Climate 2018

5th World Conference on

CLIMATE CHANGE AND GLOBAL WARMING

May 23-24, 2018 | New York, USA

Poster Presentations

Jae Heon Cho, J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

5th World Conference on
CLIMATE CHANGE AND GLOBAL WARMING
May 23-24, 2018 | New York, USA

Water quality in Lake Soyang watershed affected by sediment runoff from a highland agricultural region

Jae Heon Cho
Catholic Kwandong University, South Korea

In the wet season, a large amount of suspended sediments (SS) are discharged into Lake Soyang because of sediment erosion from highland fields. Important multiregional water sources are located in the lower Han River and the suspended sediments of the Lake Soyang affect the water quality of the water supply. This rainfall-runoff survey was conducted three times at each of the survey points. In the case of the Jaun area of Hongcheon-gun, the Jungjohangcheon, and Johangcheon, the upper part of the Jaun area is identified as a dense area of highland fields. The rainfall-runoff characteristics and the first flushing in the Jaun area were analyzed using the pollutograph and the mass-volume curve. From the Ministry of Environment's water quality measuring network, the changes on SS, BOD and TN concentration in the Soyang River watershed were analyzed with the yearly rainfall depth. Between 2012 and 2015, due to a low amount of rainfall, the three point's SS and TP concentration was low. It appears that the reason for the low TP concentration was due to a light precipitation during the year, resulting in low amount of nutrient runoff from the highland fields. Otherwise, the BOD (the index of the organic material) concentration was high because of the reduction of the stream flow on 2012, 2014 and 2015 when the rainfall depth was small. SS, BOD and TP from Soyang River, Naerincheon, Inbukcheon appears to be influenced by rainfall depth.

Biography

Jae Heon Cho is a Professor of Department of Biosystems and Convergence Engineering at the Catholic Kwandong University, South Korea. His main research area is water quality management and modeling. His representative published articles are: Watershed model calibration framework developed using an influence coefficient algorithm and a genetic algorithm and analysis of pollutant discharge characteristics and load reduction in a TMDL planning area (*Journal of Environmental Management* 2015, 163, 2-10), A river water quality management model for optimizing regional wastewater treatment cost using a genetic algorithm (*Journal of Environmental Management*, 2004, 73, 229–242).

jhcho@cku.ac.kr

Notes:

5th World Conference on
CLIMATE CHANGE AND GLOBAL WARMING
May 23-24, 2018 | New York, USA

Long term temperature prediction model based on a long short-term memory neural network in missing data condition

Inyoung Park, Jiwon Lee and **Hong Kook Kim**
Gwangju Institute of Science and Technology, South Korea

Nowadays, global warming not only intimidates humankind but also threatens the ecosystem due to its unpredictability. The ecosystem has warned about its vulnerability, and the need for long-term climate prediction has become indispensable. To build a long-term prediction model, a huge number of training data need without any flawlessness. However, there is a limitation of climate data that once it passed, we could not measure. Thus, the data are apt to be defective. This paper proposes a new long-term temperature prediction model based on a deep neural network, where some defective weather data obtained from a location are calibrated by using those from other locations. Since temperature is seasonal, we use a long short-term memory (LSTM) neural network which is a kind of recurrent neural network (RNN) known as suitable for a very long period of data. In order to predict weather data in advance up to two weeks, the proposed model is trained using actual weather data that are collected in an hourly basis for 36 years (from 1981 to 2016) of 11 different locations of South Korea, including hourly-based measurements for temperature, relative humidity, wind speed, wind direction, precipitation, and accumulated prediction. In particular, when some data are missing, they are filled with those estimated from the refining model. After that, the model is trained again using the refined data. The performance of the proposed LSTM-based model is measured in terms of the root-mean-squared error (RMSE) between actual temperatures and their predicted ones. Consequently, it is achieved that the RMSE averaged over 11 locations is about 2.29 degrees for two weeks prediction. Although the proposed model is applied to refining weather data here, this approach can also be applied to other weather data. Furthermore, the proposed model can be extended to an air pollution prediction model against global warming.

Biography

Inyoung Park is pursuing her PhD in School of Electrical Engineering and Computer Science, Gwangju Institute of Science and Technology, South Korea. She has received her BS degree in Computer Application from the Bangalore University in 2015. Her current research focuses on speech signal processing and climate change modeling based on deep neural networks.

pinyoung@gist.ac.kr

Notes:

Patricks-E Chinemerem KSJI, J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

5th World Conference on

CLIMATE CHANGE AND GLOBAL WARMING

May 23-24, 2018 | New York, USA

A projection of future climate refugee growth rate in South eastern Nigeria

Patricks-E Chinemerem KSJI
Environment & Millennium Targets Ltd, Nigeria

The aim and objective of this paper was to identify the vulnerability of the people residing within mapped communities to be exposed to civil conflicts and forced migration that will be wholly attributed to climate change. A case study approach was adopted to engage people from selected rural communities to share their experiences to civil conflicts and exposure to migration. Two states Enugu and Ebonyi were selected for this study and in each state; three communities were assessed and interacted with. A qualitative methodology adopting focus group interview and participatory approach was utilized to gather facts and data. Major findings indicated that the people residing across selected communities are exposed to growing frequencies of civil conflicts and possibility of forced migration and taking refuge in IDP camps or neighboring towns. The struggle for scarce arable and green grazing land, competition for scarce water resources and food security concerns will increase future civil conflicts and induce high growth rate of climate refugees following current changes in the climate system and its consequences on vulnerable poor communities in south eastern Nigeria's Enugu state and Ebonyi state.

Biography

Dr. Patricks-E, Chinemerem is a member of IFTDO Developing Countries Committee & Visiting Lecturer. He is from University of Port Harcourt, Nigeria. He has done his PhD, M.Phil, B.Sc., Env Dip NEBOSH, and iCert -Int'l Env. Law, MITD, MNES, MNMGS.

chinemerem.patricks@yahoo.com

Notes:

Climate 2018

5th World Conference on

CLIMATE CHANGE AND GLOBAL WARMING

May 23-24, 2018 | New York, USA

e-Poster

Yan Han, J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

5th World Conference on
CLIMATE CHANGE AND GLOBAL WARMING
May 23-24, 2018 | New York, USA

Research of effect on water resources carrying capacity in Beijing-Tianjin-Hebei region by water transfer

Yan Han
Chinese Academy of Sciences, China

The water resources shortage and water environment worsen have been becoming primary restraining factor to development of economy and society in Beijing-Tianjin-Hebei region. The evaluation of water resources carrying capacity is the key to regional water reasonable utilization. In this paper, according to the view of development of economy and society need support from water resources, an evaluation approach to research the effect on water resources carrying capacity by water transfer based on water quantity, water quality, water area and water stream has been established. The results indicate the water carrying capacities are belonging serious overloaded, especially for Tianjin and Beijing. The water shortage is the major reason of water carrying capacity overloading in Beijing-Tianjin-Hebei region, and the per capita water resources is the key factor to regional water carrying capacity. The water transfer is certainly important to improve water carrying capacity in Beijing-Tianjin-Hebei region, especially for Beijing and Tianjin. The south water to north makes water carrying capacity improve 5% in Beijing and Tianjin, respectively. It supplies an evidence for water resources reasonable exploitation in Beijing-Tianjin-Hebei to research of effect on water resources carrying capacity by water transfer. It is also important to realize the harmony among water resources, economy and society.

Biography

Yan Han is working in Chinese Academy of Sciences, China. His major research is in water resources integrated management and optimization for watershed. He has achieved some outcome of water system analysis and water optimal allocation. He has also discussed the effect on water resources capacity in region by water transfer.

hanyan78@163.com

Notes:

5th World Conference on
CLIMATE CHANGE AND GLOBAL WARMING
May 23-24, 2018 | New York, USA

Examining the Sensitivity and Impact of Anthropogenic Climate Change on North Atlantic Major Hurricane Landfall Drought and Activity

Emma Levin and **Hiroyuki Murakami**
Paul D. Schreiber High School, USA
Princeton University/GFDL, USA

North Atlantic projections of major hurricane landfall drought with increased anthropogenic forcing were derived from the Geophysical Fluid Dynamics laboratory (GFDL) High Resolution Global Dynamical Model (HiFLOR; 25-km grid) and an analysis of the recent 12-year major hurricane landfall drought (2006-2017) was completed. First, in order to effectively analyze the sensitivity of the major hurricanes to the coastline, 6 different "buffers" (0km-500km) were developed by utilizing QGIS software, extending the coastline by their respective distances. All simulations (observational and modeled) are performed with all buffer distances. Observational data is taken from 1900-2015, so all other simulations are taken in 116 year moving means. With regards to the HiFLOR model, a "control run" is completed with an 1860 simulation running for 1200 years that does not take anthropogenic climate forcing into account, while an additional 1990 simulation is completed running 300 years that that factors in post-industrialization. Frequency and duration of major hurricane drought is collected, and the 1860 "control" surpasses the 1990 simulation with a higher frequency of longer lengths of drought period, regardless of buffer distance. This demonstrates that anthropogenic forcing is not a factor with increased major hurricane drought length, and could potentially increase the frequency of MHL.

Biography

Emma Levin is a research intern at the Geophysical Fluid Dynamics Laboratory. Hiroyuki Murakami is an associate research scholar at Princeton University and the Geophysical Fluid Dynamics Laboratory.

emma.lilly10@yahoo.com

Notes:

Climate 2018

5th World Conference on

CLIMATE CHANGE AND GLOBAL WARMING

May 23-24, 2018 | New York, USA

Accepted Abstracts

J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

5th World Conference on
CLIMATE CHANGE AND GLOBAL WARMING
May 23-24, 2018 | New York, USA

Measuring forest resilience and exploring tipping point behavior

Chuixiang Yi, George Hendrey, Peipei Xu, Guangwei Mu and **Wei Fang**
School of Earth and Environmental Sciences, USA

Forests provide an important ecological service by partially balancing the global carbon budget, sequestering about one quarter of anthropogenic emissions (2.4 Gt C per year). However, several forest biomes are subject to increasing stress and tree mortality due to invasive pests, drought and fire and these appear to be exacerbated by climate change. A question arising for forest managers and policy makers is how to anticipate and deal with the acceleration of forest stress and mortality with on-going warming climate. To provide a baseline to which anticipated changes may be compared. We attempt to answer questions: how can we quantify and measure forest resilience? What kind of climate trend or pattern is the key control to forest tipping point? And what are tipping point behaviors of forests? We have explored these questions by using tree-ring data, remote sensing images, eddy flux tower data, and nonlinear stability theory. Here, we report some initial results along with the pilot-studies.

cyi@qc.cuny.edu

J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

Vulnerability of climate change impact on rural people's livelihood in Nepal

Dipti Basnet
Tongji University, China

Statement of the Problem: The adverse effects of climate change are seen in various sectors like human health and also agriculture where most of the rural people are dependent. However, its effect is varied among regions, and between different generations, income groups and occupations as well as between men and women. Several climate change events like fluctuation in precipitation pattern, more extreme weather resulting in natural disasters, and changes in air quality and food quality have a particular impact on people in their role as principal caregivers. Similarly, rural people in developing countries are highly dependent on local natural resources for their livelihood, because of their responsibility to secure water, food and energy for cooking and heating. The effects of climate change, including drought, uncertain rainfall and deforestation, make it harder to secure these resources. The changes in ecosystems and loss of diversity that are leading to reduced agricultural output and increased food insecurity are bringing greater problems to rural people as food producers, so rural people are more vulnerable to the effects of climate change. We can find that rural people are taking adaptation and mitigation measures into consideration to address the adverse effects of climate change, but they are not sufficient enough to cope with it. So, it is necessary to understand their experiences regarding climate change events, their awareness and the adaptive measures they are practicing in their day to day life knowingly or unknowingly.

Purpose: The purpose of the study was to explore rural people's meaning of climate change.

Methodology & Theoretical Orientation: I have applied qualitative approaches in order to give an insight into how people construct discourses of understanding on climate change and their action against it. The study uses semi-structured interview as a tool to garner data from local level.

Findings: Most of the rural people were unable to comprehend the direct meaning of climate change. However, they were experiencing the ongoing changes in climatic pattern.

Conclusion & Significance: The impact of climate change was felt in agriculture, livestock rearing, water resources etc. Amongst the climate change impact, agriculture sector was hardest hit.

Recommendations: As rural people are heavily dependent on agriculture, government should effort to stimulate structural transformation of agriculture sector from subsistence to commercial farming. In doing so, emphasis should be given to organic farming so that there will be win-win situation for both the agriculturalist and the environment.

diptibasnet1@gmail.com

J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

Variations between deposition and erosion environments recorded in the shell sediments during the past 1300 years in the South coast of the Korean Peninsula

Dong-Yoon Yang, Jin Cheul Kim, Ju-Yong Kim and **Min Han**
Korea Institute of Geoscience and Mineral Resources, Korea

We found five shell and gravel layers formed by storming events in the western-most Dori island of the south coast of the Korean Peninsula, in which the variations of the dominant deposition, the neutral and the dominant erosion environments were recorded during the past 1300 years. The event layers were formed at 2.2-2.9m above mean sea level in the north side of the island facing the Yeongjeon beach. The island is connected with the coast by tombolo of which the geomorphology and the height are currently very changeable at every storming event. The tombolo and the event layers are thought to be similar to their forming mechanism, because they are almost connected to each other, even though they were formed at different elevation. Regarding the different elevation, it can be inferred that the event layers were formed by the stronger storming energy than the one forming tombolo. Each storm delivered the sediments having the different ratios of two kinds of shell groups to the site. Seventeen species of shells were identified from the five layers, based on Korea Marine Invertebrates Encyclopedia, and they were divided into two groups living in sand and/or mud (group 1), on the rock and/or gravel (group 2). The weight ratios of group 1/group 2 of each layer are 0.6297 (layer 1; 720 yr AD), 0.901 (layer 2; 880 yr AD), 0.4246 (layer 3; 950 yr AD), 0.6012 (layer 3; 995 yr AD) and 0.1097 (layer 5; 1535 yr AD), respectively. The high ratios of the layers mean dominant deposition environment, and vice versa. The results provide that sediments of layers 1-4 formed in medium to dominant deposition environment of the warm period (MWP), but the sediment of layer five formed in dominant erosion environment of cold period (LIA).

ydy@kigam.re.kr

J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

5th World Conference on
CLIMATE CHANGE AND GLOBAL WARMING
May 23-24, 2018 | New York, USA

Knowledge, attitudes, practices, and action on climate change and environmental awareness of the twenty-two villages along the river banks in Cagayan de Oro City, Philippines

Lesley Casas Lubos[1] and **Lalevie Casas Lubos**[2]
[1]Liceo de Cagayan University, Philippines
[2]Bukidnon State University, Philippines

People are significant in the careful management of river ecosystems since their social and economic activities impact on the river. The study assessed the knowledge, attitudes, practices, and action of the settlers of the twenty-two villages on climate change and environmental awareness along the river banks in Cagayan de Oro City, Mindanao, Philippines. This study used quantitative and qualitative approach with field observation and questionnaires method for data collection. Results of this study indicated that the settler's knowledge, attitudes, practices and action on climate change was in a moderate level, with attitudes as the main domain, followed by knowledge, practices and action. Their environmental awareness did not translate into involvement in the river conservation, protection and sustainability. The study concludes that the settler's knowledge, attitudes, practices and action needs intervention to improve their awareness into a responsible manner in such a way that protects both public health and the environment.

lesleyclubos@liceo.edu.ph

J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

Climate change in the cool climate wine regions of Canada: Risks, opportunities and adaptive strategies

Tony B Shaw
Brock University, Canada

Established wine regions in temperate and tropical regions are witnessing the impacts of climate change characterized by extreme temperature and precipitation events and within-season and inter-annual variability, altogether affecting grape yield and wine quality. In Canada's cool climate wine regions, climate change will most likely produce mixed benefits, such as longer and warmer growing seasons, a moderation in winter temperatures and the possibility of growing less cold-hardy Vitis vinifera varieties. Also, there are favorable prospects to expand into new areas once considered climatically marginal owing to frequent damaging cold temperatures and a short growing season. However, these benefits could be thwarted by greater volatility in weather conditions and a gradual evolution in the growing conditions that could threaten suitability of the existing cool climate varieties on which the industry is established. This study provides an insightful analysis of the evolution of Canada's principal grape growing regions, assessment of the risks and benefits associated with climate change and variability and a discussion of prospective mitigation and adaptation strategies. These objectives are achieved by analyzing the daily climatic data from the 1970 to 2016 period for representative locations in Canada's principal and emerging wine regions using time series analysis to determine long-term trends in the critical viticulture indices and climatic variables; providing a baseline analysis of the temperature and precipitation data for the 1961-1990 normal period; and employing the Canadian Regional Climate Model (CRCM) to predict future changes based on selected greenhouse gas emission scenarios. The study also examines adaptive strategies with respect to viticulture practices, suitable grape varieties, risk reduction options and institutional support.

tshaw@brocku.ca

J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

Climate change and its effect on rainfall quantities in Amman-basin

Ghassan Al-Dulaimi
Philadelphia University, Jordan

This research has been done to detect the new trend in weather and evaluate the influence of climate change on the rainfall quantities in Amman basin. The basin has been chosen specifically for this research because of its importance as a groundwater supply for Amman city, which is the most populated city in Kingdom of Jordan. Three metrological station data has been used that separated in the catchment area. The results from this research deduce that the mean annual precipitation over the catchment area is reducing 25% over 47 years. Also, this research found there was an increase in the evaporation rate about 2%. Temperature also increased, in the long term, average temperature increased around 4% while in the upper limit long term increase 2%, which illustrate the recession of rainfall amount that falling in the catchment area.

dr.ghassandulaimy@gmail.com

J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

Global warming is abrupt impact of climate change

Kpetohoto Mathias
Member Coordinator of Team54Project Benin Republic, Benin

Statement of the Problem: Global warming refers to climate change that causes an increase in the average temperature of lower atmosphere, most commonly associated with the release of excessive amounts of greenhouse gases into the atmosphere. What are affects and causes of global warming? Greenhouse gases are gases that trap heat in the atmosphere are the basic of global warming. What is the role of human behavior in releasing them? That would be guiding us to understand greenhouse effect, ozone depletion, atmospheric chemistry, ecosystem, fossil fuels and energy, deforestation, ecology and ecosystem, and industrial sector. Natural causes and human activities release carbon dioxide stored for millions of years into the atmosphere, contributing to increase in greenhouse gas emissions and the warming of the planet. Researchers have reported that deforestation is one of human activities over the last years contribute to climate change. The purpose of this study was to describe that the greenhouse gas concentrations in our atmosphere will continue to increase, continuing to warm the Earth.

Methodology & Theoretical Orientation: A study using dialogue was utilized during participant observation, interviews and focus groups. An ecological framework was utilized to focus on the interaction between the greenhouse gas, the global warming and the climate change in order to guide communities to understand this relationship and the context in which it occurs.

Findings: Pollutants and other chemical compounds are released into the atmosphere due to human activity. The sun emits energy that is transmitted to the Earth. About 30 percent of the Sun's energy is reflected directly back into space by the atmosphere, clouds, and the surface of the Earth. However, greenhouse gases in the atmosphere absorb much of the energy emitted from the warm Earth's surface, preventing it from immediately escarping from the Earth's system and back into space. As a result, too large a concentration of greenhouse gases act like a blanket, making the Earth warmer and throwing off the atmosphere's natural energy balance.

mathiabik1@gmail.com

J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

5th World Conference on
CLIMATE CHANGE AND GLOBAL WARMING
May 23-24, 2018 | New York, USA

Impacts of climate model parametric uncertainty in an MPC implementation of the DICE integrated assessment model

Salman Hafeez[1,2], **Steven R Weller**[1] and **Christopher M Kellett**[1]
[1]University of Newcastle, Australia
[2]University of Essex, UK

Integrated assessment models (IAMs) are a key tool in studying the interdependence of the global economy and the climate system. For example, the dollar value of carbon dioxide emissions due to anthropogenic climate damages, known as the social cost of carbon (SCC), can be computed using the widely used DICE (Dynamic Integrated model of Climate and the Economy) IAM by solving an open-loop optimal control problem. The results of such an open-loop decision-making strategy, however, do not fully reflect the impacts of uncertainty in the dynamic response of the global climatic system to radiative forcing. An implementation of the DICE IAM based on model predictive control (MPC) is proposed. This MPC-based approach draws a clear distinction between the climate model used by DICE for mitigation planning purposes, and the "true" global climate captured by a low-order emulation of a model drawn from a state-of-the-art climate model ensemble (CMIP5, the fifth phase of the Coupled Model Intercomparison Project). The closed-loop control methodology quantifies the impact of parametric climate model uncertainty (plant-model mismatch).

c3197107@uon.edu.au

J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

5th World Conference on
CLIMATE CHANGE AND GLOBAL WARMING
May 23-24, 2018 | New York, USA

Climate change and its effect on the global economy and security: A call for more robust climate finance, prevention of climate finance against misappropriation or corrupt spending and review of articles 9 (1), (3) & (4) of the Paris agreement and 12 (8) of Kyoto protocol to the UN framework convention on climate change

Oluwaseyi O Adebayo
University of Manitoba, Canada

Climate change unleashes negative impact on human water supplies, agriculture, migration patterns, infrastructure, financial flows, disease prevalence, and economic activity. These impacts, in turn, lead to national or international security problems stemming from aggravation of internal conflicts, increased poverty and inequality, exacerbation of existing international conflicts, diversion of national and international resources from international security programs, contribution to global economic decline or collapse, or international realignments based on climate change mitigation policies. Hence, this study seeks to beam search light on the danger that climate change poses to human existence, environment, development, global economy and security. Although, the United Nations through its legal frameworks as set out in the Paris Agreement and Kyoto Protocol has put in place climate finance for mitigation and adaptation mechanism to curtail the effects of climate change. But the big question is how effective and realistic will the actualization of this mechanism be in the advent of inadequate climate finance or funding and prevalent corrupt practices in most of the developing (vulnerable) country parties? Hence, a call for more robust climate finance, prevention of climate finance against misappropriation or corrupt spending and review of the provisions of Articles 9 (1), (3), (4) of the Paris Agreement and 12 (8) of Kyoto Protocol to United Nations Framework Convention on Climate Change.

adebayooluwaseyi2013@gmail.com

J Earth Sci Clim Change 2018, Volulme: 9
DOI: 10.4172/2157-7617-C1-040

Phosphorus transfer from land to oceans accelerating under climate change

Philip M Haygarth
Lancaster University, England

The devastating hurricanes that have occurred recently in an around the Caribbean and Gulf of Mexico remind us of the great dynamics and power in our weather and climate. As well as the immediate flood and human hazards, such events can have implications for the earth's biogeochemical cycles too. My team has been studying the extent to which phosphorus losses from land to water will be impacted by climate change and land management, with detrimental impacts on aquatic ecosystems and food production. There is a great challenge in determining this, with all the complexities, controversies and uncertainties that surround it. I will describe work from my team that uses a combination of methods to evaluate the impact of projected climate change on future phosphorus transfers, and to assess what scale of agricultural change might be needed to mitigate these transfers in the UK. We combined novel high-frequency phosphorus flux data from three representative catchments across the UK, a new high-spatial resolution climate model, uncertainty estimates from an ensemble of future climate simulations, two phosphorus transfer models of contrasting complexity and a simplified representation of the potential intensification of agriculture based on expert elicitation from land managers. We show that the effect of climate change on average winter phosphorus loads (predicted increase up to 30% by 2050s) will be limited only by large-scale agricultural changes (e.g., 20–80% reduction in phosphorus inputs). Perhaps the global phosphorus cycle is now starting to accelerate with climate change, with implications for long term biogeochemical transfers to oceans.

p.haygarth@lancaster.ac.uk