# Tecniche Satellitari Robuste a supporto della viticoltura di precisione

Nicola Genzano, Roberto Colonna, Valeria Satriano, Valerio Tramutoli

School of Engineering, University of Basilicata, Potenza, Italy

Space Technologies and Application Centre, Potenza, Italy

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# Obiettivi specifici di UNIBAS nel Task T3.1

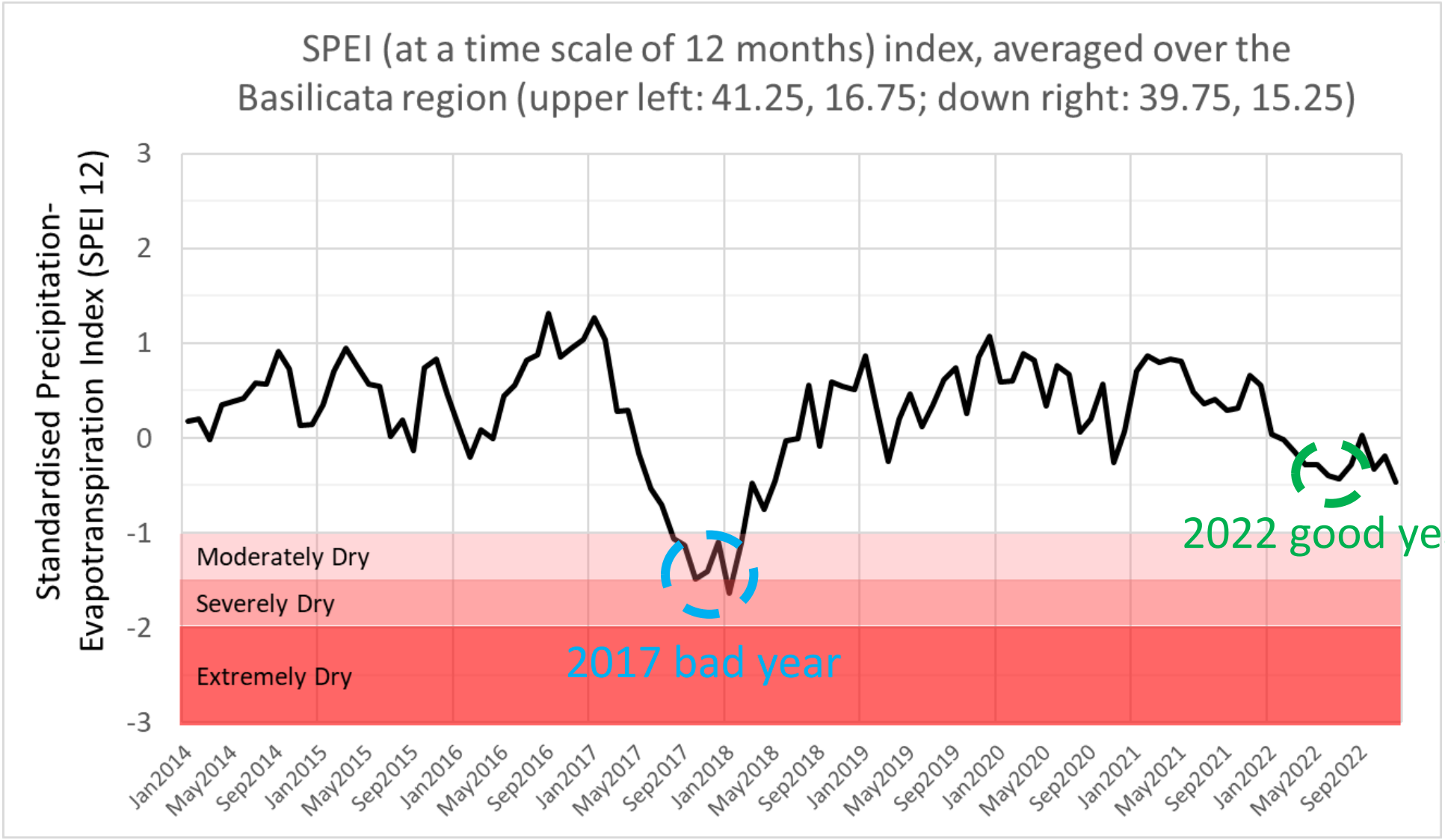
- Sviluppo di metodologie originali di analisi multi-temporale di dati satellitari acquisiti in banda ottica per il monitoraggio e la previsione della resa dei vigneti a partire da indici basati sul ciclo fenologico della vite;
- Generazione di mappe aggiornate e utili alla previsione della resa, all‘irrigazione e alla fertilizzazione mirata delle colture vitivinicole.

# *Test sites and test periods*

Vineyards located in the northern part of the Basilicata region

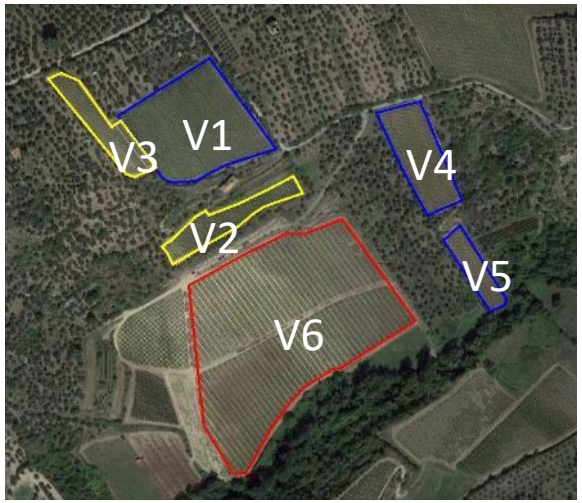
- ✓ ~ 9 hectares
- ✓ 500 meters above sea level
- ✓ mainly exposed in NE direction
- ✓ Aglianico del Vulture plants

# *Test sites and test periods*



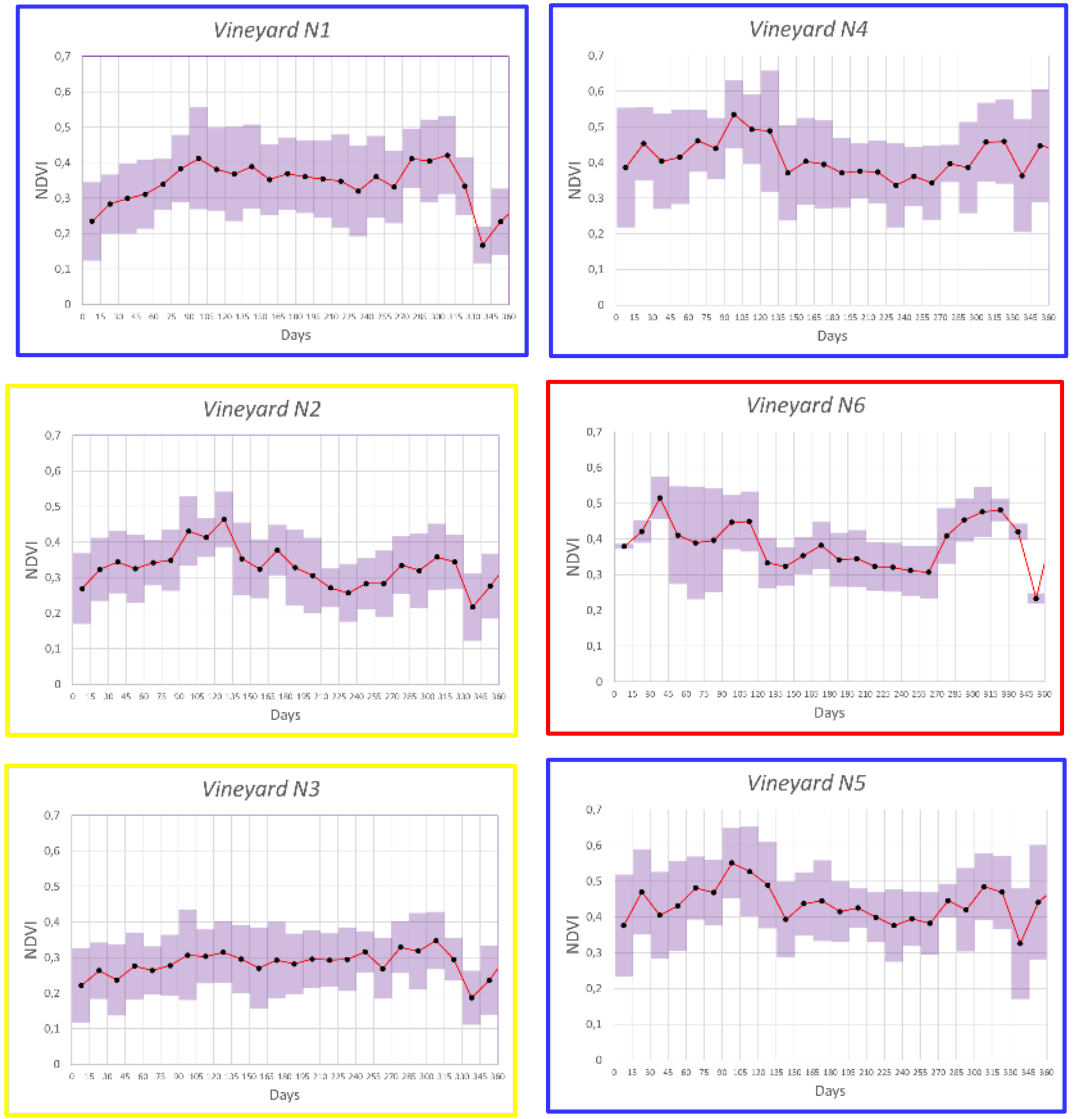
# *Learning from the past*

**Even out from extremes harvest quality and quantity strongly depends on local conditions**




NDVI time-series are used for the reconstruction of the vineyard phenological cycle

- > 500 Sentinel 2/MSI images acquired over Basilicata Region (Southern Italy) in the period 2015-2022:
  - Harmonized Sentinel-2 MSI Level-1C orthorectified top-of-atmosphere reflectance to compute NDVI,
  - Sentinel-2: Cloud Probability to identify clear sky locations.



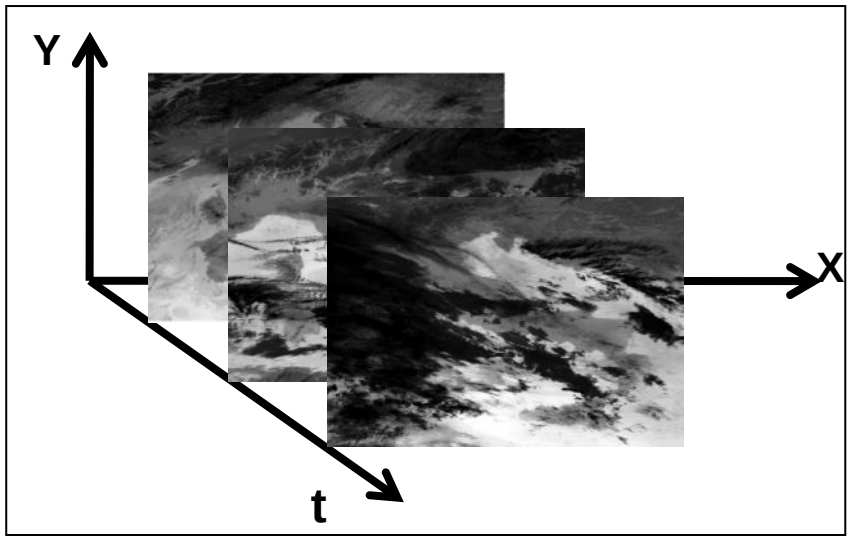

*Vineyards phenology*

*(NDVI spatio/temporally averaged Sentinel2 2015-2022)*

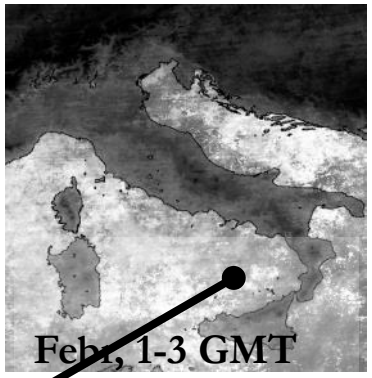
# Un approccio comune : Robust Satellite Techniques – RST

(già **RAT: Robust AVHRR Techniques,** *V.Tramutoli, 1998, 2005,2007* )

**1. Calcolo dei campi di riferimento** imperturbati per *V(**r**,t)* a partire da una serie multitemporale di osservazioni satellitari raccolte in condizioni OMOGENEE (stessa ora del giorno, mese/stagione dell'anno, etc.)




$V_{REF}(\mathbf{r})$ e $\sigma_V(\mathbf{r})$





**2. Change detection al tempo *t* con:**

$$\otimes_V(x,y,t) = \frac{V(x,y,t) - V_{REF}(x,y)}{\sigma_V(x,y)}$$

**A.L.I.C.E.**

*(**A**bsolutely **L**local **I**ndex of **C**hange of the **E**nvironment)*

# *Implementing RST for detecting significant changes in phenology (average on the vineyard)*

$$\otimes_V (x,y,t) = \frac{V(x,y,t) - V_{REF}(x,y)}{\sigma_V(x,y)}$$

ALICE
(*Absolutely Llocal Index of Change of Environment*)

$$V(N_i,t) = < NDVI(N_i,t) >$$

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

$$V(N_i,t) = < NDVI(N_i,t) >$$

Spatial average of the NDVI computed at the time *t* over the field $N_i$

$$\otimes\left(N_i,t\right) = \frac{< NDVI\left(N_i,t\right) > - \mu_{NDVI}\left(N_i\right)}{\sigma_{NDVI}\left(N_i\right)}$$

$\mu(N_i)$ and $\sigma(N_i)$ computed over all Sentinel-2/MSI images collected in the same period (fortnights) of the year in the years (2015-2022)

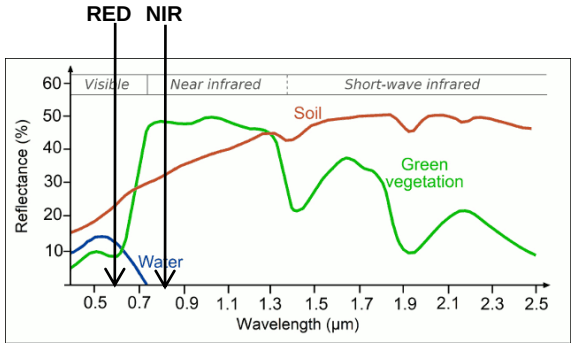
# *Implementing RST for mapping significant changes (at pixel level)*

$$\otimes_V (x,y,t) = \frac{V(x,y,t) - V_{REF}(x,y)}{\sigma_V(x,y)}$$

ALICE
(*Absolutely Llocal Index of Change of Environment*)

$$V(N_i,t) = NDVI(x,y,t)$$

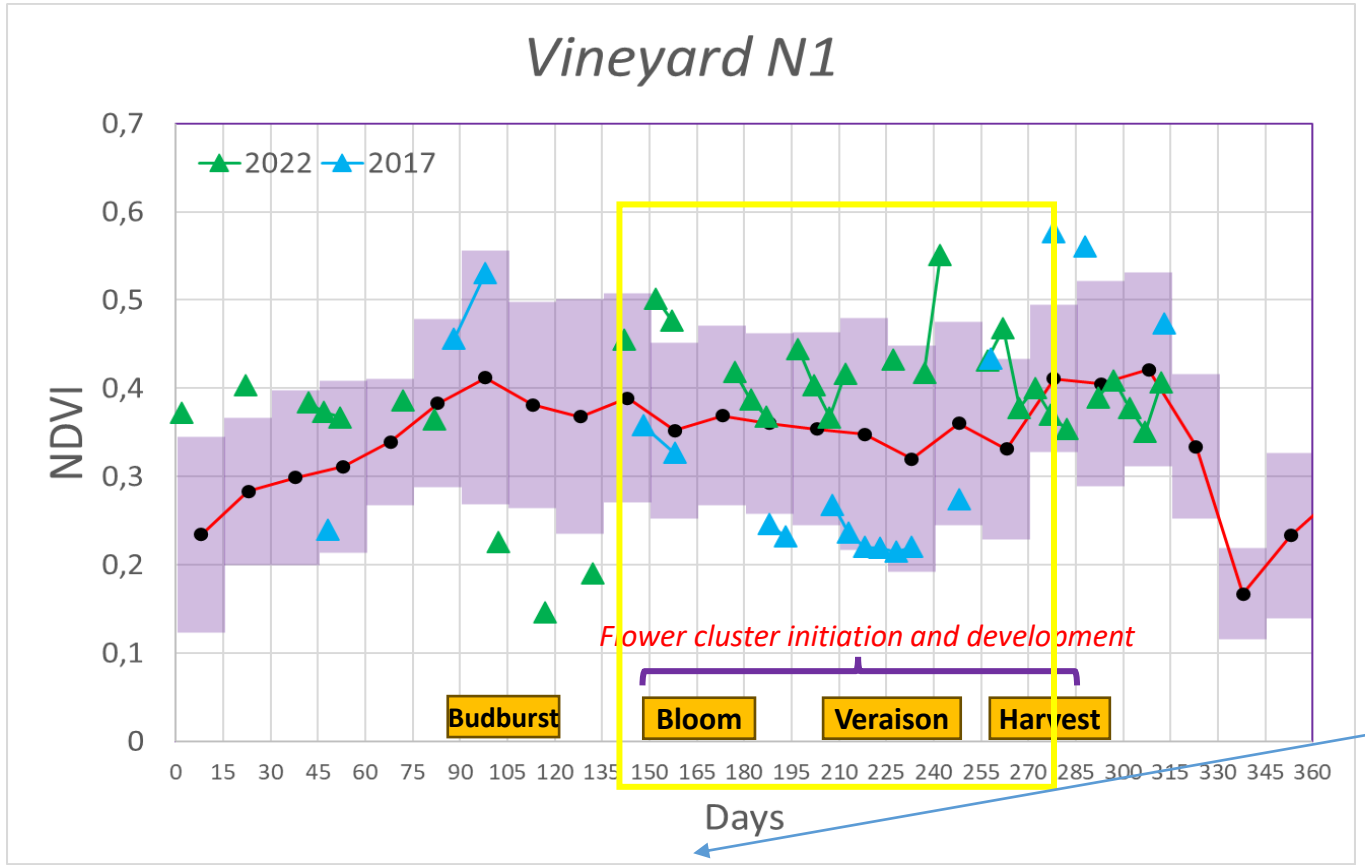
$$NDVI = \frac{NIR - RED}{NIR + RED}$$

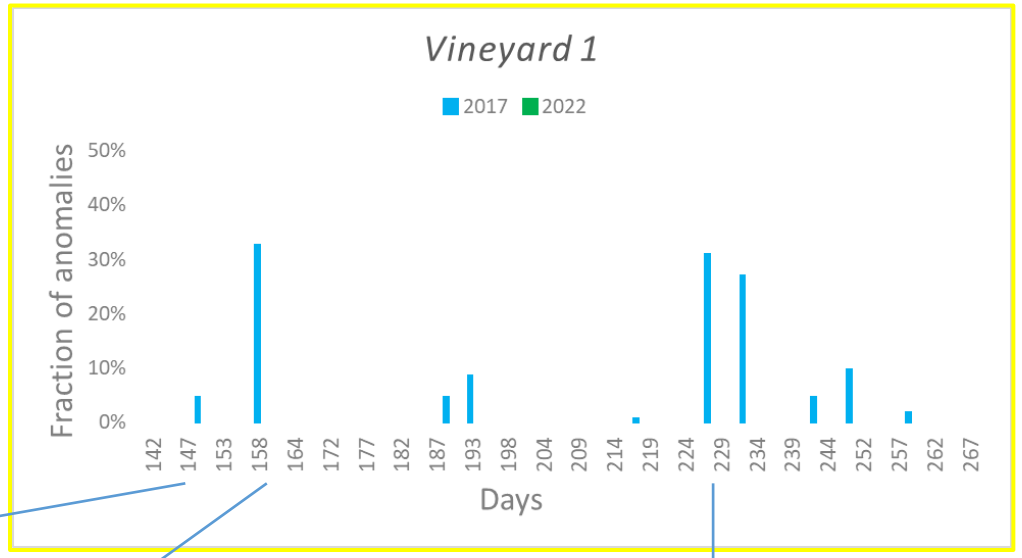



$$\otimes_{NDVI} (x,y,t) \equiv \frac{NDVI(x,y,t) - \mu_{NDVI}(x,y)}{\sigma_{NDVI}(x,y)}$$

$\mu(x,y)$ and $\sigma(x,y)$ computed over all Sentinel-2/MSI images collected in the same period (fortnights) of the year in the years (2015-2022)

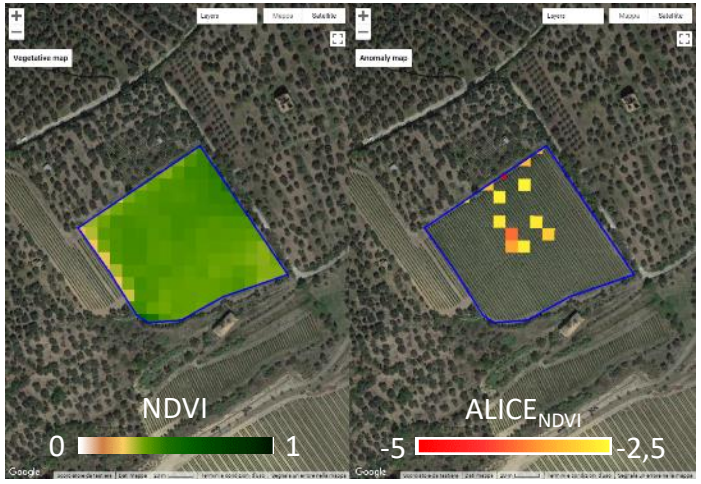
# Results



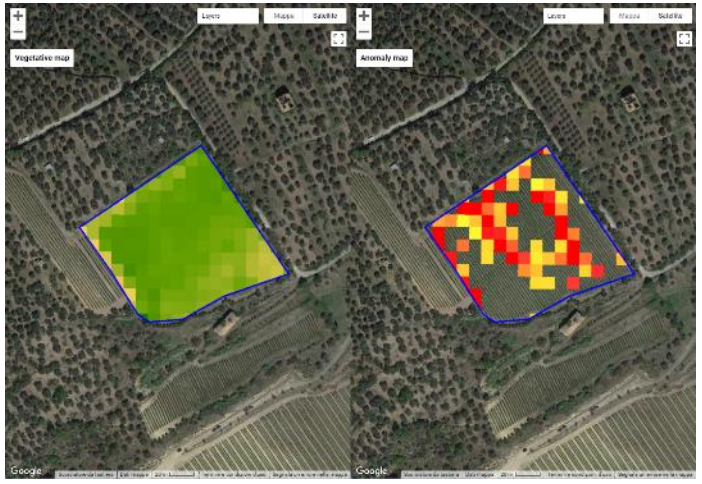




*(Higher quality well cultivated grapes for red wine)*

28/05/2017 (148)




07/06/2017 (158)



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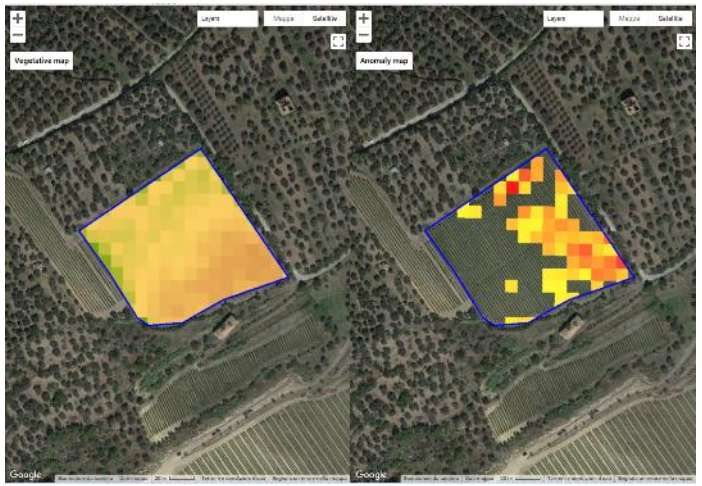

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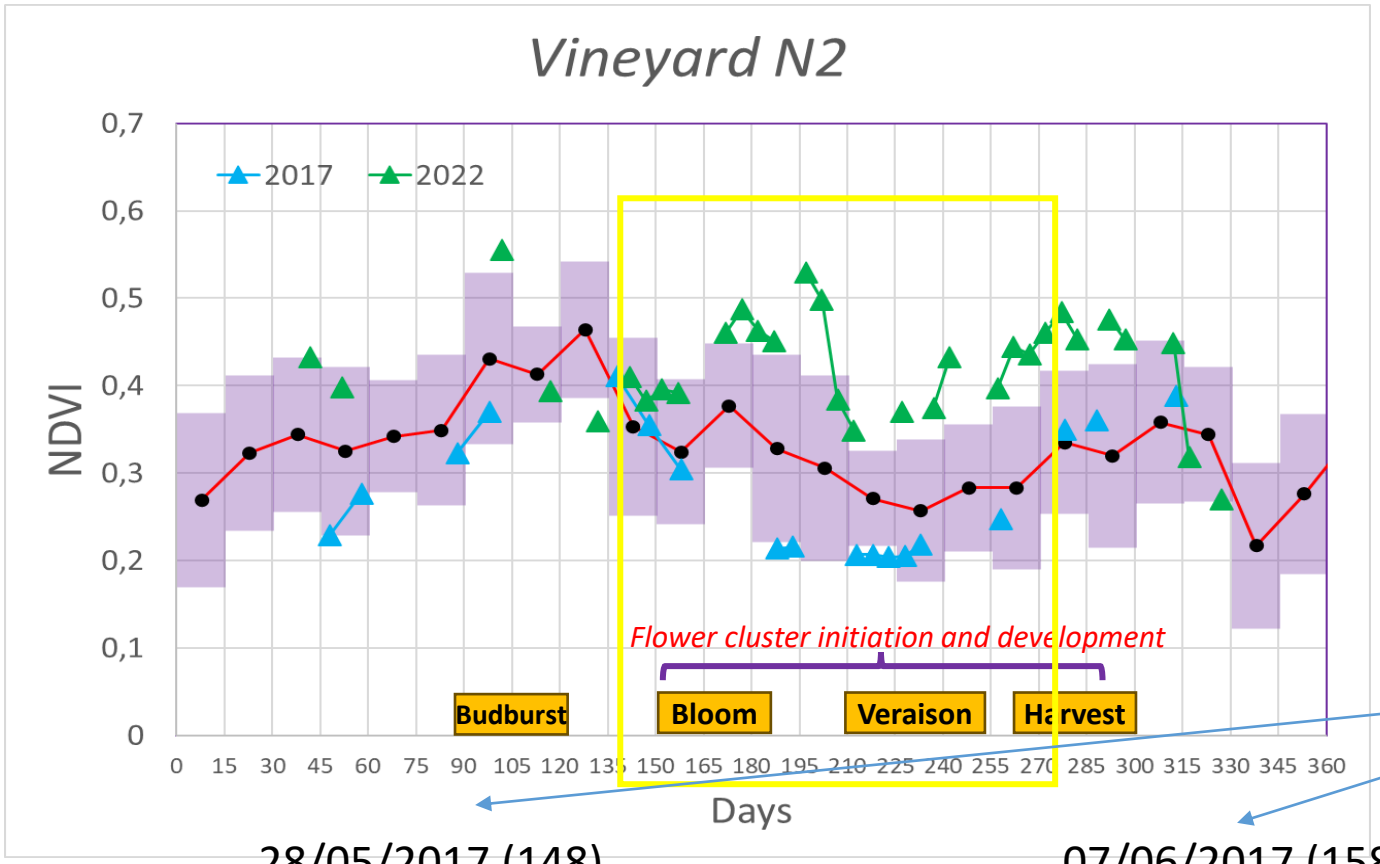


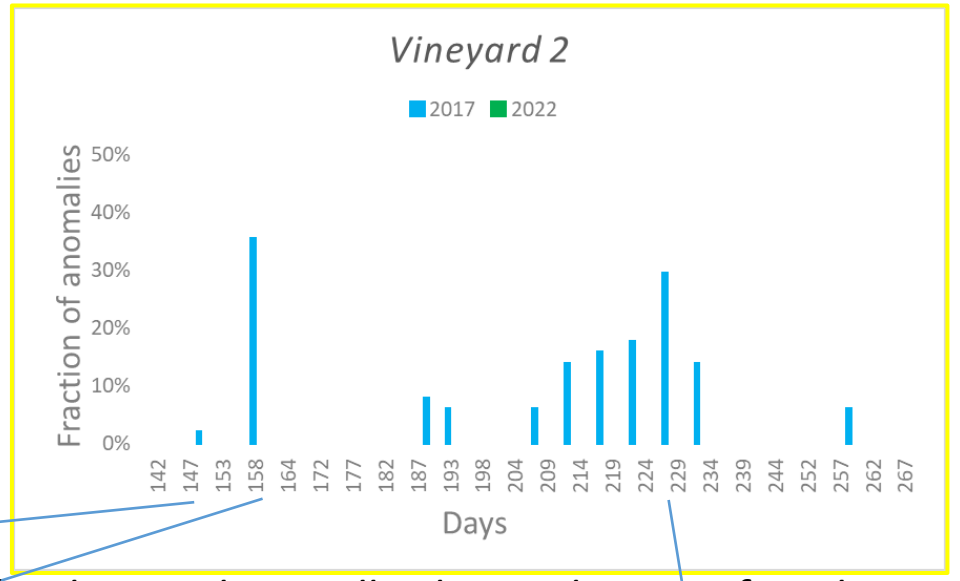


*(Higher quality well cultivated grapes for white wine)*

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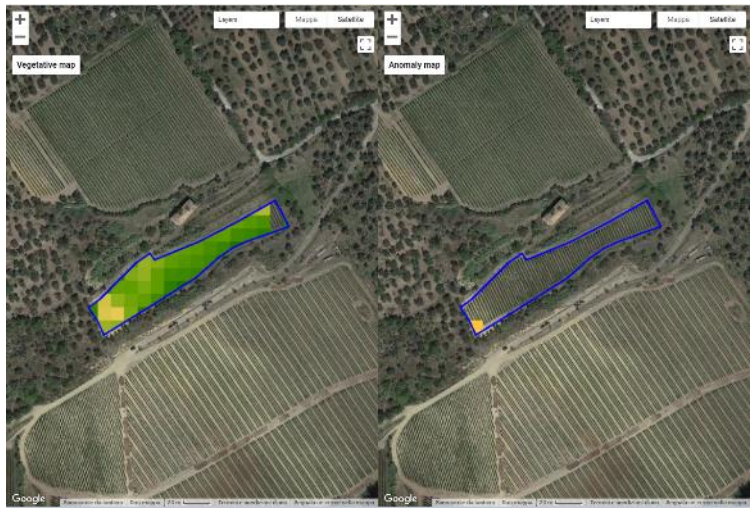


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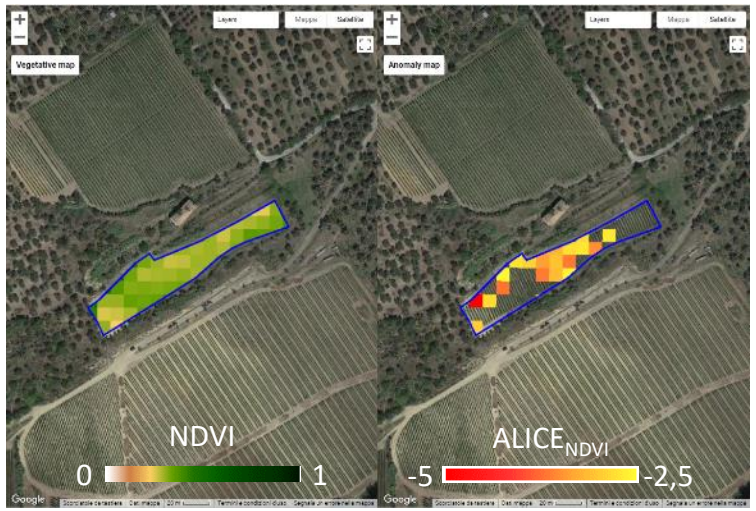


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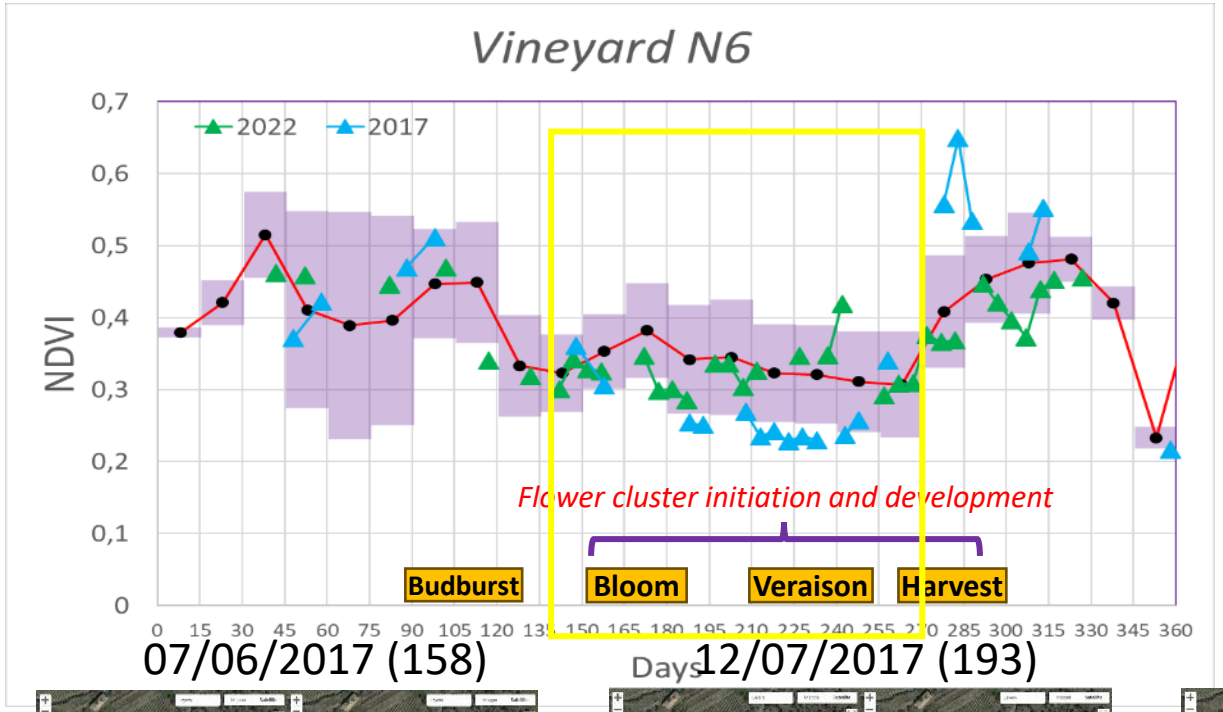


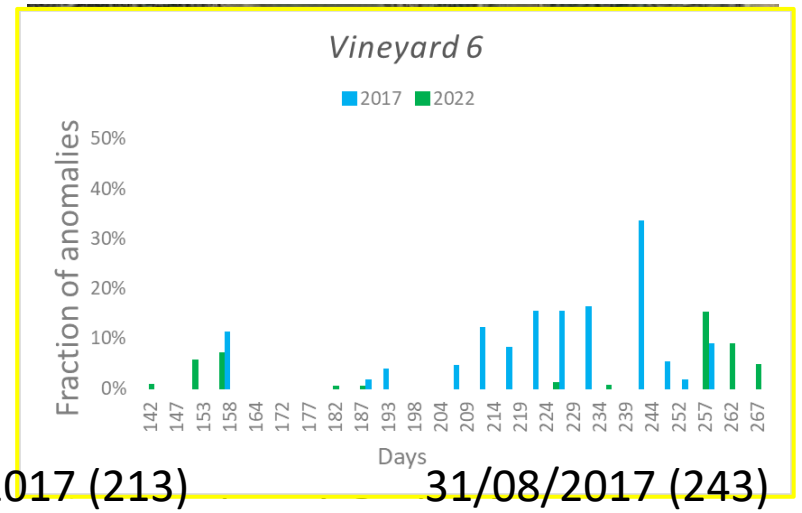


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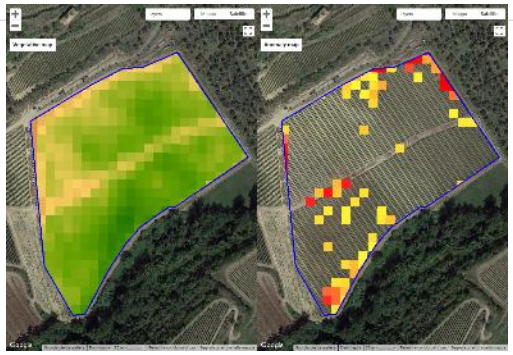

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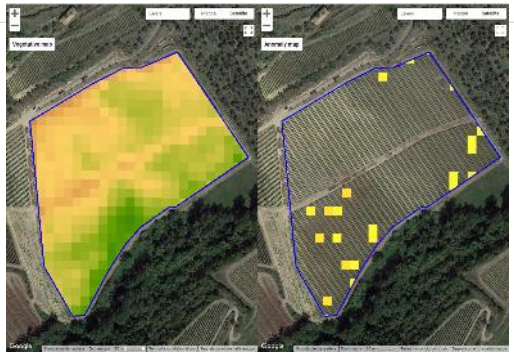

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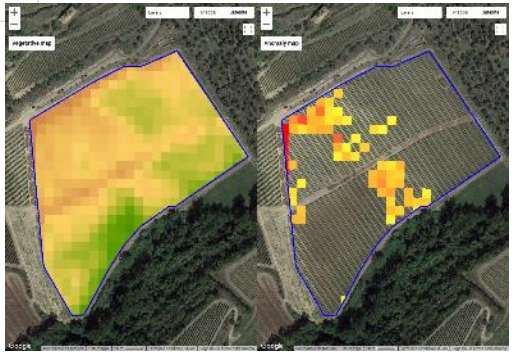

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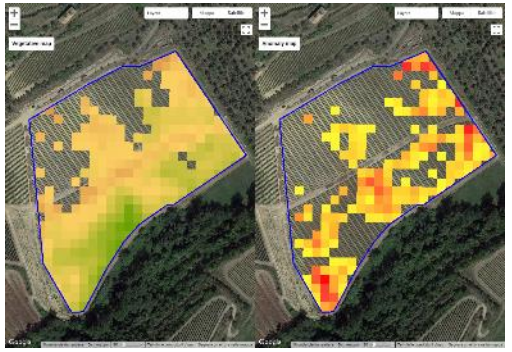

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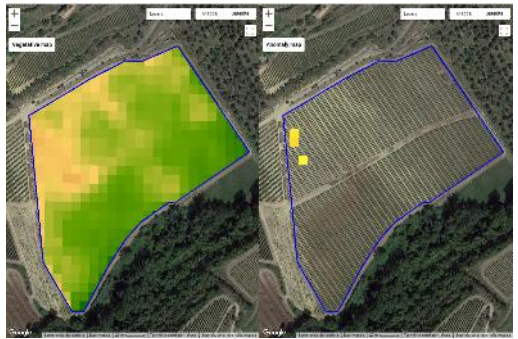

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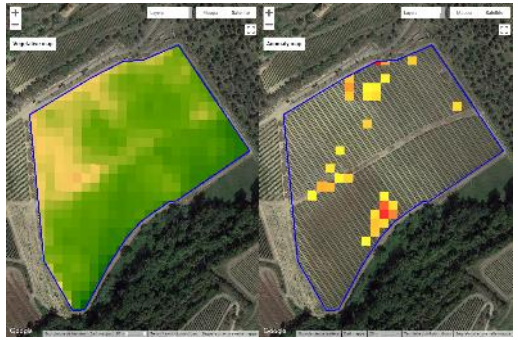

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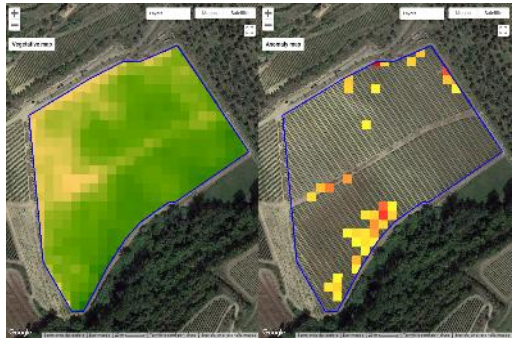

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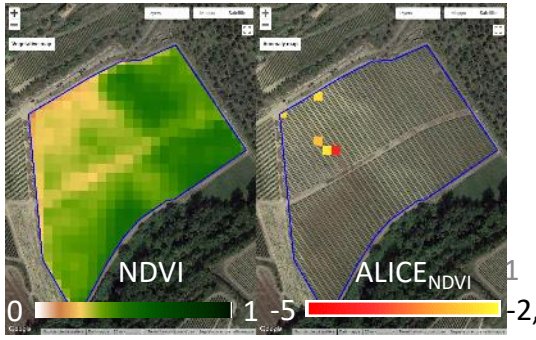
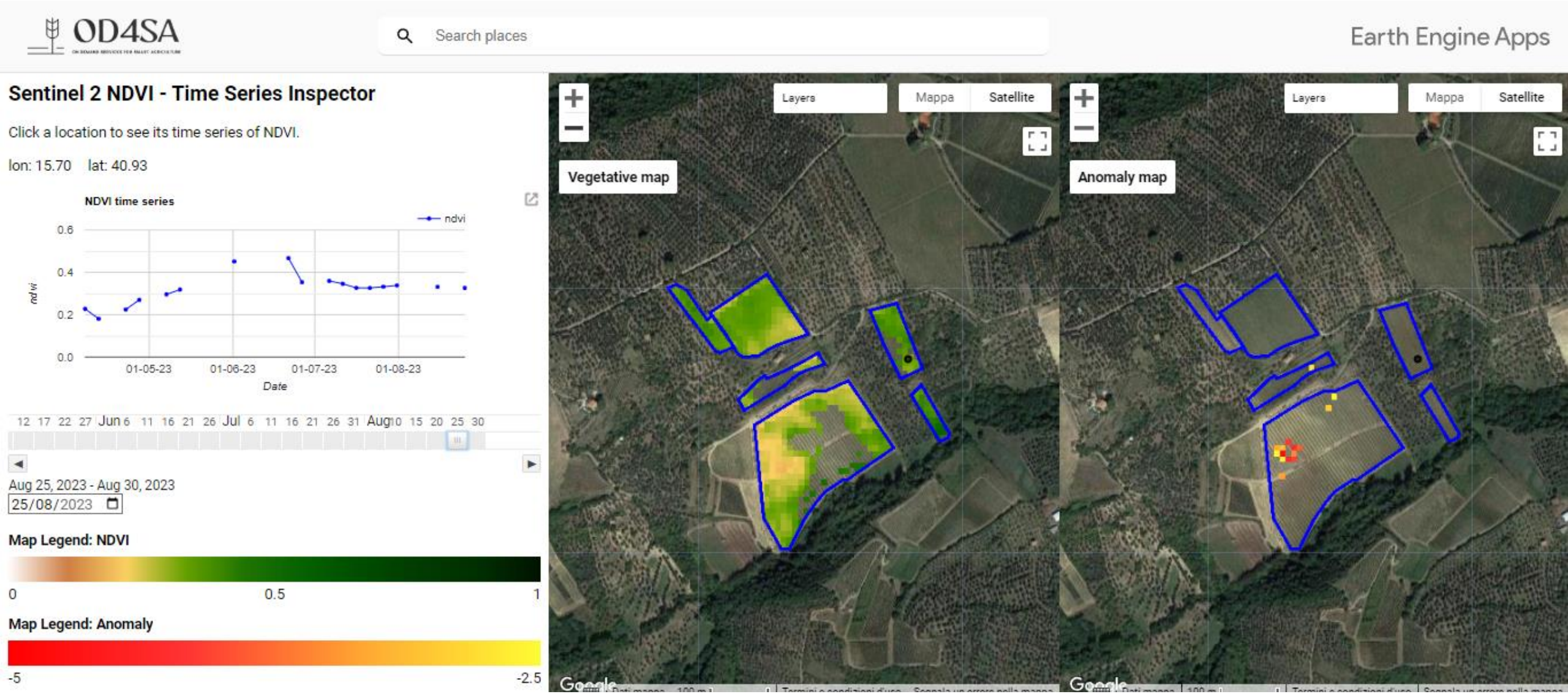
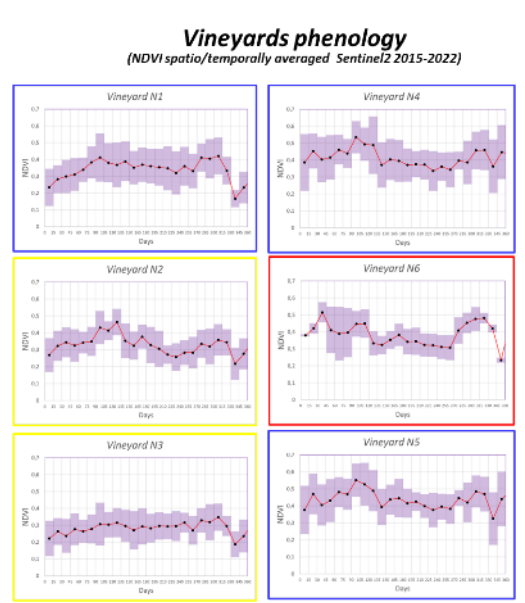


# *A tool to support winemakers*

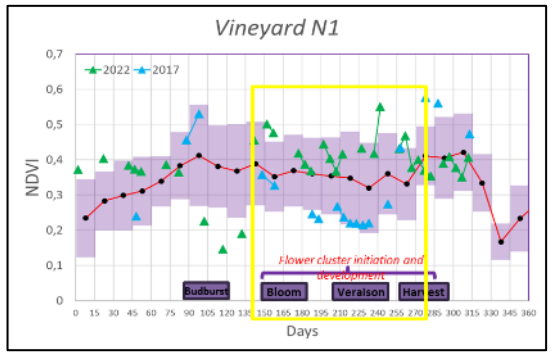


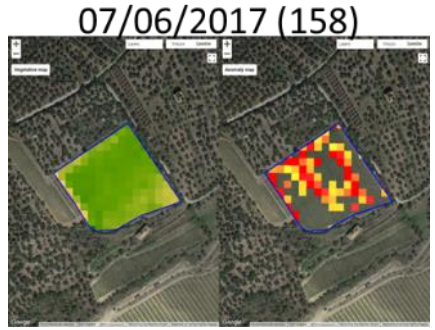
# *Summary and conclusions*

- Vineyard phenology strongly variable depending on local site conditions (soil, exposition, slope, etc.)
- In order to early detect and map significant anomalies refined methods are required




- RST approach provides:
  - timely information on vineyard response to climatological forcing
  - detailed maps in order to operate selective counter-mesures



# Disseminazione dei risultati ottenuti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