INTER⇄ACT

Transnational Access

1. GENERAL INFORMATION ON THE PROJECT

Project Acronym (ID)	**ABISCO**
Project Title	**Aboveground-Belowground Interactions in a Siberian peatland eCOsystem – effect of climate change**
Name of Group Leader	Fatima LAGGOUN-DEFARGE
General discipline	Earth Sciences & Environment
Specific discipline	Ecosystems & Biodiversity
Name of organisation	Earth Science Institute of Orleans (ISTO) - University of Orleans / CNRS / BRGM (France)
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Dates spent at the station	June, 24th – July 3th 2013 – Mukhrino Field Station
Persons who used access:	Fatima Laggoun-Defarge (France) / Benoit D'Angelo, PhD student (France) / Marie-Laure Toussaint (France) / Edward Mitchell (Switzerland) / Luca Bragazza (Italy/Switzerland).
Number of mandays used	10 days * persons = 50 mandays

2. BACKGROUD

Peatlands are now recognised as valuable pools of sequestered C and their response for predicting potential feedbacks on the global C cycle becomes crucial. The key to C accumulation in peatlands is not the high net primary production (NPP) but the low rate of organic matter (OM) decomposition. Indeed, highest C sequestration is in ombrotrophic bogs, which have low NPP. Therefore, high research priority should be given to how the constraints to decomposition in these environments are sensitive to climate. One scenario is the accelerated decomposition of OM and the resulting increase of greenhouse gases (CO_2 and CH_4) in the atmosphere. **Northern hemisphere peatlands contain one-third of the world's soil organic C stock** (455 Gt) despite accounting for only 3–5% of total terrestrial surface. Since continental regions account for a significant proportion of all northern hemisphere peatlands (e.g. much of Russia and North America) that are expected to experience strong climate changes in the coming centuries, their potential feedbacks are becoming essential for future climate projections. **For this reason, a better understanding of the biogeochemical responses of Siberian peatlands to climate change is crucial to forecast the future of soil organic C and the feedback on C cycling at global scale.**

ABISCO has strong scientific links with many present and past European and national projects[1] based for most of them on experimental studies and in which the Applicants are or have been involved as coordinators or participants. These projects address key topics of global change biology (climate change effects on ecosystems, C cycle and biodiversity) and all of them operate mostly in temperate and Western Europe (France, Switzerland, Poland) **but have weak connection to sub-arctic zones** (e.g. Siberia). Consequently, in bringing together geochemists, meteorologists, ecologists, biologists, microbiologists, hydrologists and palaeoecologists in an interdisciplinary research effort our aim is **to test the response of *Sphagnum* peatlands to drought and climate**

[1] e.g. PEATWARM of the French ANR (http://peatwarm.cnrs-orleans.fr/), CLIMPEAT of the Poland-Swiss Research Program, PEATBOG
of the ERA-Net Biodiversa Research Initiative (http://www.egs.mmu.ac.uk/peatbog/), CLIMABOG of the Swiss National Science Foundation (http://ecos.epfl.ch/page-57428-en.html), RECIPE of the 5th Framework EU project (http://www.macaulay.ac.uk/RECIPE/)

warming using two complementary approaches: a natural climate gradient and experimental climatic manipulation along this gradient.

3. OBJECTIVES

The objective of ABISCO is to evaluate the effects of temperature increase in combination with drought stress on the interactions between aboveground, i.e., plants, and belowground, i.e., soil microbes, components in controlling the production and the fate of labile C compounds.

By manipulating soil and air temperature in combination with a change in hydrological regime, we want to test the following main hypotheses:

(i) higher peat temperature and lower peat water content will result in a shift of plant species cover from a *Sphagnum*-dominated system to a vascular plant-dominated system;

(ii) an increase of vascular plant cover is promoted by a higher competitive advantage for N and P acquisition by vascular plants compared to soil microbes;

(iii) a change in plant species cover will affect the quality and the quantity of C substrate in peat soil;

(iv) climate-induced change of vegetation will affect the primary productivity of the system and soil respiration rate.

The collected data in the frame of this project will ultimately be used **to develop a model of peat accumulation in relation to the relative dominance of *Sphagnum* and vascular plants**. Indeed, any modification of the competitive ability between vascular plants and Sphagnum mosses, and between microbes and plants for N and P acquisition will necessarily affect plant productivity and then the quality and the quantity of litter that will ultimately feed the soil organic matter and C. By means of rhizodeposition, plants are expected to influence microbial abundance and activity, which will be then reflected in soil enzymatic activity, peat and water chemistry and nutrient cycling. The goal is the creation of a **biogeochemical model of C** that includes interactions between these key-compartments. The study of the most useful biological and geochemical compartments will lead to a better **identification and calibration of markers** of temperature-drought-induced changes. The patterns of the newly identified proxies throughout the peat records will be used to reconstruct climate changes during the last centuries in Siberia.

ABISCO project will be very relevant for both EU and Russian partners: (i) the opportunities available in Western Siberia to perform experimental research on **pristine peatlands** are of high value since this country hosts very representative peatlands and quantitatively important at global scale and for global change issues and (ii) the Russian researchers will gain expertise from EU partners in already tested field techniques and laboratory analyses and will have the opportunity to compare Western Siberian peatlands with those of Europe, where, because of the present climate, many peatlands are closer to the critical ecological conditions, and can thus provide valuable information on threshold.

ABISCO project will hopefully spark a long-term monitoring at Mukhrino Field Station which allows us to set up a future larger Europe – Siberia network. In this way, **ABISCO will open the door for a larger FP-7 EU project** that will integrate more partners in Europe and in Siberia, thus **developing the peatland research community in Europe**.

4. RESEARCH METHODS AND MATERIAL, ETHICAL ISSUES

This research will be carried out in collaboration with Yugra State University at Mukhrino Field Station (MFS, Siberia) which has an available experimental station equipped with (i) devices (Open Top Chambers) for experimental warming and trenches for water table manipulation (30 manipulated and control plots) and (ii) monitoring devices: piezometers and sensors for measuring

the water table level and soil temperature in each plot. The proposed research programme will be based on: (i) *in situ* monitoring of climatic and environmental variables in the manipulated and in the control plots; (ii) analysis of vegetation cover, productivity and composition during the growing season; (iii) biogeochemical characterization of plant litter, surface peat and pore water.

=> In situ *monitoring of climatic and environmental variables in the manipulated and in the control plots*

A set of data logger will be installed in the control and the manipulated plots in order to measure: soil temperature, soil water content, air temperature. Data loggers will be inserted at different depth in order to take into account the upper microclimatic conditions of living *Sphagnum* layer and the below decomposing peat layer.

=> Analysis of vegetation cover, productivity and composition during the growing season

The specific objective is to study the effect of the stress factors, i.e. experimental warming and hydrological changes, on vegetation structure and net primary production of *Sphagnum* mosses and vascular plants. Our hypothesis is that climate warming in association with drought stress will allow vascular plants to increase their performance (especially the above-ground biomass allocation) and that *Sphagnum* species will be harmed by extreme summer events. Furthermore, we hypothesise that the temperature increase will have an effect on chemical plasticity of some plants, which in turn can affect the microbial community structure.
In both control and manipulated plots, response variables will be (i) vegetation cover (point-intercept frequency measure, densities) and (ii) net primary production (indirect measures with the cranked-wire and capitulum correction methods for mosses, with biometric measures for vascular plants).

=> Biogeochemical characterization of plant litter, surface peat and pore water.

A biogeochemical characterization of plant litter, surface peat and pore-water will be carried out as representative of conditions at time "zero" of the experiment. Litter samples will be collected and sorted for the main plant species; then, tissue nutrient concentration of C, N and P will be determined. Aboveground content will be calculated based on concentration and total biomass. Pore-water samples will be collected at two different depths (upper living moss layer and below decomposing layer) and concentration of main nutrient (NO3, PO4, NH4, total N) will be determined in association with the concentration of dissolved organic C (DOC). In addition, a spectrophotometric characterization of DOC will be also carried out on peat water samples. Surface peat samples, i.e., upper living moss layer and the immediately below decomposing peat layer, will be characterized for their total nutrient concentration of C, N and P.
In peat samples as well as in pore-water samples, the activity of the four main hydrolytic enzymes will be determined: beta-glucosidase, beta-1,4-N-acetylglucosaminidase, leucine aminopeptidase and phosphatase, respectively involved in the degradation of cellulose, chitine, proteins and phosphorous. In addition, the activity of the oxidative enzyme phenol-oxidase will be also determined in the same samples.

5. IMPLEMENTATION: TIMETABLE, BUDGET, DISTRIBUTION OF WORK

Name	Dates	Mandays	Distribution of work
Fatima LAGGOUN-DEFARGE	01/07/2013 – 10/07/2012	10	Coordination / sampling and analysis of peat organic matter
Benoit D'ANGELO, PhD student	01/07/2013 – 10/07/2012	10	Sampling and analysis of solid and dissolved organic matter
Edward MITCHELL	01/07/2013 –	10	Sampling and analysis of plant and litter

	10/07/2012		protists (amoebae)
Luca BRAGAZZA	01/07/2013 – 10/07/2012	10	Sampling and analysis of nutrient content of water and enzymatic activities
Marie-Laure TOUSSAINT	01/07/2013 – 10/07/2012	10	Installation of sensors (temperature, water table…)
Sebastien GOGO*	01/07/2013 – 10/07/2012	0	Sampling and analysis of dissolved organic carbon
Alexandre BUTTLER*	01/07/2013 – 10/07/2012	0	Analysis of vegetation cover and productivity

** S. Gogo and A. Buttler will be part of the consortium but not funded from INTERACT*

5. EXPECTED RESULTS AND POSSIBLE RISKS

ABISCO project will particularly allow: **(i)** putting together various knowledge and expertise in peatland research in relation to climate change, **(ii)** analysing and comparing processes in peatlands located along a latitudinal and oceanic – continental gradient. The unique opportunity of linking the MFS of the ABISCO project to other study sites located at different latitudes, i.e., a peatland site in the temperate zone at mid-latitude (Frasne, France/ PEATWARM ANR project) and a peatland site located in temperate-cold climate at intermediate latitude (Linje, Poland, CLIMPEAT project), will permit to create a latitudinal gradient for long-term monitoring of peatland responses to climate change.

Good former cooperation between the European partners makes the project highly feasible. The expertise at hand in the associated laboratories will be shared so as to obtain the **desired added-value and for outreaching research**. This common action allows also saving time since the techniques that are being used have already been experienced and tested by the EU partners.

The applicants already proved to be efficient in dissemination of obtained data and indeed, they wrote several joint papers and cooperated in several projects. Also, the direct access to data and methods from other previous or still running projects (e.g. PEATWARM, CLIMABOG) is a tremendous asset in this project and gives a promising perspective for obtaining reliable data and for good outputs in publications. The results of ABISCO project will be used for several publications in highly ranked scientific journals, using new results from the different partners and revisiting former ones in the light of the studied oceanic-continental gradient. For the international visibility of our joint scientific effort, we will also give both oral and poster presentations at international conferences. We plan also to organise an **international workshop at Yugra University on spring 2014**, inviting speakers from other countries. This is part of the strategy for consolidating the network and paving the way for a future larger European project.

We will also plan to give free accesses to raw collected data once they have been used for scientific publications. To this aim, we are planning to create a website to store the collected raw data.