



Natural Resources
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Canada's National
Forest Inventory
Inventaire Forestier
National du Canada

Assessing Forest Damage and Disturbance in Canada

UNECE Scientific-Technical Symposium
September 29-30th 2022

Byron Smiley
Manager, National Forest Inventory



Outline



Canada's National
Forest Inventory
Inventaire Forestier
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- Canadian forest & disturbance data: Collection, Synthesis, and Reporting
- Remote sensing of forest disturbance
- Data Harmonization



Alberta



British Columbia



Manitoba



New Brunswick



Newfoundland & Labrador



Northwest Territories



Nova Scotia



Ontario



Prince Edward Island



Quebec



Saskatchewan



Yukon



Canada



Forest management in the Canadian context

- Management of Canada's forest resources falls to the provinces and territories.
- Forest disturbance and damage data in Canada is federated, most often collected by sub-national jurisdictions and then agglomerated, harmonized and summarized at the national scale for international reporting.
- National programs within the Canadian Forest Service serve to coordinate, compile, standardize and disseminate forest information at the national scale.
 - National Forest Inventory: <https://nfi.nfis.org/>
 - National Forest Information System: <https://ca.nfis.org/>
 - National Forestry Database: <http://nfdp.ccfm.org/>



Federated Forest Information in Canada



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Canada's forests: Managing for the future

Forests in Canada are managed for a variety of economic, ecological, and social benefits for both current and future generations.

Treaty/settlement lands are owned and managed by a First Nation, Métis, or Inuit authority. In addition to their rights on these lands, these authorities generally also have specified non-exclusive rights in a broader area defined in the treaty, settlement, or final agreement.

Indian reserves are Crown lands that have been "set apart by Her Majesty for the use and benefit of a band" under the *Indian Act*.

Federal reserves include military bases and training areas and other lands owned by the federal government. Forestry is rarely the primary management objective on these lands.

Private forests range from small family-owned woodlots to large woodlands owned and managed by forest companies. These forests are managed for various purposes, including commercial timber supply.

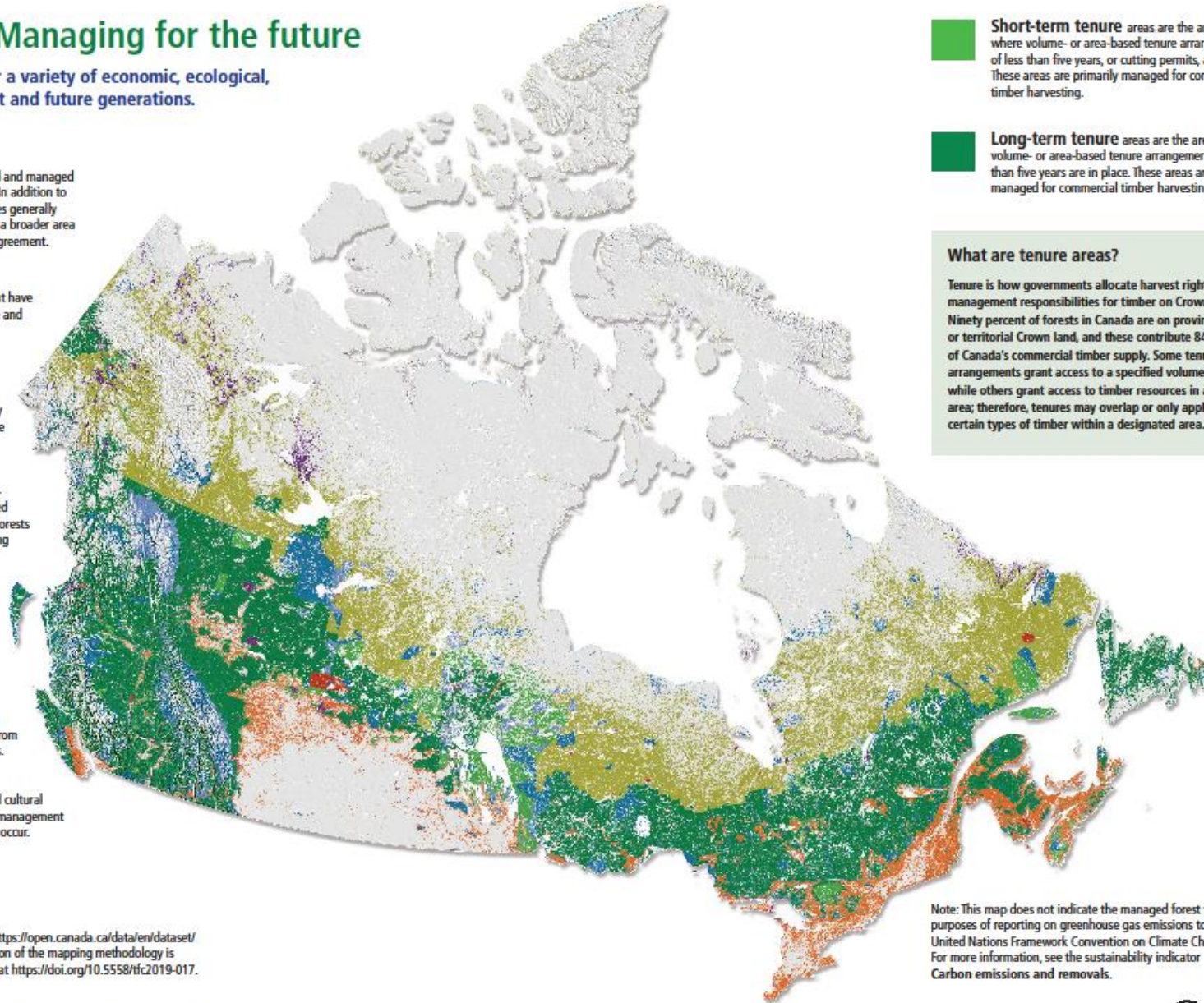
Other forest lands are areas that do not fit into any of the other categories. Fire suppression often occurs in these forests and there may be local use of forest resources.

Restricted areas are managed for a wide variety of special purposes, ranging from wildlife values in some, to mining in others.

Protected areas sustain natural and cultural heritage and conserve biodiversity. Forest management activities, such as prescribed burning, may occur.

Non-forested land

The map data and metadata can be found online at <https://open.canada.ca/data/en/dataset/d8fa9a38-c4df-442a-8319-9bbc9dc29060>. A description of the mapping methodology is published in *The Forestry Chronicle*, and can be found at <https://doi.org/10.5558/tfc2019-017>.



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Short-term tenure areas are the areas where volume- or area-based tenure arrangements of less than five years, or cutting permits, are granted. These areas are primarily managed for commercial timber harvesting.

Long-term tenure areas are the areas where volume- or area-based tenure arrangements of more than five years are in place. These areas are primarily managed for commercial timber harvesting.

What are tenure areas?

Tenure is how governments allocate harvest rights and management responsibilities for timber on Crown land. Ninety percent of forests in Canada are on provincial or territorial Crown land, and these contribute 84% of Canada's commercial timber supply. Some tenure arrangements grant access to a specified volume of timber, while others grant access to timber resources in a specified area; therefore, tenures may overlap or only apply to certain types of timber within a designated area.

Through a pan-Canadian partnership with the provinces and territories, the NFI collects, manages, compiles and disseminates forest information for national and international reporting to support Canada's environmental reputation, ensure continued market access and the social license to continue Sustainable Forest Management activities.

Note: This map does not indicate the managed forest for the purposes of reporting on greenhouse gas emissions to the United Nations Framework Convention on Climate Change. For more information, see the sustainability indicator Carbon emissions and removals.



What role does the National Forest Inventory play?



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NFIS



National Forestry Database

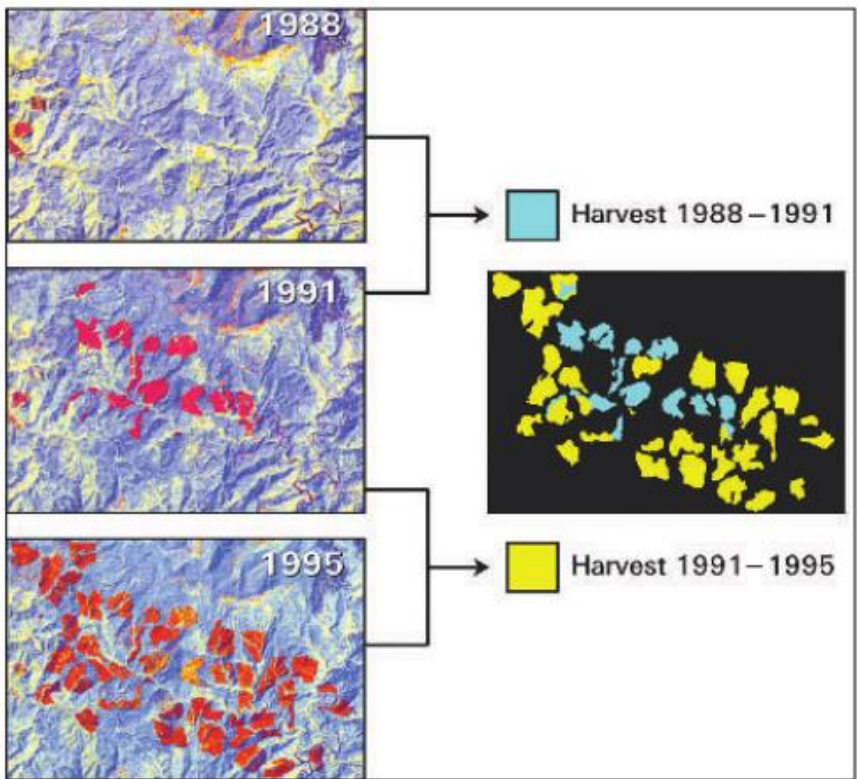


Environmental reputation
Market access
Social license

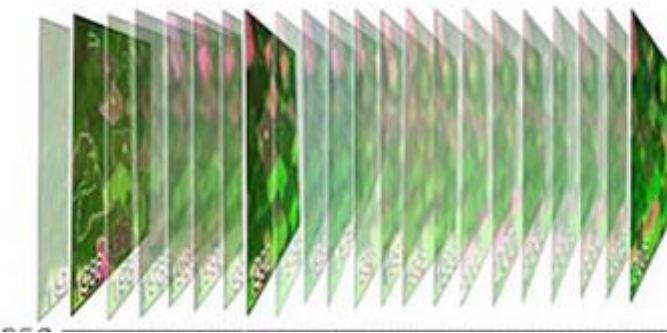


Remote Sensing of Forest Disturbance: Temporally informed

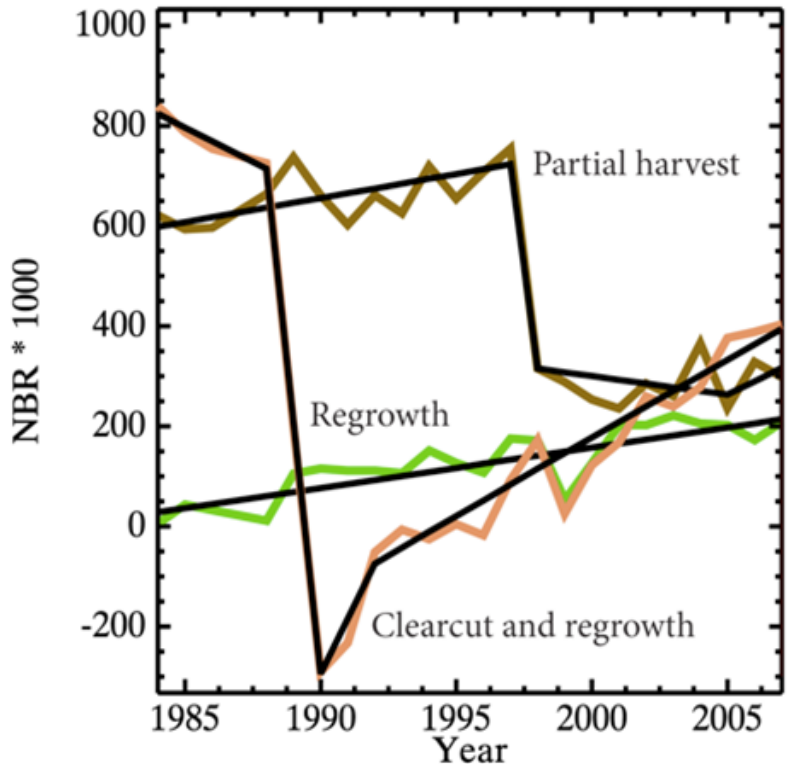
Bi-annual change detection
(Cohen & Goward 2004)



Year & magnitude of abrupt changes (harvest, fire)



Trajectory-based change detection
(Kennedy et al. 2010; Cohen et al. 2010)



Year & trends of abrupt (harvest, fire) and long-term (insect, regrowth) changes

Remote Sensing of Forest Disturbance: wildfire



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Post-fire burn scars in Canada's forests:



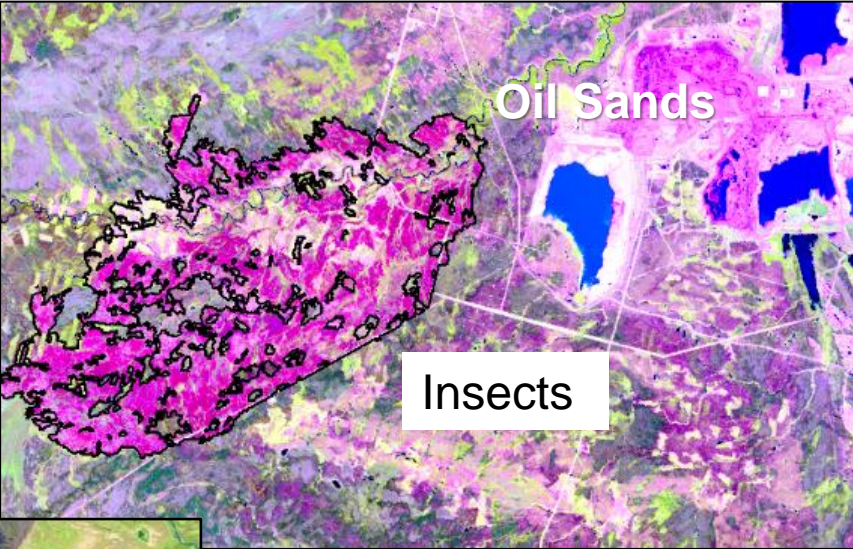
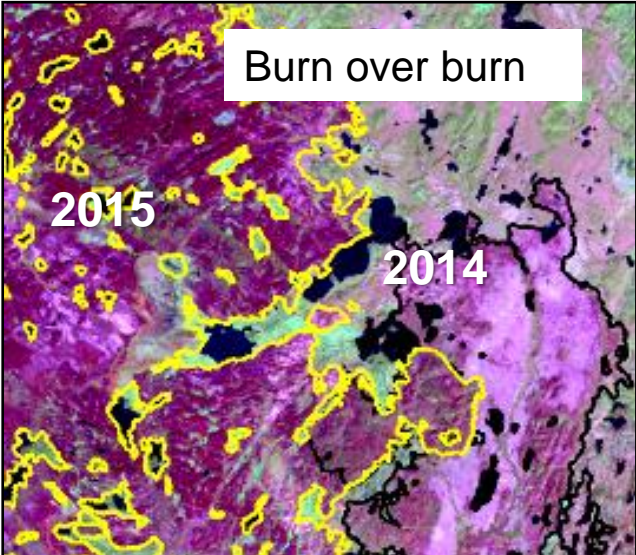
Slide provided
courtesy of Rob
Skakun &
Guillermo Castilla



Remote Sensing of Forest Disturbance

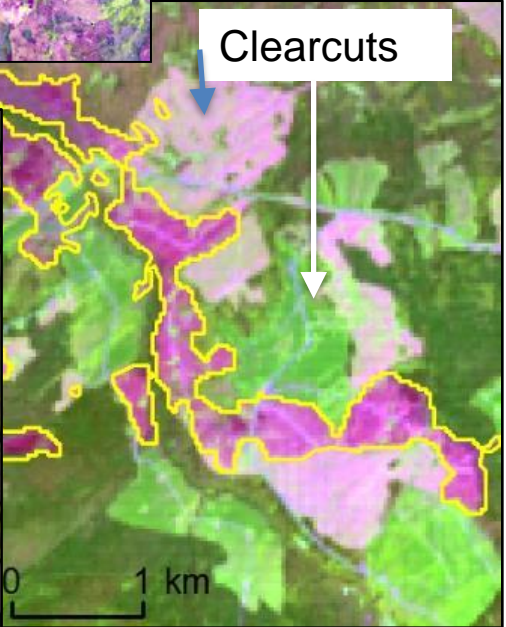
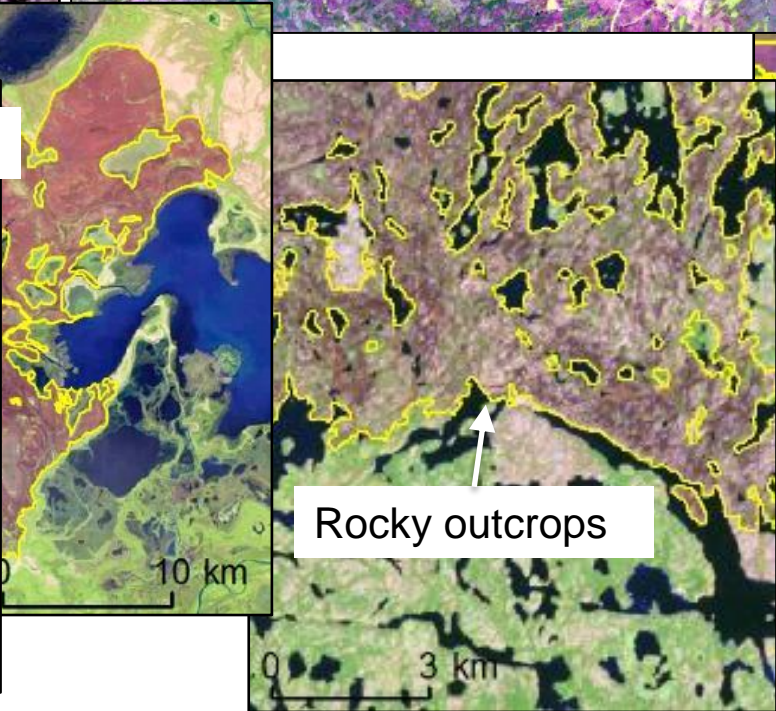
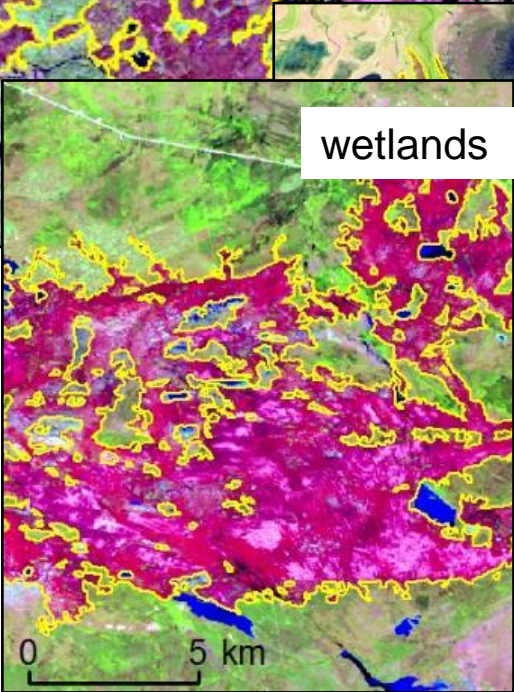


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Challenges: mapping over complex terrains and other disturbances:

Mapping in areas of human disturbance and insect infestation

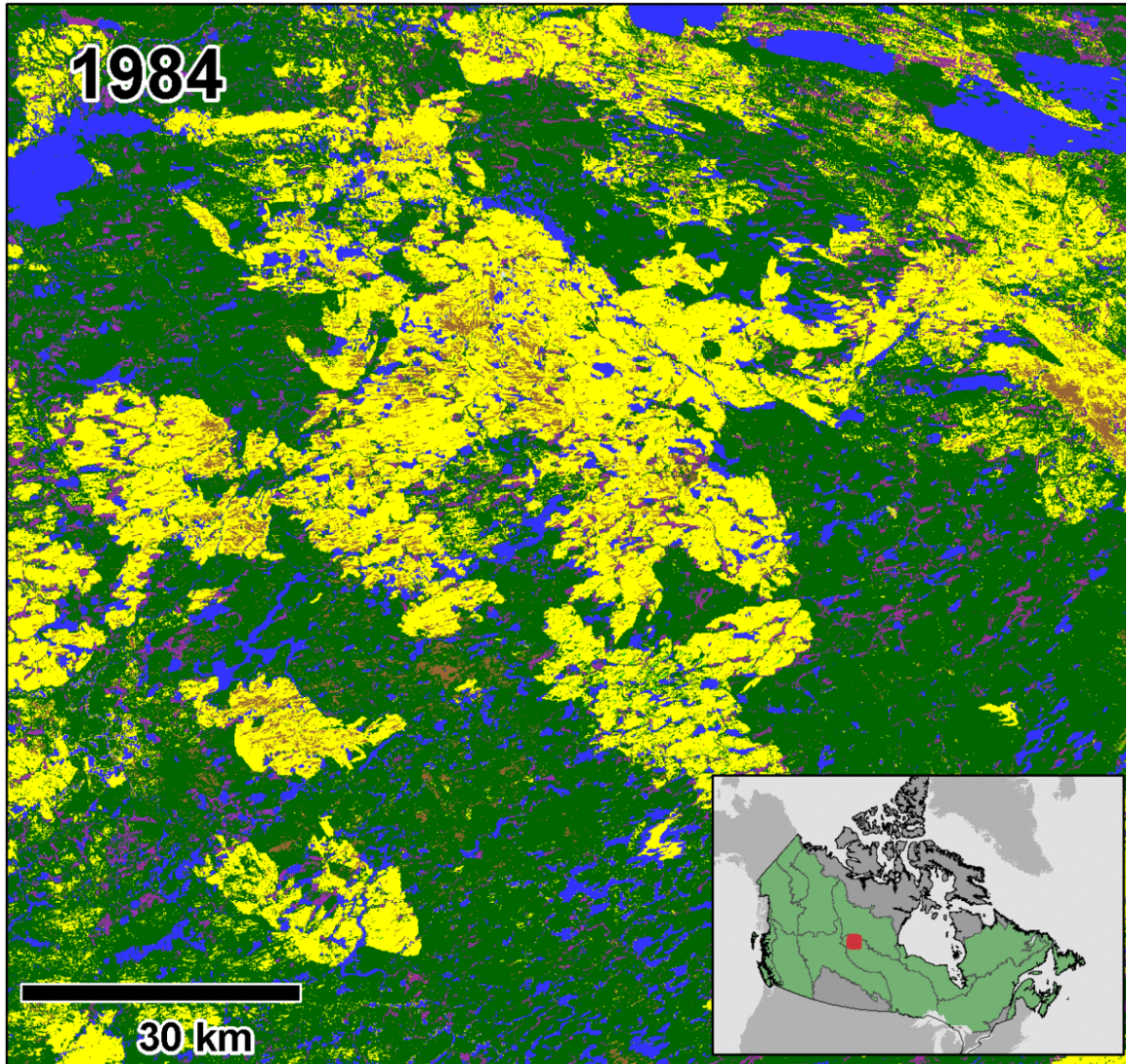


Slide provided courtesy of Rob Skakun & Guillermo Castilla

Trends and baselines

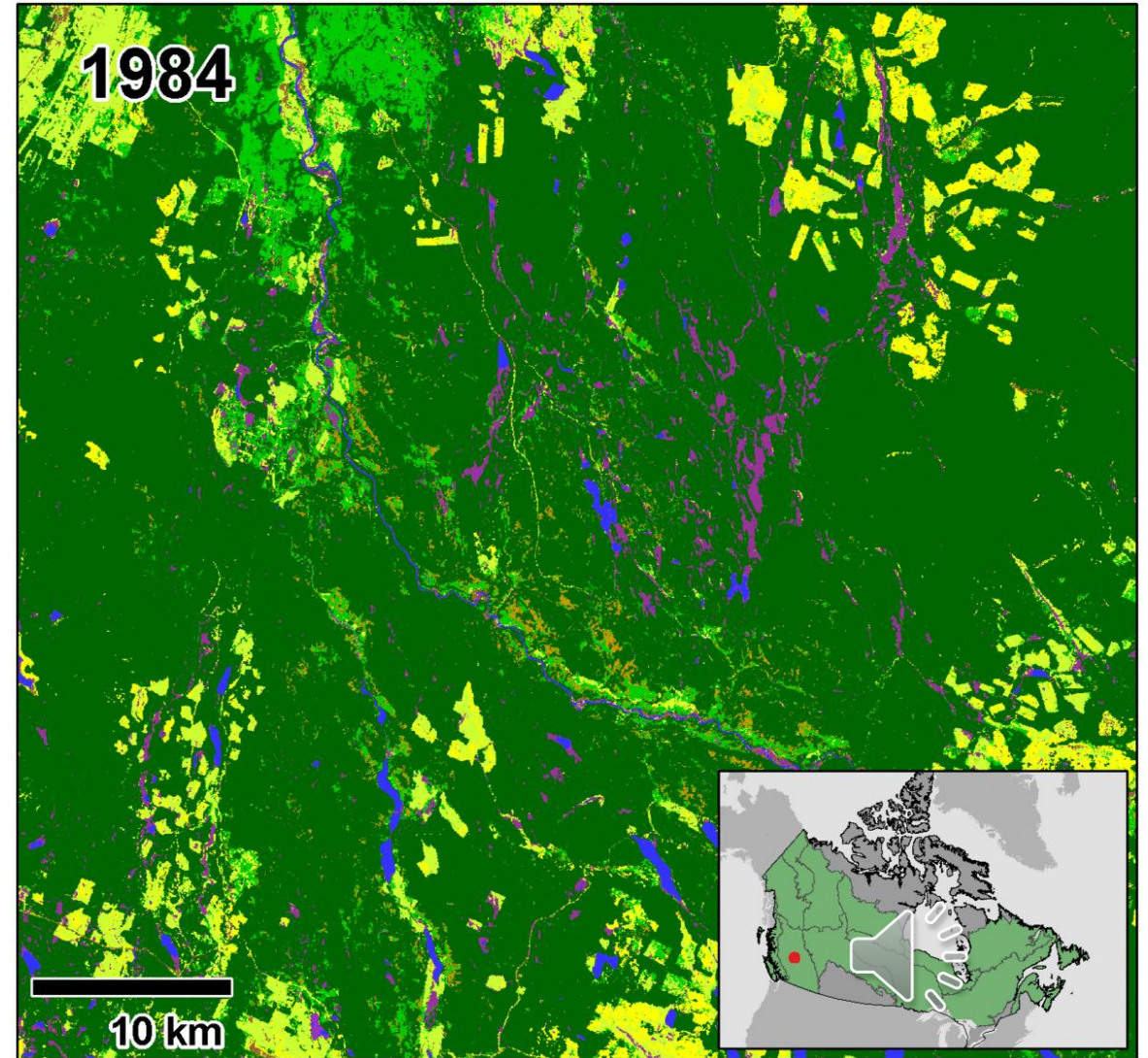
Slide provided courtesy of Txomin Hermosilla

FIRE



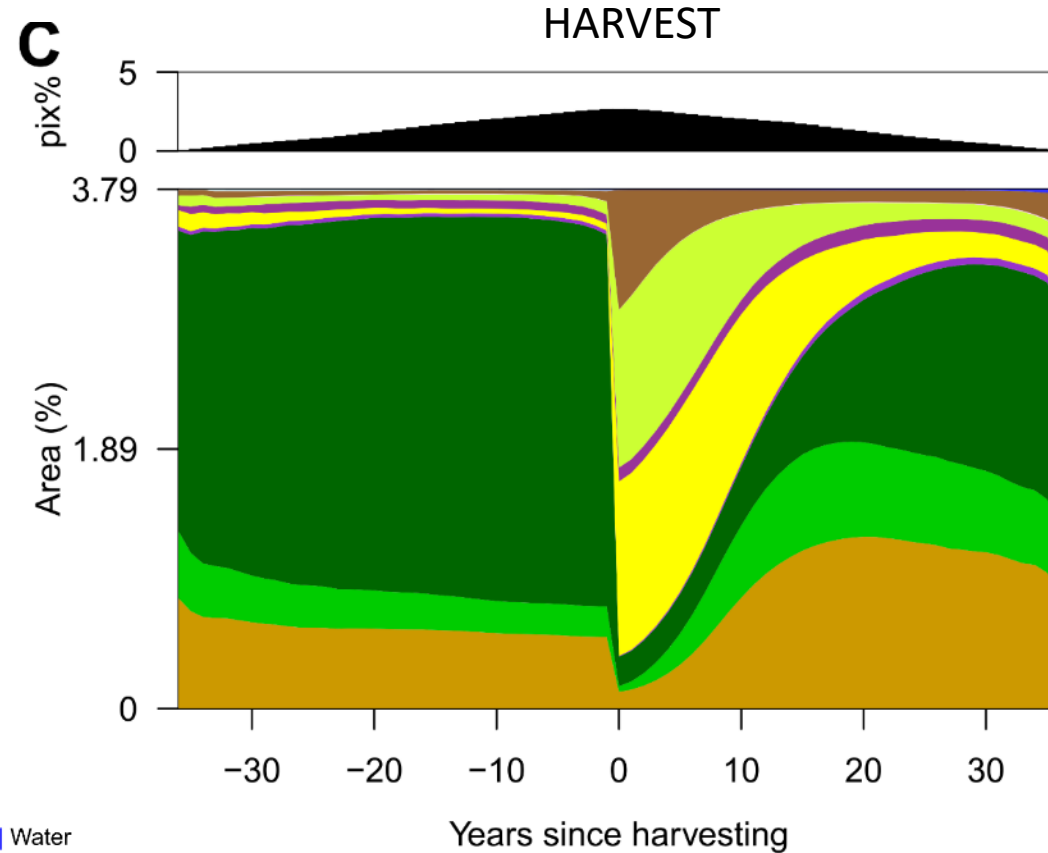
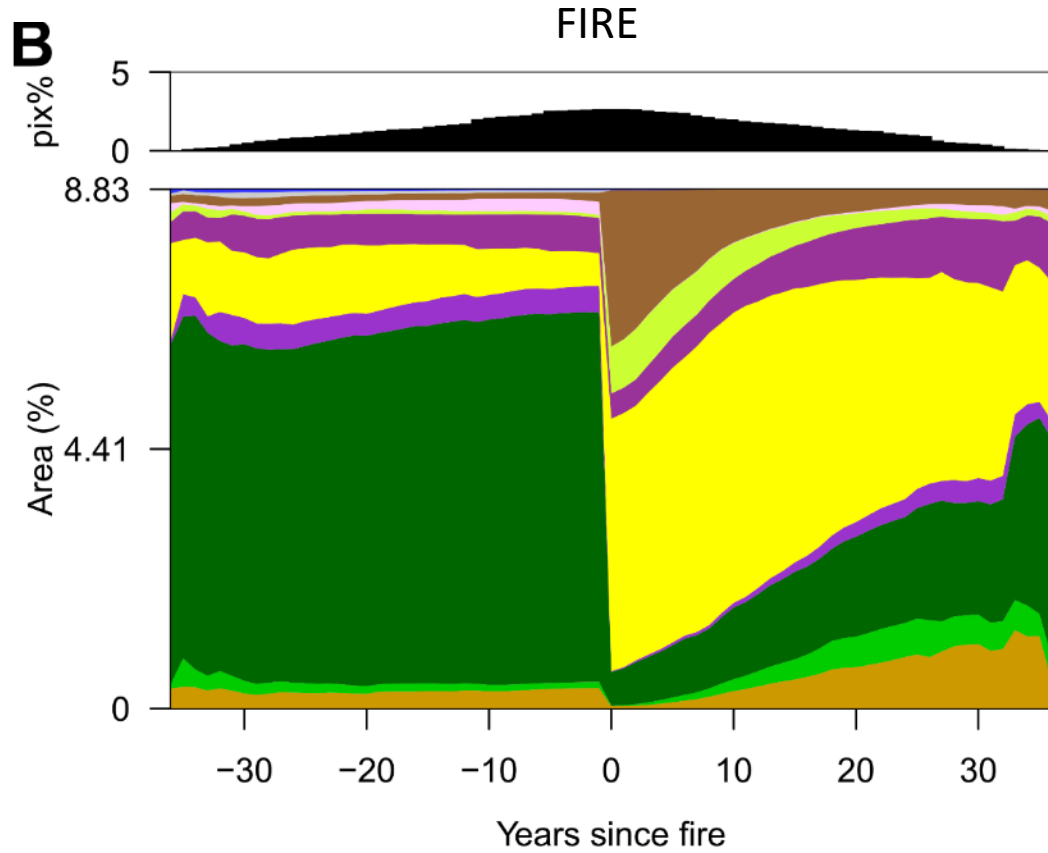
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|----------|----------------|---------|---------|---------------|-----------|
| Water | Rock/Rubble | Bryoids | Wetland | Wetland-Treed | Broadleaf |
| Snow/Ice | Exposed/Barren | Herbs | Shrubs | Coniferous | Mixedwood |

HARVESTING



- | | | | | | |
|----------|----------------|---------|---------|---------------|-----------|
| Water | Rock/Rubble | Bryoids | Wetland | Wetland-Treed | Broadleaf |
| Snow/Ice | Exposed/Barren | Herbs | Shrubs | Coniferous | Mixedwood |

Trends and baselines



- Water
- Snow/Ice
- Rock/Rubble
- Exposed/Barren Land
- Bryoids
- Herbs
- Wetland
- Shrubs
- Wetland-Treed
- Coniferous
- Broadleaf
- Mixedwood

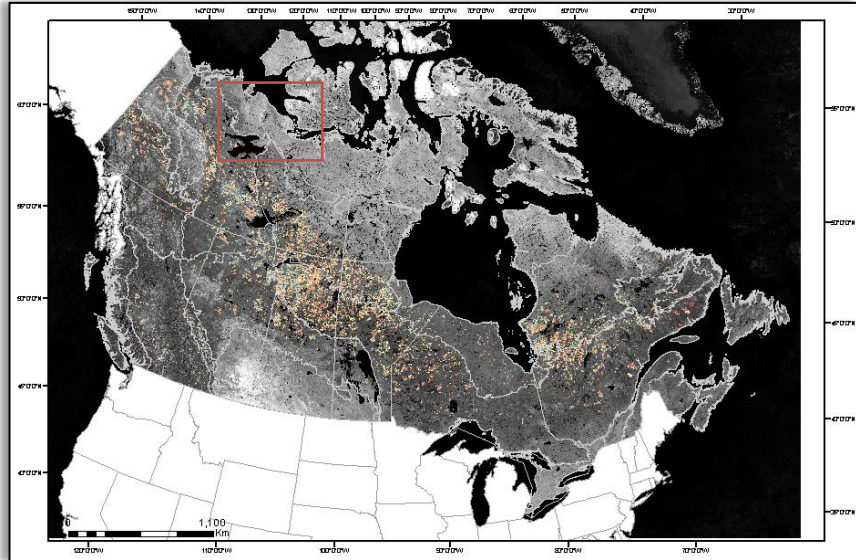


Remote Sensing of Forest Disturbance: wildfire



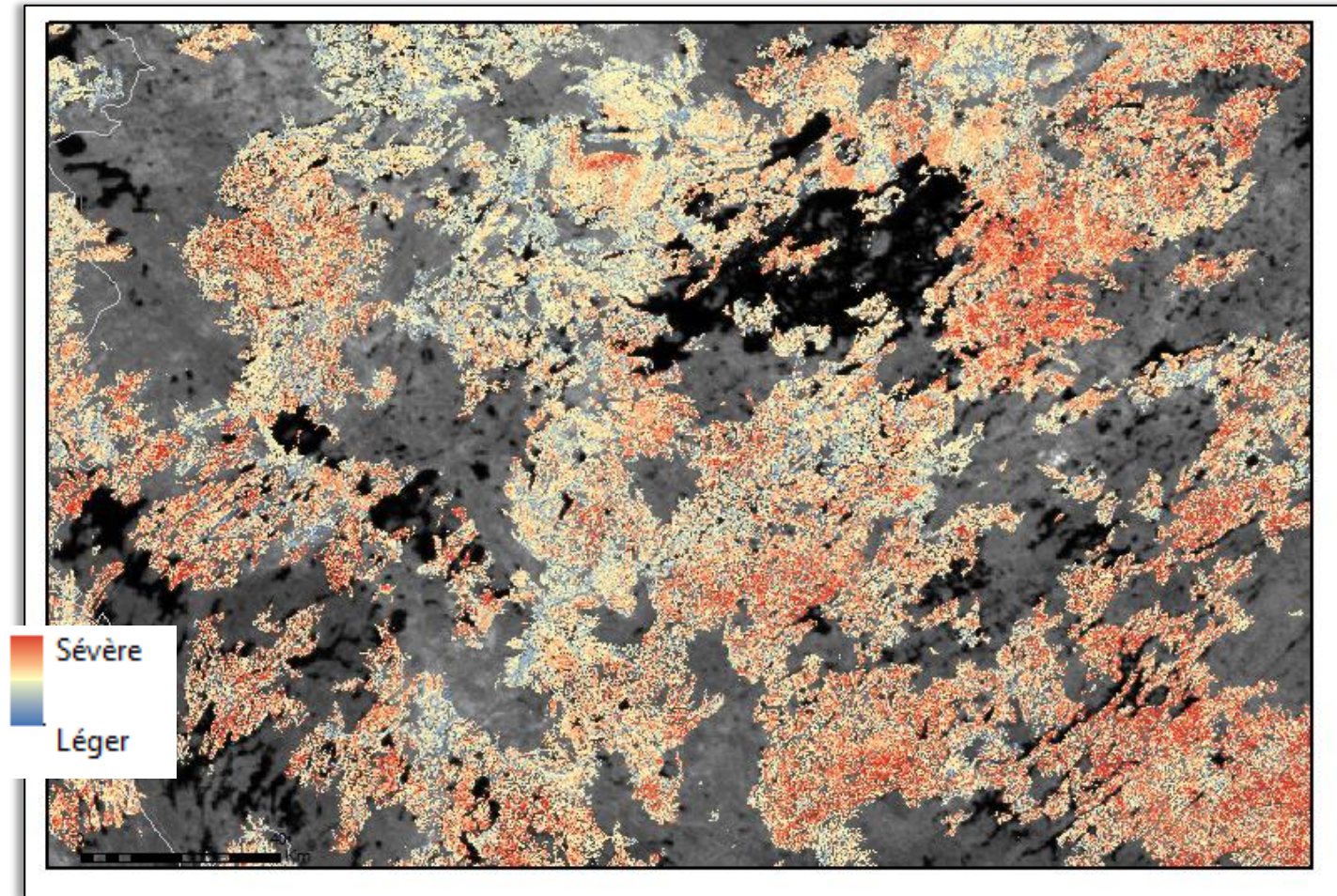
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Burn severity - CanLaBS



Guindon L, Gauthier S, Manka F, Parisien MA, Whitman E, Bernier P, Beaudoin A, Villemaire P, Skakun R. Trends in wildfire burn severity across Canada, 1985 to 2015. *Canadian Journal of Forest Research*. 2021;51(9):1230-44.

<https://cdnsiencepub.com/doi/full/10.1139/cjfr-2020-0353>



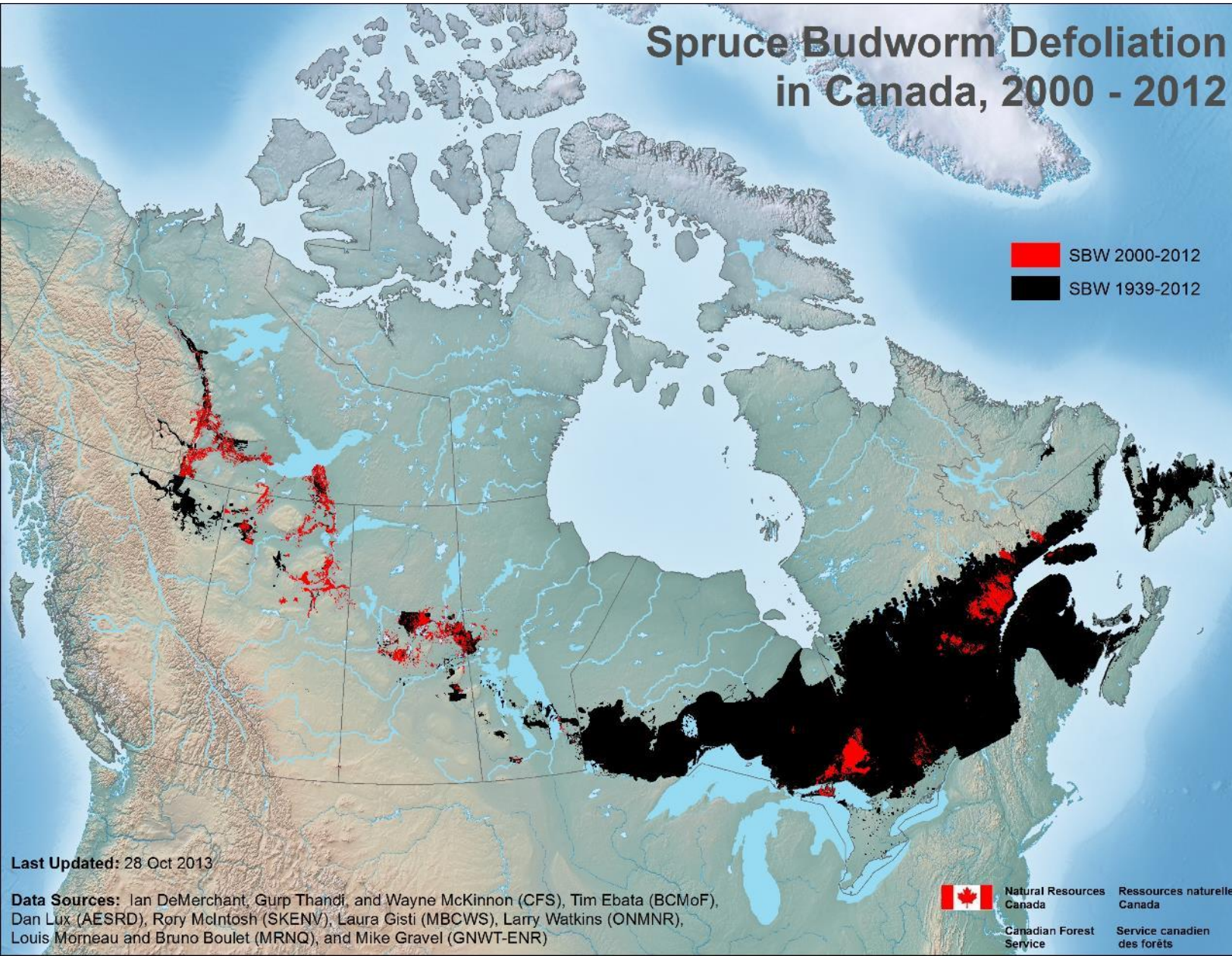
“We developed the 30 m resolution geospatial Canadian Landsat Burn Severity (CanLaBS) product from Landsat imagery, using values of pre-fire to post-fire differences in normalized burn ratios (dNBRs) for nearly 60 Mha of area burned across Canada’s forests from 1985 to 2015, complemented with estimates of pre-fire forest composition, crown closure, and biomass.”

Slide provided courtesy of Luc Guindon

Remote Sensing of Forest Disturbance: spruce budworm



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- Understanding background, baseline disturbances patterns, especially for endemic species like mountain pine beetle and spruce budworm, is essential to understanding long term impacts of climate change on forest health
- *“Spruce budworm moderate-severe defoliation, mapped via fixed-wing aerial surveys. Data originate from a range of federal and provincial sources. Survey methods vary slightly across jurisdictions and over time. Survey effort also varies over space and time, and is not always known with certainty due to a lack of documentation of flight lines, especially during the earlier decades. Data for Quebec 1939-1967 were estimated from ground survey data by Bruno Boulet. The data in this map are subject to periodic update and upgrade” - B. Cooke, CFS, Sept. 8, 2013*
- *Outbreaks recur every few decades, with an average return interval in eastern Canada of 32 ± 5 years over the 20th century.*

Data Harmonization



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- In Canada, individual datasets based on field or remote sensing data collection have been generated by the provinces and territories and the research community:
 - National Terrestrial Monitoring System Composite 2 Change products:
 - Hermosilla, T., Wulder, M.A., White, J.C., Coops, N.C., Hobart, G.W. 2015. An integrated Landsat time series protocol for change detection and generation of annual gap-free surface reflectance composites. *Remote Sensing of Environment*, 158: 220–234.
 - Hermosilla, T., Wulder, M.A., White, J.C., Coops, N.C., Hobart, G.W., Campbell, L.B. 2016. Mass data processing of time series Landsat imagery: pixels to data products for forest monitoring. *International Journal of Digital Earth*, 9(11): 1035-1054.
 - Canada Landsat Disturbance (CanLaD):
 - <https://open.canada.ca/data/en/dataset/add1346b-f632-4eb9-a83d-a662b38655ad>
- Harmonization efforts endeavour to take these disturbance datasets and compile them for consistent reporting:
 - National Forestry Database: <http://nfdp.ccfm.org/en/index.php>
 - The National Burned Area Composite (NBAC) provides fire polygons from the best-available delineations of burned area for a given year in Canada.
 - NBAC publications (open access): <https://doi.org/10.1071/WF19201>, <https://doi.org/10.3390/rs14133050>
 - NBAC data download: Canadian Wildland Fire Information System (CWFIS) - <https://cwfis.cfs.nrcan.gc.ca/datamart>. 1986 to 2020 time series
 - The National Forest Pest Strategy Information System (PSIS): https://ca.nfis.org/applications_eng.html#;
<https://www.ccfm.org/wp-content/uploads/2020/08/National-Forest-Pest-Strategy-%E2%80%93-Pest-Risk-Analysis-Framework-User%E2%80%99s-Guide.pdf>
 - Disturbance Data Foundation: https://ca.nfis.org/forestdisturbances/index_eng.html



Summary

- Forest data in Canada are federated, including the generation of forest disturbance information. These data are collected both through ground survey methods by the provinces and territories and through remote sensing.
- Given the size of Canada's forests (362 million ha) remote sensing is a crucial data source to properly monitor and assess forest disturbance
- Assessing forest disturbance and damage at the national scale requires significant harmonization efforts to ensure data are compatible.



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The following Canadian Forest Service personnel provided content for this presentation:

Ian DeMerchant, Luc Guindon, Guillermo Castilla, Rob Skakun, Txomin Hermosilla, Barry Cooke

National forest information program contacts:

NFIS	http://nfis.org/	
NFI	https://nfi.nfis.org/	
NFD	http://nfdp.ccfm.org/	
NFI data requests	https://nfi.nfis.org/en/datarequest	
NFI	Byron Smiley	byron.smiley@nrcan-rncan.gc.ca
NFI ground plots	Glenda Russo	glenda.russo@nrcan-rncan.gc.ca
NFI photo plots	Russ Thorsteinsson	russell.thorsteinsson@nrcan-rncan.gc.ca
Deforestation	Andrew Dyk	andrew.dyk@nrcan-rncan.gc.ca
NFIS	Brian Low	brian.low@nrcan-rncan.gc.ca