



# GEE for large-area disturbance mapping

Domain agnostic online semantic segmentation  
for multi-dimensional time series

Shaghayegh Gharghabi<sup>1</sup> · Chin-Chia Michael Yeh<sup>1</sup> · Yifei Ding<sup>1</sup> ·  
Wei Ding<sup>2</sup> · Paul Hibbing<sup>3</sup> · Samuel LaMunion<sup>3</sup> · Andrew Kaplan<sup>3</sup> ·  
Scott E. Crouter<sup>3</sup> · Eamonn Keogh<sup>1</sup>



Detecting trends in forest disturbance and  
recovery using yearly Landsat time series: 1.  
LandTrendr — Temporal segmentation  
algorithms

Robert E. Kennedy<sup>a</sup>, Zhiqiang Yang<sup>a</sup>, Warren B. Cohen<sup>b</sup>



Regional detection, characterization, and attribution of annual forest  
change from 1984 to 2012 using Landsat-derived time-series metrics

Txomin Hermosilla<sup>a,\*</sup>, Michael A. Wulder<sup>b</sup>, Joanne C. White<sup>b</sup>, Nicholas C. Coops<sup>a</sup>, Geordie W. Hobart<sup>b</sup>

<sup>a</sup> Integrated Remote Sensing Studio, Department of Forest Resources Management, University of British Columbia, 2424 Main Mall, Vancouver, British Columbia V6T 1Z4, Canada  
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An integrated Landsat time series protocol for change detection and  
generation of annual gap-free surface reflectance composites

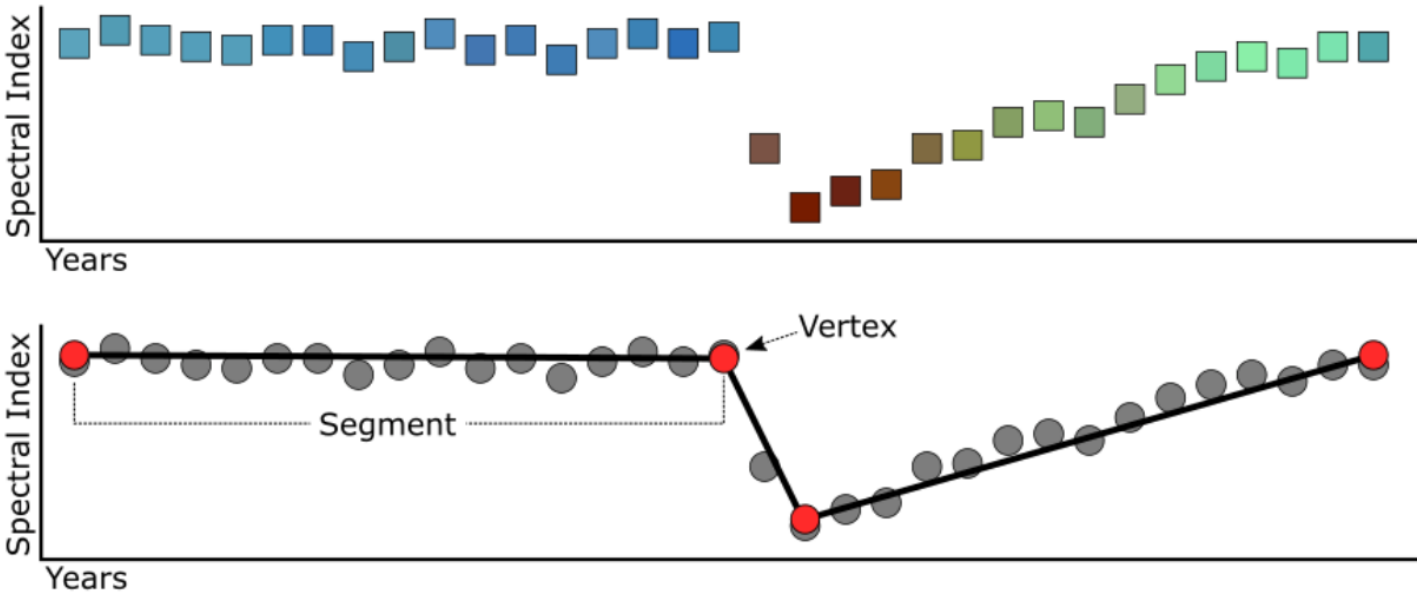
Txomin Hermosilla<sup>a,\*</sup>, Michael A. Wulder<sup>b</sup>, Joanne C. White<sup>b</sup>, Nicholas C. Coops<sup>a</sup>, Geordie W. Hobart<sup>b</sup>

<sup>a</sup> Integrated Remote Sensing Studio, Department of Forest Resources Management, University of British Columbia, 2424 Main Mall, Vancouver, BC V6T 1Z4, Canada  
<sup>b</sup> Canadian Forest Service (Pacific Forestry Centre), Natural Resources Canada, 506 West Burnside Road, Victoria, British Columbia V8Z 1M5, Canada

Mapping the forest disturbance regimes of Europe

Cornelius Senf & Rupert Seidl

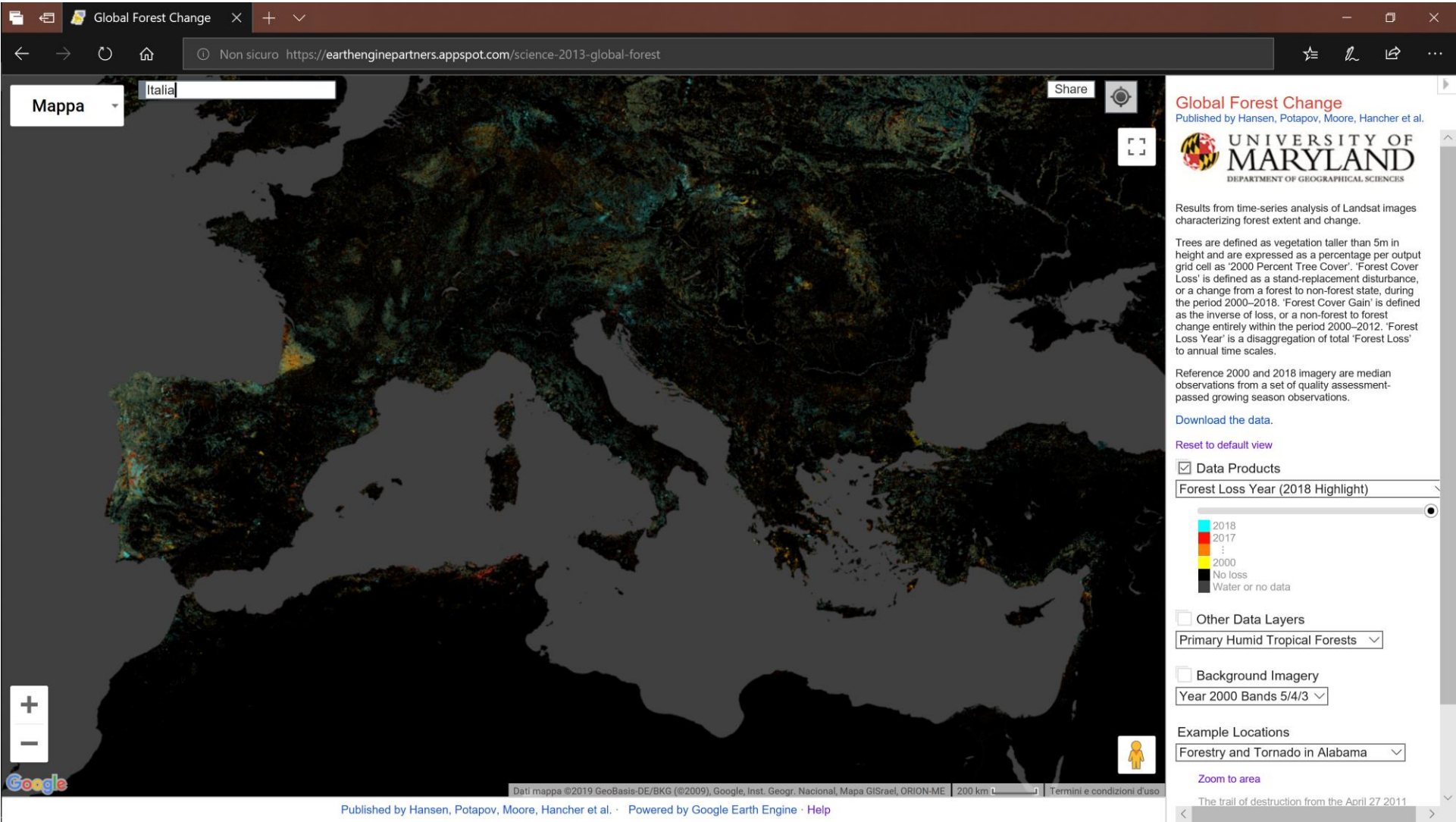
nature sustainability



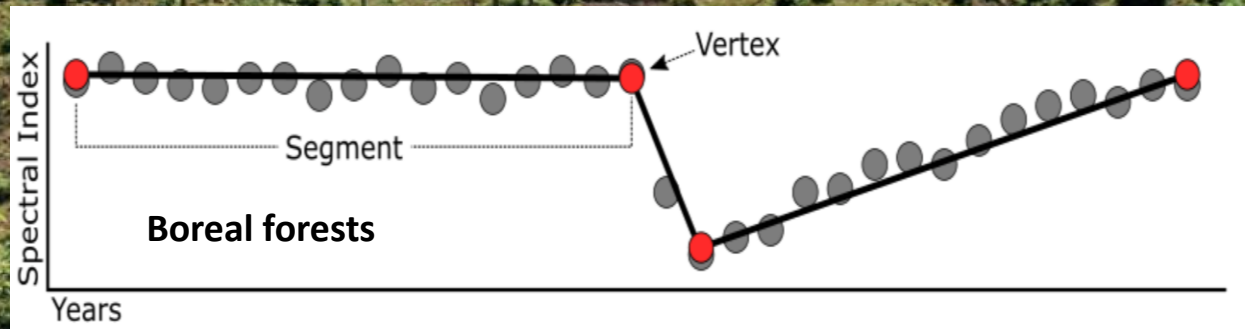
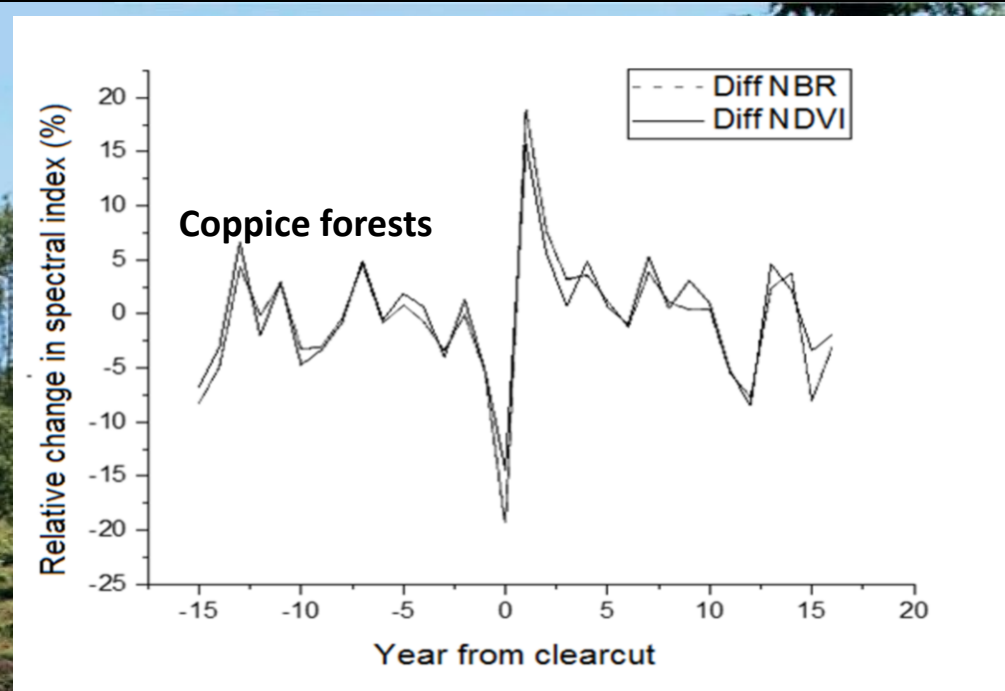
# High-Resolution Global Maps of 21st-Century Forest Cover Change

M. C. Hansen<sup>1,\*</sup>, P. V. Potapov<sup>1</sup>, R. Moore<sup>2</sup>, M. Hancher<sup>2</sup>, S. A. Turubanova<sup>1</sup>, A. Tyukavina<sup>1</sup>, D. Thau<sup>2</sup>, S. V. Stehman<sup>3</sup>, S. J. G...  
+ See all authors and affiliations

Science 15 Nov 2013:  
Vol. 342, Issue 6160, pp. 850-853  
DOI: 10.1126/science.1244693



# Differences between Boreal forests and Mediterranean coppice forests recovery rates



Annals of Forest Science (2020) 77: 40  
<https://doi.org/10.1007/s13595-020-00936-2>

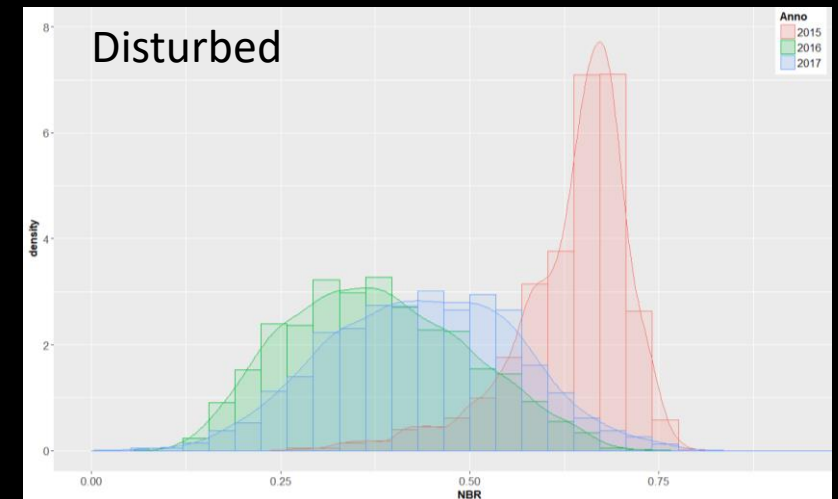
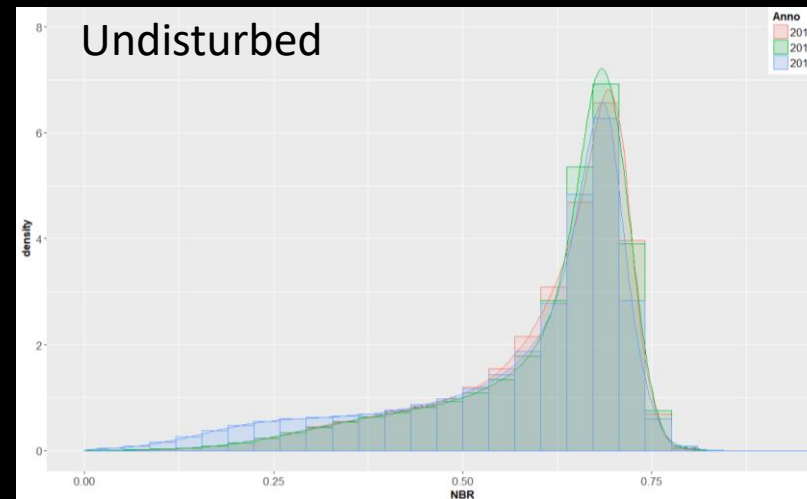
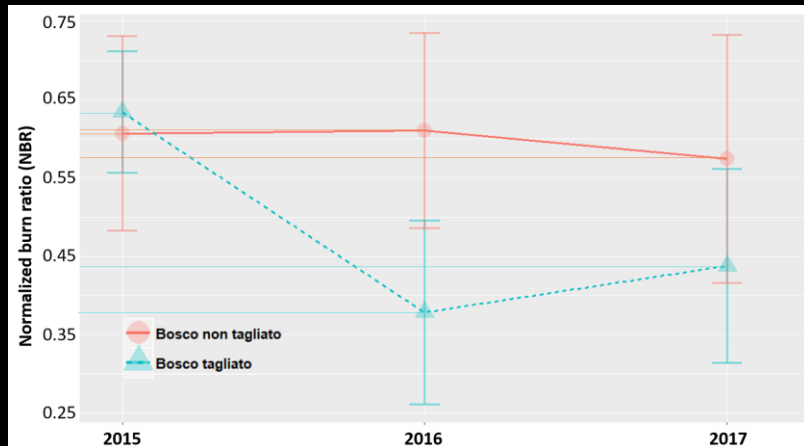
## RESEARCH PAPER

### Monitoring clearcutting and subsequent rapid recovery in Mediterranean coppice forests with Landsat time series

Gherardo Chirici<sup>1</sup> · Francesca Giannetti<sup>1</sup> · Erica Mazza<sup>1</sup> · Saverio Francini<sup>1</sup> · Davide Travaglini<sup>1</sup> · Raffaello Pegna<sup>1</sup> · Joanne C. White<sup>2</sup>

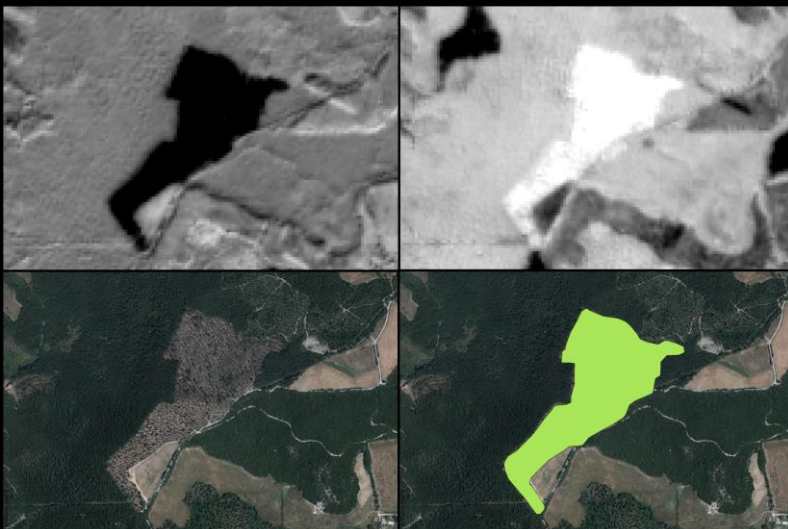


# TWO THRESHOLDS METHOD (TTM)



$\Delta NBR_{pre}$

$\Delta NBR_{post}$



remote sensing



Article

## A New Method for Automated Clearcut Disturbance Detection in Mediterranean Coppice Forests Using Landsat Time Series

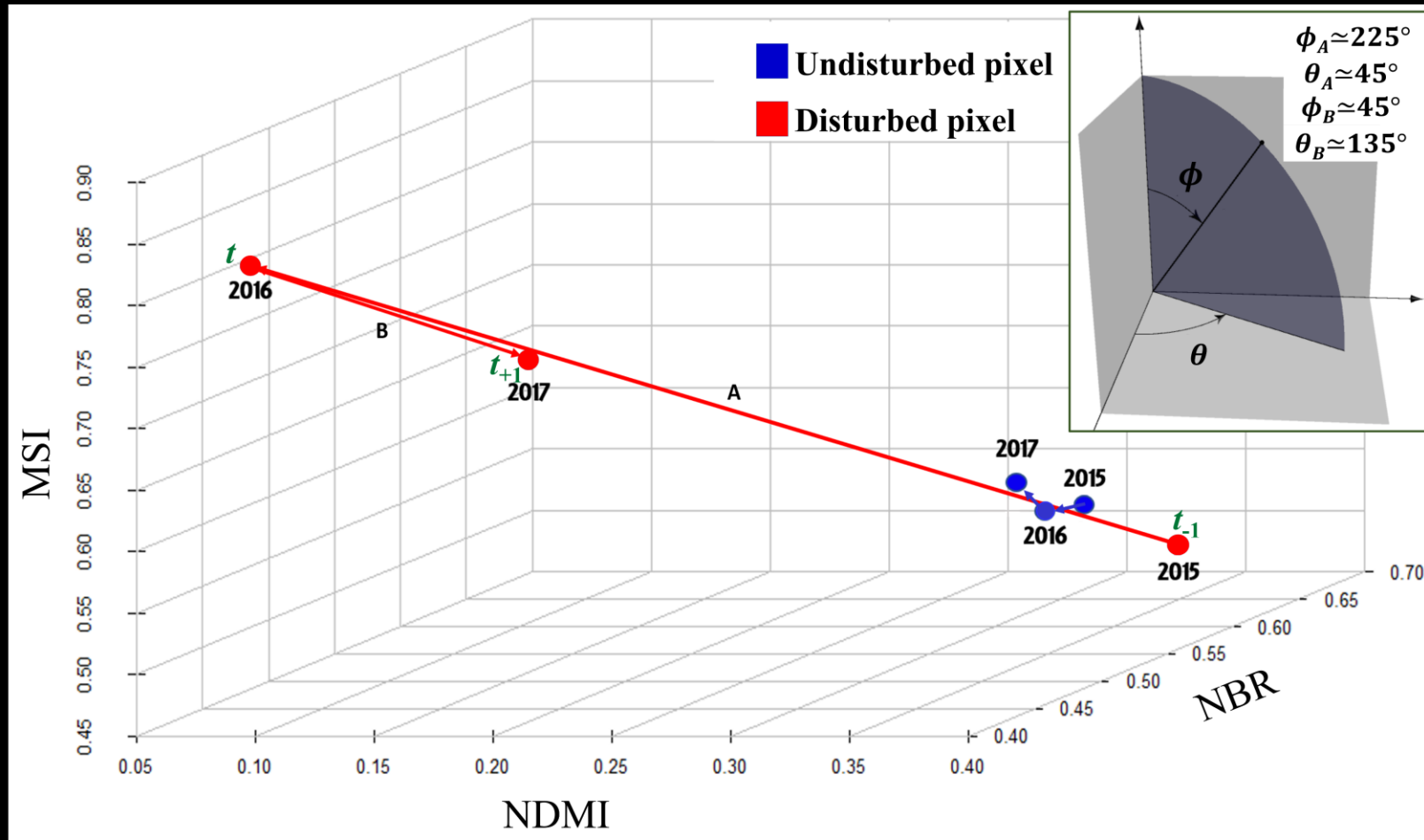
Francesca Giannetti <sup>1,\*</sup>, Raffaello Pegna <sup>1</sup>, Saverio Francini <sup>1</sup>, Ronald E. McRoberts <sup>2,3</sup>, Davide Travaglini <sup>1</sup>, Marco Marchetti <sup>4</sup>, Giuseppe Scarascia Mugnozza <sup>5</sup> and Gherardo Chirici <sup>1</sup>

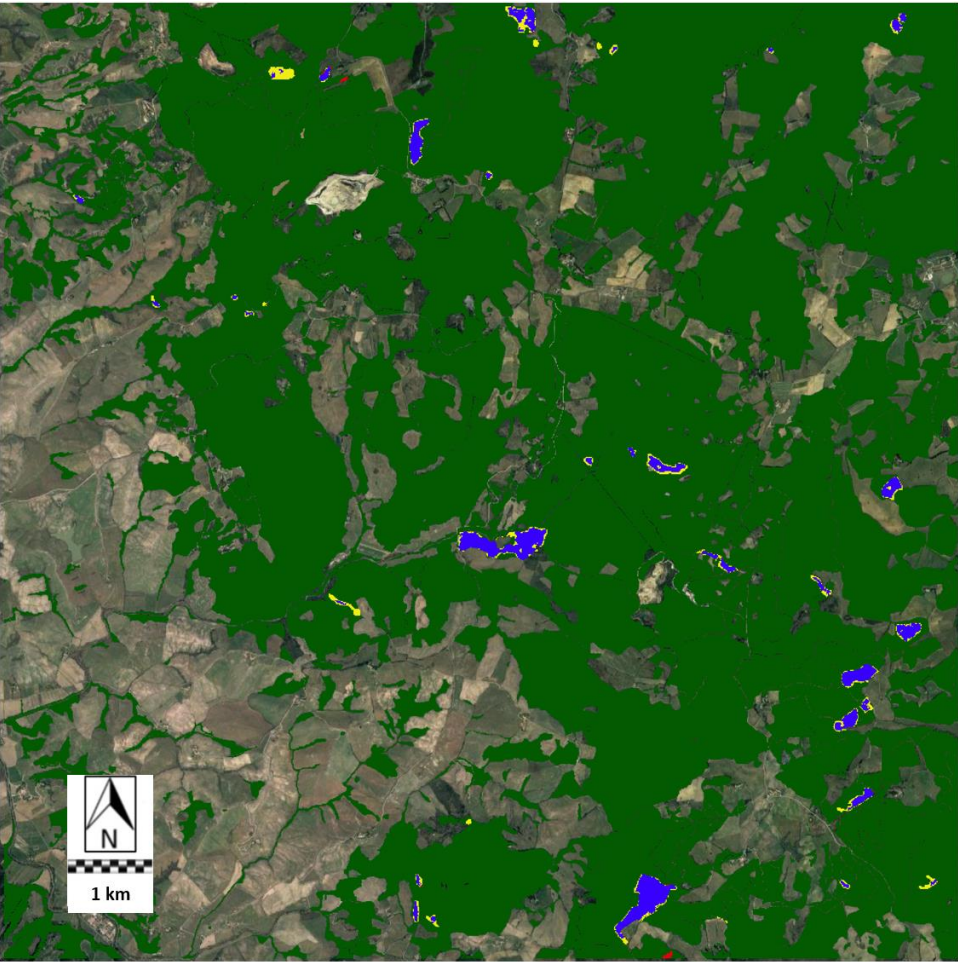
# THREE INDICES THREE DIMENSIONS ALGORITHM (3I3D)

Sentinel2  
image 2015

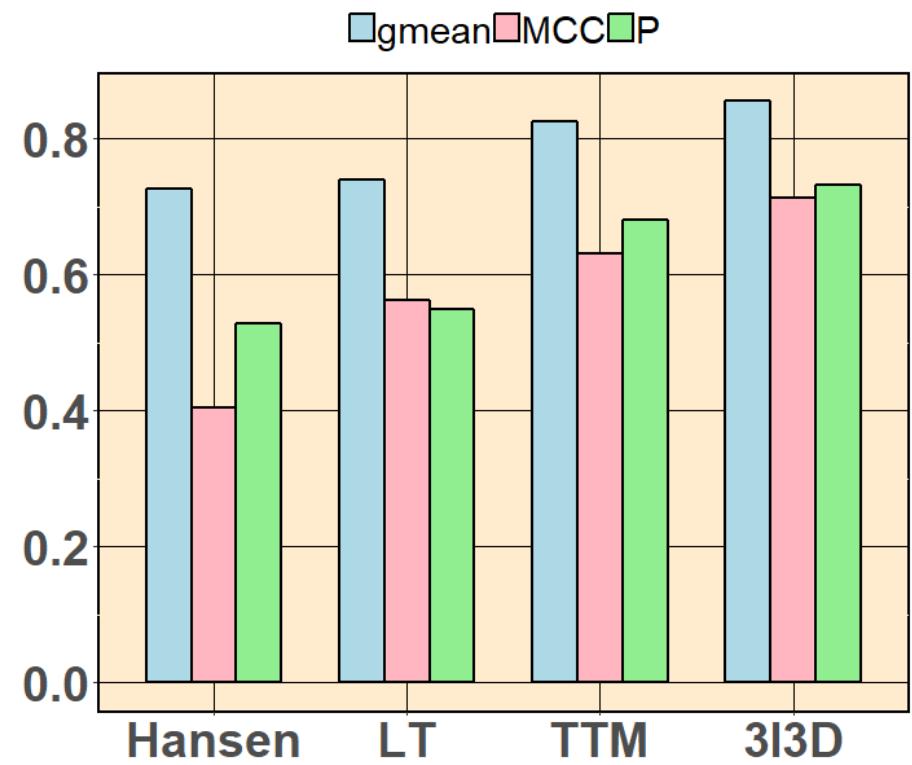
Sentinel2  
image 2016

Sentinel2  
image 2017








	True	False	False	True
Methods	Negatives(ha)	Negatives(ha)	Positives(ha)	Positives(ha)
Hansen	125873.4	325.77	131.93	147.62
LT	125779.3	198.28	226.05	275.11
TTM	125875.4	195.25	129.99	278.14
3I3D	125884.5	143.37	120.83	330.02



## The Three Indices Three Dimensions (3I3D) algorithm: a new method for forest disturbance mapping and area estimation based on optical remotely sensed imagery

Saverio Francini <sup>a, b, c</sup>, Ronald E. McRoberts<sup>d</sup>, Francesca Giannetti <sup>a</sup>, Marco Marchetti<sup>b</sup>, Giuseppe Scarascia Mugnozza<sup>c</sup>, and Gherardo Chirici <sup>a</sup>



Upscaling??

# The coming Google Earth Engine

- a cloud platform offering planetary-scale analysis capabilities
- a multi-petabyte catalog of satellite imagery and geospatial datasets

# Why Google Earth Engine?

- Huge amount of data
- Preprocessing of images already done
- Fast
- Easy to use
- Free

# What is Google Earth Engine used for?

*“analyze forest and water coverage, land use change, or assess the health of agricultural fields, among many other possible analyses.”*



Scopus

Search within

Article title, Abstract, Keywords



Search documents \*

Google earth engine

→ 1495 documents found



Contents lists available at ScienceDirect

Remote Sensing of Environment

journal homepage: [www.elsevier.com/locate/rse](http://www.elsevier.com/locate/rse)



Google Earth Engine: Planetary-scale geospatial analysis for everyone

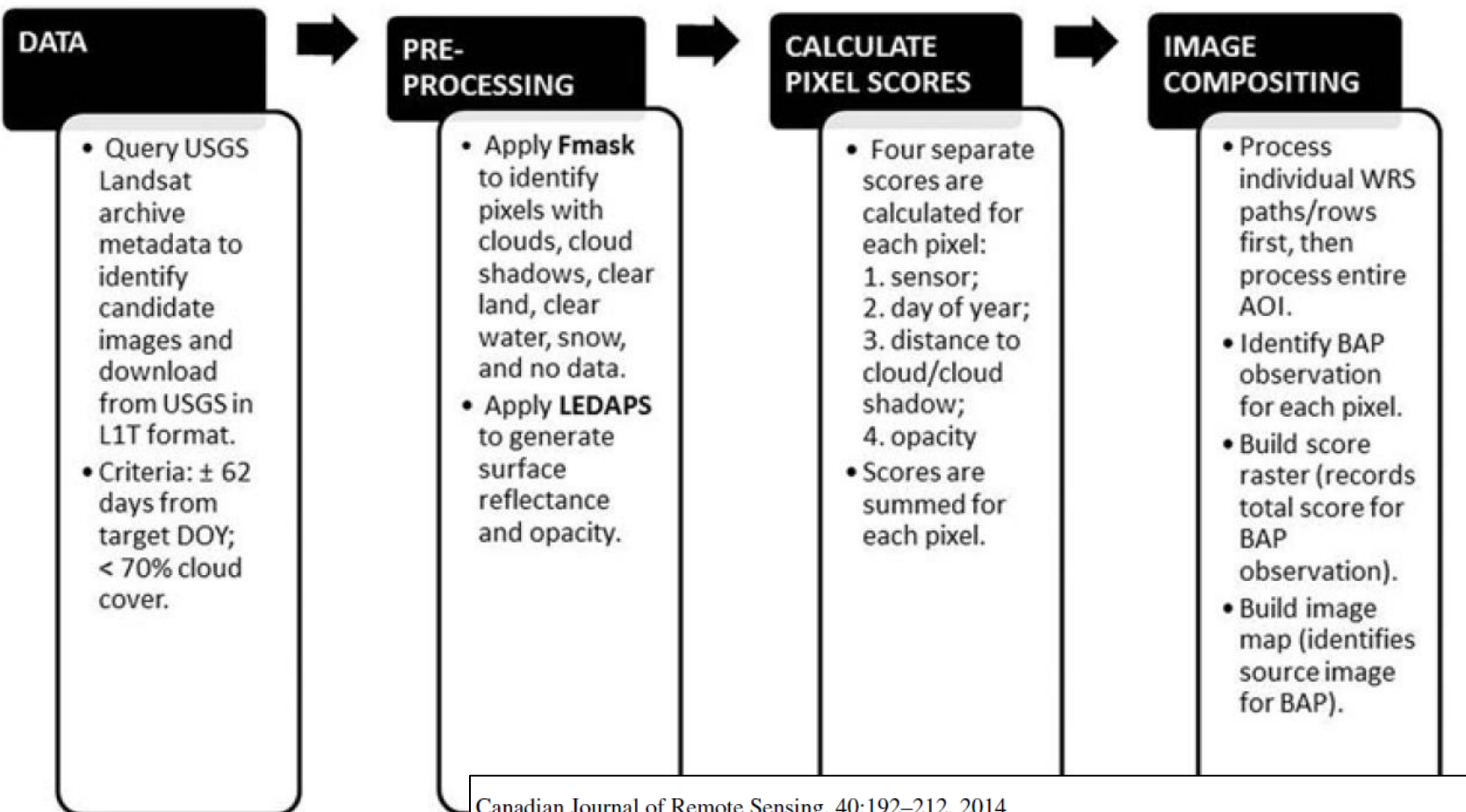
Noel Gorelick <sup>a,\*</sup>, Matt Hancher <sup>b</sup>, Mike Dixon <sup>b</sup>, Simon Ilyushchenko <sup>b</sup>, David Thau <sup>b</sup>, Rebecca Moore <sup>b</sup>

<sup>a</sup> Google Switzerland, Brandschenkestrasse 110, Zurich 8002, Switzerland

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→ Published in 2017  
Cited by 2485 documents



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DOI: 10.1080/07038992.2014.945827

## Pixel-Based Image Compositing for Large-Area Dense Time Series Applications and Science

J. C. White<sup>1,\*</sup>, M. A. Wulder<sup>1</sup>, G. W. Hobart<sup>1</sup>, J. E. Luther<sup>2</sup>, T. Hermosilla<sup>3</sup>, P. Griffiths<sup>4</sup>, N. C. Coops<sup>3</sup>, R. J. Hall<sup>5</sup>, P. Hostert<sup>4</sup>, A. Dyk<sup>1</sup>, and L. Guindon<sup>6</sup>

# Sentinel-2 images acquired in the last two days

lon: -180.82031 | lat: 70.85165 | zoom: 2

+

-

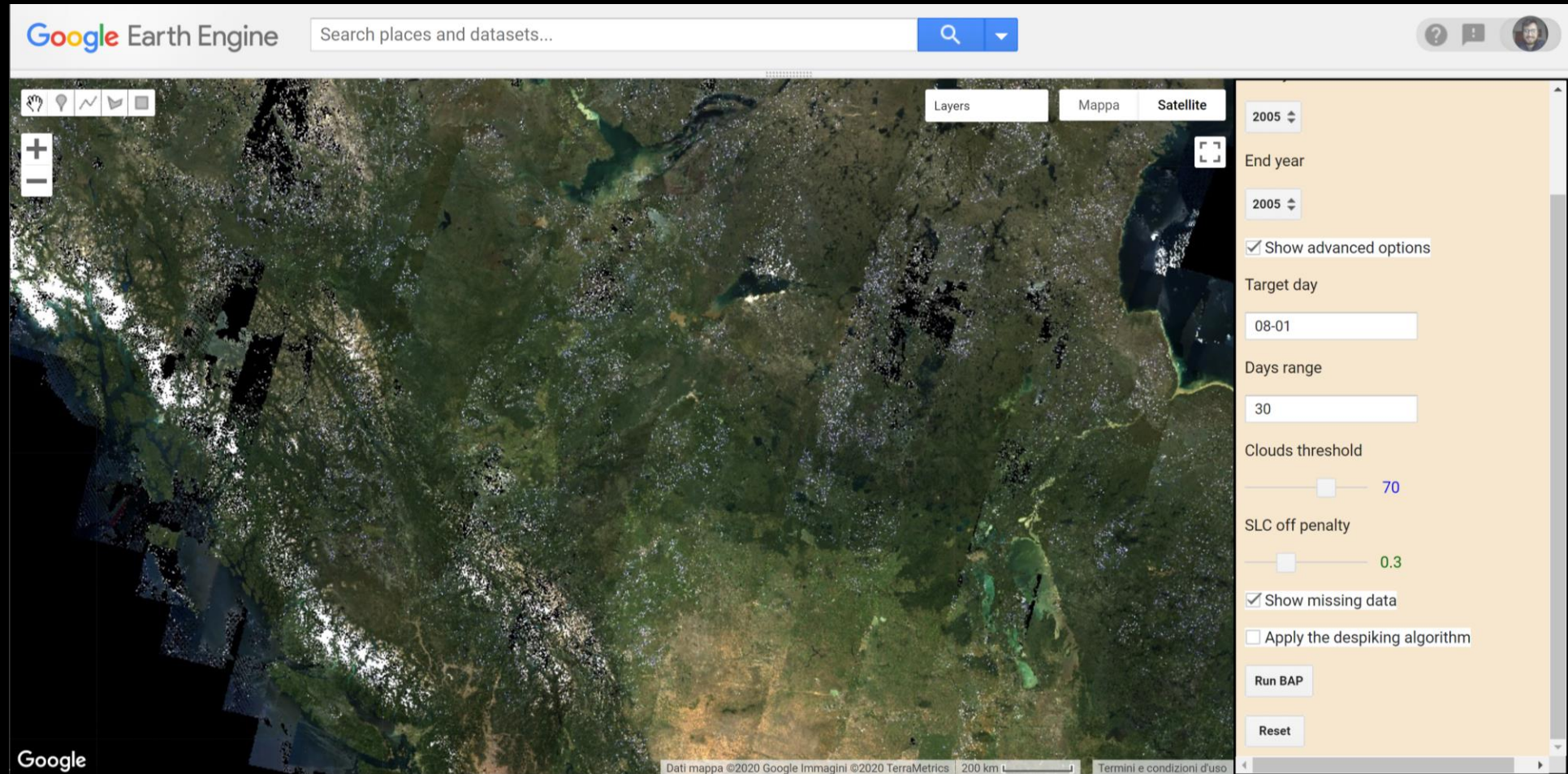
- ☐ CartoDB.Positron
- ☐ OpenStreetMap
- ☐ CartoDB.DarkMatter
- ☒ Esri.WorldImagery
- ☐ OpenTopoMap

☒ 1630824430030.82



Leaflet | Tiles © Esri — Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, UPR-EGP, and the GIS User Community

# BAP



# DESPIKED

The image shows the Google Earth Engine web interface. At the top, there is a search bar with the text "Search places and datasets...". Below the search bar, the main map area displays a satellite image of a forested region. On the right side, a settings panel is open, showing various parameters for the "Satellite" layer. The "Apply the despiking algorithm" checkbox is checked and circled in red. Other visible settings include "Days range" set to 30, "Clouds threshold" set to 70, "SLC off penalty" set to 0.3, "Show missing data" checked, "Spikes tolerance" set to 0.65, "N bands to check spikes condition" set to 3, "Infill data gaps inearly" unchecked, and "Use a piece-wise segmentation" unchecked. At the bottom of the settings panel, there are buttons for "Run BAP" and "Reset".

Google Earth Engine

Search places and datasets...

Layers Mappa Satellite

08-01

Days range

30

Clouds threshold

70

SLC off penalty

0.3

☒ Show missing data

☒ Apply the despiking algorithm

Spikes tolerance

0.65

N bands to check spikes condition

3

☐ Infill data gaps inearly

☐ Use a piece-wise segmentation

Run BAP

Reset

Google

Dati mappa ©2020 Google Immagini ©2020 TerraMetrics 200 km

Termini e condizioni d'uso

# FILLED

Google Earth Engine

Search places and datasets...

Layers Mappa Satellite

08-01

Days range

30

Clouds threshold

70

SLC off penalty

0.3

☒ Show missing data

☒ Apply the despiking algorithm

Spikes tolerance

0.65

N bands to check spikes condition

3

☒ Infill data gaps inearly

☐ Use a piece-wise segmentation

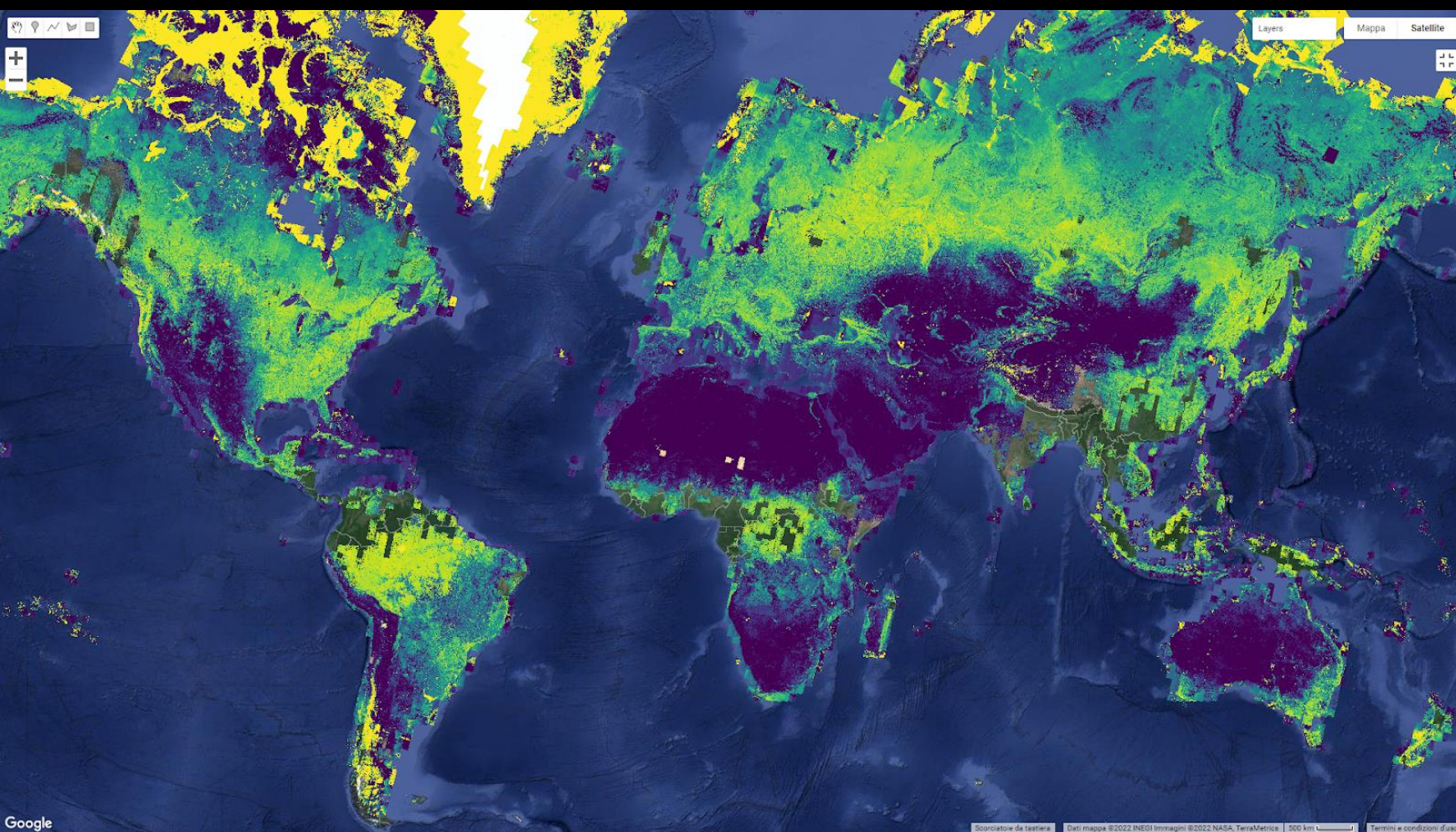
Run BAP

Reset

Google

Dati mappa ©2020 Google Immagini ©2020 TerraMetrics 200 km

Termini e condizioni d'uso



**Mike Wulder**

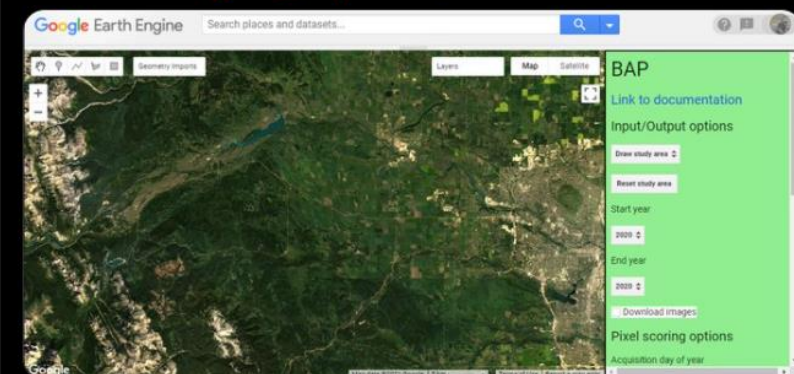
@mikewulder

The best-available-pixel (BAP) tool you have been waiting for! Implemented on [#GoogleEarthEngine](#) ([#GEE](#)). [#Landsat](#)

In [#GEEBAP](#) can tune composite parameters, create a [#timeseries](#), set area of interest, AND download surface reflectance outcomes!

Try it out:

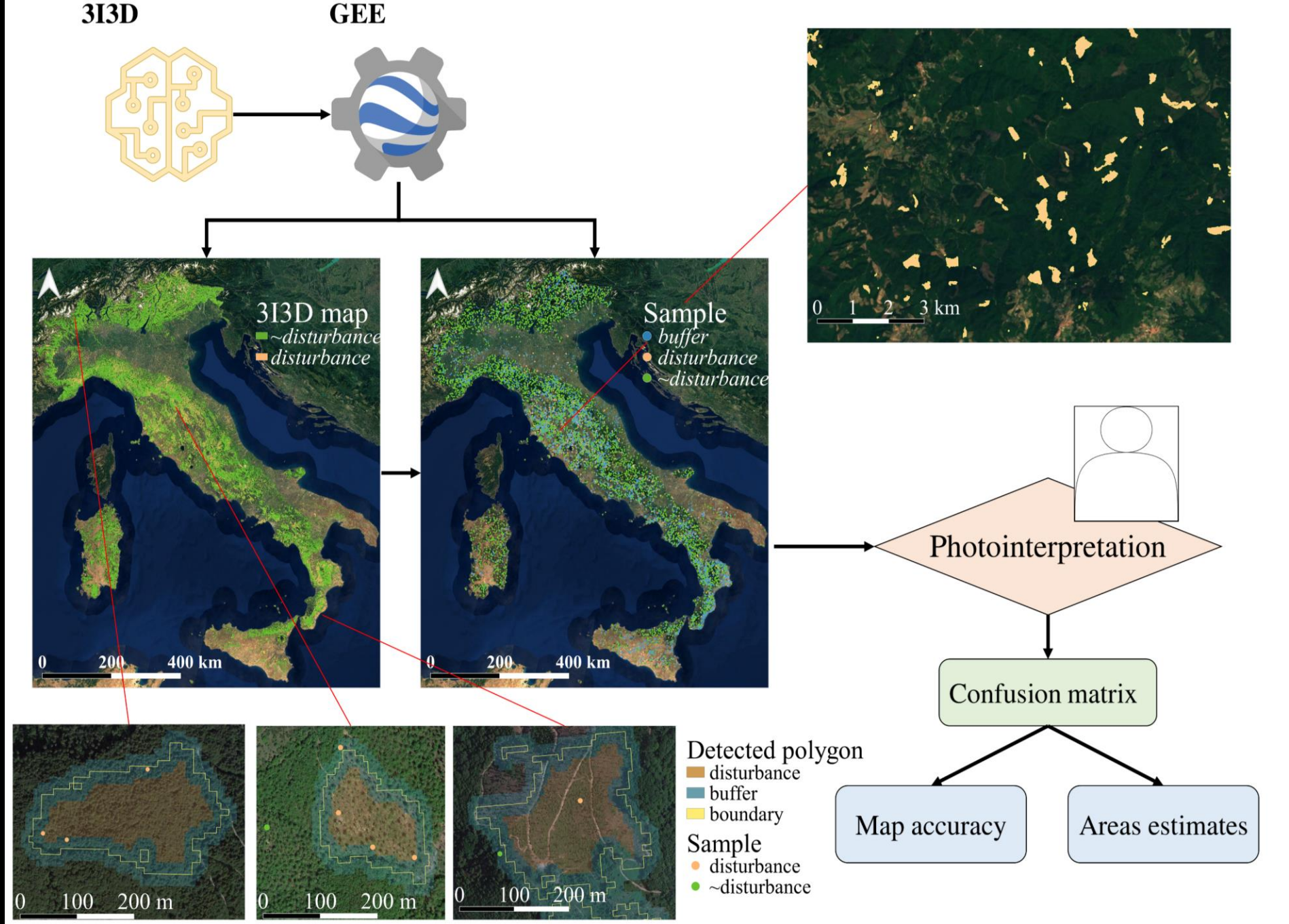
[code.earthengine.google.com/e27240a92ecf64...](https://code.earthengine.google.com/e27240a92ecf64...)



You and 7 others

8:00 PM · Apr 29, 2021 · Twitter Web App

102 Retweets 10 Quote Tweets 376 Likes



The number of processed Sentinel-2 images was **17592**: 5100 acquired in 2017, 6547 in 2018 and 5945 in 2019.



Layers

Mappa

Satellite



## Welcome to 3I3D-GEE user interface

This user interface allows you to download medoid cloud-free composites, the 3I3D change map, the class map (with change, buffer, undisturbed forest map classes), a counts table with the proportion of the map in each of the map classes and the stratified sample that can be photointerpreted to calculate area estimates and maps accuracies

Area estimates and maps accuracies can be calculate using the counts table, the photointerpreted sample and the R code we provide:

[AreaEstimator3I3DGEE](#)[Scientific publications](#)

Forest change map year

2018 ▾

Minimum 3I3D magnitude

Minimum Mapping Unit (pixel)

Forest mask

FM\_Ita ▾

Country or path/to/aoi

Drive folder to save outputs

☐ Stratified estimator

Scorciatoie da tastiera

Dati mappa ©2021

2 km

Termini e condizioni d'uso



Contents lists available at [ScienceDirect](#)

## International Journal of Applied Earth Observations and Geoinformation

journal homepage: [www.elsevier.com/locate/jag](http://www.elsevier.com/locate/jag)



### An open science and open data approach for the statistically robust estimation of forest disturbance areas

Saverio Francini<sup>a,b,c,\*</sup>, Ronald E. McRoberts<sup>d</sup>, Giovanni D'Amico<sup>a</sup>, Nicholas C. Coops<sup>e</sup>, Txomin Hermosilla<sup>f</sup>, Joanne C. White<sup>f</sup>, Michael A. Wulder<sup>f</sup>, Marco Marchetti<sup>b</sup>, Giuseppe Scarascia Mugnozza<sup>c</sup>, Gherardo Chirici<sup>a</sup>

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<sup>c</sup> Dipartimento per l'Innovazione dei sistemi Biologici, Agroalimentari e Forestali, Università degli Studi della Tuscia, Via San Camillo de Lellis, Viterbo, Italy

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<sup>f</sup> Canadian Forest Service (Pacific Forestry Centre), Natural Resources Canada, Victoria, BC, Canada



Thanks for your time  
and have a great day!