

**Prof. Arnon Karnieli**

The Remote Sensing Laboratory  
 Department of Solar Energy and Environmental Physics  
 Jacob Blaustein Institutes for Desert Research  
 Ben-Gurion University of the Negev  
 Sede-Boker Campus 84990, ISRAEL  
 Tel: +972-8-6596855 Mobile: +972-52-8795925  
 Fax: +972-8-6596805  
 E-mail: [karnieli@bgu.ac.il](mailto:karnieli@bgu.ac.il)



**פרופ' ארנון קרניאלי**

המעבדה לחישה מרחוק  
 המחלקה לאנרגיה סולרית ופיסיקה של הסביבה  
 המכונים לחקר המדבר ע"ש יעקב בלאושטיין  
 אוניברסיטת בן-גוריון בנגב  
 קמפוס שדה-בוקר 84990  
 טלפון: 08-6596855 נייד: 052-8795925  
 פקס: 08-6596805  
<https://karnieli-rsl.com/>

*Science from Above*

September 13, 2020

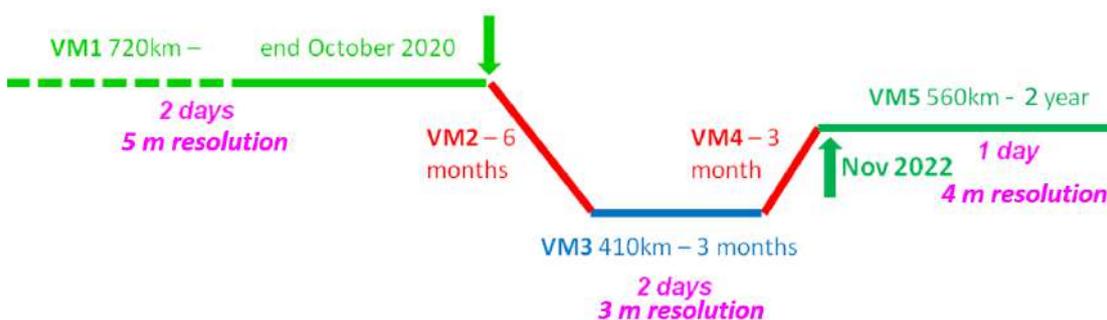
Dear colleagues,

Re: **VENμS periodic news – September 13, 2020**

**1. VENμS future updates**

Last month we celebrated three years on the VENμS satellite in space. Until the end of October 2020, we will complete three years of images. So far, the system is performed in the best possible way, and we are persevering on re-improving the products. More information in the coming Newsletter.

According to the original plan, the current mission phase, named VENμS Mission 1 (VM1), will be terminated at the end of October 2020. Then the satellite orbit will be lowered, for six months, to 410 km (VM2). VENμS will be devoted to its technological mission (VM3) for about three months. From this orbit, some parts of Israel will be imagined at two days revisit time and about 3 m resolution. Towards the end of VM3, the VENμS orbit will be changed again (VM4) until reaching 560 km. From this altitude, from November 2022, Israel and other parts of the world will be imagined for two years, once a day at 4 m resolution.

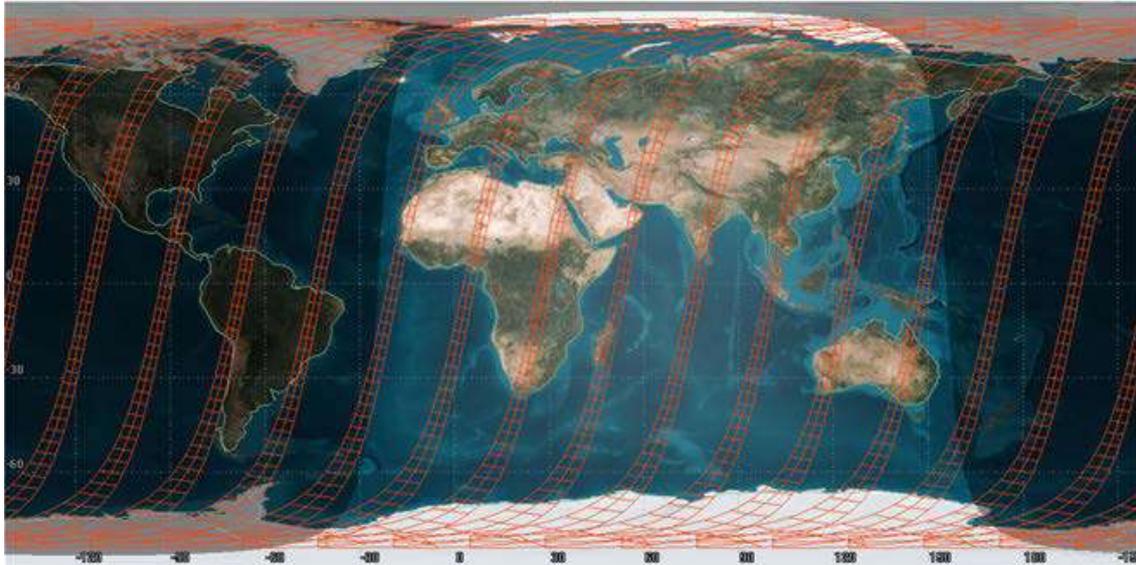


VENμS mission phase	Missions	Latitude (km)	Swath (km)	Spatial resolution (m)	Revisit time (days)	Phase duration (month)	Phase months
VM1	S+T	720	27	5	2	36	Nov. 2017 - Oct. 2020
VM2	T	720 to 410		no imaging		6	Nov. 2020 - Apr. 2021
VM3	S+T	410	15	2	2	6	May 2021 - Jul. 2021
VM4	T	410 to 560		no imaging		3	Aug. 2021 - Oct. 2021
VM5	S	560	21	4	1	24	Nov. 2021 - Oct. 2023
S = Scientific mission							
T = Technological mission							

## 2. Global orbits and research opportunities

The imaging tiles for VM3 and VM5 over Israel have not been determined. More likely, they will follow the most productive studies at VM1, considering the maneuver capabilities of the satellite.

From a global perspective, the map below shows the areas that will be covered during VM5.



In the next month, a new call for proposals will be announced to suggest international research sites within the area covered by the VM5. International collaboration is encouraged.

For more information, contact: Arnon Karnieli, [karnieli@bgu.ac.il](mailto:karnieli@bgu.ac.il), 052-8795925.

## 3. Feature paper

### **Bayesian Calibration of the Aquacrop-OS Model for Durum Wheat by Assimilation of Canopy Cover Retrieved from VEN $\mu$ S Satellite Data**

Deepak Upreti, D., Pignatti, S. Pascucci, S., Tolomio, M., Huang, W. and Casa, R. (2020) **Bayesian Calibration of the Aquacrop-OS Model for Durum Wheat by Assimilation of Canopy Cover Retrieved from VEN $\mu$ S Satellite Data**. *Remote Sensing*, **12**, 2666.

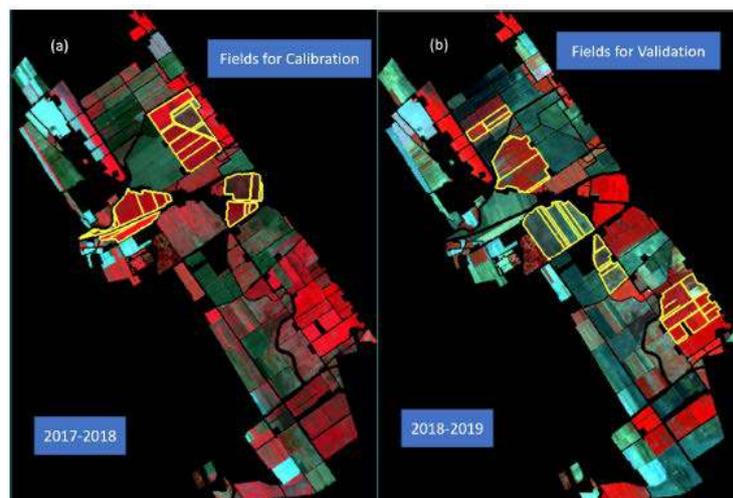
DOI: [doi:10.3390/rs12162666](https://doi.org/10.3390/rs12162666)

Abstract: Crop growth models play an important role in agriculture management, allowing, for example, the spatialized estimation of crop yield information. However, crop model parameter calibration is a mandatory step for their application. The present work focused on the regional calibration of the Aquacrop-OS model for durum wheat by assimilating high spatial and temporal resolution canopy cover data retrieved from VEN $\mu$ S satellite images.



The assimilation procedure was implemented using the Bayesian approach with the recent implementation of the Markov chain Monte Carlo (MCMC)-based Differential Evolution Adaptive Metropolis (DREAM) algorithm DREAM(KZS). The fraction of vegetation cover (fvc) was retrieved from the VEN $\mu$ S satellite images for two years, during the durum wheat growing seasons of 2018 and 2019 in Central Italy. The retrieval was based on a hybrid method using PROSAIL Radiative Transfer Model (RTM) simulations for training a Gaussian Process Regression (GPR) algorithm, combined with Active Learning to reduce the computational cost. The Aquacrop-OS model was calibrated with the fvc data of 2017–2018 for the Maccarese farm in Central Italy and validated with the 2018–2019 data. The retrieval accuracy of the fvc from the VEN $\mu$ S images were the Coefficient of Determination ( $R^2$ ) = 0.76, Root Mean Square Error (RMSE) = 0.09, and Relative Root Mean Square Error (RRMSE)= 11.6% ,when compared with the ground-measured fvc. The MCMC results are presented in terms of Gelman–Rubin R statistics and MR statistics, Markov chains, and marginal posterior distribution functions, which are summarized with the mean values for the most sensitive crop parameters of the Aquacrop-OS model subjected to calibration. When validating for the fvc, the  $R^2$  of the model for year (2018–2019) ranged from 0.69 to 0.86. The RMSE, Relative Error (RE), Relative Variability ( $\alpha$ ), and Relative Bias ( $\beta$ ) ranged from 0.15 to 0.44, 0.19 to 2.79, 0.84 to 1.45, and 0.91 to 1.95, respectively. The present work shows the importance of the calibration of the Aquacrop-OS (AOS) crop water productivity model for durum wheat by assimilating remote sensing information from VEN $\mu$ S satellite data.

For more information, contact: Deepak Upreti [dupreti@unitus.it](mailto:dupreti@unitus.it); Tel.: +39-076-1357-555



*Durum wheat fields considered for calibration (a) and validation (b) in the Maccarese Farm (Central Italy). The backgrounds are the VEN $\mu$ S images of 24 January 2018 (a) and 12 March 2019 (b) (red = 865 nm, green = 672 nm, and blue = 555 nm).*



#### 4. Special issue in Remote Sensing – call for papers



*remote sensing*

an Open Access Journal by MDPI

Consider submitting an article to the special issue of the Remote Sensing journal: "[VEN \$\mu\$ S Image Processing Techniques and Applications](https://www.mdpi.com/journal/remotesensing/special_issues/Venus)".

[https://www.mdpi.com/journal/remotesensing/special\\_issues/Venus](https://www.mdpi.com/journal/remotesensing/special_issues/Venus)

Deadline for manuscript submissions: 31 December 2020

Accepted papers will be published continuously in the journal (as soon as accepted) and will be listed together on the special issue website.

#### 5. Previous VEN $\mu$ S Newsletters

Previous VEN $\mu$ S Newsletters along with more information about VEN $\mu$ S can be read in the following link: <https://karnieli-rsl.com/newsletters>

#### 6. Unsubscribe

If you wish to unsubscribe from the future VEN $\mu$ S Newsletters, write an e-mail to [karnieli@bgu.ac.il](mailto:karnieli@bgu.ac.il).

We wish you a happy and healthy new year!

Manuel and Arnon

Ben Gurion University

