Landscape-Scale Histories and Active Monitoring of Disturbance, Seasonality, and Greenness Trends for ABoVE from Landsat

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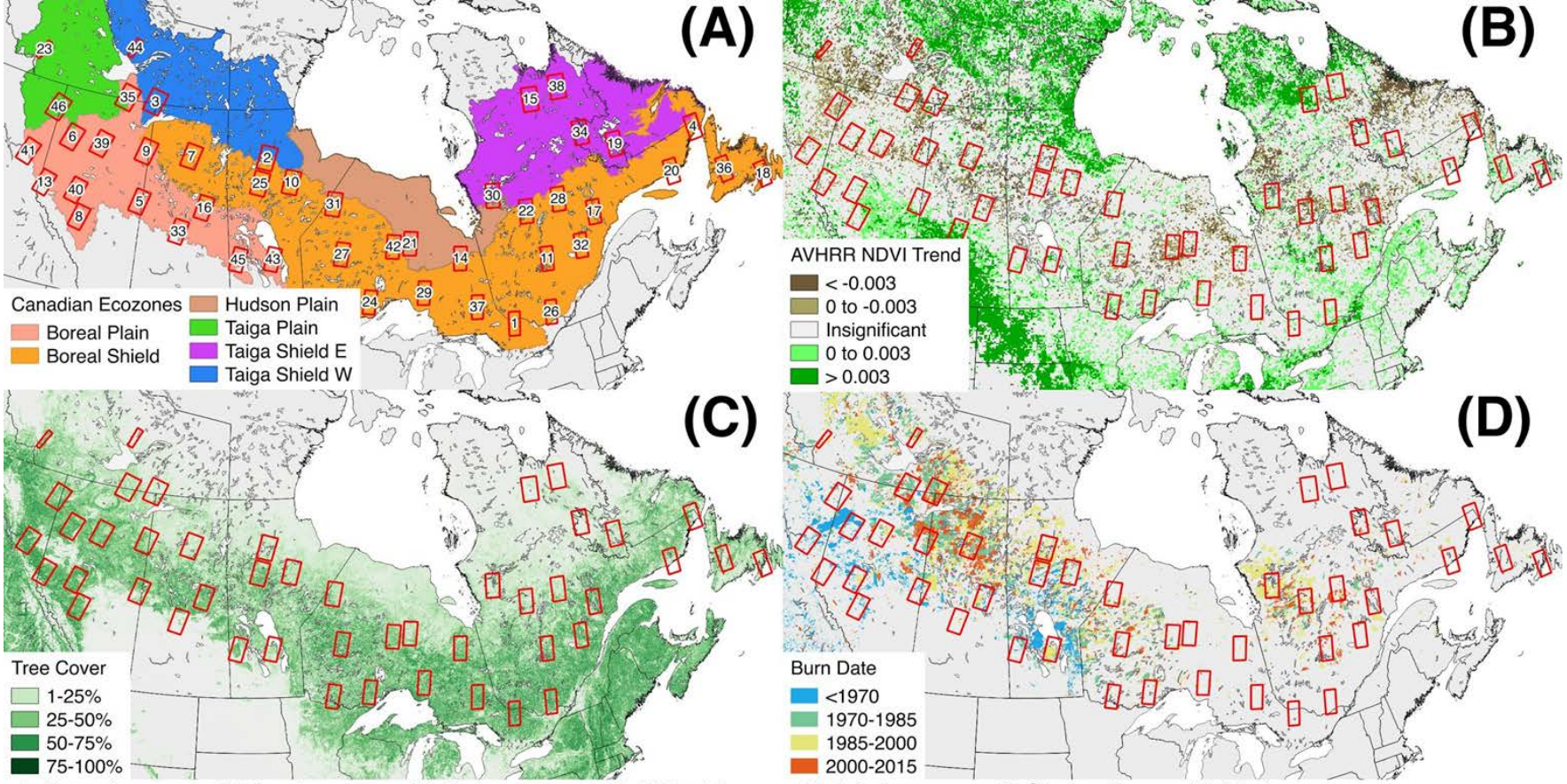
9/13/16

ARCTIC – BOREAL VULNERABILITY EXPERIMENT

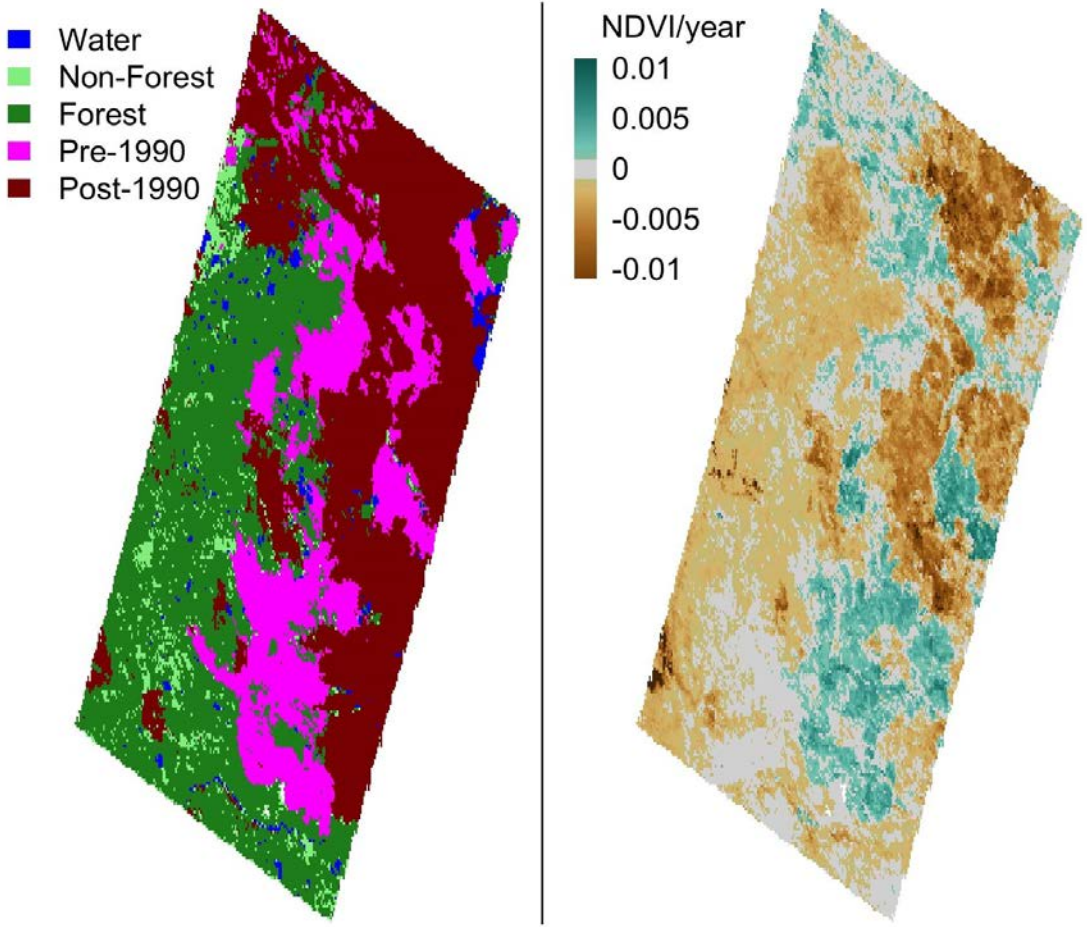
BOSTON UNIVERSITY



1. Algonquin
2. Amisk
3. Athabasca
4. Blanc Sablon
5. Bonnyville
6. Chinchaga
7. Cree
8. Edmonton
9. Fort McMurray
10. Gillam
11. Gouin
12. Kabetogama
13. Kakwa
14. Kesagami
15. Kuujuaq
16. La Ronge
17. Manicouagan
18. Marystown
19. Michikamau
20. Mingan
21. Missisa
22. Mistassini
23. Nahanni
24. Nipigon
25. NOBS
26. Ottawa
27. Pipestone
28. Pletipi
29. Pukaskwa
30. Radisson
31. Sachigo
32. Saguenay
33. Saskatoon
34. Schefferville
35. Slave
36. Stephenville
37. Sudbury
38. Torngat
39. Wabasca
40. Whitecourt
41. Williston
42. Winisk
43. Winnipeg
44. Yellowknife
45. Yorkton
46. Zama

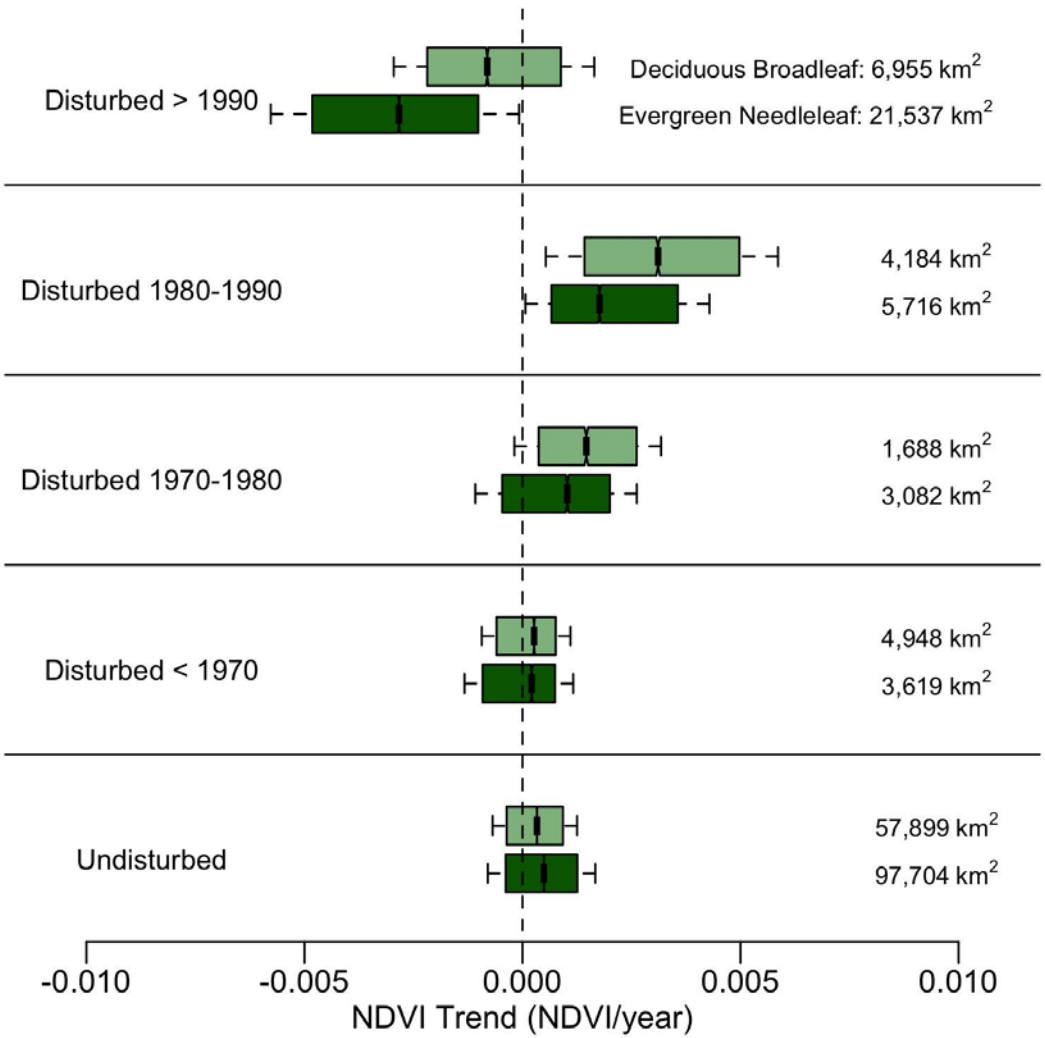
Trends in Peak-Summer NDVI

- Example site: Fort McMurray, Alberta
- Land cover and disturbance
  - Canadian EOSD LC map based on Landsat 7 ETM+ data circa 2000
  - Canadian Large Fire Database combined with CCDC-based disturbance
- NDVI trends
  - Detected using panel linear models at ~500-m scale



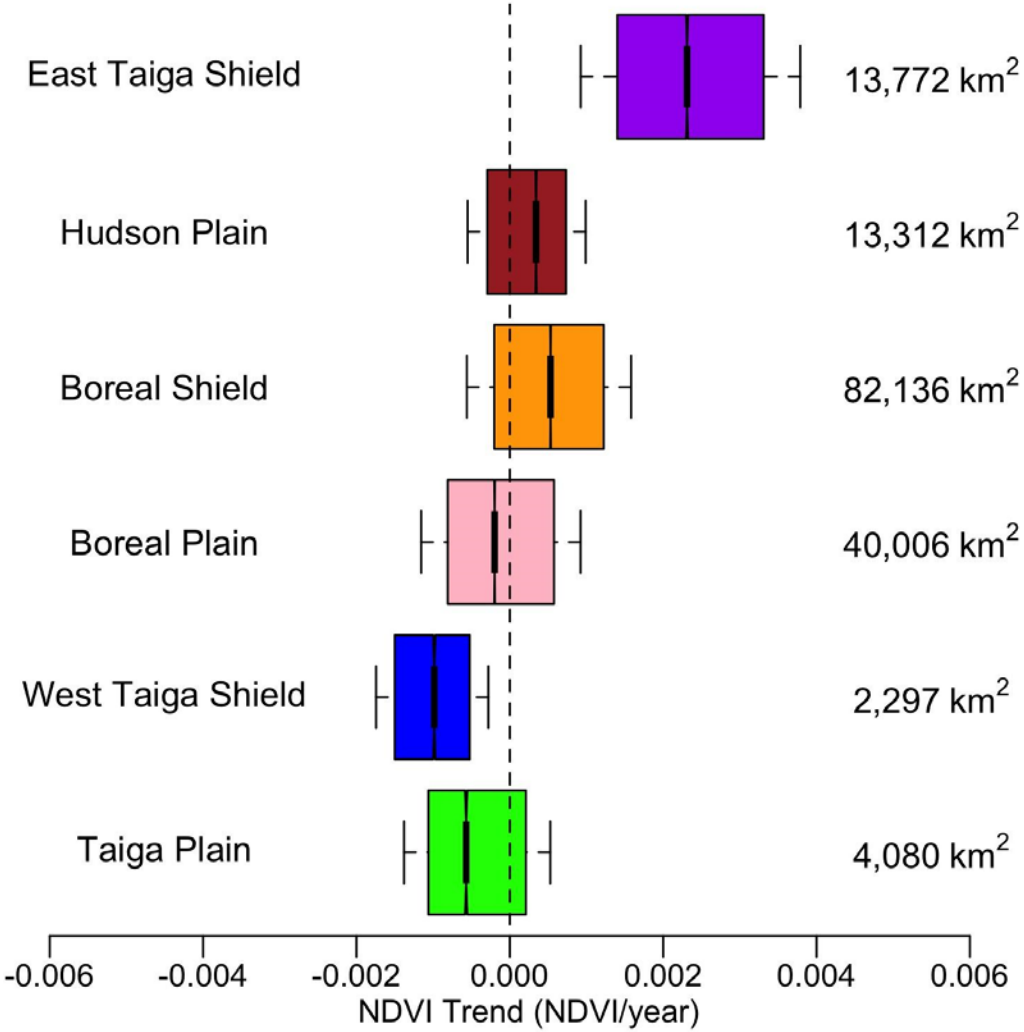
Disturbance is the dominant driver in greening and browning trends in boreal Canada

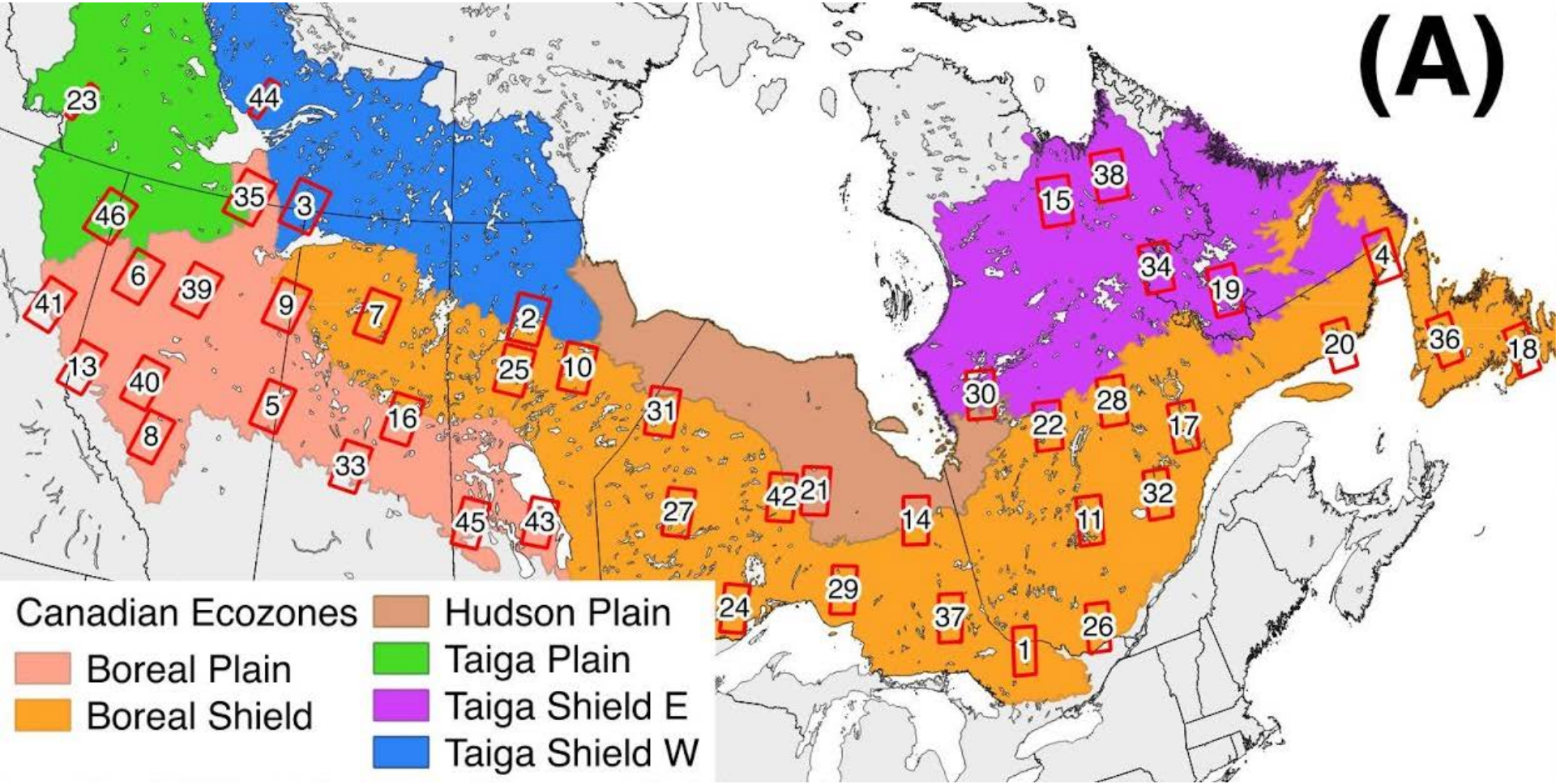
- Disturbances early in the record produce positive trends
- Disturbances late in the record produce negative trends

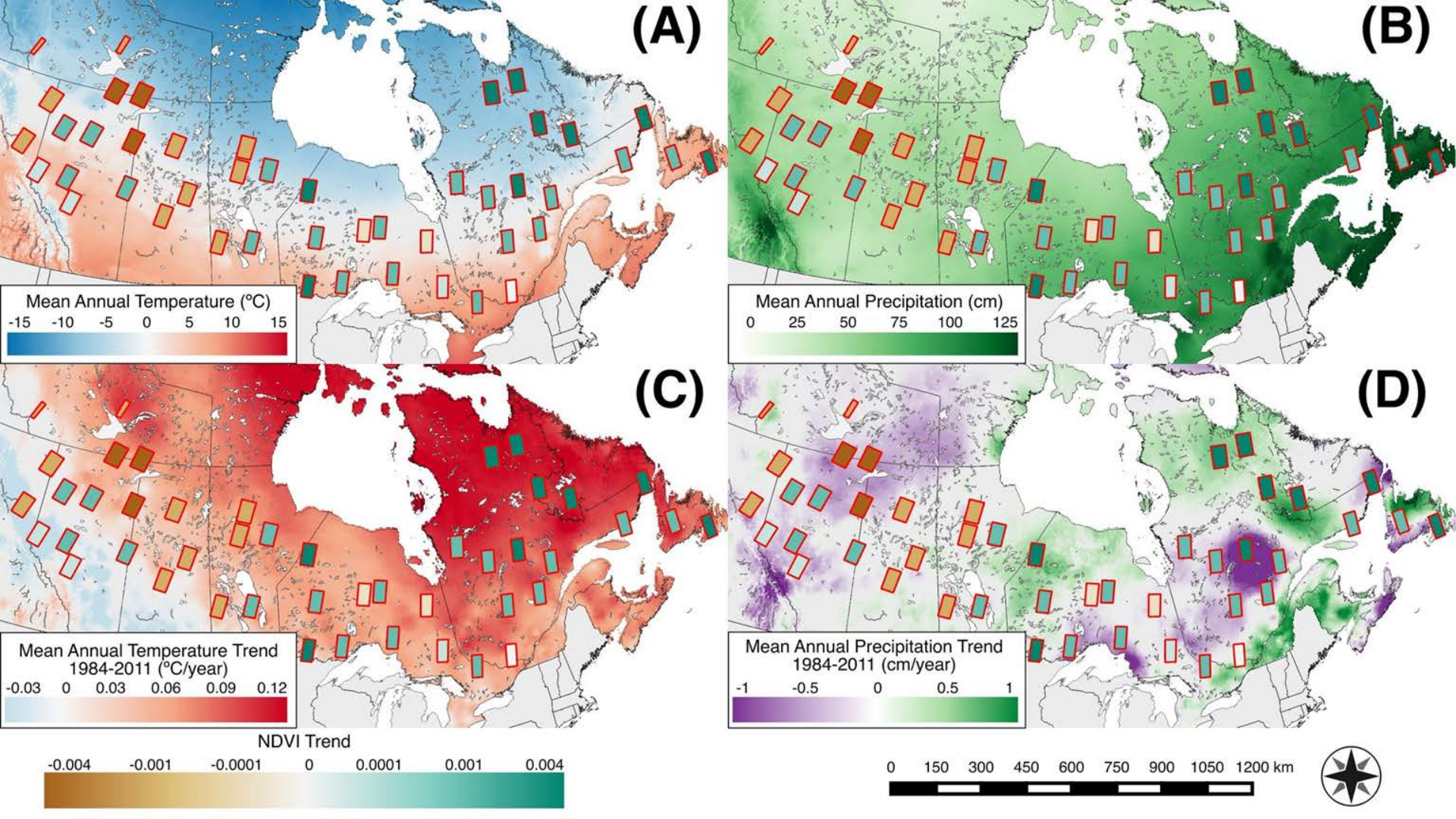


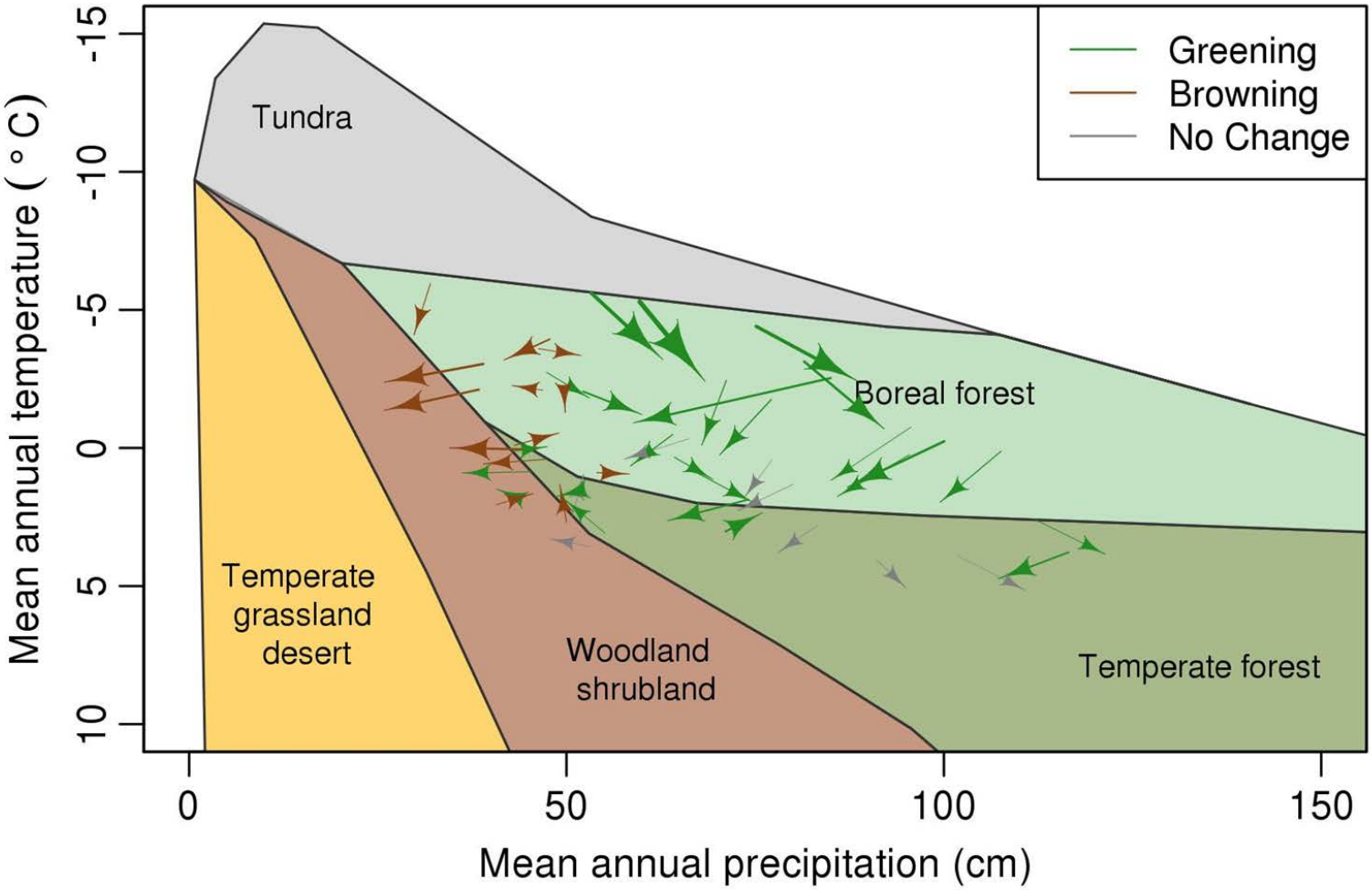
Trends for undisturbed forests show broad regional patterns

- Eastern forests show slight greening
- Western forests show slight browning
- Much smaller magnitude of trends than for disturbed forests



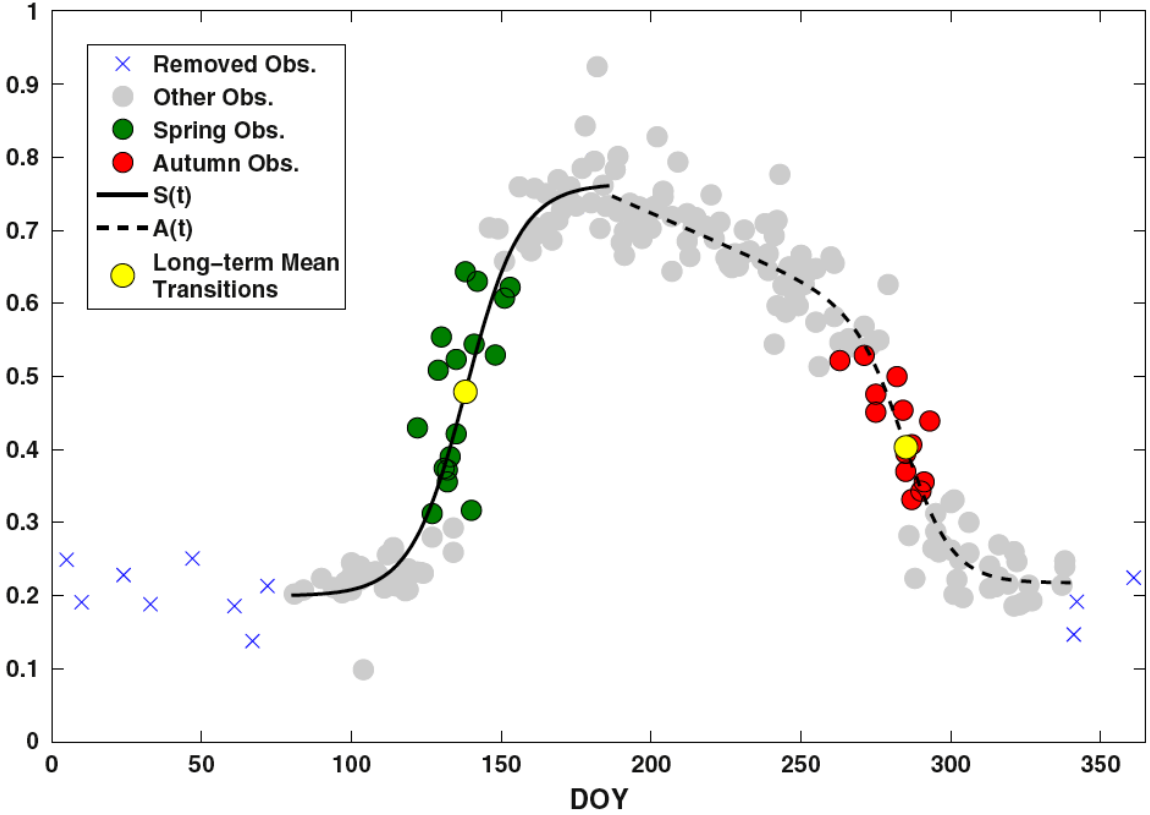

(A)
Canadian Ecozones
Boreal Plain
Boreal Shield
Hudson Plain
Taiga Plain
Taiga Shield E
Taiga Shield W
23
44
35
3
46
6
39
9
7
41
2
13
40
25
10
5
16
8
33
31
45
43
27
42
21
14
24
29
37
1
26
11
32
22
28
17
30
15
38
34
19
4
20
36
18


(A)
Mean Annual Temperature (°C)
-15 -10 -5 0 5 10 15
(B)
Mean Annual Precipitation (cm)
0 25 50 75 100 125
(C)
Mean Annual Temperature Trend
1984-2011 (°C/year)
-0.03 0 0.03 0.06 0.09 0.12
(D)
Mean Annual Precipitation Trend
1984-2011 (cm/year)
-1 -0.5 0 0.5 1
NDVI Trend
-0.004 -0.001 -0.0001 0 0.0001 0.001 0.004
0 150 300 450 600 750 900 1050 1200 km

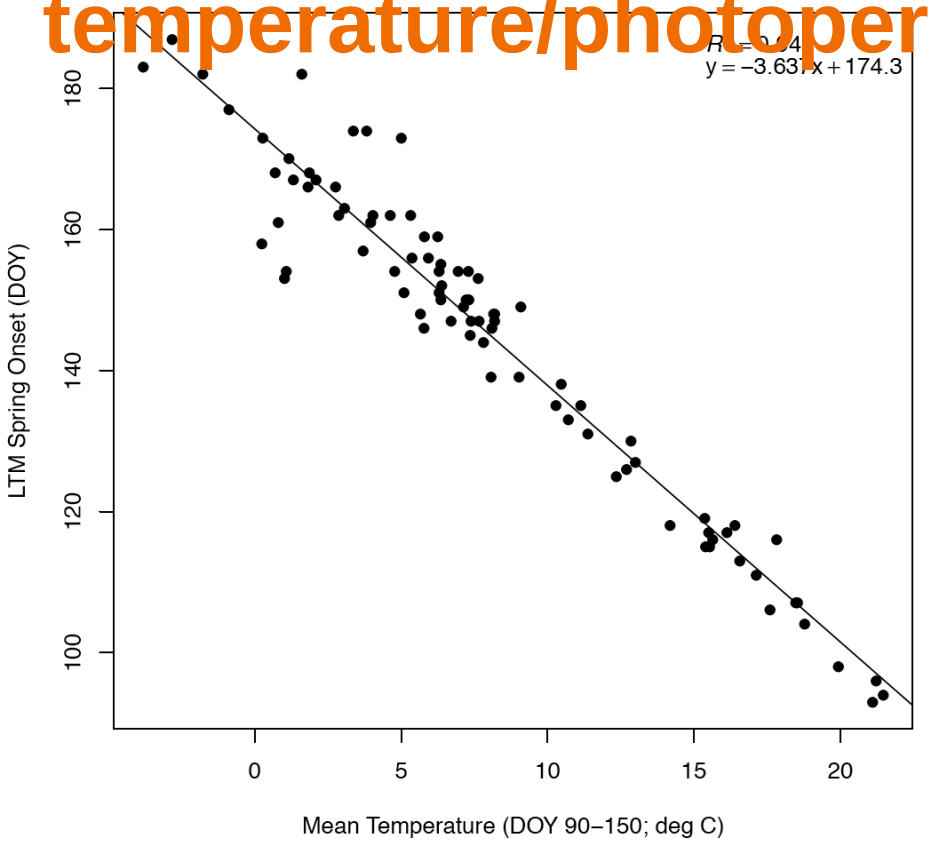

Greening
Browning
No Change
Tundra
Boreal forest
Temperate grassland desert
Woodland shrubland
Temperate forest
Mean annual temperature (° C)
-15
-10
-5
0
5
10
0
50
100
150
Mean annual precipitation (cm)

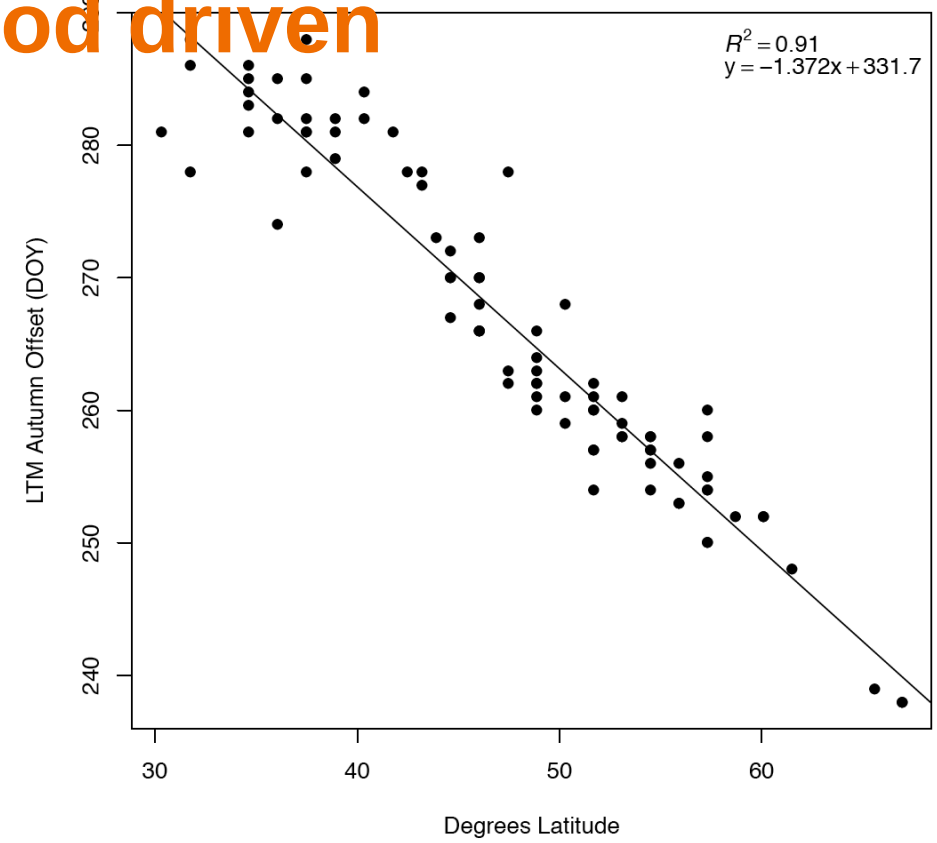
Detecting phenology from Landsat

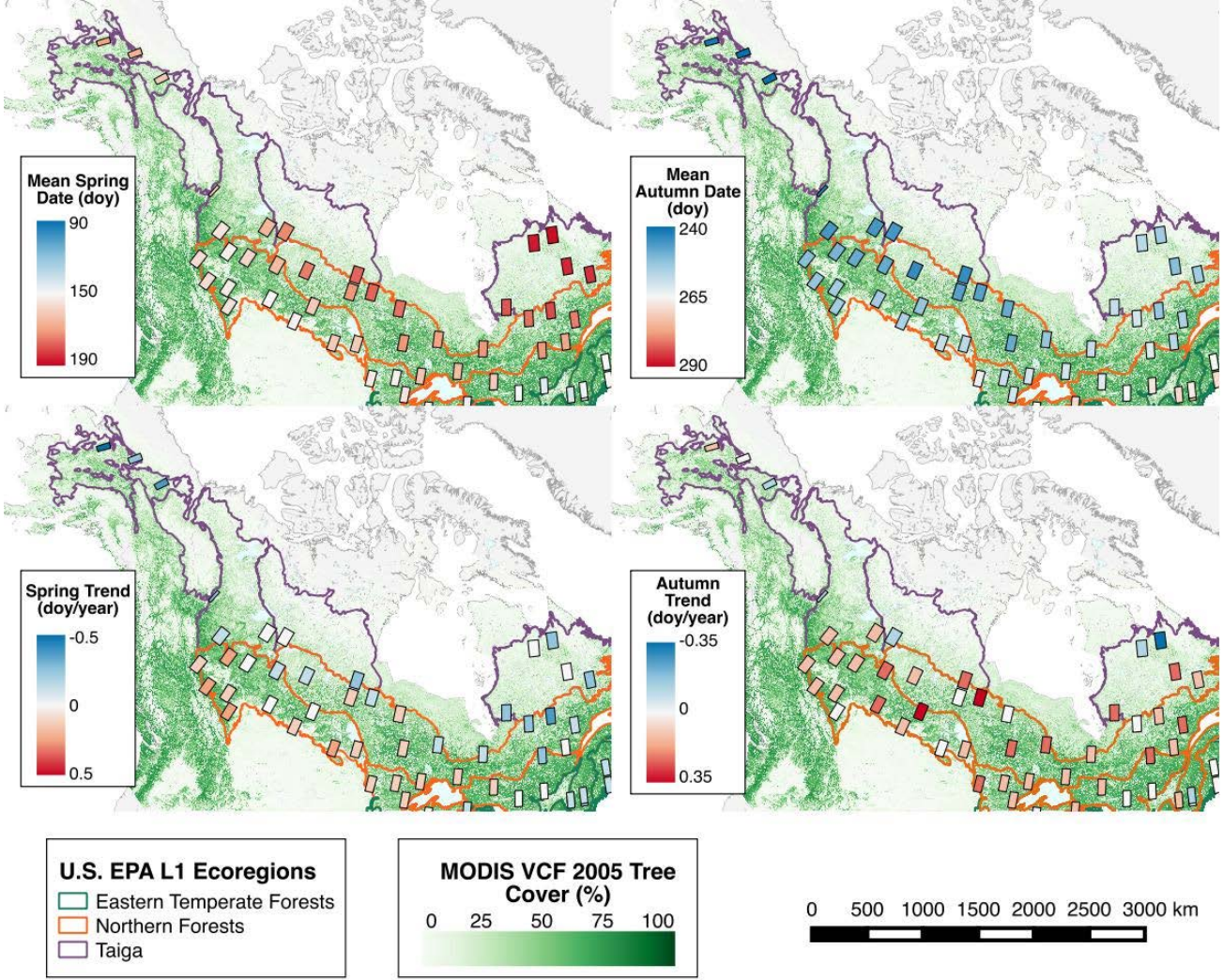
- Method based on Melaas et. al, 2013 paper in RSE
- All observations for a pixel are sorted by julian date
- Logistic curves are fit independently to the spring and fall periods
- The transition date for each year is based on deviation from that function

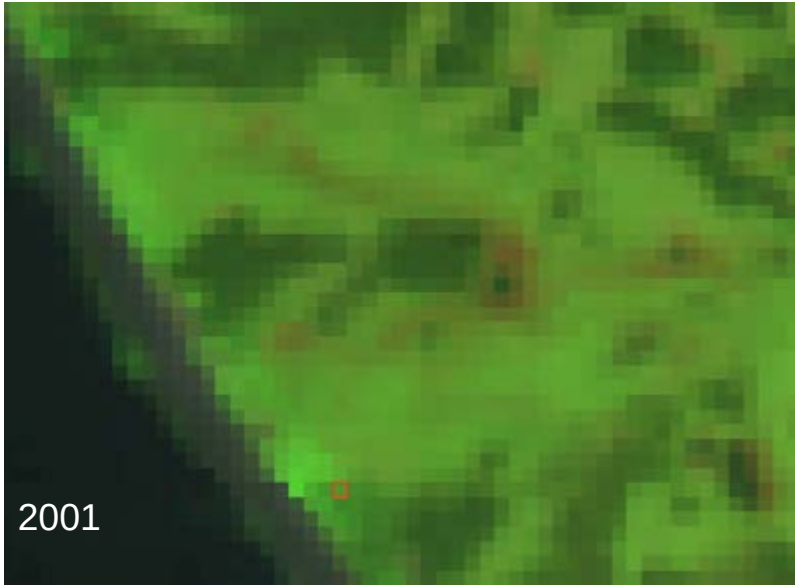


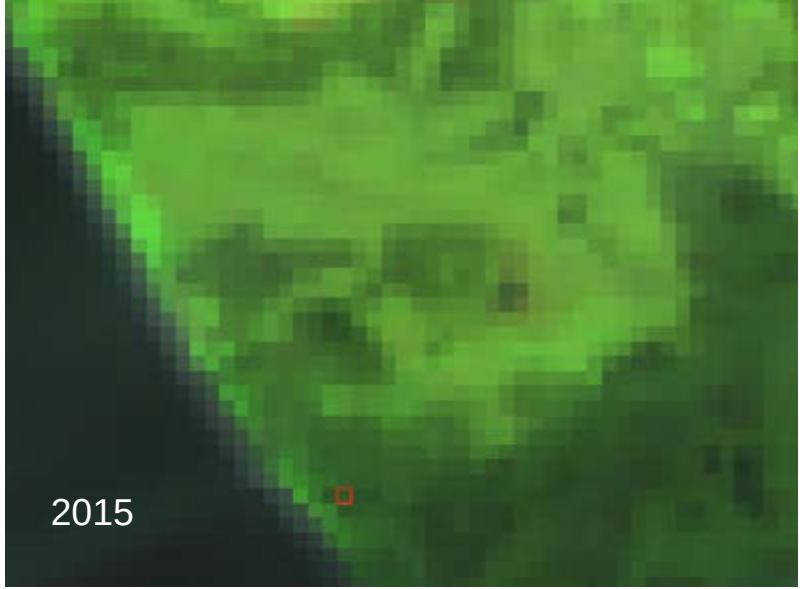
Phenological dates are temperature/photoperiod driven

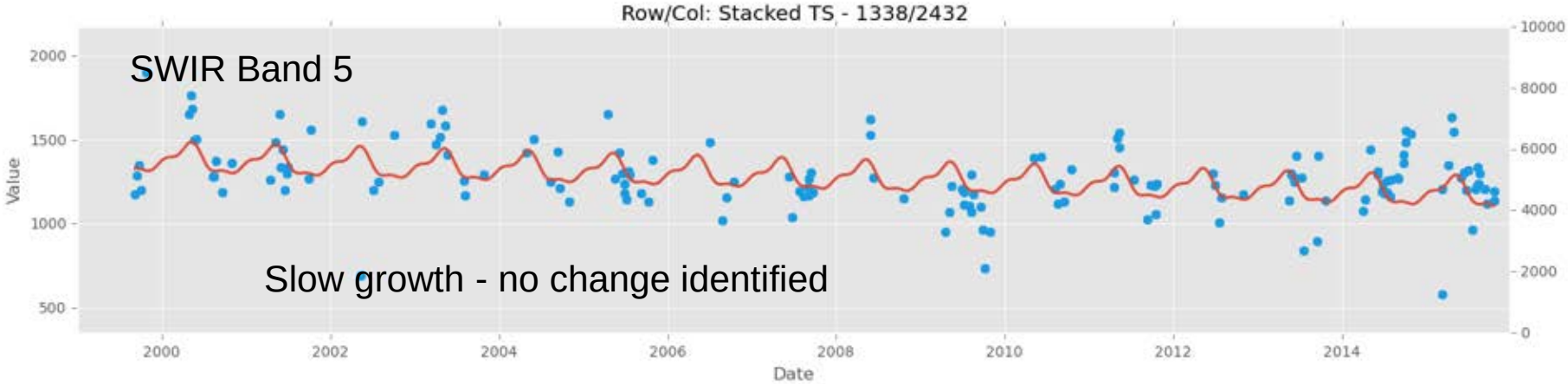


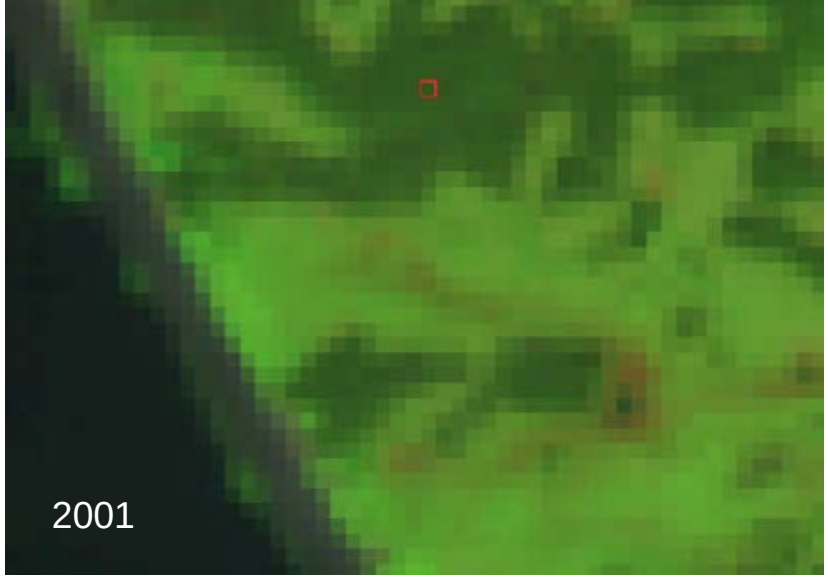


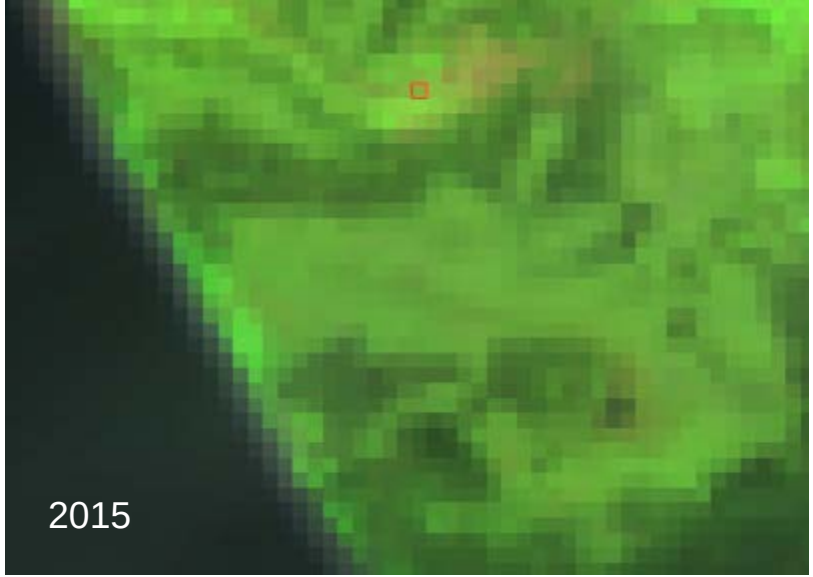

Mean Spring Date (doy)
90
150
190
Mean Autumn Date (doy)
240
265
290
Spring Trend (doy/year)
-0.5
0
0.5
Autumn Trend (doy/year)
-0.35
0
0.35
U.S. EPA L1 Ecoregions
Eastern Temperate Forests
Northern Forests
Taiga
MODIS VCF 2005 Tree Cover (%)
0 25 50 75 100
0 500 1000 1500 2000 2500 3000 km

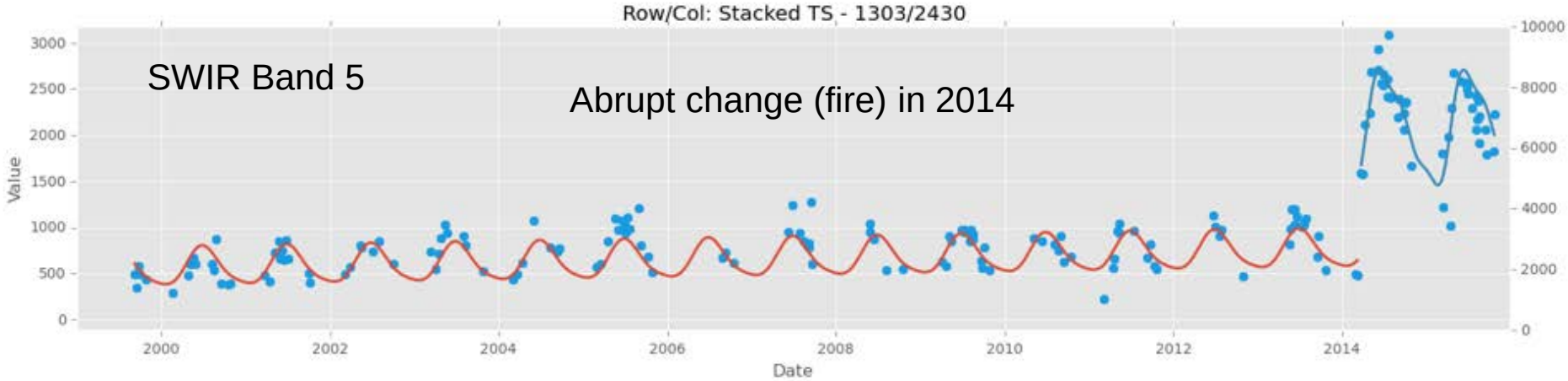

2001


2015


Row/Col: Stacked TS - 1338/2432
SWIR Band 5
Slow growth - no change identified
Value
Date
2000
1500
1000
500
2000
2002
2004
2006
2008
2010
2012
2014
10000
8000
6000
4000
2000
0

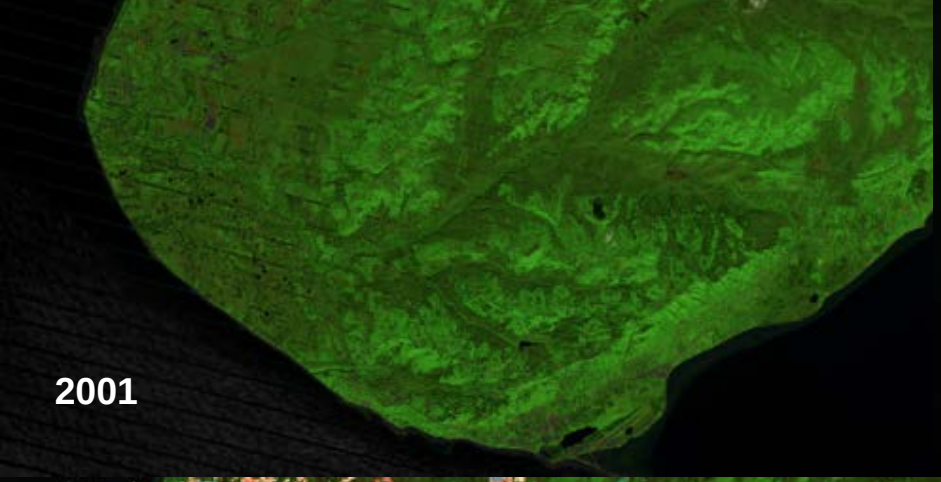

2001


2015


Row/Col: Stacked TS - 1303/2430
SWIR Band 5
Abrupt change (fire) in 2014
Value
Date
3000
2500
2000
1500
1000
500
0
10000
8000
6000
4000
2000
0
2000
2002
2004
2006
2008
2010
2012
2014

Upper Kenai Peninsula (just south of the town of Kenai)

Year of change - blue is more recent orange is older

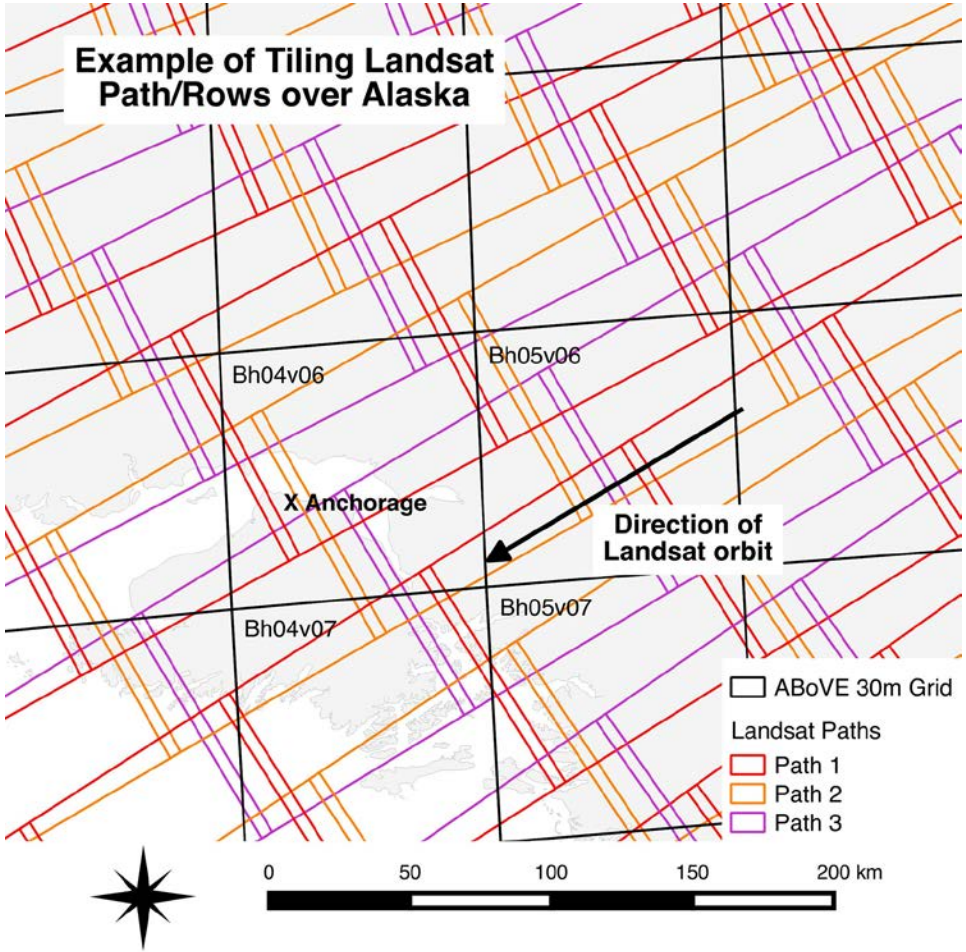


Kenai Peninsula - Homer

Year of change - blue is more recent orange is older.

Current project tas

- Creating tiled Landsat data according to the ABoVE grid and projection system
- Testing disturbance detection on a sample tile
- Will test the peak-summer NDVI trend mapping and phenological date mapping next

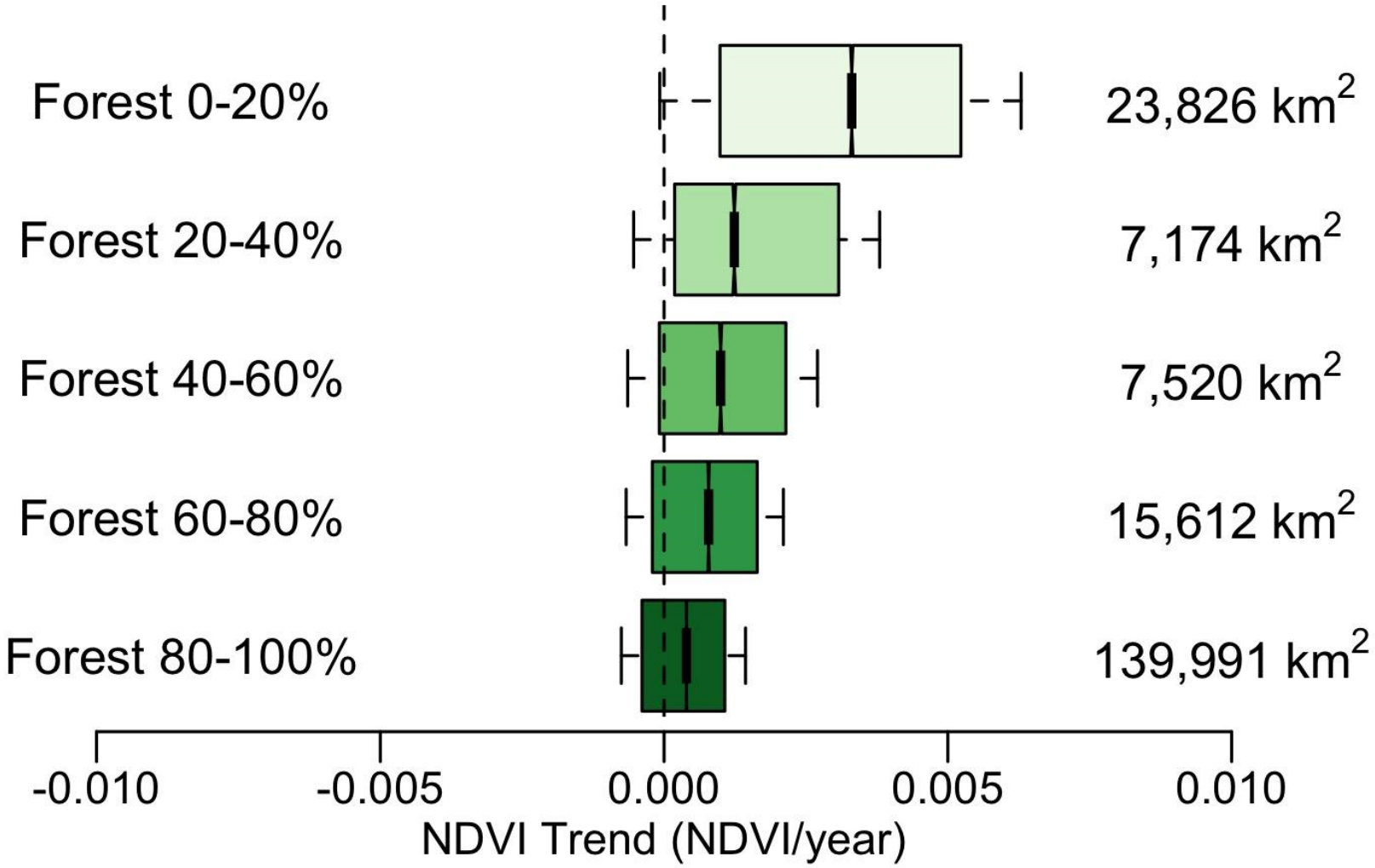


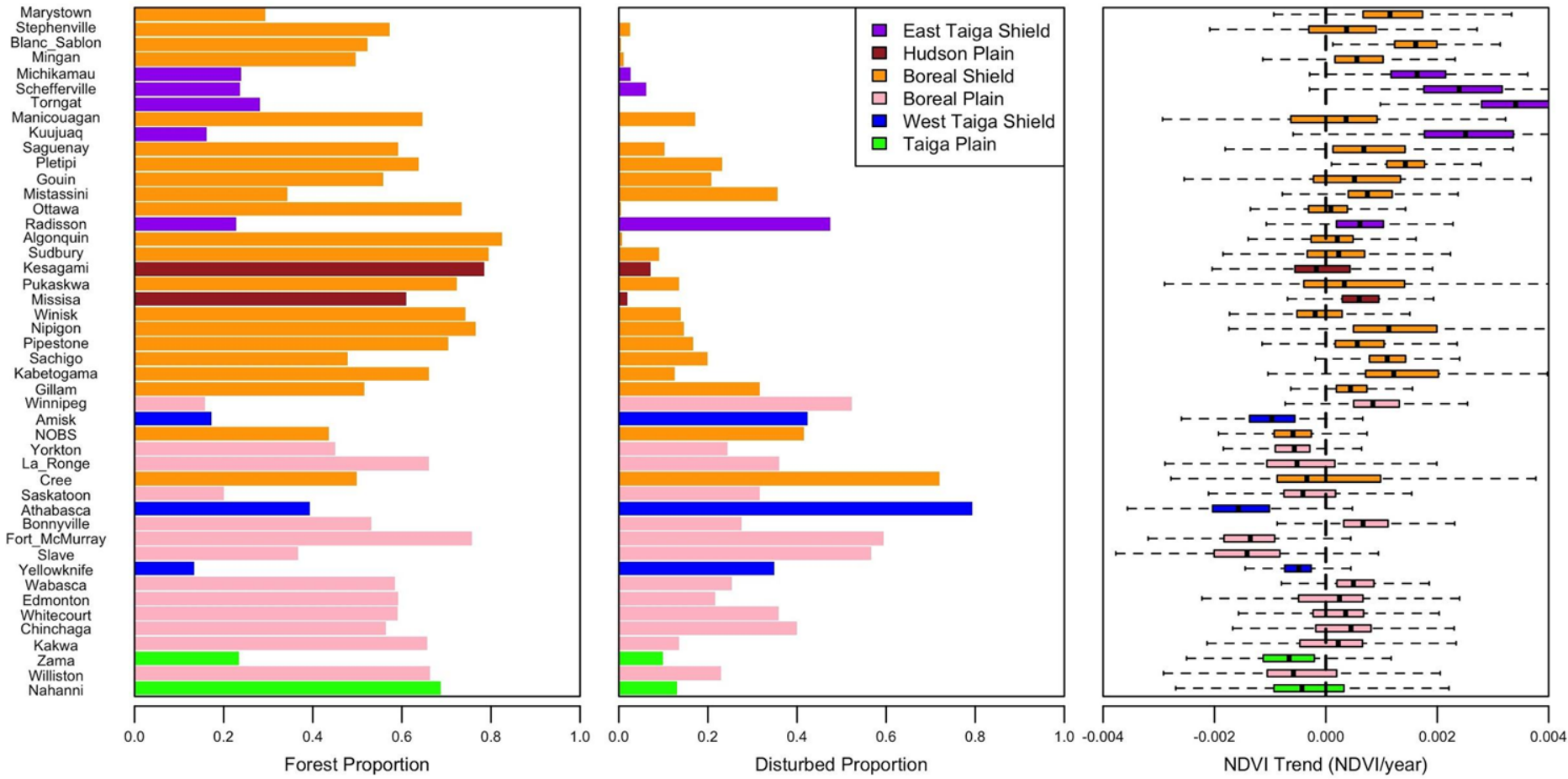
Product table for proposed outputs

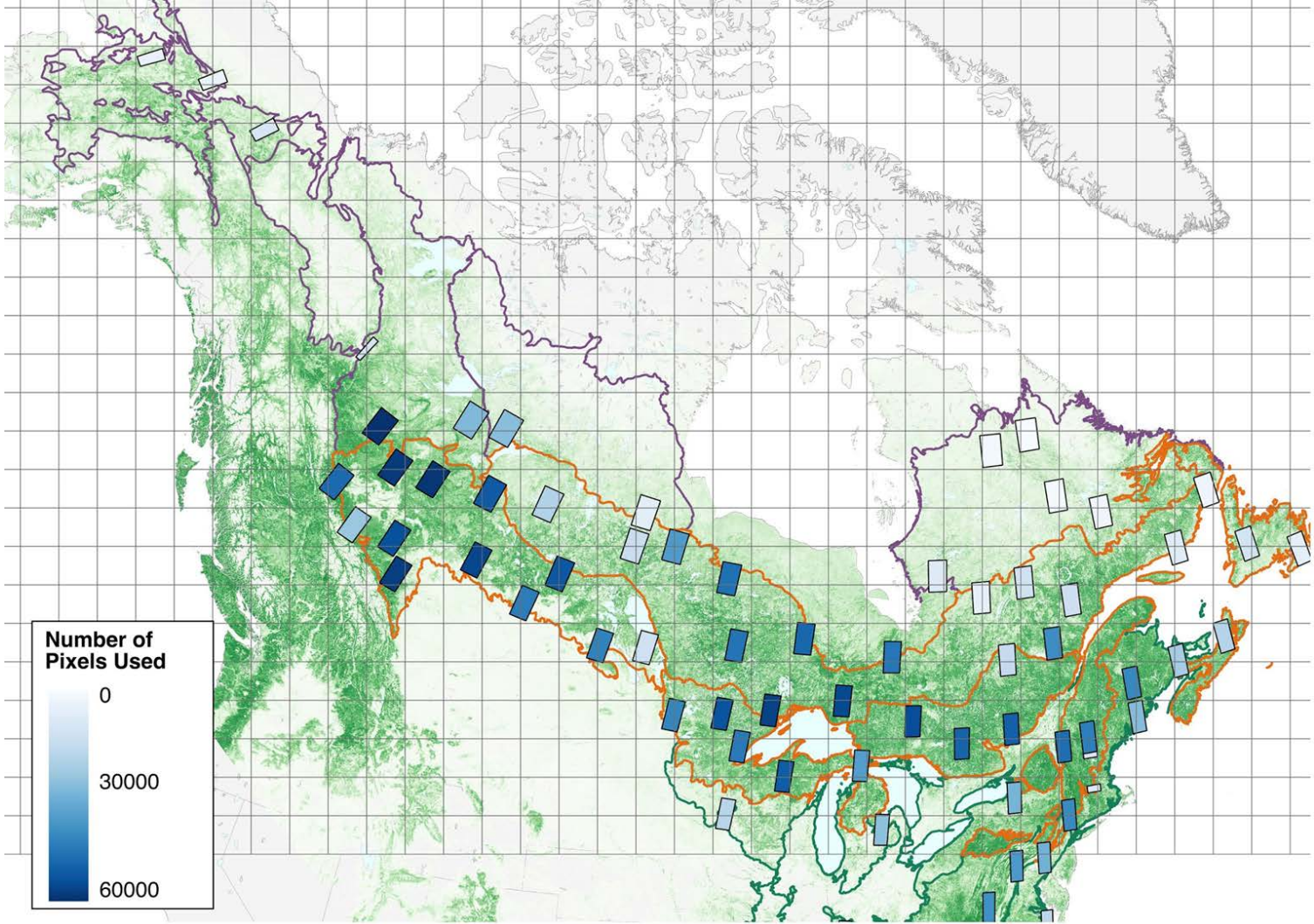
Name	Data Format	Date Range	Temporal Scale	Spatial Scale	Units
Disturbance date (last)	GeoTIFF	1985* to 2015	1 per study period	30-m	Month-Year
Disturbance date (first)	GeoTIFF	1985* to 2015	1 per study period	30-m	Month-Year
Peak-Summer NDVI composite	GeoTIFF	1984 to 2015	Annual	30-m	NDVI
Peak-Summer NDVI trend	GeoTIFF	1984 to 2015	1 per study period	30-m	NDVI/year
Peak-Summer NDVI trend significance	GeoTIFF	1984 to 2015	1 per study period	30-m	Unitless
Date of spring onset	GeoTIFF	1984 to 2015	Annual	30-m	Day of year
Date of fall offset	GeoTIFF	1984 to 2015	Annual	30-m	Day of year
Mean date of spring onset	GeoTIFF	1984 to 2015	1 per study period	30-m	Day of year
Mean date of fall offset	GeoTIFF	1984 to 2015	1 per study period	30-m	Day of year
*No detection possible for the first year in the record (1984).					

Questions? Comments?

Extra slides


Forest 0-20%
23,826 km2
Forest 20-40%
7,174 km2
Forest 40-60%
7,520 km2
Forest 60-80%
15,612 km2
Forest 80-100%
139,991 km2
-0.010
-0.005
0.000
0.005
0.010
NDVI Trend (NDVI/year)


Marystown
Stephenville
Blanc_Sablon
Mingan
Michikamau
Schefferville
Torngat
Manicouagan
Kuujuaq
Saguenay
Pletipi
Gouin
Mistassini
Ottawa
Radisson
Algonquin
Sudbury
Kesagami
Pukaskwa
Missisa
Winisk
Nipigon
Pipestone
Sachigo
Kabetogama
Gillam
Winnipeg
Amisk
NOBS
Yorkton
La_Ronge
Cree
Saskatoon
Athabasca
Bonnyville
Fort_McMurray
Slave
Yellowknife
Wabasca
Edmonton
Whitecourt
Chinchaga
Kakwa
Zama
Williston
Nahanni
0.0
0.2
0.4
0.6
0.8
1.0
Forest Proportion
East Taiga Shield
Hudson Plain
Boreal Shield
Boreal Plain
West Taiga Shield
Taiga Plain
Disturbed Proportion
-0.004
-0.002
0.000
0.002
0.004
NDVI Trend (NDVI/year)


Number of Pixels Used
0
30000
60000