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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

February 28, 2022

Re: <u>VENµS periodic news No. 32</u>

1. VENµS updates

1.1 Reprocessing VENµS Mission 1 (VM1) collection 4

77% of the entire collection has been completed and is available for downloading from the VENµS portal. Collection 4 includes now the following tiles:

- E03, E04
- S01, S02, S03, S06, S07, S08, S09, S10
- W03, W04, W05, W06, W08, W09, W10, W11, W12

The following tiles are under processing.

E02, S04, S05, W07.

This activity will be completed in the next couple of months.

Figure 1: *Strips and tiles during VM3.*

1.2 VENµS Mission 3 (VM3)

During VM3, from mid-September 2021 to the end of October 2021, we have received several VENµS L1 products with 3 m spatial resolution over three strips, as presented in Figure 1 and Table 1. Note that:

- L1 means a single date and single angle acquisition with top of the atmosphere reflectance and map projection.
- MAJA atmospheric correction will be available in the future.
- The processing of the L2/L3 products for VM3, will start after the conclusion of the reprocessing of collection

The images will not be available in the VENμS portal but will be provided upon request from venus@post.bgu.ac.il along with the shapefiles.

Table 1: *Tiles that were available for VM3. Cloud percentage of each available tile in indicated.*

Tile name	# images	20210908	20210918	20210920	20210924	20210928	20211010	20211012	20211020	20211022	20211026	20211028
ISRAELN1	10	0.0%	0.0%	0.0%	62.1%	23.9%	0.0%	34.5%	0.0%	1.9%	0.0%	
ISRAELN2	9		0.0%	0.0%	39.9%	36.5%	0.0%		5.7%	0.0%	0.0%	3.3%
ISRAELN3	9		0.0%	0.0%	33.7%	36.2%	0.0%		9.0%	0.0%	0.0%	33.0%
ISRAELN4	7		0.0%	0.0%	40.6%		0.0%		21.1%	0.0%	1.3%	
ISRAELW1	8		2.0%	0.0%	79.3%	48.0%	0.0%		65.8%	33.6%		0.0%
ISRAELW2	9		0.0%	0.0%	55.5%	46.7%	0.0%	32.9%	48.0%	21.3%		0.0%
ISRAELW3	9		0.0%	20.0%	49.4%	37.2%	0.0%	4.3%	50.1%	9.2%		0.0%
ISRAELW4	9		0.0%	0.0%	73.4%	24.0%	0.0%	0.0%	30.7%	6.7%		0.0%
ISRAELS1	8		0.0%	0.0%	43.8%	0.0%	0.0%		0.0%	0.3%		0.0%
ISRAELS2	8		0.1%	0.1%	48.0%	0.0%	0.0%		0.0%	0.0%		0.0%
ISRAELS3	9		0.0%	0.0%	39.8%	0.0%	0.0%	12.2%	0.0%	0.0%		0.0%
ISRAELS4	9		0.0%	0.0%	14.9%	0.0%	0.0%	0.3%	0.0%	0.0%		0.0%

1.3 VENμS Mission 5 (VM5)

The satellite ascending maneuver from 410 km (VM3) to 560 km (VM5) is almost completed. We expect new images in the next few days. More details in the next Newsletter.

2. Feature papers

2.1 Augmentation of vegetation index curves considering the crop-specific phenological characteristics

Arun P.V. and Karnieli, A. 2022. Augmentation of vegetation index curves considering the crop-specific phenological characteristics. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*. **15**, 1235-1243. DOI 10.1109/JSTARS.2022.3142395

Abstract: The state-of-the-art crop phenological classifiers use vegetation index (VI) time-series data and deep learning (DL) techniques. However, the scarcity of training samples limits the performance of these approaches. Unlike the conventional augmentation techniques, the data augmentation of VI curves should preserve the crop-specific phenological events. The DL-based augmentation approaches do not give good results when the training samples are limited. Also, the conventional approaches such as translation, rotation, scaling, and wrapping do not preserve the characteristic features of the index curves, thereby making them inappropriate for the VI-curve-based augmentations. This study proposes a non-DL-based data augmentation strategy that requires only a minimal number of actual training samples. In the proposed approach, the periodic phenological events and the underlying trend for each crop class are modeled to improve the augmentation. The trends of different crop classes are estimated by jointly maximizing the autocorrelation and variance, while the optimal subsequences are generalized as the phenological events. The proposed augmentation strategy of using Maximal Overlap Discrete Wavelet Transform (MODWT) for obtaining the surrogates that retain the crop-specific features and periodicities significantly improves the results. It may be noted that the proposed approach does not alter the wavelet coefficients that are characteristics of a given crop

class. The experiments using time series VI data, covering 90 fields of wheat and 60 fields of barley, confirm better accuracy of the proposed augmentation approaches as compared to the prominent approaches.

For more details, contact Dr. Arun Pattathal Vijayakumar (arunpv2601@gmail)

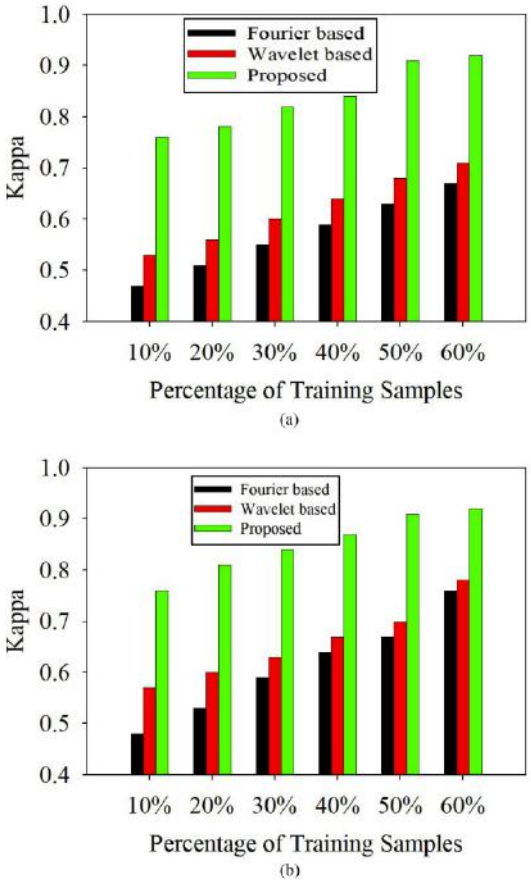

Figure 4. Comparison of the augmentation methods for varying percentage of training samples: (a) LSTM based classification; and (b) GAN based classification

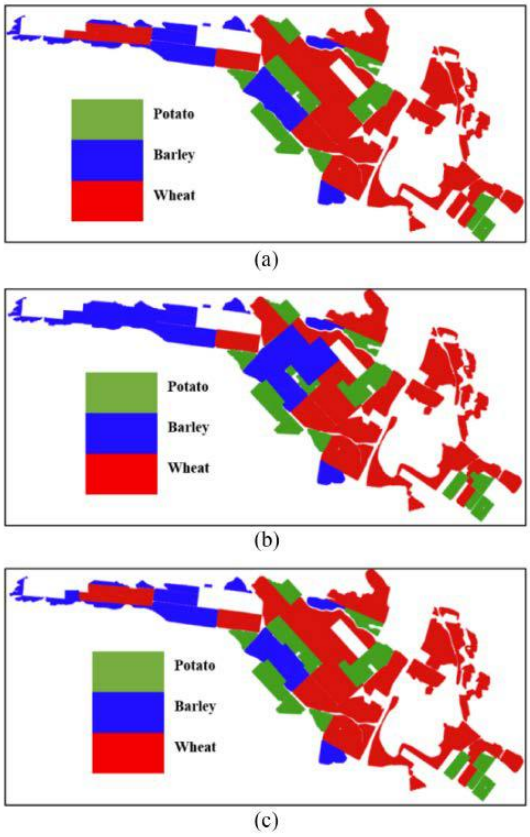

Figure 5. Visual illustration of the proposed augmentation strategy: (a) Ground truth data; (b) Wavelet based approach; and (c) Proposed augmentation strategy

2.2 Processing of VENμS Images of High Mountains: A Case Study for Cryospheric and Hydro-Climatic Applications in the Everest Region (Nepal).

Bessin, Z.; Dedieu, J.-P.; Arnaud, Y.; Wagnon, P.; Brun, F.; Esteves, M.; Perry, B.; Matthews, T. 2022. Processing of VENμS Images in High Mountain: A Case Study for Cryospheric and Hydro-Climatic Applications in the Everest Region (Nepal). *Remote Sensing*, ***14***, 1098. https://doi.org/10.3390/rs14051098

Abstract: In the Central Himalayas, glaciers and snowmelt play an important hydrological role, as they ensure the availability of surface water outside the monsoon period. To compensate for the lack of field measurements in glaciology and

hydrology, high temporal and spatial resolution optical remotely sensed data are necessary. The French–Israeli VENμS Earth observation mission has been able to complement field measurements since 2017. The aim of this paper is to evaluate the performance of different reflectance products over the Everest region for constraining the energy balance of glaciers and for cloud and snow cover mapping applied to hydrology. Firstly, the results indicate that a complete radiometric correction of slope effects such as the Gamma one (direct and diffuse illumination) provides better temporal and statistical metrics (R^2 = 0.73 and RMSE = 0.11) versus ground albedo datasets than a single cosine correction, even processed under a fine-resolution digital elevation model (DEM). Secondly, a mixed spectral-textural approach on the VENμS images strongly improves the cloud mapping by 15% compared with a spectral mask thresholding process. These findings will improve the accuracy of snow cover mapping over the watershed areas downstream of the Everest region.

For more details, contact Jean-Pierre Dedieu jean-pierre.dedieu@univ-grenoble-alpes.fr; Tel.: +33-456-520-977

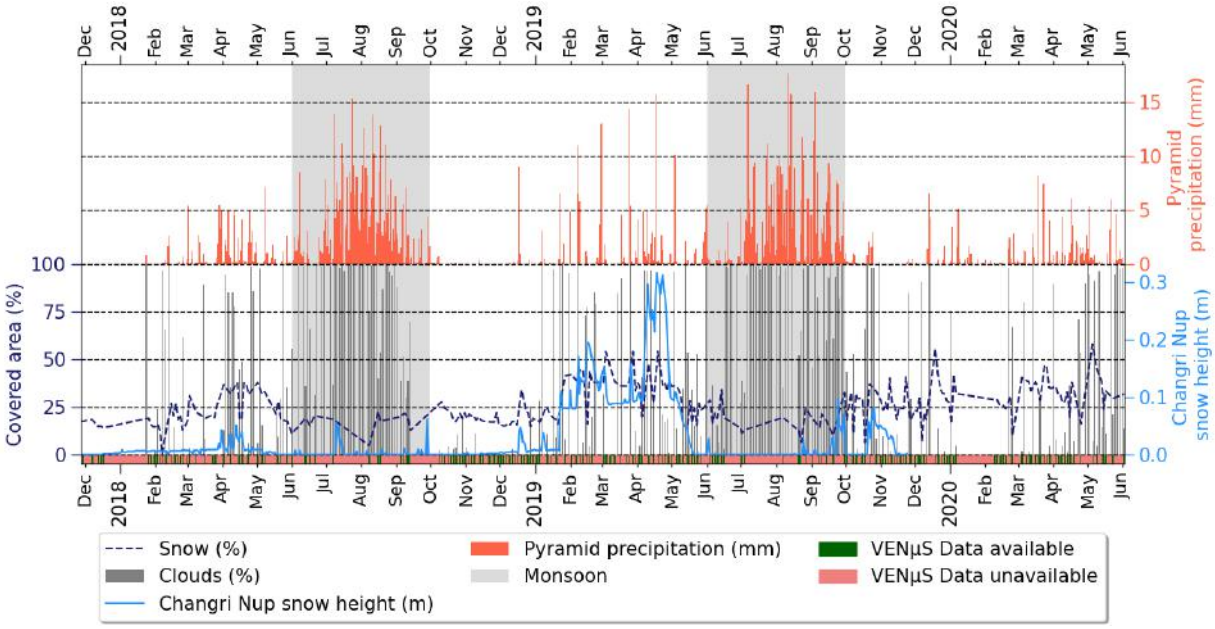

Figure 6. VENμS clouds estimation in Pheriche watershed compared to Pyramid daily cumulative precipitation (top), Changri Nup snow height and Pheriche basin interpolated snow coverage. Time period is Nov 2018 to June 2020 (bottom). VENμS data availability online is also presented. Snow covered area has been interpolated in between available VENμS images.

3. Special issue in Remote Sensing – call for papers

New deadline for manuscript submissions: 31 March 2022

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

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Best regards,

Manuel and Arnon

Ben Gurion University