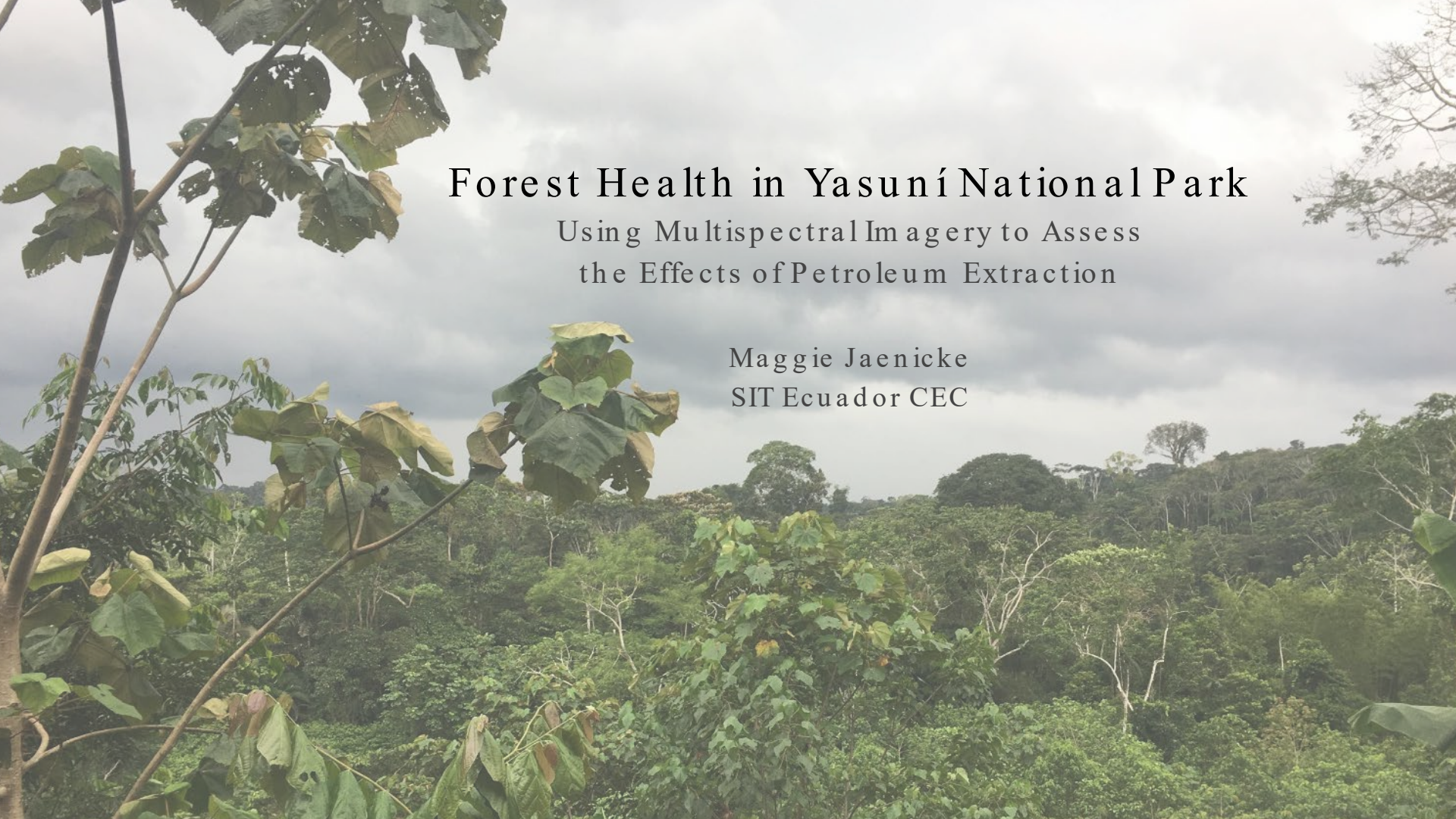

Forest Health in Yasuní National Park

Using Multispectral Imagery to Assess the Effects of Petroleum Extraction

Maggie Jaenicke
SIT Ecuador CEC

Extraction in Yasuní

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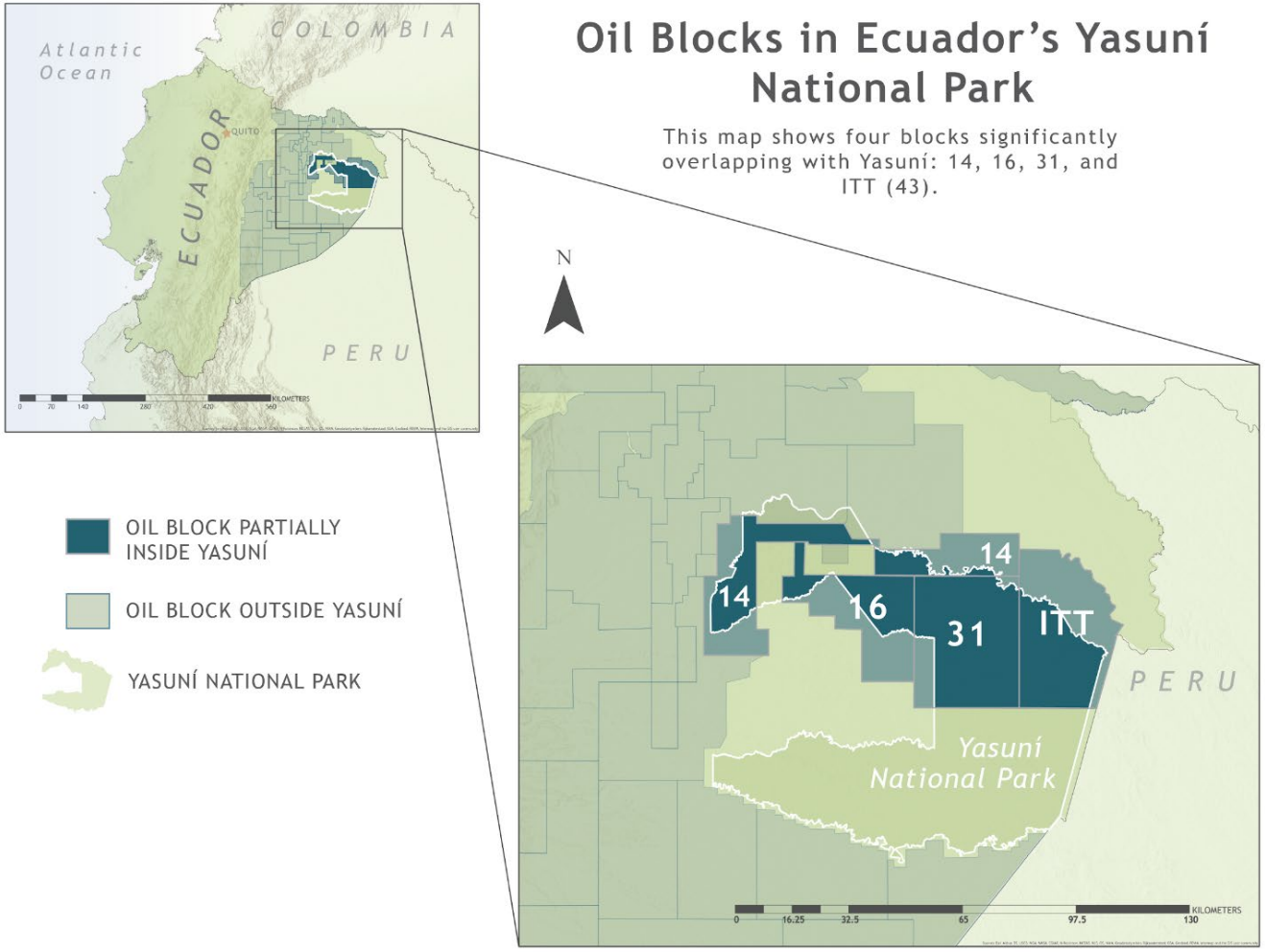
Do the average Normalized Difference Vegetation Index (NDVI) values, or “greenness,” in oil blocks 14, 16, 31, and 43 (ITT) decrease with time and exposure to petroleum extraction in the Ecuadorian Amazon?

This study hypothesizes that NDVI values will decrease with time and oil activity.

While past studies have analyzed this question across space, this study will attempt to additionally analyze these trends across time.

Oil Blocks in Ecuador's Yasuní National Park

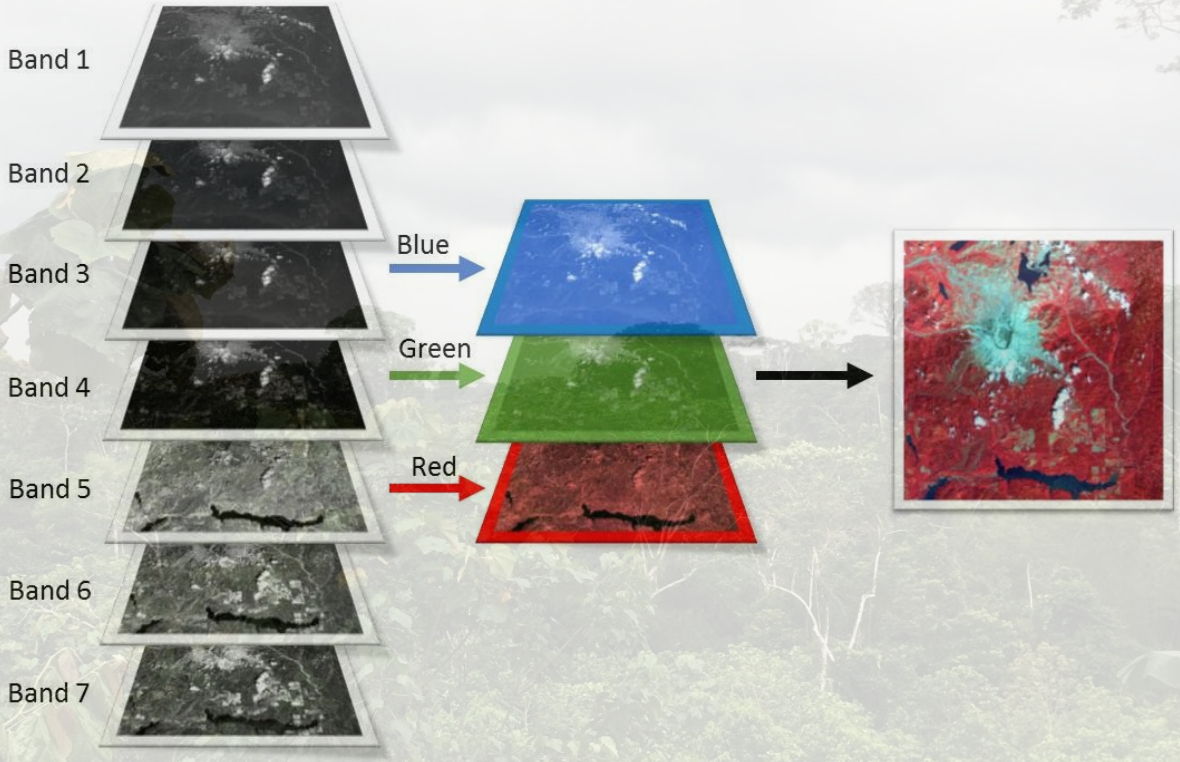
This map shows four blocks significantly overlapping with Yasuní: 14, 16, 31, and ITT (43).



Made by Maggie Jaenicke using Esri's ArcGIS Pro. Oil block data from Ecuador's Ministry of Hydrocarbons, 2013.

Remote Sensing and Vegetation Indices

- Red and NIR bands



NDVI in Ecology

Picks up chlorophyll content

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

Range from -1.0 to +1.0

+1.0 being the highest level of photosynthetic activity

Negative values - absence of vegetation / water

<+0.1 - rock, sand, or snow

+0.1-0.2 - exposed soil

+0.2-0.5 - sparsely vegetated areas or shrublands

> +0.6 - temperate and tropical rainforests

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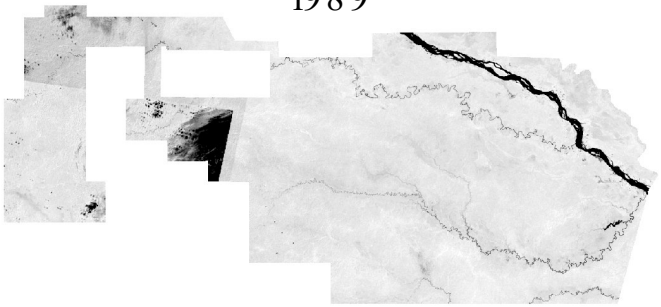
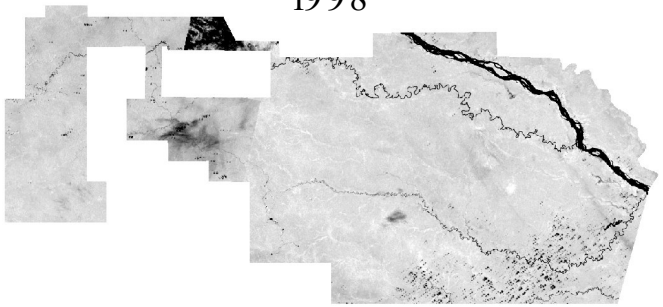
- Download in NDVI
- Subsets and means
- Average and difference of images

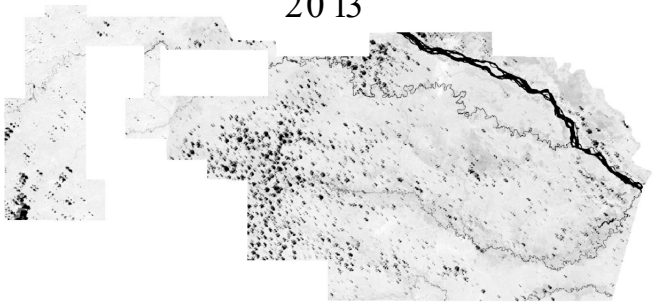
1989



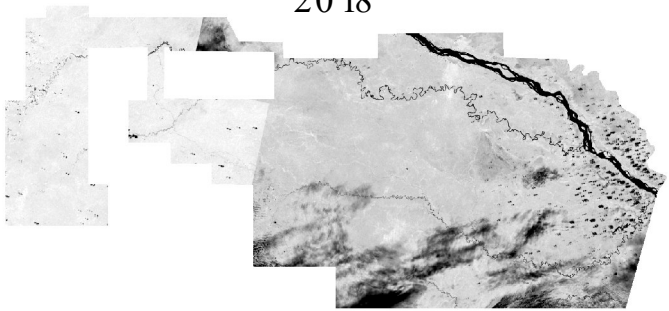
1998



2013



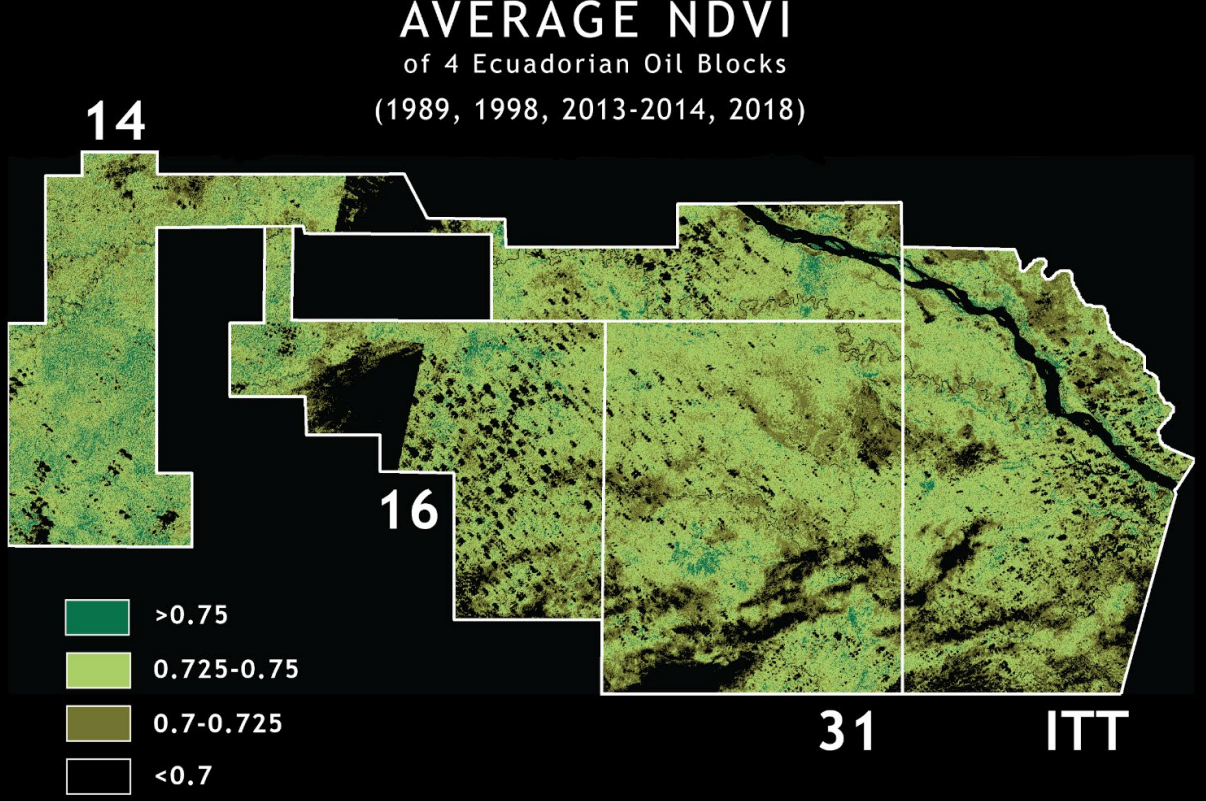
2018



Ethics

- Research from afar (Remote Sensing)
- No ground data
- Need to recognize those residing in area of study

Results

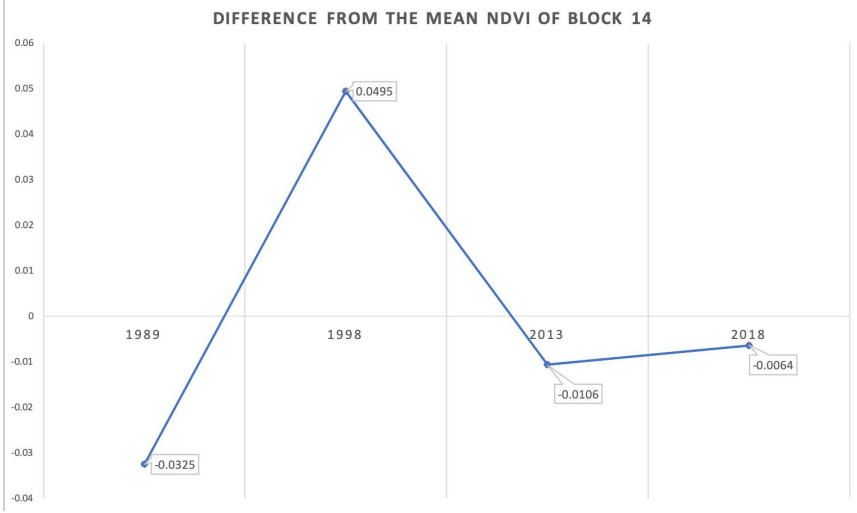

AVERAGE NDVI
of 4 Ecuadorian Oil Blocks
(1989, 1998, 2013-2014, 2018)
14
16
31
ITT
>0.75
0.725-0.75
0.7-0.725
<0.7

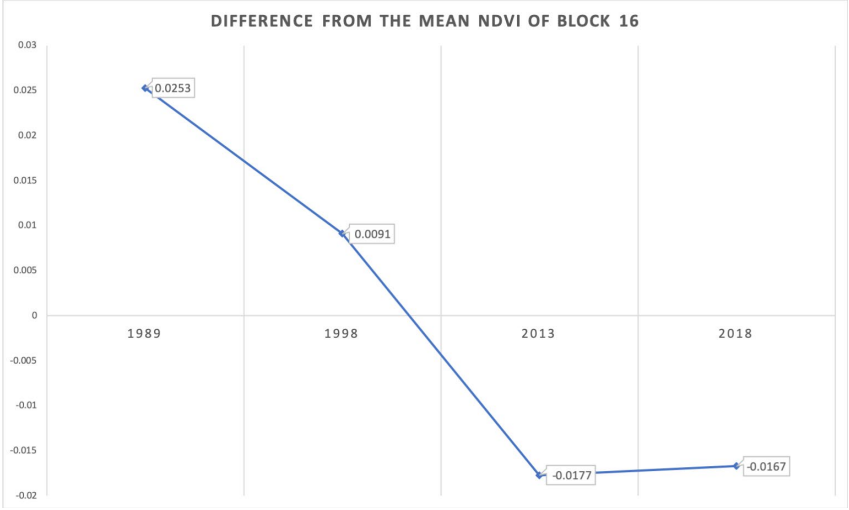
Mean NDVI excluding values below +0.25

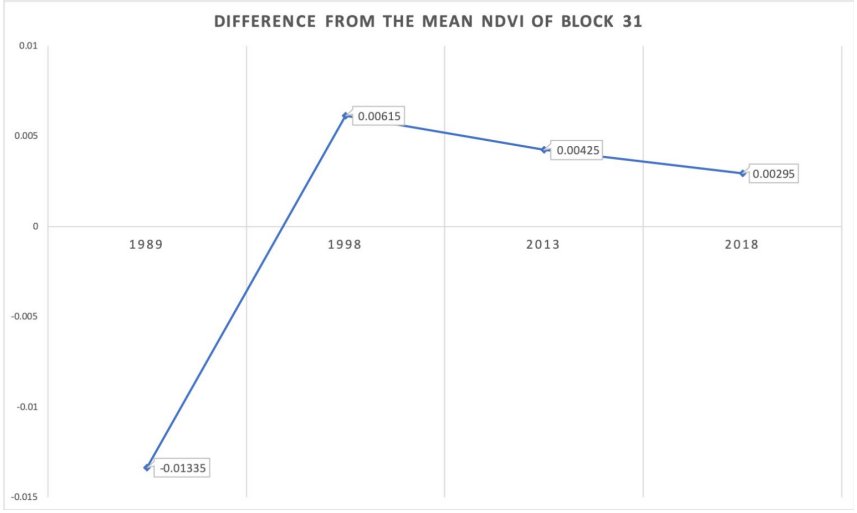
	1989	1998	2013	2018	Overall Mean
Block 14	0.5338	0.6158	0.5557	0.5599	0.5663
Block 16	0.5952	0.5790	0.5522	0.5532	0.5699
Block 31	0.5227	0.5422	0.5403	0.5390	0.53605
Block 43 (ITT)	0.5617	0.5481	0.5481	0.5442	0.5506

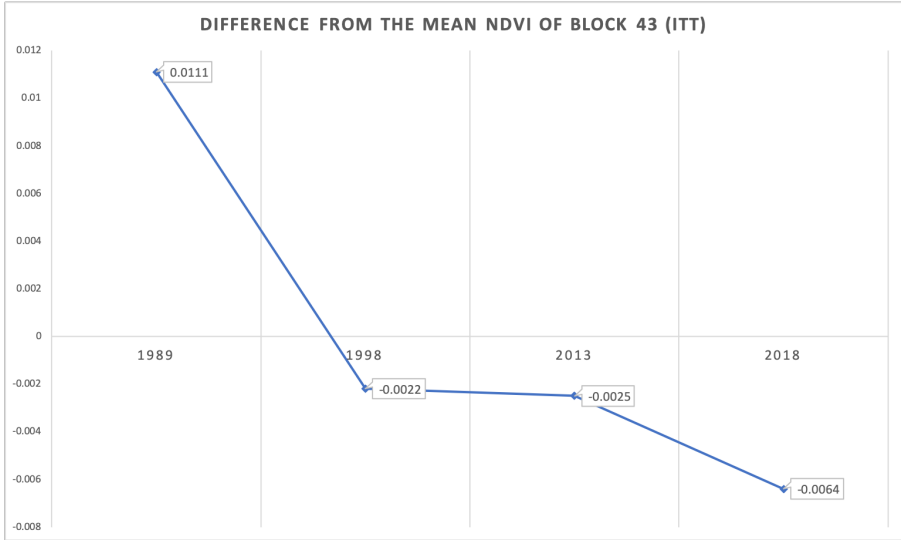
Difference from mean NDVI

	1989	1998	2013	2018
Block 14	-0.0325	0.0495	-0.0106	-0.0064
Block 16	0.0253	0.0091	-0.0177	-0.0167
Block 31	-0.01335	0.00615	0.00425	0.00295
Block 43 (ITT)	0.0111	-0.0022	-0.0025	-0.0064


DIFFERENCE FROM THE MEAN NDVI OF BLOCK 14
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
1989
1998
2013
2018
0.0495
-0.0325
-0.0106
-0.0064

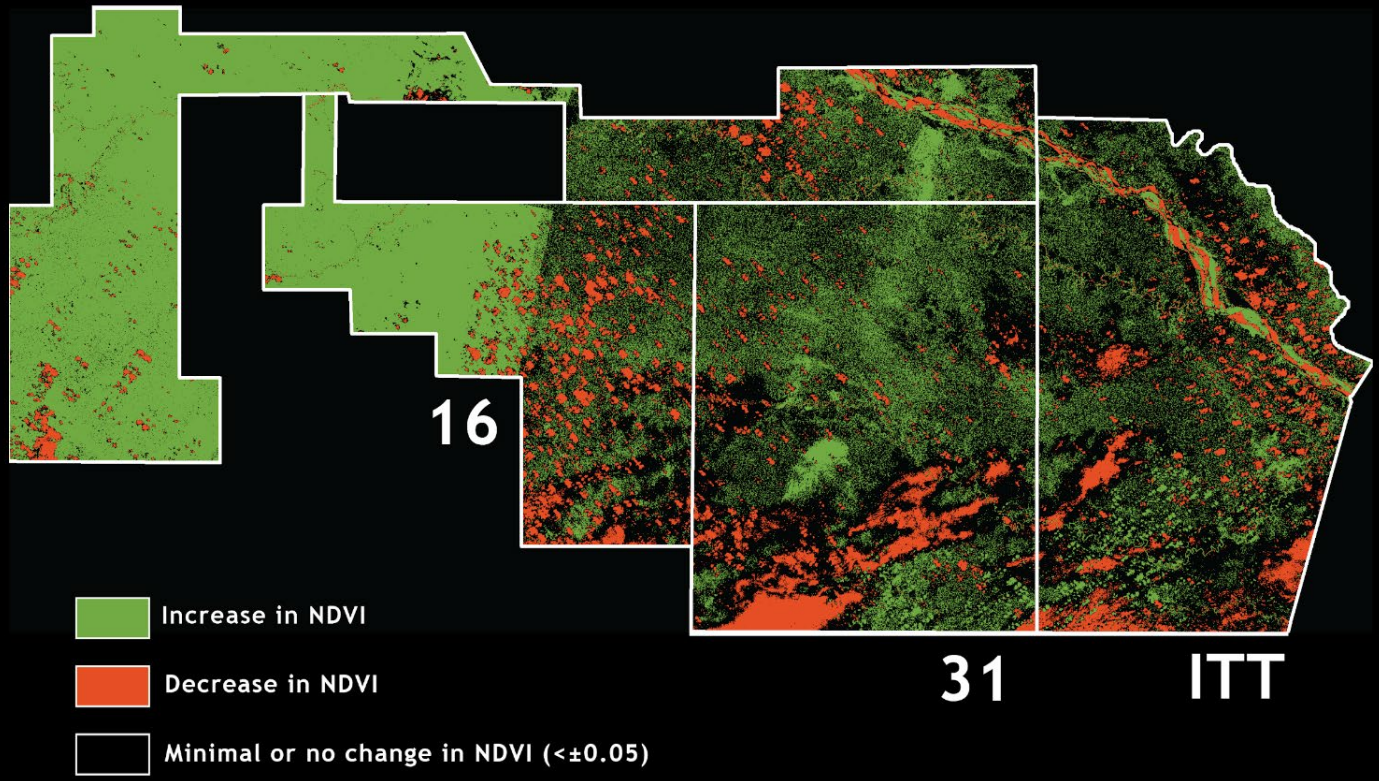

DIFFERENCE FROM THE MEAN NDVI OF BLOCK 16
0.03
0.025
0.02
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
-0.02
1989
1998
2013
2018
0.0253
0.0091
-0.0177
-0.0167


DIFFERENCE FROM THE MEAN NDVI OF BLOCK 31
0.01
0.005
0
-0.005
-0.01
-0.015
1989
1998
2013
2018
0.00615
0.00425
0.00295
-0.01335


DIFFERENCE FROM THE MEAN NDVI OF BLOCK 43 (ITT)
0.012
0.01
0.008
0.006
0.004
0.002
0
-0.002
-0.004
-0.006
-0.008
1989
1998
2013
2018
0.0111
-0.0022
-0.0025
-0.0064

CHANGE IN NDVI

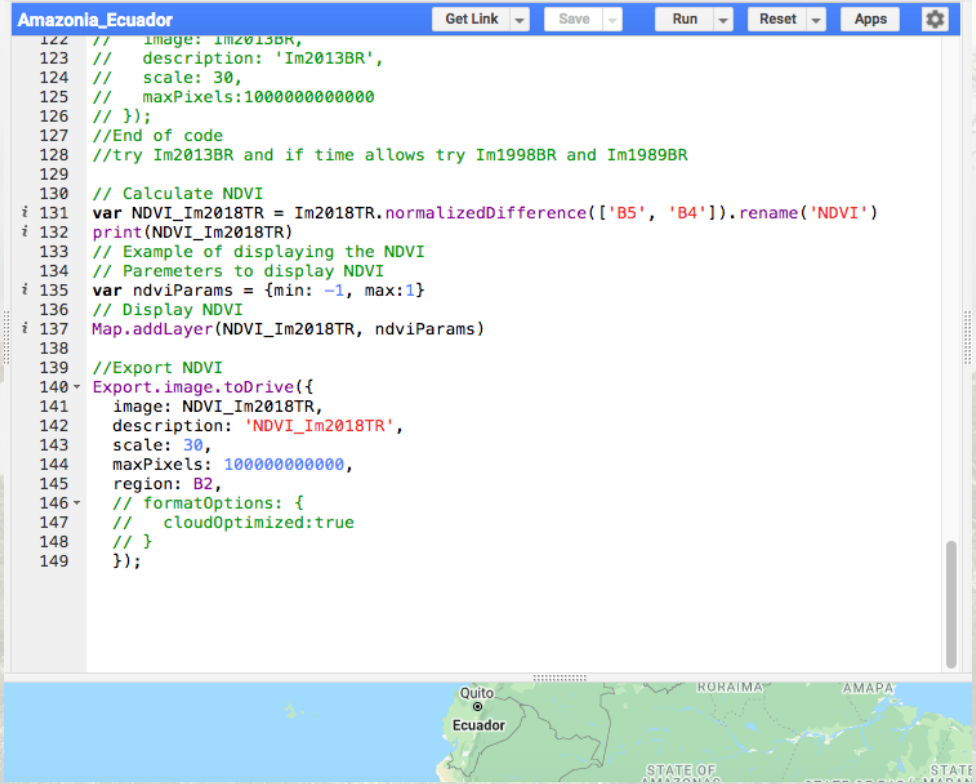
1989 and 1998 versus 2013 and 2018



Conclusion and Limitations

- Unable to come to strong conclusion, but blocks 16 and 31 largely followed their respective timelines in oil production - may provide guidance for future research.
- Limitations:
  - Clouds
  - Ground Truthing
  - Seasonality
  - Number of images

Personal Reflection



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Landsat 4. Scene LT04_L1TP_008061_19891222_20170201_01_T1, in NDVI from Google Earth Engine on May 2, 2020.

Landsat 4. Scene LT04_L1TP_008060_19891222_20170201_01_T1, in NDVI from Google Earth Engine on May 2, 2020.

Landsat 5. Scene LT05_L1TP_009060_19891221_20170201_01_T1, in NDVI from Google Earth Engine on May 2, 2020.

Landsat 5. Scene LT05_L1TP_009061_19900207_20170131_01_T1, in NDVI from Google Earth Engine on May 2, 2020.

Landsat 5. Scene LT05_L1TP_008061_19980630_20121223_01_T1, in NDVI from Google Earth Engine on May 2, 2020.

Landsat 5. Scene LT05_L1TP_009061_19980925_20161222_01_T1, in NDVI from Google Earth Engine on May 2, 2020.

Landsat 5. Scene LT05_L1TP_008060_19980630_20161223_01_T1, in NDVI from Google Earth Engine on May 2, 2020.

Landsat 5. Scene LT05_L1TP_009060_19980925_20161221_01_T1, in NDVI from Google Earth Engine on May 2, 2020.

Landsat 8. Scene LC08_L1TP_009061_20131223_20170427_01_T1, in NDVI from Google Earth Engine on May 2, 2020.

Landsat 8. Scene LC08_L1TP_009060_20131223_20170427_01_T1, in NDVI from Google Earth Engine on May 3, 2020.

Landsat 8. Scene LC08_L1TP_008060_20141203_20170416_01_T1, in NDVI from Google Earth Engine on May 3, 2020.

Landsat 8. Scene LC08_L1TP_008061_20141203_20170416_01_T1, in NDVI from Google Earth Engine on May 2, 2020.

Landsat 8. Scene LC08_L1TP_008061_20180909_20180913_01_T1, in NDVI from Google Earth Engine on May 2, 2020.

Landsat 8. Scene LC08_L1TP_008060_20180909_20180913_01_T1, in NDVI from Google Earth Engine on May 3, 2020.

Landsat 8. Scene LC08_L1TP_009061_20181018_20181031_01_T1, in NDVI from Google Earth Engine on May 3, 2020.

Landsat 8. Scene LC08_L1TP_009060_20181018_20181031_01_T1, in NDVI from Google Earth Engine on May 3, 2020.

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