

Assessment Of Remote-based Vegetation Indices To Face Agriculture Challenges In The North Mediterranean

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MEDITERRANEAN

CLIMATE CHANGE

P40E%IPITATIO

General decrease by 25% to 30%. Some areas in the North Med. And South Med. Would attend more than 50%.

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The increase of the values would reach +4°C to +5°c in inland areas.



WARM SPELLS

- Increase in the intensity and frequency of drought events.
- Very strong droughts recorder on Italy in the 2000s and from 2010 on.

+ 1 psu SEA SURFACE SALINITY

 Non-homogeneous, geographically & seasonally dependent projected changes.

AGRICULTURE

+ 0.06 psu to + 1 psu.



Main threats

- Global water resource scarcity.
- Soil salinization.

+ 25 %

At the 2025 horizon, agricultural demand would increase by 25%.



PRECISION AGRICULTURE

POPULATION GROWTH

X 2

South Med. Countries will almost double by 2050 -> threatening the fragile balance between water availability and human demand.

Study area





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- Experimental field: Bari Apulia region
- Variety: Olea europea cv. Coratina
- Growing seasons: March November 2017 March – November 2018
- **Plots:** 12 Plots 10x10m², randomly distributed
- Water treatments: Rainfed Io
 Full irrigation I100
 Replications: 6 replications / treatment

Phenological stages: Full bloom Fruit set Fruit growth (stage 1) Fruit growth (stage 2)

GB Remote Sensing Measurements

Spectral measurements

Tool: ASD HanldHeld 2 Field Spec. Time: Noon time – clear sky days Period:

- Stage Full Bllom -> Stage Harvest
- 1 Reading per stage

Manner:

- Truck-crane
- FOV of the Spec. & crown area
- 6m A.C.L.

Thermal imagery

Tool: Infrared Thermal Camera (FLIR B335) **Time:** Solar noon – clear sky days **Period:**

- Stage Full Bloom -> Stage Harvest
- 1 Reading per stage

Manner:

- Truck-crane
- VER downward (nadir view)
- 6m A.C.L.





Bio-Physiological Measurements

Stomata conductance

Tool: Steady state diffusion Leaf Porometer Time: Solar noon – clear sky days Period:

- Stage Full Bllom -> Stage Harvest
- 1 Reading per stage

Manner:

- Same-age leaves labeled at the begenning of the experiment
- Abaxial leaf conductance
- 4 fully expanded leaves / Tree
- Every 2 hours: 08:00 -> 20:00



Chlorophyll content

Tool: Minolta Chlorophyll Meter SPAD-502 **Time:** Solar noon – clear sky days **Period:**

- Stage Full Bllom -> Stage Harvest
- 1 Reading per stage

Manner:

- 8 sampling leaves / Tree
- 1.5 1.8 m from the soil surface
- N-S-E-W
- Chlorophyll $\left(\frac{\mu mol}{m^2}\right) = 10^{M^{0.265}}$



Google Earth Engine



Google Earth Engine

Gapernieus CORINE Land Coverge Scale International Caver Scale International Boundary Roly Pool 2017





Thermal images of the canopy of two trees under rainfed and full water treatments, respectively





Regression correlations, root-mean-square error and P-level-statistical significance between ground-crop parameters and spectral vegetation indices - Optimization of chlorophyll indices for drought estimation

	NDVI								
Ground parameters	A.Y. 2016-2017			A.Y.					
	R ²	RMSE	P-level	R ²	RMSE	P-level			
SWC	0.81	0.13	***	0.63	0.16	***			
G _s	0.78	508.78	***	0.84	530.90	***			
T _c	0.60	23.60	***	0.50	33.72	***			
SPAD	0.73	1780.97	***	0.54	1841.51	***			
Ground parameters	MSI								
	A.Y. 2016-2017			Α.	18				
	R ²	RMSE	P-level	R ²	RMSE	P-level			
SWC	0.77	0.50	***	0.60	0.45	***			
G _s	0.60	508.58	***	0.45	530.73	***			
T _c	0.56	23.26	***	0.29	33.45	**			
SPAD	0.81	1769.01	***	0.39	1830.98	***			
Ground parameters	NMDI								
	A.Y. 2016-2017			A.Y. 2017-2018					
	R ²	RMSE	P-level	R ²	RMSE	P-level			
SWC	0.82	0.31	***	0.61	0.27	***			
G _s	0.77	508.62	***	0.48	530.82	***			
T _c	0.69	23.41	***	0.29	33.60	**			
SPAD	0.50	1773.13	***	0.52	1836.45	***			

Regression correlations and P-level-statistical significance between ground-crop parameters and spectral chlorophyll indices - Optimization of chlorophyll indices for drought estimation

Year	Ground parameters	TCARI/OSAVI		CVI		MCARI	
		R ²	P-level	R ²	P-level	R ²	P-level
2017	SWC	0.73	***	0.90	***	0.71	***
	G _s	0.44	***	0.68	***	0.69	***
	T _c	0.44	***	0.67	***	0.67	***
	SPAD	0.66	***	0.79	***	0.54	***
2018	SWC	0.78	***	0.65	***	0.92	***
	G _s	0.51	***	0.80	***	0.81	***
	T _c	0.61	***	0.67	***	0.66	***
	SPAD	0.70	***	0.53	***	0.83	***



Timeframeofdrought-relatedspectralindexspectralindex(NormalizedDifferenceVegetationIndex)undertwotreatments

- The vegetation spectral indices NDVI, MSI and NMDI were the best indicators of drought stress at the orchard level via good correlations (low RMSE) with the ground-truth measured parameters, specially when correlated with stomatal conductance which is an important indicator of crop stress.
- All the chlorophyll-related spectral indices were positively correlated to stomata conductance and canopy temperature, showing that reflectance measurements in the red-edge spectral region allowed the concentrations of various pigments related to water status to be described.
- The ability of the satellite-derived spectral index to detect how the difference on the precipitation pattern infected the canopy response.



for your attention