



THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

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Louis Schipper and Dave Campbell (also Department of Earth and Ocean Science) collaborate closely on total carbon exchange and budgets in pastures and wetlands. Our focus is to use carbon budgets as an indicator of ecosystem sustainability and to identify ways in which to increase soil carbon content.

Team



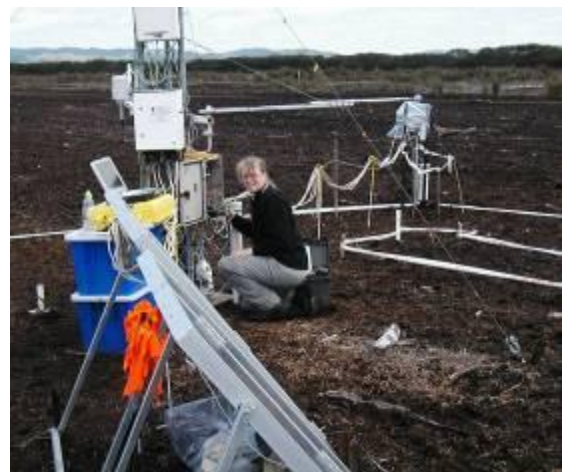
Jacinta Parenzee is the technician in charge of the Soil's laboratory in the department. Jacinta is responsible for organising labs for undergraduate teaching, training graduates in appropriate techniques, method development and research.

Dr Graham Sparling is a long time collaborator, who pretends to be retired, but works one day a week in the soils lab on a range of projects. He is currently focussed on fractionation of soil carbon, carbon losses from agriculture, Cd and U accumulation and soil quality.

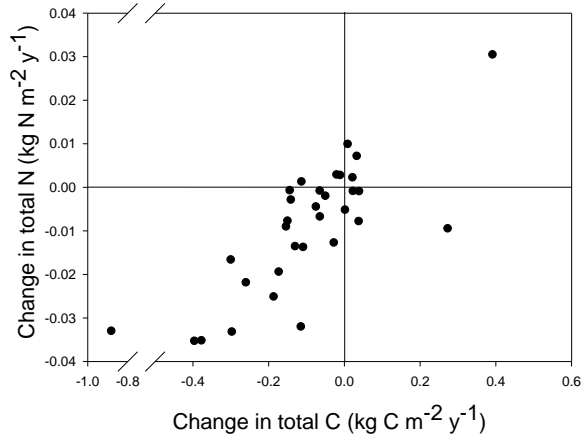
Current Research Overview

Manipulating Carbon stock in pasture

Dr Susanna Rutledge (Research Fellow) recently completed her PhD thesis on photodegradation. See: Rutledge, S.; et al (on line) Global Change Biology. Currently, Susanna is investigating approaches for increasing or maintaining soil carbon content of pasture soils using eddy co-variance approaches coupled to other measures of C flux and turnover. Funded by New Zealand Agricultural Greenhouse Gas Centre. With Dave Campbell.



Long-term changes in soil carbon and nitrogen in pastures



Recent re-sampling of pasture soil have demonstrated large losses of total C and N from the profile. Assuming linear declines between sampling times (around 20 years) indicates losses of about 1 t C ha⁻¹ y⁻¹ and 90 kg N ha⁻¹ y⁻¹. Fate of this C and N is not known. See: Schipper, L.A.; Parfitt, R.; Ross, C.; Baisden, W.T (2007) Changes in total carbon and nitrogen in New Zealand pasture soils during the past 20 years. *Global Change Biology*, 13:1138-1144. In conjunction with Landcare Research, GNS Science and MAF

Along with Dr Mike Dodd (AgResearch), we have demonstrated multi-year trends of soil carbon and nitrogen in long-term pasture trials (Schipper et al., on line *Biogeochemistry* *Doi: 10.1007/s10533-009-9353-5*) possibly in response to a series of summer droughts in the 1990s. We are currently analysing trends from the 50 year Winchmore irrigation and fertiliser trial in Canterbury. Funding from FRST via Landcare Research in collaboration with AgResearch.

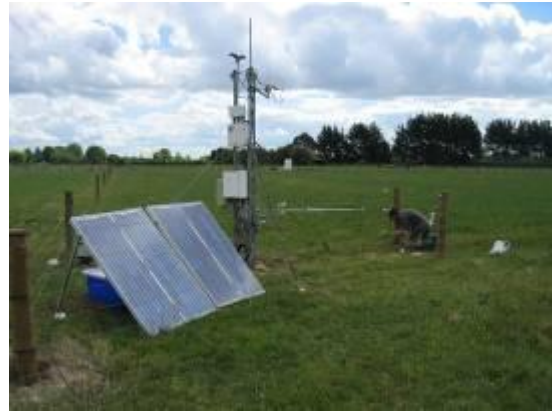


Urine impacts on soil carbon

One possible explanation for organic matter loss from soil is increased mobilisation of organic matter by urine patches deposited by stock. Suzanne Lambie (PhD candidate) is investigating whether urine application can increase the degradation and/or leaching of soil organic matter derived from forestry or pastures. Suzanne is undertaking her PhD part-time while working at Landcare Research, Palmerston North and is jointly supervised by Troy Baisden (GNS Science).

Controls of carbon balance in intensive pasture

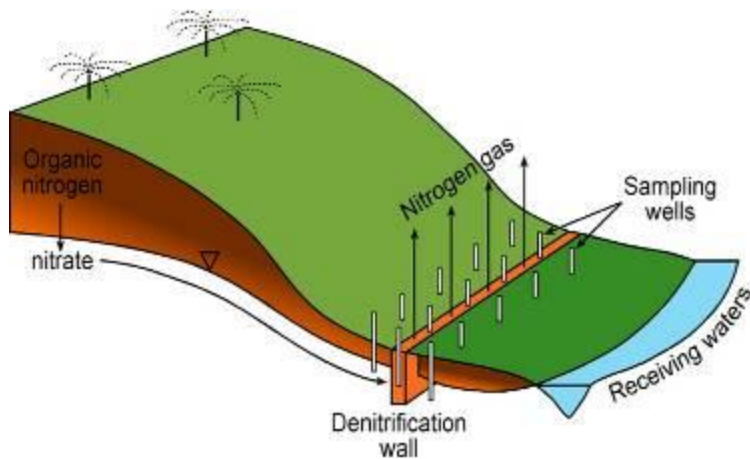
Paul Mudge and Dirk Wallace conducted MSc studies into how physical impacts (cultivation and pugging) alter the carbon balance of intensively-grazed pasture. They are using a combination of chamber and eddy co-variance techniques at the Scott research farm managed by Dairy NZ. The project is receiving funding from DairyNZ and Landcare Research and the University of Waikato.



¹⁵N isotopes as indicators of pasture development status

Following completion of his MSc, Paul Mudge is now looking at testing the utility of ¹⁵N as an indicator of pasture development to improve models N cycling. Funding from FRST via GNS Science in collaboration with AgResearch.

Denitrification walls



A denitrification wall uses sawdust to enhance microbial denitrification and strip nitrate out of groundwater. See: Schipper et al (2005). *Journal of Environmental Quality* 34: 1270-1276. Currently Lauren Long (MPhil candidate) is determining whether this wall is still functioning 14 years after construction. Funded through Fulbright scholarship.

Denitrification beds

Denitrification beds at Kinloch subdivision (right) have demonstrated total nitrate removal from treated effluent for more than two years. See: Schipper, L.A et al. (on line) *Denitrifying bioreactors – an approach for reducing nitrate loads to receiving waters*. *Ecological Engineering*. doi:10.1016/j.ecoleng.2010.04.008.





Above - large denitrification bed for treating discharge from a hydroponic glasshouse. 140 m long by 6 m wide and 2 m deep.



Stewart Cameron (GNS Science) is conducting a PhD study on the flow of effluent through denitrification beds. Stewart is using a combination of field and large scale barrel trials to determine the nitrate removal and hydraulic flows in a range of carbon substrates and will model the importance of bed design. Cameron S.C.; Schipper L.A. (accepted) Ecological Engineering. doi:10.1016/j.ecoleng.2010.03.010.

Soeren Warneke is studying the microbial ecology of denitrification beds for his PhD thesis. Initially, he will determine the environmental factors that control denitrification and nitrous oxide emissions. In conjunction with Stewart Cameron, he will try to identify management approaches that enhance denitrification while minimising nitrous oxide losses. Soeren is funded by WaikatoLink



Supervision

Current (chief supervisor)

- Paul Mudge (PhD 2009-present) ^{15}N enrichment as an indicator of pasture soil development.
- Brendon Welton (PhD 2009 –present) Nitrification inhibitors.
- Soren Warneke (PhD 2007-Present) Microbial ecology of denitrification beds.
- Stewart Cameron (PhD 2006–Present) Nitrate removal potential and hydraulic performance of carbon media for denitrification reactors.
- Suzanne Lambie (PhD 2006–Present, part-time) Soil organic matter loss under pasture and pine: responses to urine addition.
- Alice Barnett (MSc 2010-present) Carbon storage in adjacent dairy and drystock pastures.

Completed

- Susanna Rutledge (PhD 2010) Photodegradation and controls of organic matter degradation.
- Dirk Wallace (MSc 2010) Carbon losses following cultivation of pasture soils.
- Paul Mudge (MSc 2009) Annual carbon balance of an intensively grazed pasture: magnitude and controls.
- Scott Fraser (PhD 2007) Effects on Forest Ecosystems due to Application to Soil of Pulp and Paper Waste Solid Residuals.
- Natalie Watkins (MSc 2007) Nitrification inhibitors and denitrification. University of Waikato, NZ
- Bev Clarkson (PhD 2005) Restiad peat bog development, with emphasis on nutrition and mineral use efficiency of dominant species. University of Waikato, NZ
- Jeff Smith (PhD 2003). Water and carbon budgets of Waikato peat bogs. University of Waikato, NZ
- Louise Barton (PhD 1998). Denitrification in a land treatment system. University of Waikato, NZ
- Louise Duncan (MSc 1999). Controls of microbial functional diversity. University of Waikato, NZ