LAZAROA 35: 197-201. 2014
doi: 10.5209/rev_LAZA.2014.v35.47070 ISSN: 0210-9778

Importance of climatic data analysis for biodiversity studies in Mediterranean mountains of the Iberian Peninsula

José Manuel Blanquer Lorite, Alba Gutiérrez Girón & Rosario G. Gavilán (*)

Abstract: Blanquer Lorite, J.M., Gutiérrez Girón, A. & Gavilán, R.G. *Importance of climatic data analysis for biodiversity studies in Mediterranean mountains of the Iberian Peninsula. Lazaroa 35: 197-201 (2014).*

Recent studies on climate change and the development of international scientific nets for the observation and analysis of global warming on the biodiversity have had an immediate effect on Ecology labs. It is the case of Enviroclim_lab created to cover all the necessary instrumentation management to collect outdoors bioclimatic data. The analysis of such data is also included in the daily tasks.

Keywords: ENVIROCLIM_LAB, climate, climate change, vegetation, lichens.

Resumen: Blanquer Lorite, J.M., Gutiérrez Girón, A. & Gavilán, R.G. *Importancia de los ensayos climáticos para el estudio de la biodiversidad en las montañas mediterráneas de la Península Ibérica. Lazaroa 35: 197-201 (2014).*

Los recientes estudios sobre el cambio climático y el desarrollo de redes científicas internacionales para la observación de los efectos globales del calentamiento sobre el medio natural han tenido un efecto inmediato sobre las infraestructuras que los investigadores utilizan. En este sentido, se ha creado Enviroclim_lab para dar cobertura tanto a la nueva instrumentación de obtención de datos bioclimáticos en campo, como al análisis y la presentación de los datos extraídos.

Palabras clave: ENVIROCLIM_LAB, clima, cambio climático, vegetación, líquenes.

The notion of climate as a driving environmental factor governing the distribution of plants and vegetation has long been recognized (Von Humboldt, 1807; Wahlenberg, 1811; Grisebach, 1838). The importance of climate studied through its main features, temperature, precipitation, evapotranspiration, etc. or their combinations, has been indicated in different vegetation or plant geography surveys (Box, 1981; Walter, 1985; Tuhkanen, 1987;Woodward,1987; Prentice & *al*., 1992; Gavilán, 1994; Blasi & *al*., 1999). Simple climate parameters have been used to quantify and determine the influence of climate on plants and vegetation (Gavilán & Fernández-González, 1997; Gavilán & *al*., 1998; Palacios Gijón, 2011). However, these parameters in combination in the form of phytoclimatic indices is considered much useful for biodiversity studies (De Martonne, 1926; Tuhkanen, 1980; Gavilán, 2005), although other authors consider that bioclimatic indices can give redundant information or are limited to the areas where they were formulated (De Martonne, 1955; Gaussen, 1956; Fernández-González, 1997).

Recently the development of research studies by different groups worldwide together to new outdoor climate measuring instruments much more improved and precise have made necessary to update our research laboratory units in Universities and Research Centers. Our research group with a wide experience in the study of the relationships between vegetation and environment also participate on such international nets, such as the GLORIA Initiative (www.gloria.ac.at)

* Departamento de Biología Vegetal II. Facultad de Farmacia. Universidad Complutense. E-28040 Madrid, Spain. Email: jmblanq@ucm.es; algutier@ucm.es

whose objective is to establish a long term sampling of alpine plant communities.

We have then established a net of dataloggers in the summits of central Spain Mountains (Sistema Central): Sierra de Guadarrama and Sierra de Gredos. GLORIA tasks consisted in plant communities sampling but also climate measures recording (GUTIÉRREZ-GIRÓN & GAVILÁN, 2010; GUTIÉRREZ-GIRÓN & GAVILÁN, 2013). However, other research developed in our department included the installation of a micrometeorological station in Mediterranean high mountain areas where standard recording had not been done ever (BLANQUER & *al*., 2009a, 2009b, 2010, 2011). We chose Sierra de Gredos were the altitude of summits were higher than in other parts of the Sistema Central. Finally, the analysis of mountain forest management and their conservation status provide us the study of bioclimatic feature at mid altitudes in Sierra de Gredos and Sierra de Guadarrama (RUBIO & *al*., 2010).

With this in mind the research group ENVIROVEG (www.ucm.es/info/enviroveg, 2013) has created in 2012 a research laboratory called ENVIROCLIM_LAB (Comunidad de Madrid i+d) whose objectives are to provide tools to develop bioclimatic studies in the Mountains of the Iberian Peninsula. This new lab includes all standard statistic tools to analyze climatic series and regional downscaling. Data recording by Enviroclim_Lab is done by a bioclimatic net situated in Central Spain Mountains that consisted of three components:

1) A meteorological and microclimatic stations in El Morezón peak (2378 m, Sierra de Gredos) which aim is to collect different type of climatic data to get long term data for the interpretation and comprehension of climate change scenarios in alpine Mediterranean areas: i) air temperature, ii) air humidity, iii) temperature in different cushion species and lichens characteristics of the area, iv) Photosynthetic active radiation, v) solar radiation at different time intervals during the whole year. It has been recently implemented installing specific telemetric hardware to operate by distance with permanent access to gathered data, from July 2009 (Figure 1, 2).

2) GLORIA Initiative dataloggers recording temperature data of high mountain areas, in Sierra de Guadarrama and Sierra de Gredos (including Sierra de Béjar), from July 2006 (Figure 2).

3) GLORIA dataloggers recording temperature data in forest areas at altitudes around 1500 m asl. in Sierra de Guadarrama and Sierra de Gredos, from January 2006 (Figure 2).

Most of the temperature dataloggers of the Enviroclim_lab net are buried at 10 cm deep in the soil and they record soil temperature hourly. The routine analysis of data is the calculation of annual, seaso-

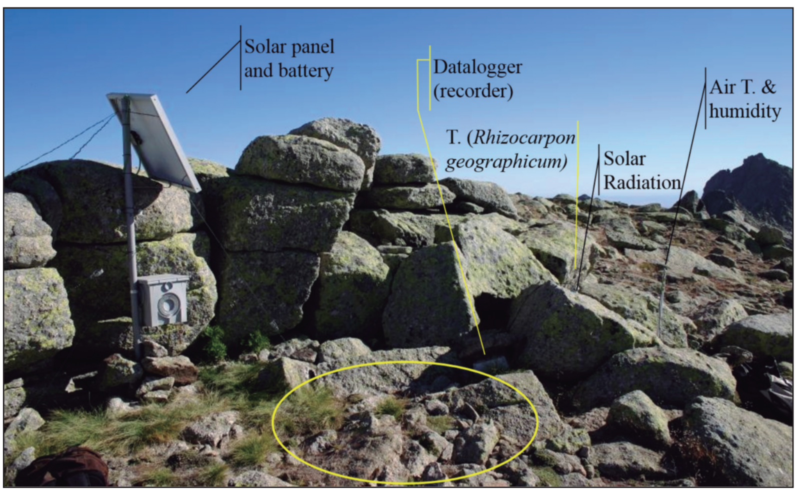

Figure 1. – Meteorological and microclimatic station of El Morezón peak. The parts and different sensor types (air temperature and humidity, solar radiation; see text) are shown in the picture. Four sensors are buried under *Silene ciliata, Jasione crispa* subsp. *centralis* and *Mucizonia sedoides* (see circle in the ground).

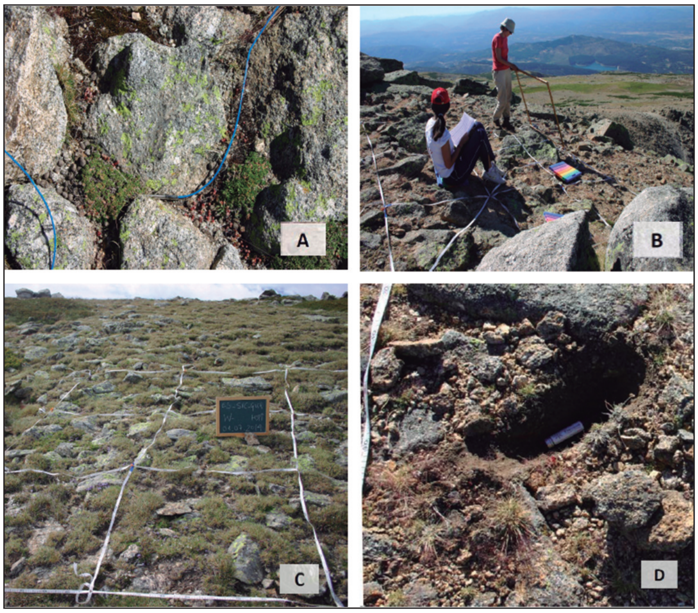

Figure 2. – Different photographs of outdoors Enviroclim_lab components. A, a sensor measuring *Jasione crispa* subsp. *centralis* in the micrometeorological station at Morezón summit (Sierra de Gredos); B-D, GLORIA tasks, B, GLORIA working in Sierra de Béjar, C, shows one of the 3x3 plots in Las Guarramillas (Sierra de Guadarrama) and D, a buried Geoprecision Soil temperature probe.

nal or monthly soil temperature indexes (Table 1). Additionally, the hourly record of temperature allows us other type of indexes such as the snow melting date in spring or the snow cover duration (Table 1), that are parameters driving the ecology of high mountain communities (KÖRNER, 2003). A basic and regular graphical exploration of annual series of data is also carry out (Figure 3). Moreover, in every site where temperature dataloggers have been installed, vegetation sampling has been done to record information of composition and structure of plant communities (Figure 2; GUTIÉRREZ-GIRÓN

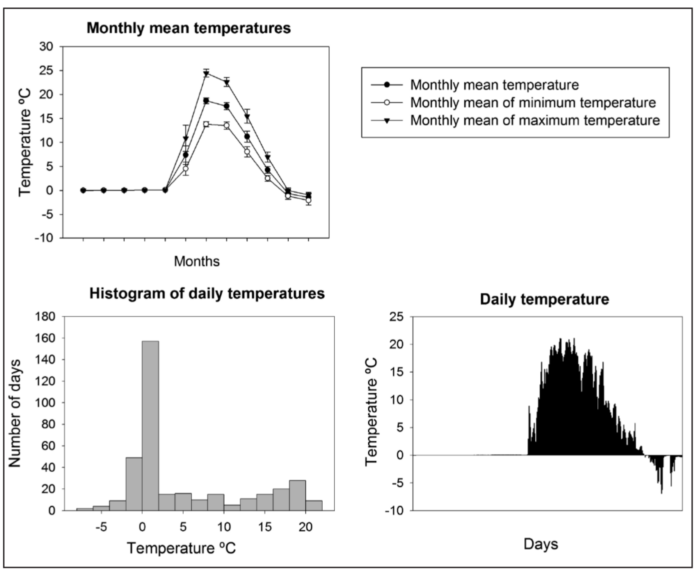

Figure 3. – Graphical exploration of annual series data routinely carried out by Enviroclim_lab.

Table 1
Summary of indexes regularly calculated from soil temperature records.

Md: Daily mean temperature.
M: Monthly mean temperature.
Max. daily: Daily maximum temperature.
Min. daily: Daily maximum temperature.
MAX: Monthly mean of maximum temperatures.
MIN: Monthly mean of minimum temperatures.
MAXA: Absolute monthly maximum temperature.
MINA: Absolute monthly minimum temperature.
MSEA: Seasonally mean temperature of each season: spring (March-April-May), summer (June-July-August), autumn (September-October-November), winter (December-January- February).
MWARM: Mean temperature of the warmest month.
MCOLD: Mean temperature of the coldest month.
MAMP: Monthly temperature range (MAX minus MIN).
MAMwarm: Temperature range of the warmest month.
MAMsummer: Temperature range of the summer.
D5C: Number of days with a mean daily temperature ≥ 5º C. It could be calculated for others thresholds of temperature (e.g. 2 ºC or 0ºC).
DG: Degree days of the vegetative period . The sum of daily mean temperatures of days with a mean daily temperature > 5ºC during the growing season. It could be calculated for different thresholds of temperature (e.g. 0 ºC, 2 ºC).
Biotemperature of Holdridge: The sum of mean daily temperatures ≥ 0º C and divided by 365 days. It could be calculated for others thresholds of temperature (e.g. 2 ºC or 5 ºC).
TDD: Mean temperature of the days with a daily mean temperature > 0 ºC and multiplied for the number of days with this condition. It could be calculated for others thresholds of temperature (e.g. 2 ºC or 5 ºC).
Snow melt date: Date of snow melting in spring. It is estimated from hourly temperature graphs.
Dsnow: Snow cover duration in days. Sum of days with a mean daily temperature of 0º C and a daily temperature variation of ≤ 1ºC.
Dice: Number of days tha soil is frozen. Sum of days the soil retained frost with a mean daily temperature < -1ºC.
Eice: Number of frozen soil events during a year. It is estimated from hourly temperature graphs.

& GAVILÁN, 2010; GUTIÉRREZ-GIRÓN & GAVILÁN, 2013); and in specific sites this vegetation is monitoring by revisiting and resampling plant communities in order to detect long-term climate change responses in ecosystems. Finally, the monitoring of superficial soil temperature conditions it is a important factor for the prediction of future changes of the biochemical cycle of carbon, since organic matter of soil represent the major terrestrial stock of carbon, bigger than the sum of atmospheric an plant biomass carbon (SCHIMEL, 1995). Enviroclim_lab data has been also recently employed in the study of C biochemical cycling and soil-plant relationships in Mediterrean high mountain ecosystems (GUTIÉRREZ-GIRÓN & *al*., 2014; GUTIÉRREZ-GIRÓN & *al*., 2015).

In conclusion from 2012 Enviroclim_lab works on statistic tools to analyze climatic series and regional downscaling of the bioclimatic net of atmospheric and soil climate records, from 2400 m asl to 1500 m asl in high mountain and forest ecosystems along Central System Mountains.

ACKNOWLEDGEMENTS

We want to thank Leopoldo G. Sancho and Daniel Sánchez-Mata comments to the a previous version of the manuscript. We also thank the Ministry of Science and Education and University Complutense the financial funding to create ENVIROCLIM_LAB, mainly BIOALPI (CGL2008-00901/BOS and PR1/08-15924-A), but also CONFOR (AGL2007-64707/FOR) and REMEDINAL2 (S-2009/AMB-1783).

REFERENCES

Blanquer, J.M., Gademann, R., Green, T.G.A., Pintado, A., Vivas, M. & Sancho, L.G. —2009a— On-line reporting of lichen activity and microclimate with Moni-da, a PAM-based chlorophyll fluorescence system — 10th SCAR Int. Biol. Symp., Sapporo.

Blanquer, J.M., Pintado, A., Raggio, J., Schroeter, B. & Sancho, L.G. —2009b— Microclimatic measurements in antarctic and subantartic regions — 17th Simp. Bot. Cript., Tomar.

Blanquer, J.M., Raggio, J., Green, T.G.A., Gademann, R., Schroeter, B., Pintado, A. & Sancho, L.G. —2010— Microclimate and photosynthetic activity of the lichen Usnea aurantiaco-atra in antarctic and subantarctic regions during the austral summer — Int. Pol. Year Oslo Sci. Conf., Oslo.

Blanquer, J.M., Raggio, J., Pintado, A., Sancho, L.G. & Gademann, R. —2011— Microclima y actividad metabólica en la Antártida marítima (Isla Livingston) — VIII Simp. Est. Pol., Mallorca

Blasi, C., Carranza, M.L., Filesi L., Tilia, A. & Acosta, A. —1999— Relation between climate and vegetation along a Mediterranean-temperate boundary in central Italy — Global Ecol. Biogeogr. 8: 17-27.

Box, E.O. —1981— Macroclimate and plant forms: an introduction to predictive modeling in phytogeography — Dr.W. Junk, The Hague.

Enviroveg —2013— GLORIA: Una iniciativa internacional para la monitorización permanente de la vegetación de alta montaña — Red-escubre 21: 12-15.

Fernández-González, F. —1997— Bioclimatología — In: Izco J & al. (Eds.). Botánica. Pp. 607-682. McGraw-Hill Interamericana, Madrid.

Gavilán, R.G. —1994— Estudio de las relaciones entre la vegetación y el clima en el Sistema Central español — Mem. Doc. (inéd.). Fac. Farmacia. Univ. Complutense, Madrid.

Gavilán, R.G., Fernández-González, F. —1997— Climatic discrimination of Mediterranean broad-leaved sclerophilous and deciduous forests in central Spain — J. Veg. Sci. 8: 377-386.

Gavilán, R.G., Díez-Monsalve, E., Izquierdo, J.L., Gutiérrez-Girón, A., Fernández-González, F. & Sánchez-Mata, D. —2012— An approach towards the knowledge of Iberian high-mountain calcareous grasslands — Lazaroa 33: 43-50.

Gavilán, R.G., Fernández-González, F., Blasi, C. —1998— Climatic classification and ordination of the Spanish Sistema Central: relationships with potential vegetation — Plant Ecol. 139: 1-11.

Gutiérrez Girón, A. & Gavilán, R.G. —2010— Spatial patterns and interspecific relations analysis help to better understand species distribution patterns in a Mediterranean high mountain grassland — Plant Ecol. 210: 137-151.

Gutiérrez Girón, A. & Gavilán, R.G. —2013— Monitoring Mediterranean high mountain vegetation in the Sistema Central: GLORIA project and collateral ecological studies — Lazaroa 34: 77-87.

Gutiérrez-Girón, A., Rubio, A., Gavilán, R.G. —2014— Temporal microbial biomass and plant biomass variation during summer in a Mediterranean high-mountain dry grassland — Plant & Soil 374: 803-813

Gutiérrez Girón, A., Díaz-Pinés, E., Rubio, A. & Gavilán, R.G. —2015— Both altitude and vegetation affect temperature sensitivity of soil organic matter decomposition in Mediterranean high mountain soils — Geoderma 237–238: 1-8.

Grisebach, A. —1838— Ueber den einfluss des climats auf die Begr¨anzung der naturlichen floren — Linnaea 12: 159-200.

Körner, C. —2003— Alpine plant life: functional plant ecology in high mountain ecosystems, 2nd ed. — Springer, Berlin.

Palacios Gijón, V. —2011— Variaciones de temperature y otros parámetros climáticos en el Sistema Central. Una aproximación bioclimática. Trab. Fin Master. F. Farmacia. Univ. Complutense, Madrid.

Prentice, I.C., Cramer, W., Harrison, S.P., Leemans, R., Monserud, R.A., Solomon, A.M. —1992— A global biome model based on plant physiology and dominance, soil properties and climate — J. Biogeogr. 19: 117-134.

Schimel, D.S. —1995— Terrestrial ecosystems and the carbon cycle — Glob. Chang. Biol. 1: 77-91.

Tuhkanen, S. —1980— Climatic parameters and indices in plant geography — Acta Phytogeogr. Suecica 67: 1-110.

Von Humboldt, A. —1807— Ideen zu einem Geographie der Pflazen nebst einem naturgemälde der Tropeländer — Tübingen.

Wahlenberg, G. —1811— Kamtschadalische Laub und Lebermoose, gesammelt auf der russischen Entdeckungsreise von dem Herrn Hofrath Tilesius und untersucht — Mag. Ges. Narutf. Fr. 5: 289-297.

Walter, H. —1985— Vegetation of the earth and ecological systems of the geo-biosphere — Springer, Berlin Heidelberg New York.

Woodward, F.I. —1987— Climate & plant distribution — Cambridge Studies in Ecology. Cambridge Univ. Press, Cambridge.

Received: 2 October 2014
Accepted: 31 October 2014