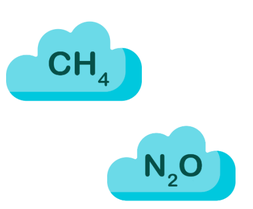
Potential of the Isotope Ratio Mass Spectrometry (IRMS) technique within the ICOS-ERIC Monitoring and Data Collection Network

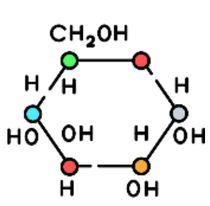
Carlotta Volterrani, Andrea Scartazza, Marco Lauteri, Enrico Brugnoli, Angela Augusti
Istituto di Ricerca sugli Ecosistemi Terrestri, CNR

- One of the key objectives of ICOS-ERIC is to understand the mechanisms regulating the GHG balance and partitioning among the various source and sink components.
- The gas analysis makes possible to evaluate the contribution of anthropogenic (fossil fuels) and biogenic (epigeal and hypogeal respiration) sources to the carbon (C) budget.
- Furthermore, the biotic components (vegetation and soil microorganisms) are influenced by the abiotic one (temperature, precipitation, nutrients, presence of pollutants, etc.), especially at the level of photosynthesis and respiration, on which depends the C sequestration and emission capacity of ecosystems.
- Isotope analyse provides information on the processes regulating the C balance in terrestrial ecosystems.



Greenhouse gases

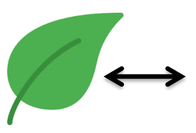
- Exchange processes between atmosphere and ecosystem
- Source and sink for CO_2



Glucose

Vegetation

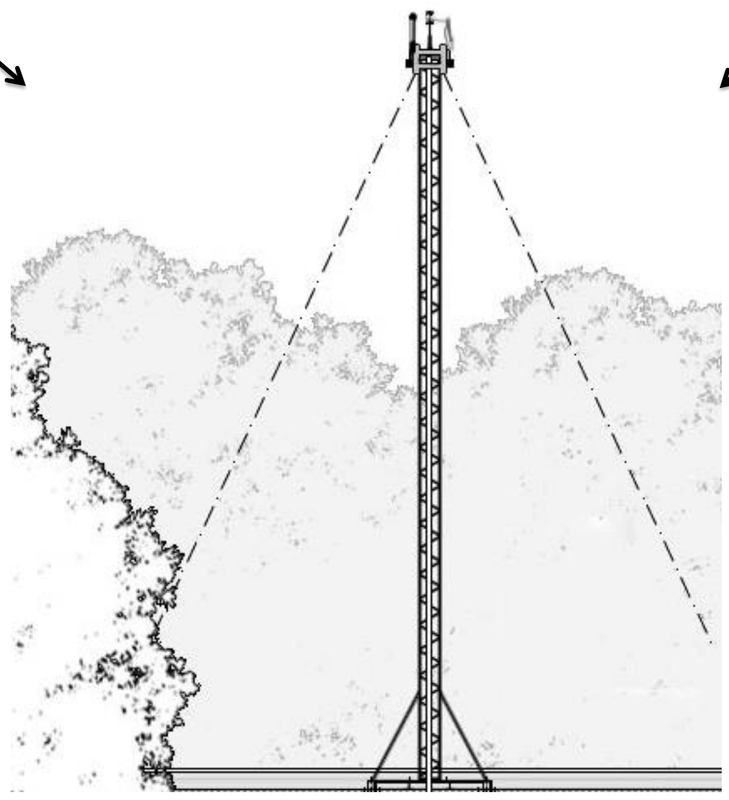
Dry matter



Leaves

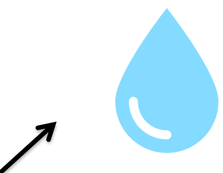
Roots

- CO_2 origin (anthropic or natural)
- Atmospheric CO_2 absorption
- Photosynthetic efficiency
- Translocation of photosynthates and source-sink relationships
- Autotrophic and heterotrophic respiratory fluxes



Source: ICOS station – Real Bosco di Capodimonte (NA); www.icos-italy.it

- The IRMS technique is based on the possibility to distinguish, for the main chemical elements, their stable isotopes, by their atomic mass.
- IRMS allows to get highly accurate and precise data on the isotope ratios of Carbon ($^{13}C/^{12}C$), Nitrogen ($^{15}N/^{14}N$), water ($^{2}H/^{1}H$ and $^{18}O/^{16}O$), and not only
- The isotope ratio of a material analysed depends on the stable isotope composition of its source and origin as well as on physical and chemical fractionations that occur during the lifetime of that material
- IRMS is used in different research topic, from environmental sciences and geochemistry, to forensic sciences, food authenticity



Water

Leaf water

- Transpiration and evaporation in the water cycle
- Leaf-atmosphere water exchanges and carbon-water relations
- Water-use efficiency at plant and ecosystem level
- Xylematic fluxes and water sources

Soil

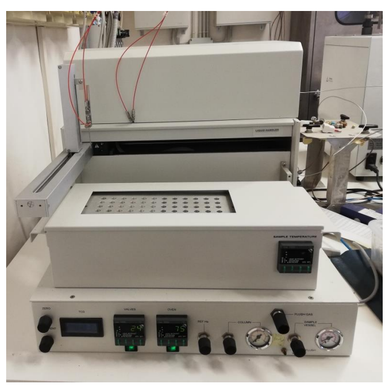
Organic carbon

Nitrogen

- Biogeochemical cycles (e.g., C and N cycles)
- Carbon stock and soil profiles
- Decomposition of soil organic matter (SOM) and analysis of different C fractions (e.g., labile and stable C pools)
- Soil water sources at different depths

IRMS Laboratory and instruments – CNR IRET (Porano – TR)

Elemental analyzer – Carlo Erba



Multiflow

Pyrolizer HT-pyrOH

Liquid face – GV Instruments

- The equipment, present at the Isotope laboratory of the IRET-CNR of Porano, with the implementation occurring in the context of the PON project **PRO_ICOS-Med** is able to support the monitoring activity of the ICOS Italian network and, especially, of the stations located in less developed regions and transition areas.
- The IRMS laboratory can contribute to substantially increase innovative research activities at ICOS sites and to extend isotopic measurements to other research infrastructures (e.g., LTER) that study the carbon cycle, the functioning of ecosystems and their resilience to climate change.

References

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Contact mail:
carlotta.volterrani@iret.cnr.it

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