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Noise Impact
non-acoustic variables

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General overview

primary research on ***community noise*** dates back to the 1950s when aircraft noise first became a ‘problem’

research aims can be categorised as;

simplify

- certification according to single event metrics (***LAmax*** and EPNdB)
- harmonised exposure-response relationships, (***LAeq*** and Lden)

complicate

- recognition that simple methods do not reflect public responses
- multiple ‘causes’ of annoyance (and other effects) with complex bi-directional interactions

simple (and increasingly out-of-date) **solutions** preferred by policy makers

ETSU R-97 1996

consensus view of an expert group:

- reference to ***standard methods*** available at that time
- government ***energy policy***
- technical ***feasibility***
- available ***research***
- professional ***experience***
- technical ***discussion***

was there any consultation with the public, or amenity groups?

daytime - background noise curve plus 5 dBA
- lower cut-off at 35-40 dBA

night-time - background noise curve plus 5 dBA
- lower cut-off at 43 dBA

ETSU R-97 1996

the ETSU R-97 ***noise limits*** are based on BS 4142, with some modifications agreed in the working group:

- not based on any substantive ***research*** available at the time
- does ***not*** appear to be working very well

the basic principle seems to be to allow ***more*** noise when the existing background is higher, with a cut-off to ***avoid impossibly low limits*** when background is low.

the design intentions seem to be:

- turbine noise should be ***relatively quiet*** compared to other noise sources
- however, practical ***feasibility*** should not be unduly constrained by noise impact
- so, ***inaudibility*** is NOT required
- the 'expert group' knows best

What can we learn from other noise?

WHO guidelines
- observation threshold for ***moderate annoyance*** at 50 LAeq
- observation threshold for ***serious annoyance*** at 55 LAeq

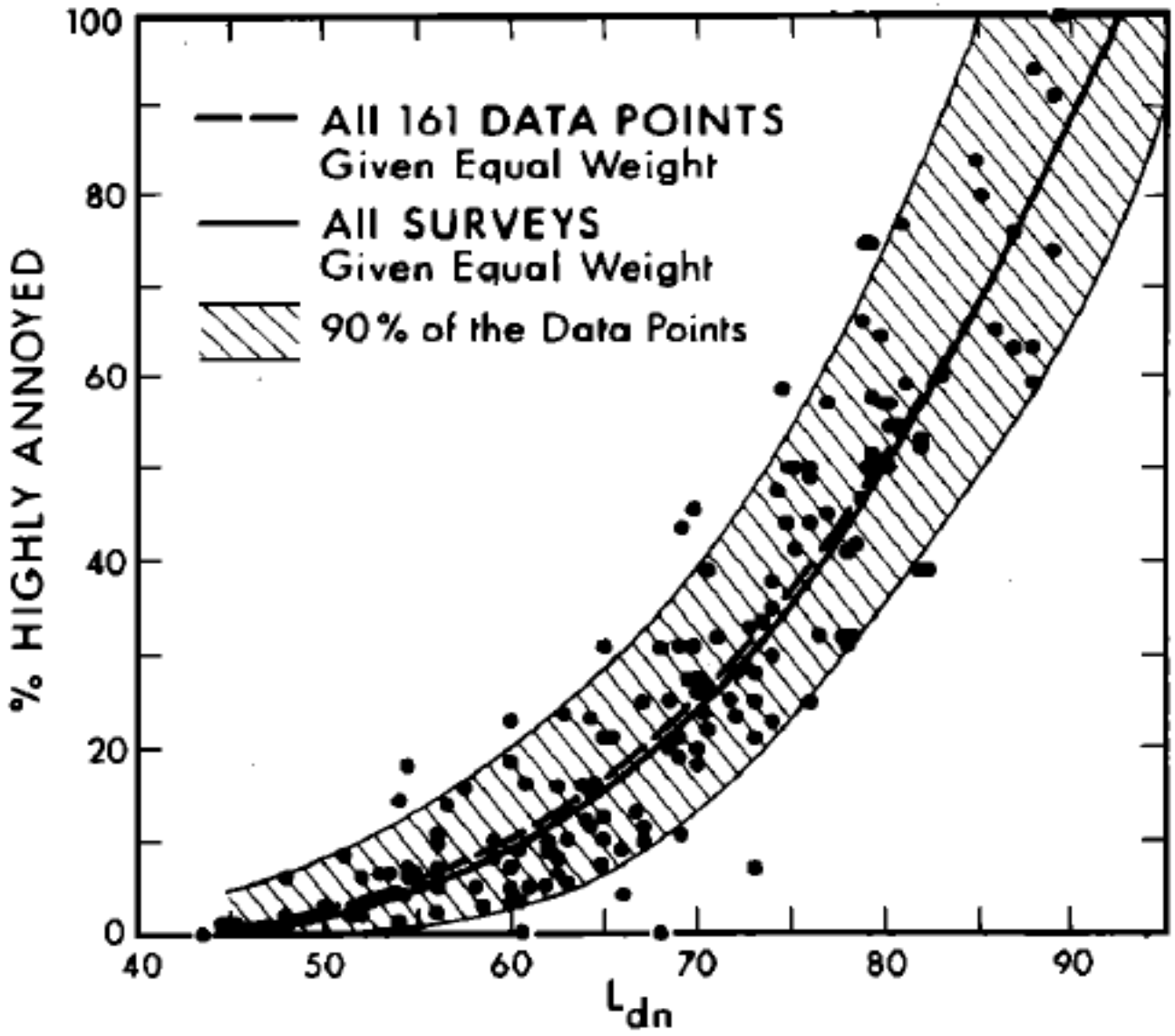
standardised ***dose-effect*** curves
annoyance increases from a low level around 50-55 LAeq

57 LAeq for ***onset of significant annoyance*** for aircraft noise

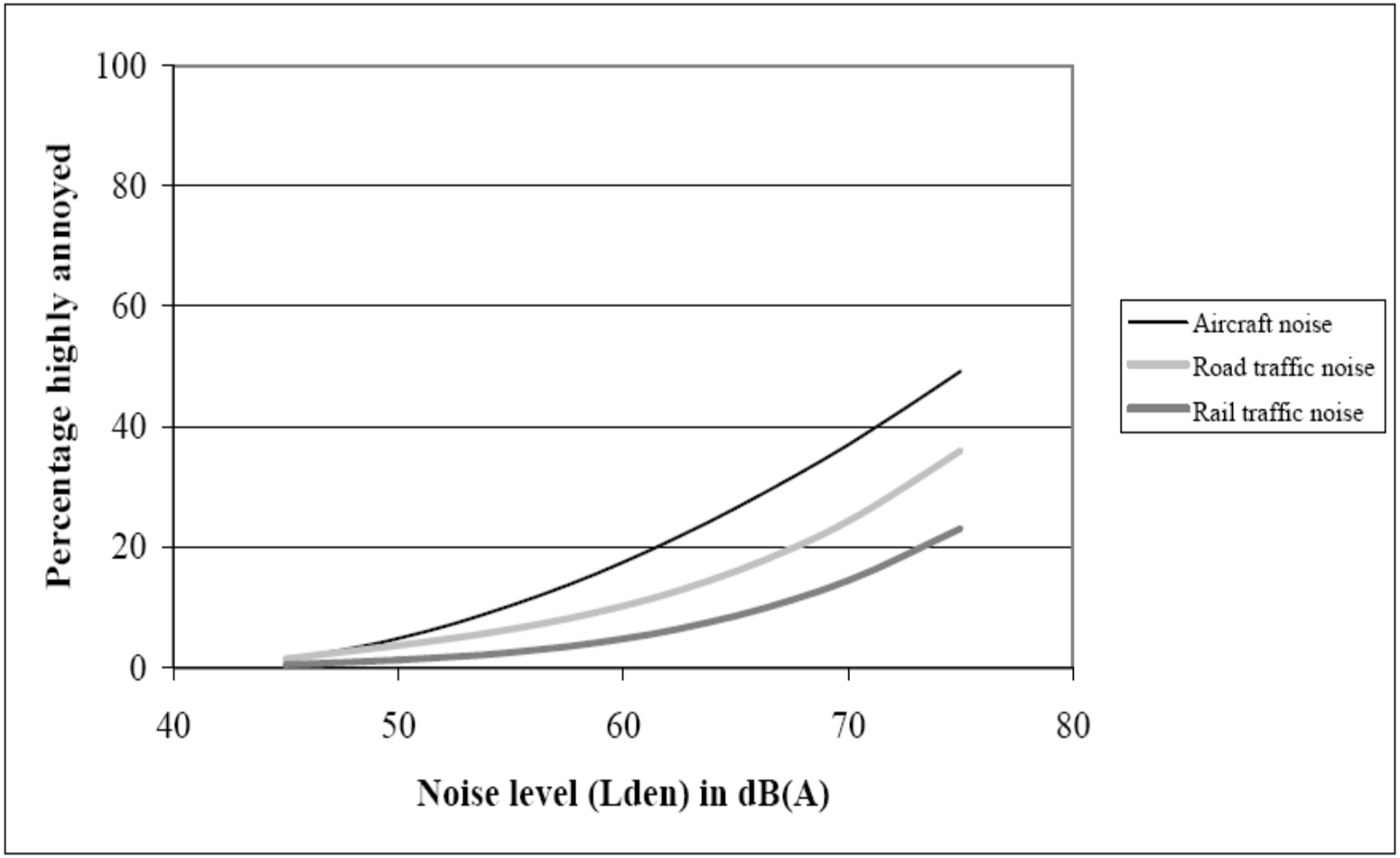
WHO guidelines for community noise

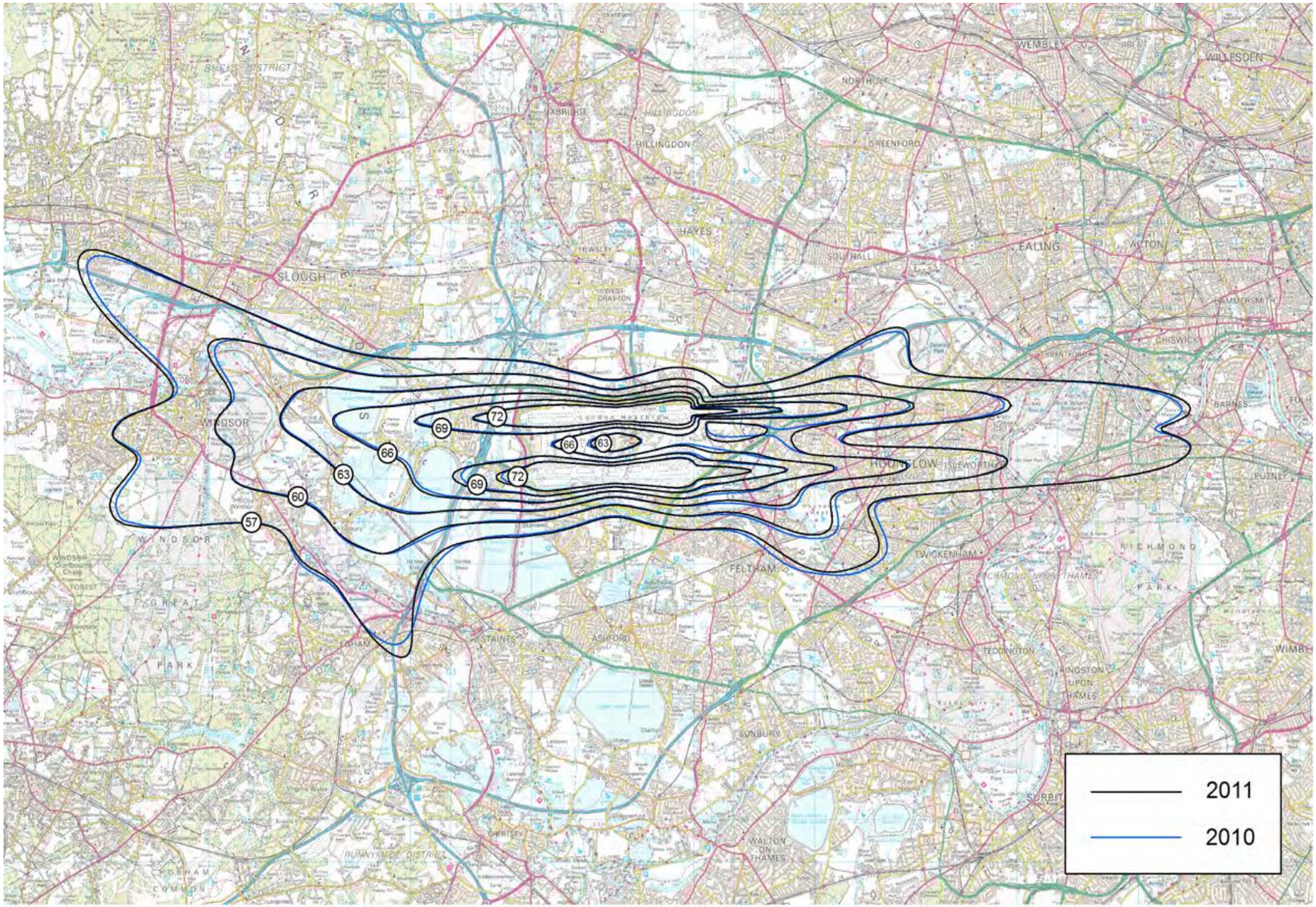
Environment	Critical health effect	LAeq	LAmax
outdoor living area	serious annoyance, daytime and evening	55	
	moderate annoyance, daytime and evening	50	
dwelling, indoors	speech intelligibility, daytime and evening	35	
inside bedrooms	sleep disturbance, night-time	30	45
outside bedrooms	sleep disturbance, window open	45	60
school classrooms	speech intelligibility	35	
pre-school bedrooms, indoor	sleep disturbance	30	45
school playground	annoyance (external source)	55	
hospital wards	sleep disturbance	30	40
hospital treatment rooms	interference with rest and recovery	as low as possible	
industrial, commercial, shopping, etc.	hearing impairment	70	110
ceremonies, entertainments	hearing impairment for infrequent patrons	100	110
public address systems	hearing impairment	85	110
headphones	hearing impairment (free field values)	85	110
toys, fireworks	hearing impairment - adults		140
	hearing impairment - children		120
parklands and conservation areas	disruption of tranquility	preserve existing	low intrusion

Schultz curve showing community response to transportation noise (Schultz, 1978)



Dose response relationships for the association between noise from different sources and annoyance derived by Miedema and Oudshoorn (2001) ***The EC standard curves*** **(from van Kempen *et al, 2005).***





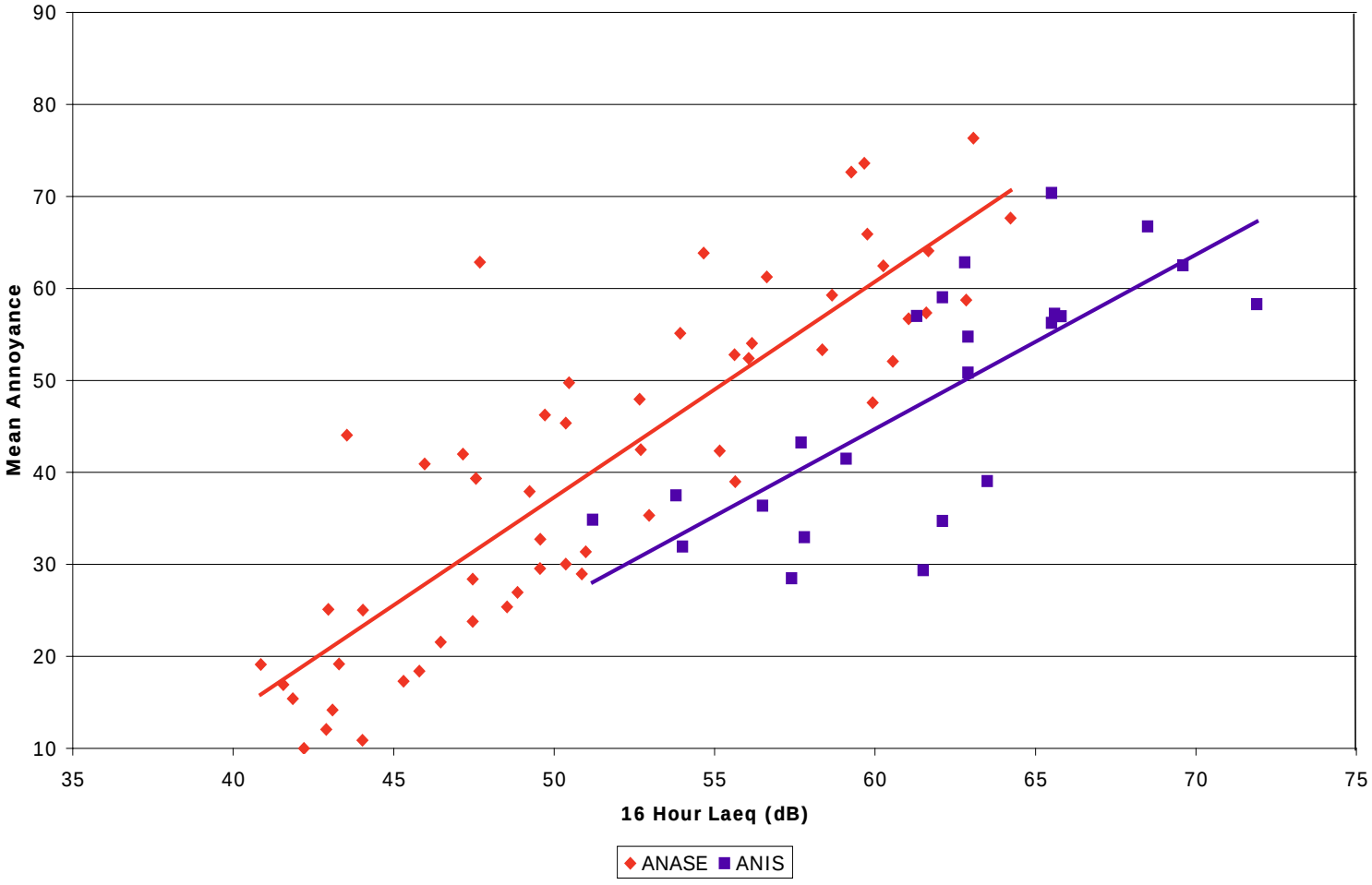
Compared with other noise?

ETSU R-97 at 35 dBA daytime is ***much lower*** than WHO 50-55 LAeq or DFT aircraft noise 57 LAeq

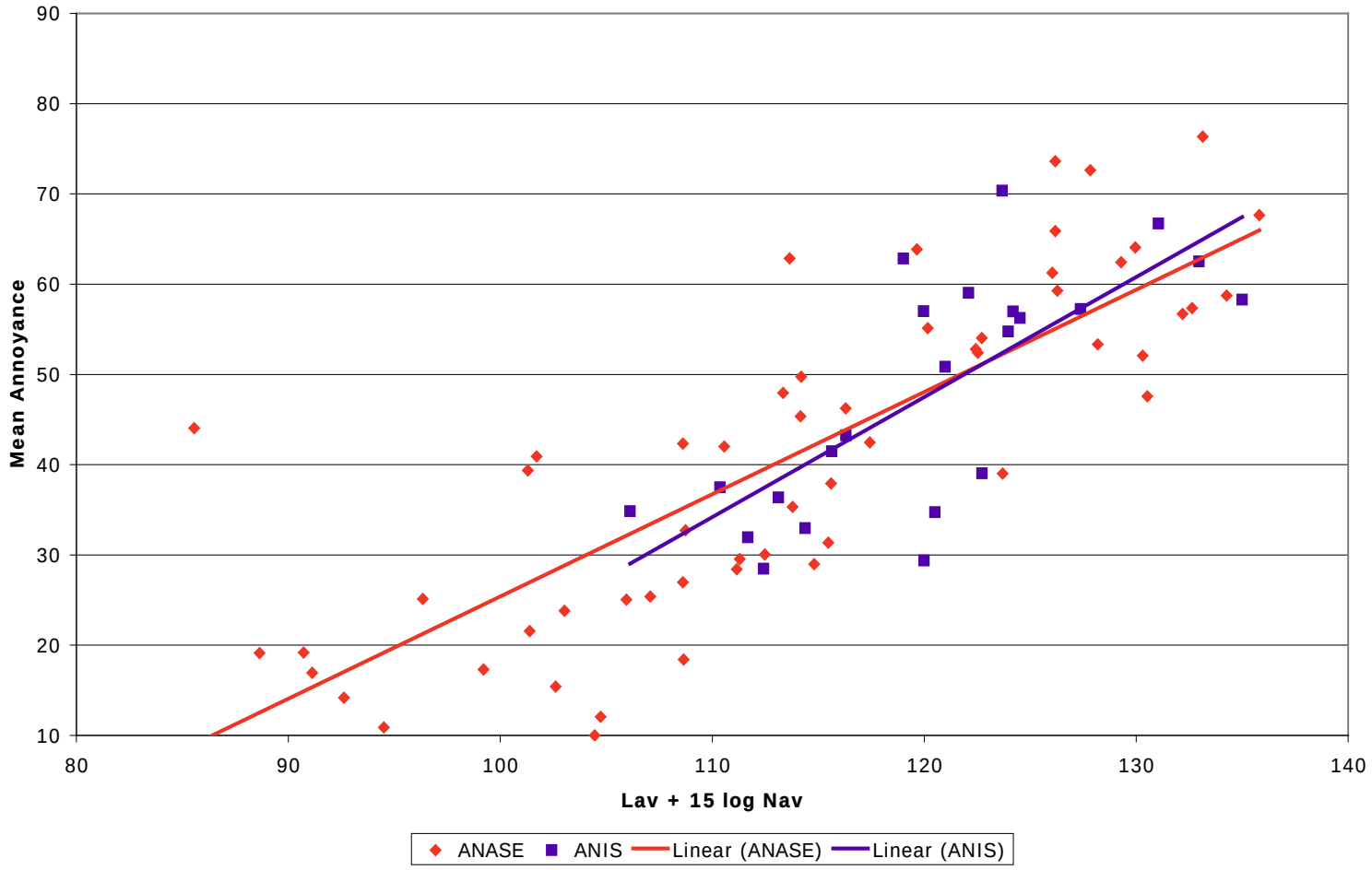
On the other hand;

- turbines don't work in ***zero wind***.
- turbine noise becomes more ***comparable*** at operating wind speeds.
- ETSU R-97 allows sufficient margin above background noise for ***audibility*** for any sensitised listener - particularly when directional variability and acoustic features such as AM are taken into account

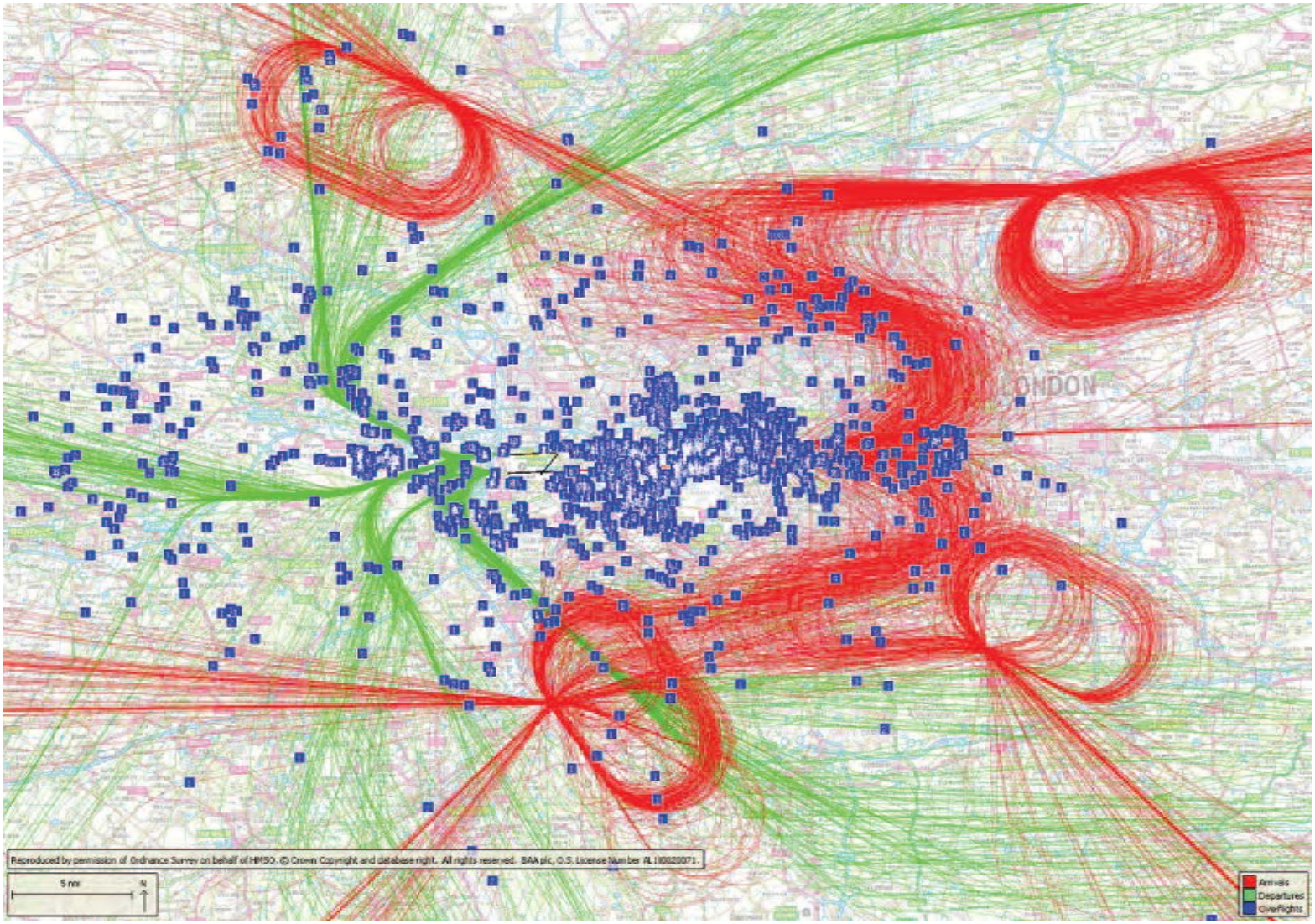
Annoyance has changed (using LAeq) ANASE (2005) against ANIS (1982)



OR consistent annoyance over time using k=15
(as in NNI which was used before LAeq)



noise complaints and flight tracks at Heathrow



Compared with other noise?

turbine noise is **NOT** unique in eliciting strong objections from a vocal minority

Most people around airports are ***annoyed*** by aircraft noise BUT this does not necessarily mean that aircraft noise is not ***acceptable***

- airports provide ***opportunities*** for air travel and are also surface access hubs (buses, trains, etc.)
- airports are major ***employers***
- airports are net ***economic contributors***
- most airports have a long history of ***noise management*** actions and ***public engagement***

what happens at typical wind farms?

residual variance

To a first approximation, total variance in individual reported annoyance can be divided into thirds:

- around 1/3rd of total variance in annoyance might be explained by ***sound level measured in LAeq***
- around 1/3rd of total variance might be explained by so-called ***moderator variables***
- around 1/3rd of total variance in annoyance is probably ***random*** and therefore not explainable

moderator variables

different kinds of ***moderator variables*** and ***effect modifier variables*** are defined separately in various more or less complex models

- not all academic analyses are equally useful
- problems of ***cause*** and ***effect***

moderators are any variable which can contribute further explanation of the relationship between any ***defined input*** (such as sound level) and ***defined output*** (such as reported annoyance)

- the ***input*** and ***output*** variables must be precisely defined or specified

moderator variables - 2

demography

- objectively measurable characteristics of ***sample populations*** such as age, sex, income, occupation, ethnicity, household size, house ownership, economic dependency

situation

- objectively measurable characteristics of ***individual experience*** such as time spent at home, house insulation, ambient sound levels, noise change

acoustic

- objectively measurable characteristics of the ***acoustic environment*** such as event sound levels (LAmax and variability), number of events, time of day, seasonal variation, frequency spectrum (EPNdB), tonal content

attitude

- ***subjectively reported opinions***, such as noise sensitivity, experience of noise, fear, preventability (beliefs), perceived control, coping strategies, trust, general attitudes, etc. This includes ***social variables*** such as group pressure, and possible ***irrational beliefs*** (such as vibro-acoustic syndrome)

demographic variables

- ***factual***, and usually easy to measure
- widely believed to be associated with actions such as ***noise complaints*** and community action
- research mostly shows demographic variables to have ***small or negligible effects on reported annoyance***
- limited interest for ***informing policy***

situational variables

- some are ***harder to measure*** than others. For example, time spent at home can vary considerably and people might not be prepared to report it accurately

- both research and anecdotal data suggests some situational variables could (or should) have ***strong effects*** on reported annoyance

- ***cause and effect*** can be difficult to unravel and, if possible, should be avoided when designing research.

- not very useful for ***informing policy***

acoustic variables

- with modern instrumentation most acoustic variables are ***easy to measure*****,** but could also be ***expensive***

- research suggests many acoustic variables could have ***strong effects*** on reported annoyance

- long time overall averages such as outdoor LAeq can ***conceal the effects*** of many important acoustic variables

- ***policy makers*** could find large numbers of acoustic input variables hard to deal with

attitudinal variables

- can be to ***deceptively easy*** to measure. The main problem is precise definition. For example, what exactly is '***noise sensitivity***'

- research suggests many attitudinal variables could have ***strong effects*** on reported annoyance

- ***cause and effect*** could be difficult to unravel and, if possible, should be avoided when designing research.

- could be much more useful for ***informing policy*** than has been taken into account in the past. Is the purpose of policy to control sound levels or to influence annoyance?

a personal view - IHF

- new turbines are an ***intrusion*** into an existing context
- ETSU R-97 is designed to permit them to be ***heard***
- ***when operating***, sound levels are NOT necessarily quite so low ***compared to other criteria***
- how much ***control*** do nearby residents actually have over their design? If experts have decided they are acceptable, ***who cares*** what the resident's opinion is?
- what ***benefits*** or ***compensation*** are offered to nearby residents to ***offset*** the intrusion?