Reducing the carbon footprint of academic conferences by online participation - the case of the 2020 virtual ECPR General Conference

Supplementary material

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Replication data available at Harvard Dataverse: https://doi.org/10.7910/DVN/2GTVCL

S1: Technical details of estimating the travel induced carbon footprint of academic conferences

This paragraph is adapted from Jäckle (2019, 634–38).

Basic approach

The basic method used to estimate the carbon footprint (*cf*) of travelling to conferences is the same as in earlier studies (Desiere 2016; Kuonen 2015): multiplying two times the distance *d* a participant has to travel from home institution to conference location (= return trip) with the average greenhouse gas emissions a certain means of transportation has per km (= emission factor *e*) gives the carbon footpring (*cf*). Distinguishing between three modes of transport (by airplane, by long distance coach and by train) and assuming that each participant only uses one means of transportation it is possible to calculate the carbon footprints for each of the three modes using the following formulas:

$$cf_{plane} = 2 \times d_{greatcircle} \times 1.2 \times e_{plane}$$

$$cf_{coach} = 2 \times d_{roads} \times e_{coach}$$

$$cf_{train} = 2 \times d_{railway} \times e_{train}$$

Calculating the travel distances

Participants' home institutions were web-scraped from the ECPR homepage (for years 2014-2019) or provided by the ECPR (for 2020). The coordinates of these institutions were automatically collected from Wikipedia as longitude and latitude values in the WGS 84 coordinate reference system. These data were then imported to the geographic information system (GIS) application QGIS. In this program three different GIS-analyses were conducted in order to obtain the travelling distances to the conferences by means of transportation – airplane, bus, and train.

1) *The shortest distance between all presenter's home institutions and the respective conference locations using the formula of the great-circle*

These data can be used to approximate distances for air travel. Using the "raw" great circle distances for the estimation of the GHG emissions would nevertheless result in a systematic bias, estimating the emissions from participants who travel to the conference by airplane too low. In many cases there are no direct flights from the presenters' hometowns to the conference locations which means stopovers and thus longer travel-distances. Furthermore, aircraft often do not take the shortest route but have to fly more inefficient detours. Kettunen et al. (2005) found that the actual distances aircrafts fly are between six to ten per cent longer than the great circle routes between the departure and the destination airports. And moreover, airports are often relatively remote from the city centres so that travelling to and from the airports adds a significant portion to the GHG emissions of airline passengers. In order to account for these three points, the great circle distances are multiplied by a factor of 1.2 to obtain more realistic numbers.[1]

2) *The routes for the fastest journey times by car/long distance coach*

Using the Openrouteservice API (https://openrouteservice.org/) from within QGIS, I calculated for each conference the fastest journey times by car, as well as the respective routes from the presenter's home institutions to the conference venue. The cartographic data underlying this endeavour comes from OpenStreetMap (https://www.openstreetmap.org/).[2]

3) *The shortest route on a railroad network*

I calculated the shortest distance between the home university and the conference locations based on a network of all existing railroad tracks. The vector data for this

[1] While long-haul flights reach higher altitudes where the CO_2 exerts more harmful effects the high-emission take-off and landing phases make up a higher proportion in short-haul flights. Thus, in this paper no distinction between long-haul and short-haul flights will be made.

[2] This street-based calculation has only been performed for home institutions closer than 6,000 km to the conference location due to routing restrictions of the Openrouteservice API. Since driving times by car/coach for larger distances are not meaningful, this restriction does not bias the overall results. Driving times and distances could be calculated for all locations within Europe (for all conferences that took place in Europe) and for the North American institutions for the 2015 conference in Montreal.

railroad network comes from https://www.naturalearthdata.com/downloads/10m-cultural-vectors/railroads/.

Emission factors

The second important factor necessary for the estimation of the carbon footprint is how much GHG[3] are emitted per passenger and per km for different means of transportation. These are the so called emission factors which different scientists, governmental as well as nongovernmental agencies have estimated. Since the calculation of the emission factors is based on a multitude of choices and assumptions, it comes as no surprise that we find significant variation in their values between the different sources. For example, one crucial aspect is the average passenger load factor since per capita emissions are certainly higher if a higher percentage of the seats remains empty. For railway travel another important decision is which kind of electricity mix is assumed to power the trains. In order to absorb potential biases from the use of emission factors that are based on diverging assumptions, I use four different sources for the emission factors (see table 1 in the article): UBA: *Umweltbundesamt* (German Federal Environmental Agency) TREMOD 6.03, 2018 (Allekotte et al. 2020), EEA: European Environment Agency TERM-report (2014), UK: Government of the United Kingdom conversion factors (Department for Business, Energy & Industrial Strategy 2020), NTM: Network for Transport Measures (2018). This range of emission factors, that are all based on partially differing assumptions thus can be seen as a minimum-to-maximum interval of possible carbon footprints.

[3] I subsume not only carbon dioxide (CO_2) to GHG, but also methane (CH_4) and nitrous oxide (NO_2). The overall GHG emissions are presented in CO_2 equivalents.

S2: Estimation of Zoom data usage

The video conferencing software used at the ECPR general conference 2020 was Zoom (https://zoom.us/). Zoom does not provide official data usage numbers, but data usage can be estimated from the recommended internet speed requirements that Zoom specifies.

Bandwidth requirements according to Zoom for a group video call

Quality	Bandwidth needed
High quality	800kbps/1.0Mbps (up/download)
Gallery view and/or 720 p HD video	1.5Mbps/1.5Mbps (up/download)
Receiving 1080p HD video	2.5Mbps (up/download)
Sending 1080p HD video	3.0Mbps (up/download)

Source: https://support.zoom.us/hc/en-us/articles/201362023-System-Requirements-for-PC-Mac-and-Linux

Assuming that both up- and download requirements must be fulfilled, the total data usage can be calculated. 1 MB = 8 Mb (MB: Megabyte; Mb: Megabit)

E.g. for 720p HD: $1.5\ Mbps = 0.1875\ MBps \triangleq 0.1875 \cdot 60 \cdot 60\ MB\ per\ hour = 675\ MB\ per\ hour$)

Data usage for Zoom group call by video quality (in MB per hour)

Quality	Download	Upload	Total
High	360	450	810
720p	675	675	1350
1080p	1125	1350	2475

Data usage is lower if participants turn off video, use screen sharing only or use the mobile application (Leboucq 2020; Abott 2020).

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