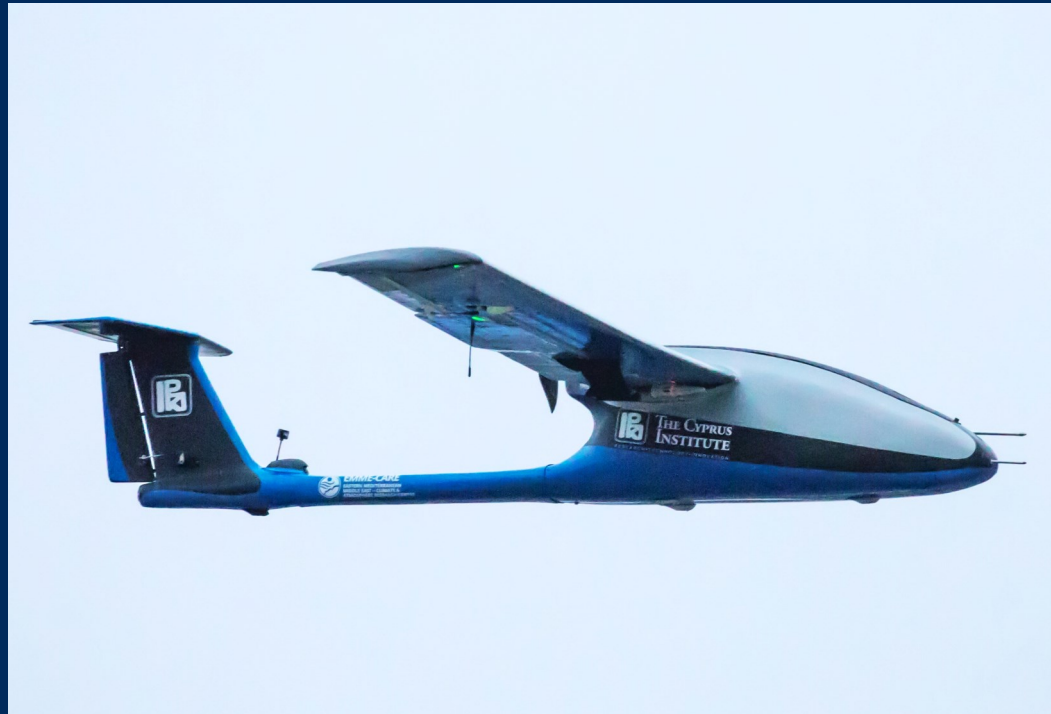


The **Unmanned Systems Research Laboratory (USRL)** is a flagship facility of the Climate & Atmosphere Research Center (CARE-C) which operates under The Cyprus Institute (Cyl). The mission of the USRL is to provide high-quality observations of atmospheric pollutants and other parameters relevant to air pollution and climate change through Research & Development of cutting edge technology in the field of Unmanned Aerial Systems (UAS). Taking advantage of its own private runway and dedicated airspace, which is near the Cyl Cyprus Atmospheric Observatory, as well as several other Cyl infrastructures, such as the instrumentation and analytical laboratories for testing and qualifying miniaturized sensors, USRL performs regular unmanned flights to document and contrast the long-range transported pollution from three continents (Europe, Africa and West Asia) and the dust aerosols from the largest desert regions in the world (Sahara, Middle East).

The **Climate & Atmosphere Research Center (CARE-C)** (<http://emme-care.cyi.ac.cy/>) is a 100-research-staff Centre-of-Excellence established in 2020 at The Cyprus Institute with €45 million of competitive funding from the EU's H2020-Teaming and the Cyprus Government. The mission of CARE-C is to establish a regional hub of knowledge to address air pollution and climate change in the Eastern Mediterranean and Middle East (EMME) through a combination of research, innovation and education activities with a regional focus.

The **Cyprus Institute (Cyl)** is a non-profit research and educational institution with a strong scientific and technological orientation. It is an issue-oriented institution, emphasizing international collaborations and cross-disciplinary research and post graduate education. Cyl is being developed by establishing research centers among which to address important and challenging problems at both the regional and international levels. These research centers are developed in partnership with leading, world-class institutions in their respective thematic areas.



Unmanned Systems Research Laboratory (USRL)

*A new generation of Unmanned Aerial Systems
for Atmospheric Research and Earth Surface Observations*



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Major Partners

Academic Partners

LSCE (CNRS-CEA-UVSQ, France)
Max Planck Institute for Chemistry (Germany)
National Observatory of Athens (NOA, Greece)
University of Helsinki (Finland)
NOAA (CO, Boulder, USA)
University of Tübingen (Germany)
University of Hertfordshire (UK)
Technical University of Darmstadt (Germany)
University Nova Gorica (Slovenia)

Private partners

EN-SCI (CO, USA)
Aerosol d.o.o. (Slovenia)
ADITESS LTD (Cyprus)

People

Prof. Jean Sciare (Head of USRL, CARE-C Director)
Dr. Christos Keleshis (Head of R&D, UAV Engineer)
S. Nicolaou (Project Manager)

Technical Team

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E. Nearchou (Electrical Engineer)
C. Constantinides (Software Developer)
C. Neoclous (Software Developer)
A. Leonidou (Composite Aircraft Developer)
C. Savvides (UAV Pilot)
N. Georgiades (UAV Pilot)
C. Hadjigeorgiou (UAV Pilot)
F. Manelidis (Intern)

Scientific Team

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Prof. E. Bourtsoukidis (Reactive Gases)
Prof. T. Jokinen (Nucleation)
Prof. G. Biskos (sensors)
Dr. M. Kezoudi (Post-doc fellow)
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Research Projects

EMME-CARE (H2020, 2019 - 2026): Eastern Mediterranean and Middle East – Climate and Atmosphere Research Centre of Excellence

Edu4ClimAte (HE, 2022-2026): Excellence Initiative towards a European Universities Alliance on Climate & Atmospheric sciences

ASKOS (ESA, 2019-2022): UAV-sensor systems for the calibration/validation of the Aeolus satellite dust products (Cape Verde, June 2022)

AQ-SERVE (RIF, 2019-2022): Air Quality Services for a cleaner air in Cyprus

SHIELD (JPI-CH, 2020-2023): UAS technology to Safeguard Heritage In Endangered Looted Districts

MATE (JPI-Oceans, 2020-2023): Maritime Traffic Emissions: A monitoring network

International Networks

ACTRIS: National Facility of the European Research Infrastructure on Aerosols, Clouds, and Trace Gases: H2020-ACTRIS-2; H2020-ACTRIS-IMP; H2020-ATMO-ACCESS

ISARRA: International Society for Atmospheric Research using Remotely piloted Aircraft

COST Action CA18235: PROFiling the atmospheric Boundary layer at European scale (2019 - 2023)

Research & Development Facilities

Established in 2010, as a national-grade infrastructure, the USRL operates a number of facilities which are unique in the Mediterranean:

- A **private paved runway** (12x200m) with overhead **airspace** (16Km², 6Km ceiling), granted by the Department of Civil Aviation, and located near the Cyl's Cyprus Atmospheric Observatory, which enables direct comparison with ground-based continuous observations of air pollutants.



- Two **state-of-the-art laboratories** (electromechanical & composite materials) dedicated to the construction of novel, tailor-made UASs for the integration of sensors.
- A **mobile ground control station** (GCS) for remote flight control of the UASs and for real-time monitoring of collected atmospheric data and other flight parameters.

Unmanned Aerial Systems (UAS)

The USRL relies on a **large fleet of multi-rotor and fixed wing UAS** offering different capacities in terms of payload, flight endurance, and maximum ceiling. USRL develops its own UAS with composite material (carbon fiber) in order to enhance these capacities with:

- Longer distance flights, >100km
- Higher altitude ceiling up to 7km
- Higher payload capacity up to 9kg
- Extended lifetime over other UAS types
- Higher performance under extreme conditions.

UAV-balloon systems have recently been developed by USRL enabling UAS to reach the upper troposphere and stratosphere (10-20km altitude) and safely return payload home.



USRL is **accredited by EASA** to operate its UAS in Europe under the "Specific Category"



Hardware/Software Sensor Systems



USRL operates its UAS with its **own Autopilot software/firmware** to enable :

- Plug-in new sensor and provide easy control, recording, and visualization at the ground
- Uniform data collection through optimal control of flight parameters
- Real-time streaming of sensor data available online

A large number of **atmospheric sensors** have been successfully tested and integrated onboard USRL UAS to provide high quality 3D mapping of the atmosphere :

- Meteo parameters (fast response P, T, RH)
- On-line Gases (O₃, SO₂, CO₂, CH₄)
- On-line Aerosol properties: size distribution (130nm-40µm diam.), total concentration, multi-λ back-scattering, absorption, & optical depth.

- Off-line Aerosol properties (chemical composition (impactor), spores/pollen)

An exhaustive description of atmospheric sensors operating onboard USRL UAS can be found at : Kezoudi et al., *The Unmanned Systems Research Laboratory (USRL): A New Facility for UAV-Based Atmospheric Observations*, Atmosphere, 2021, vol. 12, no 8, p. 1042 , <https://doi.org/10.3390/atmos12081042>

Research Activities

Climate and Atmosphere Research

The USRL supports (inter)national projects involving Cyl Research Centers as well as international research teams through TransNational Access provided by ACTRIS.

Scientific topics cover aerosol-cloud interactions, dust aerosol properties, vertical distribution of air pollutants, 3D mapping of plume, emission factors, greenhouse gas emissions, and qualification of remote sensing aerosol products (e.g. satellite cal/val and LIDAR retrieval)

Environmental Monitoring

In close collaboration with the Cyprus Department of Forests, USRL develops a new generation of UAS (multi-rotor « Inspector » and fixed wing « Surveyor ») to enhance the early detection and monitoring of Forest Fires.

3D Photogrammetry

The USRL team is utilizing its fleet of UAS in a variety of imaging applications such as the 3D reconstruction of complex terrains & monuments).

