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Urban soil carbon stability in semi-arid region: case study of Marrakech city

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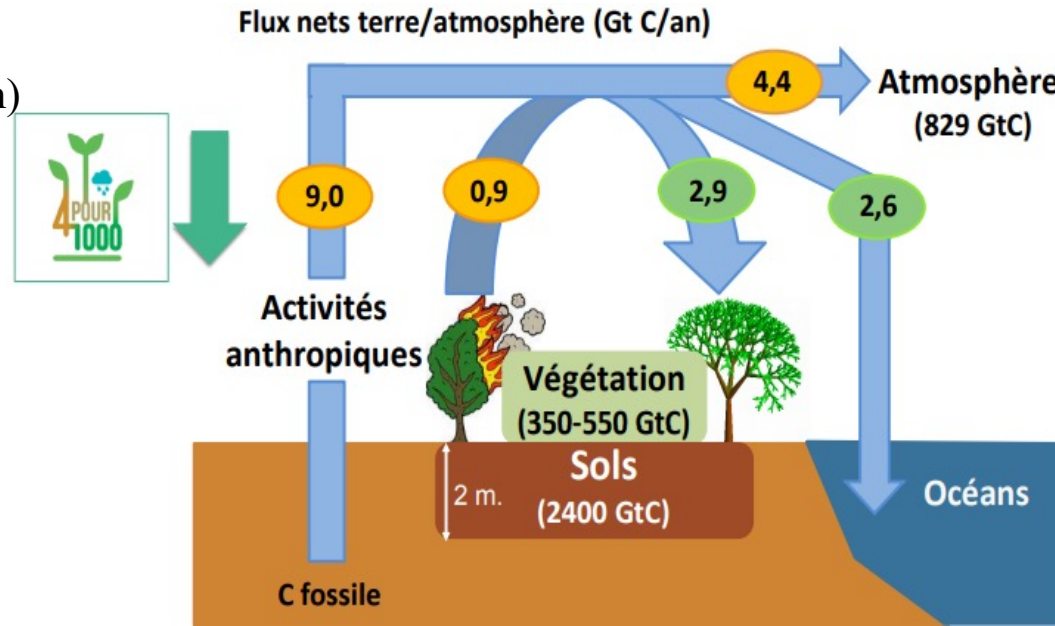
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September 2022

1. Introduction

GLOBAL CYCLE OF ORGANIC CARBON

- ❖ Soil is one of the largest pools of organic carbon (OC) (1462–1584 Pg in the top 100 cm)
- ❖ OC content is three times more than that of atmospheric or terrestrial vegetation pools (Schmidt et al., 2011)
- ❖ Small variation in soil C stock can have significant effect on atmospheric C concentration.

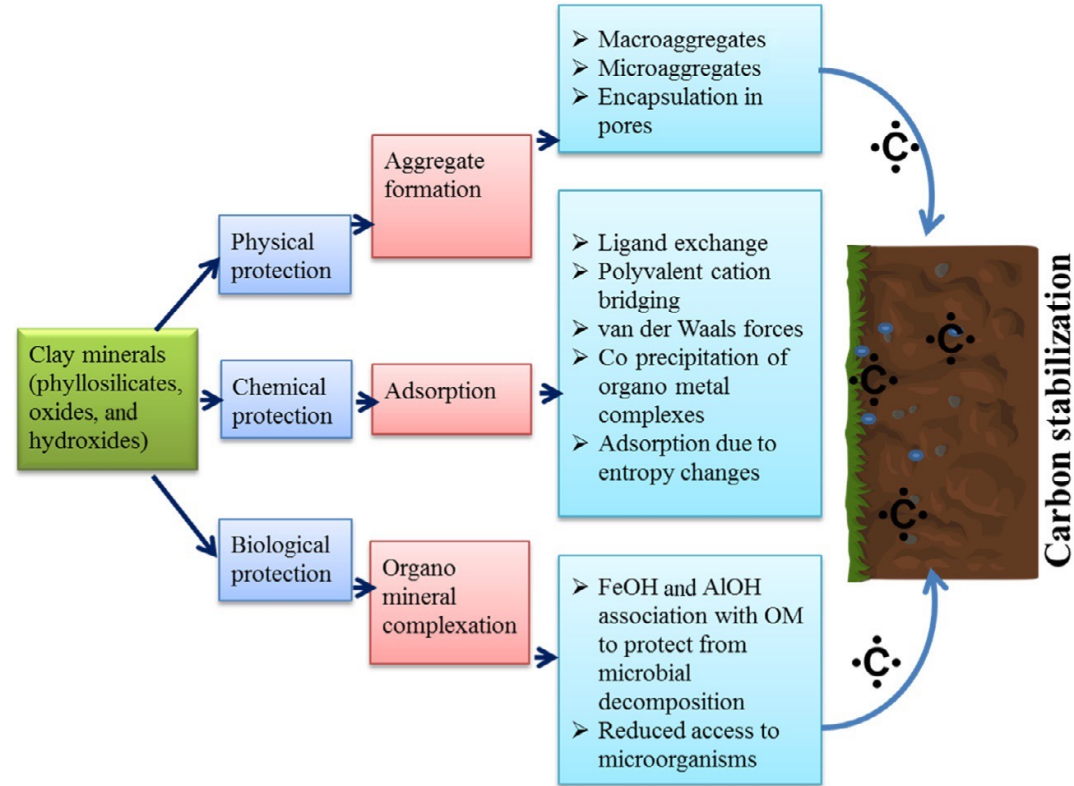


Ciais et al. 2014; Houghton 2007; Le Quéré et al. 2015

1. Introduction

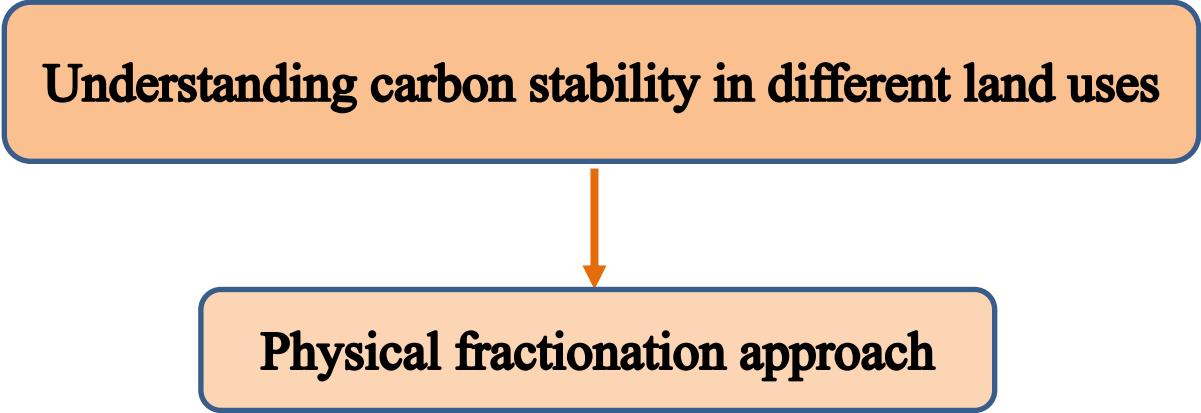
SOIL CARBON STABILIZATION

- ❖ Carbon stability: Action which slows down the decomposition of SOM by reducing the mineralization rate.
- ❖ Three main mechanisms of C stabilization: physical, chemical, and biological.



2. Objectif

Understanding carbon stability in different land uses



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graph TD; A[Understanding carbon stability in different land uses] --> B[Physical fractionation approach];
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Physical fractionation approach

3. Materials and Methods

Photos taken by BEROIGUI



Suburban agricultural soil
irrigated with treated
wastewater (SAS-TWW)

Suburban agricultural soil
irrigated with water well
(SAS-WWE)

Suburban agricultural soil
irrigated with wastewater
(SAS-WW)

Control (C)

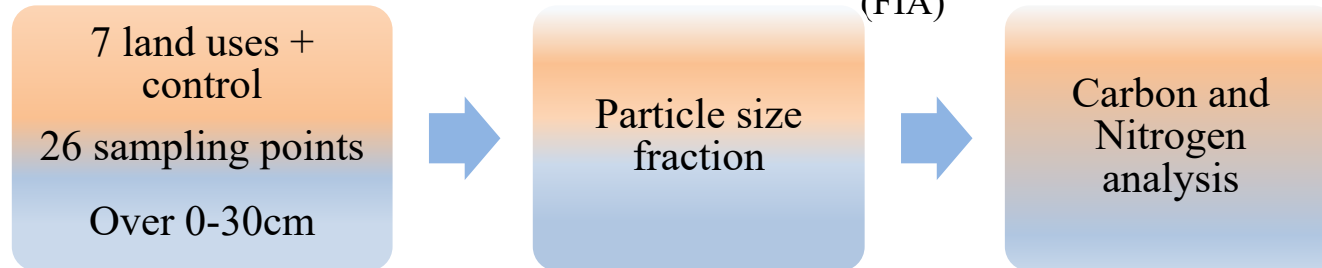


Landfill (LF)

Public Green Space (PGS)

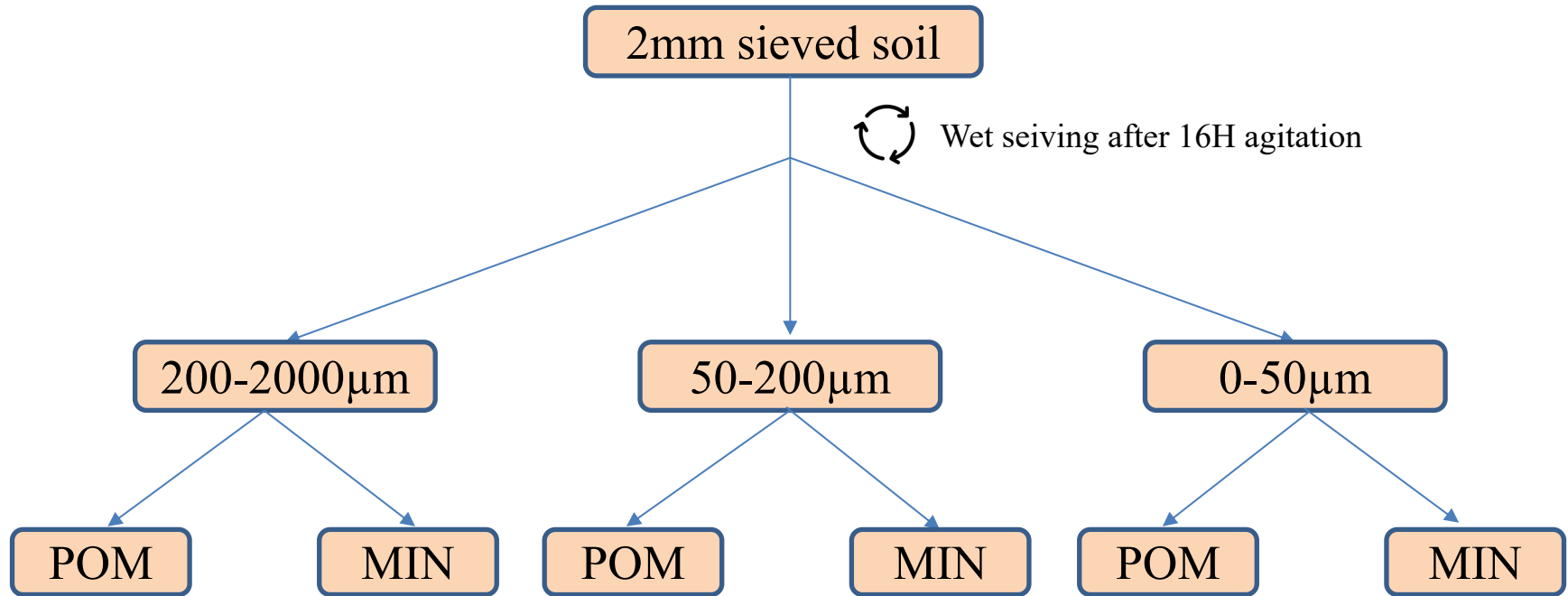
Former Industrial Area
(FIA)

Residential Area (RA)



3. Materials and Methods

PHYSICAL FRACTIONATION SCHEME (*Six et al. 2002*)



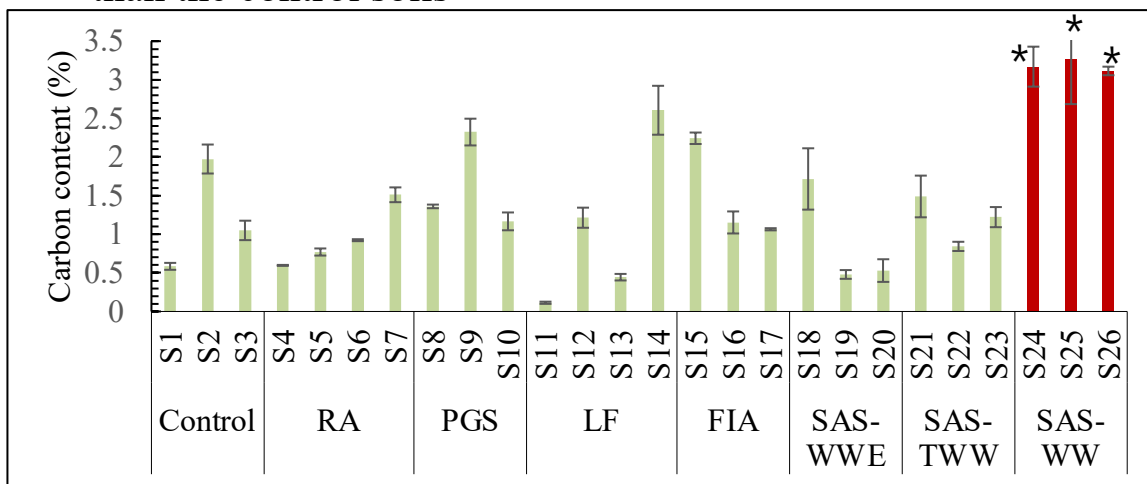
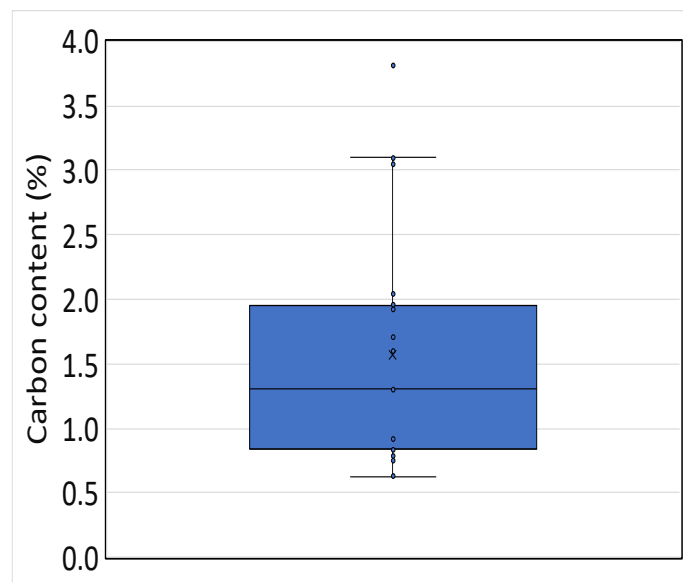
POM: Particulate Organic Matter fraction

MIN: Mineral fraction

4. Results and discussion

SOIL CARBON CONTENT IN URBAN SOILS UNDER DIFFERENT LAND USES IN A SEMI-ARID REGION

- The values varied between 0.91% and 3.16%.
- Average is 1.6%, while the median is 1.4%
- Lowest carbon content 0.1%
- Highest carbon content is 3.8%
- SAS-WW use type which had a SOC content 3 times higher than the control soils



RA: residential area

PGS: public green space

LF: landfill

FIA: former industrial area

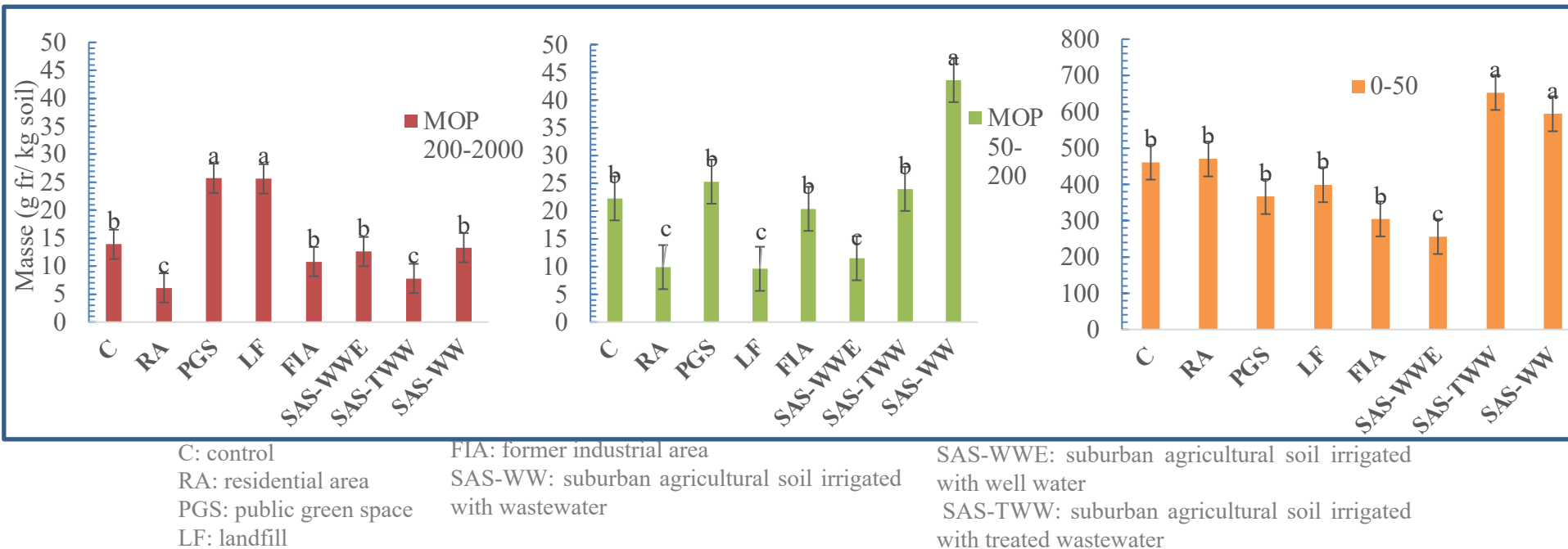
SAS-WW: suburban agricultural soil irrigated with wastewater

SAS-WWE: suburban agricultural soil irrigated with well water

SAS-TWW: suburban agricultural soil irrigated with treated wastewater

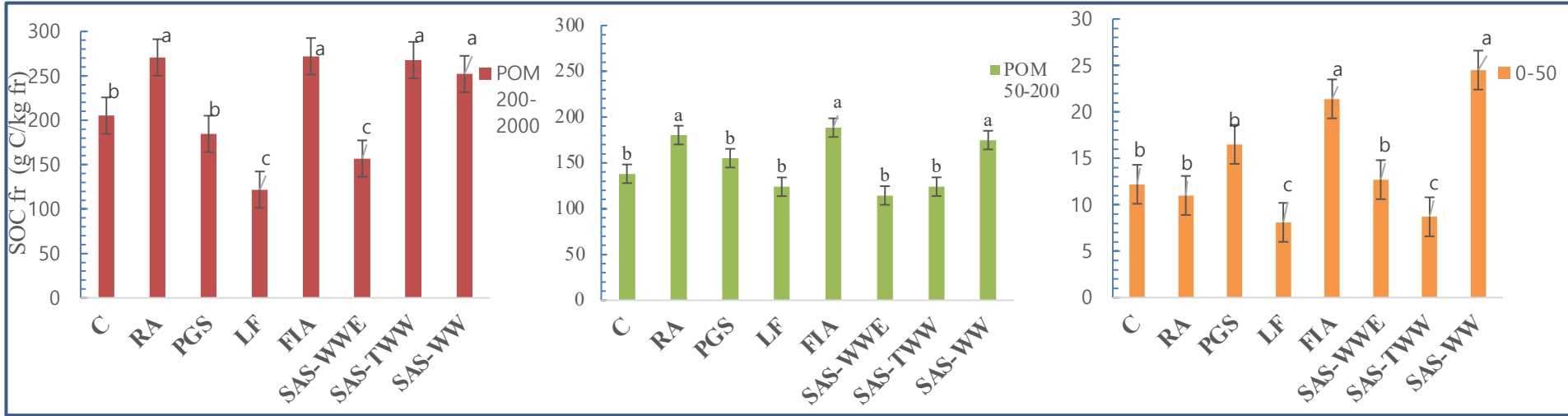
4. Results and discussion

FRACTION MASSE CONTENT IN URBAN SOILS UNDER DIFFERENT LAND USES



- Average masse content is 25g fr/kg soil for POM 200-2000 and POM 50-200.
- Fine fraction (0-50) showed 15 to 20 times higher masse content than both POM 200-2000 and POM 50-200 in studied land uses.
- To be compared to *Grandière et al. 2008*, same trend was observed for No-till system under subtropical soil.

SOIL ORGANIC CARBON CONTENT IN FRACTIONS



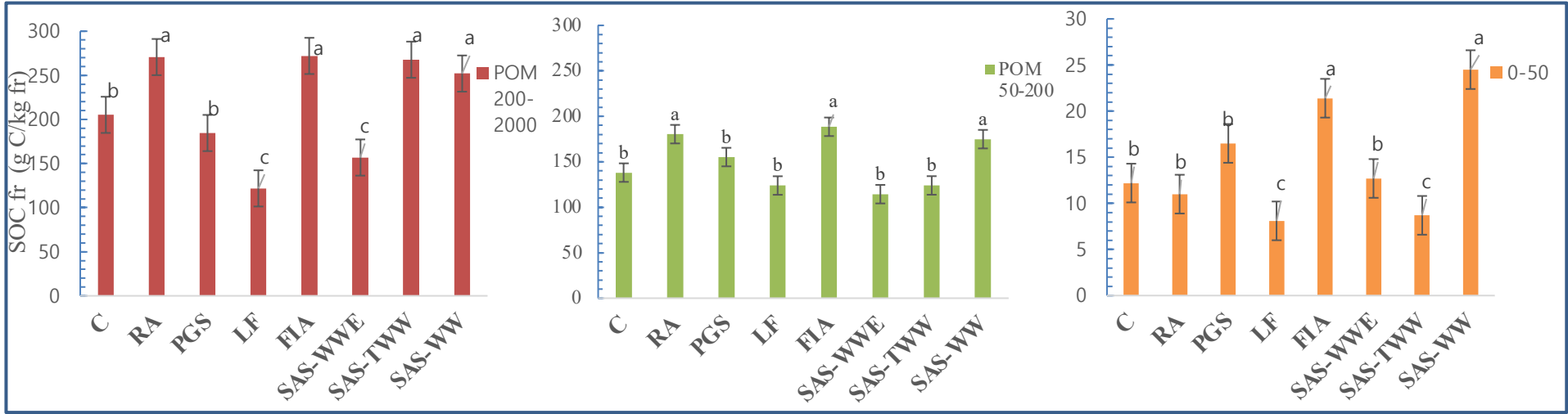
C: control
RA: residential area
PGS: public green space
LF: landfill

FIA: former industrial area
SAS-WW: suburban agricultural soil irrigated with wastewater

SAS-WWE: suburban agricultural soil irrigated with well water
SAS-TWW: suburban agricultural soil irrigated with treated wastewater

- Higher SOC recorded in POM 200-2000 μm and POM 50-200 μm than the fine fractions.
- Higher SOC for POM 200-2000 recorded for SAS-WW, SAS-TWW, FIA and RA (262, 267 and 270 gC/g) comparatively to the control (205.2 gC/kg).
- Higher SOC for POM 50-200 recorded for SAS-WW, FIA and RA (188, 174, 180 gC/kg) comparatively to the control (138 C/kg).
- Average is 15 gC/kg in fine fractions (0-50 μm)
- Higher SOC for fine fraction was recorded at SAS-WW (25 gC/kg) than the control (12.2 gC/kg), but very low SOC compared to POM fractions.

SOIL ORGANIC CARBON CONTENT IN FRACTIONS



C: control
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LF: landfill

FIA: former industrial area
SAS-WW: suburban agricultural soil irrigated with wastewater

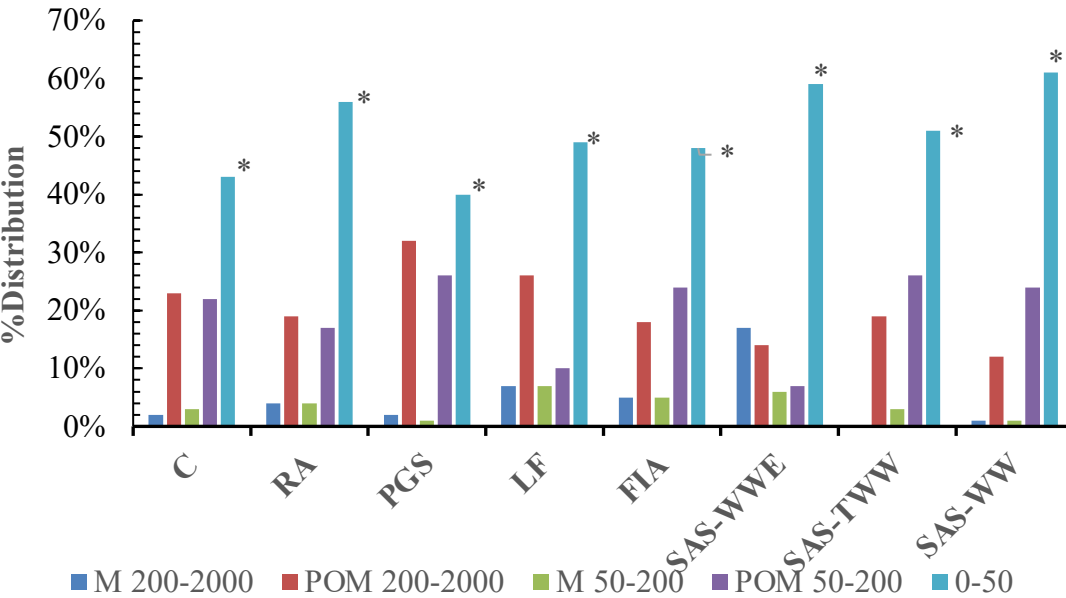
SAS-WWE: suburban agricultural soil irrigated with well water
SAS-TWW: suburban agricultural soil irrigated with treated wastewater

-To be compared to *Christensen, 1992* and *Feller, 1995* in temperate and tropical soils; our findings results recorded lower SOC in all studied fractions.

-SOC in fine fraction is protected by adsorption to mineral surfaces and by occlusion: they are then less accessible to microbial communities (Chenu & Plante, 2006)

4. Results and discussion

DISTRIBUTION OF CARBON UNDER DIFFERENT LAND USES IN A SEMI-ARID REGION



- % Carbon distribution reached a maximum of 60% for both suburban agricultural soils irrigated by well water and wastewater compared to the control (43%).
- Higher % Carbon distribution in fine fraction in all studied land uses compared to POM
- Charenbroch et al. (2005) had reported 79% carbon distribution in Moscow urban park in (Idaho, USA), while 55% was outlined in maintained green space in upper 44cm (*Cambou et al. 2018*).

RA: residential area

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Conclusion

- ❑ SOC stability is influenced by land use, soil type, and climate.
- ❑ Suburban area irrigated with wastewater showed significant carbon content.
- ❑ Regardless of soil type and land use, fine fraction is less enriched with OC compared to POH fraction, even though its carbon distribution is higher.
- ❑ The fine fraction in association with OC serve as components for the construction of microaggregates.
- ❑ The fine fraction could represent a stable fraction due to the strong binding with mineral soil particles.

Thank you for
your attention

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