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EOTiST aims to enhance the Science and Technology capacity of the Space Research Centre of the Polish Academy of Sciences (CBK PAN) and to achieve excellence in research of EO products' assimilation in the ecosystem assessment and monitoring by starting close collaboration with 3 European centers of excellence: CERN, CREAM, CNR.



Centrum Badań Kosmicznych PAN (CBK PAN) was established in 1977 as a research institute focused on terrestrial space, the Solar System and the Earth using space technology and satellite techniques. CBK PAN has participated in numerous space science missions in collaboration with: Roscosmos – KORONAS-F, Phobos-Grunt; NASA – IBEX, Chandrayaan; ESA – CASSINI, MARS EXPRESS, ROSETTA; CERN -DEMETER and TARANIS; as well as in Earth Observation (EO) programmes: GMES/Copernicus, SWEX and SMOS mission. CBK PAN is the leading Polish institution in the field of space research and its applications in geosciences, technology development and remote sensing. It also acts as an expert for the Polish government.

The Earth Observation Department (EOD) is focused on processing of satellite images and developing GIS applications. EOD's staff were involved in numerous projects with focus on both optical and radar image analysis and classification. Main topics in EOD activity include land cover/land use classification and change detection on different scales (from national to global) with new algorithms and data sources. Apart from these activities, EOD worked on natural hazards assessment, climatological studies, quality control of EO-based and GIS mapping products. Also, EOD develops its capabilities in the ecosystem services (ES)



CERTH is one of the largest research centers in Greece. It was founded in 2000 and is located in Thessaloniki. CERTH participates in this twinning project through the Information Technologies Institute (ITI). CERTH/ITI is one of the leading Greek institutions in the field of Information and Communications Technology (ICT) with long experience in numerous European and national R&D projects. Additionally, CERTH/ITI has a proven experience related to the utilization of EO data/products for the generation of products relying on its own developed modules and services. It has been involved in numerous related projects. Among others, the recently completed H2020 'ECO-POTENTIAL' and the older FP7 Space 'BIO\_SOS' ones; both providing valuable results to support ecosystem monitoring. In addition, CERTH/ITI team participates in the myEcosystem showcase working group of the recently initiated H2020 'E-Shape' project. EShape is the flagship project paving the way for EuroGEO (GEOSS). Furthermore, the team is expected to deal with artificial intelligence applications with Earth Observation data via its involvement in the H2020 'SnapEarth' project. Moreover, it will develop ICT training modules for the technologies suggested at the ENI CBC MED 'AQUACYCLE' and ENI CBC BSB 'PONTOS' projects.

Finally, CERTH/ITI has a wide network within and beyond the European remote sensing society, employing in its working team, among others, the Chairman of the Special Interest Group on the Applications of Remote Sensing in Land Use Land Cover of the European Association of Remote Sensing Laboratories (EARSel) and Copernicus Academy member.



CREAM is a public research centre dedicated to terrestrial ecology, territorial analysis and global change, pursuing excellence in the production and dissemination of knowledge, in addition to the innovation, development, and transfer of methodologies. The centre aims to contribute to improving the conservation and management of our natural environment by acting as a bridge between academia, public administrations and society and within its spheres of action. Priority research lines of CREAM are: biodiversity; functional diversity and global change, forest ecology and territorial analysis with Earth Observation. CREAM's expertise includes conservation ecology, climate change adaptation and mitigation, land use/cover dynamics, water flows and water budgets, forest biomass, GIS technologies, remote sensing, and modelling ecosystem processes. CREAM offers a recognized, high-quality training programme consisting of a doctoral programme, two official masters (GIS-Remote Sensing and Terrestrial Ecology) and periodic continued education courses. CREAM is among the 500 best international institutions of the world in six different indicators according to SCImago Institutions Rankings (SIR) and it is recipient of the Severo Ochoa Award of Excellence, the highest quality accreditation for research centres in Spain. CREAM is member or collaborator of relevant European and worldwide organizations such as: Copernicus Academy, GEOSS; OGC, ECSA, The European Water Platform, EFI, IPBES, IPCC, ALTER-net, LTER-Europe, etc.

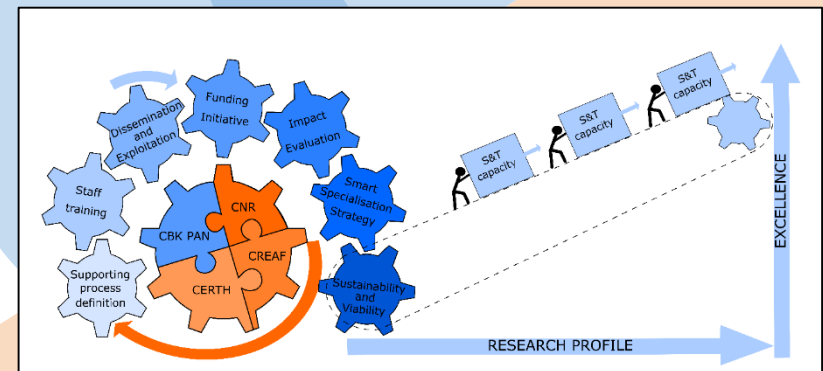


CNR is a public organization and it is the first Italian research institution for number of researchers, with a leading position in terms of spin-off and multidisciplinary research; its duty is to carry out, promote, spread, transfer and improve research activities in the main sectors of knowledge growth and of its applications for the scientific, technological, economic and social development of Italy. CNR is distributed all over Italy through a network of institutes aiming at promoting a wide diffusion of its competences throughout the national territory and at facilitating contacts and cooperation with local firms and organizations. More than 40% of CNR annual budget comes from external funds through contracts with private entities (companies, services, provision of services, agreements), with the European Union and with other international organisations.

The research group participating in the project represents two CNR institutes (Institute of Geoscience and Earth Resources and Institute of Applied Mathematics) which tackle some of this century's key environmental issues as Climate Change, Natural Hazards, Pollution and Sustainability of the use of Natural Resources. Their mission is to gather knowledge and predict the behaviour of the Earth system and its resources, to support a sustainable future for the planet and humanity.

## PROJECT OBJECTIVES

The goal of the project is to improve the scientific excellence and enhance the S&T capacity of the coordinating organization and to raise its overall research profile and the capacity of its staff in the Earth Observation (EO) supported environmental research area using in house non-exploited potential through the twinning approach.



EOTiST's activities are deployed around a Capacity Building, Dissemination and Exploitation interweaved scheme, to formulate a self-sustainable development environment, kind of public-to-private and research-to-industry ranging community of practice, for CBK PAN's research and services for the society.



## MAIN GOALS

- Enhance S&T capacity of the coordinating institution;
- Upgrade research profile of the coordinating institution and the profile of its staff by training and mobilizing of personnel;
- Increase research excellence and stimulate innovation of the coordinating institution;
- Achieve sustainable progress and future development for the today's seed group in CBK PAN;
- Promote the involvement of early stage researchers in the CBK PAN;
- Develop joint research initiatives and projects;
- Improve proposal preparation and management/administration skills in the CBK PAN.

## ECOSYSTEM SERVICES



Ecosystems such as Croplands, Wetlands, Lakes, Oceans, forests and grasslands or rivers provide the food we eat, the water we drink, and a wide array of other products, cultural benefits, and spiritual values. 🌿

Therefore, Ecosystem services are important because the benefits that human beings extract from nature are the foundation of all economies, the basis of major industries, sources of knowledge, and central to many cultures.

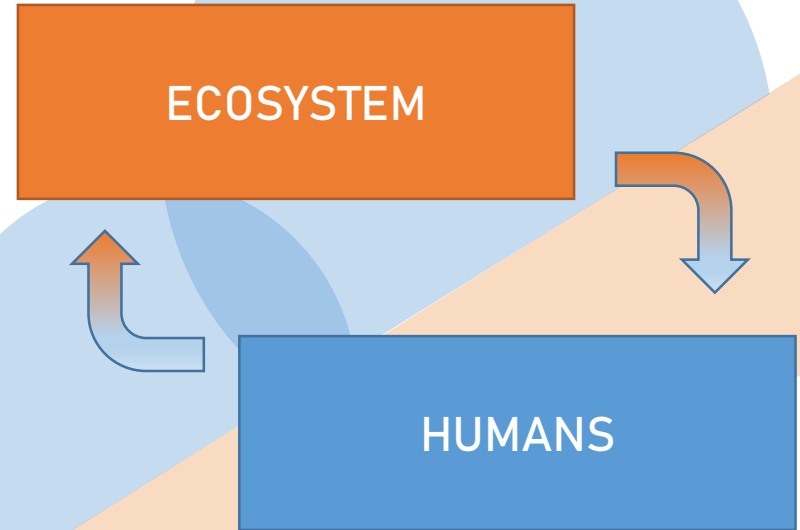
## REMOTE SENSING

Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft).

Special cameras collect remotely sensed images, which help researchers "sense" things about the Earth



## ECOSYSTEM MANAGEMENT

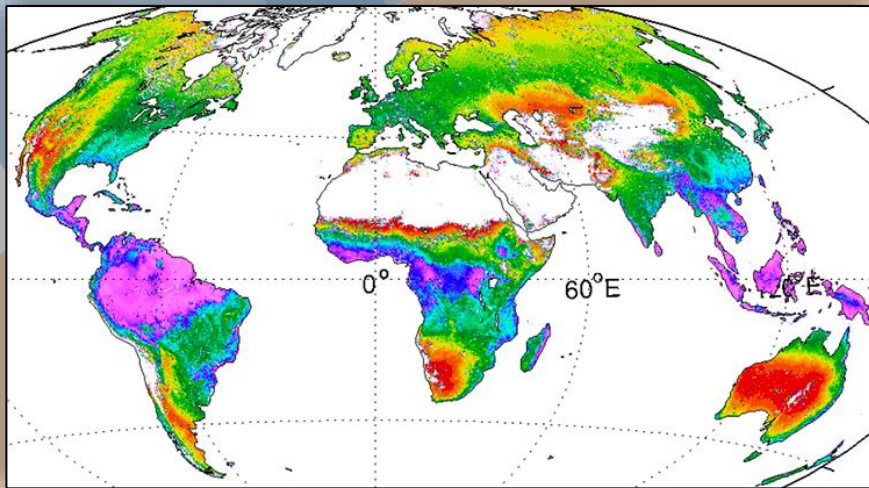


Ecosystem services can be categorized in a number of different ways, but the most used one is suggested by the Millennium Ecosystem Assessment:

- Provisioning services
- Regulating services
- Cultural services
- Supporting services

## REMOTE SENSING AND EESS

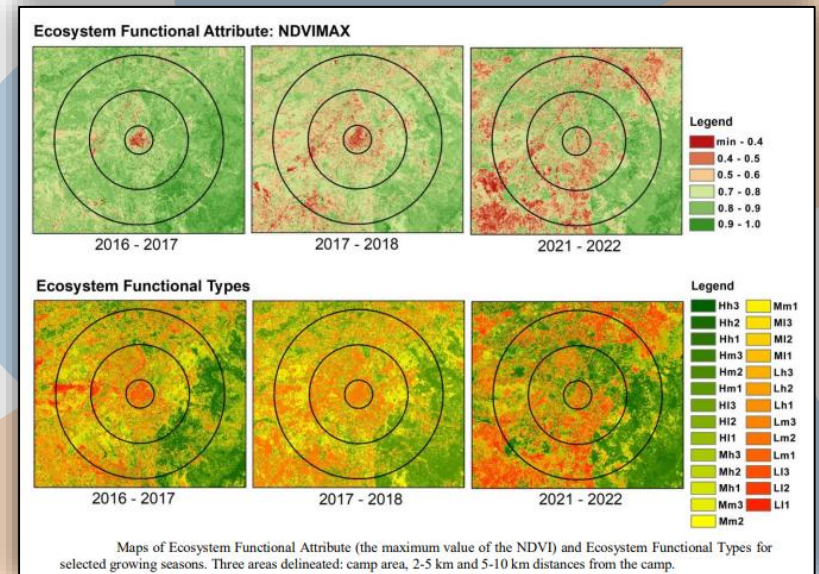
Satellite-based earth observation is probably the most economically feasible means to systematically retrieve global information with high temporal, spatial and spectral resolution over large areas.



Example – Evapotranspiration from ground surface data obtained from MODIS satellite.

## EOTIST AND EESS

Developing early warning systems for land degradation around refugee camps.

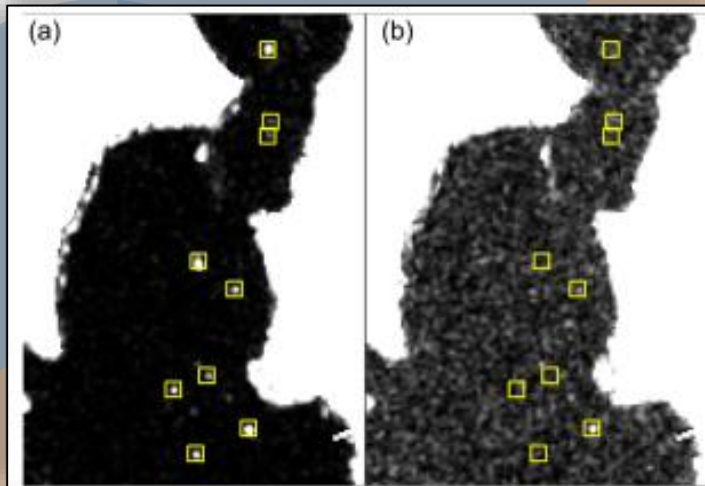


The joint research initiative of H2020 EOTiST and ARICA projects aims to better understand the ecosystem conditions around refugee camps and evaluate the capability of Ecosystem Functional Attributes (EFA) as early warning indicators of ecosystem degradation. The analysis is based on Sentinel-2 optical satellite data and derived geospatial products for the period 2016-2022, reference data collected during the field campaign in 2022, and information gathered during interviews with local authorities and NGOs.



## EOTIST AND EESS

### Small Recreational Boat Detection Using Sentinel-1 Data for the Monitoring of Recreational Ecosystem Services



Boat visibility in a Sentinel-1 image (yellow squares represent boats): (a) VV polarization and (b) VH polarization.

Recreational ecosystem services are crucial for human well-being, and nature-based recreational activities often support local economies. However, tourism is very often one of many threads that contribute to the environment, and, therefore, data regarding its spatial patterns are necessary for the long-term sustainable development of a region. The present study describes a method for the detection of small boats (<10 m in length) in lake conditions based on Sentinel-1 radar images.

## EOTIST AND EESS

### Phenological metrics derived from Sentinel-2 data for *Solidago gigantea* mapping



The mapping of invasive species is essential for effective management and conservation efforts. Phenological descriptors are temporal patterns of plant life cycle events, such as flowering and fruiting, which can provide valuable information for species identification and monitoring. The results revealed distinct phenological patterns associated with the plant, allowing for accurate identification and mapping of its distribution. The spatial distribution map highlighted areas of high risk of invasion, providing valuable information for targeted management strategies.