Migration, Spatial Mobility, and the Ecological Question

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Abstract

Climate change, species extinction, land degradation, and environmental pollution are major ecological challenges that are putting pressure on populations around the globe. With this keynote, I would like to give an overview of the breadth of the topic and highlight some areas that I find particularly interesting in the research field of migration and spatial mobility: Research designs and findings on climate change as a driver of out-migration; the relationship between new technologies and migration and spatial mobility; environmental amenities as attractors of migration.

Introduction

We all know that climate change, species extinction, land degradation, and environmental pollution are major ecological challenges that put populations under pressure around the globe. Media reports suggest that massive displacement and migration, also with destination "Europe", is one possible response to environmental threats and disasters.

This topic is of high interest to the public and the media, what is also reflected in the fact that "migration" has been dominating the World Press Photo Award for years. However, scholarly evidence about the links between environmental issues and *permanent* migration is still relatively scarce. Moreover, if the field of research is expanded to include seasonal migration and commuter mobility, many other relationships with ecological issues will emerge that could gain in importance.

Figure 1: Thomson Reuters Coverage of the 'Migration Crisis'

Yannis Behrakis/Reuters; https://www.nytimes.com/slideshow/2016/04/18/blogs/photography-pulitzer-coverage-of-the-migrant-crisis.html

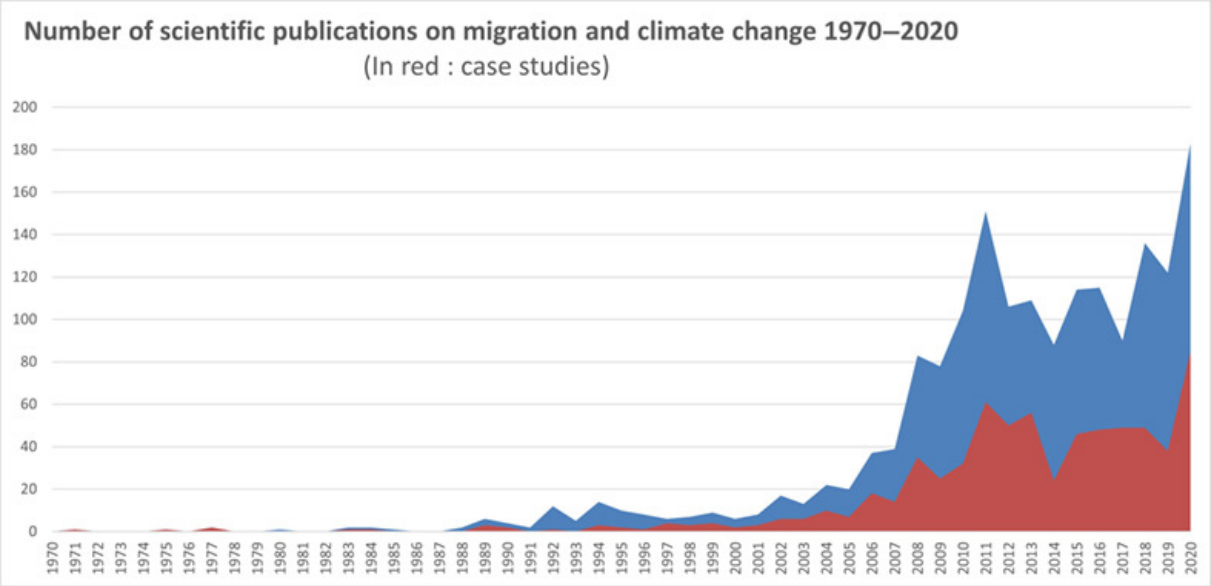
As demographers are concerned with the questions how human populations change in both, size, and composition, and how these changes might have repercussions on how humans inhabit the earth and form societies, demographers have possibly much to contribute to the research field of ecological challenges. With this keynote, I want to give an overview about the breadth of the topic and highlight some fields I consider particularly interesting.

Necessarily, these are my subjective views, as I will not be able to cover the complete field and provide you with a comprehensive literature review in this talk. Demography is an interdisciplinary science, so pieces of evidence can be found in various scientific fields. I will concentrate on 3 topics and will illustrate them with empirical findings.

1 Climate change as a driver of out-migration

I think in all of us this topic let come pictures to the mind about large groups of displaced persons due to thunderstorms, flood events, and severe droughts. However, only 20 years ago, such questions received little attention from academic and policy communities. Around 2010 the numbers of publications on the links between climate change, environmental degradation and migration grew considerably (Piguet, 2021).

Figure 2



E. Piguet (2021)

At that time, one main line of inquiry was to estimate the volume of population displacements, following publications by the IPCC (2007) and Stern (2007) which forecast future "flows" of a substantial number of environmental migrants, mainly in the direction of the "rich" Northern countries (Piguet et al., 2018).

Since then, the number of publications is at about 100 a year, among them 40 empirical studies. In Figure 2, these are the "case studies" depicted in red; case studies are defined by using specific empirical material, such as surveys, ethnographic methods, or archives of individual records. Depicted in blue are theoretical or review papers.

Newer studies based on spatial analyses of aggregated data confirm that environmental change and weather variability have a substantial impact on migration (Piguet, 2021). A recent evolution in this field of study is the use of dyadic databases that allow to assess the push and pull factors of migration flows simultaneously.

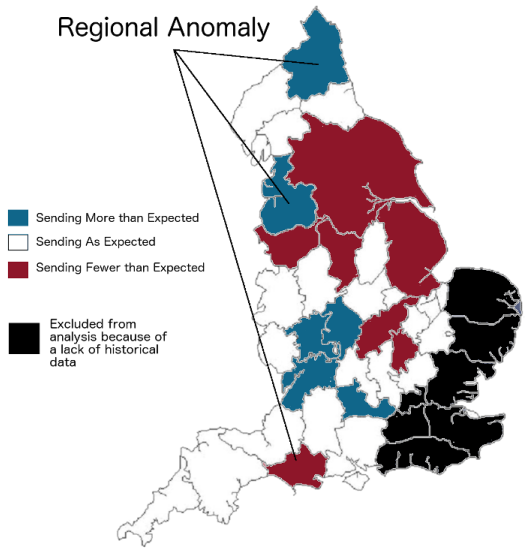
Figure 3: Interactive map of migration flows between and within regions, 2015-2020

Based on the 'Global flow of people 2.0' (2023) by Sander, Genoni & Kolowa (BiB); Frank and Schrammel (Kunstuniversität Linz), and Bauer (Statistik Wien); see also Abel and Sander (2014).
Notes: Each dot represents 1,000 migrants, 95.8 million in total, asylum seekers not included;
Explore the flows via interactive maps at: https://www.zeit.de/politik/2023-12/migration-weltweit-entwicklung-daten?freebie=701ba31b; and at https://www.bib.bund.de/DE/Fakten/Tools/Migration/Globalflows.html;

These developments gave new inspiration to Gravity Models (Anderson, 2011; Crymble et al., 2015; Ramos, 2016) based on Ravenstein's seminal papers (1885; 1889). As 'pure' environmental migration does not exist and multi-causality is the norm (Piguet, 2021), gravity models have become popular. These models allow the inclusion of other geographical links that might impact migration, such as colonial ties, common borders, common languages, and existing networks, into spatial models of migration (Backhaus et al., 2015; Mahajan & Yang, 2020).

As could be expected, the impacts of environmental degradation on the population is weaker in more affluent and industrialized countries (Cameron, 2017), and stronger in regions that are economically dependent upon the environment. According to a study of Cai et al. (2016), for example, on a dataset of international flows of migrants from 163 origin countries to 42 (mostly OECD) destinations countries in the period 1980-2010, each 1 degree C increase in temperature implies a 5% increase in outmigration from the top 25% agricultural countries of the world. By contrast, the increase in outmigration from the remaining, less agricultural countries was insignificant. Another study shows similar links between drought frequency and bilateral migration rates in India (Dallmann & Millock, 2017).

Figure 4: Outcome of Gravity Model on “Vagrant Lives” data on moves to/from London, 1777-1786



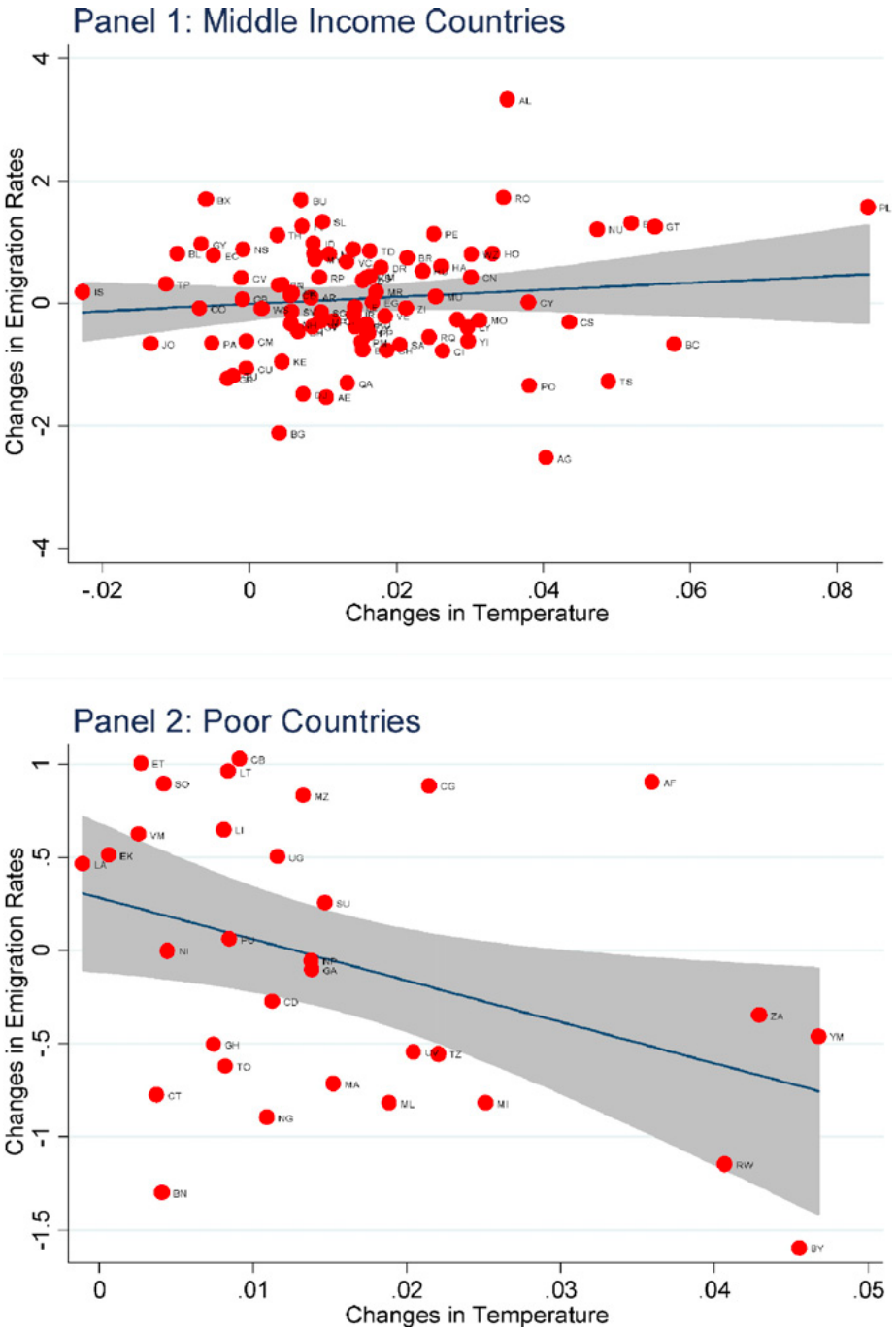
Crymble (2019); Crymble et al. (2015)

[Most recently, a study based on data from 198 origin and 16 destination countries in a timeframe from 1980 to 2015 confirmed that temperature anomalies and weather-related disasters significantly affect international migration flows (Wesselbaum, 2020). However, they also find evidence that economic constraints might reduce migration.]

Unfavorable and even threatening conditions will trigger considering migration in many individuals, but economic constraints likely deter the poorest from migrating. It was found, for example, that changing temperatures (Cattaneo & Peri, 2016), general natural hazards (Gröschl & Steinwachs, 2017) or hurricanes (Mahajan & Yang, 2020) *increase* international emigration from middle-income countries but have no effect or *reduce* emigration from poor countries.

[The migration hump theory of an inverted U-shaped relation between development and migration (de Haas et al., 2019; Hoffmann et al., 2020) and the concept of “trapped populations" in the context of environmental shocks or degradation attracted a lot of interest (Piguet, 2021).]

Figure 5: Change in emigration rates and in average temperature.

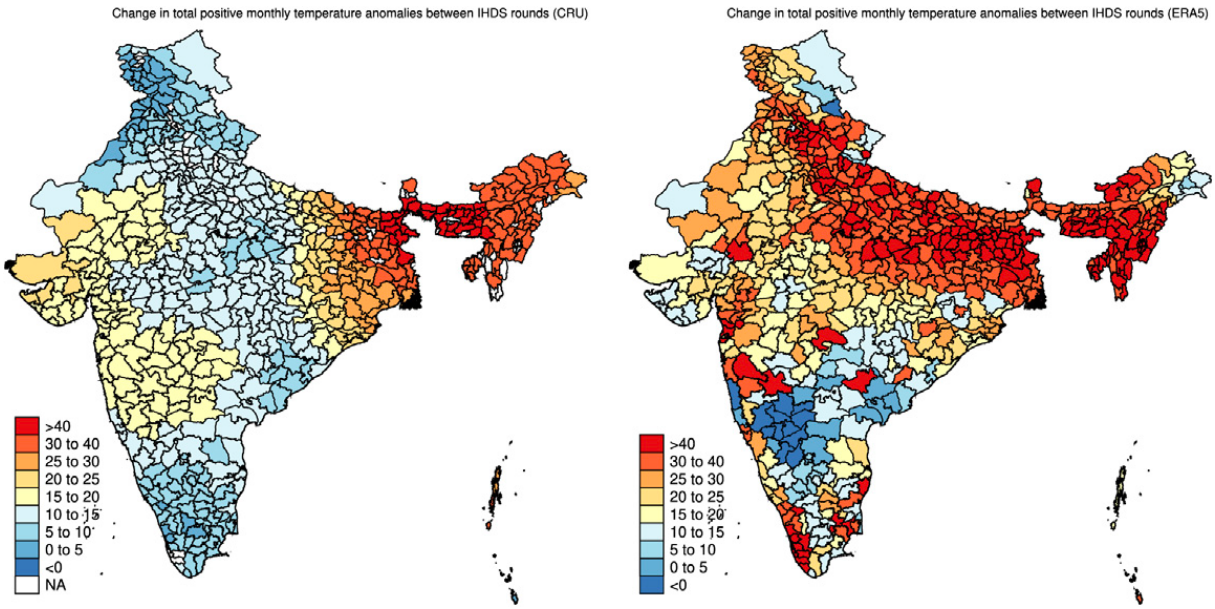


Cattaneo and Peri (2016)
Note: X-axis: nat.log. of the average temperatures between 2000 and 1981 minus the nat.log. of the average temperatures between 1960 and 1980. Y-axis: nat.log. of the average emigration rates between 1990 and 2000 minus the average emigration rates between 1970 and 1980.

About 10 years ago, researchers began to advocate for working more with individual data, and several inventories and new approaches were put to the fore (Fussell et al., 2014; Nawrotzki & DeWaard, 2016). A fine example of a recent panel study examines migration in India (Sedova & Kalkuhl, 2020). The authors combined data from the India Human Development Survey on 25,000 households with meteorological data on temperature and precipitation. They show that

adverse weather shocks do indeed *increase* interstate migration toward cities but *decrease* rural-rural and international migration.

Figure 6: Change in total positive temperature anomalies in India (1999–2003 and 2006–2010)



Sedova and Kalkuhl (2020)

Another study based on the Indonesian Family Life Survey on more than 14,000 individuals revealed that anomalous temperatures, rainfall levels and monsoon timing does not generally operate as a push factor on intra- and inter-provincial migration. Rather, the impact varies according to an individuals' gender, membership in a farm household, and location (Thiede et al., 2016). A similarly contrasted picture emerges in studies of migration intentions of populations in Ghana (Codjoe et al., 2017) and Malawi (Suckall et al., 2016). Overall, the main lesson from this family of studies is that, even if they confirm the impact of environmental drivers on migration, they also show that these links are often indirect and heterogeneous according to population profiles (Piguet, 2021).

[Another promising data source is historical data, although this body of research remains small (Piguet, 2021). One study of 19th century migration from south-west Germany to North America, based on official migration statistics, population data, weather data and cereal price records, estimated that up to 20-30% of migration was attributable to climate factors (Glaser et al., 2017). Another study based on the Historical Sample of the Netherlands capturing the migration of about 25,000 individuals between 1865 and 1937 was enriched with climate data (Jennings & Gray, 2015). The results show that detrimental climate conditions led to internal migration but only in certain periods and for certain social groups, whereas extreme rainfall *decreased* international migration.]

Most of the climatic changes related to CO2 emissions are yet to come, so their impact on migration is one prospective avenue for future research. At the same time, the digitalization of various data sources and the advancement of methods and facilities of data storage are continuing to enlarge prospective research possibilities based on historical data.

Two major trends can be outlined (Piguet, 2021):

(1) Data dis-aggregation that allows analyses at finer scales, whether spatial (i.e. municipalities rather than districts), temporal (months rather than years) or social (subgroups rather than the population as a whole). This necessitates improved databases which have benefitted from the development of remote sensing and satellite imagery.

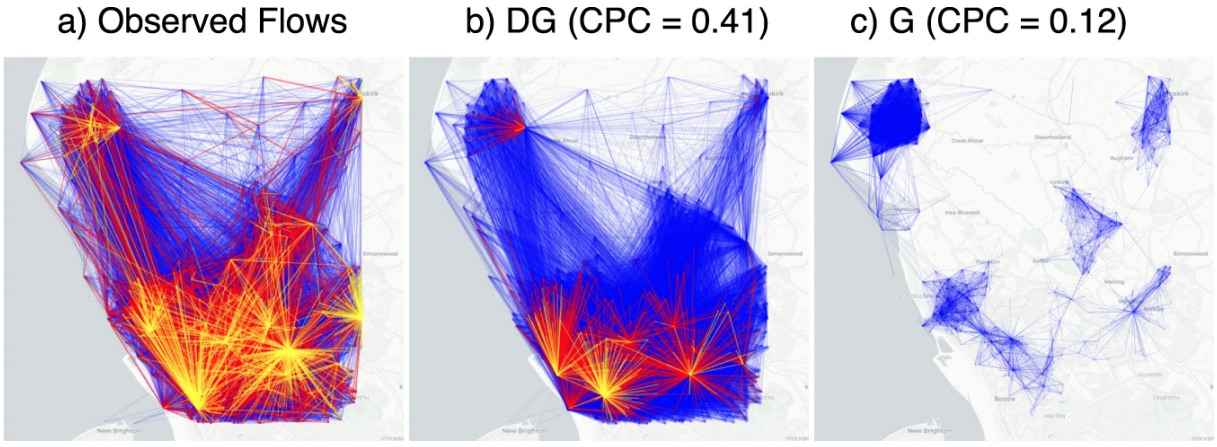
(2) Use of completely new data sources, e.g., mobile phone connections (Lu et al., 2016), Facebook (Alexander et al., 2019), Twitter (Martin et al., 2020), and even consumer credit data (DeWaard et al., 2020) allow researchers to follow populations on the move. Night light measurement was used as a proxy for population density changes (Ash & Obradovich, 2019).

[The results of such "Big Data" analyses are promising but raise also challenges: they mainly address rapid-onset environmental hazards and mobility rather than migration issues, and their representativity regarding population groups remains tricky (Piguet, 2021). However, in combination with qualitative fieldwork the results are most promising. In a study conducted in Bangladesh during and after Hurricane Mahasen in 2013 first population displacement was identified through mobile phone networks, while the second part interpreted these movements on the basis of qualitative interviews (Boas et al., 2019).]

2 The link of new technologies to migration and spatial mobility

The new information and communication technologies (ICTs) not only offer new sources of data to researchers but also have direct influences on mobility itself (Boas, 2017). Until recently, migration was normally defined as a change in the usual place of residence over a *socially significant distance* for a minimum period of time (Wagner & Mulder, 2015), in line with recommendations for migration statistics from the United Nations. The idea behind this definition was that social networks based on face-to-face interactions, e.g., with family, neighbourhood people, and at the workplace, were interrupted or at least severely distorted with migration. This is normally not the case when people move over short distances, which is therefore best referred to with another term, most often "residential mobility" (Clark, 2020 [1986]: p. 10; Kok, 1997-1999).

F7: Real commuter flows (a) versus generated flows by Deep Gravity (b) and gravity model (c).

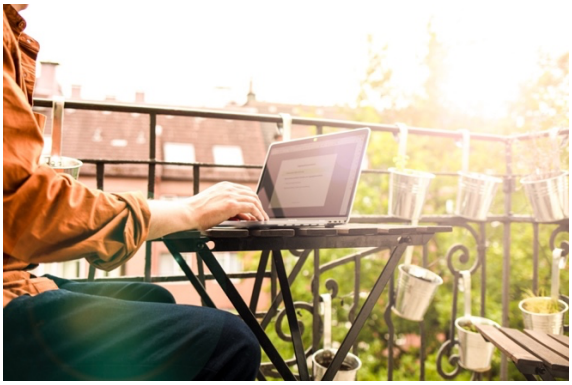


Simini et al. (2021)
Notes: Region with 1001 locations in the north of Liverpool, England, UK. Blue edges indicate flows with a number of commuters between 0 and 3, red edges between 3 and 5, and yellow edges above 5 commuters. CPC indicates the Common Part of Commuters. While both DG and G underestimate the flows, DG captures the overall structure of the flow network more accurately than G.

However, in a world where most people are connected to each other via mobile phones and social media it becomes questionable whether possibilities of face-to-face contacts should be an integral part of such definition. Moreover, the suggestion that the possibility of continued commuting tells residential mobility from migration (Clark, 2020 [1986]p. 10), seems outdated in face of high-speed trains and cheap flight connections.

New technologies that are related to human migration and spatial mobility have also potential environmental outcomes. Increased home-office practices might lead to increased sub-urbanization, as a long commute is less stressful at lower frequencies (Asmussen et al., 2023; De Abreu e Silva & Melo, 2018). Moreover, 'green' traffic infrastructures, like electrified high-speed trains and electric cars may ease our bad conscience about long commutes. Whether such land-consuming developments occur, we will only see in some years after the Corona pandemic.

Figure 8: Working from home on the balcony.



Lutsch/UHH

A third area of technology relevant for human migration beyond the fields of ICT and transportation is energy production. While the construction of hydropower plants and reservoirs has led to massive population displacements and expulsions (Tan, 2020), this is less likely to be the case with the construction of wind turbines. However, there are concerns of transforming wilderness into places for energy production, also with regard to the threat to traditional ways of life. A European example concerns the construction of wind parks in the Finnmark along the coastline of the Barents Sea in Norway, which might come into conflict with the Sámi reindeer herders (Mauk & Coulter, December 5, 2023).

Figure 9: A turbine construction worker on Kvaløya

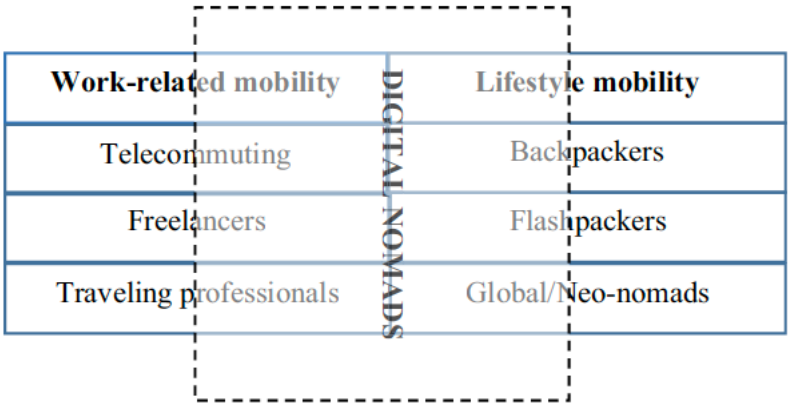
Coulter/The Dial, 11, 2023; https://www.thedial.world/issue-11/sami-reindeer-herders-wind-power-renewable-energy

3 Ecological amenities as migration attractors

This brings me to the question whether we can identify ecological amenities that attract migration. Of course, again the weather. We all know the stories about human 'snow birds' who seasonally migrate, e.g., from Sweden to Spain (Gustafson, 2002). However, in times of climate change and increasing workplace flexibility such forms of seasonal migration might be on the upswing, and their forms might diversify with regard to both, spatial trajectories and social groups.

For example, in the warmer regions more 'sunbirds' heading towards cooler destinations during the summer months can be expected. In Florida, for example, human 'sunbirds' were already counted in classified (cf. Smith & House, 2006). Up to date, such seasonal migration is dominated by pensioners and privateers, but it can be expected that those who can possibly work anywhere they want, might be interested in such a life style, too, enlarging the group of 'digital nomads' (Hannonen, 2020).

Figure 10: Digital nomadism and interrelated phenomena



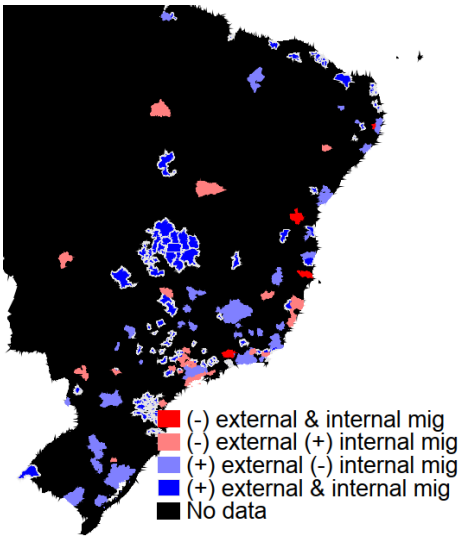
Hannonen (2020)

It might also be worthwhile to have a closer look at those part of the population that stays in regions with unfavourable environmental conditions, or even moves to it. Research on so called 'climate hot spots' aims at identifying regions that are at risk of environmental disasters and are densely populated with significant shares of vulnerable groups (de Sherbinin et al., 2019). Paradoxically, in low income countries there is a strong connection between "hotspots" of projected rapid population growth and climate change "hotspots" (Hugo, 2011). Megacities like Bangkok (Thailand), Jakarta (Indonesia) or Dhaka (Bangladesh) have in common that they have high population growth rates, that they are vulnerable to floods, and that the cityscape is sinking every year a bit more, partly because of the rapid groundwater use and the heavy weight of high-rise buildings and infrastructures made of concrete (Tay et al., 2022).

It is a challenge to disentangle the possible sources of population growth in the megacities of the Global South. A detailed analyses based on data from 377 cities in Africa, South America and South-East Asia revealed that in the average city, the annual crude rate of natural population increase was four times higher than the sum of the net internal and international migration (Lerch, 2020). This rather surprising finding comes about because the internal and international components of the total migration rate might cancel each other out. Whereas most cities

experience a positive balance with regard to international migration, at the same time they lose population due to internal migration (Lerch, 2020). Processes of sub-urbanization can be found all around the world, and internal migration to the metropolis is often directed at the outer districts (Clapson & Hutchison, 2010; Keil, 2018).

Figure 11: Negative and positive values of net migration in Brazil 2000-2010



Lerch (2020)

Without question there is a bunch of reasons why people prefer moving to outer districts, and why suburbanization is growing rapidly. People may want to escape the noise and air pollution caused by traffic and industrial plants (Diekmann et al., 2023; Preisendörfer et al., 2022; Rüttenauer & Best, 2021). It was projected that by 2030 the area of urbanized land will have nearly tripled compared to that in 2000 (Seto et al., 2012).

[Green environments offer well-documented benefits, including increased physical and mental well-being (e.g. Gascon et al., 2015; Hartig et al., 2014 for literature review; White et al., 2013). While some previous studies investigated the relevance of green spaces in cities for overall well-being and its subdomains for families (Dadvand et al., 2015; Hystad et al., 2014; Izenstark & Ebata, 2017; McCormick, 2017; McEachan et al., 2016; Wells, 2000) or older people (Xu et al., 2022), comprehensive research across life course phases is rare (see the review of Douglas et al. (2017). Moreover, there have been relatively few attempts to explore the importance of green spaces in residential relocations: Some studies analyzed the well-being outcomes of relocating to greener areas (Alcock et al., 2014; Wells, 2000; White et al., 2013), but these studies have not prospectively analyzed whether green spaces played a part in the decision-making process for relocation. Thus, the question of how much relevance urbanites attribute to the different categories of nature in their living environment remains open.]

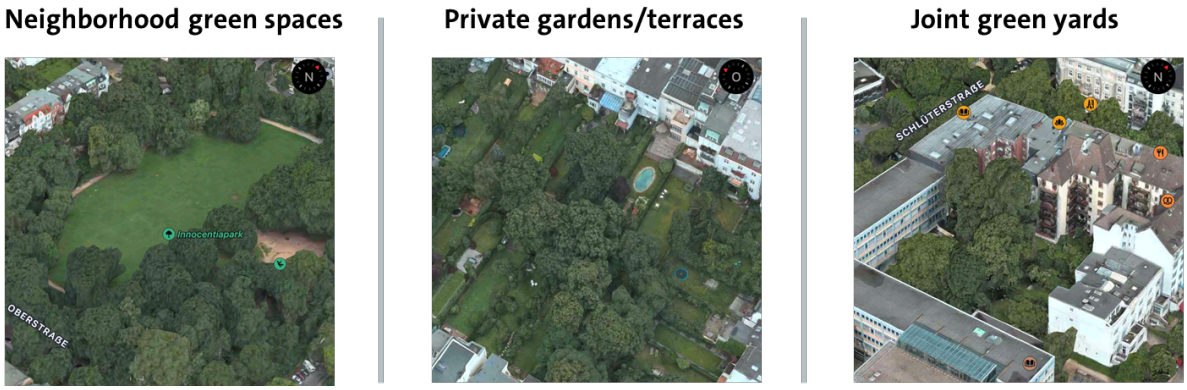
Research shows that private gardens are related to increased life satisfaction (Lehberger et al., 2021) and reduced stress (Stigsdotter & Grahn, 2004), and that having a garden improves residential well-being (Conedera et al., 2015).). But there have been few attempts to explore the importance of different categories of green spaces in residential relocations.

In light of the growing importance of shared resources (cf. Belk, 2009) and against the background of high residential pressure and tendencies towards densification, questions such

as whether exclusively private gardens might deter people from fleeing the city, or whether semi-private yards or public green spaces also might achieve this goal, are interesting.

[One might object that for most urbanites having much green around their dwelling is likely *not* among the most important reasons for moving. From a life course perspective (Bernardi et al., 2019), migration and residential relocation is not a goal as such – even not when improved housing and residential environment is named explicitly – but a *means* of realizing goals in the realms of family, work, leisure, and other life-course domains (Kley, 2011; Willekens, 1987). Consequently, the "soft reasons" that were not anchored in the events of the life course might remain hidden in the retrospective study of residential mobility. Based on the life course approach and well-established psychological models of decision-making, I therefore proposed to study the course of migration-decision making prospectively, based on the stages considering, planning, and realizing migration (Kley, 2011).]

Figure 12: Neigborhood green spaces, private gardens/terraces, shared green yards

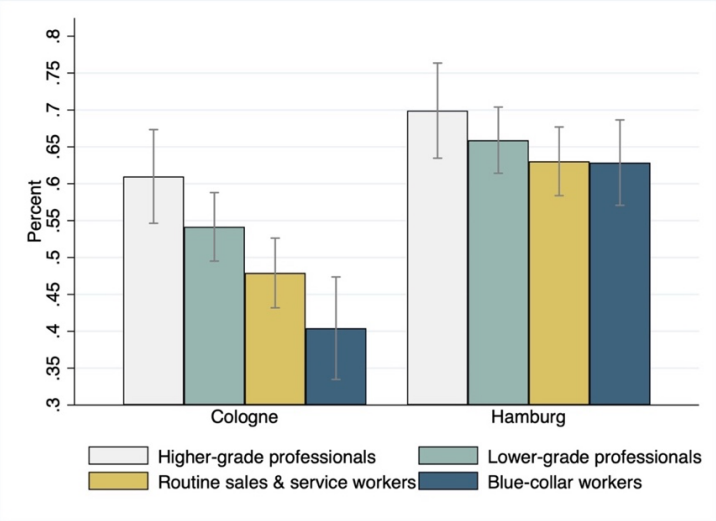


Examples from Hamburg, Google maps
Note: Shared green yards are semi-private green spaces, typically located in the courtyard of perimeter block developments or between row buildings, accessible to all residents of the adjacent apartment buildings.

Based on survey data collected in Hamburg and Cologne we find that lacking a private garden increases the probability of considering residential relocation in households with children, but not in other phases of the life course (Kley & Dovbishchuk, 2021). However, not having green in the window views, and not having a green shared yard is associated with an increased likelihood of considering relocation in all phases of the life course (Dovbischuk & Kley, manuscript; Kley & Dovbishchuk, 2021).

Moreover, our findings suggest that green window views are an important component of residential satisfaction in all social classes, but lower-class people benefit most from green window views (Kley & Dovbischuk, 2024). Considering this finding, we might conclude that Hamburg has high environmental justice with this regard, as green window views are similarly distributed across social class, whereas this might not be the case in other large German cities, as we found, for instance, for Cologne.

Figure 13: Green window views across social class, in Hamburg and Cologne



Kley and Dovbischuk (2024)
Notes: N = 1,832; CI with p < 0.10; wiso.uni-hamburg.de/wohnstudie

Conclusion

Demographic research on migration, spatial mobility, and the ecological question has many facets, and even more than I was able to highlight in this talk. Some aspects seem to be of higher relevance for the Northern countries and Germany than others. However, as many ecological processes have far-reaching consequences, our countries might be more strongly affected as it might seem at first sight. Moreover, what we consider to be interesting questions in Europe, might render results that are relevant or at least inspiring also for other world areas.

References

Abel, G., & Sander, N. (2014). Quantifying Global International Migration Flows. *Science*, *343*, 1520-1522. https://doi.org/10.1126/science.1251285

Alcock, I., White, M. P., Wheeler, B. W., Fleming, L. E., & Depledge, M. H. (2014). Longitudinal Effects on Mental Health of Moving to Greener and Less Green Urban Areas. *Environmental science & technology*, *48*(2), 1247-1255. https://doi.org/10.1021/es403688w

Alexander, M., Polimis, K., & Zagheni, E. (2019). The Impact of Hurricane Maria on Out-migration from Puerto Rico: Evidence from Facebook Data. *Population and Development review*, *45*(3), 617-630. https://doi.org/10.1111/padr.12289

Anderson, J. E. (2011). The Gravity Model. *Annual Review of Economics*, *3*(1), 133-160. https://doi.org/10.1146/annurev-economics-111809-125114

Ash, K., & Obradovich, N. (2019). Climatic Stress, Internal Migration, and Syrian Civil War Onset. *Journal of Conflict Resolution*, *64*(1), 3-31. https://doi.org/10.1177/0022002719864140

Asmussen, K., Mondal, A., & Bhat, C. (2023). The interplay between teleworking choice and commute distance. In *Technical paper, Department of Civil, Architectural and Environmental Engineering, University of Texas at Austin*.

Backhaus, A., Martinez-Zarzoso, I., & Muris, C. (2015). Do climate variations explain bilateral migration? A gravity model analysis. *IZA Journal of Migration*, *4*(1). https://doi.org/10.1186/s40176-014-0026-3

Belk, R. (2009). Sharing. *Journal of Consumer Research*, *36*(5), 715-734. https://doi.org/10.1086/612649

Bernardi, L., Huinink, J., & Settersten, R. A. (2019). The life course cube: A tool for studying lives. *Advances in Life Course Research*, *41*, 100258. https://doi.org/10.1016/j.alcr.2018.11.004

Bernstein, L., Bosch, P., Canziani, O., & al., e. (2007). *Climate Change 2007. Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report on the Intergovernmental Panel on Climate Change*. IPCC.

Boas, I. (2017). Environmental change and human mobility in the digital age. *Geoforum*, *85*, 153-156. https://doi.org/10.1016/j.geoforum.2017.07.022

Boas, I., Dahm, R., & Wrathall, D. (2019). Grounding Big Data on Climate-Induced Human Mobility. *Geographical Review*, *110*(1-2), 195-209. https://doi.org/10.1111/gere.12355

Cai, R., Feng, S., Oppenheimer, M., & Pytlikova, M. (2016). Climate variability and international migration: The importance of the agricultural linkage. *Journal of Environmental Economics and Management*, *79*, 135-151. https://doi.org/10.1016/j.jeem.2016.06.005

Cameron, M. P. (2017). Climate change, internal migration, and the future spatial distribution of population: a case study of New Zealand. *Population and Environment*, *39*(3), 239-260. https://doi.org/10.1007/s11111-017-0289-8

Cattaneo, C., & Peri, G. (2016). The migration response to increasing temperatures. *Journal of Development Economics*, *122*, 127-146. https://doi.org/10.1016/j.jdeveco.2016.05.004

Clapson, M., & Hutchison, R. (2010). Introduction: suburbanization in global society. In *Suburbanization in Global Society* (pp. 1-14). Emerald. https://doi.org/10.1108/s1047-0042(2010)0000010003

Clark, W. A. V. (2020 [1986]). *Human Migration. Reprint*. West Virginia University Research Repository.

Codjoe, S. N. A., Nyamedor, F. H., Sward, J., & Dovie, D. B. (2017). Environmental hazard and migration intentions in a coastal area in Ghana: a case of sea flooding. *Population and Environment*, *39*(2), 128-146. https://doi.org/10.1007/s11111-017-0284-0

Conedera, M., Biaggio, A., Seeland, K., Moretti, M., & Home, R. (2015). Residents' Preferences and Use of Urban and Peri-Urban Green Spaces in a Swiss Mountainous Region of the Southern Alps. *Urban Forestry & Urban Greening*, *14*(1), 139-147. https://doi.org/10.1016/j.ufug.2015.01.003

Crymble, A. (2019). Introduction to Gravity Models of Migration and Trade. In U. University of Hertfordshire (Ed.).

Crymble, A., Falcini, L., & Hitchcock, T. (2015). Vagrant Lives: 14,789 Vagrants Processed by the County of Middlesex, 1777–1786. *Journal of Open Humanities Data*, *1*. https://doi.org/10.5334/johd.1

Dadvand, P., Nieuwenhuijsen, M. J., Esnaola, M., Forns, J., Basagana, X., Alvarez-Pedrerol, M., Rivas, I., Lopez-Vicente, M., De Castro Pascual, M., Su, J., Jerrett, M., Querol, X., & Sunyer, J. (2015). Green spaces and cognitive development in primary schoolchildren. *Proceedings of the National Academy of Sciences of the United States of America*, *112*(26), 7937-7942. https://doi.org/10.1073/pnas.1503402112

Dallmann, I., & Millock, K. (2017). Climate Variability and Inter-State Migration in India. *CESifo Economic Studies*, *63*(4), 560-594. https://doi.org/10.1093/cesifo/ifx014
De Abreu e Silva, J., & Melo, P. C. (2018). Home telework, travel behavior, and land-use patterns: A path analysis of British single-worker households. *Journal of Transport and Land Use*, *11*(1). https://doi.org/10.5198/jtlu.2018.1134
de Haas, H., Czaika, M., Flahaux, M. L., Mahendra, E., Natter, K., Vezzoli, S., & Villares-Varela, M. (2019). International Migration: Trends, Determinants, and Policy Effects. *Population and Development review*, *45*(4), 885-922. https://doi.org/10.1111/padr.12291
de Sherbinin, A., Bukvic, A., Rohat, G., Gall, M., McCusker, B., Preston, B., Apotsos, A., Fish, C., Kienberger, S., Muhonda, P., Wilhelmi, O., Macharia, D., Shubert, W., Sliuzas, R., Tomaszewski, B., & Zhang, S. (2019). Climate vulnerability mapping: A systematic review and future prospects. *WIREs Climate Change*, *10*(5). https://doi.org/10.1002/wcc.600
DeWaard, J., Johnson, J. E., & Whitaker, S. D. (2020). Out-migration from and return migration to Puerto Rico after Hurricane Maria: evidence from the consumer credit panel. *Population and Environment*, *42*(1), 28-42. https://doi.org/10.1007/s11111-020-00339-5
Diekmann, A., Bruderer Enzler, H., Hartmann, J., Kurz, K., Liebe, U., & Preisendörfer, P. (2023). Environmental Inequality in Four European Cities: A Study Combining Household Survey and Geo-Referenced Data. *European Sociological Review*, *39*(1), 44-66. https://doi.org/10.1093/esr/jcac028
Douglas, O., Lennon, M., & Scott, M. (2017). Green space benefits for health and well-being: A life-course approach for urban planning, design and management. *Cities*, *66*, 53-62. https://doi.org/https://doi.org/10.1016/j.cities.2017.03.011
Dovbischuk, T., & Kley, S. (manuscript). Moving to the green? The importance of private, semi-private and neighborhood green spaces in residential relocations across the life course.
Fussell, E., Hunter, L. M., & Gray, C. L. (2014). Measuring the Environmental Dimensions of Human Migration: The Demographer's Toolkit. *Glob Environ Change*, *28*, 182-191. https://doi.org/10.1016/j.gloenvcha.2014.07.001
Gascon, M., Triguero-Mas, M., Martinez, D., Dadvand, P., Forns, J., Plasencia, A., & Nieuwenhuijsen, M. J. (2015). Mental health benefits of long-term exposure to residential green and blue spaces: a systematic review. *International Journal of Environmental Research and Public Health*, *12*(4), 4354-4379. https://doi.org/10.3390/ijerph120404354
Glaser, R., Himmelsbach, I., & Bösmeier, A. (2017). Climate of migration? How climate triggered migration from southwest Germany to North America during the 19th century. *Climate of the Past*, *13*(11), 1573-1592. https://doi.org/10.5194/cp-13-1573-2017
Gröschl, J., & Steinwachs, T. (2017). Do Natural Hazards Cause International Migration?*. *CESifo Economic Studies*, *63*(4), 445-480. https://doi.org/10.1093/cesifo/ifx005
Gustafson, P. (2002). Retirement migration and transnational lifestyles. *Ageing and Society*, *21*(4), 371-394. https://doi.org/10.1017/s0144686x01008327
Hannonen, O. (2020). In search of a digital nomad: defining the phenomenon. *Information Technology & Tourism*, *22*(3), 335-353. https://doi.org/10.1007/s40558-020-00177-z
Hartig, T., Mitchell, R., De Vries, S., & Frumkin, H. (2014). Nature and Health. *Annual review of public health*, *35*(1), 207-228. https://doi.org/10.1146/annurev-publhealth-032013-182443
Hoffmann, R., Dimitrova, A., Muttarak, R., Crespo Cuaresma, J., & Peisker, J. (2020). A meta-analysis of country-level studies on environmental change and migration. *Nature Climate Change*, *10*(10), 904-912. https://doi.org/10.1038/s41558-020-0898-6
Hugo, G. (2011). Future demographic change and its interactions with migration and climate change. *Global Environmental Change*, *21*, S21-S33. https://doi.org/10.1016/j.gloenvcha.2011.09.008
Hystad, P., Davies, H. W., Frank, L., Van Loon, J., Gehring, U., Tamburic, L., & Brauer, M. (2014). Residential greenness and birth outcomes: evaluating the influence of spatially correlated built-environment factors. *Environmental Health Perspectives*, *122*(10), 1095-1102.
Izenstark, D., & Ebata, A. T. (2017). The effects of the natural environment on attention and family cohesion: An experimental study. *Children, Youth and Environments*, *27*(2), 93-109.
Jennings, J. A., & Gray, C. L. (2015). Climate Variability and Human Migration in the Netherlands, 1865-1937. *Popul Environ*, *36*(3), 255-278. https://doi.org/10.1007/s11111-014-0218-z

Keil, R. (2018). *Suburban Planet. Making the World Urban from the Ourside In*. Polity Press.
Kley, S. (2011). Explaining the Stages of Migration within a Life-course Framework. *European Sociological Review*, *27*(4), 469-486. https://doi.org/10.1093/esr/jcq020
Kley, S., & Dovbischuk, T. (2024). The Equigenic Potential of Green Window Views for City Dwellers' Well-Being. *Available at SSRN 4737145*.
Kley, S., & Dovbishchuk, T. (2021). How a Lack of Green in the Residential Environment Lowers the Life Satisfaction of City Dwellers and Increases Their Willingness to Relocate. *Sustainability*, *13*(7), 3984. https://doi.org/10.3390/su13073984
Kok, P. (1997-1999). The Definition of Migration and its Application: Making Sense of Recent South African Census and Survey Data. *Southern African Journal of Demography*, *7*, 19-30.
Lehberger, M., Kleih, A.-K., & Sparke, K. (2021). Self-reported well-being and the importance of green spaces – A comparison of garden owners and non-garden owners in times of COVID-19. *Landscape and Urban Planning*, *212*, 104108. https://doi.org/https://doi.org/10.1016/j.landurbplan.2021.104108
Lerch, M. (2020). International Migration and City Growth in the Global South: An Analysis of IPUMS Data for Seven Countries, 1992–2013. *Population and Development review*, *46*(3), 557-582. https://doi.org/10.1111/padr.12344
Lu, X., Wrathall, D. J., Sundsøy, P. R., Nadiruzzaman, M., Wetter, E., Iqbal, A., Qureshi, T., Tatem, A., Canright, G., Engø-Monsen, K., & Bengtsson, L. (2016). Unveiling hidden migration and mobility patterns in climate stressed regions: A longitudinal study of six million anonymous mobile phone users in Bangladesh. *Global Environmental Change*, *38*, 1-7. https://doi.org/10.1016/j.gloenvcha.2016.02.002
Mahajan, P., & Yang, D. (2020). Taken by Storm: Hurricanes, Migrant Networks, and US Immigration. *American Economic Journal: Applied Economics*, *12*(2), 250-277. https://doi.org/10.1257/app.20180438
Martin, S. F., Bergmann, J., Rigaud, K. K., & Yameogo, N. D. (2020). Climate change, human mobility, and development. *Migration Studies*, *9*(1), 142-149. https://doi.org/10.1093/migration/mnaa030
Mauk, B., & Coulter, C. (December 5, 2023). A Last Wilderness. *The Dial*(11). https://www.thedial.world/issue-11/sami-reindeer-herders-wind-power-renewable-energy
McCormick, R. (2017). Does Access to Green Space Impact the Mental Well-being of Children: A Systematic Review. *Journal of Pediatric Nursing*, *37*, 3-7. https://doi.org/https://doi.org/10.1016/j.pedn.2017.08.027
McEachan, R., Prady, S., Smith, G., Fairley, L., Cabieses, B., Gidlow, C., Wright, J., Dadvand, P., Van Gent, D., & Nieuwenhuijsen, M. J. (2016). The association between green space and depressive symptoms in pregnant women: moderating roles of socioeconomic status and physical activity. *Journal of epidemiology and community health*, *70*(3), 253-259.
Nawrotzki, R. J., & DeWaard, J. (2016). Climate Shocks and the Timing of Migration from Mexico. *Popul Environ*, *38*(1), 72-100. https://doi.org/10.1007/s11111-016-0255-x
Piguet, E. (2021). Linking climate change, environmental degradation, and migration: An update after 10 years. *WIREs Climate Change*, *13*(1). https://doi.org/10.1002/wcc.746
Piguet, E., Kaenzig, R., & Guélat, J. (2018). The uneven geography of research on "environmental migration". *Population and Environment*, *39*(4), 357-383. https://doi.org/10.1007/s11111-018-0296-4
Preisendörfer, P., Liebe, U., Bruderer Enzler, H., & Diekmann, A. (2022). Annoyance due to residential road traffic and aircraft noise: Empirical evidence from two European cities. *Environmental research*, *206*, 112269. https://doi.org/10.1016/j.envres.2021.112269
Ramos, R. (2016). Gravity models: A tool for migration analysis. *IZA World of Labor*. https://doi.org/10.15185/izawol.239
Ravenstein, E. G. (1885). The laws of migration.
Ravenstein, E. G. (1889). The laws of migration. *Journal of the royal statistical society*, *52*(2), 241-305.
Rüttenauer, T., & Best, H. (2021). Environmental Inequality and Residential Sorting in Germany: A Spatial Time-Series Analysis of the Demographic Consequences of Industrial Sites. *Demography*, *58*(6), 2243-2263. https://doi.org/10.1215/00703370-9563077
Sedova, B., & Kalkuhl, M. (2020). Who are the climate migrants and where do they go? Evidence from rural India. *World Development*, *129*. https://doi.org/10.1016/j.worlddev.2019.104848

Seto, K. C., Guneralp, B., & Hutyra, L. R. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(40), 16083-16088. https://doi.org/10.1073/pnas.1211658109

Simini, F., Barlacchi, G., Luca, M., & Pappalardo, L. (2021). A Deep Gravity model for mobility flows generation. *Nature Communications*, *12*(1). https://doi.org/10.1038/s41467-021-26752-4

Smith, S., & House, M. (2006). Snowbirds, Sunbirds, and Stayers: Seasonal Migration of Elderly Adults in Florida. *Journal of Gerontology*, *61B*(5), 232-239.

Stern, N. (2007). *The Economics of Climate Change. The Stern Review*. Cambridge University Press.

Stigsdotter, U. A., & Grahn, P. (2004). A garden at your doorstep may reduce stress–Private gardens as restorative environments in the city. *Proceedings Open Space-People Space, Scotland*.

Suckall, N., Fraser, E., & Forster, P. (2016). Reduced migration under climate change: evidence from Malawi using an aspirations and capabilities framework. *Climate and Development*, *9*(4), 298-312. https://doi.org/10.1080/17565529.2016.1149441

Tan, Y. (2020). Development-induced displacement and resettlement. An overview of issues and interventions. In T. Bastia & R. Skeldon (Eds.), *Routledge Handbook of Migration and Development*. Routledge. https://doi.org/10.4324/9781315276908

Tay, C., Lindsey, E. O., Chin, S. T., McCaughey, J. W., Bekaert, D., Nguyen, M., Hua, H., Manipon, G., Karim, M., Horton, B. P., Li, T., & Hill, E. M. (2022). Sea-level rise from land subsidence in major coastal cities. *Nature Sustainability*, *5*(12), 1049-1057. https://doi.org/10.1038/s41893-022-00947-z

Thiede, B., Gray, C., & Mueller, V. (2016). Climate Variability and Inter-Provincial Migration in South America, 1970-2011. *Glob Environ Change*, *41*, 228-240. https://doi.org/10.1016/j.gloenvcha.2016.10.005

Wagner, M., & Mulder, C. H. (2015). Spatial Mobility, Family Dynamics, and Housing Transitions. *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, *67*(S1), 111-135. https://doi.org/10.1007/s11577-015-0327-4

Wells, N. M. (2000). At home with nature. Effects of „greenness" on children's cognitive functioning. *Environment and behavior*, *32*(6), 775-795.

Wesselbaum, D. (2020). Revisiting the climate driver and inhibitor mechanisms of international migration. *Climate and Development*, *13*(1), 10-20. https://doi.org/10.1080/17565529.2020.1711700

White, M. P., Alcock, I., Wheeler, B. W., & Depledge, M. H. (2013). Would You Be Happier Living in a Greener Urban Area? A Fixed-Effects Analysis of Panel Data. *Psychological Science*, *24*(6), 920-928. https://doi.org/10.1177/0956797612464659

Willekens, F. J. (1987). Migration and development: a micro-perspective. *Journal of the Institute of Economic Research*, *22*, 51-68.

Xu, T., Nordin, N. A., & Aini, A. M. (2022). Urban Green Space and Subjective Well-Being of Older People: A Systematic Literature Review. *International Journal of Environmental Research and Public Health*, *19*(21), 14227. https://www.mdpi.com/1660-4601/19/21/14227