ABBY-Net Research Workshop Agenda Munich 2022

Workshop Overview

Workshop Venue and Participants

The workshop will be held for ABBY-Net members from November 6th to 10th at the Ludwigs-Maximilian University in Munich.

Workshop Goals

- To provide a status of previous E^3-projects and learn about the actively ongoing E^3-systems and ABBY-Net Research projects
- To learn about collaborative project opportunities of individual ABBY-Net PIs and develop new project ideas for 2023
- To exchange information about co-funding opportunities
- To plan the syllabus for the 2023 summer school (i.e. Kananaskis concept with the aim to increase tangible output potential)

Tentative Program

Day 1: Nov 6	*Activity*	*Venue*
19:00 +	**Opening Workshop Dinner**	**Augustiner Lagerkeller**
Day 2: Nov 7	*Activity*	*Venue*
8:30 – 9:00	**Workshop Opening** (Dr. Ludwig)	**LMU**
9:00 – 12:00	***Session 1a: Research Highlights and Opportunities by ABBY-Net PIs***	
9:00-9:15	*Dr. Marco Pruckner*	
9:20 – 9:40	*Dr. Joule Bergerson*	
9:40 – 10:00	*Dr. Greg McDermid*	
10:00 – 10:20	*Dr. Pierre Mertiny*	
10:20 – 10:30	**COFFEE BREAK**	
10:30 – 12:00	***Special Project: Carbon Neutral LNG*** *(Dr. Juergen Karl)*	
12:00 - 13:00	**LUNCH**	
13:00 - 18:00	**Session 2) ABBY-Net Collaborative Research Projects**	**LMU**
13:00 – 13:20	**What is E^3-systems research? An Introduction and Status of Projects** (Dr. Ludwig)	
13:20 - 13:40	Presentation 1: Modelling Solar Irradiance for Seismic Line Restoration Assessment. Where do trees have enough light to grow? (Hegels)	
13:40 – 14:00	Presentation 2: Radar Interferometry as a technique for mapping surface deformation around peatland linear disturbances (Heiss)	

14:00 – 14:20	Presentation 3: Remote Sensing Microtopography and Watertable in Peatlands (Koch)	
14:20 - 14:40	Presentation 4: Carnot batteries for flexible and scalable energy storage in renewable energy systems (Weitzer)	
14:40 - 15:00	**COFFEE BREAK**	
15:00 – 15:20	Presentation 5: Investigating the environmental implications of biogas pathways using the life cycle impact assessment model (Kalu)	
15:20 – 18:00	***Session 1b: Research Highlights and Opportunities by ABBY-Net PIs***	**LMU**
15:20 – 15:40	*Dr. Ralf Ludwig*	
15:40 – 16:00	*Dr. Bernhard Mayer*	
16:00 – 16:20	*Dr. Scott Ketcheson*	
16:20 – 16:40	*Dr. Petr Musilek*	
16:40 – 17:00	*Dr. Mario Nascimento*	
17:00 – 17:20	*Dr. Matthias Schubert*	
17:20 – 18:00	**Session 3 a) Brainstorming for Collaborative New Projects for 2023**	
18:00 +	**Workshop Dinner**	

Day 3: Nov 8	*Activity*	*Venue*
9:00 – 12:00	**Excursion to renewable energy installations**	
12:00 – 13:00	**LUNCH**	
13:00 – 18:00	**Excursion to renewable energy installations**	**Solarpark Donaumoos**
18:00 – 19:30	**Workshop Dinner**	
20:30 +	**Social activity: FC Bayern game**	

Day 4: Nov 9	*Activity*	*Venue*
9:00 – 10:20	**Session 3b) Speed-dating for Collaborative New Projects for 2023**	**LMU**
10:20 – 10:30	**COFFEE BREAK**	
10:30 – 12:00	**Session 3c) Plenary sharing of new project ideas (5-10 minute presentations)**	
12:00 – 14:00	**LUNCH**	
14:00 – 15:00	**Session 4) Information on academic exchange and co-funding opportunities** (LMU, BayFOR)	

15:00 - 15:30	**COFFEE BREAK**	
15:30 – 18:30	**Session 5) Summer School Syllabus Planning**	**LMU**
18:00 – 20:00	**Workshop Dinner**	
20:00 +	**Session 3d) New project idea formulation (project outline) - drafting**	
Day 5: Nov 10	***Activity***	***Venue***
9:00 – 11:00	**Session 3d) New project idea formulation (project outline) - refinement**	**LMU**
11:00 – 12:00	**Closing Session – review and action items**	
12:00 – 13:00	**LUNCH**	
13:00 – 18:00	**Munich City Tour (Ludwig)/ Extra Time for Project Meetings**	
18:00	**Closing Workshop Dinner**	

ABBY-NET E^3-Systems Research Project Update 2022:
Modelling Solar Irradiance for Seismic Line Restoration Assessment

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Research Team:
Greg McDermid, University of Calgary, Department of Geography
Ralf Ludwig, Ludwig-Maximilians-University of Munich, Department of Geography
Scott Ketcheson, Athabasca University, Faculty of Science and Technology

Project summary

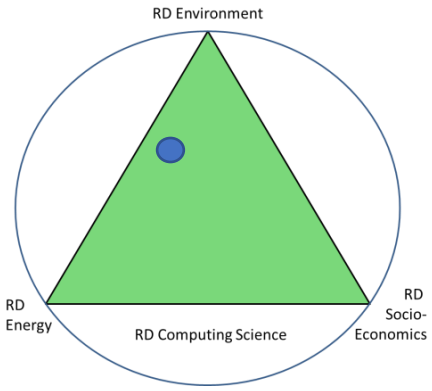
The boreal ecosystem in Northern Alberta is strongly segmented by seismic lines: linear corridors created for oil and gas exploration. Unfortunately, many of these lines are in a state of recovering slowly and may require active intervention. Knowing the site-limiting factors constraining tree growth on those lines would be beneficial for restoration management and planning. The goal of this research project is to measure and model photosynthetically active radiation (PAR) using in-situ measurements and remote sensing. My specific objectives are (i) to characterize the relative PAR conditions on seismic lines using in-situ sensors, (ii) identify the factors controlling relative PAR variability, and (iii) to develop and validate a spatially explicit model that predicts relative PAR using light detection and ranging (LiDAR) data. The project contributes to the Boreal Ecosystem Recovery and Assessment (BERA) project.

Progress to date

The project started in April 2022 and is currently underway. Accomplishments to date include (i) project specification and sampling design, (ii) procurement and calibration of in situ sensors, (iii) planning and completion of field work in the boreal forest, and (iv) the data acquisition of PAR and LiDAR data. Data preparation and pre-processing is still in progress. The aim is to begin analysis in December.

Contribution to E3-system and Implications

My goal is to contribute to boreal restoration practices surrounding seismic lines: a major anthropogenic footprint feature associated with energy (oil and gas) development. Light (PAR) availability is a growth-limiting factor for tree growth and forest establishment on industrial disturbances. Remote-sensing technologies that can effectively support the modeling of PAR availability will contribute to the efficiency and effectiveness of boreal restoration efforts.



Geographic location

The study area is located in the boreal forest of northern Alberta.

Final Outcomes

The project will be continued through a master thesis supervised by Greg McDermid and Ralf Ludwig starting this November. It is anticipated to publish a scientific paper of the results and outcomes of this study.

ABBY-NET E^3-Systems Research Project Update 2022:

Radar Interferometry as a technique for mapping surface deformation around peatland linear disturbances

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Research Team:
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Greg McDermid, University of Calgary, Department of Geography
Scott Ketcheson, Athabasca University, Faculty of Science and Technology

Project summary

Previous research has shown that mineral-filled access roads and other linear disturbances can disrupt the local hydrology in boreal peatlands. This disruptions can cause changes in surface-oscillation patterns that extend well into the surrounding landscape. Willier (2017) showed that these effects vary between wetland type, and are influenced by other factors like road orientation to the direction of water movement. This project will assess two different remote-sensing techniques – persistent scatterer interferometry (PSI) and small baseline subset (SBAS) – for characterizing surface oscillations in boreal peatlands. My goal is to observe the spatial and temporal effects of energy infrastructure (including roads, culverts and well pads) on various wetland types in northern Alberta.

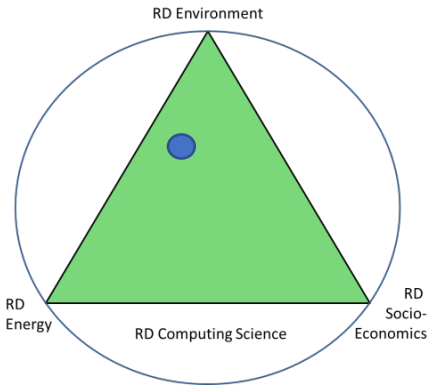
Progress to date

The project started in April 2022, and it is following the following timeline:

(1) Project specification, literature research, objectives and project design (complete)
(2) A workflow for SBAS and PSI radar interferometry for Sentinel 1 satellite data over the period of several years (seasonal analysis) from 2017 till 2022 (complete)
(3) Field work in the area of interest to familiarize myself with this specific area, take RTK measurements, read-out groundwater datalogger and collect met-station data (complete)
(4) The workflow has been implemented and some first results are finished but more data has to be processed (in progress)
(5) LMU master's thesis will be written (first few months of 2023).

Contribution to E3-system and Implications

The goal of this project is to assess the potential of Radar Interferometry as a technique for mapping surface deformation around peatland linear disturbances. Considering the big picture and where and why to situate this project within BERA the overall goal is to link surface motions to the water table and therefore to carbon emissions due to respiratory effects.



Geographic location

The fieldwork has been conducted on the Aspen lease (Imperial Energy), near the town of Ft MacKay in northern Alberta.

Final Outcomes

The aim of the project is to record the results in a master's thesis and possibly a resulting scientific paper supervised by Ralf Ludwig, Greg McDermid, and Scott Ketcheson.

ABBY-NET E^3-Systems Research Project Update 2022:
Application of LiDAR to quantifymicrotopography on seismic lines

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Research Team:
Scott Ketcheson, University of Athabasca, Faculty of Science and Technology
Ralf Ludwig, Ludwigs-Maximilians Universität, Department of Geography
Greg McDermid, University of Calgary, Department of Geography

Project summary

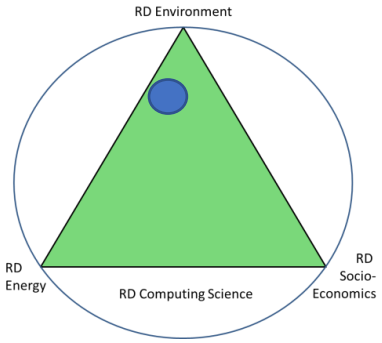
Seismic lines created for oil and gas exploration, have an estimated total length of up to 1,7 Mio. km in Alberta alone and bear complex, often problematic impacts on the ecology of the boreal forests. On many of these lines the vegetation is failing to recover and in a state of arrested succession. The variability of hummocks and hollows, characteristic for the microtopography in peatlands, influences regrowth on seismic lines, as hummocks allow young seedlings to grow slightly elevated above the shallow groundwater table. Artificial mounding has been one strategy to spur regrowth on seismic lines by creating artificial hummocks for seedlings to grow on. By identifying the level of microtopography on lines, treatment can be applied more efficiently to lines with a depressed microtopography. So far studies measuring microtopography in peatlands have been conducted using photogrammetry, which is limited in its ability to measure ground surfaces through canopy cover. Using the superior canopy penetration capabilities of LiDAR we aim to achieve accurate measurements of microtopography throughout a variety of ecosites and dense vegetation.

Progress to date

For this study high resolution UAV LiDAR-data with a point density of 150 points per sqm was collected for 28 sites in Stony Mountain, Kirby South and Surmount. To validate the quality of LiDAR derived ground models a total of around 4500 RTK-measurements were conducted in three 15 m transects. The difference between LiDAR and RTK measurements was determined in order to estimate the accuracy of the ground models across the ecosites. Microtopographic variability is then quantified by deriving the roughness of the ground model. We will then test if it is possible to derive similar results in the quantification of microtopography through lower LiDAR point densities of 10-15 points per sqm available for large parts of the BERA study region.

Contribution to E3-system and Implications

By applying treatment to lines with poor microtopography, the cost of restoring seismic lines can be lowered while limiting harmful new disruptions to regenerating lines with a healthy microtopography. Preliminary results suggest that high-resolution LiDAR enables us to penetrate decently thick canopies without disrupting accuracy to a great degree. It can be observed that roughness values for smaller seismic lines are often higher than on conventional lines, suggesting a faster recovery, although how this plays out over different ecosites has yet to be analyzed more closely.



Geographic location

The geographic location of this study area is exclusively in Alberta.

Final Outcomes

A master thesis on the microtopography of seismic lines. (Conceptual phase)
A technical paper on the application of LiDAR to measure microtopography in boreal forests. (Conceptual phase)

ABBY-NET E^3-Systems Research Project Update 2022:
Carnot batteries for flexible and scalable energy storage

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Research Team:
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Prof. Dr. Katharina Herkendell, FAU, Department of Chemical and Biological Engineering

Project summary

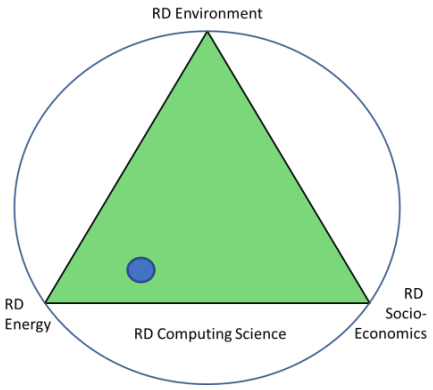
Carnot batteries are an emerging technology for electrical energy storage. A power-to-heat process utilizes surplus renewable energy to charge a thermal energy storage. The thermal energy can be transferred back to electrical energy by the reverse process on demand. The project mainly addresses the technical demonstration of Carnot batteries in energy systems with increasing share of renewables. The scope of work comprises thermodynamic simulations, design aspects as well as experimental validation at a Carnot battery pilot plant. Additionally, assessment of economic feasibility accompanies the project. Ultimately, the project targets at characterizing the technical and economic potential and analysing application scenarios of this novel energy storage technology.

Progress to date

The initial project focusing on the development and realization of a prototype was funded by the Bavarian state government within the Energy Campus Nürnberg and was completed in 2021. Highlight of the project was the commissioning of a first-of-its-kind Carnot battery pilot plant. However, research in this field did not stop with the successful proof of concept. Currently, extensive experimental testing delivers data to feed a digital twin of the plant which allows to develop effective control strategies and to determine optimizations on component and process level. Moreover, a co-supervised Master's thesis in the ABBY-Net consortium is envisaged to quantify and compare the prospects of Carnot batteries in the Canadian and German energy markets.

Contribution to E3-system and Implications

So far, a team of researchers and students from several institutes at FAU investigated and developed Carnot batteries. However, the conducted work had a strong focus on the technical engineering perspective accompanied by simple techno-economic models. An intended broader approach within the E3-system enables a holistic evaluation of this technology and spotlights novel aspects including life cycle emissions and ecological footprint. The central research question is which role Carnot batteries can play in Canadian and German energy markets with respect to competing storage technologies.



Geographic location

The simulative and experimental work has been performed at FAU so far. However, an extension of the findings to the Canadian energy market as well as interdisciplinary cooperation with experts from Alberta is intended.

Final Outcomes

The research outcomes are regularly published at conferences and in papers (see the simulative study on Flash cycles in Carnot batteries, DOI: 10.1016/j.enconman.2022.115323). Several Bachelor's and Master's theses support the research activities. Finally, the results will be published in Maximilian Weitzer's PhD thesis.

ABBY-NET E^3-Systems Research Project Summary2022:

Investigating the environmental implications of biogas pathways using the life cycle impact assessment model to support Albertan energy transitions

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Research Team:
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Prof. Joule Bergerson, University of Calgary, Dept. Of Chemical and Petroleum Engineering

Project summary

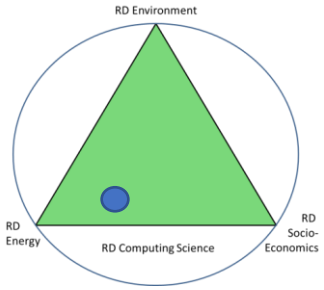
The objectives of this research is to explore different energy emission and climate change related problems while finding the tradeoffs across various impacts when maize silage is used as biogas feedstock in Canada. The purpose of this study is to explore the opportunities and challenges of alternative/renewable energy technologies in the region of Alberta (Canada) and their environmental implications for proper policy decision-making within the interface of energy transition, climate change, and environmental protection. Additionally, to evaluate the environmental impacts of cultivating corn (maize silage) and the processing (digestion and conversion) for the production of biogas for electricity and heat generation. From the study's scientific findings, relevant information on the interconnectedness of the bioenergy and the environment is generated. The project is significant because it will contribute to the existing body of knowledge on the need for reduction of excessive emission of greenhouse gases, land conversion, and nutrient delivery through bioenergy generation. The proffered solutions will help to reduce emission and strike a balance between the present and future alternative energy development and environmental prosperity.

Progress to date

Research has been completed, doctorate degree acquired. Thanks to Profs. Ralf and Joule for their support.

Contribution to E3-system and Implications

A research outcome implication for energy transition and E3-systems. The research discipline is within the boarders of RD Environment and RD Energy as indicated in the triangle below by moving the blue circle.



Geographic location

Alberta and Germany.

Final Outcomes

Environmental modeling paper to support German energy transition is published in 2021.
Life cycle impact assessment paper to support Albertan energy transition is in progress, to be published soon.
Final thesis for both case studies has been completed and submitted.