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Louis Schipper and Dave Campbell collaborate closely on 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.

### The Team and Ongoing Research



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

Jacinta Parenzee is the technical manager in the Earth and Ocean Science Department and supports Janine in the soils lab.

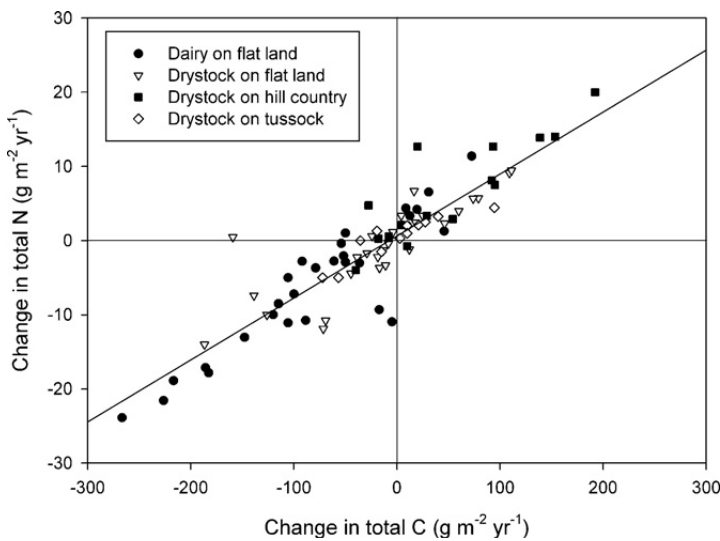
Dr Graham Sparling is a long time collaborator, who pretends to be retired, but works one day a week in the soils lab on a range of projects. He is currently focussed on fractionation of soil carbon, carbon losses from agriculture, Cd and U accumulation and soil quality.

### Denitrification beds

Denitrification beds at Karaka (below) have demonstrated total nitrate removal from hothouse for more than two years. See: Schipper et al (2010) Denitrifying bioreactors – an approach for reducing nitrate loads to receiving waters. *Ecological Engineering*. 36 (11): 1532-1543.



## Long-term changes in soil carbon and nitrogen in pastures



Re-sampling of dairy pasture soils demonstrated large losses of total C and N from the profile. Fate of this C and N is not known. See: Schipper et al. (2010) Gains and losses in C and N stocks of New Zealand pasture soils depend on land use. *Agriculture Ecosystems and Environment*. 139: 611–617. In conjunction with Landcare Research, GNS Science and MAF

Along with Mike Dodd (AgResearch), we have demonstrated multi-year trends of soil carbon and nitrogen in long-term pasture trials (Schipper et al., 2011 *Biogeochemistry*. 104(1): 35-48) 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 MSI via Landcare Research in collaboration with AgResearch.

### Increasing carbon in pasture soils

Susanna Rutledge (Research Fellow) recently completed her PhD thesis on photodegradation. See: Rutledge et al (2010) *Global Change Biology*. 16(11): 3065-3074. Currently, Susanna is investigating approaches for increasing soil carbon content of pasture soils using eddy co-variance approaches coupled to other measures of C flux and turnover.



Aaron Wall is the research technician for the project and is pictured with Ben Troughton whose farm we are currently working on. We have established two large 6 ha blocks where we will determine full carbon budgets. Currently both are planted in ryegrass/clover mix and in time one will have a mix of other pasture species planted with reported greater root biomass in an attempt to increase soil carbon. Funded by New Zealand Agricultural Greenhouse Gas Centre.

## Root contribution to soil carbon

Sam McNally is conducting his PhD on the contribution of roots from different pasture species in contributing to soil carbon. He will be measuring root stocks and rates of roots turnover for different pasture species. In collaboration with Mike Dodd (AgResearch), Johan Six (UC Davis) and funded from New Zealand Agricultural Greenhouse Gas Centre and DairyNZ.



## 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).

## Dairy vs drystock carbon stocks

Alice Barnett and Amy Taylor (MSc candidates) are measuring soil C, root biomass, and physical properties of adjacent drystock and dairy farms of the Waikato, to date they have bravely sampled 21 paired sites (42 pits to a meter!). Funded by University of Waikato, DairyNZ, Environment Waikato



## Dissolved organic carbon leaching

Emma Chibnall (MSc candidate) is measuring dissolved organic carbon (DOC) leaching below dairy pastures to determine the contribution of DOC to carbon budgets of dairy farms. She will also measure fluxes of nitrogen down through the profile. This work is in conjunction with eddy covariance measurements of CO<sub>2</sub> exchange. Funded by University of Waikato and DairyNZ and advised by Anwar Ghani (AgResearch)

## 15N isotopes as indicators of pasture development status

Following completion of his MSc, Paul Mudge is now looking at testing the utility of  $^{15}\text{N}$  as an indicator of pasture development to improve models N cycling. Co-supervisors include Troy Baisden (GNS Science and Anwar Ghani (AgResearch). Funding from FRST via GNS Science in collaboration with AgResearch.



## Decreasing nitrate leaching

Brendon Welten (PhD Candidate) is investigating approaches for applying DCD to dairy pastures to reduce nitrate leaching. Brendon also works fulltime at AgResearch with Stewart Ledgard (who is a co-supervisor). Funding is provided by AgResearch



**And the Kids**

## Full list of student supervision

### PhD and MPhil

#### In progress

- P. Mudge (PhD candidate 2009-present)  $^{15}\text{N}$  as an indicator of land development. Chair.
- B. Welten (PhD candidate 2009-present) Nitrification inhibitors. Chair.
- T. Hodges (PhD candidate at Massey University 2006-present) Competition between wetland plant species *Empodisma minus* and *Chionochloa rubra*. Committee member.
- D. Huang (PhD candidate 2011-present) committee member
- Jordan Goodrich (PhD candidate 2011-present) Carbon exchange in a restiad bog. committee member
- S Lambie (PhD candidate, 2006–present) Soil Organic Matter Loss Under Pasture and Pine: Responses to Urine Addition. Chair.

#### Completed

- S. Warneke (PhD 2011) Microbial processes and nitrate removal in denitrification beds. Chair.
- S. Cameron (PhD 2011) Manipulation of carbon media, temperature and hydraulic efficiency to increase nitrate removal in denitrification beds. Chair.
- L. Long (MPhil 2011) Longevity of nitrate removal in a denitrification wall. Chair.
- S. Rutledge (PhD 2010) Controls of organic matter degradation at Torehape peat mine. Co-chair.
- Z. Xie (PhD 2009) Environmental Impacts of Effluent Containing EDTA from Dairy Processing Plants. Committee member.
- S. Fraser (PhD 2007) Effects on Forest Ecosystems due to Application to Soil of Pulp and Paper Waste Solid Residuals. Co-chair.
- B. Clarkson (PhD 2005) Restiad peat bog development, with emphasis on nutrition and mineral use efficiency of dominant species. Committee member.
- J. Smith (PhD 2003). Water and carbon budgets of Waikato peat bogs. Committee member.
- L. Barton (PhD 1998). Denitrification in a land treatment system. Committee member.

### MSc

#### Chair

- E. Chibnall (MSc 2011- in progress) The contribution of dissolved carbon leaching to the carbon budget of a dairy farm.
- A. Barnett (MSc 2010-in progress) Soil Carbon and nitrogen contents of adjacent dairy and drystock pastures.
- D. Wallace (2010) Carbon dynamics of a dairy pasture: annual balance and impact of cultivation.
- P. Mudge (2009) Annual carbon balance of an intensively grazed pasture: magnitude and controls. University of Waikato. Winner: *TW Walker Prize* for best oral presentation by a student at NZSSS annual meeting. Winner: Sir Theodore Rigg award for masterate thesis.
- N. Watkins (2007) Nitrification inhibitors and denitrification. University of Waikato. Winner: Sir Theodore Rigg award for masterate thesis.
- L. Duncan (1999). Controls of microbial functional diversity. University of Waikato.

Committee member

Catherine Sturgeon (2011- present), Amy Taylor (2011-present), James Blyth winner International Society of Limnology *best student presentation* at NZ Freshwater Sciences Society Conference. Nov 2010 (2011); Glen Treweek (2011); Riki Lewis (2011); Ramana Sonthi (MPhil., 2011); Tehani Kuske (2009); Danfung Binoka (2008); C. Fritz (MPhil., 2007)