

Using Service-Level Mobile Internet Traffic Data to Estimate Noise Impact of Flight Trajectories on the Population

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I. PROBLEM STATEMENT

In pursuit of a more environmentally friendly and sustainable—“greener”—aviation industry, the impact of air traffic on the population has caught the attention of policy-makers, regulatory bodies, and researchers. The aviation industry, like any industry, does not act within a vacuum but requires a *social license* to be able to offer services in a sustainable manner. Thus, the negative impacts of air traffic and airports must be brought down to levels accepted by society. In this regard, despite increased efforts by the air traffic industry in general and airport operators in particular, noise emissions remain a key concern for inhabitants of noise-affected areas surrounding airports.

In order to minimize the impact of noise on the general population, air traffic controllers and airport operators require knowledge about the number of people affected by aircraft noise. Estimates of the number of people affected by aircraft noise are traditionally obtained using yearly aircraft noise exposure data and census data, yielding *noise contour maps*. The implicit underlying assumption is that people spend their daily lives mostly at their home addresses. Any intervention to reduce noise impact based on that assumption will neither reflect the realities of the people living in noise-affected areas around an airport who commute to work into another area nor of those people who commute into the noise-affected areas for work, education, and other purposes.

The analysis of mobility patterns in the population, which are not accounted for in contour maps, may yield a more accurate representation of the spatial and temporal aspects of sound in people’s daily lives. Measures towards reducing the impact of aircraft noise on the population based on such mobility patterns promise to be more effective than those based on contour maps relying on census data.

II. METHODOLOGY

We propose to use the NetMob23 dataset [1] for the analysis of mobility patterns in the population around airports. Hence, traffic data of various internet services generated in different geographic tiles around French metropolitan areas allow to obtain an approximation of the number of people present in

a certain tile at a certain time. Using these data, the noise impact of actual flights on the general population can be calculated and a what-if analysis using common departure and arrival routes for the respective airports can be conducted. In particular, we conducted a case study regarding the different noise impacts of selected flight trajectories on different days. In the future, a decision support system may propose alternative routes that may reduce the noise impact of flights given different mobility patterns.

We obtained historical flight data and information about departure and arrival routes at French airports from the OpenSky network [2], which is an online repository for ADS-B data (Automatic Dependent Surveillance – Broadcast), tracking aircraft movement. The movement data can be combined with further information about the aircraft used to operate the flight in order to more accurately estimate the noise impact of a given flight.

We base our work on previous, similar studies [3]–[6], albeit with different datasets, both in terms of spatio-temporal focus and the semantics of the data. Neither of those studies employed actual mobile phone data but relied on data collected by national statistics offices, such as daily passenger mobility surveys. We also used different metrics due to the assumption that the population present in a certain geographic tile during a specific time period is proportional to the service-level mobile internet traffic in that same geographic tile and time period.

III. CASE STUDY

To demonstrate our approach, we have selected Lyon–Saint Exupéry Airport that serves the Lyon metropolitan area, which is covered by the NetMob23 dataset. There are 67 different communes (French local administrative zones) in Lyon, that are further divided into 512 IRIS zones (Figure 1). IRIS represents a fine-grained territorial subdivision of France, where in each IRIS zone there is around 2000 inhabitants.

We calculated the *Noise Impact Index* (NII) for five different flight trajectories, which are those of actual flights having taken place on 16th March 2019, four of which were departures and one of which was an arrival, using three different types of

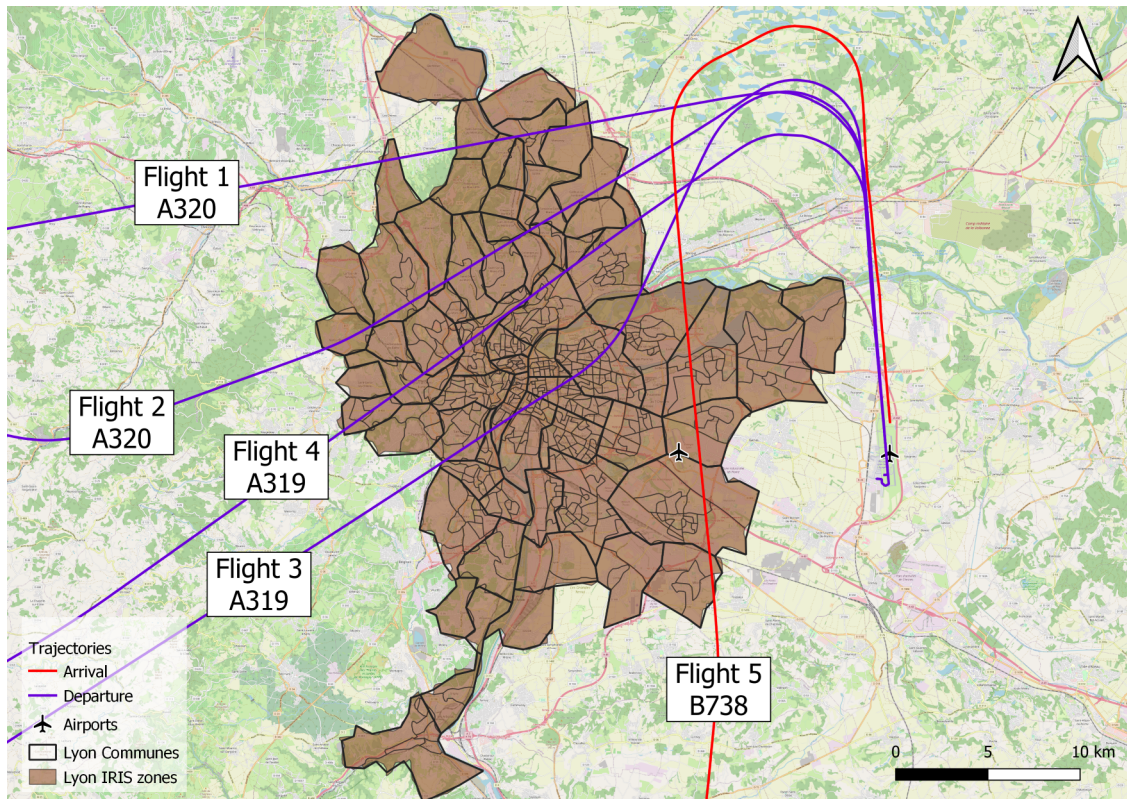


Fig. 1. Lyon communities, IRIS zones, and trajectories of selected flights

aircraft, namely Airbus 319, Airbus A320, and Boeing 737-800 (Figure 1). For each trajectory, we compared the changes in noise impact between different days from 16th–22nd March 2019 due to the different number of people affected in the areas passed by the aircraft. Hence, using the mobile internet traffic as an approximation for the actual population present in a certain area during a time period, we show that the same trajectory may have a considerably different noise impact on different days of the week. The mobile internet traffic could therefore be used by air traffic controllers to select the route for a flight with the least noise impact.

IV. FUTURE WORK

The analysis we conducted for the NetMob 2023 Data Challenge is a preliminary study for developing a decision support system guiding air traffic controllers in selecting routes with minimal environmental impact. Incorporating movement data of the general population into the systems employed by air traffic controllers for routing flights has the potential to considerably improve the quality of life of the population affected by air traffic. Hence, we envision a system that incorporates real-time mobility data of the general population into the route planning process for flights to minimize noise impact while also taking into account fuel consumption. Using the NetMob23 dataset we intend to demonstrate the usefulness of such a system and motivate further development.

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