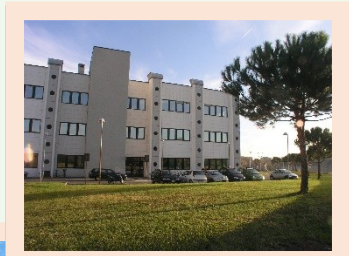


# Institute of Research on Terrestrial Ecosystems



## IRET

studies the structure of terrestrial ecosystems, functioning and productivity as well as biotic and abiotic components and their interactions also related to the global change and the anthropic pressure.

- 69 Researchers and technologists permanent staff
- 47 including technicians and administration staff
- 25 scientific staff with various research contracts

## IRET Key words

**PORANO:** Biodiversity, population genetics, ecophysiology, stable isotopes, biosphere-Atmosphere exchanges, climate change, green infrastructure, agroforestry systems, photosynthesis, metabolism of carbohydrates, biomass, bio-energy, bio-refinery

**LEGNARO:** Agro-environmental ecosystems, global change and alien species, integrated management and environmental sustainability of pesticides use

**MONTELIBRETTI:** Forest ecosystems, climate change, monitoring and sustainable management of forests molecular physiology of environmental stress, photosynthesis, VOC emissions plant biochemistry, alimurgy and nutraceuticals, bioremediation and phyto-mitigation

**NAPOLI:** Landscape reconstruction in lab technologies and sustainable products for the environment, bio-refinery of residual biomass from agriculture and industry, environment, human health

**SASSARI:** Agricultural and forest entomology, insect biodiversity, sustainable pest, management, biological control, invasive alien insect, native natural enemies

**PISA:** Soil and sediments, Soil functionality, Soil Organic Matter, C sequestration, Humic-enzyme complexes, Trace elements, Nanoparticles, Biodiversity, Biofortification, Soil pollution and remediation, Contaminants in high-risk areas

**FIRENZE:** ecophysiology of ecosystems under abiotic stress, pedosphere, microbial photosynthesis, groundwater ecology and ecotoxicology

## Laboratori speciali



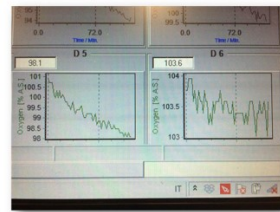
**Spettrometri**

Per gli isotopi stabili IRMS  
(Porano)



**Sequenziatore**

Laboratorio di genetica e  
biologia Molecolare (Porano)



**Microrespirometer**



**Fluorimetro-RX-IRGA**

Per studi eco-fisiologici su  
piante in condizioni di  
stress (UOS Montelibretti)



**Spettrometro (VOC)**

Per l'analisi di composti  
organici volatili - VOC  
(UOS Montelibretti)



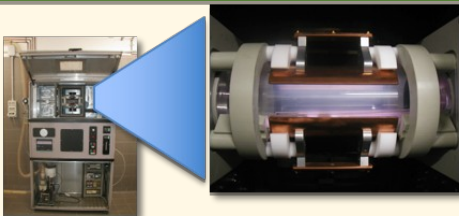
**Camera di combustione**

Per lo studio delle emissioni  
dei gas negli incendi  
(Porano)



**Culture in vitro**

Laboratorio di colture in vitro  
(UOS Montelibretti)



**Low Temperature Ashing**



**Real Time PCR**

Laboratorio di biologia  
molecolare  
(UOS Montelibretti)



**Strument. PON I-Amica**

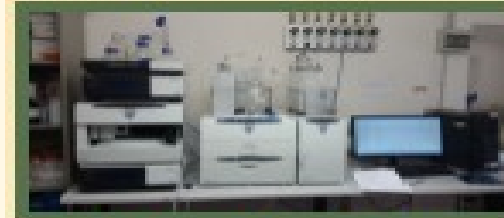
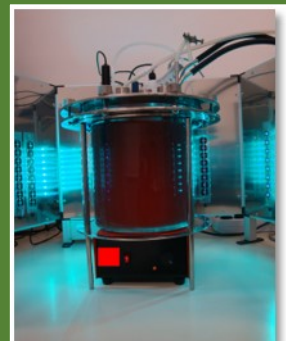
Laboratorio di tecnologie e  
servizi a supporto del territorio  
(UOS Napoli)



**Laboratorio  
microstrutture**



**Photobioreactors**



**Laboratorio di Biomasse  
(Porano)**



**Camere di crescita**

Per lo studio delle relazioni tra  
ambiente e qualità delle produzioni  
ortofrutticole  
(Porano)

## INFRASTRUTTURE



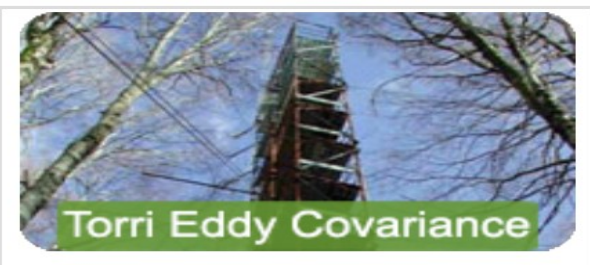
**Ozone Face**



**Campi sperimentali**



**Mesocosmi**



**Torri Eddy Covariance**



## Aim of the research

- Biodiversity and adaptive response of agroforestry systems in relation to major evolutionary factors and anthropogenic impacts
- Biodiversity as habitat template for environmental restoration

## Activities:

- Population genetics studies in natural populations and cultivated varieties of agroforestry species.
- Spatial analysis (GIS) of genetic diversity in tree populations
- Genetic variation of adaptive traits in different provenances of agroforestry species .
- Community genetics studies in agroforestry species and associated organisms.
- Genomics and transcriptomics of traits relevant for environmental adaptation of forest trees.

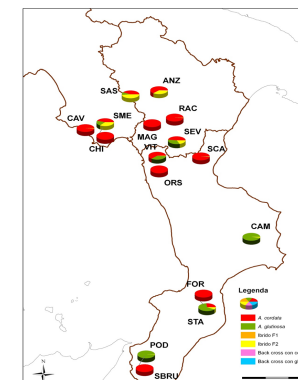
**Species:** Walnut, Chestnut, Oak, Sour Cherry, Alder, Black Locust

## IRET facilities:

- \* Databases and germplasm banks of the main studied species;
- \* Modern equipment for molecular analysis and sequencing of DNA
- \* Know-how in molecular analysis with neutral and functional markers;

# BIODIVERSITY AND SUSTAINABLE MANAGEMENT OF AGRO-ECOSYSTEMS

**Main projects financed :** Marie Curie Actions COFUND project "I-MOVE" 2013/2015, Pro.No.s.t.i.co. Umbria Region 2014-2015 (Mis. 1.2.4.-PSR 2007/2013); JUGL'ONE, MIPAF 2009-2013; BENTEN Campania-Region 2013-2016; EU Network of Excellence within the 6FP on "Evolution of Trees as drivers of terrestrial biodiversity" (EVOLTREE Contract n. 016322); 2014 – 2010; FNAP : "Frutti antichi per nuovi prodotti" Umbria Region within the framework of Misura 1.2.4 – PSR Umbria ; Italian Network of Genetic Resources BIOGENRES [http://www.biogenres.cnr.it/it/30/Gli\\_Istituti/](http://www.biogenres.cnr.it/it/30/Gli_Istituti/)



*Alnus cordata* and *Alnus glutinosa*:  
distribution map



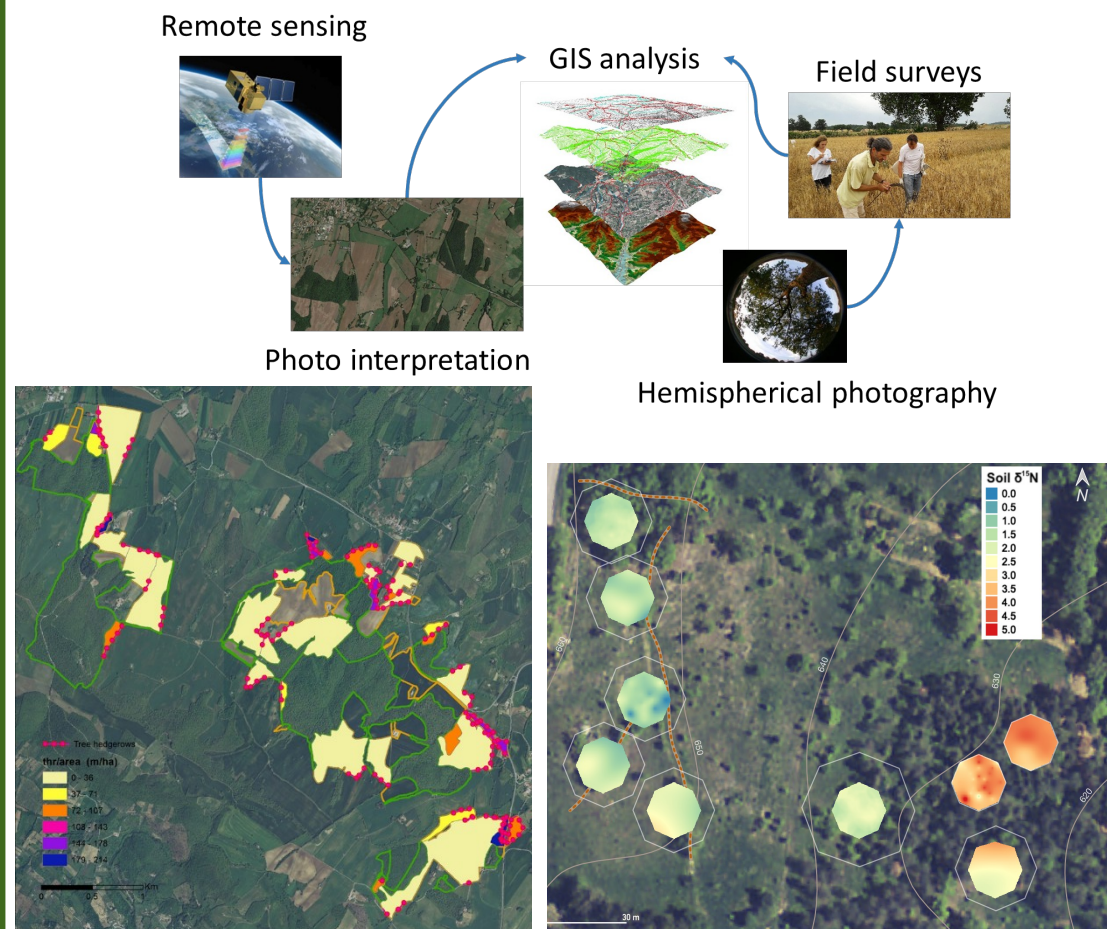
# GEOSPATIAL MODELLING FOR SUSTAINABILITY AND CONSERVATION OF AGROFORESTRY RESOURCES

Integrated use of GIS, Remote Sensing and Field surveys for:

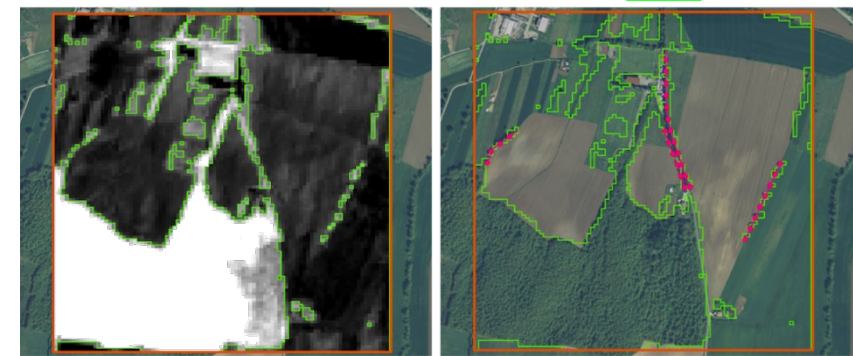
- Monitoring and assessment of agroforestry resources
- Mapping the agroforestry landscape structure
- Understanding the interactions between biological and physical components of agroforestry systems
- Assessing, mapping and quantifying the social and economic value of the agroforestry ecosystem services
- Spatial and spatio-temporal modeling of stable isotope for mapping ecological relationships in agroforestry ecosystems
- Analyzing the land cover, land use changes dynamics for restoring degraded landscape

Projects:

AGFORWARD - SidaTIM - Ecologia e produttività dei tartufi: effetti della gestione forestale



NDVI derived by HRS2 imagery      ●—● THR      □ Vegetation



## MICROWAVE AND OPTICAL REMOTE SENSING

- Satellite, Airborne, in situ image acquisition in microwave and optical ranges
- Image processing and interpretation, time series analysis
- Geostatistical interpolation
- GIS integration with climatic, topographic and anthropic datasets



# STABLE ISOTOPES ECOPHYSIOLOGY IN SOCIO-ECOLOGICAL SYSTEMS

## AIMS:

- Plant photosynthetic metabolism
- Plant acclimation and feedbacks on climate change
- Interactions between plants, soil and atmosphere, using stable isotopes as natural tracers
- Soil Organic Matter and Carbon sequestration in soil
- Deconvolution of ecosystem fluxes components combining eddy covariance and isotopic techniques
- Mycorrhizal and mutualistic relations between host plants, fungi and nitrogen-fixing bacteria
- Food authentication and traceability
- Spatial and spatio-temporal variability of stable isotope ratios involved in biogeochemical processes: geospatial modelling (ordinary and time-extended Isoscapes)

## Socio-ecological analyses in:

- Understanding the interactions between anthropic and natural components of socio-ecological systems
- Assessing system vulnerability and resilience
- Finding sustainable actions under global change scenarios

## IRET facilities:

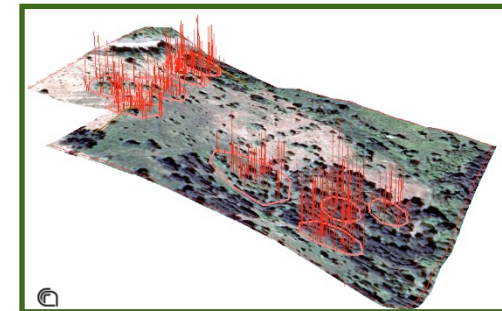
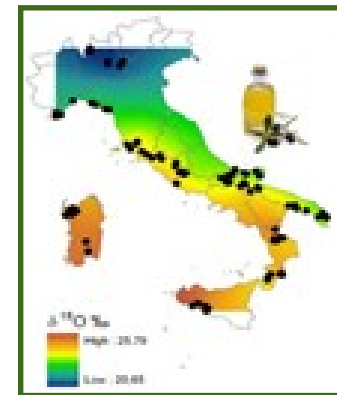
Laboratory of Isotope Ratio Mass Spectrometry ( $^{13}\text{C}$ ,  $^{15}\text{N}$ ,  $^{18}\text{O}$ ) equipped with HPLC-IRMS for "compound-specific" analysis

Gas exchange equipment for carbon flux analysis at leaf level

Remote Sensing and Geographic Information System Laboratory

## Main projects financed:

- CISIA - Conoscenze Integrate per la Sostenibilità e l'Innovazione del made in Italy Agroalimentare
- Ecologia e produttività dei tartufi: effetti della gestione forestale
- CARINA - Sicurezza, Sostenibilità e Competitività delle produzioni agroalimentari campane
- Campus QUARC - Qualità delle produzioni tipiche campane ed il suo territorio
- FP7 – INCO "FP4BATIW", Coordination and Support
- FACCE JPI - SustainFARM
- FACCE JPI - SidaTim



## Aim of the research

Planning sustainable strategies of pest management and biodiversity of groundwater

## Activities:

- Monitoring of newly introduced "alien" insects
- Insect population dynamic studies
- Biodiversity of natural enemy communities
- Evaluations of natural occurring products as insect repellents
- Biomonitoring of groundwater bodies; Assessment of: a) the habitat preferences of groundwater invertebrates; b) the impact of groundwater abstraction on groundwater fauna; c) the effect of natural disaster (earthquakes) on groundwater fauna; d) the effect of climate change on groundwater fauna; Evaluation of the sensitivity of groundwater ecosystems (invertebrates) to contamination.

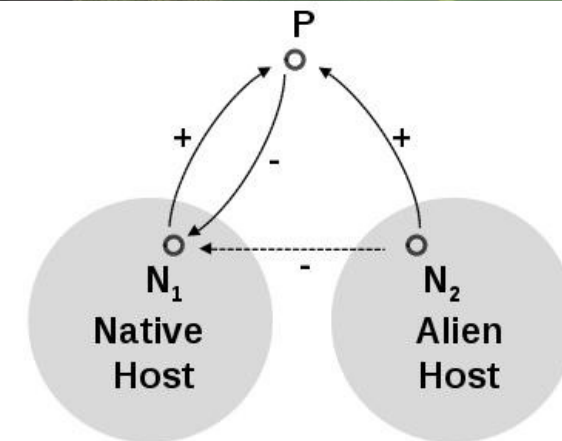
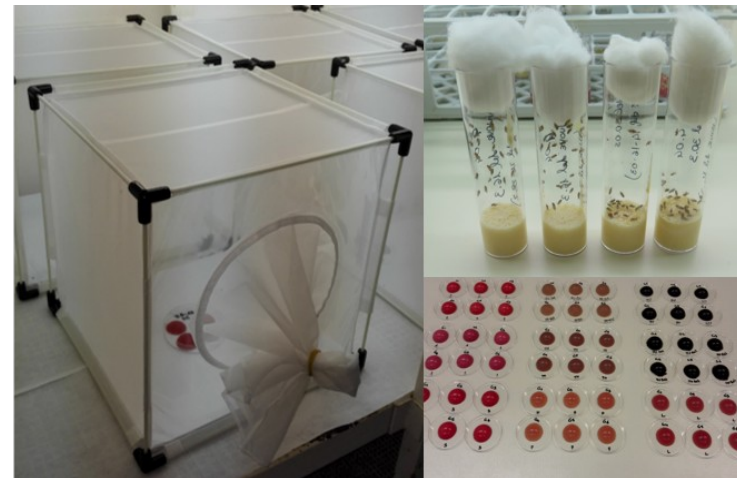
## IRET facilities:

- Microscopy laboratories for insect taxonomic identification
- Insect rearing chambers

# ZOOLOGY AND ENTOMOLOGY: SUSTAINABLE MANAGEMENT OF AGRICULTURAL AND FOREST INSECT PESTS AND GROUNDWATER BIODIVERSITY

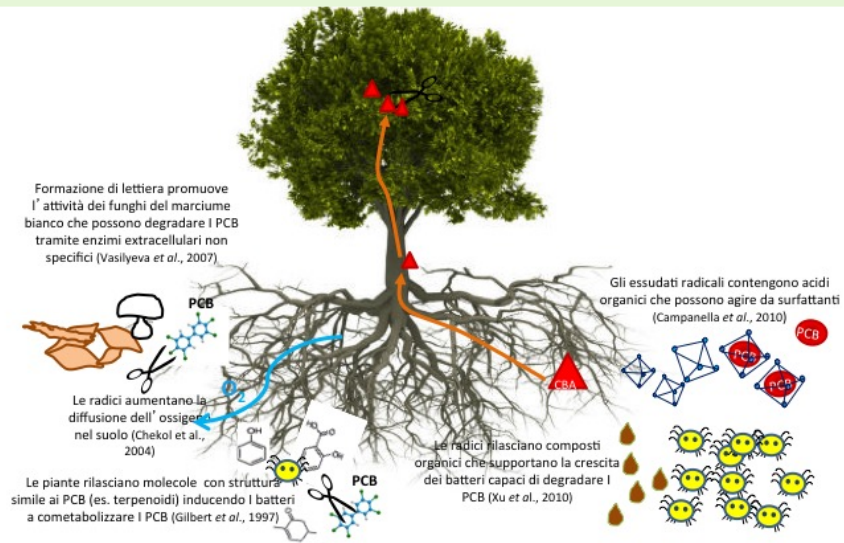
## Projects

- Repellenti edibili nella strategia "push & pull" a difesa delle colture agrarie di pregio 2018-2019 (Regione Sardegna)
- Programma regionale triennale di lotta al cinipide galligeno del castagno (*Dryocosmus kuriphilus* Yasumatsu) in Sardegna 2013-2015 (Regione Sardegna) e approfondimento: *studio dell'evoluzione del rapporto Torymus sinensis/parassitoidi autoctoni* 2016-2018 (Regione Sardegna)
- Controllo biologico del Cinipide galligeno del castagno nella Barbagia di Belvì» 2009-2012 (Provincia Nuoro)
- Gestione ecocompatibile della difesa in colture frutticole tradizionali della Barbagia di Belvì (noce, ciliegio) 2006–2008 (Regione Sardegna)
- CORIBIO Gestione dei problemi entomologici presenti nella corilicoltura biologica in Sardegna 2004-2006 (MiPAAF)





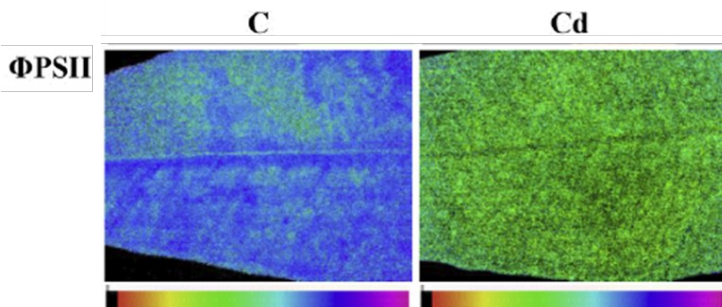
# ECOPHYSIOLOGY OF ECOSYSTEMS UNDER ABIOTIC STRESS & ENVIRONMENT RECOVERY BY PLANTS INCLUDING CARBON SEQUESTRATION



## Progetti

- EuropeAid-India (Progetto EU),
- Bonifica dei siti ex discarica di Papigno (Comune di Terni),
- Bonifica aree agricole nel bacino del fiume Sacco (Regione Lazio),
- Fitoconsumo di percolato da discarica presso Alcantara (Narni),
- Salt-tolerant plants for produced water management (ENI)
- Phytoremediation su suoli contaminati da metalli e composti organici (ENI)
- ICOS
- PON I AMICA

## Clone Viglio



## Aims

Plant responses to climatic changes and air pollutants, with focus on ozone; Exchanges with the atmosphere; Carbon, nitrogen, water and ozone balances; Wood formation and phenology; Risk assessment and definition of critical levels; Forest resilience Monitoring and recovery of polluted areas (organic and inorganic) with biological systems (plants and microorganisms)

## We have :

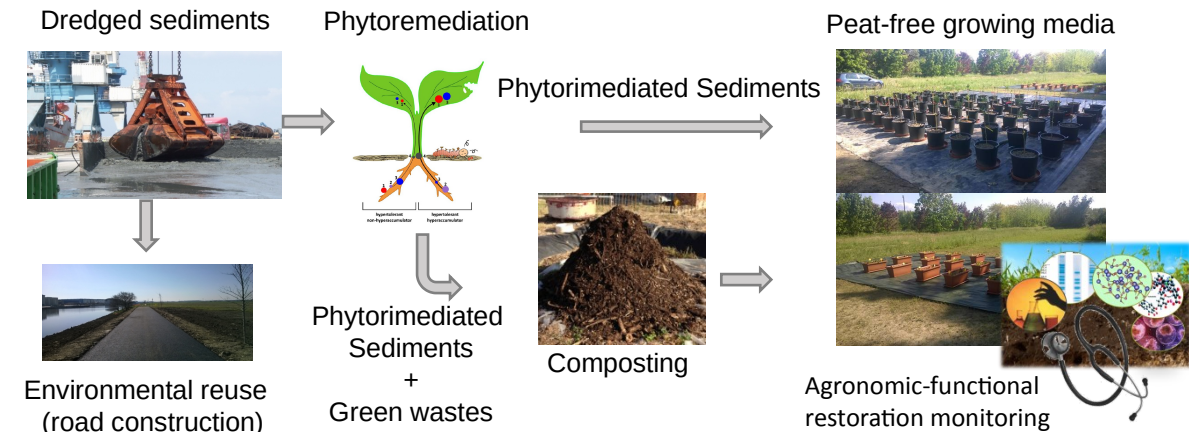
- \*Know-how on biological systems (plants fungi, bacteria) able to
- \*1) extract, accumulate and tolerate heavy metals (up to 0.1% of dw)
- \*2) degrade organic pollutants at the root level (PCB, pesticides etc )
- \*3) tolerate environmental stress revegetate degraded areas
- \*Laboratories for pollutants analysis and plant physiology and biochemistry analysis
- \*Eddy Covariance towers for Carbon fluxes
- \*Technologies for the selection of plants and genotypes for phyto-remediation (in vitro culture, hydroponics etc)
- \*Know-how on degraded environment restoration with biological systems

## Aim of research:

- 1) Sustainable management and valorization of polluted brackish and marine sediments in order to turn them into an agronomic substrate (techno-soil);
- 2) Techno-soil recycling in plant nursery (horticulture and ornamental plant production) and soil rehabilitation.
- 3) ecological role of properties and functions of soils in the biosphere; Soil physical, chemical and biological fertility; Dynamics of Soil Organic Matter (SOM); Soil C sequestration; Soil restoration; Soil Health; Microplastics in soil. Ecology, development, structure and functions of Biological Soil Crusts (BSC) in polar and arid regions; Soil colonization of microbial communities and soil formation; Microbial Biodiversity.

IRET has Know-how:

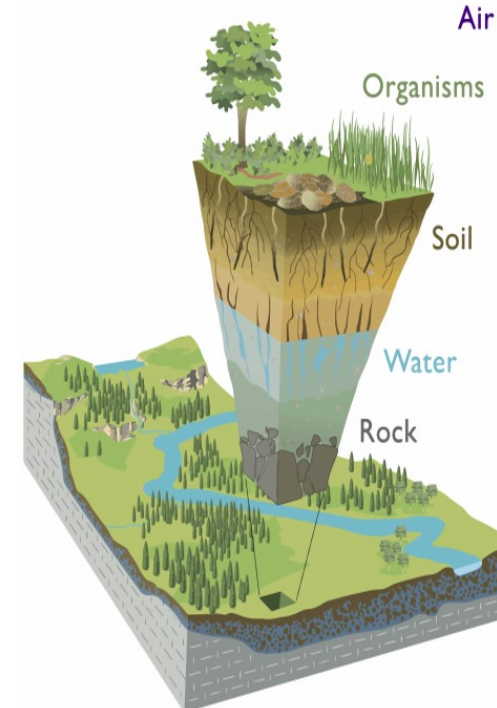
- in nature-based solutions applied to contaminated dredged sediments;
- in monitoring indicators of sediments decontamination and agronomic-functional restoration;
- in evaluation of the suitability of techno-soil, based on remediated sediments, for agricultural and environmental purposes



# SUSTAINABLE MANAGEMENT OF DREDGED SEDIMENTS BY IMPLEMENTING THE CONCEPT OF CIRCULAR ECONOMY

## Projects

- **LIFE CLEANSED** 2013-2016 Innovative integrated methodology for the use of decontaminated river sediments in plant nursery and road building - LIFE12 ENV/IT/000652
- **LIFE AGRISED** 2018 -2021 Use of dredged sediments for creating innovative growing media and technosols for plant nursery and rehabilitation - LIFE17 ENV/IT/269
- **LIFE SUBSED** 2018 -2021 Sustainable substrates for agriculture from dredged remediated marine sediments: from ports to pots - LIFE17 ENV/IT/000347
- Cassa di Risparmio Pistoia e Pescia 2017-2019 *Posidonia oceanica* and sediments for the production of an agronomic substrate to be used in nursery activity and horticulture
- **LIFE ZEOWINE** 2018-2022 ZEOlite and WINery waste as innovative product for wine production - LIFE17 ENV/IT/000427 Coordinating beneficiary IRET Pisa
- **LIFE BIOREM** 2012-2015 Innovative System for the Biochemical Restoration and Monitoring of Degraded Soils - LIFE11 ENV/IT/ 113 Coordinating beneficiary ISE Pisa





## Aims:

- a multidisciplinary research approach aimed at practical aspects of environmental monitoring and mitigation.
- Nature based solutions to implement ecosystem services in green infrastructure

## IRET can work on:

Estimation of ecosystem services at local and regional level with a focus on carbon sequestration mitigation of pollutants and improvement air quality;

Planning of urban green areas to maximize the environmental benefits and socio-economic effects by coupling air and ground satellite techniques and modeling;

Environmental health biomonitoring, in urban and suburban areas using plant bio-indicators;

Certification of vegetal species and varieties for commercial use, even through the measurement of the physiological performance for the selection of varieties and species in different settings.

## Projects

- **H2020 ProGIREG** – Productive Green Infrastructure for post industrial regeeration
- **Smart-Cities project SWaRM** - Smart Water Resource Management (Responsabile WP)
- **MIUR-PRIN project** “Modelli innovativi di analisi dei servizi ecosistemici nell'ambito di formazioni boschive urbane e periurbane (NEUFOR)” (Responsabile di unità)
- **COST Action FP 1204: “Greeninurbs”** (Coordinatore Europeo)
- **Progetto Taranto** Biomonitoraggio dell'area urbana (Responsabile)
- **RIFORTER**: Riforestazione della conca ternana (Coordinatore)
- **EU (H2020) ECOPOTENTIAL**: improving future ecosystem benefits through earth observations (OU Member)
- **Fanghi cartari per il recupero del verde urbano** (Fondazione CaRiPi)

## ENVIRONMENTAL MITIGATION THROUGH THE GREEN INFRASTRUCTURE IN URBAN AREAS & NATURE BASED SOLUTIONS



## Aim of research:

- 1) Identification of novel extremozymes and their application in lignocellulosic biomasses degradation for chemicals and biofuels production;
- 2) agro-industrial residues valorization through bioactive compounds recovery and application.

Sustainable production, characterization and use of "tailor made" biomass for biorefinery, green-chemistry and renewable energy production.

Microalgae cultures: Growth physiology, application for environmental biosensor development and renewable energy production; Green product production (H2 and bioplastics like PHAs) by photofermentative processes fed with agro-industrial wastes;

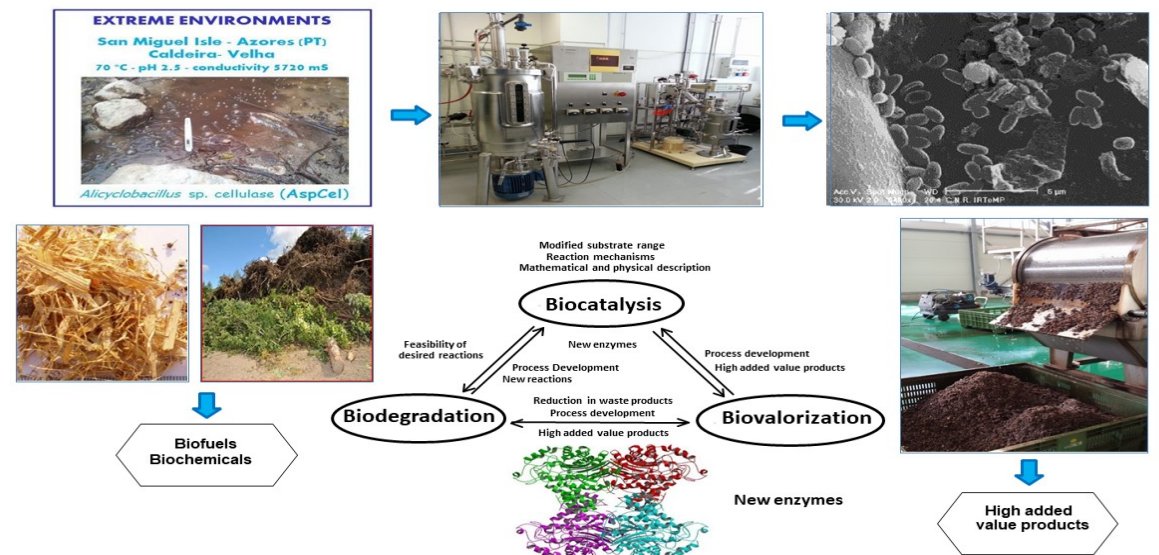
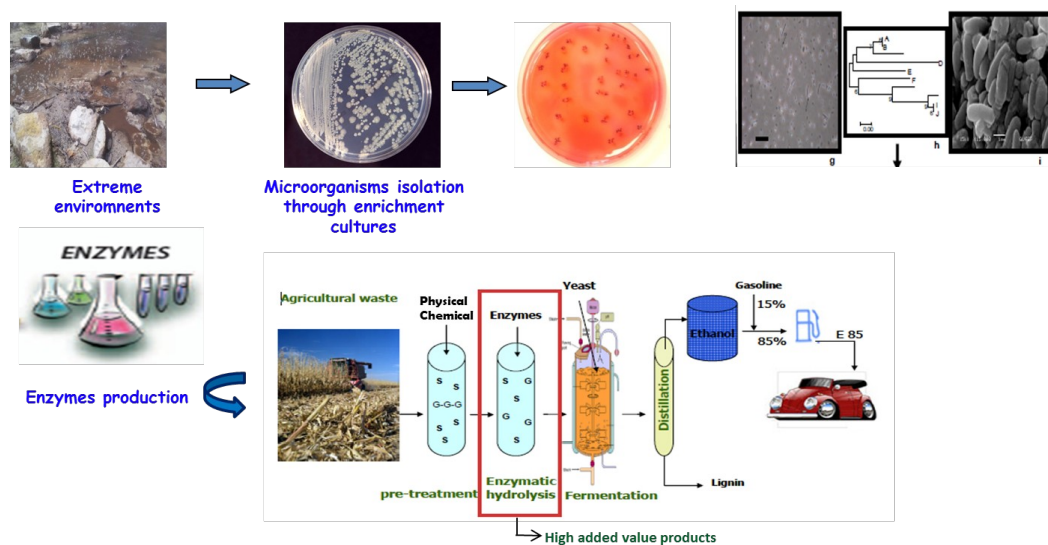
IRET expertises:

- Know-how related to cropping systems for food and for biomass in agriculture, forestry, agro-industrial and waste cycle.
- Experimental fields
- Laboratories for the fine characterization of biomass, for its deconstruction and transformation into feedstock for biorefinery

# BIOPROCESSES FOR THE ENVIRONMENTALLY SUSTAINABLE DEVELOPMENT OF AGRICULTURE, FORESTRY AND FOOD. BIOMASS, BIOREFINERY AND GREEN CHEMISTRY

## Projects

- **EFFBIOETA II** Coordinamento IBAF finanziamento MIPAF)
- **PRIT Industria 2015** Efficienza Energetica Prime Contractor Chemtex (gruppo M&G) Tecnologia per bioetanolo di II Generazione (Concluso)
- **Idrolisi dei materiali lignocellulosici** mediante enzimi isolati da microrganismi termotolleranti finanziamento ENEA (Concluso)
- **CISIA** Conoscenze Integrate per la Sostenibilità e l'Innovazione *made in Italy* Agroalimentare
- **Cooperazione scientifica** CNR-FCT (Portogallo) "Screening and characterization of microorganisms and enzymes with high potential for biofuels production"
- **ENEBIOCHEM** ([http://www.novamont.com/leggi\\_press.php?id\\_press=9](http://www.novamont.com/leggi_press.php?id_press=9))
- **BIOPOLIS** (<http://www.bio-polis.it/>)
- **ValBioCasta** Biomolecules from chestnut residues
- **TARANTO** - Energy for the environment **PON ARS01\_00637**





## Aim of research:

- Environmental factors affecting epigenetics;
- Key Enabling Technologies for purification and utilization of bioactive molecules from natural sources;
- Valorization of agri-food industrial by-products for the recovery of added-value products;

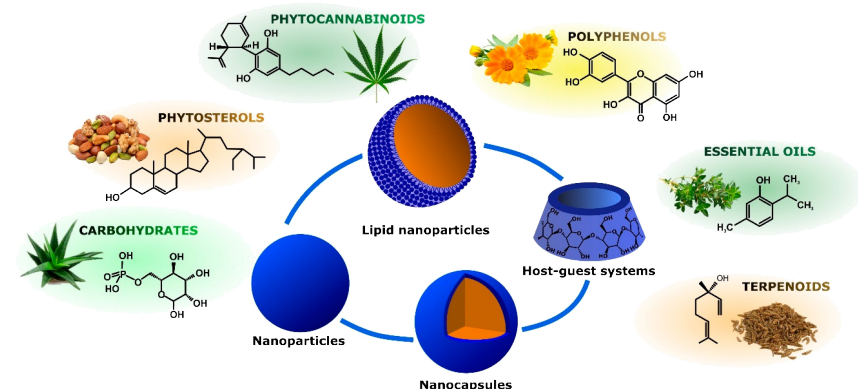
## IRET expertises:

- Design and synthesis of novel delivery platform to improve bioactive molecules bioavailability;
- Purification and characterization of bioactive molecules from food industry wastes, promoting circular economy-based strategies;
- *In vitro* and *in vivo* evaluation of potential biological effects of bioactive molecules on human health.

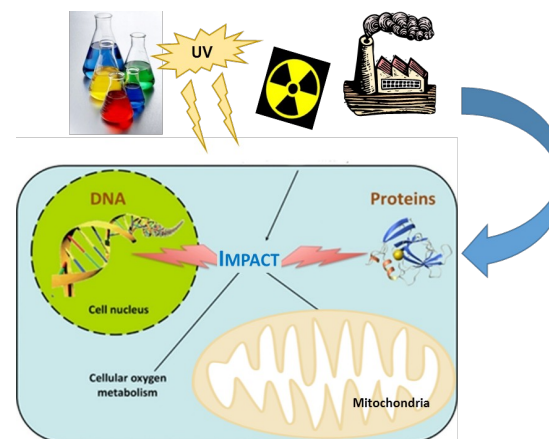
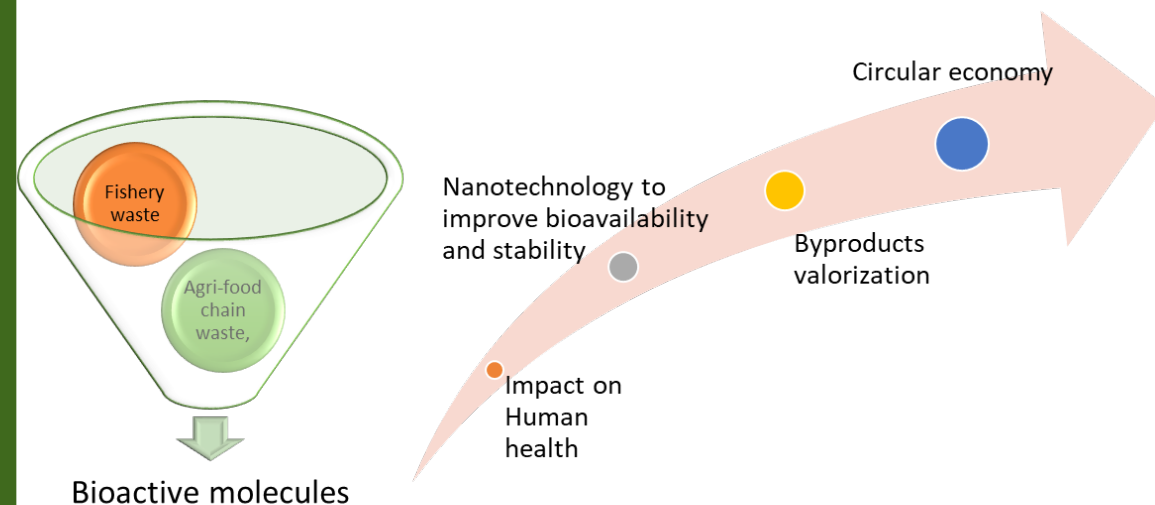
## - Partnership with private companies

## Projects:

- ABILTEC POR FESR Campania 2014/2020
  - NEWAGE POR FESR Campania 2014/2020
  - SORRISO POR FESR Campania 2014/2020
- /ptd1\_000410
- FOR.TUNA Progetto MISE
  - MAREA PON\_03\_PE\_00106\_1



## ENVIRONMENT AND HEALTH



## Research objectives

- Integration of plants into the bioregenerative system of support to the life in space.
- Transfer of knowledge to agricultural systems in a controlled environment.
- Monitoring of plant-environment interaction for food quality and safety.

## IRET expertises:

*Know-how* related to crop management in a protected environment, optimization of the control of environmental factors for the production of high quality and safety food.

## Growth chambers

With full control of temperature, humidity, light and concentration of CO<sub>2</sub>. Light can be adjusted through the use of metal halides and LED lamps.

## Laboratories of plant physiology and biochemistry

### Progetti:

- EDEN ISS H2020 COMPET-07-2014. Space exploration Life support: Ground Demonstration of Plant Cultivation Technologies and Operation in Space for Safe Food Production on-board ISS and Future Human Space Exploration Vehicles and Planetary Outposts. (<http://eden-iss.net/>).
- MAE (Legge 401/90). Bilaterale tra Italia e Stati Uniti. Progetto: Sviluppo di una serra gonfiabile per la crescita delle piante, la produzione di cibo e il supporto alla vita nello spazio. ID 00160. (2012).
- ESA MELiSSA Food Characterization Project Phase 1- Sub-contract DIAAT-Unina. 2009-2011.
- "ENEIDE" Space Mission. Collaborazione con Arsiel (Lazio).. Azimuth Unituscia 2005.
- ECOFLEX Prog. RSI-PMI - POR FERS Lazio 007/2013. Integrazione fotovoltaico organico in orticoltura.
- EXPO dei Territori, verso Expo 2015 Menzione al Progetto BAOLAB. -Sistema Agroalimentare Autosufficiente per Ambienti: Urbano, Semidesertico e Spaziale 2009.
- Menzione al Progetto BAOLAB-Sistema Agroalimentare Autosufficiente per Ambienti: Urbano, Semidesertico e Spaziale 2009. Presentato a EXPO dei Territori, verso Expo 2015.

