

Identifying forest change processes using MODIS EVI timeseries data and random forest classification

Master thesis

Supervisors: Dr. Christian Hüttich
Prof. Dr. Christiane Schmullius
M. Sc. Jonas Eberle (tech.)

4. Jahrestagung Arbeitskreis Fernerkundung

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Siegfried Clausnitzer



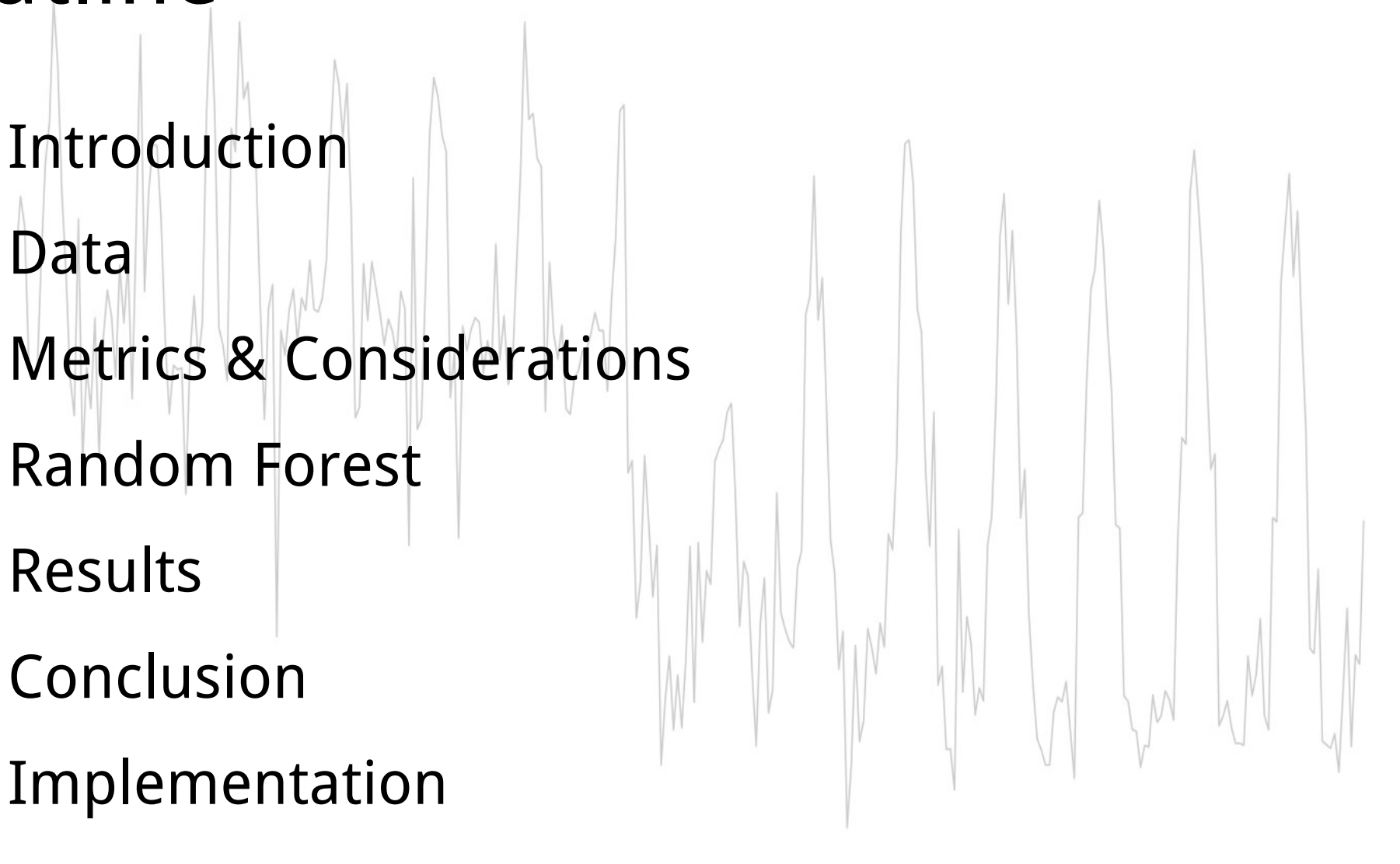
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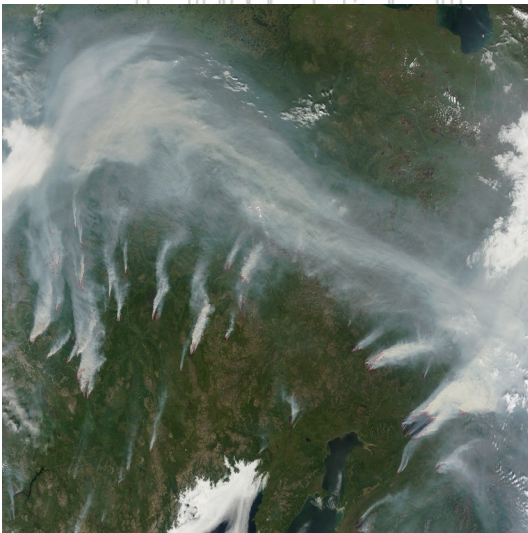
Outline

- 1 Introduction
 - 2 Data
 - 3 Metrics & Considerations
 - 4 Random Forest
 - 5 Results
 - 6 Conclusion
 - 7 Implementation
- 

1 Introduction

- Identification of forest change processes:

Fire



Logging



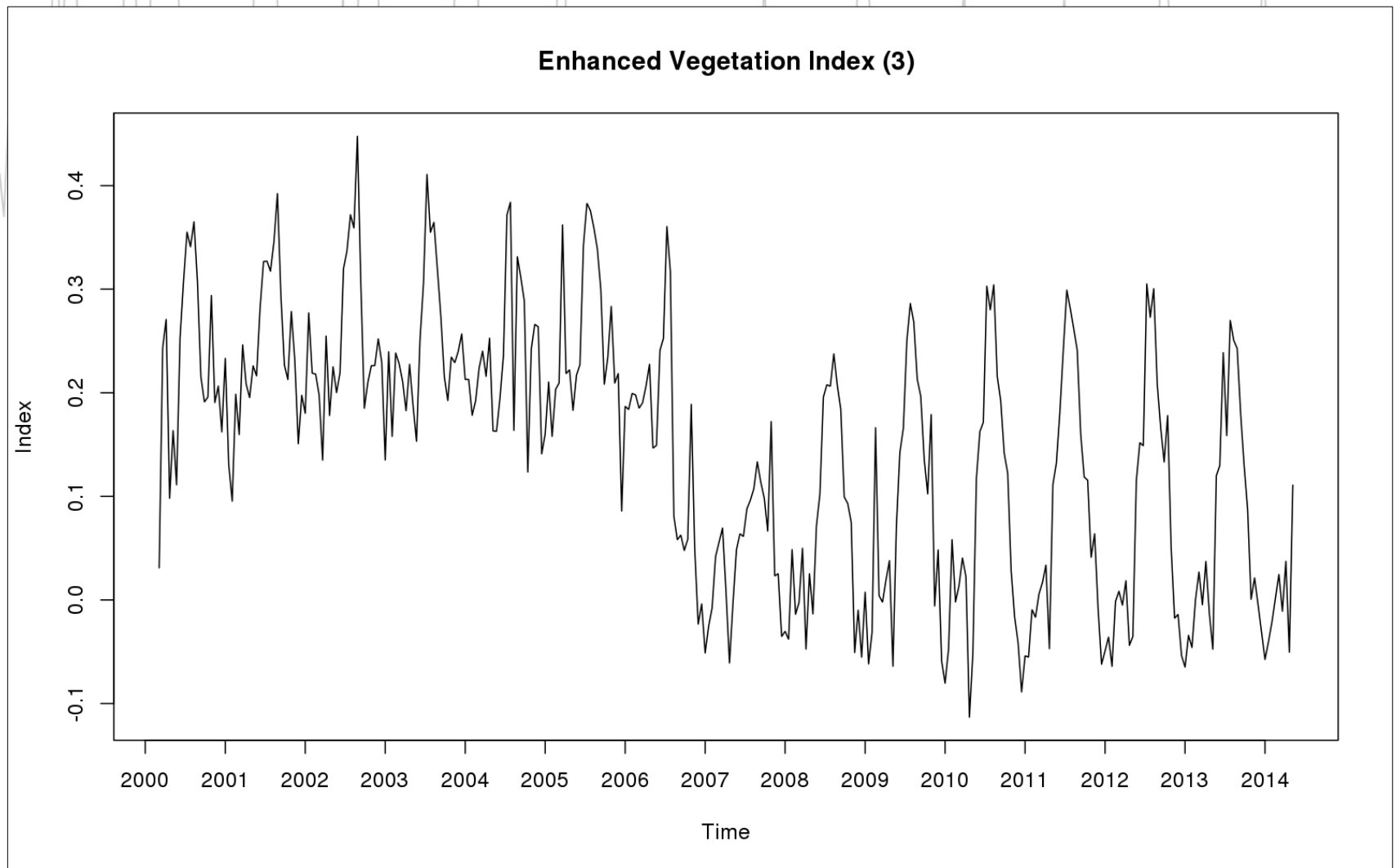
Storm



2 Data

- EVI-Timeseries MOD13Q1
(spatial res: 250 m | temporal res: 16 days | 23 values per year)

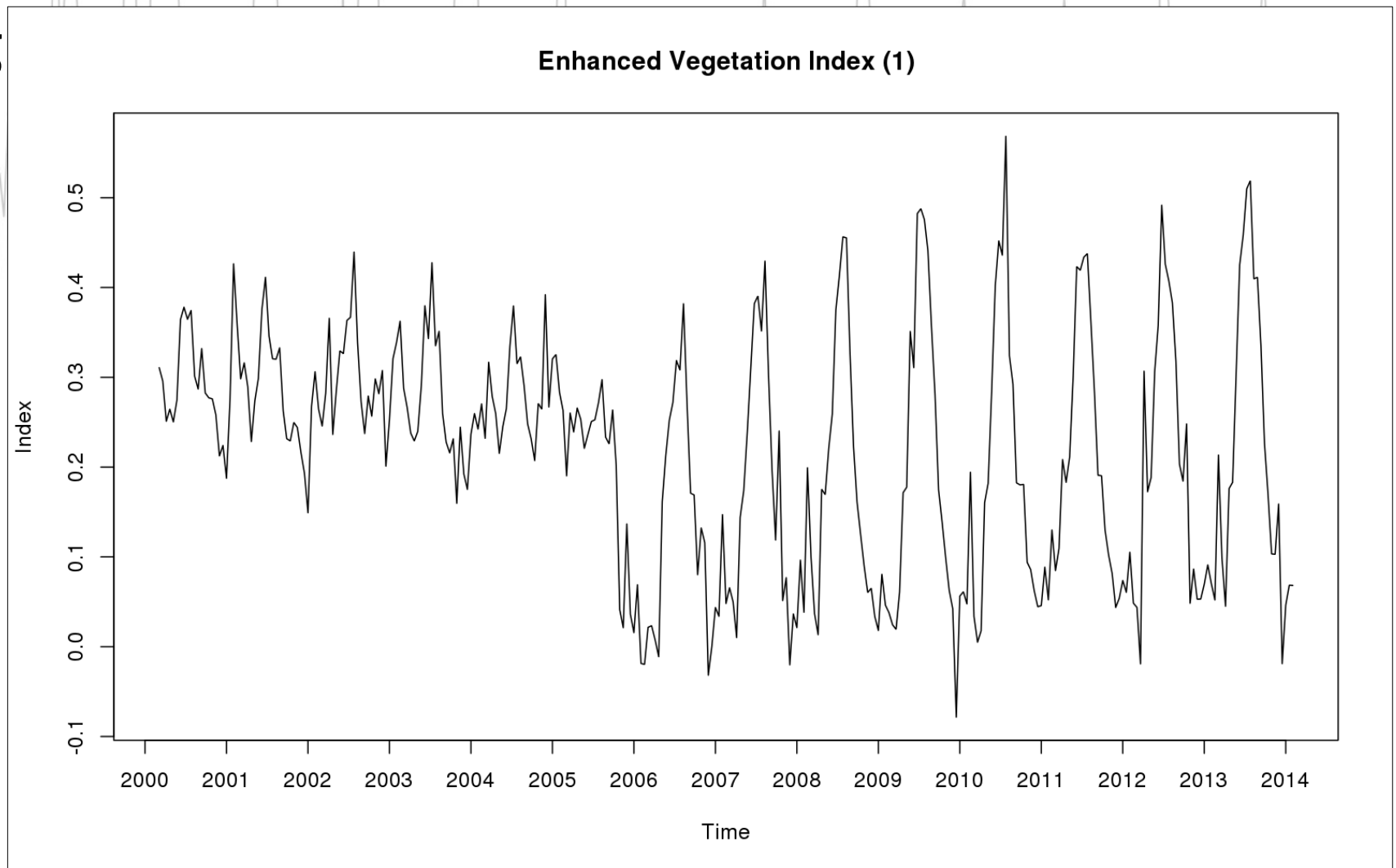
Fire



2 Data

- EVI-Timeseries MOD13Q1
(spatial res: 250 m | temporal res: 16 days | 23 values per year)

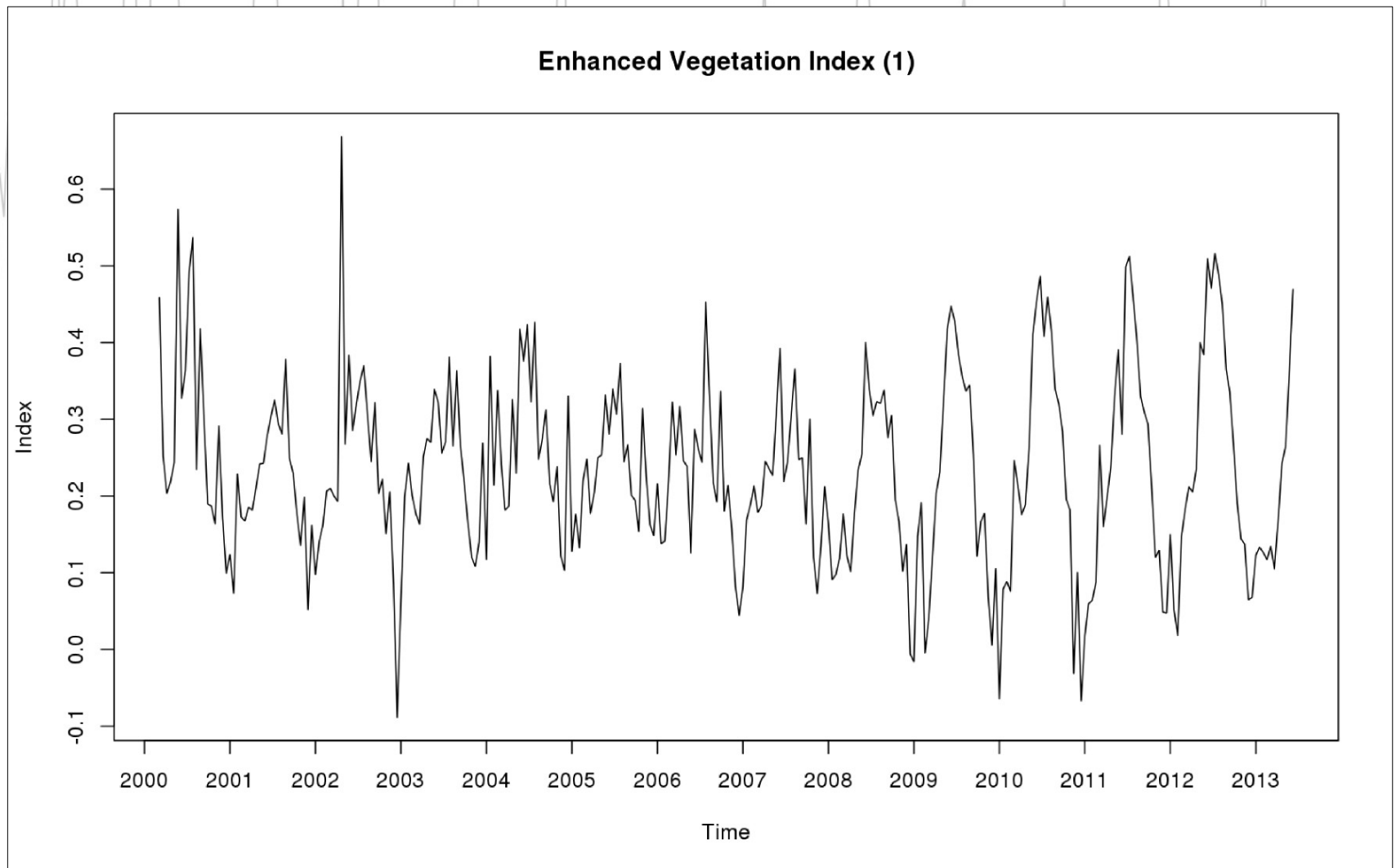
Logging



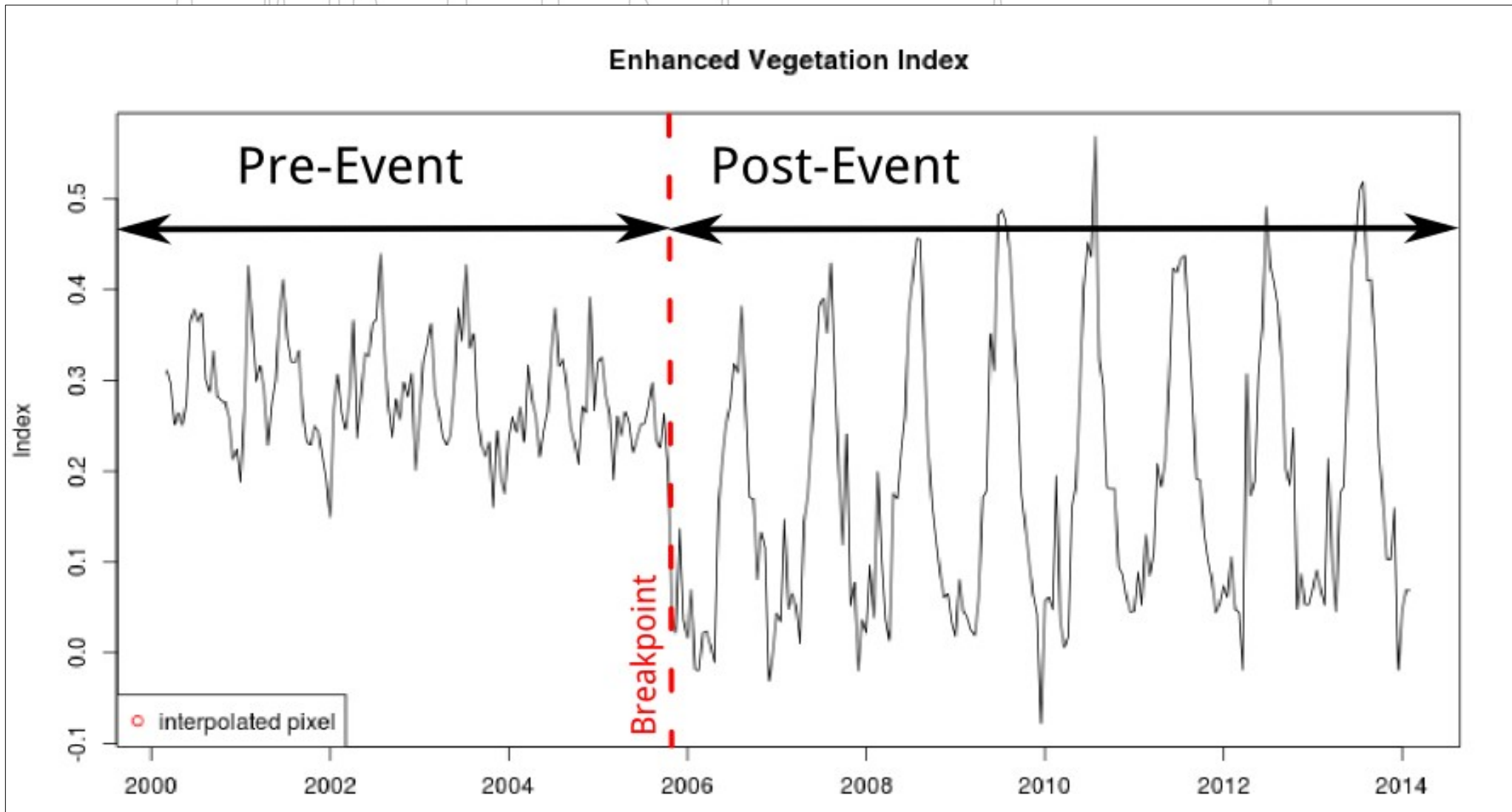
2 Data

- EVI-Timeseries MOD13Q1
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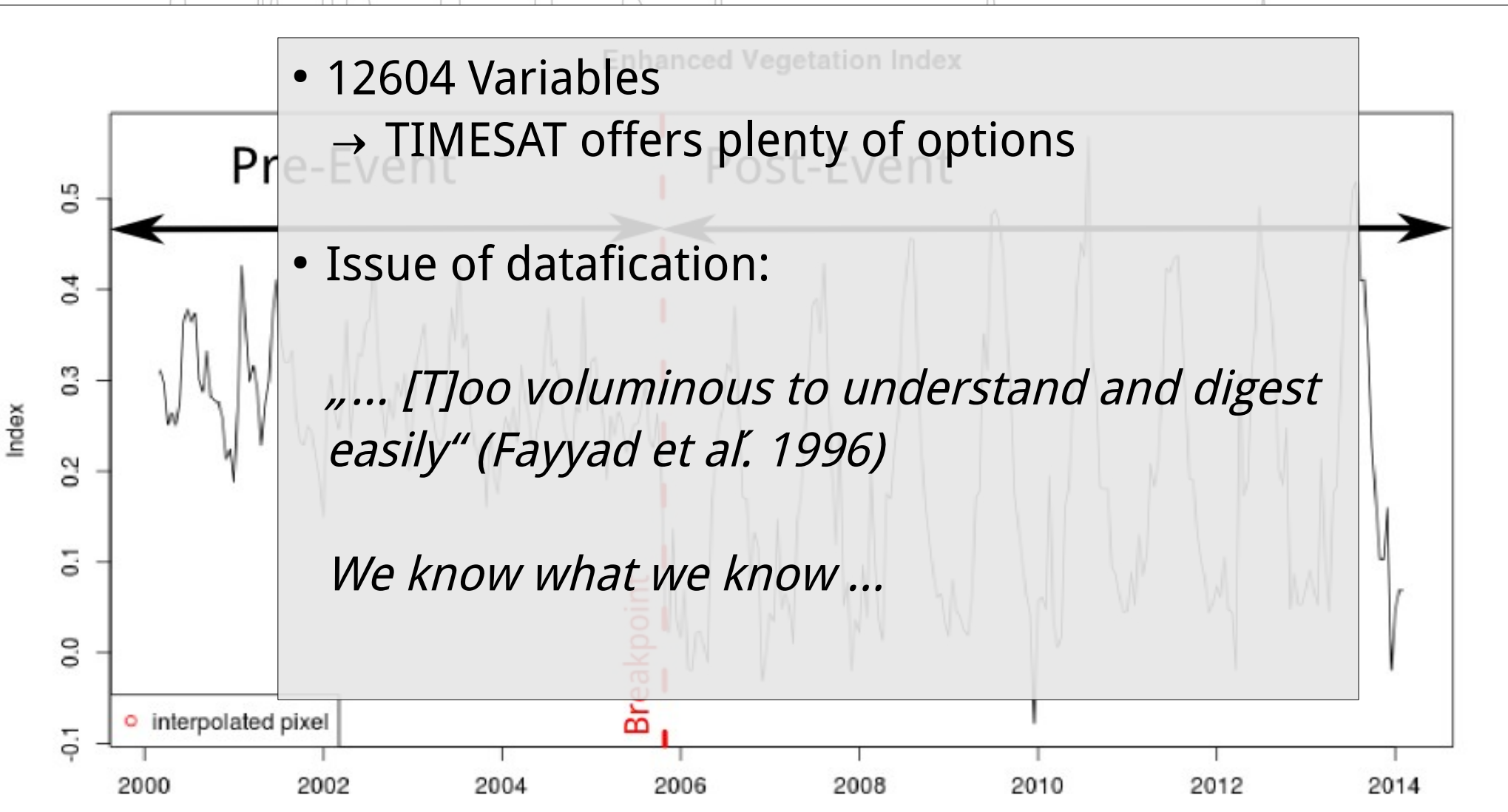
Storm



3 Metrics & Considerations



3 Metrics & Considerations



4 Random Forest

- Random Forest: Ensemble decision trees (15000)

Data (timeseries)

	1	...	n
1	$\text{var}_{1,1}$	$\text{var}_{1,..}$	$\text{var}_{1,n}$
...	$\text{var}_{...}$	$\text{var}_{...}$	$\text{var}_{...}$
150	$\text{var}_{150,1}$	$\text{var}_{150,..}$	$\text{var}_{150,n}$

Bootstrap 1

Tree 1

Bootstrap ...

Tree ...

Bootstrap 15000

Tree 15000

- Majority vote for one class by all trees (15000!)
- Evaluation of performance

Random Forest

4 Random Forest

- Random Forest: Ensemble decision trees (15000)

- The more the merrier!

→ Includes variability of classes

- Bycatch:

- Accuracy assessment

- Votes for each class

- Rating of variables (importance)

Bootstrap 1

Tree 1

→ Grey box approach

Bootstrap ...

Tree ...

Bootstrap 15000

Tree 15000

- Majority vote for one class by all trees (15000!)
- Evaluation of performance

Random Forest

Data (timeseries)

1

1

...

150

var_{1,1}

var_{1,...}

var_{1,n}

var_{...}

var_{150,1}

var_{150,...}

var_{150,n}

...

...

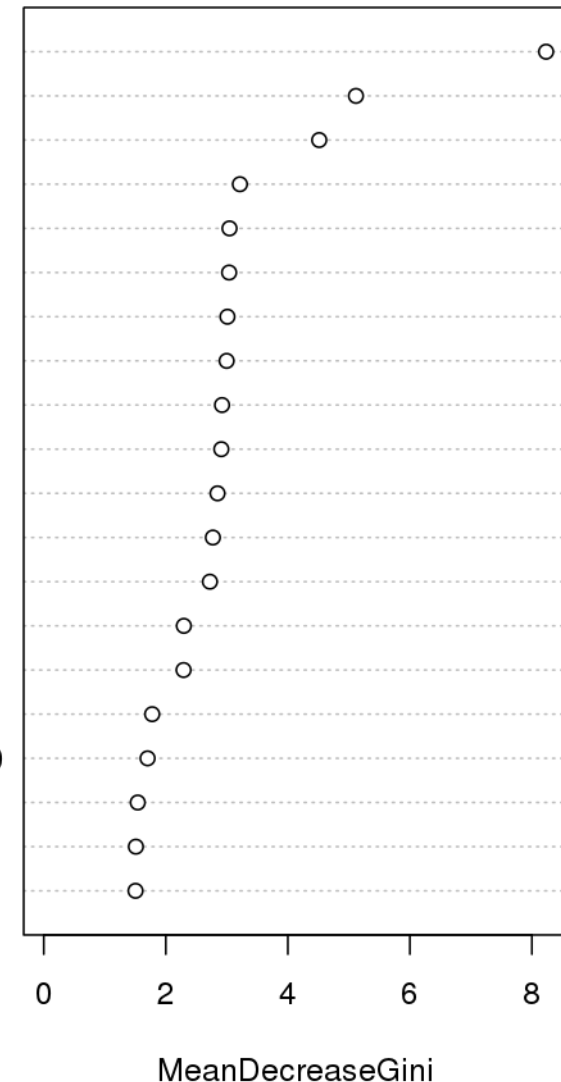
...

5 Results

- Overall Accuracy: 92 %
 - 96 % for storm
 - 90 % & for fire & logging
- Detection of important parameters:
 - Basic statistical descriptors
 - Phenological indicators
- Poor robustness for different regions

20 Most Important Variables

diff_gra
 diff_ic
 diff_sd
 bm_peak_v_2_1_10
 bm_peak_v_6_1_10
 bm_peak_v_7_1_10
 bm_peak_v_8_1_10
 diff_mean
 bm_peak_v_1_1_10
 bm_peak_v_3_1_10
 bm_peak_v_5_1_10
 bm_peak_v_4_1_10
 bm_lar_int_7_1_5
 bm_lar_int_7_1_6
 bm_lar_int_6_1_5
 bm_peak_v_1_1_8
 bm_sma_int_7_1_10
 tm_base_8_7_7
 bm_lar_int_7_1_4
 tm_base_9_8_7



6 Conclusion

- Big potential!
- Excellent for examination of feature spaces
 - Even: Description of processes behind classes by variable
- However: Low robustness due to a lack of datasets (cover variability of each class)
- Full potential of data sources not exploited yet!
- Next steps:
 - Integration of more training datasets
 - Integration of further variables / data sources

7 Implementation

www.earth-observation-monitor.net

The screenshot displays the Earth Observation Monitor (EOM) web application interface. At the top, there is a navigation bar with links for Home, Map, Datasets, Analyses, Research, Software, and About, alongside the EOM logo and a login section. The main map area shows a satellite image of a forest with several orange and yellow polygons overlaid, indicating areas of interest. A tooltip above the map reads "RandomForest - Main class of post event season". To the left of the map is a vertical toolbar with icons for map interaction. Below the map, there are controls for "Show layer availability" (set to None) and "Show climate stations" (set to OFF). On the right side, a sidebar contains a "Collection list" for "Feature 4660" and a "Datasets" section. The "Time-series data" section includes a line graph, a "Filtering" dropdown, and buttons for "Image", "CSV", and "Interactive Plot". The "Decomposition" section features another line graph and buttons for "Decompose" and "CSV". The "Disturbance Type Classification (BETA)" section has a "Disturbance type" checkbox checked, and options for "Probability of fire event", "Probability of logging event", and "Probability of storm event". Below this, there are buttons for "Add new analysis" (set to "Disturbance Type Classification (BETA)") and "Specify parameters". At the bottom right, the "Processing ID" is 56005e385457e and the "Processing directory" is visible with "View" and "Export" links. A footer at the bottom contains a question "Do you have any questions?" and copyright information for Friedrich-Schiller-University Jena, Germany, 2013-2014, by Jonas Eberle.

7 Implementation

Current:

- Static random forest classifier
- Provision of supportive information (votes, etc.)

Future:

- Data broker technology to incorporate diverse datasets
 - Socio-economic data, e.g. cultivation practice, economy, ..
 - Physical data, e.g. climate, elevation, etc
 - Linked Open Data (LOD)
- Crowdsourcing to collect and validate datasets for training

Webbased implementation of machine learning classifier!



Thanks for your attention! Any questions?

Appendix

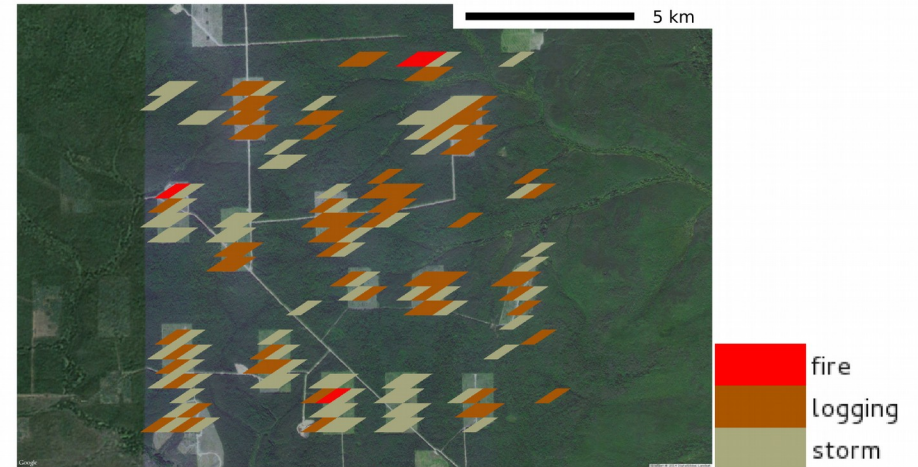
- Example of logging

Area

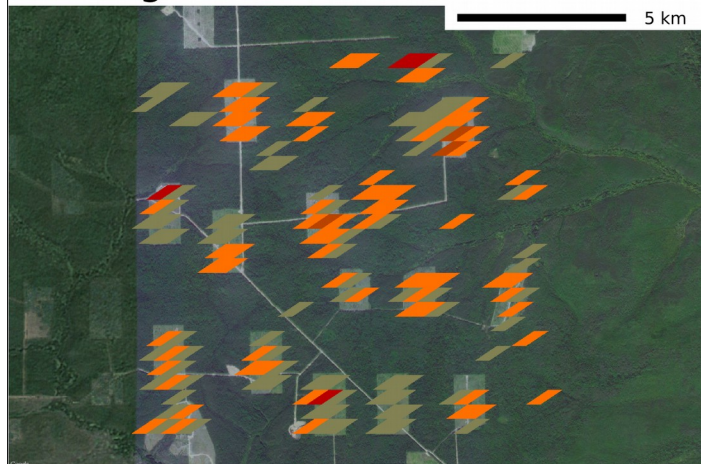


West = 101,251
East = 101,37
North = 58,1108
South = 58,0554

Results

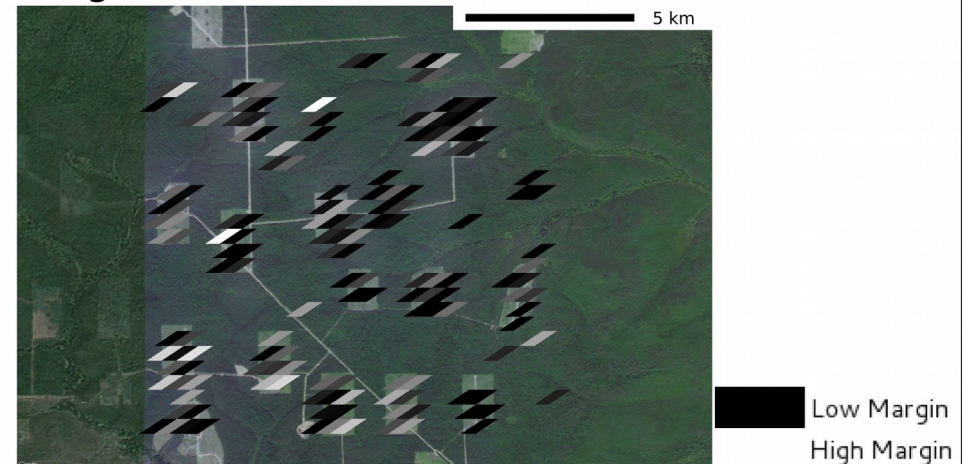


Ranking



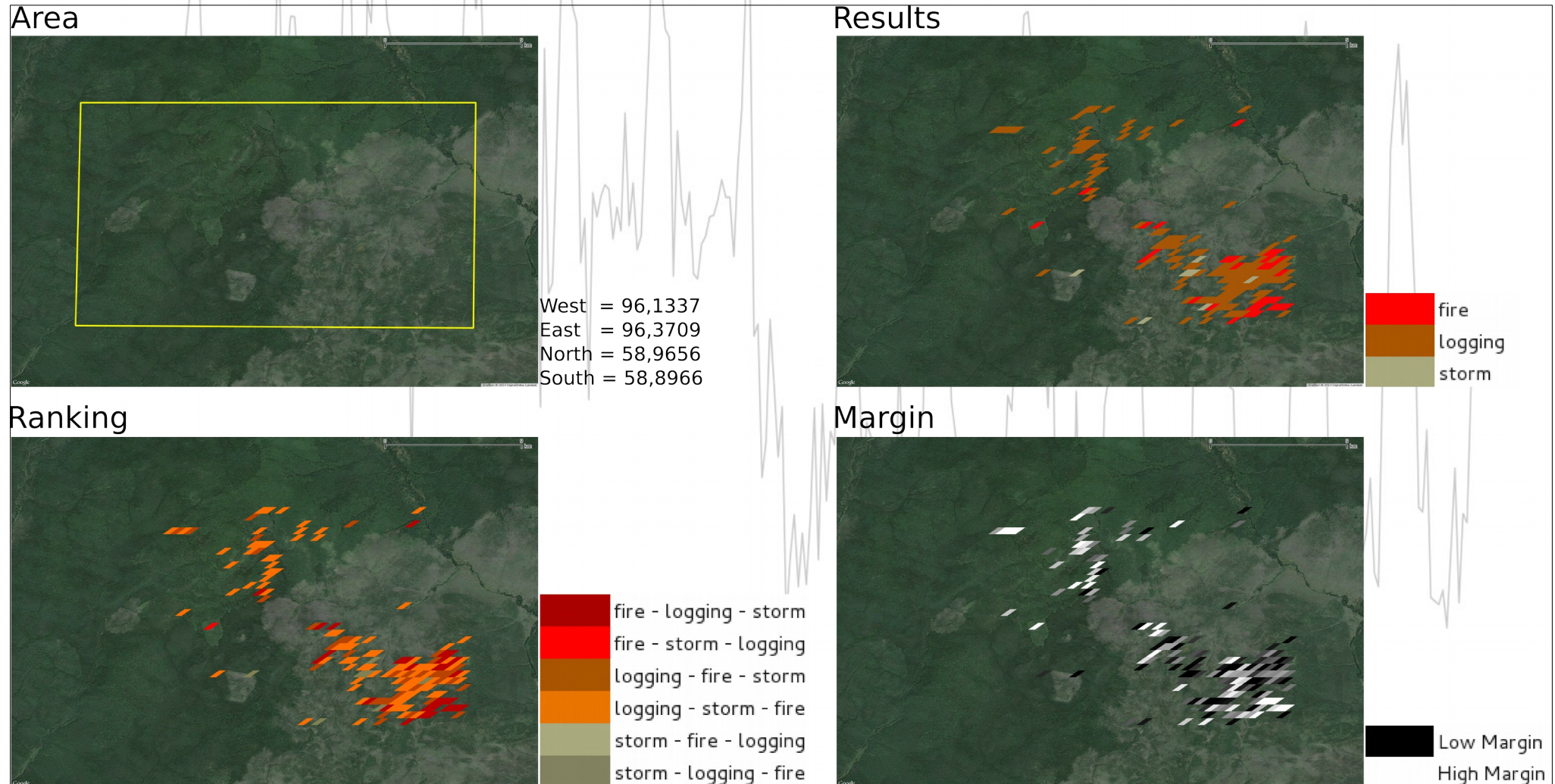
fire - logging - storm
fire - storm - logging
logging - fire - storm
logging - storm - fire
storm - fire - logging
storm - logging - fire

Margin



Appendix

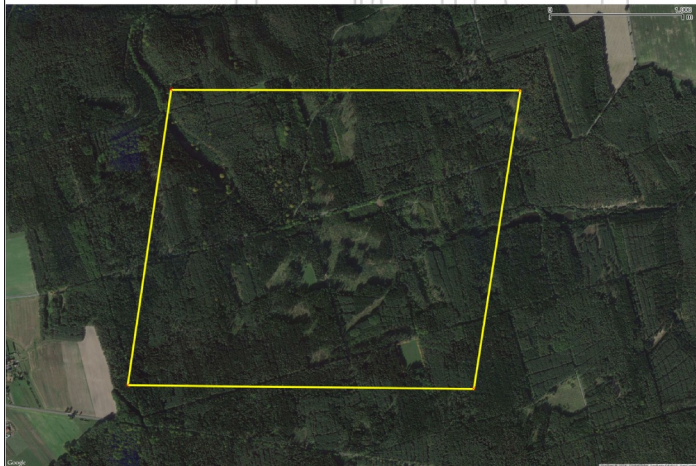
- Example of fire



Appendix

- Example of storm

Area



West = 11,6439
 East = 11,6704
 North = 50,7793
 South = 50,7665

Results



fire
 logging
 storm

Ranking



fire - logging - storm
 fire - storm - logging
 logging - fire - storm
 logging - storm - fire
 storm - fire - logging
 storm - logging - fire

Margin



Low Margin
 High Margin

Appendix

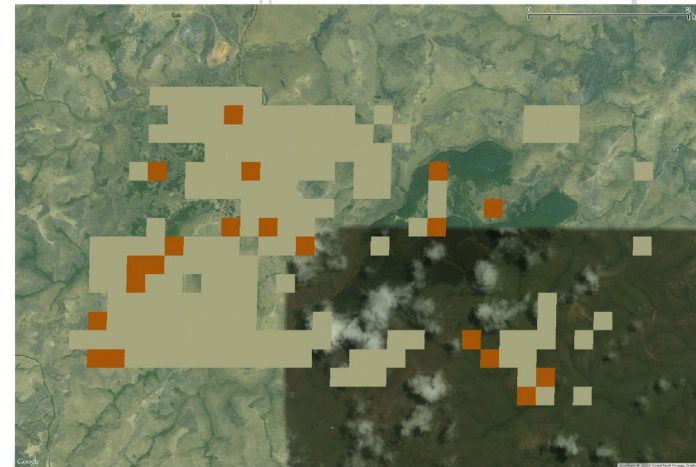
- Ngel Nyaki (Nigeria)

Area



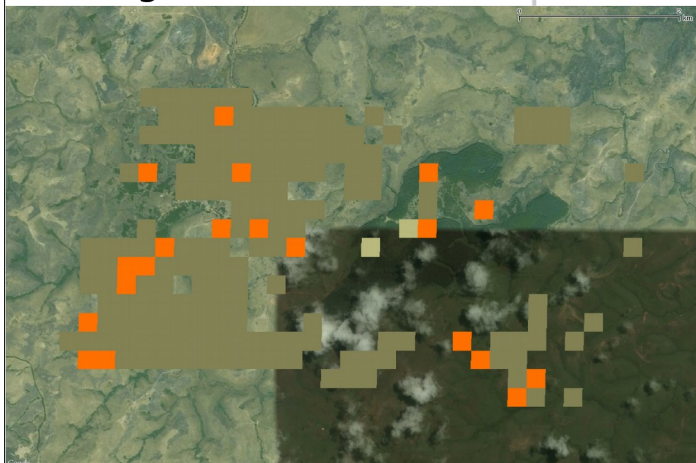
West = 11,0724
East = 11,1397
North = 7,105
South = 7,06311

Results



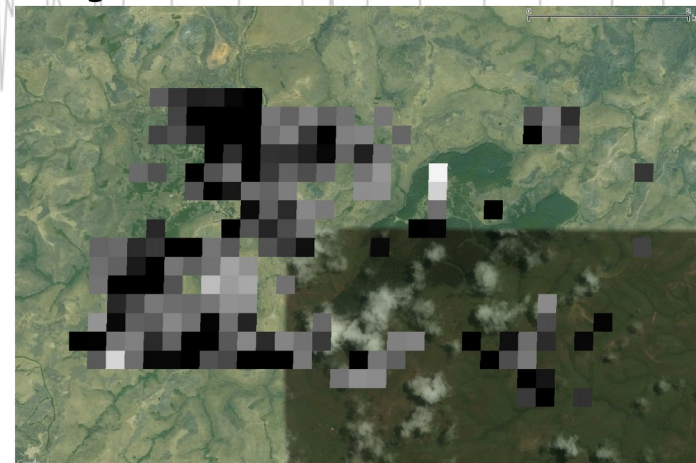
fire
logging
storm

Ranking



fire - logging - storm
fire - storm - logging
logging - fire - storm
logging - storm - fire
storm - fire - logging
storm - logging - fire

Margin



Low Margin
High Margin

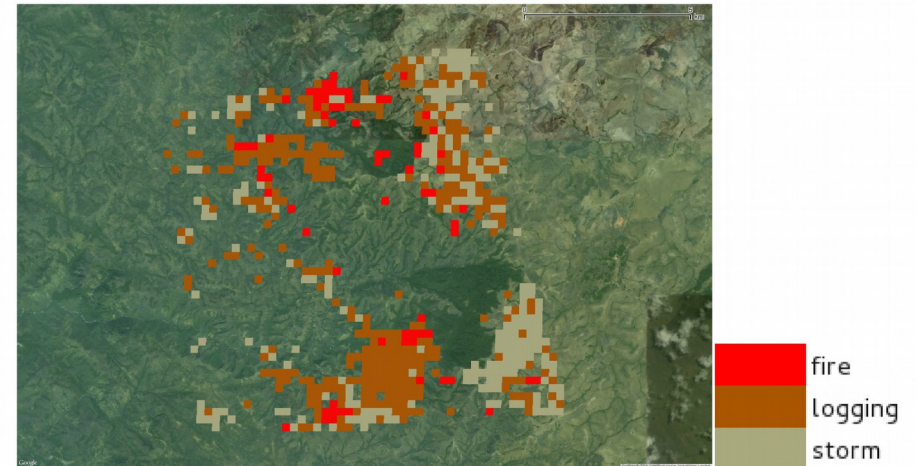
Appendix

- Kurmin Ndanko (Nigeria)

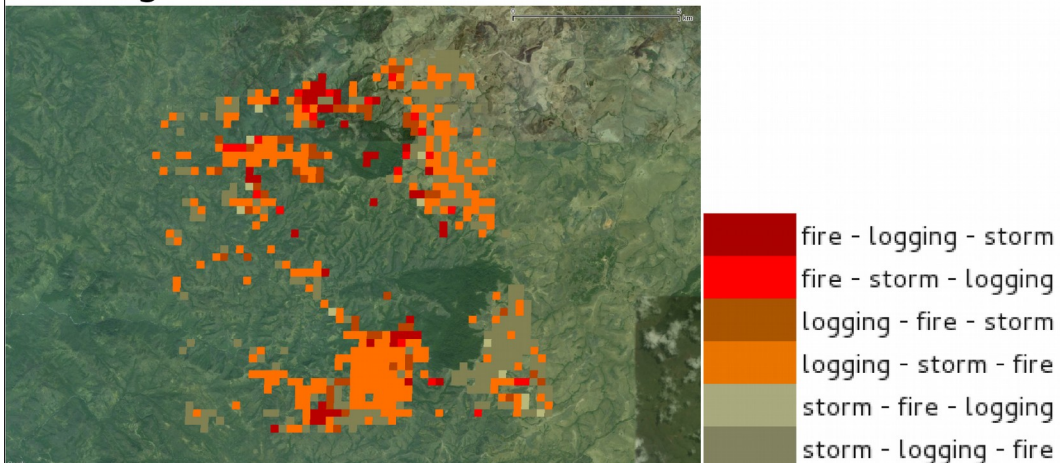
Area



Results



Ranking



Margin

