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Evaluating the potential of Iberian lakes as sensors of climate circulation patterns

Armand Hernández (1), Ricardo M. Trigo (1,2), Sonia Jerez (1), Maria T. Rico-Herrero (3), José C. Vega (4), Margarita Jambrina-Enríquez (5), Blas L. Valero-Garcés (3), and Santiago Giralt (6)

(1) Instituto Dom Luiz, Universidade de Lisboa, 1749-016 Lisboa, Portugal (ahhernandez@fc.ul.pt), (2) Departamento de Engenharias, Universidade Lusófona, 1749-024 Lisboa, Portugal, (3) Pyrenean Institute of Ecology (IPE-CSIC), Av. Montañana 1005, 50059 Zaragoza, Spain, (4) Laboratory of Limnology of the Lago de Sanabria Natural Park, Eras 1, 49300 Puebla de Sanabria, Zamora, Spain, (5) Facultad de Ciencias, Universidad de Salamanca, Plaza de los Caidos, s/n, 37008 Salamanca, Spain, (6) Institute of Earth Sciences Jaume Almera (ICTJA-CSIC), Lluís Solé i Sabarís s/n, 08028 Barcelona, Spain

Lakes are one of the best continental sensors for reconstructing past environmental and climatic changes. Recent lacustrine systems may be used for reconstructing with high-temporal resolution past climate parameters (e.g. precipitation, temperature, wind), land management changes and limnological conditions such as pH, salinity, or nutrients concentrations using a large set of techniques and proxies. Paleoenvironmental reconstructions can be improved by validating them with instrumental data, and the availability of monitoring data greatly enhances the potential of lakes to evaluate the link between the measured physical-chemical-biological parameters and the indicators from lake sediments. The Iberian Peninsula (IP) is an excellent site to conduct quantitative climate reconstructions owing to its location between the Eurosiberian and Mediterranean regions. Due to its geographic position, a large fraction of the IP climate is dominated by the most important large scale pattern of the Northern Hemisphere, i.e. the North Atlantic Oscillation (NAO). However, a number of recent works has put into evidence that besides the NAO mode there are other relevant atmospheric circulation patterns over the North Atlantic and European sector that play an important role in terms of Western Mediterranean climate. Among these we have evaluated particularly the so-called Scandinavian (SCAND) and eastern Atlantic (EA) which have commonly been overlooked.

Monthly limnological monitoring in Lake Sanabria (42°07’N, 06°43’W) and Lake Las Madres (40°18’N, 3°31’W) since 1986 and 1991, respectively, provided a unique opportunity to test the spatio-temporal relationships between meteorological data and climate modes, hydrology, lake dynamics and, in the Lake Sanabria case, how the climate signal is transferred to the lake sediments. For this purpose, we have used five complementary datasets: (1) meteorological (air temperature, total precipitation and wind intensity), (2) climate modes index (NAO, EA, SCAND), (3) limnological (Secchi disk, water temperature, conductivity, pH, dissolved oxygen, nitrate, total phosphorus and chlorophyll) in both lake systems; and in Lake Sanabria (4) hydrological (Tera River water input and output) and (5) XRF core scanner measurements carried out in short cores.

The preliminary results based on linear models and Principal Component Analyses between the different dataset variables show how the climate signal is transferred from the atmosphere to the lake, and ultimately to the sediments. Establishment of such links allowed us to infer quantitatively the pattern of precipitation and its temporal and spatial relationship with the main climate over the last decades using the limnological and sediment data in these two IP lakes. These results highlight that besides NAO, the SCAND and EA patterns must be taken into account on any analysis of climate variability in the IP.