#70765 Climate impact on the carbon emission and export from Siberian inland waters

APPLICATION INFORMATION

Application ID	70765
Submitted by	Jan Karlsson
Last updated	28.03.2014
Call	JPI Climate Topic 2: Russian Arctic and Boreal Systems

RESEARCH PROJECT

Project duration

To	31.12.2017
From	01.09.2014

Project details

Project acronym	SIWA

Project summary

Large amounts of organic carbon (C) are stored in permafrost soils at high latitudes. Climate change and the consequent thawing of permafrost cause mobilization and decomposition of these old C stocks and, hence, the release of significant amounts of greenhouse gases from land to the atmosphere. Permafrost thawing may also increase the lateral export of terrestrial C to aquatic systems altering flow pathways in the landscape. Streams and lakes play here an important role by burying C in sediments and emitting C to the atmosphere and, by that, affect the continental greenhouse gas balance and the amount of C delivered to coastal regions. Still, the current knowledge of climate impact on C cycling in inland waters at high latitudes is in many important aspects incomplete, preventing accurate quantification and predictions of their role in the C cycle and climate system.

Siberia contains vast C stocks potentially vulnerable to mobilization following permafrost thawing, and inland waters draining these regions are largely understudied. Thus, research on inland waters of Siberia is of particular importance for understanding climate change. We will carry out a comparative study of lake-stream networks across a climate gradient in western Siberia covering a large range of permafrost conditions. We will test the hypothesis that the role of the inland waters show fundamental differences across the climate gradient, with increasing emission:export ratios in a transition from cold permafrost to warm permafrost-free conditions, and that this change is mainly driven by a combination of differences in temperature dependent loss rates and differences in hydrological transit time in the inland waters along this gradient. The project is important by providing knowledge of the role of Russian inland waters in emitting C to atmosphere and in exporting C to downstream coastal regions and how this varies between different climate regimes.

Keywords

C emission, C export, carbon dioxide, methane, lakes, streams, permafrost, hydrology, modeling, upscaling

Executive summary (maximum 3500 characters including spaces).

Here we propose an integrated research program which will provide a comprehensive assessment of the importance of inland waters for the C cycle of the taiga-tundra region, including C exchange with the atmosphere and riverine export of land based C to coastal regions. The project gathers an excellent cross-disciplinary team of investigators in aquatic biogeochemistry, hydrology, tracers, permafrost dynamics and remote sensing. Each partner brings their distinctive expertise and cutting edge techniques to advance understanding the effects of warming on C fluxes.

The project will investigate climate impacts on the role of lakes, streams and flow pathways for atmospheric CO2 and CH4 emission, as well as lateral C export, in Siberia. We will test the hypothesis that a warmer climate in permafrost regions lead to fundamental differences in lateral export of terrestrial C and in the extent this C is emitted to the atmosphere vs. export downstream during passage through the inland waters. We suggest that these changes in the fate and processing of terrestrial carbon in lakes and streams are mainly driven by a combination of differences in temperature dependent loss rates and differences in hydrological transit time in the inland waters along this gradient.

The hypothesis will be tested using a space for time substitution approach, i.e. a comparative study of lake-stream networks across a climate gradient (boreal-arctic) in western Siberia, covering a large range of permafrost conditions (absence-sporadic-discontinuous-continuous). We will directly relate changes in C fluxes to hydrological descriptors of system function (e.g. soil moisture availability, surface water sources and water age distributions); we will therefore be able to explore links between climate and permafrost conditions to hydrological conditions and related differences in quantity and quality of exported C. We will also upscale the results to the whole permafrost bearing region of western Siberia and predict future C fluxes using a coupled hydrological-biogeochemical model.

The outcome will be of fundamental importance for stakeholders and the scientific community as this will provide the first quantification of the role of inland waters in the C cycle in one of the least studied but largest terrestrial northern ecosystems in the world. In particular, climate impact on C emission vs. downstream export in inland waters has not previously been linked to the hydrological dynamics. Thus, there is a weak evidence base for assessing how these processes will change with climate and permafrost dynamics. Addressing our objectives and testing the hypotheses requires an interdisciplinary project with complementary expertise on permafrost dynamics, hydrology and C biogeochemistry in both terrestrial and aquatic systems. The research merges the individual groups long experience of research and stakeholder interactions in northern environments. Thus, the research will constitute a novel and unique combination of current research carried out at the consortium institutes and allows answering questions that could not be addressed by each partner individually.

PROJECT DESCRIPTION AND PLANS

Project description

Project description (maximum 8 pages in uploaded PDF, including references): 1 vedlegg

JPI climateProject Descr..pdf

Management and dissemination

Management Plan (maximum 3 pages in uploaded PDF) 1 vedlegg

Management plan.pdf

Scientific and Societal Impact Knowledge Exchange and Dissemination Strategy (maximum 3 pages in uploaded PDF). 1 vedlegg

Knowledge exchange and Dissemination strategy.pdf

LEADING PRINCIPAL INVESTIGATOR

LPI detailed information

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PRINCIPAL INVESTIGATORS

Principal Investigator overview

Principal Investigators (in excel format) 1 vedlegg

Copy of jpi_template-pis_full-proposal.xls

Principal Investigator's details

Principal Investigators details (in PDF format, one template per PI, maximum 3 pages per PI): 5 vedlegg

JPI_PI details template_Full proposal-1_OLEG.pdf

JPI_PI details template_Full proposal_HL.pdf

JPI_PI details template_Full proposal_JK.pdf

JPI_PI details template_Full proposal_SK.pdf

JPI_PI details template_Soulsby.pdf

BUDGET

Total budget

Total budget (in Euros): 1253975

Total requested funding

Total requested funding (in Euros): 711935

Detailed budget

Detailed budget (in excel format, in Euros): 1 vedlegg

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External funding information

External Funding from other sources (including current and pending support). Please detail what is included in your in kind contributions.

Existing Resources and funding: In the past years, field deployable instruments using Near-Infrared Laser Spectrometry (NILS) including an auto-injector system to facilitate large numbers of isotopic samples have become available from Los Gatos Instruments (USA), which can provide good analytical precision (D/H ~ 1.6, 18O/16O ~ 0.2) cheaply and rapidly (~100 seconds).This provides a flexible analytical tool with the promise to revolutionize the use of isotopes to inform catchment hydrology. At the laboratory of the Northern Rivers Institute at the University of Aberdeen and SLU Umea such a NILS are being commissioned as part of a new Isotope Hydrology Laboratory which will facilitate the high amount of samples of this project. In addition, a new analyser will be delivered in April 2014 which is also able to analyse 17O simultaneously to 18O and 2H. Thus, this proposal makes the case to operationalize the application of NILS in an Arctic catchment research programme to handle a large number of samples generated. In addition, within the UK team other existing equipment includes an automatic weather station, rain gauges (~250 Euro each), 15 GW level loggers (~2000 Euro total) and Campbell data loggers (~1100 Euro each). Laboratory and office space will be provided for the PDRFs. The leading PI will provide equipment for continuous sampling for methane analysis (30 chambers, ~1000 Euro each), equipment for estimating gas exchange velocity (3 chambers with CO2 sensors, ~500 Euro each). The salaries of Swedish partners (10% for Hjalmar Laudon, 20% for Jan Karlsson) will be covered by their departments.

The UK PI and Co-I are involved in a grant funded by UK NERC Arctic Programme (NE/K000268/1), an ERC (European Research Council Grant, GA 335910) on Vegetation-Water interlinkages in high-latitude catchments and a grant funded by the Leverhulme Trust on water storage and movement in northern regions. These projects are highly relevant to the proposed study in terms of application of tracer-aided hydrological models in arctic environments. Several ongoing PhD projects are directly related to the proposed work in terms of assessment of possible climate change on hydrological response, developing and testing advanced hydrological measurement and model approaches; and aiding management decisions. Insights gained within the current projects will feed directly into the planning of experiments carried out under Nordforsk funding. It is anticipated that the projects will be able to cross-fertilize each other. This will involve close coordination amongst the existing PhDs and PDRFs funded within the other projects with the proposed PDRF positions. Thus, the requested funding will permit an extension of measurements and modelling in much more detail both in time and space, and crucially in a geographic region where these hydrological model approaches have not been applied before. This will allow taking the existing grants and opportunities of measurement, data analysis and model development to a next stage; a stage which would not be feasible with existing funding.

The partners from France and Russia (ineligible to request funding from this call) will provide important resources for the project (see Letter of support), in equivalence to at least 330kEuro covered by the mega-grant BIO-GEO-CLIM (PI Oleg Pokrovsky) and the Centre of excellence project Biota and Climate (PI Sergey Kirputin). These resources will support: 1. Salaries for French participants 10% of time (10 kEuro per year, O.S. Pokrovsky, Res Director CNRS; 5 kEuro per year, Liudmila Shirokovaa, Assistant Professor, Toulouse); 2. Salaries for Russian participants 10% Sergey Kirpotin, Sergey Kulizhsky, Sergey Vorobiev (Res Directors at TSU, 20 kEuro per year); 3. 50% of PhD student (shared between Tomsk and Toulouse, field-oriented, Tatiana Reutova, Biogeochemistry of western Siberian peat soils within the context of permafrost thaw), 50 kEuro for the full duration of SIWA project 4. Partial coverage of the field cost, 30 kEuro per year (cars, gas, equipment, sampling, help with Russian Hydrological Survey).

National annexes

National budget annex (multiple files allowed, in PDF format): 1 vedlegg

National Budget Annex_NERC_UK 18.3.14.pdf

Letters of Support

Letters of Support (in PDF format): 1 vedlegg

Letter of support.pdf

FUNDING JUSTIFICATION

Funding justification

This project incurs considerable travel expenses due to the remoteness of some of the field sites, which is inherent to research of this nature. The novel aim and scientific contribution of the proposal also requires investment in new equipment. Crucially, our partners have the logistical expertise necessary for us to conduct an ambitious and novel research programme, whilst minimising risks.

Directly incurred costs
Staff: Careful sampling and modelling analyses are central to this project. Most of the hydrological laboratory analysis will be carried out directly at the University of Aberdeen as the local isotopic analysis guarantees control on data quality. We are planning to employ 2 full-time PDRFs for two years: One will be supervised by team members Sweden and other will be part of the UK, Aberdeen group. A crucial part of the work of both PDRFs is preprocessing of existing data sets, statistical and numerical analyses of existing and newly sampled data, and the integration of the empirical data into modelling frameworks in conjunction with the PIs. Both individuals would also be assisting with preparation of published outputs and result dissemination. The Aberdeen PDRF will focus on hydrological and geochemical tracers in water flow paths, and at catchment scale (in the field), the coupled DOC-hydrological model. The majority of the PDRFs time will be spent carrying out preprocessing data, data analysis, time series analysis and modelling integration associated with the projects scientific objectives. The main role of the PDRF based at Umeå University, Sweden, will be to work with CO2 and CH4 fluxes in lakes and streams along the climate gradient. This includes measurements of CO2 and CH4 concentrations and gas exchange velocities and handling and processing the data in order to estimate C fluxes and emissions across different regions. In practise, both PDRFs will work closely together, in field but also in combining and interpreting the C flux data with data on water flow pathways and transit times.
We also apply for part (1-4 months per year) of salary for Erik Geibrink, research technician at Umeå University, Sweden. Erik will build new CO2 sensor-logger units (he has developed and tested these during last 2 years) for the project and he will install and maintain all other new equipment in collaboration with partners in Russia. Erik will take an active role in organizing field campaigns, in sampling lakes and streams, and in the GIS and remote sensing work. Eriks successful work on developing and testing simple sampling systems for continuous measurements will be highly valuable for the work in this project. This, together with PDRFs and staff/partners from Russia and France will ensure that the collection of high quality data will be practically feasible.

Fieldwork travel and subsistence, conference attendance: We have requested funds to cover travel and subsistence costs for fieldwork, project meetings, meetings with other JPI Climate projects, a workshop and travel to international conference for result dissemination. A sub-set of PIs (as appropriate to each field campaign) and the PPRFs will take part in specific campaigns throughout the project. Travel costs include vehicle hire for transport around field bases. Air fares are based on up-to-date information. Funding for travel and subsistence costs is also sought for the PIs and PDRFs to make trips for project meetings, and support for participation and presenting at 2 continental European (EGU European Geosciences Union General Assembly), and 2 intercontinental conferences (AGU American Geophysical Union) is also requested, which is an essential medium to disseminate results and to provide networking opportunities.

Other directly-incurred costs: requested include analytical costs for the water isotope (2H and 18O) samples. The rainfall-runoff relationships between these tracers can be used to estimate stream water transit times. Analytical costs of ~10 Euro per sample are inclusive of laboratory consumables (filters, standards etc). We will analyse samples of precipitation, soil-, ground-, lake and stream waters. We also plan to conduct synoptic sampling of stream and open waters throughout the catchments under higher and lower flows. In addition, for a sub-set of samples, alkalinity will be determined (using separate sample bottles avoiding contamination from paraffin used for the isotopes) to assess geographic sources of runoff. The cost for these will be ~2 Euro per determination, and are inclusive of consumables. Most of the additional chemical analysis will be carried out at Tomsk State University, Russia (covered by partners from Russia and France) but we have budgeted for that a subset of analysis will also be carried out at Umeå University, Sweden (mainly for calibration purposes before shipping equipment).

Funds for data loggers and sensors and for equipment to build the CO2 sensor-logger units (~ 300 Euro per unit) are requested to supplement existing equipment. To facilitate sampling, field consumable costs are also sought for autosamplers for sampling precipitation and stream water, precipitation collectors, stream gauging sites (using simple capacitance probes for smaller catchments) and sample bottles, as well as recurrent consumable costs such as batteries, solar panels etc. A number of minor consumables costs are also associated with operationalising and running the Near Infra-red Laser Spectroscope (NILS) as well as purchase of bottles.

Directly allocated costs
We consider the level of funds requested for directly allocated costs appropriate considering the overall budget constraints bearing in mind the logistical/planning and reporting demands on the lead PI(s). The work of the PIs will include overseeing equipment installation, managing the project team, covering grant administration and dissemination of intermediate results and overall outcome.

Knowledge exchange and result dissemination
Under item consumables we allocated some costs for result dissemination. PIs, Co-Is and PDRAs will contribute time to KE activities. As a consequence of existing contacts/networking of the PIs and Co-I, there is very significant value-added to this investment, ~10KEuro of which is support in kind from the teams respective Knowledge exchange/Press amp; Communications offices. Resources for publication in open access journals will be mainly covered by existing agreements between Universities, funding bodies and publishers (incl. charges for coloured pages) to guarantee dissemination of the outcome of the project results to the wider research community.

PARTICIPATING COUNTRIES

Participating countries by gender

	Principal Investigator		Involved researchers		Other participants		Country total		
	M	F	M	F	M	F	Male	Female	Total
Austria	0	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	0	0	0
Denmark	0	0	0	0	0	0	0	0	0
Finland	0	0	0	0	0	0	0	0	0
France	1	0	1	1	0	1	2	2	4
Germany	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0
Netherlands	0	0	0	0	0	0	0	0	0
Norway	0	0	0	0	0	0	0	0	0
Russian Federation	1	0	2	0	0	0	3	0	3
Slovenia	0	0	0	0	0	0	0	0	0
Sweden	2	0	0	1	1	0	3	1	4
United Kingdom	1	1	0	0	0	0	1	1	2
Total	5	1	3	2	1	1	9	4	13

INFORMATION FOR THE REVIEW

You may name up to three experts that should not be contacted to review your proposal due to e.g., conflicts of interest.	no conflicts of interests

Climate impact on the carbon emission and export from Siberian inland waters (SIWA)

This interdisciplinary project will link expertise in aquatic biogeochemistry hydrology and permafrost dynamics. The project will provide a comprehensive assessment of the importance of lakes and streams for the C cycle of the taiga-tundra region, including CO_2 and CH_4 exchange with the atmosphere and export of land based C to coastal regions. The outcome will be of major importance for the society by providing the first quantification of the role of inland waters in the C cycle in one of the least studied but largest northern terrestrial ecosystems in the world.

Background

Understanding climate systems requires knowledge of climatic effects on carbon (C) cycling and greenhouse gas (GHG) dynamics in coupled land-water-atmospheric systems, and in-turn, how these feed back into the climate system. Of particular importance is the understanding of climate effects on the vast amounts of organic C stored in permafrost soils and wetlands at high latitudes. Warming is likely to cause decomposition and atmospheric release of significant amounts of these C storages and, thereby, contributes to a climate warming feedback[1-3].

A major knowledge gap is to what extent C released from permafrost soils is transported, processed and emitted as CO_2 and CH_4 from inland waters vs. exported to downstream costal and ocean waters. Lakes and streams at high latitudes release significant amounts of CO_2 and CH_4 to the atmosphere[4-6]. These fluxes are largely controlled by climate dependent factors (temperature, radiation, wind, precipitation) and hydrological flow paths to water bodies, either directly or via its regulation of the terrestrial production and export of C[7, 8]. Of particular importance is the organic C released from thawing permafrost which could largely be metabolized leading to increased CO_2 and CH_4 emissions[6, 9, 10]. C emission from surface waters in areas of discontinuous permafrost has been shown to be comparable to terrestrial atmospheric C exchange and to exceed downstream C export[5, 11], implying an important role of inland waters in the C cycle.

Despite these advances in our understanding of C fluxes in lakes and streams there is a fundamental knowledge gap of climate impact on C transport and cycling in inland waters at high latitudes; especially when attempting to extrapolate and predict large scale patterns and future trends. This is particularly true for the vast areas of boreal and arctic Russia/Siberia. Experimental studies are scarce and generally of restricted spatial and temporal extent which limit their value for understanding and predicting long-term trends[12]. Comparative studies along climate gradients have provided insights about single fluxes, but to our knowledge no studies exist integrating all relevant fluxes or of complete stream-lake networks across gradients of different permafrost conditions. This is not trivial since new high resolution data suggest that there is substantial variability within and between aquatic systems[5, 10, 13, 14] and neglecting this variability will result in major errors in upscaled estimates, implying increased uncertainties in global C models and in predicting effects of climate change. A recent study of a complete network of lakes and streams in a catchment of discontinuous permafrost has shown that small 1st order streams, which are normally *not* included in GHG studies, accounted for 96% of the annual aquatic C emission although they only made up 4% of the aquatic area in the catchment[5]. Most importantly, the C emission from these aquatic systems exceeded the lateral downstream C export and significantly contributed to the C loss to the atmosphere[15] (Fig. 1). These findings emphasize the importance of studies integrating fluxes and across scales and the importance of inland waters for emitting terrestrial C to the atmosphere and decreasing the export of terrestrial C to downstream systems.

Fundamental to the knowledge gap of climate impact on C cycling in inland waters is the lack of integrated understanding of the linkages between biogeochemical controls on C fluxes and hydrological processes which affect moisture availability and the timing and pathways of water movement to streams. Hydrological conditions are important for the quantity and quality of terrestrial C export[16-18], which will influence rates of C processing in recipient inland waters [19]. However, hydrological dynamics also determine the time available for physical and biogeochemical processing of this C in recipient lakes and

streams [20], altogether implying major control of the magnitude of C fluxes in lakes and streams by climate and hydrology. Recent advances using isotopic tracers have helped constrain the geographic sources of stream runoff and their temporal dynamics in northern catchments. These tracers have recently helped condition coupled flow-biogeochemistry models that can address this issue directly[21]. Still, there have been no attempts to couple climate effect on C emissions from inland waters to hydrology.

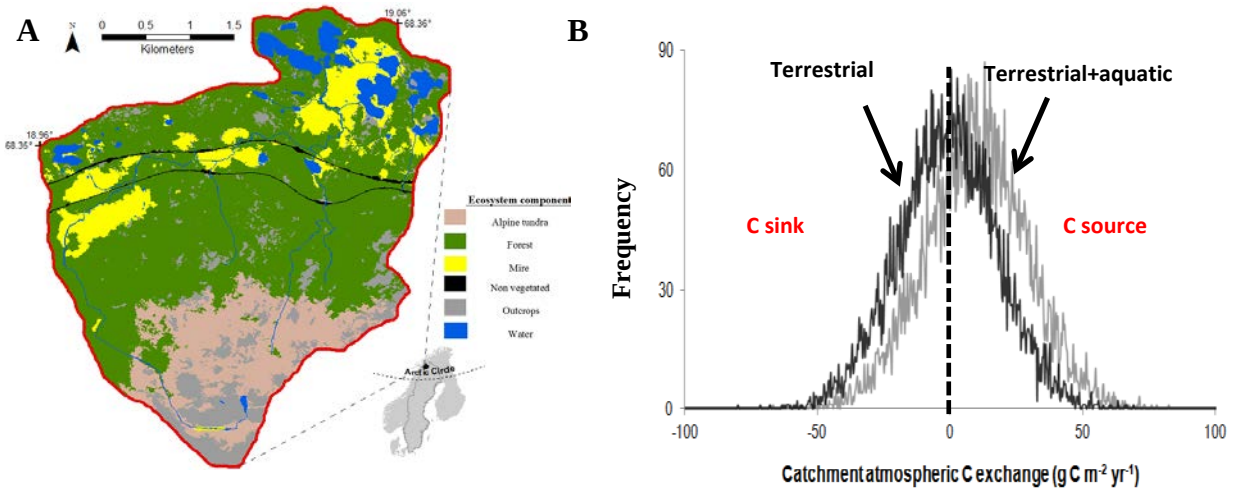

Figure 1. The role of inland waters on the C balance of a sub-arctic catchment. *We quantified the annual emission of CO_2 and CH_4 from all aquatic systems (27 lakes, 23 stream segments) in a 15 km^2 catchment (A) and compared these data with annual net ecosystem C exchange for all terrestrial ecosystems (B) and with annual C export through the outlet. The aquatic C emission exceeded the downstream C export. The data suggest that (using Monte Carlo simulation to account for inter annual variability) it is likely that the catchment serves as a net source rather than a net sink of C, especially when accounting for the often neglected C losses from aquatic systems.*

Here we propose an integrated research program which will provide a comprehensive assessment of the importance of inland waters for the C cycle of the taiga-tundra region, including C exchange with the atmosphere and riverine export of land based C to coastal regions. The outcome will be of fundamental importance for stakeholders and the scientific community as this **will provide the first quantification of the role of inland waters in the C cycle in one of the least studied but largest terrestrial northern ecosystems in the world**. In particular, C emission vs. downstream export in inland waters has not previously been linked to the hydrological dynamics. Thus, there is a weak evidence base for assessing how these processes will change with climate and permafrost dynamics. Addressing our objectives and testing the hypotheses requires an interdisciplinary project with complementary expertise on permafrost dynamics, hydrology and C biogeochemistry in both terrestrial and aquatic systems. The research will constitute a novel and unique combination of current research carried out at the consortium institutes (on C cycling, hydrological transit times, permafrost dynamics and remote sensing) and allows answering questions that could not be addressed by each partner individually.

Objectives and hypotheses

Our excellent interdisciplinary team of scientists with world-leading expertise in their respective field will investigate climate impacts on the role of lakes, streams and flow pathways for atmospheric CO_2 and CH_4 emission, as well as lateral C export, in Siberia. We hypothesize that a warmer climate in permafrost regions lead to fundamental differences in (1) lateral export of terrestrial C and (2) emission vs. downstream export of C in inland waters (Fig. 2):

(Hypothesis 1) Terrestrial C export will generally increase with warming- Warming and thawing of permafrost will increase terrestrial C export following increased mobilization of C stocks. However, the effects are likely to exhibit marked spatial and temporal variability to heterogeneities in vegetation, soil characteristics, active layer and

flow pathways[16, 22]. Thawing is generally expected to increase organic C export from areas of thick organic-rich soil horizons or shallow active layer depths. However, thawing may also decrease the organic C export to aquatic systems in case of increasing sorption in the mineral layers or increased residence times and respiration in soils.

(Hypothesis 2) With warming an increasing fraction of the terrestrial C export will be mineralized and emitted from inland waters, resulting in elevated C emissions but small changes in C export to downstream coastal regions- The change is mainly driven by a combination of differences in loss rates and hydrological residence times in the inland waters along this gradient. Temperature controls mineralization rates of organic C[23] and transit times determine the conditions for total mineralization and C emission at the landscape scale[20] (Fig. 2). We assume that variation in organic matter quality to be of secondary importance for large scale spatial patterns across the climate gradient but we will test the predictions that quality controls small-scale spatial variability in mineralization rates. Further, we will test the prediction that the ratio between CH_4:CO_2 and emissions will increase along the climate gradient which will, in combination with the general increase in C emission, result in even larger C emission in CO_2 equivalents. The rationale for this prediction is that conditions favoring net CH_4 production in aquatic systems (i.e. anoxia and high temperatures) increase with warming, but also that the supply of CH_4 from land is expected to increase with longer transit times and deeper flow pathways in soils along the gradient.

The hypothesis will be tested using a 'space for time substitution' approach, i.e. a comparative study of lake-stream networks across a climate gradient in western Siberia, combined with remote sensing and modelling. We will also upscale the results to the whole permafrost bearing region of western Siberia and predict future C fluxes using a coupled hydrological-biogeochemical model.

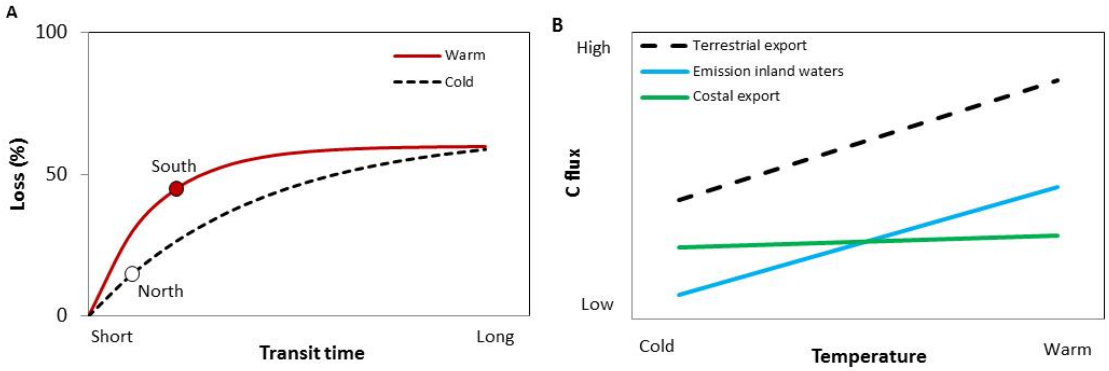

Figure. 2. Hypothetical C fluxes of permafrost bearing Siberia. *A. Loss (i.e. mainly emission vs. downstream export) of terrestrial C in warm vs. cold inland waters as a function of transit time in the aquatic network. The points indicate the hypothesized general loss in northern and southern Siberia. The differences between South/warm and North/cold sites are a result of differences in water temperature and resulting respiration rates (i.e. differences in slope of the curve) and differences in transit time. B. Change in C fluxes following warming. Burial is not included here since it is relatively small loss and does not directly affect atmospheric or costal systems.*

The proposed funding will leverage added value from the team's existing grants with opportunities for integrating measurements, data analysis and model development to provide a step change in understanding which would not be feasible with the individual existing projects alone. Insights gained within the current projects will feed directly into to the planning of experiments carried out under the JPI Nordforsk funding. It is anticipated that the projects will be able to cross-fertilize each other. The project we propose aims for high quality data across a large latitudinal gradient of remote regions in conjunction with the development of novel approaches to analyse and integrate the data. In order to accomplish this we will use the unique detailed prior knowledge, and already ongoing work, and integrate this with new measurement techniques and approaches that enable high quality data to be obtained for remote locations, and methods and models that allow upscaling relevant processes and fluxes based on available data for large regions. The

consortium has the necessary expertise by being in the forefront of scientific advances on all these points.

Research plan

The work will be organized in 4 major work packages (Fig. 3) as described below, in the requested sections for *Scientific and Societal Impact Knowledge Exchange and Dissemination Strategy* (WP4 in Fig. 3) and *Management Plan* (WP1 in Fig. 3).

The project will include a comparative study of lake-stream networks across a climate gradient (boreal-arctic) in western Siberia (Fig. 4) covering a large range of permafrost conditions (absence-sporadic-discontinuous-continuous). By including lakes and streams in a wide geographical perspective we will be able to quantify the role of inland waters all across the permafrost-bearing zone of western Siberia and to predict the potential changes following changes in future climate. We will directly relate changes in C fluxes to hydrological descriptors of system function (e.g. soil moisture availability, surface water sources and water age distributions), we will therefore be able to explore links between climate and permafrost conditions to hydrological conditions and related differences in quantity and quality of exported C.

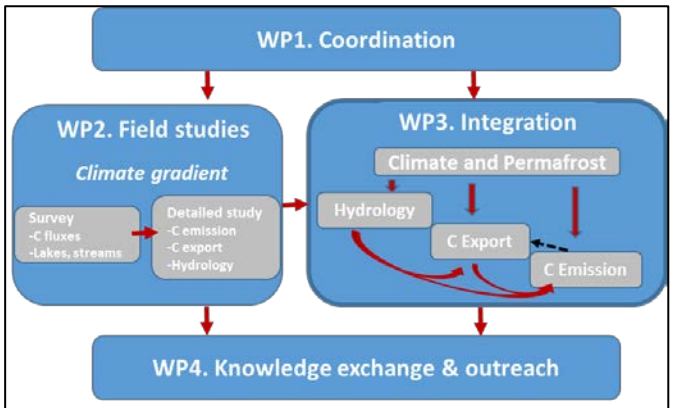

***Figure 3**. Illustration of project organization and individual work packages. The red arrows in WP3 show direct and indirect effects of climate and permafrost on C dynamics and the black arrow indicate the negative feed back of C emission on the export to downstream systems.*

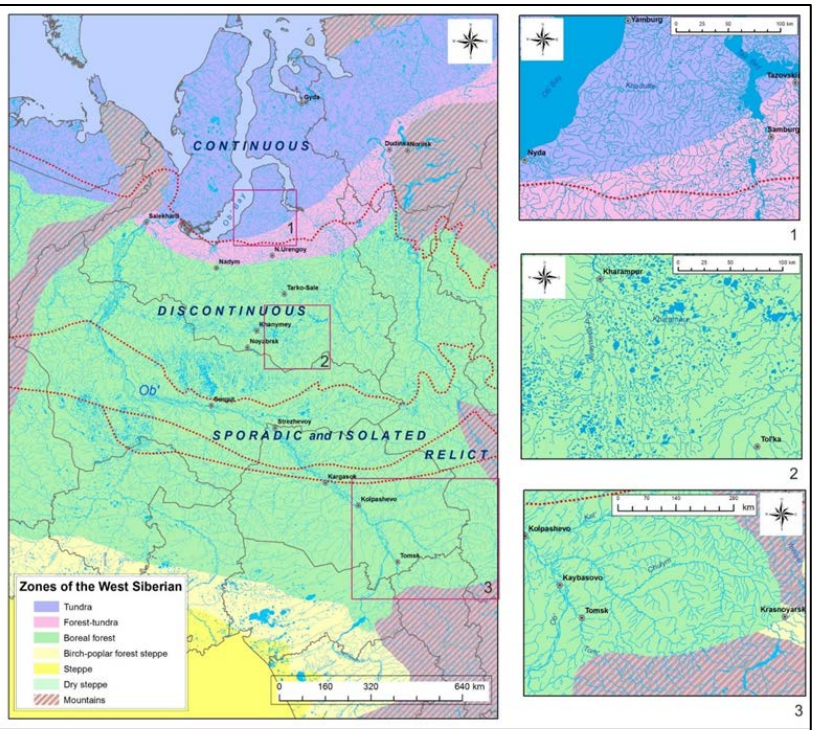

***Figure 4. Sampling sites in the western Siberian Plains.** The gradient is suitable for testing objectives and hypothesis of the project given the i) contrasting permafrost coverage, ii) relatively homogeneous geomorphology, peat soil and lithology and iii) relatively easy access to sites thanks to existing infrastructure (linked to the oil and gas industry). Note the different scale of the small maps.*

WP1. Coordination

The work of the consortium will be coordinated as described in detail in the section '*Management Plan*' in the application.

WP2. Field studies

The project includes (1) field surveys (spring, summer, autumn) of CO_2, CH_4 and stable isotopes (δ^2H, $\delta^{18}O$) concentrations in approximately 50 lakes and 50 streams, and a more (2) detailed quantification of hydrological conditions and of annual lateral and vertical C fluxes in selected catchments (1-3 per permafrost region), all distributed along the same latitudinal gradient. The project will have access to established field sites (with background data on e.g., catchment boundaries, climate, vegetation/wetlands and permafrost) and in-depth knowledge about terrestrial and aquatic ecosystems along the gradient[24, 25], and to laboratory facilities at Tomsk State University, Russia. Most of the equipment needed is

already available in the group. Detailed descriptions of major methods of importance are given below.

C emission and export-Limitations in available measurement techniques constitute a profound constraint for work in remote locations. The sensors starting to be commonly used for CO_2 (e.g. vaisala.com) are (i) too costly for use in the numbers that are needed for capturing spatial variability properly, (ii) have a relatively high power consumption and (iii) have problems with biofilm if deployed for extended periods without cleaning. Eddy covariance (EC) measurements provide continuous measurements but this technique cannot be used in streams and small rivers and water bodies and are too costly to use in multiple systems. In this project we will use recently developed equipment (by leading PI and coworkers) for automatic continuous measurements of CO_2 and CH_4. For CO_2 we use loggers based on Near Infra-Red (NIR) sensors made by Senseair (www.senseair.se) that has been adapted for use in field flux and concentration measurements in chambers. The low cost loggers are integrated sensor-logger units of small size and low power consumption, enabling use of multiple loggers in remote locations. Thus, these could be used for continuous CO_2 measurements in all lakes and streams in the project. CH_4 fluxes and gas transfer velocity (k) between water and air from intensively studied lakes will be measured continuously by using automatic flux chambers[26]. Samples for CH4 concentrations in streams will be collect by an automatic sampling system for CH_4[26] combined with data on k. The k for estimating CO_2 and CH_4 fluxes from streams will be estimated by the using the CO_2 sensor-logger units in flux chambers for streams[27]. In addition, both CO_2 and CH_4 will be sampled manually during visits to the lakes. The stream export of organic and inorganic C will be estimated from measurements of C concentrations (own and existing data) and data on discharge estimated from catchment areas and the specific runoff for each subregion. These flow estimates will be constrained by short-term measurements of river level (using capacitance probes) at selected sites which will be rated (for discharge) during the project. The terrestrial C export for each climate region will be estimated as the sum of downstream export and the atmospheric C emission from aquatic systems for catchments draining each region.

Hydrology- The hydrological fieldwork will be integrated with the C flux work and use new isotope data and pre-existing geochemical (major ion) tracers as catchment-integrating tools over a range of scales. This will provide context on the prevailing hydrological conditions and constrain the geographic source areas of stream flow dynamics at different spatial and temporal scales. It will also allow us to estimate the transit time of melt water in the terrestrial landscape and crucially within the surface water network of rivers and lakes. Based on tracer data, hydrograph separation will be used to estimate sources of runoff and lumped models will be used to estimate transit times for each available isotope record in the hydrological system (WP3). Nested tracer studies integrating spatial scales (soil profile–hillslope -sub-catchment scale) allow the passage of tracer through different landscape units and aquatic habitats to be monitored to characterise how input signals from melt and precipitation are damped and lagged allowing us to infer the time available for biogeochemical processing for the integrative WP3

Additional data- Bioassay experiments[28] will be used to assess temperature dependency in degradation rates, and in total bioavailability, of river DOC across the gradient. Dissolved organic and inorganic C will be estimated using methods routinely used by the applicants[5]. We will measure fluorescent dissolved organic matter (FDOM) and conductivity continuously in each river with the aim to also use these data for modelling DOC and DIC concentrations, respectively. Additional measurements include bathymetry, pH, nutrients and water temperature (using loggers). Additional data will be obtained from The Russian Hydrological Survey (daily discharges of 50 watersheds in permafrost-free and 40 watersheds in permafrost-bearing zones, a subset include chemistry of major elements 10-15 times per year), The Russian meteorological stations (daily temperature, wind, precipitation reasonable close to our study sites, http://meteo.infospace.ru), digital maps, Landsat and digital elevation models (for upscaling, see WP3).

WP3. Integration through modelling and upscaling

We will integrate data from field studies with Geographic Information Systems (GIS) and remote sensing data and existing data on hydrology, climate and vegetation of western

Siberia to answer the hypothesis about C fluxes for each study catchment and to upscale C emission and export across western Siberia. As a secondary aim we will also make a first attempt to advance tools to predict future C fluxes using a coupled hydrological-biogeochemical model.

Coupling C emission, export and transit time along the climate gradient- We will integrate data on C emission, C export and emission:export ratios with data on temperature dependency in degradation rates, total bioavailability of organic C and hydrological transit times for each study catchment across the latitudinal gradient (i.e from warm to cold regions). The C flux data, including the ratio between CH_4:CO_2, will also be compared with additional data on climate (temperature, precipitation), vegetation/wetlands and permafrost conditions. This part will allow assessment of how patterns in C fluxes relate to major climate dependent variables along the gradient and to test the hypothesis of the project.

Upscaling C emission from Siberian inland waters- We will upscale the results to the whole permafrost bearing region of west Siberia. The C emission will be estimated from region specific C fluxes (from detailed studies above) and areas of lakes and streams for each region. For the major rivers and lakes, surface areas and slopes will be obtained using Landsat data. Here we will benefit from previous and ongoing remote sensing work by group members[24]. Small streams will be estimated from a stream network generated using a DEM and a flow accumulation model.

The data obtained and findings will be made available for the global research community to assist future global GHG modelling efforts. We anticipate that the data generated by the project will allow synthesis and upscaling exercises beyond what could be covered by this specific project. If successful, the project will allow predictions of future C emission and C export given different scenarios of climate change. Further the project will provide data enabling construction of integrated terrestrial-aquatic GHG balances for individual catchments and for larger landscapes. This will allow assessment of not only the quantitative importance of inland waters for continental GHG balances but also of the strengths and distribution of different sources and sinks in the landscape.

Predictions with coupled hydrological-biogeochemical models- We will combine a hydrological model with a model for atmospheric CO_2 fluxes from aquatic networks, where the flux is a result of the loading of C across the land-water interface and the production and atmospheric exchange of CO_2 during passage through the network. For modelling the hydrology and terrestrial C export we will be using low-parameter lumped conceptual hydrological models[29]. We will use tracers to constrain model structure so that dominant hydrological processes involved in runoff generation are captured and conceptualised as dynamic, interconnected reservoirs[30]. Simple algorithms for DOC production and immobilization driven by air temperatures and soil moisture will be incorporated into each reservoir to model DOC delivery to streams on a daily timestep[31]. This will build on current NERC-funded work on the Yukon, Canada (Fig. 5). Whilst these models have been successful in simulating lateral DOC fluxes, we expect that they can be extended for other components of the C budget. The drivers for CO_2 evasion will be the net CO_2 supply (sum of external input and internal production) to the water and the time allowed for internal CO_2 production and gas exchange with atmosphere given the specific physical network properties (i.e. slope, depth, discharge). The CO_2 supply will be modeled from landscape specific inputs of CO_2 and OC at the soil-water interface and temperature dependent decay functions of imported OC in the aquatic systems. All necessary data for the model will be

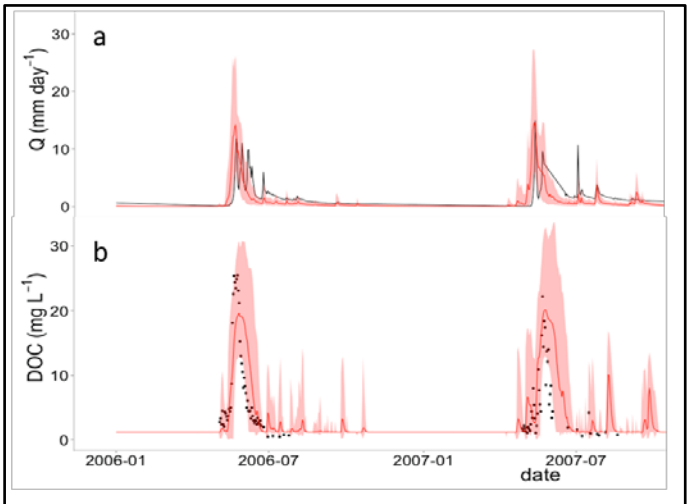

Fig. 5. Simulating hydrology and DOC dynamics in coupled hydrological and DOC model (a) Discharge response; (b) DOC dynamics in Wolf Creek, Yukon (Lessels et al. in prep.).

provided from WP2 and build upon ongoing work in boreal catchments (by JK and HL). We will use downscaled outputs from GCMs to project future hydrological change to temperature and precipitation forecasts over the next 50 years[32]. We will use these predictions to drive the coupled hydrological-biogeochemical models to estimate likely changes in C export and emission. The modelling will be carried out within an uncertainty framework to make probabilistic projections.

WP4. Knowledge exchange and outreach

Details are given in appendix '*Scientific and Societal Impact Knowledge Exchange and Dissemination Strategy*' in the application.

Interdisciplinarity, transdisciplinarity and complementarity of the team

This project gathers an excellent cross-disciplinary team of investigators each bringing their distinctive expertise to a highly integrated project. They are all highly committed to achieving integration while deploying cutting edge techniques to advance understanding the effects of warming on C fluxes. It will link internationally recognized expertise in aquatic biogeochemistry, hydrology, tracers, permafrost dynamics and remote sensing. All partners have an important role by being responsibility of specific WPs and tasks in the project (as described below) that will be important for running the project and for addressing the objectives and hypothesis of the project.

Prof. **Jan Karlsson (JK)**, Sweden (Leading PI): Project leader and coordinator. JK is responsible for assessment of CO_2 and CH_4 emission from lakes and streams, and for providing new techniques for this work, and has the main responsibility for linking the C emission in the inland waters to the specific properties (hydrology, C export, temperature, bioavailability) along the gradient.

Prof. **Sergey Kirpotin (SK),** Russia (PI): SK contribute with detailed knowledge about permafrost conditions in Siberia for selection of suitable research sites and for linking the C dynamics observed to climate and permafrost dynamics. SK will work with remote sensing for upscaling of the results. SK is also responsible for lab facilities at Tomsk State University used for chemical analysis and bioassay experiments and for existing local equipment to be used in the project.

Prof. **Hjalmar Laudon (HL),** Sweden (PI): HL is responsible for estimating the fluvial C export and the availability of this C (using bioassays) in the aquatic network, i.e. critical components for understanding the C emission and downstream C export.

Dr. **Oleg S. Pokrovsky (OP)**, France (PI): OP contributes with detailed knowledge of suitable research sites and of local infrastructure that is critical for a successful field sampling program. OP will be responsible for organizing the field campaigns, including sub-contracting local staff and arranging for transport and accommodation. OP will be part of the work estimating C emission from lakes and streams and lateral C export.

Prof. **Chris Soulsby (CS),** UK (PI): CS will manage and co-ordinate the team in the UK (DT as Co-I and the PDRF Aberdeen). CS is responsible for tracer studies to assess flow path ways of water and estimate transit times to link this to observed permafrost C dynamics. He will also oversee the hydrological component of integrated modelling studies of hydrological conditions to C generation along the study gradient. This will allow upscaling of process-based hydrological understanding for upscaling of C export in inland waters.

Prof. **Doerthe Tetzlaff (DT),** UK (Co-I): DT will provide expertise in GIS analysis, landscape ecological approaches and linkages to the NERC Artic Programme funded "HYDRA" project.

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Proposed Management Structure and Delivery Plan

This is a highly interdisciplinary, international consortium combining world-leading expertise in hydrology, C-biogeochemistry in soil-stream-lake networks, modelling and remote sensing. The integration of the expertise of the research groups at the different partner Universities in France, Russia, Sweden and UK is needed to address the complexity of the topic. All co-investigators have extensive experience in managing and working in multipartner collaborative projects (see PI details). Well-coordinated work and efficient communication are important. To ensure coordination among SIWA worktasks and successful delivery of its overall aims, our management plan builds upon the close working relationships developed among team members through past collaborations (e.g. Laudon / Tetzlaff / Soulsby in 'North-Watch' funded by the Leverhulme Trust or 'Vewa,, funded through ERC; Karlsson / Laudon in 'LEREC' and 'ForAqua' funded by FORMAS, Karlsson / Pokrovsky in "IFBAR", Kirpotin / Pokrovsky in 'BIO-GEO-CLIM' and 'Biota and climate').

Different parts (hydrology, lateral C export, C emission from lakes and streams) of the project will be of high scientific value individually but our ambition is to integrate all these parts in a novel approach that is anticipated to greatly advance our understanding of the role of inland waters in the C cycle in Siberia. Much of the publication will be therefore being carried out in collaboration where all or most partners in the consortium are involved as coauthors due to their specific knowledge. This does not only maximize quality of the project but also maximizing knowledge transfer as all partners are involved an updated on the results of individual parts.

Management Structure

Karlsson will be **Project Leader** of SIWA with overall responsibility for scientific strategy and programme management, including periodic progress and final reporting to Nordforsk and programme boards. While Karlsson will manage some resources centrally, most are distributed locally to the SIWA partners, as set out in the Justification of Resources. The work of the consortium will be organized through a series interlinked work packages (WPs, Fig. 1) and tasks (Table 1) as described in the Project description. Each work package has leaders who will coordinate the work and communicate with the group. Together with the PIs in all countries Karlsson will develop and maintain a risk register for project deliverables and milestones. Karlsson also will be responsible for project-wide communication and organizing project meetings, workshops, and engagement activities.

To monitor progress and plan activities, all PIs will have quarterly videoconferences and communicate further by email/phone as may be required to resolve any emerging issues. The full project team (PIs, PDRFs + relevant associated researchers) will meet annually, to share findings and ensure coordination among project partners. Before project meetings each partner send in a written report to the whole project group. After the project meetings the groups review their work and make a final report of current achievements and future plans. At the teleconferences each PI will report the progress of the work, specifically declaring any delays or changes according to the plan. Notes from all meetings will be distributed within the group. The project will interact with national and international colleagues and stakeholders and when necessary these will be invited to project meetings. WP1 will also organize and maintain a project web page for both public and internal exchange of information regarding project progress.

We will also convene at international conferences such as American Geophysical Union (AGU) and European Geosciences Union (EGU), which are attended by most team members anyway, as additional opportunities for team meetings. To supplement training and professional development opportunities provided for PDRFs and any linked PhDs by their host universities, SIWA has budgeted funds to support the early career researchers in networking at national and international conferences. Further funds are budgeted to support bi-lateral trips between various collaborators to ensure close coordination of the work packages with the wider project aims.

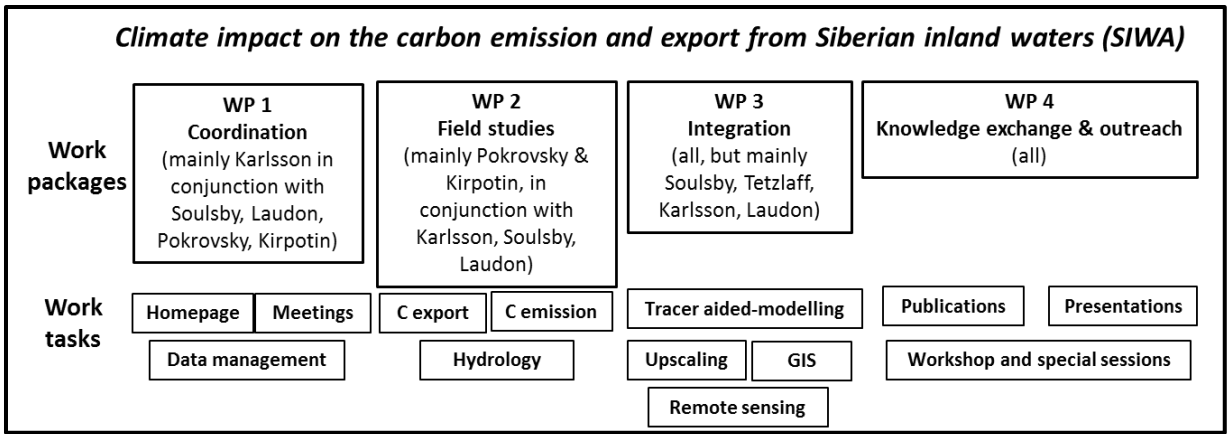

Fig. 1. Organisational structure of the consortium.

Table 1. Time plan of the project showing timing and responsibilities of major tasks within the work packages (WP).

WP	Work task	Who	2014	2015				2016				2017			
1	Coordination	JK													
	Teleconferences	All													
	Starting homepage	JK, OP													
	Project meetings	All													
2	Field and lab protocols	All													
	Selection survey sites	OP, SK													
	Purchasing equipment	JK, CS													
	Building equipment	JK													
	Survey sampling	All													
	Selection detailed sites	All													
	Detailed sampling	All													
	Add post doc positions	JK, CS													
	Employing Post doc	JK, CS													
3	Remote sensing	OP, SK													
	Modelling	CS, DT													
	Upscaling	All													
4	Scientific publ.	All													
	Popular science publ.	All													
	Organizing session	All													
	Pres. at conferences	All													
	Organizing workshop	All													

Delivery Plan, Dissemination, and Impacts

To ensure delivery of its ambitious research programme, SIWA will follow a carefully designed project plan. This is described in detail in the separate section '*Scientific and Societal Impact Knowledge Exchange and Dissemination Strategy'.* Briefly, a **website** will provide a public portal for publicizing SIWA news and events, disseminating draft papers, and archiving postprint versions of publications for 'green' open-access. In addition to conventional channels of academic dissemination through international conference presentations and peer reviewed publication in key journals, SIWA will host one **engagement workshop** in consultation with our endusers, with EAB members and other interested parties, and will bring academic and policy audiences together. We anticipate considerable interest from national-level policymakers and operating authorities.

Data management

Data management is crucial to SIWA and will be co-ordinated by Karlsson on conjunction with the PDRFs in Sweden and the UK. All PIs in the partner countries have many years of expertise in dealing with varied and complex biogeochemical and hydrometeorological datasets. The PDRFs jointly have responsibilities for overseeing and advising on dataset acquisition and generation, discovery documentation, metadata description, transformation and quality control; whilst ultimate responsibility for production of each

dataset to the correct standard lies with each PDRF and student (supervised). There are many 3rd party data sources which will be used within the project but cannot subsequently be released to datacentres because of copyright or license considerations. All incoming and generated datasets will be held securely at the respective institutions, and generated project data transferred quarterly to secure shared servers in Sweden and UK. Data generated by the project will be a mixture of types such as spatial results of biogeochemical, hydrological and remote sensing from both modelling and empirical work, taken uncertainties into account. All of this information will be released to the relevant data centres.

Addressing JPI's climate sustainability principle

The C footprint of the project will be minimized as far as possible by following the guidelines provided by JPI Climate website for travel, meetings, office and infrastructure. For this project it is of particular importance to minimize travel by virtual meetings and by having local staff taking care of a large part of the routine sampling and measurements. All necessary travel will be carefully planned in terms of location and timing to minimize travel distances and to enable use of night trains. Our aim is to minimize travel by scheduling project meetings in connection to conferences. We will also use instruments and techniques optimized to minimize the C footprint. An efficient and commonly used method for measuring the gas transfer velocity between water and air is the use of Sulfur hexafluoride. Sulfur hexafluoride is a very greenhouse gas (globing warming potential more than 20000 times that of CO_2) and because of this we will instead use a method where the gas transfer velocity is determined using a specially designed flux chamber and a CO_2 sensor. Further, the equipment used has by necessity low power consumption but we will minimize the C footprint of this part further by using solar panels to power equipment in field. We have long experience of using different solutions with solar panels at remote locations and e.g. the CO_2 sensor-logger units for continuous measurements of CO_2 in lakes and streams require very little energy (we have purposely designed and selected components to minimize power consumption) and are already developed to be used with small solar panels.

Risk management

Working in Western Siberia requires good knowledge of local conditions and equipment and methods that are simple and reliable for use in remote locations where continuous maintenance is not possible. We have carefully designed the project in order to make it feasible. The project will have access to established field sites and to laboratory facilities at Tomsk State University, Russia. Sergey Kirputin and Oleg Pokrovsky contribute with detailed knowledge of suitable research sites and of local infrastructure that is critical for a successful field sampling program. We anticipate that most of the field sits in the project are sites with previous or ongoing work. Oleg will be responsible for organizing the field campaigns, including sub-contracting local staff and arranging for transport and accommodation. Sergey is responsible for lab facilities at Tomsk State University used for chemical analysis and bioassay experiments and for existing local equipment to be used in the project. We will use equipment and techniques, largely developed by the applicants, known to work under harsh climatic conditions. Thus we believe that the risks of serious failure are small. Problems often arise during field work but from our long experience of field work at remote locations in the north we have routines and personnel to manage those situations. This include an extra set up of spare equipment, double sensors for some measurements, collection of duplicate water samples and multiple back up on collected data. A major advantage is that all sampling and field measurements could be carried out by the crew located in Russia. This will ensure collection of samples and data even if partners outside Russia, for any reason, should not be able to travel to the field sites. Also, much of the analysis could be carried out at the laboratory at Tomsk University, where also samples could be stored.

Scientific and Societal Impact Knowledge Exchange and Dissemination Strategy

This proposal brings together a strong interdisciplinary team with substantial research experience in the Arctic (Karlsson, Kirpotin, Pokrovsky, Tetzlaff) but introduces experts in hillslope and catchment hydrological, tracer-aided modelling (Laudon, Soulsby), to research in arctic environments. There are strong synergies with the NERC funded HYDRA Project, IFBAR, THAW, ERC funded VeWa (see weblinks below). Team members are involved in these other related integrative programmes creating unique opportunities for data access and linked model validation and regionalisation in the future. All co-applicants have excellent track records in terms of result dissemination, stakeholder interaction and research outputs. We will use our existing contacts to contribute to the development of the stakeholder engagement strategy for the wider JPI Nordforsk. For wider user impact we will support the programme by focusing our Knowledge exchange activities on (1) enhancing the profile of JPI climate research through collaboration with the wider scientific/policy maker communities and Russia-based researchers, (2) supporting outreach activities on the consequences of change to those dependent on the Arctic environment, in particular economic and societal impact on the local and regional communities, and (3) promoting a wider understanding of the local through to global implications of change in the northern latitudes within schools and the wider public through public engagement in science activities. The proposed key activities are described below.

Fit to JPI Nordforsk priorities

The Nordforsk strategy emphasises the urgent need to improve our understanding of key biological and physical drivers and feedbacks in Russian Arctic/Boreal system (tundra-taiga-coastal region) to enable better representation of these processes in climate models. The proposed process studies tackle key uncertainties in the feedback between physical drivers; these are directly relevant to coupled GCMs used for predicting the consequences of climatic change, and a key tool to allow society to respond to, and anticipate, potential consequences of climate and environmental change.

Dissemination of research outputs

Results will be disseminated to the wider research community through a project web-site, refereed journal papers and international conference presentations. In the UK, we will also use the communication office and public engagement grants of the University of Aberdeen for result dissemination and publishing the work. The UK and Swedish team has experience in communicating their work through the media including the BBC World Service, BBC Radio Scotland, BBC Radio 4, Swedish Television and Swedish Radio. We apply for resources to cover open assess publication, set up and maintenance of the home page, presentations of results at 1-2 international conferences per year, organizing 2 special sessions at international conferences, and organizing a workshop on continental C cycling in permafrost regions. Existing communications lines between the project team and stakeholder organisations with interest in the study sites will be consolidated. We will evaluate impact and its success by the use of metrics such as website hits and enquires, publication statistics, keynote presentations by the project team, invitations to present our research outputs and numbers of active collaborators.

Tetzlaff has ongoing collaborations with a media production company (ELU images: http://www.eluimages.com/) which has expertise in working in remote environments. This offers the following opportunities:

a) Social media campaign before, during and after the fieldwork (continuing into an exhibition itself). This would include Instagram images and twitter posts using a defined hashtag system and linking back to departmental resources, as well as Facebook and YouTube uploads.
b) An extensive set of high quality digital images, in addition to the exhibition prints, for blog, web, social media and departmental use.
c) Looped 3 to 4 minute time lapse films for projection during exhibitions.

d) Additional social media video 'tidbits' (short clips, teasers and previews) following the fieldwork.

To fund these activities, an application lead by Tetzlaff is under way to the UK Department for Business, Innovation & Skills, Science and Society Community Challenge Grant Scheme: https://www.gov.uk/science-and-society-community-challenge-grant-scheme.

Peer reviewed publications-We anticipate that the results of the project will result in several publications in highly ranked multidisciplinary and disciplinary international journals. We will follow the policies of the funding agencies for open assess publication. In terms of Open Access, the University of Aberdeen has agreements and procedures in place with RCUK and several publishers to finance open access papers. All partners have excellent track records as shown in the section including descriptions of the achivements of each PI.

Workshop-The workshop will be for 2 days and organized in connection to an international conference (e.g. ALSO, EGU, AGU) in order to avoid extra costs and travel and to increase the likelihood to attract relevant researchers and stakeholders. It is anticipated that the workshop will be organized in collaboration with partners of IFBAR (International Federation for Boreal Aquatic Research, Jan Karlsson and Oleg Pokrovsky are founding members), the THAW network (a newly created network for research on aquatic systems affected by permafrost, www.cen.ulaval.ca/thaw2014/), the UK NERC Arctic Programme (http://arp.arctic.ac.uk/) and NERC funded HYDRA (http://www.project-hydra.net/), ERC funded VeWa (http://www.abdn.ac.uk/dev-geosciences/departments/geography-environment/vewa-640.php), Changing cold regions network (http://www.ccrnetwork.ca/), as well as other related consortia funded within JPI Climate.

Knowledge exchange-The project will actively interact with national and international colleagues (e.g. via IFBAR, THAW, HYDRA, VeWa mentioned above). International guest researchers will be invited to some project meetings to stimulate global knowledge transfer and connect to possible related efforts at other latitudes. This includes other related consortia within JPi Climate where there may be large potential for added value by collaboration and exchange of knowledge. An added value of the interdisciplinary and international nature of the project is training of postdoctoral, master and PhD students in state-of-the-art methods applied to environmental studies focused on tracing sources and fates of carbon in the environment. For placement funding we will approach the NERC policy placement programme, and bid to the NERC International Opportunities Fund. For engagement with schools outside of the fieldwork area, our past experience shows it is best to use STEM Ambassadors as one school is more willing to share comment through existing schools networks. Therefore schools visits will be arranged as part of STEM programme.

Webpage and popular science information- The project will organize and maintain a project web page for both public and internal exchange of information regarding project progress. We will make the project results available to the northern population, to the general public and to various stakeholders by presenting key results in Russian, English and native Siberian population languages. Furthermore, public understanding of science will benefit significantly from the project Web site also incorporating visualisation of modelling results. If necessary, the possibility of having this printed and mailed will be explored, but it is sensed that this will not be necessary given the increasing IT capabilities of the public and stake-holder groups. We also plan to publish 2 popular science papers related to the work, including (1) a description of the background and set up of the project and (2) the key results and its implications.

Assess and storage of data

Open access to research publications and management and deposition of data generated by the project will follow policies by national funding agencies, from which funding is sought. No issues with long-term data storage are expected. Dataset do not require specialist support with database design or require computer intensive storage. All data listed above, in geo-referenced base on GPS readings and stored in database linked to a

GIS will be deposited within the relevant data centres after an embargo period of one year at the end of the project or at the time of publication. There will be no restriction on data sharing. All programming codes are routinely made available as appendix of papers and will be shared freely. For Sweden all environmental and climate data produced by the project will be made available by publishing the data through the Environment Climate Data Sweden (ECDS, www.smhi.se/ecds) metadata portal using the ECDS metadata profile. Data will be stored in a project database located at the server at the Department of Ecology and Environmental Science, Umeå University, in addition to being stored by the individual researchers. For UK data will be made available through the NERC's Environmental Information Data Centre (EIDC). The University of Aberdeen provides state of the art storage solution fully compliant will all requirements. Data quality will be the ultimate responsibility of the PI who will delegate to CO-Is quality control of soil, water isotopic data. The project will also make extensive use of existing data sets (mainly from the Russian Hydrological Survey). Much of this is already in public access after publication. No ethical issues arise.

Stakeholders and users

The proposed project tackles key uncertainties in the effects and feedbacks between changes in climate and permafrost dynamics and ecosystem biogeochemistry that are directly relevant to coupled GCMs used for predicting the consequences of climatic change; these are a primary tool to allow society, through its policy, to respond to, and anticipate, potential consequences of climate and environmental change. Hence the main beneficiaries will be northern government departments and their relevant agencies. The benefits would be improved modelling and hence more robust outputs and understanding leading to stronger evidence based policy decisions. The main route to dissemination to governments internationally is through IPCC and its scientific evidence base. Understanding the relationships between hydrology and ecosystem response is crucial for determining environmental standards for Water Framework Directives and assisting in the future development of ecologically based assessment tools.

High visibility by high quality publications, presentations, special sessions/workshops and networking is efficient means for knowledge transfer to the society (see details of these activities above). The webpage will be an addition channel for outreach to society. We will invite stakeholders to special sessions and to the workshop. We will also report to and interact with the Freshwater Ecosystem Monitoring Group (FEMG, Jan Karlsson is part of expert group lead from Sweden), an expert group within CAFF (Biodiversity working group of the Arctic Council) as we anticipate our results will have implications for understanding habitat properties of importance for freshwater organisms. Further, we will communicate the results of the project to the society via different outreach activities (regular public lectures and excursions during summer season) carried out at the Climate Impacts Research Centre (CIRC, Jan Karlsson is codirector).

Information about attachment Copy of jpi_template-pis_full-proposal.xls

The document Copy of jpi_template-pis_full-proposal.xls could not be added to this PDF. All of your application documents are also attached to the application journal entry

Please add the Principal Investigator's details, presenting a summary of achievements and the 5 most recent relevant publications, as well as an overview of other personnel represented by the PI

Name: Pokrovsky, Oleg S.

Role in Consortium: French participant

Organization: Georesources and Environment Toulouse, UMR 5563 CNRS, Toulouse

Country: France

Area of Research: aquatic biogeochemistry

Highest academic qualification: Habilitation (2009), University of Toulouse

Summary of achievements (max 3000 characters, including spaces)

O.S. Pokrovsky, Research Director at the CNRS (FRANCE), age of 41, works on the Arctic and subarctic projects since 2000. He possesses both experimental physico-chemical, microbiological and geochemical expertise. He is French coordinator of the European Associated Laboratory of Environmental Geochemistry (LEA LEAGE, 30 persons, 3 research institute) and co-directs with Prof. Jerome Viers a larger international consortium GDRI CAR-WET-SIB ("Carbon in Wetlands of Siberia"), comprising more than 50 researchers, 3 French and 7 Russian academic institutes and universities). Over past decade, O.S. Pokrovsky directed and co directed 13 PhD students, 5 Post-doctoral research associates and lead numerous national and international research programs, with an overall sum of > 2 M€ raised by him for the GET Laboratory. Among the most significant recent projects coordinated by O.S. Pokrovsky, one can mention a grant of Russian Federation for foreign scientists (50 k€ over 2 years), a coordination of the ANR "Arctic Metals" (150 k€ over 4 years for GET), a partnership in the Eco-Innovation European grant FP7 (170 k€ over 3 years for GET). In 2013, O.S. Pokrovsky was awarded a prestigious Mega-grant of Russian Ministry of Science and Education (3 M $ for 3 years) to create his laboratory on Environment, Climate and Permafrost at Tomsk State University. The topics of this mega-grant is very close to that of the current JPI project and as such, synergetic activities of international consortia should allow conceptually new understanding of the impact of climate change on aquatic ecosystems of Western Siberia.

O.S. Pokrovsky has strong academic records with ~130 papers peer reviewed papers and the same number of conference abstracts published since 1992; his HI factor is equal to 31 and the total citation number is more than 2900. He is Associate Editor of Aquatic Geochemistry and a number of Russian academic journals.

5 most recent relevant publications

POKROVSKY O.S., SHIROKOVA L.S., KIRPOTIN S.N., KULIZHSKY S.P., VOROBIEV S.N. **(2013)** Impact western Siberia heat wave 2012 on greenhouse gases and trace metal concentration in thaw lakes discontinuous permafrost zone. *Biogeosciences*, **10,** 5349-5365.

POKROVSKY O.S., REYNOLDS B.C., PROKUSHKIN A.S., SCHOTT J., VIERS J. **(2013)** Silicon isotope variations in Central Siberian rivers during basalt weathering in permafrost-dominated larch forests. *Chemical Geology*, **355,** 103–116.

SHIROKOVA L.S., **POKROVSKY O.S.,** MOREVA O.Y., CHUPAKOV A.V., ZABELINA S.A., KLIMOV S.I., SHORINA N.V., VOROBIEVA T.Y. **(2013)** Decrease of concentration and colloidal fraction of organic carbon and trace elements in response to the anomalously hot summer 2010 in a humic boreal lake. *Science of the Total Environment*, **463–464,** 78–90.

POKROVSKY O.S., SHIROKOVA L.S. **(2013)** Diurnal variations of dissolved and colloidal organic carbon and trace metals in a boreal lake during summer bloom. *Water Research*, **47**(2)**,** 922–932.

POKROVSKY O.S., SHIROKOVA L.S., KIRPOTIN S.N. **(2014)** *Biogeochemistry of thermokarst lakes of Western Siberia*, Nova Science Publishers, Inc. New York, 176 pp., ISBN 978-1-62948-567-6.

Other personnel represented by the Principal Investigator (e.g. within the Principal Investigators department / institution, via a sub-contract, etc.) – please include name, organization, position, country, and brief description of role in the consortium

Liudmila S. Shirokova, Assistant Professor at the University of Toulouse: aquatic microbiology, primary productivity and heterotrophic respiration ins Siberian lakes; balance of organic and inorganic carbon
Jerome Viers, Professor at the University of Toulouse: terrestrial biogeochemistry, stable isotope tracing of element sources in rivers and lakes; dating using radiogenic isotopes
Carole Cassaraund, Technician at the University of Toulouse: DOC and DIC measurements in aqueous solutions

Please add the Principal Investigator's details, presenting a summary of achievements and the 5 most recent relevant publications, as well as an overview of other personnel represented by the PI

Name: Hjalmar Laudon

Role in Consortium:PI

Organization: Swedish University of Agricultural Sciences

Country:Sweden

Area of Research: Carbon dynamics and transformation in riverine systems

Highest academic qualification: Professor

Summary of achievements (max 3000 characters, including spaces)

Professor **Hjalmar Laudon** holds the chair in Landscape Biogeochemistry at the Swedish University of Agricultural Sciences and is a leading member of the national and international aquatic carbon research community. He has lead several large research programs on water quality focused on process-based understanding of natural and human-induced changes in biogeochemistry and hydrology. With his large national and international network he has over 30 ongoing collaborative projects across the world spanning from Greenland in the North to Burkina Faso in the south. He is the scientific director for the Krycklan Catchment Study (www.slu.se/Krycklan) and is involved in several large international synthesis projects such as the Powell Centre (http://powellcenter.usgs.gov) and North-Watch http://abdn.ac.uk/-northwatch). Hjalmar Laudon has co-authored 140 peer-reviewed papers in total, of which the 110 has been published the last 8 years.

5 most recent relevant publications

Laudon, H., Tetzlaff, D., Soulsby, C., Carey, S., Seibert, J., Buttle, J., Shanley, J., McDonnell, J.J., and McGuire, K. (2013). Change in winter climate will affect dissolved organic carbon and water fluxes in mid- to high latitude catchment, *Hydrological Processes*, 700-709 DOI: 10.1002/hyp.9686.

Haei, M., Öquist, M. G., Kreyling, J., Ilstedt, U. and **Laudon, H**. (2013). Winter climate controls soil carbon dynamics during summer in boreal forests. *Environmental Research Letters* 8, 024017. doi:10.1088/1748-9326/8/2/0240

Laudon, H., Buttle, J., Carey, S., McDonnell, J., and McGuire, K., Seibert, J., Shanley, J., Soulsby, C, and Tetzlaff, D, (2012). Cross-regional prediction of long-term trajectory of stream water DOC response to climate change. *Geophysical Research Letters*. 39, L18404, DOI: 10.1029/2012GL053033.

Laudon, H., Berggren, M., Ågren, A., Buffam, I., Bishop, K., Grabs, T., Jansson, M., Köhler,

S. (2011). Patterns and Dynamics of Dissolved Organic Carbon (DOC) in Boreal Streams: The Role of Processes, Connectivity, and Scaling, *Ecosystems*, 14, 880-893. DOI: 10.1007/s10021-011-9452-8).

Haei, M., Öquist, M.G., Buffam, I., Ågren, A., Blomkvist, P., Bishop, K., Ottosson Löfvenius, M. & **Laudon, H** (2010). Cold winter soils enhance dissolved organic carbon concentrations in soil and stream water. *Geophysical Research Letters*, 37, L08501, doi: 10.1029/2010GL042821.

Other personnel represented by the Principal Investigator (e.g. within the Principal Investigators department / institution, via a sub-contract, etc.) – please include name, organization, position, country, and brief description of role in the consortium

Please add the Principal Investigator's details, presenting a summary of achievements and the 5 most recent relevant publications, as well as an overview of other personnel represented by the PI

Name:Jan Karlsson

Role in Consortium: Leading PI

Organization: Department of ecology and environmental science, Umeå University, Sweden

Country:Sweden

Area of Research: Aquatic biogeochemistry with focus on carbon cycling in boreal and arctic lakes and streams

Highest academic qualification: Professor

Summary of achievements (max 3000 characters, including spaces)

Jan Karlsson obtained his PhD in 2001. Since 2011, he is a full professor (chair) in physical geography with focus on aquatic biogeochemistry at Umeå University. He is the co-director of the Climate Impact Research Centre (CIRC) and leader of several large research projects. He studies the functioning of aquatic ecosystems and how these are affected by climate. His research topics include interactions between abiotic factors and biological processes with a particular focus on terrestrial-aquatic interactions and the role of terrestrial organic matter in aquatic environments. Some of his research questions include what controls the productivity of lake ecosystems. Another portion of his research focuses on what controls the production and fluxes of greenhouse gases (GHG) in aquatic systems. Karlsson studies how GHG emissions are affected by climate and land use, and their importance relative to other sources and sinks for these emissions. His studies include mainly boreal and subarctic-arctic lakes, but more recently running water and costal systems. He has published 46 scientific papers since 2001 (29 the last 5 years) including highly ranked journal as Nature, Ecology letters, Global Change Biology, Global Biogeochemical Cycles and Ecology. Karlsson has several national and international assignments, e.g. Steering committee member for AnaEE (Infrastructure for Analysis and Experimentation on Ecosystems, EU infrastructure European Commission's 7th Framework programme), and Member of the Freshwater Expert Network within CAFF (Biodiversity working group of the Arctic Council).

5 most recent relevant publications

**marks PhDs with JK as main supervisor*

*Lundin, E., R. Giesler, A. Persson, M.S. Thompson, **J. Karlsson**. 2013. Integrating carbon emissions from lakes and streams in a subarctic catchment. Journal of Geophysical Research, 118, DOI: 10.1002/jgrg.20092

Karlsson, J., R. Giesler, J. Persson, E. Lundin. 2013. High emission of carbon dioxide and methane during ice thaw in high latitude lakes. Geophysical Research Letters, 40:1-5, DOI: 10.1002/grl.50152

*Ask, J**., J. Karlsson**, M. Jansson. 2012. Whole lake metabolic balances and CO_2 saturation in unproductive lakes. Global Biogeochemical Cycles, 26, doi:10.1029/2010GB003951IF: 5.263.

Karlsson, J., T. R. Christensen, P. Crill, J. Förster, D. Hammarlund, M. Jackowicz-Korczynski, U. Kokfelt, C. Roehm, P. Rosen. 2010. Quantifying the relative importance of lake emissions in the carbon budget of a subarctic catchment. Journal of Geophysical Research, 115, G03006, doi:10.1029/2010JG001305.

Jansson M., T. Hickler, A. Jonsson and **J. Karlsson**. 2008. Links between terrestrial primary production and lake mineralization and CO_2 emission in a climate gradient in subarctic Sweden. Ecosystems, 11:367-376, DOI: 10.1007/s10021-008-9127-2.

Other personnel represented by the Principal Investigator (e.g. within the Principal Investigators department / institution, via a sub-contract, etc.) – please include name, organization, position, country, and brief description of role in the consortium

Post doc based in Sweden. The main role of the requested postdoctoral research fellow (PDRF) based at Umeå University will be to work with CO2 and CH4 fluxes in lakes and streams along the climate gradient. This includes measurements of CO2 and CH4 concentrations and gas exchange velocities and handling and processing the data in order to estimate C fluxes and emissions across different regions. The intention is that the post doc should interact with the PDRF in Abeerdeen in combining the C flux data with data on water flow pathways and transit times.

Erik Geibrink, research technician, Department of ecology and environmental science, Umeå University, Sweden. Erik is technician in JKs research group with technical responsibility for field equipment, for a large scale experimental facility and for organizing field work for several major research programs. Erik has been developing new sensor-logger units for continuous measurements of CO2 in aquatic systems. Erik will build new CO2 sensor-logger units for the project and he will install and maintain all other equipment. He will also organize the field campaigns and be part of the sampling of lakes and streams. Erik will also be involved in the GIS and remote sensing work.

Erin Hotchkiss, Post doc, Department of ecology and environmental science, Umeå University, Sweden. Erin is a post doc in JKs research group and is currently developing a model for C emissions from integrated stream-lake networks. Erin will be part of the modelling in WP3.

Please add the Principal Investigator's details, presenting a summary of achievements and the 5 most recent relevant publications, as well as an overview of other personnel represented by the PI

Name: Sergey Kirpotin

Role in Consortium: PI

Organization: National Research, Tomsk State University

Country: Russia

Area of Research: landscape ecology, climate change, geocryology

Highest academic qualification: Professor

Summary of achievements (max 3000 characters, including spaces)

PhD in Botany, Doctor's degree in Ecology ("Morphology-geometrical Approach to Investigation of Space Heterogeneity of Ecosystems and Landscapes"); Vice-Rector for International Affairs, Tomsk State University (TSU); Russian coordinator of French-Russian Groupement de Recherche International (GDRI) «CAR WET SIB Biogeochemical cycle of carbon in wetlands of Western Siberia» net project (from 2007). Task coordinator in the INTAS 03-51-6294 "The effect of climate change on the pristine peatland ecosystems and (sub)actual carbon balance of the permafrost boundary zone in Sub-Arctic Western Siberia" (2004-2007). TSU co-ordinator of TASIC SCM TUNING project SCM-T027B05 "Tuning educational programmes in Russian Higher Educational Institutes". Co-leader of Mega-grant which was given in accordance with Resolution of the Government of the Russian Federation № 220 dated April 09, 2010, under Agreement № 14.B25.31.0001 with Ministry of Education and Science of the Russian Federation dated June 24, 2013 (BIO-GEO-CLIM)».Russian coordinator of the Russian-French Centre (2013) in the field of Environment, climate, continental surface, biosphere, grouping the CNRS, 20 French Universities, the SB RAS and 14 Siberian Universities, was created under the name of "French-Siberian Centre for Education and Research". This structure is mainly aimed at coordinating, developing and fostering all activities implied in linking the fundamental research with high education that plays a crucial role in the training of new generations of young scientists, and its priority direction "Environment and Ecology"

5 most recent relevant publications

1. Kirpotin S., Berezin A., Bazanov V., Polishchuk Y., Vorobiov S., Mironycheva-Tokoreva N., Kosykh N., Volkova I., Dupre B., Pokrovsky O., Kouraev A., Zakharova E., Shirokova L., Mognard N., Biancamaria S., Viers J., Kolmakova M. 2009. Western Siberia wetlands as indicator and regulator of climate change on the global scale // International Journal of Environmental Studies. 1029-0400, Volume 66, Issue 4, Pages 409 – 421

2. Pokrovsky, O. S., Shirokova, L. S., Kirpotin, S. N., Audry, S., Viers, J., and Dupré, B. 2011. Effect of permafrost thawing on organic carbon and trace element colloidal speciation in the thermokarst lakes of western Siberia, Biogeosciences, 8, 565-583, doi:10.5194/bg-8-565-2011

3. Kirpotin S., Polishcuk Y., Bryksina N., Sugaipova A., Kouraev A., Zakharova E., Pokrovsky O., Shirokova L., Kolmakova M., Manassypov R. & Dupre B. 2011.West Siberian palsa peatlands: distribution, typology, cyclic development, present-day climate-driven changes, seasonal hydrology and impact on CO2 cycle // International Journal of Environmental Studies. Volume 68, Issue 5, pp. 1–20.

4. Pokrovsky O. S., Shirokova L. S., Kirpotin S. N., Kulizhsky S. P., and Vorobiev S. N. 2013. Impact of western Siberia heat wave 2012 on greenhouse gases and trace metal concentration in thaw lakes of discontinuous permafrost zone. Biogeosciences, 10, 5349–5365, www.biogeosciences.net/10/5349/2013/ doi:10.5194/bg-10-5349-2013

5. Shirokova L.S., Pokrovsky O.S., Kirpotin S.N., Desmukh C., Pokrovsky B.G., Audry S., Viers J. 2013. Biogeochemistry of organic carbon, CO2, CH4, and trace elements in thermokarst water bodies in discontinuous permafrost zones of Western Siberia. Biogeochemistry. 113:573–593. DOI 10.1007/s10533-012-9790-4

Other personnel represented by the Principal Investigator (e.g. within the Principal Investigators department / institution, via a sub-contract, etc.) – please include name, organization, position, country, and brief description of role in the consortium

Sergey Kulizhsky and Sergey Vorobiev (Res Directors at Tomsk State University). They will be involved in planning the logistics for the expeditions and in the actuall sampling. They will also have contacts with Russian Hydrological Survey and Meteological service. Both also have good knowledge about characterising soil conditions in the catchments.

Please add the Principal Investigator's details, presenting a summary of achievements and the 5 most recent relevant publications, as well as an overview of other personnel represented by the PI

Name: Professor Chris Soulsby

Role in Consortium: PI UK

Organization: University of Aberdeen

Country: UK

Area of Research: Catchment ecohydrology, biogeochemical and stable isotope tracers, flow path ways and storage of water in the landscape

Highest academic qualification: DSc (Doctor of Science), PhD

Summary of achievements (max 3000 characters, including spaces)

Chris Soulsby's current position as Professor of Hydrology at the University of Aberdeen has developed from a geosciences background and has been based on a sustained commitment to excellence in research. This has resulted in the authorship of almost 200 papers indexed on ISI, with >3500 citations and h-index of 36. This research has been underpinned by involvement in successful funding worth in excess of £5 million. Chris has been involved in the successful supervision of 25 PhD students and effective management of over 10 post docs, most of whom have subsequently developed significant careers in science/academia or environmental management. These achievements have been recognised by his election as a Fellow of the America Geophysical Union – the largest international learned society for Geoscientists – this is an honour conferred on just 0.1% of the 60,000 membership each year.

Chris is currently the UK representative for tracers on the Committee of International Association of Hydrological Sciences and the UK representative on European Research Basin Network. He has been a theme leader in the International Association of Hydrological Sciences (IAHS) Initiative in Prediction in Ungauged Basins (PUB) and Vice President, International Commission on Tracers, International Association of Hydrological Sciences. He receives regular invitations for keynote lectures at American Geophysical Union (AGU) and European Geosciences Union (EGU) conferences.

Catchment hydrology has been a major research focus since his PhD. He has an enduring interest in the use of environmental tracers to understand the interactions between water flow paths, storage dynamics and transit time and their influence on stream flow response. This work has been carried out in a wide variety of geographical settings and at a range of spatial scales. Related to this, he has a strong interest in how terrestrial hydrological processes connect terrestrial landscapes to riverscapes and the ecological responses. This research has had three distinct features. First, a fundamental characteristic has been its strong interdisciplinarity with excellent collaborative links – both nationally and internationally - with a wider range of other scientists and engineers. A second feature has been an increasing interest in integrating more traditional field-based, empirical approaches with mathematical models to try and synthesise understanding in a quantitative manner. An important final feature has been the management context of sustainable use of land and water resources and maintaining the ecological status of rivers against societal pressures (e.g. land use change, hydropower generation etc.)

5 most recent relevant publications

*** marks PhDs or postdocs*

1. **Birkel. C., Tetzlaff, D. And Soulsby, C. (2013) Integrating parsimonious models of hydrological connectivity and soil biogeochemistry to simulate stream DOC dynamics. *Journal of Geophysical Research – Biogeosciences.*
2. **Birkel, C. Soulsby, C., Malcolm, I.A. and Tetzlaff, D. (2013) Modelling the dynamics of metabolism in montane streams using continuous dissolved oxygen measurements. *Water Resources Research*. 49, 5260-75.
3. Soulsby, C., **Piegat, K, Seibert, J. and Tetzlaff, D. (2011) Catchment scale estimates of flow path partitioning and water storage based on transit time and runoff modelling. *Hydrological Processes.* DOI: 10.1002/hyp.8324.
4. **Dawson, J.J.C., Soulsby C., Middlemiss, S., Tetzlaff, D., and Malcolm, I.A. (2009) Is the composition of DOC changing in upland acidic streams?. *Environmental Science and Technology.* DOI: 10.1021/es901649b.
5. **Dawson, J.J.C., Tetzlaff, D, **Speed M, **Hrachowitz, M. and Soulsby, C. (2011) Do multiple sources and attenuated hydrology lead to convergent DOC fluxes in larger catchments? *Hydrological Process.* DOI: 10.1002/hyp.7925.

Other personnel represented by the Principal Investigator (e.g. within the Principal Investigators department / institution, via a sub-contract, etc.) – please include name, organization, position, country, and brief description of role in the consortium

PDRF based in Aberdeen

The main role of the requested postdoctoral research fellow (PDRF) based at Aberdeen is preprocessing of existing data sets, analysis of spatial data using Geographic Information Systems (GIS), statistical and numerical analyses of existing and newly sampled data, and the integration of the empirical data into modelling frameworks, in particular transit time modelling approaches. Soulsby's group is world-leading in using stable isotope tracers to estimate transit times of waters in different geographical locations. Another major focus is the integration of tracer data into modelling frameworks to constrain model structure and improve model parametrisation of parsimonous, tracer-aided hydrological models. The PDRF will also be responsible for data base management and assisting with preparation of published outputs and result dissemination. The PDRF will also conduct the laboratory anlaysis of stable isotope samples. Most of the laboratory isotope analysis will be carried out directly at the University of Aberdeen as the local isotopic analysis guarantees control on data quality.

Professor Doerthe Tetzlaff

Professor in Hydrology and Landscape ecology; University of Aberdeen, UK

Doerthe Tetzlaff is Professor of Hydrology and Landscape Ecology at the University of Aberdeen. She is the PI at Aberdeen for a currently active consortium "HYDRA" funded by the NERC Arctic Programme (PI of whole consortium is P Wookey). She has already ~130 peer-reviewed publications, primarily in the top-leading, ISI listed hydrological and environmental journals. The total sum of citations of her publications without self-citations (using ISI Web of Science) is 766, with an h-index of 25, which is very high value in the research field of catchment hydrology and considering that her first paper was published not before 2005**.** Her highly innovative work has being invited to write key commentaries for the journal Hydrological Processes (HP), one of the world's top hydrology journals. In 2013, she was awarded an ERC grant, as the first female hydrologist in Europe,

investigating plant-water linkages in northern ecosystems. In 2013, she was also appointed as a member of Royal Society of Edinburgh (RSE) Young Academy of Scotland. She regularly receives invitations to give keynote lectures at international conference, e.g. the “Woo lecture” of the Canadian Geophysical Union in 2014; the Nelson Lecture Series at Syracuse University and a keynote at the American Geophysical Union conference in 2013, at the Berkeley catchment science symposium in 2012 so give just few examples of the past two years. She was also just appointed as the Editor-in-Chief for Hydrological Processes, starting from January 2015.

Tetzlaff will be CO-I in the UK. Her current grants funded by the ERC and NERC Artic Programme are highly relevant to the proposed study and will provide fruitful interlinkages with the proposed study, in terms of numerical skills and approaches tested in arctic environments. Insights gained within the current projects will feed directly into the planning of experiments carried out under NERC funding. Tetzlaff also has long-standing skills in Geographic Information systems which will be invaluable for the proposed study. Due to her time commitment within her ERC grant, Tetzlaff will contribute 1 hr/week over 3 years.

Information about attachment Jpi-template-budget_full-proposal.xls

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UK Financial Annex

Summary of Resources Required for Project

Summary fund heading	Fund heading	Full economic Cost	NERC contribution	% NERC contribution
Directly Incurred	Staff	£80,547	£64,438	80
	Travel & Subsistence	£35,000	£28,000	80
	Other Costs	£65,000	£52,000	80
	Sub-total	£180,547	£144,438	
Directly Allocated	Investigators	£31,380	£25,104	80
	Estates Costs	£13,716	£10,973	80
	Other Directly Allocated	£2,049	£1,639	80
	Sub-total	£47,145	£37,716	
Indirect Costs	Indirect Costs	£103,179	£82,543	80
	Total	**£330,871**	**£264,697**	

Summary of staff effort requested

	Months
Investigator	3.2
Researcher	24
Technician	
Other	
Visiting Researcher	
Student	
Total	27.2

МИНОБРНАУКИ РОССИИ
Федеральное государственное бюджетное образовательное учреждение высшего профессионального образования «Национальный исследовательский Томский государственный университет» ТГУ

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ИНН 7018012970

№ _____
на № _____ от 6.3.2014

Letter for supporting the JPI project '**Climate impact on the carbon emission and export from Siberian inland waters (SIWA)**'

Dear members of JPI committee,

The project SIWA proposed by Professor Karlsson and his colleagues is in total agreement to our own research here in Siberia. Studying the fate of organic carbon in wetlands, in particular thermokarst lakes, is critical for our understanding of general biogeochemical cycle of carbon. Siberia is one of the most important site on the planet where both carbon sequestration (contemporary peat formation) and release (thawing of ancient carbon and its microbiological heterotrophic respiration in surface water) occur. The SIWA project proposes new approaches to investigate climate impacts on the magnitude and potential change of the role of inland waters for atmospheric carbon emission, as well as lateral C export, in Siberia. This is important knowledge for both the scientific community and populations living in this area.

We are working for a number of years with CNRS (Centre National de la Recherche Scientifique, Toulouse) team and our collaboration is very successful, by forming students and post-docs and by publishing scientific articles in internationally recognized journals. We will be proud to continue this collaboration with the SIWA JPI project, by providing field facilities and infrastructures as well as our expertise in the field biogeochemistry of wetlands in Siberia. The main financial support for the SIWA project, around 100 k€ per year, that comes from mega-grant funding BIO-GEO-CLIM of Tomsk State University (P.I. Oleg S. Pokrovsky from CNRS), 2 M$ in 2014-2015 and from the Centre of Excellence of TSU "Biota and Climate" lead by S.N. Kirpotin, 2 M$ in 2016-2017.

Vice-Rector TSU,
Professor S. Kulizhskiy