# The Dual Relationship Between Human Mobility and Climate Change in Central Asia: Tackling the Vulnerability of Mobility Infrastructure and Transport-Related Environmental Issues

**Suzy Blondin**

**Abstract** Human mobility impacts the global climate and the climate in turn impacts human mobility. Fuel-based transport emits $CO_2$ and electric transport raises the issue of electricity production and its environmental impacts. Conversely, roads, railways, vehicles and ways of travelling can be impacted by extreme climate events, such as floods, storms, thawing permafrost and melting asphalt. This second aspect of the relationship between climate change and human mobility is rarely explored, even within the scholarship on 'climate mobility'. Focusing on Central Asia, this chapter presents the specificities of the region regarding the environment–mobilities nexus and highlights the adverse impacts of climate-related mobility disruptions for the populations of the region. The chapter is based on the author's fieldwork in Central Asia, particularly in Tajikistan, and on press articles and scientific literature on the topic. It discusses the complex relationship between mobilities and climate change in Central Asia, addresses the interconnection between climate justice and mobility justice and provides policy recommendations to promote sustainable mobilities and reduce mobility dependence in the region.

**Keywords** Mobilities · Accessibility · Infrastructure · Climate change · Central Asia

S. Blondin (✉)
University of Neuchâtel, Neuchâtel, Switzerland
e-mail: suzy.blondin@unine.ch



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## 1 Introduction: Climate Mobility Studies and Current Debates

The way that climate change sets people on the move has been increasingly studied and discussed in recent years in the context of 'climate-induced migration' or 'environmental migration'.[1] Research in the field has shown the complexity of the climate change–mobility nexus, and has revealed the importance of internal, translocal and short-term mobility for populations impacted by environmental hazards (Boas et al. 2019). The concept of 'climate mobilities' 'pays attention to the multiplicity of climate change-related human mobility (involving immobility, relocation, circular mobility, etc.), its embedding in ongoing patterns and histories of movement, and the material and political conditions under which it takes place' (Boas et al. 2022, 2). On the environment–mobilities relationship, some studies have also highlighted the way everyday mobilities are threatened by environmental hazards, how some places are becoming less accessible in the context of climate change (Olsen et al. 2020; Blondin 2022), and how climate change modifies the way some populations circulate within a city or between rural and urban areas (Tuitjer 2019; Arp et al. 2019); however, these studies remain marginal within the climate mobilities scholarship. Disaster-induced mobility restrictions deserve our attention, since, in areas where mobility disruptions are frequent, the issue of habitability is at stake: reduced accessibility may prevent people from practicing essential mobilities to reach work, education, markets, banking or healthcare facilities, for instance, which may cause or exacerbate socioeconomic issues.

The aim of this chapter is twofold: it seeks to highlight the often-neglected issue of the impacts of climate change on mobility infrastructure and conditions, and to position Central Asia in the scholarly discussions on the relationship between climate change and small-scale mobilities. Based on the scientific literature, press reviews and long-term fieldwork in Tajikistan's Pamir Mountains covering a total of 9 months between 2016 and 2020 (Blondin 2020, 2021), this chapter explores both the effects of human mobility on the environment and the effects of climate change on human mobility. The first section of the chapter discusses the way mobilities impact climate change and the environment in Central Asia through the widespread use of old highly polluting vehicles, the lack of public transport in some areas and ongoing large-scale road-building projects. In the second section, the issue is approached from another angle: the impacts of climate change on mobilities are examined through the case of floods and extreme heat damaging the mobility infrastructure. The chapter then presents a discussion on the importance of studying small-scale and everyday mobilities in the context of climate change, considering the interlinkages between climate justice and mobility justice. The conclusion offers policy recommendations to address the issues highlighted in the chapter, focusing both on promoting sustainable mobilities and on reducing mobility dependence in the region.

[1] See climig.com, a comprehensive database on the topic.

## 2 How Mobilities Impact Climate Change in Central Asia

Multiple studies have provided evidence of the impacts of transport and mobility on climate change globally (see Sheller 2018 for a review). Fossil fuel-based transport causes $CO_2$ emissions directly, while electric transport raises issues relating to emissions from the production of electricity and the environmental aspects of batteries. Moreover, mobility infrastructure itself impacts the environment since it occupies land and generates air, noise, and light pollution. This section discusses these issues in the context of Central Asia, through the lens of old polluting vehicles, the lack of public transport, and the ecological impacts of new/projected road infrastructure in the region.

### *2.1 Old Vehicles and Pollution*

Increasingly, studies are raising the issue of poor air quality in Central Asian cities. Bishkek, Almaty and Dushanbe have been highlighted as cities that expose their residents to 'higher-than recommended levels of air pollution'.[2] As Sabyrbekov and Overland (2020, 3) note, for instance, 'on some days in 2019, Bishkek had the highest levels of air pollution in the world' (see also OECD 2019). The transport sector is often considered particularly polluting, especially given that in Central Asia a large number of vehicles exceed the norms for the emission of harmful substances into the atmosphere. Central Asian countries do not have special standards for old emitting cars. Nasritdinov (2021, 188) clearly sums this up, writing about air pollution in Kyrgyzstan:

> [The number of cars] has been increasing very steadily too as Kyrgyzstan was joining the Eurasian Economic Union and there were multiple speculations about the increasing tariffs on imported cars. Most cars imported to Kyrgyzstan are second hand and quite old. They do not have proper emission filtering technologies. The solution to cars would be a proper public transport, but that is in crisis too in Bishkek. The city has a very small stock of buses and trolley-buses. Instead, the majority of residents ride in marshrutkas (mini-buses), which themselves pollute the air more than any other vehicles, but they are also often very inconvenient and crowded to ride. So, for many who can afford, cars are a preferred option.

Throughout Central Asia, the use of private cars has greatly increased since the collapse of the Soviet Union and its public transport system. In places where public (trolley-)buses have stopped operating, *marshrutkas*, or minibuses, have emerged as a bottom-up solution to the lack of public transport (see Rekhviashvili and Sgibnev 2020). While *marshrutkas* offer flexibility (they operate along a variety of routes and users can usually stop wherever they want, not only at formal bus stops) and an important source of income for many households, they contribute significantly to the high levels of air pollution in Central Asian cities. Often, old or vulnerable

[2] https://blogs.worldbank.org/europeandcentralasia/five-steps-for-cleaner-air-in-central-asia.

vehicles[3] emitting high levels of carbon are used as *marshrutkas*. In many regions throughout Central Asia, the distribution of buses, trams or metros is not sufficient to limit the use of mini- and microbuses and their adverse effects on air quality. While *marshrutkas* usually complement regular public transport, they constitute the only shared transport option in some regions, especially rural ones, such as Tajikistan's Viloyati Mukhtori Kuhistoni Badakhshon (VMKB) region (which extends across half of Tajikistan's total territory).

Even in cities where buses or tramways operate well, the issue of fares also plays an important role (Asia Plus 2021). Public transport is too expensive for a large part of the population, who have no other option than to use the cheaper *marshrutkas*, even though they are often viewed as uncomfortable or as reinforcing gender inequality and social exclusion since they expose passengers to harassment, threats or theft which may prompt them to reduce certain forms of mobilities (Nasritdinov 2021; Turdalieva and Edling 2018). In some areas or at some hours, taxis (i.e. private cars rather than minibuses) are the only motorised option available, and also contribute to high carbon emissions and poor air quality due to their old age and lack of maintenance, and because they carry fewer passengers than *marshrutkas.*

While some transport experts (or development banks, such as the Asian Development Bank in Tajikistan)[4] advocate for the use of electric vehicles in order to limit or eliminate carbon emissions, this 'solution' would not seem suitable for Central Asian countries in the near future since power shortages are still frequent (RFERL 2021), and strongly impact large segments of the population, especially in Tajikistan and Kyrgyzstan. Turning to electric vehicles would raise serious issues in terms of electricity production and distribution in these countries. In addition, it is important to note that, even while the use of electric vehicles might help to reduce carbon emissions, the production and recycling of batteries remain problematic in terms of environmental impacts and sustainability.

## *2.2 The Ecological Impacts of Mobility Infrastructure*

While vehicles are central when thinking about the links between mobilities and climate change, we should not forget about the impacts of the mobility infrastructure, such as roads, railways, or airports, itself. Such infrastructure provokes air, noise and light pollution that may have profound impacts on the environment. In Central Asia today, road-building projects are numerous, and many are large scale. The Chinese government's Belt and Road Initiative (BRI) is probably the most talked about project in this domain (Vakulchuk and Overland 2019). While building or renovating roads in Central Asia seems crucial because some areas still suffer from road infrastructure decay, the adverse environmental impacts of road building should be noted. In the case

[3] For instance, the Chinese 'Tangen' minibuses in Khorog, Tajikistan, which need almost constant maintenance given their vulnerability to poor road conditions and frequent hazards.

[4] https://development.asia/insight/how-electric-vehicles-can-make-tajikistan-emissions-free.

of large-scale Chinese-led road projects, the environmental impacts of infrastructure projects are often overlooked. As Coenen and colleagues (2021, 4) observe:

> Protecting the environment while fostering economic development under the BRI will be challenging, as the initiative traverses a diverse range of fragile environments. Biophysical conditions range from forests and steppes in Russia, to ice, snow, and permafrost across the Tibetan Plateau, and tropical rainforests in Malaysia.

Building roads, railways or harbours have negative impacts on ecosystems, biodiversity and wildlife, and such infrastructure may encourage new human settlements, which would occupy more land and likely cause deforestation and/or aridification. In addition, the construction of mobility infrastructure itself results in an increase in $CO_2$ emissions and 'accelerate[s] extraction of natural resources, such as water, sand, and ferrous metal ores in countries along the BRI' (Coenen et al. 2021, 5). Since environmental regulations are getting harsher in China, countries like Tajikistan are also becoming 'pollution havens' where cement is increasingly produced (Coenen et al. 2021).[5]

Within cities as well, new infrastructure is often built at the expense of local biodiversity. For instance, in Bishkek, activists have recently spoken up about the cutting of old urban trees for the sake of road construction.[6] In addition to carbon emissions and loss of biodiversity, the cutting of trees to build infrastructure raises the issue of the adaptation of cities to global warming given that the presence of vegetation is often presented as a solution to mitigate the effects of extreme heat waves within cities (a phenomenon known as the 'urban heat island', see for instance Hiemstra et al. 2017). Thus, the elimination of green areas could have heavy consequences in Central Asian cities where temperatures regularly reach extremes. The presence of green areas in cities also has a crucial impact on urban dwellers wellbeing and connectedness to the biophysical world (Phillips and Atchison 2020).

In sum, in Central Asia, transport has a high environmental cost. Although this could be said of every part of the world, Central Asia faces the specific issue of a lack of public transport—especially electric buses or trams—combined with a heavy reliance on old and highly polluting minibuses and private cars. The famous *marshrutkas* of Central Asia are illustrative: they operate to compensate for the lack of public transport and offer a more flexible and often cheaper way to travel, but this is also more polluting and often less comfortable. Large-scale road-building projects in Central Asia also raise the issue of the ecological impact of mobility infrastructure, especially when it requires the cutting of trees, damages arable lands or grazing areas, or is situated in disaster-prone areas. While mobilities highly influence climate change, climate change in turn damages the mobility infrastructure itself and may disrupt mobilities. The next section explores the ways that climate change impacts mobilities in Central Asia.

[5] https://chinadialogue.net/en/pollution/9174-china-shifts-polluting-cement-to-tajikistan/.

[6] https://www.opendemocracy.net/en/odr/tree-cutting-and-pollution-in-bishkek/.

## 3 How Climate Change Impacts Mobilities in Central Asia

In Central Asia, some roads are frequently blocked by floods or mudslides, increasingly so as temperatures rise and glaciers melt, while other roads are buckling under extreme heat. Road closures pose a threat to the communities who depend on these roads to access products, healthcare, and work or educational opportunities (Blondin 2020). Residents of rural areas (still the majority of the Central Asian population)[7] are particularly affected by mobility disruptions since their livelihoods and quality of life depend on rural–urban mobilities. On a wider scale, the vulnerability of the road infrastructure to environmental hazards reduces economic development and international cooperation. Climate change acts as a threat multiplier in regard to such processes (Lim 2016).

### *3.1 The Effects of Environmental Disasters on Mountain Roads and Rural–Urban Mobilities*

Mountainous areas represent a large part of the Central Asian territory, especially in Tajikistan and Kyrgyzstan. A huge portion of the residents of these countries live in mountainous areas and regularly have to travel along roads that are highly vulnerable to rockslides, landslides, avalanches and/or floods. These hazards are not new and have always been part of mountain dwellers' lives. However, climate change has increased the frequency and intensity of these hazards (Hock et al. 2019) or limited their predictability. The melting of glaciers increases the runoff of many rivers, which triggers floods (ibid.). As Zhao et al. (2010) have shown, permafrost is present in many areas throughout Central Asia, and its thawing poses a serious threat to engineering infrastructure, including roads. The growing unpredictability and intensity of precipitation also provoke more rockslides and avalanches, affecting roads and paths.

Related road maintenance requires significant funding and human resources, especially in remote areas, which often does not seem to be the priority for local governments. In Central Asia's mountain areas, residents often have to repair or clear the roads themselves. In Tajikistan's Bartang Valley, for instance, residents often gather to voluntarily 'repair' *their* road with local means. They clear snow and rocks or attempt to elevate the level of the road when it is flooded using rocks, sand, and wood (Blondin 2020). This kind of repair work is often precarious and unsustainable and puts the individuals involved in dangerous situations.

In the face of environmental hazards, roads and paths are not the only things affected. Old vehicles are also highly vulnerable to challenging road conditions and need regular maintenance. In Tajikistan's VMKB region, old four-wheel vehicles—usually bought second-hand and imported from places such as the United Arab

[7] https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=Z7.

Emirates, Qatar or Japan, via Tajikistan's capital, Dushanbe—are used as shared 'taxis' in the absence of public transport. Shared car trips in the VMKB involve frequent stops for repairs and sometimes include unexpected overnight stays after cars break down. Given the remoteness of the region from the main markets, purchasing car parts is usually a long and costly process. This definitely puts into question residents' mobility capacities (also called *motility*; see Blondin 2020), their personal safety, and their potential to move back and forth between rural and urban areas. Given the harsh conditions along mountain roads, residents lack adapted mobility options. They often praise the resilience of Soviet vehicles (jeeps and trucks) on flooded and potholed roads.

In Soviet times, many villages in the Bartang Valley were not connected by road and there were no private cars. For residents of those villages, travelling included long walking trips. However, the *Moscow provisioning system* (Mostowlansky 2017) meant that even remote places such as the Bartang Valley were supplied with the most 'essential' products with the help of trucks and/or helicopters. Public bus services operated on the main road of the VMKB region (the M41), and planes would regularly connect the region with Dushanbe. The collapse of this provisioning system has meant that residents of remote valleys have had to find their own mobility options to reach the products and services they need. Even though environmental hazards are not the only reason for mountain dwellers' lack of motility, the fact that 'essential' mobilities can't be realised when roads are closed following hazards raises the issue of the habitability of affected areas. While the residents of Bartang are strongly attached to their valley and most of them aspire to remain (Blondin 2021), they often point out that *their* road represents a serious risk to their livelihoods. Throughout the mountainous regions of Central Asia, the melting of glaciers and permafrost, the increased intensity of floods, and the growing frequency of hazards raise a concern about mountain dwellers' capacities to circulate and to remain in the places they call home.

### *3.2 The Effects of Extreme Heat on Asphalt and Railways*

Away from mountainous areas, extreme heat waves also affect roads and railways. Studies covering different areas of the globe have highlighted the vulnerability of asphalt and railway tracks to extreme temperatures, with extreme heat possibly resulting in 'rutting deformations and cracking of asphaltic roads' (Makkonen et al. 2014, 692). Qiao and colleagues (2020, 342) also explain that 'flexible pavements are particularly vulnerable to extreme high temperatures that can cause a decrease in bitumen viscosity, potentially aggravating rutting (i.e., permanent deformation), roughness, and cracking'. As an example, in the summer of 2021, during the severe heat wave in Canada and the North-Western part of the USA, 'roads buckled as their asphalt cracked amid the heat' (*The Washington Post* 2021a). Closer to Central Asia, a study carried out in Xinjiang, northwest China, has shown that high temperatures

and significant daily temperature differences have caused serious asphalt pavement distresses, such as rutting and shoving.

Given that most of Central Asia's territory is characterised by a continental climate, with high summer temperatures getting even higher under the effects of climate change (Reyer et al. 2017), Central Asian roads are highly vulnerable to such processes. In July 2021, an article by Azatlyk Radiosy[8] reported road buckling under temperatures reaching up to 50 °C in Turkmenistan (Azatlyk Radiosy 2021). Summer 2021 was considered the hottest ever recorded in areas such as Central Asia, with temperatures reaching up to 44 °C in Termez, Uzbekistan (*The Washington Post* 2021b). Under the effects of global warming, such heat waves are predicted to be more frequent and more intense, which could definitely provoke mobility infrastructure failures. In addition to impressive rapid-onset hazards such as floods, rockslides and avalanches, more 'discrete' hazards such as heat waves and permafrost thaw affect mobility infrastructure and mobility conditions. These should be of interest for research on the socioeconomic impacts of climate change, especially in a climate-vulnerable region such as Central Asia. The next section discusses and re-politicises the issues of mobility infrastructure failures, accessibility and habitability in the context of climate change.

## 4 Discussion: When Climate Justice Meets Mobility Justice

Given Central Asia's topographical and climatic specificities and the region's environmental vulnerabilities, there is an urgent need to examine the way mobilities and climate change intersect in the region (Vakulchuk et al. 2022). It is crucial to ensure that populations can dwell and circulate in city suburbs and rural and/or mountainous areas, by improving public transport and the resilience of infrastructure in the face of environmental hazards. Central Asian societies are very mobile both between rural and urban areas, and regionally, between Russia and Central Asia for instance, hence the need for them to enjoy sufficient mobility capital to realise those mobilities. Studies have showed how translocality may represent a strategy in the face of the adverse effects of climate change (Sakdapolrak et al. 2016). Accessing economic and educational opportunities, products, and services, in urban centres is central to the livelihoods of rural populations; their inability to sufficiently circulate could provoke out-migration. This means that inaccessibility may lead to relocation (Blondin 2022), with territorial accessibility being part of living conditions and perceived habitability.

The 'mobility justice' approach developed by Sheller (2018) re-politicises the issues of mobility capitals, (in)accessibility and the capacity to dwell and to circulate. Studying the effects of mobilities on climate change and the effects of climate change on mobilities is a way to connect mobility justice and climate justice. Questions of how best to promote and adopt resilient and sustainable mobilities to ensure the mobilities of those who really need it in the context of climate change remain. In

[8] From the Radio Free Europe/Radio Liberty Group.

Central Asian countries, much is yet to be done to increase the population's awareness about the impacts of mobilities on climatic conditions also to increase the mobility capacities of populations that suffer from a lack of accessibility where they live (Blondin 2020).

## 5 Going Forward: Policy Recommendations

Although issues around the human mobilities–environment nexus are manifold and complex, Central Asian authorities, alongside the local populations, could work towards promoting sustainable mobilities and increasing accessibility while also reducing mobility dependencies in some areas.

### *5.1 Solutions for More Sustainable Mobilities*

**Promoting and developing public transport**: In Central Asia, more efficient, accessible and affordable public transport systems would help to reduce the number of private cars and old minibuses in an effort to lower pollution levels and to help residents increase their capacity for mobility. In Sheller's mobility justice approach (2018), this corresponds to a 'commoning of mobilities'.

**Promoting green mobilities**: In Central Asia, the active promotion of green mobilities is lacking. Authorities should prioritise the promotion of walking and cycling, or, potentially, the use of electric vehicles. For instance, authorities should address the factors that discourage cycling, such as 'being female, being a student, being a civil servant, living in a block of flats, and age' (Sabyrbekov and Overland 2020, 11) in order to create bicycle-friendly environments and make cycling more socially acceptable and valued. In Central Asia, NGOs and other organisations are already promoting cycling in active ways, as in the case of 'Car Free Day' street actions and cycling actions in Dushanbe led by the NGO Malenkaya Zemlya.[9]

**Increasing the resilience of mobility infrastructure**: Although building climate-resilient roads, railways or bridges is challenging and costly, solutions exist to make mobility infrastructure more robust and sustainable (see for instance engineering options to design 'new climate-resilient roads in the Kyrgyz Republic' by Lim [2016]).

**Avoiding new polluting road-building projects or mitigating their environmental impacts**: Although Central Asia still needs to improve its road infrastructure in many areas, it is crucial to discuss and mitigate the environmental impacts of all road (re)construction projects which threaten biodiversity and residents' wellbeing, and emit $CO_2$.

[9] https://leworld.org/en.

## 5.2 Solutions to Reduce Mobility

**Reducing mobility dependence**: Ensuring better access to 'essential' products and services (healthcare, educational opportunities, banking facilities) in rural areas is crucial to alleviating residents' mobility dependence. Provisioning 'remote' areas could relieve residents from the burden of complicated, dangerous, and costly mobilities.

**Improving emergency mobility capacities**: In the face of disasters and mobility disruptions, it is crucial to help residents leave, circulate or find shelter. Improving emergency mobility capacities in preparation for such events is critical, and includes developing evacuation, maintenance and repair systems. This would help residents deal with disasters from social, environmental, and mobility justice perspectives (Graham and Thrift 2007; Sheller 2018).

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**Suzy Blondin** received her PhD in geography from the University of Neuchâtel, Switzerland, in 2021. Her doctoral dissertation examines (im)mobilities to, from and within Tajikistan's Bartang Valley and the way rural–urban mobilities help the Bartangis to remain and to preserve intimate bonds with their Valley despite environmental risks and economic vulnerabilities. Her research also brings forward the issue of involuntary immobility caused by frequent hazard-related road closures and low motilities, which threatens local livelihoods. Her work has been published in Mobilities, Geoforum and the Central Asian Survey.