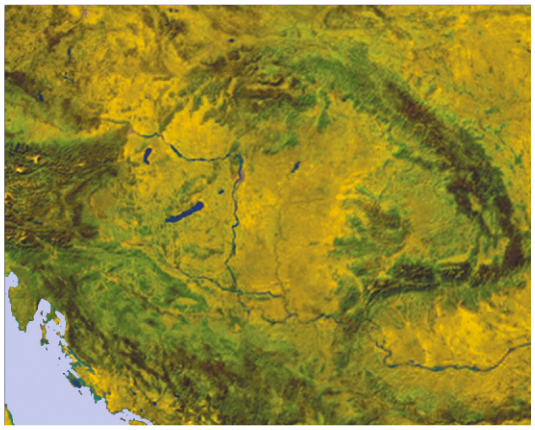
Hungarian Geographical Bulletin



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Geomorphological analysis of Tinto-B Vallis on Mars

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Abstract

This work analysis an 81 km long 1.85 km wide fluvial valley on Mars (at 2°55′ South and 111°53′ East) for the first time, located near to the so-called Palos carter and Tinto Vallis, called Tinto-B hereafter. The length of the valley is approximately 81 km, and the average width is ~1.85 km, depth ~250 m. The hypsometric curves were created in 5 different buffer sizes on the main valley and the biggest tributary valley. The tributary valley shows a youth stage in the geomorphological evolution opposite to the main valley, which shows a mature stage. The crater statistical analysis based age of the main valley (2.9 Ga) poorly correlates with the early wet period of the red planet, thus, formed somehow later than most Martian valleys. Using the model SIMWE (SIMulated Water Erosion), for the to identify the small-scaled tributary valley systems and the small-scaled erosional landforms showed area elevated drainage density. The highest density of the tributary sections is 29.02 km/km^2, and the average is 3.09 km/km^2. Considering only the main valley 0.017 km/km^2 would have been measured, suggesting dozen(s) early tributaries were heavily eroded.

Keywords: Mars, erosion, SIMWE, fluvial erosion, morphology

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Introduction

Valley networks on the Mars has been attributed dominantly to surface run-off (Craddock, R.A. and Howard, A.D. 2002; Irwin, R.P. and Howard, A.D. 2002), groundwater sapping (Carr, M.H. 1981; Carr, M.H. and Malin, M.C. 2000; Goldspiel, J.M. and Squyres, S.W. 2000; Grant, J.A. 2000) or a combination of runoff and sapping (first suggested by Milton, D.J. 1973). Even so, the Martian fluvial valleys (Baker, V.R. 1988; Baker, V.R. *et al.* 1992; Clifford, S.M. 1993; Dohm, J.M. *et al*. 2015; Hargitai, H.I. *et al*. 2019; Vaz, D.A. *et al.* 2020) show many similarities with the terrestrial fluvial system especially with the dry or semi-dry valleys, desert wadi (Hauber, E. *et al.* 2009). Fluvial structures like terraces suggest multiple periods of formation (Mangold, N. *et al.* 2004), and the correlation with other fluvio-sedimentary features and chloride salts suggest extended activity periods on Mars (Hynek, B.M. *et al.* 2010), while various terminal deposits (Salese, F. *et al.* 2020) demonstrate mainly early fluvial transport on the planet. Most valley networks formed around the Noachian/Hesperian boundary about 3.7 Ga ago (Hynek, B.M. *et al.* 2010) or earlier, but there was valley formation in later episodes even during Amazonian ages (Fassett, C.I. and Head, J.W. 2008) occasionally, although there are indications that suggest that the style of post-Noachian activity differs from the later type (Howard, A.D. *et al.* 2005).

Although current conditions are not favourable for bulk phase liquid water on Mars (Möhlmann, D. and Kereszturi, A. 2010; Martín-Torres, F.J. *et al.* 2015; Horne, D.J. 2018; Schorghofer, N. *et al.* 2018) or might

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emerge as small ephemeral flows in gullies (Conway, S. *et al.* 2019; de Haas, T. *et al.* 2019), and elevated humidity might produce microscopic liquid phase ephemerally (Pal, B. 2019), old fluvial systems are well preserved and abundant.

The analysed area is at the southern highlands, where many old fluvial systems are present (Palumbo, A.M. *et al.* 2020). It is situated near to Palos crater and Tinto Vallis *(Figure 1)*, thus, the analysed Vallis was named Tinto-B. This area includes several smaller valleys, which are located West from Tinto-B Vallis (see later the western part in *Figure 2* inset 'a').

The aims of this work are (1) to compare the target valleys with resemble other ones, (2) put the target valley to context regarding its formation age, and (3) identify and evaluate the potential eroded tributaries in the surroundings using the flow and erosional simulating SIMWE (SIMulated Water Erosion) model.

Materials and methods

Three methods were used to understand better the characteristics and formation of the target valley(s): (1) image and topography based morphological analysis, including the analysis of longitudinal and cross-sectional profiles; (2) exposure age estimation using crater size-frequency distributions at separated surface units; and (3) applied erosion model-based evaluation of surface features regarding formerly existed but heavily eroded tributaries.

Although this later model (SIMWE) has not been earlier applied to Mars before, as this is not suitable to do the calculations that are required to reconstruct the surface modifications perfectly yet, however, the identification of eroded tributaries, and provide the basis for future more detailed exploration of this modelling environment.

ESRI ArcMap 10.4.1 and GRASS GIS 7.6 were used for analysing the PDS/GIS data-

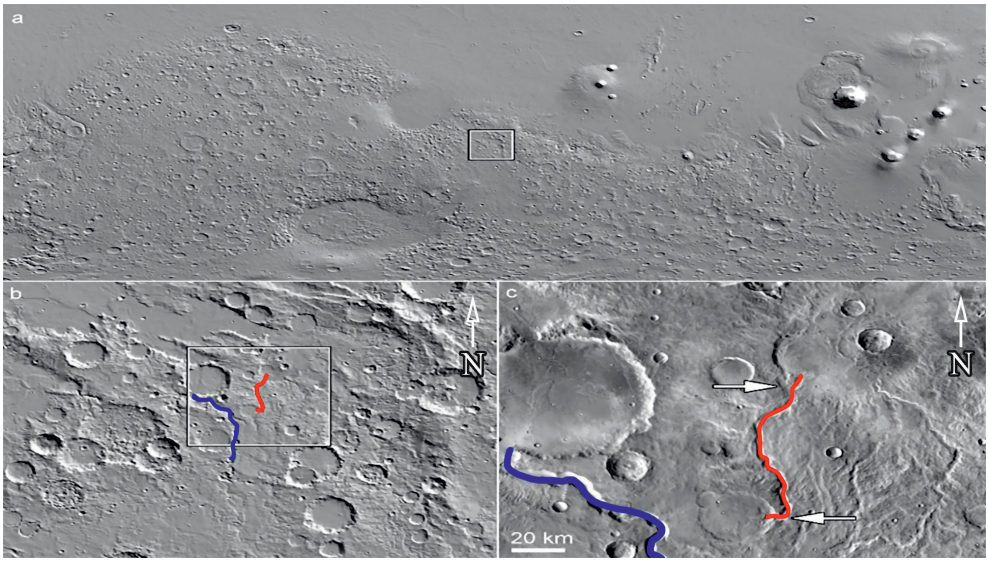

Fig. 1. Overview image from the analysed area, what is located at the southern highlands (a), close to the Tinto Vallis (b), lower left of the boxed area, while the target valley is at the centre. The target valley Tinto-B is visible in the 'c' inset, with the starting and termination points are marked with arrows. The blue line represents the Tinto Vallis, the red line shows the analysed valley, Tinto-B on inset 'b' and 'c'. *Source image*: MOLA (Mars Orbiter Laser Altimeter) shaded relief (NE) – JMARS (more detailed image, from the analysed valley on *Fig. 7*).

sets. The original DTM (Digital Terrain Model) is a HRSC (High Resolution Stereo Camera – on board Mars Express mission – Neukum, G. *et al.* 2004) based map with 50m/px (metre/pixel) resolution h0951_0000_dt4 (Sidiropoulos, P. and Muller, J. 2015) and the used CTX (Context Camera – on board Mars Reconnaissance mission) images with 5m/px resolution: P22_009796_1771_XN_02S248W/P11_005511_1761_XN_03S248W. The used coordinate system is the Martian Sinusoidal (projection-type: Sinusoidal, central meridian: 112). During the measurements, the errors from uncertainty in pixel pointing, in the database and in the georeferencing were less than 5 metres. The calculated values were used for statistical purposes.

The hydrological analysis was made in ArcMap with ArcHydroTools (used version: 10.2) to identify post fluvial eroded, thus, poorly visible ancient tributaries. In this research, the authors used the Fill tool to auto-fill the possible depressions on the used DTM and Flow Direction and Flow Accumulation tools to determine the gullies and flows on the analysed area *(Figure 2).* For crater identification the above-listed CTX image was used, where those features were counted as craters, which were at least 4–6 pixel diameter, showed an arc-shaped brighter and a darker features and they presented a circular shape together (minimum crater size: 20 metres).

As at this spatial scale, no boulders could be observed, and at the target area no noticeable crater-like erosional, mainly cryo karst pit depressions (Hargitai, H. and Kereszturi, A. 2015) were present, most craters could be firmly identified. Those surface structures were considered as impact craters, which showed a brighter than the surroundings solar facing arc-shaped area and a darker than the surroundings anti-solar facing

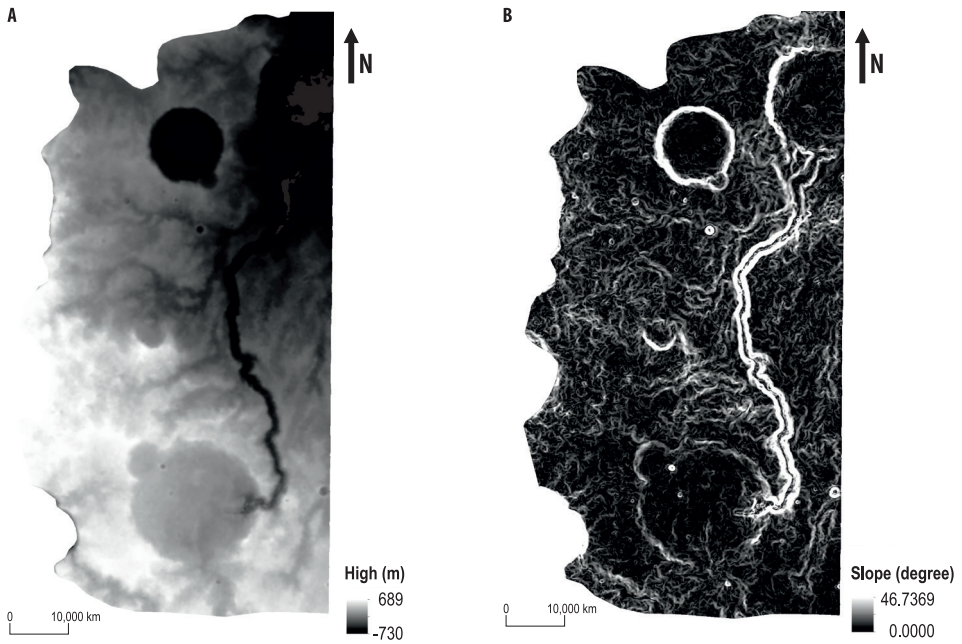

Fig. 2. The DTM (a) and the slope map (b) of the analysed area using HRSC topographic data. One of the steepest slopes (bright colour in the right inset) can be found along the main valley.

arc-shaped area, and these two form a circular shape structure. For the age estimation, the authors used the CraterTools (Kneissl, T. *et al.* 2011) and Craterstat (Michael, G. and Neukum, G. 2010) software. The age was estimated inside the selected area, characteristic to the given surface unit.

The drainage density was calculated from the former calculated flow accumulation maps in ArcMap with the *Flow Accumulation* tool. The length of the flows was measured in a 1×1 km size grid map. The drainages represent the results of the flow accumulation, where the value was bigger, than 150 and converted to polyline features. These features' cumulative length were measured in each grid cell.

For the erosion simulation, the SIMWE (SIMulated Water Erosion) model (Mitasova, H. *et al.* 2004) was applied. The model uses the original elevation file and the x and y derivatives, which are generated with the script *r.slope.aspect*. The model uses a hypothetic water depth, which is calculated from the original elevation and a user-defined given a single storm event (mm/hr) in a certain time (min) with the script *r.sim.water*.

The erosion-deposition rate was calculated with the script *r.sim.sediment*, which uses several other components, like detachment and transport coefficient, shear stress and infiltration value. The model is under testing and was applied not to estimate specific numerical erosion or deposition rate but only to identify eroded, old tributary valley segments. The model in this study was used with a 15 mm/hr rain event for 3 minutes. With this approach, more candidate valleys could be identified than based on a simple optical survey of images.

Two hypsographic curves were acquired from the main valley and the biggest tributary valley using five different buffer sizes. The central curve of the buffers is the longitudinal axis of the valley, the other also runs along the bottom of the valleys with width: 500, 750, 1,000, 1,250 and 1,500 m. The buffers outlined were made in ArcMap, the final calculation in Ms Excel.

Results

The target valley has a main deep depression, with few short (2–4 km long) tributaries at its uppermost region, however, several uncertain, heavily eroded and moderately longer tributaries could be suspected along it. The length of the main valley is approximately 81 km, and the average width is ~1.85 km, depth ~250 m. The highest point of the analysed area is +689 m in local relief, and the deepest is -730 metres, the flow direction of the valley is from South to North.

The main characteristics of the valley were compared to the nearby Tinto Vallis (*Figure 1* bottom left of 'c', also located at Tyrrhena Terra), which has been previously analysed by other authors (Rauhala, A.I. and Kostama, V.-P. 2012a). Tinto Vallis formed around 3.6–3.5 Ga probably by a catastrophic flooding event and poured its water to the 53 km diameter Palos crater, where the wall was breached out and produced an ever further outflow with about 300 km length to the north. Both fluvial and volcanic origins have been proposed for the Tinto Vallis, and formation first by stage groundwater flow (Carr, M.H. and Malin, M.C. 2000) and later by catastrophic outflow. Tinto Vallis gets gradually wider and deeper in downflow direction and presents sapping morphology with about 0.4 per cent average slope angle and width to depth ratio around 5. Its volume is about 266 km^3, which seems to be able to lay down a 120 m thick sedimentary layer at the bottom of Palos crater (Rauhala, A.I. and Kostama, V.-P. 2012b).

The valley of Tinto-B is obvious in the CTX images, it has sharp and relatively steep walls, the sharp edge and its bottom could be firmly outlined (*Figure 3*, inset 'f'). The source area is a 22.5 km sized and ~400 m deep crater with smooth, possibly infilled floor, where a moderately deep branching upper part of Tinto-B was cut into. The starting points of these tributaries are sharp and the valleys widen and deepen fast. Along most of the valley, its sides are steep enough to show partly smooth or downward

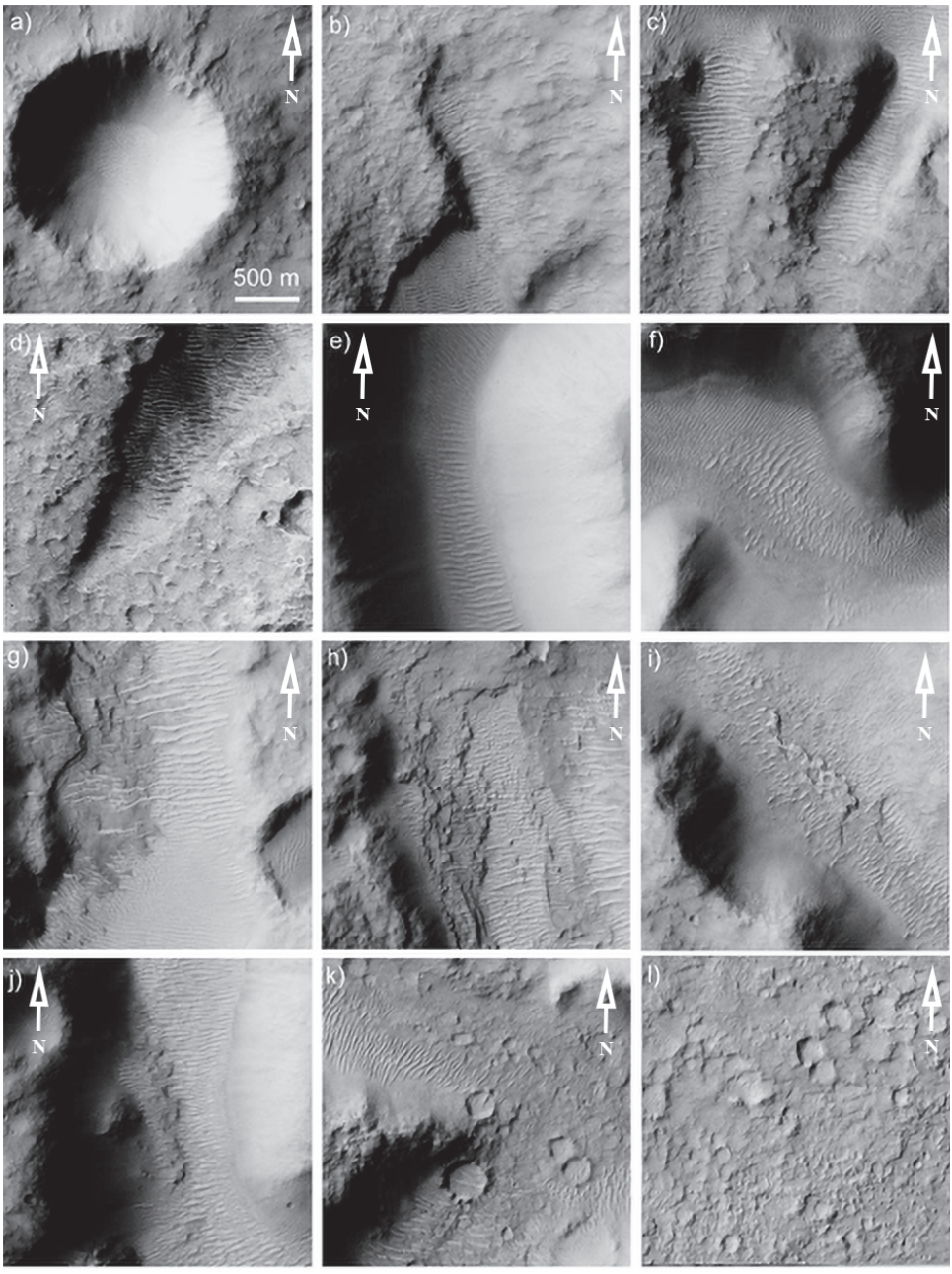

Fig. 3. 2x2 km sized insets of the used CTX images are indicated, presenting examples for the following observed morphological features. The exact locations of the images are represented on *Fig. 7.* – a = crater at the surrounding old terrain; b, c and d = small and sudden deepening tributaries at the source area; e = deep, typical section of the main valleys; f = sharp curvature of the main valley; g = system of transverse dunes at the bottom of the valley; h, i, and j = part of the layered channel deposit outcrop; k = entry mouth of the valley in the terminal crater; l = bottom of the terminal crater

striped morphology, suggesting mass movements happened there. At most of its bottom (valley floor), ripple mark patterned surface sand deposits are present. At a few locations (~8) the original, very old bedrock bottom outcrops are present at the central part of the valley (*Figure 3*, inset h, i and j). There are 13 such bedrock exposures on the mainly sand-covered valley bottom, located around the northern and southern parts of the valley. The total area of the bedrock exposures is 5,022,254 m^2, the biggest one is 2,710,238; the smallest is 27,393 m^2.

The terminal sink structure is an 18.13 km diameter crater at north where no obvious depositional structure can be identified. The interior of the terminal sink crater is filled by some smooth sediment.

Five histogram profiles made on the main valley are visible in *Figure 4* inset 'a' and the largest tributary in *Figure 4* inset 'b', using different buffer sizes perpendicular to the valley longitudinal axis.

Altogether 17 cross-sectional profiles were made of the main Tinto-B valley and other 12 of the tributary smaller valley *(Figure 5)*, which is west to the main valley (marked on *Figure 5* right image with an arrow). The cross profiles are perpendicular to the walls of the valleys and the flow accumulation lines, what was provided by the filled DTM and the flow direction raster map. The lengths of the profiles were adjusted to the width of the valley, so they are proportional to their real width of the valley.

The average length of the cross-sectional profiles on the main valley is 2,954 metres and ranged between 3,866 and 1,200 m. The average length of the tributary valley's cross-sectional profiles is 1,177 metres and ranged between 2,162 and 519 m *(Figure 6)*.

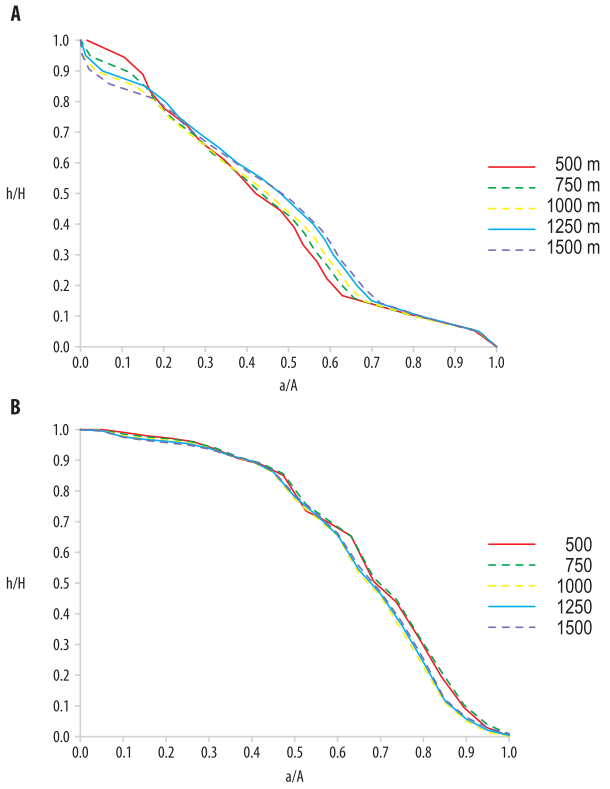

Fig. 4. Hypsographic curves in different buffer sizes (500, 750, 1,000, 1,250 and 1,500 m) on the main valley (inset a), and on the biggest candidate tributary valley (inset b).

Crater occurrence-based age estimation

The first area (ID 1) shows the estimated age of the valley bottom, considering only the bedrock exposures at the end of the analysed area Tinto-B (see *Figure 1*). The area with ID 2 shows the neighbourhood area which is probably as old as the tributaries. ID 3 shows the sediment covered crater bottom at the South and ID 4 the sediment of the crater bottom on the North, while ID 5 the sand-covered valley bottom *(Table 1, Figure 7)*. The minimum crater size changed between 18.6 and 35.9 m. The biggest crater was measured in the third area (the source crater at the South) – the maximum crater size changes between 471 and 996 metres for different areas *(Figure 8)*.

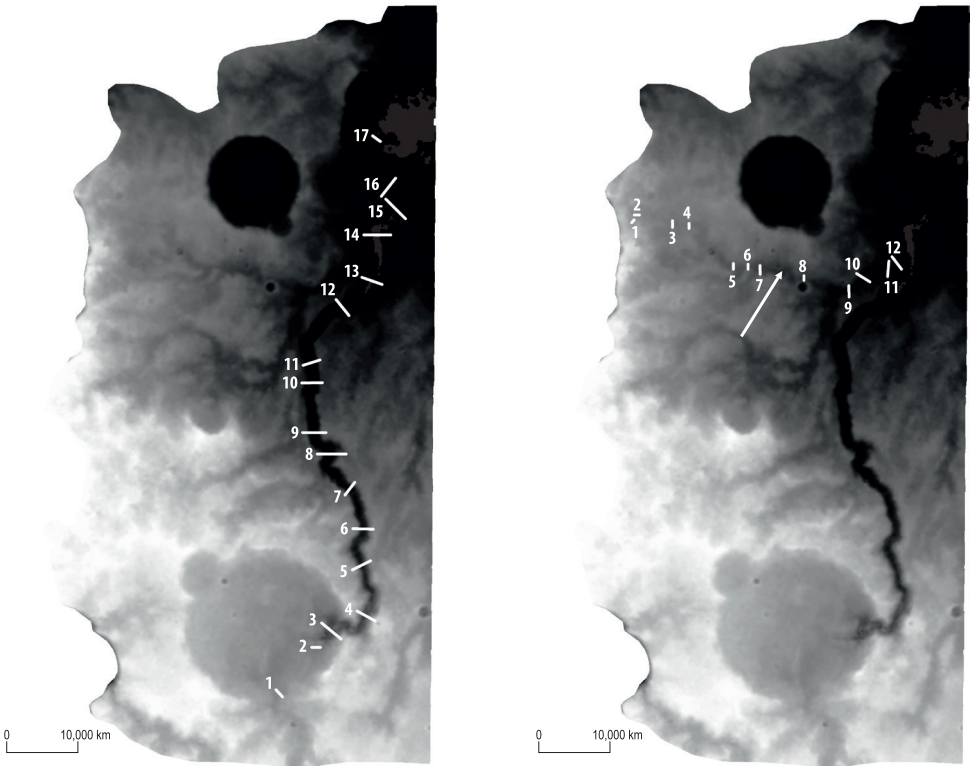

Fig. 5. Overview of the cross-sectional profiles' locations along the main (left image) and the biggest tributary valleys. The numbers show the ID of the profiles.

Table 1. Data of crater statistics

ID	Age, Ga	Crater size range, m	Number of craters	Crater density, crater/km^2
1. Bedrock exposure at valley	$2.50^{+0.8;\ -1.0}$	29–471	66	1.97
2. Neighbourhood	$3.40^{+0.1;\ -0.7}$	19–730	288	2.31
3. Source crater	$3.00^{+0.4;\ -1.0}$	36–996	150	1.36
4. Terminal crater	$2.50^{+0.6;\ -0.7}$	19–331	196	5.32
5. Dunes at valley bottom	$0.71^{+706;\ -70}$	31–108	5	1.38

Results of the drainage density map

There are several tributary valley candidates, which can be identified on topographic data but not necessarily on optical images. In *Figure 9* (left inset) the main ones are indicated with red colour, which were identified by their elongated branching depressions that empty into the main Tinto-B valley.

The flow accumulation map was created from a filled DTM and flow direction map in ArcMap using GRASS GIS software. It identified such surface locations where interconnected flow pathways might have produced surface run-off.

The drainage density for grids of 1 km^2 is shown in *Figure 9*. The highest density of the tributary sections is 29.02 km/km^2, and the

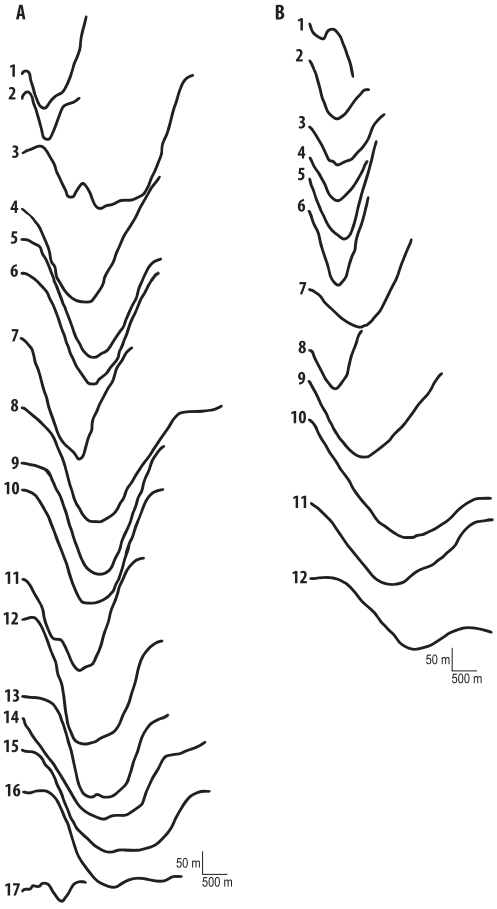

Fig. 6. Cross-sectional profiles of the analysed areas. Inset 'a' shows the main valley of Tinto-B, inset 'b' the biggest candidate tributary valley, marked by an arrow in *Fig. 5* earlier.

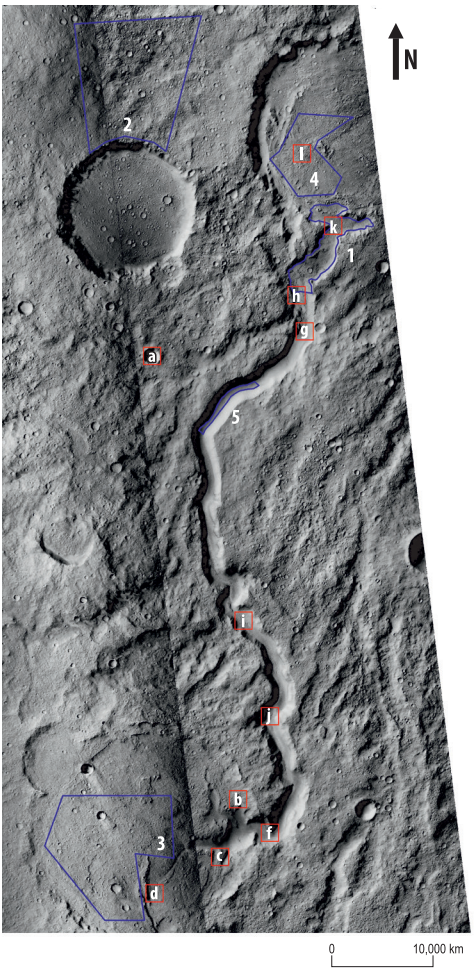

Fig. 7. Overview map of the measured areas for the crater statistics-based age estimation. The red rectangles show the locations of the images in *Fig. 3*. The blue rectangles show the position of the images from *Fig. 3.*

average is 3.09 km/km^2. Considering only the main valley 0.017 km/km^2 would have been measured.

Discussion

Morphological analysis

The water carved Tinto-B might come from the source crater, here at the starting tributaries are sharp, and the valleys widen and deepen fast, possibly pointing to surface collapse and seepage like formation of this upper reach. This phase points to confined source water (like melted ice) accumulated in the source crater. This produced the main valley that postpones the tributaries in the surroundings. The formation of tributaries (and probably a smaller earlier valley at the location of the main valley) formed previously from an aerially distributed source.

The cross-sectional profiles (see *Figure 6*) show the most important morphometric changes in the valleys. The main valley can

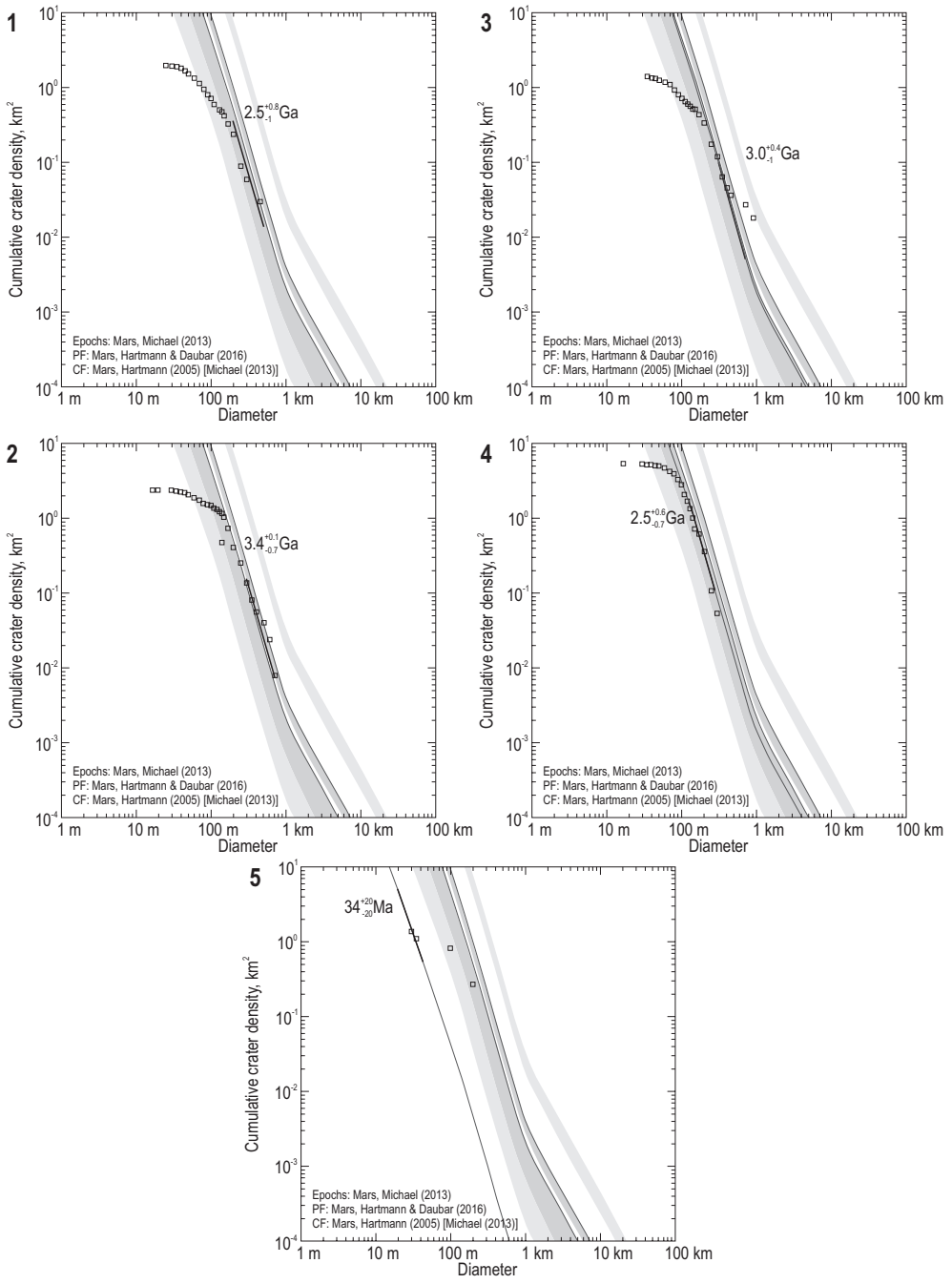

Fig. 8. Results of the crater based age estimation using the differential fit, without applying resurfacing corrections. – 1 = valley bottom bedrock age; 2 = neighbourhood; 3 = crater on the South; 4 = crater on the North; 5 = sand-covered valley bottom.

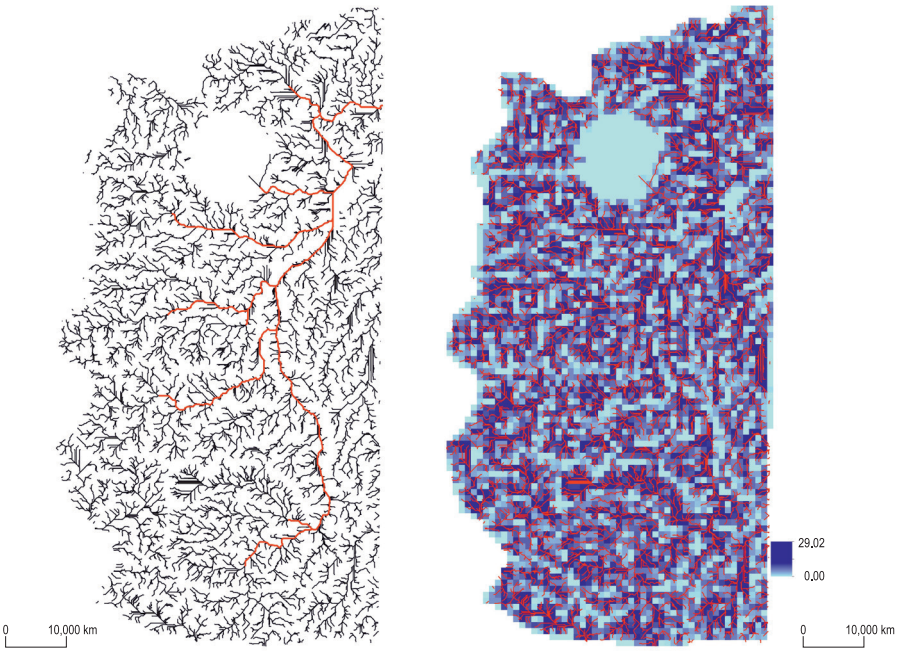

Fig. 9. The left image shows the main valley system and the supposed drainage (black lines identified automatically by ArcMap flow accumulation). The right image shows the drainage density of the analysed area in km/km^2. The red lines show the calculated drainage system, the left edge the watershed, while the straight right edge is artificial.

be subdivided into three different parts from the results of the cross-sectional profiles. The first section shows a "V" shape and steep walls (*Figure 6*, inset 'a'). The cross profile is in agreement with the existence of sand covered bedrock or deposit at head of the analysed valley. These elevated structures are not visible in the CTX images. The cross-sectional profiles of this section did not show a direct signature of erosion forms, like landslide or debris skirt. On the Earth, this kind of valley shape usually indicates erosion dominated reaches. The hypsographic curves show a steep, eroded first (upper) section in agreement with the cross-sectional profiles. The 500 m buffer clearly shows this steepness and erosion, and visible on the curves of the 750 metres buffers.

The second section of the main valley is short in distance. Here the shape of the cross-profiles shows a transition between the first and the last section: from a "V" shape to an "U" shape. The hypsometric curves here indicate an accumulation dominated area (see *Figure 6*).

The third section of the main valley is the longest of all. The shape of the cross-sectional profiles looks like "U" shaped, the walls are steep. The valley continues in the northern crater as well. This 'U' shape of the valley is not visible in the CTX images, only on these cross-profiles. The hypsometric curves of the third section indicate an accumulation dominated area in the bottom of the valley (*Figure 4* Inset 'a' – buffer 500 m) but the wall of the valley is steep (*Figure 4* Inset 'a' – buffer 1,000 m). The hypsometry curves in all buffer sizes show a fully accumulation filled valley bottom shape. On the wall of the main valley, there are many erosional features: downward striae pattern by mass

movements and some slumped structures are also visible at the feet of the valley wall.

The largest tributary valley shows a different morphology, and it cannot be subdivided into different smaller sections, according to the shape of the cross-sectional profiles. The valley is heavily eroded, with rugged walls and mass movements slope.

There is only one short part in the valley where the bottom shows erosion. This erosion is visible on the 500 metres buffer, its termination part is more eroded than the upper part, which is visible on the 500 and the 750 metres buffers.

The profile types of the analysed reaches can be classified into maturity categories according to the integrated value of the integrals. In terrestrial cases, these three categories are used: Inequilibrium stage (Youth with 0.60–1.00), Equilibrium stage (Mature, 0.35 to 0.60) and Monadnock phase (>0.35) (Strahler, A.N. 1952). The more eroded surfaces have a lower summarised integrated value. The main valley shows a more elevated Matury character (0.4556–0.4352), relatively to the biggest tributary that shows more Youth character (0.6430–0.6789). These stages point to that while the older earlier and aerially distributed fluvial activity was not enough (in duration and total discharge) to reach a mature stage, in the case of the main valley a more mature stage was achieved by the prolonged activity or by the large discharge (what was able to transport substantial sediment).

Evaluation of age estimation

The estimated ages show some uncertainty (from the limited size of the survey area, which could not have enlarged) but are useful (see *Figure 7* and *Table 1*). The valley bottom (ID 1) shows the estimated age of the main valley. Based on the exposed bedrock units, its 2.5 Ga corresponds to the Late Hesperian-Early Amazonian period, a moderately dry era of Mars when the liquid water was not abundant, but large outflows happened locally. However, it is worth to mention this age is based on a moderately small area where the probability is small for the occurrence of large craters. The age of the source crater (ID 3) and terminal crater (ID 4) are around 3.0 and 2.5 Ga, while the neighbourhood shows 3.4 Ga, which is an upper limit for the eroded tributary system around Tinto-B. The youngest surface unit is the aeolian deposited ripples of 0.71 Ga. Considering the error bars, valley might have formed up to 3.0–3.2 Ga (except the young dunes) - this value range corresponds to Hesperian Martian age.

During this Hesperian time, the megaregolith melted at the same location in the case of the growing volcanic and tectonic activity (Rauhala, A.I. and Kostama, V.-P. 2012a). This melted megaregolith created big outflow channels, like the analysed area, Tinto-B. Another important possible source is ice accumulation and melting (Cassanelli, J.P. and Head, J.W. 2016), what might occasionally happen in the Hesperian period (Scanlon, K.E. *et al.* 2018). These big flood event has been represented on the hypsometric curves more precisely in the cumulated integrated values of the created buffers. The hypsometric curves of the main valley *(Table 2)* show an eroded valley with a 'V' shape (see *Figure 6*), especially on the 500 m buffer, which shows a deep slam into the surface.

However, the age values found in this work, including the error bars could reach up to 3.0–3.2 Ga, and these are moderately far away from the 3.7 Ga. This later value is characteristic for several similar size valleys on Mars in the Late Noachian-Early Hesperian period (Fassett, C.I. and Head, J.W. 2008). In the case using tectonic-fluvial interaction smaller networks at the Thaumaia Plateau could be dated and being around 3.7 Ga (Kereszturi, A. and Petrik, A. 2020), but multiple formation periods based on different morphologies are also suggested (Baker, V.R. 2001; Phillips, R.J. *et al.* 2001; Hoke, M.R.T. and Hynek, B.M. 2007). More recent activities could be observed at the flanks of some volcanoes (Ceraunius Tholus,

*Table 2. Estimated hypsometric integral values of the analysed valleys**

Buffers	Integral method (inset a / inset b)		Possible geologic stage (inset a / inset b)	
500	0.4368	0.6659		
750	0.4352	0.6789		
1,000	0.4351	0.6430	Equilibrium stage (Matury)	Inequilibrium stage (Youth)
1,250	0.4556	0.6471		
1,500	0.4509	0.6503		

*See *Figure 4.*

Hecates Tholus, and Alba Patera), thus, valley network formation continued until the Early Amazonian, supported by ice melting (Dickson, J.L. *et al*. 2009; Hobley, D.E.J. *et al.* 2014), and subsurface breakup of water (Berman, D.C. and Hartmann, W.K. 2002). Among the proposed two formation phases of Tinto-B (earlier eroded tributaries and later confined main valley) only the earlier activity fits with the above mentioned main fluvial period of Mars, but still being younger. The formation of the main valley happened during a later period, dominated by confined sources, here possibly from ice accumulated at the southern upper crater.

Candidate tributary valleys identification

The DTM of the analysed area shows the main valley with the other candidate tributary valleys, and this second group could not be easily visible in the DTM and could also be poorly identified in the optical images, however, using the SIMWE model, the candidate drainage system could be identified automatically using the flow accumulation map (see *Figure 9*). Their small size (length of sections is about few km) and fragmented structure caused by later impact events prevented the identification by manual analysis but could be done using the SIMWE erosion model.

This map visible in *Figure 10* is called erosion (positive value) and deposition (negative value) map, which shows the possible erosion and deposition rate in kg/m^{2}s (the reddish colours show the erosion, the blueish colours show the accumulation).

The model shows two different types of the drainages. The first type shows the gullies, where the erosion is working during the rain event on the bottom of the small streams. The second type shows, where the accumulation is stronger than the erosion at the bottom on these small drainages, but the wall of streams are more eroded based on the appearance on the CTX images than the first type. These differences in the erosion in the two identified type gullies presume a different occurrence and origin in time. The drainages on the first type show a young surface, where the fresh sand can be eroded fast with a small amount of water or some fluid event. The walls of these drainages in the first type are declivitous. The second type of the identified small drainages are older, cut into deeper to the original terrain, in this case, the erosion dominates on the walls of these gullies instead of the bottom. These ages of the two identified drainage types come from the geomorphological analysation.

The total drainage density was calculated by the flow accumulation map and is 3.09 km/km^2, which is much higher than if only the main valley (identified optically) would have been considered for the same area, what gives 0.017 km/km^2. Comparing this value around 3.09 km/km^2 to other measured values from Mars, the gained results before the detailed topographic analysis gave drainage density using the well-preserved valleys for Noachian units is 0.0032 km/km^2, for Hesperian units 0.00047 km/km^2, and for Amazonian units 0.00007 km/km^2, excluding the volcanos where drainage densities could range up to 0.3–0.5 km/km^2 locally (Carr,

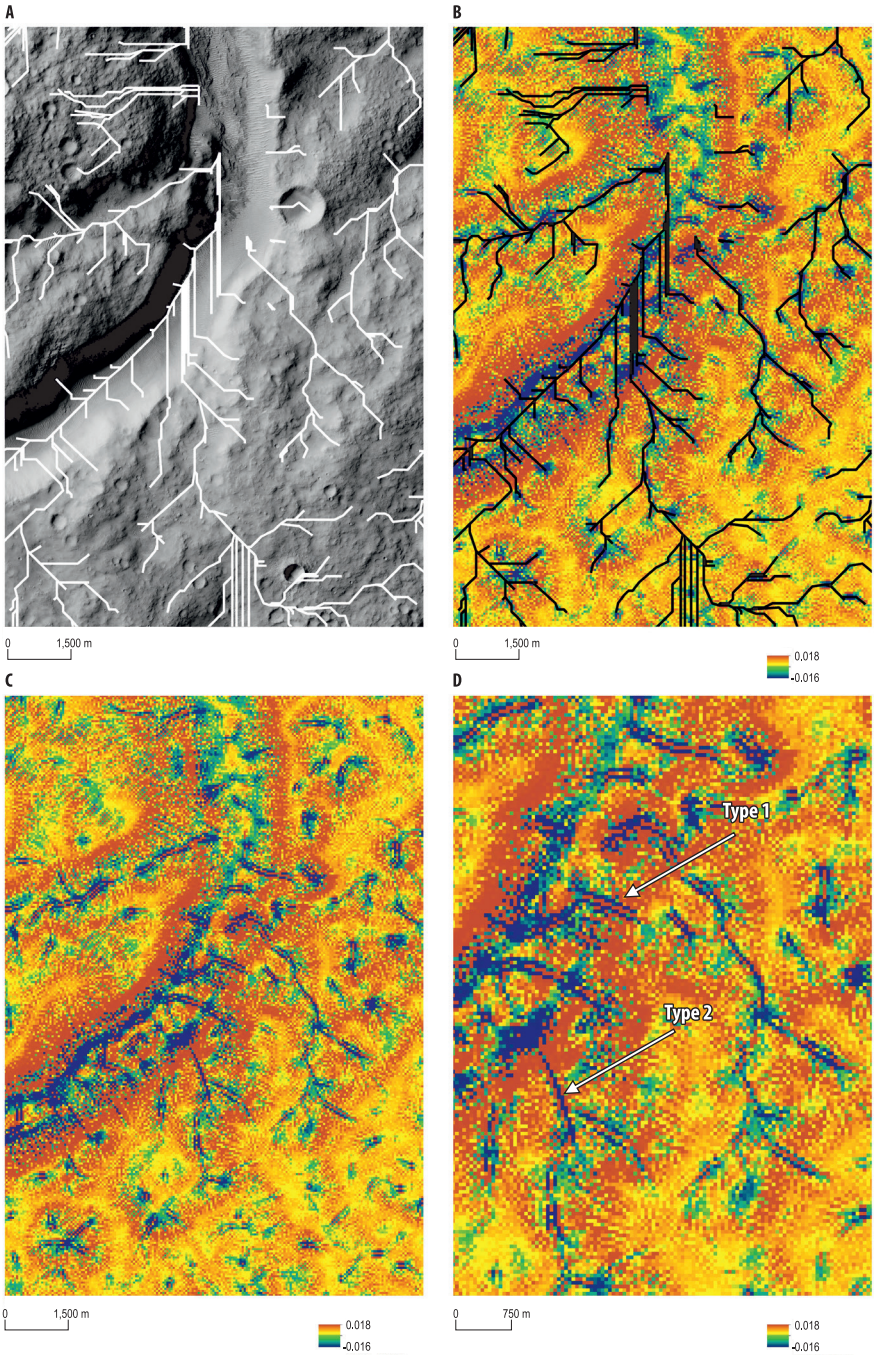

Fig. 10. Comparison between drainage map, what was generated from the flow accumulation (a) and the SIMWE erosion model (b, c and d). The positive value on insets 'b' to 'd' show the erosion. Inset 'd' shows two different types of small drainage what were identified by the model.

M.H. and Chuang, F.C. 1997). However, topographic data based valley reconstruction gave much higher drainage density: according to the analysis of Stepinski, T.F. and Collier, M.L. (2003) using MOLA data could reach 0.10–0.01 at certain locations on Mars. Craddock, R.A. *et al.* (2001) also suggested about 20 times higher drainage density than previous estimations, and Hyneck, B.M. and Phillips, R.J. (2003) also found values around 0.20–0.06. However, our values are even higher, possibly because the sophisticated flow accumulation map is more sensitive than others used earlier. Although it is possible that this value is not realistically too high, but its further analysis could be the target of future work.

Conclusions

A fluvial valley was analysed close to the Martian equator (2°55′ South and 111°53′ East) near to Palos crater and Tinto Vallis, named Tinto-B, surrounded by several smaller but heavily eroded tributary valleys.

The age estimation was made in 4 main terrain types. The source and terminal sink craters, as well as the bedrock outcrop at the bottom of the main valley showed age values ranging between 3.0–2.5 Ga, around Late and Early Hesperian. Although substantial uncertainty exists here, this period is characterised by rare but large floods events, and suggesting Tinto-B formed much later than most of the other precipitation or surface ice melting fed (not outflow category) valleys on Mars. Considering the possible tributaries in the neighbouring terrain, they might have formed earlier than the main valley, around the same period as many of the other Martian valleys.

The main valley can be subdivided in three different sections with transitions based on the shape of their cross-sectional profiles and hypsometric curves. The first section of the main valley has a 'V' shape with steep valley walls with a small number of erosional forms it, which may have been formed a huge amount of water. The second section is a transition style with more 'U' shaped with steep valley walls and landforms associated with mass-wasting processes.

The hypsometric curves were created in different buffer widths, which point to the maturity of the fluvial system. The cumulated integrated values of the main valley point to an equilibrium (mature) stage, but the biggest tributary valley has higher cumulated integrated values, which point to a youth stage.

The SIMWE model used to identify the small scale erosion landforms and estimate the possible origin points of the mass movements, which are not visible on the DTM or in the images. This was the first time to test this model in the Martian environment. The results of the model show that the average drainage density of 3.09 km/km^2 being much higher than based on only the optical images and other works – suggesting further evaluation of drainage density is required on Mars as it might be substantially larger than previously suggested.

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DOI: 10.15201/hungeobull.69.4.2 Hungarian Geographical Bulletin **69** 2020 (4) 349–361.

Trends and hotspots in landscape transformation based on anthropogenic impacts on soil in Hungary, 1990–2018

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Abstract

The transformation of the landscapes due to the anthropogenic activities is increasing worldwide. These changes are also manifested in the change of soil-forming processes. The land cover (LC) changes evaluated according to their influence on anthropogenic features of soils allows to distinguish between LC changes resulting increased and decreased human impact (HI). In our study, we assess the changes of HI on landscapes and its spatial distribution across Hungary. The changes were evaluated by using LC data of four periods between 1990 and 2018 reclassified based on the related anthropogenic soil features. To identify the hotspots of the changes 1×1 grids were applied in which the direction (increasing, neutral or decreasing HI) and frequency (number of landscape patches with LC changes) of changes were evaluated. In our research, the hotspots were identified over the studied four periods. We point out that the spatial distribution of hotspots is very different. The hotspots of the increased human impact are 2,449 cells (643.0 km^2) between 1990 and 2018, and the most of it localized in the Pest Plain (67), Csepel Plain (64) and Nagykálló-Nyírség (60). Most of the multiple hotspots are in the outskirts of Budapest to Kiskunlacháza, Bugyi, Délegyháza. As we examine the decreasing hotspot data we found 1,679 cells (1,524.9 km^2) between 1990 and 2018. In largest number, they occur on the Kiskunság Sand Ridge (38), Majsa–Szabadka Sand Ridge (37) and Nagykállói-Nyírség (36). Multiple hotspots are located in settlements Izsák, Ásotthalom, Vatta and Nyírmihályi. Regions with numerous hotspots require special management to moderate its negative consequences on soils to consider both increased anthropisation, but also extensification of land use and their consequences.

Keywords: landscape degradation, landscape rewilding, land cover change, soil naturalness changes

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Introduction

Soils traditionally are considered a four-dimensional product of five natural soil-forming factors, namely: substrate, climate, topography, vegetation, and time (Forman, R.T.T. 1995). Only in the last decades, human society was considered to add as the sixth effective soil-forming factor (Dudal, R. 2005; Ellis, E.C. and Ramankutty, N. 2008; Ellis, E.C. *et al.* 2010). Even though, the soil-forming function of anthropogenic activities cannot be disregarded since the first spread of agricultural land cultivation (Kertész, Á. 2009; Ball, B.C. *et al.* 2017; Baude, M. *et al.* 2019). The extent of area affected by the human processes, the intensity, and the diversity of ways how the society modified natural soil bodies is continuously increasing. The contribution of the humankind to soil development seems to be more and more relevant, which is indicated by occurrence and spread of anthropogenic, technogenic soils (Bouma, J. *et al.* 1998; Antrop, M. 2004). Parallelly, always were regions, where human activity decreased or disappeared for a while, which allowed regeneration, renewal of former disturbed or devastated soils (Ceauşu, S.

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et al. 2015; Navarro, L. and Pereira, H. 2015). Globally, less and less part of the surface of the Earth remains, where human society should not be considered as a significant factor of soil-forming. (Bouma, J. *et al.* 1998; Hill, M. *et al.* 2002; Antrop, M. 2004; Klijn, J.A. 2004; Csorba, P. and Szabó, Sz. 2009; Dale, V.H. and Kline, K.L. 2013; Balogh, Sz. *et al.* 2018).

Spatial pattern and its changes of these opposite processes (like soil anthropization and renewal by natural succession) could be considered as the indicator of the actual land needed by the society. Otherwise, it is a phenomenon which should be compensated, regulated, managed, and planned intentionally by the society (Lambin, E.F. *et al.* 2006; Novák, T.J. *et al.* 2013; Lundberg, A. 2018).

The study aimed to point on the changes of the spatial extent of areas, which are affected by changes in intensity of the human impacts between 1990 and 2018. In our consideration, the "Land Cover" classes (LC) and its changes are related to the grade of the transformation of soils by society. Therefore, analysis of LC and the LC changes allows an estimation of the grade of human transformation of landscapes (Incze, J. and Novák, T.J. 2016; Szilassi, P. *et al.* 2017; Novák, T.J. *et al.* 2019).

In our research, we supposed that besides of well-known processes of intensification (e.g., soil sealing, construction, degradation of soils), on extent areas LC changes were concluded in the decreased grade of "human impacts" (HI). At these sites, the changes allow a restart of soil development towards a less degraded state (i.e., organic carbon sequestration, recharge of soil nutrients, regeneration of aggregate structure and renewed horizon development). Further, we intended to identify the locations with the highest possible spatial accuracy, where these changes appear, since we consider both increasing and decreasing HI-s on landscapes requires compensatory management by local society. Therefore, a hotspot analysis was carried out, for all four study periods, where we identified single and multiple hotspots – for decreased and increased HI-s.

Data sources and methods

As the main data source to our analysis, the CORINE Land Cover (CLC) database and the CORINE Land Cover Change (CHA) datasets were applied.

In our study, the status datasets of CLC (1990, 2000, 2006, 2012 and 2018) were applied to calculate the share of re-grouped CLC classes according to the grade of their anthropogenic transformation. The methodology of surveys is standardized as it is described at Mari, L. and Mattányi, Zs. (2002), and Mari, L. 2010. The datasets at a scale of 1:100,000 were applied, on the study area (Hungary) it consists of 32 CLC classes (FÖMI, 2002). The minimum mapping unit for areal objects is >25 ha, and the minimum width of the linear objects is >100 m. Although only the area elements are identified in the CLC, there are some "linear elements" in it. Due to the differences between two time and layer, we use the CHA datasets. In these, they have mapped the less than 5 ha changes, included the motorway and some road changes. So, the GIS database, which we are created, is extended to the digital road changes. Furthermore, we only have these "linear layers" because of the mapping scale of the CORINE Land Cover Change dataset. The important road impact and the fragmentation are sometimes appeared in the CHA polygons.

Afterwards, the status data time series was complemented by change layers (CHA 1990–2000, 2000–2006, 2006–2012 and 2012–2018). It allows higher accuracy to identify changes as a comparison of the consecutive status layers (Mari, L. and Mattányi, Zs. 2002; Mari, L. 2010).

As in our earlier works it was described (Novák, T.J. *et al.* 2013; Novák, T.J. and Tóth, Cs.A. 2016; Novák, T.J. and Incze, J. 2018; Balogh, Sz. *et al.* 2019) to the CLC classes, the expectable influence on the soil cover was assigned, and the CLC classes were reclassified based on the grade of anthropogenic transformation of the soils, into four groups *(Figure 1).* One of these groups consists of CLC classes which have not been considered to have soils according to the definition of soil by WRB (World Reference Base).

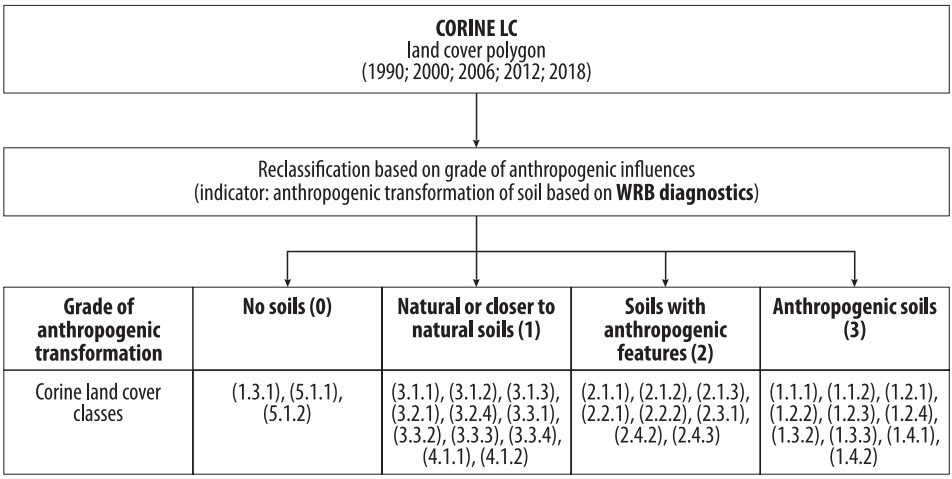

Fig. 1. Reclassification of CORINE LC classes based on the expectable anthropogenic transformation of soils

Due to repeated surveys of the CLC data, change layers (CHA) from five different years the spatial extent and share of the groups based on the grade of anthropogenic transformation could be calculated, and therefore the changes in the last three decades over the country can be tracked.

Using this classification, the CHA polygons were also evaluated. Therefore, the anthropogenic transformation grades (according to the *Figure 1*) of the cover class before and after the LC conversion was considered. In furthermore, we ignored the polygons in which the anthropogenic transformation grade before and after the conversion was falling into the same group. Here the intensity of human impact (HI) remained approximately at the same level in spite of the altered LC class, and the change was evaluated as neutral concerning the anthropogenic transformation grade. Polygons, in which the LC conversion also resulted in an altered grade of HI, were divided into two groups: LC conversions with a) increasing, and b) decreasing HI *(Figure 2).* This reclassification of CHA polygons was done for all four intervals provided by CHA dataset (1990–2000, 2000–2006, 2006–2012, 2012–2018). The extent and number of polygons showing increasing or decreasing HI were calculated for each above-mentioned time intervals. From each interval, the five most extent LC conversion types resulting increased or decreased HI were listed for further analysis concerning their consequences to soil resources.

To identify hotspots of increasing and decreasing HI a grid with 1×1 km cell size was overlain on the LC change maps, the same grid for each type and period. In every 1×1 km grid number of polygons with LC conversions resulting changed intensity of HI were counted *(Figure 3).* As we have seen in *Figure 3* the number of land cover changes (LCC) polygons are demonstrated. The hotspot methodology was assorted only those cells, which LCC number are in the upper quartile of it (e.g. like in *Figure 4.* only those which are included 2–6 polygons in the cells). The polygons of LC conversions with unchanged intensity (see *Figure* 2) of HI were eliminated from later analysis. Separately for the type of change (increasing and decreasing HI) and each study period, the basic statistic data of the grid cells were calculated. The upper quartiles of the number of LC change polygons per grid cell were considered to be the lower limit to evaluate a grid cell as a hotspot, i.e., hotspots were consid-

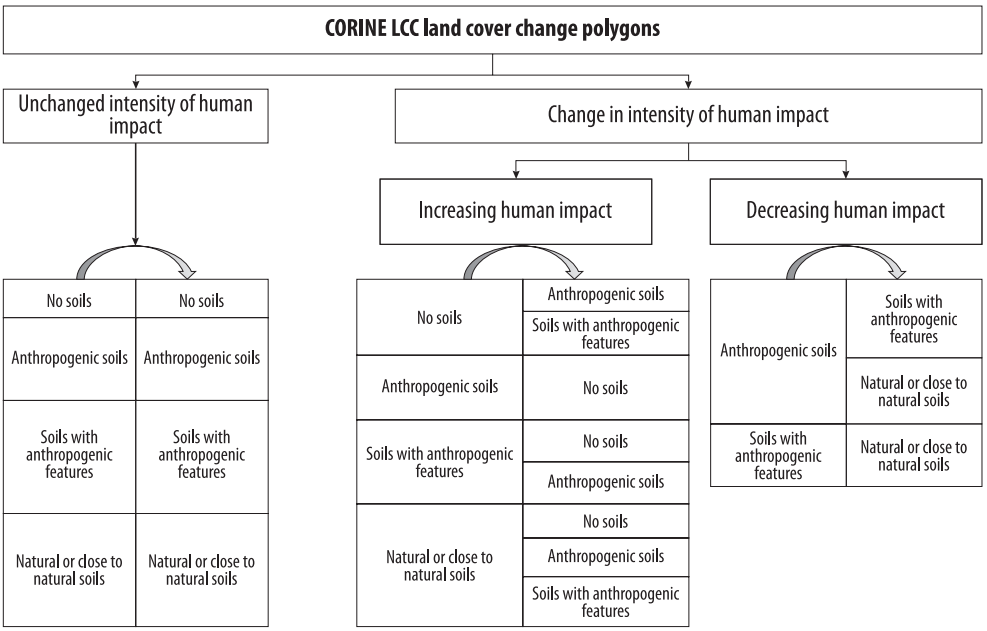

Fig. 2. Evaluations of LC changes based on the expectable change in the intensity of the HI

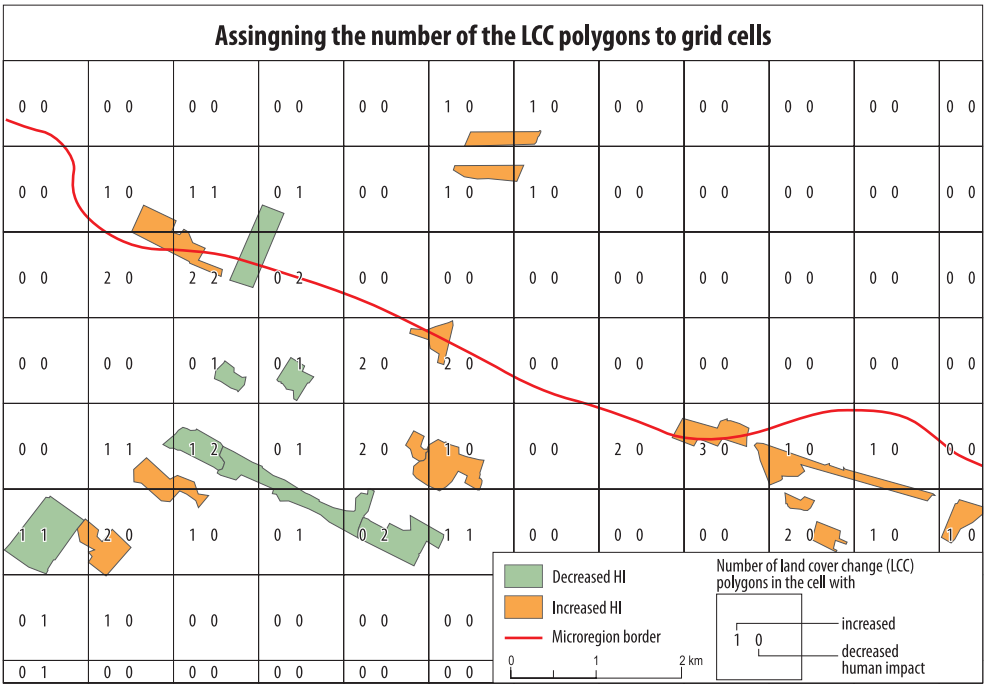

Fig. 3. The method of assigning the LCC polygons to grid cells, for later identification of hotspots

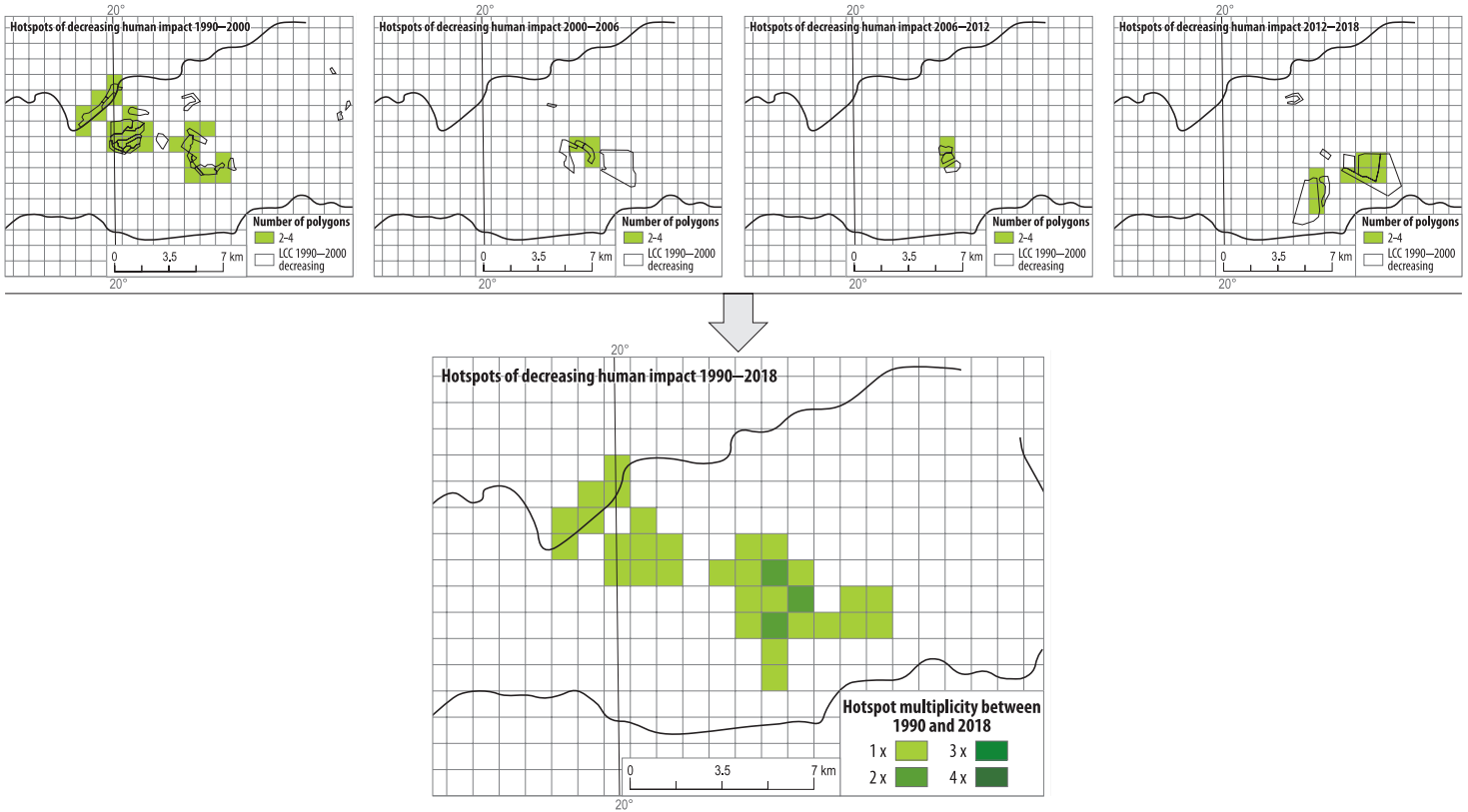

Fig. 4. Identification of hotspots in studied periods of LC changes, and highlighting hotspot multiplicity when a grid cell is a hotspot in more than one period

ered those grids, which had higher number of LC change polygons as the upper quartile of the grids for the same period and type of change *(Figure 4)*. If the hotspot lies in the bordel, we attached to that region which is occupied the largest part of the cell.

Hotspots of increasing and decreasing HI were calculated separately. Further, numerous grids proved to be hotspots not only for one period but in more studied periods. These multiple hotspots for increased and decreased HI were represented with deeper colour intensity on maps.

Results

Changes of HI

Distribution of LC classes among the groups according to the grade of HI showed slight changes between 1990 and 2018. Most LC classes belong to the group, in which the anthropogenic properties in the soil (disturbance of soil horizons, modification of soil structure, and occurrence of artificial or transported materials) can be recognized. Still, the solum itself is not predominantly a natural product of pedogenic processes. They covered 68.3 per cent of the country in 1990, and their share decreased by 3.2 per cent to 64.9 per cent for 2018 *(Table 1)*.

LC classes, which are related to soils produced completely by the anthropogenic accumulation of transported, relocated or industrially produced materials ('anthropogenic soils' – *Table 1*) occupied 5.5 per cent in 1990 and their share increased by 0.8 per cent up to 6.3 per cent until 2018. LC classes, in which soil development and horizonation are driven by meanly natural processes (succession of vegetation, topography, and climate) was 24.3 per cent and increased by 2.5 per cent in 2018 up to 26.8 per cent. These changes indicate that share of moderately anthropized soils is only decreasing, and both extreme: anthropization and renaturation of soils affect an increased area. Anyway, anthropization (LC changes with increased HI) affected smaller part of the surface between 1990 and 2018, than LC changes with a decrease of HI.

We also considered the total extent (area, km^2) and the number of polygons with changed LC class related to increased and decreased human influence separated for the four study periods *(Table 2)*.

Generally, LC change polygons with increased HI had a smaller total area and a higher number in every period. The averaged area of these polygons varied between 0.24 km^2 (2012–2018) and 0.29 km^2 (2000–2006).

Table 2. Extent and number of land cover change polygons with decreased and increased human influence between 1990 and 2018 in Hungary

Period	Land cover changes with			
	decreased human influence		increased human influence	
	Total			
	area, km^2	number	area, km^2	number
1990–2000	401.1	593	185.9	677
2000–2006	483.7	447	189.6	651
2006–2012	532.7	398	136.4	570
2012–2018	107.4	238	131.2	551

Table 1. Distribution of CORINE land cover classes among anthropogenic transformation groups (%) between 1990 and 2018 in Hungary based on anthropogenic WRB diagnostics of soils

Year	No soils (0)	Natural or close to natural soils (1)	Soils with anthropogenic features (2)	Anthropogenic soils (3)
1990	1.9	24.3	68.3	5.5
2000	2.0	24.7	67.6	5.7
2006	2.1	25.5	66.5	5.9
2012	2.1	26.0	65.9	6.0
2018	2.0	26.8	64.9	6.3

LC polygons with decreased HI had in opposite larger area, but a smaller number. Therefore, averaged extent of polygons with these types of conversion varied between 0.45 km^2 (2012–2018) and 1.34 km^2 (2006–2012). To have an overview about the substantial LC changes of the conversions, we ranked the conversion types (coded by their CORINE code before and after the LC change) according to their frequency based on their area and number we found, separately for each period. LC conversions with decreased HI proved to be less diverse than with increased HI. Namely, 77 per cent per cent (2012–2018) to 93 per cent (2006–2012) of the area affected by LC changes with decreased HI belonged into the five most frequent types *(Table 3)*, and the polygons in most frequent five types are 63–66 per cent respectively of the total number of polygons with LC changes with decreased HI. In case of LC conversions with decreased HI the initial LC was in most of the cases arable land, mineral extraction sites, complex cultivation patterns and vineyards. The conversions resulted transitional woodlands, shrubs, pastures and broad-leaved forests (see *Table 3*). It does not mean that at the moment of the conversion, the quality of landscape units suddenly changes, but this type of changes results inherently reduced level of disturbance and gives chances for the regeneration of the ecosystems and soils.

LC conversions with increased HI, therefore, show higher diversity, since the most frequent five types cover only 41 per cent (1990–2000), and 61 per cent (2000–2006) of the total area of them, and they mean only 25–37 per cent respectively of the total number of polygons with increased HI. When LC changes resulted increase in HI mostly arable lands, grasslands and pastures were turned into construction sites, mineral extraction sites, railways, and roads, industrial or commercial units (see *Table 3*). Also, when inland marshes were converted into water bodies, soils were devastated submerging under constant and higher water cover, even cancelled, according to definition of WRB, if submerged in more than 2 metre deep water.

For each period, both types of LC conversions (increased and decreased HI) the most frequent five conversion types are listed in *Table 3*. Also, the summarized data show, that the number of polygons with LC changes affecting decreased HI are smaller (1,676 and 2,449), but the extent larger (1,524.9 km^2 and 643 km^2) as that of LC changes with increased HI.

Hotspots of changed HI

As we mentioned in the data source and methods section, 1×1 km^2 grids were created. Using the grids, we prepared the hotspot analysis, based on the mentioned methodology earlier.

Hotspots were identified over the studied four periods. As before, we also highlighted the areas that contained the largest number in both the four periods and the total. To facilitate the research, these were summarized within the micro-regional boundaries and then we created the sequent table.

The spatial distribution of hotspots with increased HI is shown on *Figure 5.* Numerous hotspots proved to be hotspots not only in one studied period, but for more. Totally 2,449 between 1990 and 2018, in highest number on the Pest Plain (67), Csepel Plain (64) and Nagykállói-Nyírség (60) *(Table 4).* Most likely, the non-irrigated arable lands (211) are converted into construction sites (133) and industrial or commercial units (121), or road and railway network and associated lands (122). Furthermore, many pastures (231) are converted into construction sites (133) to. In the case of 1,012 hotspots number of LC change polygons with increased HI was in two periods higher than the respective threshold value of the hotspots. These are twofold hotspots, illustrated on *Figure 5* with more intense colour. Triple hotspots were found in 223 grids and fourfold hotspot in 45. These multiple hotspots are shown with darker colour intensity in *Figure 5.* On the map, several aggregations of triple or fourfold hotsopts can be identified. The top 5 are

Table 3. LC conversions with altered grade of HI proved to be among the most extent five types in any of the four studied periods

Naturalness class based on soils		CORINE code before-after conversion	Land cover		Total area, km²	Number of polygons
before	after		before	after		
conversion			conversion			
A) Decreased HI totally 1990–2018					*1,524.9*	*1,676*
Conversion types among the most extent five types with in any of the four studied periods with decreased HI						
2	1	211–324	Non-irrigated arable land	Transitional woodland / shrub	874.5	450
		231–324	Pastures	Broad-leaved forest	269.2	357
		211–311	Non-irrigated arable land	Transitional woodland / shrub	96.9	81
		243–324	Land principally occupied by agriculture, with significant areas of natural vegetation		23.3	54
		221–324	Vineyards		21.7	16
		242–324	Complex cultivation patterns		12.2	25
		213–324	Rice fields		8.3	2
		222–324	Fruit trees and berry plantations		7.9	23
0	2	131–231	Mineral extraction sites	Pastures	6.4	17
0	3	131–132		Dump sites	5.8	2
3	2	132–231	Dump sites	Pastures	3.8	10
B) Increased HI totally 1990–2018					*643.0*	*2,449*
Conversion types among the most extent five types with in any of the four studied periods with increased HI						
2	3	211–133	Non-irrigated arable land	Construction sites	89.8	186
		211–131		Mineral extraction sites	63.6	143
		211–121		Industrial or commercial units	49.0	187
2	0	211–512		Water bodies	41.1	96
1	2	321–211	Natural grasslands	Non-irrigated arable land	31.5	65
2	3	231–133	Pastures	Construction sites	20.2	75
1	0	411–512	Inland marshes	Water bodies	15.0	31
2	3	211–122	Non-irrigated arable land	Road and railway network and associated land	11.6	18

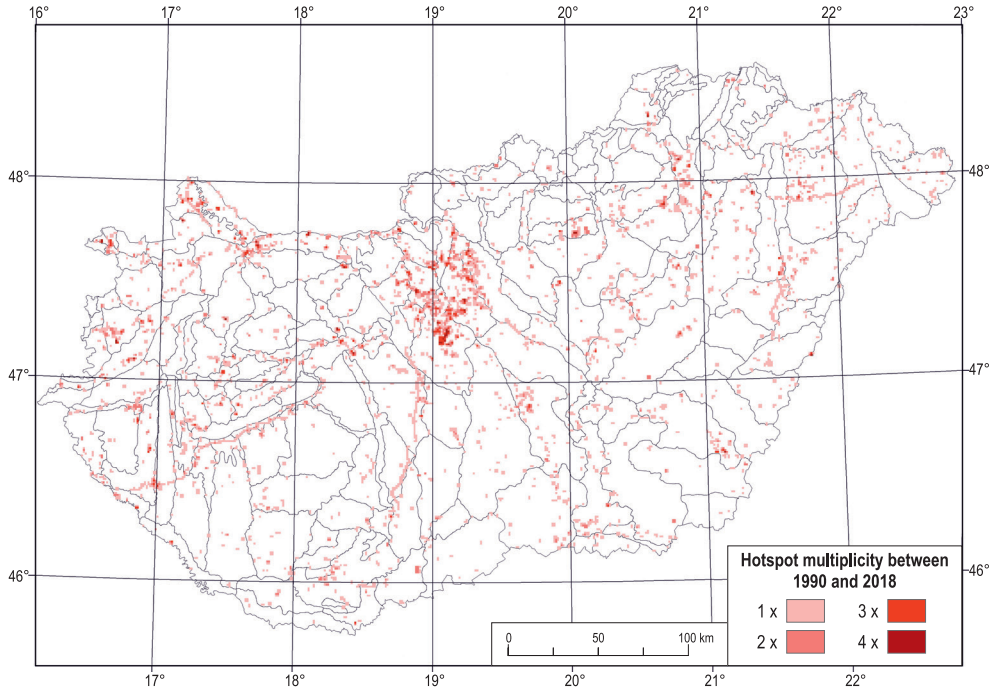

Fig. 5. Hotspots of increased human impact in Hungary based on LC changes 1990–2018

in the outskirts of Budapest highlighted by Kiskunlacháza, Bugyi, Délegyháza, besides in Győr and Bükkábrány.

In case of the LC changes with decreased HI the upper quartile of the number of polygons was 1 in all periods. This means, that all grids having at least two polygons with LC change showing decreased HI are regarded as a hotspot. The number of them is 593, 447, 401, and 238 in the above order. Totally 1,679 cells are regarded as a hotspot in any of the four-study periods between 1990 and 2018 (see *Table 4*). In largest number they occur on the Kiskunság Sand Ridge (38), Majsa–Szabadka Sand Ridge (37) and Nagykállói-Nyírség (36). *Figure 6* shows the location of further hotspots of decreased HI. Number of one-fold hotspots was found 2,379, two-fold hotspots were found in 135 grid cells and triple hotspots in 15, and no fourfold hotspot was found. The colour intensity also shows hotspot multiplicity in *Figure 6*. The most affected areas are in Izsák, Ásotthalom, Vatta and Nyírmihálydi. Usually, the non-irrigated arable lands (211) and pastures (231) and sometimes the agricultural types (213, 221, 222, 242, 243) are converted into transitional woodlands or shrubs (324). Some of the hotspots are the mineral extraction sites (131) conversation into pastures (231).

Discussion – Considerable effects of land cover conversions to soils

Numerous studies analysed the CORINE datasets based on the changes in LC (Feranec, J. *et al.* 2007; Verburg, P.H. and Overmars, K.P. 2009; Stürck, J. *et al.* 2015; Kuemmerle, T. *et al.* 2016; Plieninger, T. *et al.* 2016; Foški, M. and Zavodnik Lamovšek, A. 2019), but the high number, small individual extent and high vari-

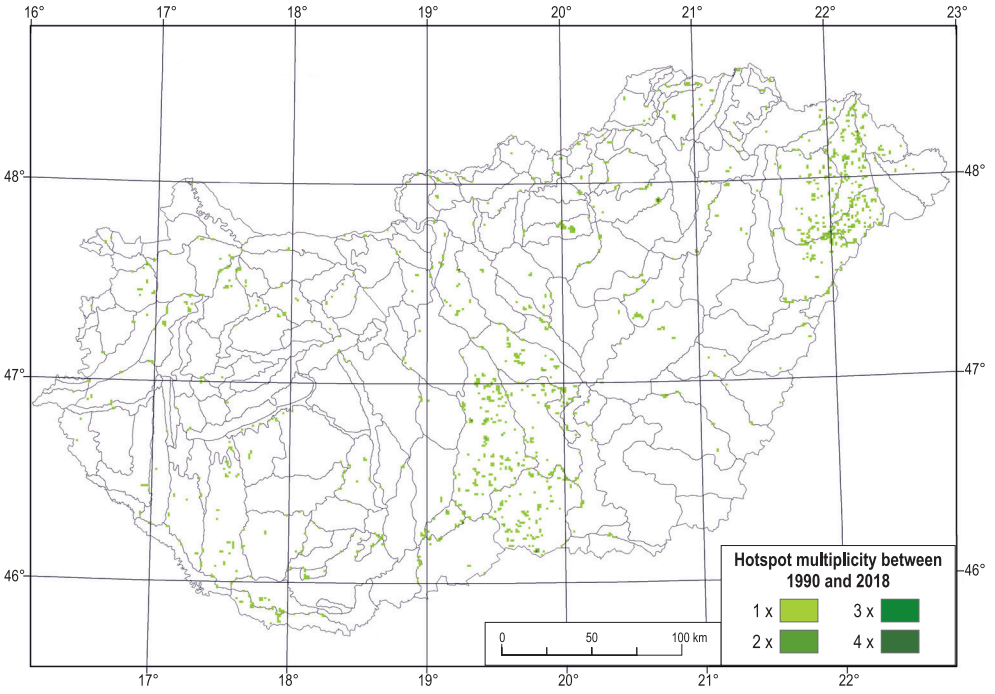

Fig. 6. Hotspots of decreased human impact in Hungary based on LC changes 1990–2018

ability of conversion types make the overview difficult and the evaluation of them complicated. We classified the conversions into three types based on the change of degree in HI, and evaluated their spatial extent considering their spatial frequency, using an auxiliary 1×1 km grid to identify the hotspots of changes.

Also, in our earlier studies (Novák, T.J. and Incze, J. 2018; Novák, T.J. *et al.* 2019) we pointed on to the regional differences of landscape changes in Hungary on micro-and meso-region level. Considering these spatial units, quite frequently changes with increased and decreased HI were possible to observe within the same micro- or meso-regions, on the other hand, the exact identification of the changes was not possible. Therefore, this different approach: applying a grid and identification of hotspots proved to be more useful. It allowed the more precise delineation of areas with increased and decreased HI, and hotspots diversity among the four study periods highlighted the location of ongoing LC changes.

Our finding, that on the expense of the extent of LC classes with moderate HI both: the extent of LC classes with increased and the decreased HI impact was growing proved useful to point on increasing differentiation of LC. Regions with numerous hotspots of increased HI requires special management to moderate its negative consequences on soils, such as accelerated erosion, soil compaction, loss of organic carbon, mixing of soil horizons, soil sealing, soil loss appear concentrated, and affect urbanized areas. Highway constructions, industrial areas, and areas with intense peri-urban residential sprawl are typical places, where the LC conversions affects intense soil anthropization (Falkenberg, J.A. *et al.* 2003; Ebels, L.J. *et al.* 2004; Csorba, P. 2005; Almajmaie, A. *et al.* 2017), so far that

natural soils are no more possible to identify and even the substrate of soils are either artificial (construction waste composited from brick, slag, concrete, asphalt) or transported by humans (gravel, sand, rock). Besides their environmental risks, it makes these regions vulnerable against climate change, limiting the potential for resilient responses. Multiple hotspots of LC changes with increased HI warns to the ongoing degradation of soils in these areas. In contrast, regions with hotspots of decreased HI can count with organic material accumulation, carbon sequestration, regeneration of structure, increase of thickness of fertile soil layer (Van Etvelde, V. and Antrop, M. 2009; Sándor, G. *et al.* 2013; Horváth, A. *et al.* 2015).

That is true that these soil processes can compensate the unfavourable ones of hotspots of increased HI, but in many cases decreasing human impact on landscapes also requires special management and control, that must be considered. In case of decreasing HI on former industrial, mining, military and constructed areas a rewilding or renaturation can be related to the long-lasting release of pollutants into the groundwater or to the atmosphere, and therefore mean environmental risks besides of their regeneration processes.

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The effects of COVID-19 on Airbnb

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Abstract

COVID-19 pandemic starting at the end of 2019, hit hard tourism and hospitality industries throughout the world. As a part of the processes, the most popular P2P accommodation service, the Airbnb also faced a rapid drop in bookings. This study explores and compares the effects of the first wave of the pandemic on the Airbnb markets of 15 cities. The analysis is based on the data retrieved from Insideairbnb.com. Booking trends are compared between 2019 and 2020 and a day-to-day analysis of occupancy rates during the first months of 2020 is also performed. Special attention was paid to the effects of pandemic on different price categories of listings. The results show that the evolution of local pandemic situation had the most significant impact on bookings and occupancy rates in the investigated cities. The characteristics of local markets and the pandemic and economic situation of sending countries had also great influence on the bookings and cancellations. In addition, in some cases the cancellations did not affect the reservations made for the later periods, meaning that tourists hoped for a quick recovery. The effect on price categories was also different from one location to another. The study provides empirical insights to the effects of the disease on P2P accommodations. Furthermore, the future of short-term rentals is also discussed briefly.

Keywords: Airbnb, tourism crisis, geography of pandemic, COVID-19, P2P accommodation, sharing economy

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Introduction

Infectious diseases have always posed threats for societies and economic activities (Jennings, L.C. *et al.* 2008; Strielkowski, W. 2020), but due to the increasing interconnectivity of our contemporary globalised world, diseases can spread even more rapidly to distant regions than before (Browne, A. *et al.* 2016; Semenza, J.C. and Ebi, K.L. 2019; Hall, C.M. *et al.* 2020; Wilson, M.E. and Chen, L.H. 2020). Furthermore, information flows are also increasingly globalised, thus, people receive up-to-date reports on the spreading and consequences of the diseases or other disruptive events. Growing public awareness and perceived risk affects consumer decisions in tourism and hospitality industry (Page, S. *et al*. 2012; Otoo, F.E. and Kim, S.S. 2018; Huang, D. *et al*. 2019; Kim, J. *et al.* 2020).

The COVID-19 (coronavirus) pandemic that appeared at the end of 2019 had a devastating effect on almost all aspects of social and economic life. Tourism, as a fragile and volatile sector (Çakar, K. 2018) was no exception; as a matter of fact, it was among the most seriously affected sectors (Higgins-Desbiolles, F. 2020; UNWTO, 2020). Due to the closing down of borders, fear from the virus and the lockdown measures applied by local and national authorities (Ren, X. 2020), international and domestic tourist flows decreased dramatically. Consequently, tourism sector experienced its largest downfall ever (Gössling, S. *et al*. 2020; Stankov, U. *et al.* 2020).

As a part of these processes, one of the most important online accommodation platforms, Airbnb was also hit hard by the pandemic. Airbnb guests cancelled their reservations or did not make new ones after the pandemic

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had started to spread (Dolnicar, S. and Zare, S. 2020). As a result, occupancy rates stagnated or decreased. The aim of this paper is to present the effects of the pandemic on the Airbnb markets, including the analysis of booking trends in 15 cities, the comparison of data from 2019 and 2020 and a more detailed analysis of occupancy rates in 2020. Furthermore, the effects on different price categories are also analysed in relation to each city.

Literature review

Airbnb – characteristics and conflicts

Several researches focus on the development and the conflicts of Airbnb in the last years. The key topics are the following: the motivations of guests, the strategies of hosts, characteristics of Airbnb supply and the effects of P2P accommodation on the destinations, regulatory aspects and taxation, the effects of Airbnb on tourism and hospitality sector and Airbnb itself as a company (Dann, D. *et al.* 2019; Guttentag, D. 2019). Several studies analyse the effects on housing markets, highlighting that due to the emergence of short-term rentals, entire apartments are withdrawn from local housing and rental markets leading to inflating rents and real estate prices (Ke, Q. 2017; Robertson, D. *et al.* 2020). As a consequence, low-income residents are excluded from tourist areas, and those who remained also developed negative perceptions (Stergiou, D.P. and Farmaki, A. 2019). In relation to the above-mentioned processes, Airbnb is often related to gentrification (Dudás, G. *et al.* 2017; Wachsmuth, D. and Weisler, A. 2018; Robertson, D. *et al.* 2020). Several analyses emphasise that despite the "sharing" rhetoric, professional, business-like use is widespread: single hosts operate multiple listings (Boros, L. *et al.* 2018; Ferreri, M. and Sanyal, R. 2018. Adamiak, C. 2019; Robertson, D. *et al.* 2020). Airbnb can contribute to the transformation of city centres as well: since it can appear in already existing buildings, it intensifies crowding and tourism gentrification (Gutiérrez, J. *et al.* 2017).

The effects of Airbnb on traditional accommodation services is also often analysed: studies have found that Airbnb influences occupancy rates and hotel prices (Hong Choi, K. *et al.* 2015; Zervas, G. *et al.* 2017; Ginindza, S. and Tichaawa, T.M. 2019) or employment in tourism (Fang, B. *et al.* 2016). However, these effects are not uniform: the type of hotels (e.g. ownership) and location matter (Dogru, T. *et al*. 2020). Guttentag, G. (2015) described Airbnb as a disruptive innovation in the accommodation sector. Taxation, for example, is a key issue in this regard (Vinogradov, E. *et al.* 2020). Since the booking of accommodation happens through Airbnb, both guests and hosts tend to avoid taxes. This creates a competitive advantage for Airbnb as opposed to hotels. Furthermore, hotels must comply with the legal framework regarding the accommodation sector, while Airbnb listings are usually out of the scope of the regulations, which is also a competitive advantage for P2P accommodations (Boros, L. *et al.* 2018). In addition to the taxation issue, the regulatory aspect of P2P accommodations is also a widely discussed topic. Several studies highlighted that existing regulatory frameworks are not suitable for the management of Airbnb and its effects on the housing market or tourism sector (Edelman, B.G. and Geradin, D. 2015; Guttentag, G. 2017). Reacting to this problem, many cities introduced restrictive measures for Airbnb, e.g. maximizing the number of rental days, requiring the registration of hosts, or creating new administrative frameworks (Hajibaba, H. and Dolnicar, S. 2017).

The relation between P2P accommodation and traditional tourism services has a particular aspect in the post-socialist region, where tourism development is fragmented and not embedded in wider economic or urban development (Gunter, U. and Önder, I. 2018; Ključnikov, A. *et al.* 2018; Smith, M. *et al.* 2018; Smith, M.K. *et al.* 2018; Belotti, S. 2019; Gyódi, K. 2019; Rátz, T. *et al.* 2020). Due to the characteristics of post-socialist housing markets (e.g. ownership structures, processes of privatisation, regulatory frameworks) (see

e.g. Enyedi, G. and Kovács, Z. 2006; Földi, Zs. 2006; Sýkora, L. and Bouzarovski, S. 2012; Grime, K. *et al.* 2019; Korcelli-Olejniczak, E. and Tammaru, T. 2020; Kovács, Z. 2020) the emergence of Airbnb contributed to the increase of socio-economic inequalities in post-socialist inner-cities. At the same time, the rise of Airbnb has also clearly contributed to the development of tourism in these cities, providing relatively cheap accommodation in city centres and nearby locations. According to recent research findings (e.g. Boros, L. *et al.* 2018; Ključnikov, A. *et al.* 2018) the share of multi-hosts (hosts managing more than one listing) in these cities is higher than the European average. At the same time, short-term rentals are regulated moderately or not at all in post-socialist cities. Therefore, the effects of COVID-19 pandemic on the hospitality industry of post-socialist cities deserve special attention.

Previous research has also revealed that the most important motivations for using P2P accommodations are the lower costs compared to hotels and the value for price (Guttentag, D. 2015; Mao, Z. and Lyu, J. 2017; So, K.K.F. *et al.* 2018; Pung, J.M. *et al*. 2019), but other factors have their significance as well. Tran, T.H. and Filimonau, V. (2020) identify four types of motivational factors: economic benefits, social benefits, functional attributes and experiences. On the other hand, lack of trust and perceived risk are both identified as de-motivational factors when considering listings on Airbnb (Mao, Z. and Lyu, J. 2017; Mahadevan, R. 2018; Mao, Z.E. *et al.* 2020). At the same time, certain kinds and levels of risks can have a positive effect on consumer behaviour in P2P accommodation services due to the perceived advantages (e.g. price, authenticity or location) and the risk-seeking attitude of travellers (Aruan, D.T.H. and Felicia, F. 2019; Yi, J. *et al.* 2020). However, previous studies could only analyse the role of perceived risk on micro level: on the scale of host and guest and usually focused on certain markets. COVID-19 represents a more general and unprecedented risk. Since Airbnb is a major force shaping today's tourism and due to the magnitude of the local effects of P2P accommodations, it is important to understand how COVID-19 has affected local Airbnb markets. The future of Airbnb is related to the future of tourism and hospitality industry and the future of our cities.

Diseases, risks and tourism and hospitality

As it was mentioned in the Introduction, tourism is a fragile sector, often severely affected by crises, natural or human-made disasters or disease outbreaks (Çakar, K. 2018; Reddy, M.V. *et al.* 2020). Thus, the consequences of these unfavourable events and post-crisis management aspects are often on the agenda. In the last two decades several major disruptions have affected international tourism, such as terrorist attacks (e.g. in New York, 2001; in Bali, 2002), the global economic crisis in 2008–2009, the eruption of the volcano Eyjafjallajokull in 2010 or the 2004 tsunami in South Asia (Hall, C.M. 2010; Lim, J. and Won, D. 2020). The most important disease outbreaks that had effects on tourism and hospitality industry were the bovine spongiform encephalopathy ("mad cow disease") in 2002–2003, the Severe Acute Respiratory Syndrome (SARS-CoV) in 2003, the avian flu in 2004, swine flu in 2009 (H1N1), Middle East respiratory syndrome-related coronavirus in 2012 (MERS-CoV) and the Ebola outbreak in 2014. All of them have been analysed and discussed intensely in the academic literature, focusing on the effects of the diseases, presenting post-crisis management perspectives and highlighting the importance of precaution (Sharpley, R. and Craven, B. 2001; Baxter, E. and Bowen, D. 2004; Henderson, J.C. and Ng, A. 2004; Gu, H. and Wall, G. 2006; McAleer, M. *et al.* 2010; Wu, E.H.C. *et al.* 2010; Rassy, D. and Smith, R.D. 2013). However, despite the calls for proactive crisis management, most of the national governments failed to elaborate effective plans for disease-related tourism management and communication (Jamal, T. and Budke, C. 2020).

Many authors concluded that the outbreaks usually caused decline in tourist arrivals, due the fact that tourists were concerned about their health and safety (Kuo, H.-I. *et al.* 2009; Mao, C.-K. *et al.* 2010; Lee, C.-K. *et al.* 2012; Joo, H. *et al.* 2019) and to non-pharmaceutical interventions (such as surveillance, border control and quarantine) (Lee, C.-K. *et al.* 2012; Ho, L.-L. *et al.* 2017; Ryu, S. *et al.* 2020). However, the effects can vary depending on the type of tourism (Shi, W. and Li, K.X. 2017). Furthermore, it is also important to point out that tourism is not only affected by diseases but is also connected with their spread. The greater mobility of people and the accessibility and affordability of air travel contribute to the rapid spread of infectious diseases (Davis, X.M. *et al.* 2013; Omrani, A.S. and Shalhoub, S. 2015; Findlater, A. and Bogoch, I.I. 2018).

As previous works on crises and tourism demonstrated, the perception of risk has a significant role in tourist decisions (Reisinger, Y. and Mavondo, F. 2005; Law, R. 2006; Tang, C.F. and Tan, E.C. 2016; Novelli, M. *et al.* 2018), although the awareness of individuals varies depending on their experiences and knowledge (Widmar, N.J.O. *et al.* 2017; Nelson, E.J. *et al.* 2019). If travellers are concerned about their health and safety, it affects tourist flows negatively. Several studies confirmed that negative effects tend to appear quickly, while the recovery could take longer time (Lean, H. and Smyth, R. 2009). Lim, J. and Won, D. (2020) investigated the recovery of tourism in Taiwan after the outbreak of SARS. Their research showed that the tourist arrivals from different markets recovered at a different rate, because the risks were perceived differently among travellers from Hong Kong, the United States or Japan. The perceptions were affected by local experiences regarding the virus or the trust in health organisations. Consequently, in the case of Japan recovery of tourist flows took longer.

Since travel decisions are strongly related to perceptions of risks, the role of communication is crucial in shaping fear and concern among potential consumers – as it was highlighted by several case studies (e.g. Faulkner, B. 2001; Baxter, E. and Bowen, D. 2004; Kuo, H.-I. *et al.* 2009; Sparke, M. and Anguelov, D. 2012; Fisher, J.J. *et al.* 2018; Maphanga, P.M. and Henama, U.S. 2019; Jamal, T. and Budke, C. 2020). Disease outbreaks influence consumer behaviour negatively – even if a virus does not infect humans (such as the case of avian flu demonstrates – Kim, J. *et al.* 2020). Alarmist voices in media strengthen the perception of risk, causing panic and leading to more severe consequences in tourism (Monterrubio, J.C. 2010), affecting destination image (Hugo, N. and Miller, H. 2017).

Communication is also important during the recovery: destinations and hotels have to convey messages about safety – focusing on revenue-generating markets. National tourism agencies play a crucial role in coordinating and supporting these activities – see the example of Tourism Authority of Thailand after the 2004 tsunami. In addition to the marketing efforts, price has also a significant role during recovery: hotels can offer discounts or special packages to attract guests (Henderson, J.C. 2005). On the other hand, cost reduction (e.g. lower labour costs, stricter financial control, reduced level of services etc.) is also an often used strategy (Campiranon, K. and Scott, N. 2014). Collaboration between various actors of tourism (e.g. between hotels, airlines, travel agencies etc.) may also contribute to cost reduction through the economies of scale, help the formation of shared visions of future, increase the influence of stakeholders on future policies, and strengthen the relations between actors (Howes, M. *et al.* 2015; Jiang, Y. and Ritchie, B.W. 2017). So far, the effects of diseases on Airbnb have been rarely analysed, due to the fact that since the emergence of this accommodation platform, there have been only a few disease outbreaks that affected tourism markets, and only with limited effect. According to Hu, M.R. and Lee, A.D. (2020) the lockdown in Wuhan, the local appearance of COVID-19 and the introduction of local restrictions all had negative

effects on Airbnb bookings – but the importance of these factors varied from one region to another. The geographical distance of disease hotspots and the local mobility levels also influenced the number of cancellations. As their analysis on London shows, the pandemic affected the structure of demand as well: due to the lower level of host-guest contact, entire homes had a competitive advantage against private rooms. Although COVID-19 pandemic caused severe crisis in tourism industry, reducing spending power and tourist demand, the first negative effects of the disease outbreak were mainly caused by the perceived risks (Rivera, M.A. 2020). This is mainly because economic problems started later than the reports on the disease outbreak had started to dominate public and political discourses.

Based on the above-mentioned risk and pandemic related context, the main questions of this research are the following: How has the pandemic hit the analysed cities; what were the main differences among them? Which factors did influence the magnitude of the decrease in bookings and cancellations the most? How were different price categories affected by the pandemic?

COVID-19: characteristics of the disease and a brief timeline of the pandemic

The first confirmed case of COVID-19 was reported in Wuhan, China on 1 December 2019 – although according to several reports there had been earlier cases of the disease. The new disease (as pneumonia of unknown cause) was reported on 31 December 2019 to the World Health Organization (WHO) Country Office in China. Several researches reported that the coronavirus appeared in Europe in the last quarter of 2019, however, the public was not aware of the danger at that time. The impact of the disease started to manifest in tourism when the disease had become a global pandemic and various non-pharmaceutical interventions were applied by national governments or global organisations (travel bans, border closures, state of emergency etc.). As a result of these measures, the threat posed by coronavirus became more evident for travellers, thus, it had a larger role in their decisions.

The name COVID-19 for the disease was announced on 11 February 2020. The WHO declared the outbreak as public health emergency of global concern on 30 January 2020. It was the sixth time that an emergency of this scale had been identified (Kamel Boulos, M.N. and Geraghty, E.M. 2020; Zheng, Y. *et al.* 2020). On 11 March 2020, the outbreak was classified as pandemic by the WHO (2020). The virus rapidly spread outside China during January (according to the epidemiological reports); the first infected person outside China was reported in Thailand on 13 January, while the first European case was reported in France on 24 January (Worldometer, 2020). The first COVID-19 related deaths in the countries concerned in our research were reported during February. National governments reacted by introducing travel restrictions and declaring states of emergency – although the timing and the exact nature of measures varied. For example, Brazil did not declare a national state of emergency, only certain cities did so. On the other hand, most of the European countries announced state of emergency almost at the same time – in the middle of March. These actions were coincided with or were followed by travel restrictions and borders closures – to slow down or prevent the spread of the disease *(Figure 1).*

Data and methods

The data used in this analysis was retrieved from the database of insideairbnb.com (Insideairbnb, 2020). This webpage provides free data on offers and bookings of local Airbnb markets. The dataset contains information on the actual price (on the day of the data collection) and availability (stored in a Boolean variable: true-false) of all listings for the next 12 months. The data is updated monthly, thus, can be used for longitudinal

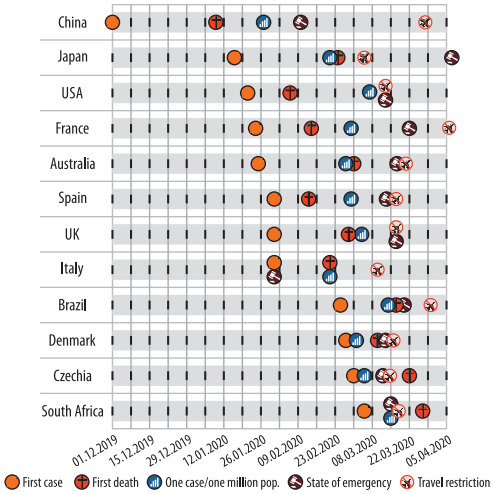

Fig. 1. The timeline of the spread of COVID-19 and measures and restrictions taken by different countries. *Source*: Edited by the authors.

analyses; analysing booking trends, prices and comparing them between various cities. The dataset has its limitations though: it does not contain data from all Airbnb listings worldwide, but only for selected cities. Furthermore, the timeframe of the data available in different locations can differ; in some cases (e.g. Tokyo), the earliest available data is from the middle of 2019, thus, it is not always possible to make a year-to-year comparison between the data from 2019 and 2020. Furthermore, the data collections in various cities do not cover exactly the same time periods *(Table 1).*

Last but not least, although the dataset contains availability and price data for each and all listings for the next 365 days, a large part of those listings becomes unavailable after three months (i.e. the value of the availability variable is 'false' for all days from the 4th month to the 12th). Our assumption is that most of them are not withdrawn from the market but are usually offered only for the next three months. As a result, a significant share of local Airbnb markets is not represented in the data for the above-mentioned period. Thus, the analysis is always based on the data for a three months' period starting from the day of the data collection (i.e. in our analysis the overlap between consecutive data collections is two months – due to the reliability of data, only these months can be compared).

To answer our research questions, we have analysed the changes in booking rates in 15 cities (London, New York, Paris, Sydney, Los Angeles, Beijing, Rio de Janeiro, Copenhagen, Rome, Cape Town, Madrid, Barcelona, Prague, Tokyo and Milan). The choice of cities was based on their tourism importance within Airbnb and because the aim was to represent various parts of the world and to provide a more comprehensive analysis of the early effects of coronavirus. Thus, the 9 largest local Airbnb markets (based on the number of listings) were selected. Madrid, Barcelona and Milan were added to the analysis because of the severity of the pandemic in these cities. Furthermore, in order to provide a more comprehensive overview, the trends of Cape Town (the largest African market) and Prague (the largest post-socialist market) were also analysed. In addition, the selection of Prague was also motivated by the fact that most of the post-socialist countries had lower infection ratio compared to Western Europe (Kouřil, P. and Ferenčuhová, S. 2020). Due to the limitations of data availability various cities had to be excluded from the analysis or could only partly be analysed. In addition, since the pandemic hit Asian countries first, the timeframe of the data collection is different in the case-study cities. In the cases of Tokyo and Beijing data from November to February were used, while in other cases the timeframe was from December to March *(Table 2).*

During our research, we used the data on availability and prices to analyse the changes in booking rates and to compare cancellations and new bookings among various price categories (price quartiles) for all cities. Four datasets were analysed in all cases: every month from December 2019 to March 2020. This timeframe covers the time when the world was not yet aware of the dangers of COVID-19 and the time when the virus

Table 1. Dates of the data collections

City	Year	Date-1 P-I*	Date-2 P-I – P-II**	Date-3 P-II – P-III***	Date-4 P-III****
Barcelona	2019	10.12.2018	14.01.2019	06.02.2019	08.03.2019
	2020	10.12.2019	10.01.2020	16.02.2020	16.03.2020
Madrid	2019	10.12.2018	14.01.2019	06.02.2019	08.03.2019
	2020	10.12.2019	10.01.2020	18.02.2020	17.03.2020
Rio de Janeiro	2019	14.12.2018	18.01.2019	11.02.2019	13.03.2019
	2020	23.12.2019	21.01.2020	25.02.2020	18.03.2020
London	2019	07.12.2018	13.01.2019	05.02.2019	07.03.2019
	2020	09.12.2019	09.01.2020	16.02.2020	15.03.2020
New York	2019	06.12.2018	09.01.2019	01.02.2019	06.03.2019
	2020	04.12.2019	03.01.2020	12.02.2020	13.03.2020
Paris	2019	07.12.2018	13.01.2019	05.02.2019	11.03.2019
	2020	10.12.2019	09.01.2020	16.02.2020	15.03.2020
Sydney	2019	07.12.2018	13.01.2019	04.02.2019	07.03.2019
	2020	08.12.2019	07.01.2020	15.02.2020	16.03.2020
Los Angeles	2019	06.12.2018	11.01.2019	03.02.2019	06.03.2019
	2020	05.12.2019	04.01.2020	13.02.2020	03.03.2020
Beijing	2019	15.11.2018	14.12.2018	18.01.2019	11.02.2019
	2020	24.11.2019	26.12.2019	21.01.2020	26.02.2020
Rome	2019	11.12.2018	16.01.2019	07.02.2019	08.03.2019
	2020	12.12.2019	12.01.2020	19.02.2020	30.03.2020
Milan	2019	11.12.2018	16.01.2019	07.02.2019	08.03.2019
	2020	11.12.2019	12.01.2020	18.02.2020	30.03.2020
Copenhagen	2019	18.12.2018	28.01.2019	17.02.2019	26.03.2019
	2020	31.12.2019	29.01.2020	28.02.2020	22.03.2020
Prague	2019	21.12.2018	29.01.2019	18.02.2019	28.03.2019
	2020	31.12.2019	30.01.2020	29.02.2020	22.03.2020
Cape Town	2019	15.12.2018	22.01.2019	12.02.2019	18.03.2019
	2020	28.12.2019	26.01.2020	27.02.2020	21.03.2020
Tokyo	2020	28.11.2019	30.12.2019	28.01.2020	29.02.2020

*Beginning of the booking phase of the Period I. **End of the booking phase of the Period I, and beginning of the booking phase of the Period II. ***End of the booking phase of the Period II, and beginning of the booking phase of the Period III. ****End of the booking phase of the Period III.

started to spread globally, severely affecting tourism flows and accommodation bookings. Since most of the travel restrictions were introduced during March, the analysed processes were influenced by the market trends without the governmental interventions. We compiled a timeline of the spreading of COVID-19 and national and local policy responses. According to several reports and analyses, the virus appeared earlier than the first confirmed cases indicate, but this is irrelevant for our analysis, the responses from governments, tourists or airlines were affected by the 'official' data and the measures taken by various actors within and outside the tourism sector (e.g. airlines, travel agencies).

Comparing of reservation numbers for the same days between two consecutive months, it is possible to determine change in occupancy rates of Airbnb listings. Growth is interpreted as net gain, while decrease is interpreted as net loss of reservations. If we have two data collections, one from 10 December 2019, the other from 10 January 2020 (i.e. booking phase), we can calculate and compare occupancy numbers for the days between 10 January and 10 March (i.e. travel phase). As we mentioned earlier, the

Table 2. List of the case-study cities and justification of their selection

Ranking	City	Number of		Justification of selection
		listings	active listing	
1	London	87,571	58,261	Top Airbnb market
2	Paris	66,414	35,097	
3	New York	51,097	32,706	
4	Sydney	40,434	22,821	
5	Beijing	39,732	35,393	
6	Los Angeles	38,851	31,575	
7	Rio de Janeiro	36,461	27,842	
8	Rome	31,450	28,803	
9	Copenhagen	28,418	10,997	
..				
13	Cape Town	24,591	20,357	Top African Airbnb market
..				
17	Madrid	21,845	17,899	Severely hit by COVID-19
..				
19	Barcelona	20,981	18,210	Severely hit by COVID-19
20	Milan	20,280	15,959	
..				
24	Tokyo	15,551	14,827	Top Asian Airbnb market*
25	Prague	14,560	11,631	Top post-socialist Airbnb market

*Outside of China. *Source*: Edited by the authors based on data from InsideAirbnb, 2020.

reliability of data drops significantly after the third month of the travel phases. As the first step of the analysis, a year-to-year comparison of bookings was made to understand the dynamics of local Airbnb markets. In the next phase of research, in order to gain a more detailed understanding of the temporal changes, a day-to-day comparison of booking numbers was made; and changes in the number of bookings for each day of the travel phase were calculated. Finally, to understand how various price categories were affected by the pandemic, the changes of bookings in the price quartiles of cities were compared.

Results

As the first step of the analysis, the changes in the number of bookings between 2019 and 2020 were compared. *Figure 2* shows the average net gain/loss in reservations per day for each travel phase. These numbers were calculated by dividing the total number of new reservations made during the preceding booking phase by the number of days within the travel phase. Each period shown in *Figure 2* consists of a booking and a travel phase (see *Table 1*).

Compared to the previous year, all the analysed cities show a decrease in the number of new bookings between February and March 2020 – the largest one was experienced in Rome. Although the most affected region was Lombardy (ca. 600 km from Rome), the decrease in Milan was lower. Paris and Prague also suffered significant drops. Spain was hit severely by COVID-19 which is reflected in the number of bookings as well: the number of cancellations exceeds the number of new bookings for Barcelona and Madrid in the third period of 2020, when the pandemic situation started to evolve in the country. It means that the number of bookings from March to May dropped significantly.

In the first half of February, Airbnb bookings in Beijing were suspended until May (Reuters, 2020), thus, the last analysed pe-

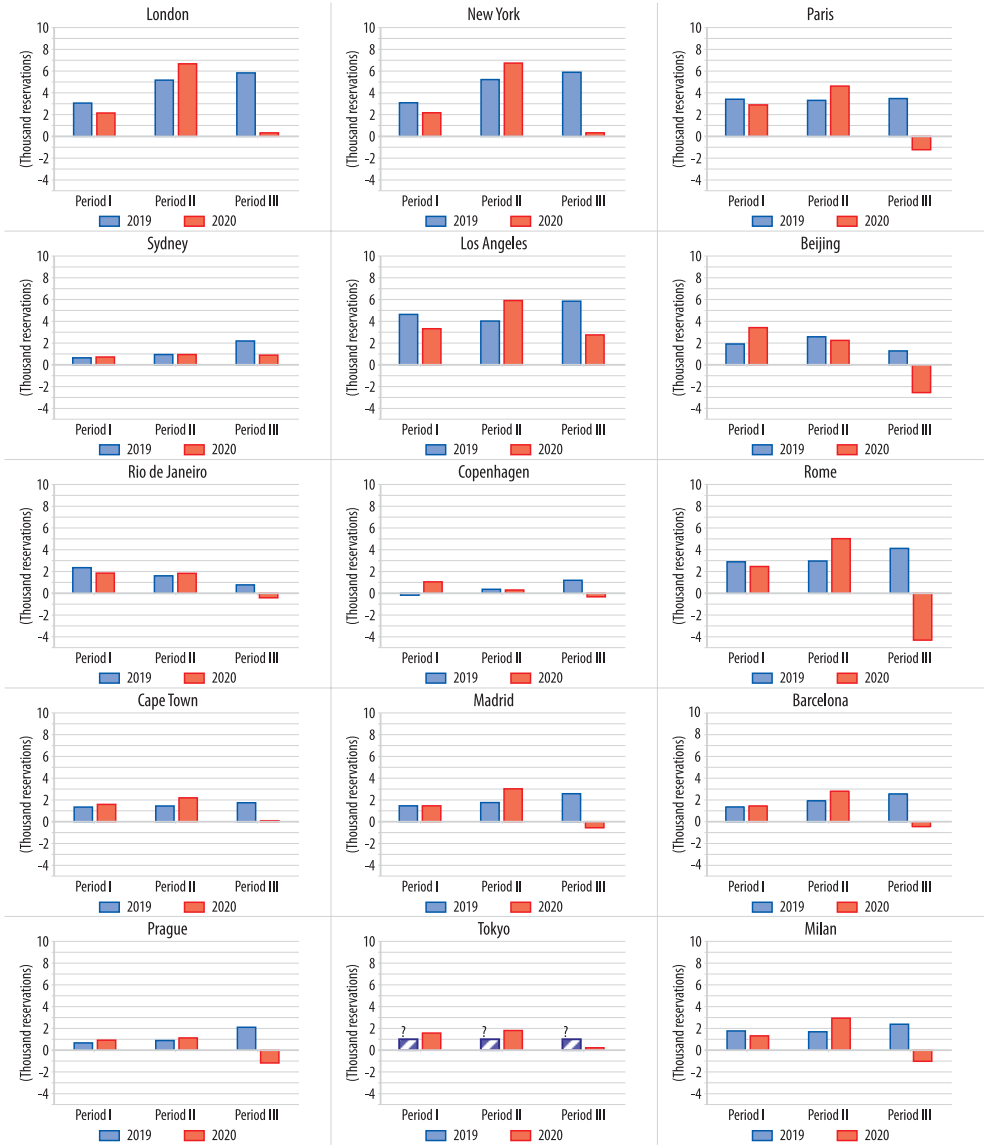

Fig. 2. Changes in daily average reservations, comparison of 2019 and 2020. *Source*: Edited by the authors.

riod from 2020 shows the largest drop in the number of bookings – but this is due to administrative reasons. The processes in London and New York are quite similar – the reason could be that as global cities they are both deeply embedded into global flows of people and information. In Los Angeles, the number of bookings decreased, but the number of new bookings in Period III almost matched the level of Period I. Additionally, Los Angeles showed the largest number of new bookings in Period III. Although the first confirmed cases in the United States were reported in January, Los Angeles remained

slightly affected until the middle of March. Our assumption is that in this case, traveller choices were affected mostly by the local situation, and the spreading of virus in other states had a lower significance. The restrictions for travellers from the Schengen Zone were introduced on 13 March, and so they did not affect the booking trends analysed in this research.

Since December, January and February are summer months on the Southern Hemisphere, the peak tourism season falls to this period. Christmas season also strengthens tourism in this period so the significance of "last minute" bookings is lower in Sydney, Rio de Janeiro and Cape Town than in the other investigated cities – i.e. travellers book their accommodations well before the travel date. Thus, the number of new reservations and the decrease in the third period are also lower in the cities of the Southern Hemisphere. In addition, the pandemic has appeared later in Cape Town and Rio de Janeiro compared to the other analysed cities. The year-to-year comparison was not possible in the case of Tokyo due to the missing data for 2019 – but compared to the first two periods in 2020 there were almost no new reservations in the third.

When analysing the effects of various events and milestones on *Figure 1*, the results show that the global events (e.g. declaration of public health emergency of global concern) had little effect on booking and cancellation trends. Instead, the local pandemic situation had more significant role in these processes; the change in the number of bookings correlates with the time elapsed from the date when the rate of fatalities exceeded the one person/million value. With time the drop in booking numbers was larger. There were two exceptions: Rio de Janeiro and Sydney. In both cases, local conditions and processes may explain this deviation. In Rio de Janeiro, the low level of COVID-19 testings and political attitudes towards the disease decreased the official numbers of infections and fatalities. While Australian bookings might have been affected by extensive wildfires.

It is important to note that other factors than COVID-19 also had their impacts on tourism and Airbnb reservations. The possible effects of Australian wildfires were already mentioned. In addition, China is the most important source of international visitors in Australia; the evolving pandemic situation in China could also affect the number of reservations. This was particularly the case after Australia had introduced a travel ban for visitors from China on 1 February 2020 (Champer Champ, 2020).

In the second step of the research, the aim was to provide a more detailed picture of the processes presented above. Thus, a day-to-day analysis was made for the occupancy rates for four data collection dates. The lines on *Figure 3* show the percentage of booked listing at the time when these data collections were made for each consecutive day. The areas between lines present direction and the extent within the change. If the lines representing a later data collection time decreases below the one representing the earlier data, then a net loss in occupancy is experienced. As we mentioned earlier, Airbnb bookings were suspended in Beijing in the first half of February 2020.

The graphs on *Figure 3* confirm the abovementioned statements – but they also reveal some peculiarities. The differing trend lines highlight the differences in booking strategies. For example, in the case of Rio de Janeiro, the steepness of the trend lines shows that most bookings are made just before the travel. In the cases of Madrid and Barcelona a net loss in occupancy can be seen from the middle of March. At the same time, this negative trend seems to have a lower effect towards the end of Period III; travellers booked accommodation for May during the third booking phase (the beginning of March). It shows that some tourists trusted that the pandemic situation would disappear by May – confirming the role of risk perception in travel plans. In Rome the bookings disappeared for the whole Period III – showing a different perception of risk in that case. In Paris and Prague, the cancellation ratio was high, but similarly to Madrid and Barcelona guests did not cancel their bookings for the end of April.

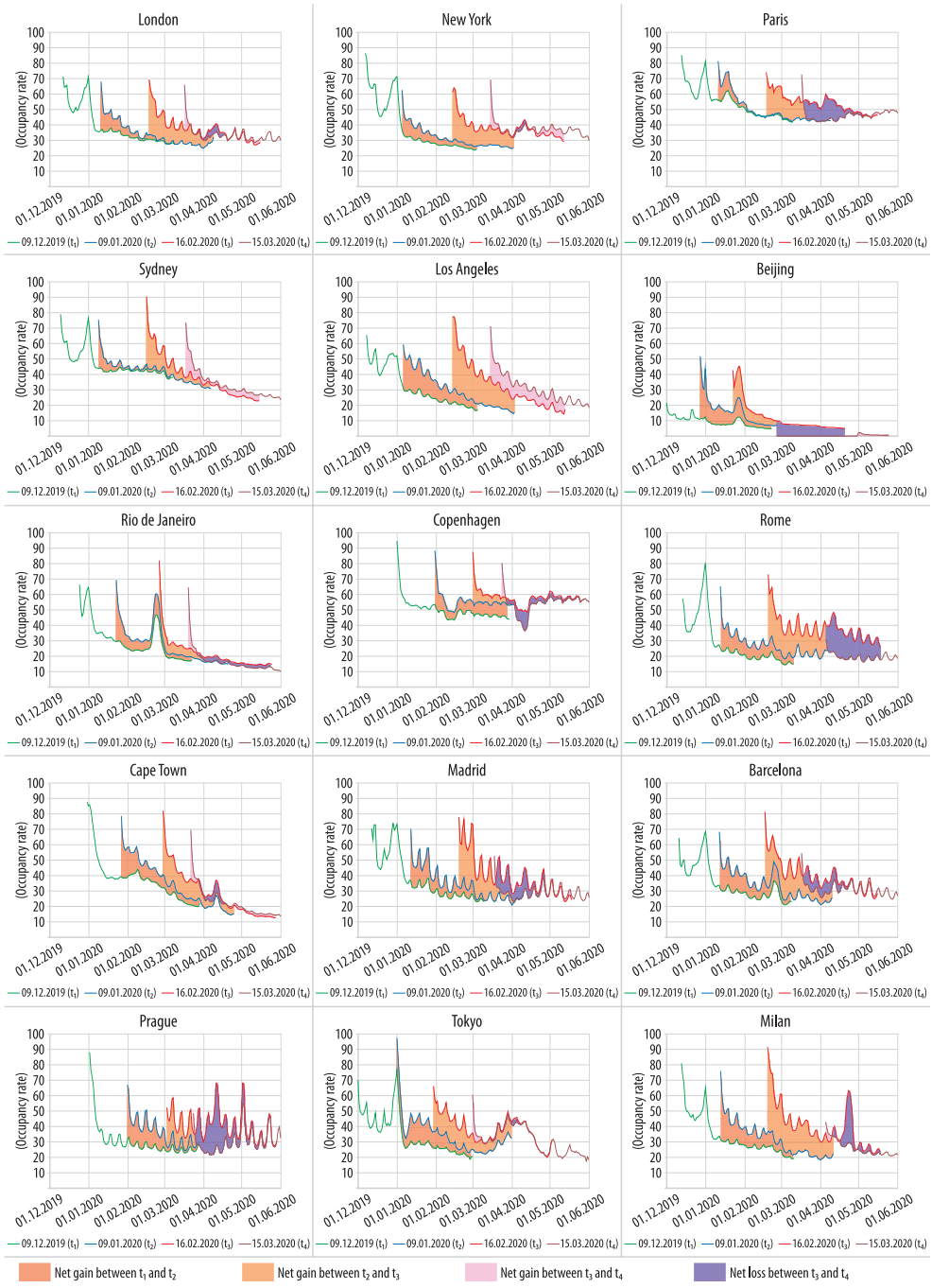

Fig. 3. Day-to-day changes of the Airbnb occupancy ratio between December 2019 and March 2020. *Source*: Edited by the authors.

The trend lines of London and New York show similar patterns here as well; the net loss in bookings appears at the beginning of April and the rate of relapse lower compared to Rome, where the most drastic decrease in occupancies was experienced. In Milan the magnitude of net loss is connected to the cancellation of the Design Week event. Copenhagen had net loss during almost the whole Period III, but the occupancy rate remained relatively high compared to the other investigated cities. Only two cities had no net loss in Period III: Sydney and Los Angeles. However, Sydney had two weeks at the beginning of April with only a minimal growth in occupancy rate. At the same time, the trend lines are quite similar for Los Angeles in each period. It confirms our previous findings; the effect of COVID-19 was minimal on the local Airbnb market during the analysed period. Tokyo shows the largest drop when comparing the maximum occupancies between data collections.

Compared to the peak occupancy of the holiday season, the maximum rates dropped more than 30 per cent for the next two phases. The possible explanations are two-fold; on the one hand, the drop is a "normal" process, since occupancy is usually higher during Christmas and New Year. On the other hand, China is one of the most important sources of tourists for Japan. In 2019 almost one-third of the tourists in Japan arrived from China. Losing one of the key sources of international tourism hit hard the Japanese Airbnb market as well. The number of new reservations in Cape Town also decreased significantly, but the length of net loss period is relatively short and new reservations were already made for May. This could be related to local circumstances: South Africa was where COVID-19 appeared the latest among the countries concerned.

During the third step of the analysis, the effects of coronavirus on different price categories of Airbnb were analysed. For the sake of that the daily average number of net gain/loss in each period for the price quartiles was calculated. Results show how the overall gain or loss occurred among the price quartiles (the first quartile consists of the most expensive listings, while the fourth the cheapest ones) during 2020 *(Figure 4)*. Data for Beijing shows the cancellation of all previously booked listings since all bookings were suspended to Period III.

According to the reservation data, the Airbnb markets of all analysed cities were affected by the pandemic – but this effect showed different patterns. In Milan, Rome, Prague, Rio de Janeiro, Copenhagen all price categories had net loss. In the cases of Rome, Barcelona, Rio de Janeiro, London and New York the more expensive listings were more affected, however, it does not always mean net loss. Unlike the previous parts of the analysis, London and New York shows distinct differences here. While in the case of New York, there was a slight increase in all quartiles, in London a net loss was experienced above the median price. In Paris, Los Angeles, Copenhagen, Madrid, Prague and Milan the second and third quartiles suffered the largest decrease, while in Tokyo listings below the median price were the most affected. The rise of occupancy rate in Cape Town at the end of Period III was related to the cheapest price category. Due to the specific situation of Australia (i.e. wildfires) Sydney does not seem to fit into the above described categories.

Discussion and conclusions

The aim of this paper was to analyse the effects of COVID-19 on the Airbnb markets of different cities. To this end, the paper focused on three interrelated research questions. The first one referred to similarities and differences between various tourist locations regarding the effects of COVID-19. As data showed, COVID-19 pandemic had serious effects on the analysed local Airbnb markets, although the characteristics of the changes varied from city to city – thus, there is no uniform model of changes. Differences are determined by several factors, e.g.:

– the characteristics of local tourism markets (i.e. seasonality, price level, key source countries of tourists);

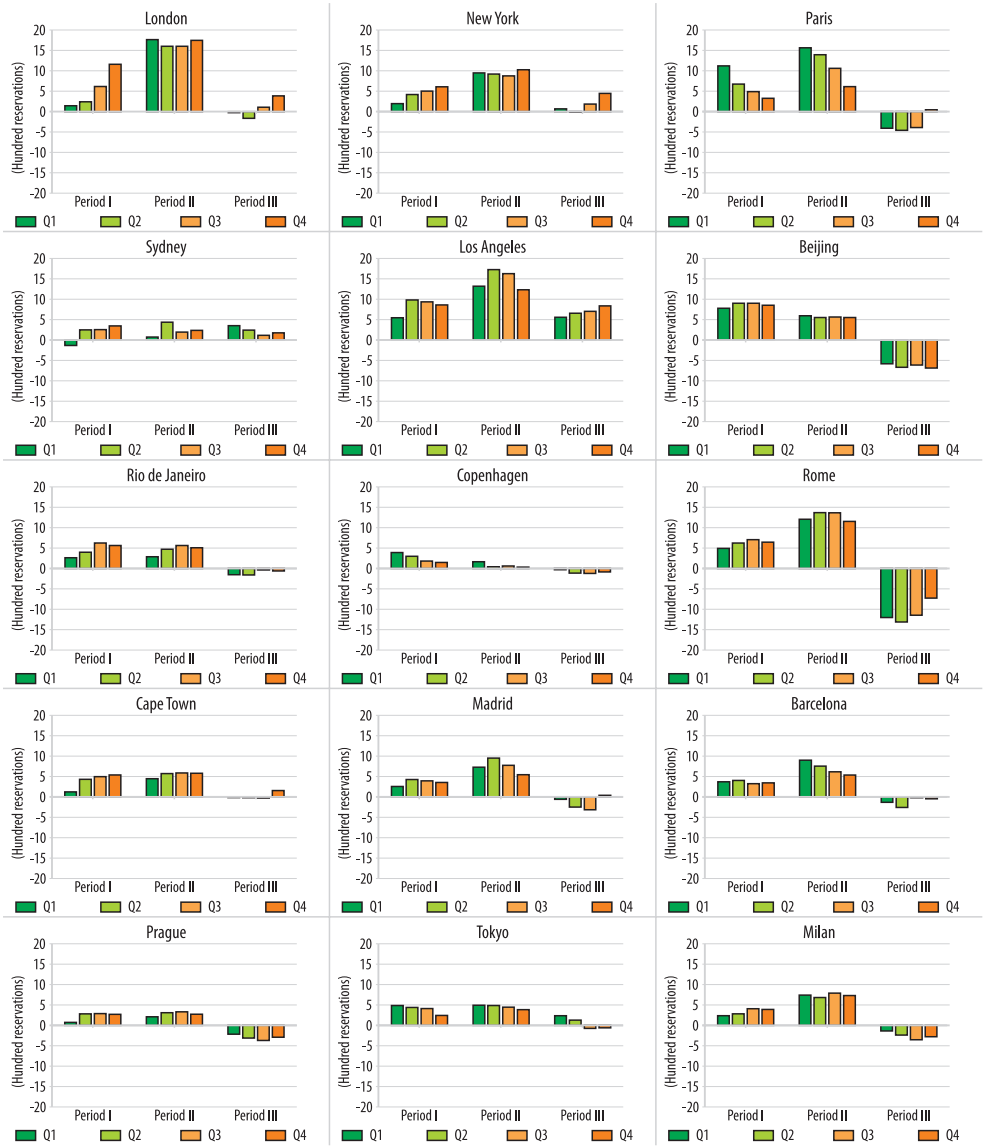

Fig. 4. Daily average reservations by quartiles between December 2019 and March 2020. *Source*: Edited by the authors.

– the time of the emergence of pandemic situation locally;
– government reactions and policies.

In some cases, the reservations made for a later date were not cancelled – as the case of Prague demonstrates. While its reasons are unknown due to the limitations of the analysed data, the relatively low infection ratio might have had an effect on this.

Based on our research findings it is difficult to provide comprehensive answers to the second and third research questions. The second

question focused on the underlying factors of Airbnb cancellations. As the data showed, guests reacted to the pandemic quickly; they cancelled their reservations and did not make new ones – well before the travel restrictions. The declaration of global health emergency had little effect on booking trends. Instead, as the link between the change of occupancy rates and time of one case per million milestone shows, the local emergence of the disease contributed more to the perception of risk. To answer the third research question, it can be stated that the different price categories were affected differently – it was also related to the characteristics of local tourism markets. Thus, the local characteristics had significant role in shaping several aspects of booking trends.

The pandemic raises questions regarding the future of Airbnb – in a wider sense regarding the future of cities and tourism as well (Rubino, I. *et al.* 2020). According to several analyses, the pandemic can provide an opportunity for a transformation in tourism industry, moving towards a more sustainable future (Brouder, P. 2020; Gössling, S. *et al.* 2020; Hall, C.M. *et al.* 2020; Niewiadomski, P. 2020; Stankov, U. *et al.* 2020). Furthermore, as several studies highlighted (Ke, Q. 2017; Dolnicar, S. and Zare, S. 2020), in many cases the hosts did not share their idle capacities – instead, they managed multiple accommodations. These enterprise-like hosts can suffer significant losses during the crisis, they can go bankrupt or decide to leave the market or to decrease their portfolio (Farmaki, A. *et al.* 2020). In addition, future policies can also affect the future of Airbnb. The effect of Airbnb on hotel industry and local communities was a highly debated issue in many localities. When the revival of tourism starts, local and national governments may support 'traditional' hotel companies due to their stronger lobbying power, role in employment and contribution to tax incomes. This support can be manifested in financial support or regulatory changes that would offer a significant advantage to hotels over P2P accommodations. This can lead to the decline of 'capitalist' multihosts (Dolnicar, S. and Zare, S. 2020).

The eventual shrinkage of local Airbnb offers would have effects on real estate and rental markets; the apartments withdrawn from the Airbnb market can become available for long-term rent or the owners can try to sell them. Thus, the price and the quantity of available flats (both for rent and for sale) can be affected by these changes. These processes can have a special relevance in post-socialist cities; where multi-hosts have a more prominent role compared to Western European cities. The regulation framework can be strengthened – as the attempts in Prague and Budapest demonstrate (Expats 2020; 24.hu 2020). If the regulations become stricter, it can change the tourism sector of these cities as well, e.g. by affecting the perceived value for money for tourists.

The length of the crisis and its effect on employment, incomes etc. will all influence how market processes and governmental policies evolve in the future. For example, tax breaks, stimulus packages and other governmental measures can provide help for certain actors in tourism and hospitality, influencing market processes (Dube, K. *et al.* 2020). Since the end of the pandemic and the subsequent economic crisis are not predictable (e.g. the consequences of the second wave of the disease – Oskam, J. 2020), it is too early to propose management recommendations. As the pandemic has caused an economic crisis, the recovery of tourism will take a longer time compared to the earlier disease-induced crises in tourism and hospitality. The experiences of previous pandemics (SARS-CoV and MERS-CoV in particular) provide insights into the possible effects and the possible directions of crisis relief. But COVID-19 caused distractions on an unprecedented scale – which means utilising past experiences has its limitations. Unlike in the case of previous diseases, the chance for a quick recovery of short-term rentals is extremely low because the length of the pandemic and the economic crisis.

Obviously, our study has certain limitations; it only focuses on certain cities and the timeframe of the analysis is limited too. We used publicly available data from Insideairbnb,

which has its own limitations regarding the content, the scope and timeframe of the datasets. The analysis only shows the changes in booking trends; the perceptions and motivations beyond the decisions are unknown.

Future research could focus on the motivations of tourists, e.g. on why they cancel (or do not cancel) their bookings? Questions related to trust and perceived risks can provide further useful insights regarding the demand side of Airbnb. The markets trends on a longer term should also be analysed: questions of how long the decrease will be and how the structure of Airbnb supply will change. As we mentioned above, the policies towards Airbnb can also change – influencing P2P accommodation markets significantly. Thus, processes within various regulatory frameworks could also be compared. Last, but not least, the severity, the length and the effects of the second wave of the pandemic (and the related reactions of various actors) can vary from one location to another, causing unforeseeable processes. These should be also analysed in future researches.

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Socially sustainable urban renewal in emerging economies: A comparison of Magdolna Quarter, Budapest, Hungary and Albert Park, Durban, South Africa

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Abstract

This study compares the social sustainability of urban renewal interventions in Hungary and South Africa. The societal and environmental challenges arising from urbanisation and the associated population growth in major urban centres around the world have increased the research and policy foci on urban sustainability and governance. While urban regeneration projects are vitally important to urban sustainability, these interventions have been widely criticised because social sustainability issues have been overlooked or ignored. Therefore, there is a need for governance practices that are applicable to different national and urban contexts. The main aim of this study is twofold: firstly, it provides a literature review on the social sustainability of urban renewal and secondly, it compares urban renewal interventions in two different geographical settings to provide recommendations about public participation and stakeholder involvement, which can contribute to increasing social sustainability of urban renewal projects. To this end, a comparative approach was adopted through the analysis of two urban renewal projects: Magdolna Quarter Programme (Budapest, Hungary) and the Albert Park (Durban, South Africa), the data for which were based on a review of secondary sources, including international literature and policy documents. It was found that although urban renewal serves a city-wide purpose (and not just a local one), the socio-economic impacts of these projects have not yet been adequately explored. Furthermore, to achieve higher urban renewal sustainability, there is a need for impact assessments (with special attention paid to the social effects) to promote public participation and empowerment.

Keywords: urban renewal, public participation, social sustainability, public-private partnership, Hungary, South Africa

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Introduction

In recent years, sustainability has been firmly integrated into the scientific and policy discourses on urban renewal (e.g. Zheng, H.W. *et al*. 2014; Zijun, Y.E. 2019). Since both concepts are concerned with economic, social, and environmental dimensions, integrated urban renewal approaches should be focused on the 'physical, social, economic and ecological aspects of abandoned urban areas through various actions, including redevelopment, rehabilitation, and renovation' (Yi, Z. *et al*. 2017, 1460). Sustainable urban renewal takes it a step further by integrating the three dimensions of sustainable development with the concept of urban renewal through the involvement and participation of various, bottom-up multi-stakeholders (Zijun, Y.E. 2019). However, social sustainability aspects have often been neglected in urban renewal schemes (Darchen, S. and Ladouceur, E. 2013; Jin, E. *et al*. 2018), primarily because of different stakeholder aims and policies.

Some authors argue that public-private partnerships (PPPs) are effective instruments to include various stakeholders and carry out socially sustainable urban renewal projects

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(e.g. Colantonio, A. *et al*. 2009). However, successful operation of PPPs is often hindered by conflicts over decision making, and inadequate cooperation schemes can easily result in the exclusion of less powerful interest groups from the urban renewal process. The operation of PPPs in urban renewal is undoubtedly a geographical question, inasmuch as PPPs are influenced by, for example, national- and local-level regulations, politics of scale, and place-specific attributes (e.g. population composition) of the effected neighbourhoods. Hence the need for studies that reveal what practices in social participation and involvement can lead to socially sustainable urban renewal in significantly different geographical contexts.

The main aim of our study is twofold. First, it provides a literature review on the social sustainability of urban renewal. Second, it compares urban renewal interventions in two different geographical settings to provide recommendations about public participation and stakeholder involvement, which can contribute to increasing social sustainability of urban renewal projects.

Accordingly, the research questions addressed in this paper are the following:

a) How can the concept of social sustainability be defined with regards to urban renewal?

b) What is the relationship between the social sustainability of urban renewal interventions and the involvement and participation of various stakeholders?

c) What lessons can be learnt with relation to social sustainability from urban renewal projects implemented in different geographical contexts?

For these purposes, a comparative approach was adopted through the analysis of two urban renewal projects: Magdolna Quarter Programme (District VIII, Budapest, Hungary) and the Albert Park (Inner city, Durban, South Africa), the data for which were based on a review of secondary sources, including international literature and policy documents. Although these interventions were carried out in different geographical contexts, they show certain similarities, serving with relevant lessons to social sustainability, stakeholder involvement and public participation.

Social sustainability and urban renewal: international trends

In recent years, increased attention has been paid in academic discourses to the social sustainability of urban renewal (Glasson, J. and Wood, G. 2009; Lee, G.K.L. and Chan, E.H.W. 2010; Dempsey, N. *et al*. 2011; Wong, L.K. and Yu, P.H. 2015). Yet, unlike economic and environmental sustainability, social sustainability has not been clearly defined as part of urban renewal and therefore has not been treated as an equally important component of sustainable development. In addition, as social sustainability definitions vary based on the researcher's field of study and profession *(Table 1),* there is no universally accepted criteria for social sustainability, which means that this area has been under-theorised and over-

Table 1. Some definitions of social sustainability

Definition	Reference
… refers to the impacts of urban infrastructure on the affordability of and access to public service delivery by poorer groups within urban society.	Roseland, M. (1998) in Koppenjan, J.F. and Enserink, B. (2009, 284)
… is a life-enhancing condition within communities, and a process within communities that can achieve that condition.	McKenzie, S. (2004, 12)
… is a quality of societies. It signifies the nature-society relationships, mediated by work, as well as relationships within society.	Griessler, E. and Littig, B. (2005, 11)
… blends traditional social policy areas and principles, such as equity and health, with emerging issues concerning participation, needs, social capital, the economy, the environment, and, more recently, with the notions of happiness, well-being and quality of life.	Colantonio, A. (2011, 40)

simplified in existing theories. Most of the definitions indicate that social sustainability has several dimensions and influencing factors, such as accessibility of public services, employment, social capital and community wellbeing, sense of community and belonging. Furthermore, an important aspect of social sustainability in urban renewal is social participation and democratic involvement. Thus, as several scholars argue, the process of urban regeneration should always include the mobilisation of potential stakeholders and the capacity building of the local community (Dempsey, N. *et al*. 2011; Holden, M. 2011, 2012).

As such, many cities are taking a bottom-up approach to urban renewal projects by actively encouraging public participation, social interaction, and cultural revitalisation (Ho, D.C.W. *et al*. 2012). However, despite these efforts, national and local governments in many countries still struggle with the conceptualisation and implementation of socially sustainable urban renewal, and policies for democratic involvement and community participation are not always effective.

There are several ways that stakeholders can be involved in urban renewal projects, one of which is through public-private partnerships (PPPs). Similar to social sustainability, PPP does not have a universally accepted definition, as it is an umbrella term, involving a wide range of concepts, and having different meanings in different geographical contexts. Nevertheless, for the purpose of our study, PPP is defined as a 'co-operation between public and private actors with a durable character in which actors develop mutual products and/or services and in which risk, costs, and benefits are shared' (Klijn, E.H. and Teisman, G.R. 2003, 137).

In recent decades, PPPs have been seen to be a solution for budget-and-time constraints, especially in large projects (Warsen, R. *et al*. 2018). However, the successful operation of PPPs in urban renewal has often been hindered by joint stakeholder decision-making processes, which has hampered the social sustainability of these projects. Grounded in experience from three Dutch case studies, Klijn, E.H. and Teisman, G.R. (2003) argued that problems usually arose when there were many stakeholders and an assumption of co-operation and interdependency, which more often than not resulted in failure, from which it was concluded that public and private sector contractual relationships are needed to focus all relevant stakeholders on the common goal. From a study in Jakarta, Rahardjo, H.A. *et al*. (2014) strongly advised that for PPP urban renewal projects to succeed, community members and non-profit organisations needed to be encouraged to participate. Mendel, S.C. and Brudney, J.L. (2012) found that non-profit organisations in Cleveland, United States, provided a 'third-space' where local people were able to voluntarily integrate with key stakeholders to tackle the challenges arising in different phases of an urban renewal project. Although PPPs are complex and difficult to implement, they have been found to result in faster and more efficient community service delivery (Houghton, J. 2011). Nonetheless, there is still less focus on social sustainability and the social participation in many urban renewal projects, and as conditions for public participation differ by country, emphasis is needed on international comparison when investigating urban renewal PPPs.

Relatively few studies have compared urban renewal projects from at least two different continents through the lens of social sustainability. In a review of urban sustainability achievements in different cultural development models in Brazil, India and Mexico, Basiago, A.D. (1998) concluded that projects could be simultaneously economically, environmentally and socially sustainable. Križnik, B. (2018) also compared institutional and planning approaches and social sustainability in urban development and regeneration projects in Barcelona, Spain and Seoul, South Korea, finding that despite community involvement being one of the key dimensions of social sustainability and the main focus of both projects being to meet the needs of all citizens, only a few selected social groups benefitted.

In a similar vein, comparing participatory urban regeneration projects in Japan and Denmark, Harada, Y. and Jørgensen, G. (2016) emphasise the importance of international comparative research as a mutual learning process. The argument here is that geography does matter in this respect as national and local circumstances (e.g. welfare system, policy context of urban regeneration) significantly influence PPPs. Hence the need for international comparative studies that investigate urban renewal PPPs in very different geographical contexts (and not only in economic core regions and western countries) and provide general lessons about how to make these urban renewal schemes more socially sustainable.

Case study selection

One of the main aims of this paper is to provide lessons for urban research and policy with regards to public participation and social sustainability of urban renewal. These lessons should be applicable to projects situated in different geographical contexts. Hence we compare two interventions from two different countries, different continents (Hungary and South Africa). Despite apparent differences, these two cases show considerable similarities as well:

(i) historical development path of the two societies: they both experienced dictatorship (although apartheid in SA was a racist one, in Hungary the regime was based on communist ideology and thus rejected the idea of social difference), and in both countries democratic social order and market capitalism have been built from early 1990s;

(ii) in the past both case-study areas were disadvantaged, crime-ridden neighbourhoods with stubborn negative image, but due to recent renewal activities they are under transformation;

(iii) both interventions were run by PPP cooperation schemes, and in both cases, international funds (EU) influenced the objectives and governance schemes of the two projects, fostering public participation and thus social sustainability.

National policy contexts

Hungary

In Hungary, urban renewal PPPs only became possible after the collapse of the Marxist-Leninist dictatorship in 1990. Before the 1990s, housing allocation was dominated by state-ownership and central bureaucratic coordination, whereas urban reconstruction referred mainly to the building of prefabricated housing estates using greenfield construction or by demolishing and replacing pre-existing old apartments in some areas. This process led to disinvestment and dilapidation in many inner-city neighbourhoods, especially in Budapest, which resulted in very poor-quality housing stock in the affected areas (Szelényi, I. 1990; Lichtenberger, E. *et al*. 1995). Furthermore, due to the selective liberalisation of the state-led command economy during the 1970s and 1980s, private investment and segmentation began to emerge in the housing sector (Bodnár, J. and Böröcz, J. 1998), coupled with social differentiation and segregation in inner-city neighbourhoods prior to 1990 (Kovács, Z. 2009).

After 1990, urban regeneration activities were profoundly influenced by the shift from a socialist state-led command economy to a liberal market economy, and by the transformation from a centralised single-party state to a democratic unitary state. The public administration system was decentralised, granting extensive autonomy for local municipalities in settlement development (Act LXV of 1990/ Act CLXXXIX of 2011 on Local Governments). Budapest is unique in this respect, as in the capital city a two-tier self-government system has been established, including the Municipality of Budapest (i.e. City Hall) and the 23 district municipalities with special legal status *(Table 2).* Thus, since 1990 the tasks and responsibilities have been divided between the district municipalities and the Municipality of Budapest, and the decision-making power of the former is still highly independent of the Budapest City Hall (Tosics, I. 2006; Enyedi, Gy. and Pálné Kovács, I. 2008).

*Table 2. Major policies, strategies and plans that have shaped urban renewal policies in Hungary**

SUPRANATIONAL POLICIES AND STRATEGIES	NATIONAL POLICIES AND STRATEGIES	BUDAPEST REGIONAL POLICIES	JÓZSEFVÁROS PLANS AND STRATEGIES
European Union 2020 Strategy	Fundamental Law of Hungary	Integrated Urban Development Strategy	
European Regional Development Fund	National Framework Strategy on Sustainable Development	Long-Term Urban Development Concept 2030	District Development Strategy
Leipzig Charter of 2007	National Strategic Reference Framework 2007–2013	Budapest Agglomeration Spatial Plan	Act LXXIV of 2016 on Townscape Protection
Territorial Agenda	Integrated Urban Development Framework		
	Competitive Central Hungary Operational Programme 2014–2020		
	New Széchenyi Plan 2014–2020		
	National Development and Territorial Development Concep		

*Compiled by the authors.

The decentralisation of public administration provided local municipalities with the right to create their own development strategies, land use plans and building regulations, still adhering to national-level policy frameworks. However, due to their limited financial resources, privatisation of the former public housing stock was a common practice amongst local governments throughout the 1990s and 2000s, and this process was supported by national regulation (e.g. Act LXXVIII of 1993). As a result, public housing share dropped markedly; for example, between 1990 and 2006, it decreased from 51 per cent to 8 per cent in Budapest (Kovács, Z. and Herfert, G. 2012), still showing considerable unevenness amongst the districts, e.g. in the 8th district this figure was 10 per cent in 2017. The liberalisation of the Hungarian economy also resulted in a massive FDI influx from the 1990s, and it facilitated investments in office-space and housing, particularly in Budapest (Földi, Z. and Kovács, Z. 2014). However, while the necessary conditions for PPPs were set, such interventions were relatively rare before the 2000s, as the urban rehabilitation projects were mostly financed by local municipalities (e.g. Budapest Urban Rehabilitation Fund, established in 1994).

Urban renewal PPPs spread in Hungary during the 2000s, which coincided with the country's EU-accession and the consequent incorporation of EU urban planning policies into Hungarian legislation. Joining the EU in 2004 opened the door to community-wide initiatives and networks, such as the URBAN, the URBACT, the EUKN and the Leipzig Charter on Sustainable European Cities. The 'integrated urban intervention' idea was also adopted at this time, which led to the introduction of the 'social urban rehabilitation' and 'socially sensitive urban renewal' concepts (Gerőházi, É. *et al*. 2004). The best example of this type of intervention was the Magdolna Quarter Programme (MQP) in Józsefváros, District VIII of Budapest. This programme was managed by Rév8, which company was established by the local gov-

ernment, but the OTP (the most important savings bank in the socialist state, which was privatised after 1990) and Budapest Municipality also had shares in it. Even though a social urban rehabilitation model had been developed, there was a considerable diversity amongst urban renewal interventions in Hungary, in terms of management schemes and financing (see Csanádi, G. *et al*. 2011; Keresztély, K. and Scott, J.W. 2012).

After 2010, the political circumstances of urban renewal changed significantly due to an authoritarian turn and massive re-centralisation in policy making, implemented by the Fidesz-government. At the same time, the country's share of EU financial transfers increased; for example, almost EUR 17,000 million from the Cohesion Fund and European Research and Development Fund was allocated to Hungary for the 2014–2020 programming period, from which approximately 5 per cent was dedicated to the 'sustainable urban development' of the cities with 'country seat' status, 1/5 of which was to be spent on urban rehabilitation (Jelinek, C. 2017). Due to the political re-centralisation, while the planning and design of local (spatial) development remained with local municipalities, the delivery of many public services crucial to social inclusion (e.g. primary and secondary schools) were transferred to central government bodies (Teller, N. 2015). Therefore, the local municipalities prepared integrated development strategies (although it was not obligatory for smaller municipalities), which served as the development project frameworks for the allocation of EU and national financial resources. While these integrated development strategies also included anti-segregation programmes, as Jelinek, C. (2017) argued, urban rehabilitation became an instrument for handling social tensions at the local level.

South Africa

During the apartheid era in South Africa, the majority of the population (Blacks, Indians and Coloureds) lived in harsh, impoverished conditions, were excluded from the mainstream economy, and were provided with limited basic services because of the segregation laws (such as Group Areas Act of 1950). The spatial divisions placed the white people in affluent communities and the Blacks, Coloureds' and Indians in segregated areas on the city outskirts. Due to deindustrialisation and the rapid urbanisation in the 1970s, there were severely deteriorating buildings in the centres of many large cities, which became even worse after the apartheid regime was dismantled in the mid-to-late 1990s as a majority of the white and middle-income inhabitants fled the inner-city districts to the more affluent suburban areas. Coupled with the withdrawal of property investment and a lack of good transport and administrative systems, the inner cities experienced an increase in abandoned buildings, which resulted in many buildings being illegally rented or being squatted in (Frenzel, F. 2014). As such, many inner cities in South Africa have been going through a 'transformation process since the faltering years of apartheid' (Frenzel, F. 2014, 437).

South Africa's first democratic elections were held in 1994 when the new African National Congress government led by former President Nelson Mandela won the elections. Many legislative policies were consequently introduced and implemented by successive post-apartheid ANC governments to correct the imbalances and injustices of the apartheid era *(Table 3)*. One of the main objectives of these policies was to renew and develop the social, economic and environmental states of the dilapidated urban regions. Twenty-five years after the dismantling of the apartheid regime, human settlement and urban development continues to be a major socio-economic challenge in South Africa.

After the South African cabinet approved the request for the development of a regulatory framework for PPP in 1997, an interdepartmental task team was appointed to determine how PPP could be used to improve service delivery, and four months after the release of the team's document in December 1999, the strategic framework for PPP was en-

*Table 3. Key recent and relevant development plans in South Africa**

INTERNATIONAL POLICIES AND STRATEGIES	NATIONAL POLICIES AND STRATEGIES	KWAZULU-NATAL REGIONAL POLICIES	DISTRICT PLANS AND POLICIESES
Sustainable Development Goals	Constitution of South Africa	Spatial Development Framework	Integrated Development Plan
African Union Agenda 2063	Redistribution and Development Programme	State of the Province	100 Resilient Cities Strategy
New Urban Agenda	National Urban Renewal Framework	Provincial Growth and Development Plan	Long-Term Development Framework
	Breaking New Ground Housing Delivery, 2005		
	Integrated Urban Development Framework		
	National Development Plan		
	District Development Model		
	National Spatial Development Framework		

*Compiled by the authors.

dorsed and the national treasury published regulations for the management and maintenance of the PPP. Despite the low number of PPP projects, the South African government has continued to adopt, revise and amend the multiple urban planning and regeneration policies to reverse the damage left by the apartheid government. Many of these policies were adapted from post-industrial city models from the United Kingdom because of their emphasis on creativity and culture. However, of all the policies, the amendment to the Income Tax Act 58 of 1962 to include an Urban Development Zone tax incentive in 2004 was one of most important steps in encouraging private sector led businesses to invest in the construction and development of commercial and residential buildings in the demarcated UDZs (South African Revenue Service, 2014; Gregory, J.J. 2016; Young, J. 2018).

During his State of the Nation Address in 2001, former President Thabo Mbeki introduced the Urban Renewal Programme and the Integrated Sustainable Rural Development Programme, saying that the main purpose of these programmes was for the government to 'conduct a sustained campaign against rural and urban poverty and underdevelopment, (by) bringing in the resources of all three spheres of government in a coordinated manner' (SONA, 2001). Eight presidential nodes in five different provinces across the country were selected to act as pilot projects for the implementation of the social urban renewal programmes and to assess the benefits of these projects on the beneficiaries in all nodes (Musakwa, W. 2008; Donaldson, R. and du Plessis, D. 2013; Mhlekude, N. 2013; Ndlela, A.P. 2013; Mbanjwa, P. 2018). The main concerns raised in all these studies were the lack of meaningful community involvement, engagement or participation, the lack of transparency between the government officials, the lack of coherence in the capacity building policies, the weak leadership management, the unclear project mandates and the exclusion of local businesses, non-government organisations and community leaders. In places where these issues persisted, the communities became despondent and no sense of community belonging was evident.

As such, the South African government recognised and acknowledged the shortfalls and adopted a new programme, the National Development Plan (NDP) Vision 2030, which

is an overarching long-term plan that seeks to eradicate poverty and eliminate inequality. The NDP seeks to involve all relevant stakeholders to create a more stable country and to ensure equal access to the opportunities in the urban areas. Furthermore, as a response to the above-mentioned issues and former President Jacob Zuma's call for the need of an urban strategy to respond to the rapid urbanisation, the Integrated Urban Development Framework (IUDF) was developed and approved by the Cabinet in 2016. The IUDF builds on the UN Sustainable Development Goals 11 and NDP by seeking to retrofit the existing cities footprint to produce cities that are connected, coordinated and compact. To complement the IUDF, President Cyril Ramaphosa went on to introduce the District Development Model (DDM) in a bid to curb the silo mentality in which different spheres of government operated. The DDM was approved in 2019 and aimed at mobilising communities, NGOs, and private sector organisations into achieving social compact.

Case study description

This sub-section outlines the two specific projects: Magdolna Quarter Programme in Budapest and Albert Park in Durban *(Figure 1).*

Magdolna Quarter Programme (MQP)

The Magdolna Quarter (in Hungarian: Magdolna Negyed) is a sub-district in the administrative area of Józsefváros (District VIII in Budapest), bordered by the Corvin Promenade, the elite Palace Quarter and a major railway station.

There were three phases in the MQP, each of which was funded by multiple stakeholders. The first phase from 2005–2008 was funded by the Municipality of Budapest and the Municipality of Józsefváros and had a total budget of EUR 3.2 million, most of which was for the partial renovation of four municipality-owned housing blocks and associated projects. The second phase from 2008–2011 was fund-

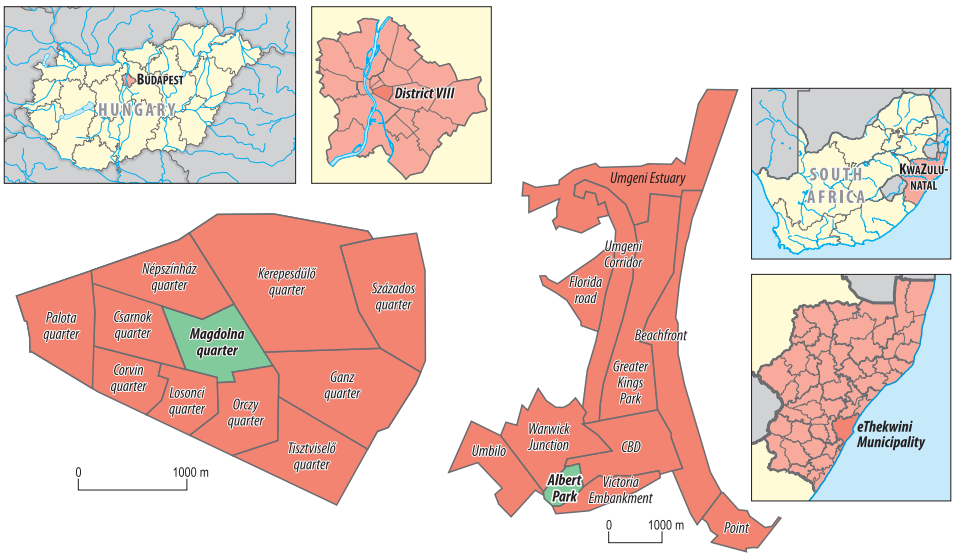

Fig. 1. Location map of Magdolna Quarter inside District VIII in Budapest (left), and Albert Park inside the Inner city of Durban (right).

ed by the European Regional Development Funding (ERDF) and had a total budget of EUR 7.2 million, with the primary project elements being focused on the revitalisation of public spaces. The third phase, between 2013 and 2015, was funded by the ERDF and European Social Fund (ESF) and had a total budget of EUR 13.9 million, most of which was for a community centre and associated project elements (see Locsmándi, G. 2011; Keresztély, K. 2017).

There were seven projects in the MQP:
- the development of a community centre from the glove factory,
- the improvement of public spaces,
- the development of economic and employment opportunities,
- the improvement of educational facilities,
- the regeneration of housing flats,
- the development of crime prevention programmes, and
- the establishment of social cohesion services.

The aim of these programmes was to integrate community members into the local planning of their area. Through this citizen participation, the authorities sought to make the Magdolna Quarter unique by encouraging the citizens to remain in the area and not relocate. The Teleki Square project *(Photos 1* and *2)*, implemented in the third phase of MQP, was initiated by the Újirány Csoport (New Direction Group) for the public park rehabilitation planning procedure. This square was historically a 'motley centre' (Alföldi, G. *et al*. 2019, 163) for newly arrived immigrants in the city, and later became a stigmatised crime ridden, functionless area.

Photo 1. The Teleki Square after rehabilitation (Photo by Fabula, Sz.)

Photo 2. Park rules of the Teleki Square after rehabilitation (Photo by Boros, L.)

Albert Park

Albert Park is located in the south-eastern part of Durban, and is bounded by Anton Lembede Street to the North, Dr Yusuf Dadoo Street to the East, Diakonia Avenue to the South and Joseph Nduli Street to the West, and was named after the large Albert Park in the area, which is also known as 'Whoonga Park' *(Photos 3* and *4)*.

As part of the Inner City Thekwini Regeneration and Urban Management Programme (iTRUMP) that was established in the late 1990s in the quest to make Durban a sustainable city, a cultural precinct was created in Albert Park where 'a cosmetic facelift of palm trees' (Erwin, K. 2018, 34) were planted in the middle of an island of buildings, new street lights were installed and an outdoor stage was built for the Durban music school. Additionally, historic buildings were renovated such as Diakonia Centre which houses various NGOs, the Durban Music School, and a small museum.

Furthermore, Albert Park is characterised by the two main streets: Diakonia Avenue and the Maud Mfusi Street: which are vastly different from each other. Diakonia Avenue

Photo 3. Dilapidated flats on Diakonia Avenue (above) and Albert Park legislation (below). (Photos by Nzimande, Z.D.)

is tastefully decorated and has multi-storied, well-maintained buildings and informal and formal businesses lining the pavement leading up to the park. However, the closer one moves to the Maud Mfusi Street, it becomes evident from the dilapidated buildings that iTRUMP has not yet ventured here, with the windows advertising various short-term accommodation and a makeshift mini-bus rank at the corner of Maud Mfusi and Alexandra Street. The paving in Diakonia Avenue and not in Maud Mfusi Street serves to entrench

Photo 4. Unutilised park with removed swings (Photo by Nzimande, Z.D.)

and exacerbate the spatial and social division between these two streets.

One of the projects in the area is the Port View Complex owned by SOCHO Property Investment. This non-profit organisation is one of the Section 21 companies responsible for the development, distribution and management of subsidised housing across South Africa. As part of the National and Provincial government plan for providing sustainable rental homes to citizens earning between EUR 92 and EUR 460 per month, Port View was one of the projects launched in 2008 to convert four old blocks into 142 one- and two-bedroom flats. The ground floor was to be utilised as an economic space with 21 commercial units available for rent. In 2012, 90 tenants were legally evicted due to their failure to pay their rent, due to an organised rent boycott that was meant to liquidate SOHCO. This jeopardised the social housing company's ability to repay its bonds (Broughton, T. 2012).

The Qalakabusha Albert Park Intervention Programme, which was aimed at addressing the social issues in the area, was launched in 2014. Many stakeholders – NGOs, the provincial government, private sector entities, and the police – pledged to commit themselves to making Albert Park a safe, clean attractive area. The then Mayor Councillor James Nxumalo 'emphasised that the challenges of vagrancy, loitering, drug-abuse and criminal elements at Albert Park needed to be dealt with as a matter of urgency' (eThekwini Municipality, n.d.). As such, the Albert Park is now much safer as compared to before.

Comparison of the aspects of urban renewal in Budapest and Durban

In this section, two urban renewal projects, the MQP in Budapest and the Albert Park Intervention Programme in Durban, are analysed based on the three criteria identified as being crucial to social sustainability: the structure and functioning of public-private partnership, community involvement, and project innovation and continuity. Although in this article the focus is on social participation through PPP in urban renewal, the continuity and innovation aspect is indispensable to sustainability, as one of the aims of this paper is to provide recommendations about social participation in urban renewal.

Public-private partnership

Magdolna Quarter

The EU accession of Hungary played a crucial role in acquiring an important source of investment (e.g. ERDF) for urban regeneration in most Hungarian settlements. Moreover, the local municipality, the Budapest municipality and private investors (e.g. OTP) also played an important role. Due to the complexity and uniqueness of this area-based project, there was an institutional instability between the stakeholders. Unfortunately, when the Józsefváros municipality composition changed substantially in 2006, Révs8 had increased conflicts with the new, right-wing Fidesz-led municipal members. However, the dedication of some of the experts directly and indirectly working in the MQP, introduced innovative methods of involving the community.

Albert Park

Due to EU's interest in South Africa's 'political dialogue, trade and economic co-operation, science and technology, and development co-operation' (Njokweni, F. 2011, 7), the Area Based Management (ABM) was partially funded by the EU with training and expert assistance also provided by the EU. While the NGOs in the Magdolna Quarter were invited by the municipality to run different social workshops, in Albert Park, the urban renewal was focused on just one main objective, the physical characteristics. As such, because of the unrest that occurred in the area when xenophobic attacks first started in 2008, to encourage dialogue, in 2009 the Nelson Mandela Foundation (NMF) joined forces with the KwaZulu-Natal (KZN) Christian Council, the KZN Refugee Council, the Refugee Social Services, the Union of Refugee Women, and Abahlali BaseMjondolo to host workshops on social cohesion between the residents to provide a space where community members could identify and discuss the different issues that they were facing in the area (NMF, 2009).

Community involvement

Magdolna Quarter

The social cohesion in the Magdolna Quarter Project was established through the active volunteering of the residents to assist in the renovation activities and by being given the opportunity to have input at public meetings. During the first phase of the housing project, the Four Buildings Association was established to represent the interests of residents; however,

it was later dismantled for unknown reasons, after which a locally based NGO (Nap Klub) took over as a meditator to express the resident grievances to Rév8. However, despite this, public participation was somewhat challenging to community members as they had never been able to express their opinions before. The high level of mistrust in the local government also encouraged citizen participation (Keresztély, K. and Scott, J.W. 2012). Local meetings, community maintenance of the new and improved green spaces and shared community responsibilities such as painting the buildings and constructing the public furniture all allowed the community to be involved in the MQP.

An NGO, called the Association for Teleki Square, was founded by the locals to actively participate in the planning and maintenance of the square. This project has been hailed as one of the few best practice community participation projects by architects, the media and the local municipality. However, it has also been criticised because of its exclusion of the marginalised groups in the community because only lower-middle class Hungarians were involved in spearheading the design and functionality process for the park (Jelinek, C. 2017).

Albert Park

The community members were fairly engaged with the local government through the ward meetings and other initiatives. However, separate projects ran by NGOs had higher resident involvement as compared to those ran by the municipality (NMF, 2009).

Project innovation and continuity

Magdolna Quarter

This program was the first of its kind in Hungary, inspired by Birmingham's urban renewal programme and the 'Soziale Stadt' programme in Germany and has been seen as a 'best practice' for an integrative form of urban renewal. The foundation of Rév8 was also an innovation in the Hungarian context, the idea of which was adopted from Western Europe (Rotterdam). The complexity of this socially sensitive project meant that key stakeholders had to decide on new, innovative methods to ensure long-term project sustainability; however, after the completion of the third phase, some services were terminated due to a lack of funds, which pointed to the need for longer term planning.

Albert Park

Over 5 years have passed since the finalisation of the then latest urban rehabilitation; however, this area is still experiencing major problems such as vagrancy, high crime levels, drug trafficking, outstanding levies and a general rise in urban decay. Unscrupulous landlords are still continuing to exploit residents due to the lack of employment in the area, and property owners, who sometimes resort to violent means to get their rent, are charging exorbitant rental fees for overcrowded flats that lack basic services (Mohamed, S.I. 1999). The tenants are reluctant to take legal action against the landlords for fear of getting arrested and/or evicted, with the illegal immigrants usually bearing the brunt of these exploitations. Furthermore, due to the Qalakabusha programme, the large group of homeless men that used to inhabit the recreational park were removed by the Metro Police and have moved next to the railway lines that are found 500 m from the park. This means that the community is now able to enjoy the green space. However, due to the current COVID-19 pandemic, the park is used to provide temporary shelter for homeless people by the Municipality.

Discussion: lessons from the urban renewal projects in Magdolna Quarter and Albert Park

This paper examined the importance of considering social sustainability as part of urban renewal projects, and especially scrutinised

the role of stakeholder involvement and public participation in the conception and implementation of such projects. Both the Magdolna Quarter, Budapest (Hungary) and Albert Park, Durban (South Africa) had similar socio-economic backgrounds as both areas had been suffering from vagrancy, were generally associated with crime and grime, and were inhabited by people who had a low average education level and disadvantaged socio-economic backgrounds. Three research questions were posed on the onset and so this section aims to answer them.

Q1: How can the concept of social sustainability be defined with regards to urban renewal?

From the literature review, it is apparent that social sustainability is a complex concept, which has several dimensions, and it has no universally accepted definition. With the present paper, we did not seek to quantify and assess the social sustainability of the two studied urban renewal projects. Instead, we qualitatively explored how social sustainability was influenced by the geographical context (e.g. local social environment, levels of governance) of public participation during these relatively long-lasting projects. Based on the cases of MQP and Albert Park, it seems that the historical and geographical contexts are relevant with respect to the social sustainability of urban renewal projects. Through the inheriting of the bureaucratic institutional legacy of the Habsburg Empire and later that of state-socialism, Hungary's path divergence during the transition level gave way to convergence under the EU (Loewen, B. 2016). Similarly, South Africa has ironically shown path dependence where egalitarian policies are a way to perpetuate inequality (Friedman, S. and van Niekerk, R. 2016). Experiences from Budapest and Durban are in line with other studies which emphasise the path dependency of urban regeneration (e.g. Couch, C. *et al.* 2011).

Furthermore, considering that the effect of path dependency and context specificity in urban policy seems to be stronger at the lower territorial levels (Moulaert, F. *et al.* 2007), the contribution of the present paper is twofold. First, we agree with those scholars who point to the importance of the neighbourhood as territorial analytical unit in the sustainability of urban renewal (e.g. Zheng, H.W. *et al.* 2017), and further argue that more attention should be paid to the path dependency of different geographical settings in these studies. Second, the role of the EU should also be underlined in the stories of MQP and Albert Park, as in both cases the European Community supported the projects through financial and policy transfer, but specific objectives and implementation structures were tailored to local circumstances. Thus, results suggest that 'download of European policies' and 'variegated Europeanization' (Carpenter, J. *et al.* 2020) can be observed not only within the EU but also outside of it. However, this phenomenon and its implications to social sustainability in urban renewal needs further investigation.

Q2: What is the relationship between the social sustainability of urban renewal interventions and the involvement and participation of various stakeholders?

Both Hungary and South Africa have comprehensive strategic, legal and policy frameworks in urban planning. In MQP, although the policies gave rise to greater PPP, community involvement was not perfect in all the different stages, but much better than before political changes in 2006. In Albert Park, despite the good policies in place, the projects saw fewer PPP, community involvement and thereafter a lack of project innovation and continuity. However, there has been more bottom-up, innovative activities occurring in the area by civil society. Therefore, the role of the state was found to be an important influential factor in the PPPs in both Hungary and South Africa. Both projects differed significantly in stakeholder involvement and the distribution of power between stakeholders. As such, MQP was criticised by some interest groups because several civil organisations were not involved in the project planning or implementation. To eliminate such problems, Leitheiser, S. and Follmann, A. (2020) suggest that grassroots initiatives should be encouraged by the authori-

ties, and the involvement of such bottom-up initiatives should be formalised in urban policy.

Social sustainability can only be achieved by continual active engagement with the community in all project stages. Uysal, Ü.E. (2012) concluded that projects that fail to engage local and affected communities risk community resistance and development delays. This was evident in Albert Park where despite rules being in place to 'control' the park activities, such as the prohibition of alcohol and drugs, it remains a 'no go zone' due to the high number of vagrants and the associated unruly behaviour. Therefore, the conception and implementation of urban renewal projects can either promote or undermine local community participation. Roberts, P. (2000) commented that the physical renovation of buildings was strongly linked to social aspects, that is, by entrenching spatial and social inequalities through poor planning, urban renewal projects can create new social problems.

One example of this was the exclusion of weaker but 'problematic groups' (mainly the homeless and the Roma) from the planning of Teleki Square (MQP). Although this green space is functioning and serves to beautify the area, it is controlled by security guards making sure that the different rules are followed (Boros, L. *et al*. 2016) unlike in Albert Park whereas there are no security measures in place, the park is deemed unsafe by the local community. This was further emphasised by Ho, D.C.W. *et al*. (2012), who found that to minimise social exclusion, community aspirations should be evaluated and assessed from project onset. Through the relatively high level of public involvement in the MQP, the residents (albeit selected) were given the opportunity to be heard; however, there was little-to-no public involvement in the Albert Park project. Therefore, the public participation was more successful in the MQP because of the effective techniques used and the large amount of work done by Rév8 and other actors. Regardless of these successes, as some disadvantaged groups remained underrepresented in the planning process, more attention could have been paid to these groups (Jelinek, C. 2017).

The vitality and uniqueness of neighbourhoods can often be damaged during urban renewal when the original residents are prohibited from returning. In his review paper, Thwala, W.D. (2009) discussed how the lack of management of urban renewal projects after completion was one of the major sustainability issues, indicating that effective local governance structures were required. While the strategic developmental plans in both South Africa and Hungary are normally long term, the urban renewal projects are often no more than 3–5 years. After the completion of the Magdolna Quarter and Albert Park projects, very few ex-post social studies were conducted to evaluate the positive and/or negative impacts these projects had had on the community. Durban has implemented several policies to attract and support entrepreneurial urbanism, which have resulted in piecemeal, uncoordinated activities that have no long-term impact or sustainability.

Q3: What lessons can be learnt with relation to social sustainability from urban renewal projects implemented in different geographical contexts?

Firstly, while public participation does not follow a rigorous approach, the greater the participation, the higher the chance that a project's objectives will be met. However, deeper public participation is not always straightforward, as this process can be tedious, time-consuming and complex (Thwala, W.D. 2009). Although often said, decision-makers should employ tailor-made, appropriate approaches to projects as conventional methods adopted from western countries are often ill-fitted as they do not take into account local traditions. For example, in MQP, civil society has played a huge role in supporting activities as bureaucracies often struggle to bring about required, radical transformation in cities. Of course, the financial investment for projects allow such NGOs to apply for grants to work in the area. In Durban, it is not an impossible scenario as the Warwick Junction urban renewal project has been internationally recognised as a good practice

due to the collaborative process with street traders and authorities to transform the space. However, besides the Asiye eTafuleni NGO working in this space, the city lacks the presence of well-established civil society organisations (Bond, P. and Mottiar, S. 2018; Sutherland, C. *et al*. 2018).

Secondly, impact assessments, such as social impact assessment, that allow community members and other relevant stakeholders to discuss socio-economic impacts of developments should be mandated in environmental legislation. Moreover, such legislation must go beyond being 'on paper' as proper, follow-up strategies should be employed to enhance social integration and assist in reducing potential community resistance to projects from inception to completion (Yeung, S.C.W. *et al*. 2007).

Lastly, limited vision, inspiration and focus to promote inner city districts and attract higher investment through urban renewal is one of the biggest weakness of local municipalities. In their paper, Turok, I. *et al*. (2019) attributed the lack of urban renewal in Durban to municipal indecision, poor delivery of basic services and general laissez-faire attitude towards urban decay. Driven motivation to decrease urban decay while increasing social inclusion and investment increases the success rate of projects. Durban has great opportunity to attract investors, however the high levels of corruption, poor coordination between governmental departments, and misaligned and discordant PPP all contribute to making investors hesitate to invest in the area.

Future research prospects and conclusions

This paper focused on socially sustainable urban renewal through an examination of two case studies in Budapest and Durban and a discussion on the different project aspects. While it was found that substantial progress had been made in involving communities in these urban renewal projects, the socio-economic impacts of these projects have not yet been adequately explored. Urban renewal plays a vital role in rejuvenating dilapidated buildings and attracting investors to the area, and thereafter improving community health and safety in the long run. However, local participation and social sustainability of projects may not be secondary considerations to public authorities as it is important to balance the interests of all stakeholders involved. As such, the on-going debate on urban renewal as gentrification, the right to city, and community engagement through social inclusion and exclusion is better understood in the context of micro-cases on disadvantaged communities. Although it could be argued that the social dimension is being incorporated into more urban renewal projects, the scale and level of this community engagement is far from satisfactory. Therefore, more studies are needed that examine the possibilities for effective sustainable community urban renewal governance.

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Does better availability mean better accessibility? Spatial inequalities in the care of acute myocardial infarction in Hungary

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Abstract

The availability of health care services is an important issue, however, improving availability of health care services does not necessarily mean better accessibility for everybody. The main aim of this study is to find out how better availability in the care of acute myocardial infarction vary with accessibility of patients' geographical location within Hungary. We applied statistical analysis and interview techniques to unfold the role of spatiality in the conditions of access to health care. Results of statistical analysis indicate significant health inequalities in Hungary. Decreasing national mortality rates of acute myocardial infarction, has been coupled by increasing spatial inequalities within the country especially at micro-regional level. According to in-depth interviews with local health care stakeholders we defined factors that support access to health care as well as important barriers. The supporting factors are related to the improvement of availability (i.e. infrastructural developments), while geographical distance, lack of material and human resources, or low level of health literacy proved to be the most relevant barriers. Main conclusion is that barriers to accessibility and availability are not only spatial but are also based on individual stages of acute myocardial infarction care. The development of cardiac catheter centres in Hungary has improved the short-term chances of infarction survival, but long-term survival chances have worsened in recent years due to deficiencies in rehabilitation care as well as low level of health literacy.

Keywords: health care, health policy, infarction, health inequality, health literacy, deprivation, Hungary

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Introduction

The decline in mortality from cardiovascular diseases is one of the success stories in the most developed countries in the second half of the 20th century. Although the mortality of cardiovascular diseases as well as coronary heart diseases has been halved in the last fifty years, it still remains the leading cause of death in developed countries (Wilkins, E. *et al.* 2017). Moreover, national health policies will face challenges in the future as the prevalence and costs of these diseases will probably increase due to ageing.

Acute myocardial infarction (AMI) is one of the most important cardiovascular diseases and this cause of death has no geographical, spatial, gender or social limit (Harper, K. and Armelagos, G. 2010). National health care systems have to provide reasonable access to cardiac care for all citizens regardless of age, gender, race, socio-economic status or place of residence. However, a growing number of studies have shown that signifi-

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cant inequalities may exist within cardiac care, especially in relation to access to invasive cardiac care (cardiac catheterization) as well as cardiac rehabilitation care following an AMI case (Hassan, A. *et al.* 2009; Aso, S. *et al.* 2011). Some of these studies demonstrated the important role of geographical distance in access to cardiac catheterization facilities (Patel, A.B. *et al.* 2007).

Buchmueller, T.C. *et al.* (2006) pointed out that increasing distances from hospitals resulted in higher death rates from heart attacks, and Seidel, J.E. *et al.* (2004) gave evidence that patients living farther from cardiac catheterization centres had lower adjusted rates of cardiac catheterization. Some authors came to the conclusion that although cardiac catheterization (percutaneous coronary intervention, PCI) as the part of invasive cardiac care could reduce mortality, enabling discharged patients to restore their health, but return to the society is still a public health problem to be solved in the current situation due to the inadequate rehabilitation (Kjær, T. and Gyrd-Hansen, D. 2008). Other studies pointed out how delay times for call medical help (decision time) reduced long-term survival chance (Yonemoto, N. *et al.* 2018). There are many studies which show that socio-economic status can also influence access to cardiac care. For example, Alter, D.A. *et al.* (1999) demonstrated that increases in neighbourhood income could increase in rates of cardiac catheterization following an AMI. Similarly, Rodrigues, E.J. *et al.* (2002) established marked regional variation in rates of cardiac procedures in patients who experienced an AMI in the province of Quebec, Canada.

While it is becoming increasingly evident that inequalities exist in access to cardiac care, relatively little is known regarding the effect of spatiality. Identifying and determining the geographical distribution of acute myocardial infarction and spatial analysis of cardiac care contributes significantly to improving health care interventions focusing on creative, novel initiatives (Seghieri, C. *et al.* 2019).

The main aim of this study is to analyse the spatial aspects of mortality of acute myocardial infarction (AMI) and determine the pattern of cardiac care regarding AMI geographical distribution in Hungary at micro-regional level. We assumed that spatial accessibility to cardiac care services would vary considerably among micro-regional units. On the other hand, micro-regional units with relatively better availability do not show up better accessibility as well. The specific objectives of this study are as follows:

1. to examine the potential geographical accessibility to cardiac care services across Hungarian micro-regions to identify under-services or poorly served geographical locations;
2. to investigate the differences between spatial characteristics of availability and accessibility;
3. to unfold the role of decision-making in the association of poor accessibility with shortage of health care services.

Theoretical background: in the light of accessibility, availability and spatiality

Access to health care is generally defined as access to a health service or a health provider, thus, defined as the opportunity with which consumers or communities are able to use appropriate services in proportion to their needs (Daniels, N. 1982; Whitehead, M. 1992). It is also defined as the use of health care, qualified by need for care (Waters, H.R. 2000). Here, access may be conceived as the interface between potential users and health care resources, and would be influenced by characteristics of those who supply as well as those who utilise the services (Penchansky, R. and Thomas, W.J. 1981). It can describe potential users' ability to use health care services when and where they are needed in time and in space (Aday, L.A. and Andersen, R.A. 1974). Availability can help to define the supply of services in relation to needs – whether there are adequate services to meet the healthcare needs (Penchansky, R. and Thomas, W.J. 1981).

There is a growing body of literature devoted to measuring and understanding geographical patterns of health care as well as health outcomes (Cromley, E.K. and McLafferty, S.L. 2011; Skinner, J. 2012). According to Penchansky, R. and Thomas, W.J. (1981) accessibility refers to the geographic availability to health care such as travel distance, time and cost (e.g. affordability of transportation). Both accessibility and availability refer to the spatial interaction between the geographical locations of health care services and population in need (Ye, H. 2016). These constructs such as accessibility, availability, spatiality as geographical locations, thus, should be considered as interrelated. Access to health care, especially when used to reflect on health inequalities, should look at the resource allocation in relation to social and health needs as well as looking at geographical distribution of services linked to measures of needs and access (Braveman, P.A. 2003; Levesque, J.F. *et al.* 2013). Therefore, it is necessary to take into account spatial factors (e.g. geographical location, travel distance) as well as non-spatial factors (e.g. socio-economic status, gender, age) simultaneously, which are interrelated to each other and influence as critical barriers access to health care. The term spatial accessibility is used to refer to the combination of availability, acceptability, appropriateness, affordability of health demand and supply (Gulliford, M. *et al.* 2002; Samuels, G. 2005; Shah, T.I. *et al.* 2016). In addition to differences in patients' needs, spatial accessibility may be due to characteristics related to the health care system (demand and supply drivers), including the volume and distribution of human, physical and financial resources (Brezzi, M. and Luongo, P. 2016).

It is clear that health care resources are not evenly distributed over space. There are significant differences between urban and rural areas, and even in cities socio-economically disadvantaged neighbourhoods tend to have relatively poor access to health care (McIntyre, D. *et al.* 2009; Wilkinson, R. and Pickett, K. 2010; Marmot, M. 2015). While many study have focused on increasing accessibility problems among countries and within a country, there is hardly any research on access to health care services on the local level.

Many researches have demonstrated that increased travel distance to health care services resulted in decreased utilization of those services and therefore increased health inequalities (Sibley, L.M. and Glazier, R.H. 2009). Other studies also confirm that the supply of health care service may influence access and use. A better supply of health care in a neighbourhood guarantees reduced travel distances, which encourages more frequent visits and helps patients maintaining better health. For example, Andersen, R.M. (1995) found a positive correlation between the number of federally qualified health centres available and the likelihood of having a usual source of care. Thus, the disparity in the geographic distribution of health care services is of great concern (Ye, H. 2016).

Accessibility of health care services is a key dimension in health inequality. Here the concept of 'health care access' is inherently multi-dimensional integrating both spatial and non-spatial factors. It is also linked to the theory of fundamental causes: the consequences of social stratification and structural inequalities can result health inequalities and not exposure to intermediary risk factors (Link, B.G. and Phelan, J. 1995).

Data and methods

In the study we used a systematic approach to identify socio-spatial consequences of policy interventions aimed to improve accessibility in the cardiac care of acute myocardial infarction of Hungary.

Our approach followed the guidance of explanatory sequential design in mixed methods (Tariq, S. and Woodman, J. 2013; Wisdom, J. and Creswell, J.W. 2013). We collected qualitative data in two steps to test quantitative findings with the following aims (*Figure 1*):

1. the aim of an initial quantitative analysis phase was to measure socio-spatial inequali-

ties of mortality data at local level (as micro-regional units) in acute myocardial infarction, followed by

2. a qualitative data collection phase built directly on the results of the quantitative phase with the aim of studying personal experiences of local health care stakeholders and national health policy-makers on accessibility and availability of cardiac care.

In this way, the quantitative results have been explained in more detail through the qualitative data.

The primary objective of our quantitative analysis was to create a typical spatial framework of selecting socio-spatial variables and to explore spatial patterns in mortality of Acute Myocardial Infarction (AMI) at micro-regional level. The complex methodology of Exploratory Spatial Data Analysis (ESDA) was used to select the appropriate quantitative ways to analysis the nature of the spatial pattern of AMI mortality data. Using the ESDA tool allowed us to gain a deeper understanding of the connection between spatial distribution of AMI mortality data and different socio-spatial variables (e.g. Ord, J.K. and Getis, A. 1995; Kelejian, H.H. and Prucha, I.R. 2010):

Principal Component Analysis (PCA): the method is a structure exploration method that is often used to create socio-economic indicators. The aim of PCA is to explore the relationships between several indicators, and join them in one or more factors. With the PCA we join six socio-economic indicators into a deprivation factor, applying Varimax rotation. The magnitude of the factor value shows the degree of deprivation.

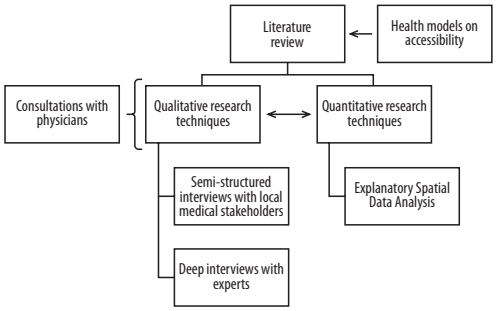

Fig. 1. Using explanatory sequential design in mixed methods

Application of Exploratory Spatial Data Analysis (ESDA): Spatial Regression Analysis: if spatial dependence can also be experienced in case of analysed variables, the traditional estimation techniques (e.g. OLS: Ordinary Least Squares) cannot be applied. However, it is always necessary to use the results of OLS as a reference value. The examination of spatial dependence was done with Spatial Durbin Model (SDM).

a) Ordinary Least Squares method – OLS:

$$y = X\beta + \varepsilon \tag{1}$$

b) Spatial Durbin Model – SDM:

$$y = X\beta + pWy + WX\Theta + \varepsilon \tag{2}$$

Explanation of the formulas: y is the vector of the values of the dependent variables, X is the vector of the values of the independent variables, β is the parameter vector for these explanatory variables, and ε is a vector of independent error probabilities with the same probability distribution. W is spatial weight matrix, ρ is spatial autoregressive coefficient, Θ is the parameter for spatially lagged values of explanatory variables. In this case, W as spatial weight matrix is based on queen matrix with first order of contiguity. It means, districts are neighbours of each other if their have common border. SDM is useful, because it defines the neighbouring values of result variables as well as explanatory variables which points to the exact existence of spatial interactions and neighbourhood effects.

Autoregressive coefficient cannot be applied directly in SDM rather than in OLS, because there are direct and indirect effects (LeSage, J. and Pace, R.K. 2009). Direct effects show the effect of explanatory variables for the given geographical location. Indirect show the spatial effect of explanatory variables as an 'neighbourhood effect' according to neighbouring matrix (Elhorst, J.P. 2014).

Likelihood ratio tests autoregressive coefficient reliability, the Breusch–Pagan test is for heteroskedasticity, and the Multicollinearity Condition Number tests the co-movement of the involved explanatory variables, the redundancy of the dataset. The performance of the regression equations was evaluated by the R2, the pseudo R2, the Akaike information criterion and log likelihood.

Convergence tests: Change of AMI mortality was calculated with the help of absolute and conditional β-convergence. According to the absolute β-convergence model, there is a negative relationship between the initial level of a variable and its rate of growth (e.g. AMI mortality), and, thus, the individual regions converge towards a common equilibrium (Barro, R.J. and Sala-i-Martin, X. 1990; Goli, S. *et al.* 2019). According to the conditional convergence, growth rates are influenced not only by the initial state but also by other factors, thus, the equilibrium state may vary depending on these factors (Janssen, F. *et al.* 2016).

a) Absolute convergence:

$$\Delta \ln y_i = \alpha + \beta \ln y_{i,0} + \varepsilon, \quad (3)$$

where α and β are the unknown parameters in the equation, ε represents the effect of the random factor.

b) Conditional convergence:

$$\Delta \ln y_i = \alpha + \beta \ln y_{i,0} + yz_{i,0} + \varepsilon, \quad (4)$$

where the new parameter (z) to the right of the equation indicates different characteristics of the districts (e.g. deprivation).

Spatial autocorrelation: we analysed spatial concentrations of AMI deaths and their changes with the help of this method. Hot spot analysis and the use of the Getis-Ord (G_i^*) statistic identified statistically significant hot and cold spots (clusters).

$$G_i^* = \frac{\sum_{j=1}^{M} w_{ij}\, d_j}{\sqrt{\frac{\sum_{j=1}^{M} d_j^2}{M}} \sqrt{\frac{M\sum_{j=1}^{M} w_{ij}^2 - (\sum_{j=1}^{M} w_{ij})^2}{M-1}}} \quad (5)$$

Explanation of the formula: M is the number of area units examined, w_{ij} stands for the i and j elements of the neighbourhood matrix, the numerator indicates the sum of the d_j values weighted by the i-th row of the neighbourhood matrix, and the values in the denominator serve for standardization (Getis, A and Ord, J.K. 1992). Calculations and visualization of the results were realized with SPSS for Windows 25, ArcMap 10.5 and GeoDaSpace and R Program.

Acute myocardial infarction statistics were based on International Classification of Diseases 11th Revision (ICD) such as I21–I23 diagnosis codes. AMI mortality data was based on standardized death rate (SDR) by gender per 100,000 between 2005 and 2015 at micro-regional level (LAU 1). ICD diagnosis codes mean the following:

I21 – Case of acute myocardial infarction;

I22 – Subsequent case of AMI;

I23 – Certain current complications following acute myocardial infarction (within the 28 days period).

Standardized death rate per 100,000 is officially publishing by gender, so it can be used only in gender aspect. Standardized death rate of AMI per 100,000 can be used only by gender, because arithmetic average cannot be calculated from male and female SDR. AMI SDR data base is based on 30 days mortality rates.

The number of micro-regional units in Hungary was 174 without 23 districts of Budapest. We did not consider Budapest's districts in our analysis, because health care services have better availability in the city which could have distorted the final results. Due to the small number and annual variation of district-level mortality, two periods and four-year averages were used in the convergence analyses (between 2005 and 2008, and between 2012 and 2015). That is, the quantitative part consists of a regression analysis based on ESDA on micro-regional data from the countryside over two multi-year periods (sample size of 2 x 175).

AMI mortality data contain only demographic variables (gender, age), but there is no further information on patient's socio-

economic circumstances. In our analysis, and index of deprivation was used to give comprehensive information about connection between AMI mortality data and spatial distribution of poverty at micro-regional level. This variable was included as a control factor in the convergence analyses, because some authors correlate cardiovascular mortality with distance to a health care service (e.g. catheter centre) as an explanatory variable and a compound measure of poverty ('deprivation') as a control variable (e.g. Nagy, Cs. *et al*. 2011; Boruzs, K. *et al*. 2018). In the regressions, deprivation allows for some additional spatial correlation between the observations. The deprivation index adjusted to the socio-economic characteristics of AMI patients was operationalised by Koós, B. (2015) using the following indicators:

– Ageing-index (proportion of population under 15 against 60+ within population);
– Ratio of households with only unemployed and inactive person(s);
– Unemployment rate (proportion in economically active population);
– Personal income tax per capita;
– Ratio of apartments without comfort;
– Ratio of those with only secondary education.

Availability was defined as spatial/geographical distance from different health care services (e.g. cardiac catheterization). In this case, distance was measured by road in km between residence (geographical centre of the given district) and geographical location of the examined health care service.

Access to health care was defined as access to catheter centre (PCI centre) in statistical analysis, because this type of intervention means a modern cardiological care which can increase short-term survival chance. This is the main reason why we interpret the role of catheter centre in AMI mortality as the distance between residence and catheter centre. On the other hand, access to health care was also defined as access to rehabilitation care as well as primary health care in the semi-structured interviews to analyse the personal opinion of respondents. Access to rehabilitation care as well as primary health care cannot be measured in statistical analysis, because of lack of suitable spatial data. The official source of data was the Hungarian Central Statistical Office and its Population Census database (2011), and the National Institute for Health Development.

The initial quantitative analysis helped us:

1. to select the local case study areas for qualitative research,
2. to work out the scopes and structure of interviews which could complete the results of the quantitative analysis,
3. to elaborate the structure of semi-structured interviews with local health care stakeholders (on the one hand with local health care professionals/workers and on the another with patients diagnosed with AMI),
4. to select common guidelines for the two types of semi-structured interviews in order to be able to compare their results,
5. to elaborate the pattern of expert interviews with national policy-makers,
6. to work out general criteria to evaluate and synthesize experiences of the interviews with special focus on the role of geographical distance in accessibility.

The local case study area was one of Hungary's counties called Békés. We have chosen this county because results of our statistical analysis confirmed the paradoxical health situation of this county according to AMI mortality as well as other health indicators. The initial point of the analysis was that the new centre of cardiac catheterization was inaugurated in 2013 in the county, however, a slight worsening in AMI mortality could be experienced in the following few years. AMI mortality rate has also been high in both genders compared to other Hungarian counties. Moreover, high rate of AMI mortality reflects the general worse mortality structure of the county. The average life expectancy at birth in Békés county was one year less than the country average in 2019. In this county 55 per cent of total mortality is due to cardiovascular diseases, which is also higher than the national average (Beke, Sz. 2019).

Semi-structured interviews with local health care stakeholders were prepared in

two steps between April and June in 2018. The primary aim was to examine personal experiences of individuals on barriers in access to cardiac care services. For instance, determinative individual (e.g. health behaviour) and institutional (e.g. supply standards) factors which had effects on access to cardiac care.

Firstly, altogether 24 semi-structured interviews were prepared with relevant cardiac care stakeholders such as cardiologist, internist, ambulance doctor, nurse, nutritionist, psychologist, physiotherapist etc. These interviews provided insights about the professional features of organizing cardiac care at local level. Secondly, altogether 29 semi-structured interviews were made with patients who had at least once acute myocardial infarction in their lifetime. Questions during the semi-structured interviews were addressed to define local difficulties and opportunities in access to cardiac care services from the patients' point of view. All questions were classified according to different phases of cardiac care such as pre-hospital, hospitalization and post-hospital care.

After the transcription of semi-structured interviews, the personal experiences were synthesized to explain the role of geographical distance in accessibility. These synthesized experiences provided the basis for expert interviews which aimed to unfold the role of national health policy in improving accessibility. Altogether 21 expert interviews were conducted with policy-makers, national health care providers and health policy advisers between February and July in 2019. The aim of expert interviews was to evaluate the effects of health policies in terms of improving the conditions of accessibility. The expertise of interviewees' skills included all level of health care, health promotion and disease management as well.

Research results: spatial inequality in the care of Acute Myocardial Infarction (AMI)

The number of deaths caused by diseases of circulatory system was 64,695, the number of deaths caused by ischaemic heart diseases was 31,828, while mortality caused by AMI was 5,758 in Hungary in 2018 (Hungarian Myocardial Infarction Registry 2019). In the past years, AMI deaths generally caused nearly one fifth of all circulatory system mortality. Hospital treatment due to AMI was 15.082 in 2018, 38 per cent of them was ending with deaths (Jánosi, A. 2019). The main problem in Hungary is the lack of significant improvement in one-year mortality in contrast to the 30 days mortality following AMI (Mérték Review, 2017).

The decrease of AMI (acute myocardial infarction) caused mortality rate started from the mid-2000s in Hungary, and between 2005 and 2015, mortality rate halved. The improvement affected both genders, and it was greater among men, however, still nearly twice as many men get a heart attack than women (Uzzoli, A. *et al.* 2019a). Frequency of myocardial infarction is highest among elderly (60+), though in recent years there was a slight increase in younger age groups as well (e.g. over 40 years).

One explanation for the improving mortality situation in Hungary is that due to infrastructural developments, from the mid-2000s new PCI centres (centre for catheterization) have been created in the country, and the capacity of already existing centres has been increased, therefore, accessibility to care has also been improved (Kiss, A. *et al.* 2019). Through health investment, the proportion of patients receiving cardiac catheter care nearly doubled between 2005 and 2015, which improved short-term survival chances.

Results of the statistical analysis

We applied quantitative methods to examine the potential geographical accessibility to cardiac care services across Hungarian micro-regional units to identify underservices or poorly served geographical locations.

In the principal component analysis, the deprivation index calculation resulted in a principal component. Indicators that interpret deprivation are suitable for principal component analysis, showing adequate match and information density (*Table 1*).

Table 1. The main statistical features of applied deprivation principal component

Indicators	Communalities	Component
Unemployment rate	0.877	0.937
Proportion of households with only unemployed and out-of-work person	0.844	0.919
Proportion of apartments without comfort	0.773	0.879
Proportion of those with only secondary education	0.752	-0.867
Personal income tax per capita	0.736	-0.858
Proportion of population under 15 on population over the age of 60 per 100 capita	0.268	0.518
Kaiser-Meyer-Olkin Measure	0.780	
Bartlett test significance	0.000	
Eigenvalue	4.251	
Cumulative variance	70.854	

According to our indicators, in the districts with high unemployment rate the proportion of households with only unemployed persons and the share of homes without comfort are higher, just like the proportion of the population under the age of 15 per population over 60 per 100 persons. Thus, a higher principal component value is accompanied by a higher value of the deprivation index.

The geographical pattern of the deprivation index presents the most important features of socio-spatial inequalities within Hungary that are characterized by Western-Eastern and Centre-Periphery relations (*Figure 2*). The spatial pattern of AMI mortality shows many similarities. As *Figure 3* shows higher AMI mortality rates are recorded in areas that are most affected by deprivation.

There is a poor to moderate positive but strongly significant relationship between AMI mortality rate and deprivation index (r = +0.352, p <0.000). Deprivation and AMI mortality is high in the eastern part of the country, mainly in border areas. However, in the economically most advanced Budapest metropolitan region low deprivation comes also with high AMI mortality. In the southwestern part of the country the level of deprivation is relatively high, but AMI mortality is low. Significant spatial dependence can be observed for both investigated indicators caused by neighbourhood effects.

Only the relevant spatial regression results are reported in *Tables 2* and *3*. Spatial All regression calculation results indicate that there is a definite convergence. This phenomenon applies to all models both in the absolute (OLS model 1) supplemented by spatiality (SDM model 1) and in the conditional (OLS model 2 and SDM model 3) convergence equations supplemented with structural features (*Tables 2* and *3*). It is based on negative regression coefficient of initial AMI mortality. It means, higher initial AMI mortality goes together with lower level of increasing with the result of more significant decreasing of AMI mortality in the examined period. The reverse is also true: lower initial AMI mortality goes together with higher level of increasing with the result of less significant decreasing of AMI mortality in the examined period.

The deprivation index behaves significantly in these models, with the control of other variables the phenomenon of deprivation increases the mortality rate of infarction. The distance from cardiac catheter centres is a relevant control factor in regression analysis. The longer distant is a district from a PCI cardiac catheter centre, the less convergence it is.

It is important to emphasize that both in absolute and in conditional convergence analysis the spatial lag of AMI change is relevant *(p)*, that is, the neighbouring values of the dependent variable affect the change of the AMI mortality in each district. That is, the neighbourhood effect is decisive in the spatial inequalities in AMI mortality.

Table 3 exactly shows the effects of explanatory variables. Based on SDM 1, in those dis-

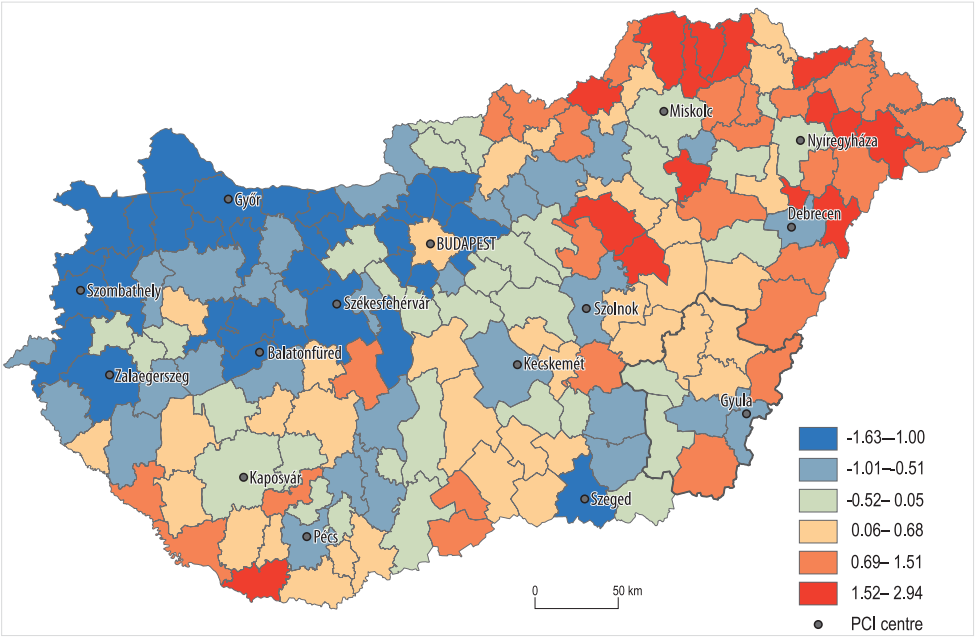

Fig. 2. The spatial pattern of deprivation index at micro-regional level in Hungary (2012–2015).

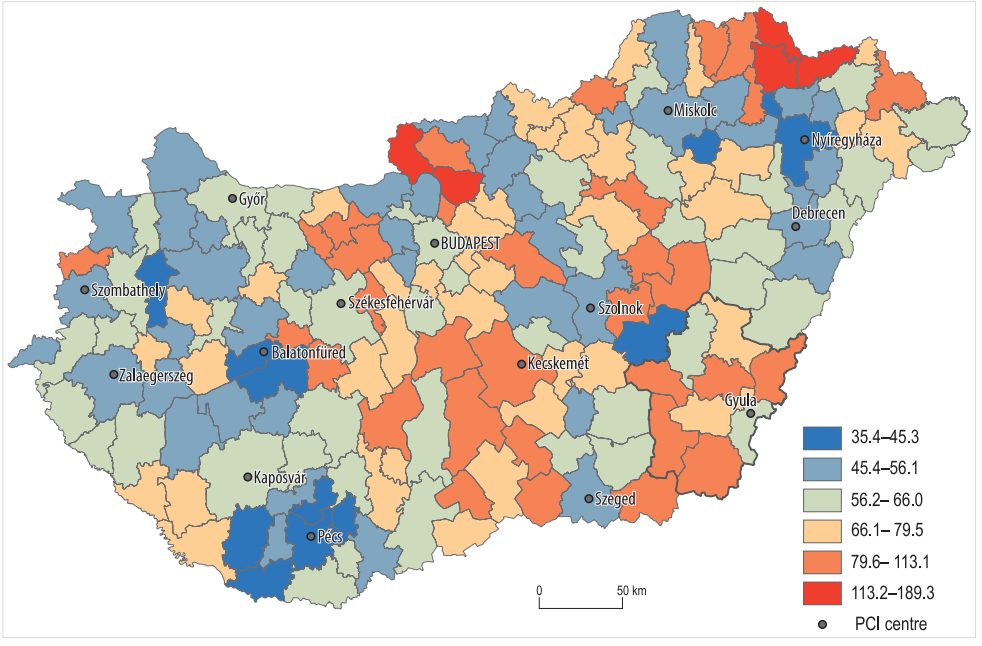

Fig. 3. Standardised death rate of acute myocardial infarction per 100,000 at micro-regional level in Hungary (entire population, 2012–2015).

Table 2. Absolute and conditional B-convergence studies of AMI mortality

Indicator	OLS (1)	SDM (1)	OLS (2)	SDM (2)
Initial AMI SDR	-0.210*** (0.044)	-0.184*** (0.042)	-0.200*** (0.044)	-0.174*** (0.042)
Deprivation	–	–	0.042* (0.024)	0.048* (0.029)
Distance	–	–	0.002 (0.001)	0.000 (0.002)
p	–	0.272*** (0.105)	–	0.220*** (0.108)
Θ initial AMI SDR	–	-0.199* (0.107)	–	-0.233*** (0.107)
Θ deprivation	–	–	–	-0.024 (0.041)
Θ distance	–	–	–	0.004* (0.002)
Constant	0.570*** (0.213)	1.527*** (0.525)	0.438** (0.216)	1.470*** (0.522)
Observations	174			
AIC	25.370	20.996	22.951	21.924
LogL	-8.685	-1.498	-5.476	2.038
R2 Adjusted	0.186	0.275	0.229	0.349
Moran test / LM residual auto. test	0.134***	0.048	0.121**	0.858
Breusch-Pagan test	8.099*	14.258*	12.610	17.980

Explanation: Estimation of all models is based on row standardized queen matrix with first order of contiguity. Standard errors are in parenthesis. p = spatial autoregressive coefficient; Θ = the parameter for spatially lagged values of explanatory variables; Moran test and LM residual auto. test = for spatial autocorrelation of standard errors; Breusch-Pagan test is for hetero-skedasticity. *Significant on 0.10%, **on 0.05%, ***on 0.01%.

Table 3. Direct and indirect effects of Spatial Durbin Models

Indicator	Direct	Indirect	Total
SDM (1)			
Initial AMI SDR	-0.198***	-0.327**	-0.525***
SDM (2)			
Initial AMI SDR	-0.186***	-0.336***	-0.521***
Deprivation	0.048*	-0.017	0.031
Distance	0.000	0.005*	0.004**

Explanation: Standard errors are in parenthesis. *Significant on 0.10%, **on 0.05%, ***on 0.01%.

tricts where AMI mortality is high there is more significant improvement, which means that convergence is existing. The results of SDM 1 also present that AMI mortality is significant in neighbouring districts. It means in the vicinity of those districts where AMI mortality is higher the convergence is also more significant. SDM 1 highlights that districts with similar AMI mortality rates are spatially concentrated, and the convergence is appeared more concentrated in Hungary. SDM 2 presents these spatial effects more sophisticated. One of main results shows the significant spatial concentration in the initial of AMI mortality as well as in its changes. Other result shows that deprivation has only local effect on AMI mortality and it has not got spatial effect on neighbouring districts. It is also valid for the role of distance from cardiac catheter centres, because it has got only indirect spatial effect on AMI mortality rates (see *Table 3* Total column). The fact is that initial AMI mortality rates of districts influence the convergence in Hungary.

The application of spatial autocorrelation method proved that spatiality is primarily an explanatory factor for spatial inequalities in AMI mortality through neighbourhood ef-

fects. The role of distance is more closely related to the geographical location of cardiac catheter centres and vacant GP services. It is also important to emphasize that traditional socio-economical peripheries function in opposite directions when spatially distributed. In the disadvantaged south-western part of the country it can be observed that in the case of men in the early period of survey cold spot neighbourhoods became hot spot neighbourhoods that is there was a deterioration in the situation between 2005 and 2008, and 2012 and 2015 (*Figure 4*). In the underdeveloped north-eastern part of the country, the initial high hot spot AMI mortality for women comes along with a very favourable trend in the future. For both genders in the most developed capital agglomeration unfavourable-high AMI mortality rate- neighbourhood spatial extension occurred between 2005 and 2008, and 2012 and 2015. The unfavourable change in female AMI mortality in the south-eastern neighbourhood is striking: that is the reason why this region (Békés county) has become the pilot area of the qualitative case study (*Figure 5*).

According to Voss, P.R. *et al.* (2006), the explanation of spatiality can stem from several reasons. On the one hand, individuals, households, communities are in interaction with one another, influence each other. On the other hand, according to grouping forces, groups with similar social status choose to live close to one another. Thirdly, according to grouping responses, individuals with similar characteristics react to external forces in a similar way.

Results of semi-structured interviews with stakeholders of local health care system

We conducted semi-structured interviews with patients and health care professionals at the local level to investigate the differences between spatial contexts of availability and accessibility.

The main questions of semi-structured interviews were the following:

– What spatial characteristics help or hinder access to health care at local level?
– How are patient journeys organized in infarction care at the local level, and what possibilities, and/or barriers do they mean for the patients?
– What is the role of availability at local level in access to cardiac care of infarction?

Based on subjective opinion of interviews with health care professionals and patients, the paradoxical misperception of availability and accessibility could be found. We discuss here only those findings that relate to the evaluation of this paradoxical situation by emphasizing the role of spatial/geographical factors.

Geographical proximity does not necessarily mean more favourable conditions in accessibility. Interviews confirmed that availability is a primary influencing factor in accessibility conditions, however, its supporting or barrier role in accessibility manifests itself diversely in the different stages of infarction care. The supporting or barrier effect of availability primarily prevails in geographical distance.

In the stage of pre-hospital care, the spatial optimization of emergency care resulted in the improvement of availability on local level. Nevertheless, it does not involve the improvement in conditions of accessibility, because due to the low level of patients' health literacy, they delay for a long time asking for medical assistance after the first symptoms of infarction.

Hospitalization contributes differently to the role of availability in the improvement or blocking of accessibility. Acute care (cardiac catheter care) is centralized, it means a clear patient pathway, which is based on a horizontal professional cooperation (between the rescue/emergency unit and cardiac catheter centre). Consequently, the establishment of cardiac catheter centre as an infrastructural investment improved both availability and accessibility on local level. It mainly means a short-term (30 days) improvement of survival chances. In contrast, in hospital rehabilitation care availability appears to be as a barrier factor for accessibility. Interviews made with health care professionals indicated, that on the one hand, approximately 30 per cent of

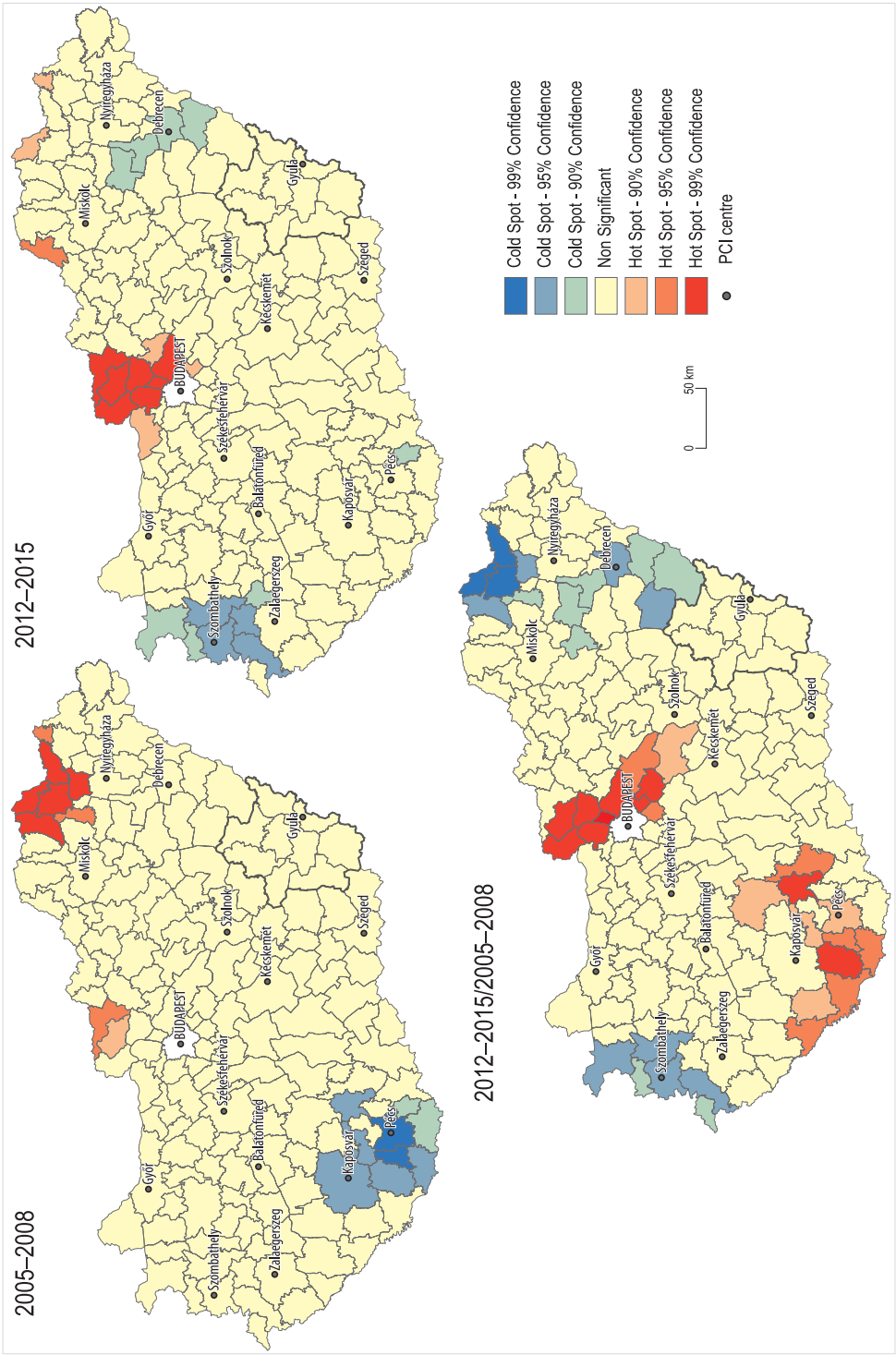

Fig. 4. Male standardized death rate of acute myocardial infarction per 100,000 and its spatial clusters at micro-regional level in Hungary.

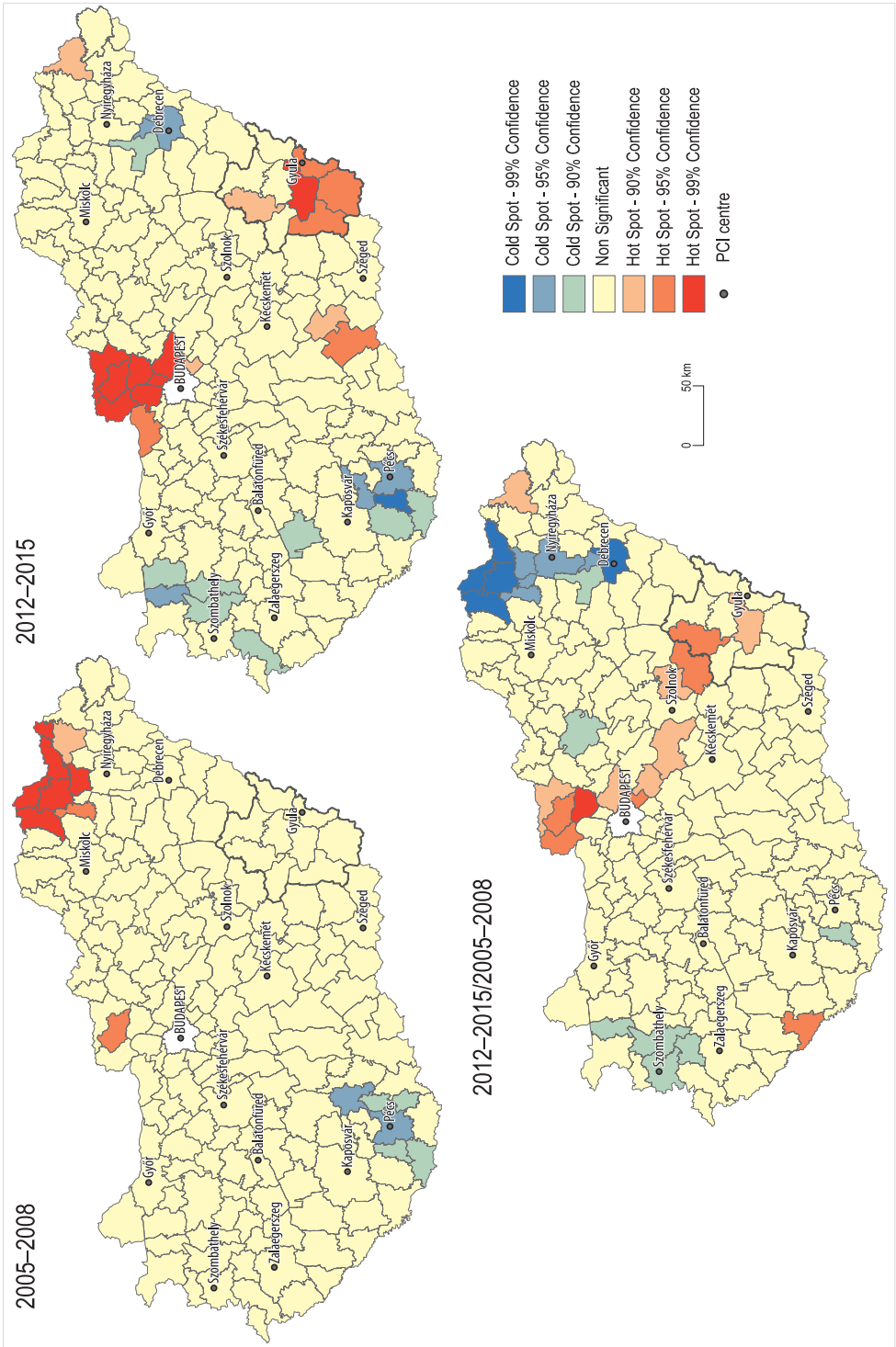

Fig. 5. Female standardized death rate of acute myocardial infarction per 100,000 and its spatial clusters at micro-regional level in Hungary.

patiens receive rehabilitation after infarction, and on the other hand, despite the inauguration of the local new cardiac catheter centre, there was an increase in the one-year mortality rate in recent years. Patient interviews confirmed that many patients refused rehabilitation in order to return to work faster, therefore, those residing nearer to the rehabilitation centre will not use health care service.

In post-hospital care, the role of the general practitioner and specialist care provision is determinative. Both provision levels are seriously affected by the lack of capacity (unfilled general practitioner's service, lack of specialist). Therefore, there is frequently no close professional cooperation between neighbouring areas (lack of integrated health care). Due to the poor road conditions, insufficient public transport, and the lack of resources (own car), patients can hardly reach neighbouring districts' health care. It means a long travelling time and/or higher cost to them.

In addition, the efficiency of rehabilitation and post-rehabilitation care depends on patient education and on health literacy. Especially in peripheral areas, for those living in small villages, the conditions for prevention and care for a healthy lifestyle are less insured (near-patient services). The long-term survival chances after infarction depend on the professional content of medical instructions, the willingness to take medication, and the success of lifestyle change. It was also mentioned in interviews that responsibility of local health care professionals such as general practitioners and specialists is significant in long-term survival chance. The lack of local opportunities to support this latter, their limited availability is determinative in urban-rural proportion. Local conditions, social norms and habits of healthy lifestyle are different in cities and villages. Given the significant socio-economic inequalities in Hungary the importance of health behaviour is one of determinants in health outcomes.

According to the unanimous opinion of the interviewed health care professionals and patients, the factors that most support accessibility are related to the improvement of availability, the infrastructural investments, and to the development of patient-centred health care (Uzzoli, A. *et al.* 2019b). It was also unanimously stated that factors that are the main barrier to accessibility are distance, lack of financial resources, difficulties of lifestyle change, weak compliance, low level of health knowledge and lack of capacities (*Figure 6*).

Fig. 6. Barriers in access to cardiac care in Hungary based on semi-structured interviews, 2018.

Results of the in-depth interviews with experts

We made in-depth interviews with experts to find out the role of decision-making in the association of poor accessibility with shortage of health care services.

The main group of questions of interviews were the following:

– What contradictions have emerged in the operation, organization and financing of the Hungarian health care system after the change of regime?
– What are the main causes and factors of socio-spatial disparities in health inequalities in Hungary?
– What is the role of decision-making in reducing health inequalities and improving accessibility in Hungary?

In-depth interviews with experts highlighted the paradoxical role of availability and accessibility in policy making. Accessibility barriers to health care are linked mainly to financial, availability and socio-cultural barriers. Increasing lack of capacity and workforce in healthcare system has led to new types of inequalities in

Hungary, resulting in a widening health gap between the upper and lower deciles of society.

The place of residence in itself is one of the relevant factors of health inequalities and conditions of accessibility: its explanatory power multiplies with existing socio-economic and socio-cultural disadvantages. It is partly a matter of value choice that in health policy making to what extent cost-effectiveness and/or social justice efforts are pursued.

Interventions to reduce health inequalities and improve accessibility should focus on areas where the greatest social benefits (i.e. health gains) can be achieved. Community-based development and patient-centred care play a key role in rehabilitation, health promotion and disease prevention. However, in areas affected by deprivation, improving availability does not necessarily mean improving accessibility. In underprivileged areas 'social distance' is increasing between patients and health services because deprivation is a barrier factor to accessibility. In such cases, subjective evaluation of distance does not refer to physical availability, but rather to the conditions of accessibility worsened by social barriers.

Conclusions

In this study, we examined the spatial dimensions of availability and accessibility in health care provision. More specifically we analysed the connection between deprivation and mortality rate of AMI, while the role of availability and accessibility in mortality rate was identified according to spatial distribution of cardiac care services. We used different quantitative and qualitative research methods to determine the role of spatial factors (e.g. place of residence, geographical distance, physical availability etc.) in access to health care. We also wanted to shed light on the paradoxical situation between the objective and the subjective factors of availability and accessibility. Main research findings are the following:

– Geographical proximity does not necessarily mean better conditions in accessibility, and stronger professional cooperation between health services;
– Availability is more a determining factor in accessibility based on patients' opinions as statistical calculations have shown;
– According to the unanimous opinion of health care stakeholders (professionals and patients), the factors that most support accessibility are related to the improvement of availability, investments in infrastructure and the provision of patient-centred care. This finding is in agreement with a number of previous studies (Buzai, G. 2013; Illés, S. and Gellérné Lukács, É. 2016).

The subjective perception of the accessibility of health care institutions highlighted that patients' use of out-of-home services delays rehabilitation because of their long travel time and reduces their willingness to participate in long-term care.

Based on the regional distribution of AMI mortality and the availability and accessibility of features of infarction care, there is a lack of community-based developments in Hungarian strategic health plans. Improvements in accessibility have mainly affected acute cardiac care in recent years, but have also failed to improve access to rehabilitation care.

Our study also has some limitations. Based on in-patient care data, we were not able to compile a morbidity database that could have been comparable with mortality database. We could not make a difference between AMI STEMI and Non-STEMI cases in mortality statistics, although, it has significance in cardiac rehabilitation. In practice, there are some cases when the catheterization is not initiated due to other factors (comorbidity, age), and these cases are not discernible in statistics. Patients' socio-economic status could only be indirectly predicted from statistical data. Interviews with patients could not be extended to relatives, although they play a key role in the success of long-term lifestyle changes, i.e. in long-term survival chances. Despite these limitations, this study provides a methodologically complex perspective on examining accessibility with its spatial factors.

Our findings also suggest that geographical aspects of health inequalities as well as access to health care should receive more attention in health development strategies. Geographical location similarly to geographical distance has primarily role in health inequalities as well as in accessibility.

Firstly, geographical concentration of health care institutions may influence availability with the result of complex disadvantages of peripheral regions.

Secondly, geographical distance has a relative role based on objective and subjective factors. Objectively, it should not appear as barrier in availability based on an optimal resource allocation. Subjectively, geographical location is at a longer distance from health care institutions means more barriers in accessibility and availability based on patients' evaluation.

Thirdly, the role of geographical distance seems to appear as a challenge for local population living in inner and geographical peripheries or in borderline areas. Fourthly, in peripheral regions with small villages hit by deprivation patient-centred health care – especially in prevention and health promotion as the part of primary health care – is missing or has many weaknesses.

Finally, typical spatial pattern of health inequalities in Hungary (Western-Eastern gradient, core-periphery relation) can influence regional distribution of material and human resources in health care.

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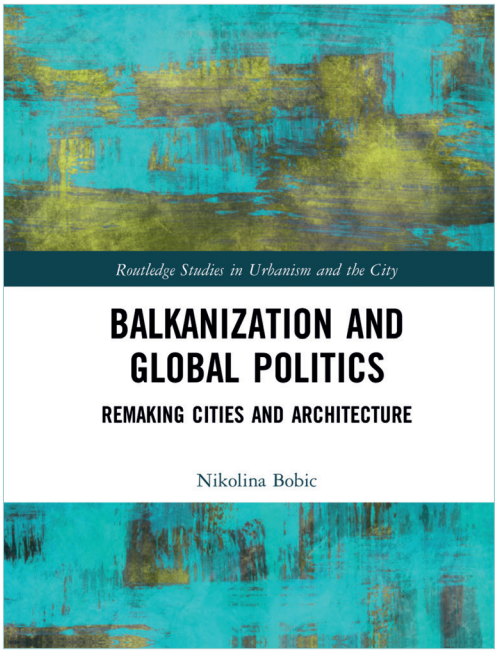
BOOK REVIEW SECTION

Bobic, N.: Balkanization and Global Politics: Remaking Cities and Architecture. London, Routledge. 2019. 228 p.

The Balkans form a distinctive unit in people's mental maps, often based on the area's stereotypical sociocultural characteristic. Depending on the context, the word 'Balkanic' can either have negative (fragmentation, division, instability) or positive connotations (inclusivity, coexistence, heterogenity), and all of these can be tied to the conditions (perceived from a Western perspective) of the territory during the turmoils of 20th century geopolitics. These forces led to violent destruction and reconstruction that left a tremendous mark on the physical and cultural landscape of the area, making the region understandable only through the discourses of *Balkanism* and *balkanisation*.

Balkanization and Global Politics examines and critically engages with these narratives in an urban and architectural form. The author is an architect by trade who also teaches architecture as a lecturer at the University of Portsmouth. Published as a part of the „Routledge Studies in Urbanism and the City" series in April 2019, the book is a continuation of her research presented in her dissertation written at the University of Sydney, with four segments published earlier (Bobic, N. 2012, 2014, 2015, 2017), all of which she expanded upon for this manuscript. According to the preface, the most important expansion is the discourse analysis of Balkanism and balkanisation which is detailed in the first two chapters.



Balkanism, with reference to, and contrasted with, Edward Said's *Orientalism* (1978), emerged from the position of the region between the imaginary West and East, without being necessarily Occidental or Oriental enough to fit into either category. This term, coined by Maria Todorova (1997), refers to a mode of identification when facing this problem of liminality. Balkanisation started with the events after the withdrawal of the Ottoman Empire from the peninsula in the 19th century and with subsequent aspirations for forming ethnically homogenous nation states in its place. The resulting geopolitical fragmentation became synonymous with the area (hence the name of the term), which in a more metaphorical sense refers to the way of solving a large heterogenic unit's problems by breaking it up into smaller, controllable homogenic parts. This makes it applicable to other scales as well, shifting the meaning of the term with it. One common way of this is creating enclaves of immigrants on the city periphery to maintain order and clear power relations – urban heterotopias (Shane, D. 1995). Despite encompassing processes stemming from the same context, these two terms have an important difference in their stance toward global dichotomies: while Balkanism is grounded in a transitory and liminal space, the goal of balkanisation is to reorder and remake for the sake of a special form of Westernisation.

From another perspective, this book is about the concept most frequently termed as urbicide, which "refers to the intentional attempt to erase or destroy a city or cities for political purposes" (Graham, S. and Gregory, D. 2009, 794). This line of thought, that arose in the 1970s from the work of architectural critic Ada Louise Huxtable (1970), later popularised for social sciences by Marshall Berman (1996), criticises the perceived consensus of planners about the necessity to modernise cities. The term gained a new dimension during the Yugoslav wars. It was used by architect and former Mayor of Belgrade, Bogdan Bogdanović, referring to the bombing of Croatian cities by the JNA (Yugoslav People's Army), comparing the destruction of UNESCO World Heritage Site Dubrovnik to "a madman who throws acid in a beautiful woman's face and promises her a beautiful face in return" (Bogdanović, B. 1995, 53, quoted by Bobic,

N. 2019, 58). The difference in this mode of urbicide lies in its methods – instead of hiding the political motives behind the veil of planning, it is conducted through raw military violence.

The author succeeds in interdisciplinarity with her writing, speaking the language of social science, addressing themes, using methods and subscribing to theories not unusual for ethnical, political or cultural geographers and urbanists. Bobic's topics transcend a number of scales, ranging from international context of the geopolitics of balkanisation, but also diving into case studies of a couple of buildings, a level which only in recent decades started to be included in geographical imagination.

After the introduction and the setting of the theoretical framework in Chapter 1, Chapter 2 continues with an extensive discourse analysis of Balkanism and balkanisation, highlighting the differing uses and interpretations across a variety of disciplines ranging from architecture through planning to sociology. Here Bobic uses a two-pronged approach through a global and a local lens simultaneously to emphasise the flexibility and mobility of the term.

Chapter 3 leads us to the detailed story of the Yugoslav wars in the 1990s, from the perspective of the parts of a dissolving country being systematically destroyed and rebuilt to assert control. This is the section that more explicitly deals with the topic of urbicide and its consequences, with Vukovar and Dubrovnik in Croatia, and Sarajevo and Mostar in Bosnia-Herzegovina examined in detail. I would like to mention the clever (and geographically pleasing) title choice of these sections: first the author describes the wartime desctruction calling it "dislocating the countries." Then, after she establishes remaking as falsifying history, we read about the chosen cities' efforts of remembering under the title "locating the countries."

Bobic introduces a new face of the concept of Balkanism in Chapter 4. It can also be understood as "a process by which certain acts of violence are normalised and/or ennobled as humanitarian, while others are constructed as acts of deep-seated barbarism" (Bobic, N. 2019, 89). Following this line of thought, she explores the coercive nature of balkanisation during and after the first humanitarian air intervention (1999 Operation Allied Force). Examples are provided as archtitectural and landscape changes from Belgrade.

The discussion of violence continues in the next chapter moving on to less direct, sudden or visible forms of it. These constricting acts of humanitarianism, the contradictions and excess of Balkanism in Kosovo, the uranium radiation and the remaining undetected bombs had even heavier, long-lasting consequences in some cases than the war itself, yet these were reported in Western media in a positive light.

The penultimate chapter introduces a Belgrade case study on how intertwining levels of fragmentation can have different outcomes when entangled with deliberate gentrification in an urban setting, raising questions about the responsibility of planning in effectively desocialising, de-Romanising and homogenising a city catering to the needs of a wealthy minority.

The ideas raised throughout the book are summarised and reflected upon in the last chapter, where the author concludes that balkanisation is a far more complex set of processes than its usual definitions would suggest, and that the liminality of Balkanism predetermines its fluidity and mobility both geographically and conceptually. This conclusion prompts a peak outside of the Balkans as well, providing recent examples of these processes from other parts of the world. Brexit signified a possible start of balkanisation inside the EU, and with smaller ethnically homogenous enclaves like Catalonia, Northern Italy, Szeklerland or Scotland (as a special case of Brexit), looking to expand their current level of autonomy, the process might bear new countries in the future as well, populist politicians are certainly looking to exploit the associated feelings of "power in homogeneity" like they did before. The last paragraphs explain how the migration crisis (and international migration in general for decades) effected the Balkans and the world's ongoing forms of balkanisation on all scales from local planning to global geopolitics, with the area being in the traditional transit zone for (mostly) Middle Eastern immigrants travelling to Western Europe.

Bobic's book deals with subjects that I find deeply geographical and its critical tone resonates well with that. It provides a detailed analysis of the concepts of Balkanism and balkanisation and contains several illuminating case studies from the intersections of urbanism, planning and architecture. Therefore, I believe it would be a good introductory text even for geographers approaching the topic for the first time, but at the same time it also proves useful for academics researching the Balkans for decades.

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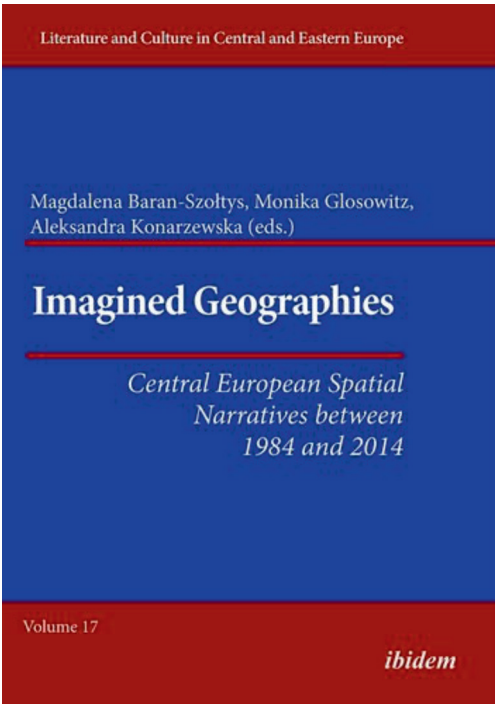
"No. «To die for one's country and for Europe» – that is a phrase that could not be thought in Moscow or Leningrad; it is precisely the phrase that could be thought in Budapest or Warsaw" (Kundera, M. 1984, 33). This is how Milan Kundera concludes the first paragraph of his famous essay *The Tragedy of Central Europe*, and this is how one can best grasp the quintessence of this book. Similar to the great Czech writer Kundera, the editors of the book and the authors of the five different chapters are interested in how the 'notion of Central Europe' is envisioned, conceptualised and perceived both geographically and culturally. Or, to put it more simple, they are trying to uncover what exactly lies beneath the term Central Europe – "regions in eastern middle Europe that attempted to 'move to the West'" (p. 9). Is it truly an imagined space only or is it something more than a permanent desire to belong to the West?

To answer these questions about the *phenomenon* called Central Europe the book includes one plus four essays, each uncovering a different aspect of the problem. The first essay "Introduction. Central Europe and Its 30 Good Years (1984–2014)" by Aleksandra Konarzewska gives the reader an overview about the past and the present of Central Europe, and introduces the different historical processes which led to the modern conceptualisation of spatial narratives. It might not be clear to someone who is not entirely familiar with the past of Central European countries why the imagined space and the various cultural narratives play such an important role in the life of people living there. To understand it I would like to rely on Jerzy Pilch's following sentence – cited by Konarzewska – from his short text *The Decalogue of a True European*: "[m]y grandma never travelled abroad; it was the frontiers of various countries and European powers that used to fly over the roof of our cottage as only they wanted to" (p. 21).



In the second study, Iris Llop gives a detailed analysis about Milan Kundera's idea of Central Europe, which reconnects with the departure point of the book. The study focuses on how Kundera developed and improved his theory about Central European identity – which was first "the historical and political point of view of a writer in exile" (p. 46), becoming later a narrative strategy representing the diverse forms of Central European identity. As Llop remarks, Kundera was preoccupied in the early 1980s with the Western misunderstanding of the situation of Central Europe. The West imagined and treated the region as a political creation, the westernmost conquests of the Soviet Union and the geographical and cultural narratives were pushed aside. In Kundera's notion, however, Central Europe was a cultural tradition or a fate which is indifferent from political borders. This led him – as a final conclusion – to treat and write about Central European identity as a narrative construction, something which is constantly changing and can be deconstructed and then reassembled from the different points of view of literary characters. Kundera's Central European identity – through his 'novelistic thinking' – is a "cultural background, a common historical fate and a collective memory, but above all approximations, … an idea that needs to be rewritten, redefined by the artist that have been determined by its influence and by those … who are committed to the Central European heritage" (p. 46).

In the two following studies, Jagoda Wierzejska and Magdalena Baran-Szołtys discuss Galicia and its representations in literature as the region is a prime example of Central Europe as an imagined space, as the buffer between East and West. In the chapter "Galicia: An Eastern or Western Land?" Wierzejska forms her discussion around how spatial narratives revolving around Galicia transformed, according to the political goals of either the empire that ruled over the region or the ethnical group(s) which wanted to

distance themselves from this empire throughout history. Galicia has always been conceptualised as a symbol of East-West dichotomy since it became a focal point for the modernisation of the Habsburg Empire. However, while the territory was described as barbaric, backward or simply just half-Asia (which is the subtitle of a six-book-volume written by Karl Emil Franzos about Galicia, Bukovina, Southern Russia and Romania) during the Josephinian reforms, in the nineteenth century, still as a part of the Habsburg Empire, it transformed into the 'last bastion' of Western culture. With the expansion of the Russian Empire from the East, the Occident constructed a new Orient for itself. A mostly political tension, the fear from a potential Russian invasion, rewrote the spatial narrative of Austria and shifted the imagined geographies. Later, the discourse around Galicia and its Western roots gained importance for the Galician Poles who believe(d) that the foundation of their prospective autonomy lies in the Habsburg history of Galicia. In recent times, pro-EU thinkers in Western Ukraine are the ones who are shaping the spatial narrative of Galicia against a pro-Russian Eastern Ukraine. As Wierzejska notes, during the Cold War period and after the transitions between 1989 and 1991 the discussion around Galicia remained on the national level in Poland and Ukraine, though the (re)construction of spatial narratives and the forces responsible for it mainly remained the same.

Magdalena Baran-Szołtys' chapter discusses how one can distance themselves from the 'great tales' and, instead of using spatial narratives to fill a geographical space with meaning, how one can create their 'own middle Europe.' In her study she presents the contemporary Polish writer Andrzej Stasiuk's conceptualisation of the imagined Central Europe. As Baran-Szołty puts it, he "develops the idea of Central Europe in such a way that it could avoid the catastrophic … dichotomy of East versus West" (p. 70). For Stasiuk, Galicia is a ground zero during the construction of Central Europe. The region (alongside with Kresy and Sarmatia) appears in his literature as a myth, a nostalgic, half-fictional Atlantis-like space (see p. 90), which is a hybrid, transcultural territory, a buffer or better said a transition between the cultures around and inside it. Although Stasiuk is seen as a mediator between East and West, both as a publisher and writer, in his works he tries to distance himself from this (mostly) geopolitical dichotomy of the liberal, capitalist West and the post-Soviet, authoritarian East. Eventually, his Galicia (and also his Central Europe) becomes an in-between non-space rather than a space imagined by a geopolitical power. Comparing Stasiuk's viewpoint to the views about Galicia which are constructed according to political goals and needs, one can acknowledge that the main difference lies in the initial intentions. While most imagined geographies and spatial narratives are constructed according to a certain demand, Stasiuk rather constructs a non-space to fill it with the products of his imagination or, as he puts it, Middle Europe is "a microcosm, which enables an imaginative, historical-philosophical reconstruction of 'Other Europe'" (p. 87).

The final chapter of the book compares nostalgia – a longing for an idealised past fuelled by the deficiencies of the present—to the notion of Central Europe as an imagined space. The author, Mariella C. Gronenthal, once again returns to Andrzej Stasiuk and his ideas about Central Europe which get materialised as a "blank screen for projections" (p. 131). If Central Europe is imagined as an empty canvas, it can be filled then with various cultural, political or historical interpretations coming from diverse directions. Therefore, Stasiuk's 'own middle Europe' "shows … structural parallels to reconstructing the past in nostalgic memories" (p. 132). The past is vague and unclear, and nostalgic memory can fill it up with fictional characteristics originating from the longings of the present. Similarly, Central Europe is wild, untamed and indefinite, thus it can be filled with different spatial narratives. Both the notion of Central Europe – with its strong historical roots, regionalism and local identities – and nostalgia are intertwining space and time. Central Europe is an ever-changing, situation-based entity, which has always been based on the action of distancing itself from another entity (e.g. the East, the West). Nostalgia is a state where someone distances themselves from the present and turns to an idealised past. Finally, both can be considered as a Thirdspace (Soja, E. 1996), an in-between space modelled by the past (in the case of nostalgia) or an actual geographical space (in the case of Central Europe) but also fuelled with the fictional idealisation of a phenomenon or a private/collective goal.

In the previous pages I described the content of *Imagined Geographies* and praised the book and its authors. However, I must note that the volume has a few minor deficiencies in my view. As I mentioned, the first chapter gives a great historical overview about Central Europe but, being more embedded in history and less in literary tradition, it unfortunately leads to a trivial break in the otherwise very coherent composition of the volume. It could have been a better solution to integrate the ideas presented in this chapter within the other sections. Another shortcoming is the title of the book, which can be considered as deceptive. Edward Said's (1978) and Benedict Anderson's (1983) work immediately came into my mind when I first held the volume in my hand. The intertextual connection with these authors suggests that the reader will be involved in a journey influenced heavily by the geographical thought, while the book's odyssey actually takes us more into the world of literature and its spatial narratives. This unbalance between the two disciplines is conspicuous if we contrast the title with the text. Finally, it is always tiresome and challeng-

ing to engage and submerge in such a controversial discourse as the one about 'in-between Europe.' Obviously, the authors make arguments which might seem odd or incorrect from different points of view but it is always important to keep in mind the origins of the thoughts presented and the situation-based knowledge of the scholars who created them.

Nonetheless, what is remarkable about *Imagined Geographies: Central European Spatial Narratives between 1984 and 2014* is the way its authors combine the theories of acknowledged scholars and thinkers such as Edward Said (1978), Benedict Anderson (1983) and Edward Soja (1996) with the ideas of brilliant writers and litterateurs like Milan Kundera or Andrzej Stasiuk. It is broadly known that geography is an interdisciplinary field of science but geo-poetics in the border zone of geography and literature has been a less known sub-discipline up until today. With the publishing of *Imagined Geographies* not only the Central Europe debate gets enriched with new theories, ideas, and information, but the readers (both academic and non-academic) can discover a new domain of the discourse – the spatial narratives constructed by literature.

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