ICAO ENVIRONMENT

ICAO Environmental Symposium 2019

DESTINATION GREEN: THE NEXT CHAPTER

Aircraft noise annoyance

Non-acoustic factors

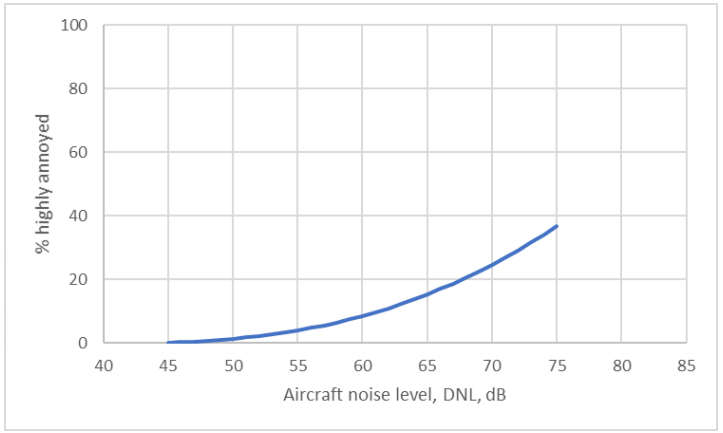
Truls Gjestland

Senior research scientist, SINTEF Digital

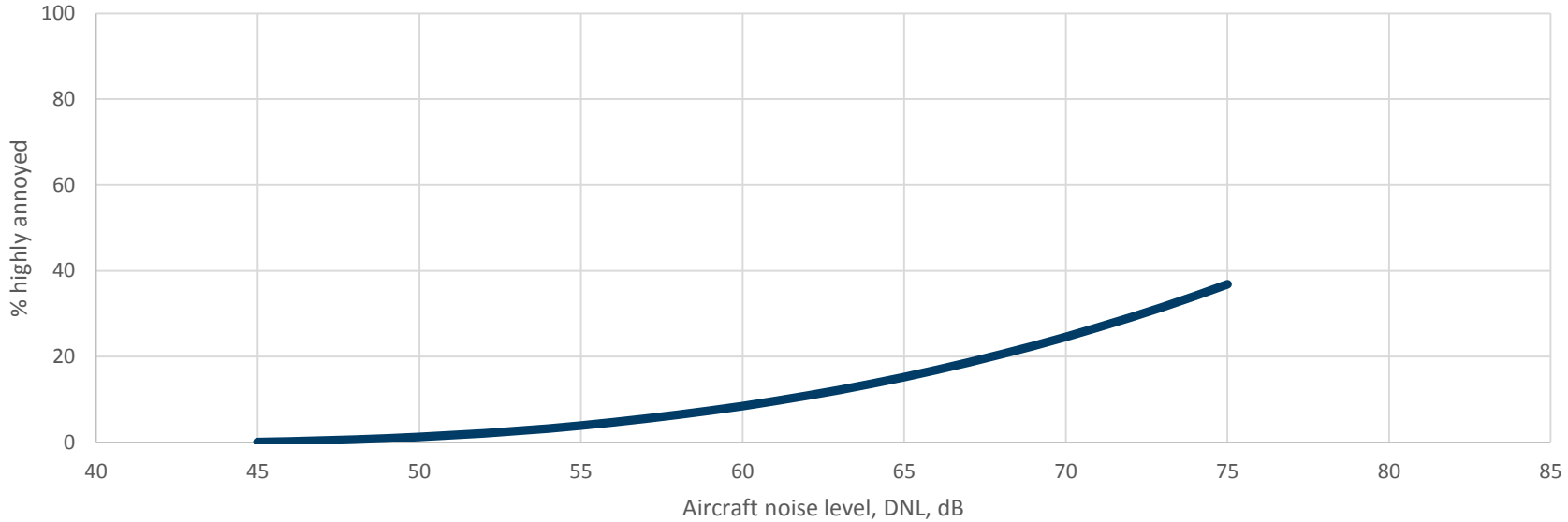
Annoyance and noise exposure

- Annoyance is assumed to be correlated with total noise exposure

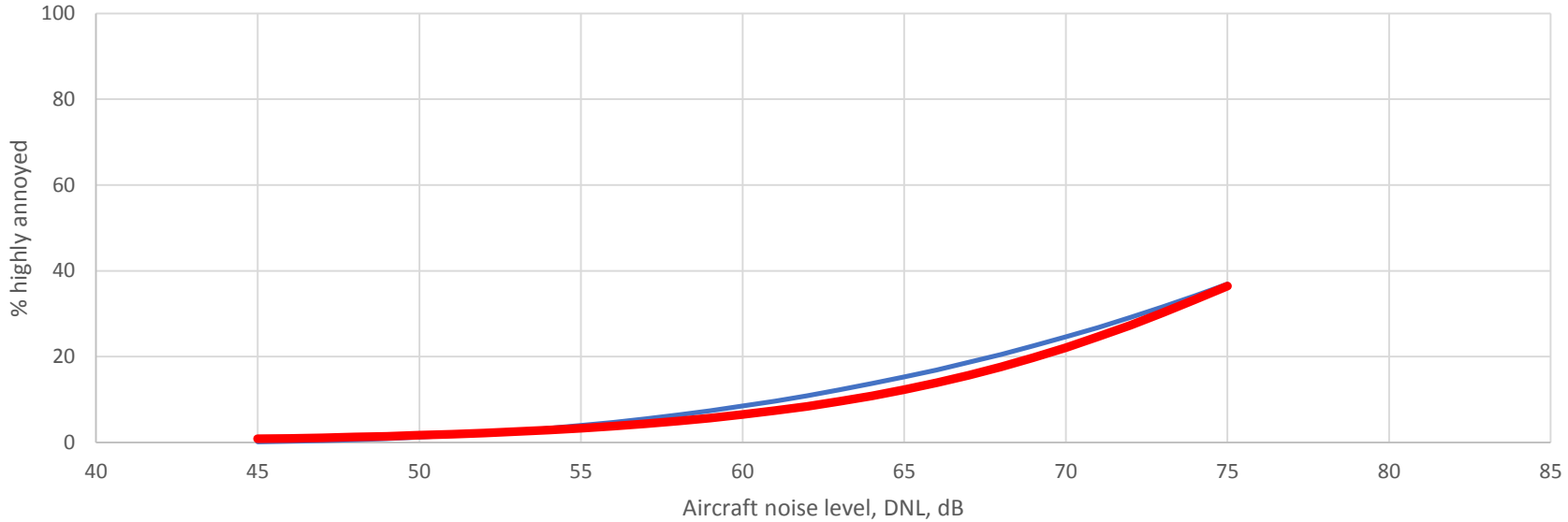
- Dose-response function
- Dosage-response function
- Exposure-response function



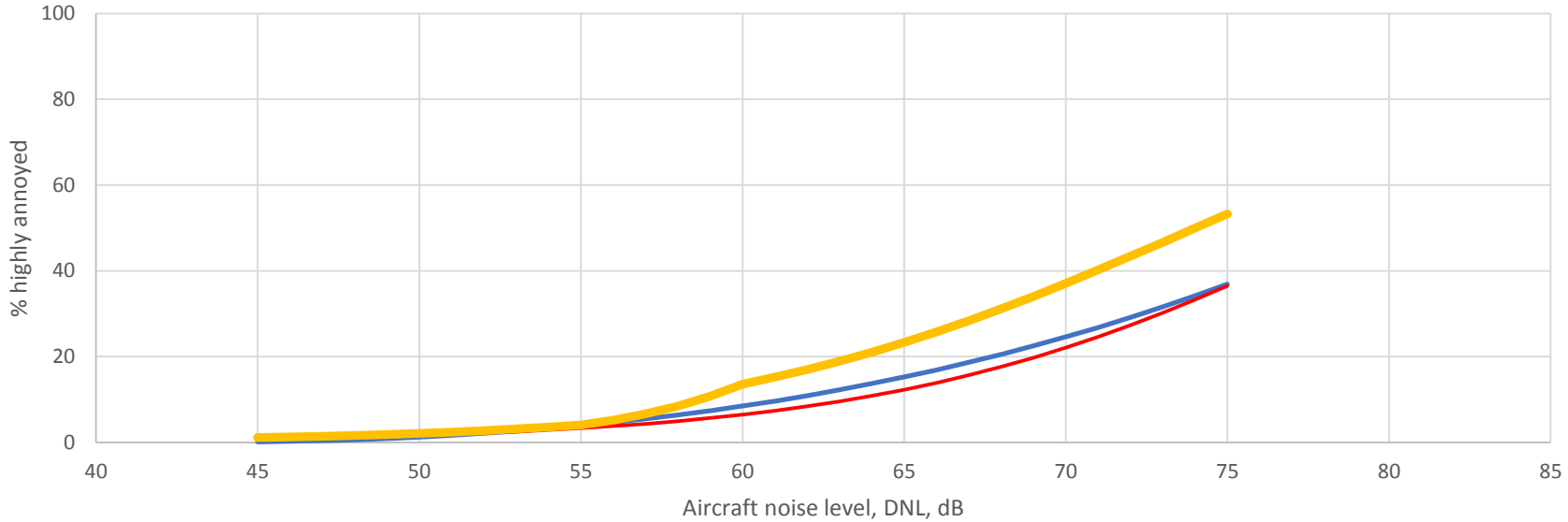
Schultz, 1978



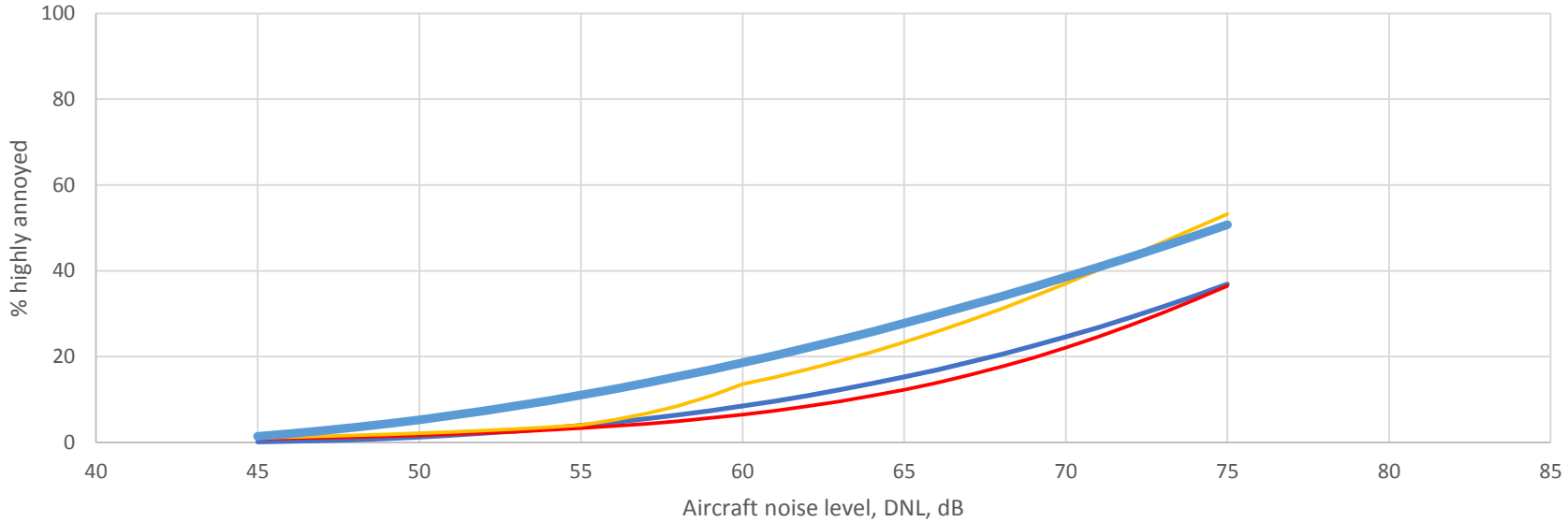
FICON, 1992


100
80
60
40
20
0
% highly annoyed
40
45
50
55
60
65
70
75
80
85
Aircraft noise level, DNL, dB

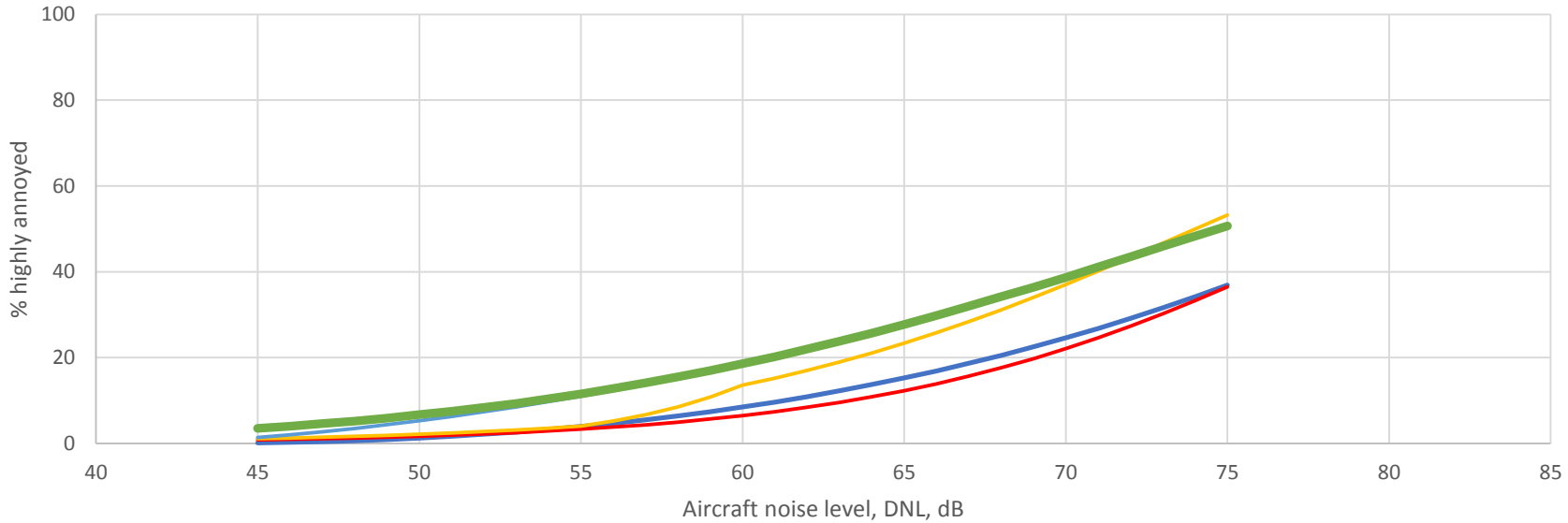
ANSI, S 12.9 part 5, 1998



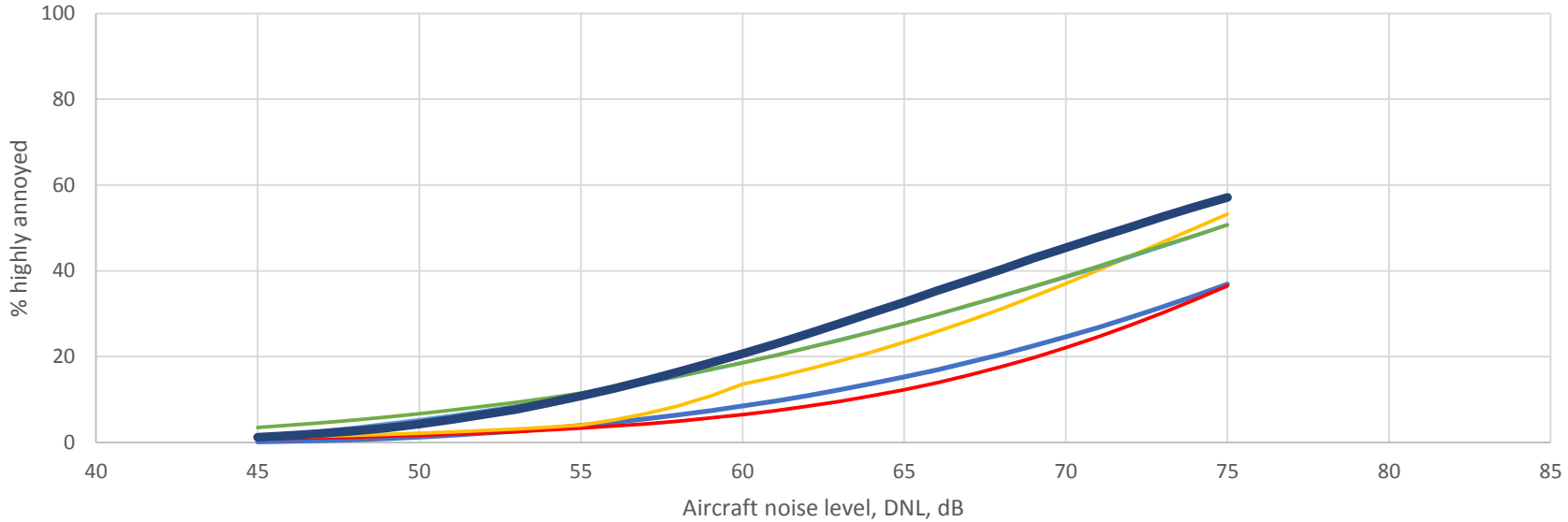
EU - Miedema & Vos, 1998



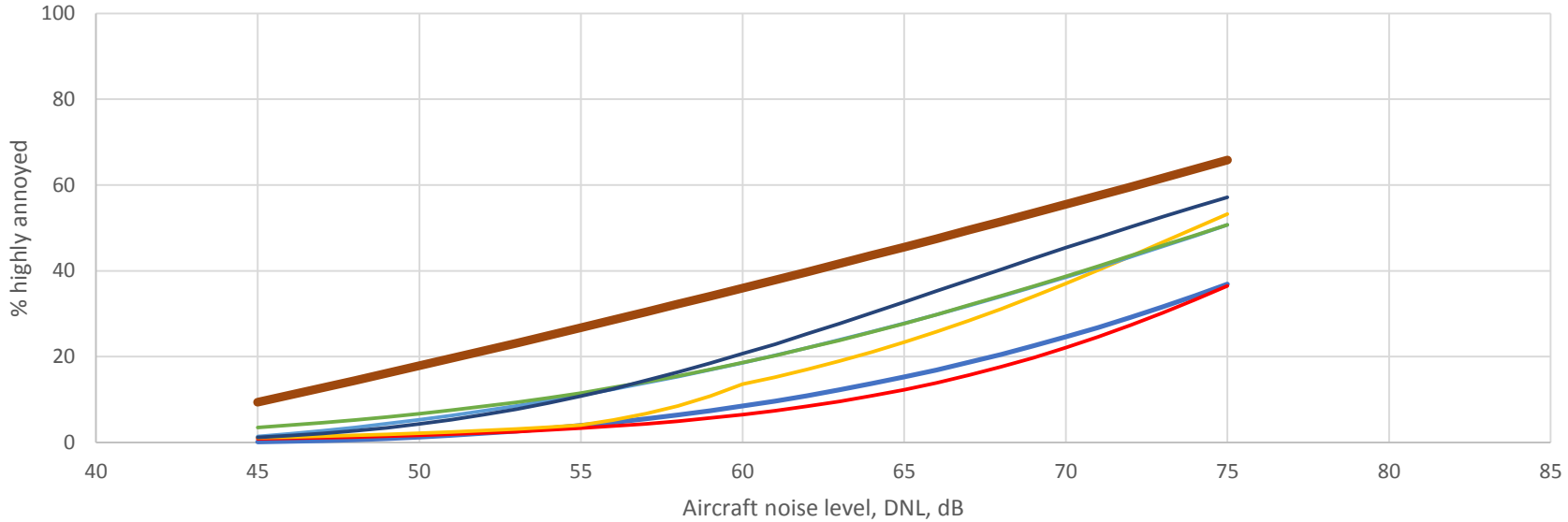
ISO 1996-1, 2016, regression



ISO 1996-1, 2016, CTL method



WHO, 2018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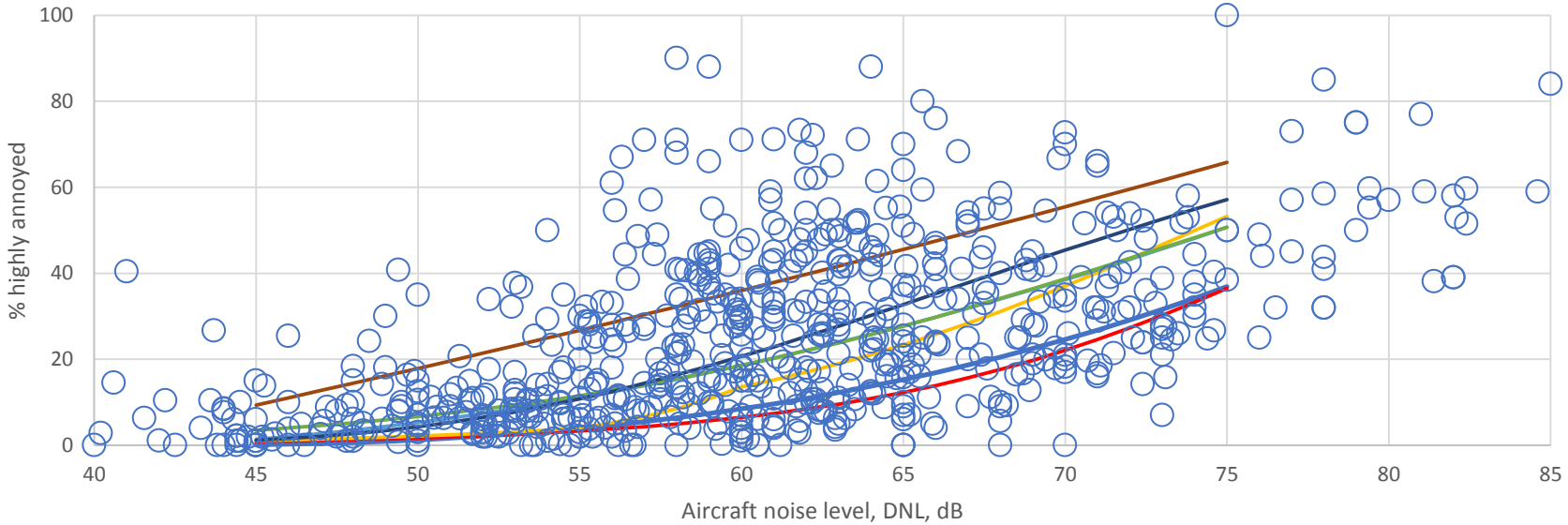
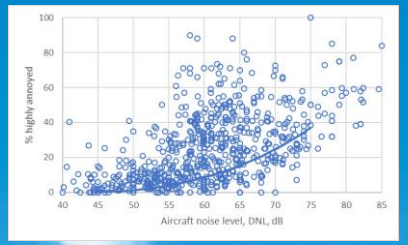
Aircraft noise level, DNL, dB

Observations from 63 surveys, 1961 - 2015



Annoyance only partly dependent on noise



- Large spread in the annoyance response
- At DNL 60 dB: 0% - 90% highly annoyed
- 10 % highly annoyed at DNL 40 – 75 dB
- Data cloud shows no obvious trend

- 1/3 of the variance is governed by the noise level (DNL)
- 2/3 of the variance is governed by non-acoustic factors

NON-acoustic factors

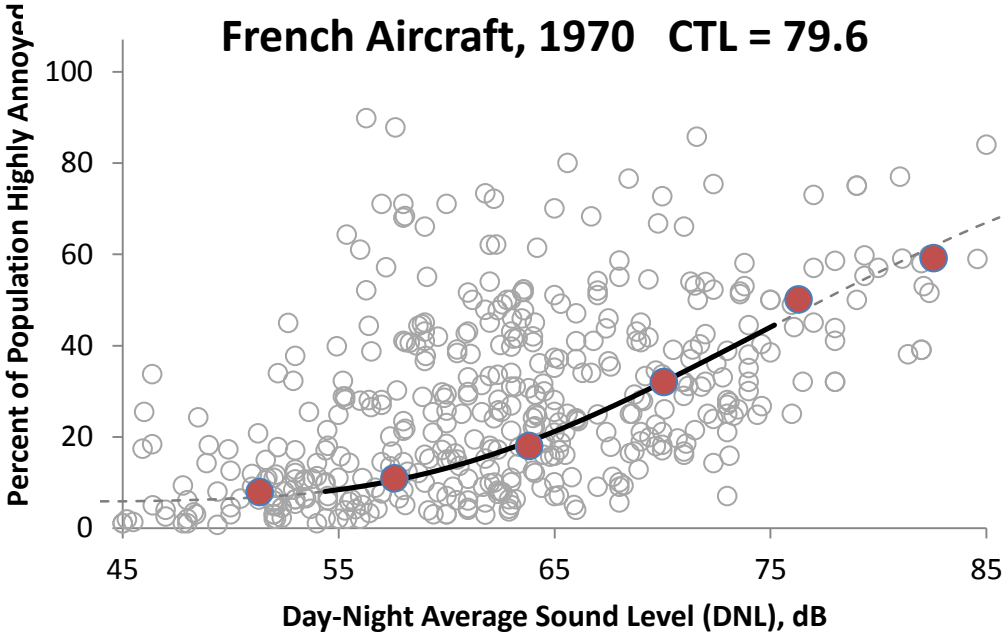
- By convention: all non-DNL factors
  - examples
- Noise sensitivity
- Fear of accidents
- Mistrust or feelings of misfeasance
- Large changes in operations, and the rate of change
- Quiet periods
- Controversial plans

The Community Tolerance Level

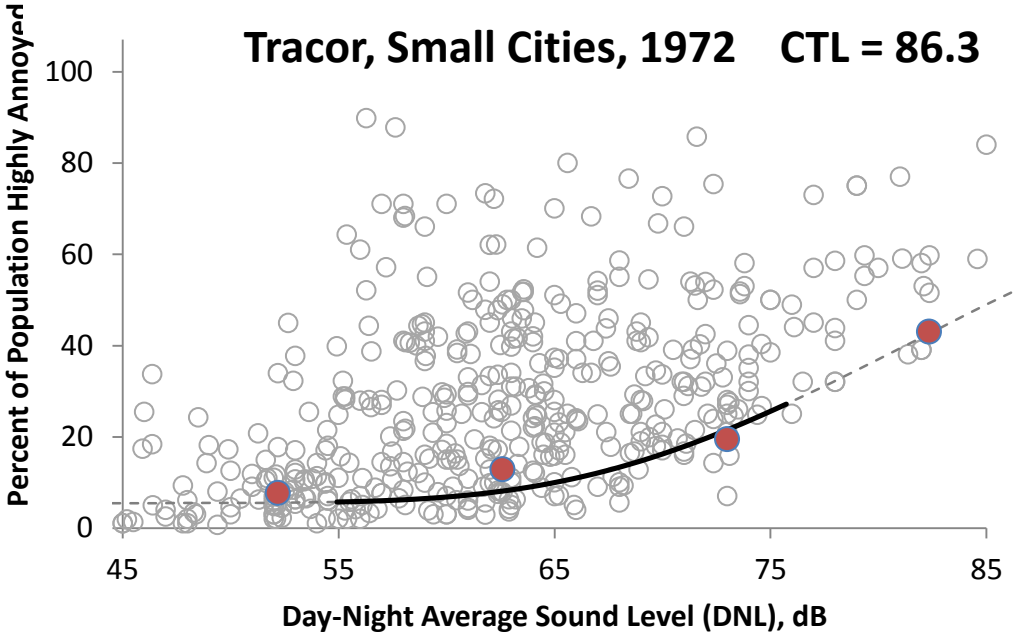
- Annoyance grows with noise exposure similar to the loudness function
- The shape of the dose-response curve is fixed
- Starting point on the noise axis is governed by non-acoustic factors

- Airports must be studied individually

CTL For Individual Surveys



CTL For Individual Surveys



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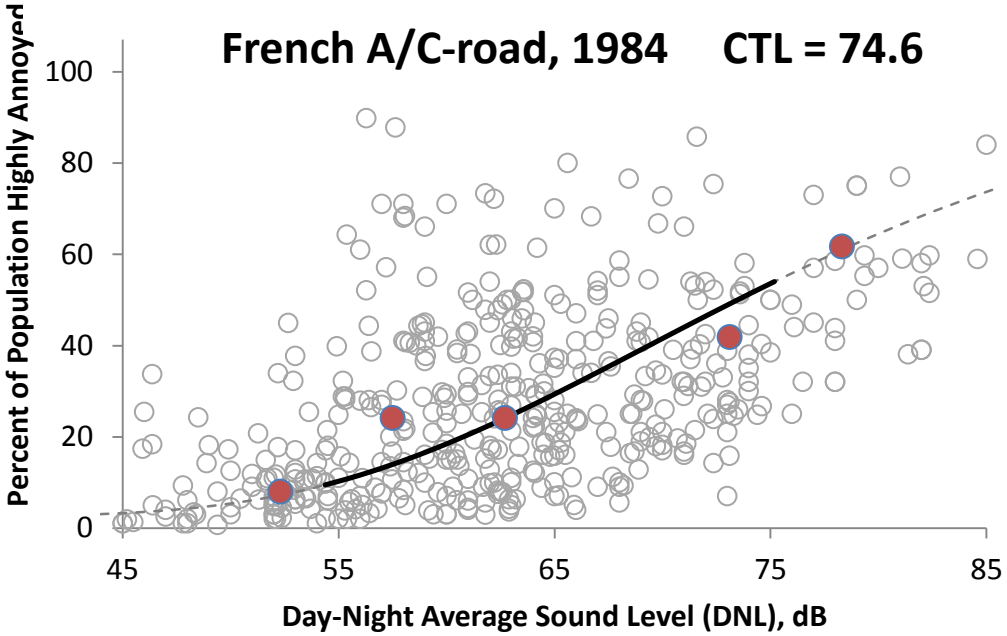
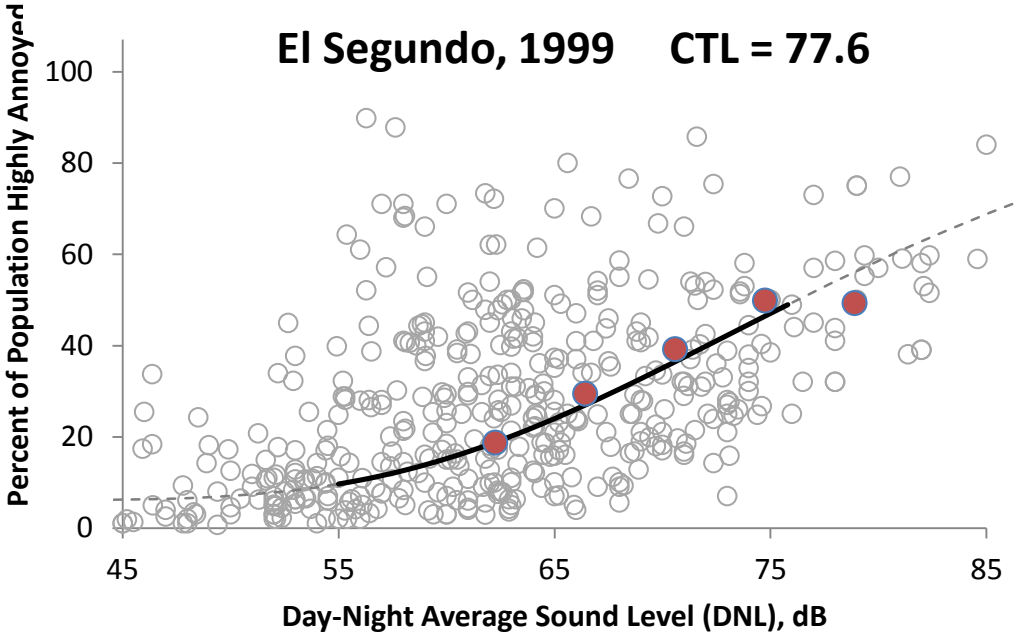
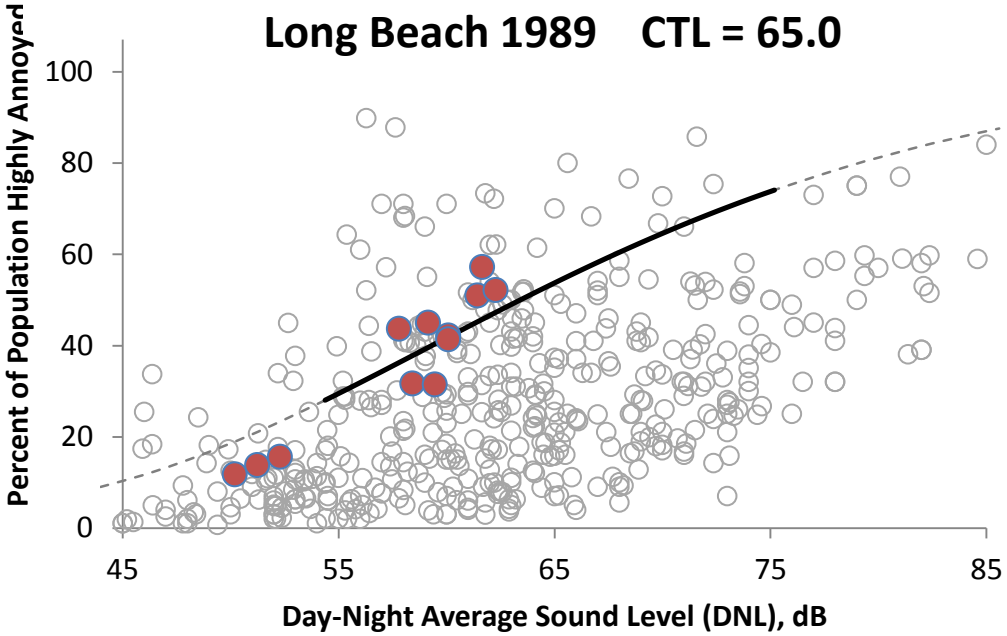


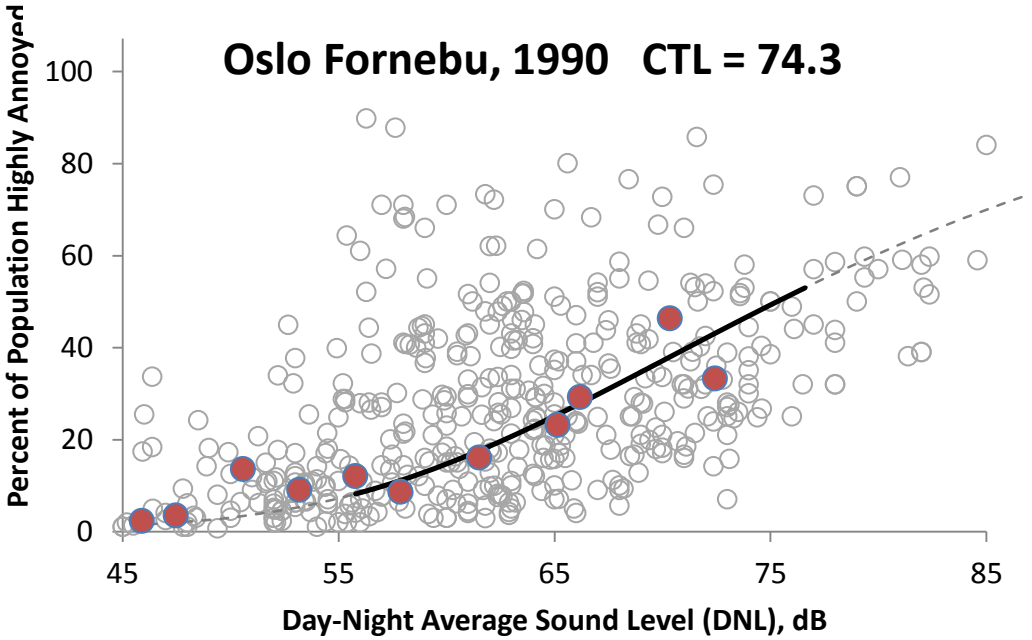
CTL For Individual Surveys



CTL For Individual Surveys



CTL For Individual Surveys



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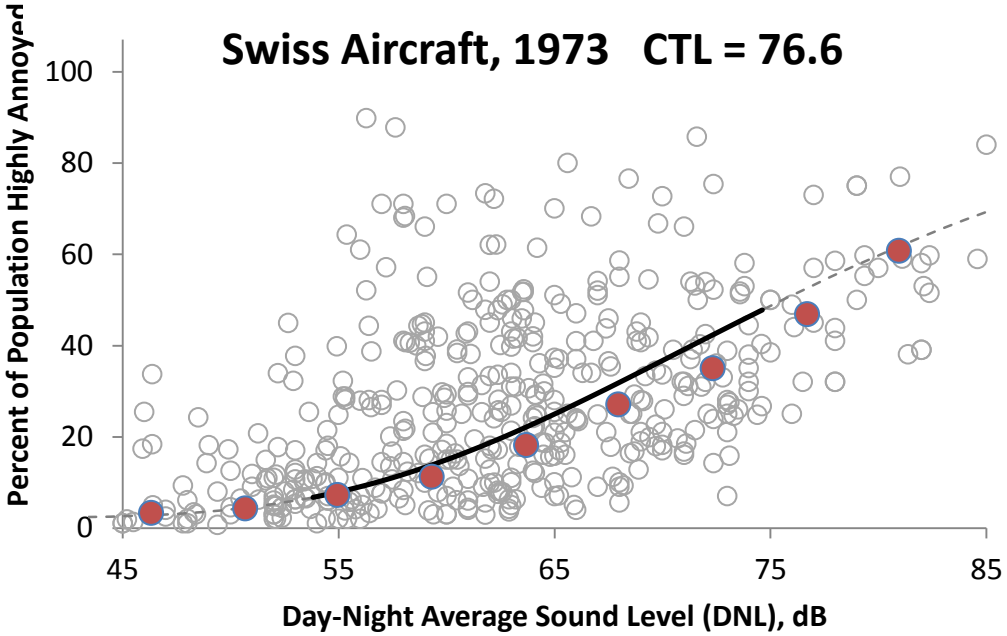

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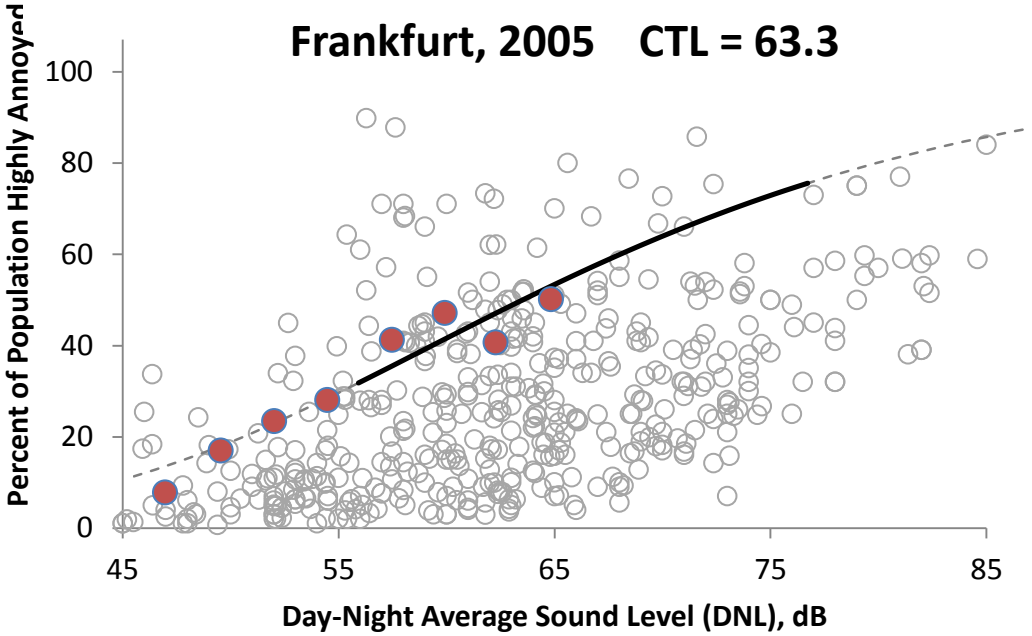
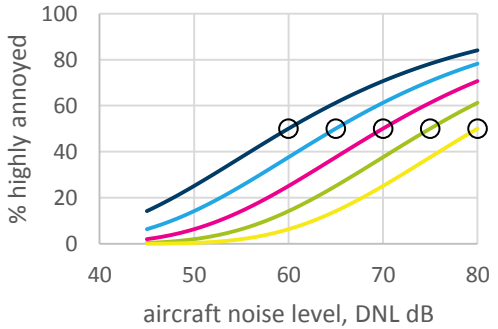


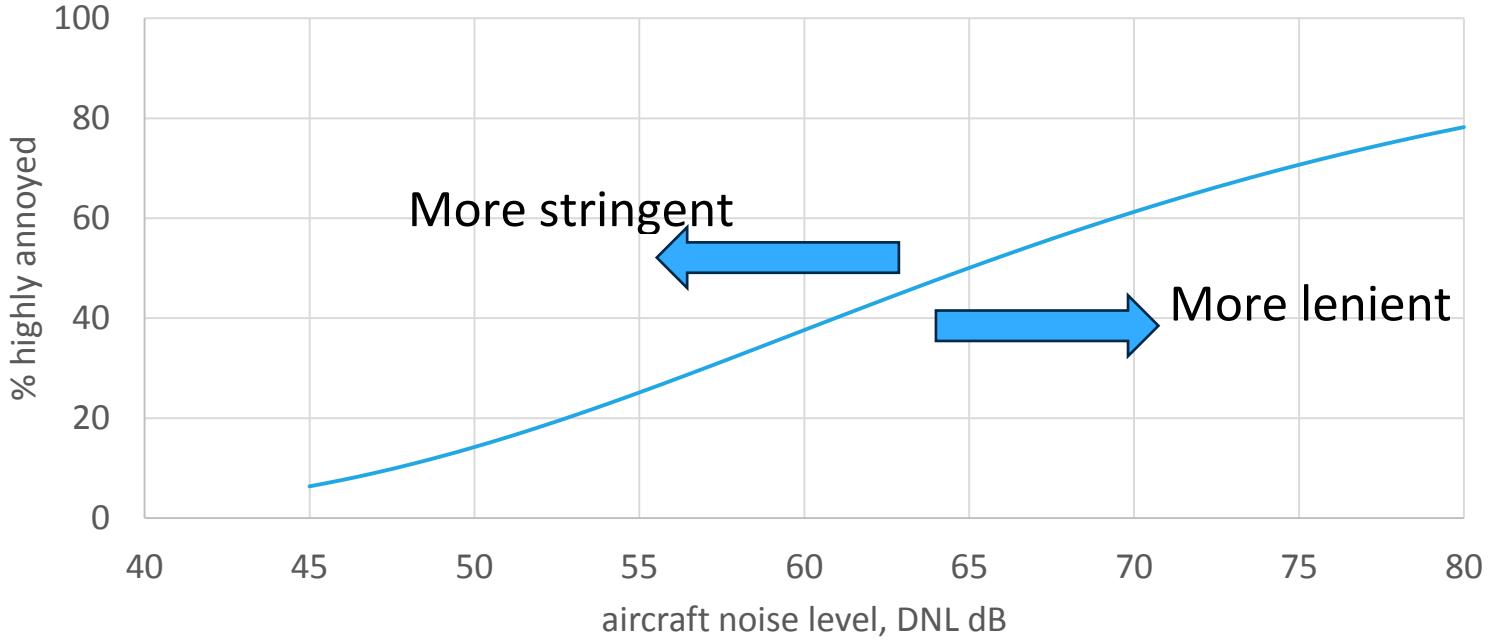
CTL – single value descriptor

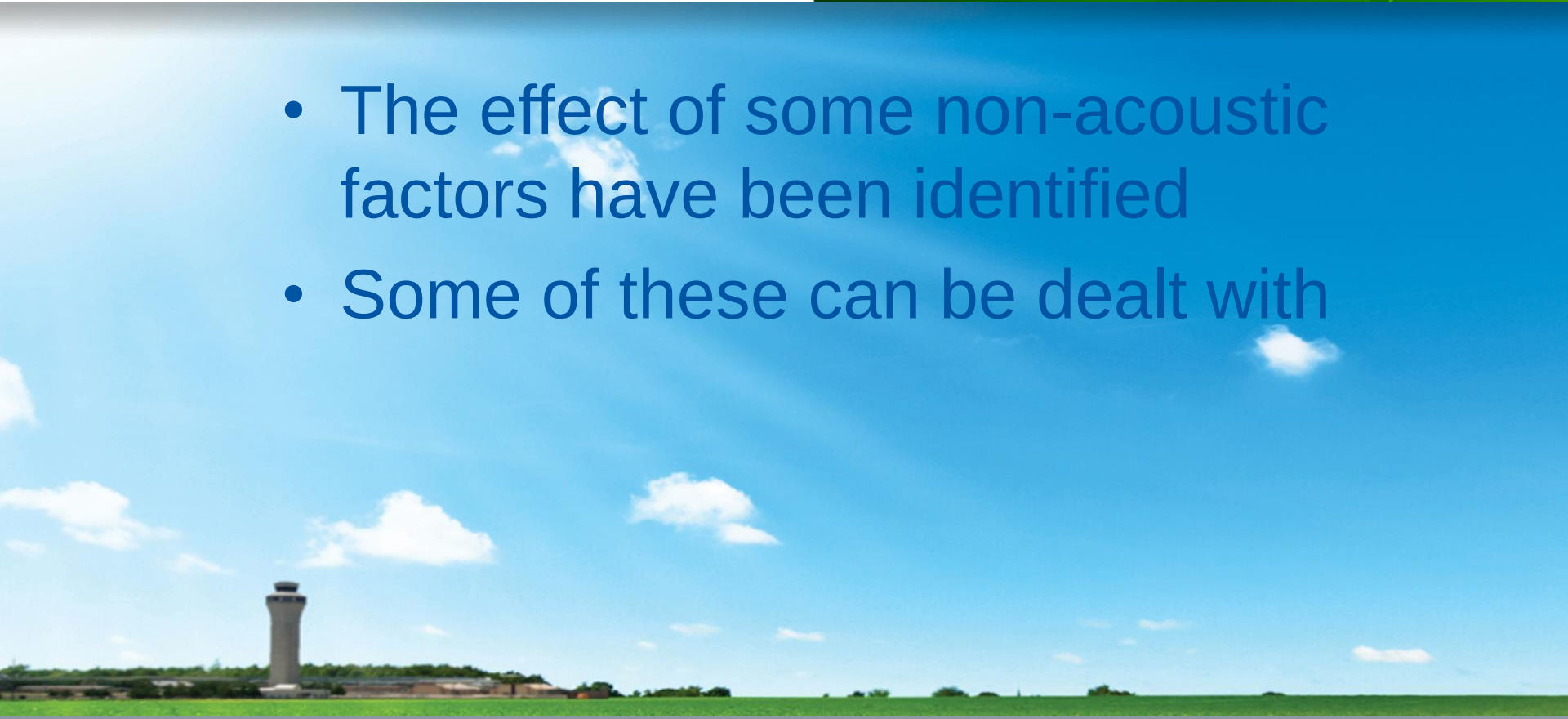
- Annoyance situation can be described by a single number – CTL value
- CTL – noise level for 50 % highly annoyed
- Differences between airports described by differences in CTL values



- Same function but different starting point on the noise axis
- Starting point defined by non-acoustic factors

How do non-acoustic factors affect the annoyance response ?

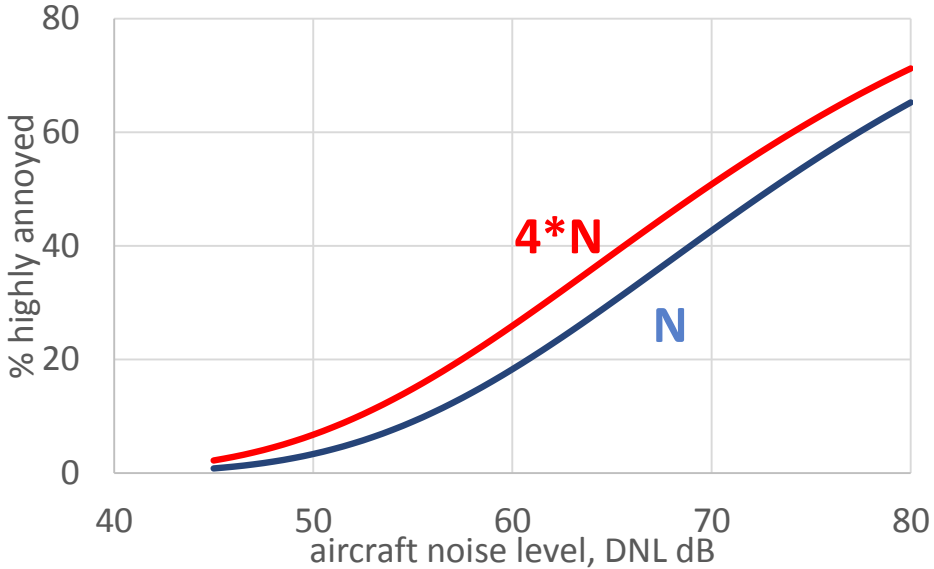




- The effect of some non-acoustic factors have been identified
- Some of these can be dealt with

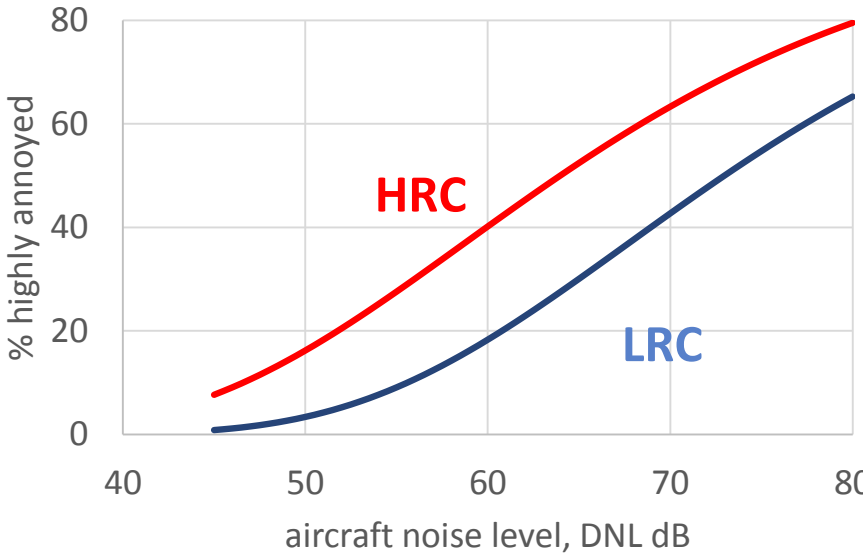
Number of aircraft movements

- At equal noise levels: annoyance increases with increasing number of movements
- Equivalent to 1.6 dB per doubling



"Rate of change"

- Stable operations, gradual growth
  LRC - low rate of change
- Abrupt operational changes, controversial future changes
  HRC - high rate of change
- Average difference in CTL: 9 dB

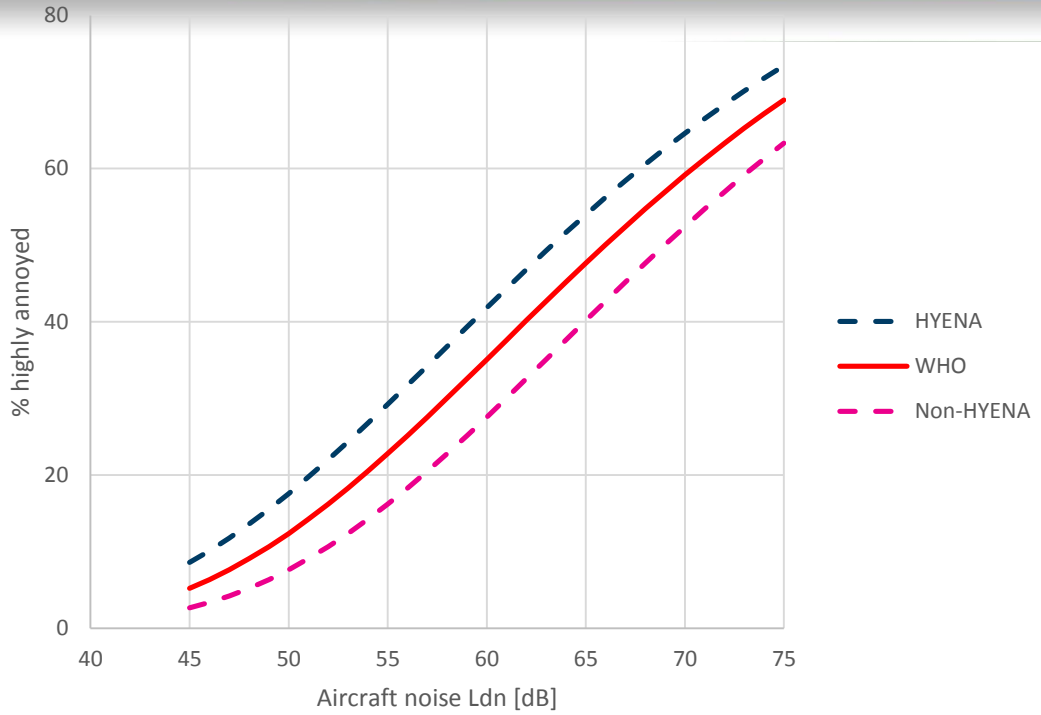


Average dose-response curve ?

- Highly dependent on the selection of surveys
- Miedema & Vos analysis: 2 HRC – 18 LRC airports
- WHO 2018: 8 HRC – 4 LRC airports

New WHO recommendations DENL 45 dB

- Average response for 12 post-2000 surveys
- Non-representative distribution: 8 HRC – 4 LRC airports
- HYENA study – 6 non-standardized surveys
- Does not matter says WHO ! ?
- About 6 dB "difference"



Conclusions

- The annoyance response is determined mainly by non-acoustic factors
- A better understanding of these factors may improve the annoyance situation
- Some of these factors can be managed/controlled by the airport authorities
- The annoyance can be reduced without reducing the noise exposure
- Environmental restrictions could eventually be specified in terms of annoyance

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THANK YOU