

Mapping Boreal Peatlands for Assessment of Vulnerability to Wildfire



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ABSTRACT

Research is being carried out in boreal peatlands (one of the largest reservoirs of terrestrial carbon in the Northern Hemisphere) to improve our understanding of their vulnerability to wildfire as climate change lowers water tables and exposes C-rich peat to burning. To quantify carbon emissions from peatlands due to wildfire, spatially explicit maps of peatland types are needed as well as information on the fire regime and burning characteristics of each type. Research presented here is on developing high quality maps of peatland types (bog, fen, marsh, and swamp) as well as level of biomass (open, wooded, forested). A multi-sensor, multi-season approach is being implemented which uses multiple dates of L-band (23 cm) Synthetic Aperture Radar (SAR) and Landsat optical-IR remote sensing data within an object-based classification workflow. Initial SAR-optical maps were trained and validated using air photo-based (circa 1980s photos) maps. However, these maps are outdated and therefore in the summer of 2010, field data on peatland types and other site characteristics were collected for more than 50 randomly selected locations. Since the boreal peatland terrain is difficult to access, site visits often required hiking long distances by foot, traversing lakes and streams by boat, and entrance by off-road vehicles. These site specific data are being used for further refinement and validation of the SAR-optical maps.

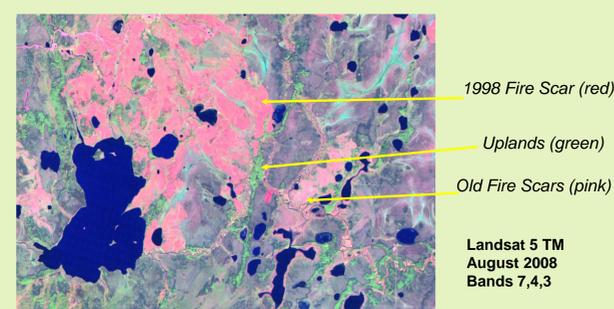
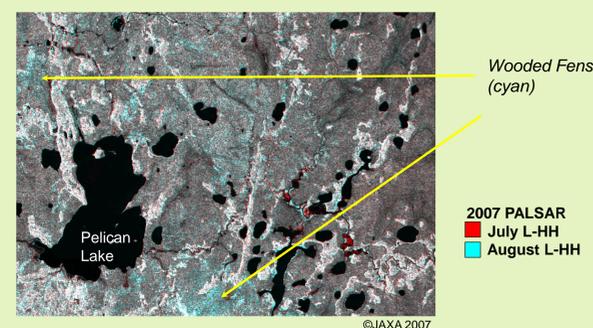
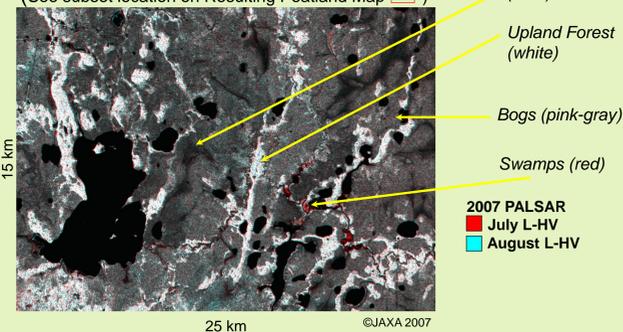
DATA SOURCES

850,000 ha Study Area of Central Alberta

- August 2008 Landsat TM Bands 1-5, and 7
- July and August 2007 PALSAR L-HH, L-HV
- June and August 2006 ERS-2 C-VV

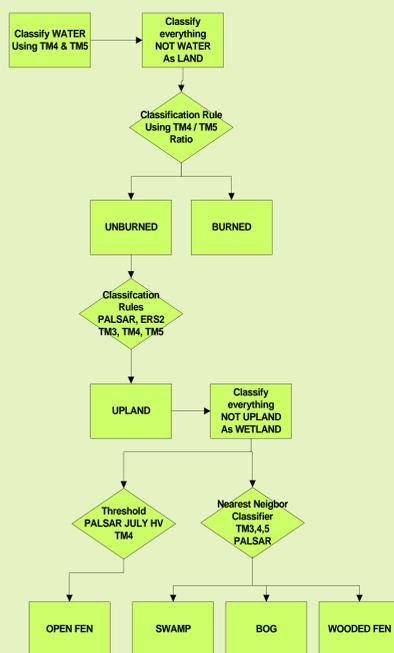
Pelican Lake Area Subsets

(See subset location on Resulting Peatland Map)

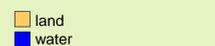


TECHNIQUES

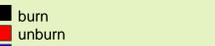
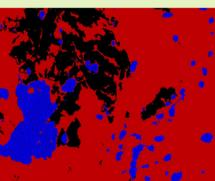
- Input data sources were segmented into digital image objects which capture homogeneous land cover types.
- Image objects were compared to reference data and classified with a top-down contextual hierarchical approach using decision tree rules and refined using nearest neighbor classification techniques.



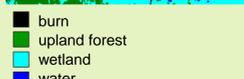
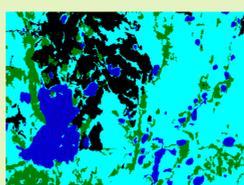
Process Tree Level 1



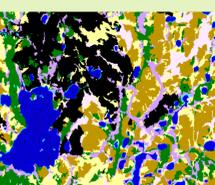
Process Tree Level 2



Process Tree Level 3



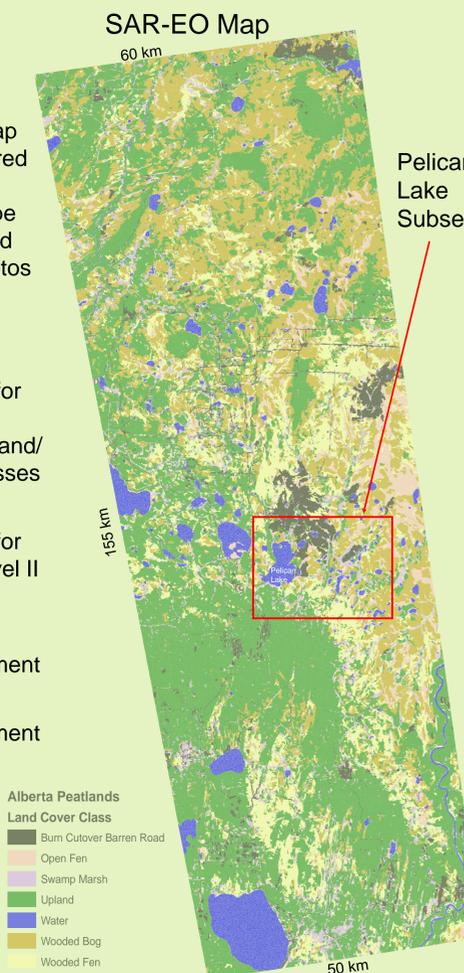
Process Tree Level 4



All thematic classes defined. See legend for full map, at right.

RESULTS

- Initial evaluation SAR-EO Map was compared to 1980's peatland type map created from air photos and field surveys.
- 85% overall agreement for broad scale Level I Wetland/ Upland classes
- 70% overall agreement for detailed Level II classes
- Fen 60% & 78% agreement
- Bog 72% & 62% agreement



SAR-EO Map	Reference Map			Total	Commission Errors
	Upland	Wetland	Water		
Upland	784	212	0	996	79%
Wetland	280	1820	3	2103	87%
Water	0	4	172	176	97%
Total	1064	2004	175	3243	
Omission Errors	74%	90%	98%		85%

SAR-EO Map	Reference Map					Total	Commission Errors
	Fen	Swamp Marsh	Upland	Water	Wooded Bog		
Fen	782	97	172	3	232	1256	60%
Swamp Marsh	18	68	25	0	19	127	51%
Upland	71	57	784	0	84	996	79%
Water	3	4	172	0	179	97%	
Wooded Bog	117	16	81	0	556	772	72%
Total	961	238	1064	175	891	3329	
Omission Errors	78%	27%	74%	98%	62%		70%

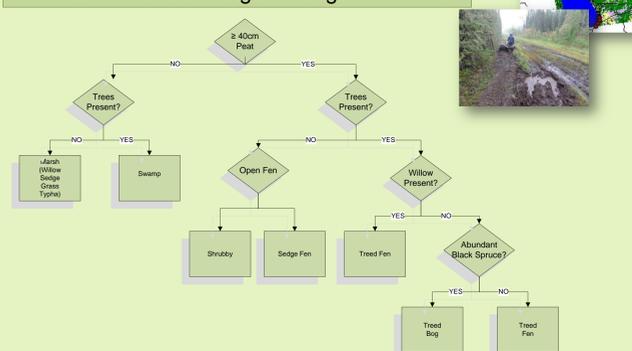


Location of the 850,000 hectare study area

FIELD ASSESSMENT AND NEXT STEPS

- Initial Field Assessment conducted Summer 2010
- Sites difficult to access. Roads are limited. Some sites required hiking > 1 km, others canoeing, or 4 wheelers
- 48 Independent field observations

Field Guide to Distinguish Bogs from Fens



Big Question: Which method is more accurate, Air Photo interpretation or SAR-EO fusion for distinguishing bogs from fens?

- Overall accuracy for broad scale Level I Wetland vs. Upland classes: 86% for both Airphoto and SAR-EO maps
- Overall accuracy for 4 classes (Fen, Bog, Swamp Marsh, Upland): 50% for the airphoto map; 57% for the SAR-EO map; 18% of the sites were on the edge of transition zones

Observer	PALSAR-Landsat Map Classes						Producer's Accuracy	Commission Error
	Open Fen	Wooded Fen	Bog	Swamp Marsh	Upland	Burn		
Open Fen	1	1	1	1	4	1	10%	
Wooded Fen	11	1	1	1	16	1	69%	
Bog	3	3	1	1	7	4	43%	
Swamp Marsh	1	1	3	1	4	4	73%	
Upland	1	4	1	4	10	18	48%	
Burn	1	1	2	2	2	2	100%	
Total	1	18	4	10	13	2	48	
User's Accuracy	0%	61%	75%	30%	62%	100%		
Commission Error	0%	61%	75%	30%	62%	100%	58%	

- **Conclusion:** Airphoto map not a great reference
- **Problem:** Remote sites difficult to access
- **Strategy:** Redefine training classes based on field data, use Airphoto Map as a guide only. Compare new classification to validation field data to be collected in Summer 2011.