

# IMPACT OF CLIMATE FACTORS ON HABITAT SUITABILITY OF AN AMPHI-ADRIATIC PLANT *FESTUCA BOSNIACA* KUMM. ET SENDTN.

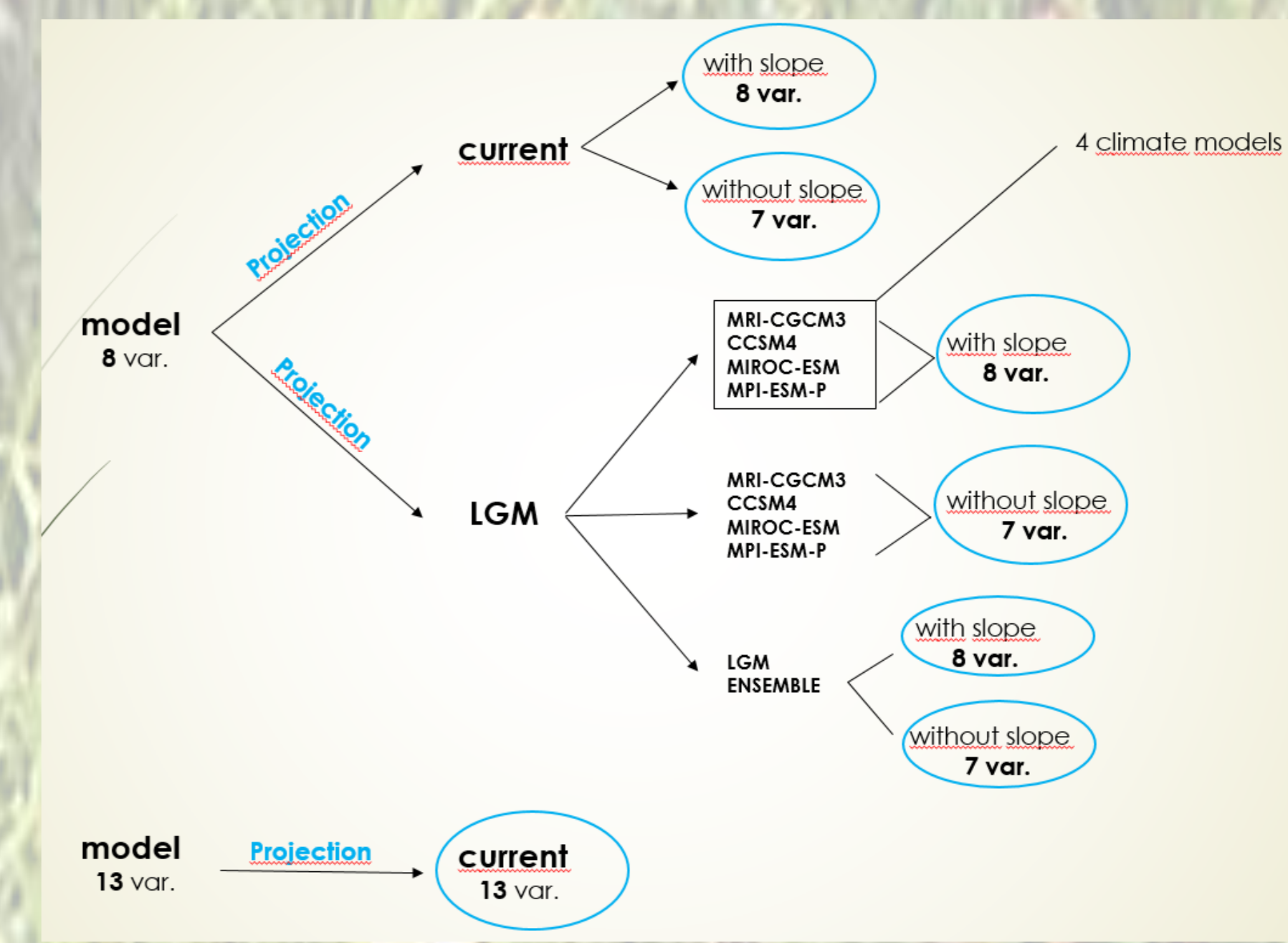
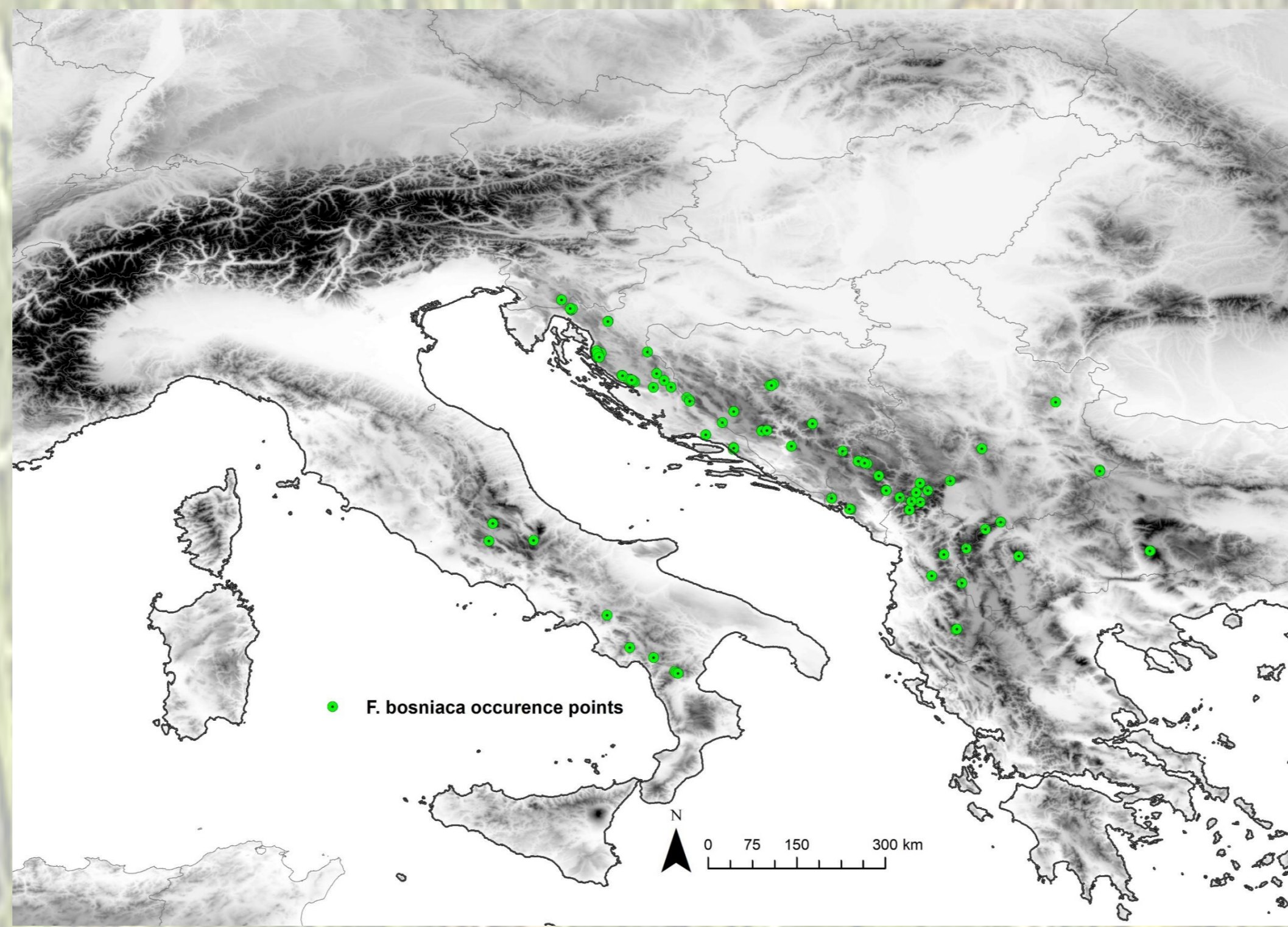
Temunović M.<sup>1</sup>, Ljubičić I.<sup>2\*</sup>, Bogdanović S.<sup>2,3</sup>, Rešetnik I.<sup>4</sup>

<sup>1</sup>Department of Forest Genetics, Dendrology and Botany, Faculty of Forestry and Wood Technology, University of Zagreb, Svetošimunska cesta 25, 10000, Zagreb, Croatia.

<sup>2</sup>Department of Agricultural Botany, Faculty of Agriculture, University of Zagreb, Svetošimunska cesta 25, 10000, Zagreb, Croatia. – e-mail: [iljubicic@agr.hr](mailto:iljubicic@agr.hr)

<sup>3</sup>Centre of Excellence for Biodiversity and Molecular Plant Breeding, Svetošimunska cesta 25, HR-10000 Zagreb, Croatia.

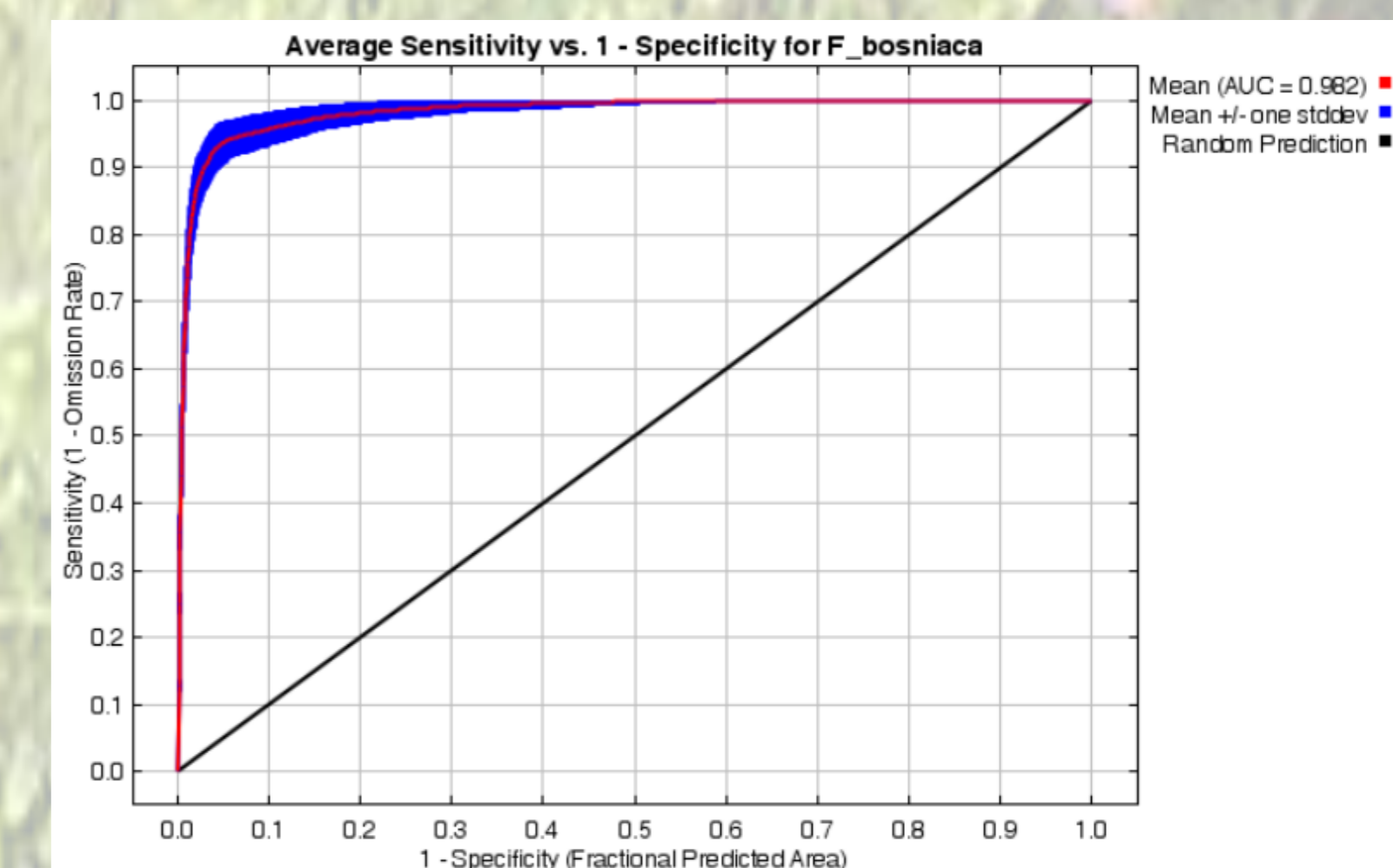
<sup>4</sup>Department of Biology, Faculty of Science, University of Zagreb, Trg Marka Marulića 20/II, 10000, Zagreb, Croatia.



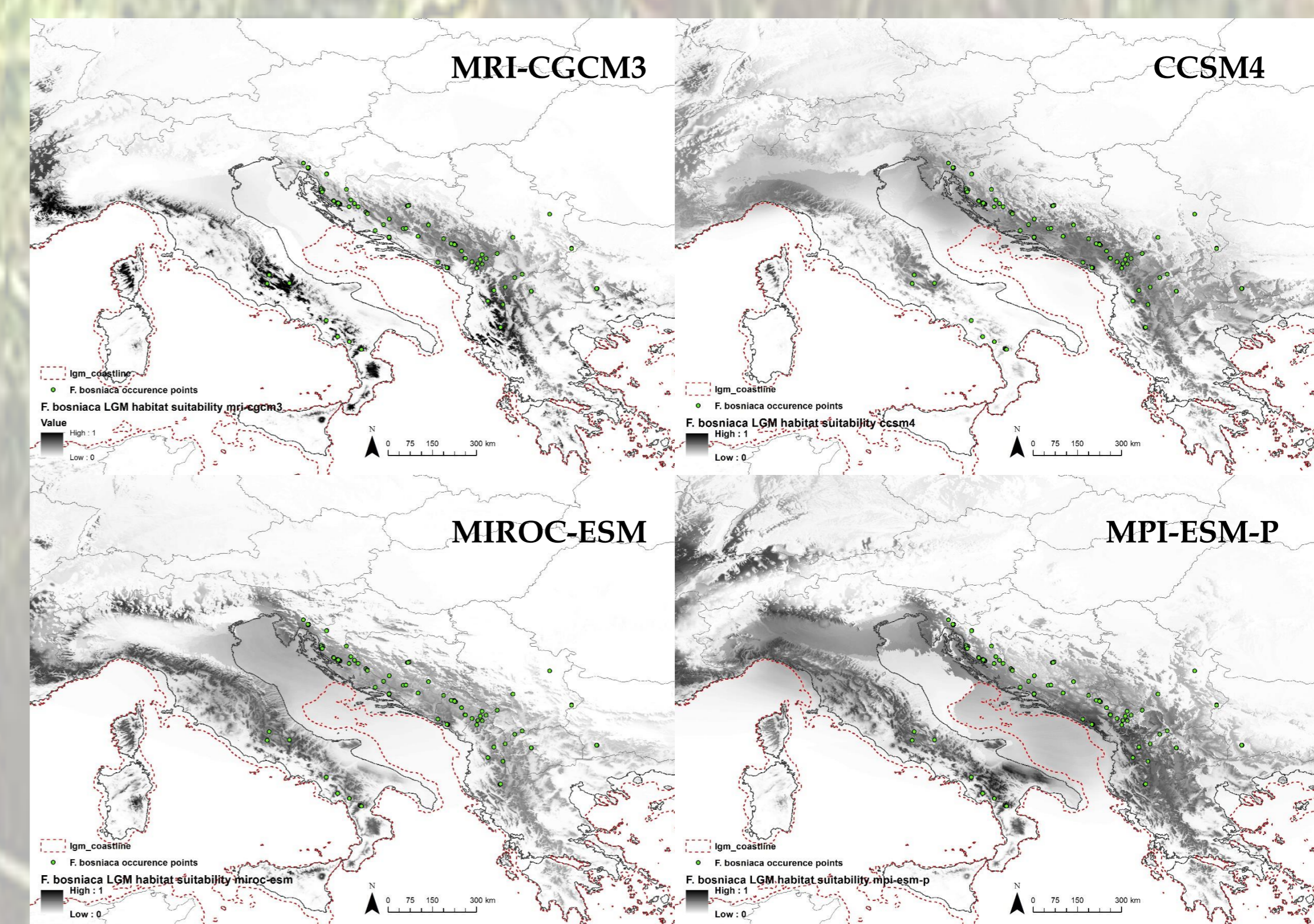
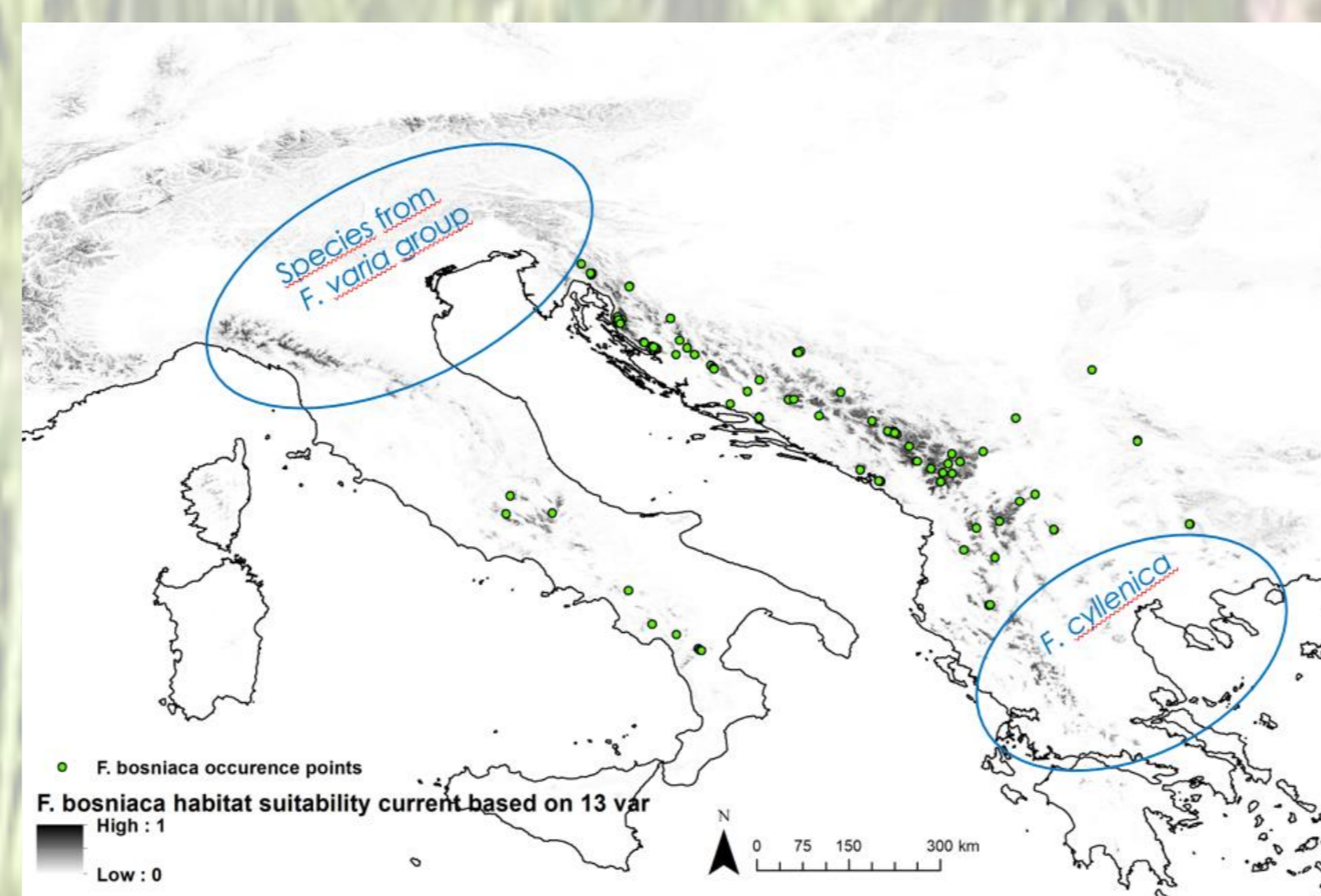
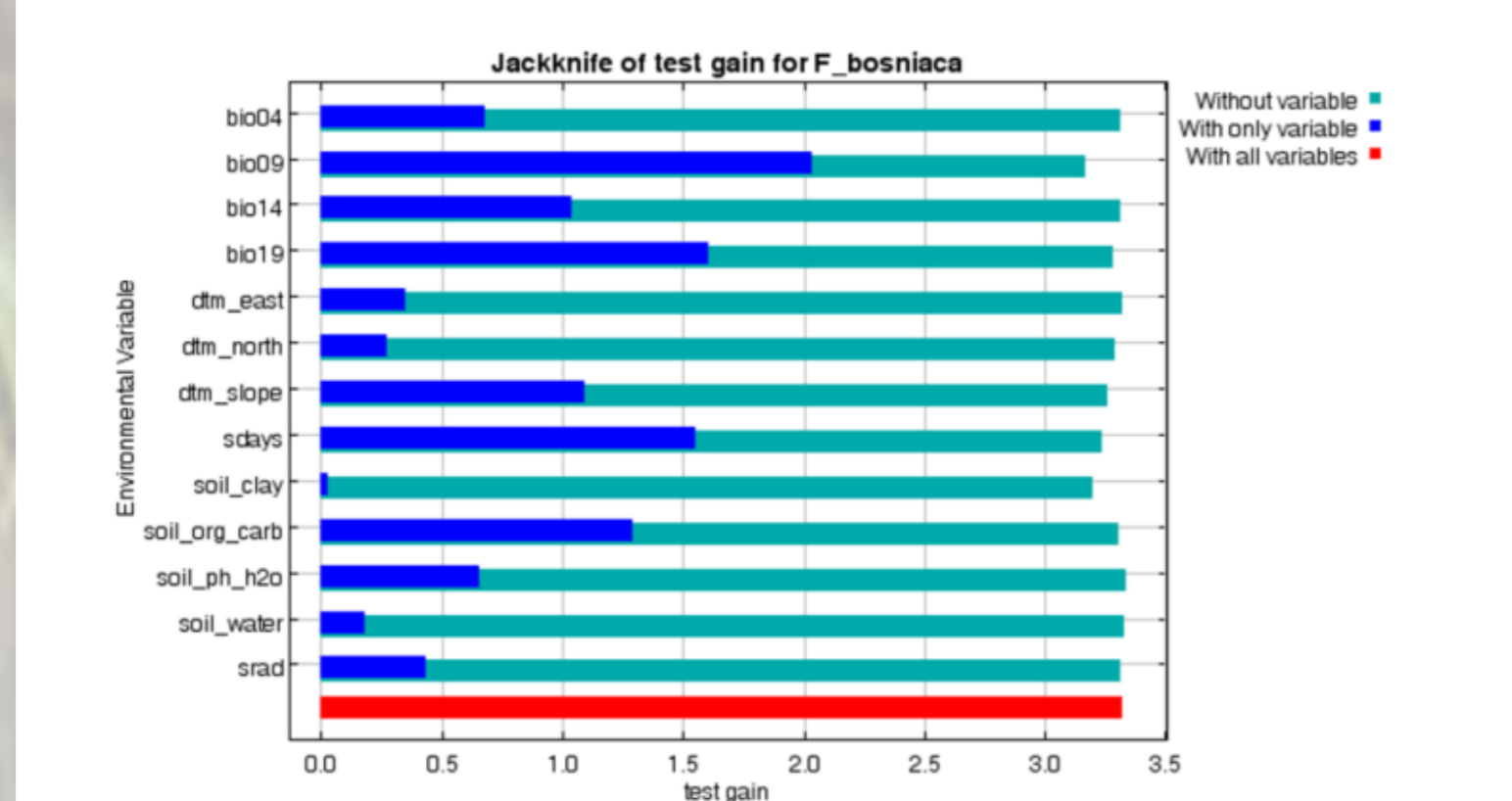
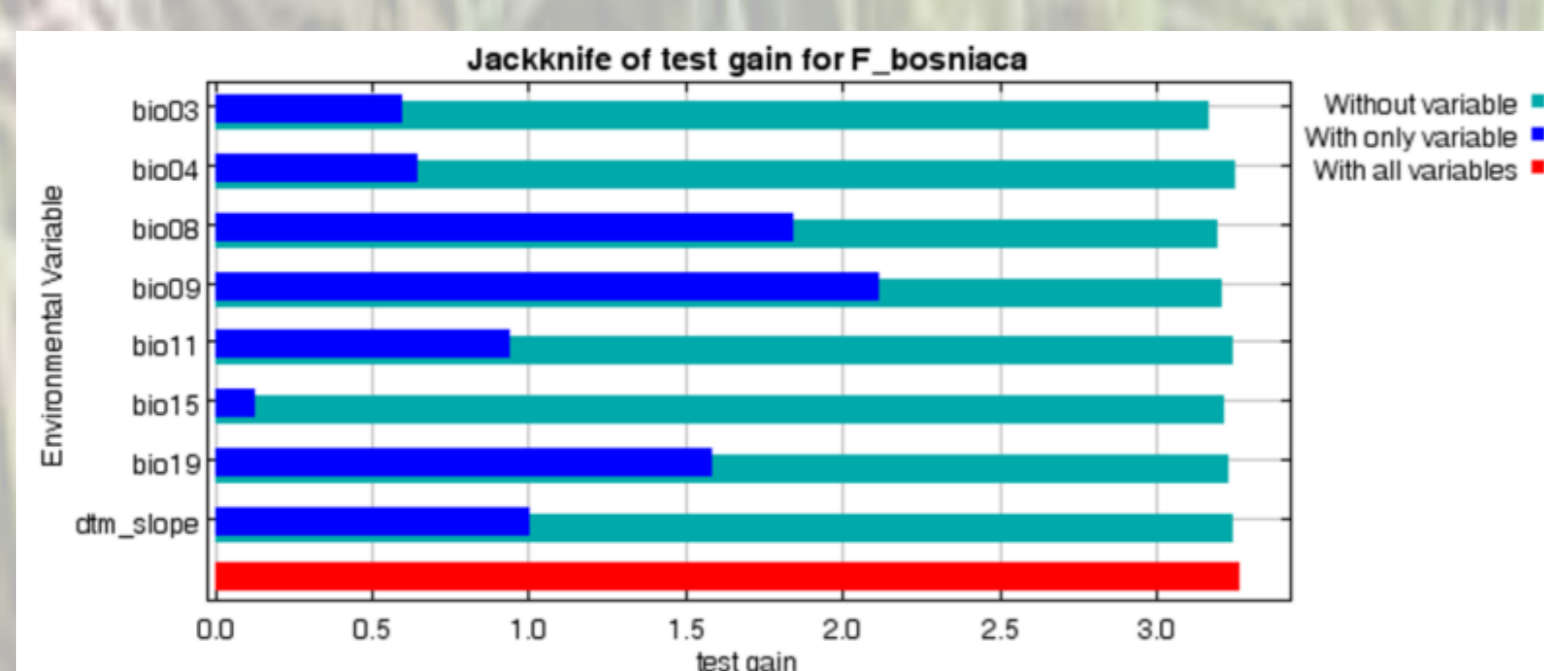
*Festuca* L. is the most species-rich genus of the grasses in Europe. *Festuca bosniaca* (belonging to *F. varia* complex) is an endemic species of the Balkan and Apennine Peninsulas, occurring in alpine and subalpine grasslands. Species distribution modelling (SDMs) was used to determine the habitat suitability for current and past (Last Glacial Maximum - LGM) time periods. The occurrence points of *F. bosniaca* were collected in the field from 2018 to 2021 and were supplemented with additional points from the Flora Croatica database. Our models were built based on the collected occurrence points for *F. bosniaca* from various sources (a total of 103 points after filtering) and a set of eight selected environmental variables which included climatic and geomorphological predictors available for both periods.

Variable	Description
bio19	mean monthly precipitation amount of the warmest quarter (kg m-2)
bio04	temperature seasonality
bio09	mean daily mean air temperatures of the driest quarter (°C)
bio14	precipitation amount of the driest month (kg m-2)
dtm_north	northness (index)
dtm_east	eastness (index)
dtm_slope	slope (°)
sdays	number of snow days
srad	solar radiation
soil_ph_h2o	soil pH x 10 in H2O
soil_org_carb	soil organic carbon content (x 5 g / kg)
soil_clay	clay content (%)
soil_water	soil water content at 33kPa

Variable	Contribution (%)
bio19	33.2
dtm_slope	16.8
bio09	16.2
soil_org_carb	13.4
sdays	7.4
bio14	2.9
soil_ph_h2o	2.7
soil_clay	2.6
dtm_north	2.1
srad	2
dtm_east	0.3
bio04	0.2
soil_water	0.1



In addition, current habitat suitability was also predicted based on 13 selected predictors (of initial set of 43 variables from CHELSA and exChelsa databases) available exclusively for the current period, including additional variables that were not available for the LGM period. SDMs was conducted using the Maximum Entropy method, with 70% of the occurrences used for model training and 30% of the occurrences used for model evaluation. All the resulting models showed very good performance (AUC > 0.9) and the main environmental variables affecting habitat suitability of *F. bosniaca* were: mean monthly precipitation amount of the warmest quarter (bio19), dtm\_slope, mean daily mean air temperatures of the driest quarter (bio09). Current habitat suitability was also influenced by soil organic carbon content and number of snow days. Projections for the LGM period were based on four general circular models (GCMs) (NCAR-CCSM4, MRI-CGCM3, MPI-ESM-P, MIROC-ESM) averaged to produce a consensus LGM projection.



Regardless of the predictor set of variables (8 or 13), the Jackknife test results (test data set) of the importance of each environmental variable for *F. bosniaca* showed that the most influential factor is the mean temperature of the driest quarter (bio09).

The habitat suitability corresponded well with the known occurrences of *F. bosniaca* in the Balkans and Apennines. The models also showed some potentially newly discovered populations in the area of the Scardo-Pindic mountains and in the north-western part of the Apennine Peninsula. When comparing the models for the LGM and the present, a much wider range was observed in the past, which may be related to the lower temperatures favoured by *F. bosniaca*.