



CyCLOPS Annual Newsletter 2021

January-April 2021

Construction Works at CyCLOPS Permanent Segment Sites

Considering the site monumentation designs, the construction works in each site were implemented. The beginning of the construction works included the removal of the surface soil in such a depth to find the pure bedrock.

Dates of CW	Site Locations
21/12/2020	ASGATA
10/02/2021	ALEVGA/AKAMAS
11/02/2021	TROULLOI/MATHIATIS
11/03/2021	SOUNI



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May-August 2021

EARSeL Symposium 2021

8 June 2021 - CyCLOPS team was strongly participated at the 40th EARSeL Symposium 2021 in Warsaw, Poland on 07-10th of June 2021; two research studies were presented as oral and poster presentation, respectively. EARSeL is a scientific network of European remote sensing laboratories, coming from both academia and the commercial/industrial sector, which covers all fields of geoinformation and earth observation through remote sensing.

«**Multi-Criteria Decision Analysis for the Installation of permanent infrastructures for continuous Space-based Monitoring of Natural Hazards**» presented by PhD candidate, Mr. Dimitris Kakoullis.



«**Space-based deformation monitoring of Coastal Urban Areas: The case of Limassol's Coastal Front**» presented by PhD candidate Mrs. Kyriaki Fotiou



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Installation of the CyCLOPS SAR Stations

The Permanent Segment of CyCLOPS MPN includes a total number of twelve (12) specifically designed calibration-grade InSAR Corner Reflectors. The array of Corner Reflectors was established in six (6) sites by installing two (2) Corner Reflectors per site to account for both the ascending and descending tracks of the current SAR satellite missions. Our CRs have significant flexibility in orientation (both in azimuth and elevation angle) to support all current SAR missions, from Sentinel-1 to TerraSAR-X and have been fully compliant with the global array of CRs established by DLR. When combining GPS/GNSS with InSAR measurements, the gaps within the CORS network can be infilled, and various anomalies of a small spatial extent that would potentially be missed within a network of discrete point observations can be eventually captured. Hence, the determination and monitoring of the 3D coordinates and velocities in a common geodetic reference frame can be achieved. Each GNSS CORS station collocated with a pair of calibration-grade corner reflectors, and it is next to the seismograph of the national seismological network.

4 June 2021- *SOUN* SAR Stations at Souni site



9 June 2021 – *MATS* SAR Stations at Mathiatis site



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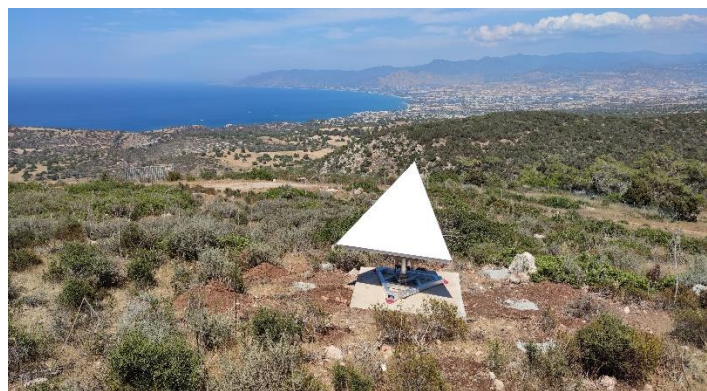
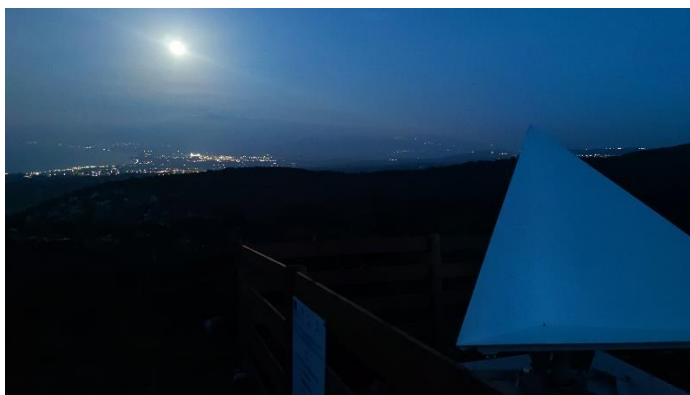
11 June 2021 – *TROU* SAR Stations at Troulloi site



16 June 2021 – *ALEV* SAR Stations at Alevga site



18 June 2021 – *AKMS* SAR Stations at Akamas site



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24 June 2021 – ASGA SAR Stations at Asgata site



IAG 2021 Presentation of CyCLOPS

02 July 2021 - CyCLOPS was presented at the IAG 2021, Beijing China

Assistant Professor Chris Danezis participated at the IAG 2021 "Scientific Assembly of the International Association of Geodesy" which took place virtually on the 28th of June to 02nd of July 2021 in Beijing, China. During the conference he gave an oral presentation entitled "CyCLOPS: A National Integrated GNSS/InSAR Strategic Research Infrastructure for Monitoring Geohazards and Forming the Next Generation Datum of the Republic of Cyprus", on the 02nd of July 2021 (session 5.7: Advances in Geodesy for Geohazard Monitoring and Disaster Risk Reduction). During the conference, he had the opportunity to promote CyCLOPS infrastructure and discuss with stakeholders and scientists. He highlighted the importance and benefit for Cyprus from establishing a strategic infrastructure unit for natural hazards funded under the CyCLOPS Project, as well as the process of the implementation of the project.

Arrival of CyCLOPS Equipment at CUT

July 2021 - According to the specifications and criteria of the CyCLOPS (Cyprus Continuously Operating Natural Hazards Monitoring and Prevention System (RPF / INFRASTRUCTURES / 1216/0050)) research program of the Department of Civil Engineering and Geoinformatics Engineers of the Cyprus University of Technology, the equipment which will be installed within seven (7) different locations nationwide has been set on track.

A competition has been announced for the equipment and specifications that are required by the program on October 16, 2019.

After the closing of the competition for the GPS / GNSS equipment that will be installed at the appointed locations, the specifications submitted by the interested parties will be thoroughly checked with the aim to make this equipment as efficient as possible in the various locations, which were deemed optimal for the necessary measurements of the CyCLOPS research project. This equipment will operate on a 24-hour basis and will provide daily accurate measurements.



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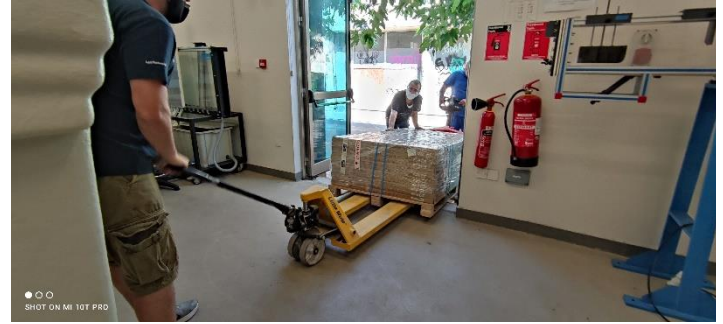
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Installation of the CyCLOPS GNSS CORS Stations

Permanent Segment (PS) of CyCLOPS includes six (6) cutting-edge continuously operating high-rate GPS/GNSS reference stations, weather stations, and tilt-meters, which have been installed at specific sites, on top of highly stable monuments to estimate ground displacements. The stations are located all over Cyprus, specifically two (2) in Limassol (ASGA, SOUN) and one in Nicosia Districts (MATS, ALEV) and, one (1) in Larnaca (TROU) and one (1) in Paphos Districts (AKMS), respectively. Each GNSS CORS station collocated with a pair of calibration-grade corner reflectors, and it is next to the seismograph of the national seismological network. The specifications of the equipment and details of the new sites follow:

Monumentation	Shallow-drilled braced Quadpod (according to UNAVCO specs) / Stainless Steel Truss
GNSS Receiver	Trimble® Alloy (GPS+GLN+GAL+BDS+IRNSS+QZSS+SBAS)
GNSS Antenna	Trimble® Ti-v2 Geodetic Choke Ring with SCIGN Radome
Weather Station	Vaisala PTU 307 with solar radiation shield
Tiltmeter	Jewell D-711-A-S
Geology	Bedrock



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26 July 2021 – TROU00CYP GNSS CORS Station at Troulloi Site



27 July 2021 – ASGA00CYP GNSS CORS Station at Asgata Site



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28 July 2021 – *SOUN00CYP* GNSS CORS Station at Souni Site



29 July 2021 – *AKMS00CYP* GNSS CORS Station at Akamas Site



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30 July 2021 – MATS00CYP GNSS CORS Station at Mathiatis Site



31 July 2021 – ALEV00CYP GNSS CORS Station at Alevga Site



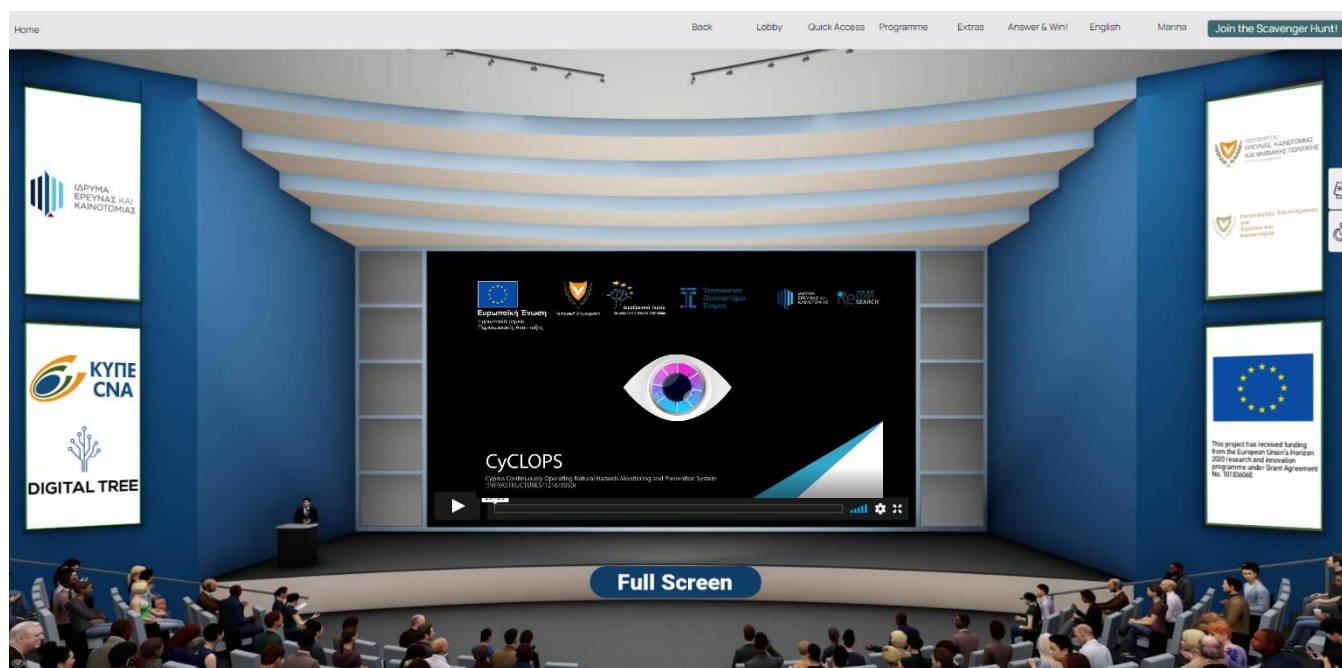


September-December 2021

Researcher's Night 2021

The 2021 Researcher's Night was originally scheduled for September 25, 2019. Due to the emergency measures taken as a result of the Covid-19 pandemic, the European Commission decided that its virtual organization on the 24th of September 2021.

CyCLOPS Project participated at the European Researcher's Night organized by the Research and Innovation Foundation of Cyprus, in auditorium live streaming. The 'Researcher's Night' is an annual event aims to the familiarization of the public with the world of science and research. Concordantly, the event highlights the importance of the scientists in the society. Our video presents the installation of the CyCLOPS multi-parametric network, in detail. You can find our video at the following [Youtube Link](#).





Installation of the CyCLOPS Mobile Segment

The Mobile Segment of CyCLOPS includes five (5) cutting-edge continuously operating high-rate GPS/GNSS reference stations, weather stations, and tilt-meters, which have been deployed in areas of interest which have already suffered the impact of natural and anthropogenic hazards. The specifications of the equipment and details of the new sites follow:

Monumentation	Stainless Steel Pillar
GNSS Receiver	Trimble® Alloy (GPS+GLN+GAL+BDS+IRNSS+QZSS+SBAS)
GNSS Antenna	Trimble® Ti-v2 Geodetic Choke Ring with SCIGN Radome
Weather Station	Vaisala PTU 307 with solar radiation shield
Tiltmeter	Jewell D-711-A-S

Installation of Mobile Segment at Pissouri Village

One of the most highly affected by natural hazards areas in Cyprus is the Pissouri Village. Pissouri is located in Limassol's district, Cyprus, equidistant from Limassol and Paphos cities. Following the re-activated ground movements within the Limnes in Pissouri, first noticed by residents in 2012, continue to cause significant architectural and structural damages to many properties, up to the present. Due to the remaining uncertainties over the depth(s) of sliding, the acceleration, and the direction of the landslides, Limnes area and Pissouri region are generally monitoring through the CyCLOPS project.

Totally three (3) GNSS Seismic Mobile Stations have been installed, covering the wider area of Pissouri village. To achieve maximum accuracy during measurements provided by the International GNSS Service (IGS) and EUREF's Permanent Network (EPN), two of the Mobile Stations have been in the highest points of the village.

25 October 2021 - CUT300CYP GNSS Mobile Station at Pissouri Area



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26 October 2021 - CUT400CYP GNSS Mobile Station at Pissouri Area



27 October 2021 - CAV000CYP GNSS Mobile Station at Pissouri Area



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Installation of Mobile Segment at Vassiliko Open-Pit Mine

Monitoring and identifying geohazards in open-pit mines, such as surface deformation, is critical in all planning and development operations stages. Landslides are considered the most dangerous natural hazard in the mining industry. Vassiliko Open pit mine is the largest Quarry in Cyprus, located in Kalavasos village in the Larnaca District. The extraction of the limestone is used as basic raw material of the cement production in Vassiliko Cement Company in Cyprus.

19 November 2021 – CUT200CYP GNSS Mobile Station at Vassiliko Open-Pit Mine





Installation of Mobile Segment at Choirokoitia Archeological Site

The lack of a comprehensive picture of sites affected by geohazards led to the conception of CyCLOPS project, to monitor monuments and sites in Europe which are inscribed on UNESCO's World Heritage List (WHL) and are potentially unstable due to geo-hazards. Choirokoitia Archeological site is endangered by falling rocks located on a steep ridge right above the archeological monuments. One (1) GNSS Seismic Mobile Station has been installed to the highest point of the site, in order to achieve maximum accuracy during measurements provided by the International GNSS Service (IGS) and EUREF's Permanent Network (EPN).

TROD00CYP GNSS Mobile Station at Choirokoitia Archeological Site





Publications 2021

1. **K. Themistocleous**, C. Danezis, and V. Gikas. Monitoring Ground Deformation of Cultural Heritage Sites using SAR and Geodetic Techniques: The Case Study of Choirokoitia, Cyprus. *Applied geomatics*, 13(1):37–49, Feb 2021. ([doi:10.1007/s12518-020-00329-0](https://doi.org/10.1007/s12518-020-00329-0))
2. **D. Kakoullis**, K. Fotiou, G. Melillos, and C. Danezis. Considerations and Multi-Criteria Decision Analysis for the Installation of Permanent Infrastructures for Continuous Space-based Monitoring of Natural Hazards. In *40th Earsel symposium*. Earsel, June 2021.
3. **K. Fotiou**, D. Kakoullis, M. Pekri, G. Melillos, R. Brcic, M. Eineder, D. G. Hadjimitsis, and C. Danezis. Space-based Deformation Monitoring of Coastal Urban Areas: The Case of Limassol's Coastal Front. In *40th Earsel symposium*. Earsel, June 2021.
4. **C. Danezis**. The Role of Strategic Infrastructures for Space-based Earth Observation vis-a-vis Resilient Societies: The Example of CyCLOPS. In Third Phase of the Consultation Forum for Sustainable Energy in the Defence and Security Sector (CF SEDSS III), Online, November 2021. European defence agency.

