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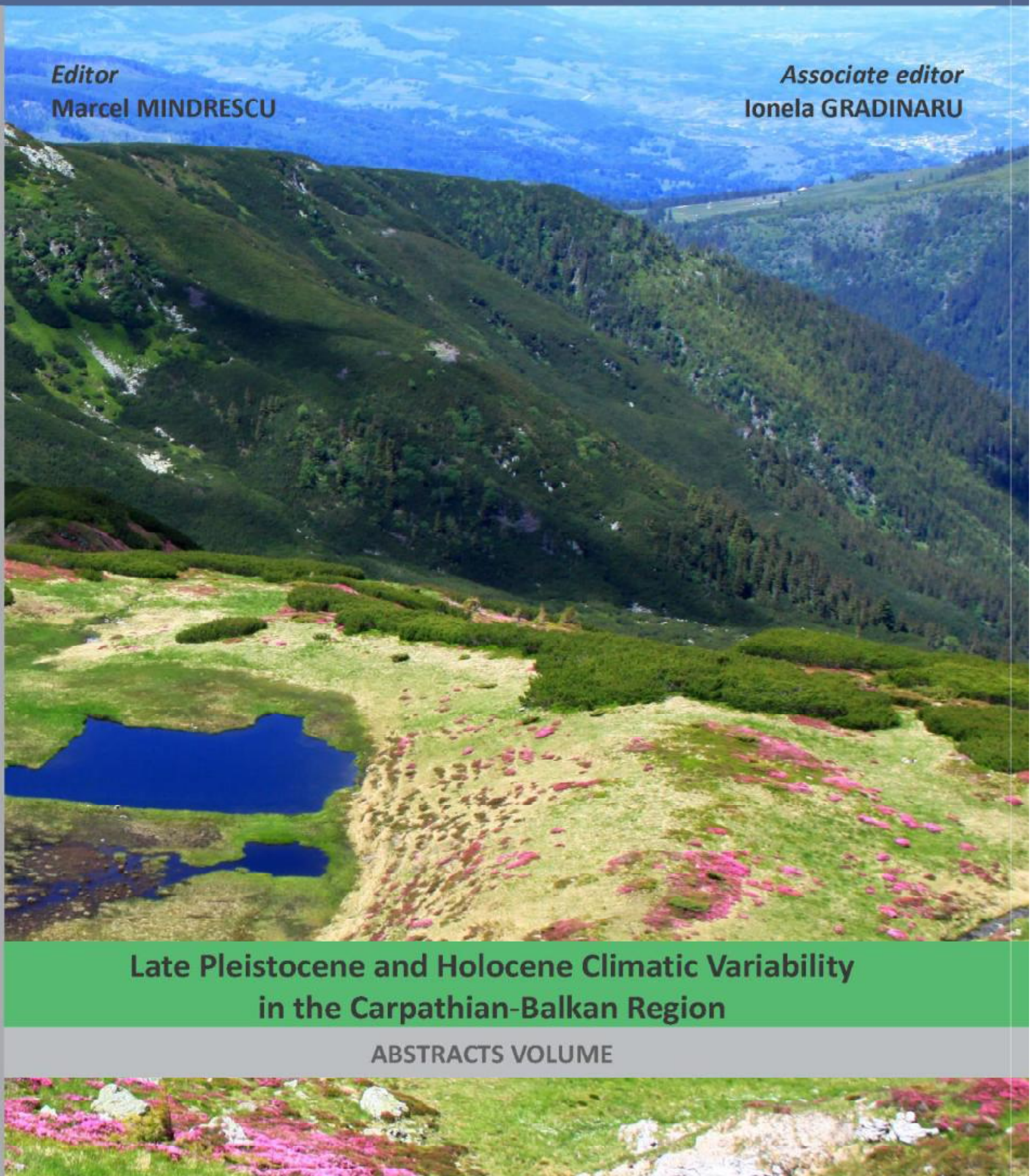

Late Pleistocene and Holocene Climatic Variability in the Carpathian-Balkan Region

ABSTRACTS VOLUME

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Late Pleistocene and Holocene climatic variability in the Carpathian-Balkan region. Abstracts volume

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Dendroclimatic Reconstruction of Summer Temperatures in Southern Carpathians

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A significant summer temperature warming trend and little or no change in precipitation variation have been observed in the southern part of the Carpathians after 1980. In this paper we seek to find similar past climatic conditions using a dendroclimatic reconstruction of summer temperatures. Regional dendroclimatic reconstruction has been conducted in four different massifs (Bucegi, Piatra Craiului, Făgăraş and Parâng Massifs) belonging to the Southern Carpathians. The four sampling sites are located nearby the upper timberline, the forest stands being here dominated by Norway spruce trees (Picea abies (L) Karst). A tree-ring width (TRW) chronology of P. abies has been used here to reconstruct summer temperatures back to the end of 19th century. Results indicate that during the considered period, the decadal periods characterized by cold summers alternate with those with warm summer temperatures.

Keywords: climate variability, regional dendroclimatic reconstruction, *Norway spruce (Picea abies* (L) Karst), Southern Carpathians

Introduction

Former studies have shown an important increase in the temperature (0.5°C / decade) and no significant change in precipitation in the high altitude areas of the Romanian Carpathians after 1980.

The instrumental climatic and remote sensing data cover mainly the 20th century, and more than 100 year-old weather stations are rather far from the studied area, therefore proxy methods (e.g. dendrochronology, sediment analysis, ice-core, pollen analysis, etc.) are more suitable to reconstruct the long-term climate variability. The dendroclimatic reconstructions have been successfully carried out in other isolated massifs of Eastern Carpathians (Kern and Popa, 2007; Popa and Kern, 2009), but no similar studies exist at a regional scale in the Southern Carpathians. The aims of this study is to reconstruct past climate variability based on the analysis of Norway spruce tree rings *(Picea abies* (L) Karst*)* located in four different forest stands located nearby the upper timberline.

Methods and data

Study area

The studied area is located in the Southern Carpathians, a mountainous region in the central part of Romania. The highest point in Romania is in the Făgăraş Range, the Moldoveanu Peak reaches at 2,544 m a.s.l. The total length of the Southern Carpathians is about 250 km. A continental temperate climate with high amount of precipitation in summer and cold winters is specific at lower altitudes of the mountain range, meanwhile alpine climate conditions with annual mean temperatures and annual precipitation amount exceeding 1200 mm characterize the areas situated above 2000 m in altitude. The timberline altitude is at about 1750 m, depending on the local climatic and geomorphological factors. Four different massifs (Bucegi, Piatra Craiului, Fagaras and Parâng Massifs) have been chosen for the dendroclimatic reconstruction presented in this study.

Dendroclimatic reconstruction of the climate variability

The four sampling areas are located within the forest stands present at the upper timberline altitudes (Bucegi Massif – 1520 m, 25 trees sampled; Piatra Craiului Massif – 1680 m, 23 trees sampled; Fagaras Massif – 1470 m, 22 trees sampled; Parâng Massif – 1750 m, 26 trees sampled). Different number of Norway spruce trees (25 trees in Bucegi; 23 trees in Piatra Craiului; 22 trees in Fagaras Massif; 26 trees in Parâng) have been selected for sampling, following classical techniques used in dendroclimatology. The increment cores have been prepared for analysis (fixed in a wood support, air-dried and sanded) and then the ring-width measured with 0.001 precision using a LINTAB 5 positioning table connected to a Leica stereomicroscope and TSAP-Win Professional software station (Rinntech 2006).

Quality control and data check of the tree-ring measurements have been performed using COFECHA (Holmes, 1983) software by transformation of time series. Each transformed series has then been tested against dating master series, segment by segment. Successive segments have been lagged with a 50% overlap. The tree-ring standardization and removing growth trends in ring-width data has been carried out using ARSTAN (Cook and Krusic, 2007) software. The chronology series has been calculated using a bi-weight robust mean. Residual chronological series (RES) have been used in this study. The best correlation coefficients for the tree-ring growth index against the climatic data have been observed for the Hugersoff growth curve method. This method is used in this study. The connection between climatic time series and the seasonal ring structure indices has been carried out using DendroClim. The transfer function employed for summer temperature reconstruction has been estimated using a general linear model (GLM).

Results

Dendroclimatological analyses

a) Response of the climatic factors on the tree-rings growth. Our analysis is based on the mean monthly temperature and on the monthly amount of precipitation starting from April of the year before the growing of the current ring (t-1) to October of the year of the present ring growing (t). The correlation coefficients between these time series and current growth index were computed. The statistical significance was tested using t-test for a significance level of 95%.

b) Dendroclimatic summer temperature reconstruction. Our study highlights the medium-frequencies variability in order to identify the warm periods with impact on different environmental changes. The decadal variability in MJJA reconstructed and observed temperatures have been analyzed applying a spline 20 years with 50 % of variance cutoff function. In this decadal variation, one can see the same climatic signal, but the reconstructed data have diminished amplitude. The lower amplitude may be explained by the standardization of ring-width data.

Based on the analyses of the temporal series, we emphasize alternative sequences decades with warm/cold summers. The occurrence of this climatic variability has been analyzed for all the sampling sites.

Conclusions

The dendroclimatic analyses of summer temperatures in the Southern Carpathians allow us to reconstruct the historical variation of summer temperatures back to the second half of 19th century. We found similar past variations of temperature and the comparable climatic signal in tree-rings for all the sampling sites investigated.

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