

Research at SERF

Samford Ecological Research Facility (SERF) Supersite

Ecosystem functions in a peri-urbanising environment

Peter Grace
David Rowlings
Martin Labadz
Clemens Scheer
Michelle Gane
Remke Van Dam
Jason Wimmer
Marcus Yates
Lona Van Delden
Elaine Mitchell

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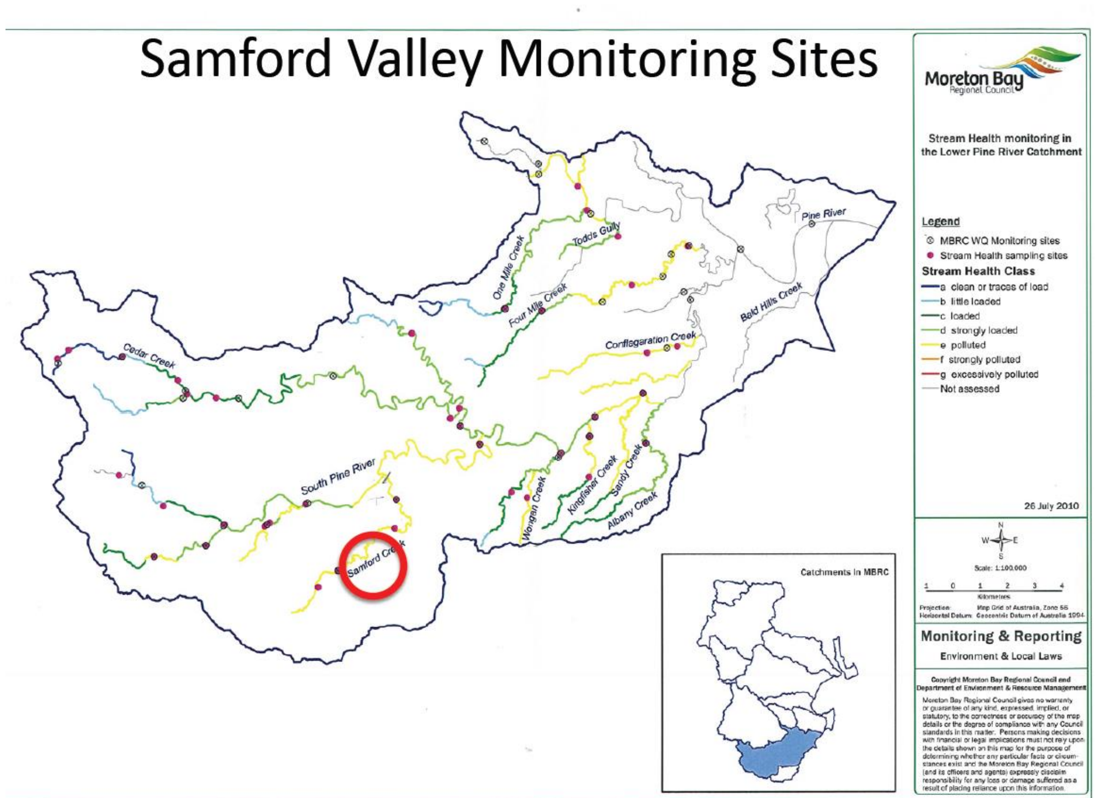
SERF: Part of Supersite focusing on peri-urbanisation in SEQ

- Quantify the impact of urbanization on key ecological processes
- Implement a landscape approach to resource management
- Integrate with the SEQ Ecosystem Systems Services Framework



Research Questions

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- Can ecosystem services be maintained in a sub-tropical urbanising environment?
- What are the effects of changing flow and biogeochemistry on primary and secondary production?
- What strategies can be implemented to maintain ecosystem services?

SERF Objectives

Impact of forest → pasture → urban

- Carbon, nitrogen &water cycle of different land-uses & vegetation types

SERF Activities

- Focus on C/N/H_2O cycles
  - Eddy covariance flux tower
  - Automated & manual flux measurements using ‘chambers’
- Soils
  - Moisture probes
  - Solute samplers
  - Nutrient sampling
- NPP forest and grassland
  - Litter traps
- Other:
  - Stream quality & flow sensors
  - Bio-acoustic sensors
  - Handheld LIDAR for biomass & wireless sensing networks
  - Hydro-geophysics for soil moisture mapping (in relation to gas fluxes)

Experimental Design

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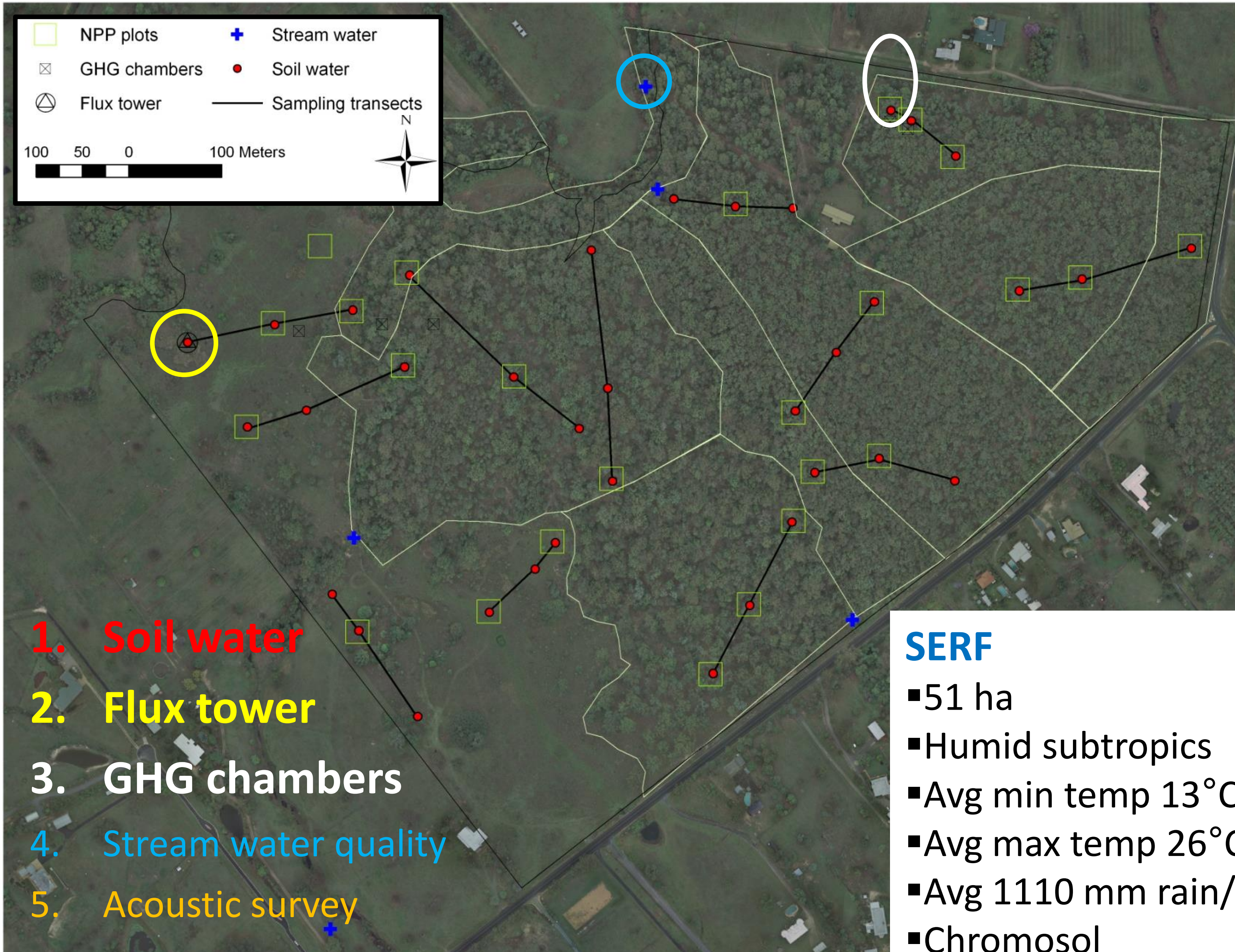
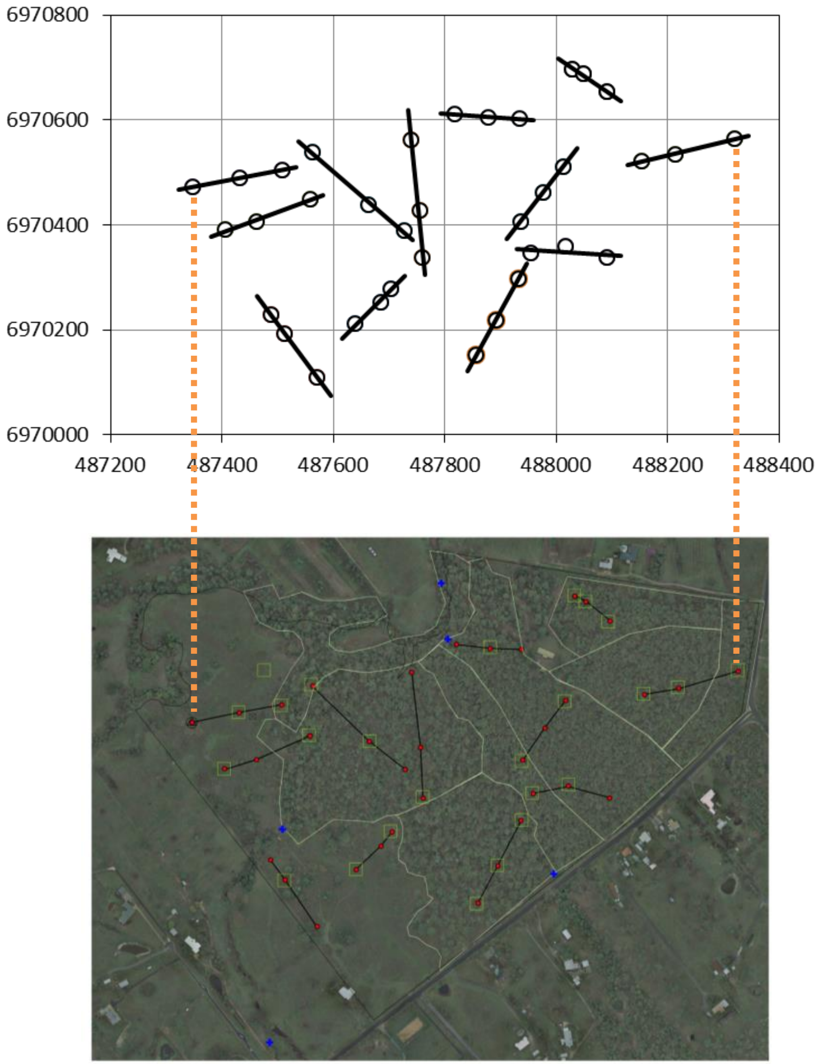


1. Soil water
2. Flux tower
3. GHG chambers
4. Stream water quality
5. Acoustic survey

SERF

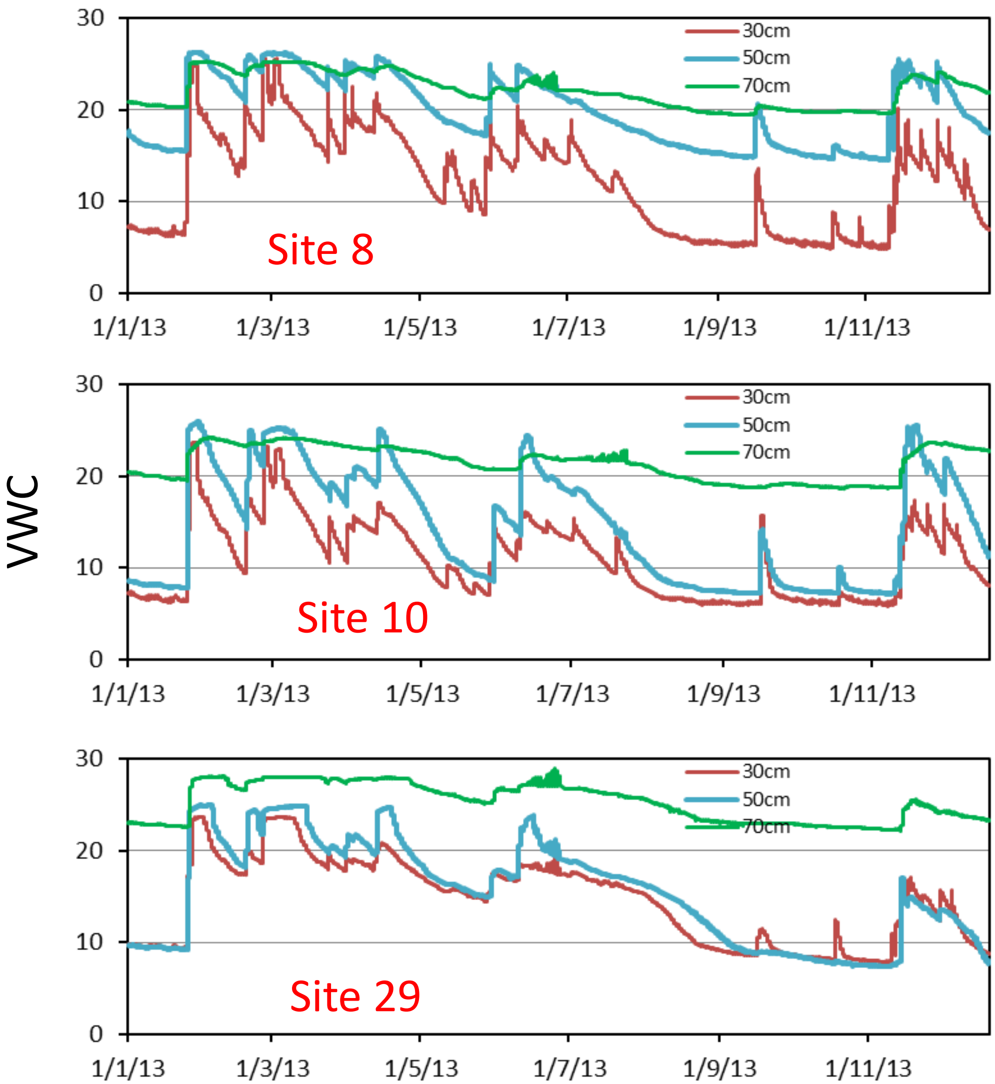
- 51 ha
- Humid subtropics
- Avg min temp 13°C
- Avg max temp 26°C
- Avg 1110 mm rain/yr
- Chromosol

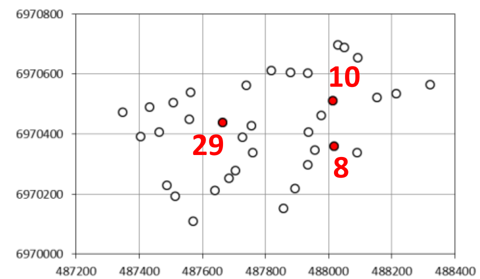
1. Soil moisture sensors



- 12 soil moisture transects
- Sensors: Diviner, Solo, Odyssey
- 3 sensor inter-comparison sites
- Logging since July 2011
  (some weekly, some bi-hourly)

Soil moisture sensors – Odyssey Results





2013 data

- Low SWC during dry winter months
- Clay below 50cm keeps SWC high

2. Flux station

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Campbell Scientific

- 3D Sonic Anemometer (CSAT3)
- Vaisala Humicap® & Radiation Shield
- Averaging Thermocouple (TCAV)
- TDRs (CS616)
- Datalogger (CR3000)

Kipp & Zonen

- Net Radiometer (CNR1 CM3)
- Net Radiometer (NR-Lite2)

Other

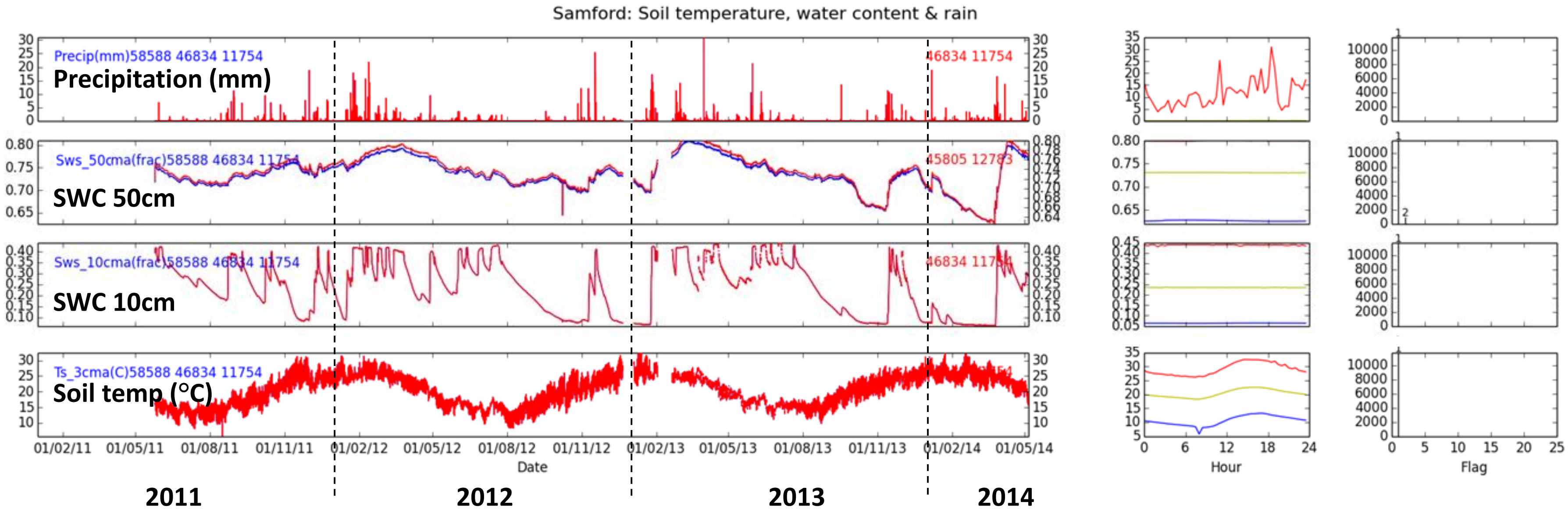
- Li-COR: open-path Infrared Gas Analyser (LI-7500)
- Gill Instrum: 3D Sonic Anemometer (WindSonic)
- Middleton: Heat Flux Plate (CN3)
- Tipping bucket rain gauge







Eddy flux station – L2 data

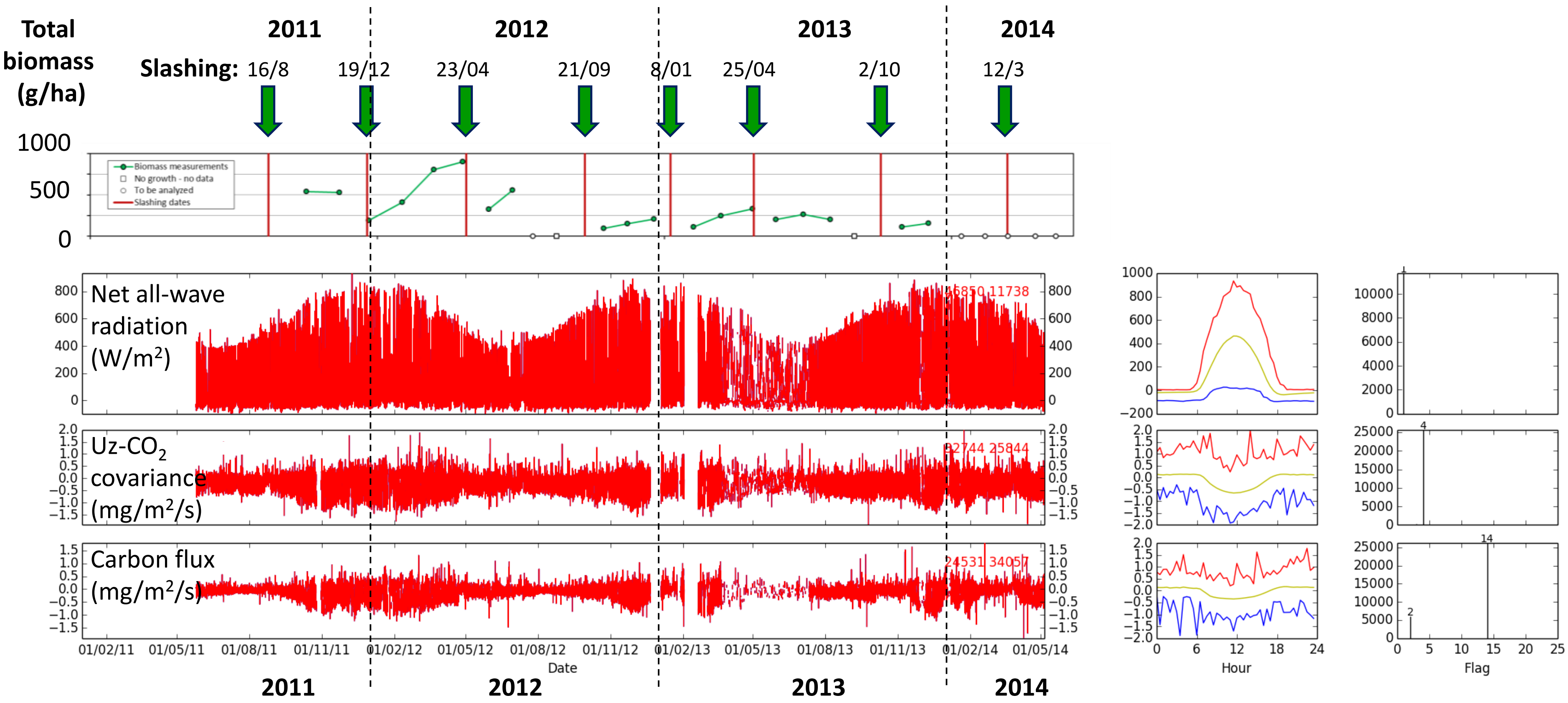


Processed and plotted with OzFluxQC.py

SERF Fluxtower basic info

- In operation since mid-2011
- Fetch length is short (fragmented vegetation cover)
- Performance issues in 1st half of 2013

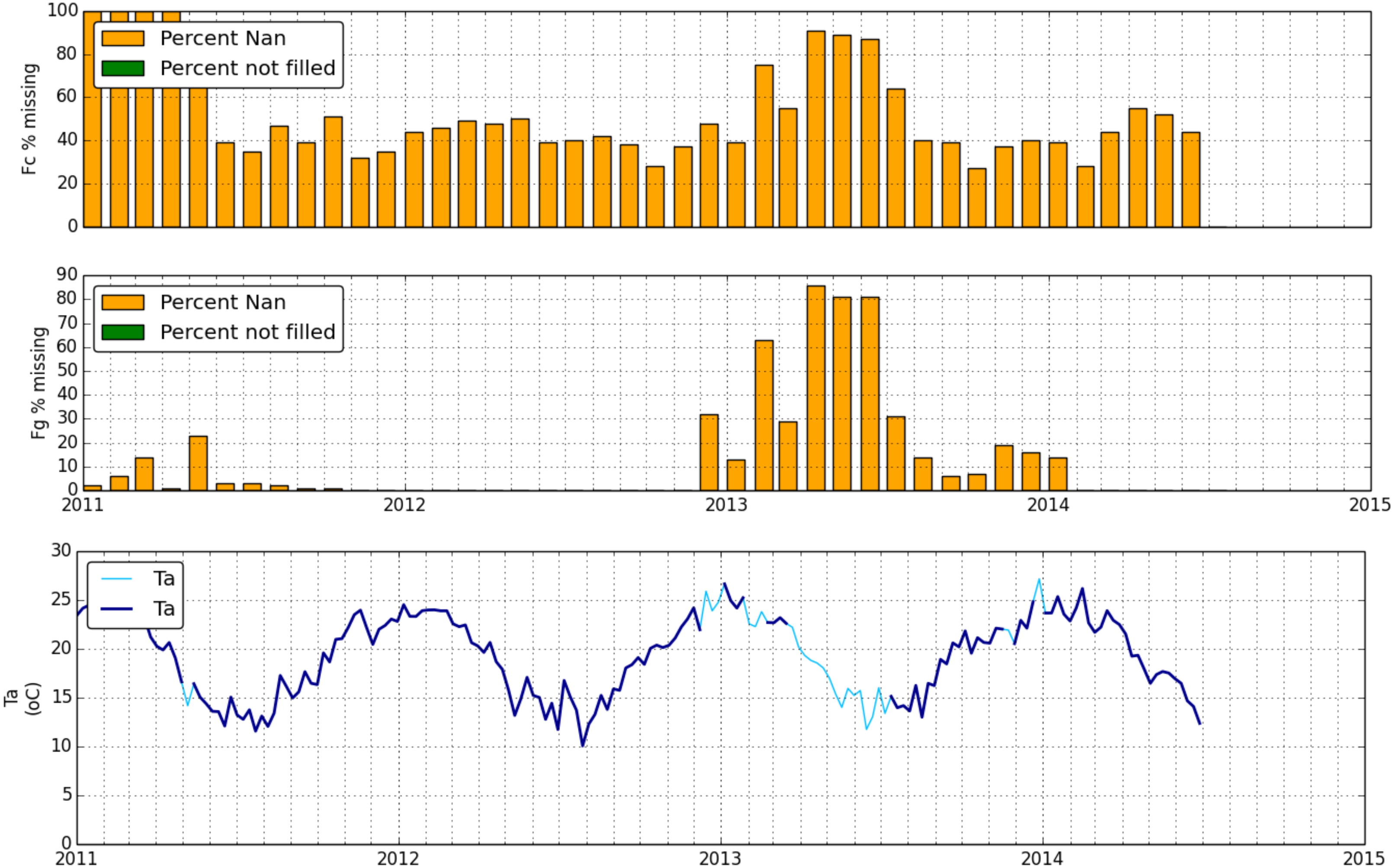
Eddy flux station – L3 data



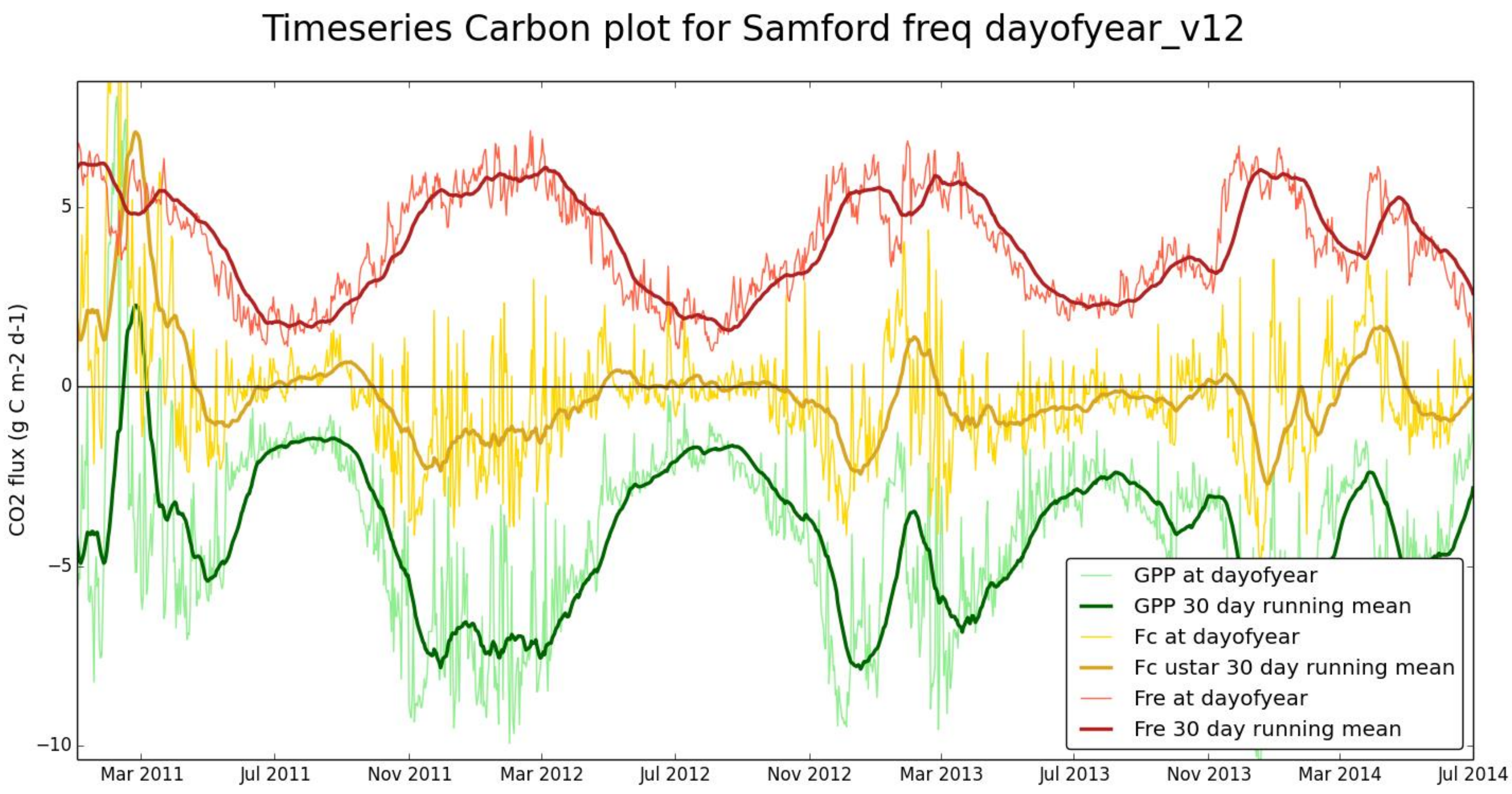
Processed and plotted with OzFluxQC.py

Eddy flux station – L4 DINGO

Plots of missing data for Fc_ustar Fe Fh Fg at Samford_v12



Eddy flux station – L4 DINGO



3. Static Chamber GHG Data

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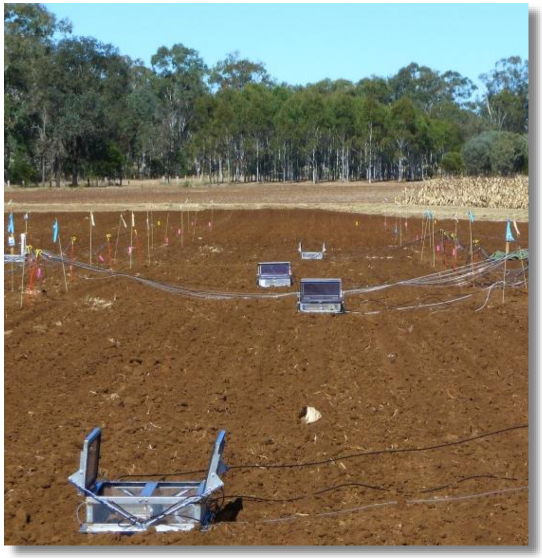

Concentrations & fluxes of:

- N_2O
- CH_4
- CO_2

Vegetation types

- Forest
- Pasture
- Turf grass (fertilized)
- Bare ground

3a. Automated chambers

- High-resolution long-term baseline studies
- On-site mass-spectrometer

3b. Manual sampling

- Study of management scenarios
- Gas samples for spectrometer
- In-situ Licor measurements

3a. Automated Chamber Measurements

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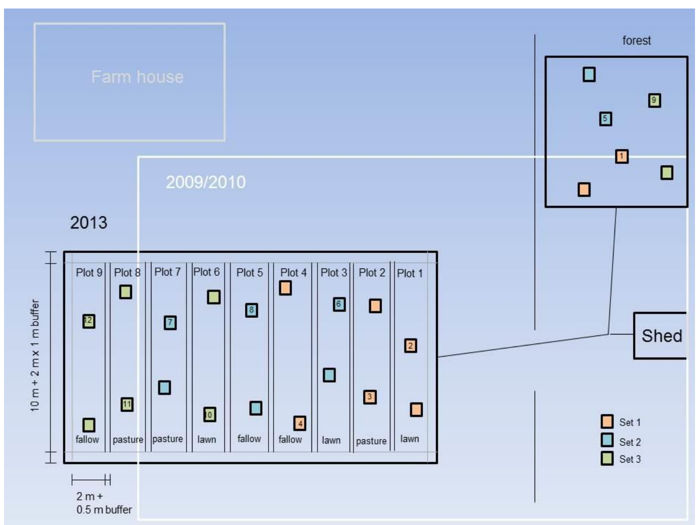
RQ: For 4 vegetation types, what are the CH_4, N_2O, and CO_2 fluxes?

Materials and methods

- 4 vegetation types
- Fluxes from 4 concentration measurements over 1hr closure
- Bi-monthly data from Mar 2009 - Feb 2010
- High frequency data (8 fluxes/d) using QUT's automated chambers (Jun-Aug '13)



3a. Results – Methane

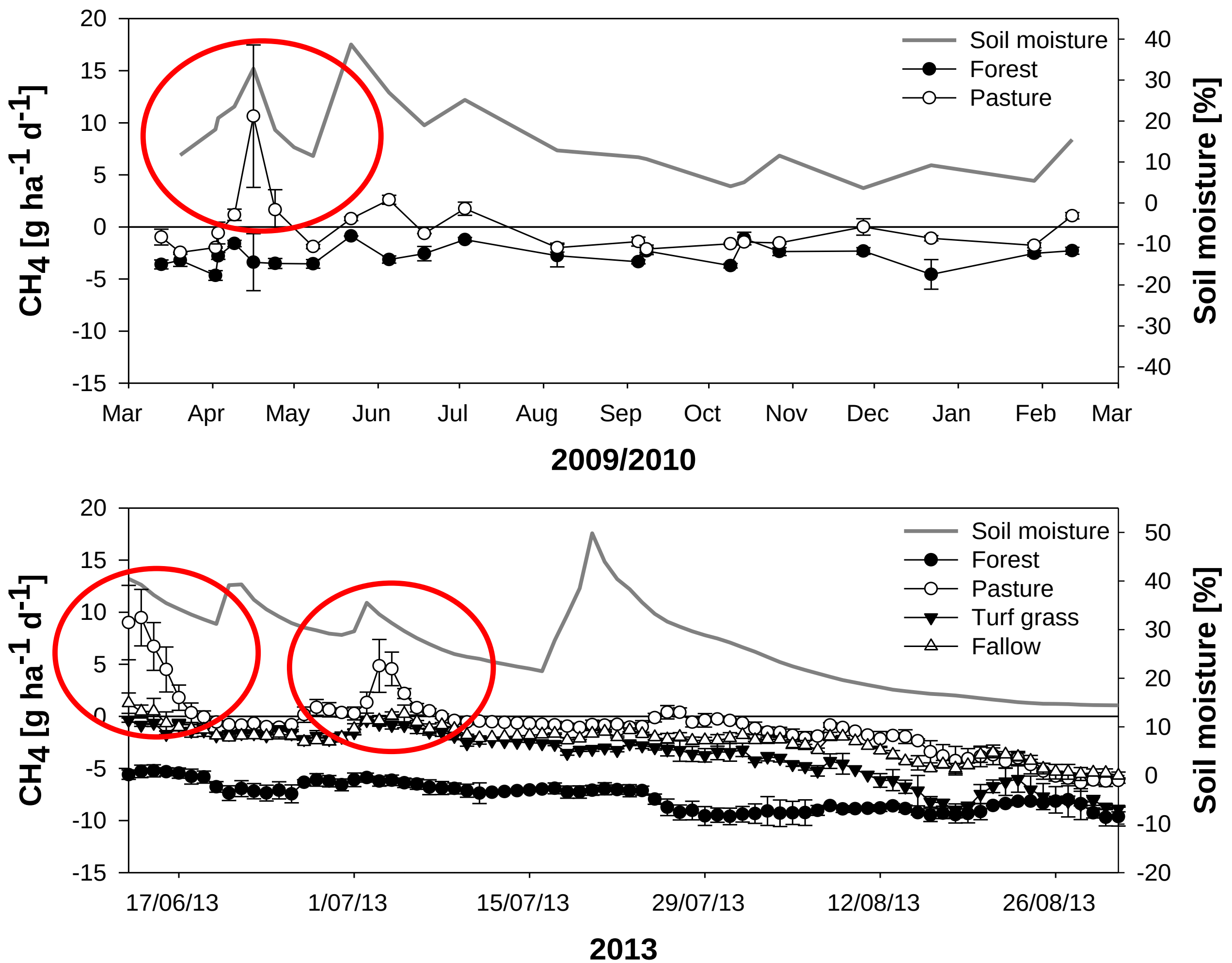
- Emission peaks in pasture following rain/irrigation
- Both bi-monthly and intensive campaigns show that native forest is a sustained C sink due to consistent methane uptake

Forest
-10.1 g ha^{-1} d^{-1}

Pasture
-1.4 g ha^{-1} d^{-1}
+13 g ha^{-1} d^{-1}

Turf grass
-4.7 g ha^{-1} d^{-1}

Fallow
-3.1 g ha^{-1} d^{-1}



3a. Results – N_2O

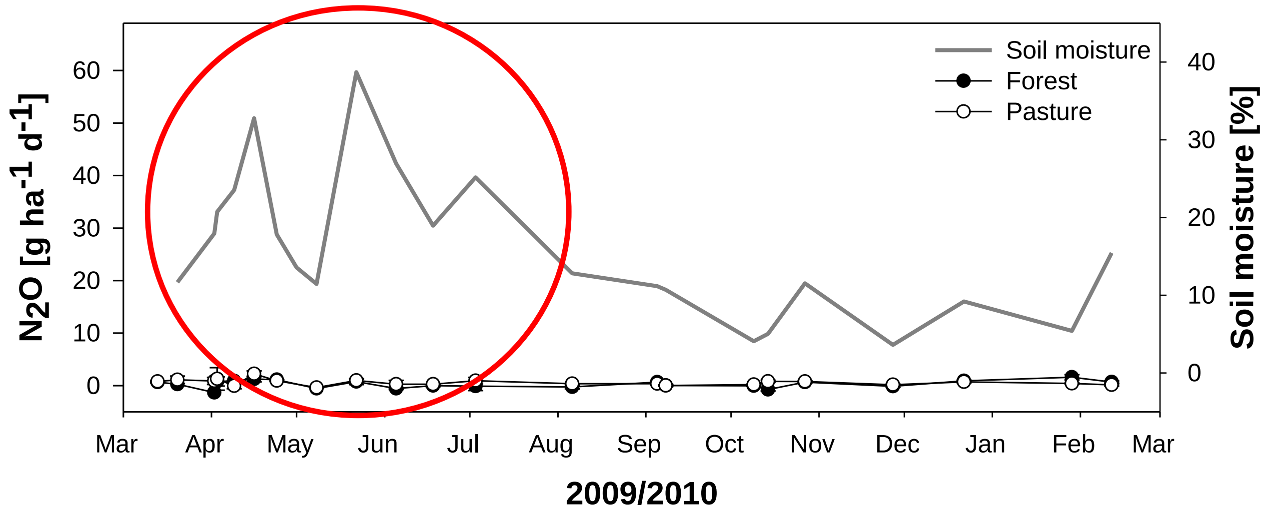
- No strong correlation between SWC and N_2O in bi-monthly dataset shows need for higher resolution data
- In high-resolution dataset emission peaks correspond to irrigation events.

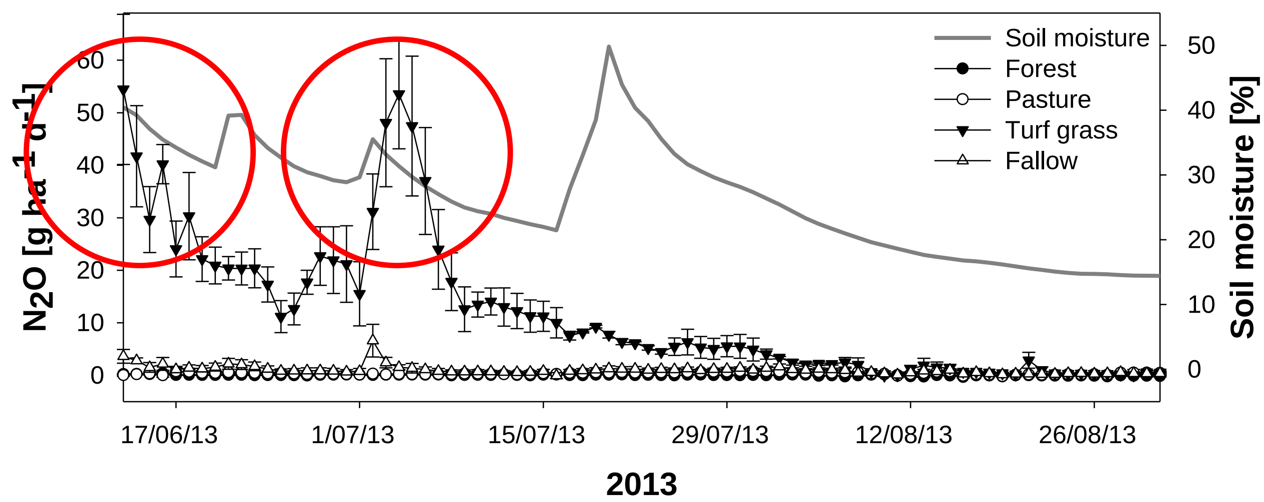
Forest
0.03 g ha^{-1} d^{-1}

Pasture
0.6 g ha^{-1} d^{-1}

Turf grass
18.7 g ha^{-1} d^{-1}

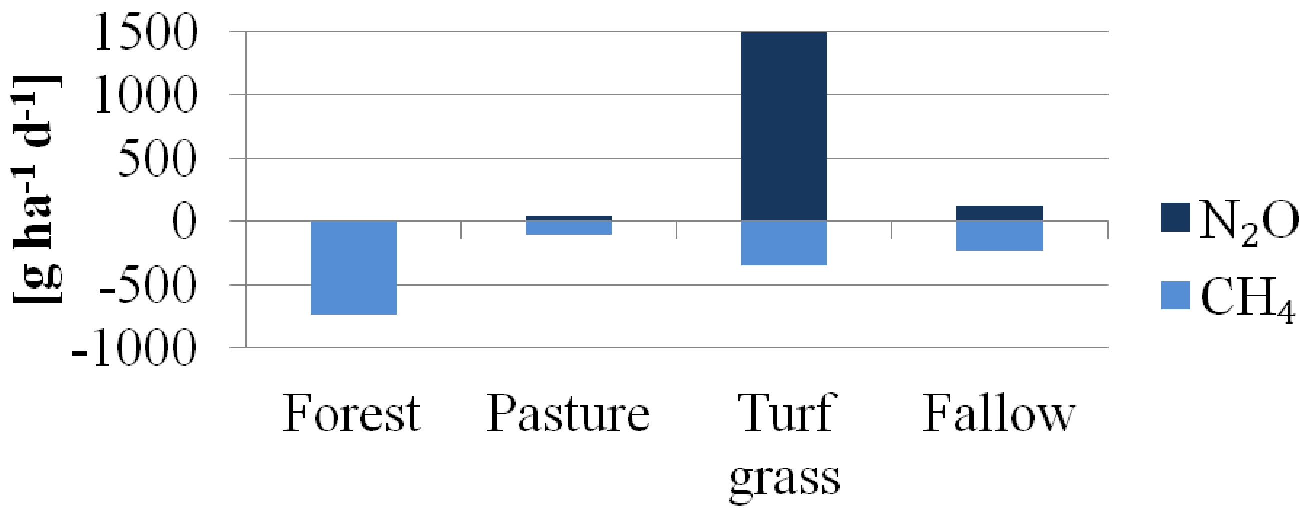
Fallow
1.57 g ha^{-1} d^{-1}





3a. Conclusions

- Significant increase in GHG emissions for land use intensification in peri-urban environments
- Cumulative fluxes for 80 day sampling campaign shows that native forest *sink* is ~7 times stronger than pasture
- Intensely managed land use like turf grass has highly elevated N_2O emissions



3b. Manual Chamber Measurements

RQ: how much above ground carbon moves into soil and how fast?
RQ: how is this process influence by agricultural management?
RQ: what pools does the carbon reside in (active / stable / inert)?

Materials and methods

- Pasture & bare ground
- *Residue* additions (tillage / no tillage)
- 10cm diameter PVC tubes used as chambers
- Weekly manual gas sampling

End: soil harvesting and fractionation

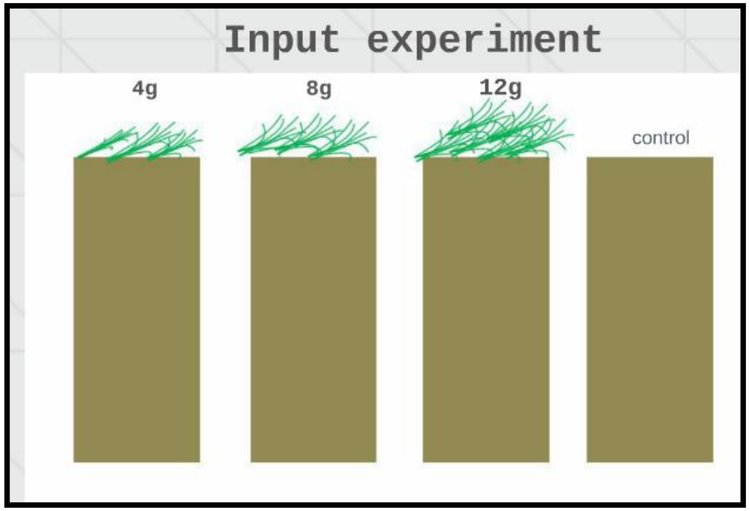
3b. Manual Chamber Measurements

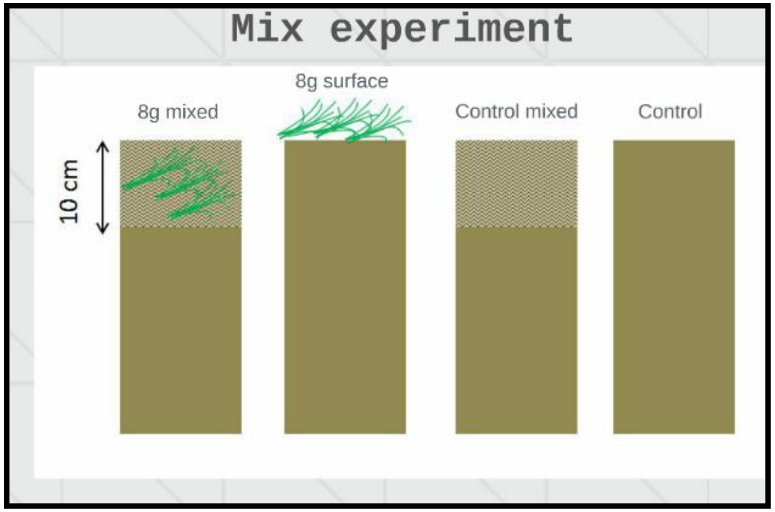
Residue experiments

- Tillage (mixing) vs non-tillage
- Input quantity

Not discussed here:

- rainfall and temperature gradients and soil type





3b. Results

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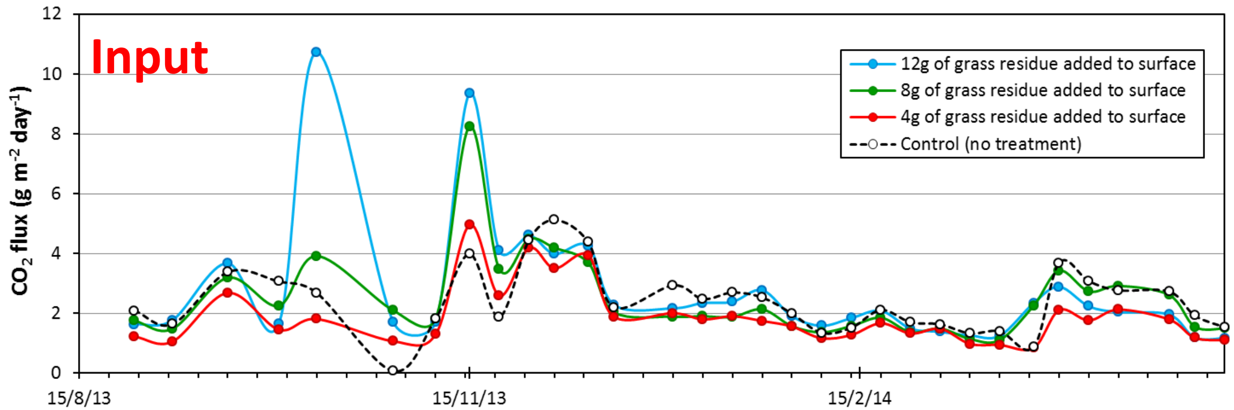
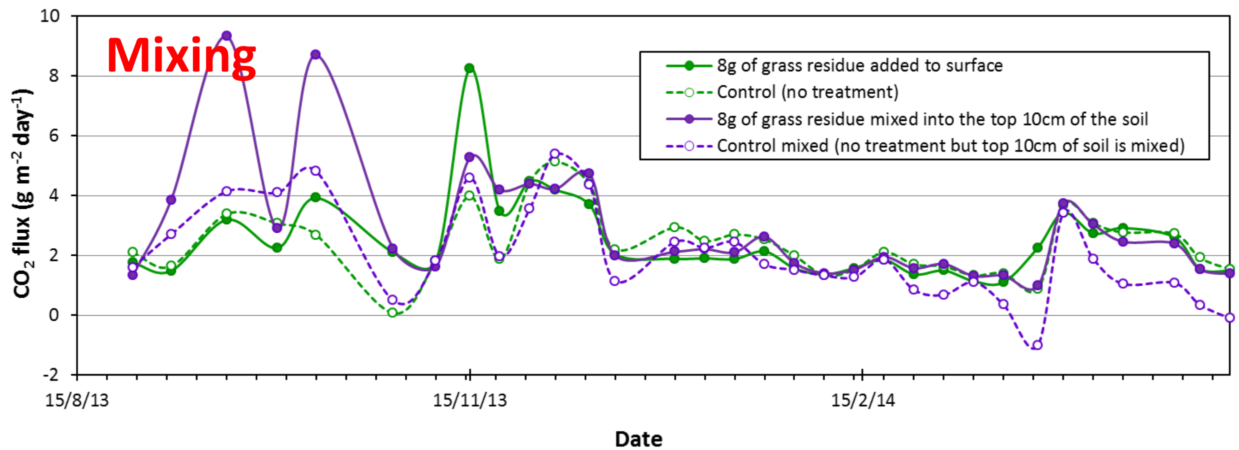
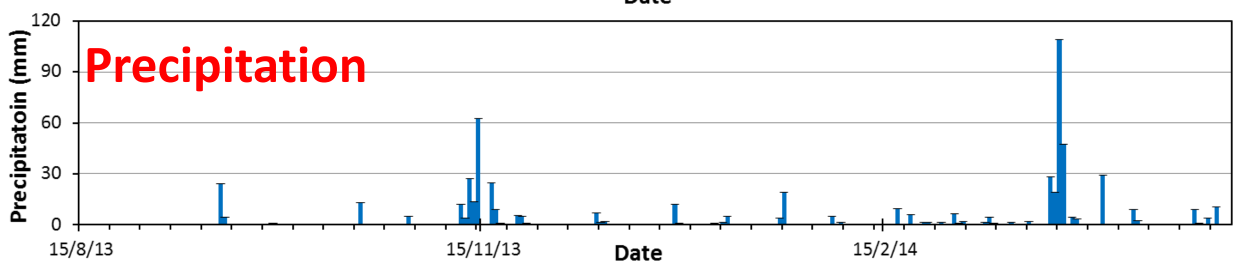






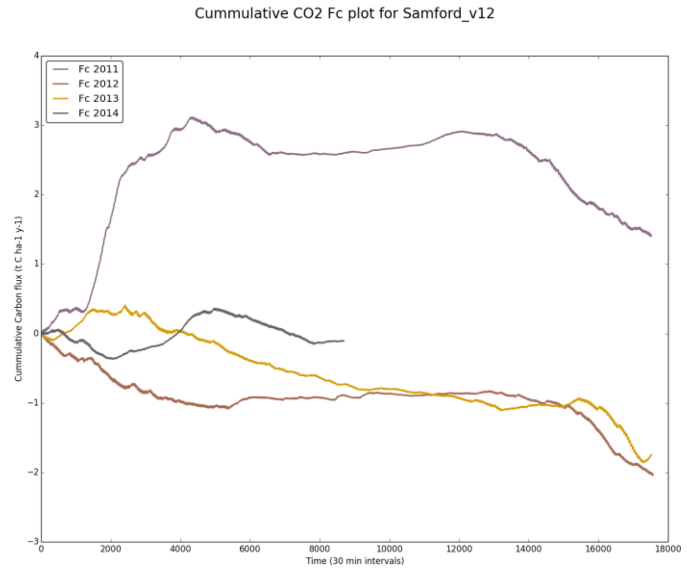
Observations:

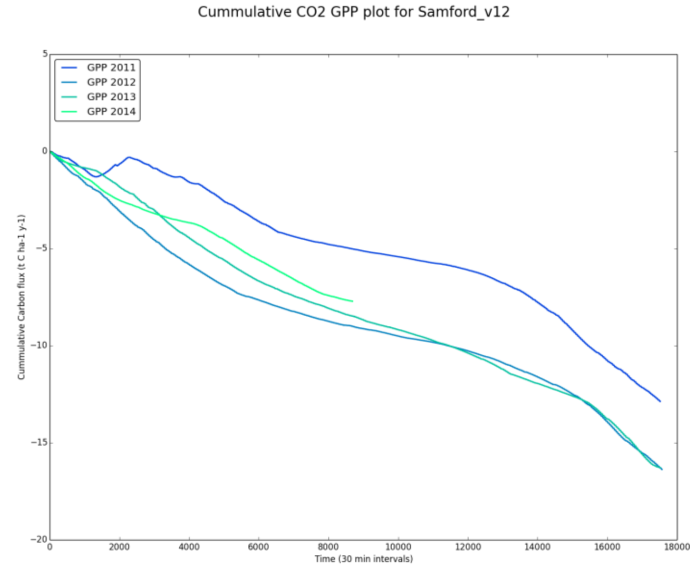
- Emissions SWC/rain driven
- Increased flux with added residue
- Flux is strongest early after treatment

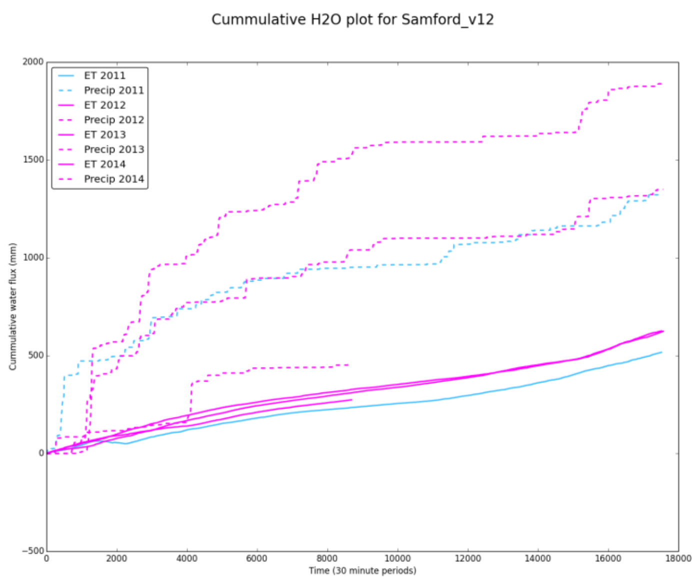
- Increased flux for mixing treatment (purple) shows influence of microbial activity
- Tillage (mixing) has greatest effect on overall N_2O and CO_2 fluxes

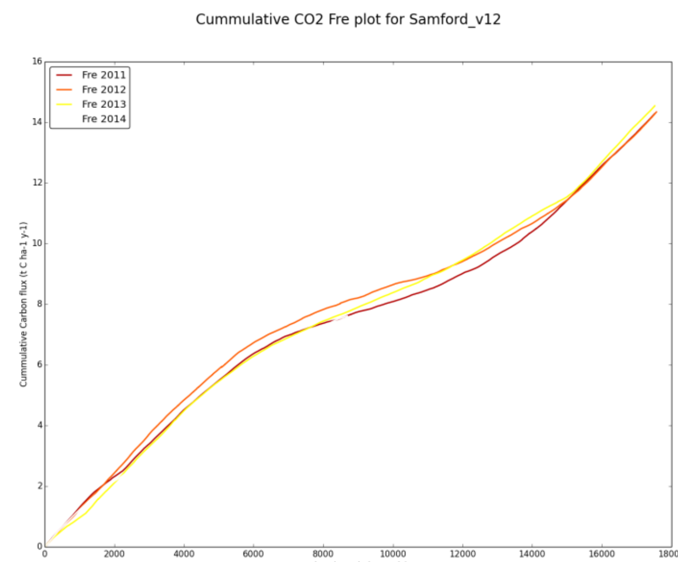
- Work in progress …

Thank you









Eddy flux station – L4 DINGO – cumulative data

Soil moisture sensors

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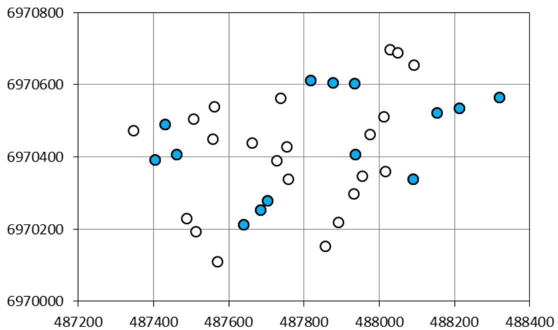
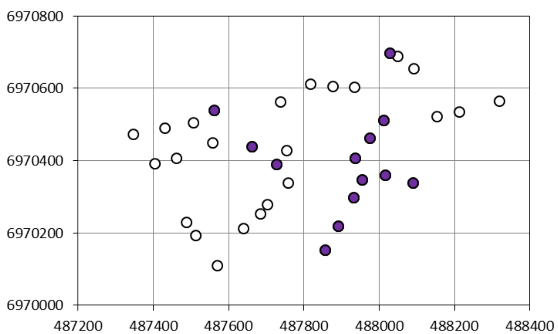


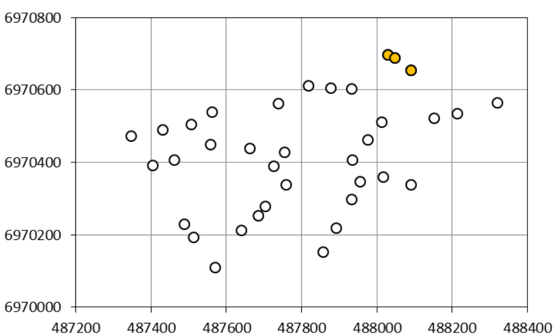
Sentek Diviner 2000

- 14 sites + 4 @ FT; 3 complete transects
- Depth: 60-130 cm (median: 100 cm)
- Depth interval: 10 cm
- Frequency: once each week



Odyssey GLRL

- 13 sites; 4 complete transects
- Depth: 90 cm
- Depth interval: 20 cm
- Frequency: 30 minute interval



Sentek Solo

- 3 sites; 1 transect
- Depths:
- Depth interval:
- Frequency: 30 minute interval

Campbell TDR

- Fluxtower
- Depths: 10, 30, 50, 80 cm