
RS03.1 – Natural environment, resources and rural development

# Exploring the potential of LandTrendr for stand age estimation in Portuguese Eucalyptus forest

André Duarte
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# Exploring the potential of LandTrendr for stand age estimation in Portuguese Eucalyptus forest

**André Duarte[1,2,3], Luís Acevedo-Muñoz [1], João Freire [3], Joel Duarte [1], Jonas Salvador[1], Sérgio Fabres[1]**

[1] RAIZ—Forest and Paper Research Institute, Portugal

[2] NOVA Information Management School, NOVA Lisbon University, Portugal

[3] Polytechnic Institute of Coimbra, Coimbra Agriculture School, Portugal

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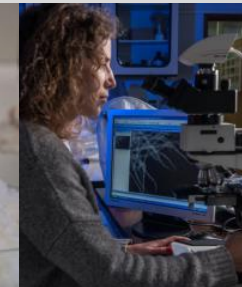
*science boosting a cutting-edge forest bioeconomy*

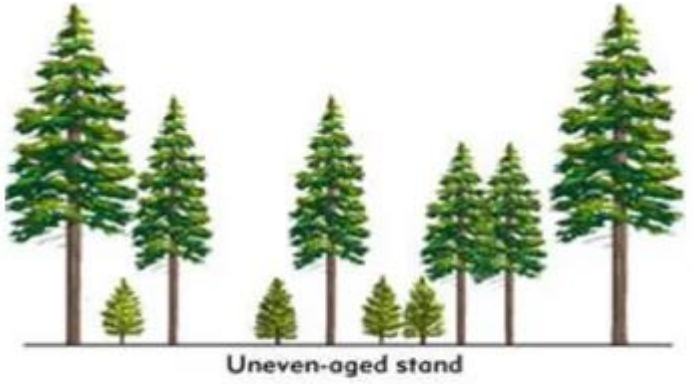




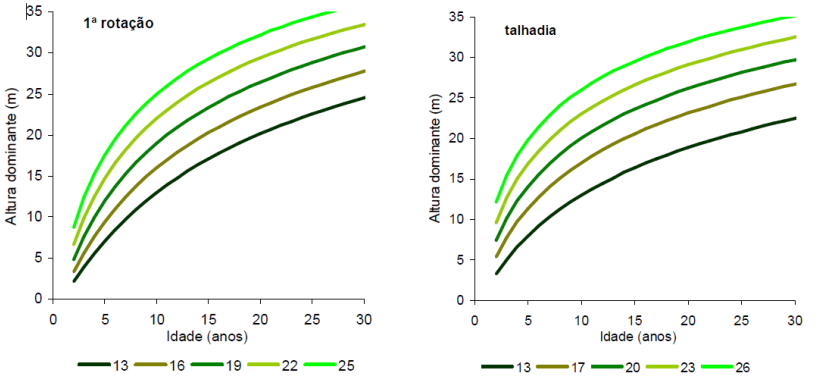



# *Forest Age*

- ✓ Forest age is critical for informing effective forest management
- ✓ Regional and National Forest Inventory programs
- ✓ Predicting site index and mean annual increment
- ✓ Important predictor of forest carbon sequestration, ecosystem services, fire management, fire behavior modeling, volume, wildlife habitat…


Source: https://forestrypedia.com/even-aged-forests-vs-uneven-aged-forests/

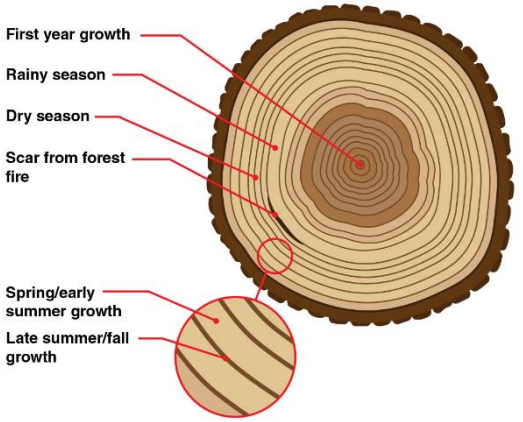



Source: Tomé et al. (2001)

# *How to measure?*

- ✓ Planting or seeding records
- ✓ by observation
- ✓ counting the whorls
- ✓ samples collected with the increment borer
- ✓ the complete analysis of the trunk of felled trees.


Source: https://www.montana.edu/extension/forestry/publications/




Source: https://climate.nasa.gov/

# *Satellite-based Remote Sensing*

- ✓ **Satellite-based Remote Sensing provide a low-cost and informative solutions**
- ✓ **Computer or cloud computing power**
- ✓ **Free and open access of dense Landsat archive (1972-until now)** **(Copernicus program as well 2017 – until now)**
- ✓ **Integration with field data at different levels (up-scaling)**
- ✓ **Prototype fine grained estimates of forest age over large spatial extents**
- ✓ **Powerful temporal segmentation models (LandTrendr, CCDC, VCT, BFAST…)**

Sources: Maltman et al. (2023) In: Estimating and mapping forest age across Canada's forested ecosystems and
Tian et al (2023) In: Forest Age Mapping Using Landsat Time-Series Stacks Data Based on Forest Disturbance and Empirical Relationships between Age and Height

# *Context and main goal*

- ✓ PRR Transform WP1: Gestão de Florestas Resilientes, Sub-projeto 1.5: Dados de deteção remota para a gestão florestal
- ✓ Atividade 2, Tarefa 1: Mapas de classes de Idade estimadas para Eucalipto-comum e Pinheiro-bravo

transform

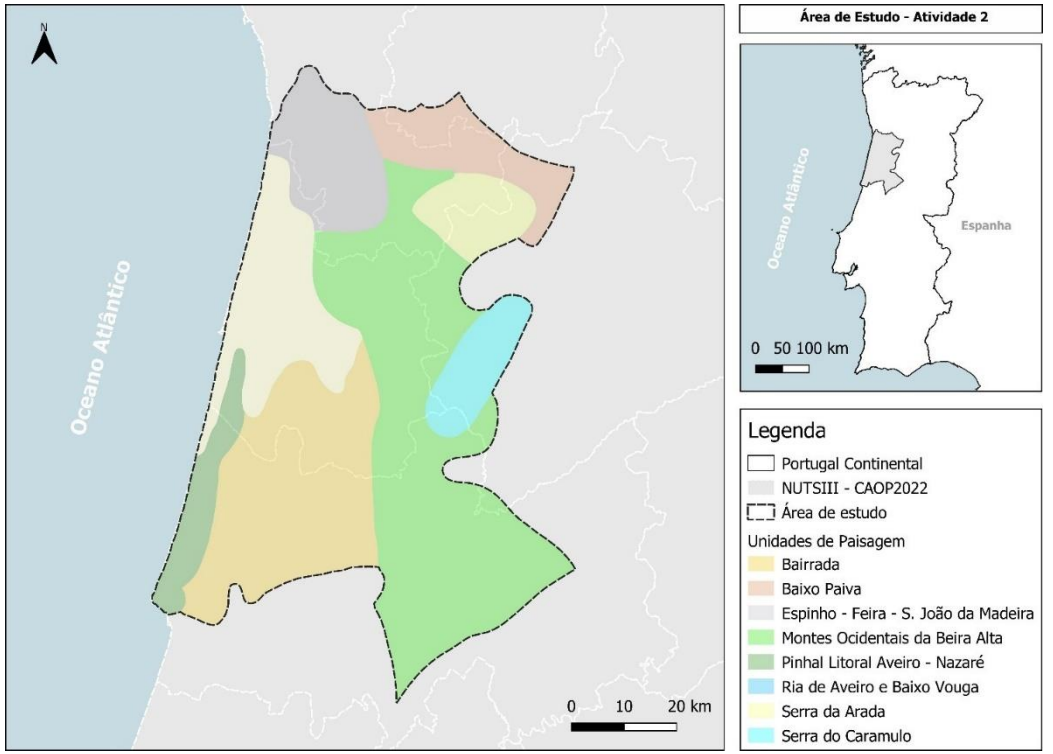
**Transformação digital do setor florestal para uma economia resiliente e hipocarbónica**

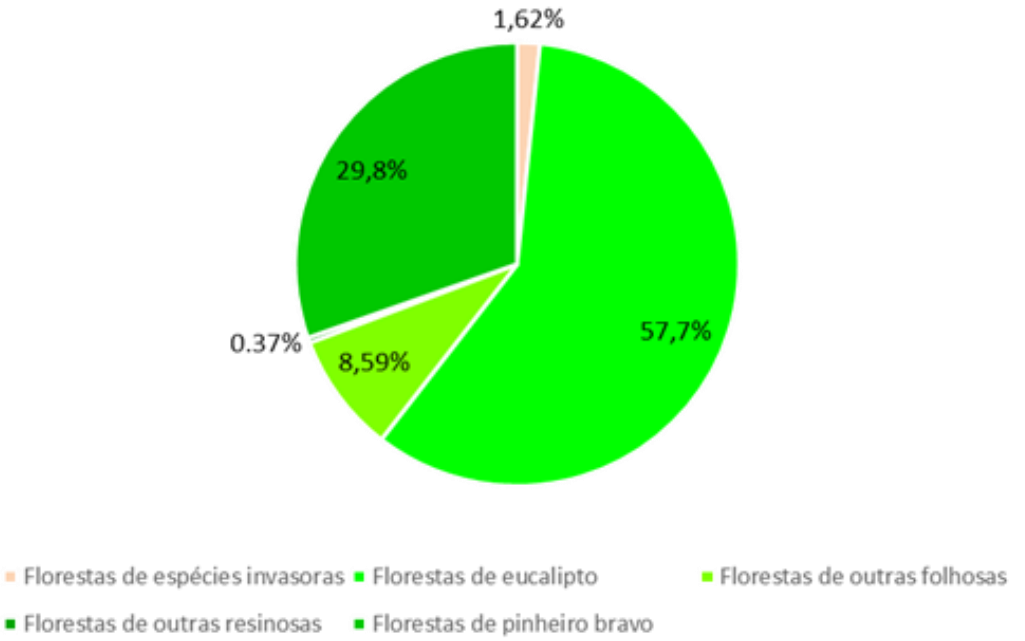
Agenda for the digital transformation of the forest sector in a resilient, low-carbon economy

## Main goal of this work:

*Eucalyptus globulus* forest age mapping using LandTrendr

# *Methodology – Study area and data collection*



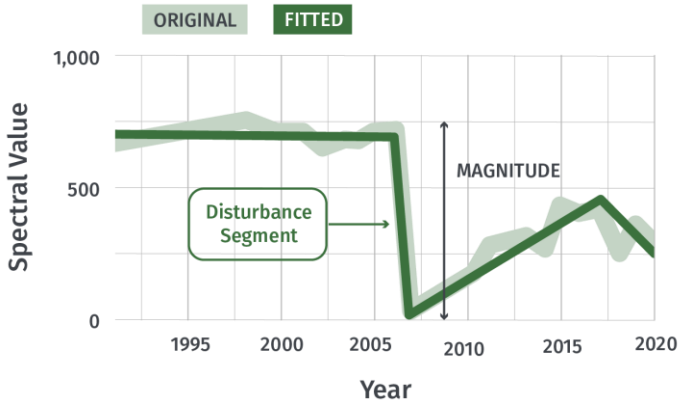

✓ **Data collection:**

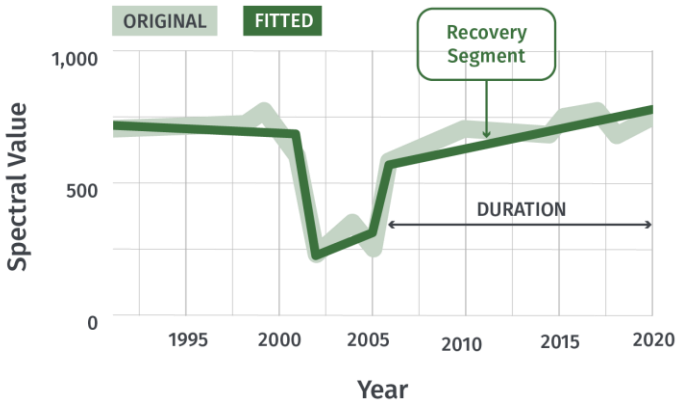
**The Navigator Company cadaster**
**Forest Age based on plantation records and observation → Validation data**

# *Methodology – LandTrendr*

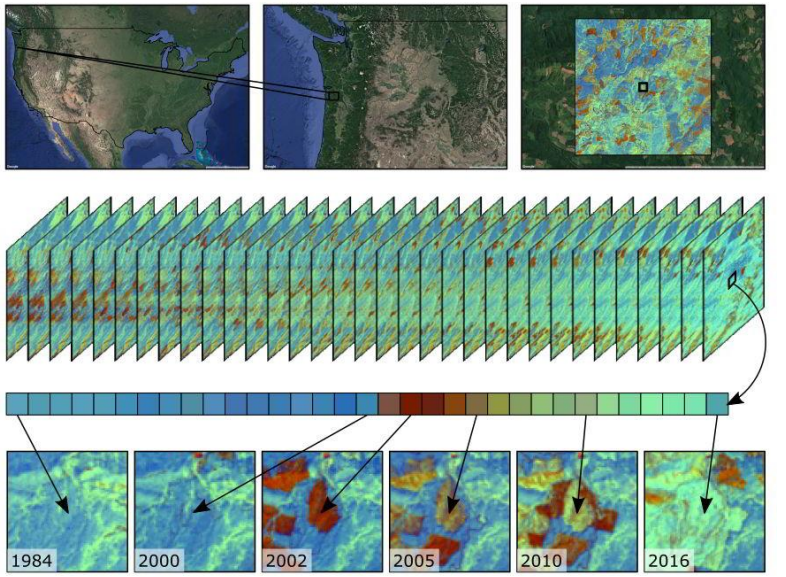
## LandTrendr - Landsat-based Detection of Trends in Disturbance and Recovery

Spectra-temporal trajectory of the pixel's images through a defined temporal window, performing a temporal segmentation and identifying break points in the reflectance values of the bands or of the vegetation index, and in turn, detecting changes.



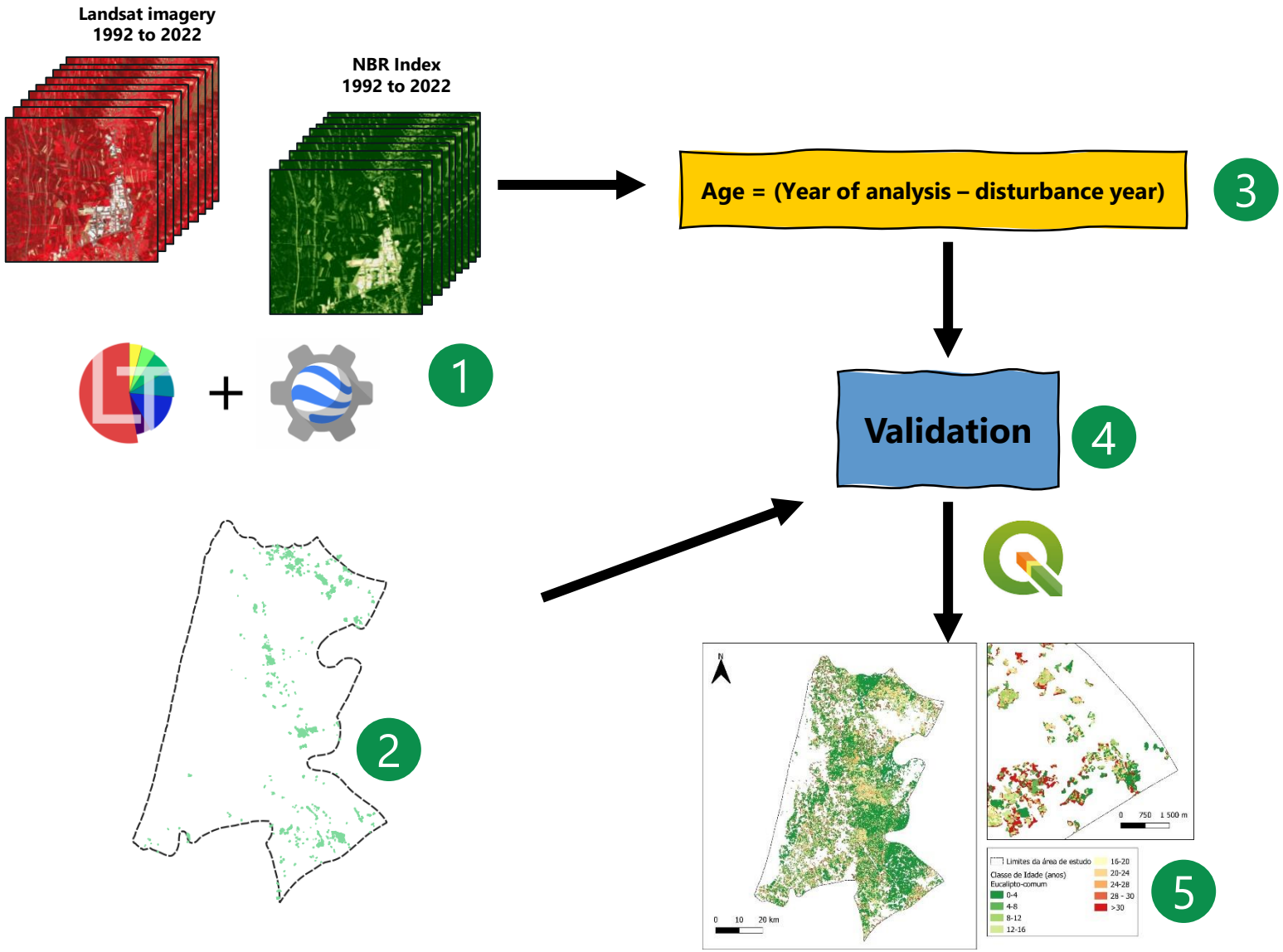




Source: https://openmrv.org/web/guest/w/modules/mrv/modules_2/landtrendr and Kennedy et al. (2010)



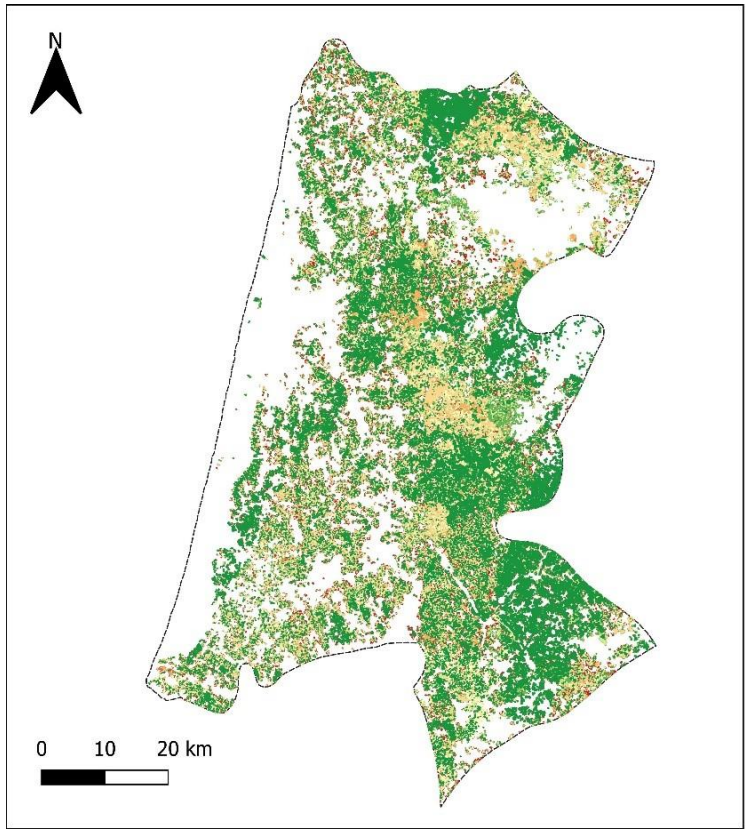

Source: https://emapr.github.io/LT-GEE/landtrendr.html

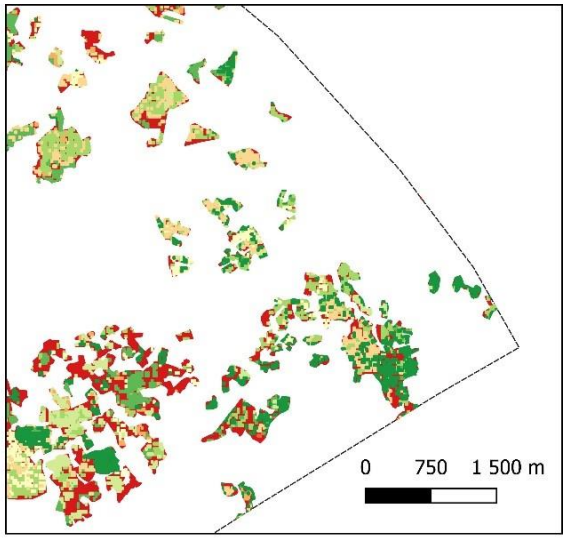
# *Methodology – Forest Age Estimation*

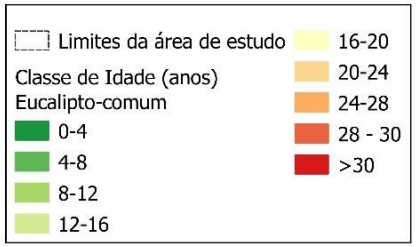



1. LandTrend Algorithm Analysis using NBR Index between 1992 to 2022.
   8 control parameters that adjust how spectral-temporal segmentation is done, and the annual image collection.
   Some modified LandTrendr Parameters:
   - recoveryThreshold: 0.75
   - pvalThereshold: 0.05
   - preval:>200
2. The Navigator Company plantation records
3. Age estimation based on difference between the reference year (2022) and the disturbance year obtained by LandTrendr vegetation change maps.
4. Cross tabulation between the 3trd step and age data stored (Mean absolute Deviation - MAD)
5. Final Map of Eucalyptus forest Age

# *Experimental results*




| Forest Age Classes (years) | Area (ha) | Area (%) |
|---|---|---|
| 0-4 | 28430.39 | 14.15 |
| 4-8 | 26649.66 | 13.27 |
| 8-12 | 19847.84 | 9.88 |
| 12-16 | 12643.14 | 6.29 |
| 16-20 | 11230.64 | 5.59 |
| 20-24 | 7859.32 | 3.91 |
| 24-28 | 7581.48 | 3.77 |
| 28 - 30 | 1422.97 | 0.71 |
| >30 | 85200.91 | 42.42 |
| | **200866.4** | **100** |

| Specie | Mean absolute deviation (MAD) | Mean deviation (MD) |
|---|---|---|
| *Eucalyptus globulus* | 3.92 | -1.14 |

# *Conclusions*

- ✓ Overall bias of 3,92 years for eucalyptus forest age
- ✓ The main limitation is the spatial resolution of the satellite imagery
- ✓ This region is characterized by a smallholding ownership forest landscape.
- ✓ Usual delays between the tree felling and the subsequent forest plantation.

## Future improvements

- ✓ Further improvements will include hyperparameter tuning and applying other disturbance approach algorithms such as CCDC, VCT, Bfast monitor.

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