Monitoring Air Miles at the Faculty of Mathematics and Natural Sciences (MNF) to reduce CO2 emissions

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ABSTRACT

critic: more focus on research To counteract the effects of climate change, a radical reduction of greenhouse gas emissions is essential. Reducing emissions is necessary for all areas of society, which includes the scientific community. Sustainable policies are being introduced progressively at universities, and for this paper relevant, the University of Zurich. The University of Zurich has actively chosen a more sustainable path and implemented "Strategy 2030" in 2022, which calls for climate neutrality until 2030. A flight emission reduction of 53% by 2030 is indispensable to achieving this goal. The first steps in the right direction have already been taken by the Faculty of Science (MNF). The MNF collected relevant information about all their paid flights from 2018 to 2020, including flight numbers, IATA codes of the origin and destination airports, booked service class (economy, premium economy, business, and first-class), and emission of greenhouse gas per flight. Analyzing the provided dataset, we were interested in how a chosen service class impacts flight emission. As a result, we conducted an R analysis to quantify the impact of selecting a lower service class has on future flight emissions. The goal is to provide the MNF with concrete approaches, starting with choosing lower service classes and thus implementing the sustainability goals of the University of Zurich.

NOTES

- Mention about the reason why we choose to not do some analysis (short distance flights) and mention the analysis by the GIUZ
- Wordcount atm: 1146

1 INTRODUCTION

critic: Write about research gap.

SDG background: Reducing flight emissions would be covered by SDG 15 and 17 according to C.Dib writing for Uniting Aviation [3].

In today's world, the topic of emissions reduction is omnipresent and is being addressed in ever larger circles. Statistically, aviation emissions are responsible for only 2% of total emissions (reference), yet they are very easy to reduce at relatively low cost. This is also what MNF in Zurich has decided and would like to change its flight behavior. The negative implications of air travel are globally well known. The aviation sector alone is responsible for 3.8% of carbon emissions (Klöwer et al., 2020). An important part of those emissions is caused by researchers who due to conferences, guest lectures, and fieldwork fly frequently to foreign universities. In recent years, travel by airplanes done by academic staff received growing attention. Especially as Universities all over the world incorporate sustainable development strategies [2]. Similarly, also the University of Zurich are setting an example to be carbon neutral and reducing air travelling by 53% by 2030. Although the majority in academic circles are in favour of this development, questions have arisen, in particular, as to whether this might not harm academic work as flying and face to face interactions play an important role in an academic career [5] (CITE KREIL). Thus researching the relationship between academic flying and academic work and finding approaches to reducing emissions via air travel became the subject of multiple studies. The study of Kreil et al. (2021) proved for example that a reduction in air travel would not affect scientific work, but also be beneficial. Possible alternatives to long-duration flights were shown in the study by Klöwer

et al. who demonstrated that virtual conferences have a higher attendance rate and how such annual global conferences could be held physically, for example, only biennially. Contrary to other papers, which thematized the problem on a more global scale, the aim of this paper is to find easy and applicable solutions to reduce air travel emissions at the university level, which are easier to implement.

1.1 Data
2 METHODS

2.1 Pre- processing

critic: What API were used? The consequence pre- processing section was all done in Python. Therefore in order to perform a statistically relevant analysis, the first step was to prepare and complete the data set. For this, one parameter was essential: the IATA flight destination for each flight, on the basis of which the flight emissions could be calculated in the second step. In order to link these IATA codes to each flight number, a Python script was written, using an API developed by Aviation Edge [1]. The API was used to retrieve the corresponding IATA departure and arrival codes for each combination of IATA flight code and IATA flight number and to read them into the record set. For the request function, the parameters "airline-IATA" and "flightNumber" were used. The former parameter refers to the identification of the airline and the latter to the number of the specific flight. Further, these new values were compared with the existing IATA destination codes and in case of a missing value, it was replaced by the query from the API. In the second step, the same procedure was carried out with the emission calculations, using an API from GoClimate [4] . The request for this API server used the parameters "Segments" consisting of departure and destination, as well as the flown class "Cabinclass". For an approximate classification, the approximate price in US dollars was also requested for each flight and stored in the data set.

2.2 Analysis

Idea: data set abut mnf staff. flights per capita For the analysis three data sets where created. The original data set by the MNF with all the original flight classes. Additionally to that 2 mirrored data sets where created, in which the cabin classes where changed to either all business or all economy. Consequently the emissions for the to later mentioned data sets were recalculated. For an equal and accurate analysis, all three data sets were tidied, removing all rows which either have the same departure and arrival airport, thus distance flight distance 0km or where the kgCO2 emissions per km where infinite. This resulted with 5465 flights in each of the data sets.

3 RESULTS

3.1 Model 1: cabin class
3.2 Model 2: short distance flights

As a result of analyzing the data and the nature of this paper, no hypothesis is made other than that the paper's goal is reducing emissions. This can be achieved in diverse ways, only one of which is specifically analyzed here – the effects of cabin classes. However, as visible in Figure 1, the preliminary results show that the space and CO2 intensive flight classes cause only a tiny portion of the emissions. Thus, it can be hypothesized that the emission targets of MNF cannot be achieved with a mandatory booking of only economy class tickets. There were 5478 flights, of which 5162 were economy and 262 were business class.

The mean emissions in kgCO2 per km flying for all business flights is 0.415 kgCO2/km. The mean emissions in kgCO2 per km flying for all economy flights is 0.311 kgCO2/km. The mean emissions in kgCO2 per km flying for regular flights is 0.317 kgCO2/km.

As can be seen in Figure.1, flights of less than 1000km are responsible for the highest emissions per kilometer flown. The same applies to the strong differences between business (red) and economy (green) and the fact that the emissions remain more or less constant for the same flight class from a flight distance of 5000km. Thus, the emissions for a flight of 5000km are not higher per kilometer compared to a flight of 15'000km.

4 DISCUSSION

Despite the script using two API's to go through all the queries, it was not possible to reference all the flight numbers. Thus, 1701 flights remained without belonging to a start and end point and could not be linked to an emission calculation. This concerns about 20% of the whole data set.
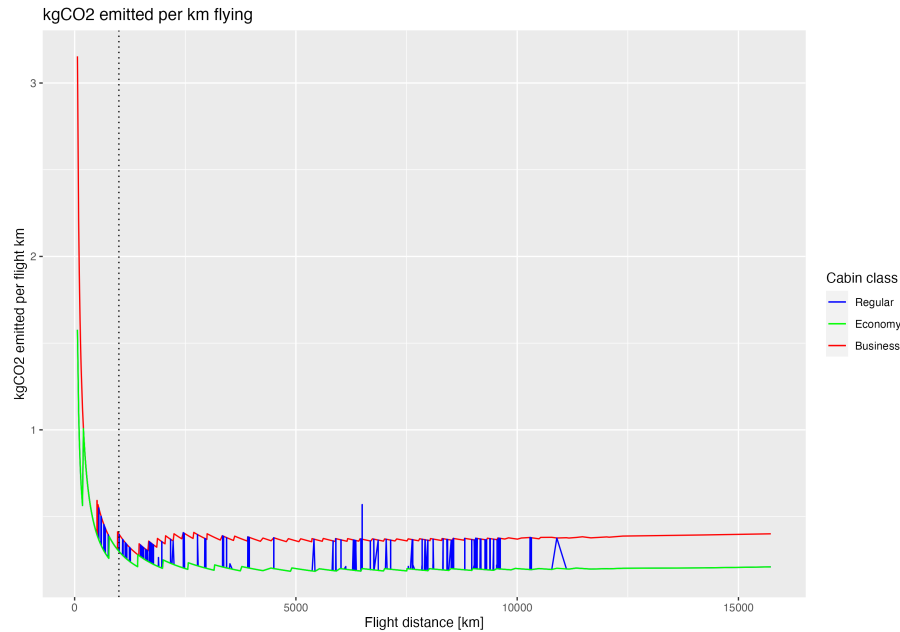
Figure 1. Emissions of CO2 in kg per flight kilometer per flight colored by cabin class

The findings of this paper will contribute significantly to MNF's ability to meet its goal of reducing aviation emissions by 53% until 2030. Likewise, this paper will demonstrate the varying implications of flight classes on the emissions emitted and illustrate how severe or not a higher flight class is on the emissions generated. Furthermore, the analysis will demonstrate for the first time the spatial distribution and focus on flights across the MNF and what spatial direction could be further explored with particular attention to groupings for flights. Further, the findings will not only be beneficial for the sustainable goals at the universities level but have also the potential to reduce emissions on a global academic scale, which would positively impact our environment and society.

5 CONCLUSION

We conclude that flying less would be beneficial.

5.1 Further research
ACKNOWLEDGMENTS

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