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Environmental Research from Welsh Universities

Quarter 3 – July to September 2011

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**Integrated Assessment Team
Environment Agency
Horizon House,
Deanery Road,
Bristol BS1 5AH
Email: Ask_Evidence@environment-agency.gov.uk**

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Introduction

About the Environmental Research Monitoring Service

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Sourcing and Indexing

All of these abstracts were taken from the Web of Science (Social Science Citation Index and Science Citation Index) database from ISI Web of Knowledge. Please see <http://isiwebofknowledge.com/> for further information about the content of the databases.

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The subject indexing is the Rapid Response Team's own and the definitions and scope for each subject term is available in the [Glossary](#). Each abstract is allocated one subject term, however, most abstracts could have more than one term associated with it, so it is worthwhile scanning through all of the subject terms for relevant abstracts.

Background

The scope of the monitoring service was developed with Kathryn Monk, Science Strategy Manager, Environment Agency Wales. This project monitors the environmental and social research outputs from Welsh Universities. Through this scan, we can see what research is being undertaken, to avoid duplication of research and helps ensure readers are fully aware of current research programmes.

If you have any questions regarding the scope of the project, please contact Kathryn Monk on 02920 466121, or Manuela Weber, Integrated Assessment Team, on 07825 826357.

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Agriculture and food

Koncsag, C. I., D. Eastwood, et al. (2011). "Recovering low molecular weight extractives from degraded straw by oyster mushroom at the farm scale for high value use." Biomass & Bioenergy **35**(7): 3276-3279.

During the cultivation of mushrooms on straw, the degradation of lignocellulose takes place under the action of enzymes releasing degradation products with small molecular weight, some of which are potentially valuable (sugars, phenolics, fatty acids, etc). These compounds may be extracted from straw after mushroom cultivation in two stages: an aqueous extraction followed by a solvent extraction. The present work is focused on the first stage of the process where water soluble compounds are extracted. It is important to conduct experiments at a scale that would reflect the amount of waste straw generated by a mushroom farm. A study was performed using a vessel of 300 L capacity with mixing impeller, by observing the influence of the temperature, extraction time and water-to-dry straw ratio on the total extracted matter and especially on sugar and phenolic compounds yields. The optimum extraction conditions were determined by taking into account the yields. From this study, it emerged that the room temperature is recommended, the water-to-straw ratio would not exceed 40:1 kg(-1) of dry straw and the extraction time should be limited to 4 h. (C) 2011 Elsevier Ltd. All rights reserved.

Robinson, G., R. M. Chalmers, et al. (2011). "A whole water catchment approach to investigating the origin and distribution of Cryptosporidium species." Journal of Applied Microbiology **111**(3): 717-730.

Aims: Investigating the distribution and origin of Cryptosporidium species in a water catchment affected by destocking and restocking of livestock as a result of a foot and mouth disease epidemic. Methods and Results: Surface water, livestock and wildlife samples were screened for Cryptosporidium and oocysts characterised by sequencing SSU rRNA and COWP loci, and fragment analysis of ML1, ML2 and GP60 microsatellite loci. Oocyst concentrations in water samples (0-20.29 per 10 l) were related to rainfall events, amount of rainfall and topography. There was no detectable impact from catchment restocking. Cryptosporidium spp. found in water were indicative of livestock (Cryptosporidium andersoni and Cryptosporidium parvum) and wildlife (novel genotypes) sources. However, C. andersoni was not found in any animals sampled. Calf infections were age related; C. parvum was significantly more common in younger animals (<4 weeks old). Older calves shared Cryptosporidium bovis, Cryptosporidium ryanae and C. parvum. Wildlife shed C. parvum, Cryptosporidium ubiquitum, muskrat genotype II and deer genotype. Conclusions: Several factors affect the occurrence of Cryptosporidium within a catchment. In addition to farmed and wild animal hosts, topography and rainfall patterns are particularly important. Significance and Impact of the Study: These factors must be considered when undertaking risk-based water safety plans.

Air

Mills, G., H. Pleijel, et al. (2011). "New stomatal flux-based critical levels for ozone effects on vegetation." *Atmospheric Environment* **45**(28): 5064-5068.

The critical levels for ozone effects on vegetation have been reviewed and revised by the LRTAP Convention. Eight new or revised critical levels based on the accumulated stomatal flux of ozone (POD gamma, the Phytotoxic Ozone Dose above a threshold flux of $Y \text{ nmol m}^{-2} \text{ PLA s}^{-1}$), where PLA is the projected leaf area) have been agreed. For each receptor, data were combined from experiments conducted under naturally fluctuating environmental conditions in 2-4 countries, resulting in linear dose response relationships with response variables specific to each receptor ($r^2 = 0.49-0.87$, $p < 0.001$ for all). For crops, critical levels were derived for effects on wheat (grain yield, grain mass, and protein yield), potato (tuber yield) and tomato (fruit yield). For forest trees, critical levels were derived for effects on changes in annual increment in whole tree biomass for beech and birch, and Norway spruce. For (semi-)natural vegetation, the critical level for effects on productive and high conservation value perennial grasslands was based on effects on important component species of the genus *Trifolium* (clover species). These critical levels can be used to assess protection against the damaging effects of ozone on food security, important ecosystem services provided by forest trees (round-wood production, C sequestration, soil stability and flood prevention) and the vitality of pasture. (C) 2011 Elsevier Ltd. All rights reserved.

Biotechnology

Dickin, E., K. Steele, et al. (2011). "Effect of genotype, environment and agronomic management on beta-glucan concentration of naked barley grain intended for health food use." *Journal of Cereal Science* **54**(1): 44-52.

(1,3:1,4)-beta-D-Glucan is an important bioactive that contributes to the ability of barley foods to help prevent type-2 diabetes. Realisation of these benefits requires understanding of genotype and environment effects on beta-glucan concentration and how this variation affects biological activity of barley foods. Field experiments showed genetic variation in beta-glucan concentration (3.0-7.0 g/100 g DM), but also considerable variation between environments. beta-Glucan concentrations were lower in the wet summer of 2007 than 2006 or 2009; and slightly less in the dry summer of 2006 than 2009. beta-Glucan was not diluted by higher grain yields. The role of beta-glucan as an assimilate buffer adds complexity to interpreting the effects of environment during grain filling. Autumn sowing and fungicide increased the duration of grain filling, decreased beta-glucan concentration but increased environmental stability; possibly due to lower demand for assimilate buffering. Lodging and foliar disease decreased beta-glucan concentration, by decreasing assimilate supply leading to remobilisation of carbohydrate from beta-glucan, so that fungicide increased beta-glucan in some disease-susceptible accessions. Sequential harvesting starting at GS 91 suggested an optimum harvest window for maximum beta-glucan concentration. The variability in beta-glucan reported here between genotypes and environments was sufficient to affect control of post-prandial blood glucose in healthy volunteers. (C) 2011 Elsevier Ltd. All rights reserved.

Eastwood, D. C., D. Floudas, et al. (2011). "The Plant Cell Wall-Decomposing Machinery Underlies the Functional Diversity of Forest Fungi." *Science* **333**(6043): 762-765.

Brown rot decay removes cellulose and hemicellulose from wood-residual lignin contributing up to 30% of forest soil carbon-and is derived from an ancestral white rot saprotrophy in which both lignin and cellulose are decomposed. Comparative and functional genomics of the "dry rot" fungus *Serpula lacrymans*, derived from forest ancestors, demonstrated that the evolution of both ectomycorrhizal biotrophy and brown rot saprotrophy were accompanied by reductions and losses in specific protein families, suggesting adaptation to an intercellular interaction with plant tissue. Transcriptome and proteome analysis also identified differences in wood decomposition in *S. lacrymans* relative to the brown rot *Postia placenta*. Furthermore, fungal nutritional mode diversification suggests that the boreal forest biome originated via genetic coevolution of above- and below-ground biota.

Climate

Alton, P. B. and P. E. Bodin (2011). "Model Estimates of the Land and Ocean Contributions to Biospheric Carbon and Water Fluxes Using MODIS Satellite Data." *Journal of Climate* **24**(14): 3558-3574.

Land and ocean are often treated separately in modeling studies despite their close links through the carbon, water, and energy cycles. However, biospheric models, particularly when used in conjunction with recent satellite datasets, provide a new, fully coupled, global perspective. The current investigation uses a new version of the Grid Enabled Integrated Earth system (GENIE-SF) to compare both the magnitude and the seasonal and zonal variation in water flux [evaporation E and precipitation (PPT)] and carbon flux [net primary productivity (NPP)] above land and ocean. GENIE-SF contains state-of-the-art representations of photosynthesis and is driven by the phenological cycles of leaf area index (LAI) and marine chlorophyll concentration, both recorded with the Moderate Resolution Imaging Spectroradiometer (MODIS) satellite sensors. The current study reveals the striking uniformity of the ocean-atmosphere carbon and water flux exchange, both temporally and spatially, compared to the corresponding land-atmosphere exchange. Although biospheric annual NPP (108 +/- 27 GtC yr(-1)) is split almost equally between land (52% +/- 9%) and ocean (48% +/- 9%), the oceanic contribution to biospheric annual E exceeds that of the land by a factor of 6.7 +/- 1.7. Simulations conducted over a 50-yr period (1951-2000) suggest that a 16% increase in land NPP, owing mainly to CO(2) fertilization, may be partially offset by a decline in marine productivity.

Carroll, M. J., P. Dennis, et al. (2011). "Maintaining northern peatland ecosystems in a changing climate: effects of soil moisture, drainage and drain blocking on craneflies." *Global Change Biology* **17**(9): 2991-3001.

The capacity of peatlands in the northern hemisphere to provide carbon storage, maintain water quality and support northern biodiversity is threatened by a combination of climate change and inappropriate land management. Historical drainage and increasing temperatures threaten the maintenance of the high water tables required for effective peatland functioning, and there is an urgent need to develop appropriate adaptation strategies. Here we use a large-scale replicated experimental design to test the effects of artificial drainage and drain blocking upon soil moisture and cranefly (Diptera: Tipulidae) abundance. Craneflies constitute a key component of peatland biological communities; they are important herbivores

and a major prey item for breeding birds. However, they are also susceptible to drought, so are at risk from future climate change. We found that crane fly abundance increased with soil moisture, in a wedge-shaped relationship; high soil moisture is a necessary condition for high crane fly abundance. Blocking drains increased both soil moisture (by 0.06 m³ m⁻³ in 2009 and 0.23 m³ m⁻³ in 2010) and crane fly abundance (1.3-fold in 2009, 4.5-fold in 2010), but the strength and significance of the effects varied between years. The benefits of restoring ecosystem moisture levels are likely to be greatest during dry years and at dry sites. This study provides some of the first evidence that adaptation management can potentially reduce some of the negative effects of climate change on vulnerable peatland systems. Management to maintain or increase soil moisture in peatlands can therefore be expected to increase populations of crane flies and their avian predators (which are of conservation and economic interest), but also increase the resilience of the ecosystem to future warming and increasingly frequent droughts, and improve carbon storage and water quality.

Corner, A. and A. Randall (2011). "Selling climate change? The limitations of social marketing as a strategy for climate change public engagement." Global Environmental Change-Human and Policy Dimensions **21**(3): 1005-1014.

Social marketing is the systematic application of marketing concepts and techniques to achieve specific behavioural goals relevant to the social good. Social marketing approaches are becoming increasingly popular among governmental and non-governmental actors seeking to engage the public on climate change. The effectiveness of social marketing in achieving specific behavioural goals is empirically well-supported. However, in the first systematic critique of social marketing as a strategy for engaging the public on climate change, we present evidence that social marketing alone is insufficient to build support for the more ambitious policy changes and interventions that constitute a proportional response to climate change. In some circumstances, social marketing approaches may even be counterproductive. We describe some alternative approaches for engaging the public, which may provide governmental and non-governmental actors with additional or preferable tools for promoting public engagement with climate change. Given the scale of the challenge, it seems critical that those seeking to engage the public are equipped with the most effective strategies available - a goal that this paper seeks to contribute to. We conclude that acknowledging the limitations of social marketing - and exploring alternative methods of engaging the public - is an urgent task for climate change communication researchers and practitioners. (C) 2011 Elsevier Ltd. All rights reserved.

Corner, A., D. Venables, et al. (2011). "Nuclear power, climate change and energy security: Exploring British public attitudes." Energy Policy **39**(9): 4823-4833.

Public attitudes towards nuclear power in the UK have historically been deeply divided, but as concern about climate change and energy security has exerted an increasing influence on British energy policy, nuclear power has been reframed as a low-carbon technology. Previous research has suggested that a significant proportion of people may 'reluctantly accept' nuclear power as a means of addressing the greater threat of climate change. Drawing on the results of a national British survey (n=1822), the current study found that attitudes towards nuclear remain divided, with only a minority expressing unconditional acceptance. In general, people who expressed greater concern about climate change and energy

security and possessed higher environmental values were less likely to favour nuclear power. However, when nuclear power was given an explicit 'reluctant acceptance' framing - allowing people to express their dislike for nuclear power alongside their conditional support - concerns about climate change and energy security became positive predictors of support for nuclear power. These findings suggest that concern about climate change and energy security will only increase acceptance of nuclear power under limited circumstances-specifically once other (preferred) options have been exhausted. (C) 2011 Elsevier Ltd. All rights reserved.

Kaduk, J. D. and S. O. Los (2011). "Predicting the time of green up in temperate and boreal biomes." Climatic Change **107**(3-4): 277-304.

Direct observations as well as Normalized Difference Vegetation Index (NDVI) data from satellites have shown earlier leaf appearance in the northern hemisphere, which is believed to result from climate warming. The advance of leaf out to earlier times in the year could be limited or even reversed, however, as temperate and boreal trees require a certain amount of chilling in winter for rapid leaf out in spring. If this chilling requirement is not fulfilled, an increasing amount of warming is required. Implications of these chilling requirements at the biome level are not clear. One approach to estimate their importance is to generalize the exponential relationships between chilling and warming established for single species. Previous work using NDVI data suggests that this is indeed feasible but much has been limited to specific biomes or a very few years of data for the modelling. We find chilling requirements for northern temperate and boreal biomes by fitting various phenology models to green-up dates determined from NDVI using various methods and 12 years of data. The models predict that in northern middle and high latitudes the advance of green-up will be limited to a total of 4 to 5 days on average (but up to 15 days regionally) over the time period 2000-2060 as estimated using two contrasting climate simulations. This results from the exponentially increasing warming requirements for leaf out when winter chilling falls below a threshold as shown by a comparison with models that consider only spring warming. The model evaluation suggests an element of regional adaptation of the warming required for leaf out in large biomes.

Conservation and biodiversity

Ansari, M. A. and T. M. Butt (2011). "Effect of potting media on the efficacy and dispersal of entomopathogenic nematodes for the control of black vine weevil, *Otiorynchus sulcatus* (Coleoptera: Curculionidae)." Biological Control **58**(3): 310-318.

The effect of five commercial potting media, peat, bark, coir, and peat blended with 10% and 20% compost green waste (CGW) on the virulence of six commercially available entomopathogenic nematodes (EPN), *Heterorhabditis bacteriophora* UWS1, *Heterorhabditis megidis*, *Heterorhabditis downesi*, *Steinernema feltiae*, *Steinernema carpocapsae*, and *Steinernema kraussei* was tested against third-instar black vine weevil (BVW), *Otiorynchus sulcatus*. Media type was shown to significantly affect EPN virulence. *Heterorhabditis* species caused 100% larval mortality in all media whereas *Steinernema* species caused 100% larval mortality only in the peat blended with 20% CGW. A later experiment investigated the effect of potting media on the virulence of EPN species against BVW by comparing the vertical dispersal of EPN in the presence and absence of BVW larva. Media type significantly influenced EPN dispersal. Dispersal of H.

bacteriophora was higher than *H. megidis*, *H. downesi*, or *S. kraussei* in all media, whereas, *S. feltiae* and *S. carpocapsae* dispersal was much reduced and restricted to peat blended with 20% CGW and coir, respectively. In the absence of larvae, most of the EPN species remained in the same segment they were applied in, suggesting that the larvae responded to host volatile cues. Greenhouse trials were conducted to evaluate the efficacy of most virulent strain, *H. bacteriophora* in conditions more representative of those in the field, using 2.5×10^9 infective juveniles/ha. The efficacy of *H. bacteriophora* UWS1 against third-instar BVW was 100% in peat, and peat blended with 10% and 20% CGW but only 70% in bark and coir, 2 weeks after application. These studies suggest that potting media significantly affects the efficacy and dispersal of EPN for BVW control. (C) 2011 Elsevier Inc. All rights reserved.

de Bruyn, M., A. R. Hoelzel, et al. (2011). "Faunal histories from Holocene ancient DNA." Trends in Ecology & Evolution **26**(8): 405-413.

Recent studies using ancient DNA have been instrumental in advancing understanding of the impact of Holocene climate change on biodiversity. Ancient DNA has been used to track demography, migration and diversity, and is providing new insights into the long-term dynamics of species and population distributions. The Holocene is key to understanding how the past has impacted on the present, as it bridges the gap between contemporary phylogeographic studies and those with inference on Pleistocene patterns, based on ancient DNA studies. Here, we examine the major patterns of Holocene faunal population dynamics and connectivity; highlighting the dynamic nature of species and population responses to Holocene climatic change, thereby providing an 'analogue' for understanding potential impacts of future change.

DeLuca, T. H. and C. A. Zabinski (2011). "Prairie ecosystems and the carbon problem." Frontiers in Ecology and the Environment **9**(7): 407-413.

There has been great interest in carbon (C) storage in terrestrial landscapes and the potential for trading C released during fossil-fuel combustion for C stored in agricultural landscapes. This is particularly important in the Great Plains of North America, where increased C storage under conservation tillage represents millions of dollars in C credits. However, we contend that the logic behind such trading is imperfect on multiple levels. We suggest that increased C storage in Great Plains soils with conservation tillage can, at best, only partially replenish what was previously emitted by tillage of native prairies. Furthermore, there is disagreement on whether reduced tillage actually does increase C storage in prairie soils. Use of alternative agricultural practices that emulate natural prairie diversity, processes, and function, as well as the establishment of permanent prairie reserves, will aid in recovery of previously lost C and provide for increased bio-diversity and resilience in the face of changing climate conditions.

Dick, J., C. Andrews, et al. (2011). "A comparison of ecosystem services delivered by 11 long-term monitoring sites in the UK environmental change network." Environmetrics **22**(5): 639-648.

The Millennium Ecosystem Assessment (MA 2003) framework was applied to provide a holistic assessment and comparison of ecosystem services delivery from 11 environmental change network (ECN) sites, following a workshop of ECN site managers. A list of common variables was agreed to represent the high level

categories defined by the MA. The resultant 73 variables, either direct ecosystem services or proxies, were divided into two subsets (readily accessible biogeographical data from all sites and additional site specific data). Similarity analysis of the biogeographical data indicated four site clusters: land with at least 50% forest cover, productive livestock farmland, uplands and a lowland grass/arable group. The first three clusters were also evident for both the additional data and for the larger combined dataset. The lowland grass/arable sites were a 'mixed use' cluster that was not apparent in the analysis of the additional or combined datasets indicating a mismatch between particular ecosystem services and specific landscapes/habitats. Procrustes analysis of the biogeographical data and the combined dataset suggested that the primary differences between datasets were due to variables associated with local management decisions which prevented harvesting of provisioning services or denied public access to the site. Drawing on comparable data from some of the most intensively researched and monitored ecosystems in the UK, this study demonstrates the challenges and limitations involved in attempting holistic assessments of ecosystem services at the site and inter-site level and highlights the importance of both local expert knowledge and consistent scientific measurement in contributing to the process. Copyright (C) 2011 John Wiley & Sons, Ltd.

Fry, D. A. and F. M. Slater (2011). "Early rotation short rotation willow coppice as a winter food resource for birds." *Biomass & Bioenergy* **35**(7): 2545-2553.

Unlike a century ago when mixed arable/pastoral farms prevailed, the current Welsh pastoral landscape lacks arable crops for arable weed seeds as a winter food resource for granivorous birds. Biomass crops such as short rotation willow coppice (SRC) where *Salix* cultivars are grown at high density (10 000-40 000 per ha) and each plot harvested on a usually three year rotation may help redress this loss. SRC, certainly in its establishment phase, and, if suitably managed, in early post-harvest rotation, offers significant winter seed resource which within one resource, such as spear thistle (*Cirsium vulgare*), may change its bird availability depending whether it is upright when used by finches or fallen when utilised by ground feeding thrushes. If this crop becomes widespread in the landscape and it is managed in an environmentally friendly way, it will provide a food resource and possibly habitat "stepping stones" in countryside currently barren of such features. (C) 2011 Elsevier Ltd. All rights reserved.

Gundale, M. J., T. H. Deluca, et al. (2011). "Bryophytes attenuate anthropogenic nitrogen inputs in boreal forests." *Global Change Biology* **17**(8): 2743-2753.

Productivity in boreal ecosystems is primarily limited by available soil nitrogen (N), and there is substantial interest in understanding whether deposition of anthropogenically derived reactive nitrogen (N(r)) results in greater N availability to woody vegetation, which could result in greater carbon (C) sequestration. One factor that may limit the acquisition of N(r) by woody plants is the presence of bryophytes, which are a significant C and N pool, and a location where associative cyanobacterial N-fixation occurs. Using a replicated stand-scale N-addition experiment (five levels: 0, 3, 6, 12, and 50 kg N ha⁻¹yr⁻¹; n=6) in the boreal zone of northern Sweden, we tested the hypothesis that sequestration of N(r) into bryophyte tissues, and downregulation of N-fixation would attenuate N(r) inputs, and thereby limit anthropogenic N(r) acquisition by woody plants. Our data showed that N-fixation per unit moss mass and per unit area sharply decreased with

increasing N addition. Additionally, the tissue N concentrations of *Pleurozium schreberi* increased and its biomass decreased with increasing N addition. This response to increasing N addition caused the *P. schreberi* N pool to be stable at all but the highest N addition rate, where it significantly decreased. The combined effects of changed N-fixation and *P. schreberi* biomass N accounted for 56.7% of cumulative N(r) additions at the lowest N(r) addition rate, but only a minor fraction for all other treatments. This 'bryophyte effect' can in part explain why soil inorganic N availability and acquisition by woody plants (indicated by their $\delta(15)\text{N}$ signatures) remained unchanged up to N addition rates of 12 kg ha⁽⁻¹⁾yr⁽⁻¹⁾ or greater. Finally, we demonstrate that approximately 71.8% of the boreal forest experiences N(r) deposition rates at or below 3 kg ha⁽⁻¹⁾yr⁽⁻¹⁾, suggesting that bryophytes likely limit woody plant acquisition of ambient anthropogenic N inputs throughout a majority of the boreal forest.

Kattge, J., S. Diaz, et al. (2011). "TRY - a global database of plant traits." Global Change Biology **17**(9): 2905-2935.

Plant traits - the morphological, anatomical, physiological, biochemical and phenological characteristics of plants and their organs - determine how primary producers respond to environmental factors, affect other trophic levels, influence ecosystem processes and services and provide a link from species richness to ecosystem functional diversity. Trait data thus represent the raw material for a wide range of research from evolutionary biology, community and functional ecology to biogeography. Here we present the global database initiative named TRY, which has united a wide range of the plant trait research community worldwide and gained an unprecedented buy-in of trait data: so far 93 trait databases have been contributed. The data repository currently contains almost three million trait entries for 69 000 out of the world's 300 000 plant species, with a focus on 52 groups of traits characterizing the vegetative and regeneration stages of the plant life cycle, including growth, dispersal, establishment and persistence. A first data analysis shows that most plant traits are approximately log-normally distributed, with widely differing ranges of variation across traits. Most trait variation is between species (interspecific), but significant intraspecific variation is also documented, up to 40% of the overall variation. Plant functional types (PFTs), as commonly used in vegetation models, capture a substantial fraction of the observed variation - but for several traits most variation occurs within PFTs, up to 75% of the overall variation. In the context of vegetation models these traits would better be represented by state variables rather than fixed parameter values. The improved availability of plant trait data in the unified global database is expected to support a paradigm shift from species to trait-based ecology, offer new opportunities for synthetic plant trait research and enable a more realistic and empirically grounded representation of terrestrial vegetation in Earth system models.

Kean, E. F., C. T. Muller, et al. (2011). "Otter Scent Signals Age, Sex, and Reproductive Status." Chemical Senses **36**(6): 555-+.

Scent is used across taxa to communicate information about signaler identity. Eurasian otters *Lutra lutra* are mainly solitary and thought to use scent as their primary means of communication. Little is known, however, about what information otters communicate through scent or what social function this performs. Headspace solid-phase microextraction and gas chromatography-mass spectrometry were used to sample and analyze volatile organic compounds from

anal scent gland secretion from 158 otters of differing sex, age, and female reproductive status. Univariate and multivariate differences were clear between adult and juvenile otters. Complex sex differences were apparent in adult otters but not in younger individuals, suggesting the use of this scent secretion in mate attraction. The scent of pregnant and lactating females was highly differentiated from male and juvenile scent, but anecdotal reports suggest females avoid communication during these times.

Energy

Fazeli, M., G. M. Asher, et al. (2011). "Novel Integration of DFIG-Based Wind Generators Within Microgrids." *Ieee Transactions on Energy Conversion* **26**(3): 840-850.

This paper proposes a novel integration of doubly fed induction generator (DFIG)-based wind farms within microgrids. The main and probably the best feature of this method is that the voltage and frequency of the microgrid are controlled by the wind generators through droop characteristics. Therefore, this control structure is quite suitable for cases where the wind generators supply significant part of the load. This paper will adjust the standard droop method in order to force the DFIG to share the load according to their available wind powers, not only their ratings. This paper focuses on microgrid application; however, the method is quite applicable for ac grid and HVdc link connections as well. The proposed control methods are validated using PSCAD/4.2.1 Professional/EMTDC simulations.

Grunewald, P., T. Cockerill, et al. (2011). "The role of large scale storage in a GB low carbon energy future: Issues and policy challenges." *Energy Policy* **39**(9): 4807-4815.

Large scale storage offers the prospect of capturing and using excess electricity within a low carbon energy system, which otherwise might have to be wasted. Incorporating the role of storage into current scenario tools is challenging, because it requires high temporal resolution to reflect the effects of intermittent sources on system balancing. This study draws on results from a model with such resolution. It concludes that large scale storage could become economically viable for scenarios with high penetration of renewables. As the proportion of intermittent sources increases, the optimal type of storage shifts towards solutions with low energy related costs, even at the expense of efficiency. However, a range of uncertainties have been identified, concerning storage technology development, the regulatory environment, alternatives to storage and the stochastic uncertainty of year-on-year revenues. All of these negatively affect the cost of finance and the chances of successful market uptake. We argue, therefore, that, if the possible wider system and social benefits from the presence of storage are to be achieved, stronger and more strategic policy support may be necessary. More work on the social and system benefits of storage is needed to gauge the appropriate extent of support measures. (C) 2011 Elsevier Ltd. All rights reserved.

Xing, Y. G., N. Hewitt, et al. (2011). "Zero carbon buildings refurbishment-A Hierarchical pathway." *Renewable & Sustainable Energy Reviews* **15**(6): 3229-3236.

Buildings account for almost half of energy consumptions in European countries and energy demand in building continues to grow worldwide. Fossil fuels are finite reserves. Impacts of peak oil will be perceived soon or later in the next decades. The scale of the challenge in reducing fossil fuel dependency in the built

environment is vast and will require a dramatic increase in skills and awareness amongst the construction professions. Building refurbishment towards zero carbon is established itself as one critical aspect to decouple from fossil fuels and tackle with future energy crisis. However, it is a very complex phenomenon cuts across disciplines. This paper categorises a range of technologies for building refurbishment in a sequential manner. A hierarchical process with embedded techniques (insulations, energy efficient equipment and micro-generation) is presented in this paper as a pathway towards zero-carbon building refurbishment. (C) 2011 Elsevier Ltd. All rights reserved.

Fisheries

Carvalho, N., S. Rege, et al. (2011). "Estimating the impacts of eliminating fisheries subsidies on the small island economy of the Azores." *Ecological Economics* **70**(10): 1822-1830.

A major problem affecting world fisheries today is overcapacity of which overfishing is both a cause and a consequence. There is a general consensus that fisheries subsidies cause great harm to the resource by exacerbating the problems resulting from the common resource issues of fisheries leading to overexploitation of the resource through a new set of perverse incentives. Many now advocate that subsidies should gradually be terminated, and that capacity enhancing and fuel subsidies should be terminated immediately. On account of the global fisheries crises, highly subsidised fisheries and the anticipated reforms of the European Union's Common Fisheries Policy this study aimed to estimate the impact of eliminating fisheries subsidies on various macro and micro economic variables pertaining to the regional economy of the Azores using a dynamic computable general equilibrium model based on a social accounting matrix. The simulation results suggest that reduction, and in particular, elimination of fisheries subsidies would have a substantial effect on the region, however, the negative social and economic effects would be largely confined to the fishing sector. Conversely, the augmentation of fishery subsidies would benefit the fishing sector with an overall adverse effect on the rest of the economy. (C) 2011 Elsevier B.V. All rights reserved.

Consuegra, S., E. de Eyto, et al. (2011). "Contrasting responses to selection in class I and class II alpha major histocompatibility-linked markers in salmon." *Heredity* **107**(2): 143-154.

Comparison of levels and patterns of genetic variation in natural populations either across loci or against neutral expectation can yield insight into locus-specific differences in the strength and direction of evolutionary forces. We used both approaches to test the hypotheses on patterns of selection on major histocompatibility (MH)-linked markers. We performed temporal analyses of class I and class II alpha MH-linked markers and eight microsatellite loci in two Atlantic salmon populations in Ireland on two temporal scales: over six decades and 9 years in the rivers Burrishoole and Delphi, respectively. We also compared contemporary Burrishoole and Delphi samples with nearby populations for the same loci. On comparing patterns of temporal and spatial differentiation among classes of loci, the class IIa MH-linked marker was consistently identified as an outlier compared with patterns at the other microsatellite loci or neutral expectation. We found higher levels of temporal and spatial heterogeneity in heterozygosity (but not in

allelic richness) for the class IIa MH-linked marker compared with microsatellites. Tests on both within-and among-population differentiation are consistent with directional selection acting on the class II alpha-linked marker in both temporal and spatial comparisons, but only in temporal comparisons for the class I-linked marker. Our results indicate a complex pattern of selection on MH-linked markers in natural populations of Atlantic salmon. These findings highlight the importance of considering selection on MH-linked markers when using these markers for management and conservation purposes. *Heredity* (2011) 107, 143-154; doi:10.1038/hdy.2010.177; published online 26 January 2011

Consuegra, S., N. Phillips, et al. (2011). "Winning the invasion roulette: escapes from fish farms increase admixture and facilitate establishment of non-native rainbow trout." *Evolutionary Applications* 4(5): 660-671.

Aquaculture is a major source of invasive aquatic species, despite the fact that cultured organisms often have low genetic diversity and tend to be maladapted to survive in the wild. Yet, to what extent aquaculture escapees become established by means of high propagule pressure and multiple origins is not clear. We analysed the genetic diversity of 15 established populations and four farmed stocks of non-native rainbow trout in Chile, a species first introduced for recreational fishing around 1900, but which has in recent decades escaped in large numbers from fish farms and become widespread. Aquaculture propagule pressure was a good predictor of the incidence of farm escapees, which represented 16% of all free-ranging rainbow trout and were present in 80% of the study rivers. Hybrids between farm escapes and established trout were present in all rivers at frequencies ranging between 7 and 69%, and population admixture was positively correlated with genetic diversity. We suggest that non-native salmonids introduced into the Southern Hemisphere could benefit from admixture because local adaptations may not have yet developed, and there may be initially little fitness loss resulting from outbreeding depression.

Eden, S. and C. Bear (2011). "Models of equilibrium, natural agency and environmental change: lay ecologies in UK recreational angling." *Transactions of the Institute of British Geographers* 36(3): 393-407.

This paper studies how anglers in northern England invoke models of equilibrium and 'the balance of nature' in making sense of the water environments where they regularly fish, and how they use these models as norms or ideals when designing environmental management, alongside an emphasis on natural agency and unpredictability. Like other publics, anglers are shown to be a heterogeneous group in how they think about nature and their 'lay ecologies' reflect the problematic way in which equilibrium is normalised in science and policy more generally, showing similarities with professional environmental managers. But anglers are unusual publics, because their lay ecologies are put to work in collectively managing water environments, through stocking, culling and habitat management. Thus anglers' environmental knowledge practices co-produce the environments in which they develop their lay ecologies, making their models of nature and equilibrium important both conceptually and materially.

Eden, S. and C. Bear (2011). "Reading the river through 'watercraft': environmental engagement through knowledge and practice in freshwater angling." *Cultural Geographies* 18(3): 297-314.

This paper examines how freshwater anglers in northern England 'read' rivers as landscapes and work with them relationally, through various sorts of embodied knowledge-practices, as part of their angling activity: processes that they call 'watercraft'. We focus specifically on water as an environment that anglers encounter as a different world: unlike land and air, water is not an everyday medium in which humans (as terrestrial animals) live and breathe. We use this example of environmental engagement to go beyond visual engagement with landscapes, to show how people develop skills of environmental interpretation, mapping and nonvisual sense-making in ways that are particular to the water encounter. We conclude by arguing for a mutual and multisensory notion of environmental engagement that considers not merely human perception but also how environments, such as water, also shape that encounter.

Roberts, L. J., J. Taylor, et al. (2011). "Environmental enrichment reduces maladaptive risk-taking behavior in salmon reared for conservation." Biological Conservation **144**(7): 1972-1979.

Hatcheries often produce bold fish that are maladapted to survive in the wild, as absence of predators and selection for fast growth tend to favour risk-taking behaviors. Not surprisingly, losses of hatchery fish through predation can be high immediately after release and this may account for the failure of many ex-situ fish conservation programmes. For supportive-breeding to be useful, it is essential that released fish are able to display natural behaviors. We compared the performance of juvenile Atlantic salmon reared in environmentally-enriched tanks receiving natural prey and subjected to simulated predator attacks with fish reared under standard hatchery conditions while keeping densities constant. No differences were detected between controls and environmentally enriched fish in survival, final size or nutritional status. Yet, changes in rearing conditions had rapid and marked effects on risk-taking behavior. Environmentally enriched fish were 2.1 times less willing, and took significantly longer to leave shelter, than controls within two weeks of enrichment. Thus our study indicates that it is possible through environmental enrichment to modify at least one component of fishes' behavior known to have clear adaptive implications, i.e. the propensity of hatchery-reared fish to take excessive risks. Ex-situ conservation could therefore benefit from rearing fish in naturalized, structurally complex environments with natural prey to promote the development of more natural behaviors. (C) 2011 Elsevier Ltd. All rights reserved.

Flooding

Calado, H., P. Borges, et al. (2011). "The Azores archipelago, Portugal: improved understanding of small island coastal hazards and mitigation measures." Natural Hazards **58**(1): 427-444.

Coastal zones are vital to small islands due to limited land availability and ocean exposure. Their significance and resident dependence result in a need to address unique small island coastal zone concerns. Recent population concentrations and increased economic activity along with accompanying lucrative coastal development are posing significant threats to human and natural system well-being. Potential environmental hazards therefore play an important role in coastal vulnerability and risk assessment, and it is only by understanding causes and consequences that policy makers, along with scientists and the public, can

establish appropriate mitigation measures. This paper addresses the lack of specific small island studies, including their unique circumstances. Coastal hazards are assessed and effective mitigation strategies suggested. A case study of the Azores archipelago highlights specific coastal hazards and demonstrates the importance of public participation when implementing mitigation measures. Furthermore, the inclusion of an external neutral and unbiased coastal management expert within the public participation process facilitated successful development of Azorean Coastal Zone Management Plans.

Xia, J., R. A. Falconer, et al. (2011). "Estimation of future coastal flood risk in the Severn Estuary due to a barrage." Journal of Flood Risk Management 4(3): 247-259.

The Severn Estuary is an ideal site for tidal renewable energy projects and the probability of coastal flood risk in the estuary will increase accordingly due to climate change. Therefore, it is significant to predict the future status of coastal flooding in this estuary using various scenarios with the effects of climate change and potential barrage construction. An existing two-dimensional hydrodynamic model is outlined first. Three scenarios at the open seaward boundary are then presented. Finally, the model was used to simulate the hydrodynamic processes in the estuary using three boundary scenarios. Simulated results show that (i) without the barrage, the maximum levels along the estuary could rise by 1.0-1.2 m due to sea-level rise, and the effect of extreme sea levels on the distribution of maximum water levels would be noticeable only in the outer estuary reach; (ii) with the barrage, the maximum water levels could reduce by 0.5-1.2 m upstream of the barrage even if a sea-level rise of 1.0 m would occur by 2100, and extreme sea levels could not influence the distribution of maximum water levels upstream of the barrage; and (iii) the future flood risk in a small coastal floodplain would increase and the potential losses could reach 6.5 pound M/year due to sea-level rise without the barrage, and it could be avoided completely if the barrage were to be constructed as proposed.

Xia, J. Q., F. Y. Teo, et al. (2011). "Formula of incipient velocity for flooded vehicles." Natural Hazards 58(1): 1-14.

With the climate change caused by global warming, the occurrence probability of urban flooding due to flash floods has increased gradually. Flush floods propagate rapidly, which can lead to significant hazard to human life and property. Flood hazard to vehicles has become more noticeable and frequent in recent years. Therefore, it is important to investigate the behaviour of vehicles on flooded streets or roads. In the current study, a formula has been derived to predict the incipient velocity of flooded vehicles according to the mechanical condition of sliding equilibrium. A series of flume experiments were conducted using three types of scaled die-cast model vehicles, with two scales being tested for each type of vehicle. The experimental data obtained for the small-scale model vehicles were used to determine the two parameters in the derived formula, and the prediction accuracy of this formula was validated using the experimental data obtained for the large-scale model vehicles. Finally, the corresponding incipient velocities under various incoming depths were computed using this formula for these three prototype vehicles. It is found that for a specified vehicle, the value of incipient velocity reaches its minimum as the incoming flow depth approaches the height of the vehicle, and the smaller and lighter vehicle like Mini Cooper is the easiest to

start sliding in floodwaters. The results can be used as a preliminary assessment to define the hazard to vehicles parking on flooded streets or roads.

Land Quality

Atanassova, I. and S. H. Doerr (2011). "Changes in soil organic compound composition associated with heat-induced increases in soil water repellency." European Journal of Soil Science **62**(4): 516-532.

Soil heating, as for example experienced during vegetation fires, often increases soil water repellency; however, no detailed analysis of the soil chemical changes associated with this increase has been conducted to date. Here we characterize the changes in organic compound composition associated with heat-induced increases in water repellency for three Australian eucalypt-forest soils (one sandy loam, two sands). Laboratory heating (300 degrees C) strongly increased water drop penetration times (WDPTs) in all soils. Soils were extracted by accelerated solvent extraction (ASE) with an iso-propanol/ammonia mixture (IPA/NH₃) 95: 5) and pure iso-propanol (IPA). Extracts were fractionated into less and more polar fractions and analysed by GC-MS. Water repellency was eliminated in unheated and heated soils by IPA/NH₃, but not by pure IPA. Before heating, total solvent extracts were dominated by n-alkanols, terpenoids, C(16) acid, C(29) alkane, beta-sitosterol and polar compounds. After heating, dominant compounds were aromatic acids, aldehydes, levoglucosan, simple sugars and glycosides. Heating resulted in a sharp absolute decrease of homologous aliphatic series of alkanols and alkanes, a shift of fatty acid signature to members <C(20) and an increase in total content of aromatic compounds. Heating also caused the formation of complex high-molecular-weight compounds detected in the more polar fractionated extracts and low-molecular-weight oxo- and hydroxyacids and aromatics in the IPA/NH₃ solvent. We speculate that these compounds in conjunction with fatty acids of <C(12) interact with organic and mineral soil surfaces and cause the observed strong increases in soil water repellency following heating.

Banwart, S., S. M. Bernasconi, et al. (2011). "Soil Processes and Functions in Critical Zone Observatories: Hypotheses and Experimental Design." Vadose Zone Journal **10**(3): 974-987.

European Union policy on soil threats and soil protection has prioritized new research to address global soil threats. This research draws on the methodology of Critical Zone Observatories (CZOs) to focus a critical mass of international, multi disciplinary expertise at specific field sites. These CZOs were selected as part of an experimental design to study soil processes and ecosystem function along a hypothesized soil life cycle-from incipient soil formation where new parent material is being deposited, to highly degraded soils that have experienced millennia of intensive land use. Further CZOs have been selected to broaden the range of soil environments and data sets to test soil process models that represent the stages of the soil life cycle. The scientific methodology for this research focuses on the central role of soil structure and soil aggregate formation and stability in soil processes. Research methods include detailed analysis and mathematical modeling of soil properties related to aggregate formation and their relation to key processes of reactive transport, nutrient transformation, and C and food web dynamics in soil ecosystems. Within this program of research,

quantification of soil processes across an international network of CZOs is focused on understanding soil ecosystem services including their quantitative monetary valuation within the soil life cycle. Further experimental design at the global scale is enabled by this type of international CZO network. One example is a proposed experiment to study soil ecosystem services along planetary-scale environmental gradients. This would allow scientists to gain insight into the responses of soil processes to increasing human pressures on Earth's critical zone that arise through rapidly changing land use and climate.

Batalla, R. J. and D. Vericat (2011). "An appraisal of the contemporary sediment yield in the Ebro Basin." Journal of Soils and Sediments **11**(6): 1070-1081.

Purpose The main aim of this work is to provide a comprehensive estimation of the sediment yield of the Ebro Basin (NE Iberian Peninsula) in the twentieth century. **Materials and methods** For this purpose, we have used the reservoir sedimentation records available for a series of large dams distributed in the catchment. Records started in 1916 and ended in 2001. In addition to the sediment yield estimates, bathymetrical records permit an evaluation of spatial variations in the sediment load of the basin and the assessment of the sediment yield of the lower reaches of the river downstream of major dams. **Results and discussion** Total sedimentation in the reservoirs of the basin is estimated to be in the order of 670×10^6 t. Sediment yield is five times higher in the northern catchments (Pyrenean Range, $370 \text{ t km}^{-2} \text{ year}^{-1}$) than in the southern ones (Iberian Massif, $78 \text{ t km}^{-2} \text{ year}^{-1}$), reflecting the particular hydromorphic conditions of these areas. Specific sediment yield (SSY) decreases with catchment area but in the southern zone is more scale-dependent. The highest SSY occurs at 350 mm year^{-1} showing a decline as runoff increases. SSY of the northern zone plots high in comparison to curves found in the literature, and this is interpreted as the consequence of historical human impact on sediment delivery. The sediment load of the Ebro Basin before the widespread construction of dams and the beginning of land abandonment is estimated to be 21×10^6 t year⁻¹. **Conclusions** The data illustrate the distinct hydrological and geomorphic behaviour of the two hydro-climatic areas analysed in this study. The SSY data show, for instance, the lower capability of the semi-arid catchments to transfer sediment loads. SSY does not show a linear relation with runoff, a fact that corroborates general patterns previously reported in the literature. Finally, the contemporary sediment load represents around the 1% of what was potentially transported during the beginning of the twentieth century, illustrating the sedimentary deficit of the lower section of the Ebro Basin.

Curtis, C. J., C. D. Evans, et al. (2011). "What Have Stable Isotope Studies Revealed About the Nature and Mechanisms of N Saturation and Nitrate Leaching from Semi-Natural Catchments?" Ecosystems **14**(6): 1021-1037.

Various studies over the last 15 years have attempted to describe the processes of N retention, saturation and NO_3^- leaching in semi-natural ecosystems based on stable isotope studies. Forest ecologists and terrestrial biogeochemists have used ^{15}N labelled NO_3^- and NH_4^+ tracers to determine the fate of atmospheric deposition inputs of N to terrestrial ecosystems, with NO_3^- leaching to surface waters being a key output flux. Separate studies by aquatic ecologists have used similar isotope tracer methods to determine the fate and impacts of inorganic N species, leached from terrestrial ecosystems, on aquatic

ecosystems, usually without reference to comparable terrestrial studies. A third group of isotopic studies has employed natural abundances of (15)N and (18)O in precipitation and surface water NO(3) (-) to determine the relative contributions of atmospheric and microbial sources. These three sets of results often appear to conflict with one another. Here we attempt to synthesize and reconcile the results of these differing approaches to identifying both the source and the fate of inorganic N in natural or semi-natural ecosystems, and identify future research priorities. We conclude that the results of different studies conform to a consistent conceptual model comprising: (1) rapid microbial turnover of atmospherically deposited NO(3) (-) at multiple biologically active locations within both terrestrial and aquatic ecosystems; (2) maximum retention and accumulation of N in carbon-rich ecosystems and (3) maximum leaching of NO(3) (-), most of which has been microbially cycled, from carbon-poor ecosystems exposed to elevated atmospheric N inputs.

Davies, R., D. Edwards, et al. (2011). "The oxidation of Fe(111)." Surface Science **605**(17-18): 1754-1762.

The oxidation of Fe(111) was studied using Auger electron spectroscopy (AES), low energy electron diffraction (LEED), X-ray photoelectron spectroscopy (XPS), ion scattering spectroscopy (ISS) and scanning tunnelling microscopy (STM). Oxidation of the crystal was found to be a very fast process, even at 200 K, and the Auger O signal saturation level is reached within similar to 50×10^{-6} mbar s. Annealing the oxidised surface at 773 K causes a significant decline in apparent surface oxygen concentration and produces a clear (6 x 6) LEED pattern, whereas after oxidation at ambient temperature no pattern was observed. STM results indicate that the oxygen signal was reduced due to the nucleation of large, but sparsely distributed oxide islands, leaving mainly the smooth (6 x 6) structure between the islands. The reactivity of the (6 x 6) layer towards methanol was investigated using temperature programmed desorption (TPD), which showed mainly decomposition to CO and CO(2), due to the production of formate intermediates on the surface. Interestingly, this removes the (6 x 6) structure by reduction, but it can be reformed from the sink of oxygen present in the large oxide islands simply by annealing at 773 K for a few minutes. The (6 x 6) appears to be a relatively stable, pseudo-oxide phase, that may be useful as a model oxide surface. (C) 2011 Elsevier B.V. All rights reserved.

Fan, W., Y. S. Yang, et al. (2011). "Finger-Printing Biodegradation of Petroleum Contamination in Shallow Groundwater and Soil System Using Hydro-bio-geochemical Markers and Modelling Support." Water Air and Soil Pollution **220**(1-4): 253-263.

This study was conducted to determine the potential of in situ biodegradation and identify the geochemical and microbial processes of the petroleum-contaminated subsurface environment using integrated hydro-bio-geochemical markers so that the risk of contamination to subsurface environment can be better understood. The contamination process and corresponding bio-geo-chemistry were analysed in parallel with geochemical and multi-variant statistical modelling at a petroleum-contaminated site in the northeast China. The total petroleum hydrocarbon analysed in the monitoring wells and soil profile demonstrated heavy contamination with potential risk to human health and environment. Further detailed analysis of petroleum fractions revealed a clear spatial variation of organic compositions in groundwater. It was evident that

biodegradation and preferential biodegradability contributed considerably to the fraction distribution pattern, which can also be implicated by carbon and microbial respiration in the subsurface environment. The steady decrease in SO_4^{2-} concentration, detection of S^{2-} , and increase in pH and alkalinity (HCO_3^-) in groundwater during the monitoring period demonstrated that sulphate reduction was the dominant biodegradation process in most contaminated zones. The results of statistical analysis further suggested that the hydro-geochemical environment was mainly controlled by the regional hydro-geochemical and sulphate reduction process associated closely with the total petroleum hydrocarbon. Knowledge from the comprehensive study provides useful insight on fate, transport and risk assessment of the petroleum contaminants in the shallow subsurface environment.

Farrell, M., J. R. Healey, et al. (2011). "Modification of Fertility of Soil Materials for Restoration of Acid Grassland Habitat." *Restoration Ecology* **19**(4): 509-519.

Use of composts for habitat restoration offers advantages in terms of efficient use of resources. Chemical amendment of compost to reduce its pH and P availability was investigated in order to improve suitability for use in reclamation of blocky quarry waste to acidic grassy heathland. The effect of these amendments was observed on competition between two grass species: *Agrostis capillaris* and *Festuca ovina*. A factorial, pot-scale greenhouse experiment was set up using two composts (one a mixture of green waste and catering waste, and the other a mixture of green waste and sewage sludge). In addition, two soils were collected from upland acidic grassland to provide a natural comparison. S^0 was applied to reduce soil pH, and $\text{Fe}(\text{OH})_3$ from a coal waste treatment plant was applied to counteract the expected increase in P availability due to acidification of the composts by S^0 . Addition of S^0 significantly reduced soil solution pH and addition of $\text{Fe}(\text{OH})_3$ significantly reduced soil solution P concentration. In one compost S^0 reduced the biomass of *F. ovina* while increasing that of *A. capillaris*, whereas $\text{Fe}(\text{OH})_3$ had no significant effect on the biomass of either species. Although S^0 and $\text{Fe}(\text{OH})_3$ did adjust the chemical properties of the soil solution, $\text{Fe}(\text{OH})_3$ did not bind P strongly enough to make it unavailable to plants. Further work is required, however, the use of chemically amended composts provides a sustainable sink for organic wastes and we conclude from this study that they have great potential for large-scale restoration of blocky waste tips.

Farrell, M., P. W. Hill, et al. (2011). "Rapid peptide metabolism: A major component of soil nitrogen cycling?" *Global Biogeochemical Cycles* **25**: 11.

Proteinaceous and peptidic nitrogen is a potential direct nutrient source for both plants and microbes in the soil, without prior degradation to amino acids and mineralization. We used a series of five sites along an elevation gradient from 15 m a.s.l. to 710 m a.s.l. along which primary productivity decreases to investigate peptide utilization rates by soil microbes. Using ^{14}C -labeled L-alanine, L-dialanine, and L-trialanine in a series of incubation experiments, we show that peptides are directly and rapidly assimilated by soil microbes, and that they are utilized for both biomass production and respiration. Alanine, dialanine, and trialanine were mineralized rapidly by soil microbes from the five sites along the gradient. Across all five sites, dialanine and trialanine were mineralized faster than alanine. In competition experiments, a 100-fold excess of alanine had no effect on the rate of trialanine mineralization in four of the five sites, and the same excess of trialanine had no effect on alanine mineralization. This is indicative of uptake of the

intact peptide by the soil microbial community. Our findings have implications for understanding terrestrial nitrogen cycling because they point to a short-circuit whereby large peptides and proteins need only be extracellularly cleaved to short chain length peptides before direct assimilation by microbes.

Fernandez-Calvino, D., J. Rousk, et al. (2011). "Bacterial pH-optima for growth track soil pH, but are higher than expected at low pH." *Soil Biology & Biochemistry* **43**(7): 1569-1575.

One of the most influential factors determining the growth and composition of soil bacterial communities is pH. However, soil pH is often correlated with many other factors, including nutrient availability and plant community, and causality among factors is not easily determined. If soil pH is directly influencing the bacterial community, this must lead to a bacterial community growth optimised for the in situ pH. Using one set of Iberian soils (46 soils covering pH 4.2-7.3) and one set of UK grassland soils (16 soils covering pH 3.3-7.5) we measured the pH-optima for the growth of bacterial communities. Bacterial growth was estimated by the leucine incorporation method. The pH-optima for bacterial growth were positively correlated with soil pH, demonstrating its direct influence on the soil bacterial community. We found that the pH from a water extraction better matched the bacterial growth optimum compared with salt extractions of soil. Furthermore, we also showed a more subtle pattern between bacterial pH growth optima and soil pH. While closely matched at neutral pHs, pH-optima became higher than the in situ pH in more acid soils, resulting in a difference of about one pH-unit at the low-pH end. We propose that an explanation for the pattern is an interaction between increasing overall bacterial growth with higher pHs and the unimodal pH-response for growth of bacterial communities. (C) 2011 Elsevier Ltd. All rights reserved.

Franz, T. E., E. G. King, et al. (2011). "Coupling vegetation organization patterns to soil resource heterogeneity in a central Kenyan dryland using geophysical imagery." *Water Resources Research* **47**: 18.

In dryland ecosystems, understanding the effects of heterogeneity in soil moisture and geophysical properties on vegetation structure and dynamics poses a suite of challenging research questions. Heterogeneity in soil depth can affect resource availability and the subsequent organization of woody vegetation, while spatiotemporal variation in soil moisture can reveal important ecohydrological feedbacks that govern the outcome of anthropogenic activities on the organization of dryland vegetation. In this research we investigate two cases of soil resource heterogeneity that affect the organization of dryland vegetation patterns by expanding previous electromagnetic induction (EMI) imaging techniques. In the first case we examine the influence of soil depth as a control on soil resource availability on hillslopes in tree-grass systems in central Kenya. Our results indicate that woody vegetation clumping occurs where soil depth changes, and the deeper rooted *Acacia tortilis* occurs on deep soils while the drought tolerant *Acacia etbaica* occurs on shallow soils. In the second case we examine daily patch-interpatch scale moisture dynamics following two different-sized rain events in a degraded landscape. With the aid of a numerical subsurface flow model, EMI, and soil moisture data, we have identified a possible positive feedback mechanism ("soil moisture halo effect") that we believe may have contributed to the proliferation and two-phase pattern formation of a native succulent *Sansevieria volkensii* in degraded ecosystems of Kenya. By determining how different plants respond to, and modify,

the soil environment, we can better understand resource capture and dynamics, which in the longterm will help to develop management strategies.

Geroni, J. N. and D. J. Sapsford (2011). "Kinetics of iron (II) oxidation determined in the field." Applied Geochemistry **26**(8): 1452-1457.

This paper presents the results of extensive field trials measuring rates of Fe(II) oxidation at a number of Fe-bearing mine drainage discharges in the UK. Batch experiments were carried out with samples taken at regular intervals and Fe(II) concentration determined spectrophotometrically using 2,2'-bipyridyl as the complexing agent. Initial concentrations for Fe(II) were 5.65-76.5 mg/L. Temperature, pH and dissolved O₂ (DO) were logged every 10 s, with pH at the start of the experiments in the range 5.64-6.95 and alkalinity ranging from 73 to 741 mg/L CaCO₃ equivalent. A numerical model based on a fourth order Runge-Kutta method was developed to calculate values for k(1), the rate constant for homogeneous oxidation, from the experimental data. The measured values of pH, temperature, Fe(II) and DO were input into the model with resulting values for k(1) found to be in the range 2.7×10^{14} - 2.7×10^{16} M⁻² atm⁻¹ min⁻¹. These values for k(1) are 1-3 orders of magnitude higher than previously reported for laboratory studies at a similar pH. Comparison of the observed Fe(II) oxidation rates to data published by other authors show a good correlation with heterogenous oxidation rates and may indicate the importance of autocatalysis in these systems. These higher than expected rates of Fe oxidation could have a significant impact on the design of treatment schemes for the remediation of mine drainage and other Fe-bearing ground waters in the future. (C) 2011 Elsevier Ltd. All rights reserved.

Harris, C., M. Kern-Luetsch, et al. (2011). "The Role of Interannual Climate Variability in Controlling Solifluction Processes, Endalen, Svalbard." Permafrost and Periglacial Processes **22**(3): 239-253.

A continuous record is presented of active layer processes at Endalen, Svalbard, over the period 2005-08. The monitored slope has a gradient of around 7 and in 2005, active layer depth was 94 cm, but this increased by around 14 cm over the next three years. The presence of an ice-rich transient layer proved highly significant in determining the timing and profiles of solifluction movement. Frost heaving was 4.2 cm in 2005-06, 6.6 cm in 2006-07 and 3.2 cm in 2007-08, but thaw settlement exceeded frost heave in each year, giving a net total ground surface lowering of 6.2 cm. In winter, segregation ice was concentrated within the upper and lower active layer, leaving the central parts ice-poor. During the summers of 2006 and 2008, thawing of the transient layer was associated with artesian pore pressures at 90 cm depth and basal soil shearing, but in 2007, when the thaw front failed to reach the ice rich basal zone, pore pressures during thaw were sub-hydrostatic and no basal shearing was observed. Solifluction shear strain during thaw settlement resulted in downslope surface displacements of 2.3 cm in 2005-06, 1.2 cm in 2006-07 and 1 cm in 2007-08. Copyright (C) 2011 John Wiley & Sons, Ltd.

Hedrich, S., H. Lunsdorf, et al. (2011). "Schwertmannite Formation Adjacent to Bacterial Cells in a Mine Water Treatment Plant and in Pure Cultures of *Ferroplasma acidiphilum*." Environmental Science & Technology **45**(18): 7685-7692.

Schwertmannite has previously been found in iron- and sulfate-rich mine waters at pH 2.8-4.5. In the present study, schwertmannite

(Fe₈O₈(OH)₆SO₄) was shown to be the major mineral in a mine water treatment plant at pH 3, in which ferrous iron is mainly oxidized by bacteria belonging to the species *Ferrovum myxofaciens*. Strain EHS6, which is closely related to the type strain of *Fv. myxofaciens*, was isolated from the pilot plant and characterized as an acidophilic, iron-oxidizing bacterium. In contrast to the pilot plant, the mineral phase formed by a pure culture of *Fv. myxofaciens* EHS6 was a mixture of schwertmannite and jarosite (KFe₃(SO₄)₂(OH)₆). In contrast to other reports of neutrophilic, iron-oxidizing bacteria, acidophilic microorganisms in the pilot plant and cultures of strain EHS6 did not show encrustation of the cell surface or deposition of minerals inside the cell, though a few cells appeared to be in contact with jarosite crystals. It was concluded that no direct biomineralization occurred in the pilot plant or in laboratory cultures. The lack of encrustation of bacterial cells in the pilot plant is considered advantageous since the cells are still able to get in contact with ferrous iron and the iron oxidation process in the mine water treatment plant can proceed.

Lellei-Kovacs, E., E. Kovacs-Lang, et al. (2011). "Thresholds and interactive effects of soil moisture on the temperature response of soil respiration." European Journal of Soil Biology **47**(4): 247-255.

Ecosystem carbon exchange is poorly understood in low-productivity, semiarid habitats. Here we studied the controls of soil temperature and moisture on soil respiration in climate change field experiment in a sandy forest-steppe. Soil CO₂ efflux was measured monthly from April to November in 2003-2008 on plots receiving either rain exclusion or nocturnal warming, or serving as ambient control. Based on this dataset, we developed and compared empirical models of temperature and moisture effects on soil respiration. Results suggest that in this semiarid ecosystem the main controlling factor for soil CO₂ efflux is soil temperature, while soil moisture has less, although significant effect on soil respiration. Clear thresholds for moisture effects on temperature sensitivity were identified at 0.6, 4.0 and 7.0 vol% by almost each model, which relate well to other known limits for biological activity in this sandy soil. The relationship between soil respiration and temperature was better described by the Lloyd-Taylor or the Gaussian functions compared to exponential function. Involving additive and interactive soil moisture effects further improved model fitting. Similarly to other low productivity semiarid ecosystems, annual soil carbon efflux values estimated by the different models were rather low (between 123.1 and 139.8 g C m⁻² yr⁻¹) as multi-year averages). (C) 2011 Elsevier Masson SAS. All rights reserved.

Mills, R., H. Glanville, et al. (2011). "Soil respiration across three contrasting ecosystem types: comparison of two portable IRGA systems." Journal of Plant Nutrition and Soil Science **174**(4): 532-535.

An accurate assessment of soil respiration is critical for understanding and predicting ecosystem responses to anthropogenic perturbation such as climate change, pollution, and agriculture. Infra-red gas analyzer (IRGA)-based field measurement is the most widely used technique for assessing soil-respiration flux rates. In this study, respiration rates obtained with two common IRGA systems (LI-COR 8100 and PP Systems EGM-4) were compared across three ecosystem types. Our results showed that both methods were highly comparable in their flux estimates, but the associated methodology used (notably the use or absence of a soil collar) resulted in greater uncertainty in flux rates and a greater degree of intrasite

variation. Specifically, the use of collars significantly decreased the flux estimate for both IRGAs compared to the no-collar estimate. The disturbance caused by collar insertion was assumed to be a major factor in causing the differing flux estimates, with root and mycorrhizal severance likely being the main contributor. We conclude that the two IRGAs used in this study can be reliably compared for overall flux estimates but emphasis is needed to validate a common measurement methodology.

Rawlins, B. G., P. Henrys, et al. (2011). "The importance of inorganic carbon in soil carbon databases and stock estimates: a case study from England." Soil Use and Management **27**(3): 312-320.

Many national and regional databases of soil properties and associated estimates of soil carbon stock consider organic, but not inorganic carbon (IC). Any future change in soil carbon stock resulting from the formation of pedogenic carbonates will be difficult to set in context because historical measurements or estimates of IC concentration and stock may not be available. In their article describing a database of soil carbon for the United Kingdom published in this journal, Bradley et al. [Soil Use and Management (2005) vol. 21, 363-369] only consider data for organic carbon (OC), despite the occurrence of IC-bearing calcareous soils across a substantial part of southern England. Robust techniques are required for establishing IC concentrations and stocks based on available data. We present linear regression models (R^2 between 0.8 and 0.88) to estimate IC in topsoil based on total Ca and Al concentrations for soils over two groups of primary, carbonate-bearing parent materials across parts of southern and eastern England. By applying the regression models to geochemical survey data across the entire area (18 165 km²), we estimate IC concentrations on a regular 500-m grid by ordinary kriging. Using bulk density data from across the region, we estimate the total IC stock of soil (0-30 cm depth) in this area to be 186 MtC. This represents 15.5 and 5.5% of the estimated total soil carbon stock (OC plus IC) across England and the UK, respectively, based on the data presented by Bradley et al. [Soil Use and Management (2005) vol. 21, 363-369]. Soil geochemical data could be useful for estimating primary IC stocks in other parts of the world.

Simfukwe, P., P. W. Hill, et al. (2011). "Soil classification provides a poor indicator of carbon turnover rates in soil." Soil Biology & Biochemistry **43**(8): 1688-1696.

Most soil surveys are based on soil geomorphic, physical and chemical properties, while many classifications are based on morphological properties in soil profile. Typically, microbial properties of the soil (e.g. biomass and functional diversity) or soil biological quality indicators (SBQIs) are not directly considered in soil taxonomic keys, yet soil classification schemes are often used to infer soil biological function relating to policy (e.g. soil pollution attenuation, climate change mitigation). To critically address this, our aim was to assess whether rates of carbon turnover in a diverse range of UK soils ($n > 500$) could effectively be described and sub-divided according to broadly defined soil groups by conventional soil classification schemes. Carbon turnover in each soil over a 90 d period was assessed by monitoring the mineralisation of either a labile (It-labelled artificial root exudates) or more recalcitrant C source ((¹⁴C-labelled plant leaves) in soil held at field capacity at 10 degrees C. A double exponential first order kinetic model was then fitted to the mineralisation profile for each individual substrate and soil. ANOVA of the modelled rate constants and pool sizes revealed significant

differences between soil groups; however, these differences were small regardless of substrate type. Principle component and cluster analysis further separated some soil groups; however, the definition of the class limits remained ambiguous. Exclusive reference values for each soil group could not be established since the model parameter ranges greatly overlapped. We conclude that conventional soil classification provides a poor predictor of C residence time in soil, at least over short time periods. We ascribe this lack of observed difference to the high degree of microbial functional redundancy in soil, the strong influence of environmental factors and the uncertainties inherent in the use of short term biological assays to represent pedogenic processes which have taken ca. 10,000 y to become manifest. (C) 2011 Elsevier Ltd. All rights reserved.

Marine

Clark, I. R. and J. A. Cartwright (2011). "Key controls on submarine channel development in structurally active settings." *Marine and Petroleum Geology* **28**(7): 1333-1349.

Submarine channel-levee systems commonly develop in structurally active deepwater settings. Despite their widespread development in such settings, only recently have researchers begun to address the response of channel-levee system evolution to deformation. Key factors which govern channel evolution and morphological development are relative rates of deformation and channel deposition and erosion, and also the number and scale of deformational structures, relative to the scale of the submarine channel. Submarine channel-structure interactions can be split into four end-members: deflection, blocking, diversion and confinement. Where deformation is coeval with channel development, an increase in the relative rate of uplift versus deposition and erosion causes a transition from channel deflection to blocking. Diversion and confinement are linked by the number, scale and orientation of structures relative to the channel flow path. Increasing the number of structures and their scale typically results in channel confinement. Underlying all of these individual controls is the distribution of local accommodation, which is determined by specific structural style. This distribution of accommodation over relatively small (<10 km) length scales strongly affects local channel development in order to attain the equilibrium profile. Knowledge of these controls on submarine channel development can increase our understanding of how these deepwater sedimentary systems evolve and distribute sediment across deforming submarine slopes. Understanding the factors governing spatial variations in channel morphology may also be applied when exploring for hydrocarbon reservoirs in structurally active deepwater settings. (C) 2011 Elsevier Ltd. All rights reserved.

Renewable energy

Carver, S. M., C. J. Hulatt, et al. (2011). "Thermophilic, anaerobic co-digestion of microalgal biomass and cellulose for H₂ production." *Biodegradation* **22**(4): 805-814.

Microalgal biomass has been a focus in the sustainable energy field, especially biodiesel production. The purpose of this study was to assess the feasibility of treating microalgal biomass and cellulose by anaerobic digestion for H₂ production. A microbial consortium, TC60, known to degrade cellulose and other plant polymers, was enriched on a mixture of cellulose and green microalgal

biomass of *Dunaliella tertiolecta*, a marine species, or *Chlorella vulgaris*, a freshwater species. After five enrichment steps at 60°C, hydrogen yields increased at least 10% under all conditions. Anaerobic digestion of *D. tertiolecta* and cellulose by TC60 produced 7.7 mmol H₂/g volatile solids (VS) which were higher than the levels (2.9-4.2 mmol/g VS) obtained with cellulose and *C. vulgaris* biomass. Both microalgal slurries contained satellite prokaryotes. The *C. vulgaris* slurry, without TC60 inoculation, generated H₂ levels on par with that of TC60 on cellulose alone. The biomass-fed anaerobic digestion resulted in large shifts in short chain fatty acid concentrations and increased ammonium levels. Growth and H₂ production increased when TC60 was grown on a combination of *D. tertiolecta* and cellulose due to nutrients released from algal cells via lysis. The results indicated that satellite heterotrophs from *C. vulgaris* produced H₂ but the *Chlorella* biomass was not substantially degraded by TC60. To date, this is the first study to examine H₂ production by anaerobic digestion of microalgal biomass. The results indicate that H₂ production is feasible but higher yields could be achieved by optimization of the bioprocess conditions including biomass pretreatment.

Choi, J. A., J. H. Hwang, et al. (2011). "Enhancement of fermentative bioenergy (ethanol/hydrogen) production using ultrasonication of *Scenedesmus obliquus* YSW15 cultivated in swine wastewater effluent." *Energy & Environmental Science* 4(9): 3513-3520.

The influence of ultrasonication pretreatment on fermentative bioenergy [ethanol/hydrogen (H₂)] production from a newly isolated microalgae biomass (*Scenedesmus obliquus* YSW15) was investigated. *S. obliquus* YSW15 biomass was sonicated for 0 min (control), 5 min (short-term treatment), 15 and 60 min (long-term treatment), which caused different states of cell lysis for microbial fermentation. Long-term sonication significantly damaged the microalgal cell integrity, which subsequently enhanced the bioenergy production. The accumulative bioenergy (ethanol/hydrogen) production after long-term sonication was almost 7 times higher than that after short-term treatment or the control. The optimal ratio of microalgal biomass to anaerobic inoculum for higher bioenergy production was 1 : 1. Microscopic analyses with an energy-filtering transmission electron microscope (EF-TEM) and an atomic force microscope (AFM) collectively indicated that cells were significantly damaged during sonication and that the carbohydrates diffused out of the microalgae interiors and accumulated on the microalgae surfaces and/or within the periplasm, which led to enhanced bioaccessibility and bioavailability of the biomass. These results demonstrate that ultrasonication is an effective pretreatment method for enhancing the fermentative bioenergy production from microalgal biomass.

Waste

Huang, L. N., W. H. Zhou, et al. (2011). "Spatial and Temporal Analysis of the Microbial Community in the Tailings of a Pb-Zn Mine Generating Acidic Drainage." *Applied and Environmental Microbiology* 77(15): 5540-5544.

Analysis of spatial and temporal variations in the microbial community in the abandoned tailings impoundment of a Pb-Zn mine revealed distinct microbial populations associated with the different oxidation stages of the tailings. Although *Acidithiobacillus ferrooxidans* and *Leptospirillum* spp. were consistently present in

the acidic tailings, acidophilic archaea, mostly *Ferroplasma acidiphilum*, were predominant in the oxidized zones and the oxidation front, indicating their importance to generation of acid mine drainage.

Jones, D. L., D. V. Murphy, et al. (2011). "Short-term biochar-induced increase in soil CO₂ release is both biotically and abiotically mediated." Soil Biology & Biochemistry **43**(8): 1723-1731.

The application of biochar to soil has been shown to cause an apparent increase in soil respiration. In this study we investigated the mechanistic basis of this response. We hypothesized that increased CO₂ efflux could occur by: (1) Biochar-induced changes in soil physical properties (bulk density, porosity, moisture content); (2) The biological breakdown of organic carbon (C) released from the biochar; (3) The abiotic release of inorganic C contained in the biochar; (4) A biochar-induced stimulation of decomposition of native soil organic matter (SOM) which could occur both biotically or abiotically; (5) The intrinsic biological activity of the biochar results in the liberation of CO₂. Our results show that most of the extra CO₂ produced after biochar addition to soil came from the equal breakdown of organic C and the release of inorganic C contained in the biochar. Using long-term (14)C-labelled SOM, we show that biochar repressed native SOM breakdown, counteracting the release of CO₂ from the biochar. A range of mechanisms to describe this negative priming response is presented. Although biochar-induced significant changes in the physical characteristics of the soil, overall this made no contribution to changes in soil respiration. Similarly, the evidence from our study suggests that changes in soluble polyphenols do not help explain the respiration response. In summary, biochar induced a net release of CO₂ from the soil: however, this C loss was very small relative to the amount of C stored within the biochar itself (ca. 0.1%). This short-term C release should therefore not compromise its ability to contribute to long-term C sequestration in soil environments. (C) 2011 Elsevier Ltd. All rights reserved.

Waste Management

Burnley, S., R. Phillips, et al. (2011). "Energy implications of the thermal recovery of biodegradable municipal waste materials in the United Kingdom." Waste Management **31**(9-10): 1949-1959.

Waste management policies and legislation in many developed countries call for a reduction in the quantity of biodegradable waste landfilled. Anaerobic digestion, combustion and gasification are options for managing biodegradable waste while generating renewable energy. However, very little research has been carried to establish the overall energy balance of the collection, preparation and energy recovery processes for different types of wastes. Without this information, it is impossible to determine the optimum method for managing a particular waste to recover renewable energy. In this study, energy balances were carried out for the thermal processing of food waste, garden waste, wood, waste paper and the non-recyclable fraction of municipal waste. For all of these wastes, combustion in dedicated facilities or incineration with the municipal waste stream was the most energy-advantageous option. However, we identified a lack of reliable information on the energy consumed in collecting individual wastes and preparing the wastes for thermal processing. There was also little reliable information on the

performance and efficiency of anaerobic digestion and gasification facilities for waste. (C) 2011 Elsevier Ltd. All rights reserved.

Cleall, P. J. and Y. C. Li (2011). "Analytical Solution for Diffusion of VOCs through Composite Landfill Liners." Journal of Geotechnical and Geoenvironmental Engineering **137**(9): 850-854.

Analytical solutions are presented for analyzing volatile organic compound (VOC) diffusion through intact composite landfill liners for two scenarios with boundary conditions at the base of either a VOC concentration of zero or a VOC mass flux of zero. A time-dependent concentration top boundary condition is included in the presented analytical solutions to model typical variations of VOC concentration in the leachate over time. The presented solutions are verified against alternative numerical solutions and applied to analyze dichloromethane diffusion through a composite liner. The analytical solutions are found to provide useful predictions of VOC concentration and mass flux for the design of composite liners. VOC concentrations and fluxes at the base of the composite liner at 30 years predicted by consideration of representative transient variation in leachate concentration, for an example problem, are nearly half of those when a constant leachate concentration assumed. DOI: 10.1061/(ASCE)GT.1943-5606.0000506. (C) 2011 American Society of Civil Engineers.

Kinuthia, J. M. and R. M. Nidzam (2011). "Towards zero industrial waste: Utilisation of brick dust waste in sustainable construction." Waste Management **31**(8): 1867-1878.

Laboratory investigations were carried out to establish the potential utilisation of brick dust (BD) in construction. The dust is a waste material from the cutting of fired clay bricks. Currently, the disposal of the dust is a problem to the brick fabrication company, and hence an environmental pollution concern. The dust was stabilised either used on its own or in combination with Pulverised Fuel Ash (PFA), a by-product material from coal combustion. The traditional stabilisers of lime and/or Portland Cement (PC) were used as controls. The main aim was to use a sustainable stabiliser material, where these stabilisers were partially replaced with Ground Granulated Blastfurnace Slag (GGBS), a by-product material from steel manufacture. Compacted cylinder test specimens were made at typical stabiliser contents and moist cured for up to 56 days prior to testing for compressive and California Bearing Ratio (CBR) strength tests, and to linear expansion during moist curing and subsequent soaking in water. The results obtained showed that partial substitution of the dust with PFA resulted in stronger material compared to using it on its own. The blended stabilisers achieved better performance. These results suggest technological, economic as well as environmental advantages of using the brick dust and similar industrial by-products to achieve sustainable infrastructure development with near zero industrial waste. (C) 2011 Elsevier Ltd. All rights reserved.

Water

Wilson, L., J. Wilson, et al. (2011). "The impact of drain blocking on an upland blanket bog during storm and drought events, and the importance of sampling-scale." Journal of Hydrology **404**(3-4): 198-208.

Organic carbon solution and transport processes which occur during periods of heavy rainfall and periods of little or no rainfall, can exert a significant control over a systems' annual organic carbon budget. In addition, either or both extremes

can be key contributors to contaminant release, water discolouration, flood risk or vegetation growth. Although there is an increasing body of work studying hydrological responses to peatland restoration, there are very little available data on the performance of restored peatlands during these key periods. This study builds on previous work from an upland peatland in Wales that has been restored through drain-blocking, and presents evidence from a landscape scale experimental study at the site. A comparison of sampling scales within the study demonstrates the necessity of larger spatial scales, in combination with high resolution datasets, in assessing catchment level responses. Our results suggest that drain blocking leads to higher and more stable water tables that are able to better resist drought periods, and thus lead to more stable discharge from the system. The shallower water tables and pooling in drains also appear to reduce the production and transport of fluvial organic carbon, and thus less organic material is available to be released as during peak flow or dry periods. Despite restoration apparently reducing the available water storage within the peat, the increase in overland flow and in pooling within blocked drains appears to have led to a less flashy system. Peak flow responses in both drains and upland streams are less severe, with more rainfall being retained within the bog. We suggest that restoration leads to a more buffered system, with more moderate responses to extreme events, and reduced release of both dissolved and particulate organic carbon. We discuss the implications of this for fluxes of fluvial organic carbon and sediment loss. (C) 2011 Elsevier B.V. All rights reserved.

Water quality

Essandoh, H. M. K., C. Tizaoui, et al. (2011). "Soil aquifer treatment of artificial wastewater under saturated conditions." Water Research **45**(14): 4211-4226.

A 2000 mm long saturated laboratory soil column was used to simulate soil aquifer treatment under saturated conditions to assess the removal of chemical and biochemical oxygen demand (COD and BOD), dissolved organic carbon (DOC), nitrogen and phosphate, using high strength artificial wastewater. The removal rates were determined under a combination of constant hydraulic loading rates (HLR) and variable COD concentrations as well as variable HLR under a constant COD. Within the range of COD concentrations considered (42 mg L⁻¹-135 mg L⁻¹) it was found that at fixed hydraulic loading rate, a decrease in the influent concentrations of dissolved organic carbon (DOC), biochemical oxygen demand (BOD), total nitrogen and phosphate improved their removal efficiencies. At the high COD concentrations applied residence times influenced the redox conditions in the soil column. Long residence times were detrimental to the removal process for COD, BOD and DOC as anoxic processes and sulphate reduction played an important role as electron acceptors. It was found that total COD mass loading within the range of 911 mg d⁻¹-1780 mg d⁻¹ applied as low COD wastewater infiltrated coupled with short residence times would provide better effluent quality than the same mass applied as a COD with higher concentration at long residence times. The opposite was true for organic nitrogen where relatively high concentrations coupled with long residence time gave better removal efficiency. Crown Copyright (C) 2011 Published by Elsevier Ltd. All rights reserved.

Kimura, S., C. G. Bryan, et al. (2011). "Biodiversity and geochemistry of an extremely acidic, low-temperature subterranean environment sustained by chemolithotrophy." Environmental Microbiology **13**(8): 2092-2104.

The geochemical dynamics and composition of microbial communities within a low-temperature (similar to 8.5 degrees C), long-abandoned (> 90 years) underground pyrite mine (Cae Coch, located in north Wales) were investigated. Surface water percolating through fractures in the residual pyrite ore body that forms the roof of the mine becomes extremely acidic and iron-enriched due to microbially accelerated oxidative dissolution of the sulfide mineral. Water droplets on the mine roof were found to host a very limited diversity of exclusively autotrophic microorganisms, dominated by the recently described psychrotolerant iron/sulfur-oxidizing acidophile *Acidithiobacillus ferrivorans*, and smaller numbers of iron-oxidizing *Leptospirillum ferrooxidans*. In contrast, flowing water within the mine chamber was colonized with vast macroscopic microbial growths, in the form of acid streamers and microbial stalactites, where the dominant microorganisms were Betaproteobacteria (autotrophic iron oxidizers such as 'Ferrovum myxofaciens' and a bacterium related to *Gallionella ferruginea*). An isolated pool within the mine showed some similarity (although greater biodiversity) to the roof droplets, and was the only site where archaea were relatively abundant. Bacteria not previously associated with extremely acidic, metal-rich environments (a *Sphingomonas* sp. and *Ralstonia pickettii*) were found within the abandoned mine. Data supported the hypothesis that the Cae Coch ecosystem is underpinned by acidophilic, mostly autotrophic, bacteria that use ferrous iron present in the pyrite ore body as their source of energy, with a limited role for sulfur-based autotrophy. Results of this study highlight the importance of novel bacterial species (*At. ferrivorans* and acidophilic iron-oxidizing Betaproteobacteria) in mediating mineral oxidation and redox transformations of iron in acidic, low-temperature environments.

Kochkodan, V., N. Hilal, et al. (2011). "The express monitoring of organic pollutants in water with composite imprinted membranes." *Journal of Membrane Science* **377**(1-2): 151-158.

In this work, composite imprinted membranes prepared via photoinitiated surface modification of PVDF and PES microfiltration membranes were used for selective recognition of the template compounds desmetryn, ibuprofen and bisphenol A in aqueous solutions. Atomic force microscopy was used to study the surface morphological characteristics of the synthesized membranes. The selective properties of the obtained membranes were evaluated. It was shown that imprinted membranes may be used as synthetic recognising elements in a portable differential capacitor sensor device for express monitoring of the target molecules in water. The sensor performance is based on registration of the alteration of dielectric permeability of a composite imprinted membrane at selective binding of the template molecules, when the analyzed water sample is filtered through the composite imprinted membrane. The effects of pH and ionic strength of the aqueous solution, as well as side organic compounds on the sensor response were studied. It was shown that the developed measuring system may be used for express preliminary water control for target organic pollutants in so called "systems of early monitoring". (C) 2011 Elsevier B.V. All rights reserved.

Social Science

Behaviour

Gavin, N. T. and T. Marshall (2011). "Mediated climate change in Britain: Scepticism on the web and on television around Copenhagen." Global Environmental Change-Human and Policy Dimensions **21**(3): 1035-1044.

Copenhagen 2009 was a major moment in the development of climate change as an issue. But climate sceptics before and during this event, sought to influence the nature of debate, and for this reason, the way Copenhagen was covered in the mass media was particularly important. This paper outlines the contours of contrarian arguments and claims, and assesses their reflection in the coverage at Copenhagen. The focus is on television, and extends to the assessment of internet - both modes of mass communication underrepresented in the existing literature. The results suggest a higher profile for contrarians and scepticism than is perhaps healthy, and speak to the role of these mass media, now and in the future, particularly with regard to the issue of public comprehension of the issues involved. (C) 2011 Published by Elsevier Ltd.

Keene, M. and A. S. Pullin (2011). "Realizing an effectiveness revolution in environmental management." Journal of Environmental Management **92**(9): 2130-2135.

The environmental movement of the 20(th) century has evolved into a large, diverse and well-financed global community that is increasingly required to prove its worth. Though the environmental sector collects and uses data to determine the status of ecological and social systems, the effectiveness of the programs and policies it uses to affect this status remains largely untested. As governments and donor institutions insist on greater transparency, accountability and evidence of what works and what does not, much is being learned from other fields (e.g. health services, education, international development) and increasingly sophisticated approaches are emerging to manage effectiveness. For example, program evaluation, adaptive management, and systematic review provide frameworks and methods to collect and use information to measure and improve performance. However, the critical data and collaborations necessary for an effectiveness revolution are marginalized by technical, cultural and political obstacles. Learning from other fields, the environmental sector must exploit key leverage points, such as flows of information and self-organization, to overcome impediments and create incentives to initiate and realize an era of effectiveness in environmental management. Published by Elsevier Ltd.

Poortinga, W., A. Spence, et al. (2011). "Uncertain climate: An investigation into public scepticism about anthropogenic climate change." Global Environmental Change-Human and Policy Dimensions **21**(3): 1015-1024.

This study presents a detailed investigation of public scepticism about climate change in Britain using the trend, attribution, and impact scepticism framework of Rahmstorf (2004). The study found that climate scepticism is currently not widespread in Britain. Although uncertainty and scepticism about the potential impacts of climate change were fairly common, both trend and attribution scepticism were far less prevalent. It further showed that the different types of scepticism are strongly interrelated. Although this may suggest that the general public does not clearly distinguish between the different aspects of the climate

debate, there is a clear gradation in prevalence along the Rahmstorf typology. Climate scepticism appeared particularly common among older individuals from lower socio-economic backgrounds who are politically conservative and hold traditional values: while it is less common among younger individuals from higher socio-economic backgrounds who hold self-transcendence and environmental values. The finding that climate scepticism is rooted in people's core values and worldviews may imply a coherent and encompassing sceptical outlook on climate change. However, attitudinal certainty appeared mainly concentrated in non-sceptical groups, suggesting that climate sceptical views are not held very firmly. Implications of the findings for climate change communication and engagement are discussed. (C) 2011 Elsevier Ltd. All rights reserved.

Governance

Jones, R., J. Pykett, et al. (2011). "Governing temptation: Changing behaviour in an age of libertarian paternalism." *Progress in Human Geography* **35**(4): 483-501.

This paper critically examines new modes of behaviour change promoted by the contemporary British state, providing a critique of libertarian paternalism as an emergent form of government in the UK. We analyse the multivalent principles and mechanisms associated with libertarian paternalism. We consider the contribution of Foucauldian theories of governmentality and psychological power within human geography to a critical analysis of libertarian paternalism. Reflecting on the example of Manual for Streets (DfT, 2007) for re-designing residential roads in the UK, we conclude by explaining why libertarian paternalist policies could lead to the formation of more, or less deliberative public spaces.

Glossary of terms

Index term	Scope
Agriculture and food	Farming Crops GM Nitrate Vulnerable Zones Pastoral Agri-food Horticulture
Air	Ambient air pollution Atmospheric air pollution Emissions from stationary sources Emissions from mobile sources Ground-level pollution (eg ozone) Air quality Air pollution substances (typically: SO _x ; NO _x ; particulates – PM ₁₀) Acid rain
Biotechnology	Bioremediation Industrial microbiology
Chemicals	Nanotechnology Pesticides Chemicals and their properties Endocrine disruption
Climate	Global warming Climate change Ozone depletion Carbon sinks Carbon emissions (include CO ₂) Carbon sequestration Carbon cycle Ice sheet instability Melting ice sheets
Conservation and Biodiversity	Species Habitats Invasive species Ecology Healthland Wetlands Biomass Grassland
Energy	Fossil fuel Electricity supply
Engineering and Construction	Building
Environmental Management	Environmental management systems (EMAS, ISO 14000) Environmental accounting Statistics Risk Hazard management
Fisheries	Shellfish

	Freshwater fishing Marine fishing
Flood	Sustainable drainage Flooding events Flood management
Forestry	Rain forests Logging Canopies
Human Health	Disease Chemical pollution
Land Quality	Contaminated land Remediation Brownfield development Soil Soil erosion
Marine	Bathing water quality Coastal zone management
Noise	Noise pollution
Nuclear	Radioactive substances Nuclear energy
Process industry regulation	Permitting, Compliance and Enforcement IPPC LAPC (Local Authority)
Planning	Town and country planning Planning consents Developmental control Regeneration Infrastructure
Pollution prevention and control	MCERTS
Products	Life cycle assessment Green product design
Renewable energy	Biofuels/biogas/biomass Wind Solar Geothermal Tidal Alternative fuels – hydrogen production
Technology and IT	GIS Data logging Satellite imagery Biosensors GPS Digital evaluation models Modelling Remote sensing Tracking
Sustainable Development	Population Environmental justice
Waste	Waste types, eg domestic, commercial, industrial, WEEE
Waste Management	Treatment options: landfill, incineration, pyrolysis, recycling, reuse, land spreading, composting
Water	Glacial water/glaciers Drinking water

	Groundwater Sewage treatment Wastewater (industrial including mine wastewater) Effluent
Water Quality	Focus on surface water quality Water Framework Directive Diffuse pollution
Water Resources	Drought Catchment areas

Social Science

Behaviour	Changing behaviours Influencing Incentives Motivation Culture
Communication	Best practice Getting the message across Debates Controversy Discourse Reaction Perception
Governance	Politics Standards Modernisation Reform Devolution
Industry & Commerce	SMEs Industry Business Corporate Social Responsibility Ethical investment Environmental performance Environmental impact Products Greening supply chain Innovation Green design
Socio-economic	Health Inequalities Deprivation

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