





Remote sensing to support health monitoring of vulnerable forest environments: preliminary results on Norway spruce and Mediterranean pines in Italy

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# Forests and climate change

# Climate change and forests: impacts (short term)

#### **Increased productivity**

- CO<sub>2</sub> fertilization
- Higher temperature (inc. growth rate)
- Nitrogen mineralization
- Longer growing season

#### **Increased disturbance**

- Size/severity of forest fires, wind damage, floods
- Rate/severity/range of native insect and disease impacts
- Invasive species





### **Vulnerable forest environments**

Mediterranean pine forest
Pinus pinea
P. pinaster
P. alepensis

**Norway spruce** *Picea abies* 





#### **Vulnerable forest environments**

#### Mediterranean pine forest



The spread of the non-native pine tortoise scale *Toumeyella parvicornis* (Hemiptera: Coccidae) in Europe: a major threat to *Pinus pinea* in Southern Italy

Antonio Pietro Garonna, Alessandro Foscari, Elia Russo, Giovanni Jesu, Silvano Somma, Pasquale Cascone, Emilio Guerrieri





#### Norway spruce



remote sensing

MDPI

#### Article

Mapping a European Spruce Bark Beetle Outbreak Using Sentinel-2 Remote Sensing Data

Michele Dalponte <sup>1,\*,†</sup>, Yady Tatiana Solano-Correa <sup>2,†</sup>, Lorenzo Frizzera <sup>1</sup> and Damiano Gianelle <sup>1</sup>





# Study area



# Remote sensing to support vulnerable forest health monitoring





Taylor & Francis

Taylor & Francis Group

• Google Earth Engine



• 3I3D Algorithm

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</sup>, <sup>b</sup>, <sup>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>

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# The coming of Google Earth Engine

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





#### Google Earth Engine 00 Search places and datasets... Q -08-01 Satellite Layers Mappa 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

mappa ©2020 Google Immagini ©2020 TerraMetrics 200 km



## Results



#### Norway spruce



L'ITALIA FORESTALE E MONTANA

#### Italian Journal of Forest and Mountain Environments





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ORIGINAL RESEARCH ARTICLE / CONTRIBUTO ORIGINALE DI RICERCA 77 (1): 23-34, 2022 doi: 10.36253/ifm-1617

#### Massive windfalls boost an ongoing spruce bark beetle outbreak in the Southern Alps

Danni da vento amplificano un attacco incipiente di bostrico dell'abete rosso nelle Alpi Meridionali

Davide Nardi <sup>(a)(h)(c)(\*)</sup> - Valerio Finozzi <sup>(d)</sup> - Andrea Battisti <sup>(a)</sup>



# Reference dataset

- Mediterranean pine forests ~ 1000 ha
- Photointerpretation of damaged in
  - 2020
  - 2021

## Results

Matthews Correlation Coefficient (MCC) = -

$$\frac{(TP \times TN) - (FP \times FN)}{\sqrt{(TP + FN) \times (TP + FP) \times (TN + FN) \times (TN + FP)}}$$

2019		Reference			2020	2020		Reference	
		undamaged	damaged		2020		undamaged	damaged	
Prediction	undamaged	TN 20984	FN 1286	22270	Prediction	undamaged	TN 742	FN 890	1632
	damaged	FP 1331	TP 2563	3894		damaged	FP 4402	TP 20130	24532
		22315	3849				5144	21020	

$$Overall Accuracy = \frac{TP + TN}{TP + FP + TN + FN}$$

OA = 90%

OA = 80%

#### Results







#### Summer 2022 Europe's hottest on record



Climatic Change (2013) 121:713–725 DOI 10.1007/s10584-013-0933-y

### Growth rate and climate responses of *Pinus pinea* L. in Italian coastal stands over the last century

Gianluigi Mazza · Maria Chiara Manetti

Received: 21 September 2012 / Accepted: 8 September 2013 / Published online: 20 September 2013 © Springer Science+Business Media Dordrecht 2013

### **Conclusion and Next**

- Growing trend in disturbed areas over the years
- Exhaustive reference data to provide statistically rigorous estimates
  - More accurate areas
  - Discriminate origin of the disorder











# Thank you

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