

Impact of N-fixing trees on soil-derived Greenhouse Gas emissions in the semi-arid Canadian Prairie

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Shelterbelts

- Carbon storage
- Greenhouse gas mitigation

Are shelterbelts created equal in terms of GHG mitigation?



Objective:

To quantify and compare soil emissions of N_2O , CH_4 and CO_2 from N-fixing and coniferous shelterbelts



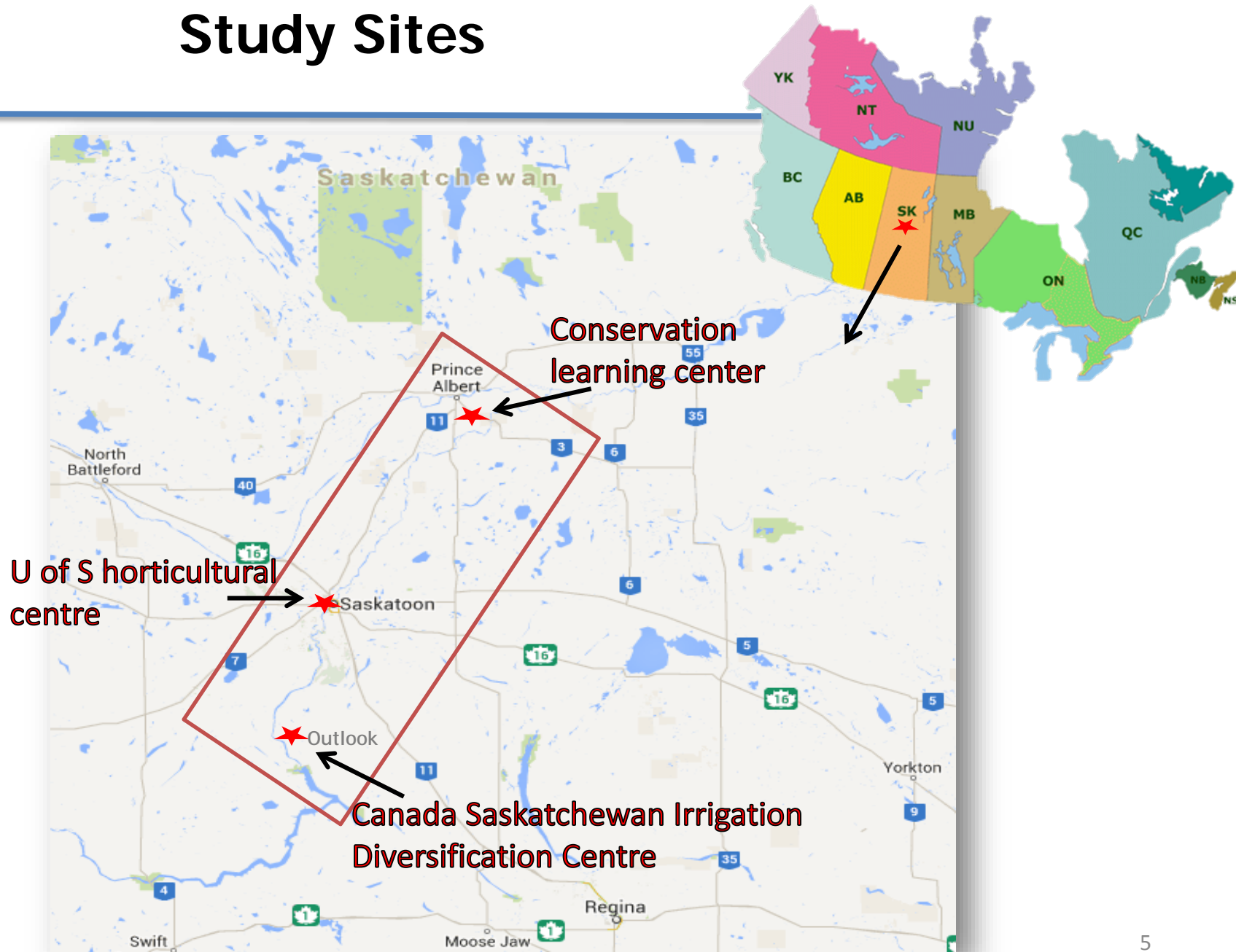
Caragana



Vs.

Conifers

Study Sites



Shelterbelt Characteristics

Location	Main species	Age (yr)	Tree rows	Length (m)	Shelterbelt orientation†	Planting space (m)	Mean DBH (cm)	Mean height (m)
<i>N-fixing shelterbelts</i>								
Outlook	Caragana	34	1	750	N - S	1	6.8	5
Saskatoon	Caragana	38	1	84	N - S	1	5.3	5.5
Prince Albert	Caragana	19	1	150	N - S	2	5.6	4
<i>Non N-fixing shelterbelts</i>								
Outlook	Scots pine	19	1	435	E - W	2.5	27.7	10.5
Saskatoon	Mixed spp.	38	1	90	N - S	2	17.5	15
Prince Albert	White spruce	41	4	70	N - S	2	15	7

Gas, soil and ancillary data

- Non-steady state, vented chambers
(2013 - 2014)
- Sampling intensity:
 - weekly, (guided by weather events)
 - 4 time points (T_0 , T_{10} , T_{20} and T_{30})
- Gas samples measured using a gas chromatograph (Bruker 450-GC)
- Soil temperature and moisture at 5 cm depth
- Soil sampling: 15 cm depth
- Statistical analysis - Two-way ANOVA
Year x species

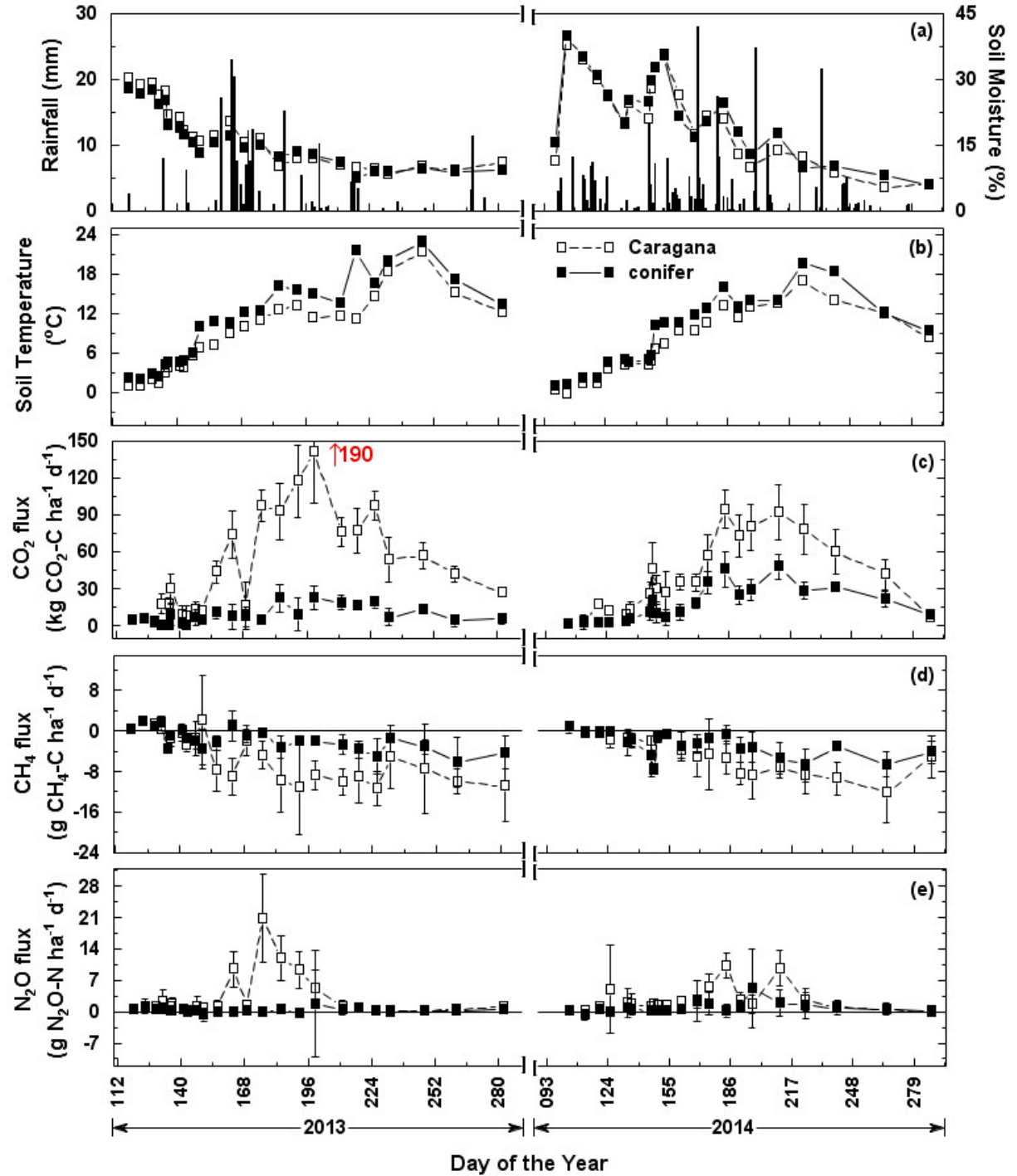


Soil properties

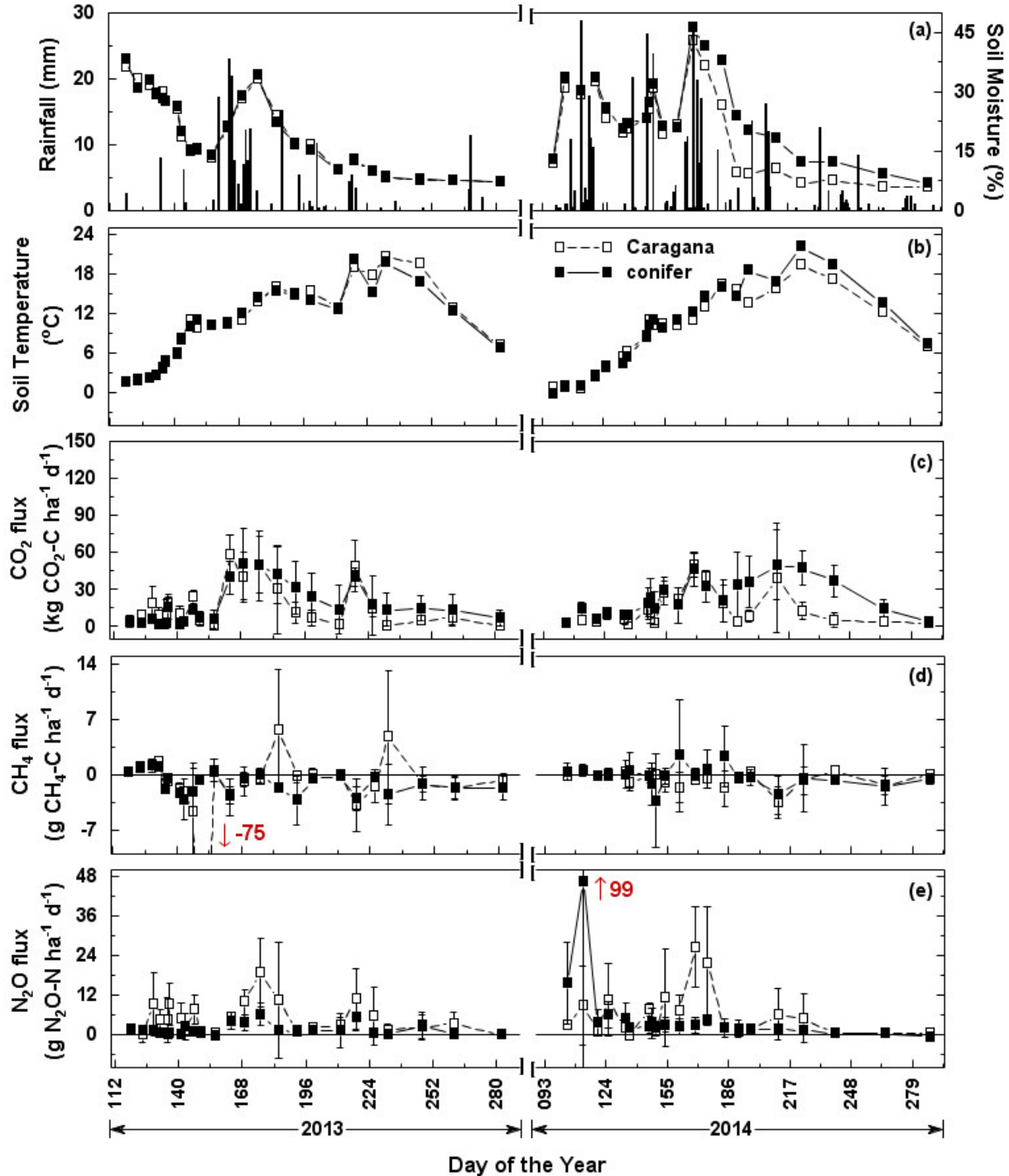
Location	Shelterbelt species	Organic C (Mg ha ⁻¹)	Total N (Mg ha ⁻¹)	NH ₄ -N (μg N g soil ⁻¹)	NO ₃ -N (μg N g soil ⁻¹)	Bulk density (Mg m ⁻³)	Soil pH
<i>N-fixing shelterbelts</i>							
Outlook	Caragana	71.2	6.2	10.3	8.4	1.26	6.97
Saskatoon	Caragana	61.8	5.6	7.9	6.1	0.93	7.12
Prince Albert	Caragana	33.2	2.7	6.4	5.5	1.20	6.90
<i>Non N-fixing shelterbelts</i>							
Outlook	Scots pine	64.8	5.5	7.6	6.0	1.30	6.83
Saskatoon	Mixed spp.	58.2	4.3	6.2	5.3	0.98	6.92
Prince Albert	White spruce	31.1	2.6	5.0	4.9	1.25	6.75

Summary of soil properties (0-15 cm) from caragana and non N-fixing shelterbelt plots

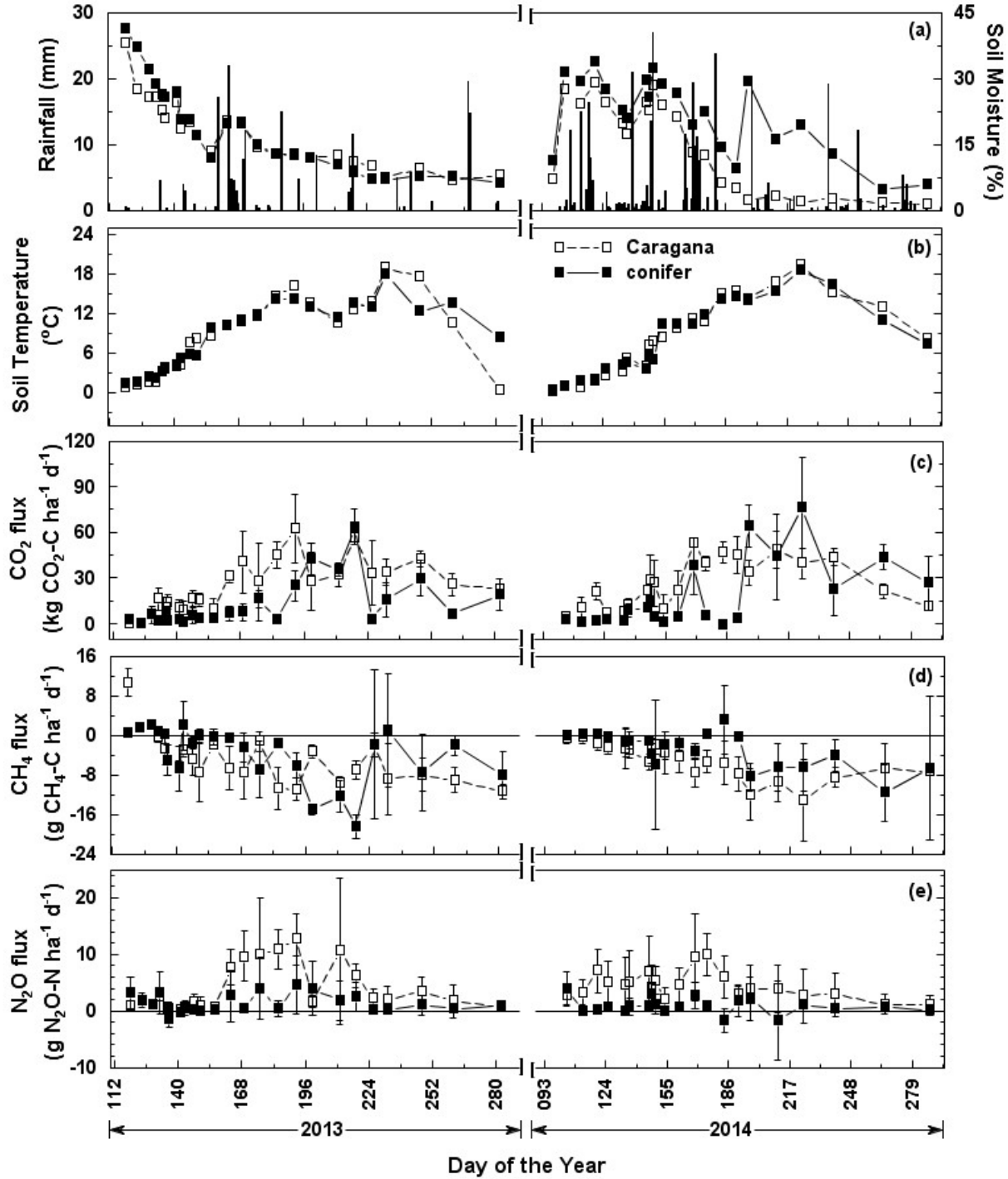
GHG fluxes
Prince Albert



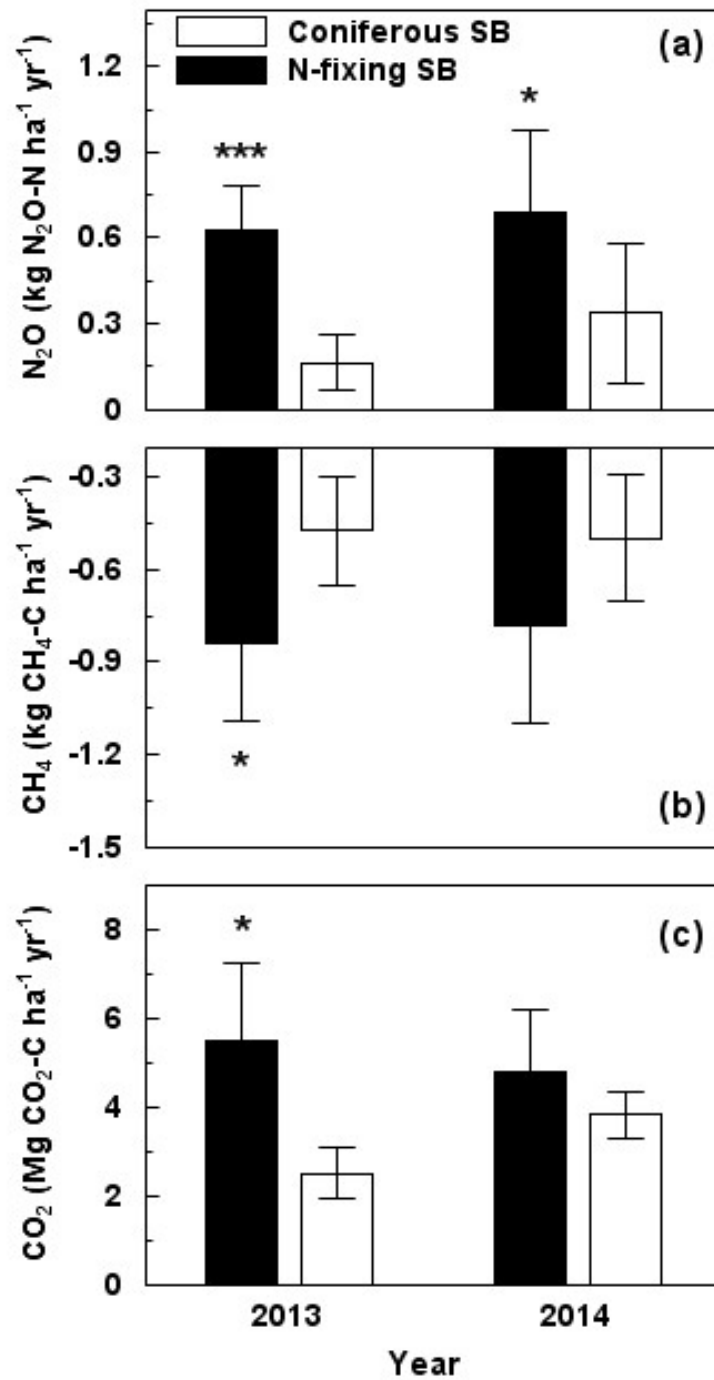
GHG fluxes
Saskatoon



GHG fluxes
Outlook



Seasonal Cumulative GHG Exchange



Summary and Conclusion

- Nitrous oxide emissions could offset gains in C storage
 - 1 kg N₂O will have the same global warming effect as 296 kg CO₂

- Inter-planting - maximize N-nutrition in non N-fixing trees while reducing potentials for N₂O emissions
 - Increased biomass yield = more C storage
 - Reduced N₂O emissions

References

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Thank you



Questions
are
guaranteed in
life;
Answers
aren't.