



EUPHORE (European PHOtoreactor) CEAM Foundation, Valencia (Spain)



RESEARCH PROGRAMS

METEOROLOGY AND ATMOSPHERIC POLLUTION

ATMOSPHERIC CHEMISTRY



METEOROLOGY AND POLLUTANT DYNAMICS



AIR POLLUTANT EFFECTS AND THE CARBON CYCLE

AIR POLLUTANT EFFECTS



THE CARBON CYCLE



FOREST RESEARCH

FOREST FIRES



FOREST RESTORATION



Forest Research Programme

Objectives:

Setting the scientific bases to improve forest management under Mediterranean conditions.

Activities:

- Develop fire prevention techniques
- Mitigate the negative effects of fires by protecting ecosystems
- Restoration of burnt and degraded mountain areas by setting up communities of fire and drought-resistant plants
- Conserve the value of Mediterranean woodlands by increasing their level of adaptation to disturbances (climate change and fires, and their interactions)



Meteorology and pollutant dynamics

Objective:

- Meteorological mechanisms & processes
Mediterranean basin → Valencia Region
- Dispersion, transport & transformation of air pollutants
→ improvement of air quality

Activities:

- Network of weather stations
- Supporting administrations in complying with regulations: environmental monitoring, action plans,....
- Weather forecast for health protection
- Meteorological assessment for **extreme events** (heat waves, floods, etc) and industrial hazards
- Evaluation of environmental impact → enterprises



Carbon Cycle and impacts of air pollutants on vegetation

Objective:

Carbon and water cycle in Mediterranean ecosystems

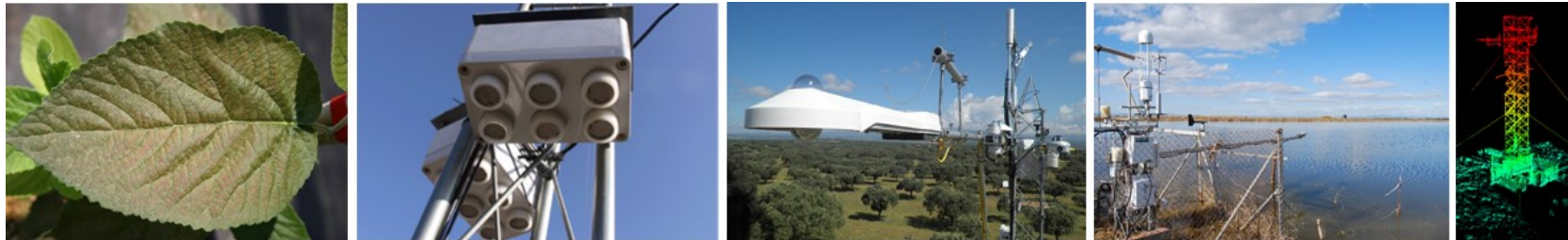
Assessment of air pollution levels and their effects on crops and natural vegetation

Activities:

- Monitoring of water and carbon cycle – eddy covariance stations (since 1999) - Participation in international networks (ICOS, FLUXNET, ICP-Forests).

→ Analysis of fluxes of main GHG (CO_2 , CH_4 , N_2O and O_3)

- Study the exchanges of C and water between ecosystems and the atmosphere, to quantify their productivity, carbon fixation capacity and sensitivity to climatic variations in the framework of CC.
- To assess the effects of air pollutants, and in particular ozone, on crops and natural vegetation.





EUPHORE is one of the major research platforms in Europe with outstanding analytical instruments to investigate chemical processes, simulating realistic conditions.



FEATURES

- Two chambers (200 m³ each)
- Natural sunlight
- Controlled conditions
- Well instrumented
- Air purification
- Nearly real conditions
- Cooled floor
- Steel protection covers
- Half-spherical FEP covers



ANALYTICAL INSTRUMENTS

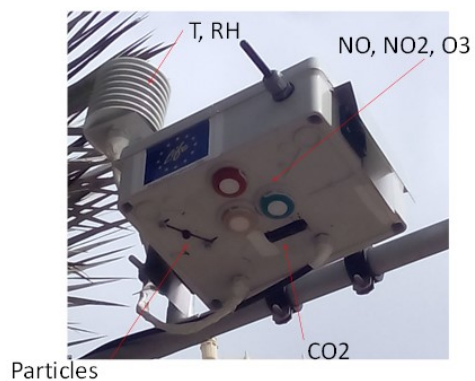
INSTRUMENT	PARAMETERS/ COMPOUNDS	INSTRUMENT	PARAMETERS/ COMPOUNDS
GAS CHROMATOGRAPHY/MASS SPECTROMETRY		MONITORS (on-line)	
GC.MS –TDS Agilent with SPME and Thermal desorption (on-line and off-line)	VOCs oxygenated-VOCs	NO/NO ₂ monitors CO Monitor	NO, NO ₂ , NO _x CO
GC-MS Thermo (off-line: C18, filters, tenax, etc)	VOCS/ Semi-VOCs, organic aerosols, polioxygenateds (gas and particle phase)	SO ₂ monitor HCHO monitor	SO ₂ Formaldehyde
GAS CHROMATOGRAPHY		O ₃ monitor	Ozone
GC-FID (off-line: SPME with derivatization)	OVOCs	HONO monitor	Nitrous acid (HONO)
GC PID/FID on-line	VOCs	NH ₃ monitor	Ammonia
LIQUID CHROMATOGRAPHY (off-line)		OTHERS	
HPLC (UV/Fluorescencia)	Aldehydes, ketones, hidroperoxides, phenols (gas phase)	Radiometers and actinometers (in situ)	Solar intensity, actinic flux, JNO ₂
LC/MS	Aldehydes, ketones, hidroperoxides, phenols pesticides, (gas and particle phase)	Barometers (in situ) Motor diesel	Pressure Diesel exhaust generation
MASS SPECTROMETRY (on-line)			
PTRMS	VOCs High time resolution	Higrometres (in situ)	Temperature and humidity
PTR-ToF-MS	VOCs High time resolution	Temperature sensors	Temperature
CIMS-HR-ToF-API with Figaero unit and Po-210 radioactive source	VOCS/ Semis-VOCs, organic aerosols, multioxygenated compounds	Horiba	Exhaust emissions (CO,CO ₂ , methane, O ₂ , NO _x , total hydrocarbures, O ₃)
OPTICAL INSTRUMENTACIÓN (In Situ)		Test bed engine	
DOAS (UV-Visible)	VOCs, NO ₂ , NO ₃ , HONO, formaldehyde, etc		
LIF (laser)	Radicals: OH, HO ₂	Control NO _x	
CEAS	VOCs, NO ₂		
FTIR (IR)	VOCs, inorganic gases	Control Humidity	
Particulate matter (on-line)		HONO Generator	
SMPS	Particle number and size	N ₂ O ₅ Generator	
TEOM (PM-1)	Aerosol mass concentration	Ionic Chromatography	Cations and anions
Particle generator and neutralizer (<PM1)		Other general laboratory instrumentation	



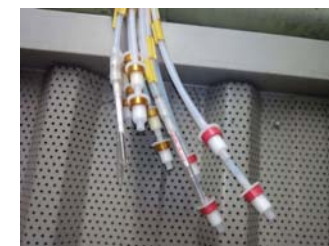
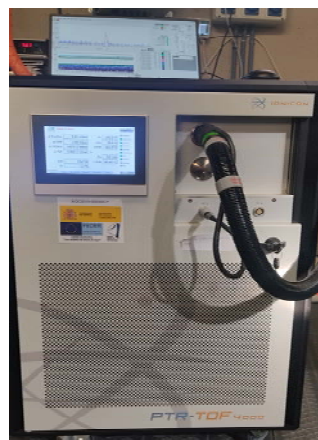
PASSIVE DOSIMETRY: SO₂, O₃, NO₂ and NH₃, VOCs

FIELD INSTRUMENTATION

LOW-COST SENSORS



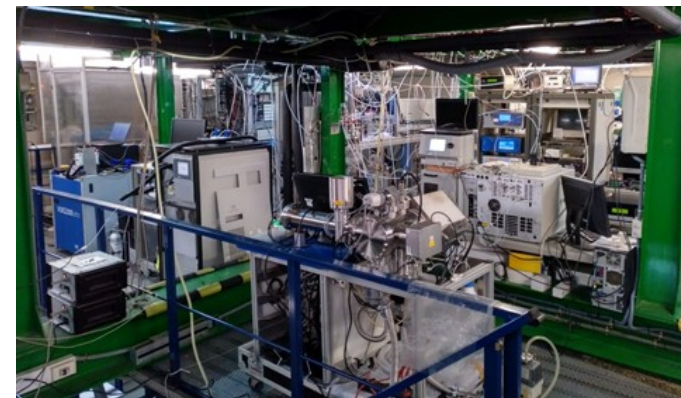
ACTIVE SYSTEMS: O-VOCs, carbonyles, hydrocarbons





RESEARCH ACTIVITY

- Simulation of different environmental scenarios (outdoor, indoor)
- Study of atmospheric behavior of biogenic and anthropogenic VOCs and semi-VOCs (life time, kinetics, etc)
- Formation of secondary products, O_3 , aerosols, etc. Special focus on compounds harmful for the health
- Intercomparison of instrumentation: state-of-the-art, low cost sensors, etc.
- Validation of photochemical models and chemical mechanisms development
- Air quality measurements in field campaigns and indoors
- Test of depolluting technologies (e.g. photocatalytics, plants, etc)

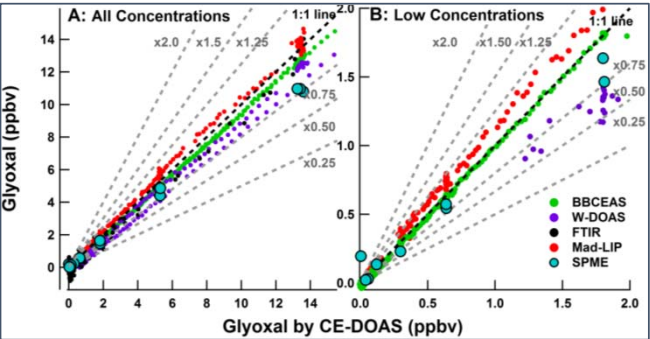




RESEARCH ACTIVITY. Examples

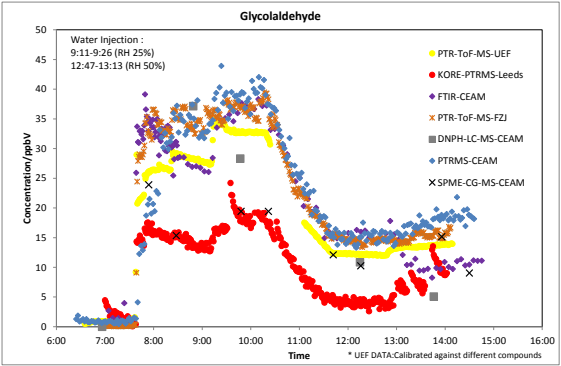
Intercomparison of instruments

Glyoxal, m-glyoxal and NO₂



- Tests under different relevant environmental conditions
- Simulation of nearly real conditions
- Study of interferences
- Validation of photochemical models

O-VOCs



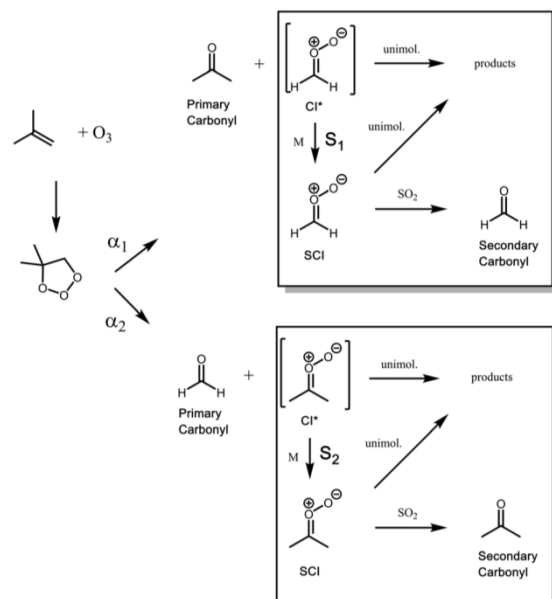
Instrumentation/ Analysis Technique	Institute Name	ID
PTR-ToF-MS	University of Eastern Finland	UEF
KORE-PTR-MS	University of Leeds	Leeds
SIFT-MS	University of York	York
PTR-ToF-MS	Forschungszentrum Jülich	FZJ
FTIR		
PTR-MS		
on-line SPME-GC-MS with derivatization	CEAM Foundation	CEAM
C18 cartridges analyzed by GC-MS		
DNP-H cartridges analyzed by LC-MS		
TENAX cartridges analyzed by GC-MS	Leibniz Institute for Tropospheric Research	TROPOS
DNP-H cartridges analyzed by LC-MS		
TENAX cartridges analyzed by GC-MS	CNR-LISA	CNR-LISA

Thalman et al., Instrument intercomparison of glyoxal, methyl glyoxal and NO₂ under simulated atmospheric conditions, AMT (2015)
 Intercomparisons of techniques for the measurement of oxygenated organic compounds at the EUPHORE chambers. To be



RESEARCH ACTIVITY Examples

Development of models and chemical mechanisms



Simplified mechanism for the production of CI and primary and secondary carbonyl products in the ozonolysis of 2-methyl propene

- **Criegee Intermediates (CI), formed in the ozonolysis of alkenes**
- **Narrowing the budget gap of HCOOH and other small organic acids**

Newland et al., Trends in stabilisation of Criegee intermediates from alkene ozonolysis, PCCP, 2020

Newland et al., The atmospheric impacts of monoterpene ozonolysis on global stabilised Criegee intermediate budgets and SO_2 oxidation: experiment, theory and modelling, ACP, 2018

Newland et al., Atmospheric isoprene ozonolysis: impacts of stabilised Criegee intermediate reactions with SO_2 , H_2O and dimethyl sulfide, ACP, 2015

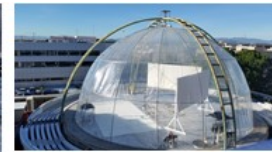
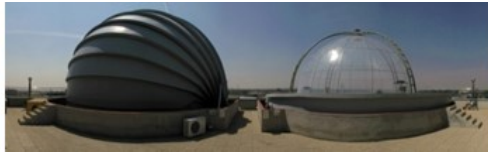
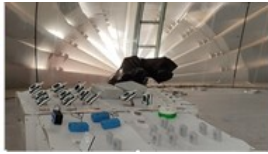
Wang et al., Aromatic Photo-oxidation, A New Source of Atmospheric Acidity, EST, 2020



INNOVATIVE AND TECHNOLOGICAL ACTIVITY

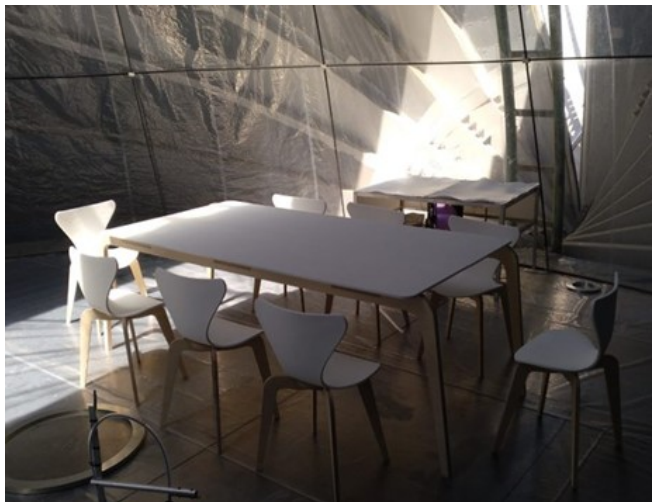


- Prototype testing of **state-of-the-art** research instruments and **new technologies**, including low-cost sensors, depolluting solutions, etc...
- **Testbed**, able to accommodate a high number of external instruments → intercomparisons (characterization, interferences under environmental relevant conditions)
- EUPHORE is versatile and is continuously evolving to adapt to specific user's and industry demands
- Results can be easily transferred to reality → step **close to market**.
- Solutions for AQ governance



INNOVATIVE AND TECHNOLOGICAL ACTIVITY Examples

**Depolluting solutions: Assessment of depolluting effectiveness
and by-products formation**



Outdoor furniture

project)



AITEX & NEXT Tech. Tecnotessile (Photocitytex



INNOVATIVE AND TECHNOLOGICAL ACTIVITY Examples

Test of new instruments and sensors



Development of a gas analyzer of HCl, BTX and other non-methane hydrocarbons in real time (Blue Industry and Science)



Tests of CO₂ low-cost sensors.
AIREAMOS

HIGHLIGHTS

- More than 100 papers in peer-reviewed journals
- EUPHORE has participated in more than 20 research EU projects (FP-x, Interreg, LIFE, H2020) coordinating and as partners
- The facility has been used since its creation by more than 60 research groups and more than 200 international researchers from Europe and USA
- Links to local and regional governments for air quality studies

CURRENT PROJECTS

- PERFECT (LIFE17, ENV/ES/000205): Pesticide reduction using friendly and environmentally controlled technologies. 01/09/2018-31/08/2024. 2.017.669 €. 8 partners. *COORDINATION*
- ACTRIS IMP (H2020-INFRADEV-2019): Aerosol, Clouds and Trace Gases Research Infrastructure Implementation. 01/01/2020-31/12/2023. **TNA Access**
- ATMO-ACCESS (H2020-INFRAIA-03-2020): Solutions for Sustainable Access to Atmospheric Research Facilities. 1/04/2021-30/03/2025. INDAIRPOLLNET (COST Action): Improving Indoor Air Quality. Coordination of WG4-h on LCS, WG4-a on techniques for inorganic compounds and WG3f+f' on particles. **TNA Access**
- CAPOX (National R+D Plan, RTI2018-097768-B-C21): Analysis of emission-driven changes in the oxidation capacity of the atmosphere over Europe. 01/01/2019-30/12/2022. 130.000 € . *COORDINATION*
- PROMETEU/2019/110, Impacts of global change in the Western Mediterranean basin: Meteorology, air pollution and forest ecosystems (IMAGINA) R&D&I projects for research groups of excellence (Prometeu 2019). *COORDINATION*
- INDAIRPOLLNET (COST Action): Improving Indoor Air Quality. Coordination of WG4-h on LCS, WG4-a on techniques for inorganic compounds and WG3f+f' on particles

Thanks for your attention!

