

Soil Carbon

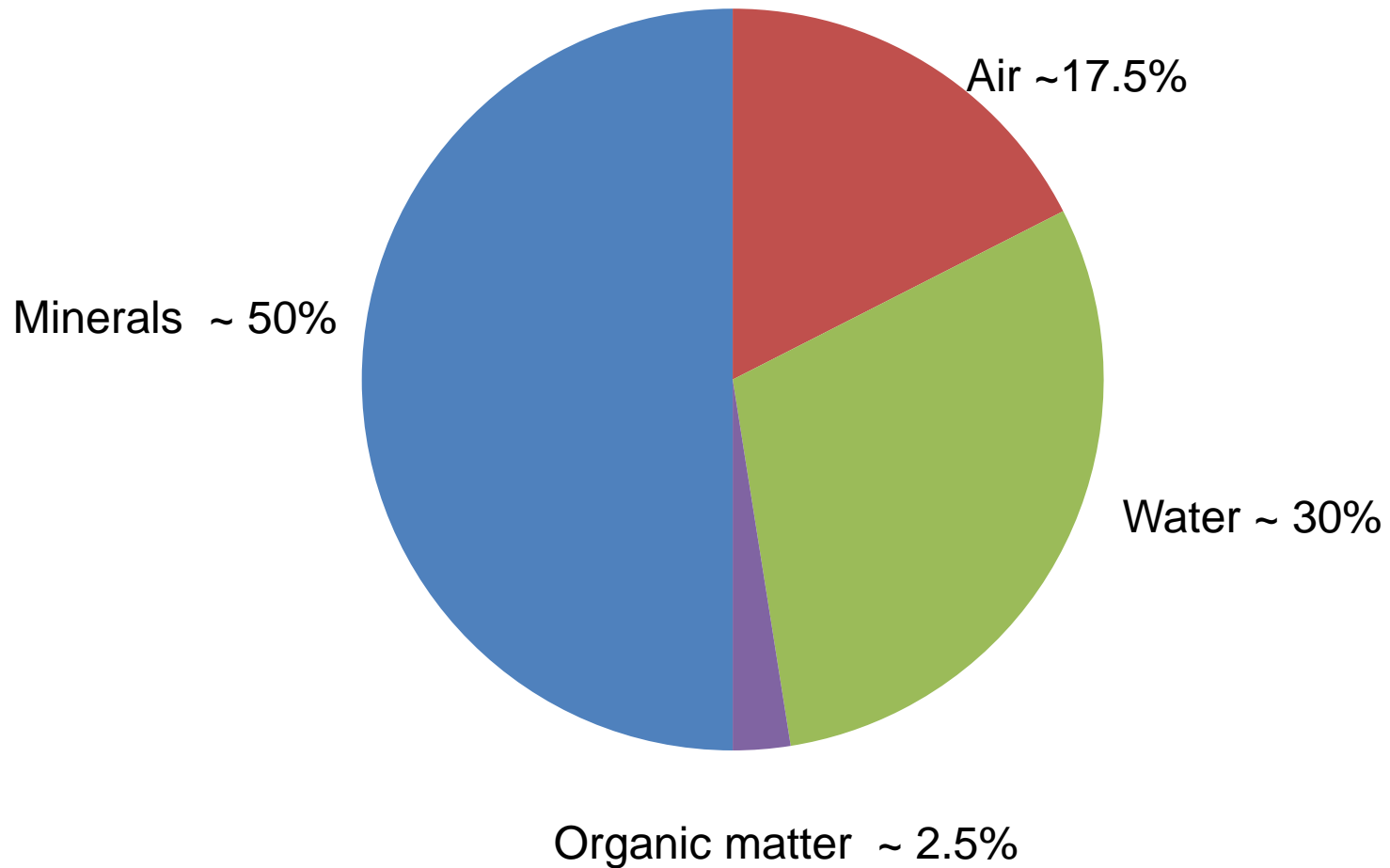
Cam Nicholson, Nicon Rural Services



Today's webinar

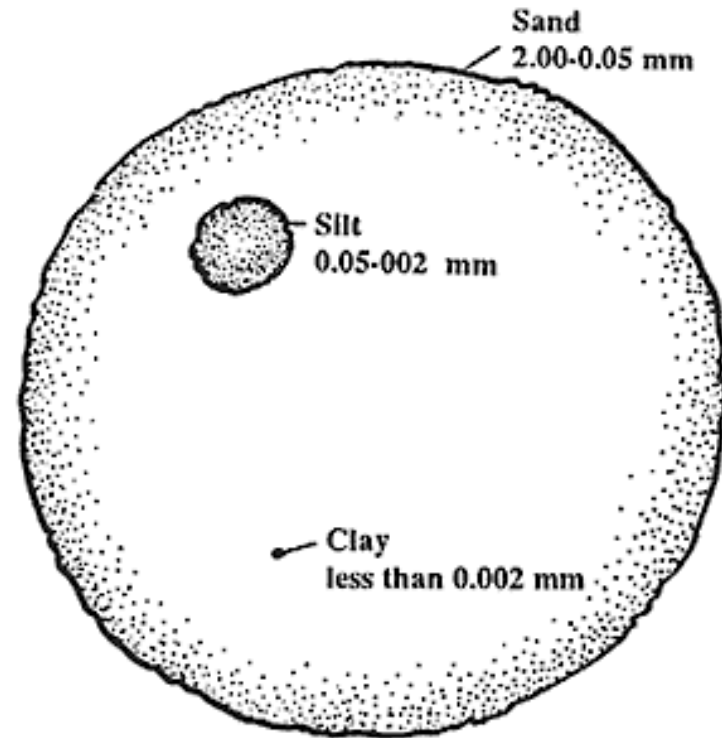
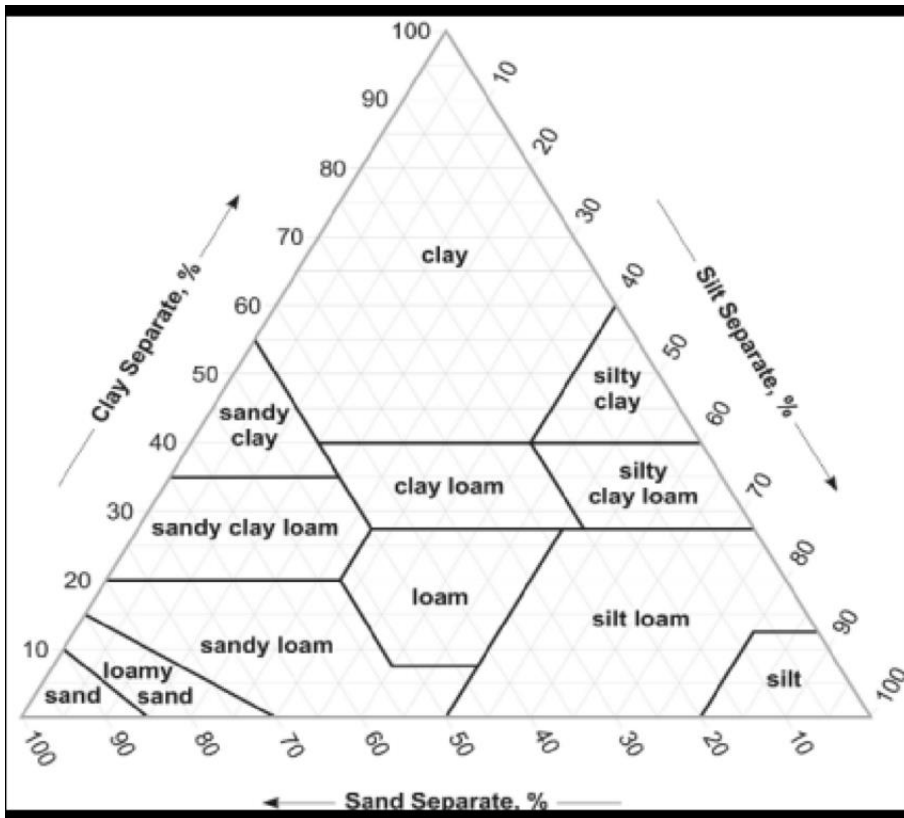
- Soil terminology & background
- Soil carbon and soil fractions
- The carbon balance
- Management of soil carbon – what can we do?
- Where are we now in relation to soil carbon
- Some soil carbon calculations

What is a soil made up of?



Soil texture

Proportion of sand, silt and clay



Bulk density

Weight of soil
for a given
volume (g/cm³)

Bulk density
typically
between 1.2
and 1.5

Bulk density >1.6 restricts
root growth



Benefits of increasing soil organic matter

- Increases infiltration and reduces evaporation (large OM)
- Stabilise soil particles, creating more space for air and water (small OM)
- Stores and releases (when it breaks down) readily available essential nutrients
- Increases cation and anion exchange sites
- Increases soil carbon

A few things about soil carbon

- Soil **organic matter** consists of plant litter, dead roots, animal remains and excreta.
- Soil **organic carbon** (SOC) is 58% of soil organic matter (SOM)

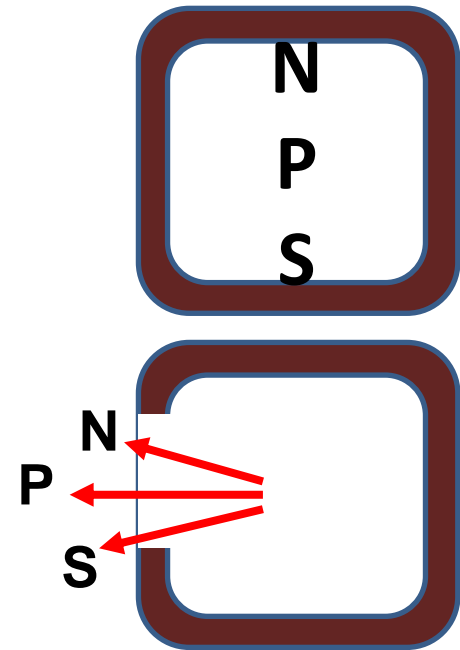
A few things about soil carbon

- Four main **fractions** of soil carbon
 - Crop residues > 2mm
 - Particulate organic carbon (POC)
 - Humic organic carbon (HOC)
 - Recalcitrant (charcoal - ROC)



A few things about soil carbon

- Soil organic matter contains nutrients:
 - **60** kg of **N** per tonne of humus
 - **12** kg of **P** per tonne of humus
 - **9** kg of **S** per tonne of humus
- Break down of organic carbon releases nutrients (mineralisation)
- Building soil carbon takes nutrients



Soil carbon balance

Inputs

- Net primary productivity (capture by plants and added to soil)
- Addition of organic materials from offsite



Image: Jeff Baldock CSIRO

Losses

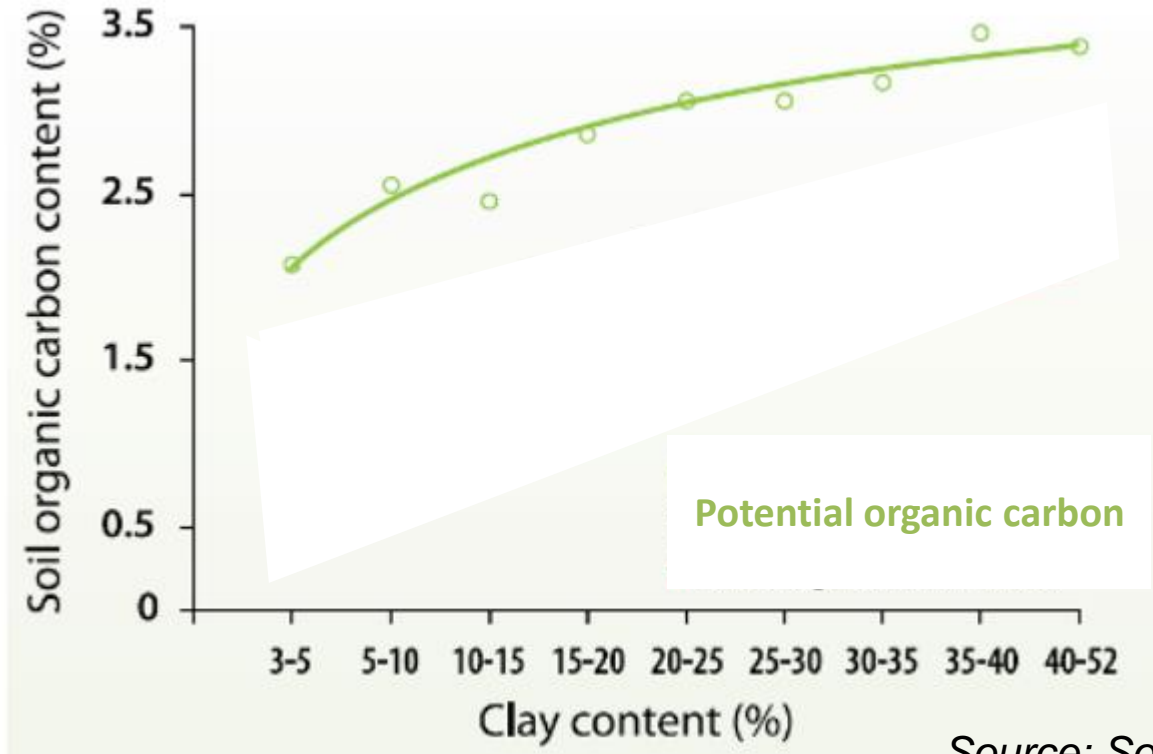
- Conversion of organic C to CO_2
- Removal of products containing C
- Cultivation / erosion

Only **5 to 10%** of the organic matter we supply as inputs turns into soil organic carbon, the rest eventually goes back into the atmosphere (eaten by soil bugs)



Soil carbon balance

There is an **upper limit** to how much carbon a soil can store – determine by **soil type**

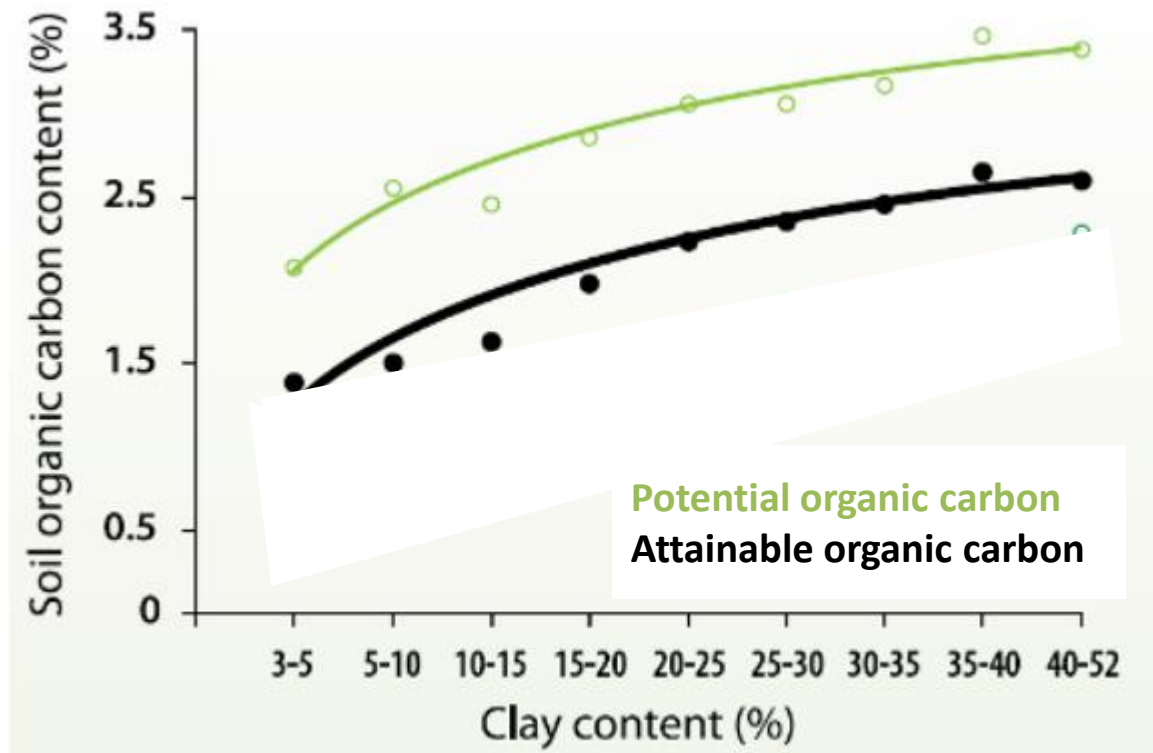


Source: [Soil quality.org.au](http://Soilquality.org.au)

Called the potential organic carbon storage

Soil carbon balance

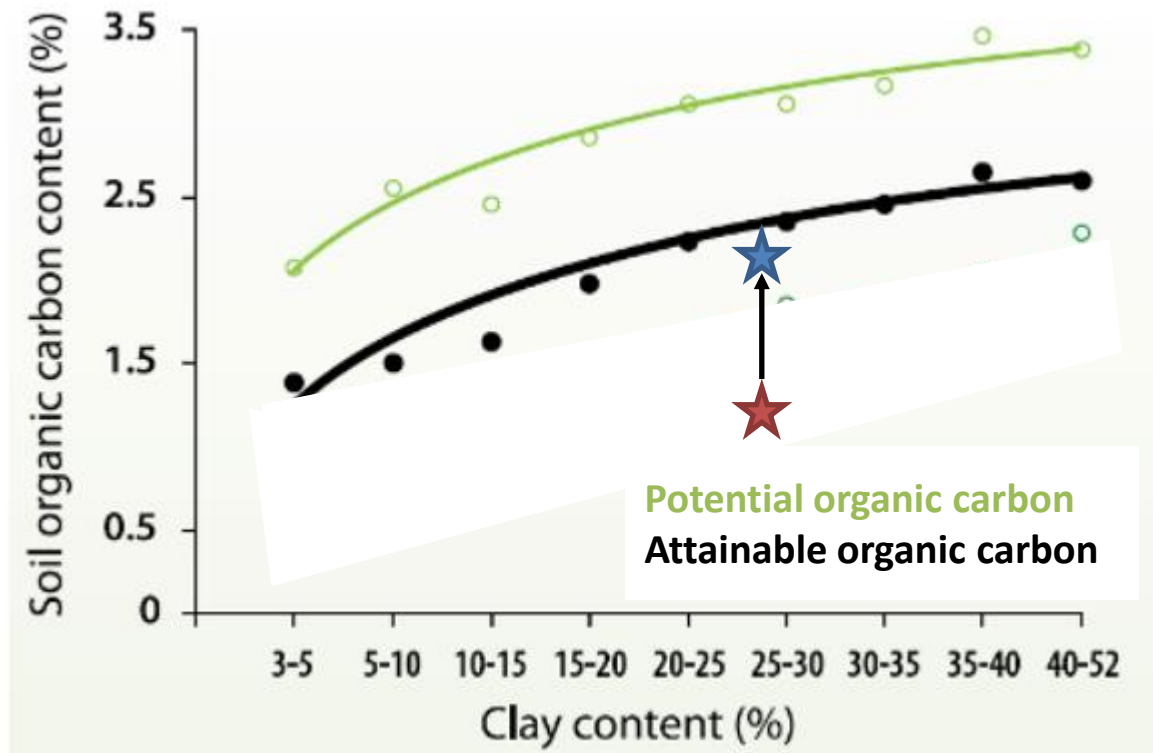
Climate will determine how close we can get to the potential yield (unless we continually add external stuff)



Called the attainable storage of organic carbon

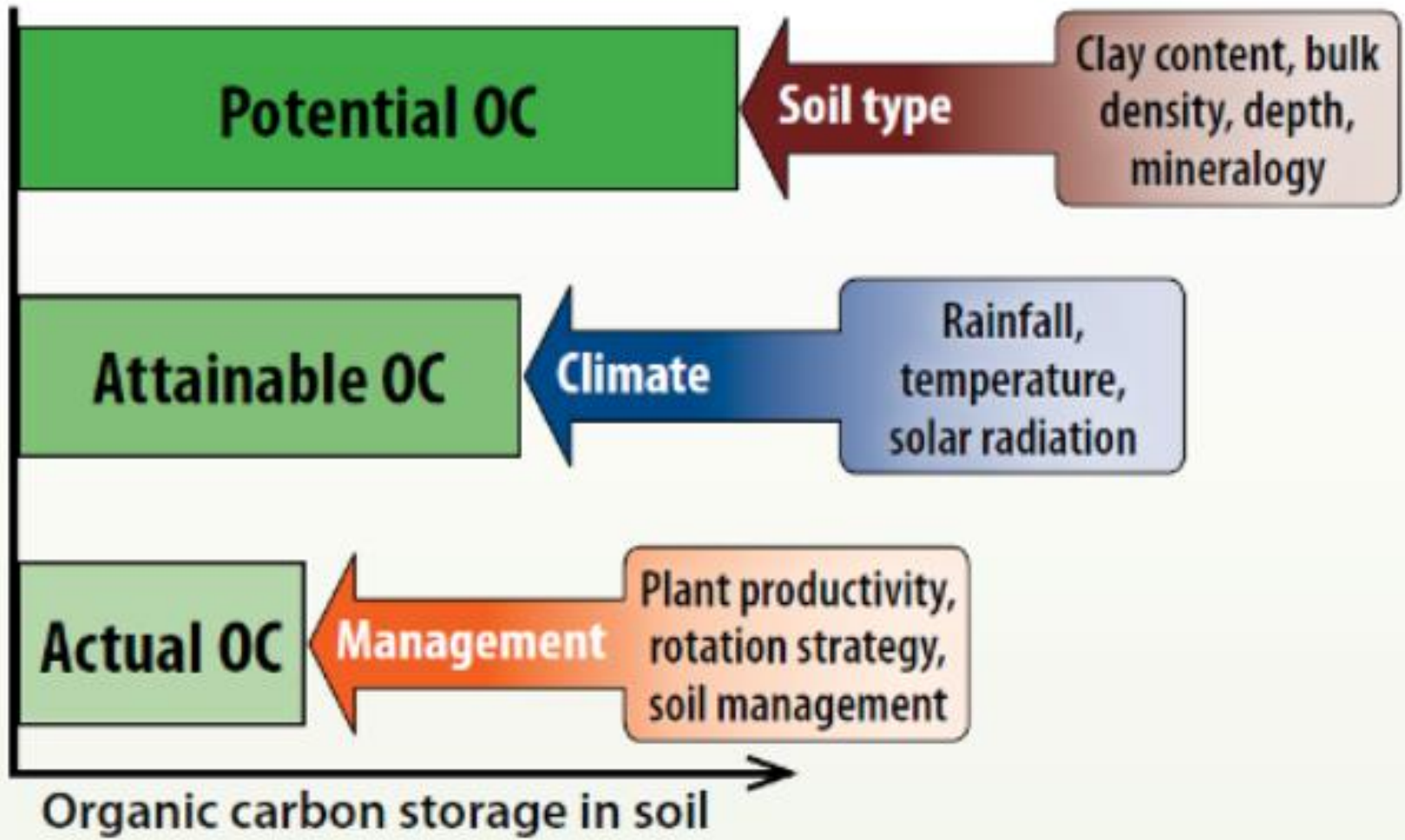
Soil carbon balance

Your management will determine how close we can get to the attainable soil carbon



Called the actual storage of organic carbon

Soil carbon balance

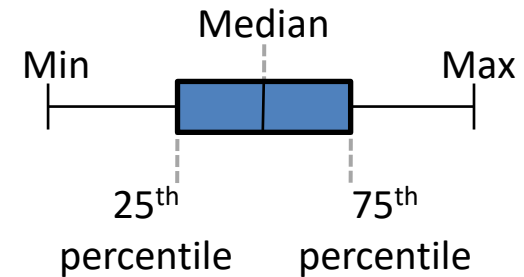
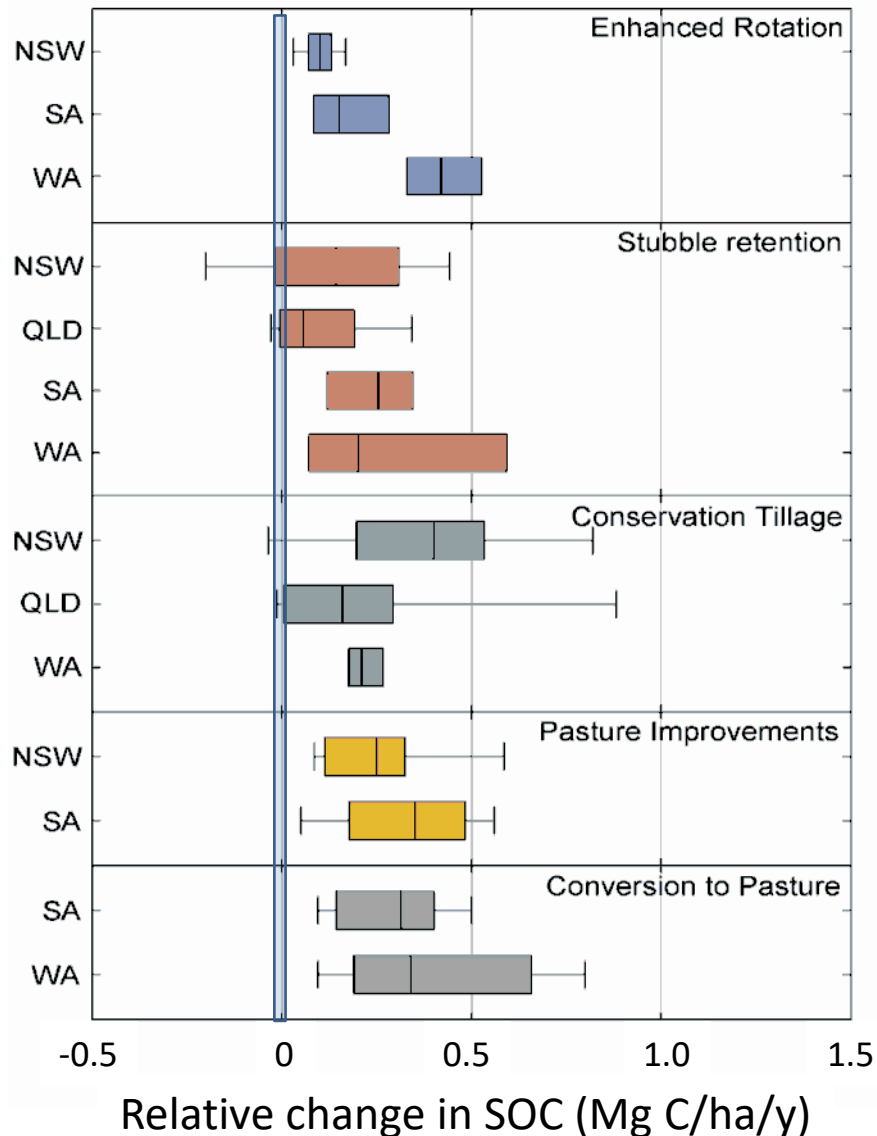


Soil carbon balance

Participant task

- List some possible methods of increasing the inputs of organic material to move the actual to the attainable
- What is your likely response to growing more organic material?
- NET FARM CARBON BALANCE (carbon footprint)

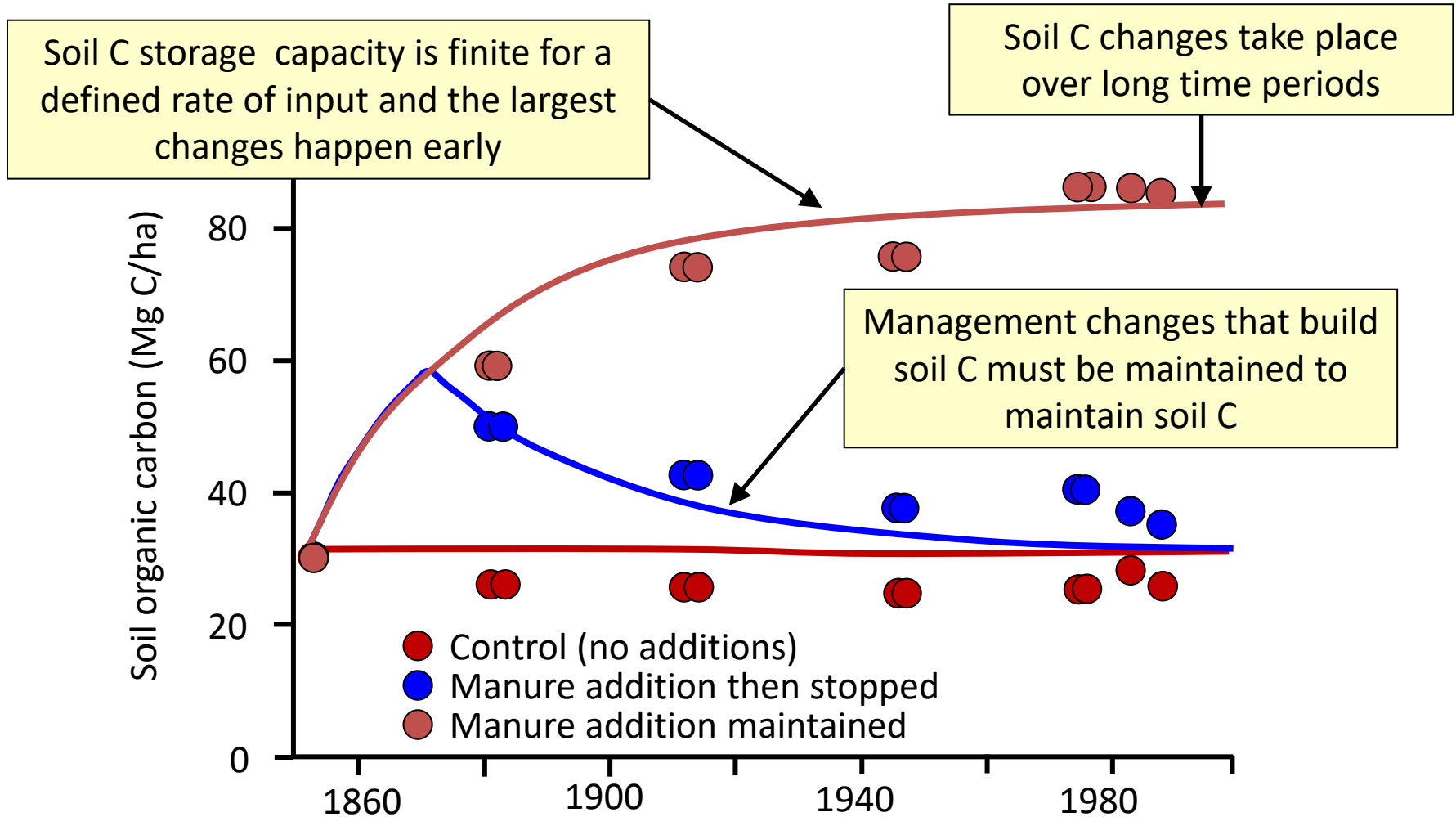
Impact of agriculture management on soil carbon



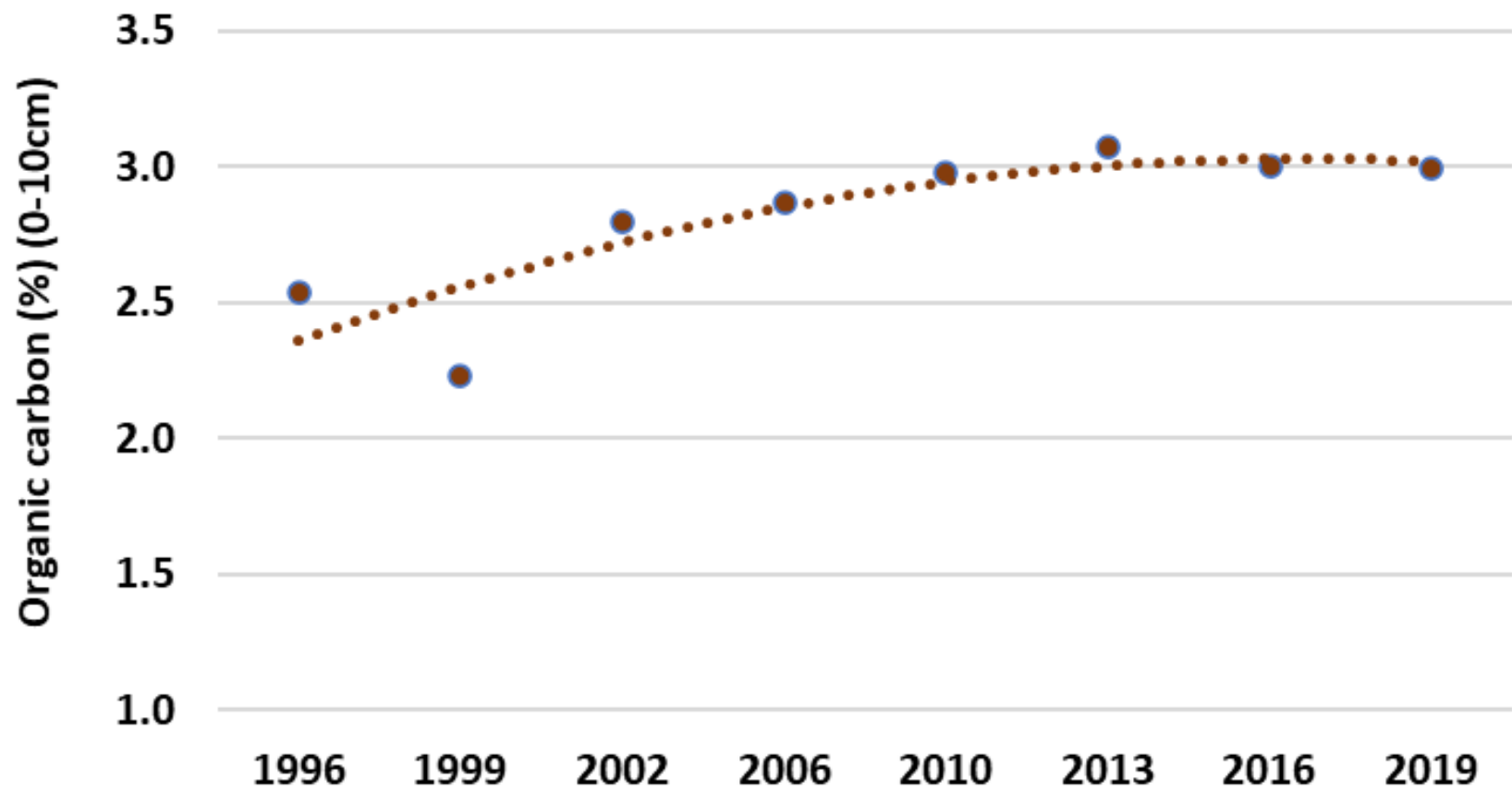
Sanderman et al. 2010 Soil Carbon Sequestration Potential: A review for Australian agriculture. CSIRO Technical report

<http://www.csiro.au/files/files/pwiv.pdf>

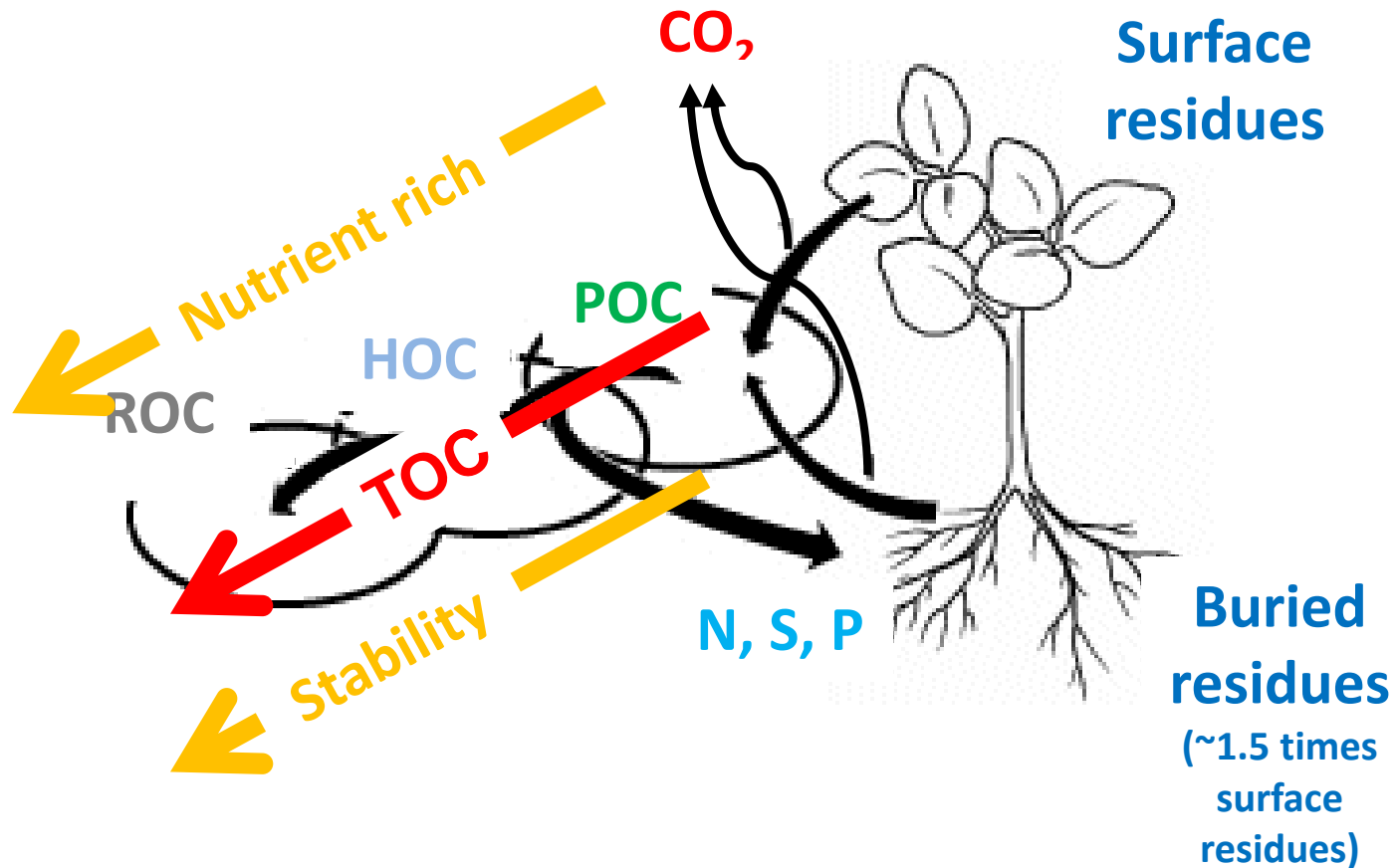
Permanence of changes in soil carbon stocks



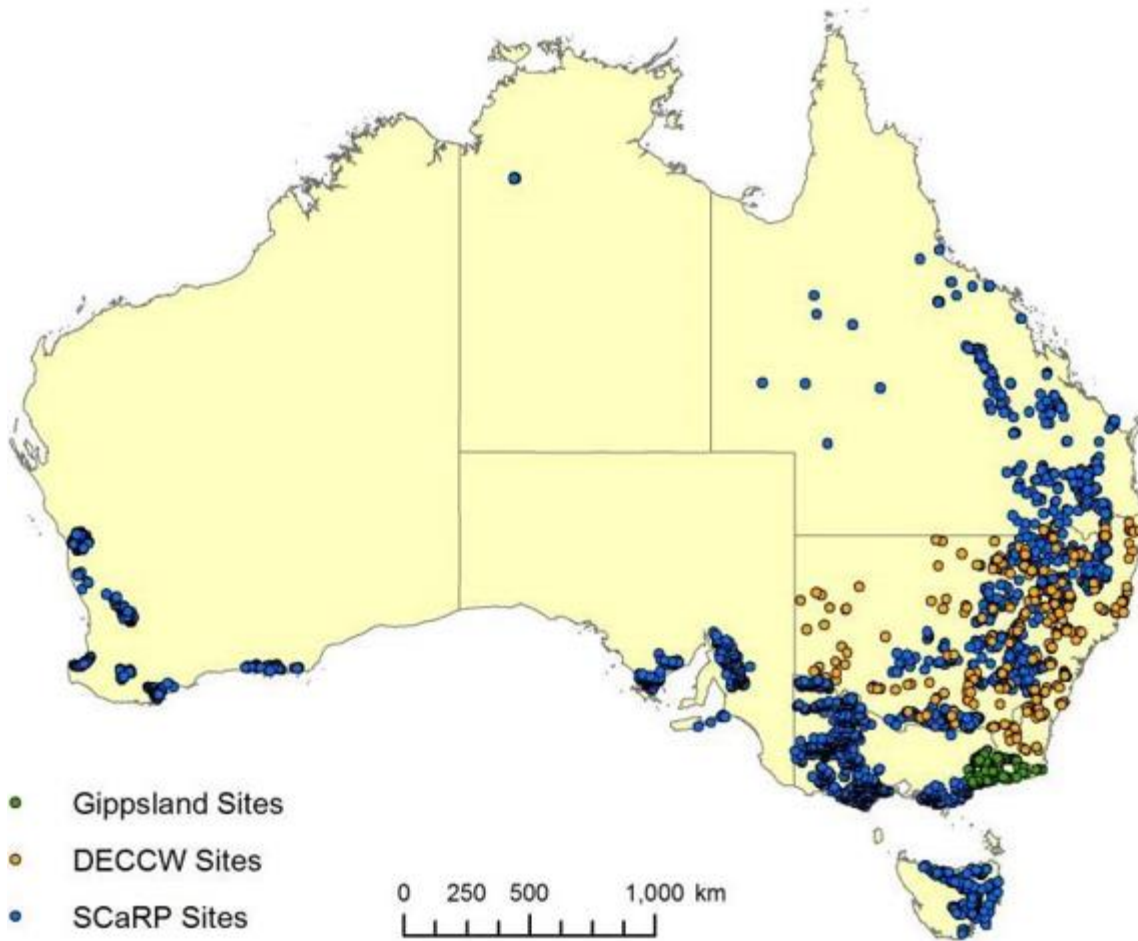
Bottom Fog



Review - organic carbon cycle



Where are we now? - SCaRP project



Samples collected and analysed by SCaRP

- 17,721 samples
- 3,836 sites

Additional samples analysed

- 2774 samples
- 690 sites

Total

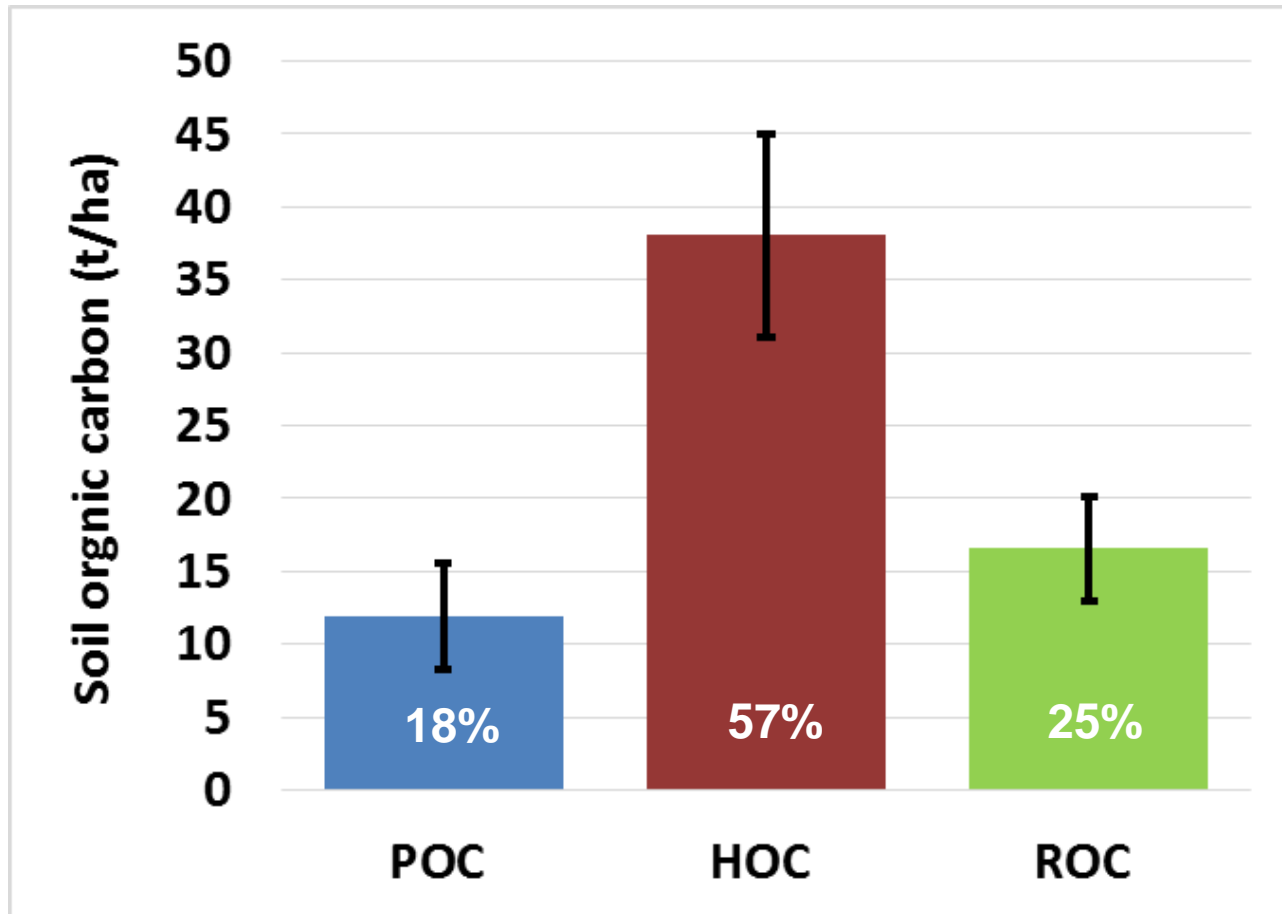
- 20,495 samples
- 4,526 sites

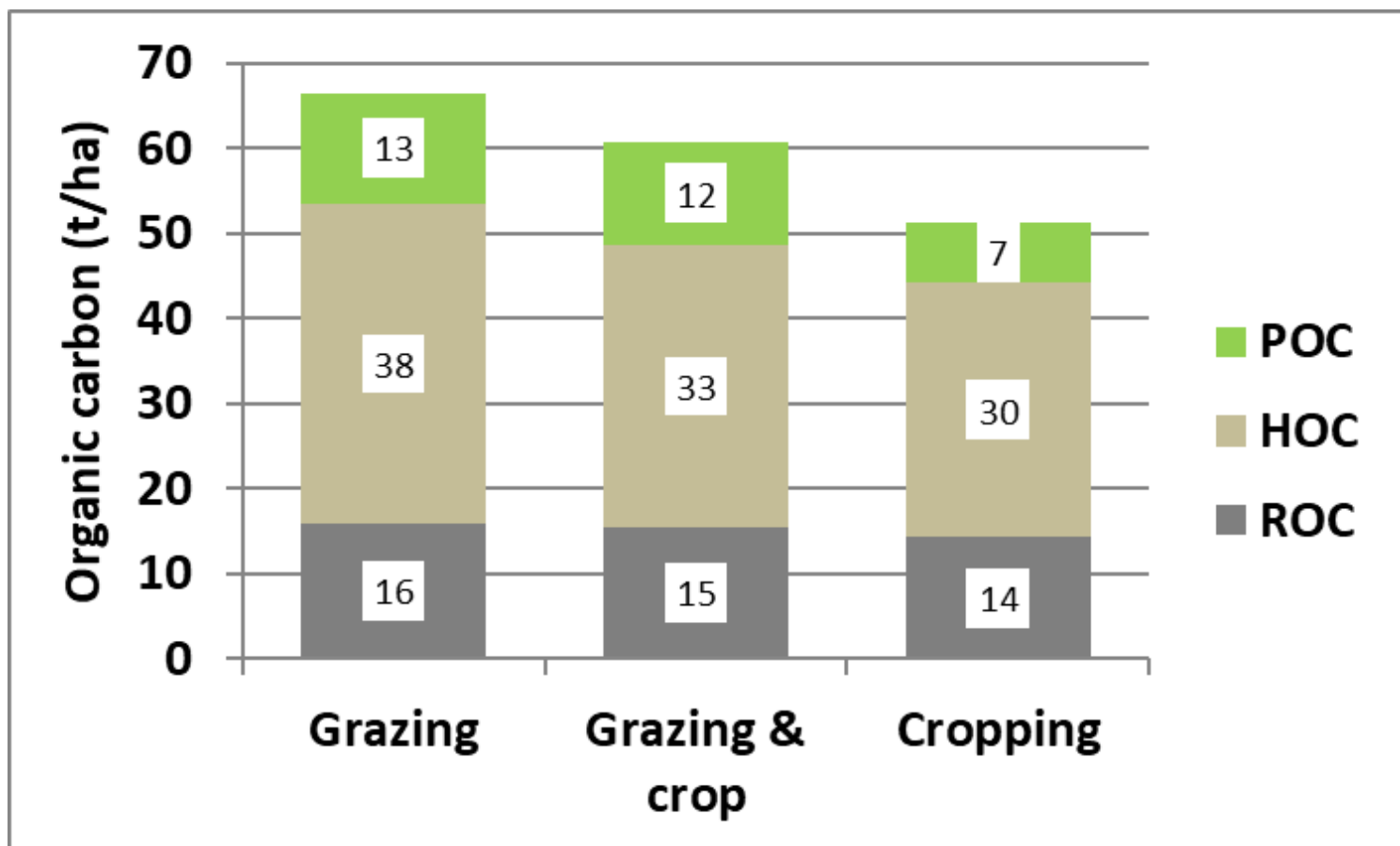
>92% from farmer paddocks

SCaRP data

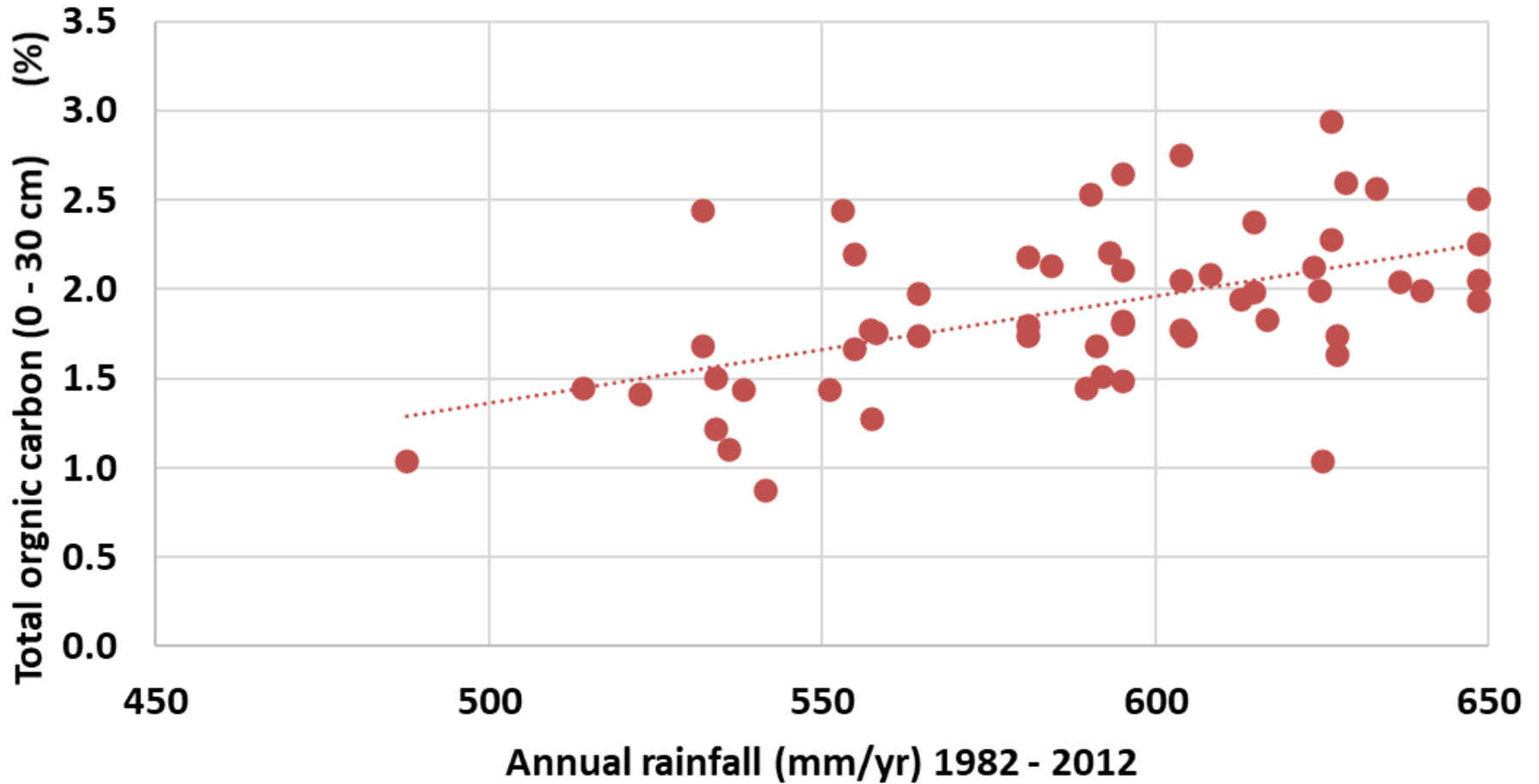
- Victorian Volcanic Plains (n=227)
- 0 - 30 cm
- All land use types
- All soil types
- ~70 t/ha OC
- Error bars = 1 std dev

- 50% in top 0-10 cm
- 67% POC in 0 -10 cm





Pasture - sheep beef



● Pasture - sheep beef Linear (Pasture - sheep beef)

Soil carbon calculations

To be aware of:

- Soil organic carbon is typically measured as a %
- Organic matter inputs are measured in t/ha
- Organic matter contain 58% organic carbon
- Need to account for shoots and roots
- 90%+ of organic inputs are eventually lost back to the atmosphere
- CO_2^e is used in carbon trading and is 3.66 times C

Storing soil carbon (soil carbon sequestration)

Excel calculator



HOW MUCH CARBON CAN SOIL STORE?

Key points

- Increasing the total organic carbon in soil may decrease atmospheric carbon dioxide and increases soil quality.
- The amount of organic carbon stored in soil is the sum of inputs to soil (plant and animal residues) and losses from soil (decomposition, erosion and offtake in plant and animal production).
- The maximum capacity of soil to store organic carbon is determined by soil type (% clay).
- Management practices that maximise plant growth and minimise losses of organic carbon from soil will result in greatest organic carbon storage in soil.

Background

Recent interest in carbon sequestration has raised questions about how much organic carbon (OC) can be stored in soil. Total OC is the amount of carbon in the

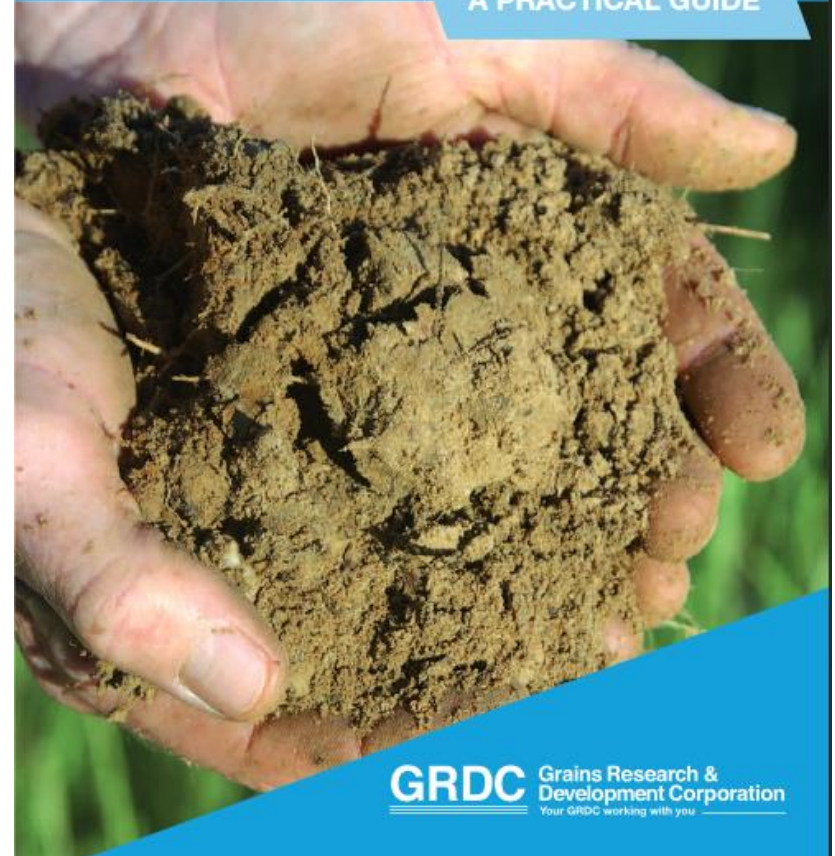
Carbon budgets in soil—Inputs and losses of organic carbon

The amount of OC stored in soil is the difference between all OC inputs and losses from a soil. The main inputs of OC

Biology

MANAGING SOIL ORGANIC MATTER

A PRACTICAL GUIDE



GRDC Grains Research & Development Corporation
Your GRDC working with you