Housing forms of poverty in Europe - A categorization based on literature research and satellite imagery

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ABSTRACT

Housing forms of poverty are often associated with the Global South, especially through the depiction of slums. In this study, we systemize physical housing forms representing poverty in Europe. The continent features a huge diversity of such forms, rooting in different politics, cultures, histories and lifestyles. We discover and categorize these unindexed housing morphologies to enlarge the scientific ontological portfolio for Europe. An extensive literature research with more than 1,000 screened items builds the fundament. We use satellite data to capture *physical morphologies* of housing forms and *geographic indicators* on location, structure and formal status. Beyond, we research socio-cultural backgrounds described by terms such as 'ghetto' or 'trailer park'. We find a huge variety in physical forms in our sample and develop a categorization of six major classes ranging from rough shelters (e.g., tents) to multi-storey buildings as general taxonomy. The research reveals diverse living forms (e. g., underground-, or deteriorated housing). Beyond the housing morphology, we describe these classes by the structural pattern and their legal status. Geographically, we find urban as well as rural locations, with a concentration in Southern Europe. The majority of morphologies relates to refugees, ethnic minorities and socio-economically prone people – the underprivileged.

1. Introduction

Poverty has always existed in human history and is omnipresent across all continents. Poverty has very different manifestations and types. In the year 1892, the cholera epidemics did not strike Europe out of nowhere when Robert Koch said that he "forgets to be in Europe", as he never had "met such unhealthy dwellings, plagues dens and breeding grounds for every infectious agent as here". More than 100 years later, we still find inhumane living conditions in Europe.

For one part of Europe's society, poverty is nothing more than an associated glimpse of remotely received audiovisual impressions by media, seemingly from another world. Respectively Sloterdijk (2013, p.223) postulates that "*only in the encounter with absolute poverty is this group reminded of its own prosperity*". The other part of Europe's society faces hard realities, e.g., in their forms of residence: these are e.g., barracks, containers, tents, caravans (Fig. 1), detention centers, squatter settlements, deteriorated ghettos, even burrows or the sewage water system, run-down large housing estates, among others.

Apart from refugee camps, housing forms of poverty are mostly associated with slums or informal settlements, predominantly known

from the Global South (Taubenböck et al., 2018). However, their existence in Europe is hardly documented (UN-Habitat, 2015a). In fact, informal and slum settlements but also other forms are abundant in Europe comprising manifold physical appearances. They commonly have their roots in societal phenomena such as discrimination (e.g., European Commission, 2011, 2020), inequality (e.g., Dauderstädt, 2017), segregation (e.g., Wacquant & Howe 2008), refusal (e.g. Korando, 2012) and escape (UNHCR, 2021a) in consequence of global markets (Sassen, 1996), economic crisis (e.g., Andriopoulou et al., 2018), climate change (UN-Habitat, 2020), natural disaster (e.g., Guadagno, 2016), terrorism (e.g., Helbling & Meierrieks, 2020), war (de Haas et al., 2019), rural exodus with urban population pressure (Davis, 2011) and lack of housing space (de Soto, 2000).

Multilateral organizations as the European Union and The United Nations have set up the agendas 'Europe 2020' (European Commission, 2010) and 'Sustainable Development Goals' (United Nations, 2019) with the vision of poverty reduction and humane living conditions. Linked to this is the necessity of more systematic data (UN-Habitat, 2015b). Although there is innumerable literature about poverty, systematic documentation of physical living forms of poverty rarely exists (Kuffer,

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Fig. 1. Examples of housing forms in poverty areas in Europe ©Google Earth

1. Refugee tent camp in Nea Kavala, Greece 2019; 2. Barracks in Santa Catalina, Madrid, Spain 2009
3. Caravans at Dale Farm, Basildon, UK 2008; 4. Containers at Konik refugee camp, Podgorica (Vrela Ribnicka) Montenegro 2014; 5. Garages in Moscow, Russia 2015; 6. Muti-Storey buildings at Lunik IX, Kosice, Slovakia 2020.

Wang, et al., 2021). Many studies are descriptive in nature, e.g., UN-Habitat (2003); Davis (2011); Hofmann et al. (2008); Kohli et al. (2012). Only few works quantitatively measure the physical (housing) structures of poverty. In a cross-sectional study, Taubenböck, et al. (2018) map and quantify a large variety of morphological forms of housing poverty across the globe. Kraff et al. (2020a) continue with a panel study documenting morphological dynamics. These studies characterize the range of housing types of poverty; however, a comprehensive documentation is not yet known.

In a global comparison, Europe is considered as a comparatively wealthy continent. Nevertheless, there are noteworthy pockets of poverty. Reasons for this are e.g., market transitions or deindustrialization (e.g., ILO, 1996; Spoor, 2004; Pojani, 2013), migrant crisis (e.g., Human Rights Watch, 2010) or geopolitics and conflicts (e.g., Van Baar, 2018; Vöckler, 2007). With its long-standing history being scene of two World Wars, its various post-war political systems, its manifold cultural and national differentness, many different manifestations of housing the social group of the poor exist across Europe (Hoekstra, 2005; Tsenkova et al., 2008). In this paper, we explore them and discuss societal reasons.

Thus, the **aim** of this paper is to portray the variety of physical housing forms expressing poverty all across the European continent. We demonstrate the broad range of morphological forms by classifying them based on three major aspects: *morphology*, *geographic indicators* and *socio-geographic backgrounds*.

With the following **research questions,** we aim to respond to the scientific and societal demand for systematic data, documentation and elucidation of the largely not systematized physical shape of poverty in Europe:

(1) Which different morphological housing forms of poverty do exist in Europe?
(2) Where do housing forms of poverty occur across the European continent?
(3) Which *socio-geographic backgrounds* feature these identified poor areas?

This article is organized as follows: In s*ection 2* the state of the art and conceptual background are reviewed. In *section 3* the methodological workflow is presented. In *section 4* the results are presented and discussed in *section 5* in the geographical frame of housing poverty and its rooting backgrounds, found by related studies. Finally, *section 6* serves as an outlook and concludes this study.

2. Conceptual background of housing forms of the underprivileged

Terminologies to describe accommodations of the poor have existed in Europe for centuries: The term '*ghetto'* has been used the first time in the year 1516 in Venice, where Jews were segregated as minority (Guetta et al., 2013). And, apart from a certain fuzziness with regard to its exact heritage (Prunty, 1998), the term '*slum'* was initially used in England and Ireland at the beginning of the 19th century to identify unhealthy, dirty and poor housing areas (Gilbert, 2007; UN-Habitat, 2003). Such conditions were omnipresent in Europe during the period of industrialization and, for instance, documented in cities of Netherlands, England, France and Denmark by geographer Züblin-Spiller (1911). Space in cities was rare and tenement houses dominated urban design. Nowadays, the physical morphology of the poor remains primarily unattended in Europe, rather investigated in the Global South (Taubenböck et al., 2018). Poverty areas are not unitary defined (Nuissl & Heinrichs, 2013) and due to relative conditions difficult to compare across administrative borders, nations or continents (Gilbert, 2007). And, although a 'Slum Atlas', an 'Almanac' (UN-Habitat 2015a, 2016), and an 'Atlas of Informality' (Samper et al., 2020) exist, the scale of information contains only aggregated statistical descriptions and limits itself terminologically, not covering other types of poverty. Further, the exact

built-up morphology is mostly not described in detail. A compendium or repository that contains all existing forms is still absent (Kraff et al., 2020a). Thus, there are innumerable definitions, statistics and research studies about poverty, that often rely on economic issues only. Due to this plurality and in order to conceptually cover poor housing conditions without a priori morphological, socio-economic or terminological restrictions, we use the term 'underprivileged' in this study.

2.1. Poverty: A relative term with multiple dimensions

It is not the aim of this paper to resume the manifold established definitions of poverty, inequality and social segregation. Existing theories and definitions are e.g., explicitly outlined by Grusky et al. (2006) or by Boeckh (2008). The authors describe, for instance, history, conceptual approaches and measurement methods, which often rely on economic figures, such as income. Beyond economic approaches, the meaning of poverty also relates to the ability to access common goods, such as education or health and standard of living (Butterwegge, 2016). These measurable absolute numbers and the relative issues differ from country to country. An approach with a more holistic claim towards this complex spectrum of poverty is the multi-dimensionally 'Alkire-Foster method' (Alkire et al., 2015) and demonstrated by the 'Global Multidimensional Poverty Index' (UNDP & Oxford Poverty and Human Development Initiative, 2020). However, this holistic claim remains difficult to measure (Thorbecke, 2013).

With the focus on Europe, the Lisbon agenda 'Europe 2020' was set up by the European Union with one goal, among others, to reduce poverty by monitoring the so-called 'Laeken indicators': these include 18 indices that typically occur in national and international assessments, such as the 'Gini coefficient' that measures income inequality (e.g., World Bank, 2021); or approaches like the 'At-risk-of-poverty rate' used by Eurostat (2021). The latter is very common and equivalized to a threshold of 60% of the national median income. Further global indices exist, e.g., 'Index of dissimilarity', 'Global Hunger Index', 'Human Development Index', among others (e.g., EU SILC, ETHOS, etc.).

In this study, we do not necessarily approach poverty by any of these quantitatively measurable issues. Since we work spatially at the level of neighborhoods, or even individual buildings/units, there is no adequate comprehensive database on poverty on such a high spatial resolution. Thus, we rely on literature sources that explicitly identify neighborhoods or individual units as 'poor' in any of the above mentioned multidimensional ways. This can be based on quantitative data, e.g., census data, but also on subjective measures, e.g., photography impressions of bad living circumstances (cf. 3.1, 3.2).

Hence, we underline that the aim of our approach is a qualitative systematization of morphological appearances of the housing forms and less their quantitative appearance. The methodological concept, including literature and data is limited in its quantitative computability. Reasons are manifold as there is an unknown basic population of poverty and its housing forms: Next to the terminological relativity, there is neither statistical provision nor comparability to data of 47 countries. There is partially different country-wise determination of hundreds of areas to be poor and there are immeasurable aspects, e.g., unregistered homeless people or tent camps. Thus, any quantitative analyzes are scientifically limited and at risk of not being complete and thus distorting. Thus, we explain rather trends based on the compiled database. To be able to quantitatively asses the amount and types of poverty areas in their entirety, all existing areas would be needed to be recorded. However, this is an impossible task for a study in this frame and likely only an unknown share of poor areas is documented in scientific literature or media. We referenced to this aspect in the respective sections 3.1, 3.3, 4.3, 6 and especially in the discussion 5.

2.2. The underprivileged

By the year 2018 one billion people inhabited '*slums*' and '*informal*

settlements' – two terms commonly mixed in a superordinate way to describe poverty areas (Gilbert, 2007). By the year 2030 the United Nations (2019) predict 3 billion people to "*require adequate and affordable housing*". Approaches have been made to avoid terminological inconsistencies. Saunders (2011) introduced the term 'Arrival City' defining areas of cheap housing for less privileged allowing them access to urban functions. In an EO-based empirical measurement Arrival Cities reveal themselves by a wide range of housing morphologies (Taubenböck et al., 2018). A similar approach by Kuffer, Grippa, et al. (2021) unites 'deprived areas' and declares still unknown characteristic differences at in-situ living conditions. Furthermore, related to the aforementioned multiple dimensions, Abascal, et al. (2022) show 'domains of deprivation' in a framework that contains, e.g., housing, hazards, unplanned urbanization, governance, among others, with which underprivileged people are confronted.

In any of these approaches, the common narrative is a setting with less privileges. A place where people are exposed, where they lack amenities, security and provision of public opportunities, where they are exposed to threats, but the place may at the same time be a stepping stone for integration into society. In sociology 'underprivileged groups' are set in context of e.g., social welfare and 'casts' who have limited access to jobs, social prestige and geographic mobility (Rao, 2005; Rammstedt, 2020). Following the Cambridge Dictionary (2021) the term 'underprivileged' includes all multiple poverty and deprivation issues mentioned above: "*without money, possession, education, opportunities, lacking basic societal advantages that most people have, poor, etc.*". Similarly, we find noted at Miriam-Webster (2021): "*deprived through social or economic condition of some of the fundamental rights of all members of a civilized society*" and furthermore, more precise in a geographic context the term underprivileged is related to people as "*underprivileged areas of the city*". In our study, we make use of this broad conceptual framework and rely on literature proofs relating to indicators defining the underprivileged to locate such areas (cf. 3.1).

3. Workflow, data and methodology

By Fig. 2, we provide an overview of the workflow: poverty areas are identified by a *literature survey* (3.1). Subsequently, the *visual image interpretation* is explained in order to identify and locate the housing objects (3.2). Further, the categorization of the physical forms by *morphology*, *geography* and *socio-geographic backgrounds* are introduced (3.3). The results are presented in section 4.

3.1. Literature survey

With an extensive literature survey, we aim for a systematic compilation of areas defined as underprivileged. We obtain the location, the status 'poverty' (including detention of non-criminals) and whether these areas are 'formal or informal' from literature sources, including scientific literature but also press and multimedia sources. We do not claim completeness due to the aforementioned unknown basic population of poverty areas. Also, we do not entirely aim to ascertain all societal reasons and processes leading to poverty. Instead, if stated in literature, we illuminate selected cases that lead to the physical circumstances of housing. We follow a geological concept separating Europe from Asia as defined by von Strahlenberg (1730), containing 47 countries (except the 'British Overseas territory' Gibraltar). As a cross-sectional study, we look for housing forms of poverty between the years 2000 and 2020.

We use multiple search engines, e.g., google scholar, scopus, jstor, openlibrary, sapub. In addition, we intensively use platform's databases like 'Globaldetentionproject.org', 'UNHCR operational refugee portal', 'European Commission's Roma national strategies on Roma inclusion', 'European Roma Rights Centre', 'Squatting Europe Kollective', 'Asylum
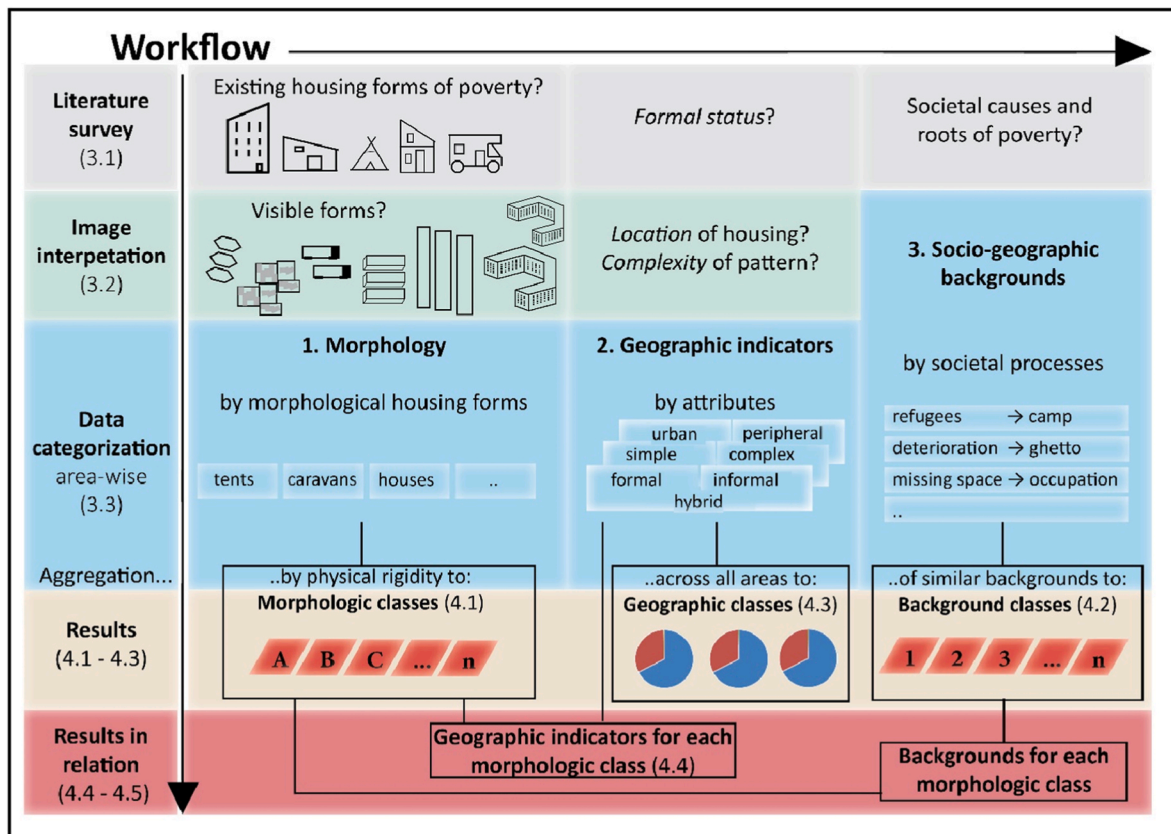

Fig. 2. –Workflow: From the Literature survey to Image interpretation to Data categorization (1. Morphology, 2. Geographic indicators, 3. Socio-geographic backgrounds) to Results.

Information database', 'Amnesty International', and many others. As search terms we e.g., seek for 'slum', 'ghetto', informal settlement', 'minority', 'deterioration', 'segregation', 'enclave', 'polarization', 'social exclusion', 'refugee camp', 'squatter settlement', 'squatting', 'building occupation', 'homeless', and others, and combinations of them. Our sources comprise scientific literature, news, media, video documentaries, photography as well as webpages and publications from governmental and non-governmental organizations. For a detailed overview see appendix A.

3.2. Image interpretation

We use current and historical satellite image data to locate sites found in the literature, to describe building structures, and, to assess location. We limit the time frame to the years 2000–2020 because a high spatial resolution of image data is a necessity for these tasks and only available over the last two decades. It contains HR and VHR optical satellite data up to approximately 0.3 m geometric resolution (e.g., Quickbird, WorldView), that allows cognitive object identification.

From the data, we capture housing structures at neighborhood level (e.g. large-estate neighborhoods) or single buildings. In any case, to locate an area of the poor from the literature survey, it is a condition that single buildings or structures are visually distinguishable in the imagery in order to classify their physical form. If VHR imagery does not exist or the quality prohibits insights, we additionally use Street View and other photographs and/or videos.

We apply the classic Manual Visual Image Interpretation (MVII) to derive the data. The approach is qualitatively done by one unbiased skilled geographer. MVII is often used in order to map poverty areas like slums (Mahabir et al., 2018; Wurm & Taubenböck 2018). Especially in dense complex urban areas, single building identification is challenging (Jacobsen & Büyüksalih, 2008; Kohli et al., 2016). MVII is an accepted and used methodology, also to delineate formal from informal areas at the high spatial level of individual buildings (Baud et al., 2010; Taubenböck & Kraff, 2014). Considering its advantages and disadvantages as well as obstacles, especially with regard to complex urban poverty areas, we rely on the workflow presented by Kraff et al. (2020b).

3.3. Data categorization

For the examination of housing manifestations of poverty, we apply image analysis according to three aspects (cf. workflow Fig. 2): *form of housing morphology*, i.e., the physical form/kind of shelter, e.g., tent, barrack, houses, caravan, etc., and combinations of different types are possible yet classified respectively; *geographic indicators*, that include 'location' [urban, peripheral], 'structure' [simple, complex] and 'formal status' [formal, informal, hybrid, no data]. And *socio-geographic backgrounds* (e.g., ghetto, trailer park, ethnic enclave, peculiarities).

We create a literature database that allows a quantitative hierarchical analysis of these three aspects:

Form of housing morphology shows the variety of physical forms. We do not a priori define any number of classes, instead follow an inductive approach, based on the empirically found morphologies. By iteratively grouping and regrouping, a two-level categorization scheme was developed: on the lower level, similar morphological housing forms merged into subgroups; on a higher level, we aggregate these subgroups to major groups of discrete classes following a similar 'physical rigidity' of the buildings. This is defined by the type of unit construction. We define a range from 'rough shelter' – without any engineering methods but simplest construction of tents – via 'makeshift shelter' to 'smaller' and 'larger stable constructions' ultimately leading to huge 'multi-storey constructions'. To avoid mixed classes, e.g., buildings surrounded by barracks, we register both appearing constructions in separated classes.

For the ***Geographic indicators,*** we use manual image interpretation to classify 'location' and 'structure' for each area dichotomously. Thus, 'location' is either urban or peripheral. This delineation is challenging as

it strongly depends on the scientific discourse about the definition of 'urban', which has not been asserted in an internationally or standardized way, mostly referring to administrative boundaries, population or social geographical ways of life (e.g., Hall & Barrett, 2012; Ruppert & Schaffer, 1973; Taubenböck et al., 2019a). Here, we chose to interpret 'urban' by cities larger than 50,000 inhabitants independent whether the area is situated in the city core or suburban. Towns with less inhabitants are classified as 'peripheral'. The '*structure*' is understood as complex, if heterogenous, organic, built-up patterns exist. Otherwise, it is classified as simple (cf. Kraff et al., 2020b), also if only one building exists. The indicator 'formal status' depends on literature sources or apparently self-explanatory facilities (e.g., governmental facilities are formal). It contains formal and informal land tenure as well as hybrids (e.g., ex post legalization).

We present the *geographic indicators* for the entire basic population to understand the overall statistical means across Europe illustrated by pie charts. Subsequently, we assign the *geographic indicators* to each *morphologic* class using descriptive statistics. Additionally, we visualize the classified morphology distribution of all researched and detected areas by cardinal directions of Europe, following the 'geographic regions' M49 standard by UNSTATS (2021).

3.3.1. Socio-geographic backgrounds

We document processes derived from the literature survey that might be a reason for the morphologies of poverty. In the field of geography and remote sensing there exist multiple characterizations of poor housing forms (Taubenböck et al., 2018). Circumstances differ, for instance, whether materials consist of wood or ferroconcrete; whether there is work in the urban or peripheral environment; or whether property is owned or taken overnight. A 'squatter settlement' differs from a 'ghetto' but both might be located within the city. We derive hints of the processual backgrounds from defined phenomena declared in the geographical discipline, as an attempt to explain the context of the embedded morphology and therefore add to the big picture. In a first step, we ascertain any *socio-geographic processes* and classify them on the lines of the above inductive approach. Subsequently, we subsume them into characteristically equivalent background classes. If literature does not offer a clear term, we classify the area in a subjective manner, based on documented issues from human-geography. For instance, barracks can be classified as refugee camp but also as squatter settlement. We apply a priori exemplified geographic terminologies from literature and rely on these authors for deeper insights: Ghetto (e.g., Agnew, 2010; Gilbert, 2010); Slum/Squatter Settlement (e.g., Nuissl & Heinrichs, 2013; UN-Habitat, 2003); Informal Settlement (e.g., Samper et al., 2020; UN-Habitat 2016); Segregation (e.g., Knox & Marston, 2001; Shevky & Bell, 1955); Refugee camp (e.g., McConnachie, 2016; UNHCR, 2021b).

In a last step, we contrast findings from this *socio-geographic* categorization to the *morphologic categorization*, in order to exemplify a societal background for each morphological major class. For instance: a 'refugee camp' is physically expressed by the existence of tents.

4. Results

In this section, we firstly present the classified results as own entities. This includes the *morphological* categories of housing forms based on the literature and EO image interpretation (4.1), the *socio-geographic backgrounds* based on the literature (4.2) and the *geographic indicators* based on the literature and EO image interpretation (4.3).

Secondly, we relate these results to possible reasons for the physical findings: by the *geographic indicators* for each *morphologic class* (4.4) and the *socio-geographic backgrounds for each morphologic class* (4.5).

4.1. Morphological forms of poor housing

Our basic sample of poverty areas has been developed out of the literature survey comprising more than 1000 items (appendix A). From

it, we derive **713** areas of documented poverty across Europe. From this sample, we create *14 subgroups* aggregated to *6 major groups* (A-F) of documented housing forms of poverty, illustrated in Fig. 3+4 and as follows:

A. **'Rough shelter'**: These have hardly any structural construction or are even without physical property that comes close to shelter. This A-type is physically less solid than any other class and is predominantly represented by tents.
   (1) Roofless/Outdoor: We find homeless living on the street in public spaces basically without any shelter except in hidden niches of buildings or other infrastructure. This subgroup is omnipresent across Europe.
   (2) Tents: There are diverse forms of tents of different sizes and quality. On the one hand, we find such tents being professionally built with visible pillars, up to several meters long. On the other hand, there are tents with weather-proof material as well as elementary 'camping tents'.
   (3) Underground: We find burrows, i.e., shelters buried underneath soil with a door and window enclosed by brick stones serving as a wall. We also find people living in canalizations with manholes as entrance, underneath channels and sector's that are formed like rooms for inhabitance.
B. **'Makeshift shelter'**: This B-type is a form of barracks and/or containers that represents an urgent, (often temporarily) built-up area. There are homogenous physical forms of either form, but in most cases barracks and/or containers are mixed, often surrounded by other forms such as tents (2).
   (4) Barracks: Shelter that is usually made of wood or loam, sometimes brick, tarpaulin, glass, corrugated iron, waste, tin, mud and cardboard box. We subsume huts/, shacks/hovels stemming from a quick build in need. Also, long-lasting deteriorated former houses exist.
   (5) Containers: Containers are e.g., used by governments to temporarily accommodate refugees or by entrepreneurs to house cheap workers such as harvest workers. We find diverse shapes, built in a long, drawn-out way, rectangular, also colored like maritime cargo units. Its material is corrugated iron. There are modular containers, cube houses and sometimes big container houses.
C. **'Mobile shelter'**: This C-type predominantly features caravans (trailers) or extraordinary converted types like a railway cars or ships.
   (6) Caravans: Caravans and trailer parks as well as combinations of trailers with other forms such as barracks, containers, houses and tents exist. There are diverse kinds in size. Some are put in place for continuous residency surrounded by vegetation and dismounted wheels, others are spatially flexible.
   (7) Railway cars: People living inside a rebuilt railway car with an immobile stand.
   (8) Ships: People living inside a docked (immobile) ship.
D. **'Small stable constructions'**: This D-type consists of houses or parts of buildings that have a more solid structural design. Buildings can
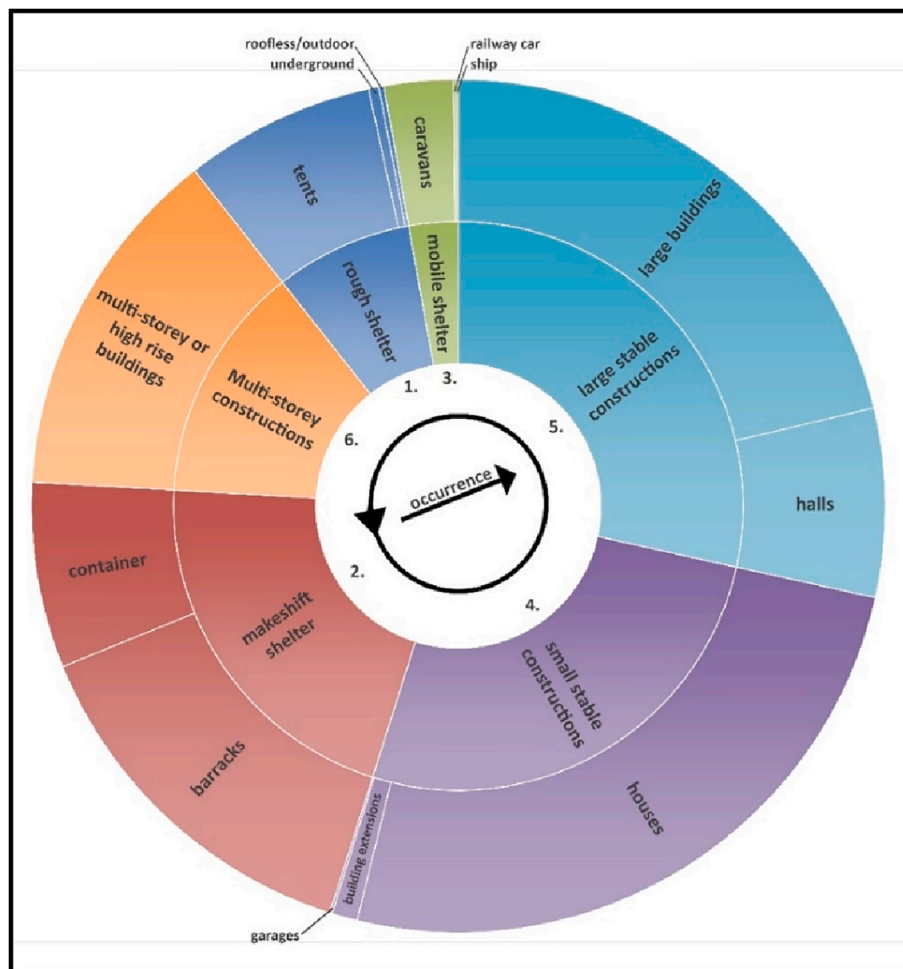

Fig. 3. Sunburst diagram: Morphological categorization of housing forms of poverty by n = 1035 physical occurrences within 713 areas and quantitative distribution in our sample.
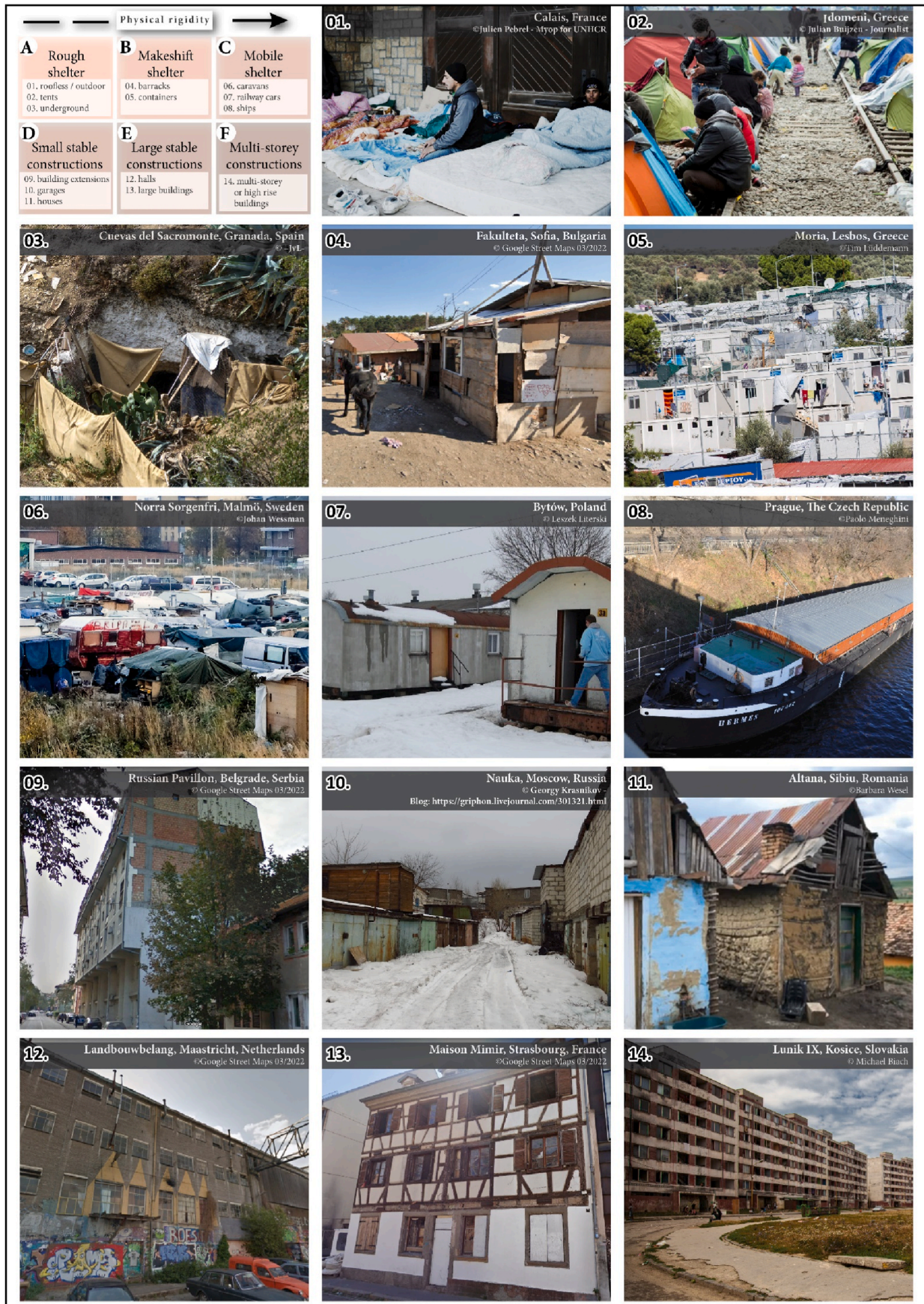
Fig. 4. Morphological categorization of housing forms of poverty: (n = 713) 6 major and 14 subgroups from rough to stable constructions.

be in any condition but, in contrast to 'makeshift shelters', a stable construction with basements and socles exists.

  (9) <u>Building extensions</u>: Vertically built-up structures upon roofs. An offset between house wall and expansion on top is detectable. There are also horizontal expansions next to the walls.

(10) <u>Garages</u>: A standalone type next to other buildings, made of corrugated iron or masonry converted from its original use.

(11) <u>Houses</u>: Poverty conditions are not always obvious by their appearance, since they often encompass diverse industrialized or quality material, wood and concrete. They occur in all physical forms - small, big, rectangular, multiangular.

E. **'Large stable constructions'**: This E-type contains halls or grand single buildings that are architecturally complex. Generally, large constructions can be found inside compounds, like agglomerated or bordered types of large or big building units, also of a similar kind.

(12) <u>Halls</u>: We find industrial halls respectively very long, drawn-out buildings, rectangular with a high roof. We also find them mixed with other buildings.

(13) <u>Large buildings</u>: This subgroup contains very big standalone buildings as well as grand architecturally complex constructions: angularly, toothed, flanks respectively free spaces. Examples are: fort, harbor, railway station.

F. **'Multi-storey constructions'**: This F-type is considered as mostly rigid or morphologically anchored. We find tenement houses with few storeys up to huge buildings with 15 and more storeys.

(14) <u>Multi-storey or high-rise buildings</u>: This subgroup comprises combined occurrences of buildings that often occur en masse and uniformly, mostly in large areas. Such tenement houses rise up to several storeys. Other multi-storey as well as the subsequent high-rise buildings are usually part of large housing estates and sometimes, but not imperatively, a physical agent of poverty.

Based on our literature review (the entire sample of references), the categorization scheme by "physical rigidity of construction" was derived resulting in these 14 representative housing classes of poverty in Europe.

4.2. Socio-geographic backgrounds of poor housing

The literature survey reveals manifold socio-geographic backgrounds for these poor housing conditions. After subsuming them (cf. appendix B), we outline the following classified major groups, elucidated in section 4.5.

1) **Homelessness:** People without shelter. Subgroups are 'roofless', 'houseless', 'insecure' or 'inadequate' shelter conditions, comparable to the ETHOS declaration (FEANTSA, 2005).

2) **Refuge and migration:** Processes such as war, climate change and economic reasons lead to asylum seekers, refugees and migrant workers at global scale. We find refugee camps, transits, pre-removal centers, temporary camps, emergency transits, permanent homes for 'Displaced Persons' (DP), infrastructurally used buildings, prisons and migrant worker camps.

3) **Urban squatter settlements:** Reasons often of economic necessity that force people to live in urban slums and squatter settlements including extravagant places such as garbage dumps and cemeteries.

4) **Informal building enlargements:** Societal backgrounds that drive people to change the built-up environment informally. This leads to roof extensions or even entire houses upon roofs, building annexes or incisions.

5) **Inner-city deterioration:** Urban succession processes of decay that affect ethnic and social segregation. As a result, we find declined areas and ghettos.

6) **Building occupation:** Forms of 'squatting', by different players and causes, reoccupied abandoned buildings by refugees, migrant workers, socio-economic weak alternative movement protagonists.

7) **Ex post natural disaster:** Processes after catastrophes such as lack of reconstruction measures leading to poverty areas. We find permanent homes for IDP, container cities and ghettos, as well as erected, yet again deteriorated neighborhoods.

8) **Ethnic segregation in suburbs and villages:** Processes leading to stigmatized high shares of minorities or separated enclaves.

9) **Other reasons and issues**: Manifold other not categorizable reasons for poverty shelter, for instance: subsidized housing, partially missing infrastructure, dropout from society.

4.3. Geographic indicators: the "where" and "how" of poor housing forms

We assess geographic indicators for our entire sample (Fig. 5): Generally, two thirds of the poverty areas among our sample are situated in an urban environment. We find that simple structures are the defining housing shape of poverty and complex areas having only a share of 17%. Most areas are of formal status with only 22% declared to be 'informal' and nearly 5% formal-informal 'hybrids'.

In our sample, we find poverty related morphologies in literature and other media in all of the selected 47 nations across Europe (except Andorra, Monaco and San Marino) (Fig. 6). Some countries feature many areas (e.g., Romania, Greece, Germany), others only few (e.g., Estonia, Iceland, Kazakhstan). It must be clearly stated here that this is only the spatial distribution within our sample/basic population derived from documented studies and reports and it is not representative for poor areas in general.

In general, the map reveals documented poor areas all across Europe. However, in certain areas such as the Balkan (as part of Southern and Eastern Europe), we observe the highest documented concentrations. There, the morphologic class B dominates. Furthermore, in some cities, we find several spots of documented poverty areas, for instance in Rome, Athens, Prishtina, Sofia. In Western Europe, we find significant occurrences across all major morphologic classes. In Northern Europe, we find the highest share of large stable constructions (37%) and in Western Europe the highest share of multi-storey buildings (23%). Reasons are manifold, as e.g., reused or occupied deteriorated existing buildings and the dominance of large housing estates. Generally, we discover mobile shelter in Western, Northern, and very rarely in Eastern Europe.

Beyond the pure morphology, we illustrate the spatial dimension of the indicators of our sample (Fig. 7): Most poverty areas classified as peripheral or informal are situated in Southern and Eastern Europe. We find more simple structural forms, but we cannot map a spatial trend.

4.4. Linking geographic indicators and morphology

The *geographic indicators* are illuminated in relation to the 6 major *morphologic* classes (Table 1). We find most of the areas representing housing forms of poverty categorized as rather stable types (classes D-F). In contrast, mobile shelter (C) shows the least occurrence. Hereby, we find the following indicator-per-class-related insights:

- **'Location'**: Only 'rough' and 'mobile shelter' are relatively equally spread between the urban and peripheral classes. In contrast 'multi-storey constructions' are only found in the urban environment. A high number of stable constructions, as well as makeshift shelters exists in the periphery, yet overweighs in the urban environment again.

- **'Structure'**: The predominant form is of simple nature. This is due to the high number of 'small' and 'large stable constructions' (19% and 25%), embedded merely in organized built-up patterns. A quite equal distribution (simple vs. complex), is found for 'makeshift' and 'mobile shelter', only.

- **'Formal status'**: The formal areas clearly overweigh, predominantly represented by 'large stable constructions' (23%). However, in sum
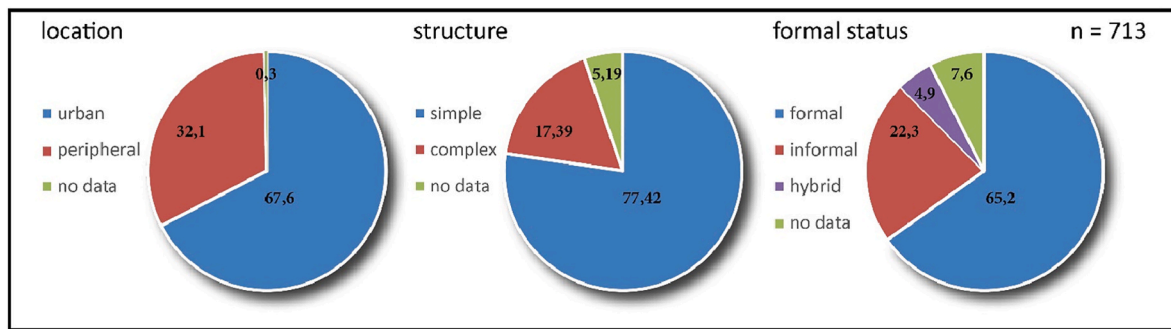
Fig. 5. Geographic indicators in sum, across the entire basic population.
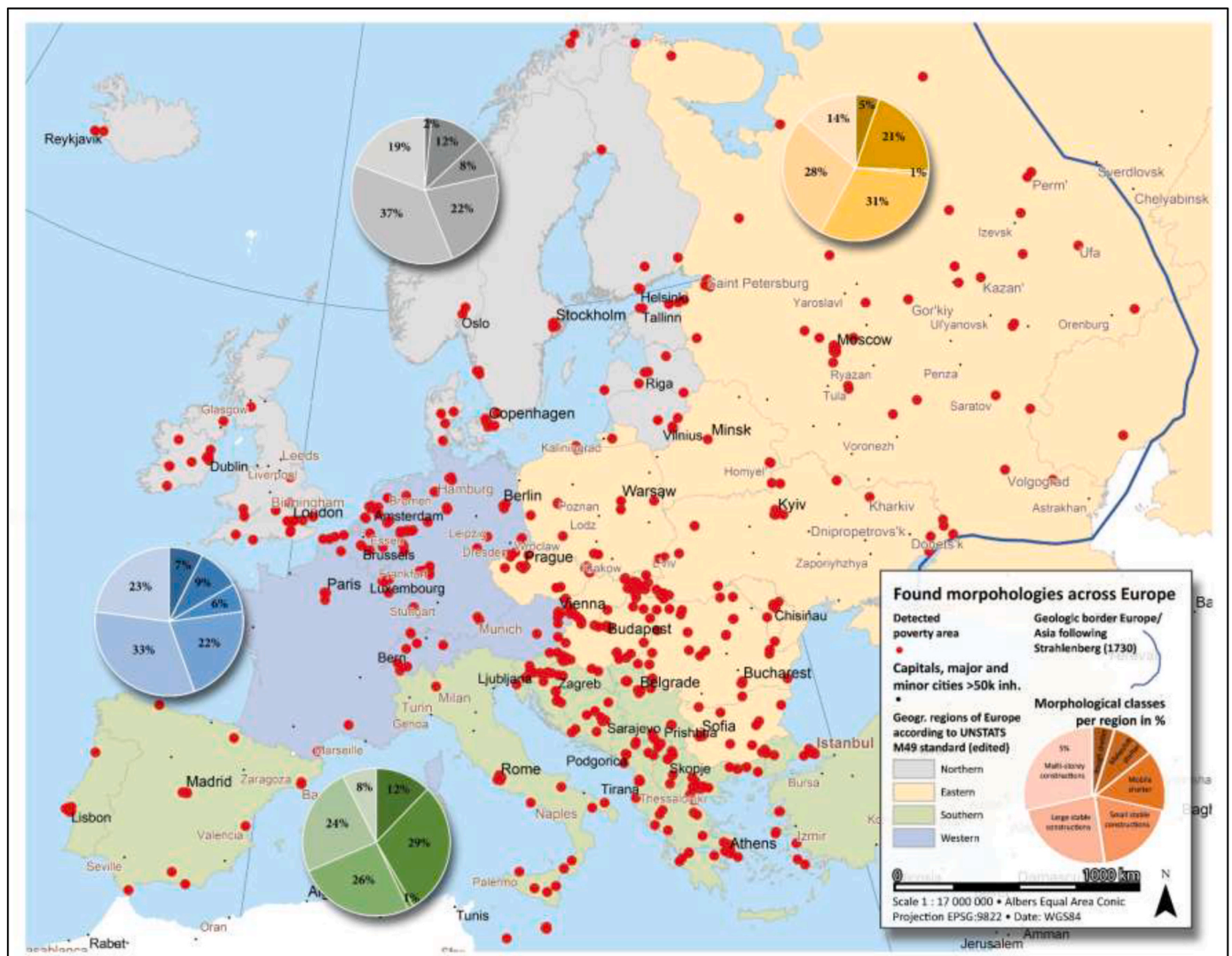

Fig. 6. Distribution of found poverty areas and their related major morphologic classes across Europe, where n = 654 (713–59 areas, without exact localization).

there are still 22% informal areas, with a highest share of 'makeshift shelter' (8%).

For some areas, it was not possible by the literature research to reveal any information; thus, depending on the indicator and class, missing data ranges up to max. 3.3%.

4.5. Linking socio-geographic backgrounds and morphology - an attempt to understand the physics of poor housing

Below, we lay out the background and processes exposed from literature (4.2), set in relation to the morphologic classes (4.1) and reveal frequent socio-geographic backgrounds (Fig. 8) as causes for the found morphologies:
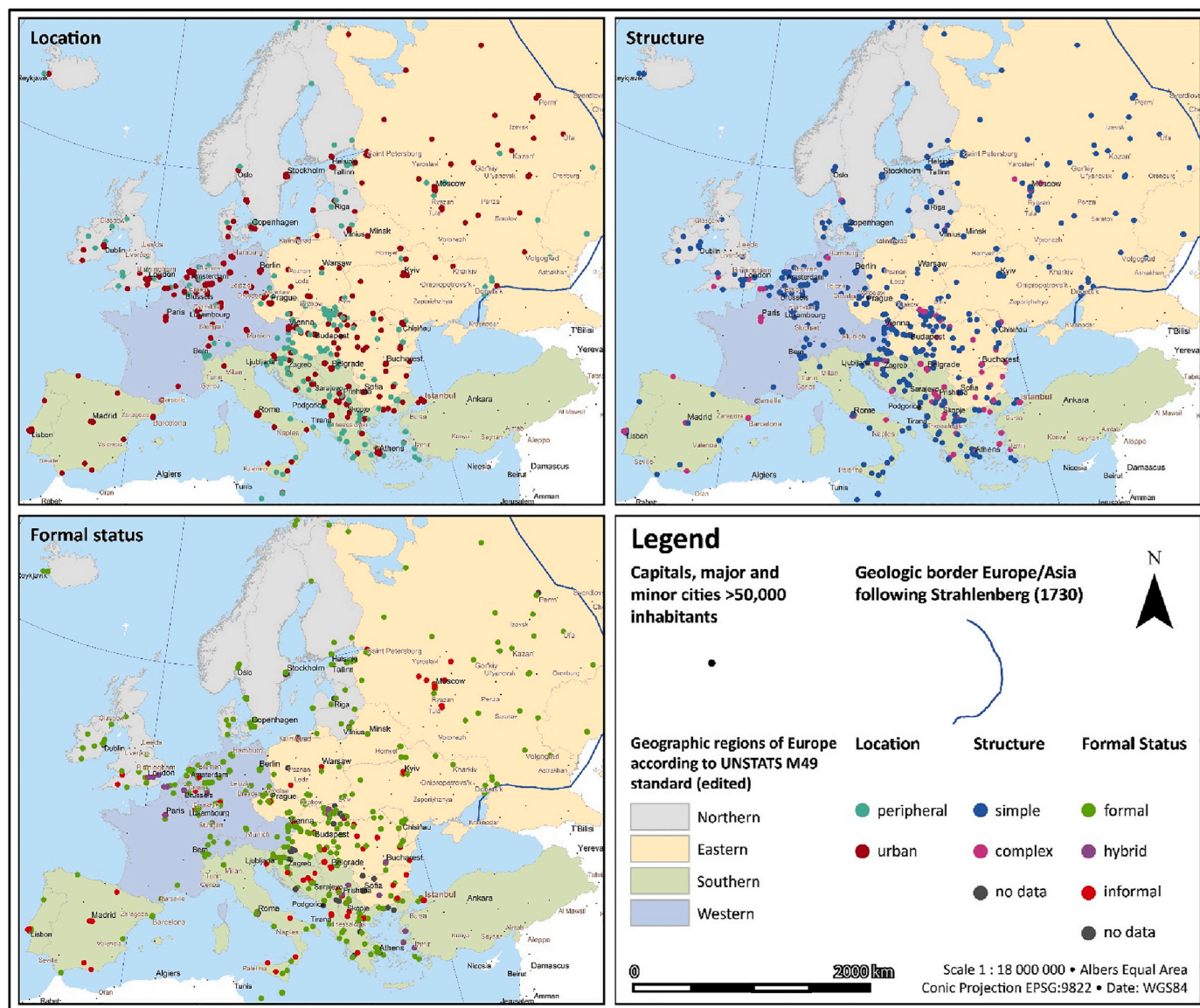
Fig. 7. Distribution of found poverty areas and their related geographic classes across Europe, where n = 654 (713–59 areas, without exact localization).

Table 1

Class distribution of basic population (1035 found morphologies in 713 areas) and *geographic indicator's* share separated in major morphologic classes.

Class distribution of 1035 found morphologies in 713 areas, classified by 14 morphologic classes												
Major classes	n = 1035		location (%)			structure (%)			formal status (%)			
	%	No.	urban	peri-pheral	no data	simple	complex	no data	formal	informal	hybrid	no data
A **Rough shelter**	7.83	81	4.25	3.38	0.19	4.83	1.74	1.26	3.96	2.61	0.68	0.58
B **Makeshift shelter**	21.06	218	13.91	7.15	0.00	10.72	9.37	0.97	7.73	8.79	2.71	1.84
C **Mobile shelter**	2.80	29	1.93	0.87	0.00	1.45	0.77	0.58	1.16	0.87	0.10	0.68
D **Small stable constructions**	26.47	274	17.29	9.18	0.00	19.13	6.28	1.06	15.56	5.12	2.51	3.29
E **Large stable constructions**	28.41	294	18.74	9.66	0.00	25.22	3.00	0.19	23.09	3.86	0.77	0.68
F **Multi-storey constructions**	13.43	139	12.75	0.68	0.00	11.59	1.84	0.00	10.63	1.35	1.16	0.29
Sums∑	100	1035	100			100			100			

1) **Homelessness:** FEANTSA & Foundation Abbé Pierre (2020) estimate the large number of 700,000 homeless people across the European Union. Due to this hardly locatable and assessable issue, we pick out few single representative samples only. Next to rough shelter, e.g., tents at Rummelsburger Bucht, Berlin (Germany) (Berliner Zeitung, 2019), we find organized conditions, e.g., in houses as

small stable constructions at Stauceni/St. Stefan in Chişinău (Caritas Moldova, 2017).

2) **Refuge and migration:** A major share of inappropriate shelter is caused by the 2015 *refugee crisis*, where different Mediterranean routes dominate. Refugee camps fulfil the function of temporary shelter. We find many informal spots where refugees live in tents, e. g., Idomeni (Greece) (Pelliccia, 2019). However, a majority of cases
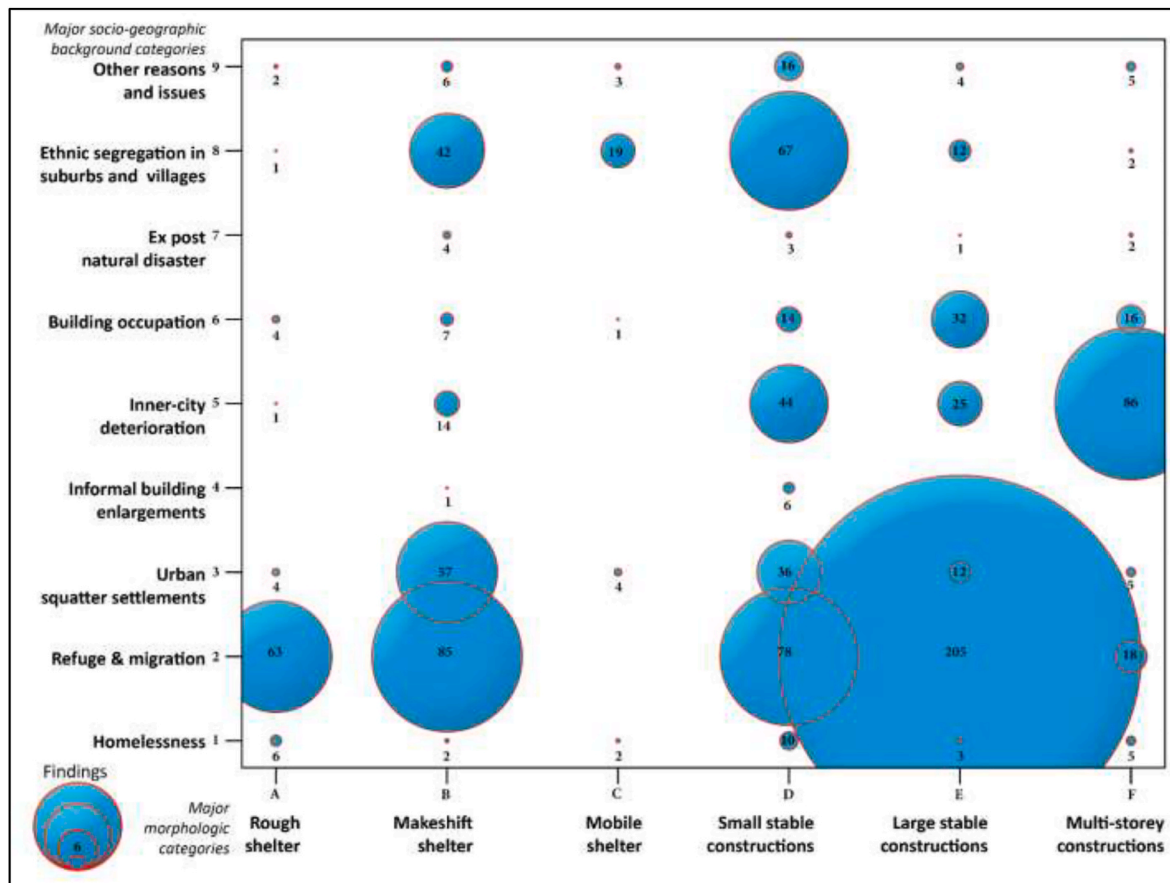
Fig. 8. Classified *socio-geographic backgrounds* opposed to major *morphologic* categories (n = 713 areas based on 1035 physical occurrences and 1056 literature items).

is framed by formal conditions, as e.g., containers and small to very large stable constructions. These are often aggregated behind fenced compounds, run by governments, UNHCR or NGOs (e.g., Hal Far (Malta); Lesbos, Samos, Chios, Athens (Greece)). Whenever migrants lose personal rights and are treated in a dehumanizing manner (Human Rights Watch, 2010), the majority of incidents is remotely undetectable. UNCHR (2014) proposes solutions to end detention but we discover numerous such centers, e.g., The Midlands Prison, Portlaoise (Ireland) (globadetentionproject.org, 2020). Along the western Mediterranean route, we find camps that reveal inhuman living conditions (Sandri, 2018) between tents, barracks and containers in the 'New Jungle', a former garbage dump in Calais (France). Rather subordinated, with respect to the number of refugees, is the eastern land route (Frontex, 2021), with tent shelter e.g., due to the 'War in Donbas' at Gukovo or Novoshakhtinsk, both in the Rostov Region (Russia). A similar 'war' setting is demonstrated by '*Internally Displaced People*' (IDP), especially with an ethnic background, resulting e.g., from the Wars in Ex-Yugoslavia. In this context we find temporary UN camps made of houses and barracks under bad health circumstances, e.g., Mitrovica (Kosovo) (Human Rights Watch, 2009).

Next to this complex issue of 'refuge', a corresponding issue demonstrates 'migrant worker' areas in South Europe, as e.g., tent camp Manolada (Greece). Since the 1990s 150 people work there in the agricultural sector (Papadopoulos et al., 2018).

3) **Urban squatter settlements:** Slums/squatter settlements are mainly exemplified by barracks and houses in bad condition, inhabited by diverse social groups, often ethnic minorities: After the

political eastern enlargement of the European Union in the year 2007, many members of ethnic minorities migrated legally as European Union citizens to other member states. Until today, the majority of them faces discrimination, stigmatization and segregation, resulting in underprivileged circumstances of living. Reasons are manifold and further outlined e.g., by the European Commission (2020). We find such places dominated by barracks e.g., in Beograd Gazela, Belgrade (Serbia); on a cemetery (Mramorska, Niš,Serbia) or on garbage dumps, e.g., Sharre, Tirana (Albania), that punctuate a tight makeshift character. Another reason that forces people to live in barracks, made of wood, corrugated iron sheet and plastics, is missing living space, e.g., Santa Catalina and La Canada Real, Madrid (Spain) caused by a stressed real estate market (Gonick, 2015).

4) **Informal building enlargements:** We find informal, sometimes hybrid legal building extensions in horizontal and vertical ways, e.g., in Dodona, Prishtina (Kosovo) or Karaburma ("Russian Pavillon"), Belgrade (Serbia) caused e.g., by spatial planning restrictions or (Yugsloav post-war) lack of housing stock (Agic, 2020; Vöckler, 2007).

5) **Inner-city deterioration:** The demand for living space has been strongly linked to the rehabilitation in Europe since WWII. Afterwards, a high need of real-estates and quick solutions led to large housing estates and tenement houses. Today, there are multi-storey buildings all across Europe. We find typical inner-city succession processes and decay, leading to 'ghettos' and 'deteriorated areas', with a dominance of multi-storey constructions, e.g., Ciocana, Chişinău (Moldova) or tenement housing estates like the so-called '*Khrushchyovka*'. This special kind has been built in the post-soviet area due to an extreme lack of housing and is statics-wise deteriorated today. Thus, people fear resettlements and demolition, e.g., in

the Tsaritsyno district, Moscow (Russia) (Gunko et al., 2018). In the case of multi-storey areas ethnicity plays a central role also, thus we find typical mono-ethnic *enclaves*, e.g., Aleea Livezilor, Ferentari, Bucharest (Romania), yet also multi-ethno areas, e.g., Rinkeby, Stockholm (Sweden), or other foreign worker areas exemplified by parts of Ottakring, Vienna (Austria). In this context, we also find poverty due to deindustrialization, e.g., in Narva (Estonia), Karosta, Liepāja (Latvia) or Köln-Kalk (Germany).

6) **Building occupation:** A totally different phenomenon, yet also in consequence of the lack of affordable housing, is called '*squatting*', synonymous for building occupation. The phenomenon has been described by Lefebvre (1974), when the urban shape and urbanization started to be strongly influenced by capital and neoliberal markets. Until today, an "*urban movement*" has risen, where its participants seek for social and artistical activities but also face economic barriers like unemployment, existential insecurity and missing accommodation. In consequence, occupation of vacant, unused, empty or abandoned buildings, often of a stable, bigger kind, in a legal or illegal way is the result. Today, more than 2400 squats exist all across Europe (Adinolfi, 2019; Squatting Europe Kollective, 2021). Generally, former smaller and larger standalone buildings are reused as social center and shelter, e.g., the former hotel 'Maison Mimir', Strasbourg (France) or a military Fort in Pannerden (Netherlands). Other examples are Rozbrat, Poznań (Poland) or whole districts like 'Freetown Christiana', Copenhagen (Denmark). In some cases, abandoned buildings are occupied by citizens providing shelter rather for refugees than for themselves, as in the case of Notara 26/Exarchia, Athens (Greece). This type demonstrates pro poor activism and slightly differs to those areas being occupied by refugees themselves, e.g., at industrial halls in Patras (Greece). For further information on different types of squatting, we refer to Pruijt (2013).

7) **Ex post natural disaster:** Next to devastation, natural disasters cause poor shelter shaping different morphologies. For instance, Baracche Fondo Fucile, Messina (Italy), a post-earthquake-erected urban neighborhood, deteriorated as inner-city slum where barrack owners nowadays fear governmental clearing programs (Guadagno, 2016). Another example is 'Karpoš City Wall' in Skopje (North Macedonia) where an earthquake in the year 1963 empowered a vivid construction of multi-storey buildings (Folić et al., 2011) and where up to 70% of the population is dependent on welfare today (Government of the Republic of Macedonia & Minstry of Finance, 2002).

8) **Ethnic segregation in suburbs and villages:** Next to issues mentioned in class (3), we find ethnic minorities having either a high share of a community or being encapsulated (*enclaves)* outside the urban center at the fringe of the city as well as in poor rural villages. The first is exemplified by el Gallinero, Madrid (Spain), where 400–600 people lack of infrastructure and where barracks are made of wood and CI-sheet. The latter is exemplified by Jarovnice, Šariš (Slovakia), that shows a landscape of barracks and containers. Outside the cities, we also find houses instead of makeshift shelter, e. g., in Kuršanec, Čakovec (Croatia), where UNDP (2014) demands multiple villages to be facilitated.

9) **Other reasons and issues**: There are plenty of other backgrounds that have no clear relation to the aforementioned classes. For instance, infrastructurally poor areas e.g., Talovka, (Kazakhstan) (Kaztag, 2018); subsidized housing e.g., Jaywick, England (UK) (Fransham, 2019); reasons for cave dwelling, e.g., at the Hill of Valparaíso, Granada (Spain) (Bertini, 2010); or dropout camps, e.g., Cuvry fallow land, Berlin (Germany) (Rollmann & Frenzel, 2017).

5. Discussion

A compendium on housing forms of poverty for Europe, their geographic attributes and their background is doomed to failure – the manifestations are manifold, only a fraction of them seem to be documented and thus, it must remain open what else exists beyond. Nevertheless, it seems an important undertaking to us to compile and systematize such a compendium according to existing knowledge, e.g. because experts criticize the absence of social constructs in morphologically featured slum investigations (Owusu et al., 2021). With it, we aim to contribute to the international demand for consistent, systematic data and a global repository of deprived areas (Kuffer, Grippa, et al., 2021) by filling the gap of unclassified morphologic appearances of housing poverty in Europe.

According to common sense, physical manifestations of poverty are a predominant phenomenon of the Global South (Nuissl & Heinrichs, 2013). However, next to discovering equivalent morphologic appearances in Europe, we even find a new paradigm of its spectrum: Conceptualized into categories following physical rigidity, a broad variety of physical forms exists. There are frequent ones such as tents, barracks, containers and stable constructions but also extraordinary rare ones such as ship 'Hermes' (anchored in Prague, Czech Republic), where homeless are hosted (The Center of Social Services of Prague, 2020). In this study, we broaden the existing ontological range on a scale where the spatial unit meets single geographic housing objects/forms (Kohli et al. (2012); Taubenböck et al. (2018); Kraff et al. (2020a); Samper et al. (2020); Kuffer et al., (2021a + b)). The common ground of all such forms is shelter to the underprivileged, a hardly measurable social group of at least 1 billion people worldwide. We are aware that our approach does not necessarily capture solely underprivileged people. Not all within this social group live in the documented housing forms and some who do are not poor (UN-Habitat, 2003). Poverty measures differ and assessments - quantitative as well as qualitative - are globally hardly comparable (cf. section 2). This fact leads to the conceptual and terminological relativity of poverty areas (Gilbert, 2007; Kuffer, 2021b): For instance, an informal land tenure in Greece is not necessarily linked to poverty (Potsiou & Ioannidis, 2006) or informal roof extensions in Serbia (Agic, 2020) mirror a real estate market in deficit, yet not always necessarily poverty. Albeit large housing estates became symbol of the underprivileged in some parts of Europe (e.g., Belgium, England, Germany), its inhabitants cannot be generalized as 'poor'. Especially Eastern European cities like St. Petersburg (Russia) and Sofia (Bulgaria) demonstrate that a socio-economic polarization does not necessarily exist across-the-board (Herfert et al., 2013). Nevertheless, in these countries we still find large estate areas represented by poor inhabitants. Another example demonstrates spots of extreme poverty in Bucharest (e. g., Ferentari), whereas a scientific narrative for Romania labels "*housing estates are neither pockets of poverty, ghettos, sites of social uniformity, or crime-ridden slums*" (Marin & Chelcea, 2018).

Due to the relativity of poverty, there are disputable issues, where to draw the line. We find missing infrastructure (sewage system, mud streets) in Jarovnice, Šariš (Slovakia) and generally poor housing conditions (container, barracks). In comparison, Dubăsarii Vechi, Criuleni (Moldova) features missing streets but normal houses. The physical perspective does not allow the latter to be judged as 'poor' but as declared by UNDP (2017), we consider missing infrastructure as a criterion for people being less privileged. Regardless of which quantitative calculation is applied (e.g., 'Index of dissimilarity', 'Global Hunger Index', etc.), poverty retains within multiple dimensions (Kakwani & Silber, 2008; UNDP & Oxford Poverty and Human Development Initiative, 2020; Abascal et al., 2022) - also hardly summable ones. The spatiotemporal dimension of poverty is often related to statistically aggregated administrative units. A neighborhood- or even housing-fine relation to poverty is mostly absent, difficult to access within a time frame of 20 years, or difficult to locate (large amount of listed literature titles with partially fuzzy nomination of areas, cf. appendixes A + B).·In this regard, areas and literature are vivid, hence this paper relies only on a fixed temporal snap-shot of each area. So, comparable quantification is one major obstacle. Another one is universal applicability: The UN 'household deprivations' unite housing forms of poverty on a global

scale and this set of indices is possible to meet EO findings (Kuffer et al., 2016; Taubenböck et al., 2018), yet not in all of its dimensions (Kuffer, Grippa, et al., 2021) - especially not such being EO-wise remotely undiscoverable (e.g., persons per room, access to drinking water). Thus, due to this complexity, we do not measure poverty remotely by satellite data but rely on documented issues. In fact, we reveal and categorize the building fabric behind poverty.

Generally, we find areas distributed across the whole continent, yet with a focus of documented areas in central and south-eastern parts of the continent (cf. Fig. 6). One major reason for these findings is the 'European migrant crisis'. Partially informal overnight shelter as well as formal areas with a very dense, complex building structure lacking basic amenities similar to refugee camps of the global south are found. Other reasons are diverse: We find upheavals in the societal system of Albania that dissociated itself from communism leading to informal townscapes like Bathore, Tirana (Tsenkova, 2010). We find IDPs regarded as stateless, e.g., in Sredorek, Kumanovo (North Macedonia) (ERRC, 2004). We find Displaced Persons' (DP) deported from a temporary residency in central Europe back to their countries of origin in Southern Europe with missing appropriate housing (e.g., Vidicovac, Belgrade (Serbia) or Medveďov (Slovakia). These *socio-geographic backgrounds* and processes are relevant examples that substantiate the found morphologies, their legal situation, physical pattern as well as location: urban ghettoization mirrored by tenement housing (Stehle, 2006); deindustrialization mirrored by large-estate housing (Hess, Tammaru, & van Ham, 2018); non formal binding plans, mirrored by informal settlements and informal building extensions (e.g., Vöckler, 2007; Ascensão, 2015; Doctors Without Borders, 2016); the aforementioned refuge from war mirrored by refugee camps (e.g., Katz, 2016; Sandri, 2018; UNHCR, 2016); but also refuge from society mirrored by building occupation and dropout camps (e.g., Adinolfi, 2019; Rollmann & Frenzel, 2017). Separate from these exceptions in the South and East, prevalently a legal character is documented and physically simply structured patterns can be found across Europe. In contrast, the common narrative of the poor is being excluded from common accessibilities. It shows yet missing societal privileges albeit in formal environments (cf. Fig. 7).

The here applied categorization of housing forms and its twofold process (major- and subgroups) is subjective to a certain degree as it relies on human cognition, which is especially challenging in complex environments (Kraff, 2020b). Thus, we cannot preclude any misclassification or issues of class overlapping. We do not claim mathematic correctness in our morphologic distributions, due to the complex nature of the social processes: For instance, there are hardly distinguishable morphologies (large housing estates, deteriorated inner-city areas, ghettos); or building extensions are not easy to delineate from normal rooftops. Whether areas are categorized as 'complex' or 'simple' depends on the conceptual approach, the image interpreter and knowledge about spatial structures. There is heterogeneous information in literature, such as various determinations (e.g., 'Reception and Identification Centre', 'Pre-Removal Detention Center', 'Retention Center'), that we assign to appropriate morphologic classes following the same background. In our opinion funneling categories is no bottleneck and might rather set a new impulse with regard to a missing consistent European or global categorization. Furthermore, this is an explorative study, in contrast to recent explanatory morphological studies, where e.g., Debray et al. (2022) used established labels to automatically classify settlement morphologies. Due to restrictions in our method, a limited number of processual findings, an uneven distribution of existing literature and an unknown and disturbed basic population, there is lack of representativity. Thus, our sample of 713 areas must not be understood as representative but as an excerpt of the reality by the documented areas and our findings shall be rather understood as 'tendencies' or 'trends' and do not serve as blueprints. However, in our opinion this approximation is a necessary baseline to systemize the existing housing forms related to the underprivileged and to understand the manifold root causes for the found morphologies. Still, we reckon a certain

legitimacy due to the high number of found occurrences and the broad bandwidth of different classified backgrounds. So far, no other comparable compendium has been set up in a similar systematic way for the entire continent.

In comparison, UN-Habitat claimed 25% of population living in insecure tenure in the year 2003 in Western Europe and in 2015(b) and 2016 an existence of 6% of urban dwellers living in extremely precarious conditions, relying on data from the UNECE by Tsenkova et al. (2008). However, this data only represents Western Europe. In our approach, we found 108 areas, also peripheral sites for Western Europe, but we assume there exist way more areas not yet documented. Thus, a comparison with the inventory compiled by Tsenkova et al. is conceptually not meaningful. Even though hardly comparable, the spatial shares of our sample across Europe are 12% N., 35% E., 38% S. and 15% W. This indicates a majority of poverty areas situated in the East and South, an information that the United Nations did not publish yet.

Many literature items are published in less common languages and we use translating tools as well as boulevard press that need to be cross-checked and questioned critically. There are plenty more indicated areas in literature but due to limited resources, we are not able to register and list them all. Hence, the managed unknown basic population of morphological forms across Europe is the reason for the chosen nominal scale with a qualitative categorization. And, neither literature, news media nor satellite imagery can comprise every location of poverty due to its highly frequent appearances, for instance the estimation of 700,000 homeless people by FEANTSA & Foundation Abbé Pierre (2020) that underlines the absence of very exact information. Consequently, it is de facto impossible to register all poverty spots. For instance, Slovakia registered more than 140 settlements inhabited by ethnic minorities under very poor conditions (European Commission, 2012). Furthermore, due to reasons of privacy, security and geoethics, data about ethnic minorities in poverty areas must be kept disguised (ECHR, 2020; Di Capua & Peppoloni, 2019; Owusu et al., 2021; Kochupillai et al., 2022). Accordingly, we do not claim completeness of all existing poverty areas in Europe. Instead, we demonstrate the variety of documented, yet so far unclassified, morphological types that we were able to discover across the continent.

Authors from other disciplines like sociology (Esping-Andersen, 1990) and architecture (Hoekstra, 2005) demonstrate country-wise classifications within the European Union. Hoekstra uses data by the European Community Household Panel and extends Esping-Andersen's theory of the welfare states to connect welfare state regimes, tenure categories and dwelling types. EU-15 countries are classified there into four categories following "liberal, social democratic, corporatist and Mediterranean welfare state regimes", depending on the household data. This quantitative classification conceptually and geographically differs from ours, yet it demonstrates hitherto existing approaches of shelter classification in relation to socioeconomic aspects like subsidies and underlines its interdisciplinary need for further systematic data attainment and -comparability across political borders.

6. Conclusion and outlook

Fighting poverty is a major objective of the international agenda, declared by the United Nations and European Union (United Nations, 2017; European Commission, 2010). Hence, it is mandatory to understand and document its worldwide proliferating existence. Humanity faces manifold global challenges resulting in a large variety of (housing) forms of poverty. Europe is a continent with complex multi-ethnic, -cultural, and -national backgrounds, thus, facets of poverty are accordingly manifold. Occasionally, media demonstrate 'sensational' types of poverty in Europe. However, scientific research on the existence of its physical range is underrepresented, as it rather focusses on the Global South - especially with regard to remote sensing (Taubenböck et al., 2018). Hence, poverty areas are mostly undocumented; if documented, only in individual studies and not typified.

In this study, we documented and classified physical housing forms of poverty ranging from rough shelter to large stable multi-storey constructions for Europe. We classified them manually at building level and located them on district level. We found such forms all across Europe. They are in parts omnipresent (e.g., street persons) or predominant in certain areas. However, our basic population was limited by the documented cases in literature and media and thus remains unknown. We do not claim comprehensiveness, we rather presented these forms as completely as possible and illustrated geographic indicators and sociogeographic backgrounds. With it, we added new findings to previous descriptions and categorization (Kohli et al., 2012; Taubenböck et al., 2018). More importantly, we documented their large variability. Thus, theoretically occurrences are possible in any kind of built-up environment.

Future geographic analyses and poverty measurements need to act in a multi-methodological way: A holistic analysis is incessant, including occurrences, physical configuration and causing factors of poverty. Remote sensing has proven its suitability for detecting built-up types and forms correlated to socioeconomic data (Sandborn & Engstrom, 2016; Taubenböck et al., 2019b; Wurm et al., 2019; Wurm & Taubenböck, 2018), yet, a physical approach is not valid to detect poverty with any certainty, its rooting processes and to understand the societal context. As the literature survey has shown, empirical (in-situ) surveys have been and are already carried out with respect to poverty in Europe; and albeit national as well as supranational institutions, NGOs and academia collect data on the socioeconomic status of the underprivileged, a database of physical appearances, a compendium, Atlas or alike is a next step to document and understand poverty and respond to the international demand for better data and knowledge. Innovative steps are done by Kuffer, Grippa, et al. (2021), who established a 'global slum repository' with multiple data sources next to remote sensing.

Finally, we end this study with an observation: Fig. 9 visualizes 'Lunik IX', a former satellite city of Kosice (Slovakia) which deteriorated to a ghetto with an ethnic minority. We found a quote, painted on the rooftop in the context of exclusion and poverty, a message that needs to be sensed remotely, maybe a distress call: "*who keeps company with wolves, will learn to howl*". It shows that harsh living conditions on the ground are even or sometimes only visible in data from space.

Disclaimer

Registering, measuring or assessing ethnic and/or minority groups disagrees with the principle of equality as well as it does disagree with the authors' scientific convention. In order to protect (personal) rights and preclude threats of discrimination and as identification based on ethnicity is not permitted in several countries, we do not point out designated ethnos or single of such communities in this study. However, our research is based on published articles and scientific literature that proof geographic proxies of poverty that are associated to minorities. With it, we refer to generalized terms and rely on generalized data only.

Authorship contributions

Conception and design of study: **Kraff, N.J.**, **Taubenböck, H.**, **Wurm, M.**; acquisition of data: **Kraff, N.J.** analysis and/or interpretation of data: **Kraff, N.J.**, **Taubenböck, H.** Drafting the manuscript: **Kraff, N.J.**, **Taubenböck, H.** revising the manuscript critically for important intellectual content: **Kraff, N.J.**, **Taubenböck, H.**, **Wurm, M.** Approval of the version of the manuscript to be published (the names of all authors must be listed): **Kraff, N.J., Taubenböck, H., Wurm, M.**

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Fig. 9. Lunik IX, Kosice, Slovakia ©Google Earth, satellite image, date 03/27/2021 - *Kto chce s vlkmi zit, musi s vlkmi vyt* [slovakian] who keeps company with wolves, will learn to howl -.

Declarations of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apgeog.2022.102820.

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