NSW NOW The new state of business

Can we increase soil C on the Monaro?

Results from the Action on the Ground Project, funded under the Carbon Farming Futures Program

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MLA Pasture Update, Nimmitabel – 7th May 2015

1. What is the effect of parent material on soil C stocks?

(Basalt, granite and low grade metamorphics)

- Parent material influences soil texture, structure and fertility
- Parent material significantly influenced TC% and C stock, as well as a range of soil properties
- Treatment comparisons should be conditional on parent material.

2. What effect does soil fertility have on C stocks?

- TC% positively correlated with TN%, POC positively correlated with available P
- But this limited dataset only provides ‘snapshots’ of soil chemical traits
- Orgill et al. reported TC% positively correlated with TN% and S.
- GrassGro modelled outputs suggest addressing critical soil nutrient levels will increase herbage mass production (OM supply).
- If addressing soil fertility increases biomass production, then this may lead to an increase in soil C stocks.

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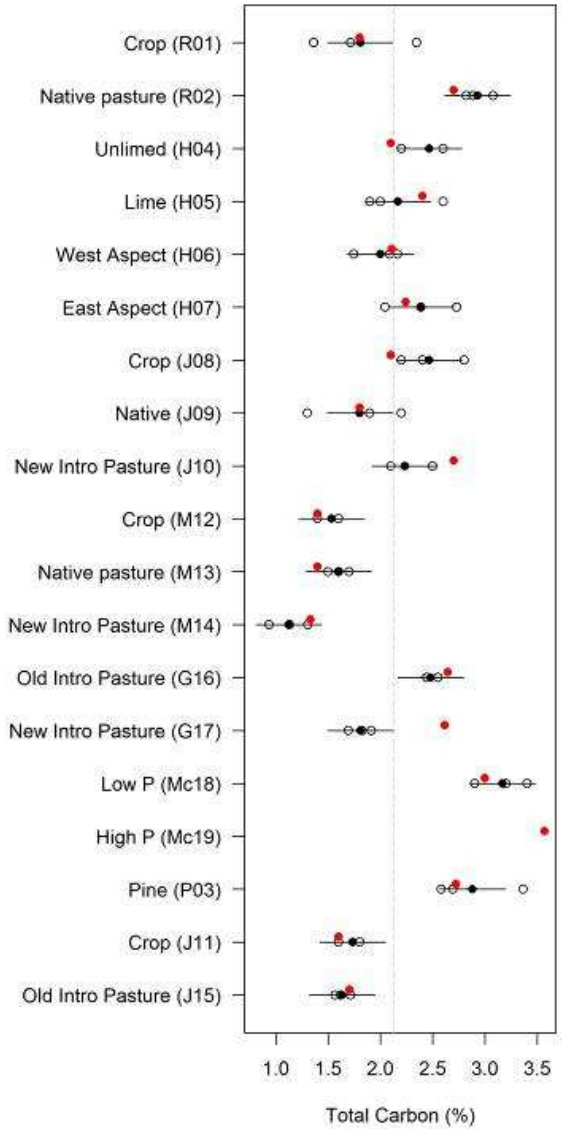
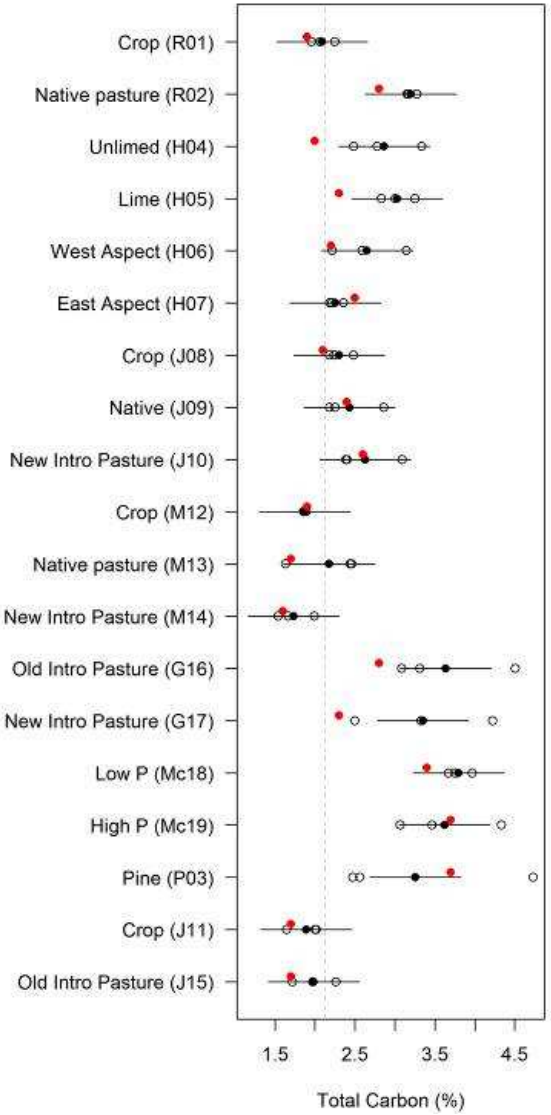
C concentration (TC%)

2012 (0 -10 cm)



2014 (0 -10 cm)



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Temporal change C stock (Mg C.ha)

Management	0 – 30cm		
	2012 (Vol)	2014 (ESM)	Difference
Crop (R01)	46.39	50.12	3.74
Native pasture (R02)	59.98	64.94	4.97
Low P (Mc18)	61.38	77.10	15.72
High P (Mc19)	78.82	73.48	-5.34
Unlimed (H04)	45.87	52.29	6.42
Lime (H05)	47.30	47.43	0.13
West Aspect (H06)	46.97	49.38	2.41
East Aspect (H07)	42.37	48.09	5.72
Crop (J08)	47.65	45.36	-2.29
Native (J09)	45.15	55.91	10.76
New Intro Pasture (J10)	68.96	69.91	0.95
Crop (M12)	40.21	53.19	12.98
Native pasture (M13)	39.94	46.80	6.86
New Intro Pasture (M14)	36.66	42.79	6.13
Old Intro Pasture (G16)	46.66	44.99	-1.67
New Intro Pasture (G17)	50.80	40.79	-10.02
Pine (03)	66.83	93.87	27.04
Crop (J11)	42.37	46.53	4.16
Old Intro Pasture (J15)	44.93	43.63	-1.30

Soil by	0 – 30cm		0 – 50cm	
Management	2012	2014	2012	2014
Crop (R01)	-14.1	-15.4	-9.7	-10.6
Native pasture (R02)				
Unlimed (H04)				
Lime (H05)	1.4	-4.9	-0.6	-6.1
West Aspect (H06)	4.3	1.0	4.4	-10.0
East Aspect (H07)				
Crop (J08)	3.0	-9.9	-0.4	-16.6
Native (J09)				
New Intro Pasture (J10)	24.6	14.9	29.9	18.7
Crop (M12)	-0.3	5.7	0.5	5.3
Native pasture (M13)				
New Intro Pasture (M14)	-4.3	-5.3	-8.0	-8.5
Old Intro Pasture (G16)				
New Intro Pasture (G17)	2.4	-5.1	-0.7	-7.0
Low P (Mc18)				
High P (Mc19)	20.3	0.9	34.5	2.3
Pine (03)	23.9	53.2	26.0	70.1
Crop (J11)	-4.5	0.8	-7.4	0.3
Old Intro Pasture (J15)				

‘Treatment’ change in C stock (Mg C.ha)

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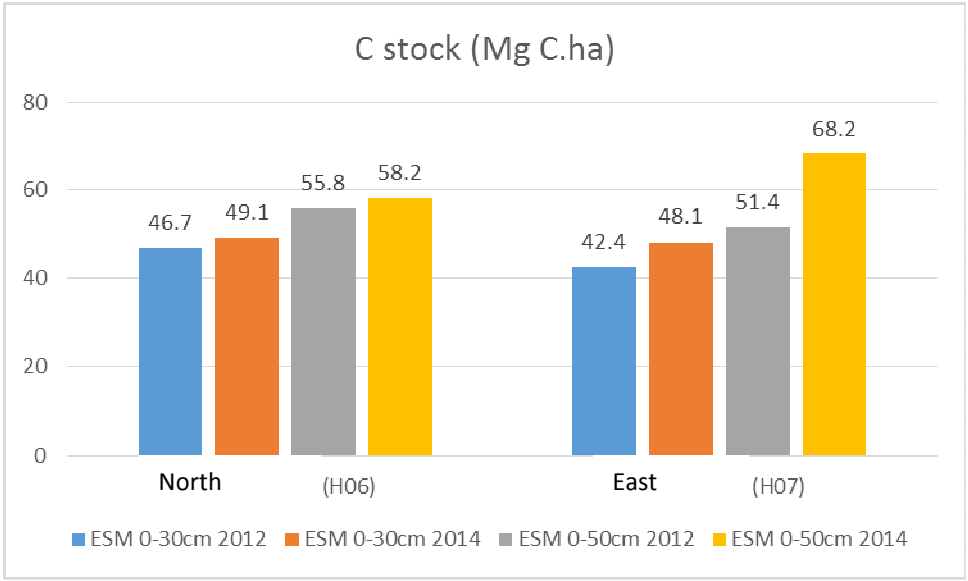
3. What influence does aspect have on C stocks under introduced perennial pasture?



- More C on North Aspect 0-30cm, although likely not signif
- More C on East Aspect 0-50cm
- Soil chemistry and GrassGro outputs suggest that increases in biomass production (OM supply) by reaching and maintaining critical P and S concentrations at this site.

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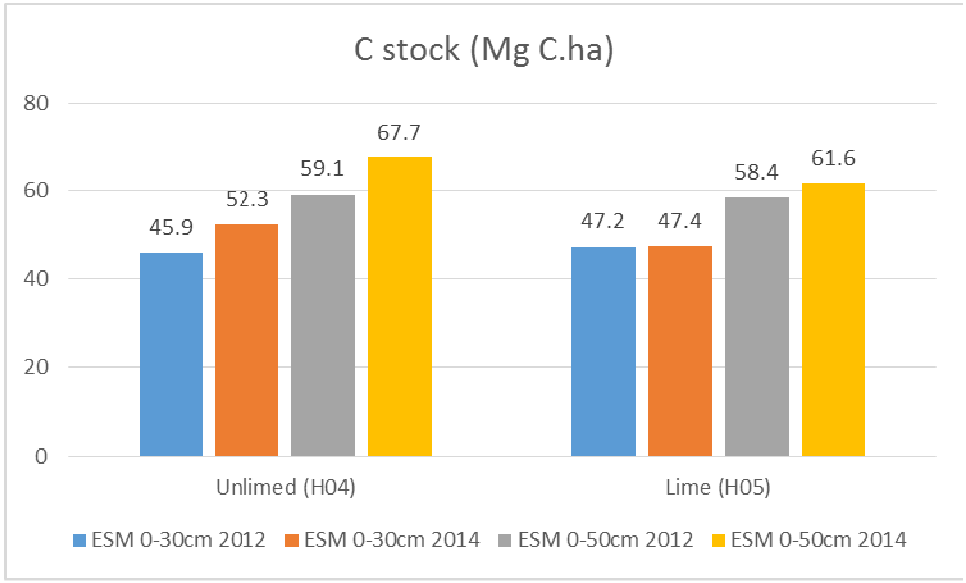
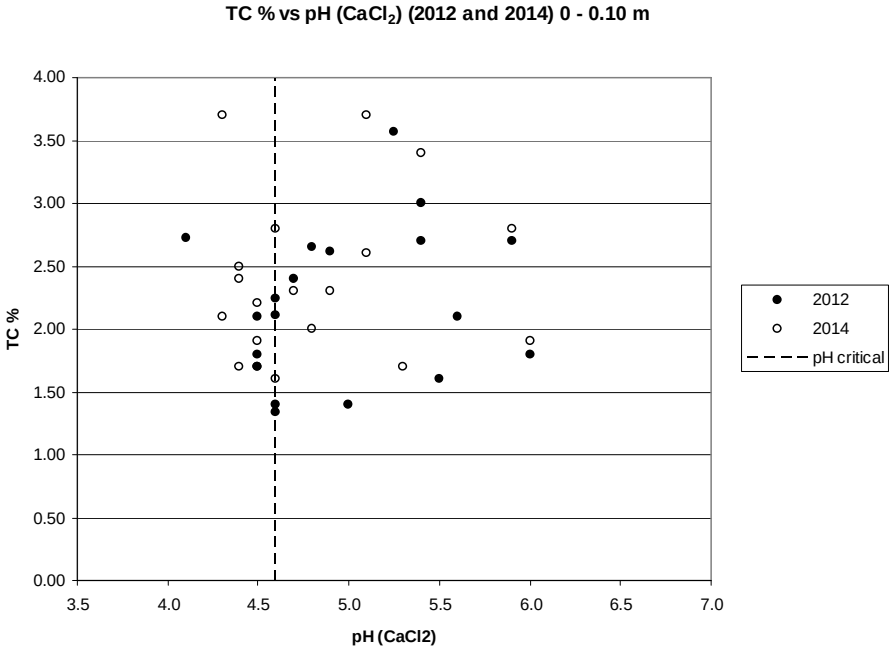
4. Does liming pasture increase C sequestration?





- Liming can have an immediate and long term influence on soil C stocks
- If soil pH was limiting plant growth, then liming can increase pasture growth and pasture composition (OM supply)
- But liming can increase microbial activity (decomposition) of OM
- Based on 2012 and 2014 soil survey, several sites with soil pH <4.6 and these sites *may* achieve increases in soil C stocks with liming

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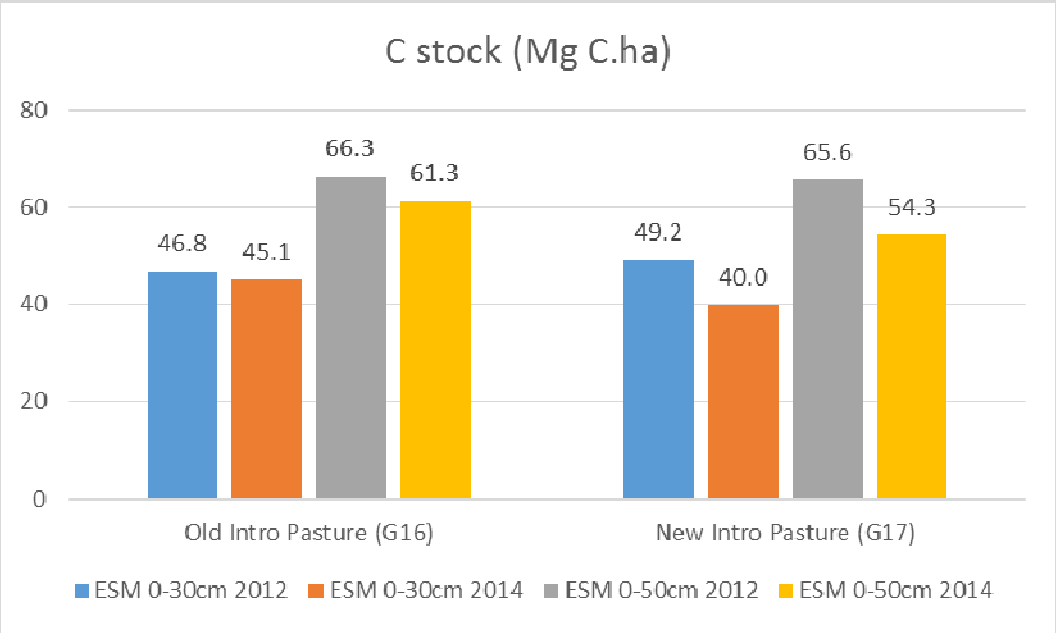
5. Does pasture age influence soil carbon stocks?



- Newly established pastures - increase soil C rapidly in the first 5 to 10 years, then plateau with steady increases in C concentration continuing for up to 30 years.
- Greater stock of C potentially representing this rapid increase.
- From 2012 to 2014 there was a -9 Mg C.ha.0.30 m decrease.
- May be explained by lower TC% in 2014 compared with individual cores; so C may be underestimated.

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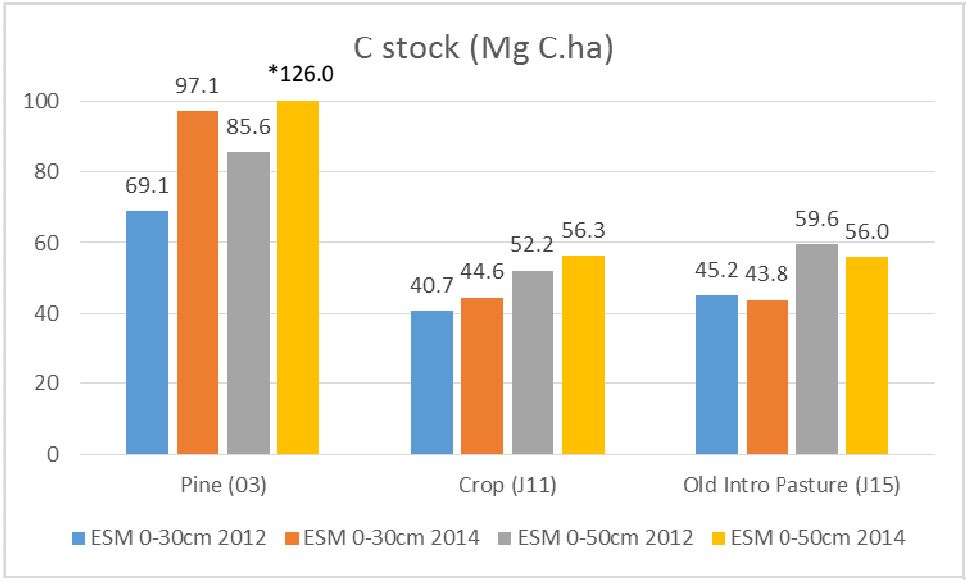
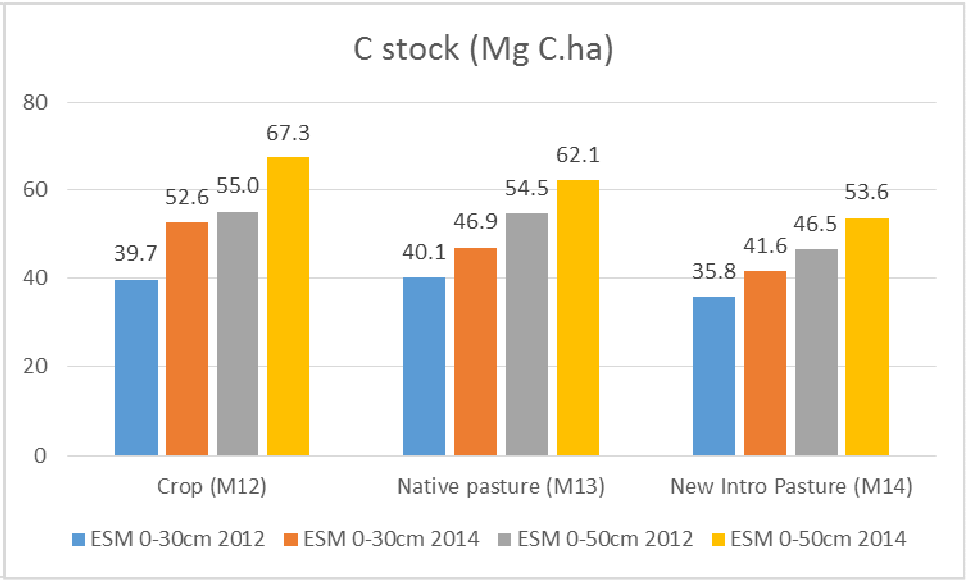
6. Does minimum disturbance cropping influence carbon stocks over a 2 year period?





- Cropping comparisons highlighted opportunities to at least maintain or increase C stocks comparable to introduced pastures.
- Soil nutrient management programs, favourable climate years (prior to and during this project), and minimal soil disturbance contributed to comparable C stocks.
- Under drier conditions, the C stocks *may* decline more under the crop compared with a perennial pasture.

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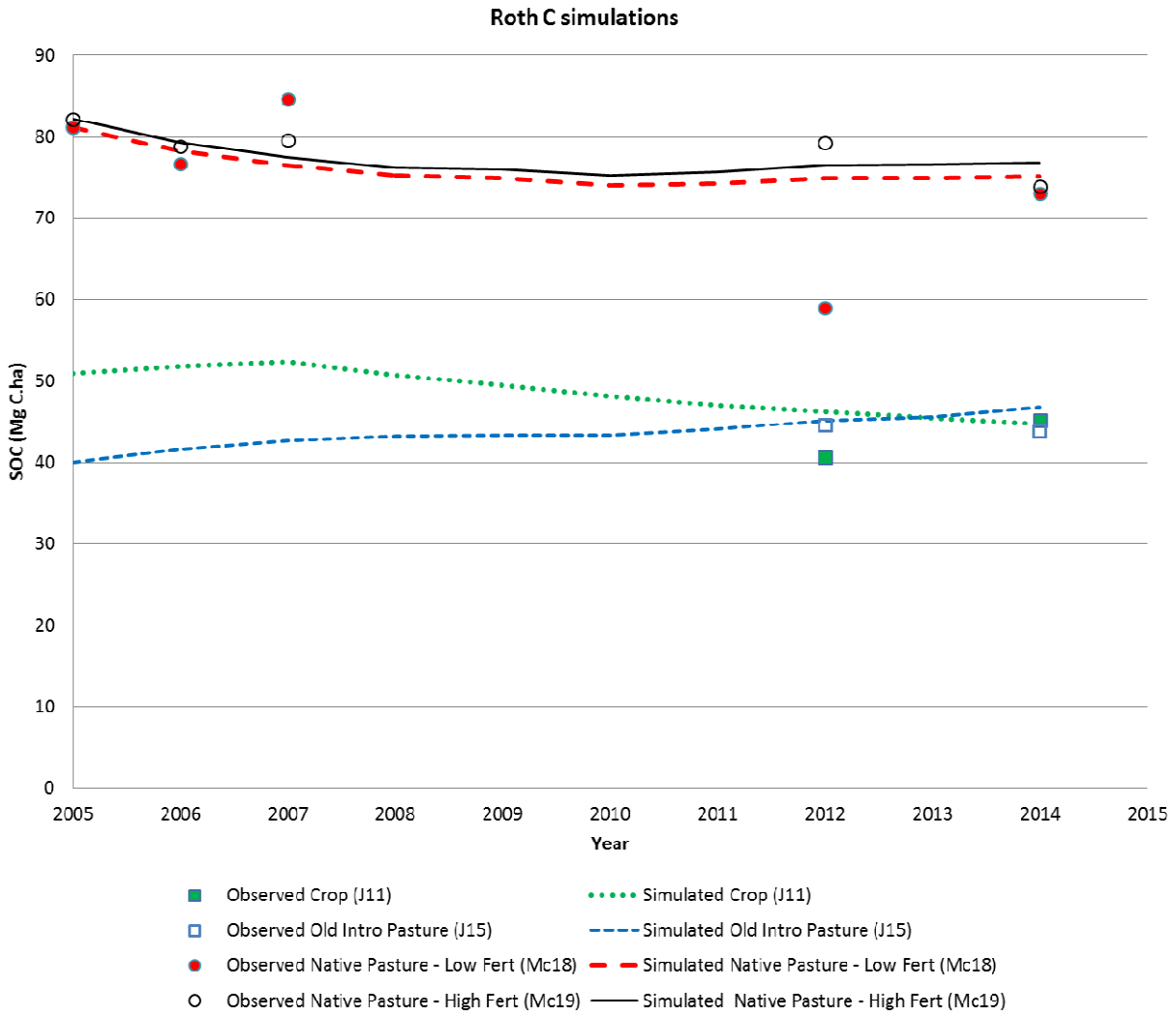
7. How does land management influence C stocks in the Monaro region?

- Soil C variation; sampling grid does not represent the paddock
- Management happens at the paddock scale; treatment may be not be detected if the variability at the site is not well understood.
- Large background levels of soil C associated with perennial pastures make it difficult to detect small changes in soil C
- Two points in time, little replication; difficult to differentiate trends from variability for reasons other than those captured in the field survey.

C stock modelling (RothC v26.3)
1: Native Pasture - High vs Low Fertiliser (basalt)
2: Crop vs Old Introduced Pasture (low grade metamorphic)



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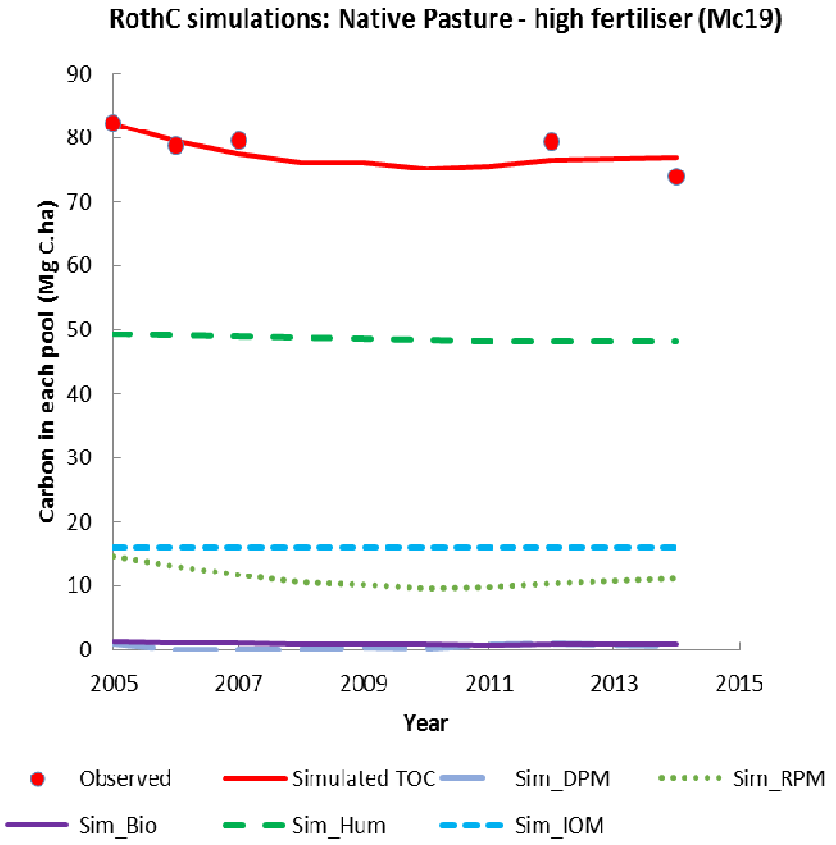
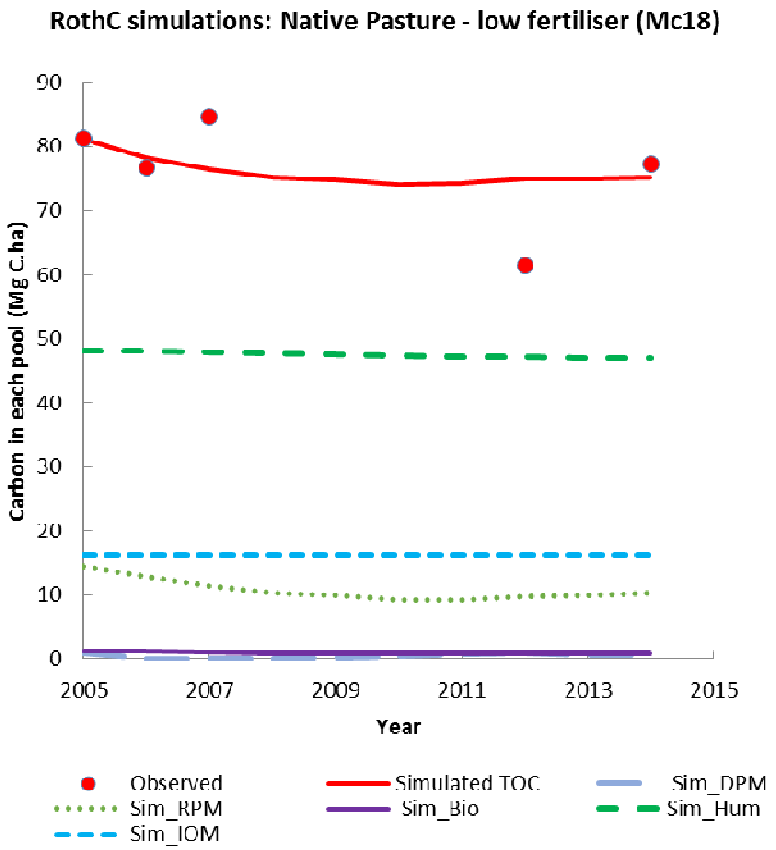
C stock modelling (RothC v26.3)
Native Pasture - High vs Low Fertiliser (basalt)





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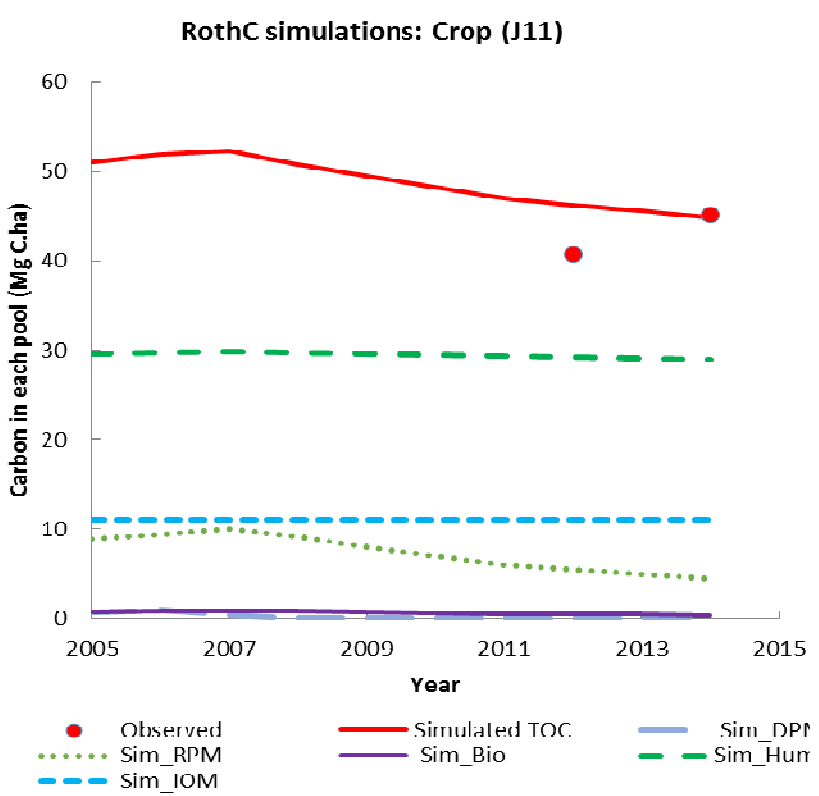
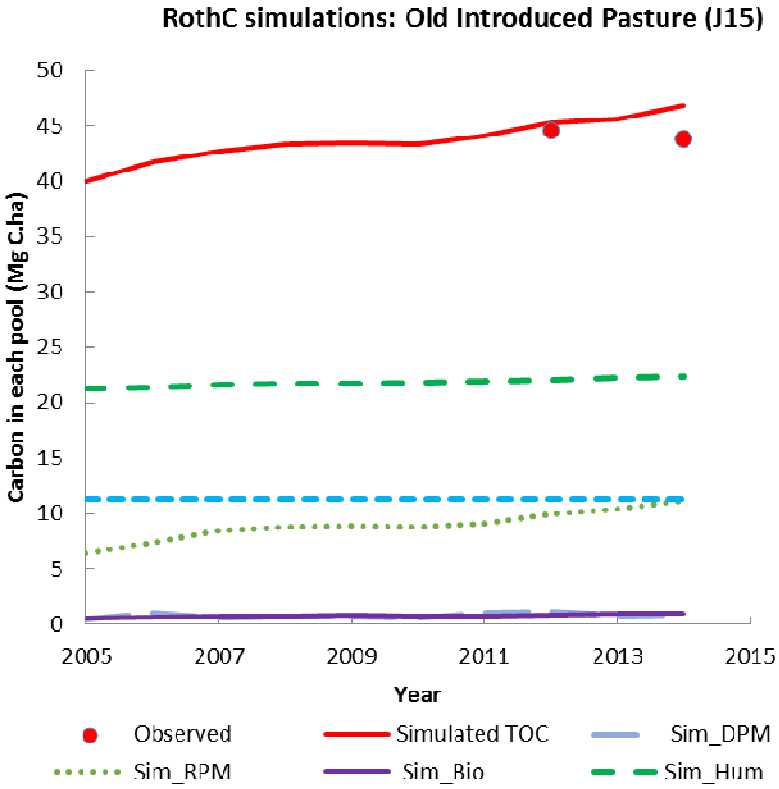
C stock modelling (RothC v26.3)
Crop vs Old Introduced Pasture (low grade metamorphic)





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7. How does land management influence C stocks in the Monaro region?

- Three strong messages come out of this project:
  1. Improving pasture production, by addressing soil nutrient requirements, will potentially increase OM supply, and therefore C stocks in soil.
  2. Opportunities for minimal disturbance cropping (on a range of soil types) to at least maintain or increase C stocks comparable to introduced pastures.
  3. If C stocks can rapidly increase at a site, they can decrease just as rapidly.

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