

Large area land cover and dynamics: Landsat opportunities and directions

Mike Wulder
Canadian Forest Service

Key partners: Nicholas Coops (UBC), Trisalyn Nelson (UVic)



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Ressources naturelles
Canada

Service canadien
des forêts

- RSE Special Issue – Landsat
- Pecora 18 –
- November 14-17, 2011, Herndon, Virginia
- *Forty Years of Earth Observations... Understanding a Changing World*
 - Achieving Pecora's vision, highlights, open archive, global mapping, next forty years

Outline

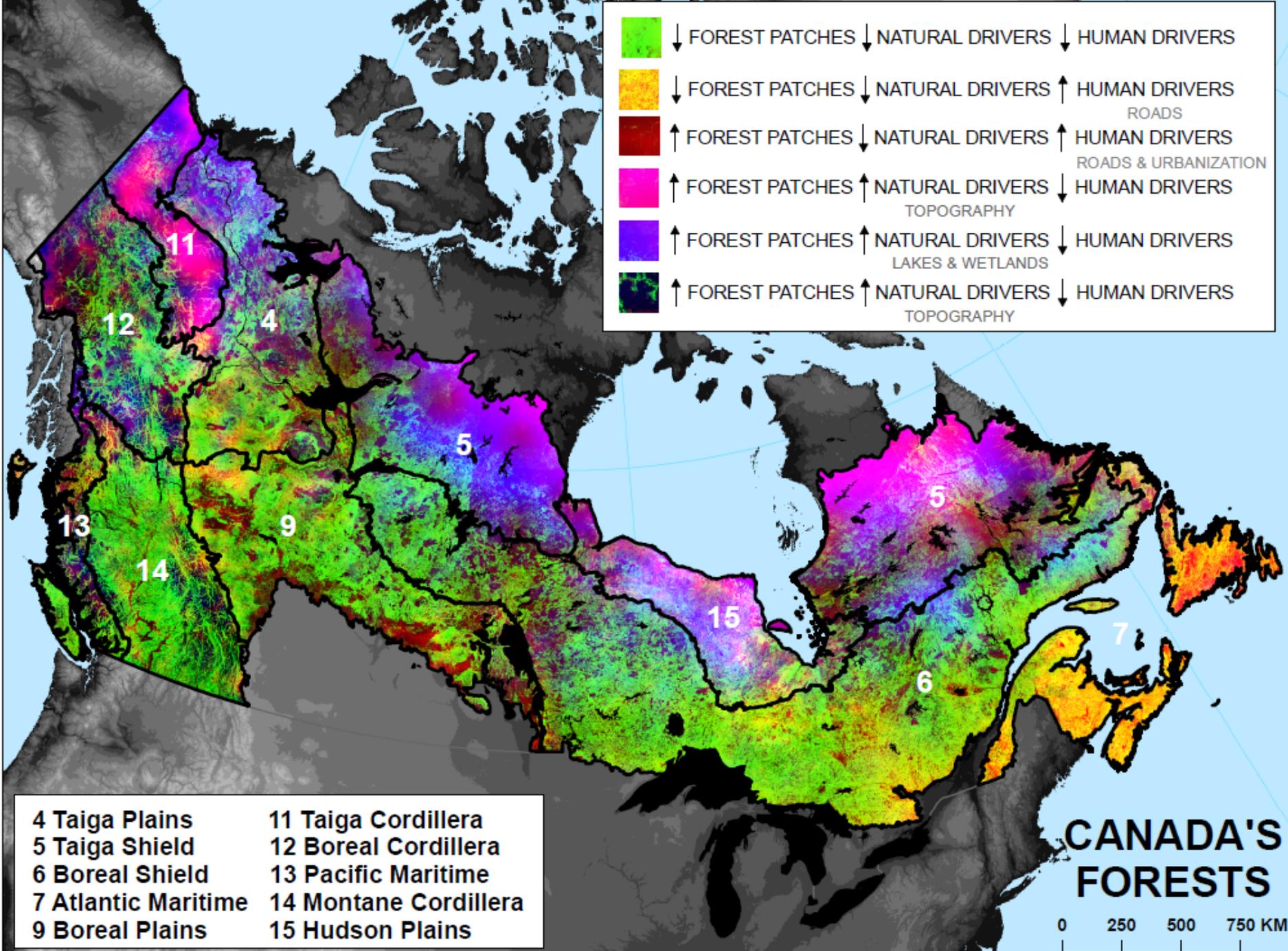
- Talk request: Lessons learned, forward looking recommendations
- Science team tenure
 - Thanks USGS, NASA, EDC, and team
- Using remotely sensed and spatial data to inform on forest ecosystem structure and function
 - Data integration
 - Modeling, spatial analysis
 - Data blending
 - Image processing
- International perspectives
- Applications
- Future considerations

Value of Landsat to National programs

- Increasingly complex questions require more frequent and spatially exhaustive data
- Canada able as a nation to “own” information
 - Land cover, dynamics, fragmentation, monitoring
- Landsat empowers nations towards information independence
- Policy development supported by data and science

National programs ...2

- Landsat promotes consistency and compatibility across national programs outcomes
- Building around remote sensing for policy and reporting
 - Need continuity; cross-sensor integration - resolution not sensor focus;
- Landsat promotes collaboration and sharing
 - Knowledge, approaches, products
 - Enables international projects/programs:
 - GEO, GFOI, FRA



	↓ FOREST PATCHES	↓ NATURAL DRIVERS	↓ HUMAN DRIVERS
	↓ FOREST PATCHES	↓ NATURAL DRIVERS	↑ HUMAN DRIVERS ROADS
	↑ FOREST PATCHES	↓ NATURAL DRIVERS	↑ HUMAN DRIVERS ROADS & URBANIZATION
	↑ FOREST PATCHES	↑ NATURAL DRIVERS	↓ HUMAN DRIVERS TOPOGRAPHY
	↑ FOREST PATCHES	↑ NATURAL DRIVERS	↓ HUMAN DRIVERS LAKES & WETLANDS
	↑ FOREST PATCHES	↑ NATURAL DRIVERS	↓ HUMAN DRIVERS TOPOGRAPHY

4 Taiga Plains	11 Taiga Cordillera
5 Taiga Shield	12 Boreal Cordillera
6 Boreal Shield	13 Pacific Maritime
7 Atlantic Maritime	14 Montane Cordillera
9 Boreal Plains	15 Hudson Plains

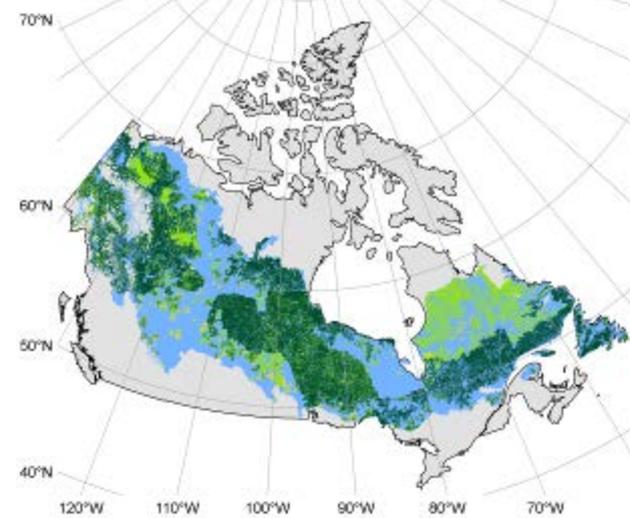
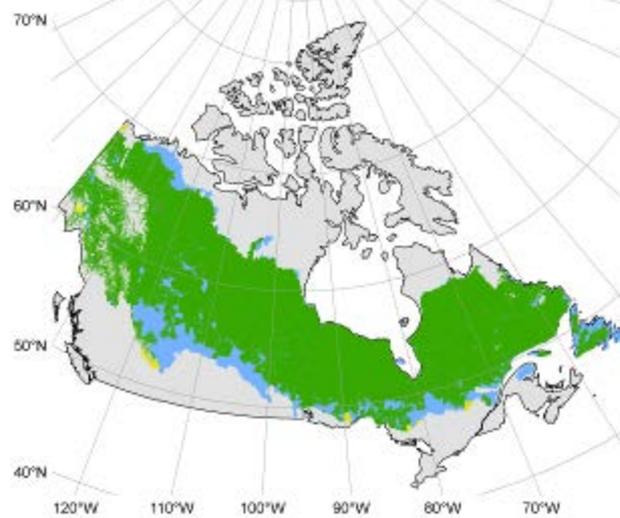
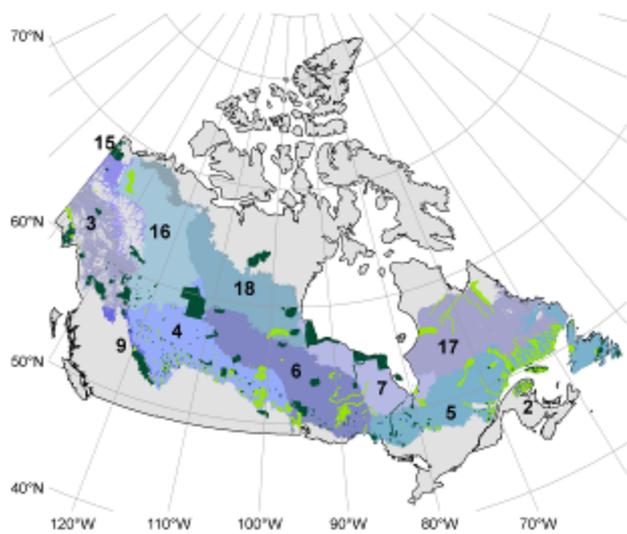
CANADA'S FORESTS

0 250 500 750 KM

Parks and protected areas

- 40 % of Canada forest
- 60 % are forest dominated ecosystems
- Approaching 10% of Canada is designated PPA
- About 6.8% of Canada's boreal is protected in 878 parks

- Q. What areas in Canada are *de facto* PPA?
- Support: Landsat fragmentation, roads, city lights, PPA maps

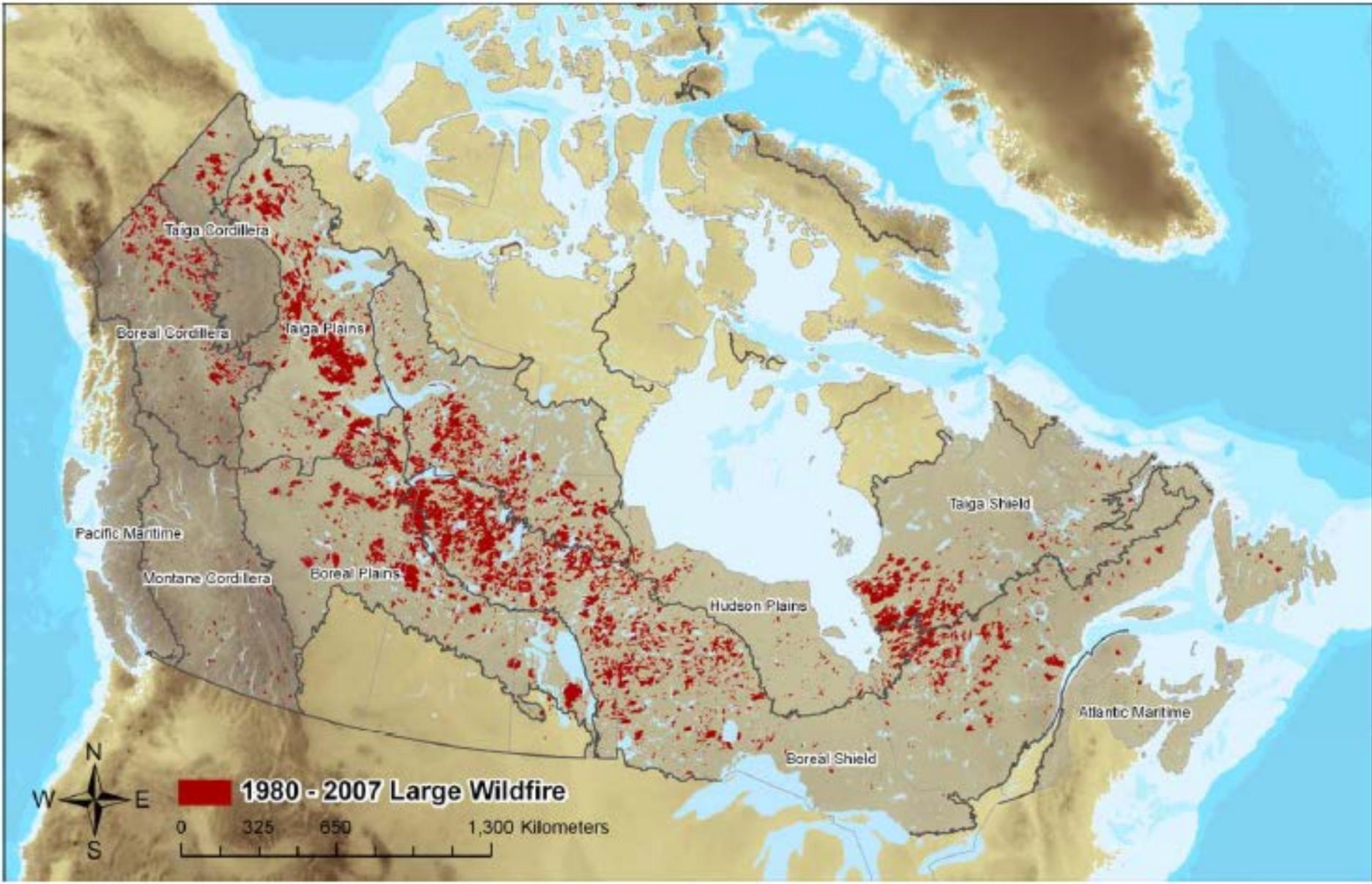


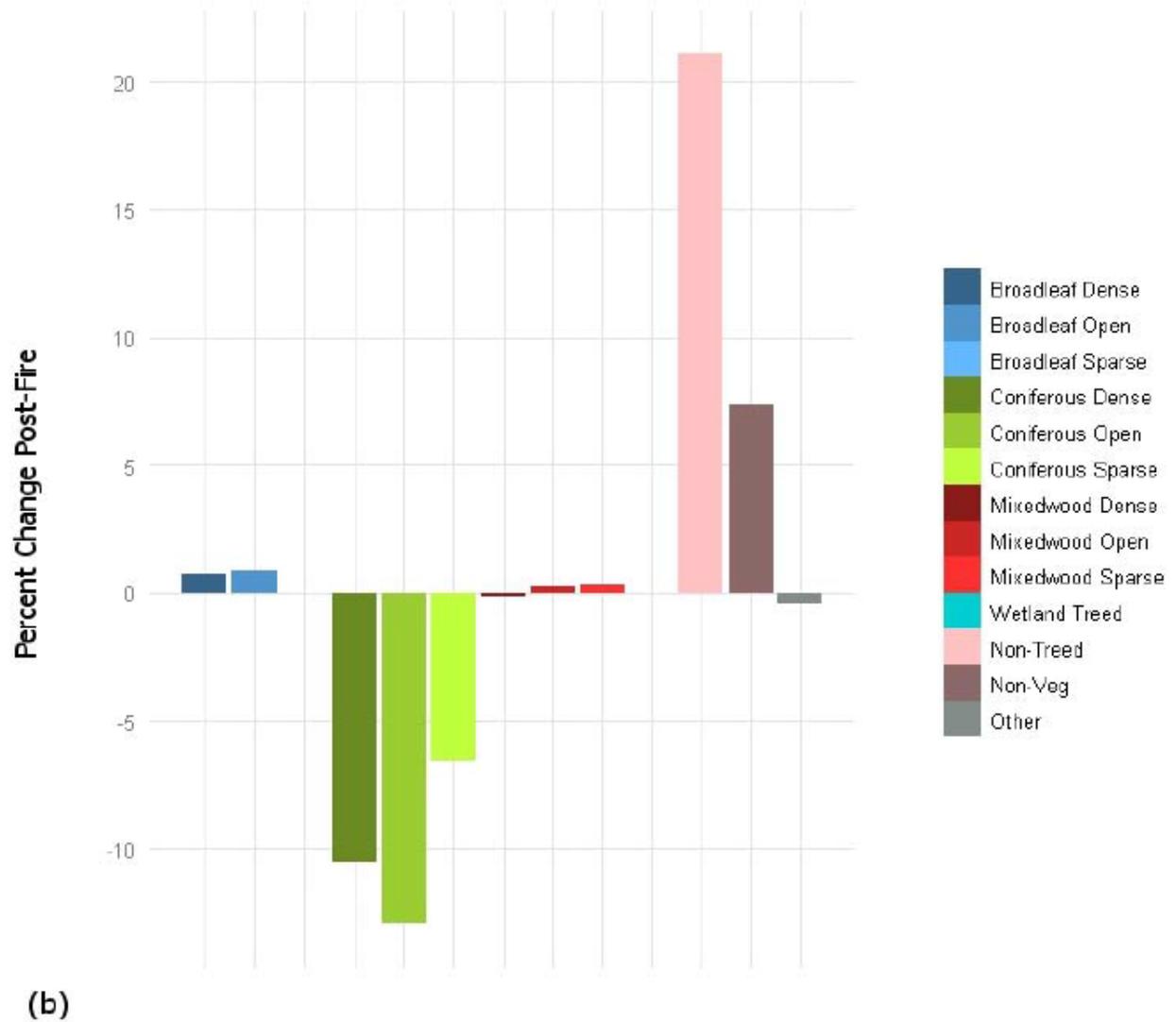
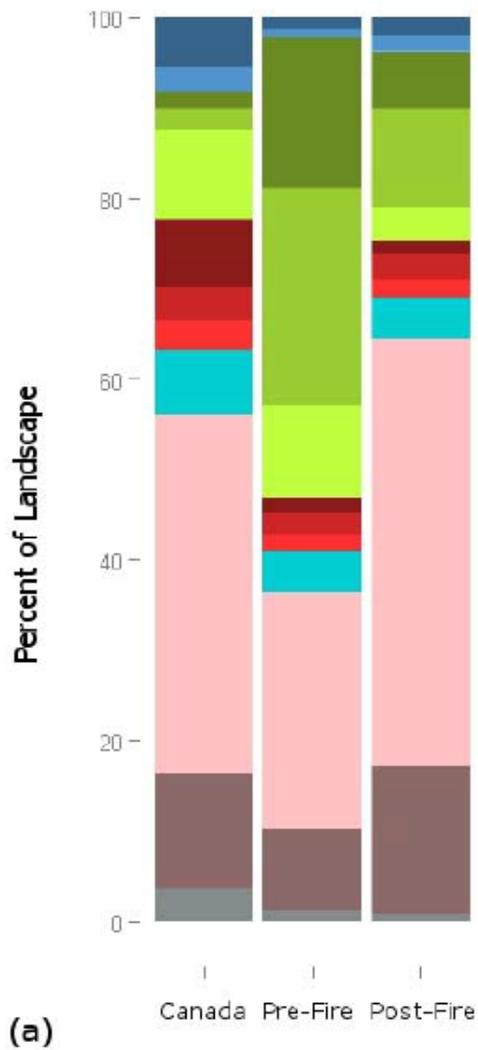
- a. Map of existing protected areas in the Canadian boreal forest.
- b. Access areas of the boreal zone.
- c. Classification of *de facto* protected areas based on landscape structure. Areas with landscape structure similar to strictly protected areas are mapped in medium (> 540 km²) and dark (> 3,000 km²) green. Those with landscape structure similar to remaining protected areas are mapped in yellow (> 540 km²) and light green (> 3,000 km²).
- Overall, between 50%, based on landscape structure, and 80%, based on anthropogenic infrastructure alone, of Canada's boreal zone exists in large, intact blocks.
- Provides quantitative base for reserve development
- Quantitative base supports inclusion of and differing climates and consideration of connectivity

Project lead: Dr. Margaret Andrew

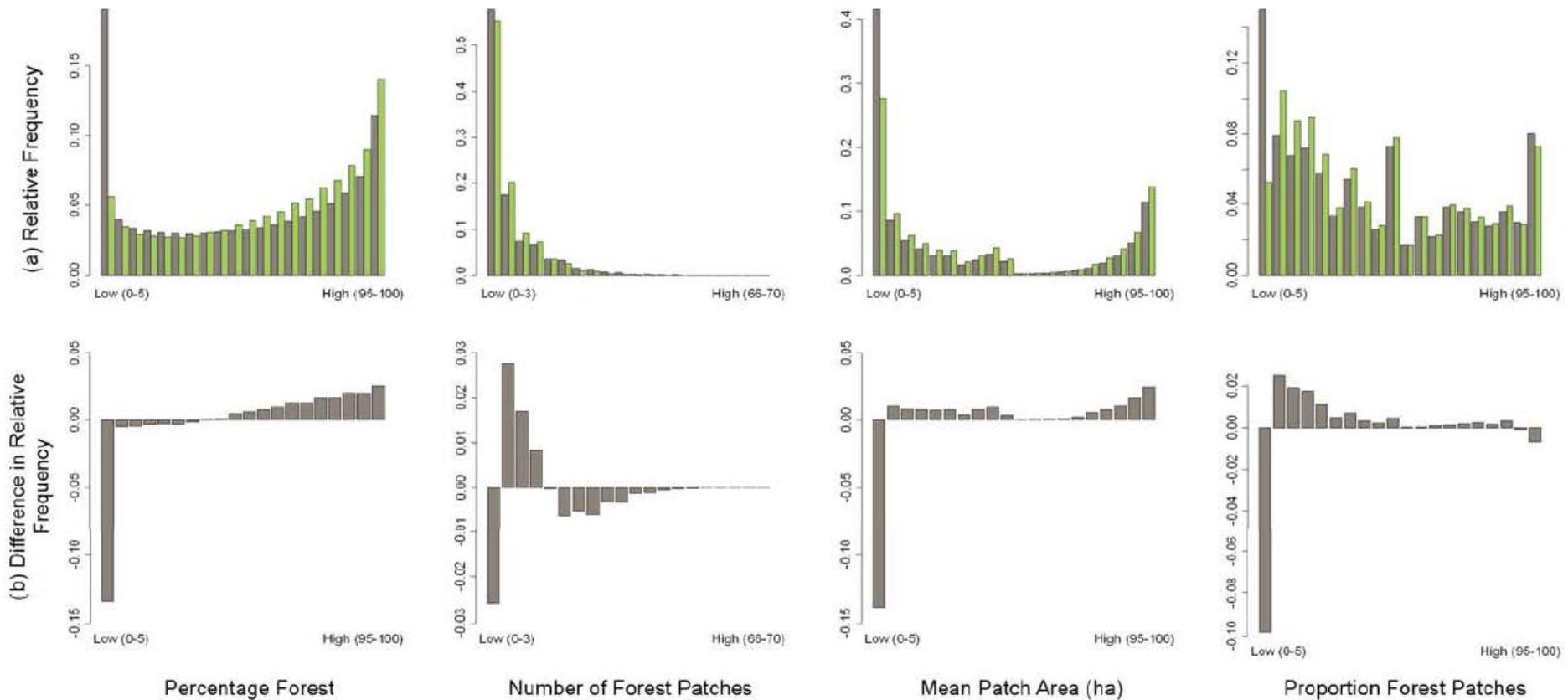
Drivers of wildfire

- Using a snapshot of Canadian land cover from 2000, we characterize pre- and post-fire landscape patterns and identify drivers of fire susceptibility at a national scale

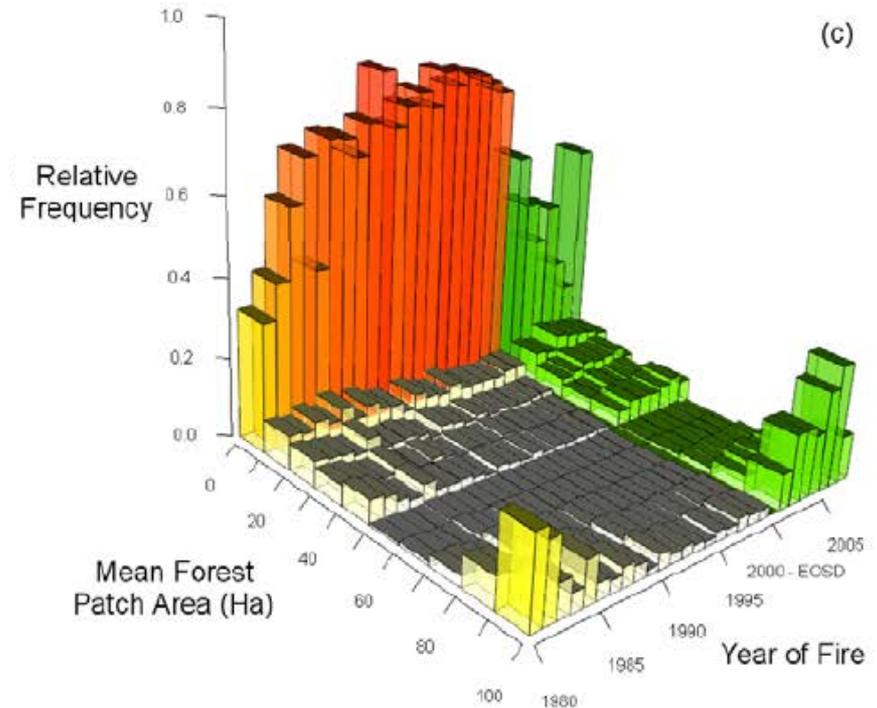
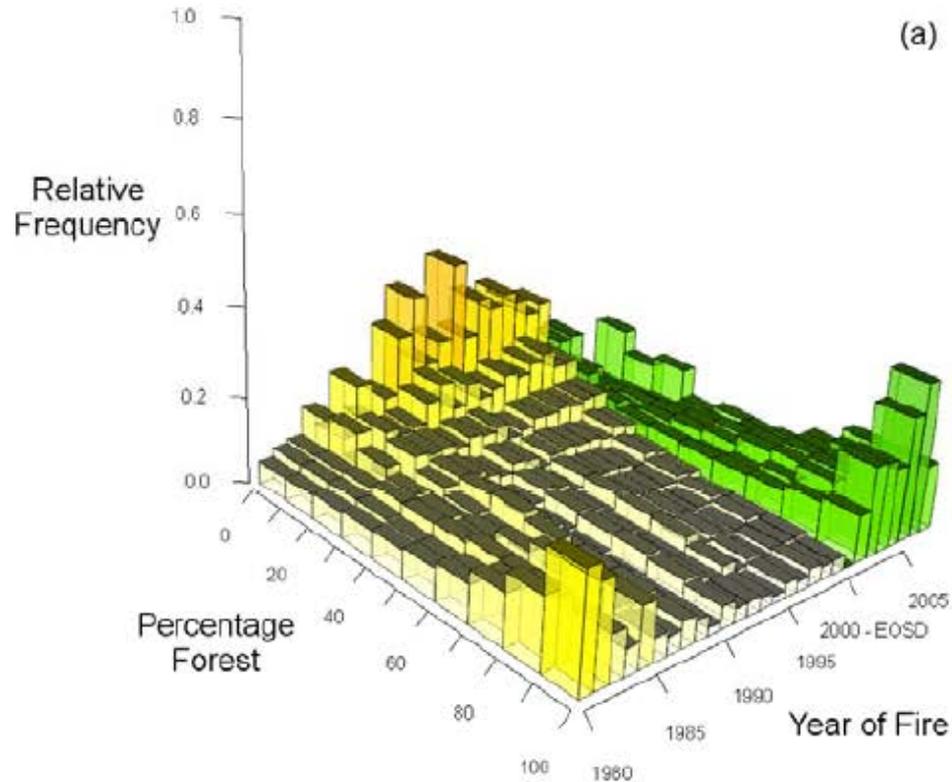




- Year 2000 land cover, pre- and post-fire



- A. histograms for all (grey) and pre-fire locations (green)
- B. histograms for difference between all ecozones and pre-fire conditions for same metrics



- 3D histograms of metric distribution by year for percent cover and mean patch area

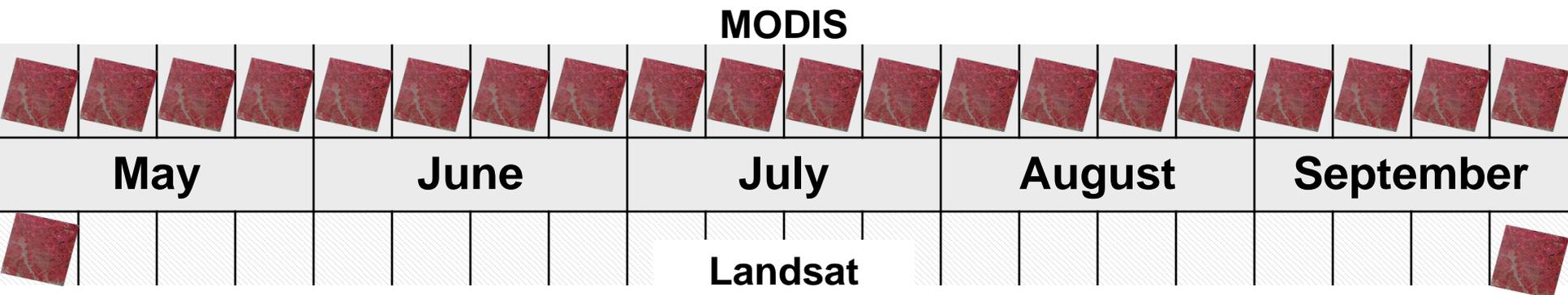
Applications - Grizzly bear habitat

- What are the disturbance characteristics over grizzly bear habitat and how do these dynamics impact usage?
- Landsat provides
 - Land cover (status)
 - Change
 - Epochal
 - Intra-annual (STAARCH)
- Lessons

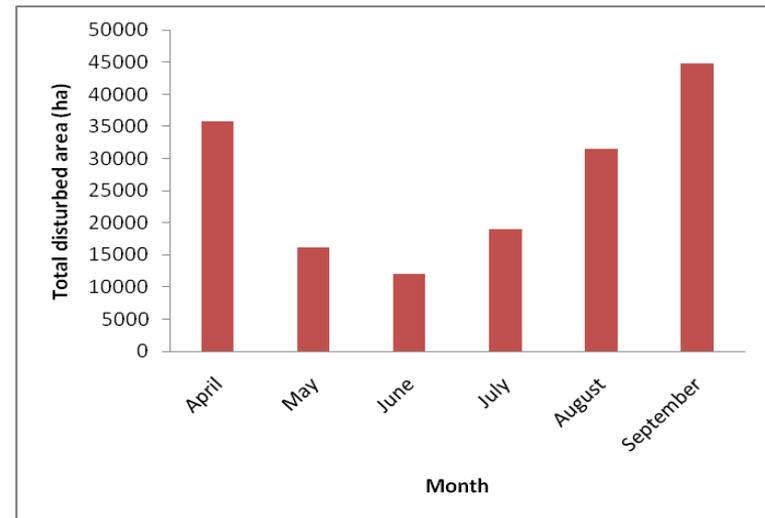
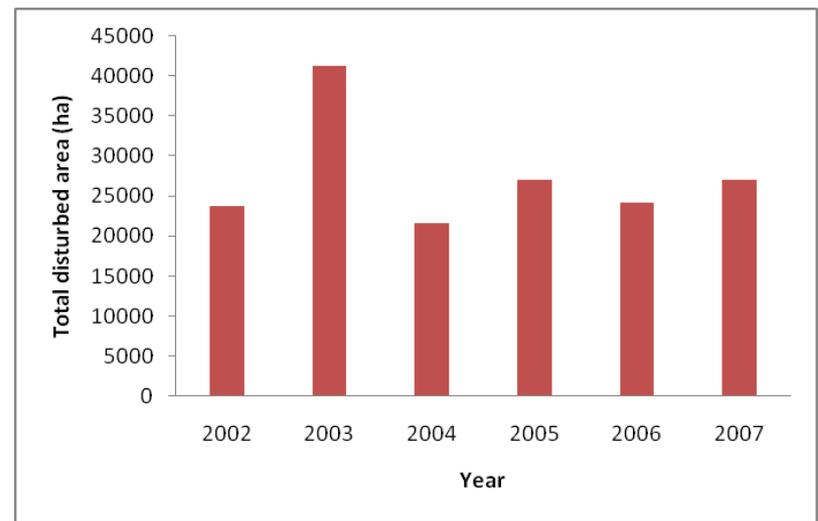
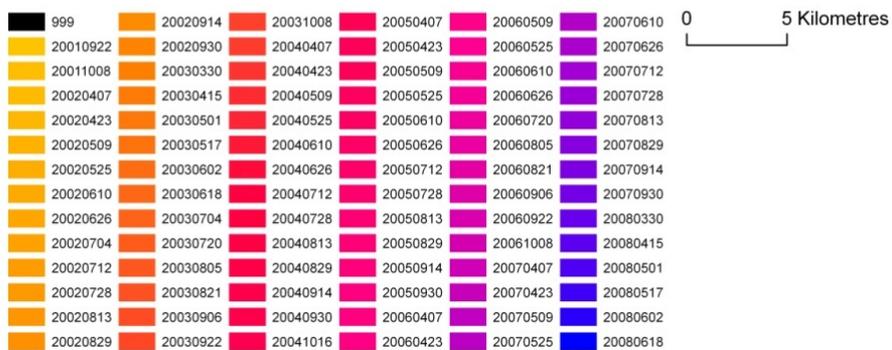
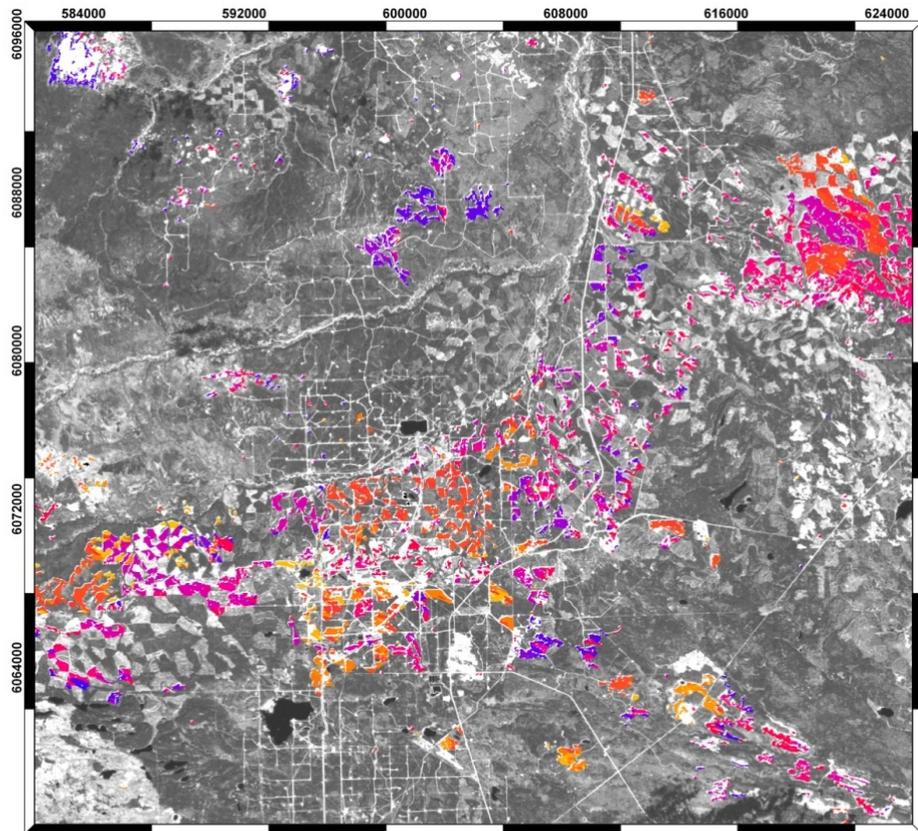
Remote Sensing – Dynamics: Data blending

- Wouldn't it be nice to have a predicable image data stream, with user defined date, no seams, over a wide-area, suitable for mapping and monitoring activities?

Further, we also want change capture possibility on a bi-weekly basis.



Mode 2: forward and constrained by temporal change



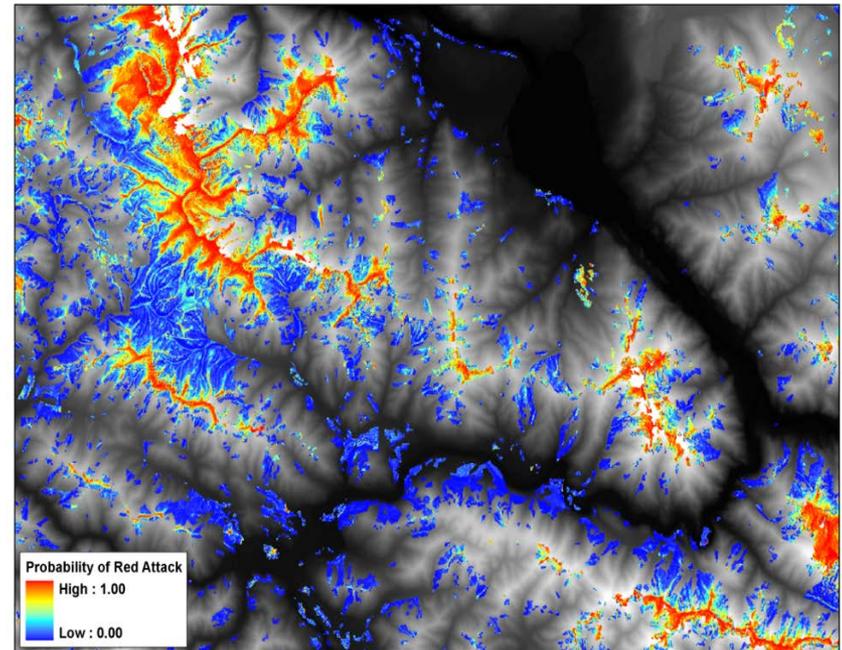
Hilker, T., Wulder, M.A., Coops, N.C., Linke, J., McDermid, G., Masek, J., Gao, F., and White, J.C. (2009). A new data fusion model for high spatial- and temporal- resolution mapping of forest disturbance based on Landsat and MODIS. *Remote Sensing of Environment*. Vol. 113, No. 8, pp. 1613-1627.

What have we learned?

- Within year
 - Seasonal aversions to disturbance differ by sex
- Between years
 - Disturbances inform on home range development
 - Disturbances provide quality habitat, but also provide for human access
- Habitat use
 - Edges
 - Find edges, label edges

Applications – Mountain pine beetle

- Background
- Infestation
 - Landsat is a primary data source for mapping
 - Year of death
- Susceptibility
 - Typically inventory driven
 - Geometric Optical Modeling



Time series notes

- Increased knowledge on the nature of changes required
 - Magnitude, persistence, type
- Labelling of change
 - Salvage harvesting
- Some transitions are more important than others
 - Deforestation vs harvesting

Where we are going?

- Modeling for detailed attributes
- Remote sensing:
 - Wall-to-wall
 - Creation of strata
 - Capture of disturbance
- Information needs to drive frequency, spatial detail, categorical detail, of attributes and disturbance
- A combined modeling framework for modeling attributes and using satellite RS for change capture is recommended.
 - Growth can be modeled, depletions mapped and integrated. (on a wide-area tessellation)
 - Higher spatial resolution RS can aid in cal / val
- Multiple outcomes, probabilities assigned

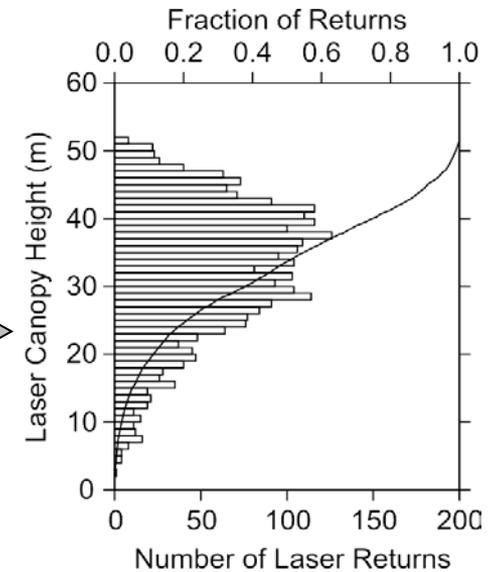
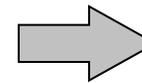
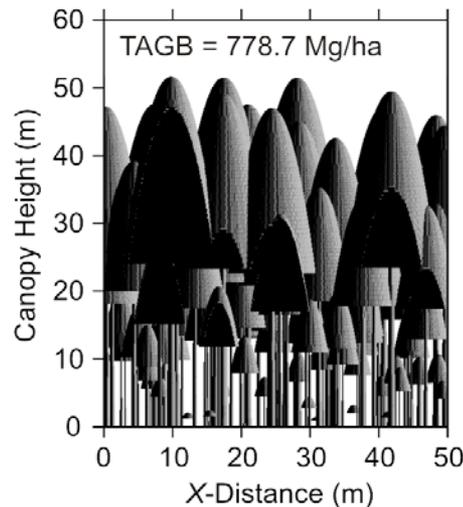
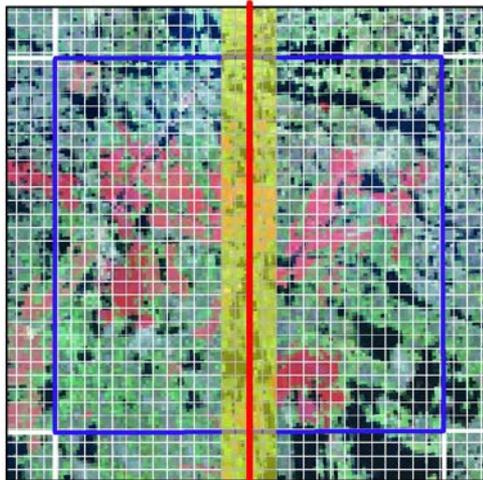
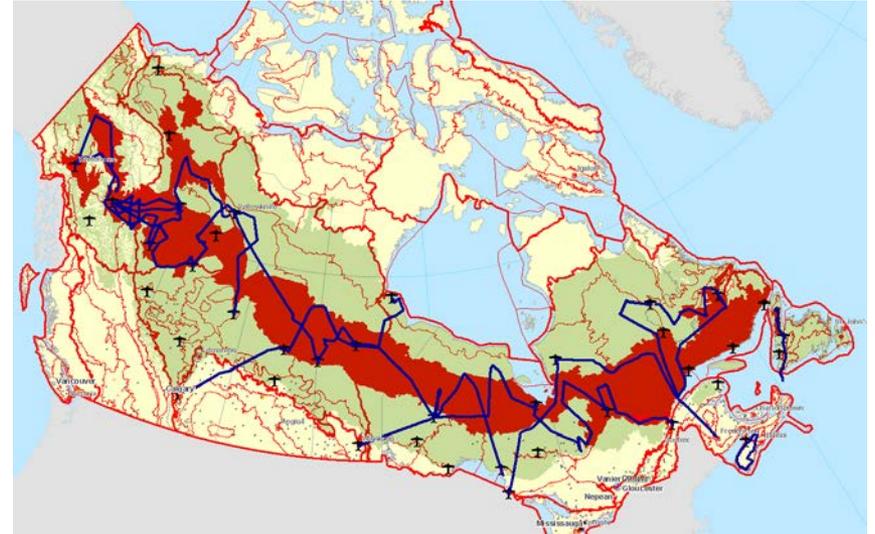
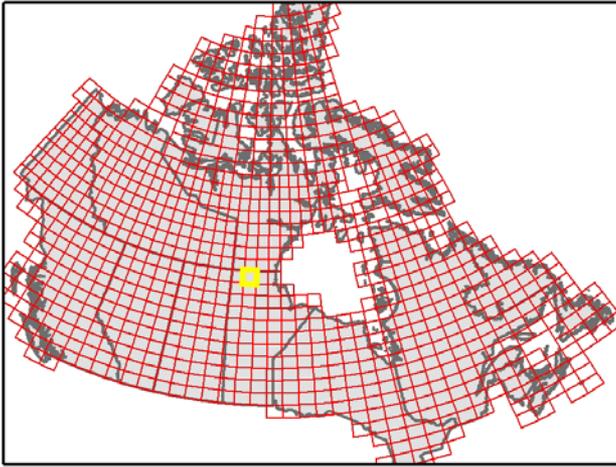
Framework notion:

Integrating multi-scale remote sensing and modeling

- Establish high spatial resolution, fine scale grid
- Populate grid through remote sensing (e.g., Landsat) and modeling
- Update the grid through satellite change detection
 - Find change, attribute change, update, model
- Confirm / adjust modeled outcomes through sample based, higher spatial resolution remote sensing (VHSR imagery, lidar)
- Repeat

Framework notion:

Integrating multi-scale remote sensing and modeling



Thank you

Contact Information:

Mike Wulder

mwulder@nrcan.gc.ca

<http://cfs.nrcan.gc.ca/subsite/wulder/>



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