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THE 28TH GENERAL ASSEMBLY

H13 Vegetation and Hydrology Interactions: A Remote Sensing Perspective

IUGG23-3459

Robust Satellite Techniques for Early Detection of Hydrological Stress in Cultivated Areas: the Case of Basilicata (Italy) Region

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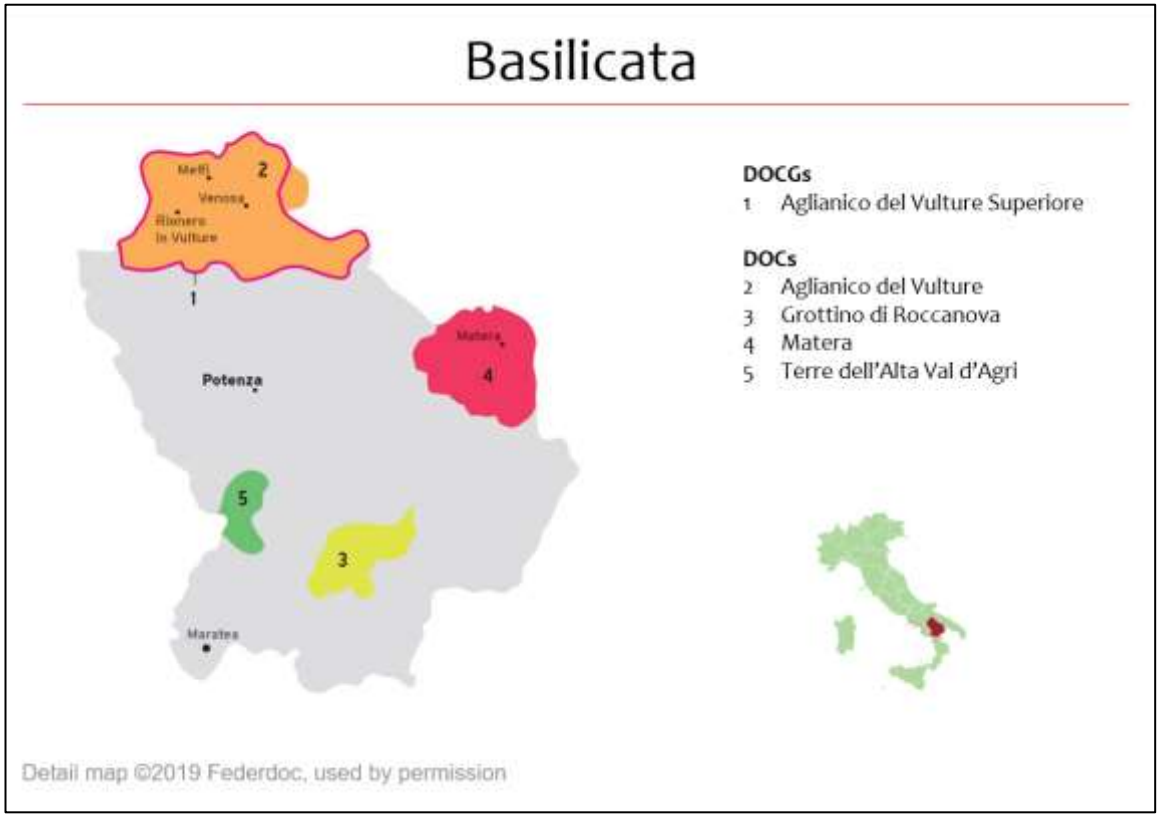
The Basilicata wine sector

- About 4,021 ha of vineyard surfaces
  - 2.879 in Potenza province
  - 1.142 in Matera province
- About 4.974 farms
  - 74% in Potenza province
    - IGT vineyards located in mountainous and hilly areas
    - DOC/DOCG vineyards located in hilly areas
  - 26% in Matera Province
    - mainly located in hilly and flat areas
- The region's primary grape variety is Aglianico del Vulture (56%)



The Basilicata wine sector

- High added value sector
- Increasing interest (and resources available) for Smart Farming but…
- … effects of Global Changes can frustrate all innovation efforts

il Quotidiano

17-GIU-2023
da pag. 15 / foglio 1 / 2

Quotidiano - Dir. Resp.: Rocco Valenti
Tiratura: N.D. Diffusione: 719 Lettori: 56000

IL CASO Situazione drammatica nel Vulture e nelle altre zone vinicole lucane

Peronospora, viticoltori disperati

Situazione dramm

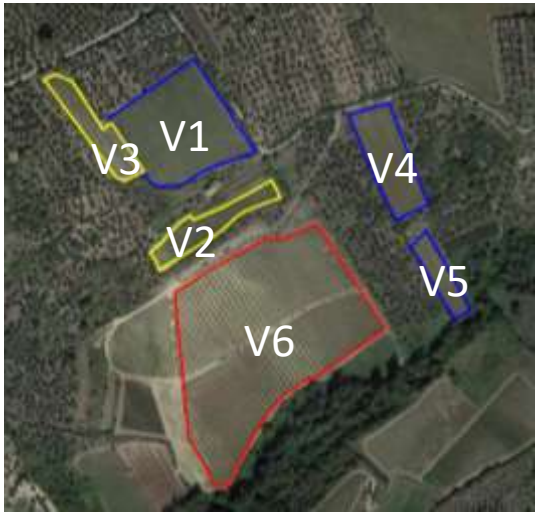
di GIANFRANCO AURILIO

La terribile piaga della peronospora sta distruggendo i vigneti di tutta Italia e la Basilicata, purtroppo, non fa eccezione. L'allarme è stato lanciato da Claudio Cufino, presidente Copagri (Confederazione produttori agricoli), che ha raccolto la disperazione di tanti viticoltori che non sanno più come fare ed ha emesso un comunicato per sollecitare la Regione a dichiarare lo stato di calamità naturale. Secondo Copagri, «ormai la situazione è compromessa del tutto» e «il raccolto del 2023 avrà un calo importante arrivando in alcuni vigneti ad un danno del 100 cento». «Ho chiesto alle aziende agricole di interloquire con i propri sindaci - si legge ancora nel comunicato - in modo da farli attivare in funzione della richiesta di calamità naturale. Il fatto che si tratti di un problema esteso, potrebbe aiutare affrontare questo problema su un tavolo nazionale fermo restando la possibilità di attivare provvedimenti a livello regionale. La Copagri di Potenza chiede alle Istituzioni locali di intervenire per trovare soluzione che vadano oltre lo stato di calamità attraverso provvedimenti, aiuti finanziari, per il mancato raccolto e per poter avviare

2023 grape downy mildew In Italy after anomalously intense and continuous raining weeks

Learning from the past

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

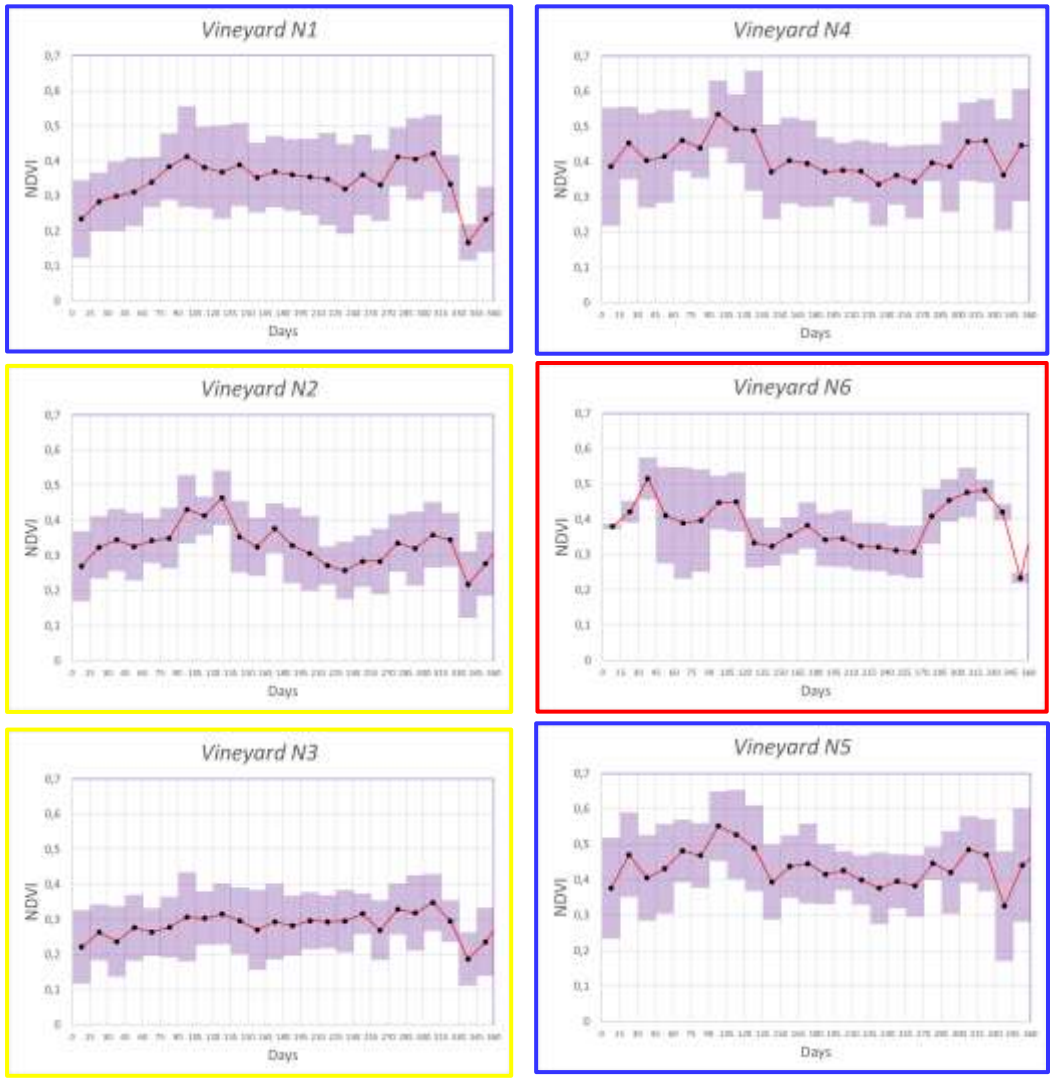


NDVI time-series are used for the reconstruction of the vineyard phenological cycle

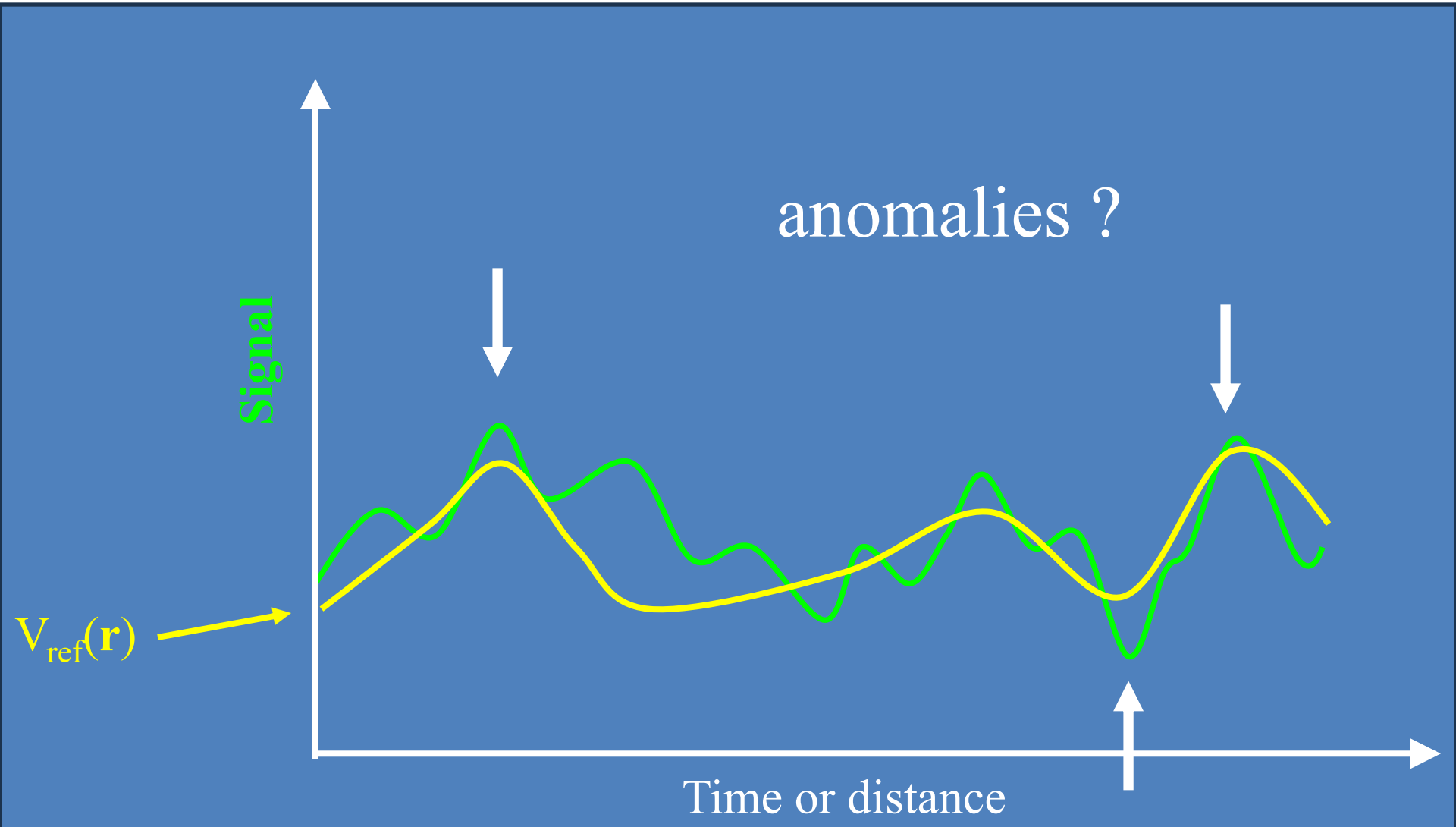
- > 500 Sentinel 2/MSI images acquired over Basilicata Region (Southern Italy) in the period 2015-2022:
  - Harmonized Sentinel-2 MSI Level-1C orthorectified top-of-atmosphere reflectance to compute NDVI,
  - Sentinel-2: Cloud Probability to identify clear sky locations.

Vineyards phenology

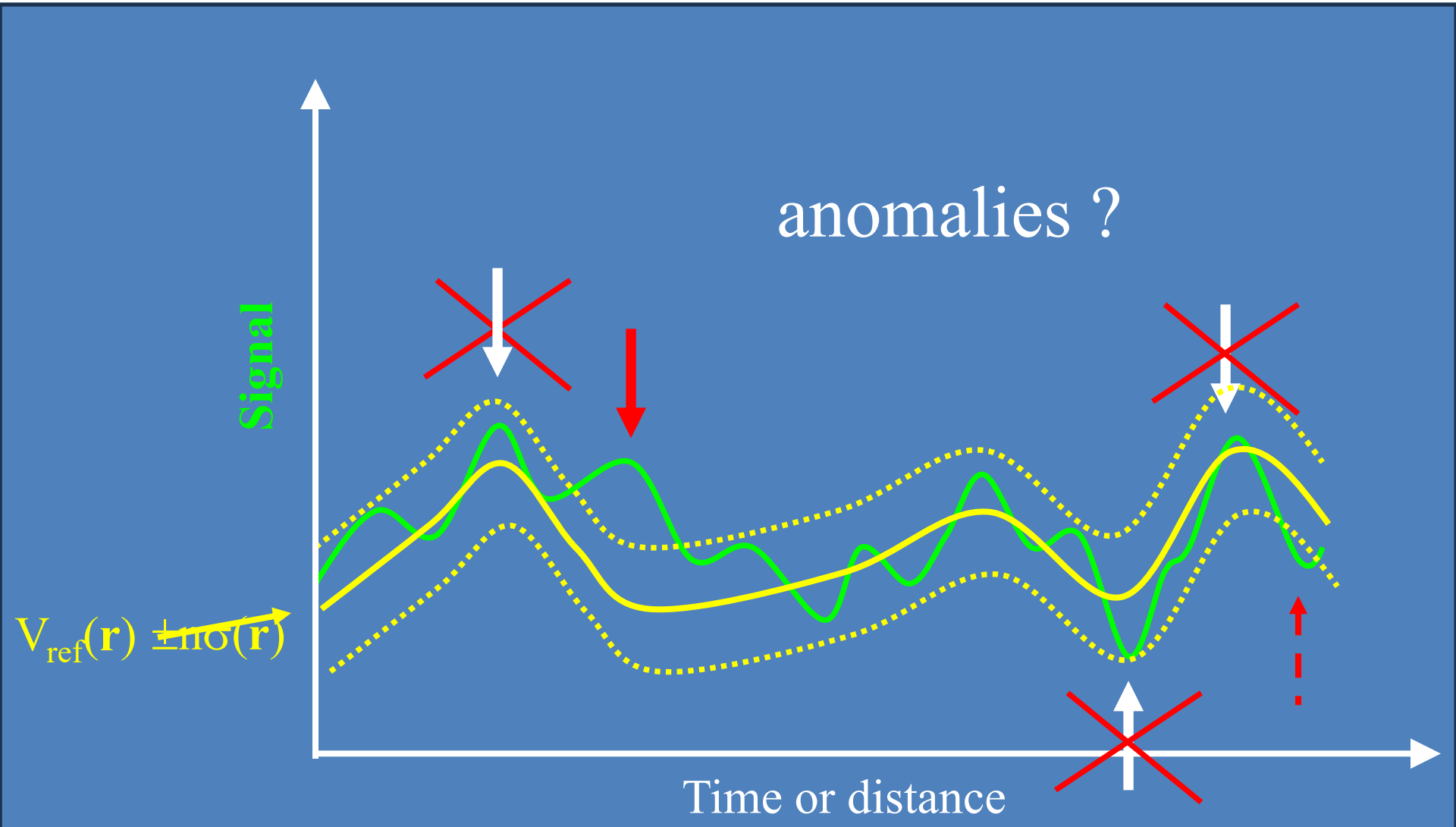
(NDVI spatio/temporally averaged Sentinel2 2015-2022)



How to early detect significant changes ?



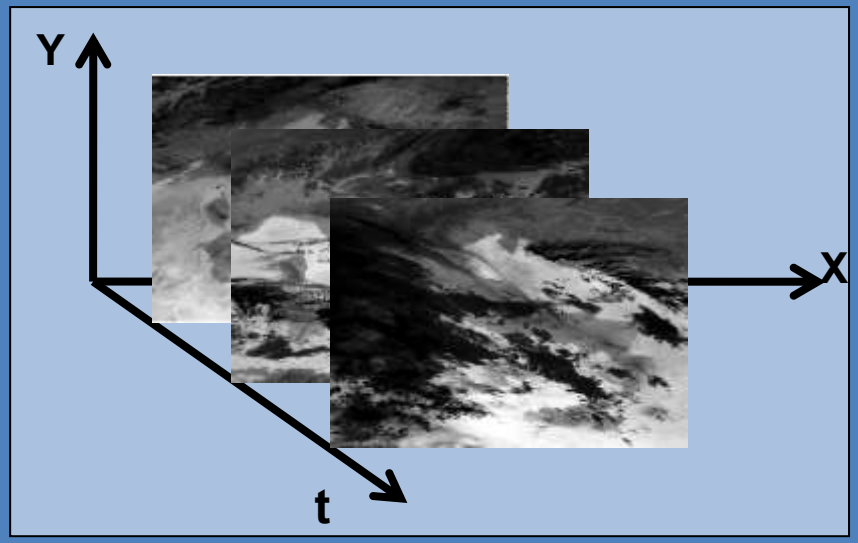
How to early detect significant changes ?



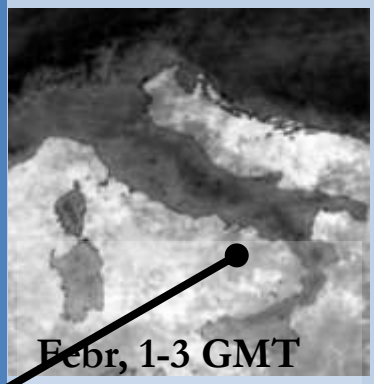
RST (Robust Satellite Techniques)

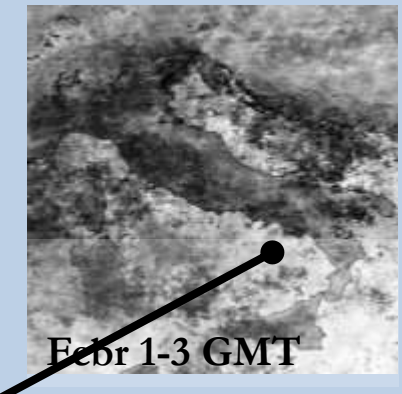
(formerly **RAT**: **R**obust **A**VHRR **T**echniques, *V.Tramutoli, 1998, 2005,2007*)

- **Computing the unperturbed reference fields for V(r,t) on a multi-temporal long-term HOMOGENEOUS (same time of the day, months of the year, etc.) historical satellite records**



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





- **Change detection at the time *t* by:**

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

A.L.I.C.E.

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

20 years of RST Applications

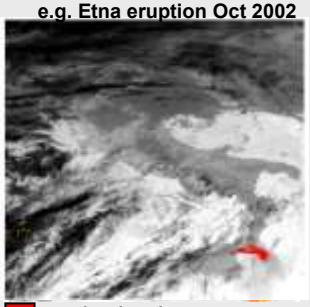
Forest fires

e.g. Fires in Italy, February 2005

fires

Volcanic Eruptions

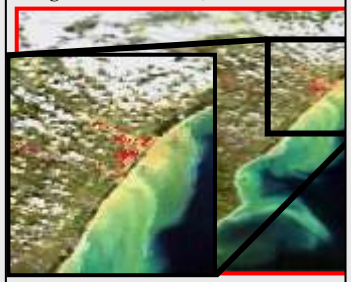
e.g. Etna eruption Oct 2002



Ash Clouds

Floods

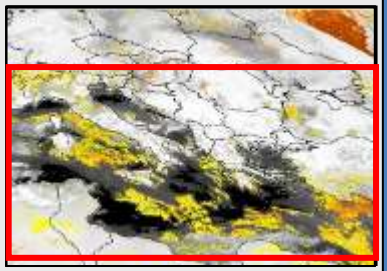
e.g. Basilicata flood, March 2011



Flooded areas

Dust storms

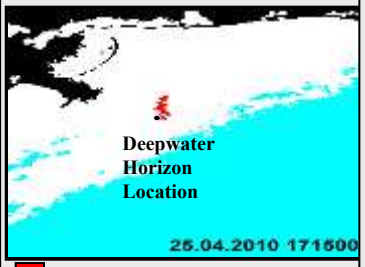
e.g.Libia 13 May 2004



Dust clouds

Oil spills

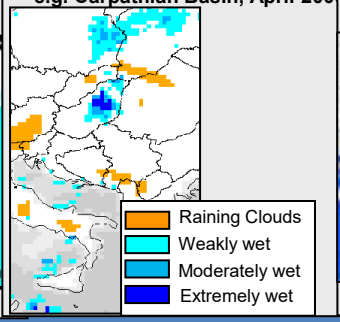
e.g. Oil spill in the Mexico Gulf, April 2010



Oil spill

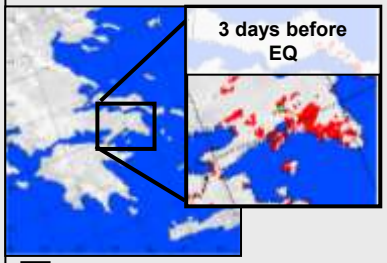
Soil wetnesss

e.g. Carpathian Basin, April 200



Earthquakes

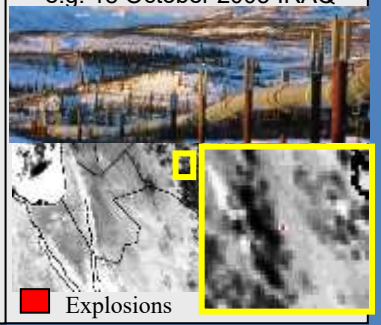
e.g. 7 September 1999 Athens Earthquake



Thermal anomalies

Infrastructures

e.g. 18 October 2005 IRAQ



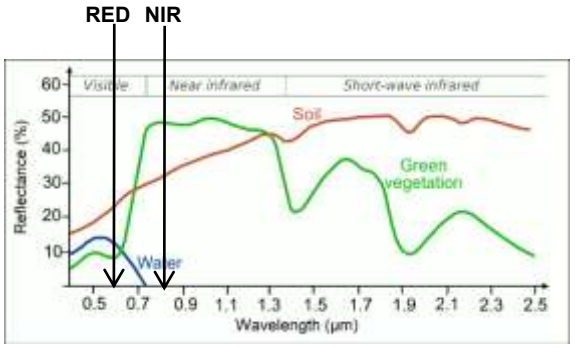
Explosions

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 LIocal Index of Change of Environment*)

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



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

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)

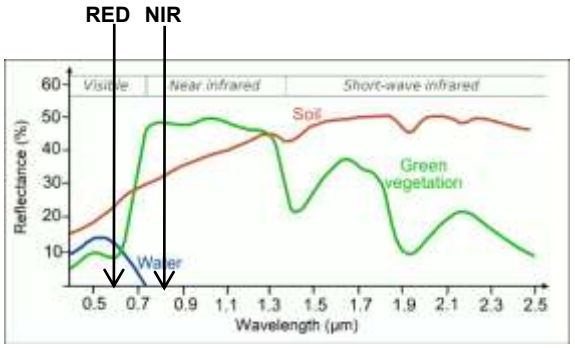
Implementing RST for mapping significant changes (at pixel level)

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

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

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

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



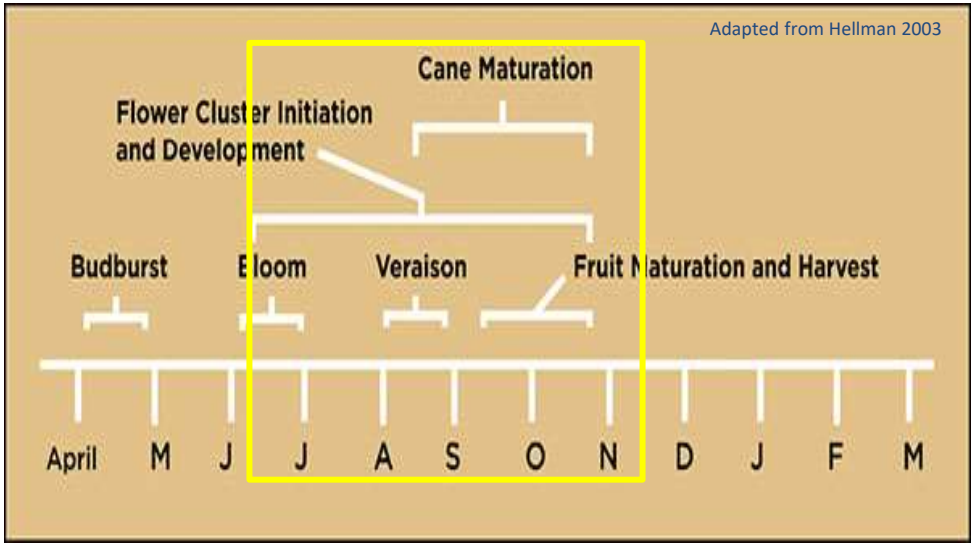
$$\otimes_{NDVI} (x,y,t) \equiv \frac{NDVI(x,y,t) - \mu_{NDVI}(x,y)}{\sigma_{NDVI}(x,y)}$$

$\mu(x,y)$ 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)

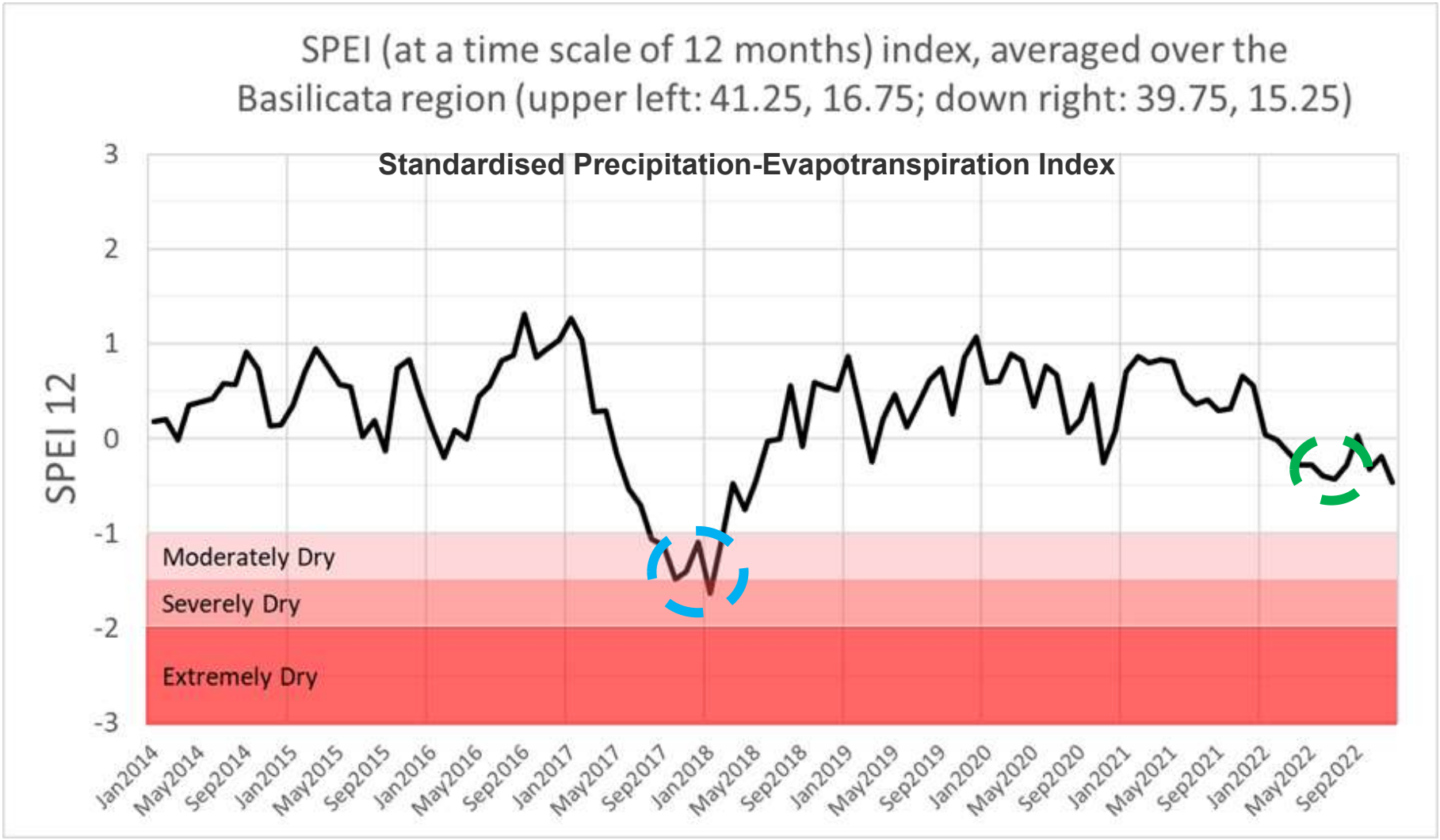
Test sites and test periods

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 testing periods

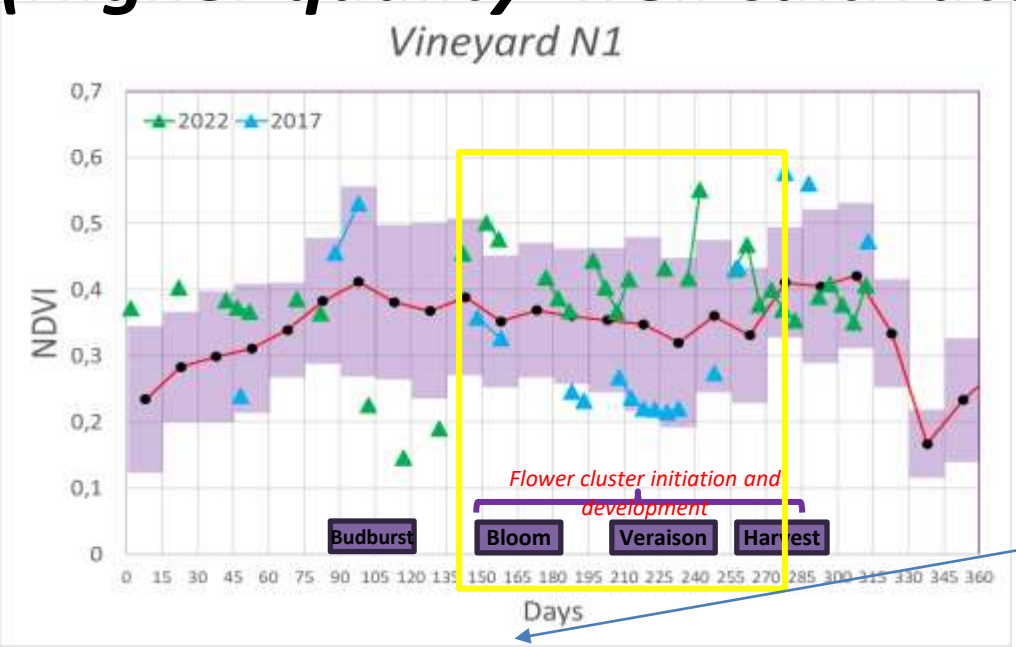


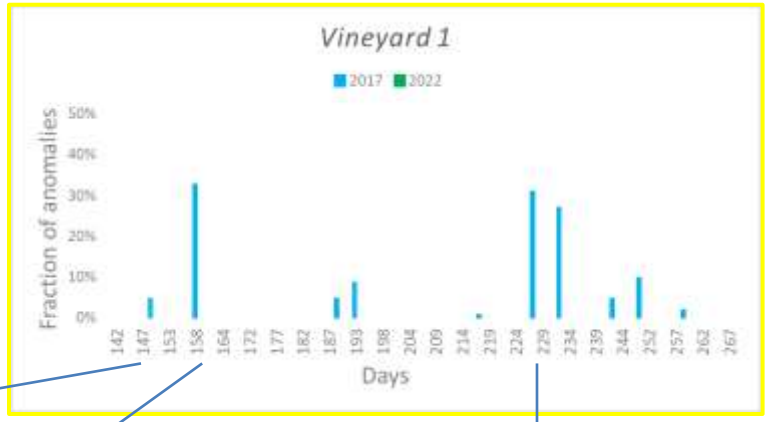
✓2017 bad year

✓2022 good year

Results Vineyard N1

(Higher quality well cultivated grapes for red wine)

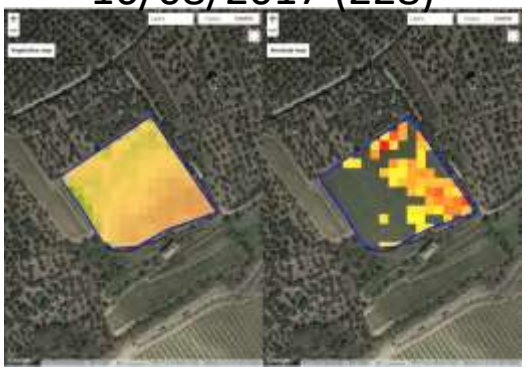




28/05/2017 (148)

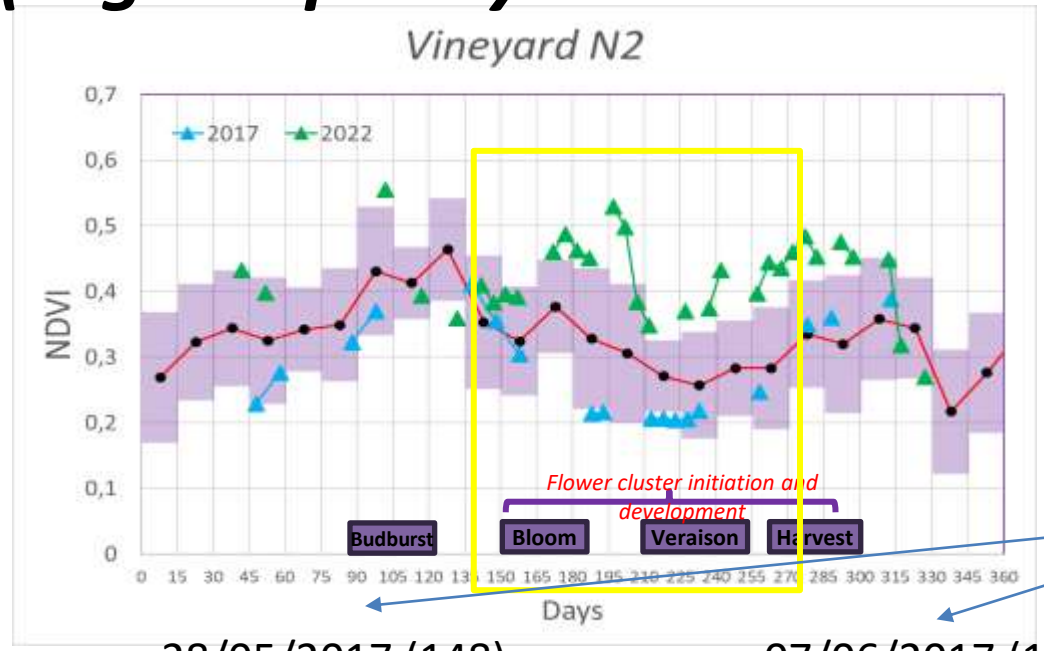
07/06/2017 (158)

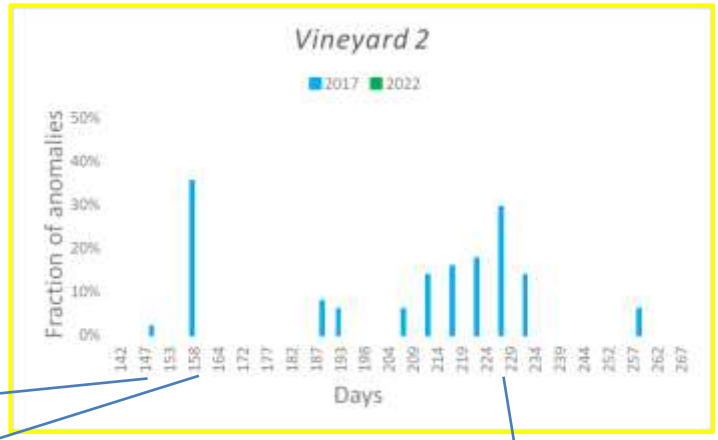
16/08/2017 (228)



Results Vineyard N2

(Higher quality well cultivated grapes for white wine)





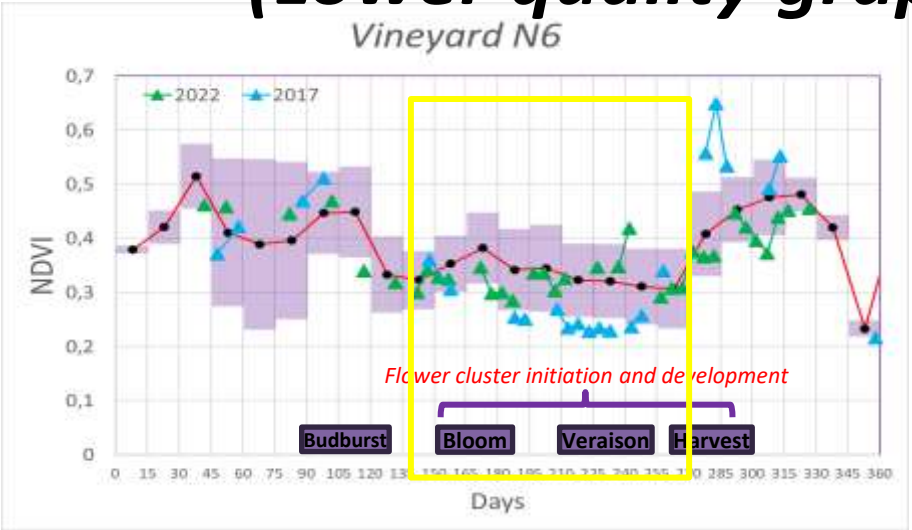
28/05/2017 (148)

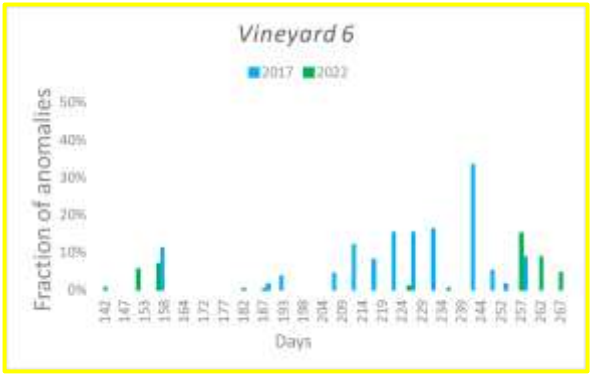
07/06/2017 (158)

16/08/2017 (228)

Results Vineyard N6

(Lower quality grapes for red wine)





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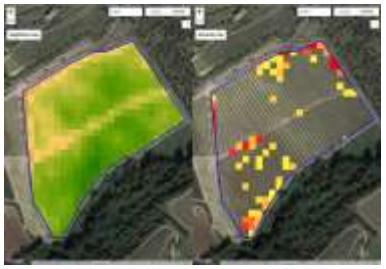

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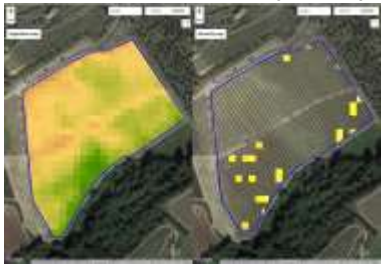

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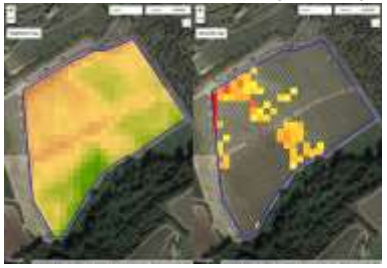
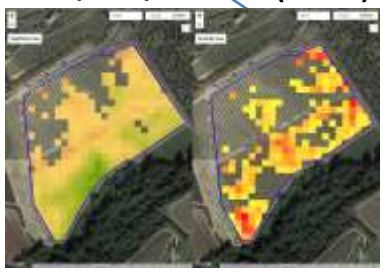


31/08/2017 (243)



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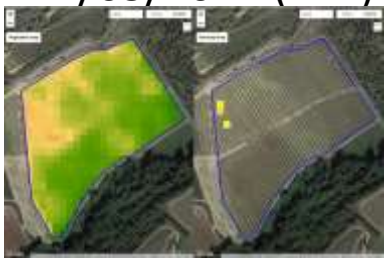

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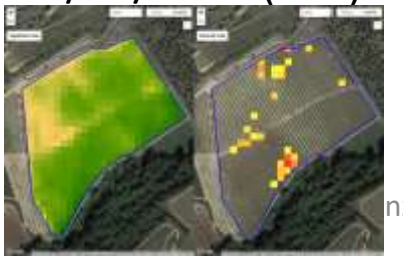

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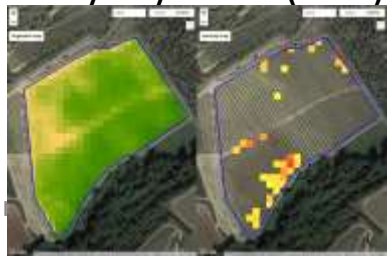

15/08/2022 (227)

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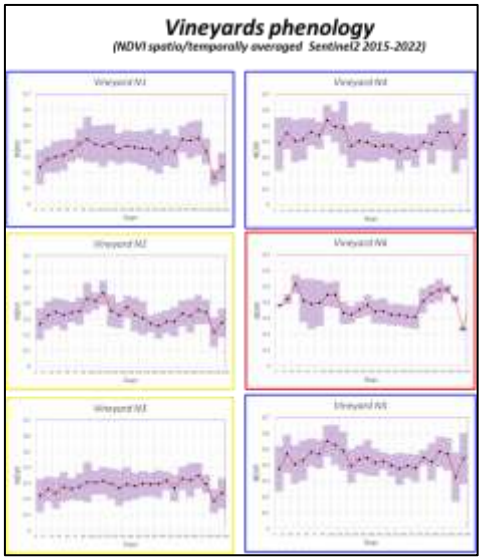
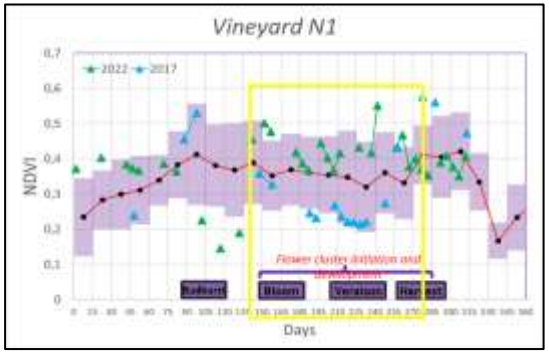
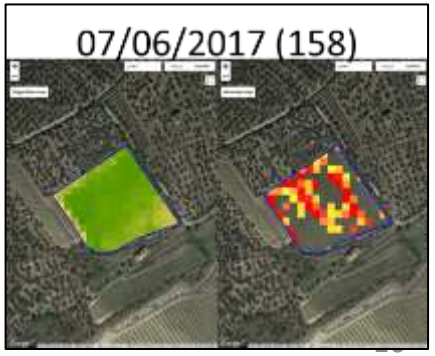
Conclusions

- 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



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Thanks for the attention

Acknowledgements

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