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Using supplemental aircraft noise information to assist airport neighbours understand aircraft noise

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ABSTRACT

This paper deals with the value of supplemental aircraft noise information in the form of combining aircraft movement numbers and noise levels to assist airport neighbours in understanding airport noise. To analyse the socio-spatial interaction of annoyance with, and interference by, aircraft noise, an alternative is recommended, namely the number of noise events above selected noise levels so that laypeople can better understand the extent of noise. The research is based on a questionnaire survey of households affected by aircraft noise around OR Tambo International Airport near Johannesburg. The results indicate that levels of annoyance and disturbance across a number of normal household activities are positively related to the number of noise events recorded, irrespective of noise levels above 60 dB.

1. Introduction

Expanding urban regions and growing demand for air travel have resulted in greater numbers of people living around airports being exposed to increasing aircraft noise levels. Traditionally, aircraft noise information is communicated to an airport's neighbours through a variety of average-energy noise descriptors. They are not noise levels that people hear, but rather, they are a result of complex scientific calculations of exposure to noise energy over a defined time period. For land-use planning, policy-makers rely on traditional average-energy noise contours produced by acoustic experts to represent aircraft noise, 'average' meaning that the total noise energy is divided into a defined time period, for example 24 h, or an evening and night period, or even the time span of a normal school day. These contours have been linked by sociological surveys to annoyance, and interference with normal everyday activities, so that aircraft noise contours can be used for land-use planning (e.g. Miedema and Oudshoorn, 2001; Standards South Africa, 2003, 2004).

Traditional, or average-energy contours, however, are not easily understood by the layperson. A major criticism is that there is rarely an actual day which is average in terms of aircraft arrivals and departures, and runway use, resulting in community arguments that averages are misleading and under report noise (Commonwealth Department of Transport and Regional Services, 2000; Albee and Burn, 2004). This paper looks at whether there are advantages in making average-energy noise contours more transparent to the layperson by supplementing them with noise information in the form of 'Number of events Above' (denoted by the prefix NA). In particular, L_{Amax}, the most basic and easily understood way to report noise, is a single-event measure that can be misleading because it does not give any information about the number of times the noise events will take place or the duration. Further, due to the multiplicity of flight tracks and aircraft types, providing single-event aircraft noise information to residents can become unwieldy and obscure to them (Eagan, 2007). To overcome these problems, supplemental noise information contours that communicate the number of L_{Amax} events above a specified

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noise level are examined. These combine information on aircraft movement numbers with their L_{Amax} single-event noise levels.

2. Methodology

Selection of the noise level to represent, and the numbers of events to show on contours is somewhat arbitrary, and here contours showing the number of events louder than 70 dBA are adopted because this is regarded as being equivalent to a level of 60 dBA inside a normal brick and mortar house with conventional roofing materials, beyond which noise becomes intrusive (Issarayangyun et al., 2005). The drawback of selecting just one level is that once a noise level is selected for portrayal, for example 70 dBA, then noise events greater than 70 dBA, are also registered, but levels below are excluded. The issue is addressed by including NA 60 and NA 80 contours. This method permits a 'look inside' an airport's average energy contours to reveal the number of occasions within a specified time period that aircraft noise levels exceed a specified threshold. For example, an NA 70 of 10 means that there would be 10 events exceeding 70 L_{Amax}.

The question may then be posed: how does supplemental noise information relate to peoples' sensitivity to aircraft noise? The answer lies in the perception an individual has of aircraft noise. A perception is an organised set of individual feelings and beliefs on any phenomenon of interest (Botha and Fouche, 2000), in this instance aircraft noise. Perceptions or aircraft noise lead to annoyance with noise, and interference by noise with normal everyday household activities.

The study area considered is based on existing average-energy contours for OR Tambo International Airport in Johannesburg. Existing land use within the noise-impacted zone is a mixture of residential, light industry and warehousing. Based on the size and shape of the average-energy noise contour zone, approximately 1000 households located under or near the flight paths of the airport were invited to complete a postal survey. Houses within the study area are constructed of traditional brick and mortar with tiled roofs and no special noise insulation. Respondents' addresses were requested to pinpoint their locations, but names were not, thus affording some anonymity. Survey responses were scrutinised, and responses with missing addresses and/or survey data were discarded, leaving 330 valid responses for analysis.

Participants were invited to report on their perception of how often they were highly annoyed by aircraft noise, and how often three specified household activities – sleep, television viewing and telephone conversations – were interfered with. A Likert-type scale was used with respondents asked to select one of: 'not at all'; 'seldom', 'sometimes', 'often', and 'very often' in response to questions about annoyance and interference with the various activities. The survey time frame covered a week, and respondents were required to be at home, between 6 pm and 6 am during that period.

Aircraft movement records for the week were obtained from the airport's air traffic controllers and these provide information on the average number of events between 6 pm and 6 am, equal to or exceeding 60, 70 and 80 L_{Amax}. The Integrated Noise Model (Federal Aviation Administration, 2003) and Transparent Noise Information Package software (Department of Transport and Regional Services, 2005) are used to calculate the NA contours. Using a GIS, these events contours were overlaid onto land-use maps to produce Fig. 1 with NA 60; NA 70, and NA 80 contours. For each of the maps, four noise zones are produced; less than 10 events (referred to as few events); 10–20 events (moderate events); 21–50 events (many events); and more than 50 events (very many events).

Respondents' geographical locations and answers were geocoded and a separate layer of information created in the GIS database containing the survey respondents' locations as points associated with attribute data in the form of the coded questionnaire answers. These points were overlaid onto the land-use maps in the GIS. The survey respondents' answers were then extracted and subjected to classification and analysis according to the zones of the sets of NA contours.

In Fig. 1, the outermost contour line represents 10 events exceeding 60, 70 or 80 L_{Amax}. the adjacent inner contour line represents 20 events exceeding 60, 70 or 80 L_{Amax} and the innermost line, 50 events exceeding 60, 70 or 80 L_{Amax}. The area outside the 10 events contour line is referred to as the least events zone. Between the 10 and 20 events contour lines is a few events zone in which between 10 and 20 events exceeding the relevant L_{Amax} level will be heard. Similarly, between the 20 and 50 events contour lines is a many events zone in which between 20 and 50 events exceeding the L_{Amax} level will be heard, and inside the 50 events contour line the very many events zone with more than 50 events exceeding the L_{Amax} being heard.

3. Number of events above (NA)

Noise annoyance to individuals is depicted in Fig. 2, classified according to the noise zones contours. Regarding the NA 60 contour, in the least events zone, just over 21% of respondents are highly annoyed, the proportion drops slightly to 13% in the few events zone when an increase in annoyance would have been expected. In the many and the very many events zones, however, the annoyances increase to 58% and 83%. The NA 70 contour shows a continual increase in annoyance from 20% in the least events zone to a high of 96% in the very many events zone. A large increase of 40% is evident between the few events zone and the many events zone.

In the few events zone with the highest noise level, nearly 30% of respondents say they are highly annoyed. Between the least events zone and the few events zone, there is an increase of 40% in reported annoyance. In the many events and very many events zones, the annoyance is at about 90%. The very many events zone shows consistently high levels of annoyance across the NA 60, NA 70 and NA 80 contour areas. This would suggest that communities that are exposed to higher numbers