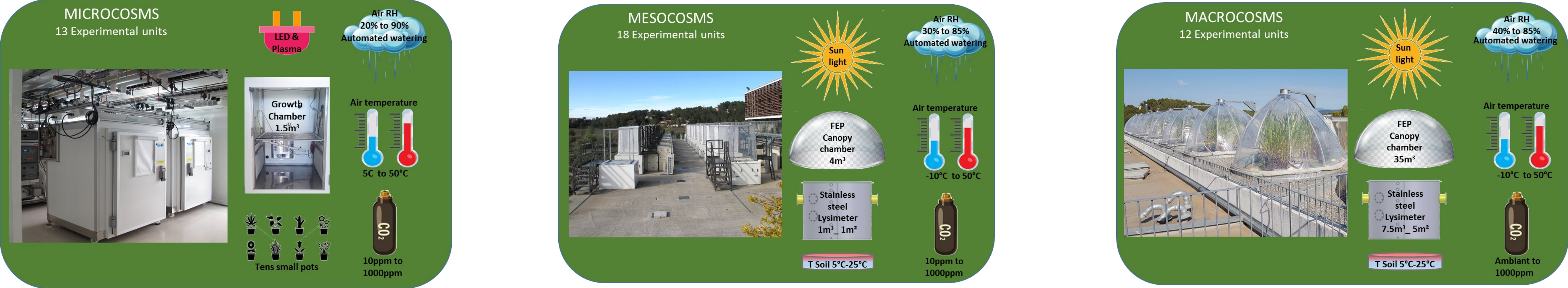# MONTPELLIER EUROPEAN ECOTRON-CNRS-INEE

Sébastien DEVIDAL, Abdel FAEZ, Emmanuel S. GRITTI, Damien LANDAIS, Hélène LEMOINE, Alexandru MILCU, Clément PIEL, Olivier RAVEL, Jacques ROY, Joana SAUZE

The Ecotron experimental platforms allow the simulation of realistic environmental conditions whilst simultaneously providing automatic measurements of ecosystem-level matter and energy fluxes at various scales. These facilities bridge the gap between the complexity of in natura studies and the simplicity of laboratory experiments.

Experimental platforms

MICROCOSMS — 13 Experimental units
Air RH 20% to 90% — Automated watering
LED & Plasma
Growth Chamber 1.5m³
Air temperature 5C to 50°C
Tens small pots
CO2 10ppm to 1000ppm

MESOCOSMS — 18 Experimental units
Air RH 30% to 85% — Automated watering
Sun light
FEP Canopy chamber 4m³
Air temperature -10°C to 50°C
Stainless steel Lysimeter 1m³, 1m²
T Soil 5°C-25°C
CO2 10ppm to 1000ppm

MACROCOSMS — 12 Experimental units
Air RH 40% to 85% — Automated watering
Sun light
FEP Canopy chamber 35m³
Air temperature -10°C to 50°C
Stainless steel Lysimeter 7.5m³, 5m²
T Soil 5°C-25°C
CO2 Ambiant to 1000ppm

Climatic control and ecophysiological monitoring network

The VLAN network used for measurements is operating via a permanent dialogue between client / server workstations via a private TCP / IP protocol. This network includes PLCs dedicated to climate control and measurement of gas exchange experimental units, machine controllers (general low voltage board, boilers, refrigeration units, etc.), supervisor stations and servers that orchestrate exchanges. Server redundancy is built into the system and guarantees the continuity of the service and doubles the data backup.
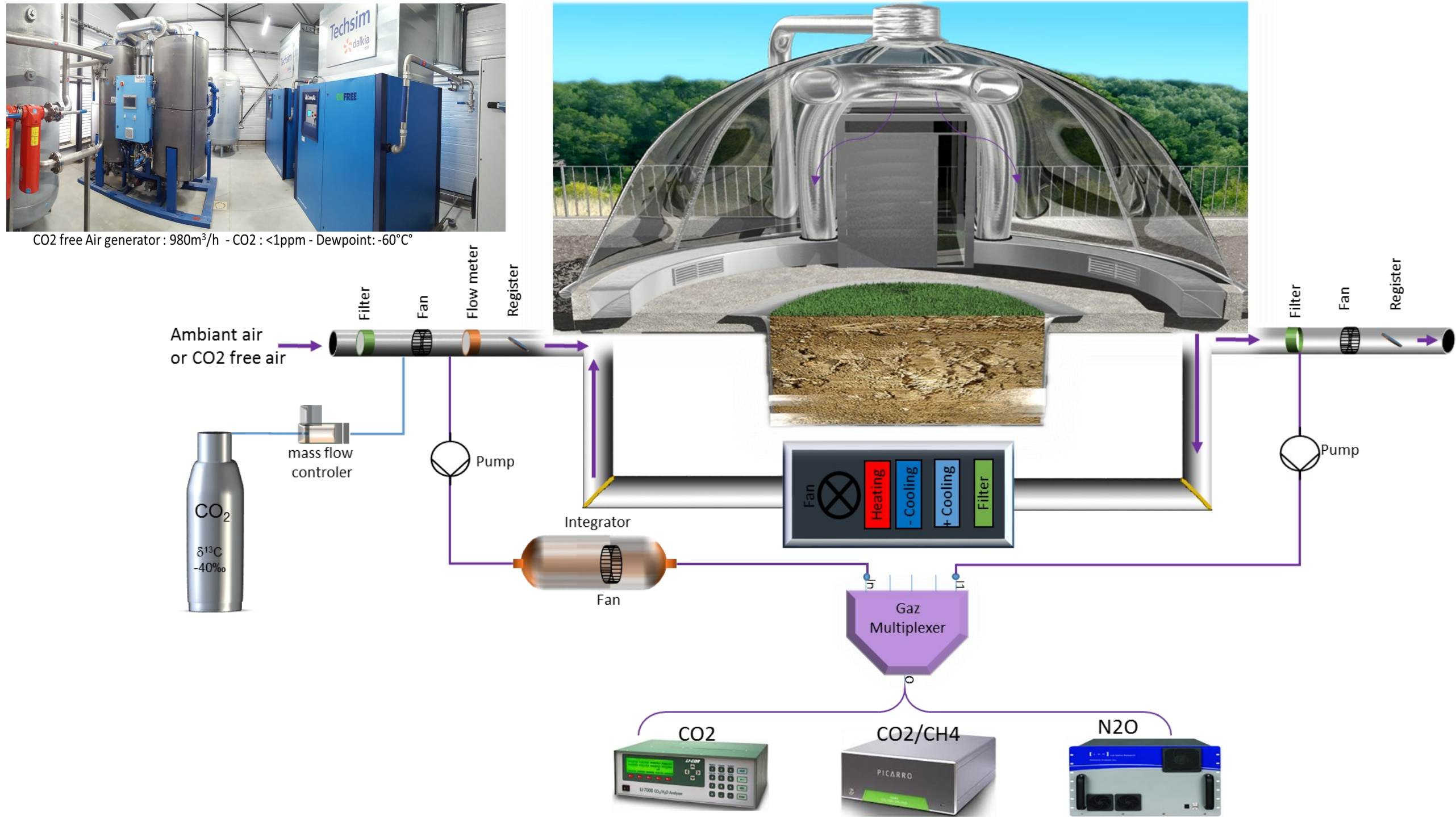
In order to optimize the access to resources for the research teams and to decouple the measurement chain from the data consultation, the data base is replicated and then saved on a remote site where the users can access it directly via a dedicated platform (Liaison).

Mesocosm Cell
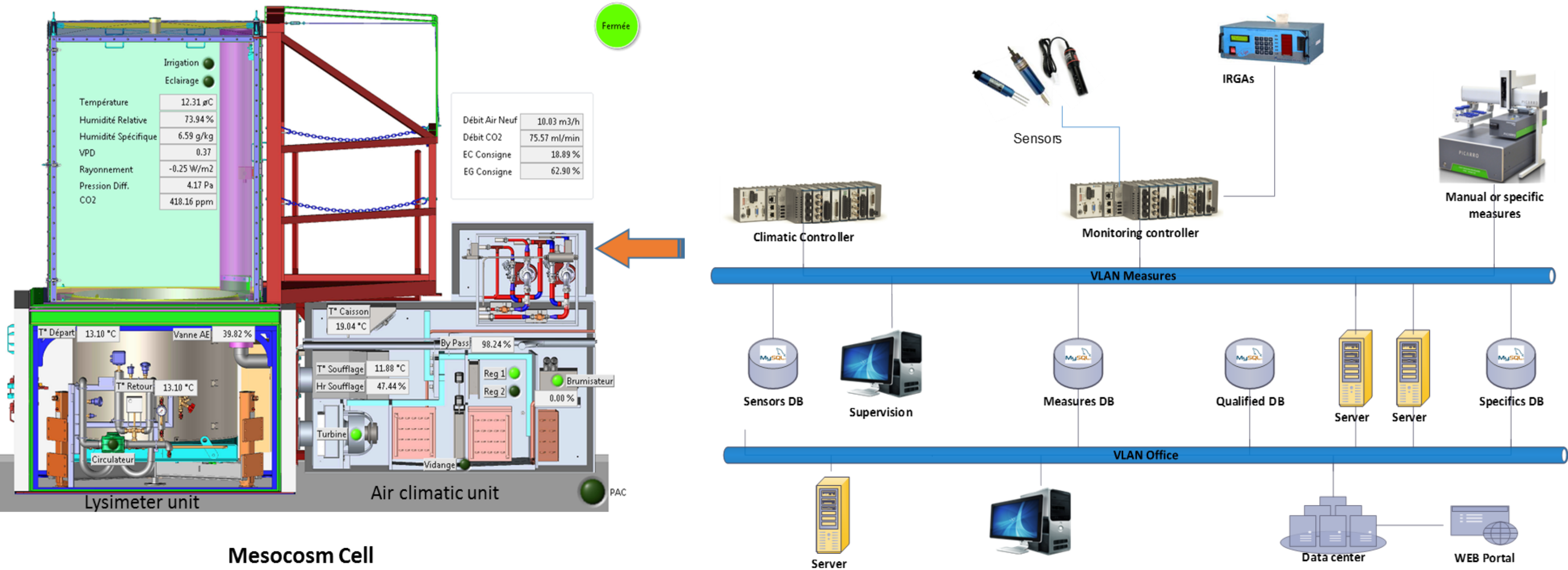
Measurements of ecosytem functioning (ecophysiology)

Gas exchange measurement principle
The trace gas fluxes exchanged between the hosted ecosystems and atmosphere are quantified through open gas exchange aproach. The mass balance of the net flux exchanged by the biological system is based on the measurement of the input air flow and the measurement of the difference in trace gas flux concentration between outlet and inlet.

CO2 free Air generator : 980m³/h - CO2 : <1ppm - Dewpoint: -60°C

The main ecophysiological measurements are described in the table below :

ABOVEGROUND		BELOWGROUND	
ONLINE	MANUAL	ONLINE	MANUAL
Fluxes (net ecosystem gas exchange) CO_2, H_2O (LICOR 7000- Picarro G2301) CO_2, CH_4, N_2O, NH_3, H_2O (Picarro G2508) **Isotopic analysers** $\delta^{13}C$, CO_2 (Picarro G2101i) δ^2H, $\delta^{18}O$, ^{17}O-excess, H_2O (Picarro L2140i) $\delta^{13}C$, $\delta^{18}O$, $\delta^{17}O$, CO_2 (Aerodyne CO_2) $\delta^{15}N^\alpha$, $\delta^{15}N^\beta$, SP, N_2O (Aerodyne N_2O) **Environment control** Air Temperature & Humidity PAR, Pressure, VPD	Leaf Area Index = LAI (Sunscan) ↳ Canopy structure Stomatal conductance (Porometer) ↳ State of stomatal opening Water potential (pressure chamber) ↳ Plant water pressure Chlorophyll concentration(SPAD) ↳ Leaf chlorophyll content Leaf gas exchange (LICOR 6400) ↳ Leaf photosynthesis Leaf fluorescence ↳ Electron transport in the leaf and study of the state of photosystems I and II	Soil Water Content (TDR) Soil temperature (TDR) Soil Water potential (Tensiometer) ↳ Soil Water tension Lysimeter mass (Gauge) ↳ Ecosystem evapotranspiration	Leachate and soil water extratction (Pore water sampler) Soil gas analysis ↳ CO2-CH4-N2O-COVs concentrations at different depths Soil sampling ↳ Gravimetric measurement of water content - Apparent density - Porosity and soil structure - Organic matter - Soil [N] - Microbial communities - Respirometry - denitrification .... Isotopic analyzer $\delta^{13}C$, $\delta^{18}O$ CO_2 + air ratios (Delta V Plus + Gasbench II)

Ambiant air or CO2 free air
filter — Fan — flow meter — Register
mass flow controler
Pump
Integrator
Fan
Gaz Multiplexer
CO2 — CO2/CH4 — N2O
Pump
filter — Fan — Register

Semantic data management

In an effort to share and devolop interoperable research data, the Ecotron will deploy a procedure to make the available data compatible with the FAIR Data Principles approach aiming to enhance the reusability of data. This work will be divided into 2 phases. First, an inventory of metadata (online, manual and note book measurements) and an annotation with standardised semantics must be performed. Second, connection with the system developed by ANAEE-France will format the data to make them fully interoperable.

Experimentations on ecosystems

Online or Manual Data
Lab electronic notebook Liaison http://ecotron.montp.cnrs.fr/
Experimental database
Semantic Modeling and annotation
Graph database
ANAEE France Data Portal
Geo DCAT — ISO 19139
netCDF — doi
Metadata and dataset generation
ANAEE France FAIR pipeline *under construction*

Damien Maurice, INRA
Christian Pichot, INRA