From Spatial Data to Time-Lapse: Creating Videos with ArcGIS and Premiere

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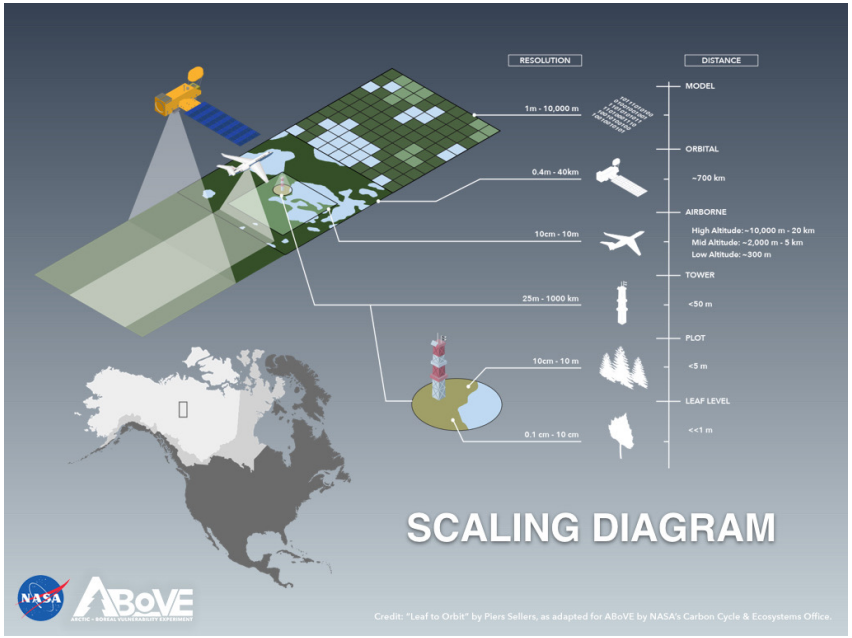
- NASA **A**rctic-**Bo**real **V**ulnerability **E**xperiment

  Explore impacts of environmental change on Arctic and Boreal terrestrial and freshwater ecosystems

- The warming in the arctic is twice as fast as the global average (IPCC, 2013)

- Boreal biomes exhibit the highest gross forest cover loss (GFCL), and NA's forest loss is above all the other continents' (Hansen et al., 2010; Natural Resources Canada, 2017)



ABoVE
ARCTIC - BOREAL VULNERABILITY EXPERIMENT

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Landsat 5/7 TM/ETM+

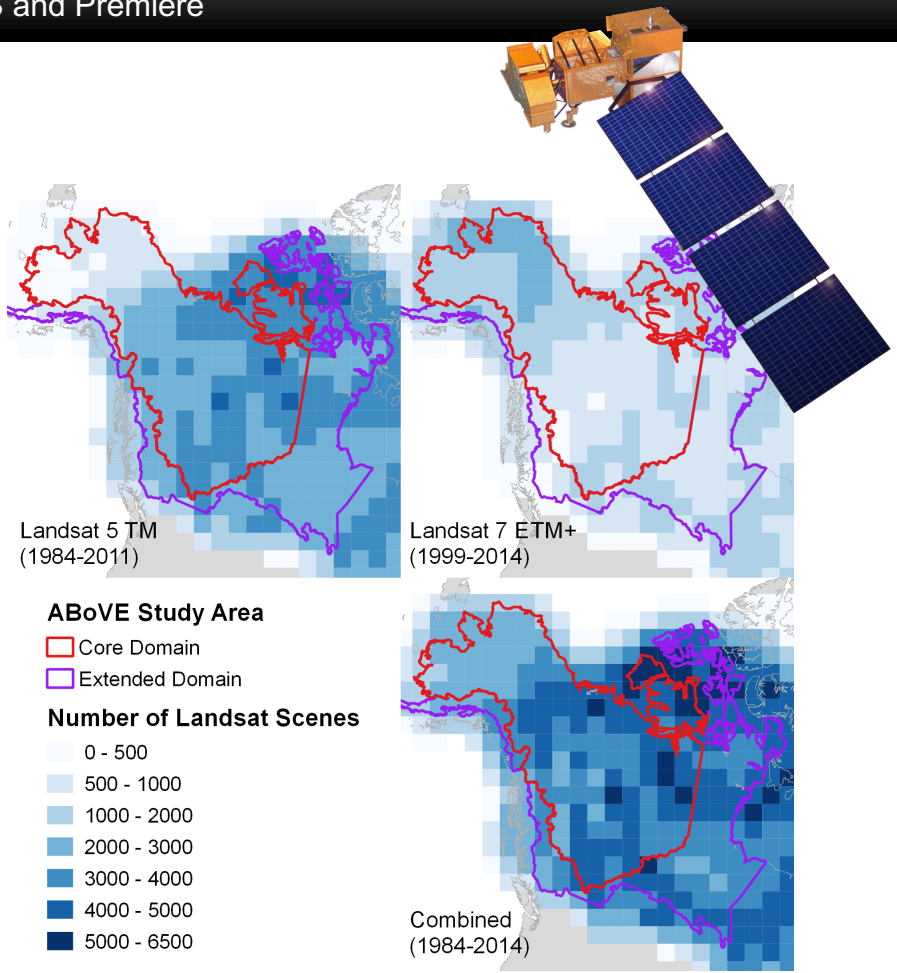
- Temporal resolution: 16 days
- Spatial resolution: 30 meters

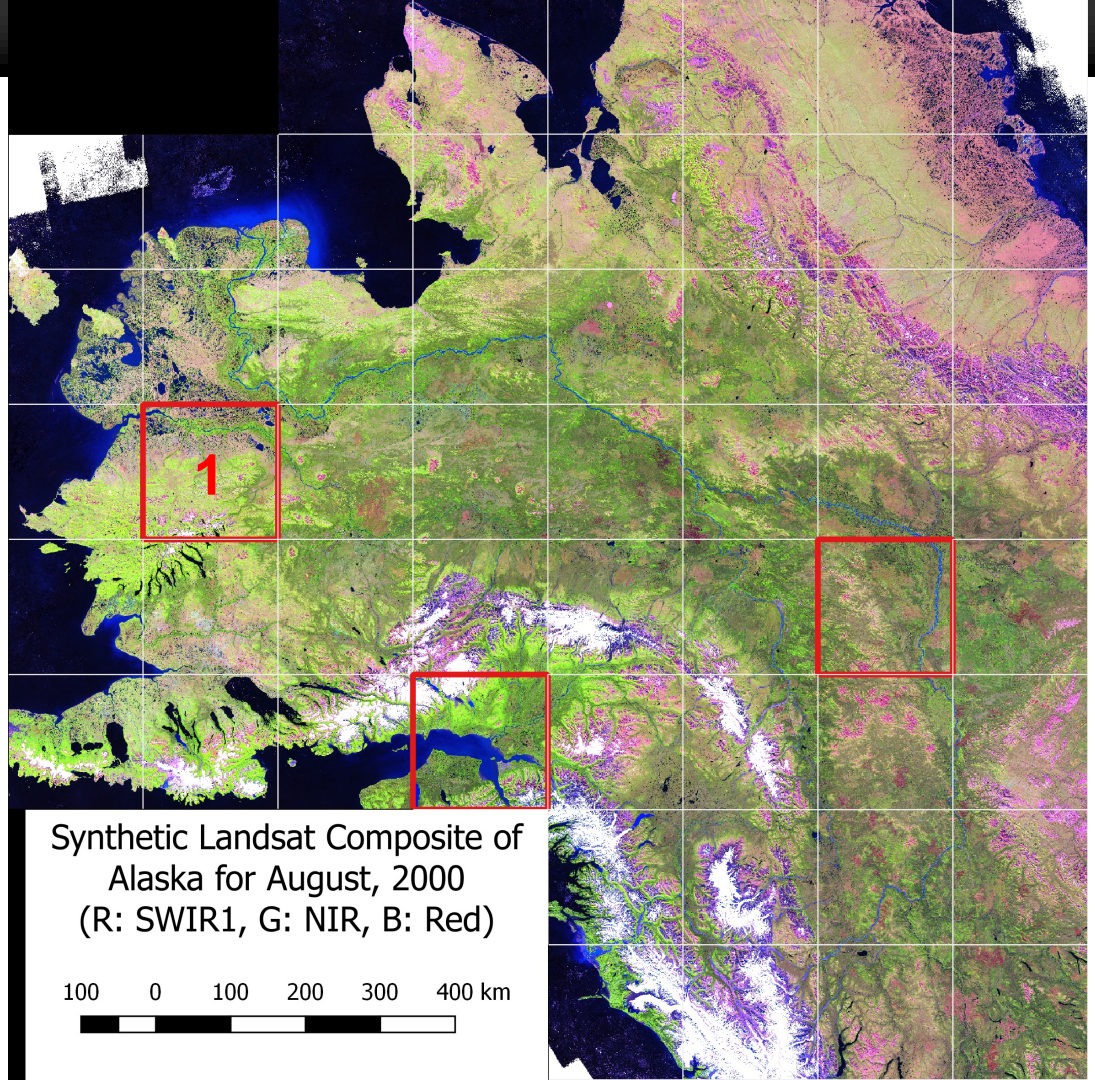
Data volume

164 tile × 6000*6000 pixels × 31 years

- The inputs to this process required 102 TB of storage and the outputs, highly compressed TIFF files, use 82 TB

	TM5	ETM+	Combined
Total tile files produced	1,136,321	504,607	1,640,928





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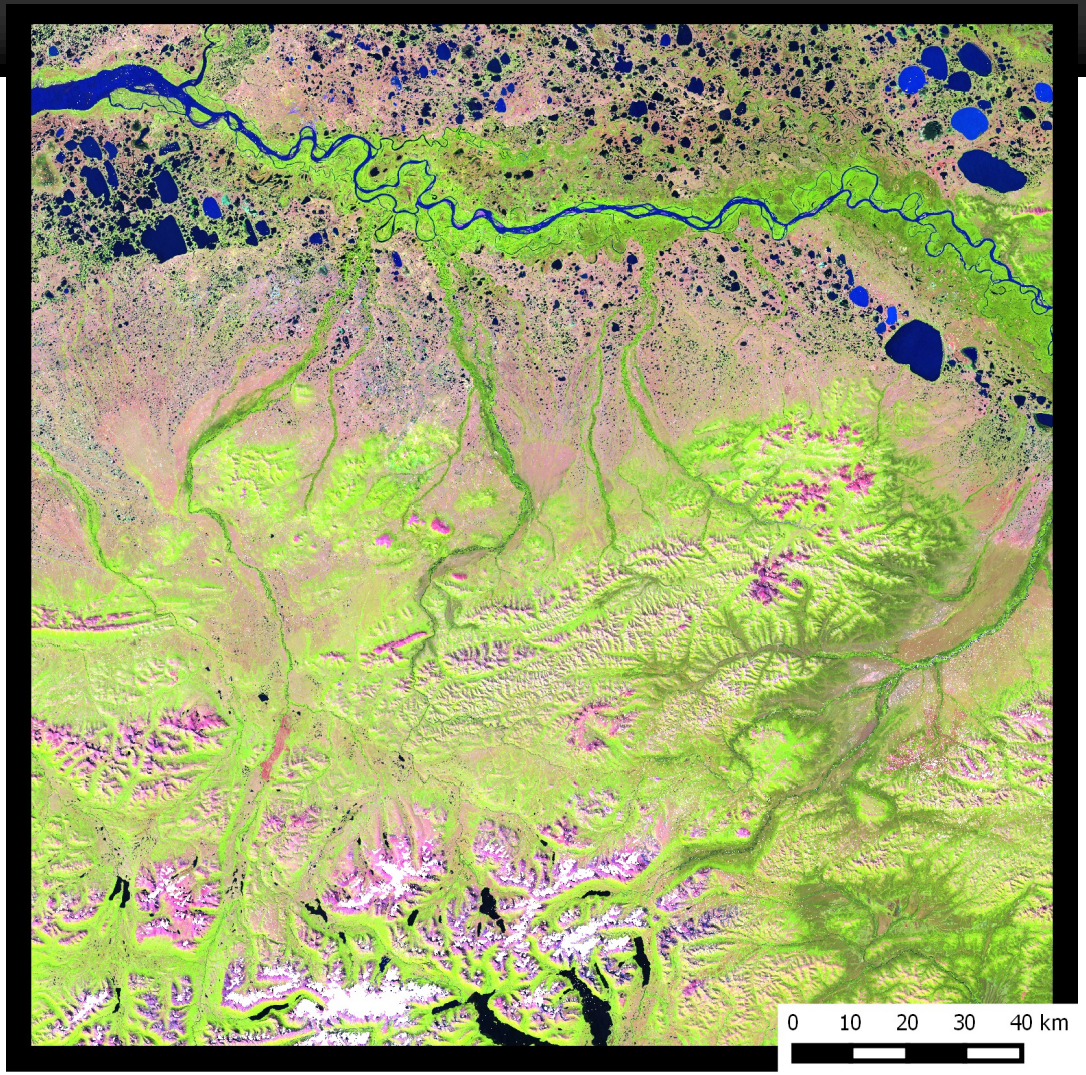

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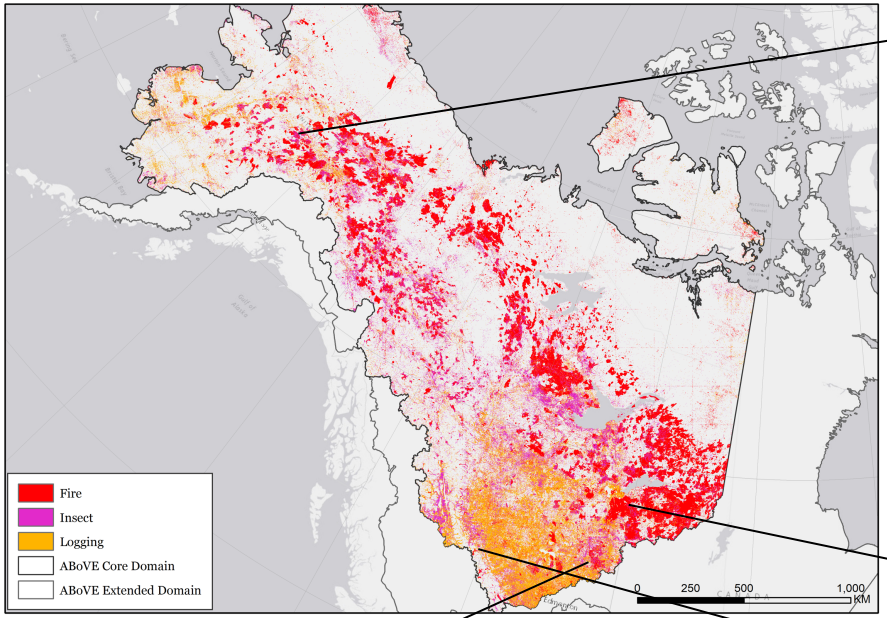
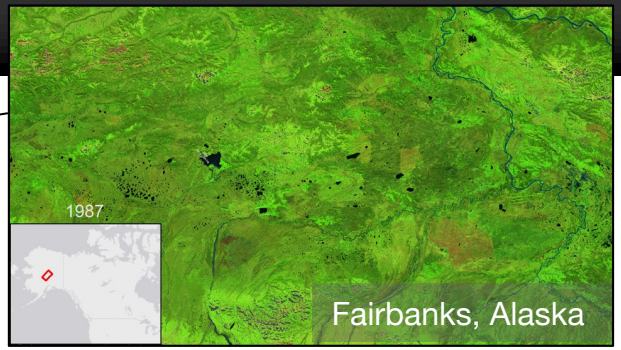
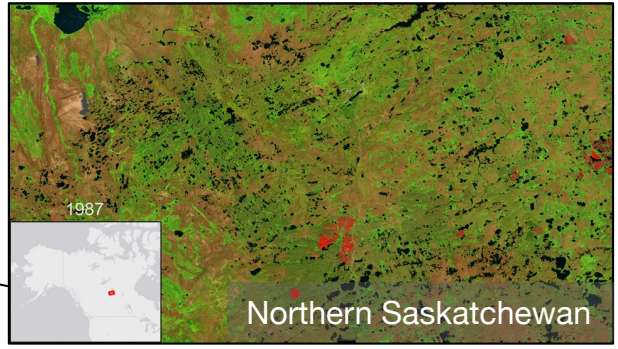
Causal Agents of Disturbance Map







Check out the video

Zhang et al., 2022, RSE

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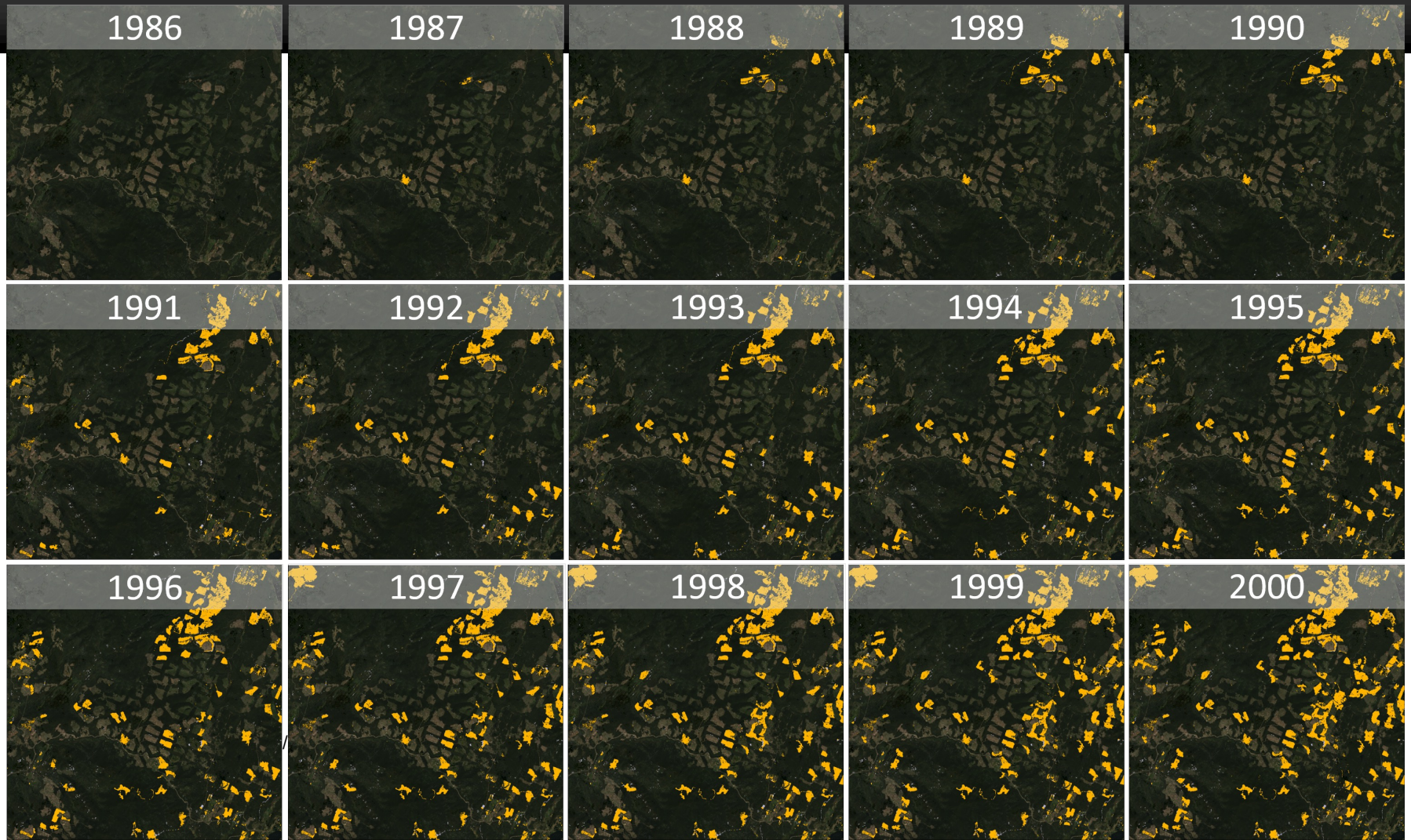
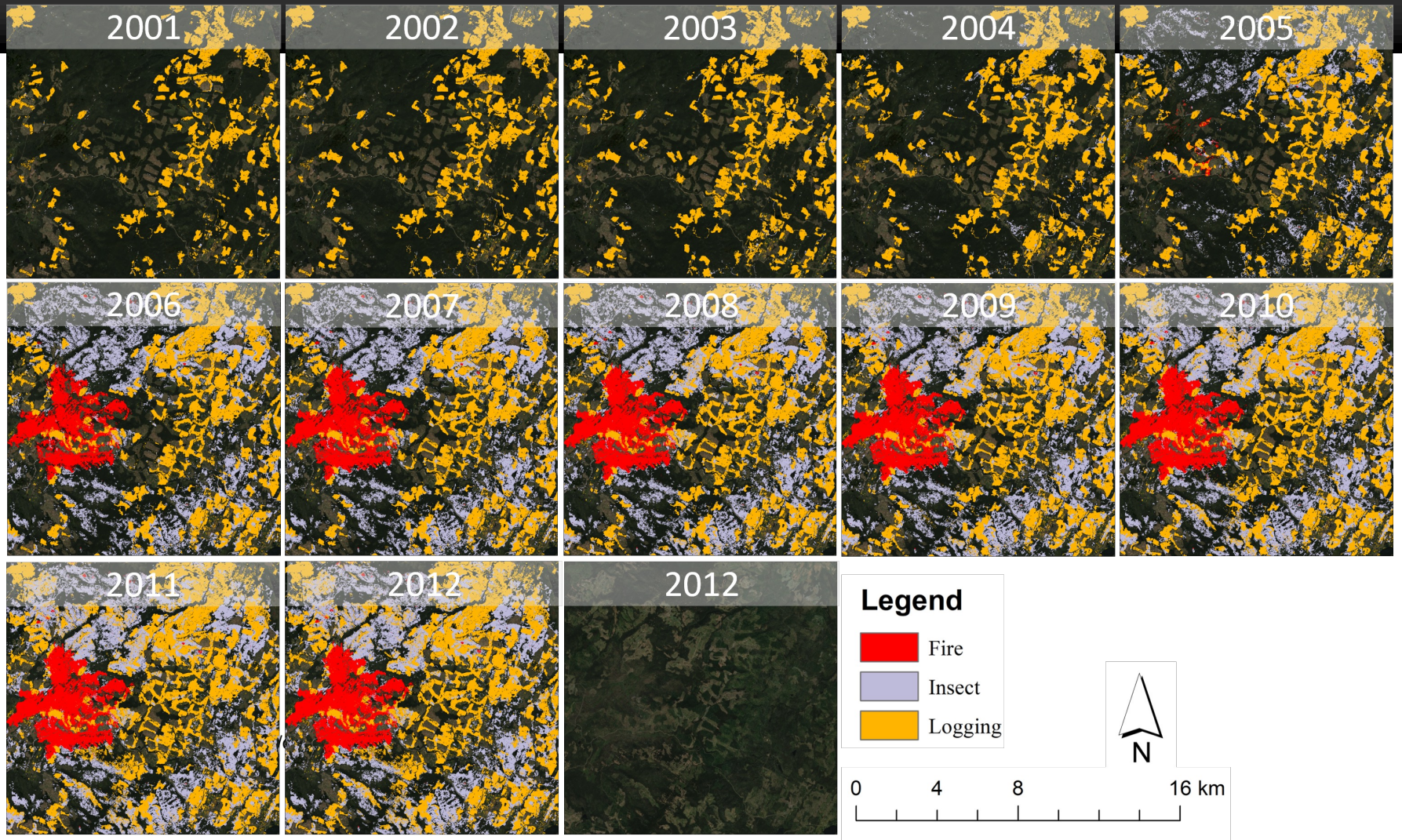
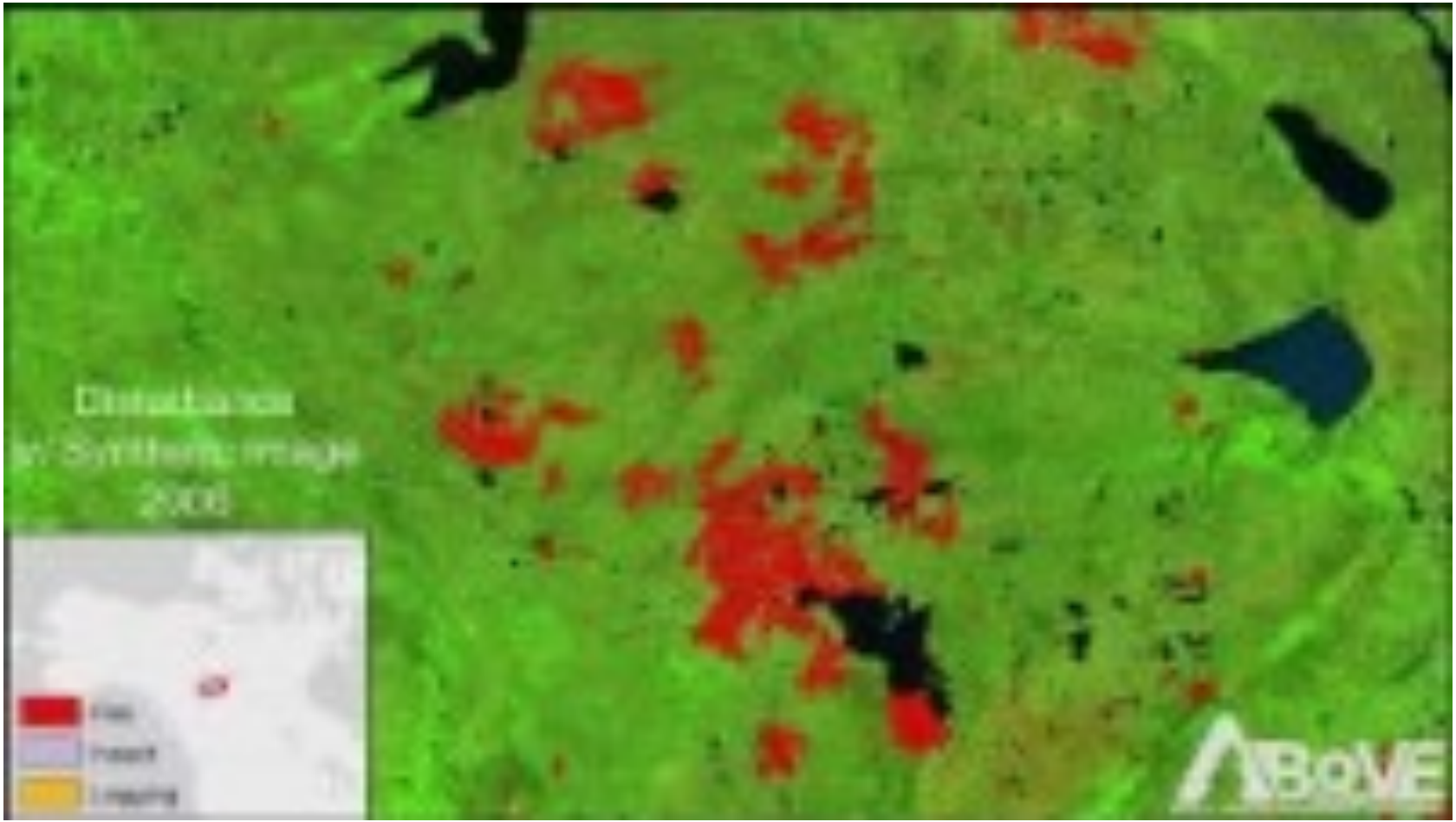

1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000


2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2012
Legend
Fire
Insect
Logging
N
0
4
8
16 km


Disturbance
in Synthetic Image
2008
BoVE

Recipe

Ingredients Breakdown

1. Annual Landsat-derived disturbance maps → Time-lapse of dataset group1
   - categorical map: 3 classes
   - 1987-2012
2. Annual Landsat peak-summer image composite → Time-lapse of dataset group2
   - continuous values
   - R: short-wave infrared (1.55-1.75μm); G: near-infrared (0.77-0.90μm); B: red (0.63-0.63μm)
3. Bounds/frames

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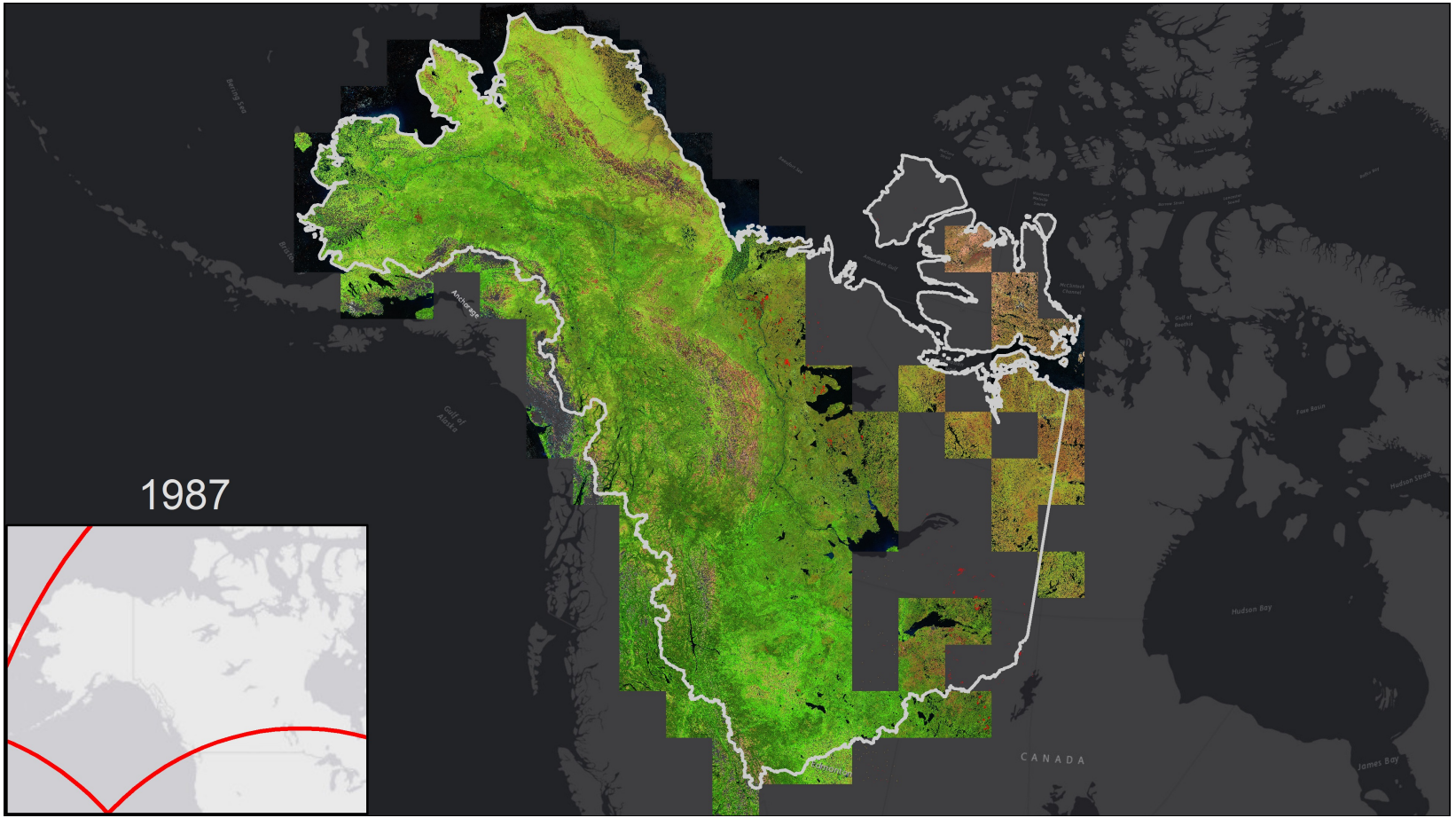
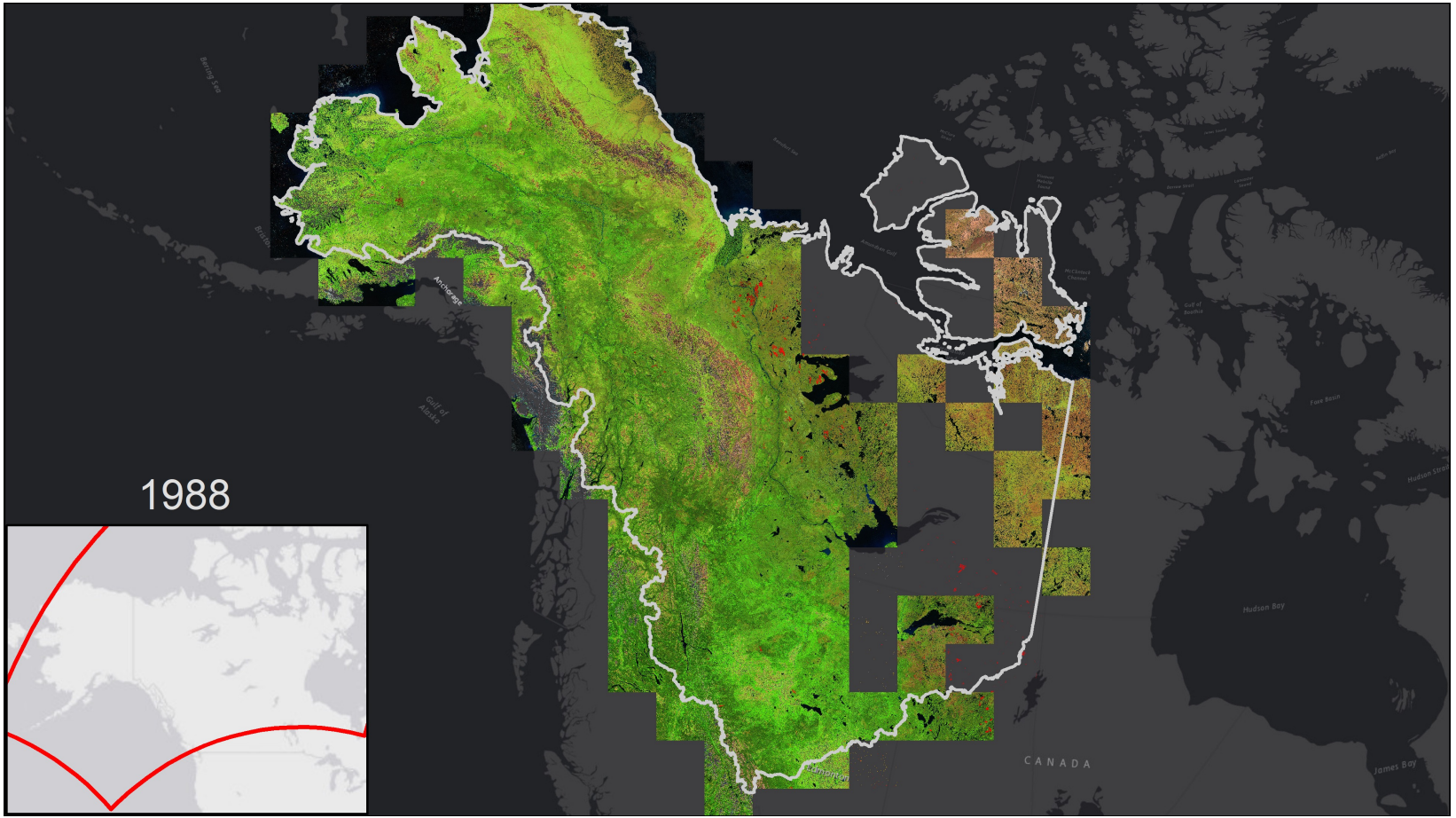
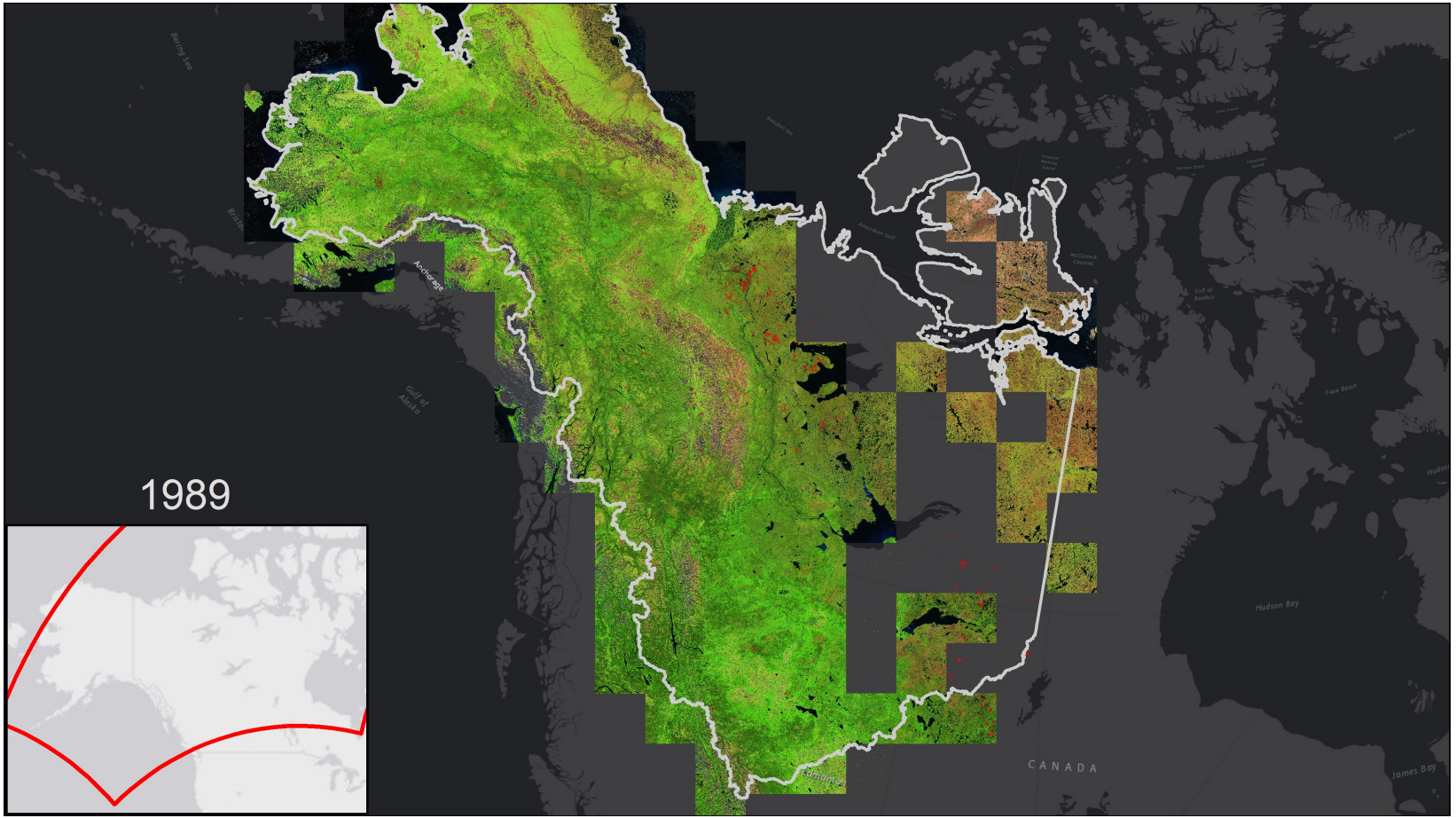
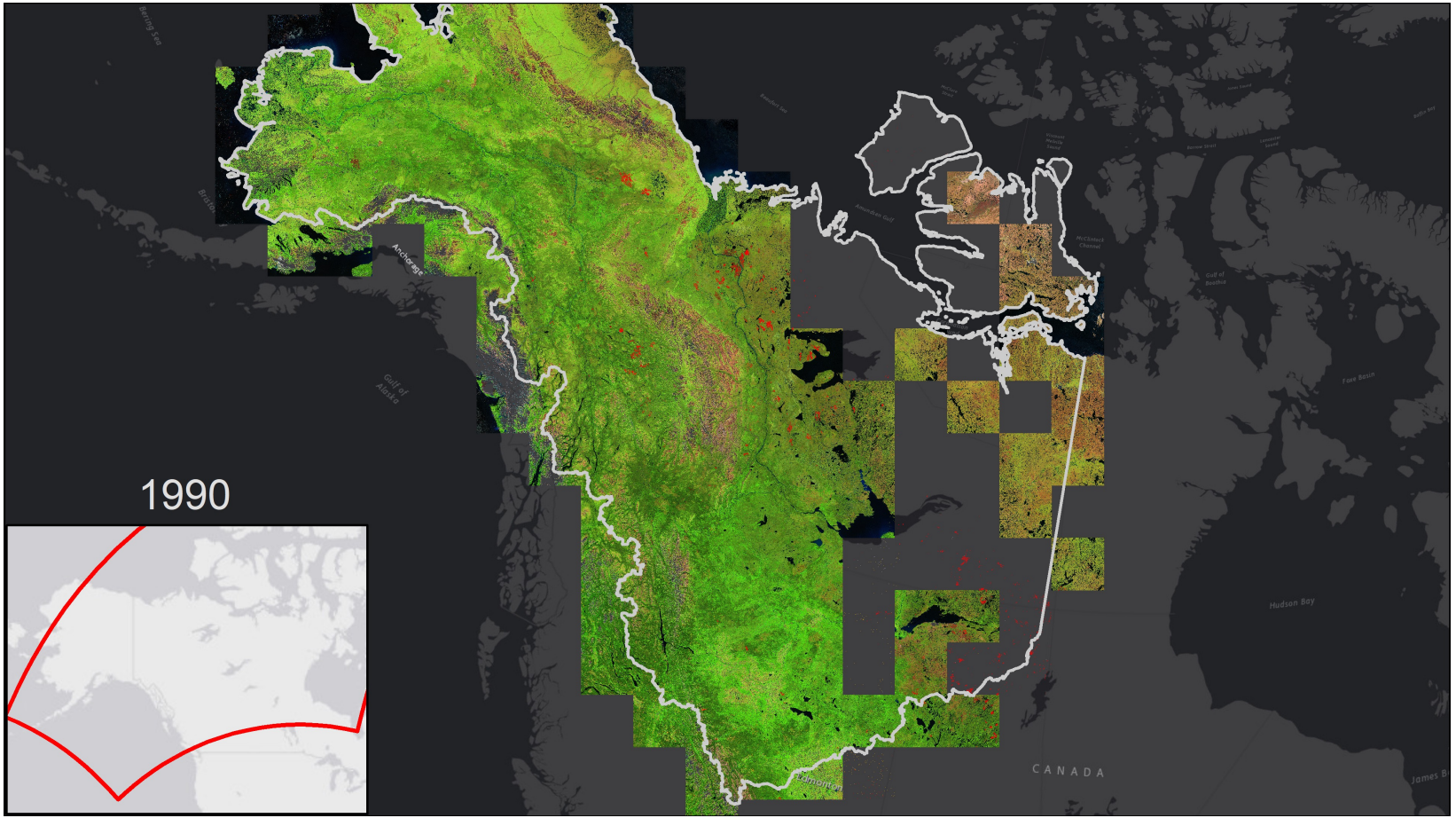
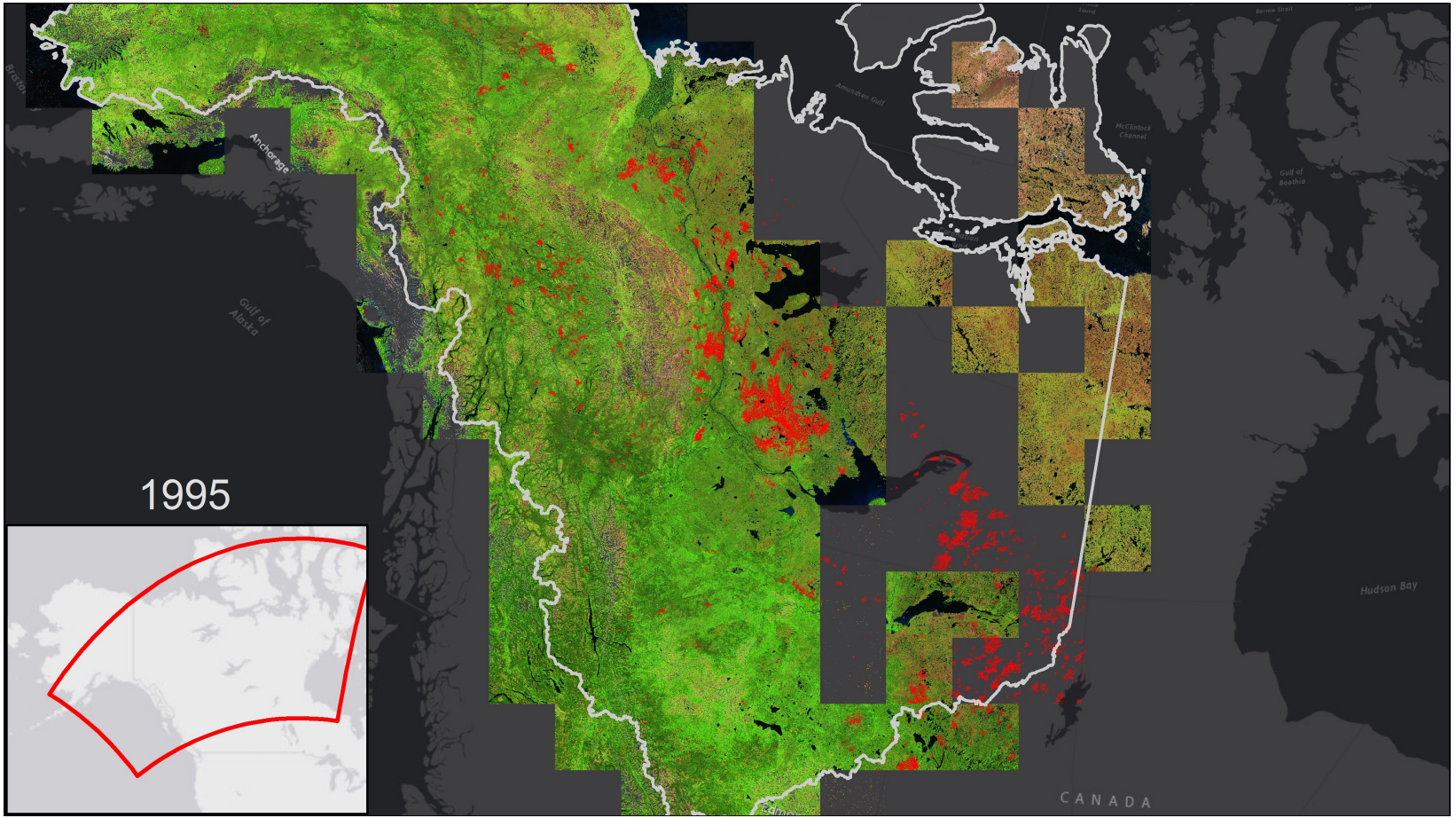
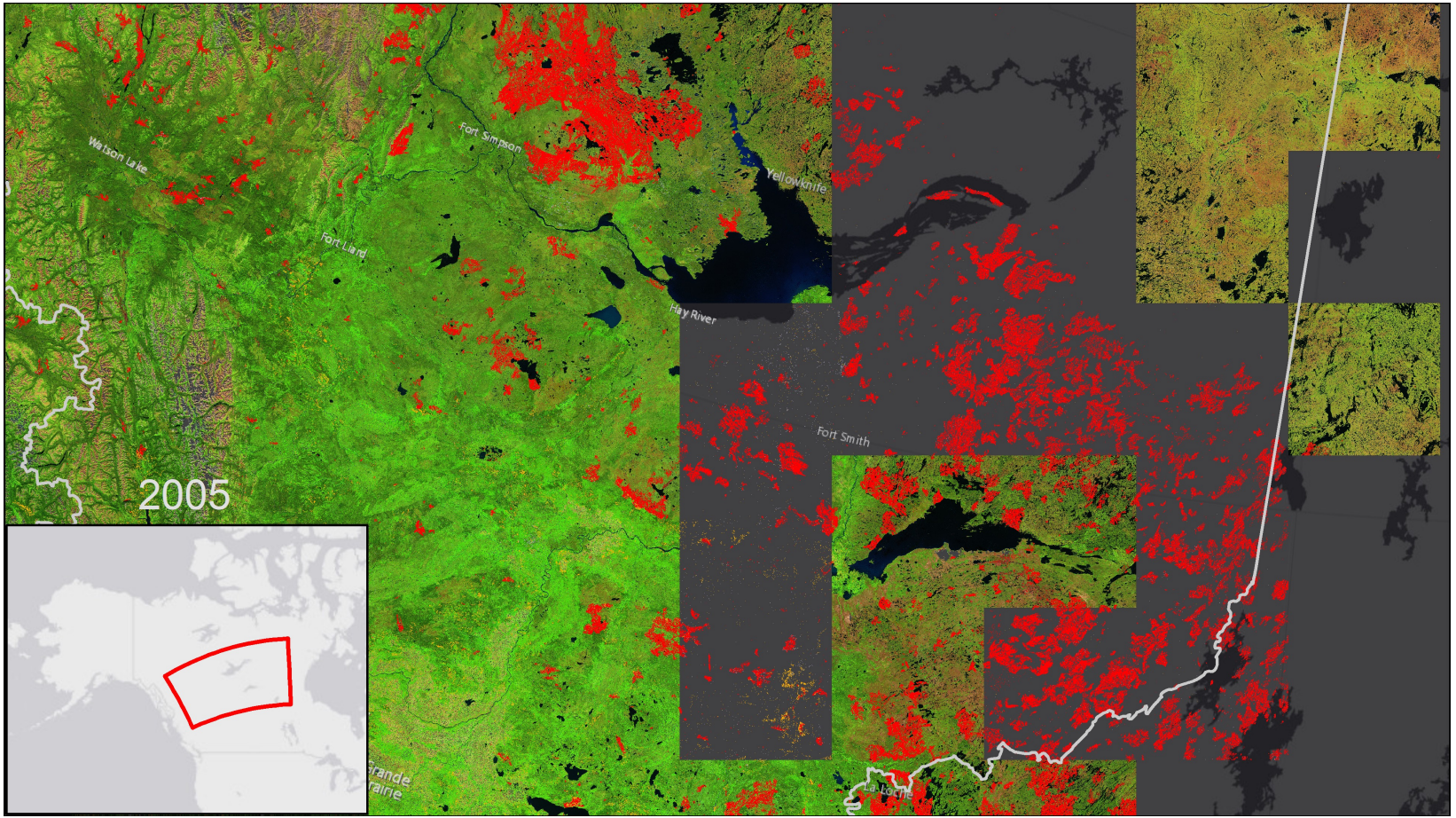

1987
CANADA
Hudson Bay
James Bay
Gulf of Alaska
Anchorage

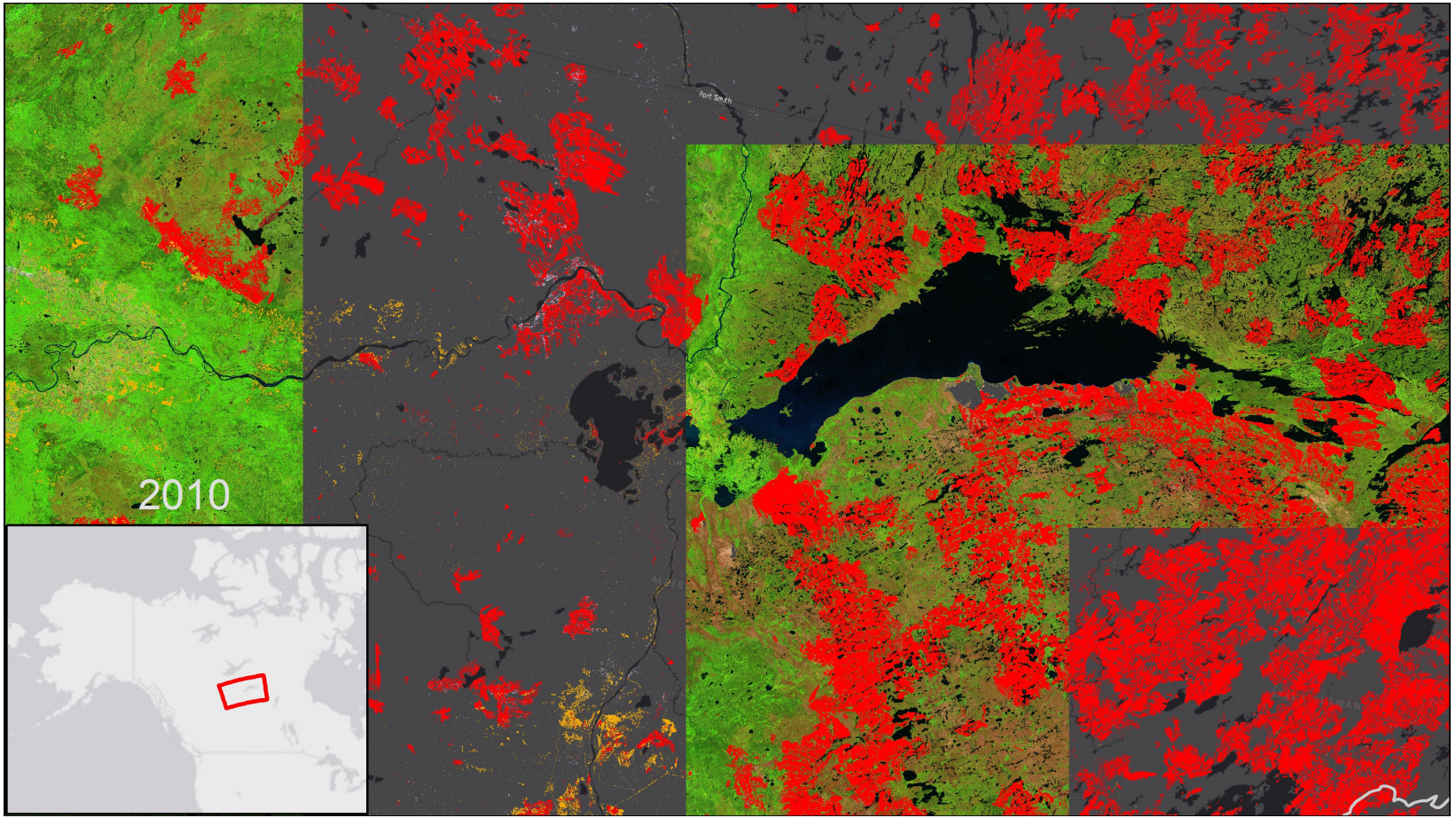

1988
Bering Sea
Anchorage
Gulf of Alaska
Hudson Bay
CANADA
James Bay

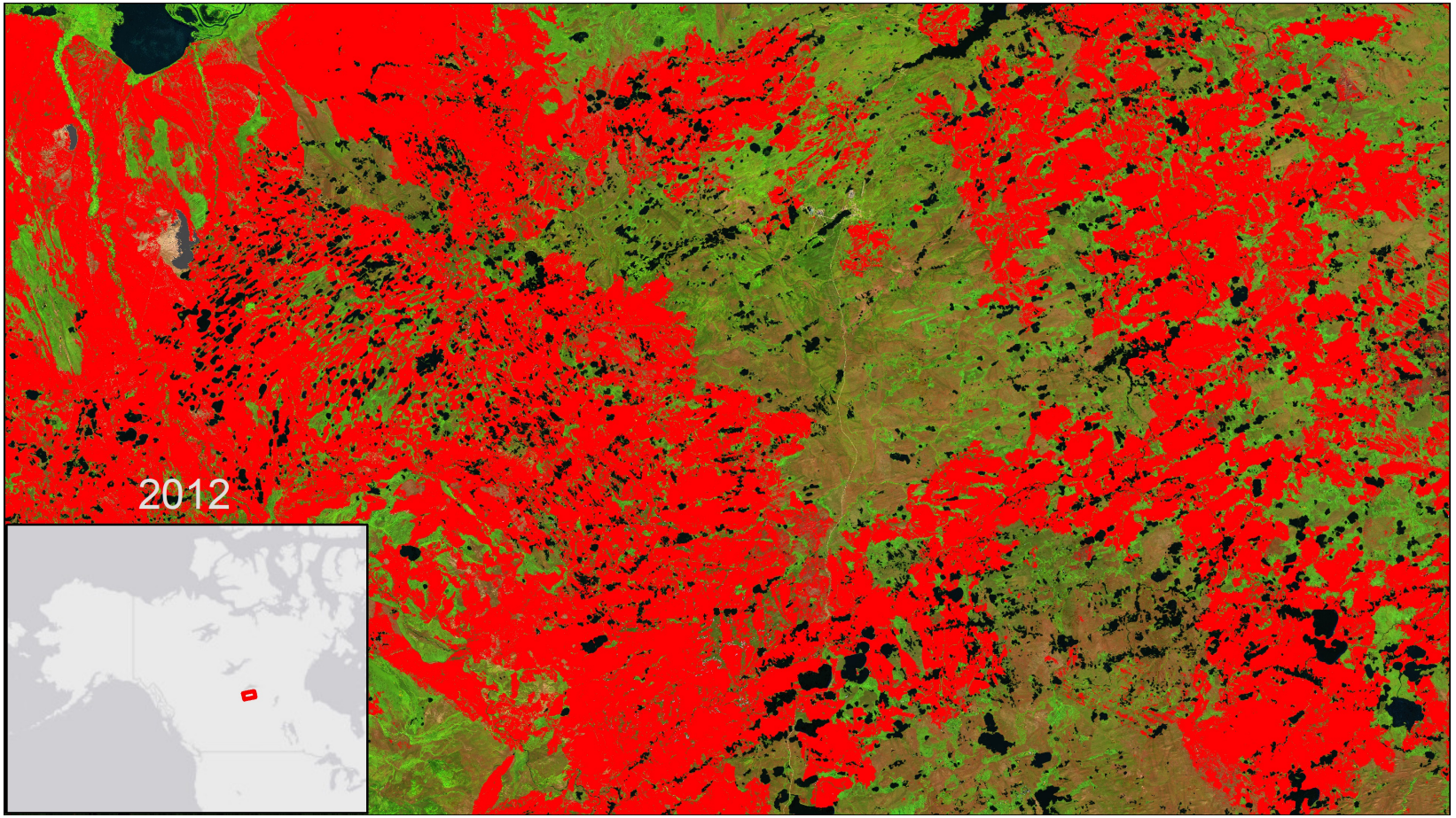

1989
Anchorage
Gulf of Alaska
Edmonton
CANADA
Hudson Bay
James Bay
Foxe Basin
Gulf of Boothia
McClintock Channel


1990
Anchorage
Gulf of Alaska
Hudson Bay
CANADA


1995
Anchorage
Gulf of Alaska
Amundsen Gulf
McClintock Channel
Gulf of Boothia
Hudson Bay
CANADA


Watson Lake
Fort Simpson
Yellowknife
Fort Liard
Hay River
Fort Smith
2005


Fort Smith
2010


2012

PURCHASING SOFTWARE

SERVICES
BORROWING EQUIPMENT
PURCHASING HARDWARE
PURCHASING SOFTWARE
FILE SERVERS
VDI – VIRTUAL DESKTOPS
REQUEST A VIRTUAL MACHINE

CAS IT can help you select and purchase hardware and software to best match your needs. For assistance, please submit a help ticket.

SOFTWARE

Microsoft and Adobe Software:
Adobe Software is free for undergraduates and faculty in CAS, and $75 for others. For more information about Adobe software, click here.

For Microsoft software pricing and availability, click here.

Statistical software (JMP, SPSS, SAS):

JMP and **SPSS**
JMP and SPSS are provided free of charge under Boston University's site license for faculty and staff teaching and conducting academic research. Visit http://www.bu.edu/tech/support/desktop/distribution/statistics/ for more information. A BU login is required.

SAS (Statistical Analysis System)
SAS can be accessed via http://www.bu.edu/tech/support/desktop/software/acsunix/software/stats/sas/ or purchased from BUMC.

MATLAB
The University has a site-license for MATLAB available to students, faculty and staff. For more information:
http://www.bu.edu/tech/support/desktop/distribution/mathsci/matlab/

X-Win32
Under Boston University's site license, X-Win32 is available for all students, faculty and staff to download. http://www.bu.edu/tech/support/desktop/software/windows/x-win32/

Stata
Stata must be acquired from the company at its website.

ArcGIS
ArcGIS is available for any faculty, students, and staff of Boston University. To acquire ArcGIS, please submit a help ticket.

Chemdraw
Two versions can be obtained free here:
https://informatics.perkinelmer.com/sitesubscription/#B

Other Software
For other software packages, SHI, also accessible through the Sourcing and Procurement site with BU-specific pricing, offers many software packages used on campus. If there are packages not offered through SHI that you need, please contact our office and we can help obtain pricing.

ArcGIS

Adobe Creative Cloud

Request Adobe Creative Cloud
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FAQs

Related Services
Computer Labs
My Media
Software Licensing & Distribution

The Adobe Creative Cloud (ACC) is a suite of software and web-based applications that creative professionals worldwide use. The suite includes over twenty individual applications that allow you to edit video and audio, process digital images, create single and multi-page layouts, render 3D objects, and many more. An ACC license also provides access to cloud storage and asset management between the various applications.

Quick Start
› See Getting Started, below.

Benefits

The Adobe Creative Cloud enables you to create and edit digital multimedia assets with industry leading tools that provide the de facto standard in media editing and creation. The majority of applications install right on your own computer and allow you to work on your digital media at your convenience. Some web-based tools (e.g. Spark, Portfolio) are also available and require Internet access.

Key Features

Adobe Creative Cloud is a collection of professional digital multimedia creation tools for print, web, and video content. ACC includes more than twenty programs such as Acrobat, Photoshop, Illustrator, and InDesign.

Features & Applications

What to Expect

The desktop applications install on your own computer. Performance depends on the suitability of your computer, please consult the recommended minimum configuration requirements. Some applications, especially in the video tools area, require more resources than others.

Requirements

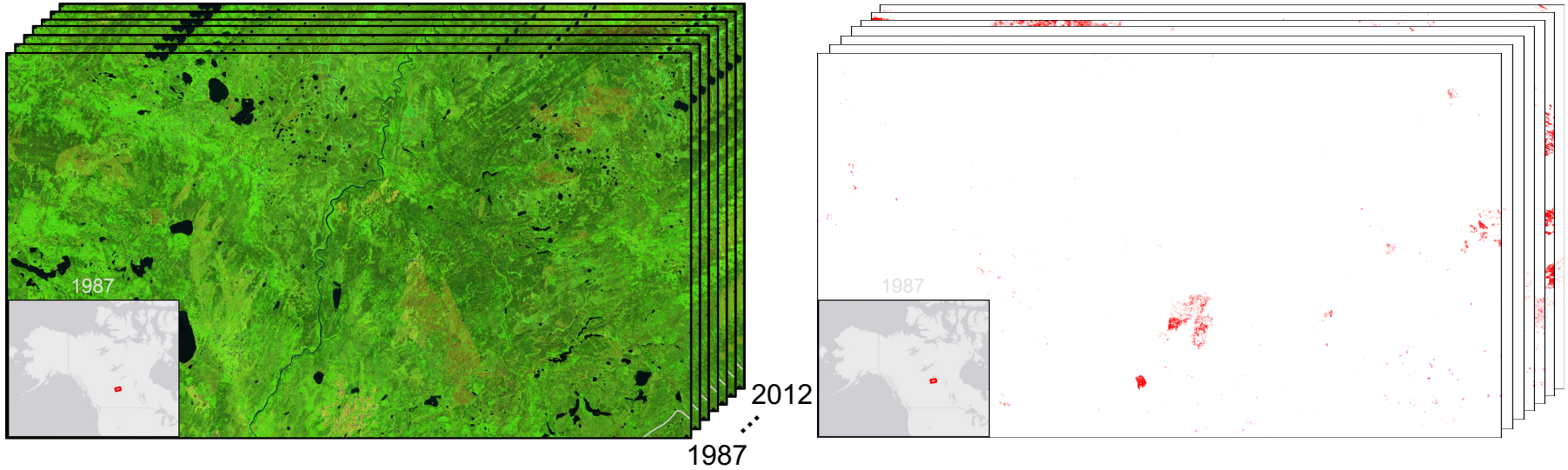
- A computer meeting the minimum requirements for the selected application
- High-speed Internet access
- Must be eligible to receive either a university sponsored (free) license or to procure a license via an Internal Service Request (ISR) – see "Cost" section for eligibility determination

Adobe

Make a movie

1. ArcGIS

   A video is basically a series of images (frames) with incremental changes, so ArcGIS was used to generate the frames that show the forest disturbances progress through the year and moving from one ROI to another.



Make a movie

1. ArcGIS

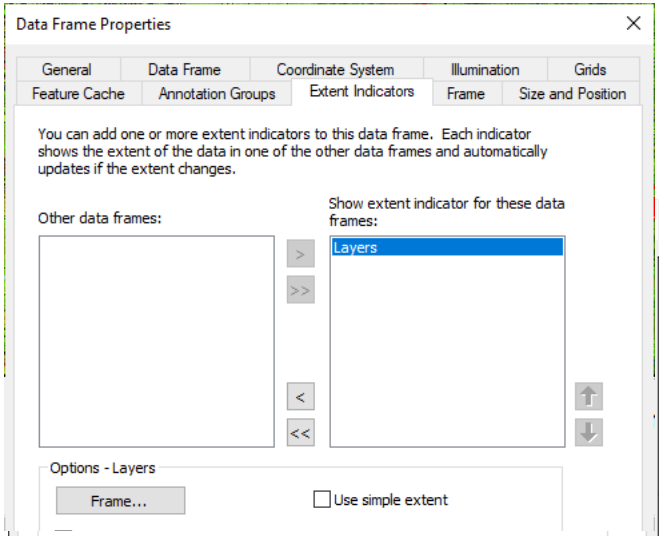
   A video is basically a series of images (frames) with incremental changes, so ArcGIS was used to generate the frames that show the forest disturbances progress through the year and moving from one ROI to another.

   1.1 Setting up ArcGIS map layout

   - Add data layers, base maps, study area boundaries
   - Add map elements (legend, inset map, text labels)

   1.2 Choose locations

   - Choose ROIs that cover the highlight of the data products. Use the “Bookmark” function in ArcMap to save the map view and record the map extent of each ROI, as the coordinates will be referred in the python script



Extent -- A – m1 -- B -- m2 …

Frames

1. ArcGIS

   1.3 Use python to generate animation frames

   When finish setting up ArcMap, switch to the python script to do the following:

   - Turn on and off layers (alternating Landsat image and disturbance map, progressing through time)
   - Move from one ROI to another ROI while transitioning through layers
   - Update map labels corresponding to disturbance map years

   python code parameters: fps, extent, xy…

```python
import arcpy
import arcpy.mapping
import numpy as np
import os

# Set up ArcGIS environments
mxd=arcpy.mapping.MapDocument('CURRENT')
dfs = arcpy.mapping.ListDataFrames(mxd,'*')
lyr=arcpy.mapping.ListLayers(mxd)

# get the larger dataframe and list all layers
domain_df  = dfs[0]
domain_df_lyrs=arcpy.mapping.ListLayers(mxd, '*', domain_df)

# Global variables
num_of_frames = 26
half_num_of_frames = 13
fps = 15

# get year label
year_label = arcpy.mapping.ListLayoutElements(mxd, 'TEXT_ELEMENT')[0]
```

1. Set up environments, speed, and fps

```python

# define extent arrary
pointname_list = ['A', 'm1', 'B']
xmin_array = [-1771581.876254060, -2120757.142032760, -2273618.185996800]
ymin_array = [2324533.703920190, 2340107.285546350, 2674486.638666930]
xmax_array = [-796219.9255301290, -1096627.093772620, -1468944.576649550]
ymax_array = [2873174.801202350, 2916180.437692620, 3127115.543924710]


```

2. decide the stops and extents (w/ zoom scale)

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```
36  # x to y function
37  for j in range(len(xmin_array)-1):
38    # move the map to the start view
39    start_extent = arcpy.Extent(xmin_array[j], ymin_array[j], xmax_array[j], ymax_array[j])
40    domain_df.extent = start_extent
41
42    # turn off all the disturbance map layers
43    for k in range(1987, 2013):
44      dis_year_lyr=arcpy.mapping.ListLayers(mxd, "*agents_" + str(k) + "*", domain_df)[0]
45      dis_year_lyr.visible=False
46
47    # calculate the movement for each frame
48    XMin_steps = np.linspace(xmin_array[j], xmin_array[j+1], num = half_num_of_frames * fps)
49    XMax_steps = np.linspace(xmax_array[j], xmax_array[j+1], num = half_num_of_frames * fps)
50    YMin_steps = np.linspace(ymin_array[j], ymin_array[j+1], num = half_num_of_frames * fps)
51    YMax_steps = np.linspace(ymax_array[j], ymax_array[j+1], num = half_num_of_frames * fps)
52
53    # path to save the frames; create one if it doesn't exist
54    frame_png_path = "D:/YT/movies/frames_v2/" + pointname_list[j] + '_to_' + pointname_list[j+1]
55    os.mkdir(frame_png_path)
56
```

3. Loop through each trajectory and calculate the movement for each frame

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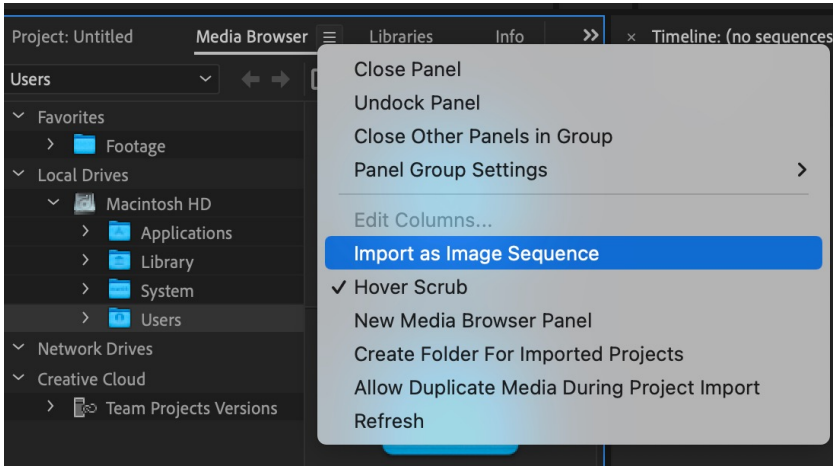
```
    # generate frames from A to m1
    if j % 2 == 0:
      start_year = 1987
      year_label.text = str(start_year)

      for i in range(half_num_of_frames * fps):
        frame_XMin = XMin_steps[i]
        frame_XMax = XMax_steps[i]
        frame_YMin = YMin_steps[i]
        frame_YMax = YMax_steps[i]

        # update the extent for each frame
        frame_extent = arcpy.Extent(frame_XMin, frame_YMin, frame_XMax, frame_YMax)

        domain_df.extent = frame_extent

        # update the year label
        year = start_year + i / fps
        year_label.text = str(year)

        if (i % fps) == 0:
          dis_year_lyr=arcpy.mapping.ListLayers(mxd, "*agents_" + str(year) + "*", domain_df)[0]
          dis_year_lyr.visible=True

        # save frames as pngs
        frame_png_fn = frame_png_path + "/" + pointname_list[j] + '_to_' + pointname_list[j+1] + "_" + str(i) + ".png"
        arcpy.mapping.ExportToPNG(mxd, frame_png_fn, "PAGE_LAYOUT", resolution=400)

    # generate frames from m1 to B
    else:
      start_year = 2000
      year_label.text = str(start_year)

      for k in range(1987, start_year):
        dis_year_lyr=arcpy.mapping.ListLayers(mxd, "*agents_" + str(k) + "*", domain_df)[0]
        dis_year_lyr.visible=True
```

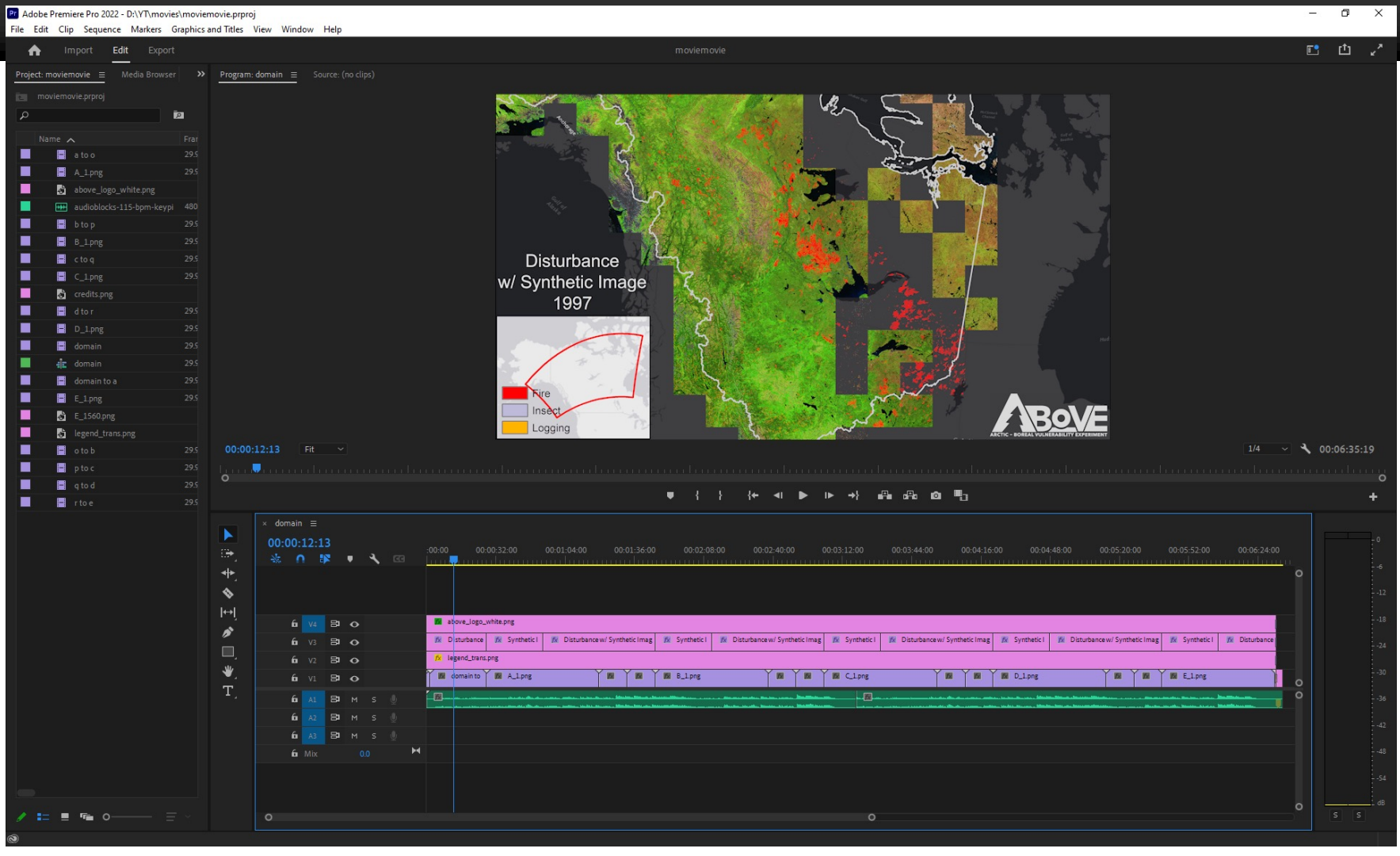
4. When to zoom in/out depends on the time scale of the datasets

2. Adobe Premier Pro

   Premier allows you to do video editing and work on post-production. All the frames just created can be pieced together here.

   - Animations
   - Texts / titles
   - Background music / Interview




Adobe Premiere Pro 2022 - D:\YT\movies\moviemovie.prproj
File Edit Clip Sequence Markers Graphics and Titles View Window Help
Import Edit Export
moviemovie
Project: moviemovie
Media Browser
moviemovie.prproj
Name
a to o
A_1.png
above_logo_white.png
audioblocks-115-bpm-keypi
b to p
B_1.png
c to q
C_1.png
credits.png
d to r
D_1.png
domain
domain
domain to a
E_1.png
E_1560.png
legend_trans.png
o to b
p to c
q to d
r to e
Program: domain
Source: (no clips)
Disturbance
w/ Synthetic Image
1997
Fire
Insect
Logging
ABoVE
ARCTIC - BOREAL VULNERABILITY EXPERIMENT
00:00:12:13
Fit
1/4
00:06:35:19
domain
00:00:12:13
00:00:32:00
00:01:04:00
00:01:36:00
00:02:08:00
00:02:40:00
00:03:12:00
00:03:44:00
00:04:16:00
00:04:48:00
00:05:20:00
00:05:52:00
00:06:24:00
V4
V3
V2
V1
A1
A2
A3
Mix
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Disturbance
Synthetic I
Disturbance w/ Synthetic Imag
legend_trans.png
domain to
A_1.png
B_1.png
C_1.png
D_1.png
E_1.png

Thanks!

Contacts

zhangyt@bu.edu
yxma@bu.edu

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