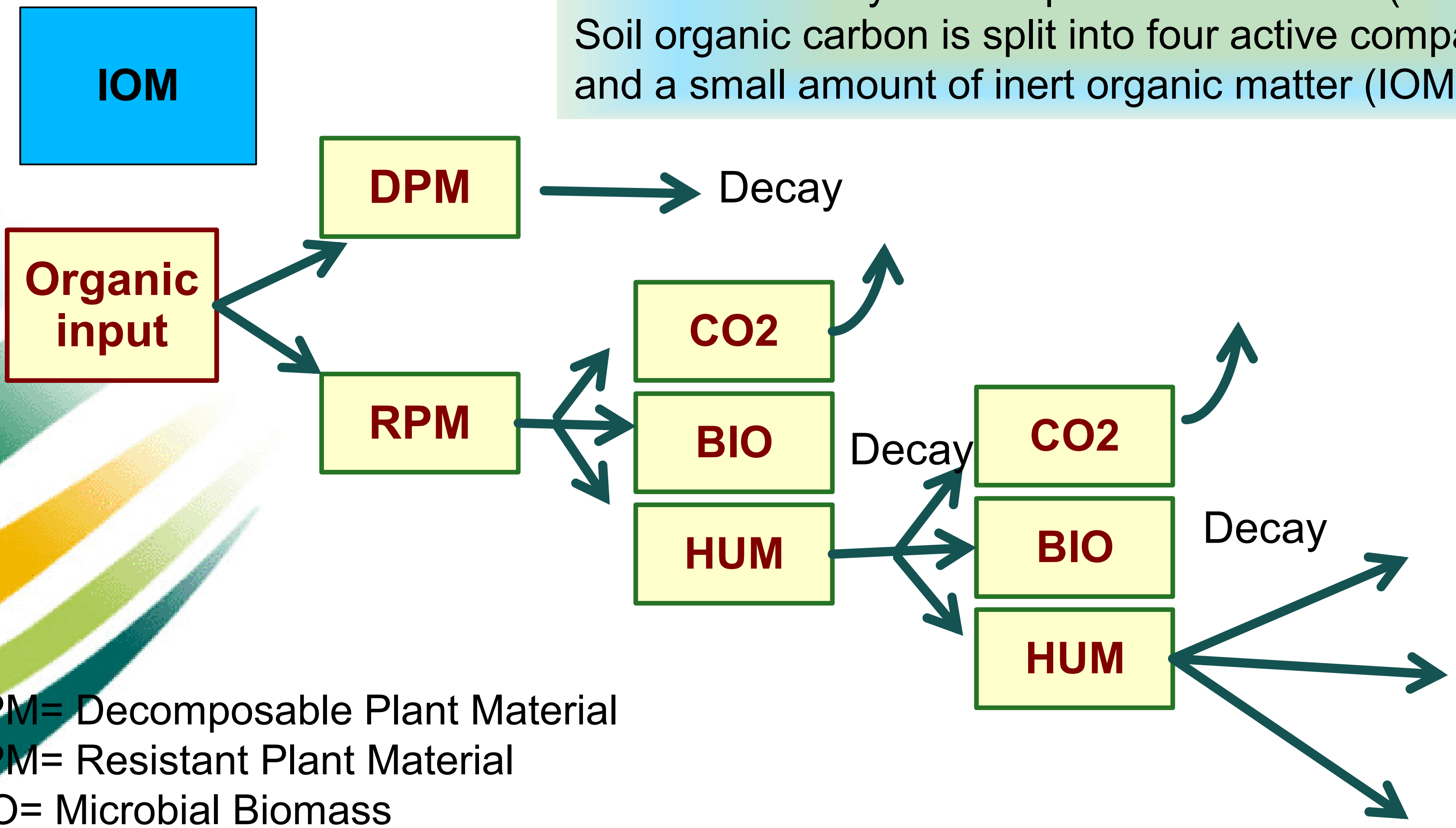
How the model works: model structure

RothC is a model to simulate the turnover of C in non waterlogged soils.
It uses a monthly time step to calculate TOC(t ha^{-1})
Soil organic carbon is split into four active compartments and a small amount of inert organic matter (IOM).



DPM= Decomposable Plant Material
RPM= Resistant Plant Material
BIO= Microbial Biomass
HUM= Humified organic matter
IOM= Inert Organic Matter

DPM/RPM for most crop 1.44 (59% DPM and 41% RPM), for deciduous 0.25 (20% DPM and 80% RPM)

How the model works

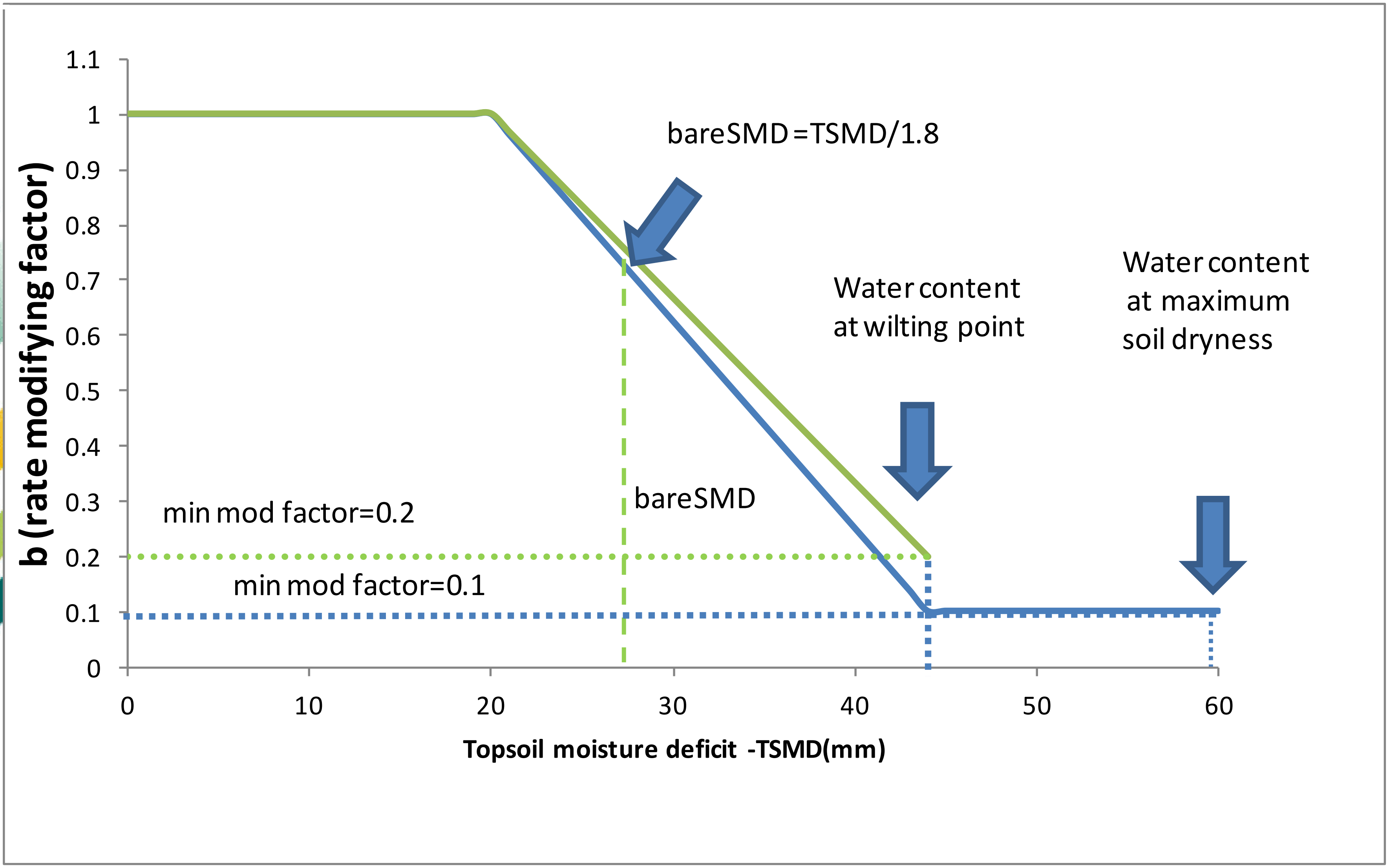
$$Y\,C\,(t\,ha^{-1}) \Rightarrow Y^{-abckt}\,C\,(t\,ha^{-1})$$

a=rate modifying factor for temperature
b=rate modifying factor for moisture
c=plant retainement factor (soil cover)
k= is the rate modifying factor for each compartment
t=time (1/12)

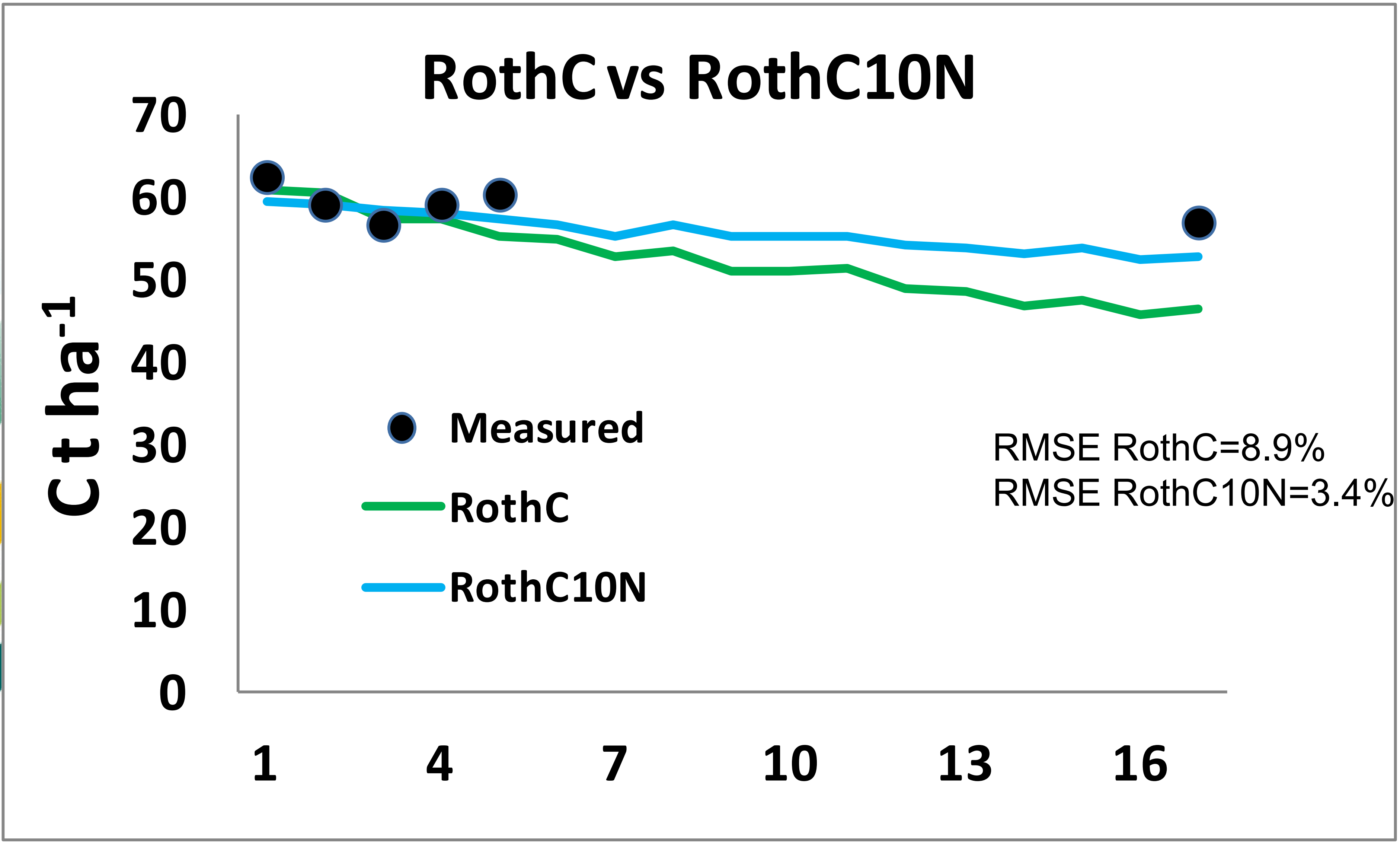
The decomposition rate constants (*k*)*, in years*$^{-1}$*, for each compartment are set at:*

	year $^{-1}$	year
DPM	**10**	**0.10**
RPM	**0.3**	**3.33**
BIO	**0.66**	**1.52**
HUM	**0.02**	**50.00**

RothC vs RothC10N*

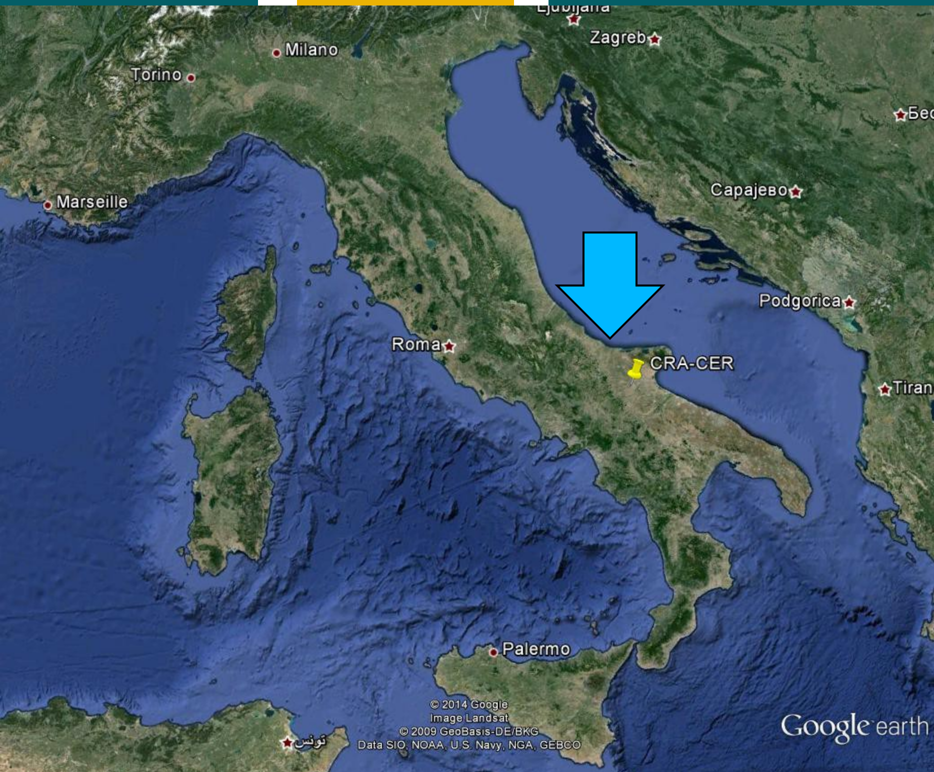


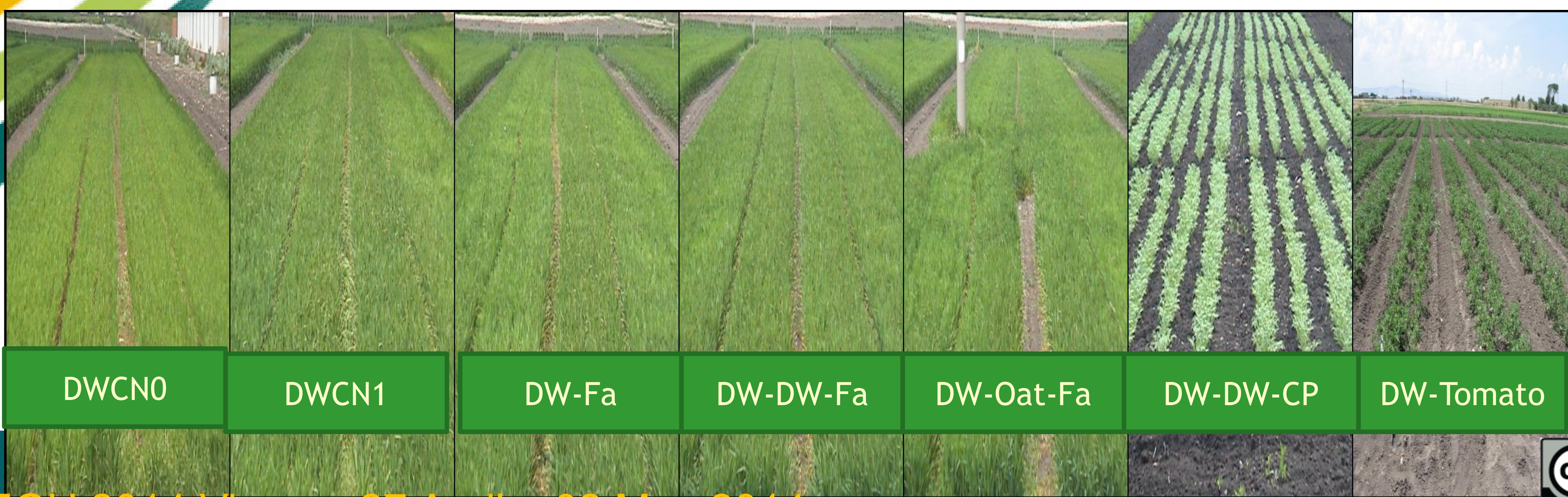
*Farina et al., 2013



Rotation Wheat-Fallow

Experimental site: Italy, Apulia, Foggia





Mediterrenean systems considered

- Continuous Durum Wheat (**DWC**)
- Durum Wheat- Durum Wheat –Fallow (**DW-DW-F**)
- Durum Wheat-Tomato (**DW-T**)

Experimental data from field

- Durum Wheat-Tickbean* (**DW-TB**)
- Durum Wheat-Durum wheat- Tickbean* (**DW-DW-TB**)
- Durum Wheat-(Tickbean)Tomato (**DW-(TB)T**)

Alternative systems

* Vicia faba minor L., used as covercrop

Climate

Weather used for simulations were generated for the baseline period and for two different future scenarios with the LARS-WG weather generator according with two ensemble multimodels, for 30 years in the scenario A1B

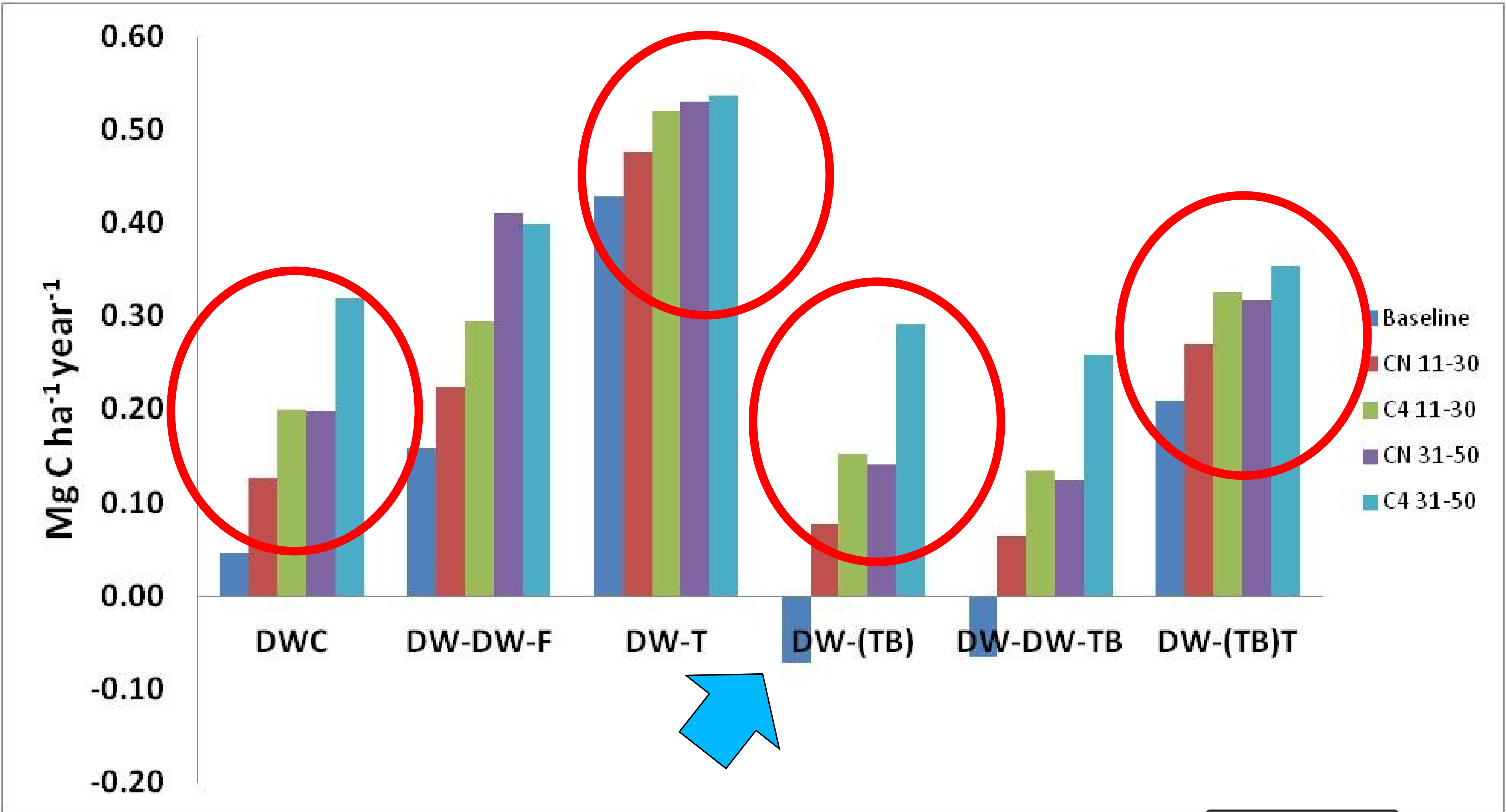
Variation of rain and temperature (%) respect to baseline climate

Climate	Rain	Temperature
C4IRCA –A1B_11-30	-1.3	7.3
C4IRCA A1B_31-50	-0.7	15.5
CNMI_RACMO-A1B_11-30	-3.8	4.0
CNMI_RACMO-A1B_31-50	-15.3	9.0

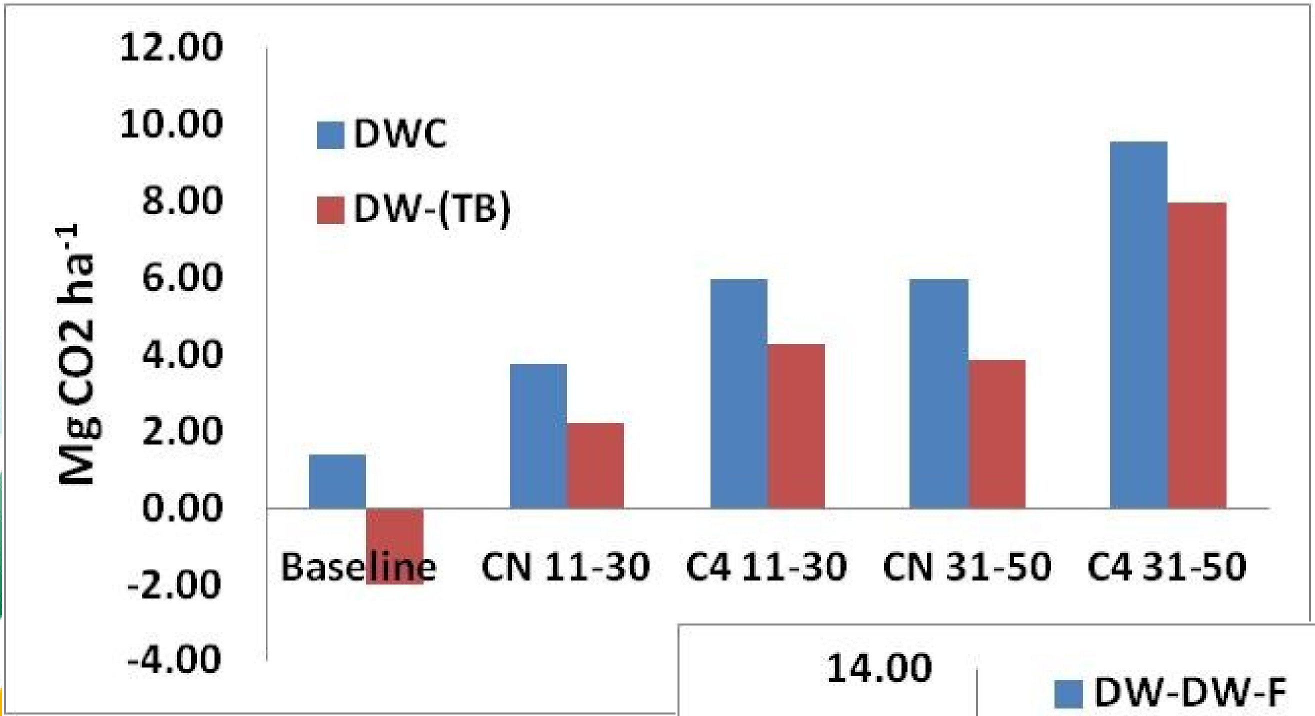
*(Racsko et al, 1991; Semenov et al, 1998; Semenov& Brooks, 1999)

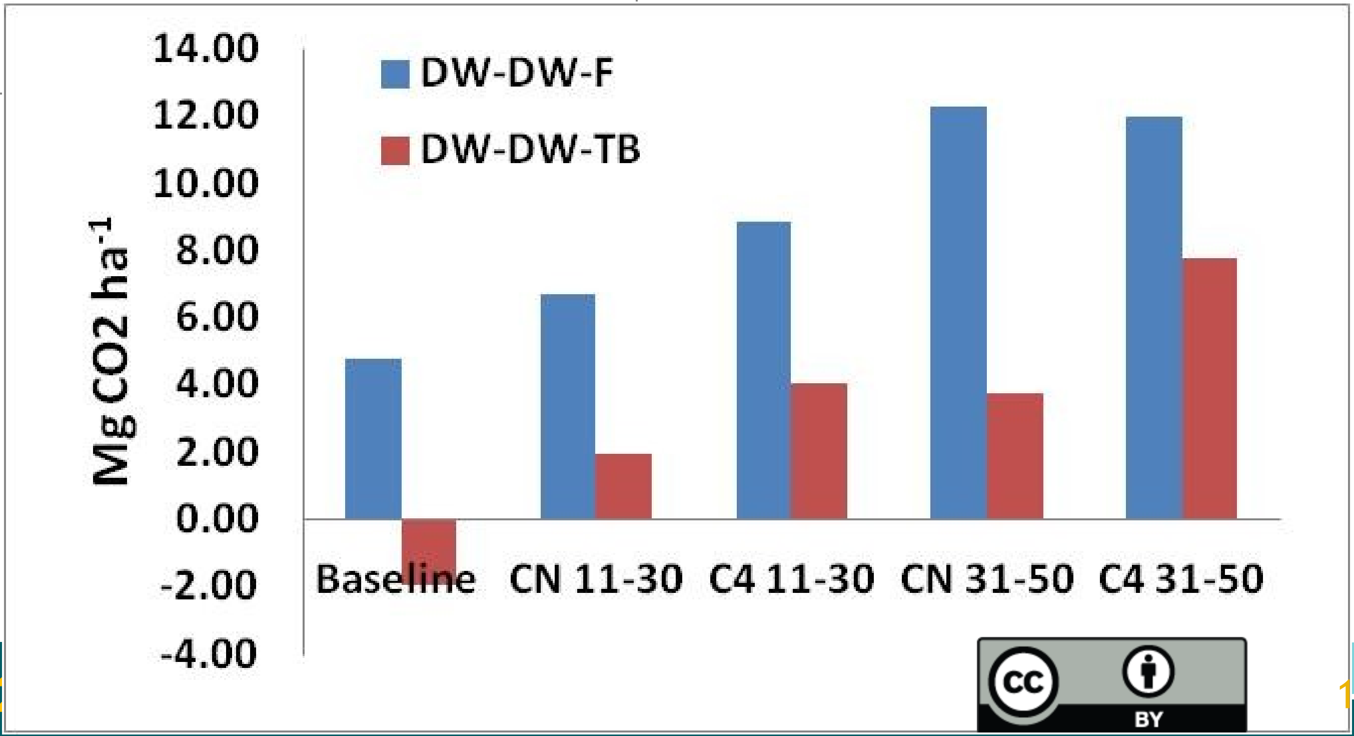
Simulation results

Yearly average C lost by the system (+) or retained in the soil (-)



Simulations results





Results

Relative variation of C respect to baseline

Cropping system	CN 11-30	C4 11-30	CN 31-50	C4 31-50
DWC	173.61	333.71	332.56	593.29
DW-DW-F	40.50	84.98	157.63	150.32
DW-T	11.13	21.25	23.62	25.27
DW-TB	207.07	313.26	296.20	505.45
DW-DW-TB	198.60	307.41	291.30	496.92
DW-(TB)T	29.12	55.19	51.76	68.99

Results

- Traditional dryland wheat-based cropping systems in Mediterranean regions reduce C content of soils in baseline and in all scenarios of climate change
- The introduction of a winter cover crop (tickbean) improved the C balance of the system under baseline and under climate change scenarios
- The two years rotation DW-TB compared to DWC increased the C annual storage from 256% (under baseline) to 9% under the most severe climate
- The rotation DW-DW-TB compared to DW-DW-F increased the C annual storage from 141% (under baseline) to 35% under the most severe climate
- The irrigated rotation including tomato and the cover crop reduced C losses by almost 50% under all climates

Conclusions

- In Mediterranean wheat- based systems there is a potential to increase the C sequestration by cropping systems
- This can be achieved by modifying the rotations, i.e. including a cover-crop in the two years rotations
- The use of a cover crop is a positive strategy in terms of sustainability, for the increase of C and N inputs, for the general improvement of soil structure, for the increase of agro- biodiversity.

Thank you for your attention

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