Hungarian Geographical Bulletin

Volume 72 Number 1 2023

Research Centre for Astronomy and Earth Sciences
GEOGRAPHICAL INSTITUTE

HUNGARIAN GEOGRAPHICAL BULLETIN

Quarterly Journal of the
GEOGRAPHICAL INSTITUTE
RESEARCH CENTRE FOR ASTRONOMY AND EARTH SCIENCES

Indexed by Elsevier-GEOBASE®, Elsevier-SCOPUS®,
EBSCO Information Services, CAB Abstracts, Current Geographical Publications,
Scimago Journal & Country Rank, Google Scholar

HUNGARIAN GEOGRAPHICAL BULLETIN 72 2023 (1)

CONTENT

Book review section

DOI: 10.15201/hungeobull.72.1.1 Hungarian Geographical Bulletin **72** 2023 (1) 3–22.

Future changes of snow-related variables in different European regions

Anna KIS[1] and Rita PONGRÁCZ[1]

Abstract

Snow has an important role in the climate system and also has environmental, natural and socio-economic impacts. Temperature, precipitation, snow coverage, snow depth and snowmelt are analysed in this study for 1971–2099 based on EURO-CORDEX simulations. In order to measure uncertainty, three different scenarios (RCP2.6, RCP4.5, RCP8.5) and five different regional climate models are taken into account. The investigation focuses on eight regions, characterised by different climatic conditions (maritime, continental, boreal). Relative changes of the selected parameters are calculated for 2021–2050 and 2069–2098 compared to the 1971–2000 reference period, in addition to the evaluation of the simulated reference. The relative role of the three main uncertainty factors (internal climatic variability, model selection, and the used scenario) is also analysed. According to our results, model selection and internal variability possess the most important roles. Based on the multi-model mean, mean temperature and precipitation total in the cold season will increase, the snow cover period will become shorter (the higher the radiative forcing change in the scenario, the greater the decrease), and snowmelt is likely to occur earlier in the northern region. Thus, the warming trend seems to have a greater effect on the snow-related variables than increasing precipitation trends. These projected changes may have a huge impact on winter tourism and sports, hence, appropriate adaptation strategies will be crucial.

Keywords: snowmelt, snow coverage, snow depth, EURO-CORDEX, climate change

Received January 2023, accepted March 2023.

Introduction

Direct or indirect dependence on the cryosphere is present in many natural, social, and even economical processes. One of the cryosphere's components is snow, which displays substantial seasonality in most regions. Due to climate change, shorter snow periods are likely to occur in the future and the shift in the seasonality of snow may have far reaching effects, especially in the northern hemisphere. Snow plays an essential role in surface energy fluxes via its albedo (e.g. Thackeray, C.W. and Fletcher, C.G. 2016), it determines runoff conditions (e.g. Würzer, S. *et al.* 2016), soil moisture (e.g. Harpold, A.A. *et al.* 2015), soil temperature (e.g. Zhang, Y. *et al.* 2008), evaporation (e.g. Neto, A.M.M. *et al.* 2020), has an impact on ecosystems (e.g. Peng, S. *et al.* 2010) and, indirectly, even on wildfires (e.g. Kitzberger, T. *et al.* 2017). Snow also has socioeconomic effects because it may influence freshwater availability (Barnett, T.P. *et al.* 2005), transport and infrastructure (e.g. Jeong, D.I. and Sushama, L. 2018), winter tourism and sports (e.g. Steiger, R. *et al.* 2017; Morin, S. *et al.* 2021).

Due to the change of temperature values and precipitation patterns, the distribution of snow in space and time is also changing. In the past decades, a decline of snow cover has already been observed worldwide (IPCC 2019). Several studies have focused on global and regional changes of snow, which have concluded that, in general, snowmelt started earlier, and overall snow depth and snow coverage decreased (e.g. Klein, G. *et al.* 2016; Fontrodona Bach, A. *et al.* 2018; Marke, T. *et al.* 2018; Brown, I. 2019; Mudryk, L. *et al.* 2020; Notarnicola, C. 2020).

[1] Department of Meteorology, Institute of Geography and Earth Sciences, ELTE Eötvös Loránd University, Pázmány Péter sétány 1/a. H-1117, Budapest, Hungary. E-mails: kiaqagt@staff.elte.hu, prita@nimbus.elte.hu

Snow plays an important role in people's lives, therefore, to build appropriate adaptation strategies taking into account the changing conditions is essential, and starts with analysing the simulated future trends. The aim of this study is to use high-resolution model simulations to investigate such future trends in snow-related variables. Specifically, we focus on the comparison of eight European regions with different climatic conditions and topography. It is novel in our study that the three main sources of uncertainty in climate simulations are also assessed for all snow-related variables. Next, data and methods are presented, then the results are shown with a discussion. Finally, the main conclusions are summarised.

Data and methods

CORDEX simulations are frequently used to investigate snow-related variables in the context of climate change (e.g. Terzago, S. *et al.* 2017; Xu, Y. *et al.* 2019; Matiu, M. *et al.* 2020). For the present analysis five EURO-CORDEX simulations (Jacob, D. *et al.* 2014) were used (*Table 1*). The selection criteria were that the regional climate model (RCM) simulations should be available (i) at 0.11° resolution for Europe, (ii) for the period 1971–2099, (iii) on a monthly basis, (iv) taking into account the RCP2.6, RCP4.5 and RCP8.5 scenarios representing a wide range of future pathways from a mitigation-involved (with national commitments) scenario to a business-as-usual (i.e. no mitigation) future (van Vuuren, D.P. *et al.* 2011). The downloaded variables, beside temperature and precipitation, are the following: snow area fraction (%), snow depth (m) and surface snowmelt ($kg \cdot m^{-2} s^{-1}$).

Matiu, M. *et al.* (2020) discovered special biases in simulated data: unrealistic meaningless values were found in the Alps, for example in the case of snow depth and snow-water equivalent (Terzago, S. *et al.* 2017). This problem emerged only in some grid points, so Matiu, M. *et al.* (2020) eliminated them from the analysis by using critical threshold values. We also found some unrealistic values in the RCM simulations, so following the study of Matiu, M. *et al.* (2020), an upper limit, namely 10 m, was introduced in the case of snow depth. Furthermore, in the case of snow cover, values under 1 percent are turned to zero in order to eliminate the extremely small values.

The evaluation of the reference period 1971–2000 was carried out in order to quantify the reliability of the RCM simulations. For this purpose, we used the ERA-20C reanalysis database (Poli, P. *et al.* 2016). Since the spatial resolution is different in the RCM simulations and the ERA-20C database, we compared spatial averages. We note that the choice of the reference database is an important factor regarding evaluation, i.e. the goodness of the RCM may depend on the selected reference database. An interpolation was performed using the nearest neighbour method, as Matiu, M. *et al.* (2020) noted that bilinear interpolation resulted in false data in the minimum and maximum values of snow cover. In order to compare the changes in locations with different climatic conditions, sub-regions within Europe were defined (*Figure 1*). Four mountainous (elevation > 500 m) areas were selected, namely, northern Scandinavia (NSc), southern Scandinavia (SSc), the Alps (A) and the Carpathians (C). The northern and southern parts of the British Isles (NBI and SBI, respectively) with an elevation higher than

*Table 1. The GCM-RCM pairs applied in the present study**

GCM/RCM	RACMO22E	CCLM4-8-17	ALADIN63	RCA4
MOHC-HadGEM2-ES	x	–	–	–
CNRM-CERFACS-CNRM-CM5	x	–	x	–
ICHEC-EC-EARTH	–	x	–	–
NCC-NorESM1-M	–	–	–	x

*All the three scenarios are available for snow-related variables.

200 m were also selected in order to represent the maritime climate in the comparison. Moreover, two lowlands (elevation < 200 m) were chosen: Finland (F), which lies in the boreal, northern belt, and the Carpathian Basin (CB), which has continental climate. The results presented in the next section refer to the spatial averages of these individual regions. Analyses of the longer period 1901–2010 based on ERA-20C regarding to these eight regions within Europe can be found in our former investigation (Kis, A. and Pongrácz, R. 2021).

As RCM simulations usually have biases, when we analyse the future trends, we do not focus on the absolute values of the variables, but on their changes. This enables us to provide the general trends of changes with acceptable accuracy. The relative changes of snow related variables for the period 2021–2050 and 2069–2098 (representing the end of the 21st century with a slight shift due to the fact that some simulations end earlier than 2100) are analysed. As mentioned above, the reference time period is 1971–2000 in every case and the changes are summarised for a so-called cold season. In this study, the definition of the cold season is based on monthly mean temperature, therefore, it does not necessarily cover the same length and months in the different regions (*Figure 2*). In order to determine this period, the average monthly temperature was determined for each year between 1971 and 2000 based on ERA-20C. If at least in one month it was under 0 °C, then it was considered to be the part of the cold season. The longest cold season occurred in northern Scandinavia (from October to May), while in the southern British Isles it consisted only of one month (February).

We also evaluate the uncertainty sources of projections. In climate studies, three main sources of uncertainty are usually considered: internal climatic variability, climate models and scenarios (Hawkins, E. and Sutton, R. 2009). In order to quantify the importance of these uncertainty sources we calculated their contributions to the overall variability,

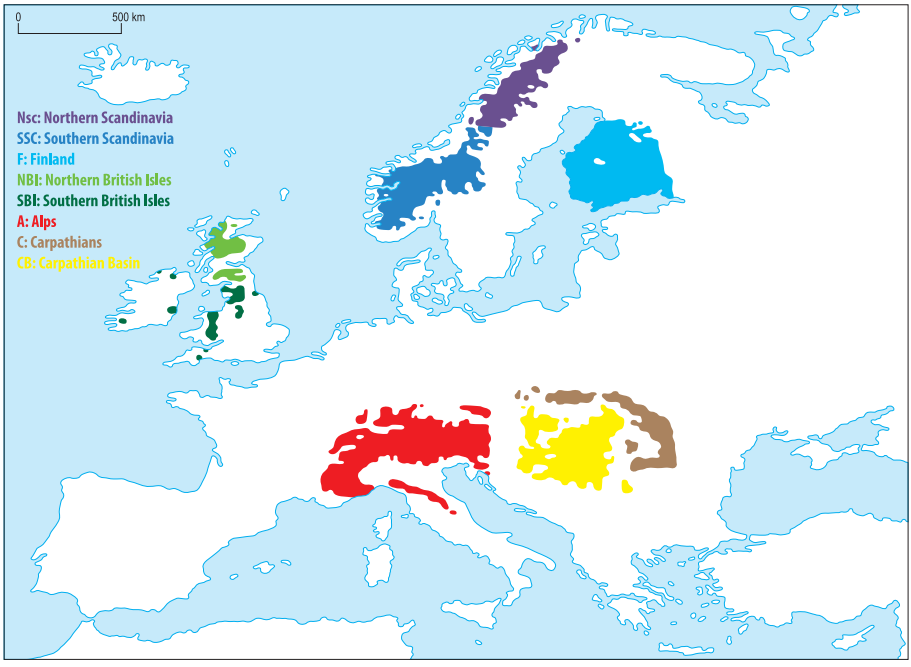


Fig. 1. The eight regions analysed in this study.

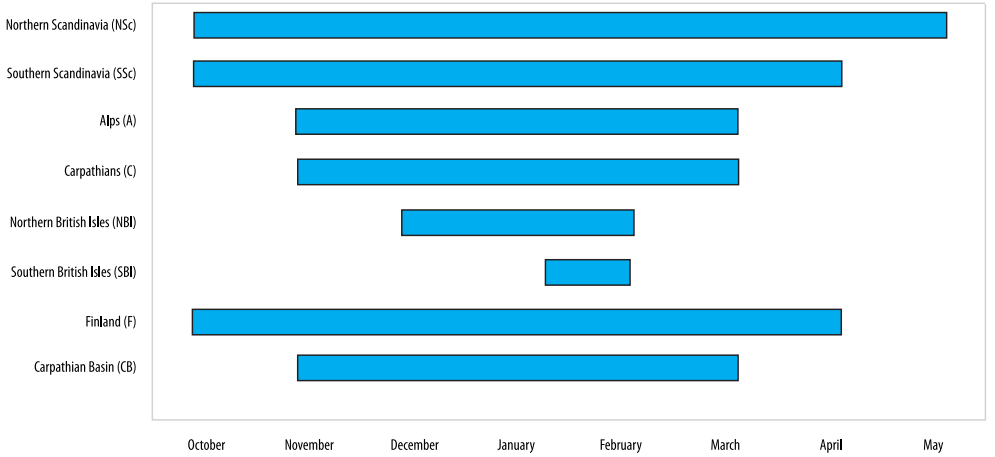


Fig. 2. The length of the winter time period (when monthly mean temperature is < 0 °C at least once during 1971–2000) in the different regions.

and determined their role compared to each other. For the model-related uncertainty, the range between the model simulations is calculated and averaged over the three different scenarios for each month and variable. For the scenario uncertainty, the spread between the multi-model means for each scenario is considered for each month and variable. We note that internal variability refers to inter-annual variability of monthly values in this study (hence, it is not directly comparable with the study of Hawkins, E. and Sutton, R. [2009]). To determine it, first, the ranges of the simulated values for the 30 years are calculated for each month, then the mean range of the five RCM simulations over the three scenario is determined. After these calculations, for each month and each region the relative importance of each uncertainty factor is determined, i.e. the value of the related uncertainty is divided by the sum of the three uncertainty values.

Results and discussion

Evaluation of the reference period

Temperature is usually underestimated by the RCMs, but the annual distribution is simulated well. The differences between the multi-model mean and the ERA-20C database are smaller (< 3 °C) in the winter months in the mountains. However, in the maritime regions, the greatest discrepancies occur in winter. In the lowlands there is a good agreement, the average yearly difference is below 0.5 °C. In the case of precipitation, an overall overestimation occurs, however, the annual distribution is captured quite well.

Snow depth is greatly overestimated by the RCMs, which can be explained by the simulated precipitation excess and the negative temperature bias. Snowmelt simulations also show overestimation in the reference period, however, again, the annual distribution is captured well. In the case of snowmelt, the best agreement occurs in lowlands; this agreement may be related to the temperature and precipitation simulations, which are more reliable in these regions as well. As an example, *Figures 3* and *4* are presented, showing the evaluation results for the Alps (as a mountainous region) and the Carpathian Basin (as a lowland).

Based on these evaluation results, we cannot select one best RCM. Matiu, M. *et al.* (2020) also found that we cannot choose the one and only best model to simulate snow-related

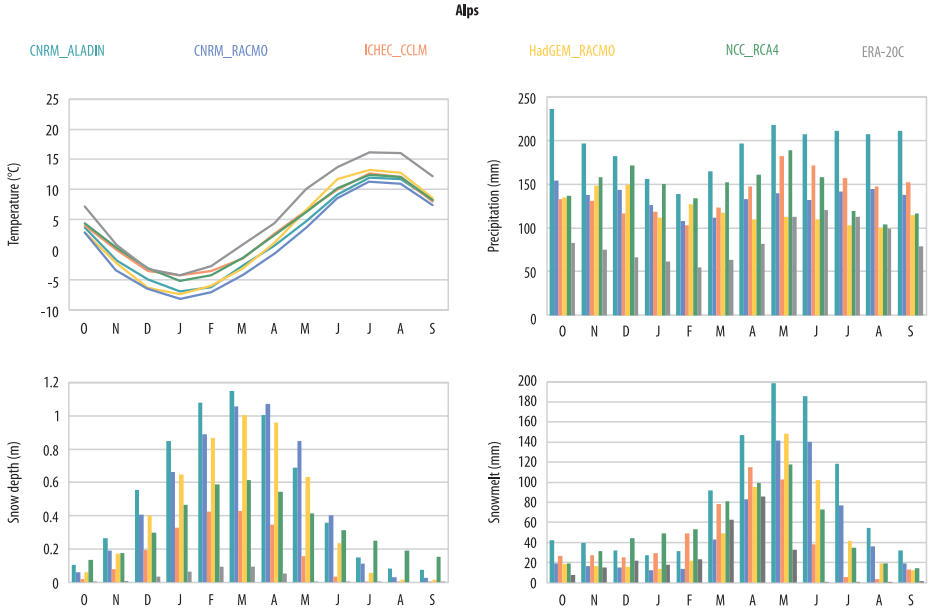


Fig. 3. Mean monthly values of temperature, precipitation, snow depth and snowmelt in the Alps in 1971–2000, based on the individual RCM simulations and the ERA-20C database.

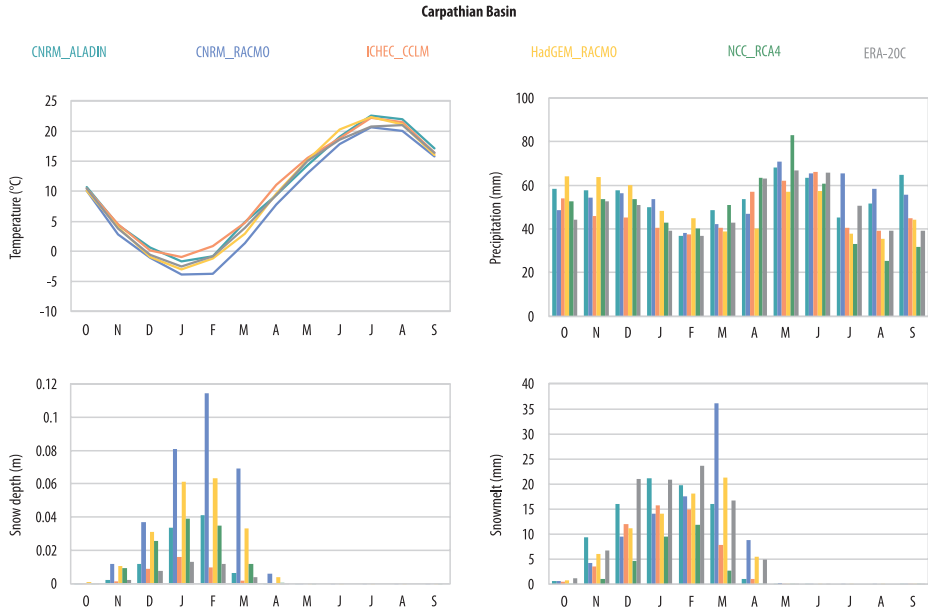


Fig. 4. Mean monthly values of temperature, precipitation, snow depth and snowmelt in the Carpathian Basin in 1971–2000, based on the individual RCM simulations and the ERA-20C database.

processes, as different variables are captured well by different RCMs. However, by using difference between the future and reference periods, climate change can be analysed reliably. Projected relative changes use the values for the reference period (the difference is divided by the reference value), therefore, the overestimation of these base values results in underestimation in the case of snow depth and snowmelt as well. Since bias in the lowlands is lower than in the mountainous regions, the underestimation of projected changes is smaller. So in order to develop appropriate adaptation strategies on regional levels, these projections serve as the least changes to take into account for the corresponding scenario.

Projected temperature and precipitation changes

An increase of mean temperature is projected for all the eight regions based on RCP8.5 (*Figure 5*). The greatest increases (> 5 °C) are simulated for Finland and the Carpathian Basin and it is at least 2 °C in Scandinavia. This may be explained by the Arctic amplification (Zhang, J. 2005). Because of this increase, the mean temperature in the cold season will be above the freezing point in Finland, while it was -4.5 °C in the reference period according to the simulations, so this change may have a significant effect on the length of the snow period. The least warming (< 0.5 °C) is likely to occur in the British Isles where the maritime climate prevails. The mean precipitation sum in the cold season will increase, with the greatest changes in Scandinavia. Former studies (IPCC 2013) also support that there will be more precipitation in northern Europe in the 21st century compared to the reference period.

To conclude, higher temperature and more total precipitation are projected for the future, but the climatic relation of the selected regions compared to each other will remain the same in the cold season. The projected temperature change is significant in every

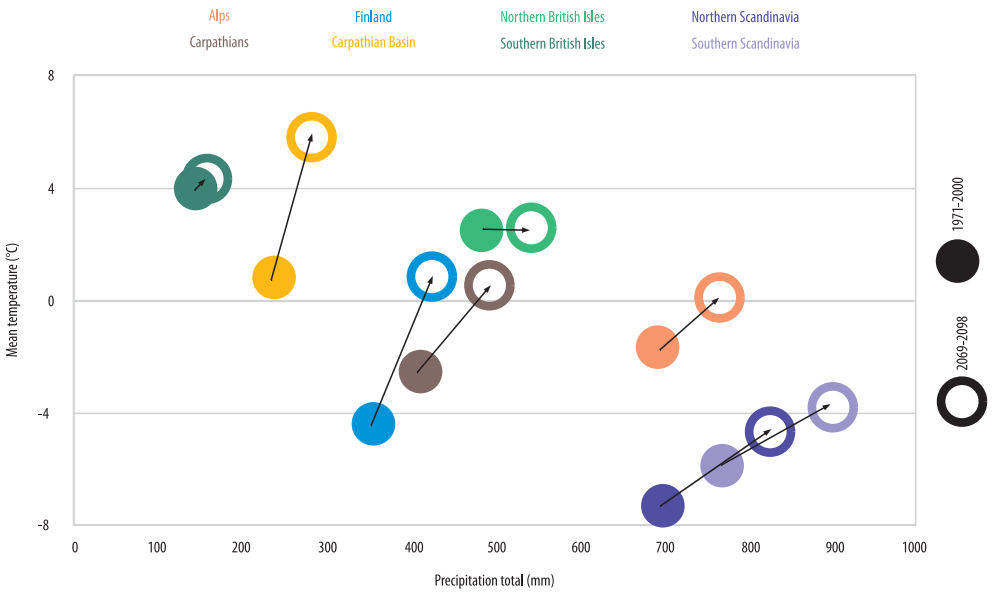


Fig. 5. The mean temperature and the mean precipitation total in the cold season in the reference period (full circles) and at the end of the 21st century (empty circles) based on the multi-model mean of five RCM simulations using the RCP8.5 scenario.

region according to every simulation based on the t-test, but in the case of precipitation there are exceptions. Our results for multi-model means are similar to other studies where more simulations are considered (e.g. Coppola, E. *et al.* 2018).

Projected changes of snow-related parameters

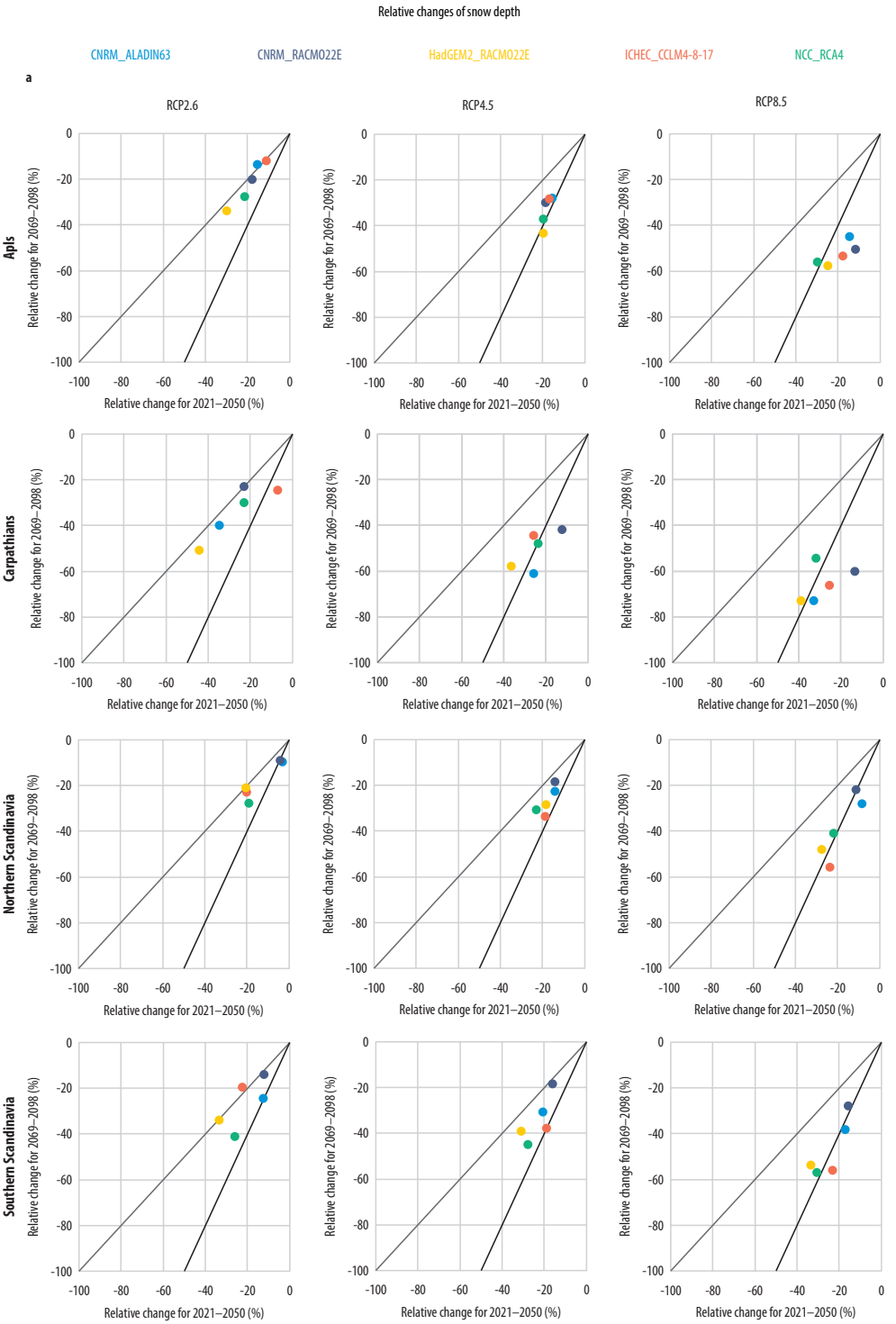
The relative changes of snow depth are analysed for the regions with higher (*Figure 6*, a) and lower elevation (*Figure 6*, b) for the cold season. One dot represents one specific RCM simulation, which shows the mean change in the cold season. According to global climate model (GCM) simulations, in general, snowfall is likely to be less in the 21st century (e.g. Krasting, J.P. *et al.* 2013; O'Gorman, P.A. 2014), however, at higher elevations an increase may occur both in annual snowfall (Krasting, J.P. *et al.* 2013) and in snow depth (Li, Y. *et al.* 2019), but the latter one is more limited because of the enhanced melting (Raisanen, J. 2008).

The changes are usually more pronounced for 2069–2098, especially in the case of RCP4.5 and RCP8.5. In the case of RCP2.6, the projected changes for the two time slices are quite similar, as this scenario assumes relatively stable radiative forcing during the 21st century. It is clear that the higher the emission, the greater and the more accelerated the decrease of snow depth by the end of the 21st century on average. This is reasonable, as the higher the radiative forcing, the higher the temperature, which has an important role in forming precipitation and in snow-melting processes, which also determines snow depth. The changes are mostly significant, with a few exceptions especially in the case of RCP2.6, in 2021–2050.

In the Alps, the RCM simulations and the projected changes for the different months are close to each other and the uncertainty related to the choice of the model is quite low, which could be a consequence of detailed sensitivity studies for this region resulting in calibrating the parametrisation constants according to this region. The greatest average decreases, which exceeds 60 percent by the end of the 21st century, are projected for the British Isles, the Carpathian Basin and Finland, i.e. over the regions with the mid-elevations and over lowlands, where generally warmer conditions dominate. In the Scandinavian regions, the RCM simulations show that the projected decrease for 2021–2050 and 2069–2098 are 4–41 percent on average according to the RCP2.6 scenario, while the mean changes simulated for the end of the 21st century are -22 – -57 percent in the case of RCP8.5. Overall, topography plays an important role in snow depth changes as less snow accumulates in lower elevated regions compared to mountains.

The relative changes of snow cover are also analysed for the cold season. The greatest average decrease (86%) is projected for the period 2069–2098 in the Carpathian Basin and in the southern British Isles, representing the warmest areas among the eight selected regions of this study. The smallest (< 12%) changes, based on the multi-model mean, are simulated for the coldest, Scandinavian regions, in the case of RCP2.6 and RCP4.5. Considering the average changes in the cold season, most of the simulations show significant changes in the case of RCP4.5 and RCP8.5.

The annual distribution of regionally averaged snow cover and snowmelt are presented in *Figure 7* based on the multi-model mean. A threshold of 5 percent in the case of snow cover and 15 mm in the case of snowmelt was introduced in order to filter small values, therefore, in the Carpathian Basin snowmelt (> 15 mm/month) occurs only in the historical period, in February and March. Snowmelt will occur earlier within the year (in 2069–2098 taking into account the RCP8.5 scenarios most changes are significant). Under the RCP8.5 scenario, the snowmelt period starts even in the winter months in southern Scandinavia, so in addition to general snow accumulation, melting may already start in the coldest part of the year by the end of the 21st century. We also note that in the historical period snowmelt occurred in Finland between March and May, but due to climate change, it will shift to sub-


Relative changes of snow depth
CNRM_ALADIN63
CNRM_RACMO22E
HadGEM2_RACMO22E
ICHEC_CCLM4-8-17
NCC_RCA4
a
RCP2.6
RCP4.5
RCP8.5
Alps
Carpathians
Northern Scandinavia
Southern Scandinavia
Relative change for 2069–2098 (%)
Relative change for 2021–2050 (%)
0
-20
-40
-60
-80
-100

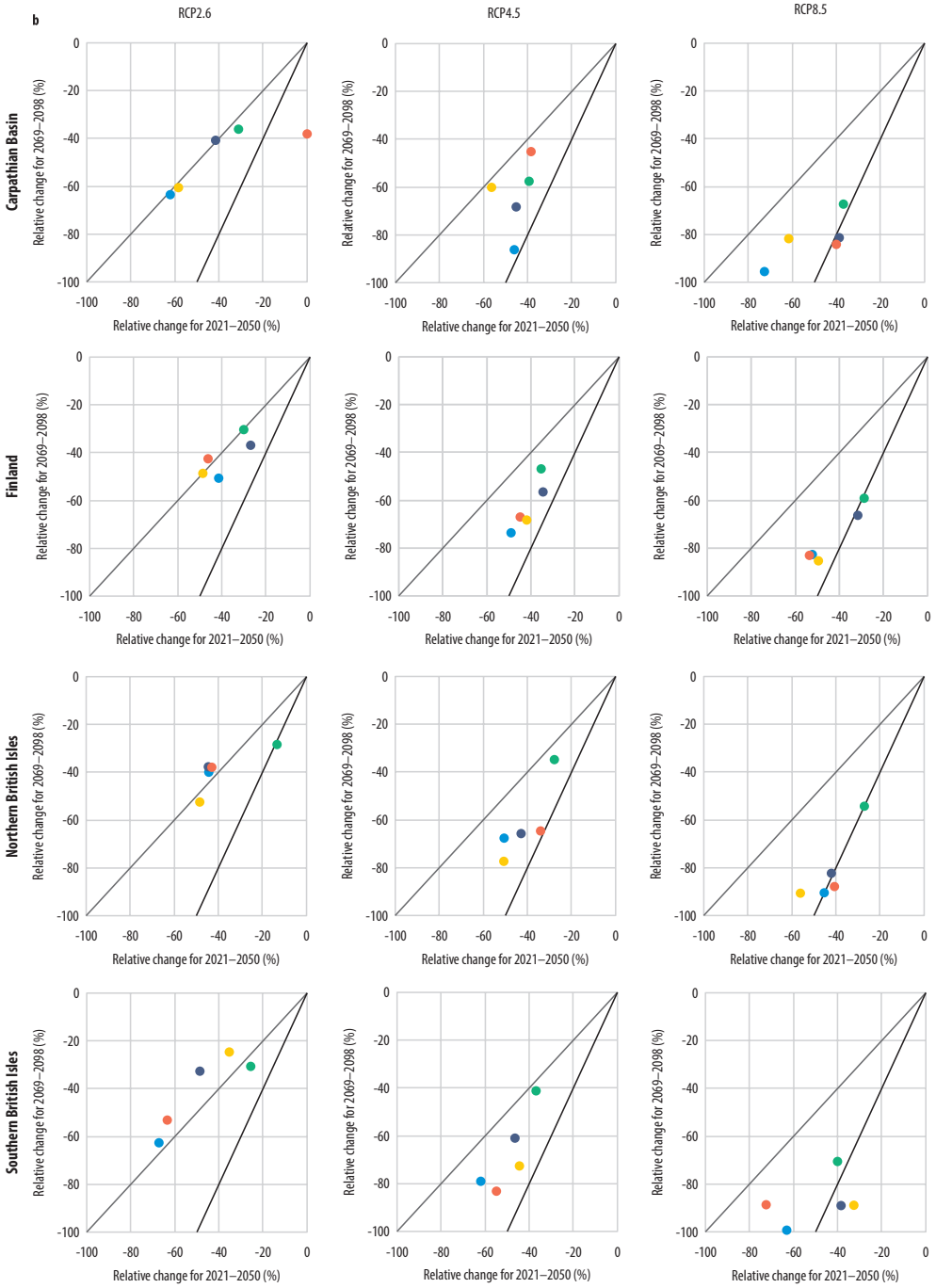


Fig. 6a.,b. Relative changes of monthly mean snow depth in the cold season taking into account the three different RCP scenarios. The different colours indicate different RCM-simulations. The solid dark grey lines show when the relative changes for 2069–2098 are the double of the relative changes for 2021–2050. The light grey lines indicate no change from the mid- to the late-21st century.

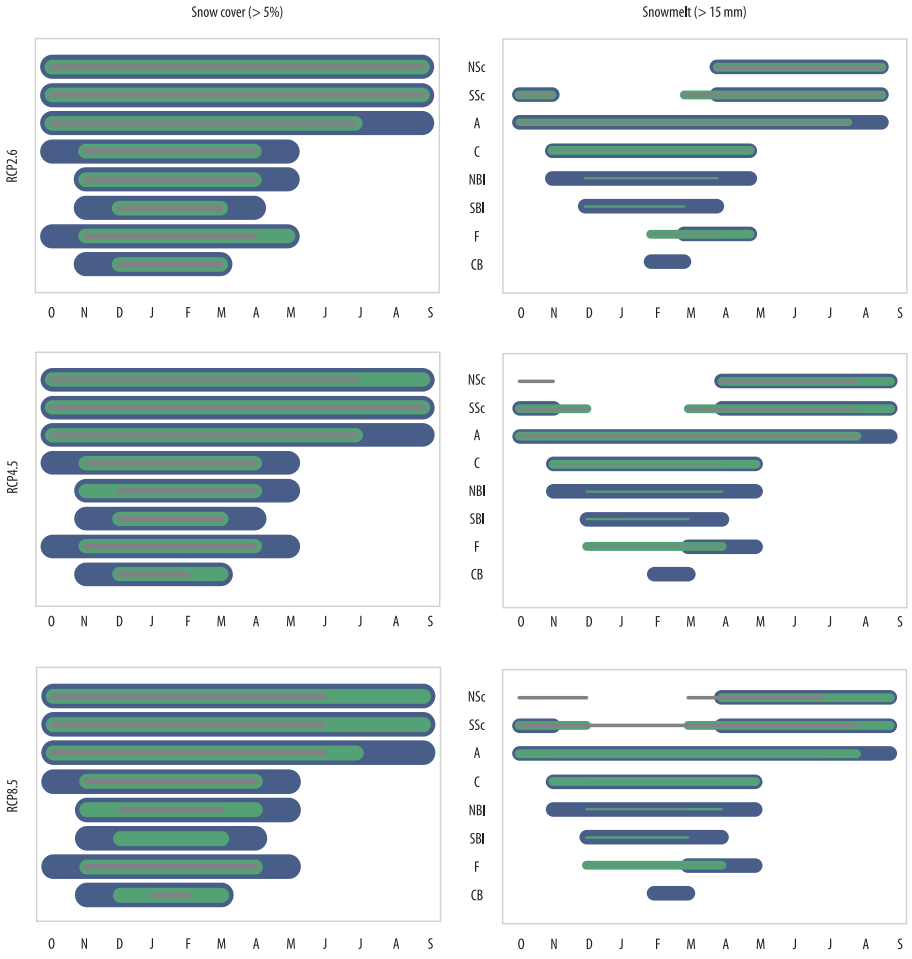


Fig. 7. The length of the period when snow cover exceeds 5 percent and snowmelt exceeds 15 mm/month in 1971–2000 (dark blue), 2021–2050 (green) and 2069–2098 (grey) based on the multi-model mean for the different regions in the case of the three RCP scenarios. (Corresponding abbreviations for the regions are shown in *Fig. 1.*)

stantially earlier within the hydrological year. In the case of RCP2.6 it is only a one-month shift, but RCP4.5 and RCP8.5 project the start of snowmelt already for December by the middle and the end of the 21st century (naturally, this does not imply that all the snow melts in this month). In the Alps, the snowmelt period will be shorter, which is in line with the results of the multi-model simulations, namely, the snow cover period will also become shorter. Coppola, E. *et al.* (2018) found that snowmelt-driven runoff is shifted earlier in the year because of higher temperature values, which results in earlier snowmelt in the Alpine region. A shift in peak runoff may have severe effects on water supply in certain regions, as the highest demand occurs in summer and autumn (Barnett, T.P. *et al.* 2005).

The greatest changes in snow cover are projected for the end of the 21st century taking into account the RCP8.5 scenario with the greatest radiative force change. Snow cover will be less than 5 percent from June to September in the Scandinavian regions,

while the exceedance of the 5 percent threshold totally disappears in the maritime climate dominating in the southern British Isles. Changes similar to those in Scandinavia are projected for the Alps as well, which is in line with former investigations focusing on this domain, as less snowfall is likely to occur in the future (Soncini, A. and Bocchiola, D. 2011; Piazza, M. *et al.* 2014; Schmucki, E. *et al.* 2017), especially in low-elevation areas (Frei, P. *et al.* 2018), furthermore, the simulated higher temperatures enhance snowmelt, which results in the decrease of snow (Raisanen, J. 2016).

In Finland, markedly shorter periods with more than 5 percent snow cover are projected for the future compared to the historical period. Shifts can be recognised for the future in the Carpathian Basin, where the multi-model mean of the simulations shows that it occurred from November to March in the historical period. For 2021–2050, according to RCP2.6 and RCP4.5, a later onset of snow coverage (December or January) is projected. If the RCP8.5 is taken into account, a substantial reduction is projected by the late-century (the snow cover period covers only January–February).

The period when snow cover exceeds 5 percent will start later in all regions, except for Scandinavia and the Alps, where only the end of this period shifts. This may be related to that, despite the warming trend, due to the boreal and mountainous conditions, it will be cold enough even in October (to favour snow formation) in these regions. In addition, if our analysis used daily data instead of monthly values, a delay in the start probably would appear in these two regions as well. The greatest decrease appears in those regions where a warmer climate can be found, i.e. the continental Carpathian Basin and maritime British Isles.

The length of periods when snow cover exceeds 70 percent (as representing a substantial coverage) is presented in *Figure 8*. Only five out of the eight regions are shown in this case, as in the Carpathian Basin and in the British Isles the multi-model mean of simulated snow cover always remains below

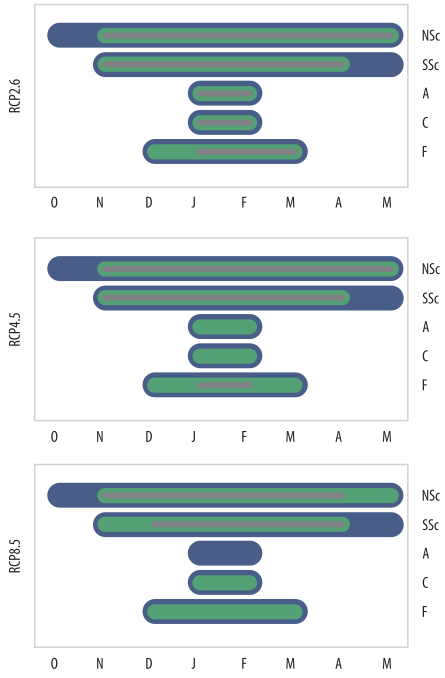


Fig. 8. The length of the period when snow cover exceeds 70 percent in 1971–2000 (dark blue), 2021–2050 (green) and 2069–2098 (grey) based on the multi-model mean for the different regions in the case of the three RCP scenarios. (Corresponding abbreviations for the regions are shown in *Fig. 1.*)

70 percent in the investigated time periods. This quite high threshold gives the potential e.g. for skiing, which is one of the most important determining factors for winter tourism, and the economic consequences highlight the key role of such analyses. Several studies showed (e.g. Breiling, M. and Charamza, P. 1999; Elsasser, H. and Messerli, P. 2001; Hopkins, D. and Maclean, K. 2014; Damm, A. *et al.* 2014, 2016; Haanpää, S. *et al.* 2015; Demiroglu, O.C. *et al.* 2018) and our results also underpin that climate change may have a negative effect on skiing, winter sports and tourism, hence adaptation will be necessary to sustain these activities. According to RCP8.5, by the end of the 21st century, substantial snow cover will be only

in the Scandinavian regions. In the case of RCP2.6 and RCP4.5, a one-month shorter snow cover period exceeding 70 percent is simulated both in northern and southern Scandinavia. A one-month shrinkage is projected for boreal Finland also taking into account RCP2.6, while in the case of RCP4.5 snow coverage will exceed 70 percent only in January and February by the end of the 21st century; in the historical period it lasted from December to March. In the Alps and the Carpathians, snow cover will be less than the critical threshold value by the end of the 21st century (except for RCP2.6), and in the Alps already for 2021–2050 in case of the RCP8.5 scenario. Most of the changes are significant, especially in 2069–2098.

In the following, two regions are highlighted where skiing and winter tourism represents an important sector: the Alps (Becken, S. and Hay, J.E. 2007) and southern Scandinavia (https://archive.nordregio.se/en/Maps/09-Other/Major-winter-resorts-in-Scandinavia/). In *Figure 9* (Alps) and *Figure 10* (southern Scandinavia) the changes of the 10th, 50th and 90th percentiles of snow depth are shown for 2069–2098 compared to the median of 1971–2000 taking into account the RCP2.6 and RCP8.5 scenarios. As the different RCM simulations are shown here (indicated by different colours), not only the multi-model mean, but the range of the RCM simulations can be assessed, too. The greatest changes (which are clearly higher in the case of RCP8.5 compared to RCP2.6) on average are projected for the late cold season, i.e. March and April in the two selected regions, when there is more snow and, thus, greater changes are possible. The 10th and 50th percentiles of snow depth show decrease in every month according to every RCM simulation, but we note that in the case of RCP2.6 these changes are small in the Alps in the ICHEC_CCLM4-8-17 simulation. In the case of RCP2.6, the 90th percentile of snow depth will increase, but under the RCP8.5 scenario, almost all simulations show a decrease, especially in the Alps. Comparing the two presented regions, the greatest changes are projected for southern Scandinavia, which may be connected to that the mean temperature of the cold period will increase by more than 2.1 °C according to the simulations, while in the Alps it is under 1.8 °C. The changes of the difference between the 10th and 90th percentiles were also investigated. We found that overall this range is projected to be somewhat smaller, especially in the Alps. In the southern Scandinavian region there are some months (in late-winter and early-spring), when an increase occurs, mainly in the case of the CNRM_RACMO22E simulations. The decrease of this inter-percentile range indicates that the inter-annual variability of individual months is also likely to decrease.

Sources of uncertainty

The relative role of the three main sources of uncertainty is calculated for each month, variable and region. In *Figures 11* and *12* the maximum value of the y-axis (1.0) is the sum of the range of inter-annual variability of individual months (the effect of internal variability on 30-year mean values would be much smaller), the range between models and the range between scenarios. Overall, the choice of the RCP scenario has the smallest (< 25%) importance (see *Figure 11*). In general, snow depth depends on internal variability more than the other two factors, especially in the continental, Carpathian regions. However, in the Alps from December to March, the internal variability and the choice of the model plays an equally important role in uncertainty, as well as in Scandinavia in January and February. In the Scandinavian regions the relative importance of the RCP scenario is greater in October, November and April compared to the period from December to March.

In the Alps and the Carpathians, snow depth and snow coverage showed greater dependence on the RCP scenario than in the case of snowmelt (see *Figure 12*). In Finland and in the Carpathians the scenario's importance increases in April and May (14–17%) as the radiative forcing's effect clearly determines temperature, which plays a key role in snowmelt processes. Comparing the regions, the great-

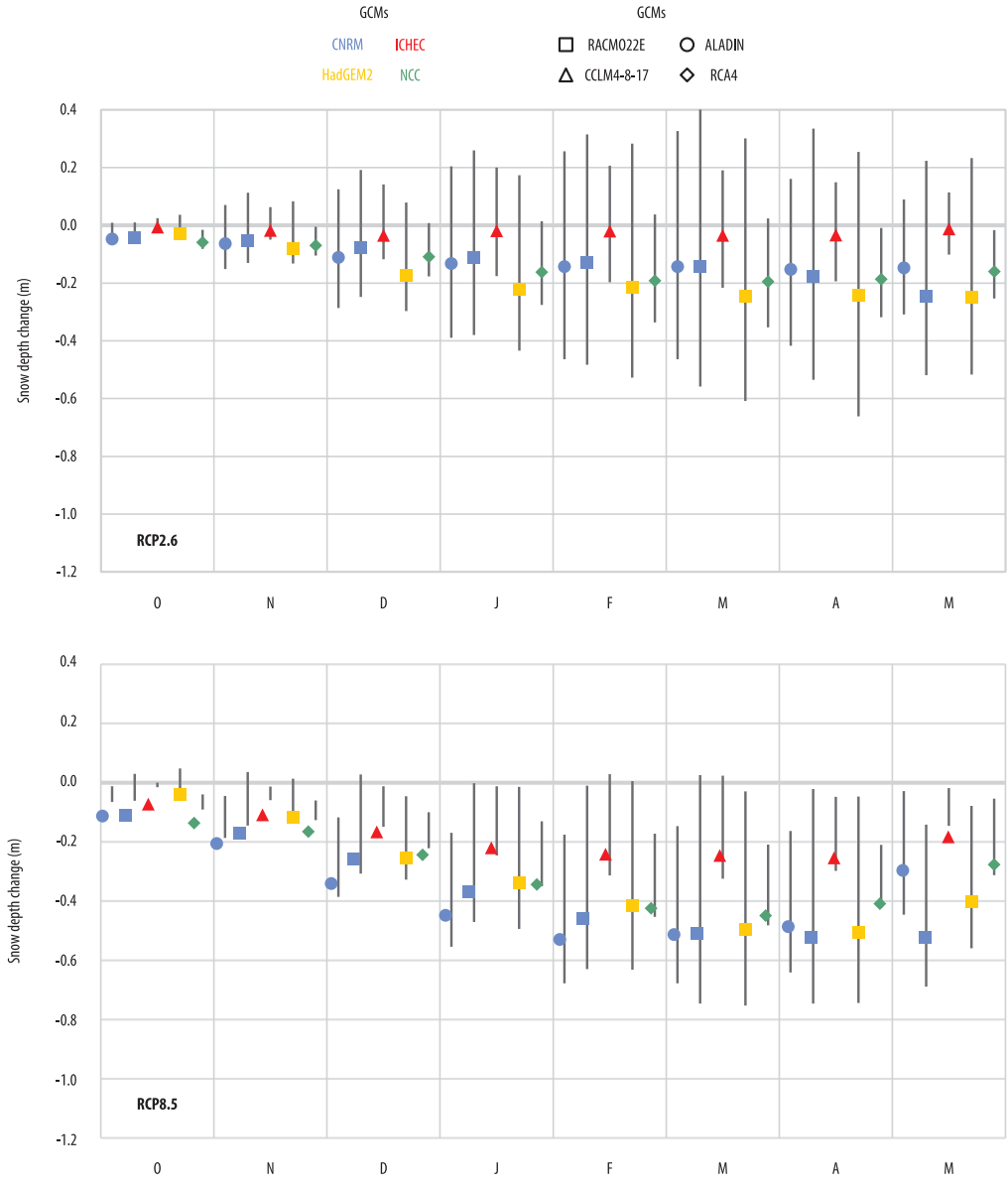


Fig. 9. The 10th, 50th and 90th percentiles of simulated snow depth changes for 2069–2098 compared to the median values (the 50th percentiles) of 1971–2000 taking into account RCP2.6 (top) and RCP8.5 (bottom) in the Alps. The vertical lines represent the interval between the 10th and 90th percentiles of projected changes, while the symbols refer to the changes of the 50th percentile. The different colours (symbols) indicate different GCMs (RCMs).

est role of the scenario occurs in Scandinavia. In the case of snow related simulations, the choice of the model has a greater role in the mountainous areas (e.g. snow depth and snow cover in the Alps or snowmelt in southern Scandinavia), while evaluation showed that the overall goodness of simulating precipitation depends on topography.

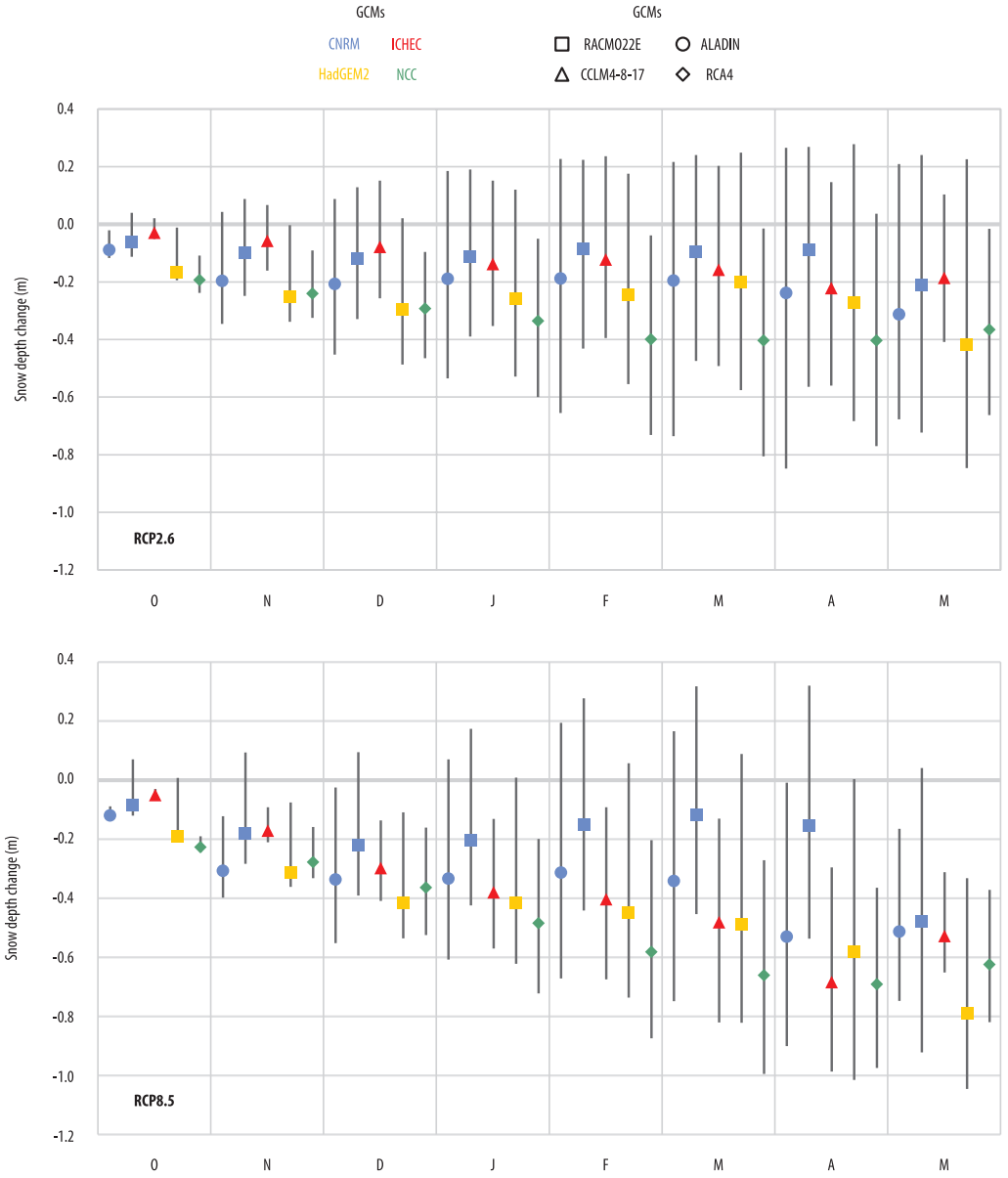


Fig. 10. The 10th, 50th and 90th percentiles of simulated snow depth changes for 2069–2098 compared to the median values (the 50th percentiles) of 1971–2000 taking into account RCP2.6 (top) and RCP8.5 (bottom) in southern Scandinavia. The vertical lines represent the interval between the 10th and 90th percentiles of projected changes, while the symbols refer to the changes of the 50th percentile. The different colours (symbols) indicate different GCMs (RCMs).

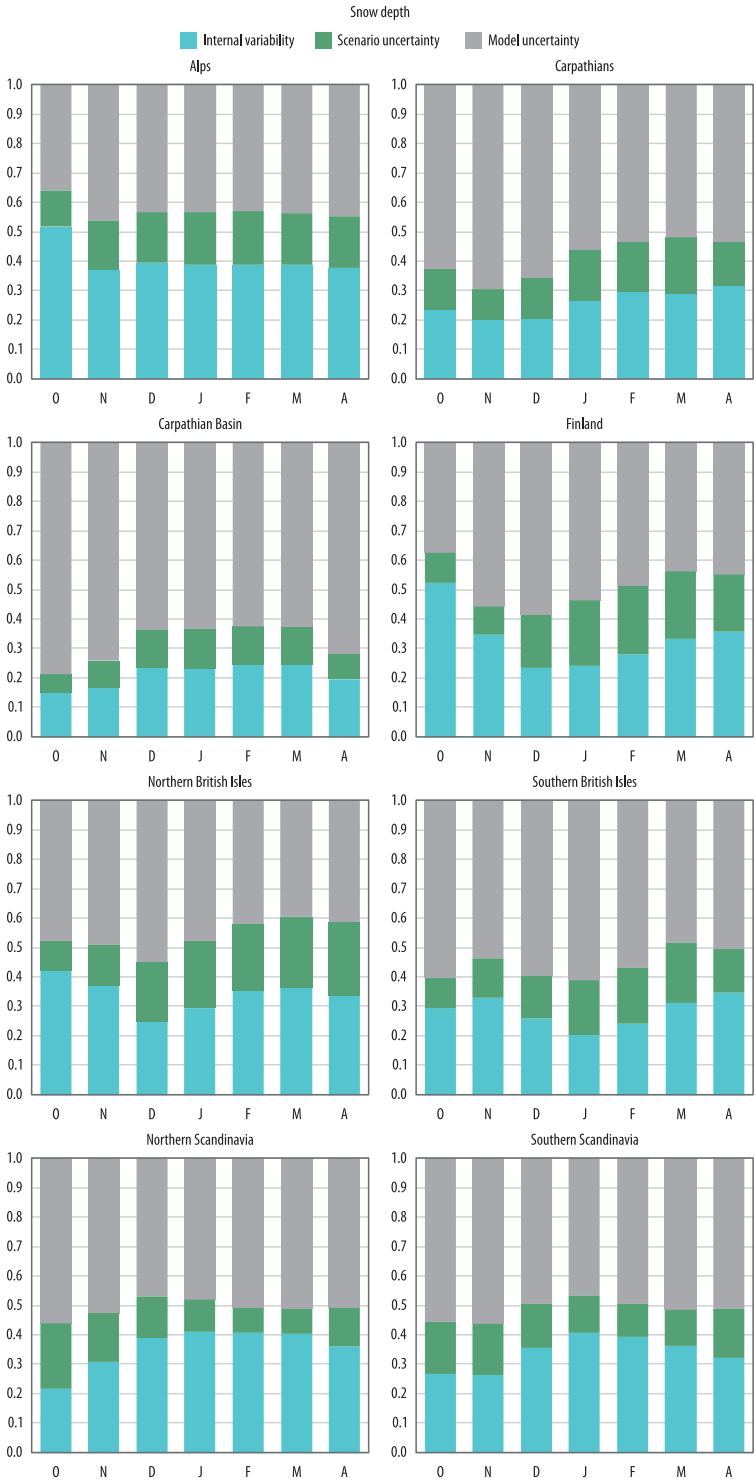


Fig. 11. The relative importance of the so-urces of uncertainty in the simulations of snow depth on a monthly scale for each region, projection by 2069–2098 compared to 1971–2000. The ma-ximum value of the y-axis (1.0) is the sum of the range of inter-annual variability of individual months, the range between models and the range between scenarios.

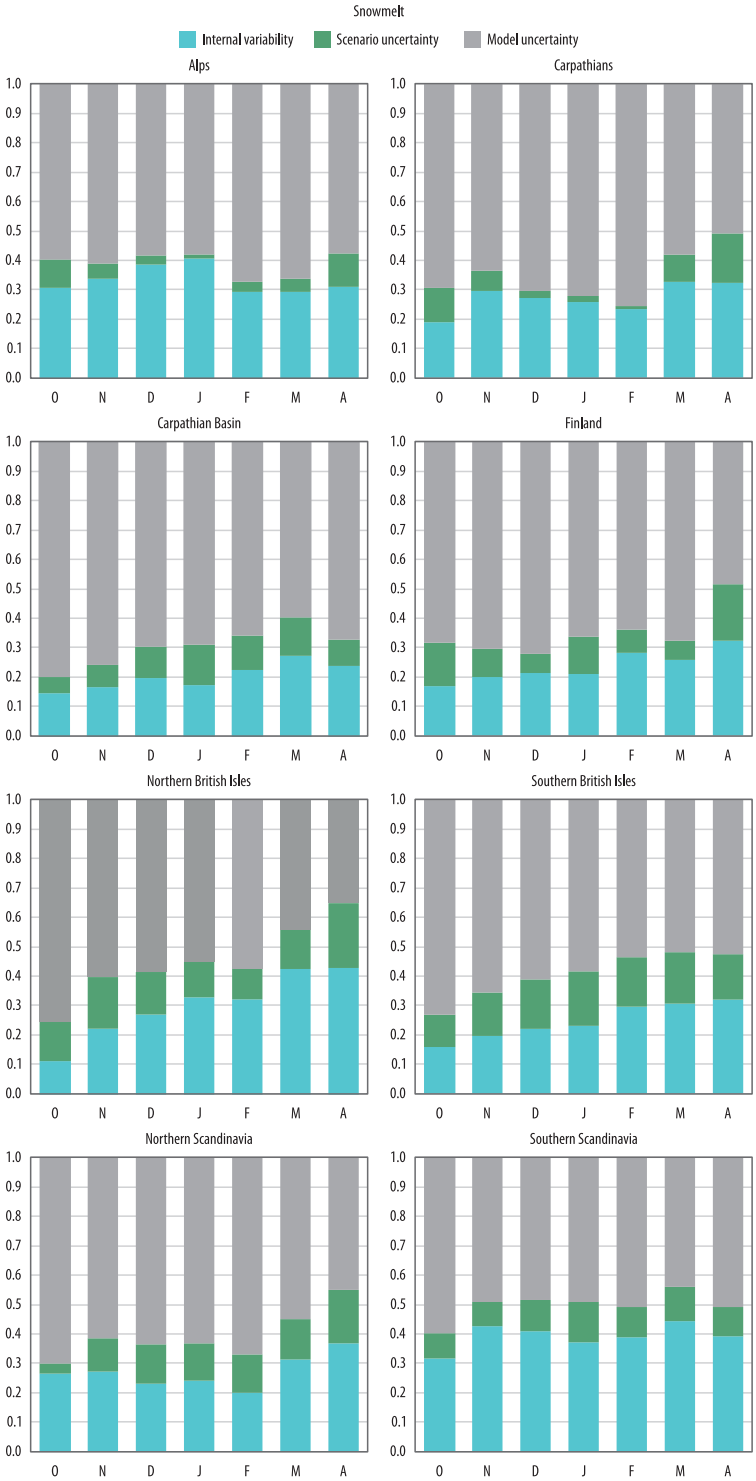


Fig. 12. The relative importance of the sources of uncertainty in the simulations of snowmelt on a monthly scale for each region, projection by 2069–2098 compared to 1971–2000. The maximum value of the y-axis (1.0) is the sum of the range of inter-annual variability of individual months, the range between models and the range between scenarios.

Conclusions

Snow-related variables are analysed in this study based on EURO-CORDEX simulations focusing on eight sub-regions within Europe. These selected regions can be characterised by different climatic conditions, namely, maritime, continental and boreal. Three RCP scenarios were taken into account in order to compare the effects of mitigation.

Based on our investigation, the following conclusions can be made:

- Compared to the internal variability and the choice of the RCM, the selection of the scenario has a smaller role in the uncertainty of projections.
- For the future time periods both the mean temperature and precipitation total will increase in the cold season in the selected regions according to the multi-model mean of the RCM simulations. The greatest temperature increase is projected for the boreal regions, which can be related to arctic amplification.
- Snow depth is likely to be less in the future: the higher the radiative forcing, the more the relative change of snow depth. The changes are not linear, i.e. the projected change is greater by the end of the 21st century compared to the period 2021–2050. The greatest relative changes are likely to occur in maritime British Isles and the lowland areas.
- Snowmelt is projected to start earlier within the year in most regions, it may already start in the winter months in Scandinavia for instance.
- Under the RCP8.5 scenario, substantial snow cover (> 70%) will be present only in the Scandinavian regions by the late century.

On the one hand, the projected increase of winter precipitation in Europe, except for the Mediterranean area (IPCC 2021), may lead to more snowfall, on the other hand, the fraction of snow may decrease due to rising temperatures, which also enhance snowmelt. Our results indicate a decreasing trend in snow-related parameters, which is in good agreement with former studies. For example, in northern Europe a decrease in snowfall is likely to occur, except for the coldest areas, where an increase is projected (Raisanen, J. 2016).

Furthermore, because of the later start of the snowfall season and the increased snowmelt, snow amount is also likely to decrease (Raisanen, J. 2016). De Vries, H. *et al.* (2013, 2014) investigated snowfall on Hellmann days (i.e. when the daily mean temperature is below freezing) in western, central and northern Europe and found that it is likely to decrease by 20–50 percent (a decrease of the frequency of Hellmann days is also projected, by about 75%) by the end of the 21st century; however, at higher elevations the change is not significant. Not only in Europe, but also in America, a decrease in the values of snow-related parameters is likely to occur in general (e.g. Xu, Y. *et al.* 2019; McCrary, R.R. *et al.* 2022), which may result in altered runoff conditions (Rauscher, S.A. *et al.* 2008) and a series of hydrologic changes like surface and subsurface water storage or streamflow (Siirila-Woodburn, E.R. *et al.* 2021).

Skiing and winter tourism will be impossible in regions located more to the south, or these sectors will have to face great challenges and find adaptation strategies to the changing climatic conditions (e.g. Damm, A. *et al.* 2014; Joksimovic, M. *et al.* 2018; Moreno-Gené, J. *et al.* 2018; Spandre, P. *et al.* 2019). Even if snow management, i.e. snowmaking, is carried out, then certain weather conditions are still necessary: it has to be sufficiently cold, the wind speed should not be too high and the wet bulb temperature also has an impact (Morin, S. *et al.* 2021). The decrease of snow-related parameters has several critical effects on other processes (e.g. energy budget, evaporation, floods) and sectors (e.g. water management, agriculture, forestry, energy supply) as well, so mitigation of climate change should be a paramount goal.

Acknowledgement: Research leading to this paper was supported by the following sources: the Hungarian National Research, Development and Innovation Fund under grants K-129162 and PD138023, and the National Multidisciplinary Laboratory for Climate Change (RRF-2.3.1-21-2022-00014). Furthermore, we thank the CORDEX program for the regional climate model simulations, and the ECMWF for compiling the ERA-20C and making it available.

REFERENCES

Barnett, T.P., Adam, J.C. and Lettenmaier, D.P. 2005. Potential impacts of a warming climate on water availability in snow-dominated regions. *Nature* 438. 303–309. Available at https://doi.org/10.1038/nature04141

Becken, S. and Hay, J.E. 2007. *Tourism and Climate Change: Risks and Opportunities*. Clevedon, Channel View Publication.

Breiling, M. and Charamza, P. 1999. The impact of global warming on winter tourism and skiing: a regionalised model for Austrian snow conditions. *Regional Environmental Change* 1. 4–14. Available at https://doi.org/10.1007/s101130050003

Brown, I. 2019. Snow cover duration and extent for Great Britain in a changing climate: Altitudinal variations and synoptic-scale influences. *International Journal of Climatology* 39. 4611–4626. Available at https://doi.org/10.1002/joc.6090

Coppola, E., Raffaele, F. and Giorgi, F. 2018. Impact of climate change on snow melt driven runoff timing over the Alpine region. *Climate Dynamics* 51. 1259–1273. Available at https://doi.org/10.1007/s00382-016-3331-0

Damm, A., Köberl, J. and Prettenthaler, F. 2014. Does artificial snow production pay under future climate conditions? A case study for a vulnerable ski area in Austria. *Tourism Management* 43. 8–21. Available at https://doi.org/10.1016/j.tourman.2014.01.009

Damm, A., Greuell, W., Landgren, O. and Prettenthaler, F. 2016. Impacts of +2 °C global warming on winter tourism demand in Europe. *Climate Services* 7. 31–46. Available at https://doi.org/10.1016/j.cliser.2016.07.003

Demiroglu, O.C., Dannevig, H. and Aall, C. 2018. Climate change acknowledgement and responses of summer (glacier) ski visitors in Norway. *Scandinavian Journal of Hospitality and Tourism* 18. (4): 419–438. Available at https://doi.org/10.1080/15022250.2018.1522721

De Vries, H., Haarsma, R.J. and Hazeleger, W. 2013. On the future reduction of snowfall in western and central Europe. *Climate Dynamics* 41. 2319–2330. Available at Available at https://doi.org/10.1007/s00382-012-1583-x

De Vries, H., Lenderink, G. and van Meijgaard, E. 2014. Future snowfall in western and central Europe projected with a high-resolution regional climate model ensemble. *Geophysical Research Letters* 41. 4294–4299. Available at https://doi.org/10.1002/2014GL059724

Elsasser, H. and Messerli, P. 2001. The vulnerability of the snow industry in the Swiss Alps. *Mountain Research and Development* 21. (4): 335–339. Available at https://doi.org/10.1659/0276-4741(2001)021[0335:TVOTSI]2.0.CO;2

Fontrodona Bach, A., van der Schrier, G., Melsen, L.A., Klein Tank, A.M.G. and Teuling, A.J. 2018. Widespread and accelerated decrease of observed mean and extreme snow depth over Europe. *Geophysical Research Letters* 45. 12312–12319. Available at https://doi.org/10.1029/2018GL079799

Frei, P., Kotlarski, S., Liniger, M.A. and Schar, C. 2018. Future snowfall in the Alps: projections based on the EURO-CORDEX regional climate models. *The Cryosphere* 12. 1–24. Available at https://doi.org/10.5194/tc-12-1-2018

Haanpää, S., Juhola, S. and Landauer, M. 2015. Adapting to climate change: Perceptions of vulnerability of down-hill ski area operators in Southern and Middle Finland. *Current Issues in Tourism* 18. (10): 966–978. Available at https://doi.org/10.1080/13683500.2014.892917

Harpold, A.A., Molotch, N.P., Musselman, K.N., Bales, R.C., Kirchner, P.B., Litvak, M. and Brooks, P.D. 2015. Soil moisture response to snowmelt timing in mixed-conifer subalpine forests. *Hydrological Processes* 29. 2782–2798. Available at https://doi.org/10.1002/hyp.10400

Hawkins, E. and Sutton, R. 2009. The potential to narrow uncertainty in regional climate predictions. *Bulletin of the American Meteorological Society* 90. (8): 1095–1108. Available at https://doi.org/10.1175/2009BAMS2607.1

Hopkins, D. and Maclean, K. 2014. Climate change perceptions and responses in Scotland's ski industry. *Tourism Geographies* 16. (3): 400–414. Available at https://doi.org/10.1080/14616688.2013.823457

IPCC 2013. Collins, M., Knutti, R., Arblaster, J., Dufresne, J.-L., Fichefet, T., Friedlingstein, P., Gao, X., Gutowski, W.J., Johns, T., Krinner, G., Shongwe, M., Tebaldi, C., Weaver, A.J. and Wehner, M. 2013. Long-term climate change: Projections, commitments and irreversibility. In *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Eds.: Stocker, T.F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S.K., Boschung, J., Nauels, A., Xia, Y., Bex, V. and Midgley, P.M., Cambridge, UK and New York, USA, Cambridge University Press.

IPCC 2019. *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate.* Eds.: Pörtner, H.-O., Roberts, D.C., Masson-Delmotte, V., Zhai, P., Tignor, M., Poloczanska, E., Mintenbeck, K., Alegría, A., Nicolai, M., Okem, A., Petzold, J., Rama B. and Weyer, N.M., Cambridge, UK and New York, USA, Cambridge University Press.

IPCC 2021. Summary for policymakers. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Eds.: Masson-Delmotte, V., Zhai, P., Pirani, A.,

Connors, S.L., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M.I., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J.B.R., Maycock, T.K., Waterfield, T., Yelekçi, O., Yu, R. and Zhou, B., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 3–32, Doi:10.1017/9781009157896.001

Jacob, D., Petersen, J., Eggert, B., Alias, A., Christensen, O.B., Bouwer, L.M., Braun, A., Colette, A., Déqué, M., Georgievski, G., Georgopoulou, E., Gobiet, A., Menut, L., Nikulin, G., Haensler, A., Hempelmann, N., Jones, C., Keuler, K., Kovats, S., Kröner, N., Kotlarski, S., Kriegsmann, A., Martin, E., van Meijgaard, E., Moseley, C., Pfeifer, S., Preuschmann, S., Radermacher, C., Radtke, K., Rechid, D., Rounsevell, M., Samuelsson, P., Somot, S., Soussana, J-F., Teichmann, C., Valentini, R., Vautard, R., Weber, B. and Yiou, P. 2014. EURO-CORDEX: New high-resolution climate change projections for European impact research. *Regional Environmental Change* 14. 563–578. Available at https://doi.org/10.1007/s10113-013-0499-2

Jeong, D.I. and Sushama, L. 2018. Projected changes to extreme wind and snow environmental loads for buildings and infrastructure across Canada. *Sustain Cities and Society* 36. 225–236. Available at http://dx.doi.org/10.1016/j.scs.2017.10.004

Joksimovic, M., Sabic, D., Vujdinovic, S., Golic, R. and Gajic, M. 2018. Duration of the snow cover and the need for artificial snow – A challenge for management in ski-centres of Serbia. In *Climate Change Adaptation in Eastern Europe*. Eds.: Filho, W.L., Trbic, G. and Filipovic, D., Cham, Springer. Available at https://doi.org/10.1007/978-3-030-03383-5_10

Kis, A. and Pongrácz, R. 2021. The role of temperature and the NAO index in the changing snow-related variables in European regions in the period 1900–2010. *Hungarian Geographical Bulletin* 70. (4): 325–337. Doi: 10.15201/hungeobull.70.4.3

Kitzberger, T., Falk, D.A., Westerling, A. and Swetnam, T.W. 2017. Direct and indirect climate controls predict heterogeneous early-mid 21st century wildfire burned area across western and boreal North America. *PLoS One* 12. (12): e0188486. Available at https://doi.org/10.1371/journal.pone.0188486

Klein, G., Vitasse, Y., Rixen, C., Marty, C. and Rebetez, M. 2016. Shorter snow cover duration since 1970 in the Swiss Alps due to earlier snowmelt more than to later snow onset. *Climatic Change* 139. 637–649. Available at https://doi.org/10.1007/s10584-016-1806-y

Krasting, J.P., Broccoli, A.J., Dixon, K.W. and Lanzante, J.R. 2013. Future changes in Northern Hemisphere snowfall. *Journal of Climate* 26. 7813–7828. Available at https://doi.org/10.1175/JCLI-D-12-00832.1

Li, Y., Tao, H., Su, B., Kundewicz, Z.W. and Jiang, T. 2019. Impacts of 1.5 °C and 2 °C global warming on winter snow depth in Central Asia. *Science of the Total Environment* 651. 2866–2873. Available at https://doi.org/10.1016/j.scitotenv.2018.10.126

Marke, T., Hanzer, F., Olefs, M. and Strasser, U. 2018. Simulation of past changes in the Austrian snow cover 1948–2009. *Journal of Hydrometeorology* 19. 1529–1545. Available at https://doi.org/10.1175/JHM-D-17-0245.1

Matiu, M., Petitta, M., Notarnicola, C. and Zebisch, M. 2020. Evaluating snow in EURO-CORDEX regional climate models with observations for the European Alps: Biases and their relationship to orography, temperature, and precipitation mismatches. *Atmosphere* 11. 46. Available at https://doi.org/10.3390/atmos11010046

McCrary, R.R., Mearns, L.O., Hughes, M., Biner, S. and Bukovsky, M.S. 2022. Projections of North American snow from NA-CORDEX and their uncertainties, with a focus on model resolution. *Climatic Change* 170. 20. Available at https://doi.org/10.1007/s10584-021-03294-8

Moreno-Gené, J., Sánchez-Pulido, L., Cristobal-Fransi, E. and Daries, N. 2018. The economic sustainability of snow tourism: The case of ski resorts in Austria, France, and Italy. *Sustainability* 10. (9): 3012. Available at https://doi.org/10.3390/su10093012

Morin, S., Smscoits, R., Francois, H., Carmagnola, C.M., Abegg, B., Demiroglu, O.C., Pons, M., Soubeyroux, J-M., Lafayesse, M., Franklin, S., Griffiths, G., Kite, D., Hoppler, A.A., George, E., Buontempo, C., Almond, S., Dubois, G. and Cauchy, A. 2021. Pan-European meteorological and snow indicators of climate change impact on ski tourism. *Climatic Services* 22. 100215. Available at https://doi.org/10.1016/j.cliser.2021.100215

Mudryk, L., Santolaria-Otín, M., Krinner, G., Ménégoz, M., Derksen, C., Brutel-Vuilmet, C., Brady, M. and Essery, R. 2020. Historical Northern Hemisphere snow cover trends and projected changes in the CMIP6 multi-model ensemble. *The Cryosphere* 14. 2495–2514. Available at https://doi.org/10.5194/tc-14-2495-2020

Neto, A.A.M., Niu, G-Y., Roy, T., Tyler, S. and Troch, P.A. 2020. Interactions between snow cover and evaporation lead to higher sensitivity of streamflow to temperature. *Communications Earth and Environment* 1. 56. Available at https://doi.org/10.1038/s43247-020-00056-9

Notarnicola, C. 2020. Hotspots of snow cover changes in global mountain regions over 2000–2018. *Remote Sensing of Environment* 243. 111781. Available at https://doi.org/10.1016/j.rse.2020.111781

O'Gorman, P.A. 2014. Contrasting responses of mean and extreme snowfall to climate change. *Nature* 512. 416–418. Available at https://doi.org/10.1038/nature13625

Peng, S., Piao, S., Ciais, P., Fang, J. and Wang, X. 2010. Change in winter snow depth and its impacts on vegetation in China. *Global Change Biology* 16. 3004–3013. Available at https://doi.org/10.1111/j.1365-2486.2010.02210.x

Piazza, M., Boé, J., Terray, L., Pagé, C., Sanchez-Gomez, E. and Déqué, M. 2014. Projected 21st century snowfall changes over the French Alps and related uncertainties. *Climatic Change* 122. 583–594. Available at https://doi.org/10.1007/s10584-013-1017-8

Poli, P., Hersbach, H., Dee, D.P., Berrisford, P., Simmons, A.J., Vitart, F., Laloyaux, P., Tan, D.G.H., Peubey, C., Thépaut, J-N., Trémolet, Y., Hólm, E.V., Bonavita, M., Isaksen, L. and Fisher, M. 2016. ERA-20C: An atmospheric reanalysis of the twentieth century. *Journal of Climate* 29. (11): 4083–4097. Available at https://doi.org/10.1175/JCLI-D-15-0556.1

Raisanen, J. 2016. Twenty-first century changes in snowfall climate in Northern Europe in ENSEMBLES regional climate models. *Climate Dynamics* 46. 339–353. Available at https://doi.org/10.1007/s00382-015-2587-0

Rauscher, S.A., Pal, J.S., Diffenbaugh, N.S. and Benedetti, M.M. 2008. Future changes in snowmelt-driven runoff timing over the western US. *Geophysical Research Letters* 35. L16703. Available at https://doi.org/10.1029/2008GL034424

Schmucki, E., Marty, C., Fierz, C., Weingartner, R. and Lehning, M. 2017. Impact of climate change in Switzerland on socio-economic snow indices. *Theoretical and Applied Climatology* 127. 875–889. Available at https://doi.org/10.1007/s00704-015-1676-7

Siirila-Woodburn, E.R., Rhoades, A.M., Hatchett, B.J., Huning, L.S., Szinai, J., Tague, C., Nico, P.S., Feldman, D.R., Jones, A.D., Collins, W.D. and Kaatz, L. 2021. A low-to-no snow future and its impacts on water resources in the western United States. *Nature Reviews Earth and Environment* 2. 800–819. Available at https://doi.org/10.1038/s43017-021-00219-y

Soncini, A. and Bocchiola, D. 2011. Assessment of future snowfall regimes within the Italian Alps using general circulation models. *Cold Regions Science and Technology* 68. 113–123. Available at https://doi.org/10.1016/j.coldregions.2011.06.011

Spandre, P., Francois, H., Verdaillie, D., Lafaysse, M., Déqué, M., Eckert, N., George, E. and Morin, S. 2019. Climate controls on snow reliability in French Alps ski resorts. *Scientific Reports* 9. 8043. Available at https://doi.org/10.1038/s41598-019-44068-8

Steiger, R., Scott, D., Abegg, B., Pons, M. and Aall, C. 2017. A critical review of climate change risk for ski tourism. *Current Issues in Tourism* 22. (11): 1343–1379. Available at https://doi.org/10.1080/13683500.2017.1410110

Terzago, S., von Hardenberg, J., Palazzi, E. and Provenzale, A. 2017. Snow water equivalent in the Alps as seen by gridded data sets, CMIP5 and CORDEX climate models. *The Cryosphere* 11. 1625-1645. Available at https://doi.org/10.5194/tc-11-1625-2017

Thackeray, C.W. and Fletcher, C.G. 2016. Snow albedo feedback: Current knowledge, importance, outstanding issues and future directions. *Progress in Physical Geography* 40. (3): 392–408. Available at https://doi.org/10.1177/0309133315620999

van Vuuren, D.P., Edmonds, J., Kainuma, M., Riahi, K., Thomson, A., Hibbard, K., Hurtt, G.C., Kram, T., Krey, V., Lamarque, J-F., Masui, T., Meinshausen, M., Nekicenovic, N., Smith, S.J. and Rose, S.K. 2011. The representative concentration pathways: an overview. *Climatic Change* 109. 5–31. Available at https://doi.org/10.1007/s10584-011-0148-z

Würzer, S., Jonas, T., Wever, N. and Lehning, M. 2016. Influence of initial snowpack properties on runoff formation during rain-on-snow events. *Journal of Hydrometeorology* 17. 1801–1815. Available at https://doi.org/10.1175/JHM-D-15-0181.1

Xu, Y., Jones, A. and Rhoades, A. 2019. A quantitative method to decompose SWE differences between regional climate models and reanalysis datasets. *Scientific Report* 9. 16520. Available at https://doi.org/10.1038/s41598-019-52880-5

Zhang, J. 2005. Warming of the arctic ice-ocean system is faster than the global average since the 1960s. *Geophysical Research Letters* 32. L19602. Available at https://doi.org/10.1029/2005GL024216

Zhang, Y., Wang, S., Barr, A.G. and Black, T.A. 2008. Impact of snow cover on soil temperature and its simulation in a boreal aspen forest. *Cold Regions Science and Technology* 52. (3): 355–370. Available at https://doi.org/10.1016/j.coldregions.2007.07.001

DOI: 10.15201/hungeobull.72.1.2 Hungarian Geographical Bulletin **72** 2023 (1) 23–40.

The challenges of commercial mountaineering on the highest Volcanic Seven Summit, the Ojos del Salado

Balázs NAGY[1], Ádám IGNÉCZI[2], Ilona KOVÁCS-SZÉKELY[3], Sebastián RUIZ PEREIRA[4], Gábor MIHAJLIK[5], Péter FELKAI[6] and László MARI[1]

Abstract

Commercial mountaineering has gained widespread popularity in recent decades. Global mountaineering challenges – e.g., the Seven Summits challenge to climb the highest summit of each continent – amplify this process, and also raise the profile of individual destinations. The highest volcano on the Earth, the Ojos del Salado in the Dry Andes (Chile/Argentina) is featured in two of the major challenges (Seven Second Summits, Volcanic Seven Summits). Thus, it is a prime extreme outdoor tourism destination. The relative ease of access and the non-technical nature of the ascent have also contributed to the increasing volume of tourism. However, our observations about commercial mountaineering practices reveal surprisingly low success rates on the summit. Based on data from our decade-long environmental monitoring programme and our field experiences,, we attribute this to the extreme environment and landscape of the mountain (e.g., cold and dry climate, strong winds, topographical situation, loose surface material), scarce mountaineering facilities, and potential misjudgements by inexperienced climbers.

Keywords: Ojos del Salado, Andes, outdoor tourism, commercial mountaineering, extreme environment, extreme landscape

Received December 2022, accepted March 2023.

Introduction

The meaning of mountaineering has evolved significantly during the 20th century; from a form of elite activity – i.e. climbing a mountain with as little outside help as possible – to a wide-ranging term encompassing climbing, via-ferrata, backpacking, trekking and hiking in mountainous regions (Apollo, M. 2017). Due to the increasing popularity of outdoor sports and the growing availability of extreme travel destinations, the volume of amateur mountaineering has been increasing steadily during the last few decades. As the vast majority amateur mountaineers use commercial tour operators, high altitude mountain trekking and climbing represents a strongly emerging new form of tourism (Johnston, B.R. and Edwards, T. 1994; Apollo, M. 2017).

Widely known global mountaineering challenges have been playing a key role in the popularisation of professional and semi-professional mountaineering (Hamill, M. 2012; Romero, J. 2014; Buckingham, E. 2015).

[1] Department of Physical Geography, ELTE Eötvös Loránd University, Pázmány P. sétány 1/a, H-1117 Budapest, Hungary.
[2] School of Geographical Sciences, University of Bristol; Bristol, BS8 1HH, United Kingdom. Corresponding author's e-mail: a.igneczi@bristol.ac.uk
[3] Department of Methodology for Business Analysis, Budapest Business School, University of Applied Sciences; Alkotmány u. 9–14, H-1054 Budapest, Hungary.
[4] Escuela de Ingeniería, Pontificia Universidad Católica de Chile; PermaChile Network, Santiago de Chile, Chile.
[5] Department of Atomic Physics, Budapest University of Technology and Economics, Budafoki út 8, H-1111 Budapest, Hungary.
[6] SOS Hungary Medical Service, Szentendrei út 103, H-1039, Budapest, Hungary.

A classic example is the Seven Summits challenge to climb the highest summit of each continent *(Table 1*, column 2–3*)*, which was proposed in 1988 (Bass, M. *et al.* 1988; Bell, S. 2000). Newer mountaineering challenges are also emerging, e.g., the Seven Second Summits challenge to climb the second highest point of each continent (see *Table 1*, column 4–5) (Horrel, M. 2012), and the Volcanic Seven Summits to climb the highest volcanoes on all the continents (*Table 1*, column 6–7). The latter was proposed in 1999 and first completed in 2011 (Andalkar, A. 1999; Cairns, S. 2020; Traver, M. 2020; Rohnfelder, A. 2021; Stone, J. 2022).

Although several of these summits are technically, physically, and/or financially demanding to climb (e.g., Mount Everest, Vinson Massif), others are more accessible for amateurs and hiking enthusiasts (e.g., Aconcagua, Kilimanjaro, Puncak Jaya). Hence, while only a few hundred people have completed one of these challenges (Jurgalski, E. and Kikstra, H. 2016), the popularity of accessible and non-technical – i.e. no specialised mountaineering techniques and equipment required – summit challenge locations has skyrocketed due to the achievement and perceived prestige of climbing such a peak (Nüsser, M. and Dame, J. 2015). Although this brings economic benefits, there are growing concerns about the increased environmental strain on fragile high-mountain environments (Johnston, B.R. and Edwards, T. 1994; Marek, A. and Wieczorek, M. 2015).

The highest peak of the Volcanic Seven Summits – i.e. the highest volcano on the Earth – is the Ojos del Salado (6,893 m a.s.l.) in the Dry Andes on the border of Chile and Argentina. This peak, first climbed in 1937 (Carter, H.A. 1957), is also included in the Second Seven Summits challenge, which makes it a prime target for amateur mountaineers and outdoor enthusiasts. The Ojos del Salado boasts easy access on the Chilean side (used by > 90% of the climbers), moderate altitude compared to an 8,000 m high peak (while still being the highest peak in its category), no significant ice coverage (Nagy, B. *et al.* 2019), no volcanic activity, and no significant danger from falling due to exposed rock faces. Most of the ascent is achieved by trekking up on a footpath crisscrossing a steep scree slope, while only the last 30–40 m involves exposed climbing through a steep couloir and a ridge. However, holds and supports are abundant, and fixed ropes are also available to assist this last part of the ascent. These characteristics usually indicate a relatively easy ascent that is achievable for a wide-variety of prospective climbers, e.g., people without significant mountaineering and outdoor experience (Doran, A. and Pomfret, G. 2019). Due to these factors, the Ojos del Salado gained considerable fame and popularity in recent decades and attracts an increasing number of climbers.

However, the extreme environment of the mountain (e.g., it is one of the driest region of the Earth) is challenging for a lot of climb-

Table 1. Summits included in the different „Seven challenges"

Continent	Seven Summits		Seven Second Summits		Volcanic Seven Summits	
	Name	Height, m	Name	Height, m	Name	Height, m
Asia	Mount Everest	8,848	K2	8,611	Damavand	5,671
South America	Aconcagua	6,962	Ojos del Salado	6,893	Ojos del Salado	6,893
North America	Denali	6,194	Mount Logan	5,959	Pico de Orizaba	5,636
Africa	Kilimanjaro	5,895	Mount Kenya	5,199	Kilimanjaro	5,895
Europe	Elbrus	5,642	Dykh-Tau	5,205	Elbrus	5,642
*Europe**	*Mont Blanc*	*4,810*	*Monte Rosa*	*4,634*	*Etna*	*3,357*
Antarctica	Vinson Massif	4,892	Mount Tyree	4,852	Mount Sidley	4,282
Australasia	Puncak Jaya	4,884	Puncak Mandala	4,760	Mount Giluwe	4,367

*The highest summits for Europe vary among different listings, depending on how the boundary between Europe and Asia is defined.

ers – many of whom are unexperienced – and contributes to a very low success rate (below ~ 30%) of reaching the summit. This causes concerns about the sustainability of the business model of private tour operators, and also about the health and safety of climbers, especially if tourist numbers increase any further. Increasing tourism also leads to significant environmental degradation, especially in highly vulnerable extreme environments. Thus, the Ojos del Salado is a prime location to investigate the relationship between mountaineering tourism and the vulnerable environment of high-altitude mountains. Furthermore, conclusions learned on the Ojos del Salado are directly transferable to other high-altitude desert volcanoes in the Dry Andes (e.g., Llullaillaco, Socompa, Bonete, Pissis, Cerro Incahuasi) that are expected to see an increased number of visitors in the near future.

In this paper, we build on our decade long field experience on the Ojos del Salado (between 2008 and 2022) and the results of our environmental monitoring programme (Nagy, B. *et al.* 2019) to explore the effects of the extreme environment on commercial mountaineering activities and vice versa. We place a special emphasis on the environmental conditions/hazards that hinder successful summit ascents, the potential for environmental degradation due to mountaineering tourism, and provide suggestions about good mountaineering practices on the Ojos del Salado. We propose that these issues are relevant to a wide range of stakeholders, including academics (both in the natural and social sciences), policymakers, tour operators and climbers.

Geographical background

The Dry Andes is about a 1,000 km long section of the Andes, mostly located within Chile, Argentina, and Bolivia. The Ojos del Salado is the highest of several – mostly volcanic – peaks that rise above 6,000 m a.s.l. from the Puna de Atacama, i.e. a vast, high altitude (~ 4,000 m a.s.l.), and mostly uninhabited plateau in the Dry Andes *(Figure 1).*

The climate of these peaks and their vicinity is extremely harsh as they fall within the hyper-arid Andean Arid Diagonal, where precipitation – even at the highest altitudes – remains below 100 mm/year due to orographic and oceanic blocking (Amman, C. *et al.* 2001; Houston, J. and Hartley, A.J. 2003). Furthermore, the spatiotemporal distribution of the precipitation is highly sporadic and any snowpack sublimates in a matter of weeks – at the most – in the dry and windy environment (Vuille, M. and Ammann, C. 1997; Vuille, M. 1999). Hence, the climatic snowline is at an extremely high altitude of ~ 7,000 m a.s.l. – the highest on Earth – just above the tallest summits (Clapperton, C.M. 1994; Kull, C. *et al.* 2002; Grosjean, M. *et al.* 2007), which prevents the formation of glaciers and perennial ice coverage. However, some ice can be found underground in the permafrost (i.e. ground with temperatures below 0 °C for at least two continuous years) above 5,000–5,500 m a.s.l. (Gruber, S. 2012; Gjorup, D.F. *et al.* 2019; Nagy, B. *et al.* 2019, 2020). During summer months, the melting permafrost feeds a few small transient ponds above 6,000 m a.s.l. on the Ojos del Salado (Aszalós, J.M. *et al.* 2020a, b). Due to these extreme conditions, the region has been used as a Mars analog site by several studies (e.g., de Silva, S.L. *et al.* 2010, 2013; Favaro, E.A. *et al.* 2020; Kereszturi, Á. *et al.* 2020, 2022).

Historical overview of mountaineering on the Ojos del Salado

Based on historical information, and our own experiences since 2008, we delineate 4 stages (periods) of mountaineering and mountaineering tourism on the Ojos del Salado:

Period I. After the first expeditions in the mid-20th century, the 1980s and 1990s were characterised by low volume occasional uncommercialised mountaineering endeavours. In April, 1984 a helicopter of the Anglo-American Mining Co. of South Africa crashed on the mountain during a mining survey. As part of the salvage operations, bulldozers

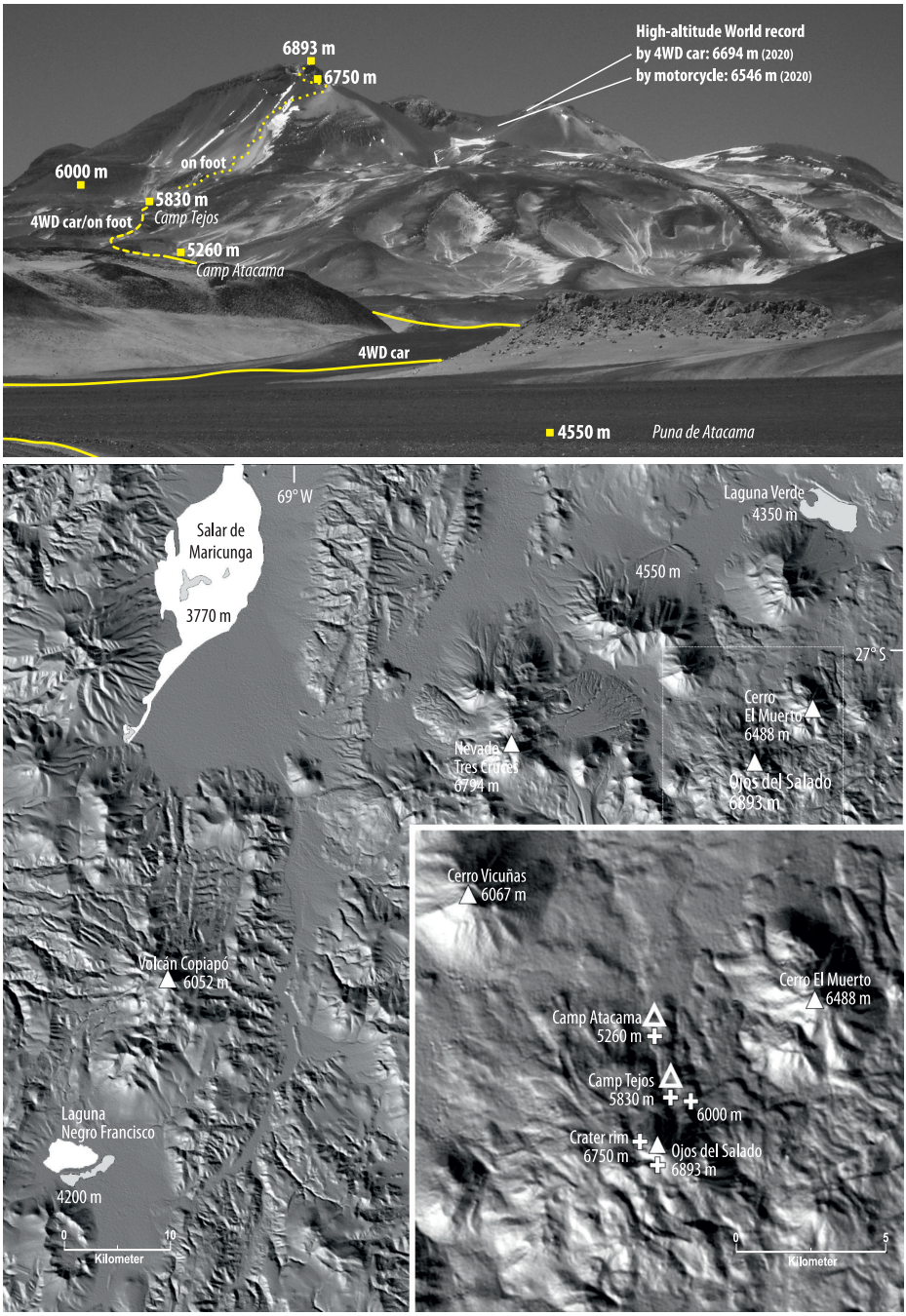


Fig 1. The Ojos del Salado, viewed from the Puna de Atacama plateau (February, 2016). Our climate monitoring sites, the normal mountaineering route, and the locations of several vehicular world records are indicated. The map inset shows the main camps (triangle) and the sites of included in our environmental monitoring program (cross). The nearest human settlement is ~ 150 kms away.

were used to create a dirt road – reaching 5,900 m a.s.l. – which was used to transport heavy equipment and a double container (Refugio Tejos/Tejos Camp at 5,830 m a.s.l.) serving as a base of operations *(Photo 1)*. This access route is still in use today.

Period II. In 2004, the Aventurismo tour operator company got concession from the Chilean government for the Chilean side of the Ojos del Salado. The company was responsible for the development and maintenance of three camp sites located along the approach to the Ojos del Salado: Camp Laguna Verde (4,350 m a.s.l.), Camp Atacama (5,260 m a.s.l.), Camp Tejos (5,830 m a.s.l.) (see *Photo 1*). They provided communal dome tents, field radios, waste collection, and a mountain rescue service equipped with portable hyperbaric bags and oxygen canisters. These safety and comfort facilities contributed to the increasing volume of tourism on the Ojos del Salado, which was designated as a zone of special environmental/touristic interest (ZOIT: Zonas de Interés Turístico) in 2006 (Servicio Nacional de Turismo, 2006). The annual number of climbers were around 300–500 during this period.

Period III. After the Aventurismo concession ended in 2015, all the aforementioned

Photo 1. Mountaineering camps on the Chilean side of the Ojos del Salado. a = Tejos Camp at 5,830 m a.s.l. in February, 2020; b = Atacama Camp at 5,260 m a.s.l. in March, 2018; c = Laguna Verde Base Camp at 4,350 m a.s.l. in January, 2010, dome tents provided by Aventurismo during the concession period (between 2004 and 2015) are visible.

services and facilities on the mountain were discontinued. Hence, since 2015 the Ojos del Salado is an independent mountaineering destination, i.e. it is possible to access and climb the summit independently and without any compulsory fees. However, the lack of infrastructure also hinders independent commercial operators. During this period, which lasted about 3–4 years, visitor numbers stagnated at about 400–500 person per year.

Period IV. In 2018, paving the National Highway 31 between Chile and Argentina was completed. This road provides direct and quick access to the Laguna Verde Camp. Meanwhile, most facilities on the mountain – except organised mountain rescue – were re-established by independent tour operators. The majority of tour groups started using 4WD vehicles to ferry equipment and supplies (and sometimes climbers) up the Tejos Camp at 5,830 m a.s.l. Tourism became highly concentrated in time, about 90 percent of the 500–600 annual visitors (pre-covid terminus) come in January and February. This is causing environmental strain – e.g., the quick degradation of the campsites – and raising the risk of accidents (Marek, A. and Wieczorek, M. 2015). Meanwhile, there is still no enhanced environmental protection from the government, e.g., the nearby Nevado Tres Cruces National Park (established in 1994) does not cover the area.

Methods

Within the framework of our climate- and environmental monitoring programme which started in 2008 (http://permachile.com), we have gathered a significant amount of quantitative data about the environmental conditions – such as temperature, aridity, wind – that can affect and potentially limit commercial mountaineering activities in the region. Our data collection strategy focuses on the monitoring of permafrost and ground ice in every major environmental zone of the region. Thus, measuring ground temperature and humidity, using data loggers (HOBO Pro v2; operation range: −40 °C to 70 °C, accuracy: ±0.21 °C), is our key activity on the field (Nagy, B. *et al.* 2019). Our loggers are buried at different depths (10–60 cm) and at several locations between the elevations of 4,550 and 6,893 m a.s.l. (see *Figure 1*). The same data loggers are also used to record air temperature and humidity at two locations, near the Tejos Camp (though at the slightly higher elevation of 6,000 m a.s.l.), and on the Ojos del Salado summit (see *Figure 1*). To investigate wind speed and its capacity to transport sediment, we installed sediment-traps at 5,200 m and 6,000 m a.s.l. – near the Atacama and Tejos Camps respectively (see *Figure 1*). We also installed and operated a mobile meteorological station while staying at the Tejos Camp between 11–14, February, 2016, to measure radiation and energy balance, wind speed and direction, air temperature, air humidity, and dew formation. Besides, in-situ measurements and sampling, we also utilise satellite imagery – Landsat 7 ETM+, Landsat 8 OLI, and MODIS (Moderate Resolution Spectro-radiometer) – to survey the sporadic snow coverage (Nagy, B. *et al.* 2019).

Since 2008, our team – collectively – spent 10 summer climbing seasons (in 2008, 2010, 2012, 2014, 2016, 2018, 2019, 2020, 2022, 2023) on the Ojos del Salado, reaching the summit 9 times. A key difference between our presence and the activities of commercial tours is that we spend around 4 weeks – of which about 2 weeks is in the highest regions (i.e. above 5,800 m a.s.l.) – on the mountain continuously, whereas commercial tours typically spend about 1 week on the Ojos del Salado. This has provided us ample opportunity to interact with several commercial tours per climbing season and observe their activities. Hence, besides our numerical data, we can also rely on our extensive field experience on the mountain to evaluate – within the context of our environmental data – the common practices and mountaineering strategies of commercial tour operators. We also use official records from the Chilean Border Agency (DIFROL: Dirección Nacional de Fronteras y Límites del Estado) and the Chilean Tourism

Agency (SERNATUR: Servicio Nacional de Turismo) to assess tourism volumes (Servicio Nacional de Turismo, 2014) and success rates. However, there are several shortcomings of these data sources: (1) no official permits are required to climb the Ojos del Salado, foreigners need to obtain DIFROL permits but these are not related to climbing; (2) Aventurismo and other private operators do not maintain reliable public records about successful and unsuccessful attempts on the summit due to conflict of interest.

Challenging environmental conditions on the Ojos del Salado

As environmental conditions are substantial in determining the success on high altitude summits, climbers are in need of detailed information about the typical conditions on a mountain (e.g., snow coverage, water resources, typical temperature range etc.) and short-term predications (e.g., meteorological forecasts). Below we list and describe the most important and challenging environmental factors on the Ojos del Salado based on data obtained by our environmental monitoring programme. We also evaluate how these conditions affect the typical mountaineering strategies and activities of commercial tours – that we observed during our decade long presence on the mountain – with a special emphasis on providing best practice guidance.

Topographical situation and high altitude

Low oxygenation which might lead to acute mountain sickness (AMS), is the principal consequence of high altitudes on human physiology. This is caused by lower oxygen concentration at high altitudes due to lower air pressure. Respiratory humidification – i.e. attaining saturation water pressure in the airways and lungs – also has a proportionally greater effect in oxygenation at high altitude (Brown, J. and Grocott, M. 2013). In order to manage the problem of low oxygenation and to avoid AMS, a well-planned acclimatisation strategy is essential. However, preparing and executing this strategy is a major challenge on the Ojos del Salado due to the topographical situation of the summit and the wider region.

Successful acclimatisation requires a "climb high, sleep low" approach. However, the possibility of gradual ascent – i.e. no large jumps in sleep height but a large enough differences between sleep and climb heights – is limited on the Ojos del Salado as it towers ~ 2,500 m above the surrounding Puna de Atacama, a vast rocky desert plateau at around 4,000 m a.s.l. (see *Figure 1*). It is quite typical to start acclimatization ascends from the Puna de Atacama, thus, mountaineers spend most of their time (> 90%) above 4,000 m a.s.l. while climbing the Ojos del Salado. The medevac of AMS patients is also hindered by the large distances (> 100 km) on the high-altitude (> 4,000 m a.s.l.) plateau, though newly paved roads largely alleviate this problem. Settlements where medical help is available are even further, around 250 km from the mountain. These factors are compounded by the lack of organised mountain rescue services, which means that oxygen bottles and portable hyperbaric bags (Gamov bags) are not readily available on the mountain, and medevac needs to be organised ad hoc. The possibility of a vehicular ascent to 5,900 m a.s.l. is also tempting – especially for inexperienced tourists – and could lead to quick onset AMS cases.

Cold temperatures

As the Tejos Camp (5,830 m a.s.l.) is the main staging area for summit attempts, it is important to know typical temperatures in the vicinity of this site. The annual mean air temperature is -10.03 °C at 6,000 m a.s.l., based on our measurements between 2014 and 2020. Although a linear trend fitted on monthly mean temperatures between March, 2014, and March, 2020, reveals a warming of +2.42 °C *(Figure 2)*, summer climbing season

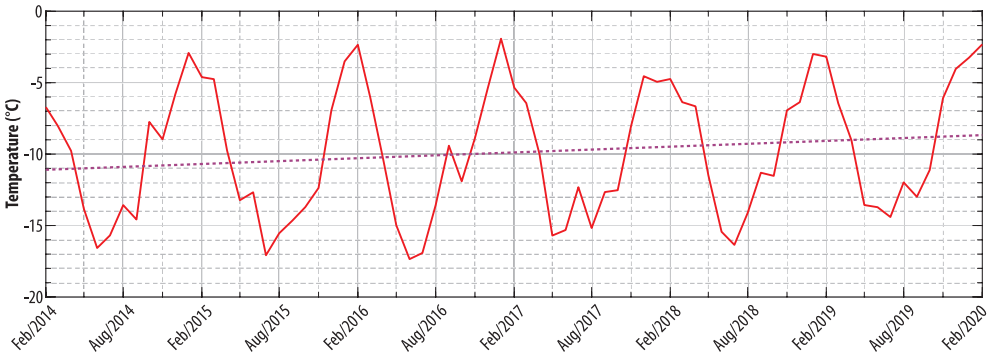


Fig. 2. Monthly mean temperatures at 6,000 m a.s.l. near the Tejos Camp between 2014 and 2020. A linear trend, showing the general warming, is also plotted.

(Dec-March inclusive) temperatures remained largely unchanged. Hence, we propose that the -6.22 °C mean climbing season (Dec-March) temperature is fairly representative for the Tejos Camp (see *Figure 2*). As summiting and returning takes about 10–15 hours from the Tejos Camp (5,830 m a.s.l.), starting before dawn, it is important to know the typical daily variability of temperatures.

Although the highest daily maximum temperatures (~ 19 °C) were observed in December, the overall daily temperature variability is more suitable for climbing in January (*Figure 3*). This is due to warmer minimum and average temperatures which are especially pronounced during the crucial early hours before dawn. On a typical January day, these early morning temperatures hold between -5 °C and -7 °C, while in December they consistently hover around -10 °C (see *Figure 3*). February is similarly suitable though slightly colder (by around 1 °C), while March is distinctively more cold in all regards, and, thus, less suitable for climbing. In fact, typical afternoon temperatures in March dip well below December temperatures (see *Figure 3*).

Our measurement site at 6,750 m a.s.l. is situated immediately above a steep 700 m high scree slope – the bulk of the elevation gain during climbing. This site is usually reached by climbers before noon. From here, climbers only need to ascend a further 150 m to the summit, though this ascent is on a steep rock wall – the most technically challenging part of the climb. This impressive and intimidating cliff is visible from this site, and many climbers give up at this point due to exhaustion and self-doubt (Nüsser, M. and Dame, J. 2015). The exposed and windy conditions at this location also contribute to the deterrence, thus, it is important to know the typical conditions here. Although our loggers are buried at 10 cm depth, we argue that they represent air temperatures well as the regolith is extremely coarse, porous, dry, and well ventilated (Nagy, B. *et al.* 2019). The annual mean (ground) temperature at this location during the 2012–2020 period is -14.86 °C. During midday, when most climbers reach the site, temperatures are at around -10 °C (see *Figure 3*). Similar to the Tejos Camp, January and February are the most favourable months for climbing, due to the mildest typical minimum temperatures (see *Figure 3*).

The last 30–40 m climb to the Ojos del Salado summit leads through a steep couloir, an exposed windy ridge, and crumbly bedrock. As the progress of climbers is slow and queueing might occur, especially with larger groups, timing the arrival well is crucial. Temperatures are generally favourable for

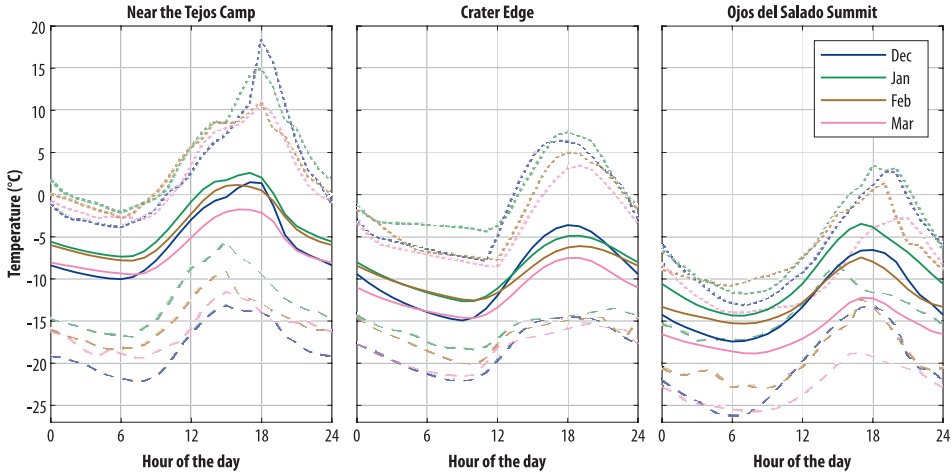


Fig. 3. The mean (solid line), minimum (transparent dashed line), and maximum (transparent dotted line) hourly temperatures measured between 2014 and 2020 near the Tejos Camp 6,000 m a.s.l (left); between 2012 and 2020 at the Crater Edge 6,750 m a.s.l. (middle); and between 2014 and 2015 at Ojos del Salado summit 6,893 m a.s.l. (right). Months of the climbing season (Dec, Jan, Feb, Mar) are calculated and plotted separately using different colours (see legend).

an early afternoon summitting (see *Figure 3*), which also avoids descending in harsh conditions. Similar to lower sites, January provides the best overall conditions, with minimum and mean temperatures between -10 °C and -5 °C (see *Figure 3*). However, these temperatures drop quickly on either side of January, with early afternoon minimums between -20 °C and -15 °C in December and February. Temperatures are even more harsh during the late climbing season in March, when early afternoon minimum temperatures are between -20 °C and -25 °C (see *Figure 3).*

Strong winds and wind chill

Although, long-term wind speed measurements are not available from Ojos del Salado, Milana, J.P. (2009) presented limited data from the Valedero Gold Mine (2000–2002), a comparable site on the Argentinian Puna de Atacama, though ~ 250 km to the south and ~ 3,000 m lower. These measurements indicate that wind-speeds between 50–100 km/h occur frequently, while wind-gusts between 250–440 km/h are also possible (Milana, J.P. 2009). As the climate is extremely arid, strong winds move and redistribute sediments easily. Hence, aeolian (wind formed) landforms such as sand dunes, ripple-marks, mega-ripples (Milana, J.P. 2009; Nagy, B. *et al.* 2019), and bedrock wind abrasion *(Photo 2)* are abundant in the region. Our sediment traps at 6,000 m a.s.l. also confirm strong wind action, as grains larger than 5 mm – significantly coarser than the sand fraction (0.05–2.00 mm) – were found in the sediment trap 50 cm above the surface. Strong wind can endanger climbers at the exposed final approach, thus, it is recommended to monitor wind levels continuously during summit ascents. The presence of coarse wind-blown debris – with grain sizes that can surpass that of the sand fraction – is also a key problem (see *Photo 2*). For example, it can lead to injuries of the cornea, thus, using protective glacier/ski googles is highly recommended. Abundant wind-blown sediment also significantly deteriorates the camping experience (e.g., sand filling tents and sleeping bags, and contaminating meals), which contributes to the exhaustion of climbers.

Photo 2. Aeolian processes on the slopes of the Ojos del Salado. a-b = Megaripples near the Atacama Camp at 5,250–5,300 m a.s.l. (February, 2020); c-d = wind-abrasion of a boulder (c: windward side, d: leeward side) at 5,900 m a.s.l. (February, 2012); e/1-2 = sandstorm on the lower slope of the Ojos del Salado at 5,300 m a.s.l. (February, 2010).

However, the most important consequence of strong wind is its negative effect on apparent temperature, as moving air leads to more intensive/quick body heat loss, i.e. wind chill (Eq. 1).

$$T_{wc} = 13.12 + 0.6215 \cdot T - 11.37 \cdot v^{0.16} + 0.3965 \cdot T \cdot v^{0.16}, \quad \text{(Eq. 1)}$$

where T_{wc} is wind chill equivalent temperature (°C), T is air temperature (°C), and v is wind velocity (km/h).

Wind chill is especially problematic during summit attempts due to the combination of early morning low temperatures and high winds. Even a very mild 10–20 km/h wind – which is almost constant in the region – can lead to wind chill equivalent temperatures (apparent temperatures) of -10 °C and -15 °C at the Tejos Camp during a typical January morning (*Figure 4).* This can easily become 5–10 °C colder on either side of January or simply due to stronger winds. Wind chill might also negate warming which occurs later in the afternoon (see *Figure 4*), as winds generally pick up speed in parallel with the warming. It is notable, that even though temperatures appear suitable late in the climbing season (e.g., March) wind chill might cause apparent temperatures around -30 °C on the summit (see *Figure 4*) making frostbite of the extremities a distinct possibility. This illustrates the problems with winter climbing, when daily mean temperatures on the summit are at around -25 °C while apparent temperatures can dip below -40 °C.

Low precipitation and humidity

There are no in-situ precipitation measurements from the highest regions of the Puna de Atacama, but numerical estimations yield very

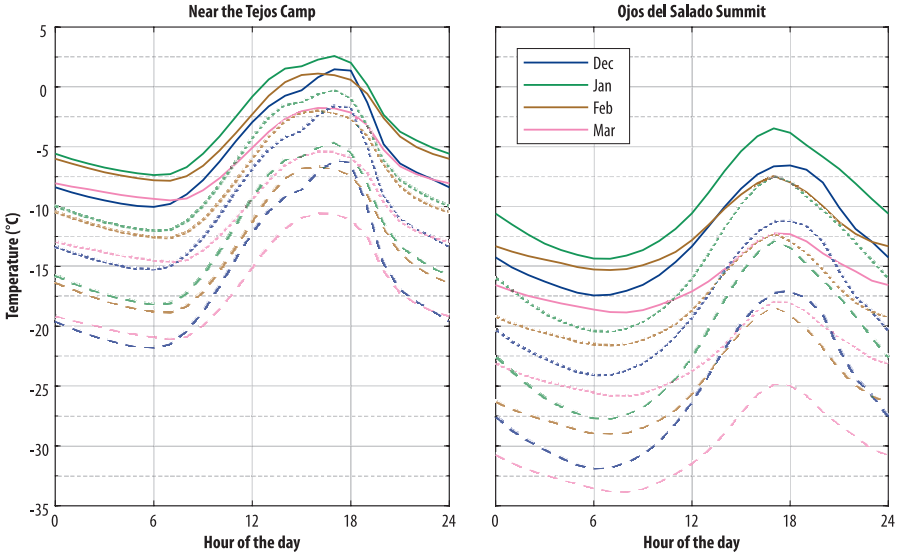


Fig. 4. Typical daily temperatures during the climbing season – i.e. mean of the hourly temperatures – and the corresponding wind chill equivalent temperatures at 10 km/h (transparent dotted line) and 50 km/h (transparent dashed line) wind speeds near the Tejos Camp 6,000 m a.s.l. (between 2014 and 2020) (left); and at the Ojos del Salado summit 6,893 m a.s.l. (between 2014 and 2015) (right).

low values that are consistent with a desert environment even at high elevations (Amman, C. *et al.* 2001). Thus, this area can be considered the highest desert on Earth, where precipitation and snow coverage is extremely sporadic and low. However, strong individual precipitation events can occur due to special synoptic metrological circumstances (Wilcox, C.A. *et al.* 2016), e.g., April, 2015 and February, 2018 *(Figure 5).* Sudden, local snow storms can also occur almost any time, though they rarely cover the whole mountain. These snow storms mostly arrive from the east and they can be electrically charged, e.g., our loggers on the summit were burned by a lightning storm in 2013.

The low precipitation and strong sublimation – due to the dry air, high wind, and strong insolation – strongly limit the persistence of snow on the ground. Thus, during the summer climbing season, the mountain is mostly snow free at around 5,000 m a.s.l., and even at around 6,000 m a.s.l. snow usually only persists for a few weeks (see *Figure 5*). This scarcity of reliable local freshwater supply force climbers to transport their whole stock of drinking water from Copiapó, 250 km away. Despite the lack of a spatially and temporally consistent snowpack on the mountain, local sheltered snow patches occur, especially near the crater rim where they are present in most years (see *Figure 5*). If the snow cover/patch is fresh and thick, it represents a significant obstacle for climbers, though sublimation can quickly diminish this. Refrozen snow patches are fairly easy to traverse by crampons, though it is important to do this well before midday before any significant melting. The aforementioned sudden precipitation events (synoptic or local) can also unexpectedly disrupt the climbing process, as most climbers only plan to spend a few days at the Tejos Camp. Furthermore, climbers are usually unprepared to deal with snowy/icy conditions in this extremely arid environment. Thus, a large proportion of climbers turn back from around 6,300–6,500 m a.s.l. in snowy conditions.

Low precipitation, the scarcity of sur face snow, ice, liquid water, and strong winds all

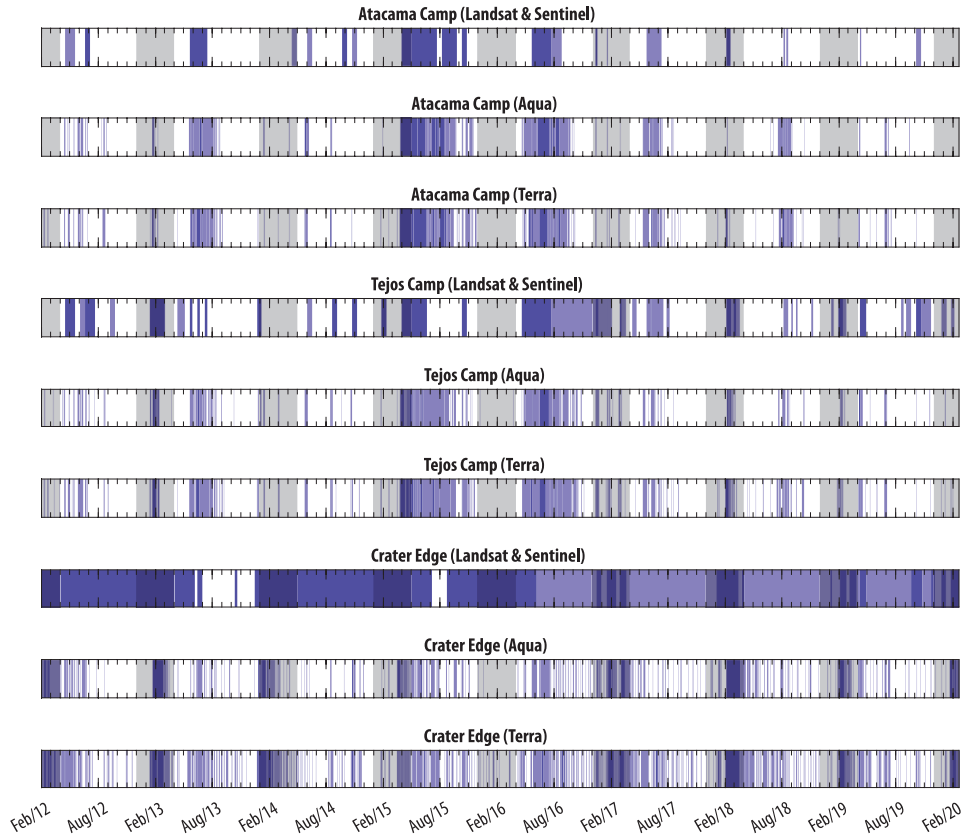


Fig. 5. Snow cover (light blue: partial snow coverage; dark blue: full snow coverage) at the Atacama Camp (5,260 m a.s.l.), Tejos Camp (5,830 m a.s.l.), and Crater Edge (6,750 m a.s.l.). Data is derived from Landsat and MODIS (aboard both Aqua, and Terra satellites) imagery for 2012–2020. Grey highlights represent the climbing seasons.

contribute to the extremely low water vapor content of the air (i.e. humidity). According to our measurements, the absolute (i.e. volumetric) air humidity (AH) – mass of water vapor divided by the volume of the air and water vapor mixture – near the Tejos Camp (at 6,000 m a.s.l.) is ranging between 0.5 and 1.5 g/m^3 during a typical climbing season morning *(Figure 6).* This is only about 5–15 percent of the optimal range of 9–13 g/m^3, i.e. 40–60 percent relative humidity at room temperature (Sterling, E.M. *et al.* 1985; Vellei, M. *et al.* 2017). Extremely dry air is even more pronounced on the Ojos del Salado summit, where the typical daily maximum AH is only about 1 g/m^3, ~ 8–11 percent of the normal range. Early afternoon – the typical time of summitting – AH is even lower at around 0.5 g/m^3, ~ 4–6 percent of the normal range (see *Figure 6).* Extremely low humidity is a major health concern for climbers (Davies, E.D. *et al.* 2016; Ladd, E. *et al.* 2016) as – compounded by the high rate of respiration – it leads to the severe drying of the skin around the mouth and nose and the mucosal lining of the airways (Tsutsumi, H. *et al.* 2007; Takada, S. and Matsushita, T. 2013). The dry

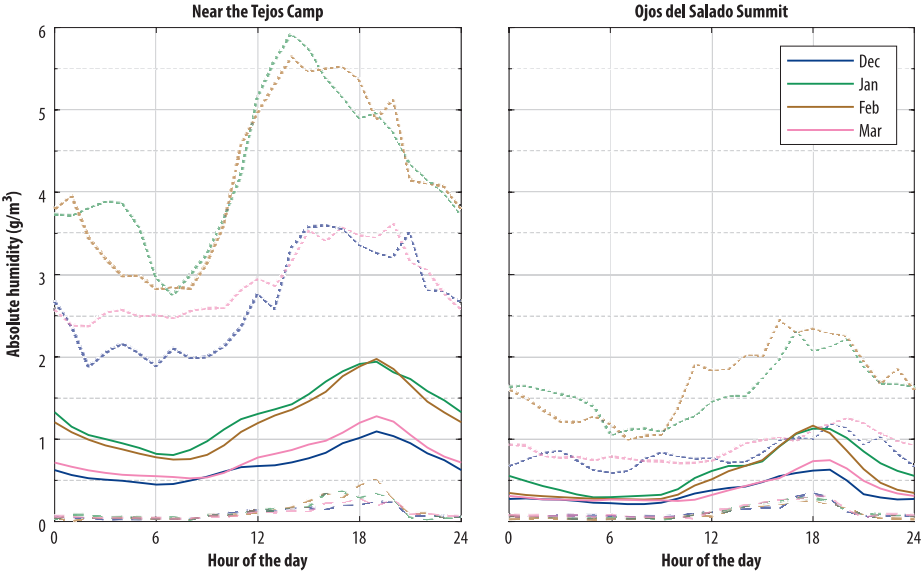


Fig. 6. The mean (solid line), minimum (transparent dashed line), and maximum (transparent dotted line) of the hourly absolute air humidity (g/m^3) measured between 2014 and 2020 near the Tejos Camp 6,000 m a.s.l (left); and between 2014 and 2015 at Ojos del Salado summit 6,893 m a.s.l. (right). Months of the climbing season (Dec, Jan, Feb, Mar) are calculated and plotted separately using different colours (see legend).

mucosa of the larynx could produce a dry, hacking cough named high altitude bronchitis (Cogo, A. *et al.* 2004; Ladd, E. *et al.* 2016), and skin dryness could also lead to injuries of the epidermis.

High insolation

The sky is usually clear until early afternoon in the climbing season, with mild overcast conditions typically prevailing later in the day. Although our records are short – just 3 complete days in February, 2016 – they indicate extremely high solar irradiation with hourly averages at around 1,100 W/m^2, even during overcast conditions *(Figure 7)*. We propose that this is due to the combination of high altitude and extremely low humidity which cause very low scattering of the incoming solar radiation (global radiation). Individual instances of higher insolation than 1,370 W/m^2 – i.e. solar irradiation at the top of the atmosphere – were also measured occasionally. We propose this is caused by reflection from high level clouds (Breuer, H. *et al.* 2020).

Dry, crumbly and unstable debris cover

Most of the Ojos del Salado mountain is covered by an unsorted (i.e. containing various grain sizes mixed together) mantle of debris/regolith, predominantly containing sand, pumice, and pyroclastic debris *(Photo 3)*. Although permafrost is present above 5,600–5,800 m a.s.l. on the Ojos del Salado, ice that could cement the regolith is almost completely absent from the upper layers of the debris mantle during the summer climbing season (Nagy, B. *et al.* 2019). This is due to the low overall water content of the regolith – caused by the combination of arid climate and high porosity – and the presence of a 20–70 cm active layer (i.e. zone with temperatures above 0 °C underlain by permafrost) during the summer (Nagy, B.

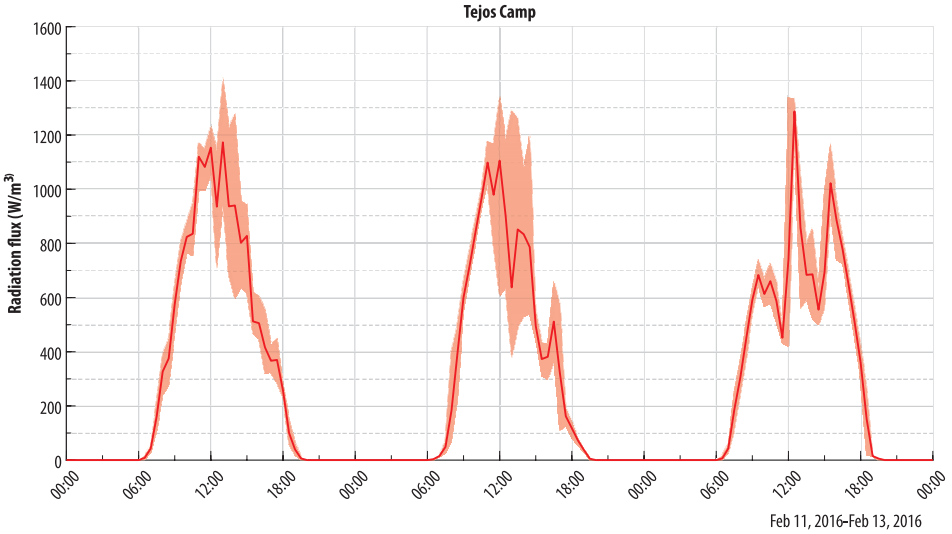


Fig. 7. Incoming solar radiation at the Tejos Camp (5,830 m a.s.l.) during 3 days in February, 2016. The solid line represents the average incoming radiation, while the shaded area represents the minimum-maximum range for each 30 minute measurement period.

Photo 3. High mountain desert-surface of the Ojos del Salado, a = coarse lag gravel pavement at 5,650 m a.s.l. (February, 2010); b = eolian sand-blanket at 5,840 m a.s.l. (February, 2016); c = sandy debris slope near the Camp Atacama at 5,350 m a.s.l. (January, 2012).

et al. 2019, 2020). Hence, the surface is extremely loose/unconsolidated which makes walking/climbing difficult and exhausting due to repeated slipping.

The unconsolidated surface material also intensifies the strong aeolian action in the vicinity of the Ojos del Salado (see section *Strong winds and wind chill*). This leads to the formation of thick sand layers or small sand dunes at around 5,000–5,800 m a.s.l., which are difficult to traverse (see *Photo 3*). The removal and redistribution of finer sediments can also leave behind coarse grained lag gravel pavements. Although these areas appear stable, usually the underlying fine sediments cannot support the weight of an adult, thus, walking across these is challenging as well (see *Photo 3*, a).

A summary of key challenges during different climbing stages

Conquering the Ojos del Salado is a fairly monotonous experience for most, as climbers usu-

ally spend more than a week in the close vicinity, which is a barren rocky desert. This physically and mentally draining experience is exacerbated by the unique combination of harsh environmental conditions. The topographical situation of the Ojos del Salado also hinders the planning and execution of a successful acclimatisation strategy. The high altitude, strong irradiation, dry air, strong winds all contribute to the severe dehydration and strong coughing that afflicts most climbers. Furthermore, even though actual air temperatures are not particularly low in the climbing season, strong wind chill could lead to frostbites. Unstable and slow walking on to the highly porous, dry and crumbly debris cover is a continuous problem which contributes significantly to the exhaustion of climbers. This debris covers and the strong winds also make camping a challenging, uncomfortable which hinders the relaxation and recovery of climbers. In fact, several geographical names in the region indicate physical hardship, isolation, hopelessness (e.g., Cerro Mulas Muertas – Peak of the Dead Mules; Cerro El Muerto – Dead Peak, etc.) which might reflect the challenges early explorers faced.

The most physically and mentally challenging – though technically easy – part of climbing the Ojos del Salado is trekking up the exposed, steep scree slope between Tejos Camp and the crater rim (6,000 to 6,750 m a.s.l.). Although this section of the climb just requires following the zigzagging footpath up the slope, resting places are scarce and the surface debris is very unstable. Thus, climbers often slide one or two steps down which is exhausting and frustrating. A large proportion of the climbers give up the attempt on the summit in the middle of this slope, at around 6,300–6,400 m a.s.l. A fairly consistent snow/firn patch also intersects the footpath to the summit at around 6,500 m a.s.l. that usually poses a significant challenge for climbers. In most cases, crampons are needed here – especially during the early hours – which are challenging to equip on the steep scree slope.

At the top of the scree slope, on the crater edge, the largest challenge is mostly psychological.Climbers catch their first up-close glimpse of the Ojos del Salado summit from this location. The steep rocky peak about 150 m above the crater rim, looks intimidating for the inexperienced. This, combined with the exhaustion due to the long climb on the scree slope and the unpleasant cold and windy early morning weather nudges many to turn back. Also, the bright orange container at the Tejos Camp is well visible from here, which tempts many to retreat to its comparable comfort.

Scaling the actual peak from the crater rim, especially the last 30–40 m, is technically the most difficult part of the climb. However, turning back is not common at this point as the summit is very close. A special source of danger on the Ojos del Salado is the long and tiring descent down the scree slope, which usually happens late in the afternoon. Climbers are the most exhausted at this stage and usually have lower coordination of their movements. This, on the unstable surface can lead to injuries and many unscheduled resting stops, partly due to frustration. Exhausted climbers who might descent on their own could – and sometimes do – fall asleep during these rest stops, which is dangerous as temperatures drop quickly at sunset.

Conclusions

The Ojos del Salado became a popular high altitude mountaineering destination in recent years, though the success rate of summit attempts is low. Although mountaineering infrastructure is quite sparse in the region, vehicular approach is easy due to recent road upgrades. Thus, we propose that the most important factor that hinders climbers in reaching the summit – and causing low success rate – is the harsh environment of the region, and the lack of proper consideration of these conditions. High altitude, cold temperatures, and strong winds are common environmental conditions on all major peaks. However, on the Ojos del Salado, these are exacerbated by extreme aridity, monotone desert landscape, and unstable surface material, which strongly accentuate other environmental challenges associated with the high altitude.

Ensuring gradual acclimatisation on the Ojos del Salado is paramount. Although it is relatively easy to reach high altitudes – e.g., the Atacama Camp (5,260 m a.s.l.) or even the Tejos Camp (5,830 m a.s.l.) – by a 4WD car, climbers should start acclimatisation well before they reach the Atacama Camp, and should continue the process even after that point. However, since the mid-2000s demand for quick and easy access to the mountain has increased. Thus, in a lot of cases, mountaineering equipment and supplies (drinking water, rations, etc.) are transported by car to the Tejos Camp, and a few days later the climbers are also ferried up. Summit attempts start from there, and climbers usually descend back to the Atacama Camp. An even more extreme form of this, is using cars to get to the Tejos Camp during the night, summit during the day, and then return to lower altitudes (even as low as sea-level) as quickly as possible.

We propose that the best strategy to safely – but also "cleanly" – climb the Ojos del Salado, is utilising vehicular transport to a limited degree. In this case climbers should spend several nights on the Puna da Atacama, and complete acclimatisation hikes there. Then, they can be transported up to the Atacama Camp by cars, but they should not utilise cars to reach higher altitudes. Cars can also be used to transport supplies and a limited amount of equipment to the Atacama and Tejos Camps. However, using cars have several consequences, beyond tarnishing the achievement of reaching the summit. Chief among these is the environmental degradation, e.g., erosion and noise pollution, and also the larger amount of waste production due to easier transportation. Unfortunately, independent waste collection and removal is still not organised around on the Ojos del Salado.

Despite these concerns, further increase in tourism and significant investments in infrastructure are expected on the Ojos del Salado for several reasons: (1) it is a prime non-technical, extreme-environment, high-altitude peak which fits very well into the profile of the extreme outdoor tourism industry; (2) it is part of the popular Volcanic Seven Summits and Second Seven Summits mountaineering challenges; (3) vehicular access is easy and cheap due to the newly upgraded international highway in the vicinity, and the presence of bulldozed dirt roads that are accessible with 4WD cars.

REFERENCES

Ammann, C., Jenny, B., Kammer, K. and Messerli, B. 2001. Late Quaternary glacier response to humidity changes in the arid Andes of Chile (18–29° S). *Palaeogeography, Palaeoclimatology, Palaeoecology* 172. (3–4): 313–326. Available at https://doi.org/10.1016/S0031-0182(01)00306-6

Andalkar, A. 1999. *The Volcanic Seven Summits*. Amar Andalkar's Ski Mountaineering and Climbing Site. Web site: http://www.skimountaineer.com/ROF/VolcanicSeven.html

Apollo, M. 2017. The true accessibility of mountaineering: The case of the High Himalaya. *Journal of Outdoor Recreation and Tourism* 17. 29–43. Available at https://doi.org/10.1016/j.jort.2016.12.001

Aszalós, J.M., Szabó, A., Felföldi, T., Jurecska, L., Nagy, B. and Borsodi, A.K. 2020a. Effects of active volcanism on bacterial communities in the highest-altitude Crater Lake of Ojos del Salado (Dry Andes, Altiplano-Atacama region). *Astrobiology* 20. 741–753. Available at https://doi.org/10.1089/ast.2018.2011

Aszalós, J.M., Szabó, A., Megyes, M., Anda, D., Nagy, B. and Borsodi, A.K. 2020b. Bacterial diversity of a high-altitude Permafrost Thaw Pond located on Ojos del Salado (Dry Andes, Altiplano-Atacama region). *Astrobiology* 20. 754–765. Available at https://doi.org/10.1089/ast.2018.2012

Bass, D., Wells, F. and Redgeway, R. 1988. *Seven Summits*. Boston, Little Brown & Company.

Bell, S. 2000. *Seven Summits: The Quest to Reach the Highest Point on Every Continent*. London, Octopus Publishing Group.

Breuer, H., Berényi, A., Mari, L., Nagy, B., Szalai, Z., Tordai, Á. and Weidinger, T. 2020. Analog site experiment in the Altiplano-Atacama Desert region: surface energy budget components on Ojos del Salado from field measurements and WRF simulations. *Astrobiology* 20. 684–700. Available at https://doi.org/10.1089/ast.2019.2024

Brown, J. and Grocott, M. 2013. Humans at altitude: physiology and pathophysiology. *Continuing Education in Anesthesia, Critical Care & Pain* 13. (1): 17–22. Available at https://doi.org/10.1093/bjaceaccp/mks047

Buckingham, E. 2015. *7 Summits*. Carlsbad, CA, Crescent House Publishing.

Carter, H.A. 1957. *Ojos del Salado.* AAC Publications, American Alpine Club, Available at https://publications.americanalpineclub.org/articles/12195707400/Ojos-del-Salado

Cairns, S. 2020. *Climbing the Seven Volcanoes*. Stroud, GB, Amberley Publishing.

Clapperton, C.M. 1994. The quaternary glaciation of Chile: A review. *Revista Chilena Historia Natural* 67. 369–383. Available at http://rchn.biologiachile.cl/pdfs/1994/4/Clapperton_1994.pdf

Cogo, A., Fischer, R. and Schoene, R. 2004. Respiratory diseases and high altitude. *High Altitude Medicine and Biology* 5. (4): 435–444. Available https://doi.org/10.1089/ham.2004.5.435

De Silva, S.L., Bailey, J.E., Mandt, K.E. and Viramonte, J.M. 2010. Yardangs in terrestrial ignimbrites: Synergistic remote and field observations on Earth with applications to Mars. *Planetary and Space Science* 58. (4): 459–471. Available at https://doi.org/10.1016/j.pss.2009.10.002

De Silva, S.L., Spagnuolo, M.G., Bridges, N.T. and Zimbelman, J.R. 2013. Gravel-mantled megaripples of the Argentinean Puna: A model for their origin and growth with implications for Mars. *GSA Bulletin* 125. (11–12): 1912–1929. Available at https://doi.org/10.1130/B30916.1

Davies, E.D., McGregor, G.R. and Enfield, K.B. 2016. Humidity: a review and primer on atmospheric moisture and human health. *Environmental Research* 144. 106–116. Available at http://dx.doi.org/10.1016/j.envres.2015.10.014

Doran, A. and Pomfret, G. 2019. Exploring efficacy in personal constraint negotiation: An ethnography of mountaineering tourists. *Tourist Studies* 19. (4): 475–495. Available at https://doi.org/10.1177/1468797619837965

Favaro, E.A., Hugenholtz, C.H., Barchyn, T.E. and Gough, T.R. 2020. Wind regime, sediment transport, and landscape dynamics at a Mars analogue site in the Andes Mountains of Northwestern Argentina. *Icarus* 346. id.113765. Available at https://doi.org/10.1016/j.icarus.2020.113765

Gjorup, D.F., Francelino, M.R., Michel, R.F.M., Senra, E.O. and Schaefer, C.E.G.R. 2019. Pedoclimate monitoring in the periglacial high mountain soils of the Atacama Desert, northern Chile. *Permafrost and Periglacial Processes* 30. (4): 310–329. Available at https://doi.org/10.1002/ppp.2029

Grosjean, M., Santoro, C.M, Thompson, L.G., Nunez, L. and Standen, V.G. 2007. Mid-Holocene climate and culture change in the South Central Andes. In *Climate Change and Cultural Dynamics: A Global Perspective on Mid-Holocene Transitions.* Eds.: Anderson, D.G., Maasch, K.A. and Sandweiss, D.H., Elsevier Publication, 51–115.

Gruber, S. 2012. Derivation and analysis of a high-resolution estimate of global permafrost zonation. *Cryosphere* 6. (1): 221–233. Available at https://doi.org/10.5194/tc-6-221-2012

Hamill, M. 2012. *Climbing the Seven Summits: A Guide to Each Continents' Highest Peak.* Seattle, Mountaineers Books.

Horrel, M. 2012. *Which is harder, the Second Seven Summits or the first one?* Mark Horrel Blog. 8 February, 2012. Available at https://www.markhorrell.com/blog/2012/which-is-harder-the-second-seven-summits-or-the-first-one/

Houston, J. and Hartley, A.J. 2003. The central Andean west-slope rain-shadow and its potential contribution to the origin of hyper-aridity in the Atacama Desert. *International Journal of Climatology* 23. (12): 1453–1464. Available at https://doi.org/10.1002/joc.938

Johnston, B.R. and Edwards, T. 1994. The commodification of mountaineering. *Annals of Tourism Research* 21. (3): 459–478. Available at https://doi.org/10.1016/0160-7383(94)90114-7

Jurgalski, E. and Kikstra, H. 2016. *Facts & figures of all 7 summiteers!* The 7 summits. Retrieved 21 June 2022. Available at https://7summits.com/7summits_statistics.php

Kereszturi, Á., Aszalós, J., Heiling, Zs., Ignéczi, Á., Kapui, Zs., Király, Cs., Leél-Őssy, Sz., Nagy, B., Nemerkényi, Zs., Pál, B., Skultéti, Á. and Szalai, Z. 2020. Cold, dry, windy and UV-irradiated: Surveying Mars-relevant conditions in Ojos del Salado Volcano (Andes Mountains, Chile). *Astrobiology* 20. (6): 677–683. Available at https://doi.org/10.1089/ast.2019.2165

Kereszturi, Á., Aszalós, J., Heiling, Zs., Ignéczi, Á., Kapui, Zs., Király, Cs., Leél-Őssy, Sz., Szalai, Z., Nemerkényi, Zs., Pál., B., Skultéti, Á. and Nagy, B. 2022. Wind-snow interactions at the Ojos del Salado region as a potential Mars analogue site in the Altiplano-Atacama Desert region. *Icarus* 378. Available at https://doi.org/10.1016/j.icarus.2022.114941

Kull, C., Grosjean, M. and Veit, H. 2002. Modelling modern and Late Pleistocene glacio-climatological conditions in the North Chilean Andes (29–30° S). *Climate Change* 52. 359–381. Available at https://doi.org/10.1023/A:1013746917257

Ladd, E., Shea, K.M., Bagley, P., Auerbach, P.S., Pirrotta, E.A., Wang, E. and Lipman, G.S. 2016. Hydration status as a predictor of high-altitude mountaineering performance. *Cureus* 8. (12): e918. Doi: 10.7759/cureus.918

Marek, A. and Wieczorek, M. 2015. Tourist traffic in the Aconcagua massif area. *Quaestiones Geographicae* 34. (3): 65–76. Available at https://doi.org/10.1515/quageo-2015-0022

Milana, J.P. 2009. Largest wind ripples on Earth? *Geology* 37. (4): 343–346. Available at https://doi.org/10.1130/G25382A.1

Nagy, B., Ignéczi, Á., Kovács, J., Szalai, Z. and Mari, L. 2019. Shallow ground temperature measurements on the highest volcano on Earth, Mt. Ojos del Salado, Arid Andes, Chile. *Permafrost and Periglacial Processes* 30. (1): 3–18. Available at https://doi.org/10.1002/ppp.1989

Nagy, B., Kovács, J., Ignéczi, Á., Beleznai, Sz., Mari, L., Kereszturi, Á. and Szalai, Z. 2020. The thermal behaviour of ice-baring ground: The highest cold, dry desert on earth as an analog for conditions on Mars, at Ojos del Salado, Puna de Atacama-Altiplano region. *Astrobiology* 20. (6): 701–722. Available at https://doi.org/10.1089/ast.2018.2021

Nüsser, M. and Dame, J. 2015. Der Ojos del Salado in der Atacama: Forschungsgeschichte und aktuelle Probleme im trockensten Hochgebirge der Erde. *HGG-Journal* 29. 78–93. Available at https://katalog.ub.uni-heidelberg.de/titel/67976037

Rohnfelder, A. 2021. *Volcanic 7 Summits*. New York, TeNeues Publishing Company.

Romero, J. 2014. *No Summit out of Sight*. Sydney, Simon & Schuster Books.

Servicio Nacional de Turismo 2006. *Declara zona de interes turistico nacional el area Salar de Maricunga – Volcan Ojos del Salado, en la region de Atacama.* Servicio Nacional de Turismo Resolucion 662. 10 July 2006, Metropolitana de Santiago, Chile. Available at https://www.sernatur.cl/wp-content/uploads/2018/10/Plan-de-Accio%CC%81n-Atacama Available at https://www.bcn.cl/leychile/navegar?idNorma=252086

Servicio Nacional de Turismo 2014. *Plan de Acción, región de Atacama, Sector Turismo, 2014–2018.* Servicio Nacional de Turismo Uploads. Metropolitana de Santiago, Chile. Available at https://www.sernatur.cl/wp-content/uploads/2018/10/Plan-de-Accio%CC%81n-Atacama.pdf

Sterling, E.M., Arundel, A. and Sterling, T.D. 1985. Criteria for human exposure to humidity in occupied buildings. *ASHRAE Transactions* 91. (1): 611–622. Available at http://sterlingiaq.com/photos/1044922973.pdf

Stone, J. 2022. *Volcanic Seven Summiters – January 2022.* James Stone (Clach Liath) Blog. 11 January 2022. Available at https://clachliath.com/2022/01/volcanic-seven-summiters-january-2022/

Traver, M. 2020. *The Volcanic Seven Summits*. Explorersweb, e-publication, 21 January 2020. Available at https://explorersweb.com/the-volcanic-seven-summits/

Takada, S. and Matsushita, T. 2013. Modelling of moisture evaporation from the skin, eyes, and airway to evaluate sensations of dryness in low-humidity environments. *Journal of Building Physics* 36. (4): 422–437. Available at https://doi.org/10.1177/1744259112473951

Tsutsumi, H., Hoda, Y., Ohashi, H., Ezaki, Y., Harigaya, J., Tanabe, S.I. and Ishizawa, T. 2007. Effects of extremely low humidity on comfort and fatigue of Japanese occupants. Conference proceeding. In *Proceedings, 6th International Conference on Indoor Air Quality, Ventilation and Energy Conservation in Buildings: Sustainable Built Environment.* Sendai, Japan, IAQVEC Publication, 167–174.

Vuille, M. and Ammann, C. 1997. Regional snowfall patterns in the high, arid Andes. *Climate Change* 36. 413–423. Available at https://doi.org/10.1023/A:1005330802974

Vuille, M. 1999. Atmospheric circulation over the Bolivian Altiplano during dry and wet periods and extreme phases of the Southern Oscillation. *International Journal of Climatology* 19. 1579–1600. Available at https://doi.org/10.1002/(SICI)1097-0088(19991130)19:14<1579:AID-JOC441>3.0.CO;2-N

Vellei, M., Herrera, M., Fosas, D. and Natarajan, S. 2017. The influence of relative humidity on adaptive thermal comfort. *Building and Environment* 124. 171–185. Available at http://dx.doi.org/10.1016/j.buildenv.2017.08.005

Wilcox, C.A., Escauriaza, C., Agredano, R., Mignot, E., Zuazo, V., Otárola, S., Castro, L., Gironás, J., Cienfuegos, R. and Mao, L. 2016. An integrated analysis of the March 2015 Atacama floods. *Geophysical Research Letters* 43. (15): 8035–8043. Available at https://doi.org/10.1002/2016

DOI: 10.15201/hungeobull.72.1.3 Hungarian Geographical Bulletin **72** 2023 (1) 41–58.

Segments of the ancient cultural landscape in the "Hungarian corner" of Moravia: A valuable pre-industrial heritage

Jaromír KOLEJKA[1] and Eva NOVÁKOVÁ[1]

Abstract

After a brief historical overview, the paper discusses two basic types of natural and cultural heritage in the territory of the "Hungarian corner" of Moravia. For 300 years, this area called a *Campus Lucsco* in the southeast of today's republic was disputed territory between the Czech and Hungarian states. Settlement therefore proceeded slowly in waves depending on the political situation. The present international border was established around the year 1333. Numerous documents of the ancient landscape, probably of medieval origin, have been preserved in the current landscape. They are the ground plans of the cores of municipalities, whether they were founded by Czech or Hungarian landlords on one hand, and the remains of ancient land distribution in the form of narrow strips of agricultural land on the other hand. Other areas succumbed to land consolidation during land reforms in the 20th century. While the ground plans of the village cores are only subject to minor changes, the small-scale use of land is still threatened by further merging. The ground plans of the municipalities and land division at the present time (in colour orthophoto maps) were visually compared with the situation documented by the stable cadastre maps from the 1820s–1830s (see *Figure 3*). Only identical areas in both sources represent urban and rural segments of the pre-industrial landscape, whose roots go back to the dated Medieval Ages. They are documented on selected representative examples well-preserved ground plans of village cores, probably of integrated Hungarian and Czech origin. Similarly, well-preserved examples of the ancient division of agricultural land in flat and dissected terrain both with poly-functional and mono-functional land use are demonstrated. The best-preserved remnants of the ancient pre-industrial landscape are equal in value to protected areas of nature and cultural monuments. Their number and quality these remnants are threatened by economic pressure.

Keywords: disputed territory, Bohemian Kingdom, Hungarian Kingdom, historical heritage, village ground plans, segments of pre-industrial cultural landscape

Received December 2022, accepted February 2023.

Introduction

The landscape changes in front of our eyes not only from year to year but also between seasons as the crops in the fields change. The main driver of change (in addition to nature and its seasonal influences) is a human economic interest. It is a confirmed assumption that in many cases they lead, among other things, to the loss of genius loci, and create typical uniform landscape. Due to the rapid changes in the landscape, there is a growing interest in preserving at least a sample of typical cultural landscapes of the past as an important natural and cultural heritage, especially in the current period of rapid forms of urbanization, globalization and an increasing number of calamitous natural phenomena. Nevertheless, relatively small areas of the landscape of Moravia (eastern part of the Czech Republic) have been preserved where economic and social pressures do not seem to have worked, or where forms of coexistence between landscape and humans have been found.

[1] Department of Environmental Geography, Institute of Geonics, Ostrava; The Czech Academy of Sciences, Brno Branch, 28 Drobného, 60200, Brno, Czech Republic. Corresponding author's e-mail: jkolejka@centrum.cz

Traditions in management that are not very effective from today's point of view survive here to varying degrees and with varying manifestations. This special heritage of the past is made up of the areas where small land division and similar land use have been preserved as in the past. However, it cannot be forgotten that in the past there were also large aristocratic and ecclesiastical estates where large homogeneous areas were farmed, similarly to after the socialist collectivization of agriculture in the former Czechoslovakia. Nowadays, postmodern human society is focusing on natural and cultural or historical heritage and the issue of its preservation. Not only protected nature areas and historical monuments, including settlement cores but additionally industrial heritage is also becoming a focus of interest. Still the preserved common (not artificial leisure parks) cultural landscapes from the time before the industrial revolution remain somewhat on the sidelines. The aim of the contribution is to point out the historical heritage in the territory where the Czech and Hungarian power and colonization efforts were intertwined. A number of relevant testimonies have been preserved in the landscape to this day without entering the public's consciousness.

The concept of ancient cultural landscapes

The ancient cultural landscape genetically predates the emergence of a traditional civil society based on civil rights and freedoms guaranteed by the constitution on the one hand, and a society realizing mass production of goods with using machines powered by energies also produced by machines on the other hand. It was formed before the era of industrial society, which revolutionized the character of developed countries.

UNESCO considers remnants of ancient landscapes to be valuable natural and cultural heritage (e.g. Mitchell, N. *et al.* 2009) and defines (ancient) cultural landscapes as "*the combined works of nature and people reflecting the long and intimate relationship between people and their natural environment*". The term 'cultural landscape', thus, encompasses the diversity of manifestations of interaction between humanity and its natural environment (UNESCO 2007). An ancient cultural landscape in the conditions of the Czech Republic or even Europe can be considered as an area whose cultural parameters were established in the period preceding the advent of industrial society.

Thus, the ancient cultural landscape may have been created during the transition from feudal to bourgeois society. In Europe and other continents or countries this transition took place at different times. The main wave of the Industrial Revolution and the industrial society that followed it came in the second half of the 19th century in the Czech lands. Thus, the cultural landscapes in the Czech lands that were created before 1850 and still retain their key characteristics can be considered ancient landscapes. In the peripheral areas of the contemporary Czech Republic, settlement took place in the form of colonization. These took place in several waves with the most extensive one in the 13th and 14th centuries. Extensive changes in property ownership were caused by the defeat of the Czech estate uprising in 1618–1620 and after the 30 Years' War when foreign military nobility acquired around half of the Czech lands. Nevertheless, it can be assumed that changes in ownership and in some places depopulation did not fundamentally change the character of the division of the territory into individual plots. One of the last territories of medieval colonization was the area of the Lucké Pole (*Campus Lucsco*) on the border of the Czech state and Hungary due to its long-unresolved nationality.

Historical sources and analysis outcomes

Lucké pole – disputed territory

The south-eastern edge of Moravia within the Czech state on the border with the Kingdom of Hungary between the Morava and Olšava rivers in the west and north on the one hand

and the international border with Slovakia (formerly known as Upper Hungary) in the south and east still bears traces of ancient affiliation from the Lucké pole (*Campus Lucsco*) on the other hand. This region, originally extending to the Váh (*Vagus*) river near Trenčín, the ridge of the Little Carpathians and the Danube river *(Figure 1)*, represented a buffer area (Válek, D. 2009) between the Czech and Hungarian states (called "confinium" on the Hungarian side), was a "terra nullius" (no man's land) for more than 200 years to varying degrees. This territory, with a maximum area of around 4,148 km^2, served to prevent border disputes in the absence of a precisely defined border. Both sides monitored the territory in a certain way and, thus, had time to prepare inland for a possible attack, which usually deterred the attacker from further progress. In addition, it was not possible to replenish supplies here.

In the 8th–10th centuries the core of the territory of the Great Moravian Empire was located here. Both successor states showed interest in this disputed territory, which led several times to conflicts. The strategies for controlling the disputed territory differed for both states. The Hungarian rulers built advanced fortified positions (castles) in the disputed territory and later colonized the surrounding territory. The Czech rulers first secured fords across the border rivers of the disputed territory, and from them colonization progressed into the interior of the "confinium". The greater part of the "confinium" was deliberately uninhabited, or even deliberately ravaged and abandoned ("Gyepüelve" in Hungarian).

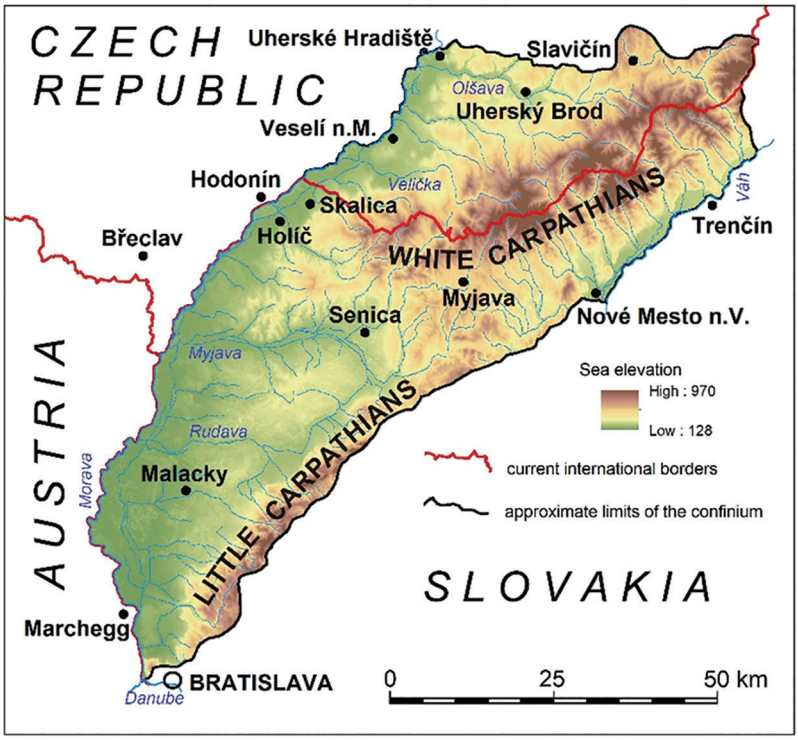


Fig. 1. Historical disputed territory between the Czech and Hungarian states at the beginning of the 11th century. All geographical names are in their current form. *Sources*: Authors' own elaboration, colour hypsometry, watercourses and state borders according to Arc CR 500.

From the Czech side, castles gradually arose (from north to south) along the western bank of the Morava river in Spytihněv, Stěnice (later the town of Uherský Ostroh, Eng. trans. Hungarian Promontory, Magyarsárvár in Hungarian), Bzenec (1015), Hodonín and Břeclav from the first half of the 11th century during the reign of Prince Břetislav I. Later in the 13th century the northern bank of the Olšava river was similarly fortified by the royal towns of Uherské Hradiště (1253, Eng. transl. Hungarian Fortress, Magyarhradis in Hungarian) and Uherský Brod (1272, Eng. transl. Hungarian Ford, Magyarbród in Hungarian) and the Brumov Castle (1225), although a customs house was located on the site of the later Uherský Brod from the year 1030.

On the Hungarian side, the consolidation of the possession of part of the "confinium" was carried out by building outposts along the *Via exploratorum* from Považie (the Váh River Valley) over the ridge of the White Carpathians to the Olšava valley and the "Bohemian Trail" from Trnava to the Chvojnice River Valley. Hungarians entered the "confinium" and conquered the localities of today's Bánov and Slavičín at the end of the 11th century. The predecessors of today's Czech Uherský Brod (probably in 1049) and Bánov (1091) were founded in the wider area of the "*Via exploratorum*". However, this territory have been in the hands of the Czech monarch since 1139 at the latest. Along the longer "Czech trade route" the advanced castle Holíč is mentioned in the middle of the 12th century and the Skalica castle in 1209. The nearby Šaštín castle, then probably on the Hungarian-Austrian border, is first mentioned in 1018. At that time, the next and probably the last significant Hungarian points beyond the Little Carpathians were probably Senica (mentioned in 1217) and Sobotište. The pressure to control the largest possible parts of the "confinium" continued on the side of both kingdoms. Temporarily held and permanent occupations gradually reduced the extent of "no man's land". From approximately the middle of the 13th century, the division of the "confinium" took place practically without any remainder, in the form of "pushing interests" from both sides *(Figure 2)*.

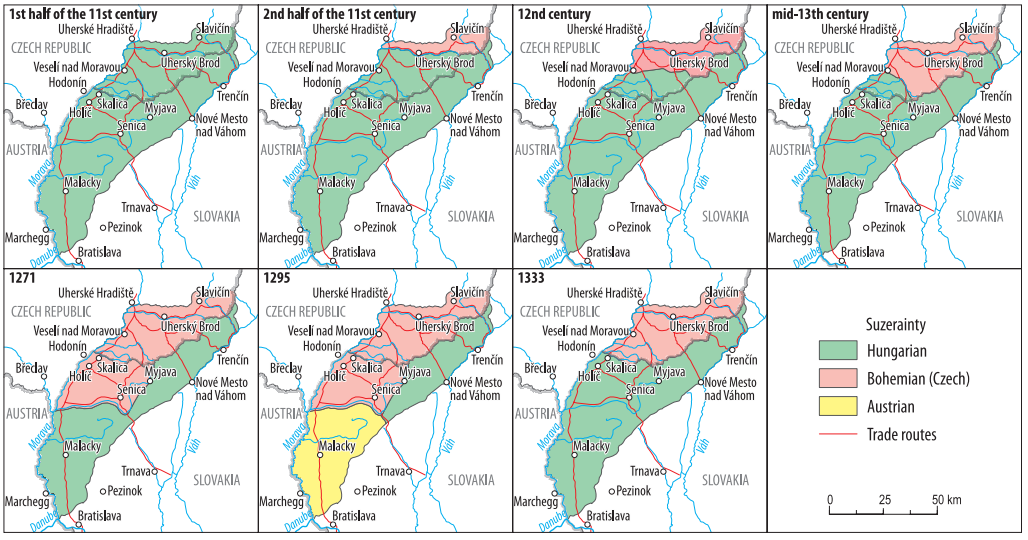


Fig. 2. Changes of suzerainty over the "confinium" in the course of time with approximate borders. All geographical names are given in current wording. *Source*: Authors' own processing.

The definitive agreement on the division of this territory was reached between the Bohemian King John of Luxemburg and the Hungarian King Charles Robert of Anjou only after the death of Matthew Csák (1321), the Hungarian magnate who controlled the Vagus Region and the other part of Upper Hungary. Matthew Csák (Matúš Čák Trenčiansky in Slovak) caused considerable problems both on the Moravian and Hungarian sides of the border with his opposition to the centralization efforts of both monarchs (Zsoldos, A. 2013). Only then, with partial corrections, did the international border stabilize in approximately its current form around 1331–1333 (see *Figure 2*).

However, the actual colonization of the perimeter of the almost uninhabited territory began much earlier on both sides. Czech monarchs founded numerous castles and fortified settlements along the Morava and Olšava rivers starting at the beginning of the millennium. The royal towns of Uherské Hradiště (1253), Uherský Brod (1272) and Uherský Ostroh (1275) and some other smaller towns were mostly established later, on the site of older settlements. The actual colonization of the interior of the *Campus Lucsco* field began around 1250, when the border at the eastern edge of the "confinium" moved to the highest range of the White Carpathians. The starting points of this colonization were mostly located on the edge (on the Morava and Olšava rivers) of the region and some within the perimeter. Only a very small number of settlements existing before the division of the *Campus Lucsco* (perhaps Hluk, Velká and Blatnice pod Sv. Antonínkem) could function as a focus of colonization from within. The systematic settlement of the divided territory of the former "confinium" could, thus, fully develop only during the reign of the first Luxembourgers on the Czech throne. At that time, there was probably a characteristic, and in some places still visible, division of the land into typical narrow "colonization" belts, usually running perpendicular to the axis of the long valley villages. The Czech part of the former "confiniun" is part of the ethnographic region of Slovácko. Its foothill part is called "Dolňácko" (Lower Land) and the mountain part is called "Horňácko" (Upper Land).

Research methods and data

Historical landscape heritage of the "Hungarian corner" of Moravia in the contemporary landscape can be identified in two forms: 1) the historical cores of settlements, and 2) the remains of an ancient organization of agricultural land. These are the results of ancient human activity, which most likely originated here already in the High Middle Ages and which have been preserved in the present landscape in a minimally altered form to this day. The research was based on the hypothesis that stable cadastre maps document the results of the development of municipalities and the surrounding cultural landscape from the Middle Ages to the emergence of industrial society in the Czech lands traditionally dated after 1850.

As expected, both these types historical cultural heritage are presented in old maps and current cartographic documents. The searching for segments of the pre-industrial landscape was carried out according to a certified methodology *(Figure 3)* applicable elsewhere (Kolejka, J. *et al.* 2018).

Relatively reliable cartographic documents about the ground plan of the settlement cores and land division can be found in Habsburg military maps and especially in the stable cadastre in Moravia from the 1820s–1830s. The actual procedure of inventory of remnants (segments) of the ancient pre-industrial cultural landscape was carried out on-screen comparing visually landscape appearance in the recent colour orthophoto map (publicly available at Mapy.cz) with publicly available old maps of the stable cadastre (in the administration of the Moravian Land Archive – www.mza.cz) cadastre after the cadastre both off-line and on-line. In total, it was necessary to "visit" electronically 108 cadastral areas of the historic land of "confinium" in the territory of Czech Republic. The original intention to use image analysis procedures to search for a characteristic land use mosaic in the current ortho-

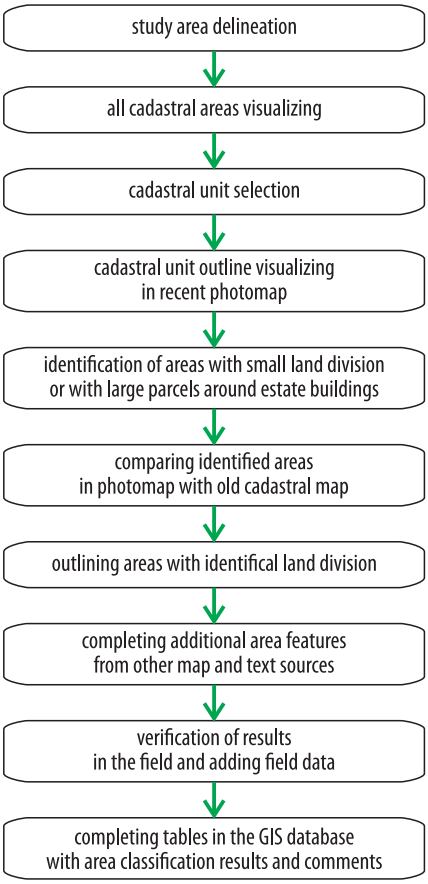


Fig. 3. Inventory flow chart of remnants of the ancient cultural landscape. *Source*: Authors' own processing.

photo map failed due to the extreme variety of patterns sought as mentioned in the introduction: small land division, remnants of landlord estates and town/village cores. Subsequently, the knowledge obtained about the segment of the old landscape was verified in the field.

Historical heritage as research results

Preserved ancient settlement cores

The research led to the identification of the cores of municipalities (towns and villages) where it is highly probable that only minor changes influenced them in later periods. They did not arise until 700 to 800 years after the existence and demise of the "confinium" on the border of the medieval Czech and Hungarian states. Certain support can be found in the probable historical development of the "confinium" territory.

The river bed of Olšava at the northern edge of the "confinium" can be considered the oldest more or less documented border in the current territory of the formerly disputed region. The ground plan of the village of Nezdenice in the Olšava valley is remarkable: perhaps in the 17th century it still had a "Hungarian" part on the southern bank at the bend of the river and a "Moravian" one on the opposite bank. Unlike the later planned colonization settlements, it still had a chaotic layout and land division at the time of the cadastral mapping in 1828 *(Figure 4)*. The ground plan of the

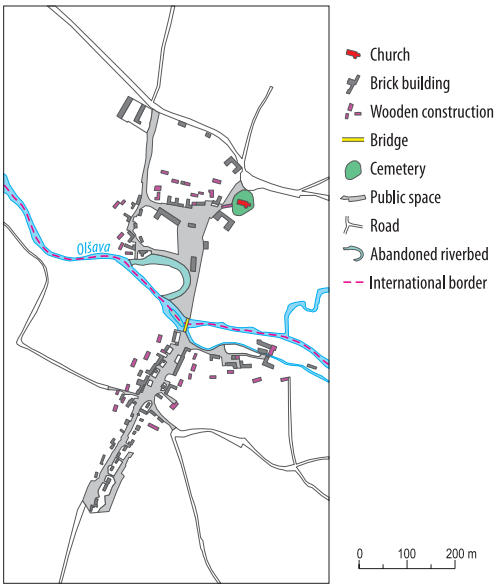


Fig. 4. The street and road network and the distribution of buildings in the village of Nezdenice on the river Olšava (according to the imperial imprint of the cadastral map from 1828) shows two urbanization cores, each on one side of the river forming the border between the territories with Czech and Hungarian sovereignty around the 11th century in the former "confinium". *Source*: Authors' own processing.

village with two "centres" has been preserved to this day. Both were probably separated by the border between the two states in the 11th century and connected by a ford or a bridge over the river. Each village centre was a node of a specific road network.

In the middle of the 13th century, the border probably ran more to the south on the river Veličká. A different development on the sides of the border can be inferred from the "double centre" of the village of Velká nad Veličkou *(Figure 5)*. This village was established in a relatively deep river valley, which opens to the north into slightly undulating terrain. In 1827, the two "centres" were connected by a ford in the places where the bridge is today. Also, each of these centres was served by a local road network. The village is the metropolis of the "Horňácko" sub-region in the ethnographic region of Slovácko.

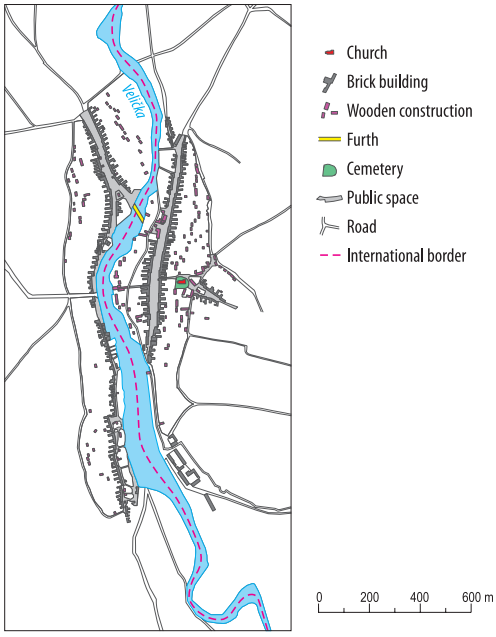


Fig. 5. The street and road network and the distribution of buildings in the village of Velká nad Veličkou on the river Veličká (according to the imperial imprint of the cadastral map from 1827) shows two urbanization cores, each on one side of the river probably forming the border between the territories with the Czech and Hungarian sovereignty within the former "confinium" around the middle of the 13th century.
Source: Authors' own processing.

The ground plan of the municipality of Blatnice pod Svatým Antonínkem *(Figure 6)* has an atypical appearance compared to other municipalities in the region of the "Hungarian corner" of Moravia (according to the stable cadastre map from 1827). It is located at the mouth of the Svodnice creek from the hilly terrain to the plain. Apparently, it was founded at the intersection of two important trade routes. According to some authors, the patronage of the municipal church of St. Andrew indirectly testifies to the Hungarian foundation of the village (Mudrik, M. 2020). This means that the village was in the Hungarian sphere of influence in the 12th century (Mitáček, J. 2016).

The originally Romanesque church of St. Andrew was rebuilt, but the first written mention of the village dates back to 1371 (Sedlář, J. 1999). According to the stable cadastre map, the land was divided into very small and very narrow parcels. To the west and to the south of the inner village, they are arranged parallel to the longer axis of the village and do not connect to the much wider gardens behind the individual houses, even if the terrain allows it. To the north of the village there are plots of land with vineyards perpendicularly arranged to the extended axis of the village, which is also unusual here (compared to the opposite side of the road). To the northeast of the village´s core, the division of land already has a typical character of colonization villages, and the plots in the form of narrow strips run up along the slope. However, they do not connect to the gardens behind the houses, but run up from wine cellars at the foot of the slope. The distribution of land in the south of the village closer to the building is made perpendicular to the longer axis of the village. It is immediately followed by strips of vineyards parallel to the longer axis of the village, but following the slope. Another peculiarity is the ancient parallel street to the northeast of the main street (axis) of the village.

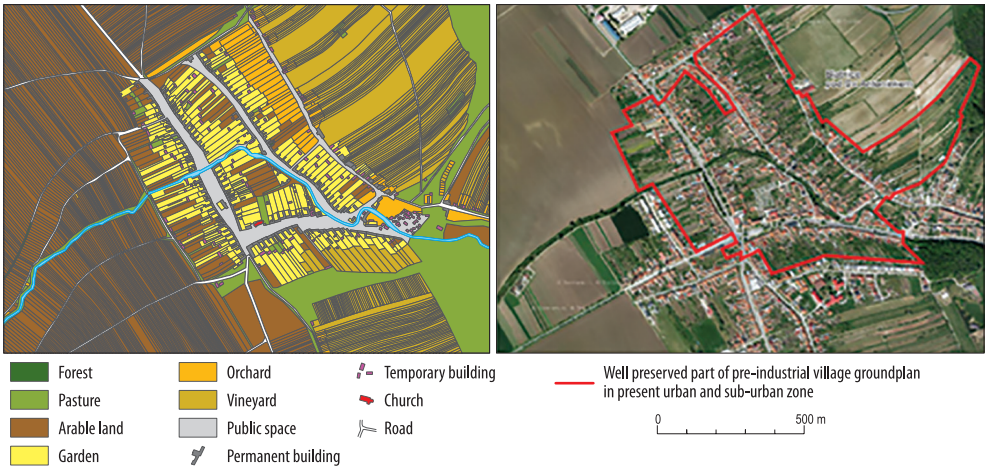


Fig. 6. The traditional wine-growing village of Blatnice pod Svatým Antonínkem was probably founded by Hungarians before the year 1200. It has preserved most of its medieval layout, what is unusual in Moravia. Land use in 1827 according to the imperial imprint of the cadastral map (left), the preserved part of the medieval ground plan of the village drawn in the current orthophoto 2018 (right). *Sources*: Authors' own processing of the cadastral map at www.mza.cz and orthophoto at Mapy.cz).

The ground plan of the core of the Hluk municipality and the division of agricultural land around it have a typical medieval colonization character. The historical core of the market town (since 1525), and standard town (since 1970) is located on a gentle slope above the Okluka river, sloping to the south, in the space of an inconspicuous corridor connecting the rolling landscapes to the east and west of the municipality through the significantly deep and narrow valley. The buildings were laid out along the widened main east–west road. Church property (according to the stable cadastral map from 1827) adjoins the centre of the settlement from the north (St. Lawrence), and the landlord´s castle from the south *(Figure 7)*. Hluk was perhaps one of the Czech colonization strongholds in the "confinium".

The core of the village Suchov *(Figure 8)* in the sub-region "Horňácko" (documented in the stable cadastre map from 1827) was formed on the watershed ridge between two streams along the road leading from the foothills to the White Carpathians. The village is first mentioned in 1500. The village bears the typical signs of medieval colonization. These are seen in the street-like character of the village centre at the line of extension of the through north–south road. The core is by a continuous development, which is followed by the regular division of the garden area at the back of the houses with approximately the same width as the street in front of the houses. Approximately perpendicular to the axis of the village, not only the division of the garden area takes place, but also parallel strips of arable land, regardless of the character of the terrain across the neighbouring valleys and ridges up to the border of the cadastre or the forest. South-west of the upper end of the village stood the Kanšperk castle, mentioned in 1360.

Remains of the ancient division of agricultural land

The remains of an ancient agricultural landscape represent an interesting type of landscape heritage here. In the territory of the Czech Republic, areas with a land use structure that has been preserved with minimal

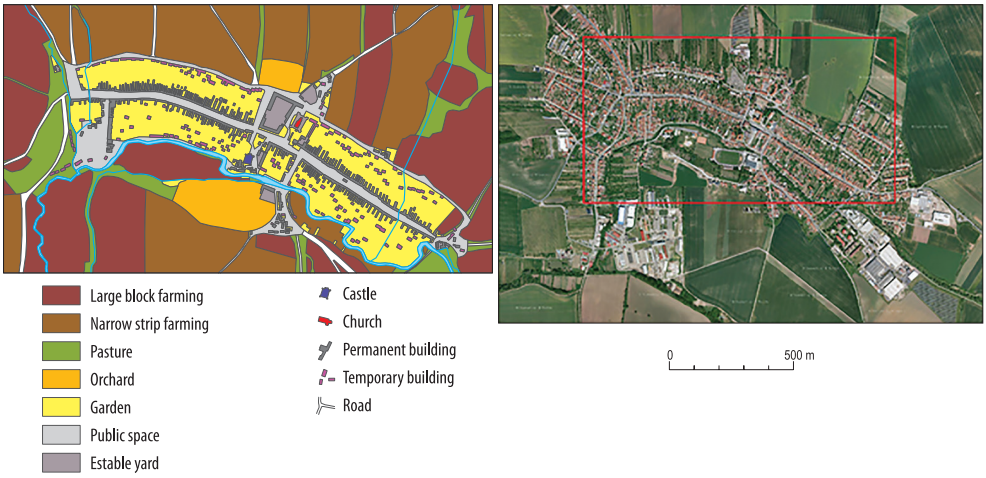


Fig. 7. The town of Hluk preserves well the medieval ground plan of the colonization village distributed along the main road with branching roads at both ends of the original development while the buildings of secular and religious administration are its centre. A simplified version of the land use in 1827 according to the cadastral map (left), the same territory on the recent 2018 colour orthophoto (right) shows the territorial growth of the city along all roads leaving the ancient core. *Sources*: Authors' own processing of the cadastral map at www.mza.cz and orthophoto at Mapy.cz

Fig. 8. The colonization village of Suchov was established at the foot of the White Carpathians along a long-distance trade road. While the ground plan of the medieval core (according to the cadastral map from 1827 on the left) practically did not change, the medieval division of land almost completely disappeared after the consolidation of land during the socialist collectivization of agriculture (according to the current 2018 orthophoto on the right). The development was supplemented by a large building of the agricultural cooperative (east of the centre of the village), and the former division of the land is now only indicated by strips of bushes on parts of the former edges. Sources: Authors' own processing of the cadastral map at www.mza.cz and orthophoto at Mapy.cz

changes since the compilation of the oldest available reliable cartographic documentation – detailed maps of the stable cadastre from 1820–1830 – can be considered such areas.

A small land holding serves as an indicator of the ancient landscape in the conditions of the Czech Republic. This is because of a series of land reforms and political upheavals, the most significant of which were related to the collapse of the Austro–Hungarian Monarchy and the subsequent land reforms, but especially to the socialist collectivization of agriculture after the WW2. Before 1850 there was also large-scale use of land on noble, church and city estates. However, a number of small land holdings arose from the redistribution of abolished large estates. The proof of the antiquity of the cultural landscape can be its reliable documentation in the period before 1850 only. The predominant type of rare segments of the ancient cultural landscape in the former "confinium" are areas with a small division of land, in contrast to the large-scale land use of the current cultural landscape *(Photo 1).*

Cultural landscapes have been categorized within the UNESCO World Heritage framework by origin, development and association with diverse events (according to IFLA 2017, modified).

1. Conceived cultural landscape. It includes garden and park landscapes constructed for aesthetic reasons.

2. Organically evolved landscape. It developed in connection with and in response to the natural environment. Two subcategories can be distinguished:

a) Relict or fossil landscapes where the evolutionary process ended sometime in the past.

Photo 1. Large-scale modern agriculture characterizes the current cultural landscape of the "Hungarian corner" around the town of Hluk (Photo by Kolejka, J. 2019).

b) Continuing landscapes are landscapes in which the development process is still ongoing.

3. Associative cultural landscape is a type that is related to cultural traditions. An associative cultural landscape is a physical place where the intangible aspects of cultural heritage are embodied.

Among the organically developed relict landscapes, ancient cultural landscapes represent the remains of perhaps larger territories in their surroundings, which, however, have succumbed to the processes of innovation and lost their original character. An overview of historical cultural landscapes is available in the Czech Republic (Kuča, K. *et al*. 2020). However, only a small number of them show a land use structure comparable to the pre-industrial period. For the historical territory of Moravia, their inventory was carried out in the years 2016–2020 as part of the NAKI Program project of the Ministry of Culture of the Czech Republic under the title "Inventory of the pre-industrial landscape of Moravia and ensuring public awareness of its existence as cultural heritage" at the Institute of Geonics of the Academy of Sciences of the Czech Republic in Ostrava.

A considerable attention is paid to the ancient landscape in the contemporary scientific community from a number of points of view. The history of interest in the medieval landscape dates back to the middle of the 19th century, especially in the Anglo-Saxon world (Rippon, S. 2018). Aspects of the reconstruction of such a landscape to a specific period, questions of its functioning (White, D. and Graeme, J. 2012), the state of property conditions (Hull, D. 2001), dramatic stages of change and their causes (Houfková, P. *et al.* 2015) or their current role (Hronček, P. *et al*. 2022) prevail. Attention is paid to selected types of objects (primarily sacral, feudal settlements), the character of settlements and communications, usually at the local level (e.g. Stamper, P. *et al.* 2018). Somewhat aside of interest is the covering search for the residuals of the ancient landscape in the current landscape.

An example of a successful inventory of pre-industrial landscape segments of all sizes is the region of the Flemish Community in Belgium, where a sample inventory and classification of the identified areas was carried out, as well as the incorporation of findings into regional legislation and spatial planning practice (van Eetwelde, V. and Antrop, M. 2005). The Belgian inventory process was based on the comparison of high-quality old maps from the end of the 18th century and contemporary aerial photographs with subsequent verification of selected areas in the field, following evaluation and recommendations. The Walloon Community of Belgium carried out a similar inventory on part of its territory. The remains of the old landscape were mapped in Saxony (Thiem, K. and Bastian, O. 2014).

There is a sample record of examples of "historical landscape structures" (Slámová, M. and Jančura, P. 2012) and "historical structures of the traditional agricultural landscape" in Slovakia (Špulerová, J. *et al.* 2016). In Slovakia, a nationwide inventory of the remains of the ancient landscape is also underway at the local level (see Hreško, J. and Petluš, P. 2015), with special attention paid to mountain areas (Hreško, J. *et al.* 2015).

Interest in the inventory of old landscape residues can be observed in the regions of Brittany in France ("bocage" type records), Alentejo in Portugal (forest-agricultural complex), Great Britain (Bunce, R.G.H. *et al.* 1996; Hull, D. 2001; etc.), the Netherlands (Mücher, C.A. *et al.* 2003), and Ireland (Simms, A. 2004). The European Convention on Landscapes also encourages member countries to pay attention to "ordinary" landscapes. The underappreciated remnants of old land use structures can be such a type of landscape (Council of Europe 2000). A number of researchers mainly express concern about the future of the remains of the ancient cultural landscape.

Within the framework of the above-mentioned project, the research team identified 31 areas with preserved pre-industrial landscape structure *(Figure 9)* on the territory of the former "confinium", comparing the current orthophoto map with the old maps of

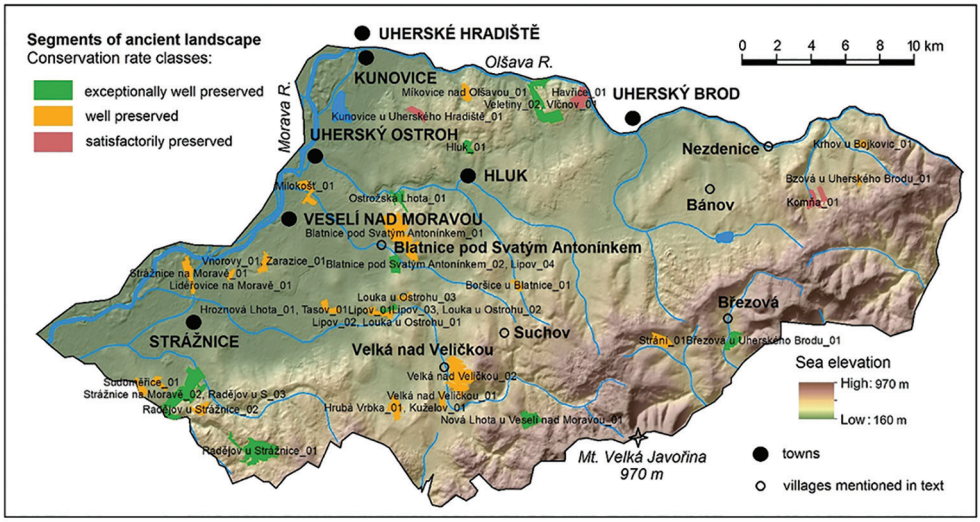


Fig. 9. "Hungarian corner" in Moravia with the remains of the ancient cultural landscape. *Sources*: Authors' own processing, elevation map and rivers based on the Arc CR 500 data.

the stable cadastre. An overview of its basic features was compiled for each such segment of the ancient landscape *(Table 1)*. An important part of the acquired information is the evaluation of the current state of each detected remnant of the old landscape, or a qualified estimate of its degree of preservation, and determination of the main forms of threat. These facts are then followed by proposals for framework management measures.

The qualitative classification of pre-industrial landscape (PreIL) segments according to their current state or degree of preservation distinguishes *(Table 2)*:

Segments marked as 'exceptionally well preserved' (level 1) – they have maximally preserved original land division and also in general the representation of the original land use forms, including edges; they show some only isolated differences from the state on the imperial impressions of cadastral maps.

Segments marked as 'well preserved' (level 2) – have significantly preserved original land division, but the representation of original land use forms has not been preserved: there has been a change of cultures, tree overgrown plot edges, or a change of the pattern of land use forms, but the visual landscape character has basically been preserved.

Segments marked as 'satisfactorily preserved' (level 3) – show mostly preserved land division (some originally separate plots are unified) and the share of original land use forms changed; non-native land use forms are introduced (orchards and vineyards on allotments, cottages, etc., threats are abundant).

The size classes of the PreIL segments (see *Table 2*) are determined conventionally.

The identified remnants of the ancient cultural landscape with small land parcels are a rare historical natural and cultural heritage. in the current landscape, clearly dominated by large homogeneous areas of arable land, permanent crops (vineyards and orchards, or meadows) and forest. The ancient landscape segments with the highest level of preservation can be categorised as historical and natural heritage, similarly such as the region's architectural monuments and nature and landscape reservations. Because of a large part of the area of interest has a slightly undulating terrain, the most valuable surviving

Table 1. Basic parameters of the pre-industrial landscape (PreIL) segment Hluk

The name of the pre-industrial landscape: Hluk	Region: Slovácko	Geographic coordinates of the centre of gravity: 48°59′59.9″N 17°31′17.9″E	Number of local segments in given cadastral territory: 1
Location in Moravia: Zlín Region, District of Uherské Hradiště, Vizovická vrchovina Upland (Hlucká pahorkatina Hillyland)			

PreIL classification criteria						
Cadastral territory: Hluk	PreIL segment code in the geodatabase: Hluk_01	Total area: 28.64 ha	Size category: PreIL area	Use of plots: Narrow strips of mainly orchards with grass, less arable land leading regardless of terrain to the distant axis of the village, cottages	Degree of preservation: 1–2	Threats: Land pooling, and land abandonment

Natural characteristics						
Location in terrain	Altitude, m	Climate	Slope	Aspect	Geology	Soil
			% of total			
Two slopes undulating central part of the high escarpment away from the village	245–321	W2	90 G 10 S	50 SE 30 S 20 SW	80 flysch sandstones and clay stones 10 mixed sediments	100 modal luvisols
Recommendation: Maintain current use, especially to prevent the merging of parcels.						
Explanations: G – gentle (3–15°), S – steep (more than 15°), SE – south-east, S – south, SW – south-west						

Source: Authors' own processing.

Table 2. Classification of segments of the pre-industrial landscape

Size classification			Quality classification		
Size, ha	Size category	Number	Preservation level	Preservation category	Number
0–50	area	17	1	exceptionally well preserved	9
51–100	district	9	2	well preserved	19
over 100	union	5	3	satisfactorily preserved	3
Total		*31*	*Total*		*31*

Source: Authors' own processing.

remnants of the ancient landscape are preserved more in the dissected terrain, which was not reached by the efforts to combine plots into large blocks during the socialist collectivisation of agriculture.

The state of the landscape in the 1820s is very similar to a small area (28.64 ha) north of the town of Hluk *(Figure 10).* As in 1827, it is now dominated by a mixture of permanent crops (orchards), arable land and pastures running in narrow strips down slopes. The site is located on the slope open to the south. However, compared to the situation at the beginning of the 19th century, almost all the wooden huts at the foot of the slope have disappeared. Similar objects are now irregularly located at different heights in different strips of land *(Photo 2).*

A small area (55.11 ha) on the flat to slightly sloping valley floor south of the village of Březová demonstrates the significant predominance of arable land strips. Here the style of land arrangement is well preserved, but it is quite common for adjacent plots to be combined for common use from year to year *(Figure 11).* Compared to the situation in 1828, the route of the main north–south

Fig. 10. Evidence of the practical conformity of the use of the ancient landscape area north of the town of Hluk (on the left the current state of use - according to the recent orthophoto map from 2018, on the right the state in 1827 according to the imperial imprint of the cadastral map. *Sources*: Authors' own processing, orthophoto map – Mapy.cz, imperial imprint – www.mza.cz

Photo 2. The segment of the ancient cultural landscape north of the town of Hluk with multifunctional land use similar to the state at the time of cadastral mapping about 200 years ago (Photo by Kolejka, J. 2019).

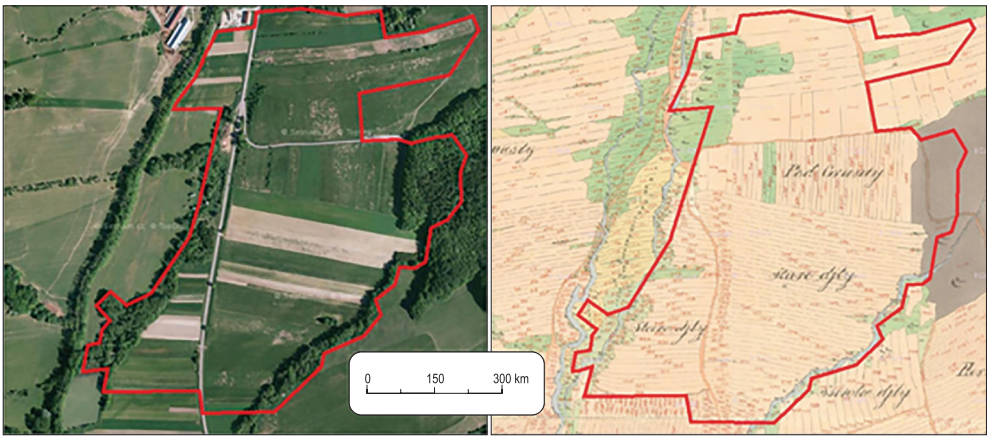


Fig. 11. Example of great similarity of current and ancient landscape use in the area south of the village of Březová (on the left the current state - according to the recent orthophotomap from 2018, on the right the state in 1828 according to the imperial imprint of the cadastral map. *Sources*: Authors' own processing, orthophoto map – Mapy.cz, imperial imprint – www.mza.cz

valley road has changed, some field roads have disappeared, watercourses have been straightened, and the pasture areas adjacent to the streams have become overgrown with shrubs and low trees. The overall character of this section of the cultural landscape in the White Carpathians has not changed substantially in almost 200 years *(Photo 3).*

Discussion

At the present time of very rapid economic and social changes, changes are taking place in the landscape, especially in its use. Driving forces are mainly represented by the pressure to further intensify land use on the one hand, while on the other hand, in LFA it is the abandonment of land, or the transition to extensive use. Professional groups, the territorial administration, but also the lay public pay significant attention to these often dramatic changes. Society's attention is increasingly turning to the past. Its manifestation is, among other things, UNESCO's growing efforts to ensure the protection and sustainable development of the network of world heritage sites. As of 2020, there were a total of 114 cultural landscapes of all types (see IFLA, 2017) on the list of World Heritage Sites out of a total of 1,121 UNESCO sites (Brumann, Ch. and Geller, A.E. 2022). They are usually represented by larger areas. So far, however, few countries have carried out a national or at least a regional inventory of the remains of the ancient cultural landscape (Hull, D. 2001; van Eetwelde, V. and Antrop, M. 2005; Thiem, K. and Bastian, O. 2014) and attempted to classify them (Jelen, J. *et al*. 2021).

In the historical territory of Moravia, this process also took place in the "Hungarian corner", where, in addition, the beginning of the formation of these remains can be fairly accurately dated from the historical context thanks to the delayed stage-like colonization (settlement) of the disputed territory. This represents a significant difference compared to similar initiatives, where the establishment of old landscapes is usually not known, or it concerns a relatively recently created cultural landscape. However, only a very small part of the extraordinary extensive professional literature (usually oriented towards local issues, or protection, or individual assessment,

Photo 3. Very rare example of preserved medieval land use in the form of narrow plots of arable land in slightly sloping terrain south of the village of Březová in the White Carpathians (Photo by Kolejka, J. 2018).

peculiarities or history of the historical landscape) is devoted to methods of identification and classification of small remnants of the ancient cultural landscape. The contribution of this contribution, thus, consists in: 1) practical application and verification of the inventory method of the remains of the old landscape at the regional level, 2) subsequent attention paid to the area with the possibility of relatively accurate dating of the foundation of these remains, 3) development of a qualitative classification of the remains of the old landscape according to the degree of preservation, 4) presentation of procedures on the historically specific territory of the former disputed territory between the Czech and Hungarian states.

Conclusions

There is a relatively dense network of nature conservation areas, historical buildings and areas in the Czech Republic. Segments of the ancient cultural landscape as joint products of nature and human activities are also numerous. No one among them could be included in the UNESCO categorization as "relict or fossil" organically developed landscapes due to small dimensions.

In the conventionally defined region of the "Hungarian corner" in Moravia, settlement and use of the landscape took place in a politically uncertain area in waves depending on the power situation of each period. That is why there are still evidences of the activities of both the Czech and Hungarian medieval states in the territory, which has no equivalent in the Czech Republic. Thus, to this day, forms of landscape heritage of Czech and Hungarian origin exist side by side (both in urbanized areas, or in open landscape). Many localities were practically untouched by modernization efforts in the past and represent remnants of the ancient landscape.

The identified areas of such landscape heritage have been carefully recorded, but now it is necessary to inform the professional community, the territorial administration and the general public about the results of the research in order to be able to formulate society's relationship to such places to find suitable forms of its protection in the future and also to present them as very attractive objects of tourist interest, in the given case also of international tourism. They can serve as important object of public interests or educational destination (Rátz, T. *et al.* 2020).

The value of the best-preserved localities is comparable to areas of preserved nature and historical cultural monuments. It should also be noted that the economic pressure on a number of identified areas in the open landscape and in developed areas is considerable. Between the years 2020–2022, two valuable sites of the ancient landscape disappeared. It is therefore appropriate to interest the local public and the authorities in spreading awareness about the value of the identified sites, and about their potential contribution to municipalities and the region. All identified locations are available on the Internet (http://arcgis.adbros.com/project/detail/6) at a resolution corresponding to a scale of 1:10,000 and larger, so they can be respected in planning activities at all levels.

***Acknowledgement*:** The inventory and research of segments of the pre-industrial landscape took place within the project "Inventory of the pre-industrial landscape of Moravia and ensuring public awareness of its existence as a cultural heritage", supported by the Ministry of Culture of the Czech Republic under No. DG16P02B042.

REFERENCES

Brumann, Ch. and Gfeller, E.G. 2022. Cultural landscapes and the UNESCO World Heritage List: perpetuating European dominance. *International Journal of Heritage Studies* 28. (2): 147–162. Doi:10.1080/13527258.2021.1941197

Bunce, R.G.H., Barr, C.J., Clarke, R.T., Howard, D.C. and Lane, A.M.J. 1996. ITE land classification of Great Britain. *Journal of Biogeography* 23. (5): 625–634.

Council of Europe 2000. *The European Landscape Convention.* Strasbourg, CE Publication.

Houfková, P., Bumeri, J., Pospíšil, L., Karlík, P. and Hejcman, M. 2015. Origins and development of long-strip field patterns: A case study of an abandoned medieval village in the Czech Republic. *Catena* 135. 83–91.

Hreško, J., Petrovič, F. and Mišovičová, R. 2015. Mountain landscape archetypes of the Western Carpathians (Slovakia). *Biodiversity and Conservation* 24. (13): 3269–3283.

Hreško, J. and Petluš, P. (eds.) 2015. *Atlas archetypov krajiny Slovenska* (Landscape archetypes catalogue for Slovakia). Nitra, Univerzita Konštantína Filozofa.

Hronček, P., Gregorová, B. and Weis, K. 2022. Medieval religious landscape and its use in religious tourism. Case study of the early gothic church Koscielisko surroundings in Kysuce, Slovakia. *GeoJournal of Tourism and Geosites* 41. (2): 571–582.

Hull, D. 2001. *Turning the Plough. Midland open fields: landscape character and proposals for management.* Northampton, Northamptonshire County Council. Available at https://www.cheltenham.gov.uk/downloads/file/9196/h9_-turning_the_plough_ midland_open_fields_landscape_character_and_proposals_for_management_david_hall_dated_may_2001

IFLA 2017. *UNESCO World Heritage Cultural Landscapes Definitions.* IFLA International Federation of Landscape Architects, Cultural Landscapes Committee. Available at https://iflaclc.org/definitions.html.

Jelen, J., Šantrůčková, M. and Komárek, M. 2021. Typology of historical cultural landscapes based on their cultural elements. *Geografie* 126. (3): 243–261. Available at https://doi.org/10.37040/geografie2021126030243

Kolejka, J., Batelková, K., Kirchner, K., Krejčí, T., Nováková, E., Ondráček, S. and Zapletalová, J. 2018. *Postup identifikace segmentů předindustriální krajiny v České republice. Certifikovaná metodika* (Procedure for identifying pre-industrial landscape segments in the Czech Republic. Certified methodology). Brno, Ústav Geoniky AV ČR, Oddělení environmentální geografie.

Kuča, K., Bendíková, L., Demková, K., Dostálek, J., Ehrlich, M., Fialová, Z., Klepárník, R., Krausová, V., Kučová, V., Kupka, J., Malina, O., Martinková Kuchyňková, H., Matějka, D., Matějková, H., Medková, L., Salašová, A., Sedláček, J., Šantrůčková, M., Šesták, O., Trpáková, L., Veith, T., Vondráčková, S., Vorel, I., Weber. M. and Žallmannová, E. 2020. *Historické kulturní krajiny České republiky* (The historic cultural landscape of the Czech Republic). Průhonice, Výzkumný ústav Silva Taroucy pro krajinu a okrasné zahradnictví v.v.i.

Mitáček, J. 2016. Fenomén „Lucké pole" nad otázkami a odpověďmi věčné záhady moravsko-slovenského pomezí (The Lucko Field phenomenon. Questions and answers about everlasting mystery of the Moravian and Slovakian border). *Studia Comeniana et Historica* 46. (95–96): 236–278.

Mitchell, N., Rössler, M. and Tricaud, P.-M. 2009. *World Heritage Cultural Landscapes. A Handbook for Conservation and Management.* World Heritage Papers 26. Paris, UNESCO.

Mudrik, M. 2020. *Prostupnost a ochrana hranic státu ve vrcholném a pozdním středověku. Archeologické doklady v moravsko-uherském hraničním a příhraničním území* (Transit and protection of the state border in the High and Late Middle Ages. Achaeological evidences in the Moravian-Hungarian border and border areas). MSc Thesis, Brno, Masarykova univerzita, Filozofická fakulta, Ústav archeologie a muzeologie.

Mücher, C.A., Bunce, R.G.H., Jongman, R.H.G., Klijn, J.A., Koomen, A.J.M., Metzger, M.J. and Washer, D.M. 2003. *Identification and Characterisation of Environments and Landscapes in Europe*. Wageningen (Alterra), Alterra rapport 832.

Rátz, T., Michalkó, G. and Keszeg, R. 2020. Educational tourism and nation building: cross-border school trips in the Carpathian Basin. *Hungarian Geographical Bulletin* 69. (1): 57–71. Available at https://doi.org/10.15201/hungeobull.69.1.5

Rippon, S. 2018. Understanding the medieval landscape. In *50 Years of Medieval Archaeology, 1957–2007.* Ed.: Gilchrist, R., London, Routledge, 227–254. Available at https://doi.org/10.4324/9781315089034

Sedlář, J. 1999. Umělecké památky (Artistic monumensts). In *Veselsko. Vlastivěda moravská.* Ed.: Nekuda, V., Řada topografická, sv. 66. Brno, Muzejní a vlastivědná společnost v Brně, 395–483.

Simms, A. 2004. Historical landscape studies in Ireland. *Belgeo / Belgian Journal of Geography* 2004. (2–3): 301–320. Available at https://doi.org/10.4000/belgeo.13698

Slámová, M. and Jančura, P. 2012. Typológia historických krajinných štruktúr (Typology of historical landscape structures). In *Krajina-človek-kultúra,* 15. máj. 2012, Zvolen, Technická univerzita vo Zvolene.

Špulerová, J., Dobrovodská, M., Štefunková, D., Piscová, V. and Petrovič, F. 2016. History of the origin and development of the historical structures of traditional agricultural landscape. *Historický Časopis* 64. (1): 109–126.

Stamper, P., Flatman, J. and Herring, P. 2018. *Medieval Settlements: Introductions to Heritage Assets.* Swindon, Historic England. Available at HistoricEngland.org.uk/listing/selection-criteria/scheduling-selection/ihas-archaeology/

Thiem, K. and Bastian, O. 2014. *Historische Kulturlandschaftselemente Sachsens.* Schriftenreihe, Heft 18, Dresden, Landesamt für Umwelt, Landwirtschaft und Geologie.

UNESCO 2007. *Convention Concerning the Protection of the World Cultural and Natural Heritage*. Christchurch, UNESCO World Heritage Committee.

Válek, D. 2009. *Středověká kolonizace Veselska* (The medieval colonisation of the area Veselsko). MSc Thesis, Brno, Masarykova univerzita, Filozofická fakulta.

Van Eetwelde, V. and Antrop, M. 2005. The significance of landscape relic zones in relation to soil conditions, settlement pattern and territories in Flanders. *Landscape and Urban Planning* 70. (2): 127–141.

White, D. and Graeme, J. 2012. *Medieval English Landscape, 1000–1540*. New York, Bloomsbury Publishing PLC.

Zsoldos, A. 2013. Kings and oligarchs in Hungary at the turn of the thirteenth and fourteenth centuries. *Hungarian Historical Review* 2. (2): 211–242.

Other sources:

Arc ČR 500 – ARCDATA PRAHA, ZÚ, ČSÚ (2014): ArcČR 500 digital geographical database, vs. 3.2. www.arcdata.cz (cit. 6. 12. 2022).

www.mza.cz – Moravian Land Archive, imperial imprints of cadastral maps.

Mapy.cz – orthophoto maps.

www.cuzk.cz – digital terrain model.

http://arcgis.adbros.com/project/detail/6 – open access database „Pre-industrial landscape of Moravia".

DOI: 10.15201/hungeobull.72.1.4 Hungarian Geographical Bulletin **72** 2023 (1) 59–74.

Gender features of the Kazakhstan labour market in the context of sustainable development

Gulnara NYUSSUPOVA[1], Gaukhar AIDARKHANOVA[1], Laura KENESPAYEVA[1] and Roza KELINBAYEVA[1]

Abstract

Kazakhstan is demonstrating its commitment to promoting gender equality and working closely with the global community. Over the past decade, the gender gap in the structure of labour force of Kazakhstan has slightly decreased. However, gender gaps persist. Women in Kazakhstan make up slightly more than half of the total population of the country, but their contribution to indicators of economic activity, growth and well-being of republic is significantly below their potential. In this article, gender dynamics of Kazakhstan labour market are explored at macro and micro levels using GIS. In this article, authors tried to answer the following questions: What is the gender situation in the labour market of Kazakhstan, as a country of Central Asia region with an Eastern mentality? Does the growing number of employed women lead to higher levels of gender equality in the Kazakhstan labour market? What are the characteristics of women's employment compared to men's? The results of research show that women's increased access to jobs has not led to a significant reduction in the gap in earnings and incomes between men and women. This is due to the gender segregation of vocational education, which lays the foundation for sectoral differentiation of employment with different geographical distributions. Also, the so-called "glass ceiling" or low accessibility to leadership positions hinders women's greater competitiveness. In addition, such an important element of labour market as unpaid domestic work, which is mainly occupied by women, is still not recognized.

Keywords: gender inequality, labour market, labour force, GIS, Sustainable Development Goals (SDG), human capital, regions, spatial differentiation.

Received May 2022, accepted January 2023.

Introduction

Significant progress has been made recently in moving towards gender equality, and the position and activities of the governments of several countries of the world have been characterized by a positive attitude towards this problem. Ensuring gender equality is one of the factors for achieving sustainable development and effective economic growth of the country and region. Despite the growing attention to the problems of gender inequality, professional segregation, and insufficient use of women's human capital in the economy, most countries are not able to overcome barriers to equal rights for men and women. The gender factor determines educational and career opportunities, influences the social status of an individual in society, influences professional self-determination and self-realization.

Representatives of various scientific schools of the 17th–18th centuries, studying market relations, paid attention primarily to men as active participants in production and social processes, not taking into account the subordinate position of women, who for a long time were not considered as social units, which did not allow assessing the domestic work of women and mothers as a process of reproduction of human capital.

The involvement of women in social production in the 18th–19th centuries did not lead to an

[1] Al-Farabi Kazakh National University, 71 al-Farabi Ave., Almaty, Republic of Kazakhstan. E-mails: gulnara.nyusupova@kaznu.kz, gaukhar.aidarkhanova@gmail.com, laura.kenespaeva81@gmail.com, zhar80@mail.ru

active study of the problem of social equality of the sexes, and the justification of discrimination against women by property relations excluded gender aspects from the analysis of society and caused gender deformation in the social policy of "real socialism" as classical Marxists declared (O Zhenskom Voprose… 1971).

Only in the 19th century researchers of the concept of "living productive forces" in the context of approaches to the assessment of human capital in their works, assessing the human capital of the nation, considered it as a combination of the male and female human capital of the country. This was the starting point for further gender-based labour market research by scholars such as Sinha, J.N. (1967), who looked at the impact of economic growth and education on women's labour force participation, Lincove, J. (2008) who studied the relationship between national income and women's labour market participation, Lam, D. and Duryea, S. (1999), Matas, A. *et al.* (2010), Contreras, D. *et al.* (2011) highlight the importance of education in women's labour force participation. Han, J-S. and Lee, J-W. (2020) made an analysis and assessment of human capital in terms of the composition of the labour force by age, gender, education and wage level.

Gender aspects of inequality in the world of work are described by different scientists using different bases. Kessler-Harris. A. (1982) explains the current position of women in the structure of labour relations through the concept of the ideology of the family, which for a long time kept women away from jobs, from reaching the heights of their profession, giving much more importance to their reproductive function.

Hartmann, H. (1976) argues that capitalism seeks to maintain a patriarchal society in which men can exercise control over women's labour, ensuring and protecting their own privileged position. In conditions where women are not allowed to enter highly paid and prestigious professions, they look at marriage as a means of resolving material problems and are ready to put up with domestic exploitation.

Game, A. and Pringle, R. (1983) in "Gender at Work" describe the situation of women working in the context of the development of computer technology. According to their observations, the growth of computerization did not lead to a decrease in labour market segregation, but only secured a certain area of professional activity in the field of information technology for women, blocking access to more prestigious activities.

Mies, M. (1986) in "Patriarchy and Accumulation on a World Scale", argues that considering housekeeping as a natural role for women means reducing her paid work to just a source of "additional" income, thus, justifying lower wages for women) and isolating women workers from each other and from working men (which prevents collective struggle in the workplace).

Agarwal, B. (2007) in her work on gender, property and power "Towards freedom from domestic violence" demonstrates that the ability of women to own and inherit property acts as a serious deterrent to spousal violence.

Women's empowerment is one of the 17 sustainable development goals. SDG 5 is not only a vital goal in its own right, but it is also a cross-cutting goal for all SDGs by virtue of the recognition that economic and social development depends on the achievement of gender equality (Bushati, B. and Galvani, A. 2017). The relationship of gender equality and religion, ethnicity, age and environment studied by Kumar-Pathania, S. (2017). Gender equality issues within the SDGs were also considered by Küfeoğlu, S. (2022) and Zampone, G. *et al.* (2022).

The majority of women in the world work long hours a day, although most of their work is related to family or childcare responsibilities, which prevents them from working outside the home (ILO, 2017). A study of the correlation between fertility and female employment showed that until the mid-1970s, a strong negative relationship prevailed in developed countries, but subsequently the correlation became low (Engelhardt, H. *et al.* 2004). This was due to greater availability of childcare services, family policies

(maternity leave), changing attitudes towards working mothers, and an increase in part-time jobs (Rindfuss, R. and Brewster, K. 2000). Although the balance between motherhood and employment is still negative in some developing countries, even though they are experiencing strong economic growth (Contreras, D. *et al*. 2011). Kern, L. explores gender processes from the point of view of geography, the role of a woman living in an urban environment (Sági, M. 2022).

Buribayev, Y.A., Khamzina, Z.A., Yermukhametova, S., Turlykhankyzy, K., Yessengazieva, A. and Oryntayev, Z. studied the possibilities of ensuring equal employment for men and women in Kazakhstan, proposed measures to improve legislation on labour protection and working conditions, improve working conditions, as well as the possibility of introducing and expanding flexible forms of employment, studied the role of international legal instruments in the formation of national methods for ensuring gender equality in Kazakhstan (see Buribayev, Y.A. and Khamzina, Z.A. 2019; Khamzina, Z. *et al.* 2022).

GIS tools have also been used to highlight issues of gender inequality. Brown, S. (2003) used field research and GIS to explore gender roles, responsibilities and workloads in a spatial context. Considered women's employment in Oman and modelled the women's employment rate based on GIS (Shawky, M. 2018). A GIS platform has been created to visualize gender inequality at the subnational level in the Lower Mekong region (see https://servirmekong.maps.arcgis.com/apps/webappviewer/index.html?id=3867739472d14d9f9f6bebb17f6f976b). Scientists from Shahid Chamran University studied and analysed women's socio-cultural barriers to using public transport in Iran using GIS tools (Goodarzi, M. *et al.* 2020). In the book edited by Ozdenerol, E. (2021), scholars have explored using the latest mapping and GIS applications, contemporary issues of gender inequality such as the visualization of gender dynamics at the macro and micro levels, the role of GIS in the context of gender inequality, the adaptation of GIS for the criminal justice response to domestic violence, and to address gender-based violence, spatial inequalities in gender representation across industries, social and environmental injustice faced by female migrant workers, a social vulnerability index is presented to identify spatial patterns of social vulnerability and gender inequalities.

The gender gap in the global labour force participation rate has narrowed. Despite the progress made, some gender gaps remain and greater efforts are needed to close them. In particular, the gender gap in unemployment remains large, especially for young women. In addition, women continue to be disproportionately represented among contributing family workers and in other forms of informal employment. Despite some improvements, women continue to face significant pay gaps caused by occupational segregation and discrimination, as well as different working hours compared to men in paid and unpaid work (Asif, I. *et al.* 2018).

According to World Bank research, women are excluded from working life in some societies. In the world, the share of working women is 49 percent, and the share of working men is 75 percent. Gender inequality persists in the distribution of power. Globally, women head less than 20 percent of all businesses (World Bank, 2019). Women work in economically less productive sectors and in occupations that offer potentially fewer opportunities for on-the-job learning.

In the process of employment, women face industry-specific legislative restrictions. In 65 countries women are prohibited from working in the mining industry, in 47 countries employment opportunities for women in the manufacturing industries are limited, and 37 countries do not allow women to work in the construction industry. Moreover, in 29 countries around the world, women have shorter hours of work than men (World Bank, 2019).

In the development strategies of international organizations, the problem of gender equality as a component of socio-economic development is perceived as an important direction of state policy.

The Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), adopted in 1979 by the UN, defines the imperative of equality in results, not just equality in opportunities: it is not enough to develop anti-discrimination laws, it is necessary to form a mechanism for their application in public life and the economy, to guarantee true gender equality, so that women enjoy equality in their daily lives. The dual goal of achieving gender equality should be taken into account: on the one hand, it is the expansion of opportunities and choices for women, on the other hand, the realization of national potentials for a positive response to the interests and problems of women.

In the Synthesis Report of the UN Secretary-General on the Sustainable Development Agenda prepared for the Global Summit (September 2015), 12 out of 17 goals are gender-sensitive. Of course, the position of women in the world over the past quarter century has undergone significant changes for the better in areas such as education and health care, as well as the level of employment in the labour market, sources of income.

And what is the situation in Kazakhstan, in the country of the Central Asian region with an Eastern mentality? What are the characteristics of women's employment compared to men's? With over a decade of experience in implementing a comprehensive gender equality strategy and an updated policy approved in 2017, Kazakhstan demonstrates an unwavering commitment to promoting equality between women and men.

Over the past two decades, Kazakhstan has committed itself to some international agreements, adopted many laws and developed government measures that have become a key condition for increasing the participation of women in public life. Based on the observance of international agreements, such as the Beijing Declaration and Platform for Action (1995), the UN Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) (1998), the Millennium Development Goals, the republic has developed its Gender Equality Strategy for 2006–2016, which until recently served as the main reference point for government activities in the gender area. In connection with the completion of the implementation of the Gender Strategy 2006–2016. The Government has prepared a Concept for Family and Gender Policy until 2030.

Programs within the framework of gender policy should be developed based on legislative and socio-economic factors, but it is also necessary to take into account the established ethno-economic and geopolitical conditions, including national and cultural traditions. However, the assessment of indicators of socio-economic development of the regions of the Republic of Kazakhstan indicates gender disproportions associated with existing national traditions, which is especially evident in the southern regions of the country due to various mental, national and religious characteristics that determine attitudes towards women. In the south of Kazakhstan, the population is territorially and historically closely connected with the peoples of Central Asia and adheres mainly to the views characteristic of eastern countries in relation to women. Whereas, the inhabitants of Northern, Northwestern, and Eastern Kazakhstan border on Russia, which causes the concentration of the European contingent in the regions and a more loyal attitude towards women (Shatrov, M. 2013; UN News. 2016; Representation… 2020).

Data and methods

This article assesses progress and gaps about gender equality and women's empowerment in Kazakhstan, based on information from global databases and available in the country, with a focus on the following key areas of SDG 5: women's access to decent work, low-paid female labour, increase in women's unpaid work, overrepresentation of women in the informal sector, women's participation in decision-making, women's and girls' access to education and training.

The analytical part of the study began with an analysis of the level of participation of women in the labour force of the Republic of

Kazakhstan in comparison with other countries. For country analysis, the statistical database of the International Labour Organization (ILO) was used. When selecting indicators, we relied on a system of indicators to track progress towards the SDGs and key ILO indicators. Also, these indicators seemed relevant to us, since in the analysis the gender imbalance was clearly expressed in them. The gender characteristics of some key demographic indicators, labour market indicators (Labour force participation rate, Employment rate, Employment by sectors of the economy, Wages, Employment in the informal economy, Unemployment, Unpaid domestic work) were analysed in the context of the regions of the Republic of Kazakhstan. For this purpose, statistics were collected for the last 20 years (2000–2021) from statistical collections, the "Taldau" information and analytical system, the national SDG reporting platform of the Bureau of National Statistics of the Republic of Kazakhstan to analyse gender dynamics in the context of the regions of Kazakhstan. Although gender statistics are available in Kazakhstan compared to other Central Asian countries, many indicators are missing at the micro level, which does not provide a clear picture of gender differences and hinders regional analysis of gender processes. The general legislative framework for statistics is generally gender-neutral.

For the assessment, a mixed methods approach was adopted, including spatial comparative, statistical analysis, GIS methods. Gathering gender statistics in a geographic context and retaining baseline location information can reveal patterns in data that would otherwise be missed, draw insights into gaps, missed opportunities and, ultimately, entry points for policy agendas. The use of GIS in the analysis of gender issues will help to identify spatial patterns of gender imbalance and with the presence of a relationship with the location of certain objects. GIS will allow not only to make a quantitative analysis, but also to bring the results to an understanding through visualization. The result of the spatial analysis will be thematic maps reflecting the results of the research work.

The geo-information part of the study is based on the scientific and methodological principles and ideas of the general theory of cartography of domestic and international integrated mapping. A geodatabase (DB) was developed on objective indicators of the labour market. The database consists of two types of information: statistical and spatial. Vector layers are created and processed in GIS and meet the basic requirements of vector information (required detail, reliability, accuracy, compliance with the requirements for the coordinate system and cartographic projection, data exchange format, etc.). Vector layers are loaded into the database as a cartographic base for all thematic maps and contain information about the boundaries and settlements of administrative-territorial entities. The basis of computer software is the instrumental geographic information system ArcGIS.

Results and discussion

Kazakhstan, being a country with a vast territory, has difficulty balancing regional differences between a few centres and a vast periphery (Nyussupova, G. *et al.* 2021). Differences across regions make it difficult to achieve gender equality and the empowerment of women and girls in the country (SDG 5), as well as an obstacle to other Sustainable Development Goals, such as ensuring healthy lives and promoting well-being for all at all ages (SDG 3), inclusive and quality education (SDG 4), promoting sustained, inclusive and sustainable economic growth (SDG 8), building resilient infrastructure and promoting sustainable industrialization and innovation (SDG 9).

The article presents an analysis of gender differences in Kazakhstan with a focus on the following areas of SDG 5: women's access to decent work, women's low-paid work, increase in women's unpaid work, women's overrepresentation in the informal sector, women's participation in decision-making, women's and girls' access to education and training. These areas highlighted in SDG 5 continue to seriously undermine the potential to achieve

equal rights, opportunities and quality of life for women not only in Kazakhstan but also in many other countries of the world.

Women's access to decent work

According to official statistics, at the beginning of 2021, 9,719.2 thousand women lived in the Republic of Kazakhstan, which is 51.5 percent of the total population of the country. The number of women exceeds the number of men, while the life expectancy of women is on average 10 years longer than the life expectancy of men in all regions of Kazakhstan *(Figure 1)*.

In Kazakhstan, according to the ILO, the participation rate of women in the labour force in 2019 was 62.8 percent. The republic maintains a stable level of employment of women and is not inferior in this regard to many countries, including countries with highly developed economies *(Figure 2)*. However, the contribution of female labour to the indicators of economic activity, growth,

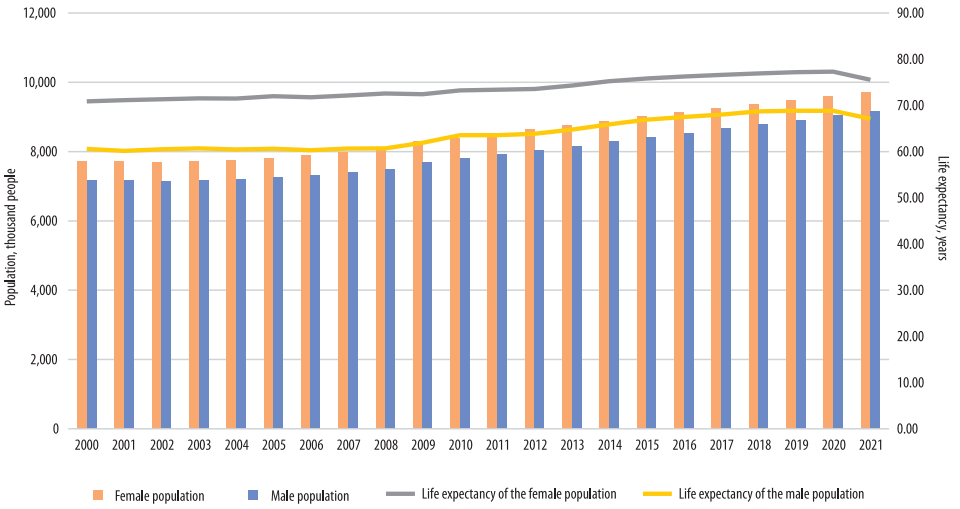


Fig. 1. Dynamics of the sex structure of the population and life expectancy of the male and female population in the Republic of Kazakhstan, 2000–2021. *Source*: Bureau of National Statistics of the Republic of Kazakhstan.

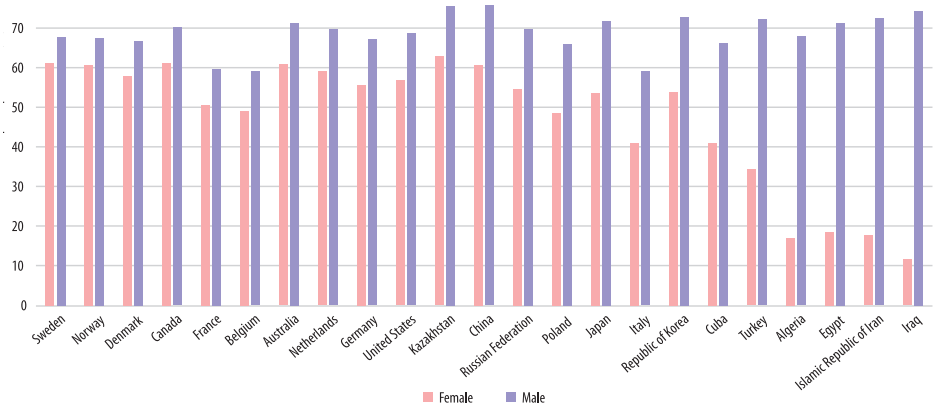


Fig. 2. The share of the male/female population in the labour force for 2019. *Source*: ILOSTAT, https://ilostat.ilo.org/

and the well-being of the population is much lower than its potential.

According to the International Monetary Fund, the global economy is losing from 10 percent of GDP in developed countries to 30 percent in South Asia, the Middle East and North Africa due to inequality between women and men (Kalpana, K. *et al.* 2017) In addition, the study shows that increasing the participation of women in the labour force significantly increases the rate of economic growth and the well-being of the country (Jonathan, D.O. *et al.* 2018).

However, there is a significant gap in the gender structure of the labour force. If, in developed countries, the gap is about 6 percent, then in Kazakhstan this figure is twice as large. Thus, in the republic, the level of participation of women in the labour force in 2020 was 63.7 percent, which is 11.8 percent lower than among men. The gender gap in the labour force shows no signs of narrowing. In the republic, by region, the same trend is observed in the gap between the share of women and men in the labour force *(Figure 3).* In all regions of the republic, the male population prevails in the structure of the labour force.

According to the Bureau of National Statistics, gender differences in employment status are small. The employment rate of women in Kazakhstan in 2020 amounted to 94.6 percent or 4,212.5 thousand people. Over the past 20 years, the employment of women in the republic has had a positive trend. Thus, compared with 2001, the employment rate of women by 2020 increased by 6.6 percent, or by 983.9 thousand working women *(Figure 4).* About 76.6 percent of the employed population, both women and men, are employed, about 23.4 percent are self-employed. The main area of female employment is the service sector. It employs 55.2 percent of women.

The global pandemic and the state of emergency introduced in connection with this in 2020 have seriously affected the Kazakhstan labour market. The acceleration of the transition to flexible forms of employment due to COVID-19 in 2020 is now reflected in the wide spread of remote work in Kazakhstan. The result of this in Kazakhstan was the development of alternative forms of employment, the active involvement of women and rural residents in labour activities. Thus, every 3rd remote worker in the country is a rural resident.

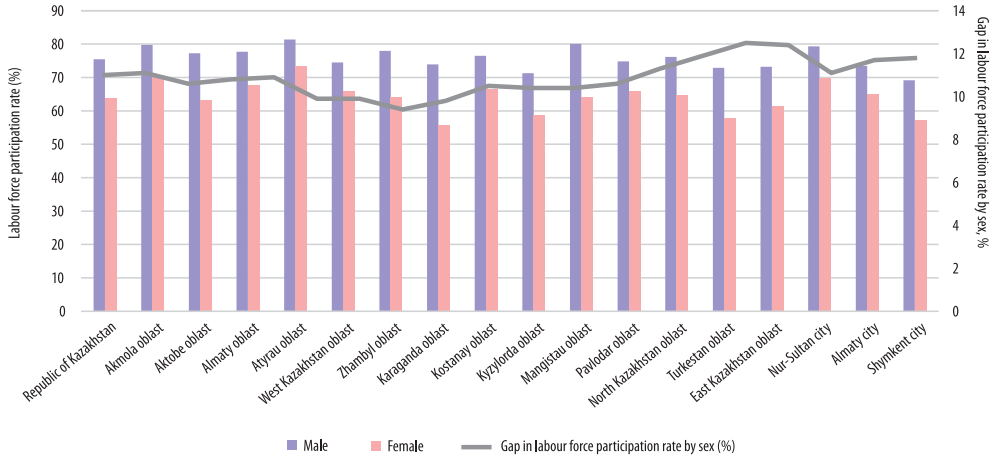


Fig. 3. The share of the male/female population in the labour force for 2020 by regions of the Republic of Kazakhstan (see left axis). Dynamics of the gap in the coefficient of the female and male population in the labour force in the Republic of Kazakhstan (see right axis). *Source*: https://taldau.stat.gov.kz/

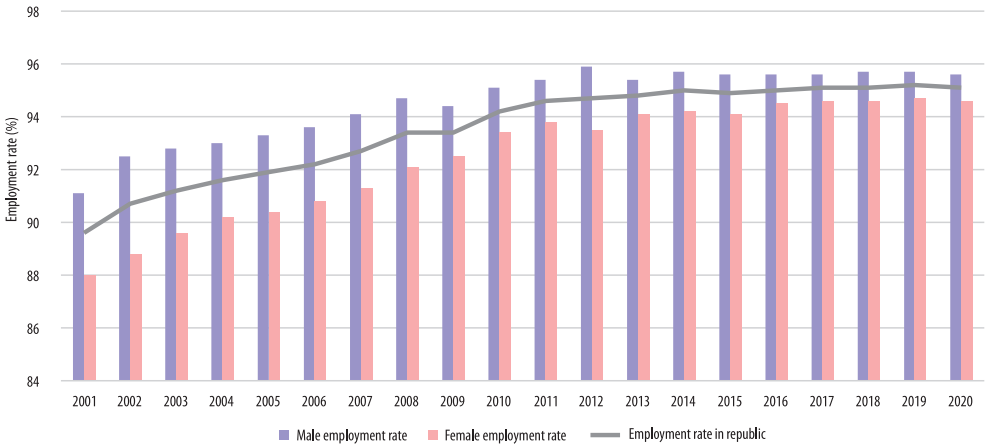


Fig. 4. Dynamics of the level of employment by sex in the Republic of Kazakhstan, 2001–2020.
Source: https://taldau.stat.gov.kz/

Many organizations in Kazakhstan have transferred employees to remote work (70% of employees), using online technologies as much as possible, but faced issues of proper design and organization of work processes. As a result of the state of emergency in 2020, Kazakhstan adopted legislative amendments to the Labour Code to improve the legal regulation of remote work. Now in the legislation, there are such concepts as "remote work" and "combined remote work".

Although, in general, there is an increase in the employment of women in the republic, a regional analysis shows that the growth in the use of female labour is due to cities of republican significance (Nur-Sultan, Almaty and Shymkent), and several regions (Almaty, East Kazakhstan, Karaganda and Turkestan oblasts) *(Figure 5).* The growth of women's employment in large cities of the country is explained by the predominance of the service sector in them, where women's labour is most concentrated. Almaty and Turkestan oblasts are adjacent to large cities of the republic, where women from the oblast come to work.

At the same time, the distribution of men and women by sectors of the economy differs markedly. Thus, in the areas of transport and construction, 23.3 percent of employees in each area are represented by women. In addition, the proportion of women is 1/3 of workers in the industry.

The highest concentration of women (over 72%) was noted in the areas of education, health care, as well as in the field of accommodation and food services (63.5%). Also, women accounted for about 60 percent of all workers employed in trade and financial activities compared to men *(Figure 6)* (see Gender statistics of the Bureau of National Statistics of the Republic of Kazakhstan, https://gender.stat.gov.kz/).

There are several reasons for the uneven distribution of women and men across sectors of the economy. Thus, the choice of activity is accepted by many women in favour of more flexible work schedules to combine work and family responsibilities. Gender stereotypes also influence the professional self-determination and career development of women. As a rule, only a small share of women has a technical education and relevant qualifications. Until recently, women in the republic were denied access to 191 types of work related to adverse working conditions, hard physical work (until 2018 there were 287) (Labour Code of the Republic of Kazakhstan, 2021). In October 2021, a law

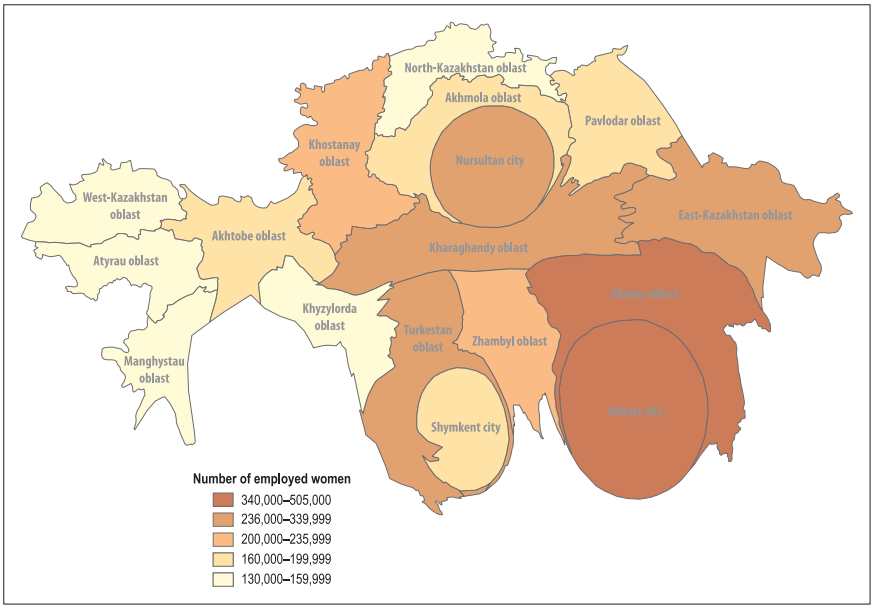


Fig. 5. Employment of women by regions of the Republic of Kazakhstan, 2020. *Source*: https://taldau.stat.gov.kz/

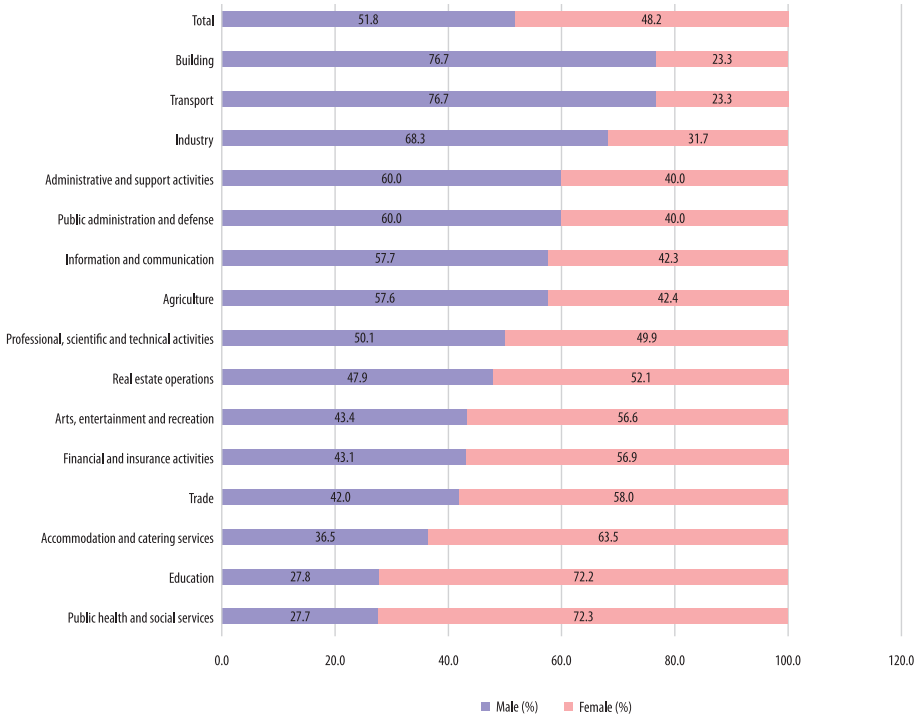


Fig. 6. Share of employed by groups of types of economic activity by sex in the Republic of Kazakhstan, 2020. *Source*: https://taldau.stat.gov.kz/

was signed that removes restrictions on the employment of women from the Labour Code (Law of the Republic of Kazakhstan, 2021). This action to eliminate discrimination against women became part of the Human Rights Priority Action Plan approved on 11 June 2021. However, the most overriding factor remains the gender segregation of vocational education, which lays the foundation for sectoral employment differentiation.

Women's low-paid work

Women's greater access to jobs has not led to a significant reduction in the gap in earnings and incomes between men and women. Some of the countries where the income gap between men and women is particularly large are among those that have experienced the fastest growth in female employment in recent years. As a rule, these are countries with pronounced export orientation, such as China, the Republic of Korea, Singapore and Chile. This trend suggests that the traditional pattern of discrimination against women's access to employment appears to be giving way in some cases to a targeted preference for female workers. It should be emphasized here that this preference is usually based on the consent of women to perform unskilled work, receive low wages, as well as their reputation as obedient and uncomplaining workers.

In the regions of Kazakhstan, as well as the average for the republic, women's wages are 30–35 percent lower than men's ones. In 2020, women's wages were 75 percent of men's wages. Over the past 10 years, the dynamics of the ratio of wages of men and women shows that women, on average, earned 32 percent less than men *(Figure 7)*, women received the least wages in 2018 (65.8% of men's wages), but 2020 saw a sharp drop in the male-to-female wage ratio of 9.2 percent from its

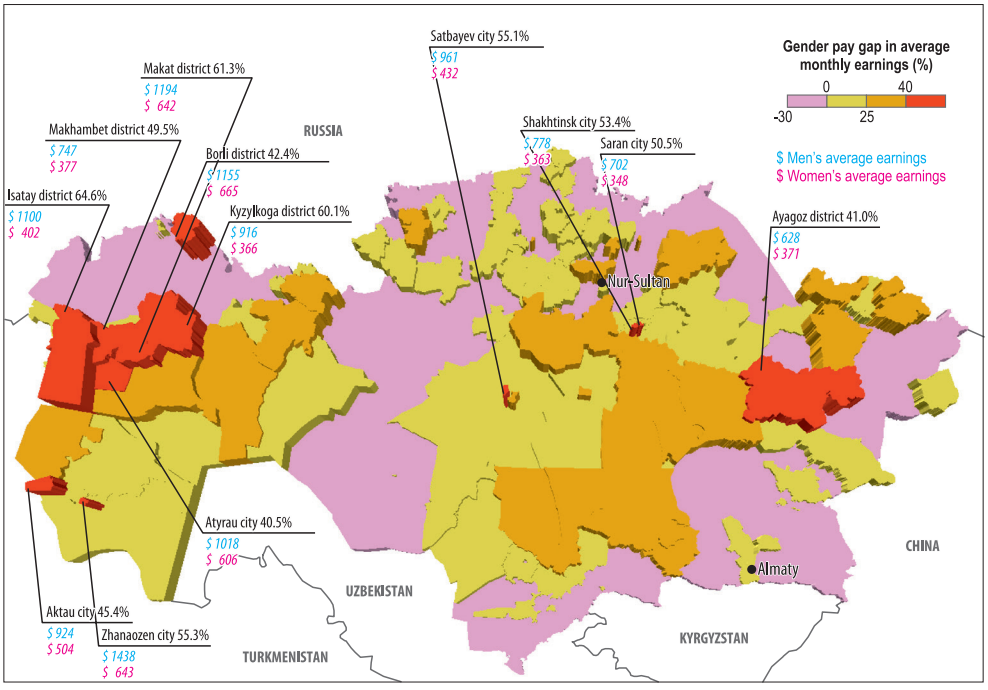


Fig. 7. Differences in earnings of men and women in Kazakhstan, 2020, in percent.

lowest point in 2018. This phenomenon is explained by a 25 percent increase in the salaries of teachers from 1 January 2020, 72.2 percent of which are women, as part of the execution of the order of the President of the Republic of Kazakhstan Kassym-Jomart Tokayev (Law of the Republic of Kazakhstan, 2019).

The gender pay gap tends to be much lower among first-time labour market entrants and tends to widen as workers age. Thus, in 2020, the largest gender pay gap was noted in the age groups of 35–44 years (36.7%) and 45–54 years (35.0%), the smallest in the age groups of 65 years and older (25.3%) and below 25 years (16.9%) (see "Taldau" information and analytical system, https://taldau.stat.gov.kz/).

The gender pay gap is largely affected by socio-economic factors – the number of men and women in a certain type of economic activity, their profession, education, age, length of service, and so on in Kazakhstan.

A regional analysis of the gender pay gap shows that this indicator deserves special attention in Atyrau and Mangystau regions, where the difference is 45–50 percent, and in some areas of Western Kazakhstan, women earn about 35 percent of the wages of men (Isatay, Makat, Kzylkoga, Borli, Makhabet districts, and Zhanaozen, Aktau, Atyrau cities) (see *Figure 7*). This imbalance is explained by the predominance of the oil and gas sector of the economy in these regions, where female labour is less competitive. A high gender imbalance in wages is also characteristic of regions where the metallurgical sector of the economy is developed (Satpaev, Shakhtinsk, Saran cities and Ayagoz district). In the capital of the Republic of Kazakhstan in Nur-Sultan city, the imbalance is explained by the fact that construction is developed here, where mainly men work and the civil service, where senior positions with high wages are occupied mainly by men.

Investments in women as human capital are higher than the return on these investments as a result of the incomplete demand for women in the field of employment, which reduces their level of economic activity and manifests itself in lower wages compared to men by 30–35 percent.

Increase in women's unpaid work

The gender imbalance in wages in the republic is also partly explained by the fact that women have less time for paid work because they are engaged in unpaid household chores. As in most parts of the world, a significant proportion of unpaid domestic work is done by women. As a result, women tend to work longer hours than men. For example, according to the International Labour Organization, on average in the world, women spend 4.4 hours on unpaid work, while men spend only 1.7 hours. The smallest gap remains in Norway, where women work 3.7 hours without pay, while men work 3 hours. In the US, the figure is 3.8 hours versus 2.4 hours (Georgieva, K. *et al.* 2019).

In Kazakhstan, a woman spends an average of 2.2 hours per day in paid work and 4.1 hours in unpaid care work and housework. For comparison, one day in the life of an ordinary Kazakhstani man is 3.3 hours at a paid job and 1.8 hours doing unpaid household chores (ILO, 2019).

It is worth noting the uneven impact of the pandemic on men and women. The COVID-19 pandemic has not only exacerbated inequalities around the world but also exposed many of the gender-based issues that exist in Kazakh society. As mentioned above, of course, teleworking gives women the opportunity to work and combine household chores, thereby allowing them to feel satisfied with financial independence and the availability of free time for the family. But this situation is not ideal either. It is worth noting that the boundary between the workplace and home disappears, the boundary between work and personal time and other side costs are erased.

With the closure of kindergartens and schools due to the dangerous sanitary and epidemic situation, women began to work even more due to the increased burden of caring for children. The number of paid hours at best has not changed, and at worst it has decreased or disappeared altogether. On average, the volume of women's household chores increased by 1.5–2 times.

Many studies show that gender imbalances in unpaid work not only deprive women of economic opportunities but also impede the qualitative growth of the economies of countries. The ILO estimates that 16.4 billion hours a day are spent on unpaid care work worldwide. This is the equivalent of 2 billion people working an 8-hour day every day without pay (ILO, 2018). In Europe and Central Asia, women devote 2 times more time to unpaid care work than men (4.5 versus 2.2 hours). And when we consider paid and unpaid work together, women generally work longer hours than men (Çağatay, N. *et al.* 2017).

Oxfam experts concluded that the value of women's unpaid labour is 10 billion USD a year or 1/8 of the world's GDP (Oxfam International, 2022). In Australia, the contribution of unpaid care work to GDP is 41.3 percent (of which women account for 26.8%). In Kazakhstan, unpaid work is estimated at 2.5 percent of GDP (of which 1.8% is the contribution of women). Gender disparity in the distribution of unpaid care work leads to growing gender gaps in the labour market and in other areas that affect the position and status of women in society. There is an inverse relationship between the length of time spent on unpaid care work and women's labour force participation. Care responsibilities also affect the quality of women's employment. In some countries, due to gender inequality in the distribution of unpaid work, the reduction of the gender gap in education did not bring significant changes to the labour market (Ferrant, G. *et al.* 2014). The relationship between a woman's role in the family, occupational choice, and income suggests that narrowing the gender pay gap could lead to a reduction in violence against women.

Employment of women in the informal sector

Work in the informal sector lacks security and social protection, is associated with hard work, is poorly paid and provides limited opportunities for the development of human capital. There is a certain gender imbalance in official unemployment figures in Kazakhstan. In 2020, the share of unemployed women was 5.4 percent compared to 4.4 percent for men. In 2020, the share of women in the unemployed population amounted to 53.3 percent and the economically inactive population -62.3 percent (https://taldau.stat.gov.kz). Part of this gap can be explained by the fact that women are more likely to take maternity leave.

Self-employed women and men in Kazakhstan do not contribute to a pension fund or receive social insurance and are therefore economically less secure and have precarious working conditions. Measures have been taken to reduce informal self-employment, including among women. Thus, in 2001, women accounted for 47.7 percent of the self-employed, but by 2020 the share of self-employed women has decreased to 45.5 percent. The majority of self-employed women work in agriculture (38.7%) and trade (40.4%). Self-employed men also tend to work in these sectors, as well as in transport, warehousing and construction (https://gender.stat.gov.kz/).

Participation of women in decision-making

In addition to sectoral differentiation, the labour market of Kazakhstan is characterized by professional segregation. This means that women are underrepresented in senior leadership in most sectors of the economy. Women have the right to participate in public life and hold public office, according to the Beijing Platform for Action, women's participation in political life should be at least 33 percent. Despite some progress in promoting gender equality in the country, Kazakhstan has a lot of work to do in achieving SDG 5 to ensure full effective participation and equal opportunities for women at all levels of decision-making in political, economic, and public life.

Thus, in 2020, women headed only 17.9 percent of large enterprises, 28.3 percent of small and 33.2 percent of medium-sized enterprises

in Kazakhstan. Education is the only field of activity where the prevailing share of managers is women (64.4%). 47.4 percent of top managers in health and social services are women. In the financial and insurance sector, 41.7 percent are women managers, in the hotel and restaurant business 41.1 percent. A small number of women leaders are noted in agriculture (14.8%), mining (12.7%) and construction (16.9%).

In addition, the higher the position, the smaller the number of women holding it compared to men. So, according to the Bureau of National Statistics, in 2020, the average salary of men working as heads of all levels of organizations was 1,417.7 USD, a labour protection engineer 638.4 USD, and an economist 508.9 USD. This is 1.1-1.5 times higher than the average salary of women in similar positions and professions (https://gender.stat.gov.kz/).

Access of women and girls to education and training

Kazakhstan has approved a Roadmap for the Development of Higher Education until 2020, which outlines the role of education and research institutions in the development of a knowledge-based economy and the preparation of a modern skilled workforce. The transition to a more knowledge-based economy significantly accelerates the advancement of gender equality. There is a high level of gender segregation in Kazakhstan's labour force. The pre-requisites for this begin already from the moment the applicants choose higher educational institutions. Gender differences are especially evident in vocational education. Vocational schools must attract a gender-balanced number of students in in-demand majors to meet future labour demand. A learning environment that offers a wide variety of careers and is free from gender stereotypes will allow students to freely express their abilities and interests, which will ultimately lead to optimal educational outcomes.

Conclusions

The Republic of Kazakhstan has maintained a stable level of women's participation in the labour market, which distinguishes it favourably from most other Central Asian countries. However, a geographical analysis of women's employment shows that women's employment is territorially differentiated. The growth of women's employment in the republic is provided by the cities of republican significance (Nur-Sultan, Almaty and Shymkent), and a number of regions (Almaty, East Kazakhstan, Karaganda and Turkestan oblasts). The main factor in the regional differentiation of the female labour force is the disproportion in the incomes of the regions, the predominance of the service sector in the economy of these regions. High economic growth smooths out gender disparities. Regions with middle and low income in the republic – Almaty and Turkestan oblasts are regions – "donors" of commuting labour migration for the cities of Almaty and Shymkent.

In the republic, there is also an uneven gender distribution across sectors of the economy. Women are employed mainly in lower paid sectors such as health and social work (72%), education (72%) and other services.

In addition to sectoral differentiation, the labour market of the Republic of Kazakhstan is characterized by professional segregation. Women are underrepresented in senior leadership in many sectors of the Kazakh economy. On the basis of ADB (2018) data, sociological research by Sarsembayeva, R. (2017), we believe that the main reasons for gender segregation are gender stereotypes common among the population of Kazakhstan, which affect professional self-determination and career growth of women. Thus, according to the analysis of public opinion conducted by Sarsembayeva (2017) on attitudes towards gender equality and the beliefs of women and men in this regard, many respondents associate the role of women to a greater extent with the family and home than with the economic and political spheres. Moreover,

the percentage of women who share this belief (39%) exceeds the percentage of men who share this opinion (25%). Similarly, the EBRD report "Life in Transition" (2016) found that two-thirds of both men and women in Kazakhstan surveyed believe that men are better at political leadership than women. According to about 86 percent of respondents, a woman should do household chores, even if her husband does not work, this opinion is shared by both women and men.

The wide access of Kazakhstan women to jobs has not reduced the gap in earnings and incomes between men and women. In terms of wages, there remains a gap between the pay of men and women. In some regions of the republic (Atyrau, Mangystau oblasts), the difference in wages between men and women is more than 50 percent. For example, statistics show that in some districts of the Atyrau oblast (Isatay, Makat districts) women earn 394 USD against 1,083 USD of men's wages, which is about 35 percent of men's wages.

The pay imbalance is partly since women have less time for paid work because they are doing unpaid household chores. In particular, women take breaks from work to have children, and significantly more often than men take extended maternity leave. Women also have more responsibility for housework, including caring for elderly family members, which forces them to leave their jobs. Gender disparity in the distribution of unpaid care work leads to growing gender gaps in the labour market and in other areas that affect the position and status of women in society. The Kazakh government is in no hurry to recognize unpaid female labour worthy of material compensation, and even the COVID-19 pandemic, which has exacerbated the problem many times, is still unable to change the current situation. In developed countries, the policy of employment of women in the labour market is more flexible.

Many women choose to work in favour of more flexible work schedules to balance work and family responsibilities. The prerequisites for this begin already from the moment the applicants choose higher educational institutions. Thus, the basis for sectoral differentiation of employment is laid. Thus, gender stereotypes influence the professional self-determination and career development of women. As a rule, only a small proportion of women have a technical education and relevant qualifications.

Despite some progress in promoting gender equality in the country, Kazakhstan still has a lot of work to do in achieving SDG 5. To further empower women, the country needs:

- Development of gender statistics. Although gender statistics are available in Kazakhstan compared to other Central Asian countries, many indicators are missing at the micro-level, which hinders the regional analysis of gender processes.
- Increasing the representation of women in politics and leadership positions in national, regional and local governments;
- Development of the service sector, expansion of women's telecommuting or part-time employment as an alternative form of employment. What would be a powerful factor in increasing women's participation in the labour force;
- Ensuring the availability of childcare services, family policy (maternity leave), changing attitudes towards working mothers;
- Eliminating stereotypes in education and the professional field, encourage the promotion of women to leadership positions and reduce the wage gap;
- Introduction of gender planning of the state budget, which can provide a more effective policy aimed at achieving gender goals. At present, gender budgeting in Kazakhstan is still at an early stage of development.

The under demand of women in employment, the decline in their level of economic activity, lower wages, and the increased burden of childcare and unpaid domestic work all negatively affect the quality of life of women and reduce the return on women's human capital.

REFERENCES

ADB 2018. *Kazakhstan Country Gender Assessment*. Institutional document. Manila, Philippines, Asian Development Bank, Available at http://dx.doi.org/10.22617/TCS179181

Agarwal, B. 2007. Towards freedom from domestic violence: The neglected obvious. *Journal of Human Development* 8. (3): 359–388.

Asif, I., Gaddis, I., Palacios-Lopez, A. and Amin, M. 2018. The labour productivity gap between female- and male-managed firms in the formal private sector. *Policy Research Working Paper* 8445, Washington, D. C., World Bank.

Brown, S. 2003. Spatial analysis of socioeconomic issues: Gender and GIS in Nepal. *Mountain Research and Development* 23. (4): 338–344. Available at https://doi.org/10.1659/0276-4741(2003)023[0338:SAOSIG]2.0.CO;2

Buribayev, Y.A. and Khamzina, Z.A. 2019. Gender equality in employment: The experience of Kazakhstan. *International Journal of Discrimination and the Law* 19. (2): 110–124. Available at https://doi.org/10.1177/1358229119846784

Bushati, B. and Galvani, A. 2017. Images of gender among western and eastern perspective: The case of Bahrain. *European Journal of Geography* 8. (3):126–137.

Çağatay, N., İlkkaracan, I. and Sadasivam, B. 2017. *Policy Brief – Investing in social care for gender equality and inclusive growth in Europe and Central Asia.* UN Women Europe and Central Asia, UNDP, 2017/03. Available at https://eca.unwomen.org/en/digital-library/publications/2017/03/policy-brief-investing-in-social-care-for-gender-equality-and-inclusive-growth-in-eca

Contreras, D., Mello, L. and Puentes, E. 2011. The determinants of labor force participation and employment in Chile. *Applied Economics* 43. 2765–2776.

EBRD 2016. *Life in Transition: Kazakhstan*. Brussels, EBRD European Bank for Reconstruction and Development. Available at http://www.ebrd.com/what-we-do/economic-research-and-data/data/lits.html

Engelhardt, H., Kökogel, T. and Prskawetz, A. 2004. Fertility and women's employment reconsidered: A macro-level time-series analysis for developed countries, 1960–2000. *Population Studies* 58. (1): 109–120.

Ferrant, G., Pesando, L.M. and Nowacka, K. 2014. *Unpaid Care Work: The missing link in the analysis of gender gaps in labour outcomes.* Issues Paper. Paris, OECD Development Center. Available at https://www.oecd.org/dev/development-gender/Unpaid_care_work.pdf

Game, A. and Pringle, R. 1983. Sex and power in hospitals: The division of labour in the 'health' industry. In *Gender at Work*. Chapter five. Ed.: Game, A., North Sydney, Allen and Unwin, 94–118.

Gender statistics of the Bureau of National Statistics of the Republic of Kazakhstan. Web site. Available at https://gender.stat.gov.kz/

Georgieva, K., Alonso, K., Dabla-Norris, E. and Kochkhar, K. 2019. *The Economic Costs of Undervaluing "Women's Work."*. Washington, D. C., International Monetary Fund.

Goodarzi, M., Firoozi, M. and Saeidi, O. 2020. Investigating and analysing women's sociocultural barriers in using the public transport system in Ahvaz metropolis. *European Journal of Geography* 11. (3): 76–95. Available at doi.org/10.48088/ejg.m.goo.11.3.76.95

Han, J-S. and Lee, J-W. 2020. Demographic change, human capital, and economic growth in Korea. *Japan and the World Economy* 53. March 2020, 100984.

Hartmann, H. 1976. Capitalism, patriarchy, and job segregation by sex. Part 2. *Journal of Women in Culture and Society* 1. (3): 137–169.

ILO 2017. *Women, Gender and Work*. Geneva, Switzerland, ILO International Labour Office.

ILO 2018. *Care Work and Care Jobs for the Future of Decent Work*. Geneva, Switzerland, ILO International Labour Office.

ILO 2019. *The Unpaid Care Work and the Labour Market*. An analysis of time use data based on the latest World Compilation of Time-Use Surveys. Ed.: Charmes, J., Geneva, Switzerland, ILO International Labour Office.

Jonathan, D.O., Alvarez, J., Espinoza, R. and Papageorgiou, C. 2018. *Economic Gains from Gender Inclusion: New Mechanisms, New Evidence.* Washington, D. C., International Monetary Fund.

Kalpana, K., Jain-Chandra, S. and Newiak, M. 2017. *Women, Work, and Economic Growth.* Washington, D. C., International Monetary Fund.

Kessler-Harris. A. 1982. *Out to Work: A History of Wage-earning Women in the United States.* Oxford, Oxford University Press.

Khamzina, Z., Buribayev, Y., Taitorina, B., Yessengazieva, A. and Kuttygalieva, A. 2022. Towards non-discrimination and gender equality: The role of international labour standards. *Sustainability* 14. (9): 5349. Available at https://doi.org/10.3390/su14095349

Küfeoğlu, S. 2022. SDG-5: Gender equality. In *Emerging Technologies*. Sustainable Development Goals Series. Ed.: Küfeoğlu, S., Cham, Springer, 277–288. Available at https://doi.org/10.1007/978-3-031-07127-0_7;

Kumar Pathania, S. 2017. Sustainable development goal: Gender equality for women's empowerment and human rights. *International Journal of Research -GRANTHAALAYAH* 5. (4): 72–82. Available at https://doi.org/10.29121/granthaalayah.v5.i4.2017.1797

Labour Code of the Republic of Kazakhstan dated 23 November 2015, No. 414-V (as amended and supplemented as of 1 July 2021).

Lam, D. and Duryea, S. 1999. Effects of schooling on fertility, labour supply, and investments in children, with evidence from Brazil. *Journal of Human Resources* 34. (1): 160–192.

Law of the Republic of Kazakhstan dated 27 December 2019, No. 293-VI (On the status of a teacher).

Law of the Republic of Kazakhstan dated 12 October 2021, No. 67-VII (On amendments and additions to certain legislative acts of the Republic of Kazakhstan on issues of social protection of certain categories of citizens).

Lincove, J. 2008. Growth, girls' education and female labour: A longitudinal analysis. *The Journal of Developing Areas* 41. (2): 45–68.

Matas, A., Raymond, J. and Roig, J. 2010. Job accessibility and female employment probability: The cases of Barcelona and Madrid. *Urban Times* 47. (4): 769–787.

Mies, M. 1986. *Patriarchy and Accumulation on a World Scale: Women in the International Division of Labour.* London and Atlantic Heights, N. J., Zed Books Ltd.

National SDG reporting platform of the Bureau of National Statistics of the Republic of Kazakhstan. Web site. Available at https://kazstat.github.io/sdg-site-kazstat/en/

Nyussupova, G., Aidarkhanova, G. and Young, S.S. 2021. The impact of the transformation of the economy of the Republic of Kazakhstan on the reproduction of human capital: socio-economic aspect. *Studies of the Industrial Geography Commission of the Polish Geographical Society* 35. (2): 38–52. Available at https://doi.org/10.24917/20801653.352.3

O zhenskom voprose: K. Marks, F. Engel's, V.I. Lenin (On the women's issue: Marx, K., Engels, F., Lenin, V.I.). Moskva, Izdatelstvo Politika, 1971. (In Russian)

Oxfam International 2022. *Why the Majority of the World's Poor are Women*. An on-line publication. The Hague, Netherlands, Stichting Oxfam International. Available at https://www.oxfam.org/en/why-majority-worlds-poor-are-women

Ozdenerol, E. 2021. *Gender Inequalities: GIS Approaches to Gender Analysis*. First edition. Boca Raton, FL, CRC Press. Available at https://doi.org/10.1201/9780429196584

Representation of the Foundation Friedrich Ebert in Kazakhstan, 2020. *Values of Kazakhstan Society in the Sociological Dimension.* Almaty, DELUXE Printery LLP Publishing House.

Rindfuss, R. and Brewster, K. 2000. Fertility and women's employment in industrialized nations. *Annual Review of Sociology* 16. (26): 271–296. Doi: 10.1146/annurev.soc.26.1.271

Sági, M. 2022. Kern, L.: Feminist City: Claiming Space in a Man-made World. Book review. *Hungarian Geographical Bulletin* 71. (3): 301–304. Available at https://doi.org/10.15201/hungeobull.71.3.6

Sarsembayeva, R. 2017. *Implementation of the Gender Equality Strategy in the Republic of Kazakhstan for 2006–2016: The Sociological Analysis.* Astana, Association of Women in Business.

Shatrov, M. 2013. *Vospitanie zhen po yuzhnomu* (Education of wives in the south). Vox Populi, on-line. Available at https://voxpopuli.kz/1412-vospitanie-zhen-po-yuzhnomu/ (In Russian)

Shawky, M. 2018. Spatial patterns of female labour force participation in Oman: A GIS-based modelling. *The Professional Geographer* 70. 1–16. 10.1080/00330124.2018.1443480.

Sinha, J.N. 1967. 'Dynamics of female participation in economic activity in a developing economy'. In *Proceedings of the World Population Conference.* Belgrade, 30 August–10 September 1965. Vol. 4. UN Department of Economic and Social Affairs, New York, UN Publications, 336–337.

"Taldau" information and analytical system. Web site. Available at https://taldau.stat.gov.kz/

UN News 2016. Expert: more and more women in Kazakhstan turn to non-governmental organizations for support. Shakhnoza Khasanova, Vice-President of the Sana Sezim Center. Available at https://news.un.org/ru/audio/2016/04/1033111

World Bank 2019. *World Development Report 2019: The Changing Nature of Work*. Washington, D.C., World Bank. Doi:10.1596/978-1-4648-1328-3

Zampone, G., Nicolò, G., Sannino, G. and De Iorio, S. 2022. Gender diversity and SDG disclosure: The mediating role of the sustainability committee. *Journal of Applied Accounting Research* 2022. 6. Available at https://doi.org/10.1108/JAAR-06-2022-0151

DOI: 10.15201/hungeobull.72.1.5 Hungarian Geographical Bulletin **72** 2023 (1) 75–85.

A new way to understand urban-rural relations: Habitus studies of rural places

Vanda JÓVÉR[1]

Abstract

"Taken for-granted divisions of geographic space (such as centre and periphery) must be viewed according to Bourdieu, as the effect of distance in social space, i.e. the unequal distribution of the different kinds of capital in geographical space" – as Reed-Danahay, D. (2020, 17) puts it in their book about the spatial aspect of Pierre Bourdieu's action theory. Field, social space, capital, disposition, and habitus are all essential components of Bourdieu's theory, but what about places? This paper focuses on the importance of geographical space, place and scales in a habitus analysis and tries to show the possibilities the concept of habitus can offer in spatial studies. While research on the relationship between Bourdieu's concept of habitus and spatiality is becoming increasingly popular (Berger, V. 2018; Németh, K. 2020; Reed-Danahay, D. 2020), still few scholars (e.g. Máté, É. *et al.* 2022) undertake place-based habitus analyses. The present paper aims to provide an overview of the international academic discourse on place-based (in this case mainly rural) habitus analysis. Considering a dozen empirical studies from different perspectives and in different geographical areas, I focus on the specificities of habitus analysis in rural places. After briefly introducing the concept of habitus and its critiques, I will describe the characteristics of habitus studies in rural places by presenting various views. Then, I will show how the relationship between rural and urban habitus studies suggests that habitus does indeed contribute to the persistence of urban-rural structures.

Keywords: habitus, Bourdieu's action theory, urban-rural structures, rural places

Received December 2022, accepted February 2023.

Introduction

According to Lipstadt, habitus studies can be considered "the spatial studies of lives" (Lipstadt, H. 2008, 38). These studies focus on the habitus of the individual, which is significantly shaped by the determining role of family and education. Some interpretations (Reed-Danahay, D. 2020) have argued that spatiality is an essential aspect of Bourdieu's concept of habitus, while only a few studies have so far emphasized the importance of place (e.g. Lindner, R. 2003; Neuhaus, F. 2015; Máté, É. *et al.* 2022). Among the place-based habitus studies, the present study focuses mainly on studies related to rural places. Since urban space is often used as a reference point in studies of rural places, I will also briefly mention the role of urban space in shaping the habitus of rural places.

As well as using the concept of habitus as a theoretical framework, the analysis of the difference between rural places and urban places has long been addressed for a long time in social sciences. Studies used different perspectives to explore the components of the urban-rural relationship, including the few studies of place-based habitus that have been conducted in the last two decades. These works try to capture the relationship between place and habitus by interpreting Bourdieu's much-debated concept of habitus in diverse ways. The present paper aims to provide an overview of the international aca-

[1] Doctoral School of Earth Science, ELTE Eötvös Loránd University, Pázmány Péter sétány 1/a. H-1117 Budapest, Hungary. E-mail: vanda.jover(at)hotmail.com; https://orcid.org/0000-0001-6668-6082

demic discourse on place-based (in this case mainly rural) habitus analysis. After presenting the approach and its critiques, I will illustrate the possibilities of applying the concept of habitus as a theoretical framework in research on places. By comparing the defining elements of the methods and interpretations of the habitus of rural places that emerge from each study, I interpret the relationship between urban and rural habitus. As a result, I draw attention to novel aspects of habitus analysis that can contribute to understanding rural-urban relations.

Methodology

This study aims to comprehensively analyse the possibilities of interpreting the habitus of (rural) places. The concept of habitus, often disputed due to specific conceptual weaknesses, offers several different interpretations, mainly related to time and space. The present study does not aim to define habitus. It, however, undertakes to present different interpretations of habitus to show how the use of its concept as a theoretical framework can contribute to an understanding of differences, that are place-based. Using the Jstor database (January 2022), I will try to shed light on the particularities of habitus research in rural areas and of rural habitus itself in the light of twelve empirical studies (plus one rather theoretical approach from Dirksmeier, P. 2006).

My paper is based on the different interpretations of habitus depending on the researchers´ stance and the subject, method, and conclusion of the research. I filtered for the common usage of words 'rural' and 'habitus' in the abstract, since geographical space, and above all rurality, is a key element in the present analysis. This study analyses all search results without exception, regardless of discipline *(Table 1).*

The articles analysed here were all written after the year 2000, mainly by sociologists and anthropologists, the research areas are varied. In my view, it is important to underline that the studies analysed here all highlight the dimension of the place. Many interpretations of Bourdieu's concept tend to be more concerned with definitional precision, often ignoring the spatial aspects of habitus. In contrast, the present paper focuses on the possibilities arising from examining the relationship between habitus and (rural) places.

The concept of habitus and some of its critiques

In the second half of the 20th century, Pierre Bourdieu developed the first comprehensive description of his theory to understand similar patterns of action (Bourdieu, P. 1977 [originally written in French, first published in 1972]). Habitus, which is part of Bourdieu's theory of action, is also commonly used in

*Table 1. The authors of the empirical studies analysed here**

Published	Authors	Research field	Research area
2001	Ilahiane, H.	Anthropology	Ziz Valley (Morocco)
2004	Corbett, M.	Sociology	Nova Scotia (Canada)
2005	Bender, S.	Anthropology	Japan
2008	Funnell, R.	Sociology	Southwest Queensland
2009	Watt, P.	Urban Studies	Essex (England)
2010	Pini, B., Price, R. and McDonald, P.	Sociology	Queensland (Australia)
2012	Benson, M. and Jackson, E.	Sociology	London neighbourhoods
2014	Koo, A., Ming, H. and Tsang, B.	Sociology	Hebei province (China)
2014	Seeberg, V.	Education Sciences	Western China
2015	Ling, M.	Anthropology	Shanghai neighbourhoods
2016	Lai, L.	Anthropology	Rural China
2019	Requena-i-Mora, M. and Moreno, G.M.	Sociology	Spain

*With the date of publication, and the author's research field.

everyday language, with a history of the concept going back to the work of Aristotle. In one of Bourdieu's formulations (2009), habitus is a system of enduring dispositions that, drawing on experience, functions as a pattern of perception, evaluation, and action in every moment of the present. In Bourdieu's view, actions are often explained by examining the 'coercive and constraining' effects of social structure (for more on this, see Fáber, Á. 2017). In Bourdieu's interpretation, habitus plays a key role in the cementing of existing inequalities. Bourdieu argues that everyone has a habitus, which can be interpreted as a stable framework of action. Habitus, thus, forms similar individual and social patterns of practice based on experience. But this action frame does not mean a static fixedness of experience of the past, it also gives the possibility to react to the impulses of the present.

Although habitus is not one of Bourdieu's best-known concepts, it is undoubtedly the most controversial, mainly because of its latent determinism (Reay, D. 2004). The concept of habitus has mostly been criticized (King, A. 2000) for providing an "overdetermined explanation of social action" (Jackson, P. 2008, 165), essentially ignoring the factor of individual freedom of choice. Bourdieu, P. (1990) describes habitus as a limited number of choices that the agent can make. The same habitus can lead to different actions, in which the 'field' associated with the action plays a significant role. In Bourdieu's words, "practice is the result of a dialectical relationship between situation and habitus" (Bourdieu, P. 2009, 213).

The field in question, like habitus, is part of the conceptual framework of Bourdieu's practice theory. In Bourdieu's theory of action, fields constitute the 'objective' structural system of social space. The fields interact through their specific 'rules of the game' with both the action and the habitus. The habitus itself is activated through contact with the field and results in different practices depending on the context (Fáber, Á. 2018). An important attribute of fields is that they are "things that objectively exist in reality and can be examined by empirical methods" (Fáber, Á. 2018, 68). Interpreting the interrelationship between field and habitus, the field can be imagined as a social medium, for example, the scientific field, where specific rules of the game prevail. The agent's habitus reacts with this field to produce practices that conform to the field´s set of rules. This does not mean, of course, that the same habitus in interaction with other fields cannot lead to different actions, nor does it mean that the practices typically adopted in a given field are compatible with the rule system of other fields. In Fáber's interpretation of Bourdieu, habitus "operates without problems only in the context in which it has been acquired" (Fáber, Á. 2018, 57).

Conceptual considerations for understanding the habitus of rural places

Besides, the critiques highlighted above, of particular interest here are those related to the application of the habitus concept in geography. In their debate with Entrikin, J.N. (2001) and Casey, E.S. (2001) on habitus, Entrikin argues that the use of Bourdieu's concept in geography (1990) leads to misunderstandings, not only of the individual´s relationship to space but also of key concepts such as place and space. The concept of habitus assumes that agents in similar positions within a given field can be associated with similar dispositions and hence similar actions (Jackson, P. 2008). This leaves us wondering how we can attribute a habitus to a neighbourhood, or even a village, and what relationship habitus has to space in general. In various studies of habitus, the influence of family, education, or work often plays a role, but *physical* space is relegated to the background of the analysis. If we assume, as Berger puts it, that "habitus is created by incorporating the constraints of social space" (Berger, V. 2018, 142), and if we consider "appropriated" physical space or even a particular place, as social, then we must take into account not only the constraints of social space in the Bourdieusian sense but also the character of the space or the place itself. (Social reality, according to Bourdieu, is objec-

tified in appropriated physical space, for more on this see Bourdieu, P. 1996.) Appropriated physical space, whether we think of the relations within a city or the rural-urban divide, is "similarly like fields, a space of struggle" (Berger, V. 2018, 149). Considering this further, "habitus guides spatial practices and the shaping of spaces" (Berger, V. 2018, 148), creating certain structures, and we can assume that these structures also reflect on the habitus that creates them. In my opinion, it may be a conceptual gap to attribute a certain habitus to a concrete place, but the study of habitus in relation to place wants to draw attention to the fact that space or place can also have a structuring, habitus-forming effect, a specific set of rules that essentially shape practice.

According to Reed-Danahay, D. (2020), the concept of habitus is Bourdieu's most important contribution to spatial studies (which is not exclusively limited to social space) and can shed light on the links between social practices and (appropriated) physical space. Reed-Danahay even concludes in their interpretation of habitus that it is almost inseparable from spatiality. As Bourdieu argues "social space tends to be translated, with more or less distortion, into physical space" (Bourdieu, P. 2000, 134). Consequently, habitus, which is closely related to the position in social space, is also linked to physical space. In Reed-Danahay's interpretation, for Bourdieu "social space is an underlying structure of symbolic classification that is expressed and constructed by the positioning of and relationships between habitus and physical space" (Reed-Danahay, D. 2020, 16). In the following, I will show that considering the empirical studies discussed here, research in rural areas shows specificities not only in the methods of analysis but also in the interpretation of habitus.

Different perceptions of habitus in rural settings – Literature review

Researchers of habitus have used various methods to reconstruct the creation and persistence of spatial and social structures. In spatial studies, there have been few examples of analogous studies, and most of them have focused on urban space (e.g. Lindner, R. 2003; Neuhaus, F. 2015). In urban habitus, the daily routine appears as a part of habitus to a different extent (Neuhaus, F. 2015), i.e., a set of semi-consciously repeated daily actions, like going to work or shopping. In contrast, the authors focus on other elements in the rural habitus, such as the role of family, tradition, or work in shaping the habitus. Studies of urban habitus tend to focus on the functioning of the city and the impulses that affect it, while the increasingly competitive field of cities requires diversity and specificity to be marketable. (Although not using the concept of habitus, building on lifestyles, attitudes and daily activities Fabula, Sz. *et al.* [2021] illustrates essentially similar results on urban diversity.) Consequently, the habitus of cities presents a more colourful, less uniform picture than that of the rural habitus, in which general preconceptions of the city and urban existence play an important role. Urban and rural concepts, however, coincide in the analysis that habitus is based on opposing dispositions. Rural habitus cannot be characterized regardless of the urban habitual elements, and also the characteristics of cities or urban districts can be better interpreted in the light of the rural habitual elements.

Considering the studies discussed here, the rural habitus gives the impression of a counterpart to Dirksmeier's specific conception of the urban habitus. Dirksmeier, P. (2006) relates urban habitus in general to the capital of the individual living in the city. (According to Bourdieu's (1990) theory, every individual has capital that is not necessarily material but can be economic, symbolic, or cultural). In Dirksmeier's theory, 'urban behaviour' is a kind of surplus on the scale of an individual's capital. The extent of the surplus may vary according to the perception of a given urban space and may accordingly influence the individual's position in the social space. In this interpretation, the acquisition of 'urbanity' (certain habits, behaviours, dialects)

may represent a capital surplus for an individual living in a rural area, even if no real change in the individual's social status occurs (for more about the habitus as 'social sense of place', see Németh, K. 2020). Take, for example, the memorable 'up-and-coming' figure in classic literature, Julien Sorel, who expected his spatial mobility to lead to progress in social space. Moving from the countryside to the city or from a small town to the capital can often mean an increase in cultural capital and prestige. These indicate above all the acquisition of a set of tools ('place-based cultural capital') that makes the agent compatible with the new environment. An example could also be Pierre Bourdieu, who "from a rural family in the South of France, became an emblematic figure in French intellectual and scientific life" (Fáber, Á. 2017, 45), and in the process, Bourdieu's habitus underwent an organic change. This could also imply that the possession of a rural and an urban habitus are mutually exclusive, with the individual either possessing the 'surplus capital' of urbanity or not.

As in the case of urban spaces, stigmatization and selective belonging can be observed in rural studies. Selective belonging is a form of response to stigmatization (Wacquant, L. 2007) when a group of residents of a neighbourhood with a dubious reputation wants to distance themselves from the community. To do so, they draw cognitive (or even tangible) boundaries around themselves to portray their neighbourhood as better situated (Watt, P. 2009). Whether it is the Ziz Valley in Morocco (Ilahiane, H. 2001), or Peckham in London (Benson, M. and Jackson, E. 2012), habitus can play a key role in the (de)valuation of certain places. Conscious reflection, based on which the agent shapes their actions, clothing, etc. to 'fit the place', can over time become semi-conscious, and automatic. This mechanism impacts the 'quality' of the place, contributing to the maintenance of existing structures. This is not only a feature of cities and neighbourhoods but can also be observed in rural areas, within or between municipalities, and can be the basis of segregation. People with different 'place-based' habitus can often no longer recall the real cause of the conflict over time. Their experiences in the past persist in their habitus and influence the structures of the present. In the words of Jackson, habitus can be "a central mechanism in the reproduction of political, social, and economic structures" (Jackson, P. 2008, 166).

Exploring rural habitus – Different approaches to ruralism

In the following, I present the defining elements of the rural habitus. By highlighting the differrent interpretations of habitus according to the researcher's views, as well as the object, method, and conclusion of the research, I will try to show how the concept of habitus can help to understand spatial differences. In their study of habitus in Morocco, Ilahiane, H. (2001) focuses on a marginal social group, the Haratin (freed slaves), living in an area close to the Sahara. They consider habitus as a norm of action that drives the individual to do the 'right thing'. Hence, the practice is a product of habitus, and the agent reproduces the belief about the right action, excluding the possibility of other modus operandi. The author presents, through in-depth interviews and by reflecting on historical factors, the coexistence of three groups of people who have lived in the same area for a long time, the Arabs, the Berbers, and the Haratins. The Haratin people have historically been an 'oppressed' social group, like women, but gradually gained the right to land ownership and political representation as a result of French colonialism. Despite the change in power relations, however, the ever more common hostility towards each other and the discourse of 'us and them' has not decreased but come to the forefront. According to the formerly 'privileged' inhabitants, the habitus of the Haratins stigmatizes the perception of the whole region, and they foresee the birth of a new Somalia. Here, the image of Somalia is being used by politicians as a negative vision. (For more on the spa-

tial dimensions of fear produced by politics and Othering, see Sági, M. 2022a.) Despite the disappearance of legal distinctions, the society living here does not question the negative preconceptions of the other side, and the antagonism is deeply embedded in their actions. Ilahiane, H. (2001), in their interpretation of habitus, sees the individual as highly vulnerable to the habitus of their group, which may be explained by the strong structuring influence of religion. Despite the economic capital and power acquired by the Haratins, 'Monsieur le Capital and Madame de la Terre', in Marx's words, still haunt the habitus of the villages of the Ziz Valley (Ilahiane, H. 2001).

Funnell, R. (2008) has researched the role of rural habitus in individual decisions in small rural towns in Southwest Queensland. In their interpretation, habitus is not a pure academic concept. Funnell draws attention to rural forms of disposable capital, which can be sharply divided along the lines of biological sex. The body and the experiential capital that is embedded in it play a key role in their study of local men. Similar to Funnell, R., Bender, S. (2005) writes about the importance of embodied capital. He examined the relationship between body and place in a Japanese community, analysing the tradition of "Taiko" drumming. Of the studies analysed here, Bender's research highlighted the most the importance of embodied capital and the connection between 'local bodies' and 'local places'. The body capital gained in rural places, the experience of physical work in a rural environment, and a strong physique are difficult to build on in the context of urban living because they are not necessarily advantageous for administrative work traditionally associated with cities. Funnell, R. (2008) highlights not primarily the social structures in rural areas but the prejudices against urban life, which make holders of capital acquired through agricultural activity stay due to the limited utility of their experience. The author, like Bourdieu, argues for the role of education, and gender, in shaping habitus.

Similarly, the close link between rural habitus and agriculture is emphasized in another study of rural Australia (Pini, B. *et al.* 2010). In their study, the authors analyse the emergence of certain categories, such as the rural working class, and the role of education, constructed in the context of the urban-rural contrast. They, like Funnell, R. (2008), describe gender, the development of physical skills instead of theoretical knowledge acquired in school, and, in this context, the body with its embedded habitus as key factors in the rural habitus. This form of embodied capital is a recurrent element in habitus linked to rural places, which, in contrast to urban habitus analyses, divides habitus according to gender. In the authors' approach, education and teachers have a great responsibility in shaping the construction of rural areas, whether encouraging or cautioning students to continue their education. Their point of view reflects the assumption that for the individual, further education is likely to open the way to an urban habitus.

Corbett, M. (2004) examines, in their work on Nova Scotia, a frequent conclusion of policy analyses, which argues that the primary cause of rural 'underdevelopment' is the under-education of rural youth. Through in-depth interviews, they describe the quality of 'place-bounded cultural capital' that plays a decisive role in decision-making through the habitus of interviewees. The issue of gender is also important in Corbett's (2004) study, where they characterize educational institutions as traditionally gendered. They argue that women in the study have fewer opportunities to make a living through physical labour, and, thus, more women typically take their chances on the school benches. (Similarly to Corbett, albeit with a different approach was taken, Timár, J. and Velkey, G. [2016] write about the structuring effect of gender on the migration decisions of people living in rural spaces.) Considering women's experiences in the field, Corbett, M. describes the school as a choice that generally offers the possibility of social and spatial mobility. In school, the individual gains the-

oretical knowledge from unfamiliar places rather than practical knowledge from the place they know, i.e., 'alienation'. Corbett concludes that the educational system and the place-bound habitus work against each other, with place-bound cultural capital, seemingly conflicting through education-acquired uniformed capital, opening the way to disaffiliation.

Requena-i-Mora, M. and Moreno, G.M. (2019) investigated environmental awareness in the habitus of a rural community in Spain by conducting in-depth interviews. They described rural communities as generally less wasteful, although the people they interviewed rarely described themselves as environmentalists. According to the authors, environmental awareness is not a conscious good deed in rural areas, but merely a mode of action ingrained as a result of socialization. Taking their conclusions further, the same element of habitus, environmental behaviour, can be both reflexive and unconscious, depending on the place. What is a conscious pattern of action in the case of the urban socialized agent (although it may become routine over time) is a natural way of practice in the rural habitus, the individuals do not reflect on their actions in this way, nor do they identify themselves as environmentalists.

Whether it is the study of the formation of an individual´s life course or the habitus of place, agricultural activity is a recurrent element in the rural concepts of habitus mentioned in this paper. The Moroccan conflict referred to above was based on the distinct roles played by certain ethnic groups in agriculture, historically established and long legally regulated, while others contrasted rural cultural capital with urban cultural capital. The rural habitus, in the light of these studies, limits the capital that can be acquired by the agent, who, by choosing to try urban life, forgoes the knowledge offered by tradition and picks up an urban habitus. In the urban context, the rural habitus and its capital seem to be incompatible with action. Considering these studies there is an equivalence between rural habitus, agricultural activity, and the identification of rural areas, which contributes significantly to the low prestige of rural cultural capital in an urban context. According to Funnell, R. (2008), the traditional division of labour in rural habitus remains unchanged despite its change with the restructuring of agriculture. In their statement, Funnell, R. couples the urban-rural relation with the dimension of the 'agriculture-industry contrast', one of the most dominant elements in the construction of the countryside. Perhaps one of the most important findings of the studies analysed here is that almost all of them show urban habitus and the quality of urban capital forms over rural ones. This raises further questions about habitus´ role in preserving differences, given that the habitus studies themselves assume a strongly questionable hierarchical relationship.

The above-mentioned habitus studies, however, do not reveal what kind of habitus is eventually created by multiple migrations between urban and rural areas over the course of life, whether there is a transition between the two, or what commuting entails (for more on this, see Németh, K. 2020). In their study on habitus, Koo, A. *et al.* (2014) analyse the impact of migration on the individual. Their interviewees are school-age children who, during their studies, are forced to relocate to large cities due to their parents' pursuit of better income opportunities. They then eventually return to their rural residence due to the specificities of the Chinese education system. Almost all of those interviewed have suffered a decline in their academic performance after returning to their school of origin, and their cultural capital gained in the city has not been of use in the rural school. To achieve what the authors call a 'higher-qualified' effect, students who landed at urban schools acquired over time the dialect, dressing habit, and behaviour of the citizens, which were of little value and made integration more difficult upon their return. According to Seeberg, V. (2014), the disproportionality of the education system is a major contributory factor to the location-dependence of the ability to

build on cultural capital and, thus, cementing the urban-rural divide. Ling, M. (2015), writing on the stigmatization of vocational schools, describes a similarly contradictory relationship. While the tastes and dressing of students from rural places change, the biggest tension is caused by the change in their work preferences. By studying in an urban school, students prefer indoor office work, which Ling, M. (2015) sees as conflicting with the state´s agenda of reproducing low-skilled service workers. The results of these studies suggest that not only the rural habitus is not adaptable to an urban context but also those with an urban habitus have difficulties in thriving in rural areas, and, thus, calling into question the hierarchical relationship suggested by previous findings.

During mobility, the context of action changes, not only the place where the action takes place but also the field. Whether mobility is a commute or a permanent change of location, the reflection on the changed context affects the individual´s habitus if the action toolkit they possess is not compatible with the new context. In addition, going back to the stable nature of habitus described above, it is important to mention Németh's argument (2022) about Hadas' concept of plural habitus (Hadas, M. 2021), according to which if habitus is constantly changing, how can it be defined as a (more or less) stable system of dispositions? Bourdieu, P. assumed (in Reed-Danahay's interpretation, 2020) that the individual longs to feel at home and that mobility is linked to the feeling of happiness that this implies. Those who choose to migrate or commute in the hope of a 'better life' may acquire a very particular habitus. The newly emerging secondary framework of action, often called the split habitus, can prevent individuals from feeling 'at home' and comfortable in the spatial and social context in which they act. As a result of spatial mobility, the actor needs multiple sets of tools (for more on this, see Hadas, M. 2021). Moving between places often creates a sense of being an outsider, in essence never really feeling at home (Reed-Danahay, D. 2020).

Certain habitus-shaping factors, such as gender, race or class, and capital embedded in the body, are more strongly reflected in rural than in urban habitus studies. The authors of the habitus studies presented above (Ilahiane, H. 2001; Funnell, R. 2008; Pini, B. *et al.* 2010) analyse the role of habitus almost exclusively in shaping men's choices. Rural habitus in their reflection is characterized not only by the dominant element of agriculture but also (perhaps due to the individual positioning of the researchers) by masculine dominance and certain invisibility of other genders. The importance of gender in shaping habitus has been stressed by Bourdieu, P. and by those who have further developed his concept (McClelland, K. 1990; Reay, D. 2004). Belonging to gender, or not belonging to the dominant gender, can be embedded in the individual´s habitus in a comparable way to belonging to a religion, social class, race, or any group (for more about the powerful structuring effect of gender in urban spaces, see Sági, M. 2022b). Habitus leaves its mark on the body through actions, whether it is a strong physique due to physical work or a disposition to do or not to do certain things. The inclusion of geographical space, location, and scales (like the body itself) in a habitus analysis, and the use of the concept of habitus in geography in general, can, in my opinion, make an important contribution to the understanding of existing urban-rural differences.

In the following, I briefly summarize the findings of the empirical habitus studies listed here, with a particular focus on the interpretation of habitus, the methodology, and certain recurrent elements (body, gender, and class) that may contribute to the persistence of urban-rural differences. Furthermore, I am to provide a clearer understanding of the interpretations of the rural habitus, especially in the light of the studies analysed here. On the other hand, if I take into account that for Bourdieu reality is relational and "places and spaces are defined in relation to each other" (Berger, V. 2018, 149), then an understanding of urban habits(es) and their study is essential to the analysis of rural habitus.

The majority of the studies listed here try to capture the rural habitus (more precisely, the habitus of different specific places with very similar elements) through the individual or group, mainly based on interviews. Most concentrate on the role of the rural place in shaping individual choices and life courses (Corbett, M. 2004; Funnell, R. 2008; Pini, B. *et al*. 2010; Koo, A. *et al.* 2014; Seeberg, V. 2014; Ling, M. 2015). They seek to show how the rural habitus (and the associated embodied agricultural capital, weak exchange-valued symbolic capital, family demands, etc.) contributes to the maintenance of existing structures. Similarly, Ilahiane, H. (2001), Bender, S. (2005), Watt, P. (2009), Benson, M. and Jackson, E. (2012), and Requena-i-Mora, M. and Moreno, G.M. (2019) examine the persistence of structures through habitus, but they focus on practices rather than life course. The dimension of time appears in a completely different way in these studies, but they also highlight the structuring role of habitus. However, I would highlight two of the studies listed, which use a different method of analysis, moving away from the individual. Both Shavit and Lai look at a specific mediator (Shavit, Z. [2013] websites, Lai, L. [2016] the spaces of a traditional home) and use them to demonstrate the relationship between place and habitus. I consider that this is a way of overcoming the contradiction that Bourdieu's notion of habitus is primarily about the individual or the group and that these studies are trying to say something about space, but mostly about specific places.

With varying emphasis, the body is a recurring scale in the studies. Bender, S. (2005) (connection of local bodies to local places) and Pini, B. *et al*. (2010) (choosing body over mind) are more explicit about embodied capital being inseparable from the place, but others (such as Funnell, R. [2008] or Requena-i-Mora, M. and Moreno, G.M. [2019]) also write about practices, embodied capital, linked to place. Gender is also a frequent element in close connection with the body, and is an important structuring factor about the rural habitus. The 'traditional' gender roles, the practices expected of the male body (physical work) and the spaces linked to it, as well as the spaces traditionally associated with women (in these studies, duties linked to the home, or school), determine the forms of capital that can be acquired or that are to be acquired, reinforcing the resulting possible emigration (mainly women) or staying (men).

The most dominant central factor in writings about the conflicting field of urban-rural relations (Corbett, M. 2004; Watt, P. 2009; Pini, B. *et al*. 2010; Benson, M. and Jackson, E. 2012; Shavit, Z. 2013; Koo, A. *et al.* 2014; Ling, M. 2015; Requena-i-Mora, M. and Moreno, G.M. 2019) is class. Class is an important category in Shavit's bourgeois construction of the idyllic rural (2013), in Watt's selective belonging of the middle class (2009), in Ling's stigmatization of migrant students (2015), in Requena-i-Mora's and Moreno's everyday practices of urban post-materialism versus rural poor (2019), in Benson's and Jackson's middle-class practices of space-making (2012), etc. They, following Bourdieu's views, see the rural habitus as the result of a conflictual relationship between dominators and oppressed, which contributes to the maintenance of structures. The oppressor in this relation may be a capital-owning class, or even (as in all the China-focused studies cited here) the state itself. As a result of the symbolic violence exerted by oppressors, rural places, in the light of these studies, can be associated with a number of different socio-spatial constructions of urban-rural relations, from the idyll to the "troubled places" (Corbett, M. 2004), through post rural (Shavit, Z. 2013), or quasi rural (Watt, P. 2009). These are all spatial categories that are closely related to perception, action patterns, and thereby to habitus.

Conclusions

Hence, Bourdieu's concept of habitus (1990) is difficult to separate from place-boundedness and can, therefore, not only be understood in the context of social space. The rural habitus studies discussed here portray rural

habitus as the agent´s capital, which plays a decisive role (depending strongly on factors such as gender or class) in shaping an individual´s choices and life course. The analytical aspects of the rural habitus concepts examined here reflect a 'multi-layered' habitus, in which family plays a primary role, followed by educational experience and work, and the role of geographical place is also crucial. Differences in spatial habitus studies may arise from the different choices of study methods (justified by the urban/rural context). Rural habitus studies use in-depth interviews providing a more nuanced understanding of individuals' dispositions than either quantitative (Neuhaus, F. 2015), or qualitative (Molotch, H. *et al.* 2000; Lindner, R. 2003) studies in urban spaces.

Overall, the spatial habitus studies show a hierarchical relationship between urban and rural areas. Considering rural habitus analyses, the availability of urban habitus offers the actor more opportunities, while the value of rural capital decreases as one moves away from the rural area. However, urban capital cannot always be utilized in a rural context. To use the metaphor of Blondeel, P. (2005), once an individual learns to perceive and behave in a group- and site-specific way, they will be able to read and write the map, whether in a rural or urban area. The relationship between rural and urban habitus studies suggests that habitus does indeed contribute to the persistence of urban-rural structures through the reproduction of social practices. Using habitus as a theoretical framework can help to understand the emergence and reproduction of specific structures and differences in both urban and rural areas.

REFERENCES

Bender, S. 2005. Of roots and race: Discourses of body and place in Japanese "Taiko" drumming. *Social Science Japan Journal* 8. (2): 197–222.

Benson, M. and Jackson, E. 2012. Place-making and place maintenance: Performativity, place and belonging among the middle classes. *Sociology* 47. (4): 793–809.

Berger, V. 2018. *Térré szőtt társadalmiság* (Space formed by sociality). Budapest, L'Harmattan.

Blondeel, P. 2005. *Reading and (re)writing the city: the use of the habitus concept in urban research and development.* Paper for the international conference: Doing, thinking, feeling home: the mental geography of residential environments. 14–15 October 2005, Delft, The Netherlands.

Bourdieu, P. 1977. *Outline of a Theory of Practice.* Cambridge, Cambridge University Press.

Bourdieu, P. 1990. *The Logic of Practice.* Cambridge, Polity Press.

Bourdieu, P. 1996. *Physical Space, Social Space and Habitus.* Oslo, Institut for sociologi og samfunnsgeografi.

Bourdieu, P. 2000. *Pascalian Meditations.* Stanford CA, Stanford University Press.

Bourdieu, P. 2009. *A gyakorlat elméletének vázlata & Három kabil etnológiai tanulmány* (Outline of at theory of practice & Three etnographic studies on kabils). Budapest, Napvilág Kiadó.

Casey, E.S. 2001. On habitus and place: Responding to my critics. *Annals of the Association of American Geographers* 91. (4): 716–723.

Corbett, M. 2004. 'It was fine if you wanted to leave': Educational ambivalence in a Nova Scotian coastal community 1963–1998. *Anthropology & Education Quarterly* 35. (4): 451–471.

Dirksmeier, P. 2006. Habituelle Urbanität. *Erdkunde* 60. (3): 221–230.

Entrikin, J.N. 2001. Hiding places. *Annals of the Association of American Geographers* 91. (4): 694–697.

Fáber, Á. 2017. *Pierre Bourdieu 'politikai fordulata'* (Pierre Bourdieu's 'political turn'). Doctoral dissertation. Budapest, ELTE TáTK.

Fabula, Sz., Skovgaard Nielsen, R., Barberis, E., Boros, L., Hedegaard Winther, A. and Kovács, Z. 2021. Diversity and local business structure in European urban contexts. *Hungarian Geographical Bulletin* 70. (1): 65–80.

Funnell, R. 2008. Tracing variations within 'rural habitus': an explanation of why young men stay, or leave isolated rural towns in Southwest Queensland. *British Journal of Sociology of Education* 29. (1): 15–24.

Hadas, M. 2021. *Outlines of a Theory of Plural Habitus. Bourdieu Revisited.* London, Routledge.

Ilahiane, H. 2001. The social mobility and the re-working of Bourdieu's habitus on the Saharan frontier, Morocco. *American Anthropologist New Series* 103. (2): 380–394.

Jackson, P. 2008. Pierre Bourdieu, the 'cultural turn' and the practice of international history. *Review of International Studies* 34. (1): 155–181.

King, A. 2000. Thinking with Bourdieu against Bourdieu: A 'practical' critique of the habitus. *Sociological Theory* 18. (3): 417–433.

Koo, A., Ming, H. and Tsang, B. 2014. The doubly disadvantaged: How return migrant students fail to access and deploy capitals for academic success in rural schools. *Sociology* 48. (4): 795–811.

Lai, L. 2016. *Hygiene, Sociality, and Culture in Contemporary Rural China.* Amsterdam, Amsterdam University Press.

Lindner, R. 2003. Habitus der Stadt – ein kulturgeographischer Versuch. *Petermanns Geographische Mitteilungen* 147. (2): 46–60.

Ling, M. 2015. "Bad students go to vocational schools!": Education, social reproduction and migrant youth in urban China. *The China Journal* 73. 108–131.

Lipstadt, H. 2008. 'Life as a ride in the metro': Pierre Bourdieu on biography and space. In *Biographies and Space. Placing the Subject in Art and Architecture.* Eds.: Arnold, D. and Sofaer Derevenski, J., New York, Routledge, 35–54.

Máté, É., Pirisi, G. and Trócsányi, A. 2022. Városi, falusi, mindkettő, egyik sem? Társadalmi habitusvizsgálat egy Tolna megyei falu, Gerjen példáján (Urban, rural, both, neither? A social habitus study exemplified by Gerjen, a village in Tolna County). In *A vidéki Magyarország a pandémia korában: IX. Falukonferencia*, Pécs, PTE, 185–196.

McClelland, K. 1990. Cumulative disadvantage among the highly ambitious. *Sociology of Education* 63. (2): 102–121.

Molotch, H., Freudenburg, W. and Paulsen, E.K. 2000. History repeats itself, but how? City character, urban tradition, and the accomplishment of place. *American Sociological Review* 65. (6): 791–823.

Németh, K. 2020. Marginalizált térből átmeneti térbe. Egy térbeli-társadalmi mobilitási pálya megélt jelentései (From marginalized space to transitional space. Lived meanings of a spatio-social mobility trajectory). *Szociológiai Szemle* 30. (2): 50–71.

Németh, K. 2022. From the pluralisation of habitus towards the theory of plural habitus. *European Journal of Social Theory* E-publication, 1–5. Available at https//journals.sagepub.com/doi/abs/10.1177/13684310221117769

Neuhaus, F. 2015. *Emergent Spatio-temporal Dimensions of the City.* London, Springer.

Pini, B., Price, R. and McDonald, P. 2010. Teachers and the emotional dimensions of class in resource-affected rural Australia. *British Journal of Sociology of Education* 31. (1): 17–30.

Reay, D. 2004. 'It's all becoming a habitus': Beyond the habitual use of habitus in educational research. *British Journal of Sociological Education* 25. (4): 431–444.

Reed-Danahay, D. 2020. *Bourdieu and Social Space.* New York, Berghahn.

Requena-i-Mora, M. and Moreno, G.M. 2019. Another turn of the screw on the environmental opinions: Utilizing surveys and social discourses to investigate the social perception of environmental issues. *Conservation & Society* 17. (1): 38–50.

Sági, M. 2022a. The geographical scales of fear: Spatiality of emotions, emotional spatialities. *Hungarian Geographical Bulletin* 71. (1): 55–65.

Sági, M. 2022b. Kern, L.: Feminist City: Claiming Space in a Man-made World. Book review. *Hungarian Geographical Bulletin* 71. (3): 301–308.

Shavit, Z. 2013. The bourgeois construction of the rural. *Israel Studies Review* 28. (1): 98–119.

Seeberg, V. 2014. Girls' schooling empowerment in rural China: Identifying capabilities and social change in the village. *Comparative Education Review* 58. (4): 678–707.

Timár, J. and Velkey, G. 2016. The relevance of the political economic approach: The interpretations of the rural in the migration decision of young women and men in an economically backward region. *Journal of Rural Studies* 30. 1–12.

Wacquant, L. 2007. Territorial stigmatization in the age of advanced marginality. In *Urban Outcasts: A Comparative Sociology of Advanced Marginality.* Ed.: Wacquant, L. Cambridge, Polity Press, 66–77.

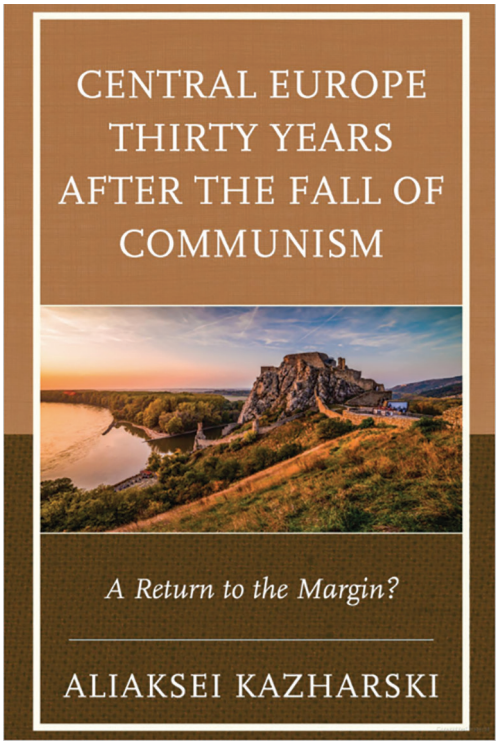
Watt, P. 2009. Living in an oasis: Middle-class disaffiliation and selective belonging in an English suburb. *Environment & Planning* 41. (12): 2874–2892.

BOOK REVIEW SECTION

Kazharski, A.: Central Europe Thirty Years after the Fall of Communism. A return to a Margin? Lanham, Lexington Books, 2022. 226 p.

At an international academic conference in Bratislava in June 2022, Aliaksei Kazharski began his book presentation by acknowledging that Russia's invasion of Ukraine had rendered his newly published study, *Central Europe Thirty Years after the Fall of Communism*, outdated. The war drastically altered Central European politics in the four months between February and June. At the time of Kazharski's presentation, the war had become the predominant geopolitical issue in the region, overshadowing the EU migration crisis and Covid pandemic, which are the main themes of his book.

In relation to the war, two significant changes had taken place in the geopolitical landscape of Central Europe. Firstly, the unity among the countries of the Visegrad Group that formed over the migration issue in 2015 had dissipated due to Hungary's neutrality towards the war and its continued cooperation with Russia. On the other hand, Poland, the Czech Republic, and Slovakia have actively supported Ukraine since the beginning of the invasion and made substantial contributions to their neighbour's defence. Secondly, these efforts have led many journalists and analysts to argue that the centre of power in Europe is shifting eastwards and away from France and Germany (Erlanger, S. 2023).



Nevertheless, these geopolitical transformations have not reduced the relevance or usefulness of Kazharski's book. In fact, its significance has increased due to the unexpected timing of its publication coinciding with Russia's invasion of Ukraine. As a result, the book has become the most up-to-date source on the bygone era of Central European politics. Kazharski demonstrates exceptional expertise in the politics and history of Slovakia, the Czech Republic, Poland, and Hungary, which is truly remarkable. Through a combination of rich empirical area studies and International Relations theorization, the book offers a unique and insightful contribution to the field. Furthermore, the study provides a necessary comparative basis for understanding the changes and continuities in Central European geopolitics after February 2022. Hence, it should be read because of the changes that have occurred in the region since its publication, not in spite of them.

The book examines the evolution of perceptions surrounding Central Europe over a thirty-year period encompassing the 1989 revolutions in the former Eastern Bloc and the outbreak of the Covid pandemic. The author's initial contention is that the dominant geopolitical understanding of Central Europe was transformed by the 2015 European Union debates on migration policy and the refugee redistribution plan, widely known as the migration crisis in Europe.

Prior to this, the dominant geopolitical meaning of Central Europe was that of a region transitioning from the Russian-dominated Eastern Bloc to its rightful place in the West. This narrative was realized through the integration processes of the EU and NATO and the eventual membership of the former Warsaw Pact states in these Euro-Atlantic institutions.

However, the enthusiasm for Europe in Central Europe gradually waned in the face of persistent economic disparity and diverging social values between the EU's eastern and western member states. This inequality paved the way for the geopolitization of regional differences in the context of the 2015 migration crisis. To defend their rejection of the EU's policy of refugee redistribution, the Visegrad Group (V4) countries, led by populist leaders such as Viktor Orbán

and Jaroslaw Kaczyński, redefined a new Central Europe as a racially homogeneous, Christian, and conservative moral centre of the EU. They aimed to spearhead a cultural counter-revolution, reimagining Europe as a culturally and politically conservative union of nation-states rather than a federation governed by supranational institutions from Brussels.

In the book, Central Europe is treated as a region-building discourse rather than an objectively defined geographical region. The author focuses on the shifting meanings and contexts of Central Europe without attempting to establish its geographical boundaries. Through an examination of moments of discursive change, Kazharski identifies a continuity in the ever-changing concept of Central Europe since its emergence in the 19th century. This continuity is reflected in the aspiration to escape marginality and assert belonging to Europe's core.

Different meanings of Central Europe may suggest different strategies for achieving this aim, but at their core, they all serve to emphasize the political, economic, cultural, moral, or historical centrality of the region within Europe. The two dominant narratives of Central Europe in the past three decades – the post-1989 return to Europe and the post-2015 anti-migration region-building among the Visegrad Group – have both sought to bridge the inequality gap with Western Europe, but through different means. The former sought to imitate and adopt Western norms, while the latter sought to advance local norms and ideas as a better alternative to existing Western ones, with the goal of establishing a new normative order in Europe.

Furthermore, the author delves into the policy contexts and institutional frameworks that underpin region-building efforts. The author asserts that the post-2015 rebellion of the Visegrad quartet is limited in both temporal and sectoral terms. Temporally, the region-building of Central Europe and its institutional representation in the form of the Visegrad Group is a specific, event-driven phenomenon that wanes as geopolitical context changes. Hence, Kazharski characterizes post-2015 Central European region-building as *ad hoc regionalism*. In terms of policy sectors, the rebellion against Western European hegemony falls short, neglecting crucial areas such as the economy and security. The Visegrad economies are all dependent on Germany and other Western countries, while their defence and security policies are outsourced to NATO. As a result, the focus of their counter-hegemonic geopolitical efforts is restricted to cultural, demographic, and migration policies.

Despite their counter-hegemonic posture, the Visegrad countries remain deeply enmeshed in the institutional structures of the Western-dominated economic and political order from which they benefit. The author uses the term *embedded revisionism* to describe this dynamic, in which revisionist actors are not entirely rejecting the status quo but instead selectively challenging it from within. This nuanced take on Central European geopolitics offers a compelling lens through which to analyse the region's ongoing efforts to escape marginality and assert its place at the core of Europe.

Finally, the author posits that embeddedness and revisionism are not necessarily at odds. In fact, embeddedness affords the possibility of revisionism. As the EU and NATO manage issues such as the economy and security, where the Visegrad countries lack consensus, these nations can concentrate their political efforts on areas of agreement. These common ground issues provide the foundation for their counter-hegemonic efforts.

There are two issues that I found problematic and confusing about the book's theoretical arguments. Firstly, the argument regarding the post-2015 shift in the meaning of Central Europe rests on a misperception of the normative divide between Western Europe and the Visegrad Group. The author's assertion that the migration crisis led to a normative rupture between the two geographical regions of the EU lacks adequate evidence and reifies politically motivated geopolitical narratives. Anti-migrant political movements promoting civilizationist visions of Europe exist in both parts of the continent (Brubaker, R. 2017; Casaglia, A. *et al.* 2020). Meanwhile, despite its purported embrace of multiculturalism and refugee welcoming policies, the Western European mainstream has implemented a violent and brutal border policy towards migrants, resulting in numerous deaths at Europe's land borders and in the Mediterranean. There is evidence of the continuity between the EU's migration policy and Central Europe's rejection of immigration (Kallius, A. 2016), such as Hungary's southern border fence, which Viktor Orbán justified based on the existence of Spain's anti-migrant fortifications in Ceuta and Melilla.

To the author's credit, several times throughout the book, he mentions that we should not overstate the East-West divide and acknowledges the existence of multiple viewpoints within the same place. Yet, this acknowledgement does not change the book's central line of reasoning.

Furthermore, the author's treatment of the supposed divide between Western and Central Europe in the context of the migration crisis raises serious questions about the critical distance necessary in analysing political discourse. The "East–West clash" is a political narrative pushed by the likes of Orbán to deflect criticism of their illiberal policies. By accepting this geographic division as a neutral fact and positioning figures like Orbán solely on one side of the divide, the author fails to critically engage with politically motivated discourse. When the author argues that the "migration crisis revealed the largest normative gap between the great European powers such as Germany and the governments and societies of Central Europe" (p. 45), he (unintentionally) echoes Orbán's claim that "European citizens want something different from that which is put forward by most European governments. People want us to

defend our borders" (Orbán, V. 2015). Such slippage of political categories into academic language undermines the author's goal of critically analysing politics.

Secondly, the author's definition of Central Europe as a region-building discourse requires clarification. What does this definition refer to: an attempt to form a policy coalition or a political move to legitimize a particular stance by spatially framing a difference with an opponent? In the first scenario, Central Europe gains meaning through regional cooperation, while in the second scenario, it is established through the communication of external differences and regional political identity claims. This distinction is crucial, as the author defines Central Europe not as an objective reality but as a discourse in Chapter 1. Yet, Chapter 2 advances a new meaning of Central Europe based solely on the cooperation of countries on migration within the existing framework of the Visegrad Group.

In his description of the dominant version of the Central Europe discourse in the 1990s, the author shows how the perception of Central Europe as a "lost cousin" of Western Europe influenced the foreign policy priority of Euro-Atlantic integration in the former Socialist states. The author identifies not only a policy consensus among the region's states but also the crucial role of the Kunderian myth of Central Europe in forming this consensus of *return to the West*. In contrast, when tracing the post-2015 shift towards a new vision of Central Europe, the author only highlights a policy consensus within the Visegrad Four (V4) and a normative division along the East-West geographical lines within the European Union (EU). However, what the author's argument and discourse analysis lack is a demonstration of the centrality of Central Europe in V4's policy discourse on migration.

The book's initial chapters examine how the four Visegrad countries, through a partial identification with and revision of the EU normative order, have come together as an ad hoc institutionalized grouping. The subsequent chapters, however, highlight the differences in the domestic and individual perspectives on Europe among Slovakia, the Czech Republic, Poland, and Hungary. Chapters 4 to 6 provide empirical details on how each member of the V4 pursued individual strategies to overcome marginalization in the post-2015 period.

In addition, each empirical chapter begins with a section in which the author provides an overview of the main geopolitical traditions and geographical imaginations that are derived from each country's interpretation of its history. These historical-geographical narratives, analogies, and images play a significant role in shaping the geopolitical reasoning of contemporary politicians, serving as the building blocks for their current arguments. The reader is, thus, provided with an introduction to the historical geopolitics of the four countries, as well as a deeper understanding of contemporary politics.

In particular, the author notes that the governing elites of Slovakia and the Czech Republic have a similar understanding of Europe's core and periphery, but position their countries differently within this framework. The Slovak elites maintain that the country is part of the EU core, while the Czech elites adopt a more nuanced approach, seeing the country's position in between the core and periphery as the most beneficial to its sovereignty. The author argues that this difference is due to a deep-seated fear of German encroachment on Czech sovereignty that is not present in Slovakian geopolitics.

In contrast, Poland and Hungary share many similarities in their strategies for dealing with marginality. Rather than accepting the existing European core-periphery spectrum, they seek to reorder it, promoting a new geographical imagination of Europe in which they are seen as the moral centre and heroic bastion of conservative, Christian Europe of nation-states.

The vision espoused by leaders such as Orbán and Kaczyński is distinct from the 1990s reorientation towards the West, yet it also echoes the 1980s dissident and romanticist discourse on Central Europe, which relied on a double othering of both the East (represented by the USSR/Russia) and the West (perceived as lacking in spirituality and culture). This discourse builds upon the tripartite geography of Europe, as conceptualized by Milan Kundera and earlier by Jenő Szűcs, as discussed in the excellent genealogical overview presented in Chapter 1. It is fascinating to find how this contemporary illiberal and anti-Western discourse is rooted in a pre-existing geopolitical tradition that defines Europe in civilizational terms and positions Central Europe as the keeper of European culture that has been forgotten in the West.

However, the empirical chapters fall short of the expectations set by the book's initial theoretical discussions. Rather than exploring how each V4 country leverages the discourse on Central Europe to position itself within Europe, the analysis primarily focuses on state-centric discourses with limited consideration of the regional scale. As a result, the concept of Central Europe is largely absent from the discourse analysis presented in these chapters, including the final chapter on the pandemic. This represents a missed opportunity to examine and assess the book's central thesis through specific case studies, and to determine the extent to which the discourse on Central Europe as a geopolitical trope for escaping marginality features in national politics.

Based on the sample of geopolitical discourse analysed in the book, the reader will find little evidence that Central Europe as a region-building discourse has any influence on domestic debates about core-periphery relationships, either as a counter-hegemonic strategy or as a vision for unification with the dominant core. On the contrary, the empirical data presented in the book indicates that these debates are inward-looking and centred on the state and the nation. As the author notes at the end of the Czech-Slovak chapter, "small states construct the core-periphery relations for themselves" (p. 103).

In the book's final chapter, the author examines the impact of the Covid pandemic on previously established "Central European revisionist political discourses." Despite initially suggesting that this would shed light on the changing nature of Central Europe as a counter-hegemonic region-building discourse, the chapter focuses on how the pandemic altered the relationship between three scales of geographical identification: national, European, and global. The analysis shows that the Visegrad countries maintained their strong counter-hegemonic stance towards Europe, but the geographical landscape shifted, with the national scale emerging as the dominant image of the self. Meanwhile, the European and global scales saw increased securitization and othering.

In conclusion, the book's last chapter offers an insightful analysis of the reconfiguration of geographical scales during the pandemic, but falls short in its examination of Central Europe as a region-building discourse.

Ultimately, the book offers a compelling conceptual framework to comprehend the shifting geopolitical dynamics in the region. In our current context, the image of Central Europe as a moral centre continues to hold sway, particularly in the political discourses of Poland and Hungary. Poland, for instance, has assumed a leadership role in the European effort to support Ukraine's defence of its sovereign statehood. The towns of Rzeszów and Przemyśl, in south-eastern Poland, have emerged as the main logistical hub for Western aid to Ukraine and a key conduit for Ukrainian refugees seeking safety. Despite its peripheral location in topographical terms, this area has become Europe's geopolitical centre in the ongoing war. Hungary on the other hand, has adopted a different stance, maintaining neutrality in the war and preserving its ties with Russia. Prime Minister Orbán has positioned himself as the sole European leader advocating for peace, casting Hungary as an "island of peace" in a sea of conflict (Orbán, V. 2022). Although this stance represents an immoral attempt to justify continued cooperation with Russia, Orbán has used this strategy to claim a moral high ground in the European geopolitical landscape.

The Polish-Hungarian rift has taken a toll on the Visegrad Group as a collective, yet Central Europe appears to have only gained influence. The firm pro-Ukrainian policy of the region's countries, with the exception of Hungary, has become hegemonic, in large part due to the backing of the United States, which Germany and France now follow, sometimes reluctantly. However, this increase in influence has also resulted in two key shifts. Firstly, the concept of Central Europe has evolved from previous crisis periods, now standing for Atlanticism and anti-Russian geopolitics, rather than cultural counter-revolution and Christian illiberalism. Secondly, the Visegrad quartet has given way to a new regional alignment, which has shifted northward and slightly eastward to include the Baltic states and Finland.

It is too soon to predict the long-term impact of the Russian-Ukrainian war on the core-periphery geographies in Europe. Despite the increased influence of Central and Eastern European states, Western Europe, led by Germany and France, still holds greater economic and political power. The book's notion of *ad hoc regionalism* accurately reflects the current state of affairs. It is uncertain whether the newly formed regional cohesion, which includes the Baltic states and Finland but excludes Hungary, can endure beyond the war and pose a challenge to the Franco-German hegemony in Europe.

However, this shift in the political-geographical landscape between Western Europe and Russia could result in the term "Central Europe" losing its relevance as a geographical description for the emerging regionalism. Paradoxically, despite its increasing geopolitical sway, Central Europe may become an unintended casualty of the war.

Gela Merabishvili[1]

Acknowledgement: This publication has been made within the project "Peripheral Geopolitics" (PD 139188), supported by the National Research, Development, and Innovation Office (NKFIH) via Postdoctoral Excellence Programme.

REFERENCES

Brubaker, R. 2017. Between nationalism and civilizationism: The European populist moment in comparative perspective. *Ethnic and Racial Studies* 40. (8): 1191–1226.

Casaglia, A., Coletti, R., Lizotte, C., Agnew, J., Mamadouh, V. and Minca, C. 2020. Interventions on European nationalist populism and bordering in time of emergencies. *Political Geography* 82. 102238.

Erlanger, S. 2023. Ukraine War Accelerates Shift of Power in Europe to the East. *The New York Times*, 26 January 2023.

Kallius, A. 2016. Rupture and continuity: Positioning Hungarian border policy in the European Union. *Intersections. East European Journal of Society and Politics* 2. (4): 134–151.

Orbán, V. 2015. *Those who are overwhelmed cannot offer shelter to anyone*. Government of Hungary, 3 September 2015. Available at https://2015-2019.kormany.hu/en/the-prime-minister/the-prime-minister-s-speeches/those-who-are-overwhelmed-cannot-offer-shelter-to-anyone

Orbán, V. 2022. *Speech by Prime Minister Viktor Orbán at an event hosted by the Association of German Chambers of Commerce and Industry*. Cabinet Office of the Prime Minister. 10 October 2022. Available at: https://miniszterelnok.hu/speech-by-prime-minister-viktor-orban-at-an-event-hosted-by-the-association-of-german-chambers-of-commerce-and-industry/

[1] ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Social and Economic Geography, Budapest, Hungary. E-mail: gela.merabishvili@ttk.elte.hu

Kunc, J., Križan, F., Novotná, M., Bilková, K., Sikos, T.T., Ilnicki, D. and Wyeth, R.: Thirty Years of Retail Transformation in V4 Countries. Warsaw, De Gruyter Poland, 2022. 200 p.

The economic and social turn that happened in the world economy from the beginning of the 1990s has brought significant changes for the post-socialist countries of East-Central Europe (ECE). The regime change in 1989–1990 raised new challenges for the countries, while the effects of globalisation have become more and more apparent in the region. Under these circumstances, the countries of ECE had to transform their economic structures from planned to market-based economies, including the institutional system, the ownership of companies, foreign and trade policies, regulations, and sectoral reorganisation in industry, agriculture and even the retail sector in the given countries. Several books and articles have dealt with the effects and process of regime change, some of which are summarising the performance of specific sectors.

The recent book is an international collaboration of seven authors that aims to present recent developments in the retail industry in the Visegrad countries. It is a niche scientific work, which gives an overview of four countries' retail sector in the last 30 years, as only some short and mid-term reports (from e.g., Euromonitor, GfK, FAO, and different e-commerce reports) dealt with this issue previously, but no comprehensive analysis was made.

The volume starts with a short introduction about the background of the analysis and the initial situation the countries started to develop from in the 1990s. In the authors' opinion, "retail belonged to those economic sectors in which the transformation experienced a very dynamic and intensive development" (p. 7). The authors emphasise that both globalisation and internationalisation have made a huge impact on the development of retail stores in ECE, especially after the change of their regimes at the beginning of the 1990s. Big international supermarkets have appeared in every country but with different intensity, and they have significantly contributed to the changes in consumer behaviour.

The book has a sum of 200 pages, from which – not considering literature – the chapters cover 171 pages. After the brief introduction, we get insight into four countries' retail sector characteristics, and we can check the differences among them from the perspective of local researchers and in quite similar structure in each chapter.

Chapter 2 (by Kunc, J. and Križan, F.) takes the reader on a journey through the world of Czech retail transformation from the beginning of the 1990s. The chapter starts with a brief historical background and gives a good interpretation of the following subchapters. It emphasises that the transformation in the retail sector of Czechia (and the Czech part of the former Czechoslovakia) was quite significant. Before 1990, the socialist regime and command economy regulations prevailed in the country. Hence, the spatial distribution of stores did not reflect the purchasing power of inhabitants at different locations, and many cities suffered from insufficient services. The transformation was significant in both qualitative and quantitative terms. At the beginning of the 1930s, the number of stores was above 170,000 stores, which dropped until the end of WWII to nearly 82,000, and kept declining until 1989 to about 43,000. Not only the number of stores but also the average sales area was quite small in comparison with Western Europe. During the regime change, the need for qualitative improvement was the most emphasised in the agglomerations of Prague, Brno, and Ostrava.

After 1990, two processes started parallel with each other: the opening of new private businesses and stores, and the privatisation of former state-owned properties. The reader can experience the main phases of transformation in the Czech retail sector, noting that these are not fully separate from each other but rather parallel and overlaying processes. The early

stage of transformation brought about atomisation, with privatisation and the number of stores doubling, which was followed by (or partly going along with) intensifying internationalisation with the stores of retail chains as Tesco, Lidl, and Penny Market entering the Czech retail sector. The biggest wave of internationalisation happened between 1991–1998. Until 2009 and thereafter, the Czech retail sector experienced dynamic growth regarding the number of stores, sales area, and the number of employees, along with diversification. A special paragraph deals with the formation of networks and larger business units (supermarkets, discount stores, hypermarkets, and shopping centres) which developed mainly after 1995.

The chapter ends with two summaries. The first one gives insight into retail activity in rural regions (mainly settlements with less than 500 inhabitants), and emphasises that government support programs were successful and not so many closures happened. The second summary is about retail parks that host individual economic units at a common location, and the creation of which is recently very intensive in the Czech Republic. (In 2020, 23 retail park projects were completed or expanded while 14 brand new retail parks were built).

From my perspective, one of the most interesting parts deals with the diffusion of stores and scrutinises whether it was centralised diffusion (following the urban network's hierarchy) or contact diffusion (as in the case of Lidl). It is also interesting that the biggest wave of shopping centre openings took place between 2005 and 2008, following predominantly an out-of-centre policy and green and brownfield investments, reaching on average 5,000–20,000 m^2 sales areas. The chapter ends with insights into the impacts of Covid-19 on the sector and emphasises the emergence of e-commerce. Chapter 3 (by Križan, F. and Bilková, K.) is dedicated to retail in Slovakia and starts with the notion that a common feature of these post-socialist countries is that the transition to the market economy was not easy because of the lack of political, legal, and economic structures of the market economy. This is also true for Slovakia, where the transformation of the retail sector was very intensive and both structural and functional changes happened. The chapter gives an overview of the process in three stages and presents a complete picture of the last nearly 80 years. After WWII, huge nationalisation started in the Slovakian part of former Czechoslovakia and privately owned retail units, making up almost 80 percent of the whole network in 1948, was fully nationalised until 1960. Parallel with this and differently from Czech areas, a small increase happened in the number of stores until 1989. But like the Czech retail sector, the Slovakian one experienced a low density of the retail network and small sales area per inhabitant, so the composition of business units was not ideal. In spatial terms, Slovak retail concentrated in the towns and larger villages before privatisation.

The authors guide the reader through the transformation process that started after 1989, when thousands of new retail units were opened, and the first hypermarket was settled in the country as a sign of globalisation. Besides, a huge wave of privatisation started in the same period, resulting in the restructuring of retail sales. By 1998, more than 90% of the revenue concentrated in private sector companies. From the second half of the 1990s, globalisation became even stronger, which resulted in changing consumer behaviours and the spatial concentration of retail.

A special paragraph deals with the formation of retail networks (supermarkets, discount stores, hypermarkets, and shopping centres), which in the case of Czechia developed mainly after 1996 in terms of supermarkets and 1999 in terms of hypermarkets. An interesting fact in the chapter is that "only 13 percent of Slovakia's current shopping centres were opened before 2003" (p. 66). The biggest boom in shopping centres happened between 2006 and 2010, in the first years predominantly with greenfield, and later with brownfield investments, in most cases along an out-of-centre strategy, and with a sales area of 5,000-20,000 sq. m on average (similarly to the Czech case). The chapter presents the spatial diffusion of stores and notes that as an effect of globalisation, selected specialised stores has started to concentrate in space and this process is still lasting nowadays.

The fourth and longest chapter (by Sikos, T. T.) describes the transformation of the retail sector in Hungary. It begins with explaining the historical background and shows that in 1940 only 27 percent of the country's stores concentrated in the capital city Budapest, but the share of Budapest was 45 percent from employees and 60 percent from turnover, so the distribution of shopping-related indicators was not equal. The store creation process speeded up in the 1960s, together with an increase in the floor space of shops. Most of the total turnover fell on state-owned shops, but the share of these radically decreased from 76.5 percent in 1952 to 62 percent in 1980 in favour of cooperative forms of ownership. The share of private turnover was extremely low before the regime change.

After 1989, significant changes happened in Hungary's retail sector, as both a wave of privatisation occurred and foreign chains started to gain importance. The author mentions that the Coop network was established in 1995 with 465 stores, which significantly contributed to the transformation of retail. The chapter also contains the major data about mergers and acquisitions (like in the case of Auchan and Cora stores), and a hierarchy of the factors affecting the players in food retail, which is a valuable piece of the analysis. The reader can scrutinize the transformation of sales channels through the figures in subchapter 4.6, which emphasises how hypermarkets, supermarkets, and discount stores are emerging instead of independent small shops. This transformation has

led to a concentration of retail turnover and stores, as "the 3 largest store chains has generated almost 40 percent of total gross sales in 2019. For nine retail chains, this value already accounts for about 4/5 of the national turnover (81%)" (p. 87).

A significant and strong part of the chapter is a detailed overview of the spatial distribution of different shops and chains (i.e., Tesco, Lidl, Spar, Coop, CBA). A spatial distribution map shows the location of shops and the major hotspots and cold spots for every type of shop. We can see which store is concentrated in Budapest and its agglomeration, or in the major regional towns, and what kind of stores exist the spatial and economic peripheries.The next part of the chapter deeply examines the formation and character of shopping centres in Hungary. The author distinguishes between 7 generations of shopping centres from 1976 until nowadays. In the case of Budapest, the 10-year period of the third to sixth generations of shopping centres from 1996 to 2005 was the most intensive. For each generation, the reader can see some illustrative examples of the biggest shopping centres and their surroundings in the urban space.The last major section of the chapter deals with the effects of the Covid-19 pandemic on the retail sector, which gives deep insight into the impacts of this shock. The author emphasis that in Hungary, just like elsewhere, "the customers' behaviour has changed as a result of the spread of the virus (panic buying, changing product preferences, and later revenge shopping)" (p. 116). The chapter illustrates different forms of habit change in various periods of crisis (before the pandemic, restrictions, vaccinations, and the end of the pandemic).

The fifth chapter (by Ilnicki, D. and Wyeth, R.) presents the characteristics of the retail sector in Poland. After a brief introduction to the theory of retail research, the chapter presents the stages of retail development in Poland. In the era of a centrally controlled economy before the regime change, the absolute number of retail outlets increased significantly, by four times from 1950 to 1990, and the population per outlet decreased seriously. After the transformation, there was a fourfold increase in the number of stores due to the economic reforms of the Polish government. A short description of these reforms is a strength of the chapter (e.g., antimonopoly act, a new housing law, amendment of acts like acts on cooperatives). The reader can observe the importance of urban agglomerations and voivodeships (the highest-level administrative divisions in Poland) concentrating a large population, as here the number of stores is also the highest. The chapter illuminates spatial disparities between urban agglomerations and peripheral regions, as the "number of residents per store in 1998 varies on average to 68 in urban areas and 145 in rural areas" (p. 134).

The chapter goes on to discuss the current situation and shows that, although the number of stores significantly decreased from 2000 to 2020, the average store area per retail unit has increased a lot in the same period. Parallel with this, the number of supermarkets and hypermarkets has increased, as it is presented in the subchapter on the chain structure of the Polish retail sector. An interesting part of this section is the analysis of maps on the spatial distribution of hypermarkets and supermarkets, which identify hot spots in the Polish landscape, with the highest concentrations in the most populous cities and towns. Until 2020, the Polish cities and communes (on LAU1 level) showed clear West–East differences in the number of supermarkets per 10,000 residents and indicated a strong trend of concentration after 2010.

We can observe a similar evolution of shopping centres as in the other three Visegrad countries, but the case of Poland is different in terms of having three intensive periods of shopping centre construction projects (1998–2001, 2008, 2014) with different intensities. The most typical shopping centres are those within a size range of 5,000–19,999 sq. m.

Probably the most "colourful" part of the chapter for the readers are the case studies of large-format retail chains like Tesco, Kaufland, Lidl, Dino, Netto and Intermarche, which predominantly show uneven geographical concentration along the West–East axis. The concrete examples of different stores provide apprehensible clues for interpreting the spatial distribution of the retail sector in Poland. The conclusion of the chapter gives a detailed overview of the chapter's content, which highlights the essence of the retail sector's transformation in Poland.

Chapter 6 (by Kunc, J. and Križan, F.) is a quasi-overview of the whole region's retail transformation. It summarises the main consequences of the process while giving a complex view of the sector. It is one of the most valuable descriptions for comparing different dynamics in the V4 countries. Although it is only 7 pages, it contains critical information. The authors emphasise that retail in the V4 has changed a lot in the past three decades, which has resulted in the functional and spatial transformation of the retail network. Successful privatisation and internationalisation happened in the whole area, and new large-space retail stores have entered these countries. However, the types of retail markets are different in each country, including "all-embracing internationalised retail markets in Poland and Hungary; an intermediate stage in the Czech Republic, and partly internationalised retail markets in Slovakia" (p. 167). Besides external internationalisation, internal internationalisation within the Visegrad Group has taken place. Globalisation has affected in the four countries not only the shopping centres (mainly resulting in the concentration of centres with an average area of 5,000–10,000 sq. m) but also the consumer behaviour. Although the transformation can be evaluated as successful, the average space of retail facilities is much

below the Western European average. The Covid-19 pandemic has brought about an increase in online purchases and the use of ICT tools, so the transformation of the retail sector will not stop in the future.

The book aims to provide a comprehensive insight into the Visegrad countries' retail sector transformation that started after the regime change and shows the case of the four countries. The theoretical and practical usefulness of the book is unquestionable. For easier understanding and transparency, the whole book uses self-edited figures, maps, and tables, which give an illustrative picture of the topic. It contains important scientific findings for specialists dealing with territorial analysis and the retail industry, both nationally and internationally. The book is a good, easy-to-consume and enjoyable piece for the readers. I would recommend it to anyone with an interest in retail industries, including readers outside the academic sector.

Dóra Szendi[1]

[1] University of Miskolc, Faculty of Economics, Institute of World and Regional Economics, Miskolc, Hungary. E-mail: dora.szendi@uni-miskolc.hu

Manuscript reviewers

2020–2022

The editors of the Hungarian Geographical Bulletin would like to thank the following experts who have offered their assistance in reviewing manuscript submissions to our journal issues between Number 1 in 2020 and Number 4 in 2022. Their efforts and useful comments have been of great service for the authors and the journal.

BACSI, Zsuzsanna (Keszthely)
BAGOLY-SIMÓ, Péter (Berlin)
BAKACSI, Zsófia (Budapest)
BALATONYI, László (Budapest)
BARCZA, Zoltán (Budapest)
BARTLOMIEJ, Glina (Poznań)
BASIK, Sergei (Kitchener)
BEKE, Szilvia (Gyula)
BENEDEK, József (Cluj-Napoca)
BENKHARD, Borbála (Debrecen)
BOGDAN-ANDREI, Mihai (Bucharest)
BONČINA, Andrej (Ljubljana)
BOROS, Lajos (Szeged)
BOTTLIK, Zsolt (Budapest)
CALEB, Melenya (Kumasi)
CHOLII, Serhiy (Kyiv)
CSAPÓ, János (Pécs)
CSOMÓS, György (Debrecen)
CZAPIEWSKI, Konrad (Warsaw)
DADASHPOOR, Hashem (Tehran)
DALLEN, Timothy (Phoenix)
DEZSŐ, Zsuzsanna (Budapest)
DICK, Jan (Edinburgh)
DRAGIĆEVIĆ, Slavoljub (Belgrade)
DUSEK, Tamás (Győr)
EGRI, Zoltán (Szarvas)
ERŐSS, Ágnes (Budapest)
FALK, Martin (Bø)
FICSOR, Johanna (Baja)
FOLINAS, Sotiris (Thessaly)
GÁL, Tamás (Szeged)
GARCÍA-ARNAY, Ángel (Zaragoza)
GARTNER, Georg (Vienna)
GAVRILOV, Milivoj B. (Novi Sad)
GETZNER, Michael (Vienna)
GLAMUZINA, Nikola (Split)
GULYÁS, Ágnes (Szeged)
GYENIZSE, Péter (Pécs)
HALÁSZ, Levente (Budapest)
HALBAC-COTOARA-ZAMFIR, Rares (Timişoara)
HALMAI, Ákos (Pécs)
HANUS, Martin (Prague)
HARANGOZÓ, Gábor (Budapest)
HASZPRA, László (Sopron)
HEGEDŰS, András (Miskolc)
HEGEDŰS, Gábor (Szeged)
HOFIERKA, Jaro (Košice)
HOLEC, Juraj (Bratislava)
HRUŠKA, Vladan (Ústí nad Labem)
HURBÁNEK, Pavol (Ružomberok)
IRIMIÁS, Anna (Budapest)
JAKOBI, Ákos (Budapest)
JORDAN, Peter (Vienna)
KARÁCSONYI, Dávid (Budapest)
KERTÉSZ, Ádám (Budapest)
KEVE, Gábor (Baja)
KEVICKÝ, Dominik (Brno)
KIS, Anna (Budapest)
KISS, András (Amsterdam)
KISS, Edit Éva (Budapest)
KODERMAN, Miha (Koper)
KOLOSSVÁRY, Endre (Budapest)
KOVÁCS, Ferenc (Szeged)
KOVALCSIK, Tamás (Szeged)
KRAFT, Stanislav (České Budějovice)
KRŽIČ, Aleksandra (Belgrade)
KUNDU, Debolina (New Delhi)
LABANCZ, Viktória (Gödöllő)
LAKATOS, Mónika (Budapest)
LASKOWSKA, Iwona (Łódź)
LÁSZLÓ, Péter (Budapest)
LEMENKOVA, Polina (Brussels)
LEMOS, Fernando (Guarda)
LENGYEL, Balázs (Budapest)
MAIER, Günther (Vienna)
MAJO, Juraj (Bratislava)
MAMADOUH, Virginie Djemila (Amsterdam)
MATLOVIČ, René (Prešov)
MICHALKÓ, Gábor (Budapest)
MIKA, János (Eger)
MUCSI, László (Szeged)
NAGY, Egon (Cluj-Napoca)
NAGY, Erika (Budapest)
NAGY, Gábor (Budapest)
NÉMETH, Károly (Palmerston North)
NÉMETH, Krisztina (Budapest)
NOVÁK, Tibor (Debrecen)
ORANJE, Mark (Pretoria)
OUŘEDNÍČEK, Martin (Prague)
PARAJKA, Juraj (Vienna)
PATKÓS, Csaba (Eger)
PENÍŽEK, Vit (Prague)
PÉNZES, János (Debrecen)
PETIŠKA, Eduard (Prague)
PETROVIĆ, Aleksandar (Belgrade)
PIRISI, Gábor (Pécs)
PREDA, Mihaela (Bucharest)
RAŠKA, Pavel (Ústí nad Labem)
REPE, Blaž (Ljubjana)
RIZZO, Raffaela Gabriella (Brescia)
SÁGI, Mirjam (Budapest)
SARKADI, Noémi (Pécs)
SCHERRER, Daniel (Lausanne)
SCHWARZ, Ulrich (Vienna)
SEBESTYÉNNÉ SZÉP, Tekla (Miskolc)
SIPOS, György (Szeged)
SKARBIT, Nóra (Szeged)
SKOKANOVÁ, Hana (Brno)
SONUÇ, Nil (Izmir)
STANÍČKOVA, Michaela (Ostrava)
ŠULC, Ivan (Zagreb)
ŠUŠKA, Pavel (Bratislava)
SÜTŐ, László (Eger)
SVOBODÁ, Hana (Brno)
SZABÓ, Balázs (Budapest)
SZABÓ, György (Debrecen)
SZABÓ, Péter (Brno)
SZABÓ, Szilárd (Debrecen)
SZALAI, Ádám (Szeged)
SZALAI, Zoltán (Budapest)
SZEMETHY, László (Pécs)
SZIGETI, Cecília (Győr)
SZILASSI, Péter (Szeged)
TARASOV, Ilya (Kaliningrad)
TÁTRAI, Patrik (Budapest)
TELBISZ, Tamás (Budapest)
TOLESH, Fariza (Astana)
TORMA, Csaba (Budapest)
TÓTH, Gergő (Budapest)
TÓTH, Géza (Budapest)
TULUMELLO, Simone (Lisbon)
TUROK, Ivan (Cape Town)
UJHÁZY, Noémi (Budapest)
UZZOLI, Annamária (Budapest)
VACCA, Andrea (Cagliari)
VIDA, György (Szeged)
ZAWILIŃSKA, Bernadetta (Kraków)
ŽENKA, Jan (Ostrava)
ZIZALA, Daniel (Prague)

GUIDELINES FOR AUTHORS

Hungarian Geographical Bulletin (formerly Földrajzi Értesítő) is a double-blind peer-reviewed English-language quarterly journal publishing open access **original scientific works** in the field of physical and human geography, methodology and analyses in geography, GIS, environmental assessment, regional studies, geographical research in Hungary and Central Europe. In the regular and special issues also discussion papers, chronicles and book reviews can be published.

Manuscript requirements

We accept most word processing formats, but MSWord files are preferred. Submissions should be single spaced and use 12pt font, and any track changes must be removed. The paper completed with abstract, keywords, text, figures, tables and references should not exceed **7,000 words**.

The Cover Page of the article should only include the following information: title; author names; a footnote with the affiliations, postal and e-mail addresses of the authors in the correct order; a list of 4 to 8 keywords; any acknowledgements.

An abstract of up to **300 words** must be included in the submitted manuscript. It should state briefly and clearly the purpose and setting of the research, methodological backgrounds, the principal findings and major conclusions.

Figures and tables

Submit each illustration as a separate file. Figures and tables should be referred in the text. Numbering of figures and tables should be consecutively in accordance with their appearance in the text. Lettering and sizing of original artwork should be uniform. Convert the images to TIF or JPEG with an appropriate resolution: for colour or grayscale photographs or vector drawings (min. 300 dpi); bitmapped line drawings (min.1000 dpi); combinations bitmapped line/photographs (min. 500 dpi). Please do not supply files that are optimised for screen use (e.g., GIF, BMP, PICT, WPG). Size the illustrations close to the desired dimensions of the printed version. Be sparing in the use of tables and ensure that the data presented in tables do not duplicate results described elsewhere in the article.

REFERENCES

Please ensure that every reference cited in the text is also present in the reference list (and vice versa).

Reference style

Text: In the text refer to the author's name (small capitals with initials) and year of publication. References should be arranged first chronologically and then further sorted alphabetically if necessary. More than one reference from the same author(s) in the same year must be identified by the letters 'a', 'b', placed after the year of publication.
Examples: (Ridgewell, A.J. 2002; Maher, B.A. *et al.* 2010) or Ridgewell, A.J. (2002); Maher, B.A. *et al.* (2010).

Journal papers:
Aagaard, T., Orford, J. and Murray, A.S. 2007. Environmental controls on coastal dune formation; Skallingen Spit, Denmark. *Geomorphology* 83. (1): 29–47.

Books:
Pye, K. 1987. *Aeolian Dust and Dust Deposits.* London, Academic Press.

Book chapters:
Kovács, J. and Varga, Gy. 2013. Loess. In *Encyclopedia of Natural Hazards.* Ed.: Bobrowsky, P., Frankfurt, Springer, 637–638.

Book reviews

Book reviews should be between 2,000 and 3,000 words (including references).

Submission

Submission to this journal occurs online. Please submit your article via http://ojs3.mtak.hu/index.php/hungeobull/about/submissions

All correspondence, including notification of the Editor's decision and requests for revision, takes place by e-mail.

Publisher:
Research Centre for Astronomy and Earth Sciences
1121 Budapest, Konkoly Thege Miklós út 15–17., Hungary

Editorial office:
Geographical Institute, Research Centre for Astronomy and Earth Sciences
1112 Budapest, Budaörsi út 45., Hungary
Phone, fax: +36 1 309 2628
E-mail: geobull@mtafki.hu, kovacs.zoltan@csfk.org
Distribution: GABRIELLA PETZ, petz.gabriella@csfk.org
Full text is available at https://ojs3.mtak.hu/index.php/hungeobull

Typography: ESZTER GARAI-ÉDLER
Technical staff: FANNI KOCZÓ, ANIKÓ KOVÁCS, GÁSPÁR MEZEI

Cover design: ANNA REDL
Printed by: Premier Nyomda Kft.

HU ISSN 2064–5031
HU E-ISSN 2064–5147

Distributed by the Geographical Institute, Research Centre for Astronomy and Earth Sciences

Subscription directly at the Geographical Institute, Research Centre for Astronomy and Earth Sciences (H-1112 Budapest, Budaörsi út 45), by postal order or transfer to the account IBAN: HU24 10032000-01730841-00000000. Individual copies can be purchased in the library of the Institute at the above address.