Photosynthetically active radiation climatology in Greece for optimal vineyard planning and exploitation

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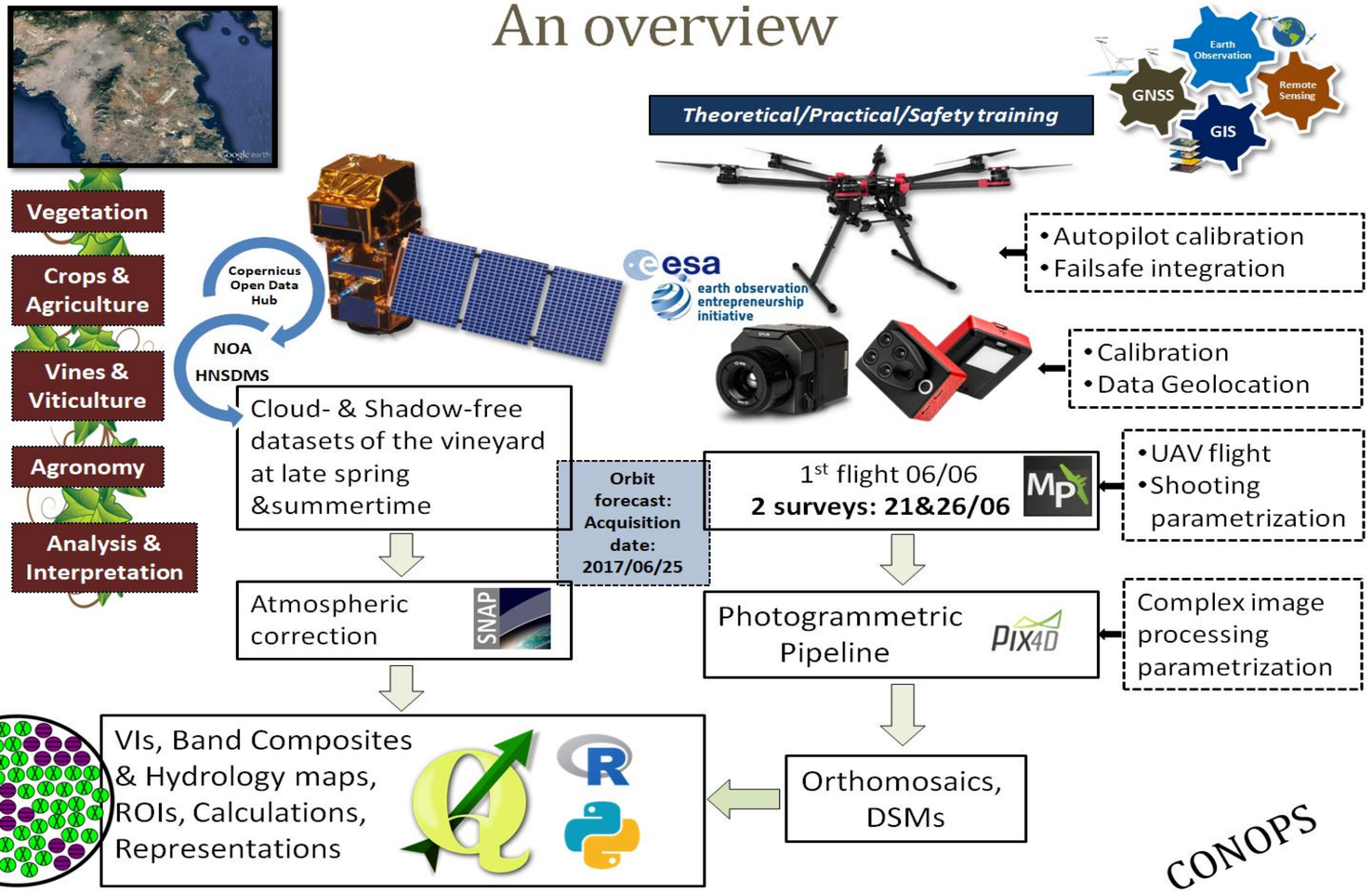
Motivation & Methodology

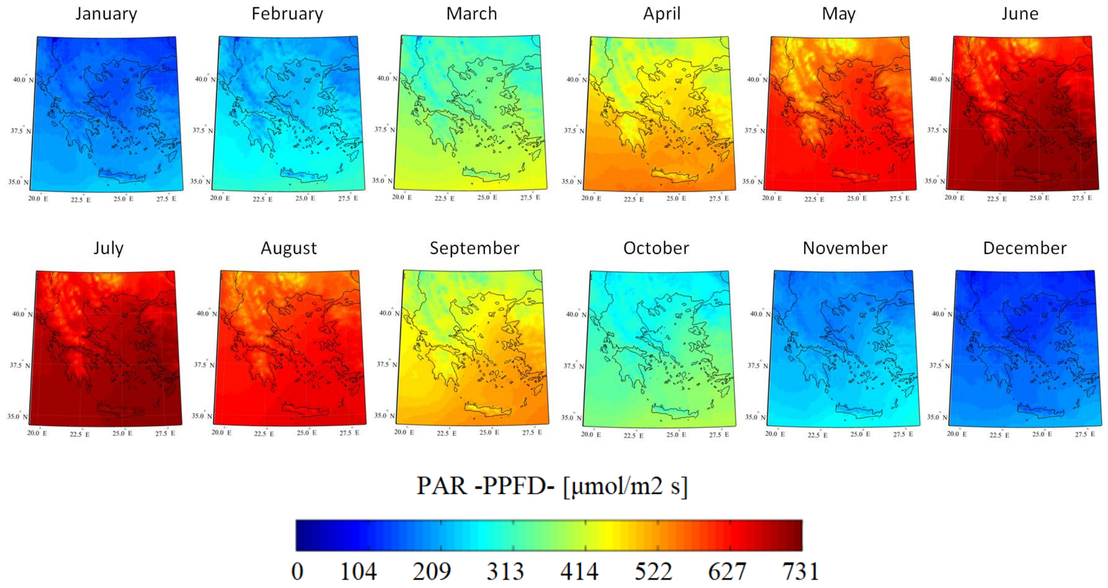
❖ Greece presents unique climatological conditions for wine production from the ancient times. One of the most critical parameters affecting this climate is the Photosynthetically Active Radiation (PAR). PAR provides the energy that supports photosynthesis and primary production by green plants and provokes several effects on grapevine, mainly because of its relation to the ultraviolet band that stimulates the production of important compounds directly involved in yield characteristics. Despite its importance there is a lack of climatological studies about PAR in Greece.



➢ In particular, we developed the first tailored Atlas of PAR, in support of the local wine producers and the wider agricultural community. This Atlas, in terms of photosynthetic photon flux density, will provide the necessary background information for "smart" and efficient vineyard programming in Greece.

➢ Simultaneously, by using airborne and space-borne remote sensing techniques (e.g. Unmanned Aircraft Systems, Sentinel-2) and for a specific pilot vineyard at Spata (Attica), we report on additional stress factors, irrigation issues, crop vigor, hydrological behavior etc, in order to optimize the cultivation practices.

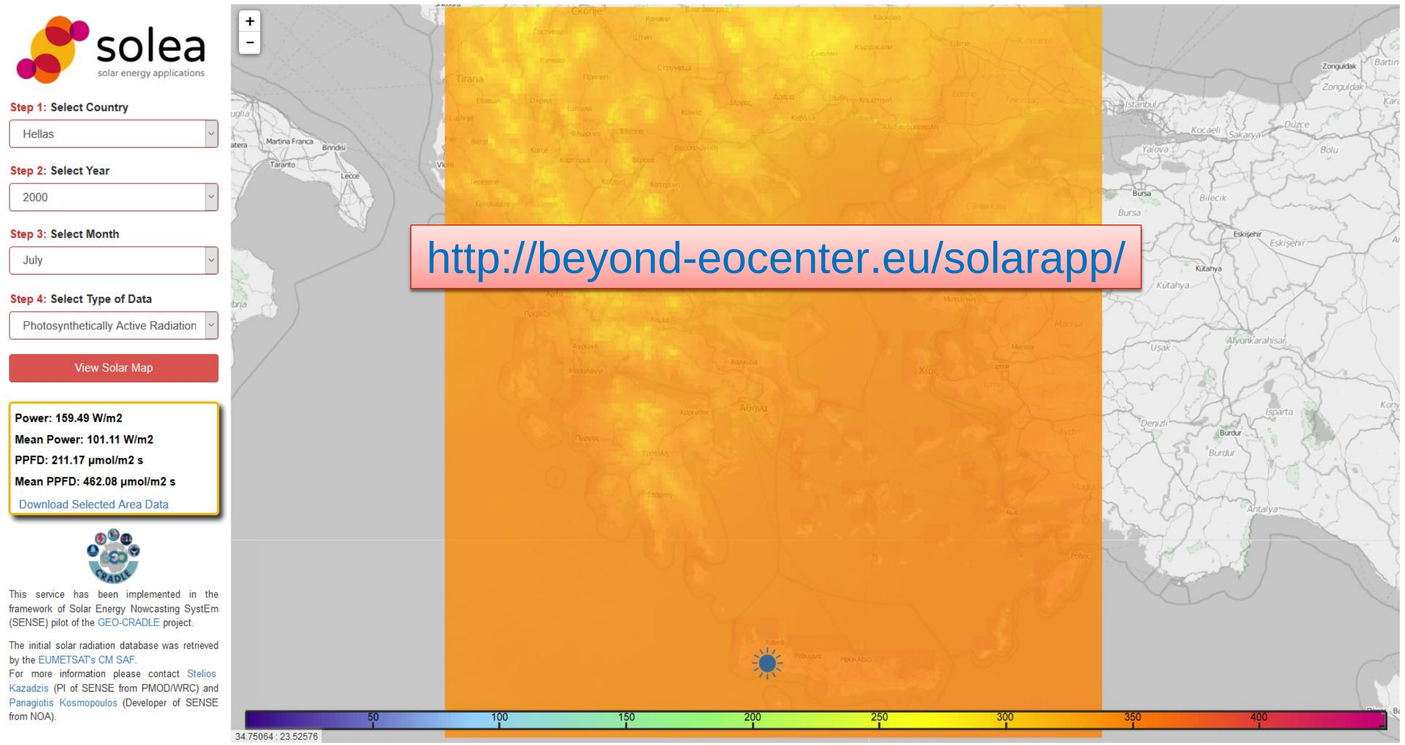
PAR Climatology & Applications



➢ The climatology of PAR is based on a 15-year climatology from the solar radiation databases and products of the EUMETSAT's Satellite Application Facility on Climate Monitoring (CM SAF), taking into account the clouds and aerosols impact on PAR, while the spatial resolution is almost 3 km at nadir, maximizing the exploitative value of the solar energy technologies.

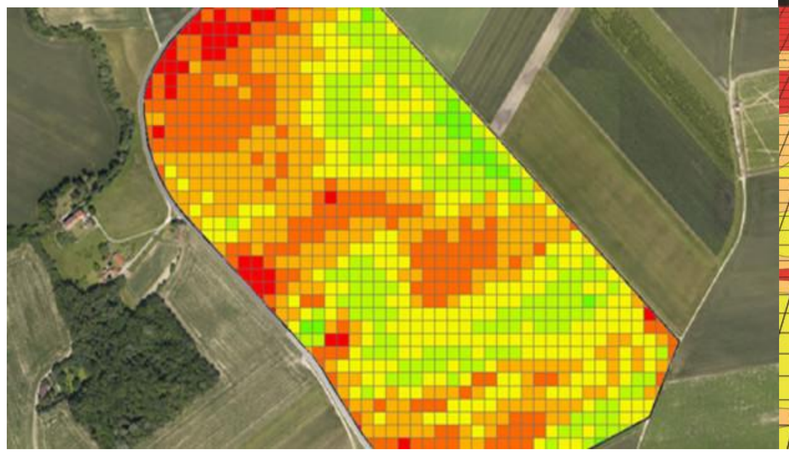
➢ PAR was calculated by using the spectral global horizontal irradiance information in the region 400-700 nm and this techniques was applied for various scientific purposes (Dimitropoulou et al., 2018).

The PAR is available in terms of power (W/m2) and photosynthetic photon flux density (PPFD) in µmol/m2 s.



Remote Sensing for agriculture is a solution looking for a problem

- Continuous monitoring and background
- Efficient and fully interactive cultivation



Photosynthetically Active Radiation Climatology In Greece For Optimal Vineyard Planning And Exploitation

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Motivation & Methodology

Greece presents unique climatological conditions for wine production from the ancient times. One of the most critical parameters affecting this climate is the Photosynthetically Active Radiation (PAR). PAR provides the energy that supports photosynthesis and primary production by green plants and provokes several effects on grapevine, mainly because of its relation to the ultraviolet band that stimulates the production of important compounds directly involved in yield characteristics. Despite its importance there is a lack of climatological studies about PAR. Simultaneously, by using airborne and space-borne remote sensing techniques (Unmanned Aircraft Systems, Sentinel-2) and for a specific pilot vineyard in Spata (Attica), we report on additional stress factors, irrigation issues, crop vigor, hydrological behavior etc, in order to optimize the cultivation practices. With this study, we propose the synergistic use of remote sensing and modeling techniques as a promising tool for effective vineyard planning and exploitation, and the selection of the pilot location, will enable further investigation of the effects of the urban conditions on the vineyards, both directly (e.g. air quality) and indirectly (e.g. impacts on PAR).

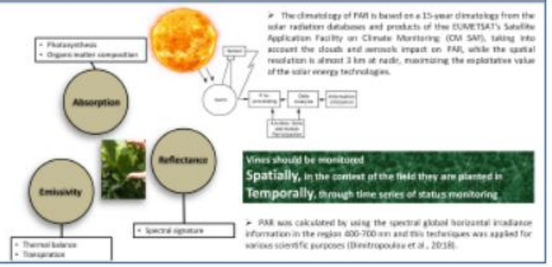
- In this study, we present different EO techniques and smart technologies combined within the SMURBS/ERA-PLANET project, in order to inquire the benefits from the synergy of different observational platforms developed under the smart city approaches on parallel activities like agriculture.

Precision

Modulating cultural practices as a function of spatial and temporal variabilities within agricultural fields

Precision farming: Farming and variability sensing
Precision Agriculture for the Agricultural sector

- In particular, we will develop the first tailored Atlas of PAR, in support of the local wine producers and the wider agricultural community. This Atlas, in terms of photosynthetic photon flux density, will provide the necessary background information for "smart" and efficient vineyard programming in Greece, focusing also on a specific pilot vineyard at Spata, which is a peri-urban field in the region of Attika, during the cultivation period of summer.



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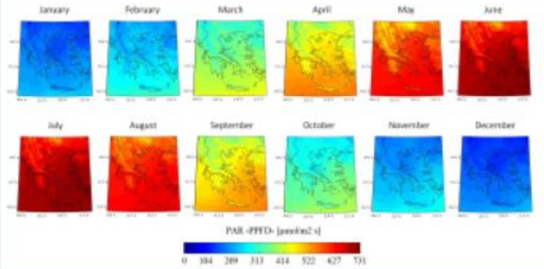
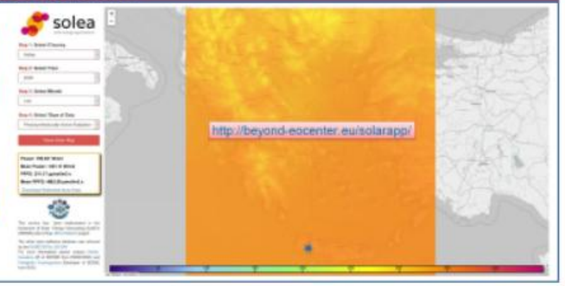
Vines should be monitored
Spatially, in the context of the field they are planted in
Temporally, through time series of status monitoring

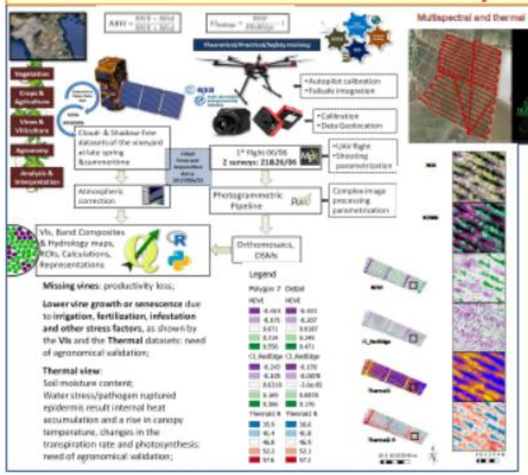
- PAR was calculated by using the spectral global horizontal irradiance information in the region 400-700 nm and this techniques was applied for various scientific purposes (Dimitropoulou et al., 2018).

PAR Climatology & Applications





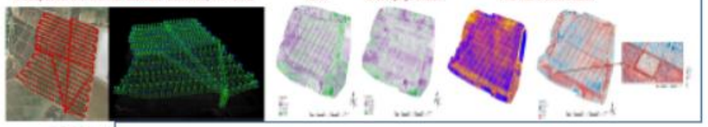
Pilot Vineyard & Remote Interpretation



Missing vines: productivity loss;

Lower vine growth or senescence due to **irrigation, fertilization, infestation and other stress factors**, as shown by the **VIs** and the **Thermal** datasets: need of agronomical validation;

Thermal view:
Soil moisture content;
Water stress/pathogen ruptured epidermis result internal heat accumulation and a rise in canopy temperature, changes in the transpiration rate and photosynthesis;
need of agronomical validation;



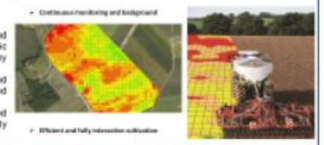
Conclusions

Remote Sensing for agriculture is a solution looking for a problem

The purpose of this study was the precision agriculture and viticulture by using EO techniques. So, it's mainly a showcase, an exhibition, a proof of concept and a preliminary analysis of the remotely sensed results with suitable scientific precision tools. The results demonstrate the potential of such a systematic monitoring formula.

A Precision Viticulture experiment

- Multiple variability factors were recognized and examined: stress, irrigation, vigor, anthropogenic activities, topography, hydrological behavior and many more.
- Exceptionally rich and accurate agronomical and scientific knowledge was extracted with the related analysis (qualitative & quantitative).
- Best monitoring practices were assessed and executed for the UAS and the payloads: theoretically, practically and technically.



- Continuous monitoring and background
- Efficient and fully interactive cultivation

- As a result, the synergistic use of remote sensing and modeling techniques is expected to serve as a promising tool for effective vineyard planning and exploitation, and the selection of the pilot location, will enable further investigation of the effects of the urban conditions on the vineyards, both directly (e.g. air quality) and indirectly (e.g. impacts on PAR).

- Such an application and agronomical engineering multidisciplinary approach to vineyards cultivation would provide consistent and trustworthy knowledge to science, the farming community, government and other interested parties. Those layers of information can be thus exploited throughout the scientific community and commercially through service oriented solutions like the presented applications.

Acknowledgments. This study has been implemented in the framework of the EU's Horizon 2020 SMURBS/ERA-PLANET project (http://smurbs.eu/) under grant agreement No 689443 and the Horizon 2020 Geo-Cradle project (http://geocradle.eu/) under grant agreement No 690133.