Environmental Research Letters

LETTER

The environmental footprint of academic and student mobility in a large research-oriented university

Julien Arsenault1, Julie Talbot1, Lama Boustani1, Rodolphe Gonzalès1 and Kevin Manaugh2

1 Département de Géographie, Université de Montréal, Canada
2 Department of Geography and McGill School of Environment, McGill University, Canada

E-mail: julien.arsenault.1@umontreal.ca

Keywords: academic mobility, student mobility, nitrogen footprint, carbon footprint, air travel

Supplementary material for this article is available online

Abstract

Academic mobility for field work, research dissemination and global outreach is increasingly recognized as an important contributor to the overall environmental footprint of research institutions. Student mobility, while less studied, also contributes to universities’ environmental footprint. Université de Montréal (UdeM) is the largest university in Montréal, Canada. It has a research budget of 450M$, employs 1426 full-time professors, and has a total student population of 33,125 undergraduate and 12,505 graduate students. To assess the footprint of academic mobility at UdeM, we surveyed the research community (n = 703; including professors, research professionals and graduate students) about their travel habits. We also measured the contribution from travel undertaken by sports teams and international students as well as students engaged in study abroad and internships programs using data provided by the university. While the average distance travelled for work and research purposes by the UdeM community is around 8525 km/person, professors travel more than 33,000 km/person per year. We also estimated that the 5785 international students or students enrolled in study abroad programs travel annually around 12,600 km/person. UdeM’s per capita annual travel-related C and N footprints vary, with international students generating for example 3.85 T CO2 and 0.53 kg N while professors generate 10.76 T CO2 and 2.19 kg N. Air travel emissions are the main contributors to these footprints. We provide insights into the distribution of travel-related environmental footprint within the university, the main reasons for travelling, the most frequent destinations, and the factors preventing researchers from reducing their travel-related environmental impact.

1. Introduction

Long-distance travel, to attend workshops, conferences and to engage in field work is a central component of academic careers and indeed to university’s internationalization strategies and orientations, and is often considered beneficial to their reputation (Ackers 2008, Glover et al. 2017). While academics and, to a lesser extent, students, are encouraged to be hypermobile, the environmental burden that this hypermobility generates is often ignored (Caset et al. 2018). The substantial environmental impact of academic conferences, one of the components of academic mobility, has garnered increasing attention over the last two decades (e.g. Hischier and Hilty 2002, Spinellis and Louridas 2013). For example, the paradox of flying to conferences where climate change or environmental research is presented and discussed has been repeatedly addressed in research (Nevins 2014, Attari et al. 2016) as well as opinion or news pieces targeted at academics (Grémillet 2008, Fox et al. 2009, Burke 2010, Langin 2019).

While attending conferences is an important component of the environmental footprint of research (Achten et al. 2013), other activities also generate environmental impacts, including travel for field work, theses defenses and committee meetings and, if academic mobility is taken in a wider sense, graduate students’
interships. Studies looking at academic mobility typically identify passenger air travel as the most important contributor to the academic travel environmental impact. Air travel is one of the least energy efficient modes of transportation, though it is important to note that its efficiency relative to rail and bus modes varies by distance travelled (while bus travel is much more efficient to air at short and medium distances, this changes at longer distances), as well as factors that may vary by local provider (Liu et al 2016). Globally, it accounts for 2%–3% of the total CO₂, fossil fuel emissions, and its relative importance continues to grow (Lee et al 2009). Universities have variable policies regarding air travel, from an absence of recognition of its environmental impact, to an explicit acknowledgment of its environmental impact, and to the establishment of mitigation strategies (Glover et al 2018).

In addition to professors and students travelling to field sites and conferences, travel by international students to attend university (and to visit home), as well as the travel related to students temporarily leaving their home university for a semester or more, also generates environmental impacts. International student mobility is increasingly valued (Grantham 2018) and has been rising steadily over the last few decades and is expected to continue to rise. For example, in Canada, temporary study visas given to foreign students increased by a factor of 4.6 between 2000 and 2018 (IRCC 2019). The environmental impact of that mobility has very seldom been addressed.

Environmental footprints are a way to assess the environmental impact of human activities by quantifying the ‘human appropriation of natural capital’ (Hoekstra and Wiedmann 2014). The carbon (C) footprint is a relatively well established metric to quantify the amount of carbon dioxide (CO₂) emitted directly or indirectly because of human activity (Wiedmann and Minx 2008). Nitrogen (N) footprint is a more recent metric used to quantify the amount of reactive nitrogen lost to the environment because of the consumption of food and energy (Leach et al 2012). In the case of transportation, we consider reactive N emitted by fuel combustion. These have seldom been applied to specifically address the environmental impact of academic and student mobility together, although some footprint metrics have been applied to conferences (e.g. Nevinss 2014) and to research (e.g. Achten et al 2013, looking at the carbon footprint of a PhD), and the impact of different forms of travel have been assessed as part of wider, institutional-level C footprint assessments (Ozawa-Meida et al 2013).

In this context, we focus on the environmental impact of the transportation component of both academic and student mobilities using C and N footprints as our metrics, with special emphasis on air travel, using Université de Montréal (Canada) as a case study. This assessment is focused on work- or study-related mobility and therefore does not include daily commutes to and from the institution. Our objectives are to (1) generate a portrait of academic and student mobility in a large research-oriented university; (2) calculate the C and N footprint of the travel component of such mobility; and (3) address possible approaches to reduce the environmental impact of academic travel.

2. Methodology

2.1. Université de Montréal: context and overview

Montréal is home to 11 universities and graduate-studies institutions, with Université de Montréal (UdeM) being the largest. It is Canada’s sixth university in terms of research grants with an annual research budget of 450M$ (CAUBO 2018). In the 2017–2018 academic year, UdeM, not counting its affiliated schools HEC and Polytechnique, which are administered separately, employed 1426 full-time professors, and had a population of 45 630 full- and part-time students, of which 12 505 were graduate students. UdeM also welcomed 5003 international and 981 interprovincial students, confirming its global outreach, and 788 of its students were involved in study abroad programs.

2.2. Data gathering

An online survey designed to capture the university community academic travel habits (approved by UdeM’s Research Ethics Board Office) was distributed via the administrative offices of each academic department and was sent by email to all professors, students, postdoctoral fellows and research staff (supplementary material for details is available online at stacks.iop.org/ERL/14/095001/mmedia). The participation was voluntary. This survey asked the respondents to provide the number of research- and work-related trips they took in the 2017–2018 academic year to different regions of the world: inside the province of Québec but out of the Montréal metropolitan area, to other Canadian provinces, to the Canadian Arctic, to the United States, to Latin America, to Europe, to Russia, to the Middle East, to China or East Asia, to India or Central Asia, to Southeast Asia, to Africa, and to Oceania. We then asked the specific location of travel, the mode of transportation used and the reasons for travelling for three trips. We also asked open questions on carbon offsetting and the use of alternative meeting methods. No personal question was asked in order to preserve the anonymity of the respondents.

The survey was available online from mid-May to late August 2018 and a reminder email was sent in late June. We received a total of 815 responses. After cleaning the database of incomplete responses, inadequate answers (e.g. personal travel) or respondents that were not targeted by the survey (e.g. administrative staff), 703 responses were kept: 113 professors (8% of all...
UdeM’s professors), 44 postdocs (9% of all postdocs), 367 graduate (3% of all graduate students), 115 undergraduate students (9.5% of all undergraduate research assistants) and 64 research staff (14% of all research staff). Using data from the human resources and the unions, we estimated the number of research staff to be 450 full-time employees and the number of undergraduate research assistant to be 1200, or 5% of all undergraduate students.

Additional data sources were used to capture further travel-related factors. Student mobility data (international students and students involved in study abroad programs) for the year 2017–2018 were accessible through the Office of International Students. Sports team mobility data were given by UdeM’s sports team administration. We obtained full sports team data including details on every travel made in the 2017–2018 academic year. Data included the number of people travelling (athletes and staff), the destination and the mode of transportation used. Note that sports teams are a non-mutually exclusive group in this research, as they may include international students, research assistants and regular employees.

2.3. Data analysis

Based on the academic mobility survey, we estimated the percentage of people who travelled in the 2017–2018 academic year and assessed the main regions visited by each group. To calculate each region’s distance from Montréal, we determined a centroid based on the specific location of travels provided by the respondents when they had to provide details for three of their trips. The centroid allowed us to calculate the mean distance between Montréal and the cities visited in the region, using the great circle distance equation (Chen et al. 2004).

We used the survey averages to estimate travel frequency and destinations for each position susceptible to travel for academic purposes (professors, post-doctoral fellows, graduate students, undergraduate research assistants and staff). For each position, we calculated the per capita distance travelled by summing all annual distance travelled per person and dividing it by the number of people in each position who answered the survey.

For each mode of transportation, we estimated the average distance travelled and the percentage of trips to each destination based on the details provided by the survey respondents on three of their travels.

For students enrolled in study abroad programs, we were able to gather information about the visited cities. However, as the Office of International Students could only provide the number and country of origin of international students, we used the capital city of their country as the place of origin and assumed that the students made one round-trip per year. For students from the United States, we used the country population centroid as the point of origin because the possible range of the distance travelled from Montréal to the US is very large. We measured the distance from Montréal to each of these locations using the great circle distance equation. We assumed all students travelling to and from international destination, except for the US, travelled by plane. For students travelling to and from the US and other Canadian provinces, we used the same percentages of car, bus and train travels as the ones that were obtained from the academic mobility survey.

2.4. C and N footprints calculations

C and N footprints were calculated with the University of New Hampshire’s SIMAP platform (https://unhsmiap.org) which accounts for the different modes of transportation. For each mode of transportation, the fleet and fuel mix emissions factor is calculated using the US averages. For air travel, the emissions factor is the average of all aircrafts’ emissions factors available in the US in 2008, 2011 and 2014 and takes into account landing and take-off. Passenger kilometers are multiplied by the calculated emissions factors. The emission factors used in the calculations are from the National Emissions Inventory of the US Environmental Protection Agency (EPA 2014). C footprint, based on 100 year global warming potential, was estimated by summing the CO2 equivalent of CO2 and methane (CH4) emissions for research-related financed travelled and for student mobility. N footprint is estimated by summing the N equivalent of nitrous oxide (N2O) and nitrogen oxides (NOx) emissions (Leach et al. 2013). The methodology used for the C footprint calculations in SIMAP are the ones codified by the GHG Protocol Initiative (GHG Protocol, 2004), where the CO2 equivalent of CH4 is obtained by multiplying CH4 emissions by 25 based on the CH4 warming potential.

Although our survey was non-probabilistic, it is currently the best estimate we have of the weight that academic travel has on the C and N footprints of UdeM. We did not collect personal information on the respondents other than their affiliation to a faculty or a school. Based on these results, we know that the distribution of the respondents between the different faculties and schools is roughly the same as the actual distribution of the university community. For example, 50% of the respondents are from the Faculty of Arts and Sciences (UdeM’s largest faculty), which accounts for 46% of the University community.

3. Results

3.1. Academic mobility

The results of the survey show that most academic travels are to short-distance, within-Québec locations and that international travels are mostly to the US or to Europe (figure 1). Ninety-seven percent of professors travel at least once a year, mostly to Europe, inside the
province of Québec or to other Canadian provinces, travelling on average 7.1 times yearly for a total of more than 33 000 km per person (table 1). Of the 7.1 trips made by professors, 2.3 were to local, within-Québec locations, 1.3 were to other Canadian provinces and 3.5 were international, mostly to Europe and to the United States. In Europe, France was the most visited country with 33% of the responding professors having travelled there at least once in the 2017–2018 year. Postdoctoral fellows travelled on average 4.6 times per year (13 590 km), mostly to local (2.2 trips) and international destinations (1.5 trips). Undergraduate research assistants (1.2 trips per year, 0.7 within Québec and 0.3 to other Canadian locations), graduate students (3.3 trips per year, 2.1 within Québec and 0.4 to Canadian locations) and staff (2.8 trips per year, 2.3 within Québec and 1.5 to other Canadian locations) all mostly travelled within the country.

In terms of total distance travelled, international trips are more important than local trips (see supplementary material). Of the 33 080 km travelled by professors, only 4350 and 1120 km were to other Canadian provinces or within Québec, respectively, but 27 600 km, or 83% of the total distance travelled, were to international destinations. Likewise, between 70% and 78% of the total distance travelled by students, postdocs and research staff was to international destinations.

Purposes for travelling vary (figure 1 and supplementary material). 66.9% of the survey respondents travelled to conferences or to take part in seminars or workshops. Only 18.2% of the respondents travelled for field work or research purposes, 7.4% for other...
academic tasks (committee, thesis evaluation or student supervision) and 2.9% for multiple purposes.

3.2. Student mobility
In 2017–2018, there were 5003 international students studying at UdeM, with the majority coming from France (2912), and 981 out-of-Québec Canadian students, mostly from Ontario (558). The 788 UdeM students enrolled in study abroad programs mostly travel to the US, Europe or to Japan (figure 2). Assuming one round-trip per year per person, data shows that international and interprovincial students and those enrolled in study abroad programs travel 12 578 km/person annually on average, while individual students from other Canadian provinces travel 2209 km yr⁻¹ (table 2). UdeM sports team members travelled on average 1480 km yr⁻¹ and 93% of them travelled at least once to out-of-Québec locations. However, most trips are within-province.

3.3. Transportation modes
When merging academic and student mobility, 43.1% of all trips are done by car, 35.1% by plane, and 20.3% by bus or train. A small proportion of trips, mostly for

![Figure 2. Countries and provinces of origin of international or out-of-province students (red) and destinations visited by UdeM’s exchange students (blue). The numbers in the circles, as well as their sizes, show the total number of students originating from and having travelled to the different locations.](image)

| Location          | Number of IIT students | Number of students in exchange | Travelled distance by students (km) |
|-------------------|------------------------|-------------------------------|-----------------------------------|
| France            | 11 028                 | 2912                          | 34 297 100                        |
| China             | 20 934                 | 217                           | 4752 400                          |
| Belgium           | 11 096                 | 113                           | 1875 430                          |
| Brazil            | 16 412                 | 100                           | 1854 710                          |
| Japan             | 20 785                 | 18                            | 1351 025                          |
| Cameroon          | 18 664                 | 71                            | 1362 460                          |
| Switzerland       | 11 890                 | 73                            | 1248 570                          |
| Morocco           | 11 376                 | 112                           | 1274 090                          |
| Senegal           | 12 468                 | 81                            | 1072 240                          |
| Haiti             | 6130                   | 54                            | 410 710                           |
| US                | 3538                   | 46                            | 403 490                           |
| Other Canadian provinces | Average = 1096 | 981 | 2235 800 |
| Other countries   | Average = 15 100       | 1206                          | 22 937 590                        |
|                   |                        |                               | Total travelled distance by students (km) 72 839 815 |
research purposes, are done by pickup truck. Trips made by car averaged 288 ± 122 km per trip, and cars were used for 69.0% of within-province trips, 22.2% of the trips to other provinces and 17.2% of the trips to the US. Trains and buses (305 ± 80 km per trip) were used in 27.4% of local and national trips and 4.3% of the trips to the US. Air travel (4876 ± 1851 km per trip) was used for all other international destinations and the Canadian Arctic, for both academic and student mobility. When looking at student mobility alone, air travel was used for 87.4% of the trips and 96.9% of the total distance travelled.

3.4. C and N footprints
The results show that UdeM’s per capita C and N footprints are, on average, 2.97 T CO2 and 0.53 kg N respectively and weighted for the demographic proportion of each position. Professors have a per capita footprint of 10.76 T CO2 and 2.19 kg N and international and exchange students a footprint of 3.85 T CO2 and 0.53 kg N (figure 3). Sports team members have a C footprint of 0.50 T CO2 and a N footprint of 0.10 kg N. Overall, student and sports team mobility have combined C and N footprints of 23 049 T CO2 and 3.20 T N. Of these C and N footprints, 84% are due to air travel.

3.5. Carbon offsets
Only 11.2% of the professors and 5.6% of the students and staff have bought C offsets at least once in the 2017–2018 academic year (see supplementary material). Of all the surveyed people, 60.2% did not know what C offsetting was or did not know how to buy offsets and 6.7% of the people had no interest in buying C offsets. Some respondents also explained their opposition to C offsetting by the lack of confidence they have towards the organizations proposing them. Some also believed C offsetting was a sort of ‘green washing’ and that responsibility should not be put on individuals but rather on broader collective/societal levels, the problem being ‘systemic and not individual’. However, 26.6% of the professors expressed the will to purchase C offsets but explained that such expenses were not allowed by research funds and therefore did not buy offsets.

3.6. Alternative technological solutions
When asked to provide information on the use of alternative solutions to travel, such as videoconferencing, 23.0% of the respondents said they have never used such technology and 68.5% of the respondents said they would like to use it more often or have an easier access to it on campus. For many respondents, technological solutions facilitate their work by saving them time (80.3%) or by reducing logistics issues associated with travelling (71.1%). However, 31.5% of respondents do not see any interest in using alternative meeting solutions, mostly because of inefficient technology (44.3%) or to facilitate human interaction (42.4%).

4. Discussion
Hypermobility, whether to pursue studies abroad, to conduct research or to attend conferences, has become a central component of the university experience for many students and most academics. In this research, we show that a large proportion of the student population travel great distances over the course of their studies, and that researchers (including staff and graduate students) are engaged in various activities that require extensive travelling to local and international destinations. For example, at the upper end of the distribution, the longest total distance travelled by a UdeM professor was 175 960 km. This is similar to numbers shown by Langin (2019).

We show that academic and student mobility disproportionally contribute to the environmental footprints of the UdeM community members. The
professors that answered our survey, through their work-related travel alone, have a per capita annual C footprint (10.76 T CO$_2$) that is in the same range than the per capita average household C emission in Canada (13.14 T CO$_2$; Maraseni et al. 2015). Extrapolating our results to the entire community (weighting the footprint per respondent category for its demographic weight within the university, see supplementary material for details), we estimate that academic mobility contributes to 39% and 14% of the total C and N footprints of UdeM, respectively (unpublished data). Academic air travel alone contributes to 30% and 7% of C and N university footprints. When adding student mobility (including sports team travels), we evaluate that student and academic mobility together contributes to 60% and 20% of the university C and N footprints, respectively. Total C and N footprints of the university include emissions from the university-owned transportation fleet, stationary fuels, research animals, purchased utility consumption, daily commuting of the university community (employees and students), food sold on campus, paper products consumption and waste and wastewater.

Our results therefore indicate that academic and student mobility can be the main contributors to a research-oriented university C footprint, and an important contributor to its N footprint. Few other published results are directly comparable to our results. Some studies have looked at the weight of academic air travel specifically on the total C footprints of academic institutions. For example, business air travel contributes to 2% of the total C footprint of the University of Cape Town in South Africa, an institution that is comparable in terms of the number of students and staff to UdeM (Letete et al. 2011), while air travel accounts for 14% of all emissions at the smaller Yale University (Thurston and Eckelman 2011), and about one third of the CO$_2$ emissions of a small Swiss technical university (Giers et al. 2019). Some estimates also include, like in our case, both academic and student mobility. A UK-based university of about half the size of UdeM has a total C footprint contribution from ‘business travel, visitor travel, UK based student travel and international student travel’ of 11% (Ozawa-Meida et al. 2013), while academic and student mobility contributed to 16% of the C footprint of the Norwegian University of Technology and Science, an institution with more than 42 000 students and 7400 staff (Larsen et al. 2013). Finally, new numbers show that researchers from McGill University, another research-oriented university of similar size located in Montréal, make 3.1 airplane trips per year on average and that emissions associated with long distance travel are seven times larger than those related to daily commutes (Manaugh and Kramer, under review).

The environmental weight of academic and/or student mobility depends on many factors, including the size of a university, its geographical location, its internationalization policies, and its research budget. While international and domestic students seem to carry a large proportion of the environmental burden of mobility in our study, this is very much tied to the geographical location of UdeM, located within a very large country. In contrast, European institutions may have a large number of students coming from nearby countries looking for an international experience, reducing the environmental cost of internationalization. Another aspect specific to UdeM is the fact that it is located in a francophone setting within a wider anglophone context. This is reflected in the origin of international students, 72% of which are from francophone countries around the world. This may also be true to some extent for academic mobility, as our results show that the main destination for academic travel is France.

The environmental weight of mobility also depends on factors affecting the weight of the rest of the pollution sources in the percentage calculation. For instance, although the role of student and academic mobility on the C and N footprint of UdeM seem very high compared to other published results, the fact that hydroelectricity provides most of the energy required by university operations reduces the weight of energy emissions in the footprint calculations, giving an exacerbated value to travel footprints (unpublished data).

The level to which universities are considered to have control over student and academic mobility is debatable, although mobility and internationalization of university activities are considered a token of success and sometimes prestige in the academic discourse (Glover et al. 2017, Grantham 2018, Wynes et al. 2019). While some universities recognize the environmental impact of mobility in their sustainability policies, many have either no specific policy to reduce this impact, or directly encourage mobility (Høyer and Naess 2001, Hopkins et al. 2016). When applied, specific policies aimed at reducing pollution due to travel have the potential to substantially reduce the environmental impact of travel. For example, Giers et al. (2019) estimated that for a technical university located in Switzerland, replacing all business class air travel by economy class, replacing short flights (<1000 km) by rail travel and replacing indirect trips by direct ones could reduce the CO$_2$ emissions of the institution by up to 36%, without hindering mobility. Another good example of an institution response to the environmental cost of air travel is Arizona State University, where a tax is charged to researchers or departments responsible for travelling to fund carbon mitigation initiatives (ASU 2019).

As much of academic travel is written into grant proposals for professors, the large Federal and Provincial granting bodies in Canada (SSHRC, NSERC, CIHR), have a potentially powerful role to play in nudging behaviour change and reducing emissions. This could take the form of allowing, or even requiring,
academics to offset carbon emissions of travel; limiting the number of flights allowable per grant; or only allowing expenses for regional and national travel (e.g. within a distance of 500 km) to be by rail or bus (or the equivalent of the lowest cost bus trip), for example. These ideas would likely meet resistance, but may be required to address the scope of the issue.

Beyond the policies and orientations of institutions, the decision to travel is still in most cases an individual one. Although we did not explore the deep motivations of researchers and students for travelling, our results show that a notable majority of the community involved in academic mobility would like to use remote meeting technology more often or have better access to it. However, increased virtual mobility is not necessarily a substitute to actual mobility as it could rather allow researchers to be present at more networking opportunities or meetings, especially in the case of conflicting obligations (Storme et al. 2017).

Interestingly, a recent study showed that while frequent travel is often associated with academic success, no correlation was found between the travel behaviour of academics at different stages of their careers and metrics of academic productivity (Wynes et al. 2019), questioning the importance of ‘academic jet-setting’ (Nevins 2014) for professional success.

5. Conclusion

We evaluated the contribution of academic and student mobility to the environmental footprint of a large, research-oriented university using C and N footprints as our metrics. Our results show that mobility, and especially air travel, constitutes a large proportion of the environmental footprint of UdeM. This case study is limited to one campus over one financial year, and the lack of data on distance travelled by both academics and students in other institutions makes it difficult to determine whether our data are representative of a wider trend, especially since distance travelled by academics and students is very geographically-dependent. Hence, more estimates of academic and student mobility metrics are needed. Nevertheless, while universities strive to internationalize their activities, it is difficult to ignore the large role that transportation, and especially air travel, plays in the environmental footprint of universities. Interestingly, many universities are actively aiming to reduce emissions related to daily commutes to and from their campuses, but have made fewer attempts to identify and pursue strategies to reduce, the much larger, impacts of long-distance travel. This research has identified opportunities to potentially reduce the environmental impact of academic mobility via policy changes, remote connections, or emissions offsetting.

Acknowledgments

We would like to thank Stéphane Béranger, Roxane Maranger and Gabriel Fauveaud for their comments on preliminary versions of the survey. We also thank the administrative offices of each academic department at UdeM for distributing the survey. We finally thank all the survey respondents for helping us gathering the data.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available for legal and/or ethical reasons.

ORCID iDs

Julien Arsenault https://orcid.org/0000-0002-7840-1838

References

Achten W M J, Almeida J and Muyss B 2013 Carbon footprint of science: more than flying Ecol. Ind. 34 352–5

Ackers I 2008 Internationalisation, mobility and metrics: a new form of indirect discrimination? Minerva 46 411–35

ASU 2019 Price on carbon for air travel FAQs (https://cfo.asu.edu/Price-on-carbon-for-air-travel-FAQs)

Attari S Z, Krantz D H and Weber E U 2016 Statements about climate researchers’ carbon footprints affect their credibility and the impact of their advice Clim. Change 138 325–38

Burke I C 2010 Travel trade-offs for scientists Science 330 1476

Case F, Boussauw K and Storme T 2018 Meet and fly: sustainable transport academics and the elephant in the room J. Transp. Geogr. 70 64–7

CAUBO 2018 Financial Information of Universities and Colleges (https://caubo.ca/knowledge-centre/surveysreports/fiuc-reports)

Chen C L, Hsu T P and Chang J R 2004 A novel approach to great circle sailings: the great circle equation J. Navig. 57 311–25

Ciers J, Mandic A, Toth L D and Veld G O 2019 Carbon footprint of academic air travel: a case study in Switzerland Sustainability 11 1–8

EPA 2014 National Emissions Inventory Data (https://epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data)

Fox H E et al 2009 Why do we fly? Front. Ecol. Environ. 7 294–6

Glover A, Strenger Y and Lewis T 2017 The unsustainability of academic aeromobility in Australian universities Sustain. Sci. Pract. Policy 13 1–12

Glover A, Strenger Y and Lewis T 2018 Sustainability and academic air travel in Australian universities Int. J. Sustain. High Educ. 19 756–72

Grantham K 2018 Assessing international student mobility in Canadian university strategic plans: Instrumentalist versus transformational approaches in higher education J. Glob. Citizsh. Equity Educ. 6 1–21

Grémillet D 2008 Paradox of flying to meetings to protect the environment Nature 455 1175

Hischier R and Hilty L 2002 Environmental impacts of an international conference Environ. Impact Assess. Rev. 22 543–57

Hoeckstra A Y and Wiedmann T O 2014 Humanity’s unsustainable environmental footprint Science 344 1114–7
Hopkins D, Higham J, Tapp S and Duncan T 2016 Academic mobility in the Anthropocene era: a comparative study of university policy at three New Zealand institutions J. Sustain. Tour. 24 376–97
Høyer K G and Næss P 2001 Conference tourism: a problem for the environment, as well as for research? J. Sustain. Tour. 9 451–70
IRCC 2019 Temporary Residents: Permit Holders (https://open.canada.ca/data/en/dataset/90113b00-59b6-49e8-afa3-b4cf8facaee)
Langin K 2019 Climate scientists say no to flying Science 364 621
Larsen H N, Pettersen J, Solli C and Hertwich E G 2013 Investigating the carbon footprint of a university—the case of NTNU J. Clean. Prod. 48 39–47
Leach A M, Galloway J N, Bleeker A, Erisman J W, Kohn R and Kitzes J 2012 A nitrogen footprint model to help consumers understand their role in nitrogen losses to the environment Environ. Dev. 1 40–66
Leach A M, Majidi A N, Galloway J N and Greene A J 2013 Toward institutional sustainability: a nitrogen footprint model for a university Sustain. J. Rec. 6 211–9
Lee D S, Fahey D W, Forster P M, Newton P J, Wit R C N, Lim L L, Owen B and Sausen R 2009 Aviation and global climate change in the 21st century Atmos. Environ. 43 3526–37
Letete T C M, Mungwe N W, Guma M and Marquard A 2011 Carbon footprint of the university of Cape Town J. Energy South Afr. 22 1–11
Liu H, Xu Y, Stockwell N, Rodgers M O and Guensler R 2016 A comparative life-cycle energy and emissions analysis for intercity passenger transportation in the US by aviation, intercity bus, and automobile Transp. Res. D 48 267–83
Manaugh K and Kramer G 2019 Understanding the determinants and impacts of academic long-distance travel Transportation submitted
Maraseni T N, Qu J and Zeng J 2013 A comparison of trends and magnitudes of household carbon emissions between China, Canada and UK Environ. Dev. 15 103–19
Nevins J 2014 Academic jet-setting in a time of climate destabilization: ecological privilege and professional geographic travel Prof. Geogr. 66 298–310
Ozawa-Meida L, Brockway P, Letten K, Davies J and Fleming P 2013 Measuring carbon performance in a UK university through a consumption-based carbon footprint: De Montfort University case study J. Clean. Prod. 56 185–98
Spinellis D and Louridas P 2013 The carbon footprint of conference papers PLoS One 8 e66508
Storme T, Faulconbridge J R, Beaverstock J V, Derudder B and Witlox F 2017 Mobility and professional networks in academia: an exploration of the obligations of presence Mobilities 12 403–24
Thurston M and Eckelman M J 2011 Assessing greenhouse gas emissions from university purchases Int. J. Sustain. High Educ. 12 225–35
Wiedmann T and Minx J 2008 A definition of ‘carbon footprint’ Ecological Economics Research Trends ed C C Pertsova (Hauppauge: Nova Science Publishers) pp 1–11
Wynes S, Donner S D, Tannason S and Nabor N 2019 Academic air travel has a limited influence on professional success J. Clean. Prod. 226 959–67