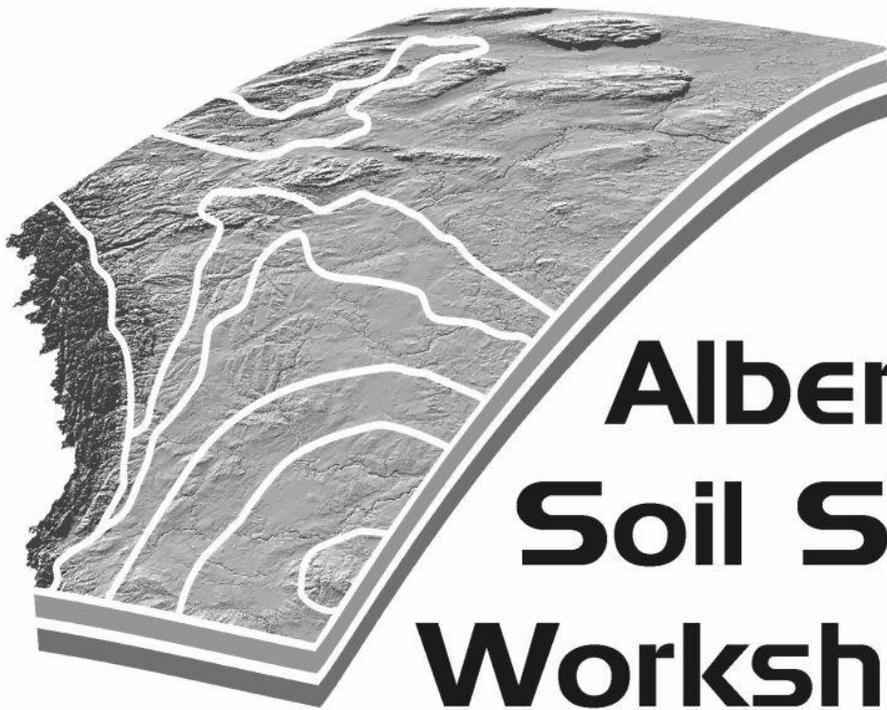


Program for the 55th Annual



Alberta Soil Science Workshop

Workshop Theme:

**Harnessing Big Data to
Advance Soil Science**

February 20 to 22, 2018

InnoTech Alberta
Edmonton, Alberta

www.soilsworkshop.ab.ca

About the Alberta Soil Science Workshop

The Alberta Soil Science Workshop is held to facilitate regional interaction among professionals in soil science. Typically 100 to 150 participants gather for a 1½ to 2 day program that comprises 40 to 60 oral and poster presentations. These include: keynote papers focussed on the workshop theme, technical papers within five distinct fields, and volunteer papers. Currently the five technical groups are: Land Use and Rangelands, Soil Fertility, Technology and Soil Science, Land Reclamation, and Forest, Riparian and Wetland Soils. This year we have a special technical session on the Technology and Soil Science.

Workshop participants are professionals from private industry (e.g. consultants in agronomy, pedology, reclamation, remediation, and environmental services; chemists from commercial analytical laboratories), government (federal, provincial, municipal) and academia (universities and colleges). The Workshop is graduate student-friendly, providing an excellent opportunity to enhance presentation skills in a supportive setting (travel bursaries are available for out-of-town students; awards are provided for the best student presentations).

Update on Alberta Soils Tour

Konstantin Dlusskiy, Ph.D., P.Ag, Chair of Soils Tour

The Alberta Soils Tour (AST) and the Alberta Soil Science Workshop (ASSW) were born the same year – in 1962 under the umbrella of the Alberta Advisory Fertilizer Committee. The two events went hand by hand for the last 55 years but the role of ASSW in AST evolved with time. From 1962 to and 1988, both were organized by the Alberta Soil Advisory Committee (ASAC). In 1989, the ASAC was abolished and initiative was held by volunteers. Between 1990 and 2013, ASSW sponsored the Tour that was organized by a group of enthusiasts. Since 2013, the group lost its interest in organizing this event with a 50-year tradition and the AST was ready to go extinct.

In 2016, a new group of volunteers picked up the ball. AST was reinitiated under an umbrella of the ASSW. In 2017, ASSW adopted the AST as its integral part, and the Soils Tour Sub-Committee was formed to keep succession of the AST. The Organizing Committee of the ASSW took the responsibility to organize the AST every two years and to find volunteers to do that.

The Sub-Committee and a group of volunteers from across the Province organized the 2017 Alberta Soils Tour to the Athabasca Oil Sands Region in May 2017. The 3-day event brought over 50 participants across boreal landscapes of Alberta to Fort McMurray and north of it. Tour Leaders provided background on soil formation and the various soil profiles for each of the landscapes encountered during the Tour. Various soil conservation, land reclamation, and agronomy challenges were addressed through the prism of pedology. Having 2016 Fort McMurray Fire fresh in memory, special emphasis was made on forest fire history in the area. The 2017 Tour attracted many sponsors across Canada and received a very positive feedback from its participants.

The AST is not just a two or three day field trip hosted biannually. It requires preparation trips, arrangements for logistics and post-tour presentations. At this point, we are already planning for the 2019 Tour. It will go across the prairies of Central Alberta likely starting in Red Deer, AB.

The current activities of the Soils Tour Sub-Committee include:

- Presenting the 2017 Tour at the Volunteer session (see the Abstract in this volume),
- Announcing the 2019 Alberta Soils Tour at the ASSW General Meeting,
- Presenting at the AIA Edmonton Branch meeting in March 2018,
- Contacting potential partners and volunteers in the Red Deer-Drumheller area,
- Organizing a reconnaissance trip to select sites (May-June 2018), and
- Encouraging potential volunteers to join the Soils Tour Sub-Committee and the 2019 Tour team.

At the ASSW, we believe that the AST is an important component in propagation of soil science in Alberta and future education of environmental professionals. It is also

a great opportunity for networking and professional development. We are looking forward to organizing the AST through the years to come for the benefits of soil science and professionals in Alberta.

Alberta Soil Science Workshop Organizing Committee

Past Chair	Preston Sorenson Maapera Analytics, Edmonton AB
Chair	Dani Degenhardt InnoTech, Edmonton AB
Treasurer	Derek MacKenzie Department of Renewable Resources, University of Alberta, Edmonton AB
Sponsorship	Janna Casson Alberta Agriculture and Forestry, Lethbridge AB
Soils Tour	Konstantin Dlusskiy Paragon Soil and Environmental Consulting
Secretary	Ben Thomas Agriculture and Agri-Food Canada, Agassiz, BC
Web Administrator	Andrew Underwood InnoTech, Edmonton AB

Technical Session Chairs

Soil Fertility	Len Kryzanowski Alberta Agriculture and Forestry, Edmonton AB
Land Use and Rangelands	Karen Raven and Janna Casson Alberta Agriculture and Forestry, Edmonton AB
Land Reclamation	Deo A. Heeraman Wood, Calgary AB
Forest, Riparian and Wetland Soils	Bin Xu Northern Alberta Institute of Technology, Peace River AB
Technology and Soil Science	Preston Sorenson Maapera Analytics, Edmonton AB
Volunteer Session	Konstantin Dlusskiy Paragon Soil and Environmental Consulting

Sponsors

We would like to thank the following sponsors for helping make the 2018 Alberta Soil Science Workshop possible.



Program – 2018 Alberta Soil Science Workshop

Tuesday, February 20, 2018

- 15:00 – 17:00 PM** Registration and Refreshment break in Cafeteria
- 15:00 – 17:30 PM** Pre-workshop on The Anthroposolic Soil Order
(Multipurpose Room H1-16)

Wednesday, February 21, 2018

- 7:00 AM** Registration
- 7:00 – 8:00 AM** Breakfast (Cafeteria)
- 8:00 – 12:00 PM** Plenary Session (Auditorium)
- 10:00 – 10:25 AM** Coffee and Refreshments (Cafeteria)
- 12:00 – 1:00 PM** Lunch (Cafeteria)
- 1:00 – 2:25 PM** Technology and Soil Science Technical Session (Multipurpose Room H1-16)
Soil Fertility Technical Session (Auditorium)
- 2:25 – 2:45 PM** Coffee and Refreshments
- 2:45 – 4:10 PM** Technology and Soil Science Technical Session (Multipurpose Room H1-16)
Soil Fertility Technical Session (Auditorium)
- 4:10 – 5:30 PM** Poster Session
- 4:10 – 5:30 PM** Refreshment and Appetizers (Cafeteria)
- 6:00 – 9:00 PM** Banquet and Entertainment (Radisson Hotel)

Thursday, February 22, 2018

- 7:00 – 8:00 AM** Breakfast (Cafeteria)
- 8:00 – 10:05 AM** Land Use and Rangelands Technical Session (Multipurpose Room H1-16)
Land Reclamation Technical Session (Auditorium)
- 10:05 – 10:35 AM** Coffee and Refreshments
(Cafeteria)
- 10:35 – 12:00 AM** Volunteer Technical Session (Multipurpose Room H1-16)
Forested, Wetland and Riparian Soils Technical Session (Auditorium)
- 12:00 – 1:00 PM** Lunch and ASSW Business Meeting
(Cafeteria)

Detailed Program

Tuesday, February 20, 2018 – Afternoon

Pre-workshop – Multipurpose Room H1-16

3:00 – 5:30 PM The Anthroposolic Soil Order

Dr. Konstantin Dlusskiy

Paragon Soil and Environmental Consulting

Increasing anthropogenic activity resulted in continuously expanding areas of disturbed and human-made soils. In many cases, those soils cannot be adequately described using the existing soil classifications, including the 3rd edition of the Canadian System of Soil Classification (CSSC).

This issue has been addressed through multiple researches across the World. Extensive review provided by Dr. Anne Naeth with colleagues (Naeth et al, 2012) shows that none of the classification systems, developed by that time, satisfy the needs of Canadian soil scientists. In a response, the team proposed a new Soil Order to be included in the coming 4th edition of the CSSC (Naeth et al 2012). The system was considered by the Canadian Society of Soil Science (CSSS) and used in development of the Field Handbook for the Soils of Western Canada (Sec 4: Pennock et al 2015; Sec 5: Pennock et al 2016).

Since publication of the Handbook in 2016, Anthroposolic soil classification is at the field testing stage. Members of soil and land reclamation communities are encouraged to test the classification and provide their feedback to CSSS for future rectification.

Participants of this workshop will review:

- classification of Anthroposols,
- diagnostic features, and
- nomenclature of anthropogenic soil horizons.

Examples from various reclaimed areas will illustrate common variants of Anthroposols in Alberta. These examples will provide an opportunity for workshop participants to practice description and classification of Anthroposols. Discussion will be focused on limitations of the proposed classification, possible ways to improve

it, and on the feedback to the CSSS.

Wednesday, February 21, 2018 – Morning

Plenary Session – Auditorium

- 7:00 – 8:00** **Breakfast – Cafeteria**
- 8:15 – 8:30** **Welcome and Introduction**
Dr. Dani Degenhardt
InnoTech Alberta
- 8:30 – 9:15** **Standing on the Shoulders of Giants: Soil survey for the next generation**
Dr. Angela Bedard-Haughn
University of Saskatchewan
- 9:15 – 10:00** **Shifting from Precision Agriculture to Decision Agriculture**
Jack Payne
Farmer's edge
- 10:00 – 10:25** **Coffee and Refreshments – Cafeteria**
- 10:25 – 11:10** **New Paths to Extracting and Synthesizing Science in Management and Biomedicine: Is There a Future For Big Science in Soil Science?**
Dr. Krista Uggerslev
Northern Alberta Institute of Technology
- 11:10 – 11:55**
Ryan Brown
Starscream Aerial Services
- 12:00 – 1:00** **Lunch – Cafeteria**

Wednesday, February 21, 2018 – Afternoon

Concurrent Technical Sessions

PM	Agronomic Soil Fertility Auditorium	Technology and Soil Science Multipurpose Room H1-16
1:00 – 1:05	Chair: Len Kryzanowski Alberta Agriculture and Forestry	Chair: Preston Sorenson Maapera Analytics
1:05 – 1:25	<p>Response of Industrial Hemp to Different Nitrogen Rates Grown on Luvisolic Soils in Peace Region of Alberta</p> <p><i>Jan Slaski¹ and Khalil Ahmed²</i></p> <p>¹InnoTech Alberta, Vegreville, AB ²SARDA Ag Research, Falher, AB</p>	<p>National Pedon Database pedon data entry tool - a step towards harnessing big data</p> <p><i>Javed Iqbal¹, David Spiess¹, Michael Bock² and Ben Stewart</i></p> <p>¹Alberta Agriculture and Forestry, Edmonton, AB ²Agriculture and Agri-Food Canada, Ottawa, ON</p>
1:25 – 1:45	<p>Soil N balance after soybean and dry bean in southern Alberta</p> <p><i>Tram T.N. Thai^{1,2}, Francis J. Larney², James E. Thomas¹, Manjula S. Bandara³ and Doon G. Pauly⁴</i></p> <p>¹Dept. of Biological Sciences, University of Lethbridge, Lethbridge, AB ²Agriculture & Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB ³Alberta Agriculture & Forestry, Crop Diversification Centre South, Brooks, AB ⁴Alberta Agriculture & Forestry, Lethbridge, AB</p>	<p>Biggish Data: Compilation and Use of the Upland Forest Soil Carbon and Profile Database</p> <p><i>Cindy Shaw¹, Kelly Bona¹, Oleksandra Hararuk² and Werner Kurz²</i></p> <p>¹Canadian Forest Service, Northern Forestry Centre, Edmonton, AB ²Canadian Forest Service, Pacific Forestry Centre, Victoria, BC</p>
1:45 – 2:05	<p>Harmsen-Mitscherlich model to predict 4R crop nitrogen requirements in Alberta</p> <p><i>Symon Mezbahuddin¹ and Len Kryzanowski¹</i></p> <p>¹Alberta Agriculture and Forestry, Edmonton, AB</p>	<p>Water Nutrient Management of Athabasca River Basin in Changing Climate</p> <p><i>Junye Wang¹ and Narayan Kumar Shrestha¹</i></p> <p>¹Faculty of Science and Technology, Athabasca University, Edmonton, AB</p>

2:05 – 2:25	<p>Alberta Farm Fertilizer Information and Recommendation Manager (AFFIRM):</p> <p>Decision Support Tool for Agriculture Nutrient Stewardship</p> <p><i>Len Kryzanowski¹, Symon Mezbahuddin¹ and Trevor Wallace¹</i></p> <p>¹Alberta Agriculture and Forestry, Edmonton, AB</p>	<p>High Resolution Measurement of Soil Organic Carbon and Total Nitrogen with Laboratory Imaging Spectroscopy</p> <p><i>Preston Sorenson¹, Sylvie Quideau¹ and Benoit Rivard²</i></p> <p>¹Department of Renewable Resources, University of Alberta, Edmonton, AB</p> <p>²Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB</p>
2:25 – 2:45	Coffee break – Cafeteria	
	Environmental Soil Fertility Auditorium	Technology and Soil Science Multipurpose Room H1-16
2:45 – 2:50	Chair: Len Kryzanowski Alberta Agriculture and Forestry	Chair: Preston Sorenson Maaper Analytics
2:50 – 3:10	<p>Measuring the Environmental Footprint of Alberta Peas</p> <p><i>Aung Moe¹, Roger Bryan¹, Tom Goddard¹, Kerrienne Koehler-Munro¹, Len Kryzanowski¹, Mark Olsor² and Nevin Rosaasen³</i></p> <p>¹Alberta Agriculture and Forestry, Edmonton, AB</p> <p>²Alberta Agriculture and Forestry, Stony Plain, AB</p> <p>³Alberta Pulse Growers, Leduc, AB</p>	<p>Automation of Data Management for Effective Use of Near Infrared Spectroscopy</p> <p><i>Mark Beasse¹ and Preston Sorenson¹</i></p> <p>¹Maaper Analytics Inc., Edmonton, AB</p>
3:10 – 3:30	<p>Long-term Rotation and Fertilization Management Effects on Soil Properties, Crop Response to Fertilizers and Greenhouse Gas Emissions</p> <p><i>Mekonnen Giweta¹, Miles Dyck¹, Sukdhev S. Malhi¹ and Dick Puurveen¹</i></p> <p>¹Department of Renewable Resources, University of Alberta, Edmonton, AB</p>	<p>Predictive Soil Mapping Pilot in NE Alberta</p> <p><i>Craig Aumann¹</i></p> <p>¹InnoTech Alberta, Edmonton, AB</p>
3:30 – 3:50	<p>Evaluation of nitrogen stabilizers for enhanced nitrogen use efficiency and reduced greenhouse gas emissions in Alberta cereal</p>	<p>Unmanned Aerial Vehicles (UAVs) Based High Resolution Data Acquisition for Gravel Pit Assessment and Reclamation Planning</p>

	<p>crops</p> <p><i>Miles Dyck¹, Yuanpei (Kean) Gao¹, Dick Puurveen¹ and Len Kryzanowski²</i></p> <p>¹Department of Renewable Resources, University of Alberta, Edmonton, AB</p> <p>²Alberta Agriculture and Forestry, Edmonton, AB</p>	<p><i>Yohannes Getachew¹ and Deo A. Heeraman¹</i></p> <p>¹Wood, Calgary, AB</p>
3:50 – 4:10	<p>A detailed inventory for estimating nitrous oxide and methane emissions from agriculture with application to Alberta province</p> <p><i>Junye Wang¹ and Dimitre D. Dimitrov¹</i></p> <p>¹Faculty of Science and Technology, Athabasca University, Edmonton, AB</p>	
4:10 – 5:30	Poster Session	

Wednesday, February 21 – Afternoon
Poster Session 4:10 – 5:30 PM

1.	<p>Reforestation of the boreal forest using hitchhiker seedling stock Jessica J. Hudson, Amanda L. Schoonmaker, Brad D. Pinno and M. Derek MacKenzie</p>
2.	<p>Natural Salinity Characterization of Soils in Southern Alberta Nelson F. Bernal and Alfredo Carcamo</p>
3.	<p>Reclamation of a winter road built with wood chips: application of the peat inversion technique in a new context Melanie Bird, Bin Xu and Kimberley Murray</p>
4.	<p>Developing Novel Materials for Reclamation and Remediation of Land and Water Jin-Hyeob Kwak, Scott X. Chang, M Anne Naeth and Mohamed Gamal El-Din</p>
5.	<p>Effect of pine sawdust biochar on greenhouse gas emission from forest and grassland soils under laboratory condition Prem Pokharel, Jin-Hyeob Kwak, Scott X. Chang and Yong Sik OK</p>
6.	<p>Conservation Farming across the Soil Zones in Alberta Wallace Sawchuk, Deb Werk, Janna Casson and Rob Dunn</p>
7.	<p>N₂O Emissions and Barley Productivity as affected by Land Application of Biosolids Carmen Cecilia Roman Perez, Guillermo Hernandez Ramirez, Jichen Li, Germar Lohstraeter and Len Kryzanowski</p>
8.	<p>Could dung pats treated with and without ivermectin alter insect activities and impact soil available nitrogen on native pastures? Courtney Soden, Xiyong Hao, Ben W. Thomas, Jessica Stoeckli, Kevin Floate and Newton Lupwayi</p>
9.	<p>Yield Response to Available Soil Nitrogen in Wheat in Western Canada Musfira Jamil, Allen Good and Guillermo Hernandez Ramirez</p>
10.	<p>Area-Based Nitrous Oxide Emissions from Wheat Fields under Contrasting Fertilizer Types applied in the Fall or Spring E.M. Shakila K. Thilakarathna, Guillermo Hernandez Ramirez, Dick Puurveen, Len Kryzanowski, Germar Lohstraeter and Leigh-Anne Powers</p>
11.	<p>Assessing agronomic nitrogen management to mitigate environmental and</p>

	<p>economic losses in Alberta</p> <p>Symon Mezbahuddin, David Spiess, David Hildebrand, Len Kryzanowski, Daniel Itenfisu and Robert Grant</p>
12.	<p>Estimating nitrogen mineralization for improved nitrogen fertilizer recommendations in Alberta</p> <p>Symon Mezbahuddin, Len Kryzanowski, Ross H. McKenzie, Adil Akbar, Craig Sprout, Germar Lohstraeter, Leigh-Anne Powers and John O'Donovan</p>
13.	<p>More Carbon may not be Better for Scoring Functions to Assess Soil Health in Long-Term Manure Plots</p> <p>Ben W. Thomas, Jessica L. Stoeckli, Courtney Soden, Elisha Jones, Xiying Hao, Kui Liu and Sherry A.E. Fillmore</p>
14.	<p>Broad spectrum biocontrol potential exhibited by plant growth promoting rhizobacteria native to diverse agro-ecological regions</p> <p>Saira Ali, Sohail Hameed, Asma Imran, George Lazarovits and Mazhar Gonadal</p>

Thursday, February 22, 2018 – Morning
Concurrent Technical Sessions

AM	<p style="text-align: center;">Land Reclamation Auditorium</p>	<p style="text-align: center;">Land Use and Rangelands Multipurpose Room H1-16</p>
8:00 - 8:05	<p style="text-align: center;">Chair: Deo A. Heeraman Wood</p>	<p style="text-align: center;">Chair: Karen Raven Alberta Agriculture and Forestry</p>
8:05 – 8:25	<p>Biochar affects aspen seedling growth and function of reclaimed soils in the Athabasca oil sands region</p> <p><i>Sebastian T. Dietrich¹ and M. Derek MacKenzie¹</i></p> <p>¹Department of Renewable Resources, University of Alberta, Edmonton, AB</p>	<p>Big Data, Earth Observation and Innovation: Importance of Networks & Asking the Right Questions</p> <p><i>Shane Patterson¹</i></p> <p>¹Conservation and Reclamation Policy, Alberta Environment and Parks, Edmonton, AB</p>
8:25 – 8:45	<p>Optimization of cost and functionally effective vegetation management solutions for forest reclamation: Project set up and first year results</p> <p><i>Amanda Schoonmaker¹, Stefan Schreiber¹ and Trevor Floreani¹</i></p> <p>¹Boreal Research Institute, Northern Alberta Institute of Technology, Peace River, AB</p>	<p>Data Access for Innovation: Open Data Areas Alberta</p> <p><i>Erik Holmlund¹</i></p> <p>¹Alberta Data Partnerships Ltd., Edmonton, AB</p>
8:45 – 9:05	<p>Wheat Yield and Soil Properties Reveal Legacy Effects of Artificial Erosion and Amendments on a Dryland Dark Brown Chernozem</p> <p><i>Francis J. Larney¹ and Andrew F. Olson¹</i></p> <p>¹Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, Lethbridge, AB</p>	<p>State of the Prairie Cover Monitoring and Reporting between 1986 and 2016: Grassland Vegetation Classification for State of the Prairie Reporting Using Temporal Statistics Images based on a 30 year Landsat Satellite Archive for Alberta focused in the Grassland and Parkland Natural Region</p> <p><i>Derek Rogge¹, Preston Sorenson¹, Thomas Esch², Ron McNeil³, Karen Raven⁴, David Spiess⁵, John O'Donovan⁶, Elwin Smith⁷</i></p> <p>¹Maapera Analytics Inc., Edmonton, AB</p> <p>²German Aerospace Center, Oberpfaffenhofen, Germany</p>

		<p>³Prairie Conservation Forum, Edmonton, AB</p> <p>⁴Prairie Conservation Forum, Alberta Agriculture and Forestry, Edmonton, AB</p> <p>⁵Alberta Agriculture and Forestry, Edmonton, AB</p> <p>⁶Agriculture and Agri-Food Canada, Lacombe Research and Development Centre, Lacombe, AB</p> <p>⁷Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, Lethbridge, AB</p>
9:05 – 9:25	<p>Regeneration dynamics of seedling origin aspen: Managing for resiliency in forest restoration</p> <p><i>Carolyn King¹ and Simon Landhäusser¹</i></p> <p>¹Department of Renewable Resources, University of Alberta, Edmonton, AB</p>	<p>The potential supply of ecosystem services from livestock BMPs in Alberta's rangelands</p> <p><i>Majid Iravani¹, Karen Raven², Eric Butterworth¹ and Marian Weber³</i></p> <p>¹Alberta Biodiversity Monitoring Institute, University of Alberta, Edmonton, AB</p> <p>²Alberta Agriculture and Forestry, Edmonton, AB</p> <p>³InnoTech Alberta, Edmonton, AB</p>
9:25 – 9:45	<p>Decomposition of trembling aspen leaf litter under long-term nitrogen and sulfur deposition: Effects of litter chemistry and forest floor microbial properties</p> <p><i>Qi Wang¹, Jin-Hyeob Kwak¹, Scott X. Chang¹ and Woo-Jung Cho²</i></p> <p>¹Department of Renewable Resources, University of Alberta, Edmonton, AB</p> <p>²Department of Rural & Biosystems Engineering, Chonnam National University, Gwangju, Korea</p>	<p>Effect of Grazing System on Greenhouse Gas Emissions from Grassland Soils on the Canadian Prairies</p> <p><i>Bharat Shrestha¹, Scott Chang¹, Edward Bork¹, Cam Carlyle¹, Karen Thompson¹, Mark S Boyce², James F. Cahill³, Jessica Grenke², Ray Desjardins³, Ward Smith³, Steven I. Apfelbaum⁴ and Richard Teague⁵</i></p> <p>¹Faculty of Agricultural Life and Environmental Sciences, University of Alberta, Edmonton, AB</p> <p>²Department of Biological Sciences, University of Alberta, Edmonton, AB</p> <p>³Agriculture and Agri-Food Canada, Ottawa Research and Development Centre, Ottawa, ON</p> <p>⁴Applied Ecological Services, Inc. Brodhead, WI</p> <p>⁵Dept. of Ecosystem Science and Management, Texas A&M University,</p>

		College Station, TX
9:45 – 10:05	<p>Influence of strip-shelterwood harvesting on snowpack dynamics and seasonal soil moisture in the Southern Alberta Rockies</p> <p><i>Daniel Greenacre¹, Uldis Silins¹, and Miles Dyck¹</i></p> <p>¹Department of Renewable Resources, University of Alberta, Edmonton, AB</p>	<p>The effects of simulated grazing on litter microbial enzyme activity, vegetation, soil thermal properties and soil health in Alberta's rangelands</p> <p><i>Sara Barszczewski^{1,2}, Cameron N. Carlyle¹ and Xiyang Hao²</i></p> <p>¹University of Alberta, Edmonton, AB</p> <p>²Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, Lethbridge, AB</p>
10:05 – 10:35	Break	
	<p>Forested, Wetland and Riparian Soils</p> <p>Auditorium</p>	<p>Volunteer Session</p> <p>Multipurpose Room H1-16</p>
10:35 – 10:40	<p>Chair: Bin Xu</p> <p>Northern Alberta Institute of Technology</p>	<p>Chair: Konstantin Dlusskiy</p> <p>Paragon Soil and Environmental Consulting</p>
10:40 – 11:00	<p>Dynamics of Ion Adsorption by PRS Probes in Moderately-Saline Wetlands</p> <p><i>Eric Bremer¹, Jim J. Miller², T. Curtis², Jeremy A. Hartssock³ and Dale H. Vitt³</i></p> <p>¹Western Ag Innovations, Lethbridge, AB</p> <p>²Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, Lethbridge, AB</p> <p>³Center for Ecology and Department of Plant Biology, Southern Illinois University, Carbondale, IL</p>	<p>Activities of Dung-Breeding Insects Affect Soil Fauna in Grasslands</p> <p><i>Newton Lupwayi¹, Derrick Kanashiro¹, Kevin Floate¹ and Xiyang Hao¹</i></p> <p>¹Agriculture and Agri-Food Canada, Lethbridge, AB</p>
11:00 – 11:20	<p>The impact of permafrost thaw on the carbon store of a peatland complex in western Canada</p> <p><i>Liam Heffernan¹, Cristian Estop-Aragonés², Klaus-Holger Knorr³ and David Olefeldt⁴</i></p> <p>¹Department of Renewable Resources,</p>	<p>Monitoring Cultivation Practice Change using Landsat</p> <p><i>David Hildebrand¹</i></p> <p>¹Alberta Agriculture and Forestry, Edmonton, AB</p>

	<p>University of Alberta, Edmonton, AB</p> <p>²Department of Renewable Resources, University of Alberta, Edmonton, AB</p> <p>³Ecohydrology and Biogeochemistry Group, Institute of Landscape Ecology, Münster, Germany</p> <p>⁴Department of Renewable Resources, University of Alberta, Edmonton, AB</p>	
11:20 – 11:40	<p>Saturated zone depth variation at toe and depressional slope positions in a doughnut-moraine landscape</p> <p><i>Ivan Whitson¹</i></p> <p>¹Whitson Innovations Inc., Edmonton, AB</p>	<p>Soil carbon fluxes in a North American temperate alpine ecosystem</p> <p><i>Cole Brachmann¹, David S. Hik¹ and Guillermo Hernandez Ramirez¹</i></p> <p>¹Department of Renewable Resources, University of Alberta, Edmonton, AB</p>
11:40 – 12:00	<p>Rhizosphere microbial communities and boreal forest vegetation shifts</p> <p><i>Sarah Thacker¹ and Sylvie Quideau¹</i></p> <p>¹Department of Renewable Resources, University of Alberta, Edmonton, AB</p>	<p>Alberta Soils Tour 2017</p> <p><i>Konstantin Dluskiy¹, Len Leskiw¹ and Larry Turchenek¹</i></p> <p>¹Paragon Soil and Environmental Consulting Inc., Edmonton, AB</p>
12:00 – 13:00	Lunch and ASSW Business Meeting (Cafeteria)	

Plenary Session Abstracts

Wednesday, February 21, 2018

Standing on the Shoulders of Giants: Soil survey for the next generation

Dr. Angela Bedard-Haughn

University of Saskatchewan, Saskatoon, SK

angela.bedard-haughn@usask.ca

Biography

Angela Bedard-Haughn is a professor in the Department of Soil Science at the University of Saskatchewan. She was born and raised in the Black soil zone, on a farm a few miles north of St. Brieux, SK. She completed her B.Sc. in Physical Geography and her M.Sc. in Soil Science at University of Saskatchewan before heading south to University of California at Davis for her Ph.D in Soil Science. She returned to Saskatoon in 2004 and joined the Soil Science faculty in 2006. Her research focuses on applied pedology: examining how soil properties affect – and are affected by – land use and climate change, with an emphasis on wetland soils, digital soil mapping and soil information management.

Shifting from Precision Agriculture to Decision Agriculture

Jack Payne

Farmers Edge, Olds, AB

jack.payne@farmersedge.ca

Abstract

Precision agriculture which utilizes variable rate fertilizer applications is recognized as a component of 4R Nutrient Stewardship. However, advances in technology is providing farmers with access to much more information which can complement variable rate applications. Big data management is a key component of managing a sustainable farming operation. This presentation will discuss some of the new sources of data which farmers can use to make management decisions.

Biography

Jack is currently an Operations Coordinator with Farmers Edge. He is responsible for development of operating procedures, training and learning paths for staff. He provides mentorship and training for agronomists and farmers with emphasis on precision or variable rate agriculture practices. Jack grew up on a grain farm in west central Saskatchewan and received his formal education at the University of Saskatchewan.

Prior to joining Farmers Edge Jack was an instructor with Olds College for 14 years teaching courses in weed management, soil fertility, environmental farm management, pesticide application, and crop diagnostics. Previous to this he spent 12 years with Alberta Agriculture working as a District Agriculturist and Regional Soils Specialist in southern Alberta.

He has served on the Prairie Certified Crop Advisor Board as well as committees for the Alberta Pulse Growers Association. Jack is an avid outdoorsman and enjoys fishing and archery with family.

New Paths to Extracting and Synthesizing Science in Management and Biomedicine: Is There a Future For Big Science in Soil Science?

Dr. Krista Uggerslev

Northern Alberta Institute of Technology, Edmonton, AB

KristaU@nait.ca

Abstract

Massive amounts of scientific data are locked behind paywalls with billions of research findings buried in lengthy and hard-to-find journal articles. Not being able to locate and extract findings impedes progress and the application of new knowledge. Inspired to build a solution to these challenges, Dr. Krista Uggerslev co-created metaBUS to aid in advancing science and foster evidence-informed decision making in the field of management. She demonstrates how the team was able to build data visualizations to work in the management field, and explores a second set of approaches for building and organizing information for ready location and synthesis in the biomedical field through the SyntheSci project. Is soil science rife for this type of big science solution?

Biography

Dr. Krista Uggerslev is the Applied Research Chair in Leadership and Talent at the Northern Alberta Institute of Technology. Krista holds Ph.D. and M.Sc. degrees in Industrial and Organizational Psychology from the University of Calgary, and was a tenured Associate Professor in the Asper School of Business at the University of Manitoba. Krista's research has appeared in the world's top academic journals in applied psychology and business, and has been presented to national and international audiences including NATO. She leads two big science projects, metaBUS and SyntheSci, aiming to revolutionize how we locate and integrate scientific data.

Soil Fertility Technical Session Abstracts

Wednesday, February 21, 2018 – Afternoon

Response of Industrial Hemp to Different Nitrogen Rates Grown on Luvisolic Soils in Peace Region of Alberta

Jan Slaski

InnoTech Alberta Vegreville, AB

Khalil Ahmed

SARDA Ag Research Falher, AB

Corresponding author: research@sarda.ca

Abstract

The study was aimed to investigate the response of seed and fiber type hemp to different rates of nitrogen grown on Luvisolic soils. The trial was run for three years at Falher (2015-2017) in Randomized Complete Block (RCB) design with four replications. Six rates of nitrogen: 0, 30, 60, 90, 120, and 150 kg/ha were applied in the form of urea to test the response of hemp cultivars; X59, Finola and Silesia. P, K and S rates were applied according to soil test recommendations for an average yield. The three years of study experienced unfavorable weather conditions including drought, waterlogging and hail.

Increasing nitrogen rates have significantly affected performance of three varieties representing different usage types, including grain type Finola and X59 and fiber type Silesia. For these tested varieties, increasing N rates increased the grain and straw yield. It seems that increasing nitrogen supply had more profound impacts on grain production than on stem biomass. The application of nitrogen fertilizer slightly increased the population of male plants in the canopy and delayed the maturity. Genotypical differences were found among the tested varieties with regard to nitrogen applications. Both studied grain-type varieties (X59 and Finola) were more responsive to the increasing rate of N fertilizer than the fiber type Silesia with respect to seed production, while the opposite was reported for stem production indicating that separate N fertilization programs should be developed for varieties of different usage types. These observations indicate that separate N fertilization programs should be recommended for varieties of different usage type meant for different production end points (i.e. grain or fiber) and could be further adjusted to match weather conditions.

Soil N balance after soybean and dry bean in southern Alberta

Tram T.N. Thai

Dept. of Biological Sciences, University of Lethbridge, Lethbridge, AB
Agriculture & Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB

Francis J. Larney

Agriculture & Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB

James E. Thomas

Dept. of Biological Sciences, University of Lethbridge, Lethbridge, AB

Manjula S. Bandara

Alberta Agriculture & Forestry, Crop Diversification Centre South, Brooks, AB

Doon G. Pauly

Alberta Agriculture & Forestry, Lethbridge, AB

Corresponding author: tram.thai@uleth.ca

Abstract

Numerous studies have reported the effects of plant density on yield of soybean [*Glycine max* (L.) Merrill] and dry bean (*Phaseolus vulgaris* L.), but effects of density on soil N balance are less well documented. We conducted experiments at Bow Island and Lethbridge, AB using soybean, dry bean and barley (*Hordeum vulgare* L., a non-legume) in Year 1 (2014, 2015) followed by wheat (*Triticum aestivum* L.) with no N fertilizer in Year 2 (2015, 2016). In Year 1 there were two soybean genotypes, at two row spacings (wide row – 35 cm and narrow row – 17.5 cm); and three seeding densities (30, 50, 80 seeds m⁻²). Dry bean was planted in narrow (35 cm, 25 seeds m⁻²) or wide rows (52.5 cm, 40 seeds m⁻²), at 0 and 60 kg N ha⁻¹. We compared 3 methods of estimating N fixation (¹⁵N natural abundance, N difference, wheat N uptake) and estimated soil N balance using above and below ground biomass. Dry bean had a lower N fixation ability compared with soybean, but N gain for wheat following dry bean was 2 times that of soybean (46 vs 24 kg ha⁻¹). However, both legumes resulted in deficits in soil N balance in legume–wheat systems (–129 kg ha⁻¹ for dry bean; and from –153 to –168 kg ha⁻¹ for soybean), even allowing for some estimation of N from belowground biomass.

Harmsen-Mitscherlich model to predict 4R crop nitrogen requirements in Alberta

Symon Mezbahuddin, Len Kryzanowski

Alberta Agriculture and Forestry, Edmonton, AB

Corresponding author: symon.mezbahuddin@gov.ab.ca

Abstract

Nitrogen is often the most limiting nutrient to crop yield. Crop nitrogen availability can also be affected by moisture availability and agronomic nitrogen management. 4R (Right Source @ Right Rate, Right Time and Right Place) nitrogen management has the potential to optimize crop nitrogen use towards profitability and reduction of environmental footprint of crop production. Determining crop nitrogen requirements under different 4R management scenarios requires better predictive capacity of how crop yield varies with 4R nitrogen management under different moisture conditions. However, fertilizer application is not only an agronomic decision but also an economic decision. It is therefore imperative to have an agro-economic model to recommend 4R nitrogen fertilizer management for different crops, under different moisture conditions.

The objective of this study was to define N and water requirements of canola, barley and wheat in a semi-arid climate and to develop a predictive model for making N fertilizer recommendations. The Harmsen-Mitscherlich equation is a biologically relevant model which recognizes law of diminishing returns, and assumes that crop yield is plateaued at a maximum or potential yield. This potential yield is limited by moisture availability, and increases linearly with increasing moisture availability. The model also assumes that crop nutrient availability increases curvilinearly with increasing moisture availability. Hence, predicted crop yields by this model are functions of yield based water and nutrient (e.g. nitrogen) use efficiencies that are agronomically relevant and quantifiable. Once yield based water and nitrogen use efficiencies are known, crop nitrogen requirements can be predicted for different moisture and nitrogen availability.

The data used to validate the model were from the field experiments of the “Enabling Adoption of Environmentally Smart Nitrogen (ESN) Technology to Maximize Economic Returns and Environmental Benefits in Alberta”. Over 40 site-years of field research data spanning 5 years (2008-2012) for 9 field sites across Alberta was used in this study. Each field site had 3 crops (canola, barley and wheat) and 3 nitrogen fertilizer sources (urea, ESN and urea/ESN blend). Fertilizer timing and placement treatments included 1) fall banded, 2) spring banded, and 3) spring seed placed. There were 5 nitrogen fertilizer application rates (0, 30, 60, 90 and 120 kg N/ha) for each source/timing/placement combination. Pre-plant soil and post-harvest plant sampling provided an assessment of Mitscherlich-modeled relationships among yield, soil N and water availability, economic optimal N supply, and fertilizer rates over the course of the study.

Regressions of modelled vs. measured crop yields produced R^2 of around 0.8, slopes within 0.1 of 1.0 and smaller intercept values indicates the model's ability to predict crop yield responses under different 4R nitrogen management scenarios over wide range of soil and moisture conditions across Alberta. The model also predicted crop yield variations due to different 4R nitrogen management options at a given moisture condition for a given soil zone. The yield response functions will be incorporated into the Alberta Farm Fertilizer Information and Recommendation Manager (AFFIRM), to allow the user to evaluate 4R Nutrient Stewardship options.

Alberta Farm Fertilizer Information and Recommendation Manager (AFFIRM): Decision Support Tool for Agriculture Nutrient Stewardship

Len Kryzanowski, Symon Mezbahuddin and Trevor Wallace

Alberta Agriculture and Forestry, Edmonton, AB

Corresponding author: len.kryzanowski@gov.ab.ca

Abstract

The Alberta Farm Fertilizer Information and Recommendation Manager (AFFIRM) is a decision support software that aids the user to make nutrient management decisions, and has been in existence since 1996. Modernization of this stand-alone software application to a stable, sustainable and reliable web browser application began in 2014. In addition, enhancements based on extensive Alberta-based field and laboratory nutrient stewardship research provides various management choices including: nutrient sources (fertilizers and manure), timing (fall vs spring) placement (surface, seed-placed and subsurface banding) options with economic analysis to determine appropriate nutrient rates of application, to optimize agronomic and economic benefits, and minimize environmental impacts.

AFFIRM provides practical access and use of foundational and current Alberta agronomic research, information and diagnostics to support Alberta producer nutrient management decisions. It will serve as a platform for delivery of current and future nutrient management research and information. It is a highly effective knowledge translation and transfer decision support tool. Science based agronomic research is combined with economics to aid farmers and other users when making nutrient use decisions by encouraging efficient nutrient use management and practices specific to their farm operations and conditions to improve crop productivity, economic profitability, competitiveness, and environmental sustainability. It allows the user to develop specific management option scenarios; match decisions made by experts; reach a target market; help change nutrient management practices; results in improved economic returns; and continues to be used by a spectrum of users including producers, researchers, students, industry agents, consultants and extension specialists.

Measuring the Environmental Footprint of Alberta Peas

Aung Moe, Roger Bryan, Tom Goddard, Kerrienne Koehler-Munro, Len Kryzanowski and Mark Olson

Alberta Agriculture and Forestry, Edmonton and Stony Plain, AB

Nevin Rosaasen

Alberta Pulse Growers, Leduc, AB

Corresponding author: aung.moe@gov.ab.ca

Abstract

Sustainability of agri-food systems has never been more important than it is today. An Alberta pea environmental footprint assessment using a method called life cycle assessment (LCA) was completed to understand the sustainability performance and identify opportunities for improvement. Farm data from Alberta pea growers was collected for the 2015 crop year on crop yield, farm inputs (seed, inoculant, fertilizers, herbicide, fungicide and desiccant), field operations (seeding, chemical application and harvesting) and transportation distances for farm activities and deliveries.

Alberta pea production contributed to a lower carbon footprint than other crops because of less nitrogen (N) fertilizer required and the adoption of a no-till system. Crop inputs and field operations were major contributors to the carbon footprint and other environmental footprints of Alberta pea production. Synthetic fertilizers, particularly phosphorus fertilizer and field emissions accounted for a majority of the environmental footprints from crop inputs. Alberta pea's carbon footprint was 0.183 kg CO₂-e/kg of peas at the farm gate. LCA results provide a better understanding of which farm inputs or operations contribute to the greatest environmental footprints and are an effective way to communicate information on the products' environmental footprints to stakeholders across supply chains.

Long-term Rotation and Fertilization Management Effects on Soil Properties, Crop Response to Fertilizers and Greenhouse Gas Emissions

Mekonnen Giweta, Miles Dyck, Sukdhev S. Malhi and Dick Puurveen

Department of Renewable Resources, University of Alberta, Edmonton, AB

Corresponding author: mdyck@ualberta.ca

Abstract

The effect of long-term fertilization history and crop rotation on growing season nitrous oxide (N₂O) and carbon dioxide (CO₂) emissions, wheat yield, wheat N uptake, N₂O emission intensity and soil properties was conducted over five growing seasons (2013-2017) at the University of Alberta Breton Plots. Long-term fertility treatments included check, manure, NPKS, NPK and PKS fertilizers in two contrasting crop rotations: a 2-year wheat-fallow (WF) rotation, and a 5-year wheat-oat-barely-alfalfa/brome hay (WOBHH) rotation. Long-term rotation has had a significant impact on wheat response to fertilizer nutrients. For example, in the 5-year rotation, wheat yield increases attributable to applied S are comparable to applied P, but no response to applied S has been observed in the WF rotation. With respect to growing season N₂O emissions, the long-term N balance, which differs according to rotation and fertilizer treatment, was the primary explanatory factor with variations in annual environmental conditions (timing and amount of precipitation, temperature, spring moisture conditions) being a secondary factor. Wheat N uptake was also largely controlled by the same two factors affecting growing season N₂O emissions – long-term N balance, and growing season conditions – which was born out by the significant linear relationship between growing season N₂O emissions and crop N uptake. In treatments where all macronutrients were applied (NPKS), wheat yields were greatest and N₂O emission intensities were lowest, suggesting a long-term approach to nutrient management planning is needed to increase productivity and reduce environmental impact.

Evaluation of nitrogen stabilizers for enhanced nitrogen use efficiency and reduced greenhouse gas emissions in Alberta cereal crops

Miles Dyck, Yuanpei (Kean) Gao and Dick Puurveen

Department of Renewable Resources, University of Alberta, Edmonton, AB

Len Kryzanowski

Alberta Agriculture and Forestry, Edmonton and Lethbridge, AB

Corresponding author: mdyck@ualberta.ca

Abstract

Nitrogen stabilizers incorporated in N fertilizers (i.e., enhanced efficiency fertilizers) are intended to decrease the rate of N transformations in the soil in order to better match the timing of plant N demand with soil N supply. The objectives of this research are to compare soil N₂O-N fluxes and crop growth response to conventional and enhanced efficiency fertilizers with respect to timing of application (fall versus spring) and N rate (0, 50, 100 and 150% of recommended rates). In the fall of 2015, field trials were initiated at Ellerslie and Lethbridge for the 2016 and 2017 growing seasons. Enhanced efficiency products, SuperU, eNtrench-treated urea and ESN were compared to conventional urea and 0N controls. This presentation will focus on the effects of the interaction between rate, product and timing on wheat yield and N₂O-N emissions.

A detailed inventory for estimating nitrous oxide and methane emissions from agriculture with application to Alberta province

Junye Wang and Dimitre D. Dimitrov

Faculty of Science and Technology, Athabasca University, Edmonton, AB

Correspondence to: junyew@athabascau.ca

Abstract

Agriculture is an important source of greenhouse gas emissions (GHGs) contributing to climate change. Canada signed the Paris Agreement on climate change in 2015 and sets up targets for reducing emissions of GHGs. However, GHG sources are heterogeneous spatially and temporally from agriculture. Thus, it is desirable to identify the major sources and conduct a spatially-explicit estimation of CH₄ and N₂O emissions from agriculture in order to mitigate effectively GHG emissions due to heterogeneous agricultural activities. In this study, a detailed inventory was developed to estimate nitrous oxide (N₂O) and methane (CH₄) emissions from Alberta agriculture. The inventory used the IPCC approach with agricultural survey data such as dairy cows, cattle cows, pigs, sheep, poultry, other animals, grasses, legumes, other crops), and Geographic Information System (GIS) mapping. Methane emissions from enteric fermentation (247.04 Gg) prevail over those from manure (20.39 Gg), nitrous oxide emission from manure (8.89 Gg) are comparable to those from soil (11.02 Gg), with cattle cows emitting most N₂O and CH₄, followed by plant N₂O emissions, and pigs and dairy cows CH₄ emissions. The results showed spatial variation of N₂O and CH₄ emissions, which could be useful to identify source strengths/hotspots of GHGs and help various mitigation strategies. It is straightforward to replace Tier 1 emission factors using Tier 2 or 3 ones from process-based models. The future work will develop the emission factors of Tier 2 or 3.

**Technology and Soil Science Technical Session
Abstracts**

Wednesday, February 21, 2018 – Afternoon

National Pedon Database pedon data entry tool – a step towards harnessing big data

Javed Iqbal, David Spiess

Alberta Agriculture and Forestry, Edmonton, AB

Michael Bock, Ben Stewart

Agriculture and Agri-Food Canada, Edmonton, Ottawa, ON

Corresponding author: javed.iqbal@gov.ab.ca

Abstract

The National Pedon Database (NPDB) is a comprehensive national database that captures soil pedon (point) location, site and profile morphological, chemical and physical attribute data. Soil pedon data has historically been captured across Alberta and the rest of the country as an integral part of soil survey mapping, environmental assessment and a variety of other project/research related work. Over the years this data has been captured in a variety of digital and hard-copy formats, often ending up buried on office shelves and corporate or personal hard drives. This data has been collected at great cost to the public as a result of government support of these projects, and to the private sector that often collects this information as part of regulatory requirements. There is a desire to capture not only this historical data, but also new data that may be collected as part of ongoing projects, into a single, publically available national pedon database that can support digital soil mapping and other soil modeling activities. Data entry in a standardized format using a publically available data entry tool will greatly advance the capture of pedon data.

A Pedon Data Entry Tool has been created that stores data in a format that conforms with NPDB structure and national soil pedon data standards and at the same time is user friendly for ease of data entry. Attribute data is captured through the tool in the NPDB required format by the use of drop-downs which provide acceptable data ranges and classes, thereby minimizing data entry errors. This also reduces the need for data entry by a soil scientist familiar with the soil attribute standards. All of the database jargon is dealt with internally while the user of the tool can focus on data entry. The prototype version 2.3 of the NPDB Pedon Data Entry Tool captures general pedon details including soil classification, location, site, and profile, horizon and morphology information. Currently the tool is being used to capture historical pedon data collected as part of soil survey work in Alberta mountain National Parks. This work will provide necessary User Acceptance Testing that will assist in improving the tool. The next iteration of the tool will capture additional datasets (physical and chemical) and will be made available to other interested parties in order to garner additional feedback and user testing. Ultimately, the tool will be available for public/industry use, may

expand to be available online and will provide an important step towards harnessing “big” soil pedon data from across Canada.

Biggish Data: Compilation and Use of the Upland Forest Soil Carbon and Profile Database

Cindy Shaw, Kelly Bona

Canadian Forest Service, Northern Forestry Centre, Edmonton, AB

Oleksandra Hararuk, Werner Kurz

Canadian Forest Service, Pacific Forestry Centre, Victoria, BC

Corresponding author: cindy.shaw@canada.ca

Abstract

With limited time and resources to collect primary data, scientists have recently focused on adding value to the existing, widely distributed, information on soils and soil carbon. Compilation of large soil profile databases is a huge undertaking and accomplishment in itself, but with soil being the most uncertain component of terrestrial biogeochemical cycles, it is invaluable for improving our understanding of biogeochemical processes in the soil. At the Canadian Forest Service we compiled a large forest soil carbon profile database that contains 3,253 pedons from across Canada. The purpose of creating the compilation was to improve our understanding and ability to model forest soil carbon dynamics. We will discuss challenges associated with compilation of the dataset, discuss the contribution of this dataset to advances in soil carbon modelling, and describe the demand for the dataset from other users (e.g., mappers, carbon scientists) once it was created.

Water Nutrient Management of Athabasca River Basin in Changing Climate

Junye Wang and Narayan Kumar Shrestha

Faculty of Science and Technology, Athabasca University, Edmonton, AB

Correspondence to: junyew@athabascau.ca

Abstract

The Athabasca River Basin (ARB) is an ecologically and economically significant resource for the development and sustainability of northern Alberta communities. However, the ARB under changing climate could be more vulnerable than others because their glaciers, freezing soils and peatlands are sensitive to the slightest of changes in climate. This has posed serious threats to the water resources, sustainable goods production and ecosystem. In this paper, we investigated this issue in the watershed to quantify the impacts of climate change on water quality status using a modified process-based model – Soil and Water Assessment Tool (SWAT) and remote sensing data. A SWAT model is then built-up, followed up by a multi-site and multi-objective (streamflow, sediment and temperature) calibration and validation using data in 1983-2013 with a high spatial resolution (25 km) daily future climate data. The results show that the modified model is able to capture the dynamics of water nutrients, such as dissolved oxygen, carbonaceous biochemical oxygen demand (cBOD), total nitrogen and phosphorus with a wide range of accuracy. The climate change would further be exacerbated (16.52 kgN/ha and 4.89 kgP/ha) in future. This implies that the impacts of climate change on the cold watershed could be serious. Finally, we tested different alternative management options to compare water quality status of Athabasca River Basin (ARB) under changing climate. Significant reduction in future nutrients concentrations (~20% on nitrogen and 60% on phosphorous) can be achieved using an optimal combination of management practices and the ecological status of the basin can be improved. This demonstrates that the results can help in agricultural and soil managing of the ARB in a more holistic way.

High Resolution Measurement of Soil Organic Carbon and Total Nitrogen with Laboratory Imaging Spectroscopy

Preston Sorenson and Sylvie Quideau

Department of Renewable Resources, University of Alberta, Edmonton, AB

Benoit Rivard

Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB

Corresponding author: ptsorens@ualberta.ca

Abstract

Soil is a critical component of global biogeochemical cycles, and there is an increasing need for cost effective tools to measure soil carbon stocks and determine soil nitrogen contents. Reflectance spectroscopy can deliver large volumes of soil carbon data. However, as soil carbon concentrations can be spatially heterogeneous, imaging spectroscopy presents the best potential to provide high resolution measurements and accurately characterize soil carbon heterogeneity. For this study, discrete, intact and unground soil samples were collected and analyzed using a SisuROCK automated hyperspectral imaging system in a laboratory setting, focused on the shortwave infrared portion of the electromagnetic spectrum. Samples were also analyzed for soil organic carbon and total nitrogen concentrations by dry combustion to prepare a training data set. Predictive models were built using continuous wavelet processing along with partial least squares regression and CUBIST models. Spatial variation of carbon and nitrogen was determined using Moran's i and comparisons of spatial variations among soil types and horizons were made using a spatial generalized least squares model. Overall, soil organic carbon was more aggregated in Chernozemic soils and in B and C horizons compared to A horizons. Nitrogen in turn showed more aggregation for all soil types and horizons compared to soil organic carbon. Results indicated that imaging spectroscopy can be successfully used to measure and characterize the spatial variability of soil carbon and nitrogen at the soil aggregate scale.

Automation of Data Management for Effective Use of Near Infrared Spectroscopy

Mark Beasse and Preston Sorenson

Maapera Analytics Inc., Edmonton, AB

Corresponding author: mbeasse@maapera.com

Abstract

Recent innovations in near-infrared spectroscopy (NIRS) have allowed the technology to transition into commercial applications and increase sampling capabilities by magnitudes. While this enables investigators to more accurately describe site conditions, the large amount of data can significantly increase management effort. Manual manipulation of data is a huge time sink and is often a source of error. To maintain data integrity and reduce management effort, the design of a data pipeline that protects 'big data' and automates processing is necessary.

During the development of an NIRS system that measures petroleum hydrocarbons (PHCs) and soil texture, Maapera Analytics Inc. designed such a data pipeline. Written entirely in 'R', it manages data from the logging of digital input to the delivery of product. This eliminates manual manipulation of data, errors created by multiple copies, and each step in the pipeline is entirely automated. In this case-study, we compare standard industry operations and data collection using NIRS technology to illustrate the difference in data management requirements.

During a standard environmental site assessment, the primary investigator advanced 14 boreholes. They used site observations (visible appearance, odour, etc.) and their professional judgement to select 15 samples out of 105 to be submitted for wet extraction and analysis. After five days they received analytical results for eight parameters per sample for a total of 120 data points. The data was delivered in a spreadsheet.

Using NIRS technology, four subsamples were analyzed from each sample (n=105) to quantify within-sample variability. Analysis delivered quantitative results in a 'read-only' text file for eight parameters from each subsample in four hours for a total of 3,360 data points.

Processing of the data automatically calculates the median sample result for all parameters (840 data points). Spatial analyses read the data from the protected file and iteratively test model options to produce the lowest sum of squared error. This produced 14 vertical profiles, 44 rasters, and four 3-dimensional models for this case-study in three minutes. Hydrocarbon fingerprinting was used to illustrate leaching of PHCs and soil texture data to illustrate mobility risk for contaminants. Creation of these conceptual models took two additional minutes.

This case-study clearly illustrates the potential to produce large volumes of quantitative data using NIRS technology and the value of developing a data pipeline to

manage it. Data integrity can be protected, compared quantitatively, and delivered in a fraction of the time required by standard means.

Predictive Soil Mapping Pilot in NE Alberta

Craig Aumann

InnoTech Alberta, Edmonton, AB

Corresponding author: craig.aumann@innotechalberta.ca

Abstract

Many jurisdictions have used machine learning techniques to create predictive maps of soil properties. To determine whether such techniques could be used to create maps of soil parameters used in AB, these techniques were tested in a 75x100 km area in NE Alberta. Soil information for ~9,500 sites was provided by Conoco, Suncor and Cenovus from their EIA and PDA reports, and included information on the categorical variables drainage, order, great group, subgroup, surface expression, parent material, parent material texture, and soil series; and the continuous variables top soil depth and sub soil depth. Random forest models were fit for each of these soil parameters using predictor variables that included geomorphometric variables derived from a 10 m DEM, and the principal components derived from LANDSAT and MODIS imagery. Cross-validation was used to assess model agreement to an independent, randomly chosen test dataset not used to develop the model.

Across all 8 categorical soil parameters, all accuracies were > 0.66 and for 6 parameters the accuracies were greater than 0.75. Kappa (a measure of accuracy that accounts for chance agreement) was greater than 0.54, and for 5 parameters kappa > 0.76 . For the continuous variables top-soil and sub-soil depths, the average standard error of the residuals on the test data were 10.3 cm and 10.7 cm, respectively.

Based on these results and the maps produced, predictive soil mapping shows great potential for creating soil maps that can be used as part of the environmental assessment process.

Unmanned Aerial Vehicles (UAVs) Based High Resolution Data Acquisition for Gravel Pit Assessment and Reclamation Planning

Yohannes Getachew and Deo A. Heeraman

Wood, Calgary, AB

Corresponding author: deo.heeraman@woodplc.com

Abstract

Unmanned aerial vehicles (UAVs) or drones have presented the convenience of acquiring high spectral, spatial and temporal resolution images with a fraction of the cost of a conventional aerial survey. In recent years, advances in UAV technology, digital data storage, computer hardware and software have made remote sensing a cheaper, efficient and versatile biophysical data acquisition technique for a wide range of environmental applications.

This paper presents an application of UAV to acquire high spatial resolution aerial imagery and generate accurate orthorectified imagery and ground elevation data for a reclaimed gravel pit located in southern Alberta. The data was acquired in the visible spectrum (Red Green Blue) with a 35 mm, 36 mega pixels camera mounted on a Trimble UX5 High Precision (HP) UAV flown over 0.5 km² area and an altitude of 105 m above the ground. A total of 1,241 photos with 90% forward and 83% lateral overlap were acquired with the UAV. The on board global navigation satellite system (GNSS) measured a post-processed kinematic (PPK) point, in a continuous mode, with each photo taken. Five ground control points for the flights and 48 additional ground control points were measured throughout the study area using a real time kinematic (RTK) device for data accuracy assessment. The total size of the raw data collected over the study area was 60 GB.

The imagery data obtained from the UAV was used to (i) calculate the dimensions and volumes of topsoil, subsoil and aggregate (gravel) piles present at the reclaimed gravel site and, (ii) generate a digital elevation model of the gravel pit area at an average horizontal and vertical accuracy of 1 cm and 2 cm respectively. The total area currently under active mining operation is determined to be 31.1 ha (76.8 ac). The volume of topsoil and subsoil piles were calculated to be 37,491 m³ and 13,107 m³ respectively (total 50,598 m³). The pre-disturbance soil survey conducted for the site determined that the average topsoil and subsoil depths to be 20 cm and 30 cm respectively with an estimated 75,000 m³ topsoil and subsoil that can be salvaged from the site. The estimate from the aerial survey shows a difference of 24,402 m³ of reclamation material. Assuming a required replacement depth of 80% of the average pre-disturbance topsoil depth (16 cm), the available topsoil pile would be enough to reclaim only 23.4 ha. In other words, if the entire disturbed area was to be reclaim with the available topsoil material, an average topsoil depth of 12 cm, which is 60 % of the average pre-disturbance topsoil depth (20 cm), would only be attained.

Poster Session Abstracts

Wednesday, February 21, 2018 – Afternoon

Reforestation of the boreal forest using hitchhiker seedling stock

Jessica J. Hudson

Department of Renewable Resources, University of Alberta, Edmonton, AB

Amanda L. Schoonmaker

NAIT Boreal Research Institute, Peace River, AB

Brad D. Pinno

Department of Renewable Resources, University of Alberta, Edmonton, AB

M. Derek MacKenzie

Department of Renewable Resources, University of Alberta, Edmonton, AB

Corresponding author: jhudson@ualberta.ca

Abstract

The presence of native species is a key objective of reclaiming industrial sites. Regeneration of vegetation on disturbed soils can be affected by undesirable species. Cover cropping of native plant species is a strategy that addresses a key reclamation objective and may also reduce the dominance of undesirable species. However, seed-based deployment of native plant species (which is the conventional mechanism of cover cropping), has constraints including a lack of sufficient quantities of native seed, low emergence rates and slow initial growth. Planting a rooted herbaceous seedling may overcome some of the constraints but the incremental costs would be substantial. Alternatively, 'hitchhiking' a native forb in the same nursery container as a desirable native woody species could counterbalance some of the costs as well as provide, targeted and localized cover crop protection to the woody plant. However, this concept has not been widely tested to-date. This study will present results from an ongoing field study that is examining the survival and growth of hitchhiker nursery stock out-planted into contrasting soil environments.

Four woody species were used in this study including: paper birch (*Betula papyrifera*), Bebb's willow (*Salix bebbiana*), and white spruce (*Picea glauca*). Each was co-grown with a native forb, fireweed (*Chamerion angustifolium*). The timing of sowing (sow date) the fireweed into the nursery container (following the sowing of the woody species) was evaluated at three time periods for the deciduous species and two time periods for the spruce. Singly grown plants of all species under evaluation were produced concurrently. Nursery stock was produced in the spring-summer of 2016 and out planted into recently reclaimed industrial sites with contrasting surface soil adjustment where one site had been furrowed and the other site was left as a track-packed soil surface (following topsoil placement).

After one growing season, preliminary results indicated that the sow date influenced initial tree height and growth of birch and spruce. Earlier fireweed sow dates resulted in greater vegetation cover and survival of fireweed, but was often associated with shorter woody plants, however both species did show some level of survival and growth in all sow dates. Learnings from this study would be appropriate for future reclamation of mixed wood boreal forests.

Natural Salinity Characterization of Soils in Southern Alberta

Nelson F. Bernal and Alfredo Carcamo

Amber EnviroServices Inc. Calgary, AB.

Corresponding author: nbernal@beckinghamenviro.com

Abstract

Tier 1 guidelines for soil remediation in Alberta are based on two parameters: electric conductivity (EC) and sodium saturation ratio (SAR). The soils in the central and south-east part of the province are characterized by high natural salinity in some cases due to parent geological material and or due to evapotranspiration regimes bringing salts to the surface. when a saline or sodic area is affected by brine releases due to oil and gas operations there may be a change in EC and or SAR or may be masked by the natural salinity. The combination of these two sources of salinity, natural and anthropogenic, make the current Tier 1 guidelines insufficient to separate out one source from the other. We propose a new methodology to establish natural background salinity compositions in soil samples to define realistic remediation goals for brine contaminated soils. In addition, we explore new tools to identify sources of salinity in soils and groundwater.

The data used in this study were obtained from soil samples collected at three contaminated sites in south-east Alberta. A total of 300 saturated paste analyses were available for the interpretation, including the concentrations of main salinity ions such as chloride (Cl), sodium (Na) and sulfate (SO₄). The salinity data was first compared against EC in order to identify the main ion(s) responsible for high EC values in contaminated and background samples. In background samples, a very good correlation between Na and SO₄ (R²=0.96) was found. These trends were then contrasted with contaminated soil ionic compositions. The data showed Cl trends departing from background values, describing the path of the contamination plume. The Na and SO₄ background trends were also used to identify anomalous Na and SO₄ in contaminated samples.

The strong correlation found between Na and SO₄, in background samples for three different locations in south-east Alberta, suggests a common source of salinity for these soils. Evaporitic minerals such as halite (NaCl), mirabilite (NaSO₄), gypsum (CaSO₄) and anhydrite (CaSO₄.H₂O) may be the main source of salinity. The distribution of Cl in the soil profile appears to be closely related to the infiltration of local precipitation, whereas the distribution of Na and SO₄ can be explained by the tendency of these ions to form minerals in the soil such as gypsum and mirabilite. The concentration of Na and SO₄ in the first 50 cm of the soil profile, may be the result of seasonal fluctuations of the water table and intense evaporation.

Reclamation of a winter road built with wood chips: application of the peat inversion technique in a new context

Melanie Bird, Bin Xu, and Kimberley Murray

NAIT Boreal Research Institute – Peatland Restoration, Peace River, AB

Corresponding author: mbird@nait.ca

Abstract

Resource extraction in the north is supported by the installation of various linear features, such as seismic lines, temporary winter, and permanent access roads through wetland ecosystems. Reclamation of these systems, particularly peatlands, requires first addressing the abiotic themes of hydrology and surface substrate. Properly addressing these factors will facilitate the establishment of wetland vegetation communities and ensure the long-term stability and recovery of proper wetland functions.

This project features the reclamation of a temporary winter road constructed with thick wood chip overburden through a circumneutral fen. Based on learnings from our first well pad restored to peatland status, we applied the peat inversion technique by burying the wood chips underneath excavated peat and created hydrologic and soil conditions suitable for natural regeneration of fen species such as *Carex*, *Salix*, and *Betula* spp. The site was reclaimed in winter 2014 with additional modifications in late summer of 2015. Here we present details of the operational techniques and discuss current site progress and initial findings based on vegetation survey and greenhouse gas data from the 2017 growing season. Potential alternative applications for the peat inversion technique and revegetation through natural ingress and stock planting will also be discussed.

Developing Novel Materials for Reclamation and Remediation of Land and Water

Jin-Hyeob Kwak, Scott X. Chang, M Anne Naeth, Mohamed Gamal El-Din

Department of Renewable Resources, University of Alberta, Edmonton, AB

Corresponding author: scott.chang@ualberta.ca

Abstract

To facilitate the reclamation and remediation of land and water, novel reclamation materials need to be developed that are economical, can be made with readily available materials, and are efficient in removing contaminants of emerging concern. Biochar is one of those promising materials, and its properties and utility differ with feedstock type and production conditions, including pyrolysis temperature and post pyrolysis activation treatment. Therefore, relationships between pyrolysis conditions and biochar properties for each feedstock type, especially for those locally available, need to be established. Most previous studies have evaluated the efficiency of biochar produced under certain pyrolysis conditions on specific contaminant removal. Novel biochar with high surface area and porosity and a variety of functional groups that will be effective for removing multiple contaminants from contaminated soil and water need to be developed through surface modification during biochar production. The objective of this study is to produce novel biochars that have high sorption capacity and are effective in removing a variety of contaminants from water and soils.

Locally available feedstocks for biochar production will include softwood sawdust; canola (*Brassica napus* L) and wheat (*Triticum*) straws; as well as cattle manure pellets. Biochars will be produced using a conventional pyrolysis unit at 300, 500 and 700 °C and using a microwave at 200, 250 and 300 °C with or without activations. Characterization of the produced biochars will include elemental composition, surface functional group, surface morphology, surface area, ash and mobile matter contents, pH, and cation exchange capacity. Produced biochars will be tested for their adsorption and desorption capacities of heavy metals which are common in contaminated soils and water. Outcomes from this study will provide relationships between pyrolysis conditions and biochar properties for each feedstock type.

Effect of pine sawdust biochar on greenhouse gas emission from forest and grassland soils under laboratory condition

Prem Pokharel, Jin-Hyeob Kwak and Scott X. Chang

Department of Renewable Resources, University of Alberta, Edmonton, AB

Yong Sik OK

O-Jeong Eco-Resilience Institute (OJERI) & Division of Environmental Science and Ecological Engineering, Korea University, Seoul, Republic of Korea

Corresponding author: ppokhare@ualberta.ca

Abstract

The Paris Agreement of the United Nations Framework Convention on Climate Change has identified the reduction of anthropogenic greenhouse gas (GHG) emission from agriculture and forestry as one of the most relevant strategies to meet the goal of limiting warming to less than 2 °C relative to the preindustrial era. Soil amendment with biochar, a biomass derived char produced by thermal decomposition in partial or total absence of oxygen, has been proposed as an effective means to reduce GHG emission from agriculture and forestry. However, the potential of biochar to reduce GHG emission from the soil varies with land use type and pyrolysis conditions of biochar production.

This study investigated the effects of soil amendment with biochars produced by different methods on GHG emissions. Pine (*Pinus koraiensis* Siebold & Zucc.) sawdust biochar was produced at 300 and 550 °C with and without steam activation (coded as BC300-S, BC550-S, BC300 and BC550, respectively). They were applied to forest and grassland soils at 1.5% (w/w) rate in a 100-day laboratory incubation experiment. Application of BC550 reduced ($P < 0.05$) cumulative CO₂ emission from the forest soil by 16.4% relative to the control (without biochar application), but not from the grassland soil. Biochar application did not have significant effects on CH₄ uptake from either soil. Application of BC550 and BC550-S reduced the cumulative N₂O emission by 27.5 and 31.5%, respectively, in the forest soil and 14.8 and 11.7%, respectively, in the grassland soil, as compared to the control. The effects of BC300 and BC300-S on cumulative CO₂ and N₂O emission were not significant in both soils except BC300-S significantly reduced cumulative N₂O emission from the forest soil. The effects of BC550 and BC550-S on N₂O emission were persisted until the end of 100-day incubation indicating a possible long term effects of these biochars. The BC550 and BC550-S showed highest potential of mitigating GHG emission under laboratory conditions; they should be tested in long term field trials before considering them in ecosystem management strategies aiming for GHG emission mitigation.

Conservation Farming across the Soil Zones in Alberta

Wallace Sawchuk, Deb Werk, Janna Casson

Alberta Agriculture and Forestry, Lethbridge, AB

Rob Dunn

FarmWise Inc., Lethbridge, AB

Corresponding author: wally.sawchuk@gov.ab.ca

Abstract

Conservation farming has brought change to the agriculture landscape in Alberta. This project looked at the representative Soil Landscape of Canada (SLC) areas that were predominantly managed for dryland grain production in Alberta's Brown (B) and Dark Brown (DB) Soil Zones (SZ). This study used the long term (20 year) changes in conservation cropping system adoption, crop diversification and crop production. Land use was based on the 1991 and 2011 Statistics Canada Agriculture Census information, interpolated to the representative SLC areas for the study. Precipitation was based on the nearest available Alberta Climate Information Services (ACIS) data¹ and crop yield estimates for the two time periods were derived from Alberta Financial Services Corporation (AFSC) crop insurance records specific to the representative areas².

Crop year precipitation was similar for the two time periods in both the BSZ and DBSZ areas selected for analysis. In comparing 1990 – 1992 with 2010 – 2012, aggregate grain yield and precipitation use efficiency (PUE) increased by 87% in the BSZ and 73% in the DBSZ. The increase was a result of two factors: increased cropped area (due to a reduction in summerfallow) and increased yield per unit area. Crop diversity increased within both areas with a transition from a rotation that was predominately cereal crops and summerfallow to rotations that included cereal, oilseed and pulse crops.

Summerfallow declined and adoption of practices like no-till and crop diversification increased between 1991 and 2011 in these two landscapes representative for dryland cropping in Alberta's Brown and Dark Brown soil zones. Increased crop area (reduced summerfallow) and increased production per unit area contributed to a large increase in aggregate grain production and PUE over this time period. Next step in this project is to select representative SLC's in the Black Soil Zone and complete this analysis for the same two time periods.

¹ Interpolated Weather Data Since 1961 for Alberta Townships. Alberta Climate Information Service. <http://agriculture.alberta.ca/acis/township-data-viewer.jsp>

² Alberta Financial Services Corporation (AFSC) special request aggregated to an appropriate regional scale for analysis.

N₂O Emissions and Barley Productivity as affected by Land Application of Biosolids

Carmen Cecilia Roman Perez, Guillermo Hernandez Ramirez, Jichen Li

Department of Renewable Resources, Faculty of ALES, University of Alberta, Edmonton AB

Germar Lohstraeter, Len Kryzanowski

Environmental Strategy and Research Section, Alberta Agriculture and Forestry, Edmonton, AB

Corresponding author: romanper@ualberta.ca

Abstract

Nitrous oxide (N₂O) is one of the most important greenhouse gases (GHG) because it has 298 times the global warming potential of carbon dioxide (CO₂) and it is the major source for depleting stratospheric ozone layer. Agriculture is responsible for more than 60% of anthropogenic global emissions due to the application of synthetic nitrogen-based fertilizers. Biosolids are by products from municipal wastewater treatment plants that can have beneficial use such as agricultural and forestry application and land reclamation. Nowadays, Canada still uses the IPCC 2006 Tier I emission factors to estimate GHG emissions associated with the land application of biosolids, which assumes 1% of mineral N applied to soils is lost as N₂O. Also, the N use efficiency of the organic and inorganic N compounds in biosolids, generated from different treatment technologies, including anaerobic digestion, alkaline stabilization, or composting, that could be used by agricultural producers across Canada is very poorly understood. The objective of this research is to quantify the N₂O emissions from a cropland fertilized with three types of biosolids under two types of placement (surface vs. incorporation); and to assess the efficacy of biosolids as a nutrient source for barley (*Hordeum vulgare*) biomass production.

To determine N₂O emissions, 15 treatments (including one control) growing barley for silage, were evaluated. For organic amendments, three types of biosolids were applied, while urea was applied as mineral fertilizer. Treatments with a mix of biosolid and urea in a proportion of 50%- 50% were also evaluated. Regarding to fertilizer placement, both, organic and mineral fertilizer were evaluated under surface and incorporation methods. Treatments were displayed in a randomized complete block design with four replications. To determine the yield production, the barley biomass was quantified at harvest for each treatment. Air temperature and rainfall data were taken from the weather station located at the Edmonton International Airport.

Results indicate that precipitation and biosolid incorporation lead to higher N₂O emissions. Two major peaks of N₂O fluxes (73.9 and 89.5 g N ha⁻¹day⁻¹) occurred few

days following 5.8 and 4.0 mm of rainfall, respectively. Incorporation increased N₂O fluxes typically by 2-4 times compared to surface application. Treatments with liquid mesophilic anaerobic digested showed the highest N₂O emissions (both daily and cumulative). Barley biomass was typically higher in treatments that combined biosolid with 50% urea and were incorporated.

Could dung pats treated with and without ivermectin alter insect activities and impact soil available nitrogen on native pastures?

Courtney Soden, Xiyong Hao, Jessica Stoeckli, Kevin Floate and Newton Lupwayi

Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, Lethbridge AB.

Ben W. Thomas

Agassiz Research and Development Centre, Agriculture and Agri-Food Canada, Agassiz, BC

Corresponding author: Xiyong.hao@agr.gc.ca

Abstract

Ivermectin (IVM) is a medication commonly administered to cattle to treat and prevent many types of parasites. Widespread use of this parasiticide has the potential to adversely affect non-targeted species of dung-breeding organisms, as treated cattle deposit approximately 20 kg of dung per day with peak excretion rates of 60 mL IVM per kg of fresh dung. The feeding and tunneling activities by these insects alters the chemical and physical properties of both cattle dung and surface soil, which may alter available nitrogen (AN) within the soil environment.

To determine these effects on semiarid pastures, we quantified dung and soil AN from quadrates containing bare soil, dung treated with and without IVM and the soil beneath dung pats. The quadrats were covered with chicken wire to exclude non-insect disturbance. In year one (2016-2017) of this study, soil and dung was collected at weeks 1, 2, 4, 8, 12, 16, and 52 after deposition and residual soil was collected at weeks 8, 16 and 52. During year two (2017-2018) of this study collection occurred at weeks 1-6,8,10,12,14,16,20,25,40,and 52 after deposition and residual soil was collected at weeks 4,8,16, and 52. Data from year one of this study suggest there is reduced soil AN beneath treated dung pats as compared with non-treated dung pats. This study is performed in conjunction with entomologic, microbial, and greenhouse gas emission monitoring to verify the role of IVM treated dung pats on both the insects and soil environment.

Yield Response to Available Soil Nitrogen in Wheat in Western Canada

Musfira Jamil, Allen Good

Department of Biological Sciences, University of Alberta, Edmonton, AB

Guillermo Hernandez Ramirez

Department of Renewable Resources, University of Alberta, Edmonton, AB

Corresponding author: musfira@ualberta.ca

Abstract

In most cropping systems, nitrogen (N) availability is one of the bottlenecks that reduces crop productivity. Plant N requirement is fulfilled by the addition of nitrogenous fertilizers which results in introduction of massive anthropogenic N in the environment and this result in an increased risk for environmental losses. To increase grain productivity as well as to mitigate potential detrimental environmental effects, 4R Nutrient Stewardship offers a comprehensive set of best management practices (BMP) for nutrient management in particular for nitrogen fertilization. Right fertilization rate is one of the components of this framework and this is also important for improving nitrogen use efficiency (NUE).

To explore the relationship between available soil N and wheat (*Triticum aestivum*) yield, spring soil N and yield data were collected from a field north of Edmonton in fall of 2015. Soil samples were collected at a depth of 15 cm while wheat grain productivity data was recorded with a yield monitor mounted on the combine harvester. Results indicated that quadratic was the best model to explain the relationship between grain yield and available soil N with root mean square error (RMSE) of 347 and coefficient of determination (R^2) of 0.95 ($n= 17$). This model also showed that the highest grain yield of 4963 kg ha⁻¹ was attained with 25 mg NO₃-N kg⁻¹ soil, and beyond this level of available N, the yield plateaued. Piecewise regression proved to be the second best model with slightly larger RMSE (357) and similar R^2 (0.95) as the quadratic approach. According to this model, the yield threshold was 4445 kg ha⁻¹ at 18 mg NO₃-N kg⁻¹ soil. Linear and hyperbola models performed relatively poor with RMSEs of 602 and 585, respectively. These models can provide useful insights into estimating the optimum rate of nitrogen fertilization for subsequent growing seasons.

Area-Based Nitrous Oxide Emissions from Wheat Fields under Contrasting Fertilizer Types applied in the Fall or Spring

E.M. Shakila K. Thilakarathna, Guillermo Hernandez Ramirez, Dick Puurveen

Department of Renewable Resources, University of Alberta, Edmonton, AB

Len Kryzanowski, Germar Lohstraeter, Leigh-Anne Powers

Alberta Agriculture and Forestry, Edmonton, AB

Corresponding author: sekanaya@ualberta.ca

Abstract

Application of inorganic nitrogen fertilizers can increase the emissions of nitrous oxide (N_2O) which is not only a potent greenhouse gas but also a precursor for the depletion of the stratospheric ozone layer. Enhanced efficiency N fertilizers (EENFs) are developed to control the transformations of N and increase the N plant uptake through reducing fertilizer loss. A two-year (2015-2017) field study was conducted to investigate the effect of spring versus fall applications of conventional and EENFs on N_2O emissions in St. Albert, Alberta. In the fall, eight N treatments were established; control, urea and anhydrous ammonia (AA) as conventional fertilizers, as well as polymer-coated urea (environmentally smart N - ESN®), urea with N-(N-butyl) thiophosphoric triamide (NBPT) and dicyandiamide additives (Super U®), urea with N-(N-butyl) thiophosphoric triamide (NBPT) and N-(2-nitrophenyl) phosphoric triamide (NPPT) (LIMUS®), urea with nitrapyrin additive (eNtrench®), and AA with nitrapyrin additive (N-Serve®) as EENFs. During the fall, the plots assigned to spring N treatments were kept fallow, and in the subsequent spring the same treatments were applied in these spring plots as conducted in the fall. The N_2O emissions were measured using manual chambers. Large N_2O peaks were observed after soil thawing and high rainfall events indicating that the increasing soil moisture is the key triggering factor for pulse N_2O emissions. Mean cumulative N_2O emissions from spring treatments were significantly greater than fall treatments in the experimental year of 2015-2016 while the opposite result happened in 2016-2017 (fall > spring), suggesting that weather and soil conditions following the fertilizer applications showed more direct influence on N_2O fluxes than the timing of application of fertilizers (fall vs. spring). Even though mean cumulative area-based N_2O emissions in 2015-2016 were not significantly different across any of individual N treatments, emissions from EENFs were significantly lower than emissions from conventional fertilizers ($P < 0.05$), showing that 30 % of N_2O emissions can be reduced through adoption of EENFs. Conversely, in the year 2016-2017, N management choices did not impact emissions. The role of EENFs in reducing N_2O emissions was not consistent across our two experimental years, and these emissions were highly influenced by weather conditions.

Assessing agronomic nitrogen management to mitigate environmental and economic losses in Alberta

Symon Mezbahuddin, David Spiess, David Hildebrand, Len Kryzanowski, Daniel Itenfisu

Alberta Agriculture and Forestry, Edmonton, AB

Robert Grant

Department of Renewable Resources, University of Alberta, Edmonton, AB

Corresponding author: symon.mezbahuddin@gov.ab.ca

Abstract

Agronomic nitrogen management is critical for sustainable crop production. Nitrogen use efficiency in Alberta ranges from 30-50% depending upon crops, soils and weather conditions. Remaining nitrogen can be prone to losses to air (emissions of nitrous oxide, ammonia and nitrogen gas) and to water (nitrate leaching) resulting in substantial environmental and financial losses. The 4R (Right source at the Right place, Right time and Right rate) nutrient stewardship has potentials for minimizing these losses. However, quantifiable estimates of potential environmental and economic savings from 4R nutrient stewardship in Alberta are still scarce. This project is a proof of concept that aimed to evaluate a process-based ecosystem model "ecosys" to derive numerical estimates of nitrogen losses from alternative N-fertilizer management scenarios differing in their sources, timings, placements and rates across different soils in Alberta under varying weather conditions, and agronomic management. Preliminary site-level model validation followed by provincial level scaling up showed initial promises of this approach. Modeled outputs of grain carbon and nitrogen uptakes and soil N₂O emissions corroborated reasonably well against field measurements over 4 site years (2008-2011) for two sources (Urea and ESN), two timing (fall and spring), one placement (banding), and three rates (0, 60, and 120 kg N ha⁻¹ yr⁻¹) across black, brown, and gray soil zones of Alberta under barley cultivation. After site-level validation, the modeling protocol was scaled up to derive township level (~10 km × 10 km) provincial estimates of agronomic nitrogen losses in Alberta. An economic analysis followed to help producers identify how much financial savings/gains can be made by adopting beneficial 4R nutrient management practices. Hence, this project will provide the basis for Alberta producers with alternative options to identify beneficial nutrient management practices for environmentally sustainable and economically viable crop production.

Estimating nitrogen mineralization for improved nitrogen fertilizer recommendations in Alberta

Symon Mezbahuddin, Len Kryzanowski, Ross H. McKenzie, Adil Akbar, Craig Sprout, Germar Lohstraeter and Leigh-Anne Powers

Alberta Agriculture and Forestry, Edmonton, AB

John O'Donovan

Agriculture and Agri-Food Canada, Lacombe, AB

Corresponding author: symon.mezbahuddin@gov.ab.ca

Abstract

Historically in Alberta, recommendations for nitrogen fertilizer requirements were commonly based on the level of NO₃-N present in the top 60 cm of the soil prior to seeding and how it relates to crop yields. It was assumed that the nitrogen mineralized from the soil during the growing season was either, not important, or closely correlated to the initial soil NO₃-N content, or correlated to soil zones. However, the nitrogen (N) mineralized during the growing season is very important to crop production and it is variable, depending on soil moisture and temperature and the inherent N-supplying capacity of the soil. Nitrogen mineralization potentials were calculated using a nitrogen mineralization model that estimated potentially mineralizable N from hot KCl ammonium that eventually gave rise to actual mineralizable N as functions of daily soil moisture and temperature. This estimated mineralizable N showed strong relationships ($R^2 \sim 0.8$) with soil organic matter, which opens up an opportunity of estimating N mineralization for different soil zones in Alberta. This estimating of potential available N to crop through mineralization would thus provide an opportunity of incorporating N mineralization in estimating fertilizer N requirements, thereby further improving N fertilizer recommendations to aid all important agronomic and economic decision making by Alberta producers.

More Carbon may not be Better for Scoring Functions to Assess Soil Health in Long-Term Manure Plots

Ben W. Thomas

Agassiz Research and Development Centre, Agriculture and Agri-Food Canada,
Agassiz, BC

Jessica L. Stoeckli, Courtney Soden, Elisha Jones, Xiying Hao

Lethbridge Research and Development Centre, Agriculture and Agri-Food Canada,
Lethbridge, AB

Kui Liu

Swift Current Research and Development Centre, Agriculture and Agri-Food Canada,
Swift Current, SK

Sherry A.E. Fillmore

Kentville Research and Development Centre, Agriculture and Agri-Food Canada,
Kentville, NS

Corresponding authors: xiying.hao@agr.gc.ca and ben.thomas@agr.gc.ca

Abstract

Efforts to quantify soil health have steadily increased throughout the past few decades. With the development of the Soil Health Institute in 2013 and the institute's endorsement of 19 Tier 1 soil health indicators in 2017, the attempt to measure soil health has clearly become a global priority. While soil health emerged from the desire to assess soil quality, judging the relative health of a soil with indicators of soil quality has long occupied the minds of soil scientists. One reality of producing beef cattle in feedlots with capacities of up to 50,000 head of cattle in southern Alberta, is that manure is costly to transport offsite and is often applied at much higher rates than annual crop N or P demands. As Alberta has more than 40% of the cattle in Canada, a long-term experiment was established in 1973 to determine how repeated heavy annual beef cattle manure application altered soil and ground water quality.

Repeatedly applying beef cattle feedlot manure at these Long Term Manure Plots in Lethbridge, Alberta has led to large increases in soil salinity, soil test P, nitrate levels and mineralizable N and P. Although the scoring function for the comprehensive soil health assessment states more C is better, in this study more applied C corresponded with greater soil salinity, soil test P, nitrate levels, and mineralizable N and P. Therefore "*more C is better*" may be an inappropriate scoring function for long term applications of beef cattle feedlot manure at rates that exceed annual crop nutrient demands. This indicates that specific scoring functions may be required for soils with a long-term history of manure application. Although our experimental design was limited to one study location with both irrigated and dryland crop production, future research

should investigate a multi-site approach to develop a robust scoring function for cropland subjected to high manure applications.

Broad spectrum biocontrol potential exhibited by plant growth promoting rhizobacteria native to diverse agro-ecological regions

Saira Ali, Sohail Hameed, Asma Imran, George Lazarovits and Mazhar Gondal

Saira Ali

Renewable Resources Department, University of Alberta, AB

Sohail Hameed, Asma Imran and Mazhar Gondal

National Institute for Biotechnology and Genetic Engineering, Faisalabad, Pakistan

George Lazarovits

A & L Biologicals, London, ON

Corresponding author: saira2@ualberta.ca

Abstract

The use of antagonistic rhizobacteria is a promising strategy to control fungal diseases of crops. The study presented here screened 200 rhizosphere-associated bacteria for the ability to promote plant growth and antagonistic activity against a range of fungal pathogens of plants including: *Fusarium oxysporum*, *F. moniliforme*, *Rhizoctonia solani*, *Colletotrichum gloeosporoides*, *C. falcate*, *Aspergillus niger* and *Aspergillus flavus*. Bacteria were isolated from rhizosphere of maize, rice, wheat, potato, sunflower and soybean growing in different agro-ecological regions of Pakistan. Of the total rhizobacterial isolates, 48 exhibited broad-spectrum in vitro antifungal activity against the selected fungal strains. Amongst these 48 rhizobacteria, thirteen isolates showed greater than 70% antagonistic potential and were selected for further studies. The antifungal metabolites produced by the bacteria included diffusible and/or volatile antibiotics and cell wall degrading enzymes such as: proteases, chitinases and cellulases. Seven strains were identified as *Pseudomonas* and five as *Bacillus* spp., based on 16S rRNA sequence. They also exhibited the plant growth promoting traits: including the production of indole-3-acetic acid, ACC- deaminase and solubilization of inorganic phosphates, biofilm formation and production of quorum sensing molecules. The inoculation of these strains resulted in disease suppression as well as plant growth promotion in controlled (growth room) and greenhouse conditions. The strains received 20-27 points, out of total 31, for biocontrol and plant growth promoting potential. A *P. aeruginosa* strain *FB2* and a *P. fluorescens* strain *LB1* emerged as potential rhizobacteria with the possible commercial value as biocontrol as well as biofertilizer agents.

Land Reclamation Technical Session Abstracts

Thursday, February 22, 2018 – Morning

Biochar affects aspen seedling growth and function of reclaimed soils in the Athabasca oil sands region

Sebastian T. Dietrich and M. Derek MacKenzie

University of Alberta, Department of Renewable Resources, Edmonton, AB

Corresponding author: sdietric@ualberta.ca

Abstract

Restoring ecosystem function following oil sands surface mining involves the reestablishment of biotic and abiotic ecosystem components which affect biogeochemical cycles and fluxes. In boreal forest ecosystems, pyrogenic carbon (PyC) is a native soil component that affects a variety of biogeochemical parameters. Biochar is a manmade analog for PyC and its amendment to cover soils used for reclamation might be a suitable method for reestablishing ecosystems that function more similarly to upland forest ecosystems recovering from fire. To evaluate the benefits of biochar to reclamation cover soils, we compared characteristics and function of peat mineral mix (PM) and forest floor mineral mix (FFM) with and without biochar amendment in a greenhouse study using a completely randomized design. We examined effects on nutrient bioavailability (NO_3 , NH_4 , P, K, S, Mg, Ca), foliar nutrient concentration (N, P, K, S, Mg, Ca, Na, Mo), soil respiration, rhizosphere polysaccharide concentration, soil organic matter (SOM) stability, and *Populus tremuloides* Michx. seedling growth. Seedling growth increased significantly on PM cover soil with biochar amendment. Biochar improved K nutritional status and potentially interacted with Na bioavailability in PM, affecting growth. Soil respiration decreased significantly in PM with biochar amendment and increased in FFM. Soil organic matter stability was positively correlated with tree growth and increased with biochar amendment. Our findings suggest that biochar can have a significant positive effect on upland forest reclamation in the Athabasca Oil Sands Region, especially on sites that are reclaimed with PM.

Optimization of cost and functionally effective vegetation management solutions for forest reclamation: Project set up and first year results

Amanda Schoonmaker, Stefan Schreiber, Trevor Floreani

NAIT Boreal Research Institute, Peace River, AB

Tyler Niles

Wild + Pine, Edmonton, AB

Corresponding author: trevorf@nait.ca

Abstract

The goal of this study was to evaluate the effect of different vegetation management solutions for forest reclamation at a reclaimed borrow pit. All tested treatments in this study share a common overall objective that was to: (i) overwhelm a reclamation site with desired herbaceous and woody species and (ii) concurrently reduce vegetation cover of undesirable species. Five approaches were tested in different combinations:

- (1) Planting woody species: high density planting to kick-start canopy development.
- (2) Pre-emergent herbicide: applying Torpedo™ (at 580 or 1160 g ha⁻¹) to prevent the germination of agronomic and noxious species that have been banked in stockpiled topsoil, followed by planting woody species seedlings.
- (3) Post-emergent herbicide: using Clearview™ (at 230 g ha⁻¹) to spot apply herbicide in between planted seedlings to kill undesirable vegetation.
- (4) Native forbs: planting plugs of fireweed (*Chamerion angustifolium*) and/or goldenrod (*Solidago canadensis*) with developed root systems to give desirable forbs a head start in occupying below and above ground space.
- (5) Seeding native grass: broadcasting awned wheatgrass (*Agropyron trachycaulum* var. *unilaterale*) to inhibit development of undesirable species.

All treatment combinations (14 in total) have been deployed in the field. The key findings after the first growing season were that: (1) herbicide applications do not significantly impair growth and development of the deployed target species and (2) herbicide treatments were successful in decreasing undesirable herbaceous species cover. With only a three-month growing period (May to August), it was not expected to see the anticipated long-term treatment effects to emerge for the other approaches (such as woody and forb planting). Focus will be on concepts and project setup logistics, along with first year vegetation data.

Wheat Yield and Soil Properties Reveal Legacy Effects of Artificial Erosion and Amendments on a Dryland Dark Brown Chernozem

Francis J. Larney, Andrew F. Olson

Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre,
Lethbridge, AB

Corresponding author: francis.larney@agr.gc.ca

Abstract

Topsoil removal (simulated or artificial erosion, de-surfacing), whereby incremental depths of topsoil are mechanically removed with an excavator, is a recognized method in quantifying erosion effects on soil productivity. The ability of soil amendments (e.g. manure, fertilizer, crop residues) to restore productivity to variously 'eroded' surfaces may also be studied with this approach. The oldest artificial erosion experiment in Alberta dates to 1957 at the Agriculture & Agri-Food Canada Research Centre, Lethbridge. Various sub-studies, aimed at restoring soil productivity, were imposed on the site including one which ran from 1980–85 and one from 1987–91. Using wheat yields from 1993–2010 and soil properties in 2011, objectives of the current study were to quantify legacy effects of (i) erosion (topsoil removal) which occurred in 1957; and (ii) amendments which were applied in 1980–85 and 1987–91. This places maximum legacy effect timelines at 54 yr for soil erosion and 31 yr for soil amendments. Legacy effects of both erosion and amendments were still evident on wheat yield in 2010 as well as on soil properties in 2011.

Regeneration dynamics of seedling origin aspen: Managing for resiliency in forest restoration

Carolyn King and Simon Landhäusser

Department of Renewable Resources, University of Alberta, Edmonton, AB

Corresponding author: cking1@ualberta.ca

Abstract

Aspen (*Populus tremuloides* Michx.) is a foundational tree species, native to large areas of North America. The resilience of aspen forests can be attributed to the species' ability to regenerate vegetatively after aboveground disturbance, where new shoots can be produced from its large clonal root system and from retained stumps. More recently, aspen of seedling origin has been planted on many boreal forest reclamation sites. In this situation seedlings are genetically independent and have self-reliant root systems. It is unclear how these seedling origin aspen stands will respond to aboveground disturbance, and whether they provide enough suckering to successfully regenerate to forests via clonal propagation. Our research aims to understand the extent of clonal regeneration in 8 to 12-year-old aspen trees, and to determine how this is related to disturbance type, planting density, and root system characteristics. Selected aspen trees were cut at either 0 cm or 25 cm stump height, left standing but with their roots severed, or were left as an untreated controls (n=80). The type and amount of regeneration for each tree was assessed at the end of the summer. In 2016 all remaining trees (n~1700) were removed from the sites, and regeneration was assessed. Trees cut at 0 cm produced on average 7.5 suckers per individual root system compared to 2.5 suckers in the 25 cm cut and severed root treatments. Small diameter trees produced more stump sprouts than large diameter trees. In 2016, trees planted at a lower density and possessing larger individual root systems produced more suckers than smaller diameter, higher density stands. The results indicate that stands originating from planted aspen seedlings have the ability to recover from disturbance, but this is dependent on individual root system size and planting density, suggesting that individual root systems maintain independence and are competing for resources.

Decomposition of trembling aspen leaf litter under long-term nitrogen and sulfur deposition: Effects of litter chemistry and forest floor microbial properties

Qi Wang, Jin-Hyeob Kwak, and Scott X. Chang

Department of Renewable Resources, University of Alberta, Edmonton, AB

Woo-Jung Choi

Department of Rural & Biosystems Engineering, Chonnam National University, Gwangju, 61186, Republic of Korea

Corresponding author: scott.chang@ualberta.ca

Abstract

Litter decomposition rates are affected by abiotic and biotic factors such as climate, soil physico-chemical properties, litter chemistry, nitrogen (N) availability, and activities of soil organisms. Elevated N and sulfur (S) deposition originated from oil sands mining and upgrading activities can change soil microbial properties, litter chemistry, and litter decomposition rates in the surrounding forest ecosystems in northern Alberta. We studied 1) the effect of long-term N and S deposition on litter chemistry and soil microbial properties, and 2) the effect of changed litter chemistry and soil microbial properties on litter decomposition (CO₂ emission) in a 100-day laboratory incubation experiment using trembling aspen (*Populus tremuloides*) leaf litter and forest floor collected from a mixedwood boreal forest that has been subject to simulated N and S deposition for 10 years. Litter chemistry (lignin, total carbon (C) and N, and calcium (Ca), aluminum (Al), manganese (Mn), and magnesium (Mg) concentration) and forest floor microbial properties (microbial biomass C and N, and extracellular enzyme activities) were analyzed. Ten years of N and S addition increased N ($P < 0.05$ unless otherwise stated) and decreased lignin concentrations resulting in lower C/N and lignin/N ratios in the litter. In addition, N and S addition increased forest floor microbial biomass ($P < 0.01$) and enzyme activities. Cumulative CO₂ emission (C_{cum}) from litter was greater from the N and/or S addition treatments than that from the control, probably due to decreased C/N and lignin/N ratios in litter from the N and S addition treatments; meanwhile, C_{cum} from litter was not affected by soil microbial activity. The results indicate that N and S deposition enhances decomposition of aspen leaf litter by decreasing C/N and lignin/N ratios, suggesting that long-term exposure to high levels of N and S deposition can significantly change C (and associated nutrients) cycling in forest ecosystems in the oil sands region.

Influence of strip-shelterwood harvesting on snowpack dynamics and seasonal soil moisture in the Southern Alberta Rockies

Daniel Greenacre, Uldis Silins, and Miles Dyck

Department of Renewable Resources, University of Alberta, Edmonton, AB

Corresponding author: greenacr@ualberta.ca

Abstract

Mountain snowpacks regulate soil water storage and play a critical role in determining downstream water production from Alberta's forested eastern slopes. The linkages between snow accumulation/melt, with spatial and temporal patterns of growing season soil moisture were studied in a strip-shelterwood harvested watershed in 2016 and 2017 as part of a larger watershed study on several alternative forest harvesting strategies in SW Alberta.

Snow accumulation in 2016 and 2017 was greater in harvested strips (209 ± 104 mm, and 313 ± 124 mm) than in unharvested reserves (69 ± 35 mm, and 189 ± 31 mm) because of reduced snow interception losses, however, variation in radiation across harvested strips due to solar angle and shading produced significant differences in snow accumulation and melt timing. Snowpack on the shaded side of a harvested strip persisted 20 days longer than that on the sun exposed side, and 15 days longer than in the unharvested reserves. These strong spatial patterns in snow accumulation and melt produced similarly strong patterns in subsequent summer soil moisture, with soil water storage from 0-60 cm persisting at 21 to 120 % and 6 to 45 % higher in harvested strips than forested reserves, in respective years. These results strongly reinforce the key role of radiation forcing in regulating both snowpack accumulation/melt and the seasonal legacy of snowpack dynamics as key regulators of soil moisture.

**Land Use and Rangelands Technical Session
Abstracts**

Thursday, February 22, 2018 – Morning

Big Data, Earth Observation and Innovation: Importance of Networks & Asking the Right Questions

Shane Patterson

Conservation and Reclamation Policy, Alberta Environment and Parks, Edmonton, AB

Corresponding author: shane.patterson@gov.ab.ca

Abstract

Alberta's working landscape encompasses a broad range of industrial, recreational and cultural land uses resulting in our province being a data rich jurisdiction. When combined with Alberta's management and regulatory frameworks a unique opportunity emerges that could enable innovation in areas such as big data, remote sensing, and earth observation. However, moving in this direction will require government and regulators, who are traditionally risk averse, as well as industry to change the way they think about how they collect, manage, and use data.

Many organizations in the resource development sector, including government and regulators are being faced by resource constraints. The move towards cumulative effects and integrated resource management are forcing those organizations to seek out and apply innovative approaches to aid in informing decisions at different scales. These pressures, along with the need to use datasets consisting of common indicators, that are readily accessible and affordable, reliable, scalable and scientifically defensible lay the groundwork to enable innovation around big data, remote sensing, and earth observation.

Since 2011, a number of collaborative projects have been undertaken involving the use of new technologies for collecting, integrating, and analyzing remote sensing and earth observation data. This presentation will provide an overview of some of that work.

Data Access for Innovation: Open Data Areas Alberta

Erik Holmlund

Executive Director, Alberta Data Partnerships Ltd., Edmonton, AB

Corresponding author: erik@abdatapartnerships.ca

Abstract

Management of land, water and natural resources to meet social, economic and environmental outcomes is a priority in many jurisdictions. In Alberta management frameworks are being implemented to enable sustainable land and resource management to provide long-term social, economic, and environmental benefits. These systems are complex, encapsulating energy, mineral, forest, agriculture, land, air, water, and biodiversity resources.

To support the management of these resources, the development of technologies that enable more accessible, timely, scalable, interoperable, science-based data upon which governments and stakeholders are needed to support informed decision-making. Earth observation (EO) and geospatial data and technologies help meet this need, and form an integral part of the spatial data infrastructure needed to support these approaches. Greater access to data is often required to commercialize these technologies.

Led by Alberta Data Partnerships (ADP), with support from Alberta Economic Development and Trade, six areas consisting of 25 townships each that are representative of provincial and encompass a range of recreational, commercial, and industrial activities were selected. By making available, through an Open Data licence, a range of datasets comprised of EO (i.e., aerial and satellite imagery, LiDAR, radar), and geospatial information (i.e., cadastral maps, land ownership, vegetation, and soils information), the project aims to fuel creative ideas and enable data users to solve challenges.

ADP can also provide pre-commercialization funding of up to \$40,000 to Alberta SMEs and researchers developing innovative decision support tools (e.g., data analytics, sensors, integration platforms) for decision makers and resource managers using earth observation data and technologies for security, environment, natural resources, and land use management. ADP asks proponents to respond to Industry and Government Challenges and provide innovative and practical solutions.

State of the Prairie Cover Monitoring and Reporting between 1986 and 2016: Grassland Vegetation Classification for State of the Prairie Reporting Using Temporal Statistics Images based on a 30 year Landsat Satellite Archive for Alberta focused in the Grassland and Parkland Natural Region

Derek Rogge and Preston Sorenson

Maapera Analytics Inc., Edmonton, AB

Dr. Thomas Esch

German Aerospace Center (DLR), German Remote Sensing Data Center, Land Surface Department, Oberpfaffenhofen, 82234 Weßling Germany

Ron McNeil

Prairie Conservation Forum (PCF), Edmonton, AB

Karen Raven

Prairie Conservation Forum (PCF), Alberta Agriculture and Forestry, Edmonton, AB

David Spiess

Alberta Agriculture and Forestry, Edmonton and Lethbridge, AB

John O'Donovan

Agriculture and Agri-Food Canada, Lacombe Research and Development Centre, Lacombe, AB

Elwin Smith

Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, Lethbridge, AB

Corresponding author: psorenson@maapera.com

Abstract

Native grasslands and parklands continue to experience pressure from land use change. Federal data shows 25-30 % of Canada's Grasslands habitat remains. The need for defensible, cost effective and accurate information to support land use decisions by land managers has never been greater.

Further to this, consistency of monitoring and reporting methods over time make a compelling case to support initiatives such as payment for ecosystem services, biodiversity conservation, and continuing support for ensuring native grasslands for livestock and wildlife.

The Prairie Conservation Forum (PCF) initiated a large collaborative project to evaluate land use change in the Prairie and Parkland Regions. As part of this overall project, Agriculture and Forestry and the Prairie Conservation Forum (PCF) funded a

study of using the TimeScan temporal statistical data developed by the German Aerospace Centre (DLR) as a means for evaluation of grassland extent and change over time. This project was initiated to explore new approaches to gather more consistent and accurate data and information using multiple sources of data as well as evaluating a fresh approach to grassland cover classification using temporal statistics from a 30 year archive of Landsat 5 6 7 and 8 imagery and comparing the results other satellite natural land cover inventories carried out in the recent.

The Potential Supply of Ecosystem Services from Livestock BMPs in Alberta's Rangelands

Majid Iravani

Alberta Biodiversity Monitoring Institute (ABMI), University of Alberta, Edmonton, AB

Karen Raven

Alberta Agriculture and Forestry, Edmonton, AB

Eric Butterworth

Alberta Biodiversity Monitoring Institute (ABMI), University of Alberta, Edmonton, AB

Marian Weber

InnoTech Alberta, Edmonton, AB

Corresponding author: iravani@ualberta.ca

Abstract

Recently, much attention has been paid to explore opportunities to enhance the provision of ecosystem services (ES) in Alberta's rangelands through market-based approaches such as carbon credits for beneficial management practices (BMPs). Robust, reliable and comparable data on the provision of multiple ES necessarily underlies policies incorporating ES valuation and markets into rangeland conservation and restoration. Yet, we are generally lacking spatially explicit, comprehensive data and information on the supply of rangeland ES from BMPs that is needed to inform policy. To support a better accounting of the supply of multiple ES and potential tradeoffs in Alberta's rangelands, we developed spatially explicit organic carbon models for native ranges and tame pastures of a representative watershed in southern Alberta (Indian Farm Creek Watershed, 14,145 ha). We then assessed the long-term (30 years) impacts of several alternative livestock BMPs on the potential supply of two main carbon-related ES of soil organic carbon storage (SOC) and aboveground plant biomass production (AGB). Finally, we assessed the level of uncertainty in the supply of these ES from different livestock BMPs.

The simulated response of SOC and AGB in native ranges and tame pastures varied among livestock BMPs, depending on timing and intensity of livestock grazing. The simulation results indicated gains in SOC from most of the livestock BMPs implemented, whereas relatively little gains or reductions in AGB were predicted under different livestock BMPs. However, predicted changes in SOC and AGB under different livestock BMPs varied across the watershed, depending on the ecological condition of the sites. Overall, our findings suggest that livestock BMPs have the potential to be a useful strategy to enhance the provision of multiple ES in Alberta's rangelands. The information and knowledge developed in this study provide a baseline to assess whether appropriate livestock BMPs will lead to rangelands that can provide a

sustainable livelihood to ranchers through rangeland good and services over the long-term.

Effect of Grazing System on Greenhouse Gas Emissions from Grassland Soils on the Canadian Prairies

Bharat Shrestha, Scott Chang, Edward Bork, Cam Carlyle and Karen Thompson

Faculty of Agricultural Life and Environmental Sciences, University of Alberta,
Edmonton, AB

Mark S Boyce, James F. Cahill and Jessica Grenke

Department of Biological Sciences, University of Alberta, Edmonton, AB

Ray Desjardins and Ward Smith

Agriculture and Agri-Food Canada, Ottawa Research and Development Centre, Ottawa,
ON

Steven I. Apfelbaum

Applied Ecological Services, Inc. 17921 Smith Road Brodhead, WI, USA

Richard Teague

Dept. of Ecosystem Science and Management, Texas A&M University, TX, USA

Corresponding author: bshresth@ualberta.ca

Abstract

Even though rangelands provide many ecological goods and services (EG&S) such as carbon (C) sequestration and storage, regulation of water quality and flow, provision of wildlife habitats, and maintenance or enhancement of biodiversity, few data have quantified the environmental effects of various grazing systems on the rangelands. Cattle grazing systems on rangelands include the timing, duration, and frequency of defoliation that influence rangelands' EG&S. Adaptive multi-paddock (AMP) grazing is a rotational grazing management practice that rotates cattle herds through paddocks at high animal densities for short periods of time and allows a longer vegetation recovery time. We tested if AMP grazing reduces the net C balance of northern temperate grasslands as compared to traditional grazing systems (Non-AMP) across a climatic gradient in Alberta, Canada. We compared *in-situ* emissions of greenhouse gases (GHG), including carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), from 11 pairs of AMP and Non-AMP ranches. Gas samples were collected using static gas chambers biweekly from August to mid-October 2017. Air temperature, soil temperature, and soil moisture also were recorded simultaneously. Results showed that the CO₂ efflux rates varied spatially ($P < 0.03$) and temporally ($P < 0.0001$) ranging from 0.54 to 2.45 $\mu\text{mol s}^{-1} \text{m}^{-2}$ on AMP ranches and from 0.55 to 3.21 $\mu\text{mol s}^{-1} \text{m}^{-2}$ on Non-AMP ranches. However, the effects of grazing systems on CO₂ efflux was not significant ($P = 0.61$). We did not find any difference either in effluxes of CH₄, N₂O or the net GHGs between these two grazing systems. The GHG efflux declined with time in

the growing season and soil moisture was positively correlated with observed GHG emissions. In summary, the first year of measurements showed that GHG emissions did not differ between AMP and Non-AMP ranches. The lack of differences in the first year could be due to the restricted window of field measurement of GHGs, which precluded the spring and mid-summer periods, which are important in these northern temperate grasslands. In subsequent years we will be assessing the full growing season. Work is continuing for the summer 2018 and 2019 in order to examine the inter-annual variability of the net C balance of these systems.

The Effects of Simulated Grazing on Litter Microbial Enzyme Activity, Vegetation, Soil Thermal Properties and Soil Health in Alberta's Rangelands

Sara Barszczewski

Department of Renewable Resources, University of Alberta, Edmonton, AB
Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre,
Lethbridge, AB

Cameron N. Carlyle, Xiyang Hao

Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre,
Lethbridge, AB

Corresponding author: barszcze@ualberta.ca

Abstract

Soil provides many ecosystem goods and services (EG&S) necessary for the support of life, such as air and water purification, carbon sequestration, habitat for the flora and fauna, and nutrient cycling. Due to the sizeable area of Albertan rangelands (an estimated 7.4 million hectares), maintenance of soil health in rangelands is of vital importance for sustainable productivity and overall ecosystem health within Alberta. Cattle can affect soil properties and processes through trampling and removal of vegetation which mechanically break down litter, compact litter and soils and their removal of vegetation reduces biomass inputs and alters plant community composition. We tested these effects by simulating cattle trampling and defoliation at different times of year (spring, fall) in a fully factorial experiment at three grassland sites with different climates, and vegetation types. Soil thermal properties, extracellular enzymatic activity and the plant community were measured for this study. Preliminary soil thermal properties results have shown site variation, as well as some treatment variation at the sites with higher average moisture; more drastic effects will likely be seen in years following treatment application. From preliminary results, it is suggested that site effects will be seen in response to treatment, as well as changes over time. Through a renewed focus on rangeland soil health, the longevity of these ancient ecosystems will be ensured through better management practices.

Volunteer Technical Session Abstracts

Thursday, February 22, 2018 – Morning

Activities of Dung-Breeding Insects Affect Soil Fauna in Grasslands

Newton Lupwayi, Derrick Kanashiro, Kevin Floate and Xiying Hao

Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre,
Lethbridge, AB

Corresponding author: newton.lupwayi@agr.gc.ca

Abstract

Insect activity in cattle dung accelerates dung decomposition and release of nutrients from the dung into the underlying soil, which we hypothesized would affect the underlying soil fauna. To test this hypothesis, we measured the density of soil nematodes and soil micro-arthropods on native grassland in southern Alberta for each of three treatments. Treatment 1 (Dungⁱ) comprised dung pats treated with ivermectin to reduce insect activity. Treatment 2 (Dung^c) comprised dung pats without ivermectin. Treatment 3 (Contr) was bare soil. Soil cores (100 cm³) from beneath the pats (Treatments 1 and 2) and for Treatment 3 were collected from four field replicates, and soil fauna were extracted, periodically over a 52-week period starting a week after pat placement in May, 2016. Averaged over all treatments (including sampling time), the abundances of the fauna in the soil were in the order (counts/100 cm³): Prostigmata (331 for Tydeidae and 149 for others) > Acaridae (85) > Mesostigmata (21) > Oribatida (5) = Nematodes (4) = Collembolans (1). Insect activity increased the abundances of nematodes (Dung^c > Contr = Dungⁱ), Mesostigmata (Dung^c > Dungⁱ = Contr) and Collembolans (Dung^c > Dungⁱ = Contr), especially during the first eight weeks of dung decomposition. However, Prostigmata and Acaridae (both Dungⁱ = Dung^c > Contr) were not affected by insect activity, especially after week 16, even though the dung itself increased their abundances relative to the Contr without dung. Oribatida were more abundant where insect activity was reduced (Dungⁱ > Dung^c = Contr), but only in weeks 4 and 16. Therefore, insect activities in cattle dung increased the abundances of nematodes, Mesostigmata and Collembolans, had no effect on the abundances of Prostigmata and Acaridae, and reduced the abundance of Oribatida.

Monitoring Cultivation Practice Change using Landsat

David Hildebrand

Alberta Agriculture and Forestry, Edmonton, AB

Corresponding author: david.hildebrand@gov.ab.ca

Abstract

Much of the cultivation being done for annual crop production has been reduced due to the adoption of continuous cropping practices. The reduction of summerfallow has been one of the most significant cultivation practice changes in terms of the impact on soil conservation. It is possible to use the Landsat archive dating back to 1984 to identify summerfallow and then develop measures of practice change on an annual basis for any given area over time. Using this archive we can provide consistent and quantitative measures on summerfallow reduction on an annual basis. This will be useful to the public, industry and policy-makers.

The current *modus operandi* is to use Census of Agriculture data to look at several cultivation practices on a census area (e.g., municipality) at snapshots every 5 years. By using satellite imagery we can look at the change from summerfallow to continuous cropping on an annual basis on a variety of geographies (e.g., township, municipality, etc.). This would also aid in interpretation of the conservation farming model output results on beneficial management practice (BMP) adoption especially if data anomalies are found (soils, categorization, weather/drought).

Soil carbon fluxes in a North American temperate alpine ecosystem

Cole Brachmann, David S Hik

Department of Biological Sciences, University of Alberta, Edmonton, AB

Guillermo Hernandez Ramirez

Department of Renewable Resources, University of Alberta, Edmonton, AB

Corresponding author: cbrachma@ualberta.ca

Abstract

Alpine regions are heavily impacted by global climate change; warming at roughly twice the rate of the global average. Due to the magnitude of change occurring at these regions, mountains are increasingly the focus of ecological investigations. However, little information is available about soil carbon fluxes in mountain ecosystems and potential feedback processes on escalating climate change. Soil fluxes can be impacted by climate change by changes in temperature, moisture, and nutrient availability. These factors will also influence the plant and microbial communities that mediate further variations in soil fluxes. Measuring carbon fluxes from sites that differ in soil properties, elevation, and plant community development can provide evidence for the range of soil fluxes that may be present within mountain ecosystems.

In situ CO₂ and CH₄ fluxes were measured with a portable laser analyzer in a closed, dynamic flux chamber system. The chambers were set-up in recently-deglaciated terrain (early sites) and later successional areas (late sites), as well as in three elevational bands along two transects on an east-facing slope. The early and late sites were measured twice a day for three days, while the transects were measured once a day. Composited soil samples were collected from each location and analyzed for pH, electrical conductivity (EC), NH₄, NO₃, C:N, δ¹⁵N, and texture. Microbial biomass (phospholipid fatty acids – PLFA) was also collected in the early and late sites. In general, late sites had a larger efflux of CO₂ than early sites while also having the strongest influx of CH₄. Late sites had significantly higher amounts of PLFA's (both bacterial and fungal) than early sites, however the bacteria:fungi ratio was unchanged between the sites. The higher microbial biomass present at the late sites is a likely contributor to the increased carbon fluxes (both CO₂ and CH₄). Increased CO₂ fluxes in late sites highlight the potential for reduced carbon sequestration in alpine soils as climate change continues; however, the production of CO₂ may be offset by the influx of CH₄ in these soils.

Alberta Soils Tour 2017

Konstantin Dlusskiy and Len Leskiw

Paragon Soil and Environmental Consulting Inc., Edmonton, AB

Larry Turchenek

Retired, formerly with AMEC Foster Wheeler, Edmonton, AB

Corresponding author: kdlusskiy@paragonsoil.com

Abstract

The Alberta Soils Tour 2017 was held on May 29 to May 31, 2017, traversing northeastern Alberta with focus on soils across the Athabasca Oil Sands Region. With over 50 participants onboard, the Tour started from Edmonton, went to Fort McMurray, further north to the Fort Hills, and returned to Edmonton. Stops along the Tour included a wide variety of sites discussed through the prism of pedology:

Day 1

- Stop #1** Crow Lake Provincial Park: Luvisol-Gleysol-Mesisol catena on glacial till and Brunisols on glaciofluvial deposits; vegetation recovery from 2002 House River Fire
- Stop #2** Mariana Lake Lodge: vegetation recovery from 1995 Mariana Lake Fire
- Stop #3** Fort McMurray: 1st year vegetation recovery from 2016 Fort McMurray Fire
- Stop #4** Oil Sands Discovery Center, Fort McMurray: Demonstration of crude oil extraction from bituminous sands

Day 2

- Stop #5** Fort McKay outcrop: Brunisols on shallow bedrock; oil sands exposure
- Stop #6** Fort Hills: Brunisols on glaciofluvial deposits and on eolian sediments over gravelly glaciofluvial deposits; vegetation recovery from 2011 Richardson Fire
- Stop #7** Syncrude Mildred Lake Operations: Land of Giants, a Syncrude mining equipment exhibit and Wood Bison Viewpoint overlooking reclaimed areas and the Beaver Creek Bison Ranch
- Stop #8** Gateway Hill: Anthroposols on overburden materials reclaimed in 1980s and 1990s
- Stop #9** Dunvegan Gardens, Fort McMurray: Regosol-Gleysol catena on recent fluvial sediments of Clearwater River; agriculture in Fort McMurray area

Day 3

- Stop #10** Suncor Site: Wapisiw Lookout and natural trails on a reclaimed tailings pond
- Stop #11** Allan Jenkins farm near Wandering River, AB: Luvisol-Gleysol catena on glaciolacustrine sediments; soil reclamation on pipelines
- Stop #12** Ray Gauthier farm near Athabasca, AB: Luvisol-peaty Gleysol catena on glacial till and glaciolacustrine sediments, cultivated wetland.

**Forest, Wetland and Riparian Soils Technical Session
Abstracts**

Thursday, February 22, 2018 – Morning

Dynamics of Ion Adsorption by PRS Probes in Moderately-Saline Wetlands

Eric Bremer

Western Ag Innovations, Lethbridge, AB

Jim J. Miller and T. Curtis

Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, Lethbridge, AB

Jeremy A. Hartsock and Dale H. Vitt

Center for Ecology and Department of Plant Biology, Southern Illinois University, Carbondale, IL

Corresponding author: ericbremer@westernag.ca

Abstract

Plant Root Simulator (PRS[®]) probes are ion exchange membranes in a plastic support that have been widely used to assess nutrients in wetlands and other ecosystem types. The rate of ion adsorption by PRS probes depends on ion activity and diffusivity in soil solution and its relative strength of adsorption. Saline conditions may lead to rapid equilibrium of dominant ions on the membrane and may require the use of shorter burial periods. In two separate studies, we determined ion adsorption over time periods ranging from two hours to sixteen days. In a riverbank study conducted along a sodic reach of the Little Bow River, the dominant ion (sulfate) increased exponentially over a two-week period, while other ions peaked at burial periods ranging from four hours to one week. In general, burial for seven days was suitable for determining impacts of riverbank conditions on nutrient levels. In a study conducted in an extreme-rich fen near Fort McMurray, ion adsorption after one day was similar to that after sixteen days for most nutrients, indicating that a stable or dynamic equilibrium was obtained for most elements. However, potassium declined after one day, likely due to displacement by more strongly held cations, while iron and manganese increased, likely due to increasingly anaerobic conditions. Based on both studies, burial for one day provides a clear measurement of nutrient differences in moderately-saline wetlands, while burial for two weeks provides similar measurements for most nutrients, but may result in lower or higher nutrient levels, depending on ion selectivity and soil conditions.

The impact of permafrost thaw on the carbon store of a peatland complex in western Canada

Liam Heffernan

Department of Renewable Resources, University of Alberta, Edmonton, AB

Cristian Estop-Aragonés

Department of Renewable Resources, University of Alberta, Edmonton, AB

Klaus-Holger Knorr

Ecohydrology and Biogeochemistry Group, Institute of Landscape Ecology, Münster, Germany

David Olefeldt

Department of Renewable Resources, University of Alberta, Edmonton, AB

Corresponding author: wheffern@ualberta.ca

Abstract

Northern peatlands have acted as a globally significant sink of atmospheric carbon and contain a third of all terrestrial soil carbon, with a significant proportion of this found in the discontinuous permafrost zone of western Canada. Ongoing warming of the north's climate has accelerated permafrost thaw and threatens the stability of this vast carbon store. Previous studies have shown substantial losses of soil carbon post permafrost thaw, with the majority of these losses occurring within the first decade of thawing. The objective of this study is to assess the net effect of permafrost thaw on carbon storage in a peatland complex found within the discontinuous permafrost zone of western Canada.

We used a chronosequence approach to measure carbon stocks in 8 peat cores from an intact permafrost peat plateau and two adjacent thawed permafrost bogs, ranging in thaw age from ~30 years (young), to ~75 years (intermediate), and to ~350 years (mature). We observed carbon losses from the sylvic, forested peat layer post permafrost thaw across all cores. However, we did not observe significant losses of old carbon from other peat layers and the sylvic peat carbon losses did not greatly affect our overall carbon stocks. These results suggest that while permafrost thaw results in the loss of old previously accumulated carbon this does not impact the strength of their carbon sink potential.

Saturated zone depth variation at toe and depressional slope positions in a doughnut-moraine landscape

Ivan Whitson

I Whitson Innovations Inc., Edmonton, AB

Corresponding author: iwhitson@telus.net

Abstract

The soil drainage regime of mineral soils found at toe and depressional slope positions is of considerable importance to riparian and wetland ecosystem function in the boreal-parkland transition regions of Alberta. The temporal variation of depth to the saturated zone at these slope positions has received little attention. The objective of my work was to better understand the temporal variation of shallow groundwater at these slope positions. The study location was forested and had a doughnut-moraine landscape. Piezometers were installed beginning 2011 at transects in three subwatersheds at depths ranging from 180 to 276 cm below surface. Soil characteristics were documented during borehole excavation. From 2012 to 2017 groundwater depth was measured from 10 to 17 times per year beginning in March and extending in some years to November. Piezometer stem elevation was measured once per year relative to a steel benchmark using a survey rod and level. Groundwater surface elevations were adjusted to the common benchmark for direct comparison. Two sites were instrumented with pressure transducers for continuous measurement of groundwater depth over the April to October period.

Surface elevation difference between depressional and toe positions ranged from 0.8 to 1.6 m. While depressions had Gleysolic soils, toe slopes had subgroups of the Gleysolic, Luvisolic and Solonetzic orders. Most depressional sites lacked carbonate-rich horizons. Organic horizon thickness varied from 20 to 45 cm in depressions and 4 to 15 cm at toe positions. Over the six year period, groundwater depth for depressional piezometers varied from above-surface to 2-2.5 m below surface, while at the toe ranged from occasional surface flooding to about 2.0 m below surface. Depressional slope positions had a much higher frequency of surface flooding than toe positions. Data collected on a 0.25 hr interval showed that with sufficient snow depth, groundwater elevation at both toe and depressional piezometers rose rapidly during snowmelt and then receded over the subsequent summer. Duration of May-Oct saturation differed between the two slope positions, particularly in shallower increments. Days saturated in the 30-50 cm depth increment was 3 to 94 days/year for the depression and 8 to 59 days/year for the toe position. At the 0-10 cm depth increment, days saturated ranged from 0 to 73 days/year for the depression and from 0 to 4 days/year for the toe.

The similarity of saturated zone depth amplitude between the two slope positions may reflect higher retention of water in doughnut-moraine landforms than other glacial landforms. Differences in duration of saturation may help explain organic horizon

thickness at the two slope positions. Data from this site suggest that organic horizon thickness may serve as an additional indicator for the upland-wetland threshold in wetland delineation studies. Future work will examine vertical hydraulic gradient differences and surface runoff at these sites.

Rhizosphere microbial communities and boreal forest vegetation shifts

Sarah Thacker, Sylvie Quideau

Department of Renewable Resources, University of Alberta, Edmonton, AB

Corresponding author: sjthacke@ualberta.ca

Abstract

Climate change threatens the boreal forest—the largest terrestrial store of carbon in the world. Given continued increases in mean annual temperature, will the boreal forest—currently a global carbon sink—continue to sequester carbon or become a carbon source and further exacerbate climate change?

We investigated microbial community response to expected vegetation shifts with climate change, which for Western Canada will correspond to a shift from white spruce to aspen. We focused on the rhizosphere, a hotspot for microbial activity in soil, where priming could destabilize existing organic matter. Rhizosphere samples were collected at the Ecosystem Management Emulating Natural Disturbance (EMEND) project in northern Alberta, Canada. Phospholipid fatty acid (PLFA) analysis was used to characterize microbial community composition and multiple substrate induced respiration (MSIR) to examine microbial community function. We compared undisturbed stands of aspen and spruce to investigate future vegetation shifts, and 17-year-old clear-cuts of both stand types where aspen is naturally regenerating.

Preliminary results revealed that the microbial communities of undisturbed spruce stands differed from aspen stands in both composition and function. Aspen rhizosphere community composition differed in the two clear-cut stands, indicating a legacy effect of spruce in clear-cut spruce sites. Overall rhizosphere microbial communities differed from the bulk soil, and differences were observed for specific PLFA chemical structures and MSIR substrates. Next steps include determining what observed differences in microbial community composition and function could mean for soil carbon flux. Additionally, measurement of PLFA isotopic ratio showed differences between rhizosphere and bulk soil PLFAs, potentially indicating that these microbes are utilizing difference carbon sources.