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פרופ' ארנון קרניאלי

המעבדה לחישה מרחוק
המחלקה לאנרגיה סולרית ופיסיקה של הסביבה
המכונים לחקר המדבר ע"ש יעקב בלאושטיין
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Science from Above

September 24, 2021

Dear colleagues,

Re: VENμS periodic news – September 24, 2021

1. VENμS updates

1.1 Collection 4 - reprocessing of old VENμS images

The following 14 tiles have been completely reprocessed: E03, E04, S01, S02, S03, S06, S07, W03, W04, W08, W09, W10, W11, and W12.

This reprocessing corresponds to 52% of the entire tiles in VM01. The following tiles available in collection 4 (within one month) are W05 and W06.

Do not hesitate to contact us with any questions (manuel.salvoldi@gmail.com).

1.2 VENμS Mission 3 (VM3)

VENμS is currently orbiting at 410 km under the title VENμS Mission 3 (VM3). This phase of the mission consists of an electric propulsion test and demonstration. A limited number of images are acquired over Israel only to verify the proper operation and performance of the camera. However, due to technical issues, no images have been transferred to the Israeli VENμS Scientific Center. Once received, images, characterized by 3 m spatial resolution and 2 days revisit time, and 15 km swath, will be available in the VENμS portal https://venus.bgu.ac.il/venus/

Note that there will be no international sites during VM3.

1.1 VENμS Mission 5 (VM5)

VENμS Mission 5 (VM5) is expected to start in January 2022. The satellite will fly at 560 km. Accordingly, the spatial resolution will be 4 m, while the revisit time will be one day. The swath will be 21 km. However, in order to increase the observed area over Israel, the revisit time will be fixed to two days. Two strips will be acquired on day 1, while the other two on day 2.

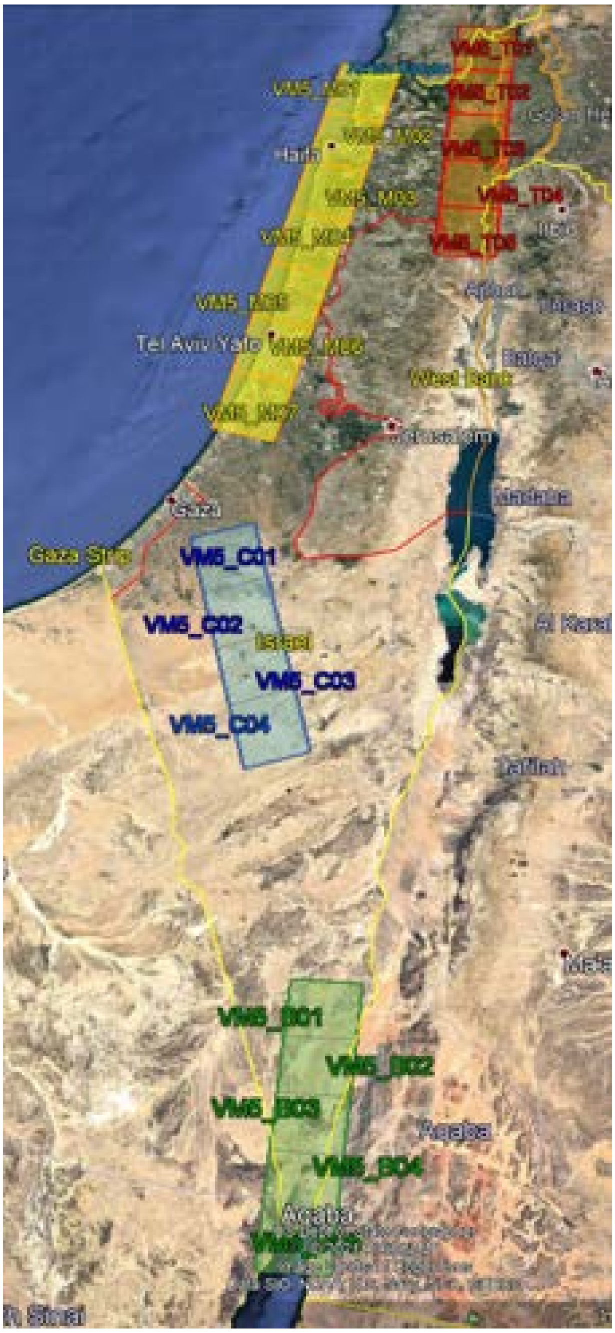


Figure 1: *VENµS strips over Israel during VM5.*

2. VM1 Summary

As for August 2021, after 4 years of the VENµS operation, Israeli scientists downloaded over 40,000 tiles. Figure 2 illustrates the monthly and cumulative downloaded imaged over Israel, and Figure 3 shows the statistics of the tile orders.

The Web of Science (ISI) (https://www.webofscience.com/) lists more than 50 papers published in scientific journals and conferences (see Appendix A).

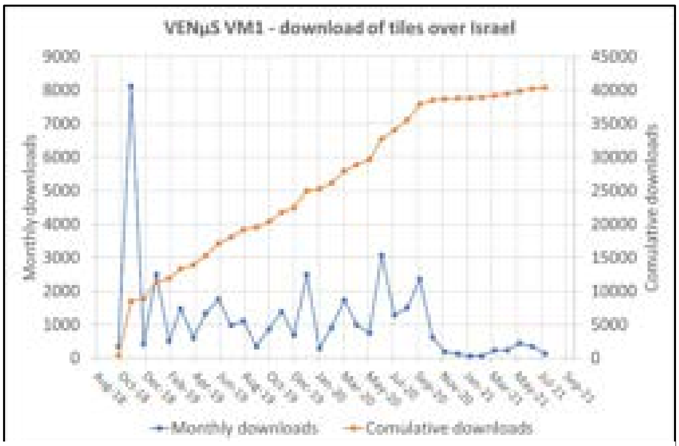


Figure 2: *Monthly and cumulative downloaded imaged over Israel*

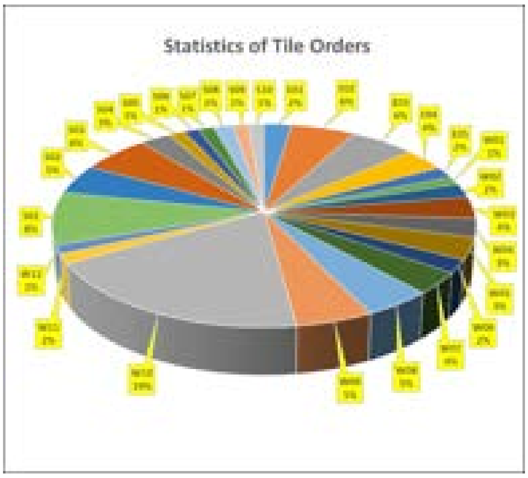


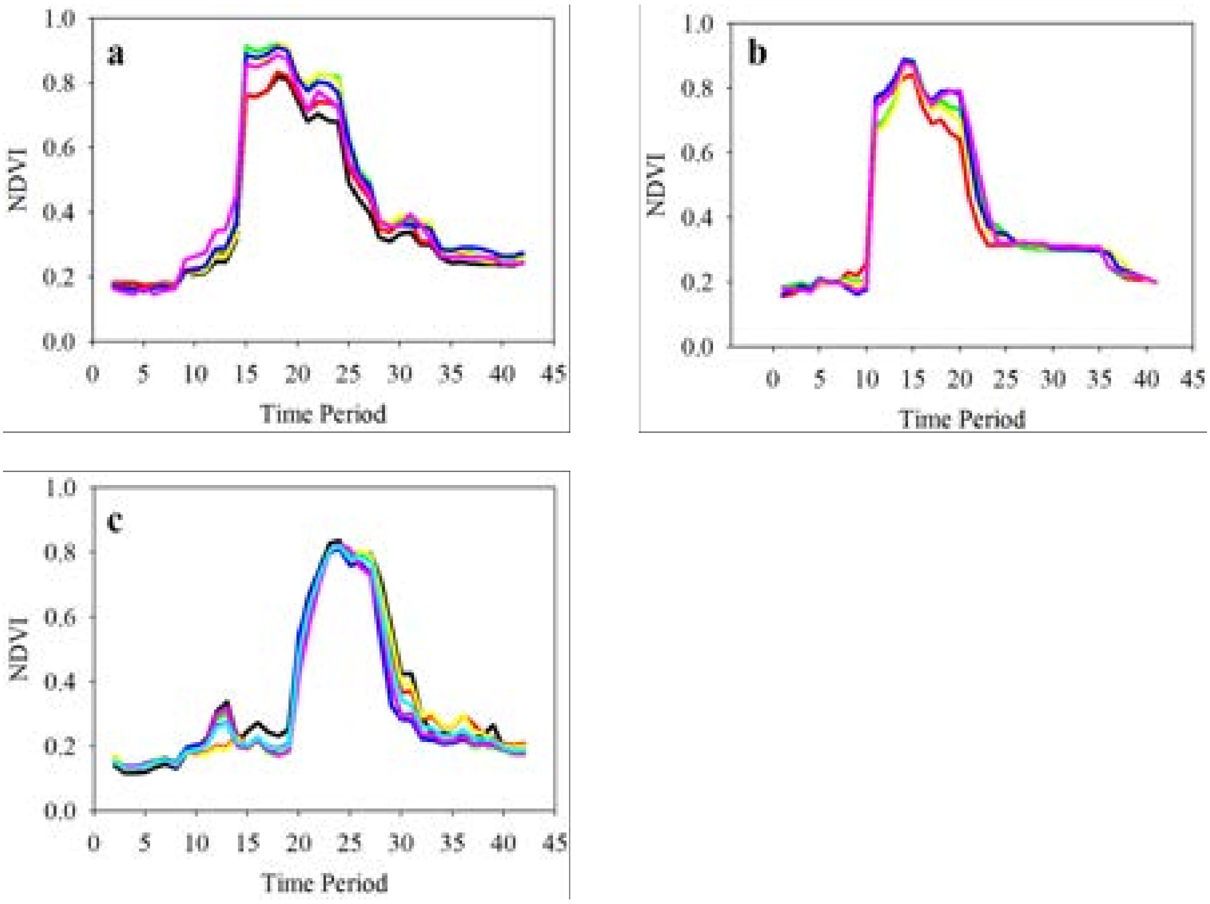
Figure 3: *Statistics of the Israeli tile orders*

3. Feature paper

Deep feature learning and latent space encoding for crop phenology analysis

Arun, V.P. and Karnieli, A. 2022. Deep feature learning and latent space encoding for crop phenology analysis. *Expert Systems With Applications*. 187 (115929). https://doi.org/10.1016/j.eswa.2021.115929

Abstract: The high spatial, spectral, and temporal resolutions of the Vegetation and Environment monitoring New Micro-Satellite (VENµS) satellite data facilitate field-level phenological analysis of crops. This study proposes deep learning (DL) based approaches to resolve the issues prevalent in crop phenology-based fingerprint estimation at field-level using VENµS satellite data. An encoder-decoder-based framework, called piece-wise kernel encoding network (PKNet), is proposed for missing data imputation of the vegetation index (VI) curves derived from time-series image data. PKNet adopts interpolation-based convolution, dynamic time wrapping (DTW) based layer formulation, and imputation-specific constraints for optimal smoothing of the irregularly sampled VI curves. Besides, PKNet learns kernel parameters dynamically. A variational encoding framework called a dynamic-projection-based generalization network (DPGNet), is proposed to generalize the pixel-level VI curves to synthesize a representative VI curve for a given field. DPGNet is more effective than the use of multiple moments as it is resilient to outliers and learns normally distributed latent space with a small number of samples. The current research also proposes a classifier, called dynamic time wrapping based capsule network (DTCapsNet), which learns a discriminative latent space and accurately models the VI curve features. The DTCapsNet considers the time-series nature of the input using DTW-based convolution layers. The feature characterization improves generalizability and gives good results, even with a limited number of training samples. Experiments using the ground truth information and satellite images, acquired over two farms in Israel, illustrate that the proposed frameworks give better results than the commonly-used existing approaches.



Examples of field-level phenological fingerprints learned by DPGNet for randomly selected fields of (a) Barley; (b) Wheat; and (c) Potato.

For more information contact: Dr. Arun Pattathal, arunvi2601@gmail.com

3. Special issue in Remote Sensing – call for papers

New deadline for manuscript submissions: 31 December 2021

remote sensing

an Open Access Journal by MDPI

Consider submitting an article to the special issue of the Remote Sensing journal: "VENµS Image Processing Techniques and Applications". https://www.mdpi.com/journal/remotesensing/special_issues/Venus

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

4. Previous VENµS Newsletters

Previous VENµS Newsletters, along with more information about VENµS, can be read at the following link: https://karnieli-rsl.com/newsletters.

5. Unsubscribe

If you wish to unsubscribe from the future VENµS Newsletters, write an e-mail to karnieli@bgu.ac.il.

Best regards,

Manuel and Arnon

Ben Gurion University

Appendix A: VENμS-related publications before and during VM1

Adeluyi, O.A., Harris, A., Clay, G., & Foster, T. (2019). A Comparison of Retrieval Approaches for Estimating the Seasonal Dynamics of Rice Leaf Area Index from simulated Sentinel-2 data. In C.M.U. Neale, & A. Maltese (Eds.), *Remote Sensing for Agriculture, Ecosystems, and Hydrology*. DOI:10.1117/12.2533304.

Arun, P.V., & Karnieli, A. (2021). Deep Learning-Based Phenological Event Modeling for Classification of Crops. *Remote Sensing, 13*, DOI:10.3390/rs13132477.

Baba, M.W., Gascoin, S., Hagolle, O., Bourgeois, E., Desjardins, C., & Dedieu, G. (2020). Evaluation of Methods for Mapping the Snow Cover Area at High Spatio-Temporal Resolution with VENμS. *Remote Sensing, 12*, DOI:10.3390/rs12183058.

Bar-Massada, A., & Sviri, A. (2020). Utilizing Vegetation and Environmental New Micro Spacecraft (VENμS) Data to Estimate Live Fuel Moisture Content in Israel's Mediterranean Ecosystems. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 13*, 3204-3212, DOI:10.1109/jstars.2020.3001677.

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Dedieu, G., Hagolle, O., Karnieli, A., Ferrier, P., Crebassol, P., Gamet, P., Desjardins, C., Yakov, M., Cohen, M., & Hayun, E. (2018). VENμS: Performances and First Results After 11 Months in Orbit. In, *Igarss 2018 – IEEE International Geoscience and Remote Sensing Symposium* (pp. 7753-7756).

Dick, A., Gamet, P., Marcq, S., Dedieu, G., Hagolle, O., Crebassol, P., Raynaud, J.L., Hillairet, E., & Enache, S.J. (2018). VENμS Commissioning Phase: Specificities of Radiometric Calibration. In, *Igarss 2018 – 2018 IEEE International Geoscience and Remote Sensing Symposium* (pp. 4320-4323).

Dubinin, V., Svoray, T., Stavi, I., & Yizhaq, H. (2020). Using LANDSAT 8 and VENμS Data to Study the Effect of Geodiversity on Soil Moisture Dynamics in a Semiarid Shrubland. *Remote Sensing, 12*, DOI:10.3390/rs12203377.

Elbaz, S., Sheffer, E., Lensky, I.M., & Levin, N. (2021). The Impacts of Spatial Resolution, Viewing Angle, and Spectral Vegetation Indices on the Quantification of Woody Mediterranean Species Seasonality Using Remote Sensing. *Remote Sensing, 13*, DOI:10.3390/rs13101958.

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