THEME 2 – TERRESTRIAL CARBON

Newsletter June 2012

Scottish Alliance for Geoscience, Environment and Society

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Introduction from Theme Convenors, Kate Heal and Susan Waldron

Here we update you on news from Theme 2 members and SAGES, including opportunities to apply for research enabling funding. This newsletter focuses on research at the interface of the terrestrial and the atmospheric carbon cycles. We would like to hear from you of any items or suggestions for future newsletters. Finally, we hope to see you at the SAGES meeting in Edinburgh on 14 September 2012.

Kate Heal, The University of Edinburgh, k.heal@ed.ac.uk
Susan Waldron, University of Glasgow, susan.waldron@glasgow.ac.uk

SAGES showcase meeting: The meeting highlighting SAGES achievements has been rescheduled to Friday 14 September 2012 at the Royal Society of Edinburgh. Keep this date free and look out for further information.

Theme 2 research enabling funds

Theme 2 has a total of 4K research enabling funds to spend by August 2012. Few responses were received to our email request for applications so we are extending the deadline to 20 June. Applications are advised not to exceed £1-1.5K and should be emailed to Kate or Susan. Applications are particularly encouraged that forge new collaborations, especially with other Scottish funding pools and internationally.

SFC funding for SAGES members reminder: Do not forget that funding is available for SAGES members to develop FP7 proposals that involve Scottish SMEs. For details of how to apply contact SAGES Administrator Heather Russell (Heather.Russell@glasgow.ac.uk).

SAGES Carbon in Scotland paper update: The draft position paper on carbon cycling research involving Scotland-based scientists was circulated for feedback to all who responded to the online survey. A revised manuscript taking account of the feedback received will be circulated in June 2012 for a final check prior to submission to "Earth & Environmental Science Transactions of The Royal Society of Edinburgh" in July 2012.

Extra-terrestrial carbon research: Andy McLeod (The University of Edinburgh) is part of a European team which has recently shown that UV irradiation of meteoritic material could produce CH_4 which would explain a substantial fraction of the CH_4 mixing ratio on Mars. The research was published on 30 May in Nature doi:10.1038/nature11203. More details in the next newsletter.

SAGES research on terrestrial-atmospheric carbon cycle linkages: Here SAGES colleagues report their ongoing research projects - some more terrestrial-based and others more atmospherically based.

Tom Wade, The University of Edinburgh

NERC Recognised Airborne GeoSciences Facility: Airborne GeoSciences is a NERC Recognised Facility within The University of Edinburgh's School of GeoSciences, operating a modified light aircraft (see image below) with

ECO-Dimona at Kiruna airport, northern Sweden. Photo credit Emily Potter.

extensive scientific instrumentation in support of atmospheric and environmental research. Over recent years we have been very grateful to receive significant financial support from SAGES, contributing to the purchasing of equipment and the salary of the facility manager/pilot.

Since becoming operational in 2007, Airborne GeoSciences has successfully supported NERC and EU funded research projects both in the UK and across Europe, with deployments as far afield as Arctic Lapland, and as close to home as Griffin forest, near Aberfeldy. The facility has worked extensively in support of studies of terrestrial carbon dynamics, in particular by the measurement of carbon fluxes across landscape and regional scales using airborne eddy covariance and atmospheric profiling techniques, and the mapping of vegetation photochemistry using advanced optical remote sensing. High resolution photo-surveys, and the derived vegetation classification maps, have also been of great value for scientists working at landscape scales.

The Airborne GeoSciences facility provides unique opportunities to researchers in the atmospheric sciences, in particular offering direct measurements of meteorological variables and atmospheric chemistry at very high spatial and temporal resolution within the boundary layer and lower troposphere, and remote sensing of surface properties at resolutions that are frequently unobtainable by any other means. We are able to operate across scales of tens to hundreds of km, and repeat measurements several times a day if so required. With appropriate permits, we are able to operate as low as 30 m to sample processes within the lowest parts of the atmosphere. Costs and environmental impacts are considerably lower than those of larger platforms – our aircraft, for example, burns fuel at a rate of around *0.5%* of that of certain larger platforms.

We are always pleased to discuss potential research ideas and collaborations with our SAGES colleagues. Please contact Tom Wade at tom.wade@ed.ac.uk, or visit our web-pages at: www.geos.ed.ac.uk/abs/research/micromet/Current/airborne/

G. Matt Davies, University of Glasgow and Alan Gray (CEH)

Managed burning and carbon fluxes from peatlands: Whilst there has been an increasing amount of work examining the effects of regular managed burning on gaseous and dissolved carbon fluxes from peatlands, we have little idea how variation in fire severity affects carbon dynamics. Fire severity is a qualitative term that describes the immediate impact of burns and, during experimental fires, is often assessed by measuring, for example, the degree of fuel consumption and the extent of soil heating (see image below of a high severity fire).

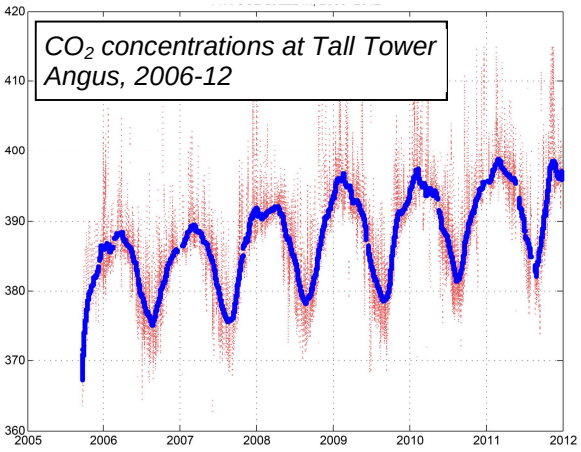
A smouldering fire slowly spreading through dry peat underneath a blanket of wet moss.

Getting an accurate idea of fire severity after a wildfire is more difficult as making strict pre- vs. post-fire comparisons is not possible. Our NERC-funded project aims to assess above and below ground carbon dynamics following the spate of wildfires that occurred in spring 2011. So far we have established carefully-selected, paired burnt-unburnt plots on fires that burnt at a range of severities in the Scottish Southern Uplands, North York Moors and the Peak District. We have developed a modified version of the Composite Burn Index to assess fire severity and Rut, our brave field assistant, has been out over the winter harvesting samples from our plots to estimate fuel consumption. In the summer we will return to our field sites to assess vegetation regeneration and to measure CO_2 and CH_4 fluxes. Our eventual objective is to understand the linkages between pre-fire vegetation structure, fire weather, fire behaviour and post-fire carbon dynamics.

Peatland fires are of low intensity (have a low heat release rate) but very high severity. They are extremely difficult to control, can lead to almost complete fuel consumption (including the peat itself), release significant amounts of sequestered carbon and lead to long-term changes to ecosystem function. Our project aims to understand how carbon dynamics are affected by a spectrum of fire severities from high intensity, low severity surface fires through to high severity smouldering.

John Moncrieff, The University of Edinburgh

Tall tales of greenhouse gas concentrations: The tall masts that dot the landscape and that are festooned with aerials and satellite dishes may do more than just transmit your TV, radio or cellphone signal; they may be part of a pan-European network of observing sites to accurately measure the atmospheric concentration of the main greenhouse gases (GHGs). We have been measuring CO_2, CH_4, N_2O, SF_6, H_2, CO and radon from the top of a telecoms mast near Dundee since 2005. The air is drawn from a height of 220 m down a tube into a number of gas analysers where the concentration of these gases is measured to levels of precision and accuracy established by the World Meteorological Organization. The CO_2 results below clearly show the seasonal changes in CO_2 concentrations detected at the tower.



Why do we want to do this?

1. We want to know just how quickly GHGs in the atmosphere are changing. By measuring atmospheric CO_2 accurately for example, we understand how sources and sinks of carbon change over time and what role climate and climate change play in this.

2. If we measure GHGs in the atmosphere accurately we can determine whether or not we are meeting our international commitments to reducing emissions from industry or from power generation or transport. For some GHGs we know that there is an element of under-reporting going on; Tall Towers make use of the atmosphere as a 'no hiding place' to verify emissions. This is the subject of James Howie's PhD in our group.

3. Observations from a Tall Tower in combination with inverse models and atmospheric transport equations can tell us where and when the gas we measure was emitted. This can be useful for working out how different land surface types such as agriculture or forests respond to atmospheric drivers of C-exchange. This is the subject of Luke Smallman's PhD in our group.

4. We can use a network of similarly equipped Tall Towers as 'early-warning' stations that might detect for example, releases of CH_4 from hydrates in the Arctic.

Acknowledgements: Tall Tower Angus has been funded from European Community Framework 6 and 7 Programmes and also recently from the UK's Department of Energy and Climate Change.

Successful PhD thesis defence:
Congratulations to Theme 2 SAGES-funded PhD student, Audrey Wayolle, who passed her PhD viva with minor corrections. Audrey was supervised by Phil Wookey and Clare Wilson (University of Stirling) and Mathew Williams (The University of Edinburgh) and her thesis title was: "Multiscale Soil Carbon Distribution in Two Sub-Arctic Landscapes. Please remember to inform Heather Russell of SAGES affiliate students (PhD students with supervisors from at least two Scottish Universities).

Call for PhD studentship information:
We are compiling information on current Theme 2-relevant PGR studentships supervised by SAGES members. Please email Kate or Susan the names of relevant projects and supervisors by 20 June, if you have not provided this information to us already.

More dates for your diary in 2012

- 12 July, `Geomorphology and the Terrestrial Carbon Cycle' meeting at the University of Exeter, organised by the Carbon and Geomorphology working group of the British Society for Geomorphology. To register (no fee) and for more information email S.De-Baets@exeter.ac.uk
- 20-21 August, CLAD (Carbon Landscapes and Drainage) KE network final meeting, University of Stirling. Contact Simon Drew: simon.drew@stir.ac.uk
- 29 November, SAGES Graduate School Annual Retreat, The Burn, with guest speaker Professor Iain Stewart. Let Heather Russell if you plan to attend.