



"Dunarea de Jos" University of Galati

REXDAN Research Infrastructure (Rexdan RI)

Galati, Romania

2022

The **REXDAN** Research Infrastructure is the main result of the project **An Integrated System for the Complex Environmental Research and Monitoring in the Danube River Area**, SMIS code 127065 and has been designed as a focal point for interdisciplinary research in the field of **Energy, environment and climate change**.

This infrastructure includes two components:

- the **REXDAN** research vessel;
- the **REXDAN** Research Center

which will contribute directly to increasing research performance through cooperation with European and international research teams.

The research vessel will navigate along 2000 km of the navigable sector of the Danube and can host up to 10 researchers that will have the opportunity to perform research over a wide geographical area including the river basin. Research related to: water, sediments, soil, air, biodiversity, bathymetry, hydromorphology, chemistry, biology, physics, environmental science, ecology, topography, atmospheric chemistry, sustainable development, etc.



The **REXDAN** Research Infrastructure has clearly European and international dimensions.

REXDAN research vessel

The **REXDAN** research vessel, the largest on the European Union inland waters, will include 9 modern laboratories in which academics and researchers of "Dunarea de Jos" University in Galati and researchers from Romania and abroad will carry out their activity.

The **REXDAN** research vessel is being built at ATG Giurgiu Shipyard and will be completed in January 2023.

General characteristics

Main dimensions:

- Total length: maximum 44 m, total width: maximum 10.5 m, draft: maximum 1.80 m;
- Overall height: according to the restrictions on the E80 route between Passau-Sulina (about 7.4m);
- Total displacement about 400 t;
- Autonomy: minimum 1000 km for navigation;
- Minimum 10 days for supplies for the crew (crew and researchers).

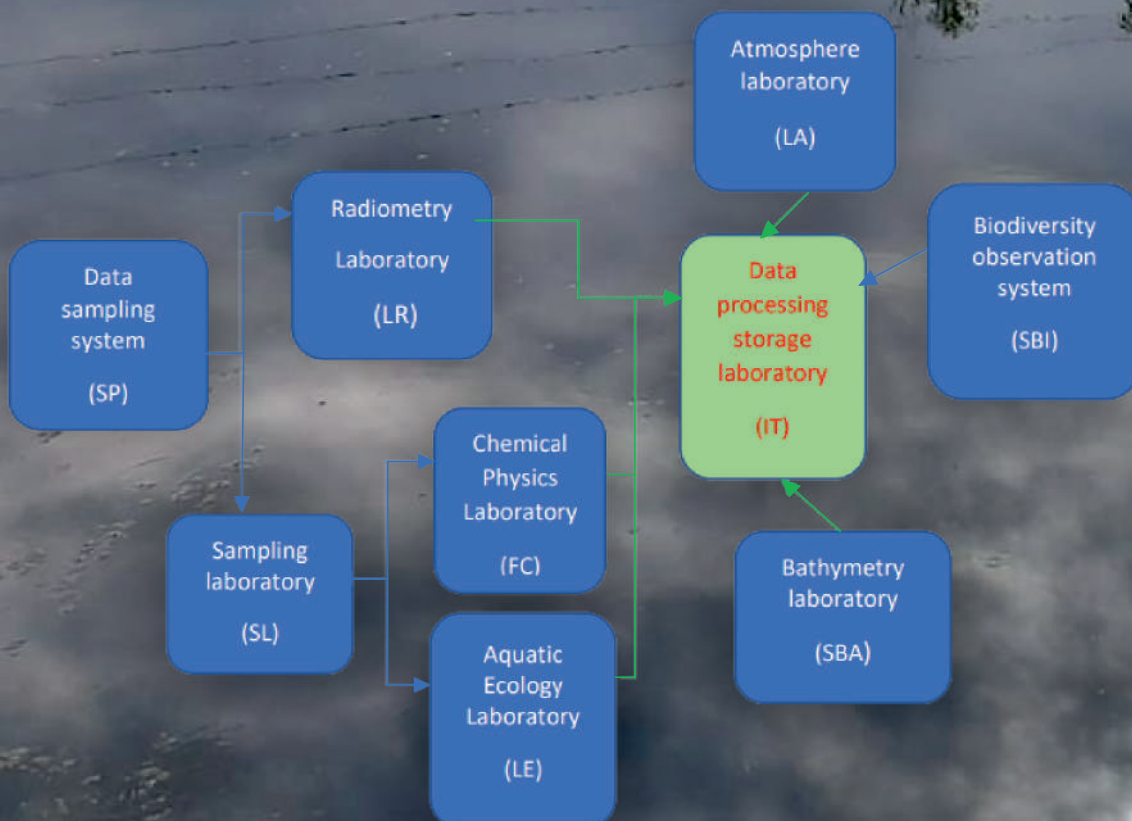
Destination:

- Mobile laboratories, environmental research vessel on the Danube River, Danube Delta, etc.;
 - Passenger ship for short voyages / Support ship for conference organization.
 - Researchers: 10 people (with permanent accommodation on board the ship);
 - Passangers: minimum 30 passengers on short-term trips (1 day) / conferences.
- Facilities for disabilities persons are available.



Laboratories and activities

- Data sampling system – dragging system, main deck, crane and working boat;
- Radiometry laboratory;
- Sampling laboratory- main deck
- Chemical Physics Laboratory;
- Aquatic Ecology Laboratory;
- Atmosphere laboratory -on top deck and atmosphere room;
- Biodiversity observation system- on top deck and wheelhouse;
- Bathymetry laboratory – Immersed instruments and wheelhouse;
- Data processing storage laboratory- IT Lab.





Research topics/applicability:

- Measurements of water, air, quality parameters;
- Scan bottom river and river water flow parameters;
- Bottom ground river analyze;
- Fish school detection;
- River and side river large aerial view configuration and changes;
- Collecting data about Danube river ecosystem.

ROMANIA

GALATI

Impacts:

- Protection of the EU citizen again health risks;
- Integrated activity in the politics of the EU Community;
- Document climate changes;
- Detecting pollution level;
- Impact of and on the Green Energy;
- Monitoring ecological accidents and events;
- Join people protecting TERRA.

Rexdan Research Center

The scientific novelty of the *REXDAN* Research Infrastructure lies in:

- holistic research activities and a methodological qualitative integration of extensive aquatic ecosystems;
- a highly-specialized and complex approach of chemical, physical, biological and biodiversity factors by using statistically-calibrated interdisciplinary algorithms, which will lead to new concepts;
- the possibility to assess the impact of hydrotechnical works carried out for maintaining channel navigability on the biodiversity (migratory species of ichthyofauna and birds);
- permanent and mobile observation systems which will allow monitoring of climatic parameters (continuously) and of atmospheric composition in areas where such measurements are sporadic or non-existent. The continuity of such measurements is essential for determining events caused by climate change.

The *REXDAN* Research Center includes 9 laboratories in which activities specific to the field of smart specialization *Energy, environment and climate change* will be carried out:

- The Laboratory for Sample Conservation and Preparation
- The Chromatography Laboratory
- The Instrumental Analysis Laboratory
- The Spectrometry Laboratory
- The Ecology Laboratory
- The Genetics Laboratory
- The Bathymetry, Hydrology, Topometry Laboratory
- The Climate Change Observation Platform
- The Data Storage/Processing Laboratory.

The Chromatography Laboratory

GC MS laboratory - GC Trace 1310 coupled to TSQ 9000 VPI Mass Spectrometer - Thermo Fisher Scientific and Thermal Desorption System - Unity-xr



Analysis, performances:

- Qualitative and quantitative analysis at high resolution: organochlorinated pesticides, polycyclic aromatic hydrocarbon (PAHs), polychlorinated biphenyls (PCBs); alkylphenols - endocrine disruptors, microplastics etc.;
- Triple quadrupole GC-MS / MS;
- Automatic sample introduction system using the Headspace technique;
- Mass range: 1.2 - 1100;
- High sensitivity;
- Femtogram detection limit.

Research topics / applicability

Environment:

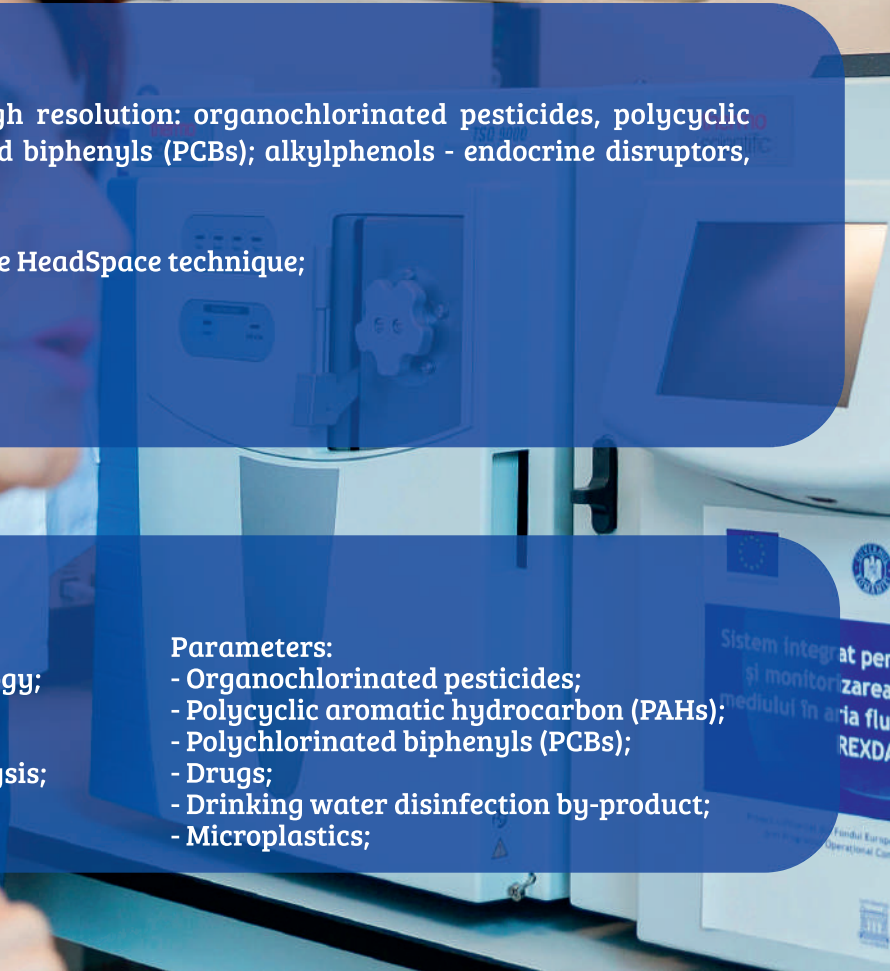
- Water
- Soil
- Biota
- Air

Other:

- Forensic Toxicology;
- Food industry;
- Agriculture;
- Oil and gas analysis;

Parameters:

- Organochlorinated pesticides;
- Polycyclic aromatic hydrocarbon (PAHs);
- Polychlorinated biphenyls (PCBs);
- Drugs;
- Drinking water disinfection by-product;
- Microplastics;



High resolution LC-MS / MS -Vanquish Flex UHPLC Systems coupled to Orbitrap Exploris 120 Mass Spectrometer - Thermo Fisher Scientific.

Analysis, performances:

- Qualitative and quantitative analysis at high resolution and exact mass of compounds at the level of traces in complex matrices;
- Resolution up to 120,000 (FWHM);
- Mass range of m/z 40–3 000;
- Scan rate of up to 22 Hz;
- High precision and sensitivity.



Research topics / applicability

Environment:

- Water;
- Soil;
- Biota.

Parameters:

- Non-volatile pesticide;
- Personal care products;
- Pharmaceutical compounds;
- Hormones and endocrine disruptors.

Other:

- Clinical Research;
- Forensic Toxicology;
- Food industry;
- Agriculture.

Ion chromatograph - IC Dionex ICS-6000 Thermo Fisher Scientific

Analysis, performances:

- Qualitative and quantitative analysis at high resolution: Anions: F^- , Cl^- , Br^- , NO_2^- , NO_3^- , PO_4^{3-} , SO_4^{2-} ; Cations: Li^+ , Na^+ , NH_4^+ , K^+ , Mg^{2+} , Ca^{2+}
- Double channel - simultaneous analysis of anions and cations;
- High pressure for fast analysis;
- High resolution;
- Excellent sensitivity, stability and ease of use.



RESEARCH DIRECTION:

- water quality;
- sustainability;
- environmental chemistry;
- environmental toxicology;
- environmental biotechnology, bioremediation, biodegradation;
- soil science;
- natural resources management
- biogeochemical cycles.

Research topics / applicability

Parameters:

Anions:

F^- , Cl^- , Br^- , NO_2^- ,
 NO_3^- , PO_4^{3-} , SO_4^{2-}

Cations:

Li^+ , Na^+ , NH_4^+ ,
 K^+ , Mg^{2+} , Ca^{2+}

Other:

- Food industry;
- Pharmaceutical industry;
- Aquaculture;

Environment:

- Water

The Spectrometry Laboratory

ICP-MS with speciation Nexion 2000C, PerkinElmer

Research topics / applicability

Approximately 80 elements from the periodic table.

- metals, metalloids, heavy metals (Cd, As, Ni, Cr - group 1 carcinogens), trace metals, alkali metals, alkaline earth metals

Other:

- nutrient level (P, S, Mg, Ca, K) in soil and plants
- nanoparticles;
- metalloproteins.

Laboratory FT-IR Spectrometer with Microscope - Spectrum 3
Laboratory FT-IR Spectrometer with Spotlight 400 Microscope, PerkinElmer

- Research topics/applicability:
- microplastics (identification, characterization, quantification);
 - drugs;
 - pharmaceuticals;
 - additives;
 - hydrocarbs.

MICROPLASTICS

SEDIMENT

WATER

FOOD

HUMAN
PLACENTA

HUMAN
BLOOD

FISH



UV-Vis-NIR laborator spectrophotometer with integrating sphere (Model Cary 5000, Agilent)

Research topics/applicability: drug analysis; DNA and protein concentration; pesticide residues in aquaculture; soil and crop composition; enzymes; minerals; vitamins; additives; chlorophyll determination; monitoring water quality, soil and atmosphere; collecting spectra for various environmental samples useful in creating databases.



RESEARCH DIRECTION:

- water quality;
- sustainability;
- environmental chemistry;
- environmental toxicology;
 - soil science;
- natural resources management.

The Aquatic Ecology Laboratory

Research stereomicroscope with digital camera - Zeiss SteREO Discovery.V12

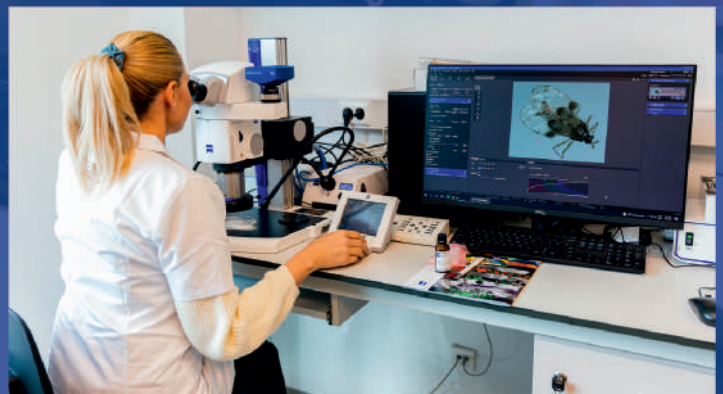
Analysis, performances:

- observation, preparation, sorting, manipulation and documentation of specimens;
- taxonomic discrimination for samples /specimens of fauna and vegetation;
- high quality and color photos of the biological samples;
- real time images/image storage and recordings.



Research topics/applicability:

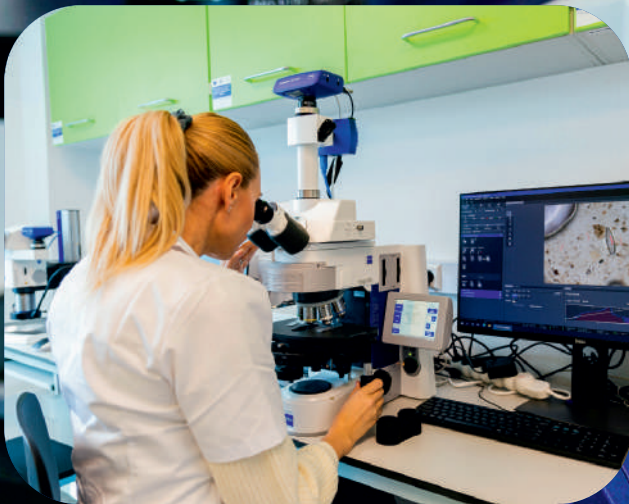
- Environmental research, education, medicine, restorations;
- Biology and medicine: developmental biology, microbiology, anatomy;
- Materials Engineering and Science: materials testing, fiberglass engineering.



**Transmitted light microscope
ZEISS Axio Imager 2**

**Analysis, performances:
Fine taxonomic discrimination in:**

- Cell biology - Investigation of subcellular compartments: cell nucleus, mitochondria or dynamic processes;
- Developmental Biology - documentation and analysis of processes that result in the differentiation, regeneration, or growth of cells, tissues, and organisms;
- Pathology pathological evaluations and determinations
- Human genetics - hybridization fluorescence method, identifies genetic loci/genes on chromosomes based on DNA probes
- Histology - perfect presentation of colors, rapid and accurate relocation of conclusive diagnostic locations in the specimen.



Research topics/applicability:

- Scientific and research fields in biology, environment;
- Medical examinations in laboratories (research);
- Industrial applications (pharmacology, engineering).





Inverted microscope with transmitted light - ZEISS Axio Vert.A1

Analysis, performances:

- determination of environmental, biological and chemical samples, can be connected to the tube sedimentation chamber;
- quantitative and qualitative analysis and determination of phytoplankton samples;
- research and analysis of samples specific to laboratories of biology, environment, medicine.

Applications:

research in the field of biology, environment and medicine.

RESEARCH DIRECTIONS:

- Assessment and monitoring of the aquatic ecosystems – Danube;
- Plant and animal taxonomy;
- Biodiversity management;
- Ecological process modeling and ecological statistics;
- Microbiology;
- Ecotoxicology;
- Water resources management.

The Bathymetry, Hydrology, Topometry Laboratory

UAV Drone with LIDAR and video, photogrammetric, thermal and spectral cameras Model FAE 1115 Predator

Research topics/applicability:

- high-quality video recordings and pictures;
- multispectral images;
- air quality;
- georeferenced frames;
- LiDAR georeferenced point clouds;
- thermal images and video recordings;
- precision orthophotoplans;
- MDT / MDS
- temperature, humidity, atmospheric pressure, PM 1.0, PM2.5, PM10, O3, NO2, CO, SO2, CxHx, HCl, H2S, NH3.



Electronic topographic level TOPCON DL-501

Research topics/applicability:

- level quotas with high precision;
- level differences with high precision.

3D Laser Scanner

Model: FARO Focus Plus S350.

Accuracy: $\pm 1\text{mm}$ up to 2 mil pts/sec

Research topics/applicability:

- georeferenced point cloud;
- visible images;
- three-dimensional images.



Base + Rover terrain GPS set, with rugged tablet terrain TOPCON HIPER HR.

Accuracy: $\pm 3\text{mm}$ H/V static.

Research topics/applicability:

- coordinates of points with subdecimetric precision;
- static recordings;
- RTK recordings;
- coordinate points for GIS.



Road profile system TOPCON RD-M1 Scanner

Research topics/applicability:

- georeferenced point cloud;
- travel trajectory;
- TIN model;
- DTM / DSM model;
- coordinates of high precision points;
- transverse and longitudinal profiles;
- volumes to add or shave of a road or dike.



Mobile scanner with camera and capture distance up to 100m TOPCON IP-S3

Research topics/applicability:

- georeferenced point cloud;
- travel trajectory;
- TIN model;
- DTM / DSM model;
- coordinates of high precision points;
- visible panoramic images;
- RAW data.





RESEARCH DIRECTION

Topography and bathymetry

- Topography monitoring;
- River hydro morphology;
- 3D digital models;
- suspended sediment concentration;
- Infrastructure 3D mapping;
- Discharge and water velocity monitoring;
- River flow analysis.

Geographic Information Systems

- GIS for urban planning;
- Sediment transport simulation;
- Flood Risk and Hazard
- Pollutants transport simulations (rivers/lakes);
- Land-use planning.

Teledetection and fotogrametry applications

- High accuracy ortophotoplans;
- Spatial monitoring with UAV methods;
- Multispectral analysis (forestry/land cover);
- Digital terrain models form UAV's.

The Climate Change Observation Platform



Cloud radar RPG-FMCW-94-DP



Research topics/applicability:

- reflectivity (Z_e);
- rain drop size distribution;
- ice shape and orientation;
- boundary layer characterization;
- lightning detection;
- qualitative new precipitation estimation;
- weather and fog nowcast;
- wind retrieval;
- hydrometeor classification.

Radiometer RPG-HATPRO-G5



Research topics/applicability:

- vertical profiles of atmospheric temperature;
- vertical profile of atmospheric humidity (relative and absolute humidity);
- Liquid Water Path (LWP);
- Integrated Water Vapor (IWV);
- wet and dry delay;
- stability indices.

OTT Parsivel² Disdrometer



Research topics/applicability:

- Precipitation type, intensity,
- drop size distribution, radar reflectivity
- Simultaneous measurement of 32 classes for particle sizes and velocities



Ceilometer CHM 15k „NIMBUS“ – Lufft

Research topics/applicability:

- vertical profiles of atmospheric temperature;
- vertical profile of atmospheric humidity (relative and absolute humidity);
- Liquid Water Path (LWP);
- Integrated Water Vapor (IWV);
- wet delay;
- dry delay;
- stability indices.

Rapid-E Real-Time Bioaerosol Detector

Research topics/applicability:

Identification of airborne particles ranging between 0.3 and 100 micrometers, including bacteria, fungal spores, viruses, pollen, and other aerosols.





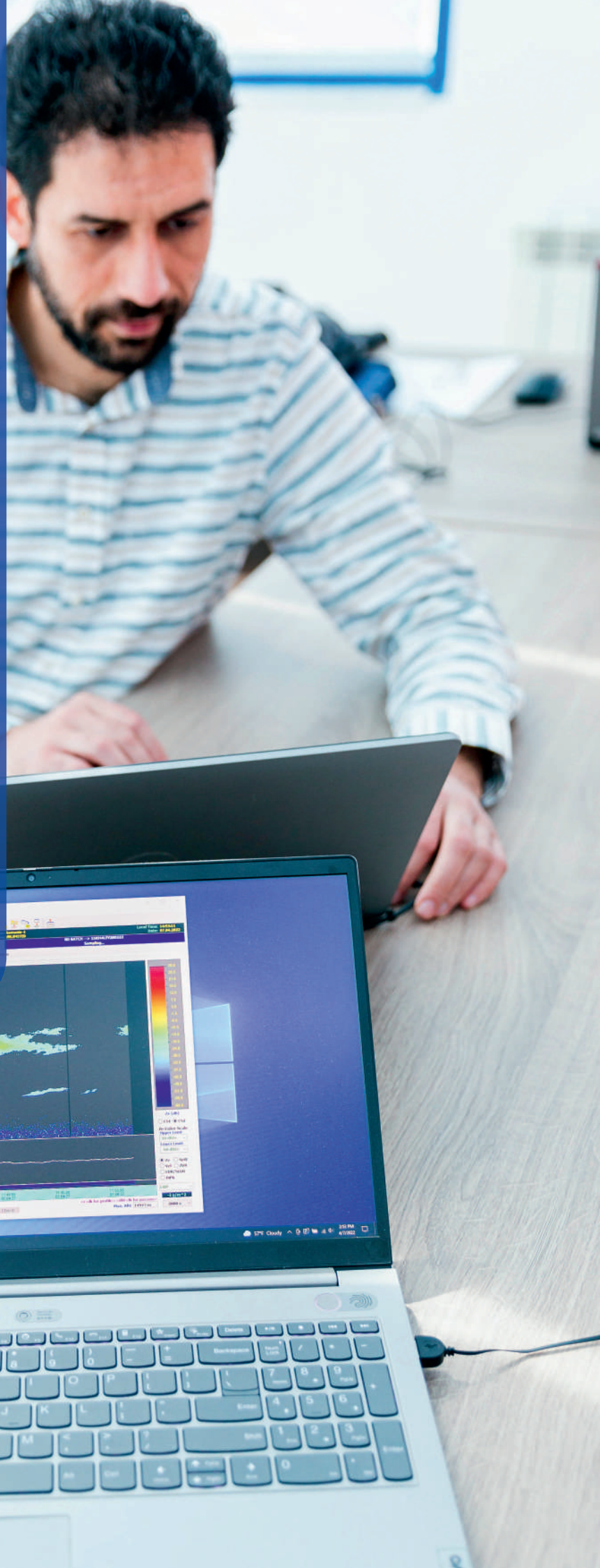
Professional Meteorological Station

Research topics/applicability:

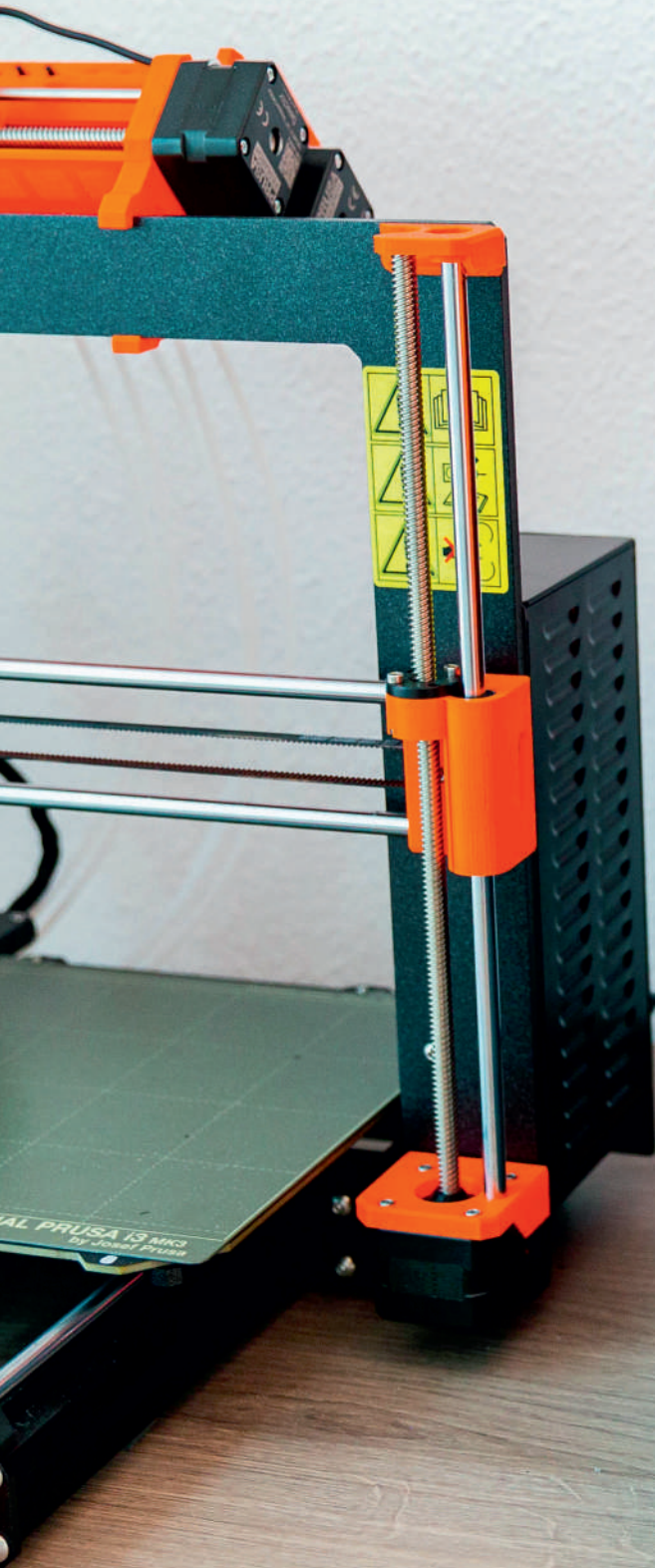
- Continuous measurements of meteorological parameters: temperature, humidity, wind, precipitation, pressure, visibility

RESEARCH DIRECTIONS

- atmospheric composition observations;
- cloud variability and effects on/caused by climate change;
- solar variability;
- satellite data validation;
- precipitation.



The Data Storage/ Processing Laboratory

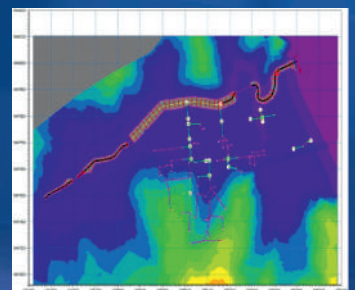


IT equipment:

- Water resistant laptops and tablet for in field data gathering;
- 2 in 1 laptops for map generation;
- Performance laptops and PC for running numerical and graphical models;
- Standard data processing laptops;
- Printing equipment (A4, A3, A0 and 3D printers);

Research and basic software:

- CAD software (BricsCAD);
- Matlab (data processing software);
- Flood simulation software;
- Basic computer software (Windows, Office, Antivirus);



The Laboratory for Sample Conservation and Preparation

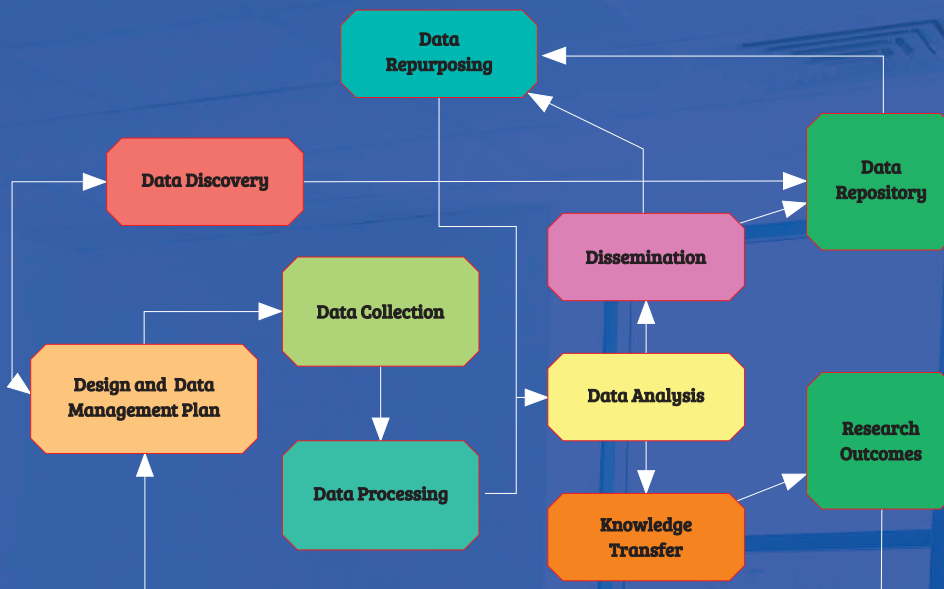
Includes equipment for preparing environmental (air, water, soil, biota) samples which may be subsequently analyzed with the other high-performance, state-of-the-art equipment available in the REXDAN Research Infrastructure.

The same equipment is used for preserving chemical reagents and samples. All the equipments are the new generation.

List of equipment with which the laboratory is equipped:

- magnetic stirrer with multi-station heating;
- ultrapure water device with UV filter, final filter;
- distillation and deionization apparatus;
- ultrasound bath;
- water bath;
- analytical balance;
- technical balance;
- laboratory centrifuge with cooling;
- laboratory oven;
- laboratory glassware washing machine;
- laboratory vibrating mill;
- laboratory press for the preparation of samples to be analyzed with FT-IR;
- digital micropipette set;
- CBO5 analysis system for 20-24 samples;
- microwave digestion system;
- extraction/ purification system of samples by extraction;
- automatic titrator.

RESEARCH ACTIVITIES



The main activities are:

- Storage, processing and protection of data;
- Generation of multidisciplinary databases, maps;
- Running numerical and graphical models ;
- Support applications for preparing and conducting field data collection campaigns;
- Dissemination the results of the research activity;
- Production of spare parts and various fastening systems/subassemblies (3D printing).

Programme: Horizon Europe Framework

REXDAN targeted actions for HORIZON MISS - Mission Ocean, seas and water:

Danube sturgeons' conservation research network



Danube River restoration and ecosystem connectivity research network



- Improve eco-system connectivity in the Danube River basin;
- Enhanced restoration of freshwater ecosystems in the Danube River basin;
- Restore the stocks of emblematic fish species, as sturgeons, in Danube - Danube Delta macro-system;
- Create new aquatic ecological corridors and shift the status of protected areas to strictly protective.

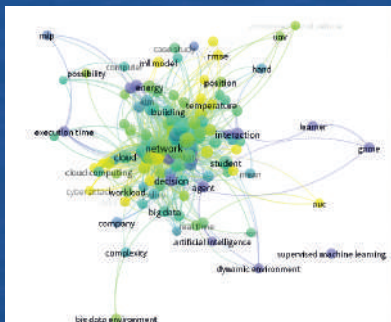


REXDAN targeted actions for HORIZON BIODIV - Biodiversity and ecosystem services



Aquatic ecosystems stressors research network

- Develop knowledge for identifying priority conservation areas and establishing effective and resilient ecological networks;
- Elaborate forecasting models related to fish stocks - different trophic niches - water pollutants in order to increase the monitoring and control capacity of aquatic habitats;
- Use of deep learning for specific species classification, plankton monitoring, fish abundance and pollution hotspots identification;
- Elaboration of Web-GIS application as information management tools in support of decision-making process.



Aquatic ecosystems modeling research network

REXDAN targeted action for Horizon Europe Climate Science

- Developing mitigation and adaptation strategies and policies tackling the global climate crisis based on understanding its causes, evolution and impact

