



## Stable isotopes in Ecology and Environment: a tool to integrate scales and complexity

**Lecturers/Organizers:** Cristina Máguas, Cristina Antunes, Florian Ulm, Rodrigo Maia (cE3c/DBV, FCUL)

**Calendar:** May 26<sup>th</sup>- 30<sup>th</sup> 2025, Intensive 5 days course, seminars + lab classes.

**Duration:** 36 hours (contact hours)

**Schedule:** 9:00-17:30

**Overview:** Currently, climate changes or alterations are known to be reflected on the stable isotope ratios of Hydrogen, Nitrogen, Carbon, Oxygen and Sulphur present in atmospheric gas forms, fresh or ocean water, as well as in plants and animals and organic matter in the soil. Samples from those matrices can provide a record for such changes across a given length of time and / or space. Also, ecological and physiological processes often reflect on stable isotope ratios, again setting a record in plant, animal or other living tissues. Many such processes will establish typical “isotopic signatures” which can allow for a geographical discrimination of the origin (or growth) of a given living tissue; at the same time, the time scales involved in establishing those isotopic markers will depend upon metabolic turnover time of a given isotope, residence time of a given organism or cycling time in the ecosystem. For those, and other, reasons, stable isotopes ratios are widely used in diverse ecological areas of research, integrating multidisciplinary approaches together with biochemistry, molecular biology, physiology geochemistry and climate sciences.

**Objectives:** Introduction to stable isotopes ratios as tools to understand global, ecosystem and community level bio/geo cycles; Light isotopes: H, N, C, O and S isotopes, geo cycles and ecological significance; Sampling and analytical methodologies in stable isotope analysis.

**Program:**

Stable isotopes ratios as tools to understand global, ecosystem and community level bio/geo cycles:

What are stable isotopes; isotopic abundance; stable isotope ratio notation;

Equilibrium and kinetic fractionation; stable isotope ratios sources of variation;

Reading stable isotope ratios in global, ecosystem and community level bio/geo cycles; geological and historical record; isotopes as proxies for ecosystem functions and human activity.

Stable isotopes of the bio-elements:

H, N, C, O and S isotopes and their bio/geo cycles;

Water, CO<sub>2</sub> and Nitrogen – the major natural bio/geo cycles, their relations to climate change and human activity; Sulphur and fossil fuel pollution; N and C in food webs; forensic applications; isoscapes.

### **Methods:**

Isotope ratio mass spectrometry (IRMS);

Sample automated introduction systems for IRMS: online, offline, EA-DUMAS, thermal conversion, equilibration, GC-IRMS;

Sampling and matrices: sample preparation in diverse matrices (plants, animals, soils, specific compounds).

Participants have to be present at 85% of the contact hours (this means that they can miss one half-day), and actively participate in all activities.

This course can give credits to PhD programmes at FCUL or of programmes with partnership from FCUL and other institutions with 6h-7h of contact hours per ECT, as a function of specific requirements. **For these students additionally to the exercises done during the week the delivery of a written report done after the course is mandatory.** For programmes with less hours of contact per ECT (6h/ECT, getting 6 ECTs from the course) students need to do an additional assignment (summary report). If needed 1 or 2 additional hours of contact may be added. Such report(s) are also advised for other students requesting accreditation of the course in their institutions.

**Nº (min, max) students:** 10-20

**Minimal formation of students:** Bachelor in Biology, Natural Science or related areas

**Directed to:** Teachers, researchers, 2nd and 3rd cycle students, laboratory technicians in the areas of environmental studies, ecology, health, ecosystem management, conservation.

### **FEE**

Free for 1st year PhD students in Doctoral programmes at FCUL (e.g. Biologia), Biodiversity, Genetics and Evolution (BIODIV UL; UP), Biology and Ecology of Global Changes (BEAG UL, UA) and Sustainability Science (UL, several institutions), when the course counts credits for their formation, in which case the delivery of a final report done after the course is mandatory; the course is also free for more advanced PhD students of the BIODIV programme (ULisboa or UPorto); 50 € for more advanced PhD students of cE3c of other programmes; 80 € for PhD students of the PEERS network (CFE); 125 € for FCUL Master students and unemployed; 180 € for BTI, BI and other PhD students; 250 € for Professional and postdocs.

When the maximum number of students is reached, 10 vacancies will be available for non-paying 1st year PhD students mentioned above, being, by order of preference students from: 1) cE3c; 2) BIODIV (not from cE3c); 3) FCUL (not from cE3c); 4) Sustainability Science (not from cE3c or FCUL); 5) BEAG (not from cE3c or FCUL).

**Deadline for applications:** May 2<sup>nd</sup> 2025

### **How to apply**

Candidates should fill a FORMULARY that will be available after the call is open.

This formulary is strictly confidential, as explained in the introduction, and the data are required because the cE3c Advanced Courses are also offered as part of the PRR programme of FCUL.

When filling the formulary mind to:

- 1) FILL ALL THE MANDATORY FIELDS
- 2) UPLOAD CV AND MOTIVATION LETTER, both mandatory; use the names as instructed there
- 3) If you want to resume later SAVE the formulary, otherwise you will need to fill everything again
- 4) At the end SUBMIT the formulary before exiting

For any doubts please contact the cE3c coordinator of the cE3c courses Margarida Matos, email [mmmatos@fc.ul.pt](mailto:mmmatos@fc.ul.pt) and the teacher Cristina Antunes ([cmaantunes@fc.ul.pt](mailto:cmaantunes@fc.ul.pt))