Soundscape indicators and mapping

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Outline

Soundscape indicators | descriptors | indices

Towards soundscape indices

Soundscape mapping

Soundscape descriptors

measures of how people perceive *the acoustic environment*

Soundscape indicators

measures used to predict the value of a soundscape descriptor

e.g., Sound level (L) measured in dB is an indicator of perceived loudness (Ψ)

$$\Psi = 2^{L/10}$$

Soundscape INDICES

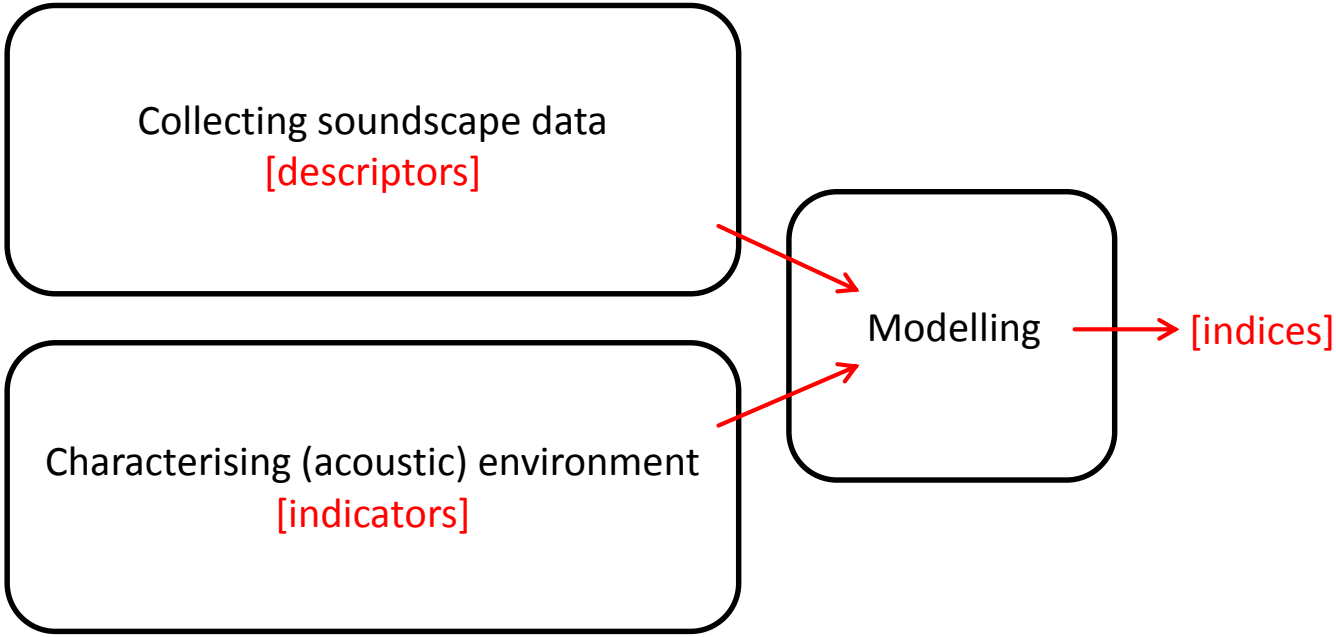
single-value scales derived from either indicators or descriptors that allow for comparisons across soundscapes

Soundscape indicators and descriptors: a review of the literature

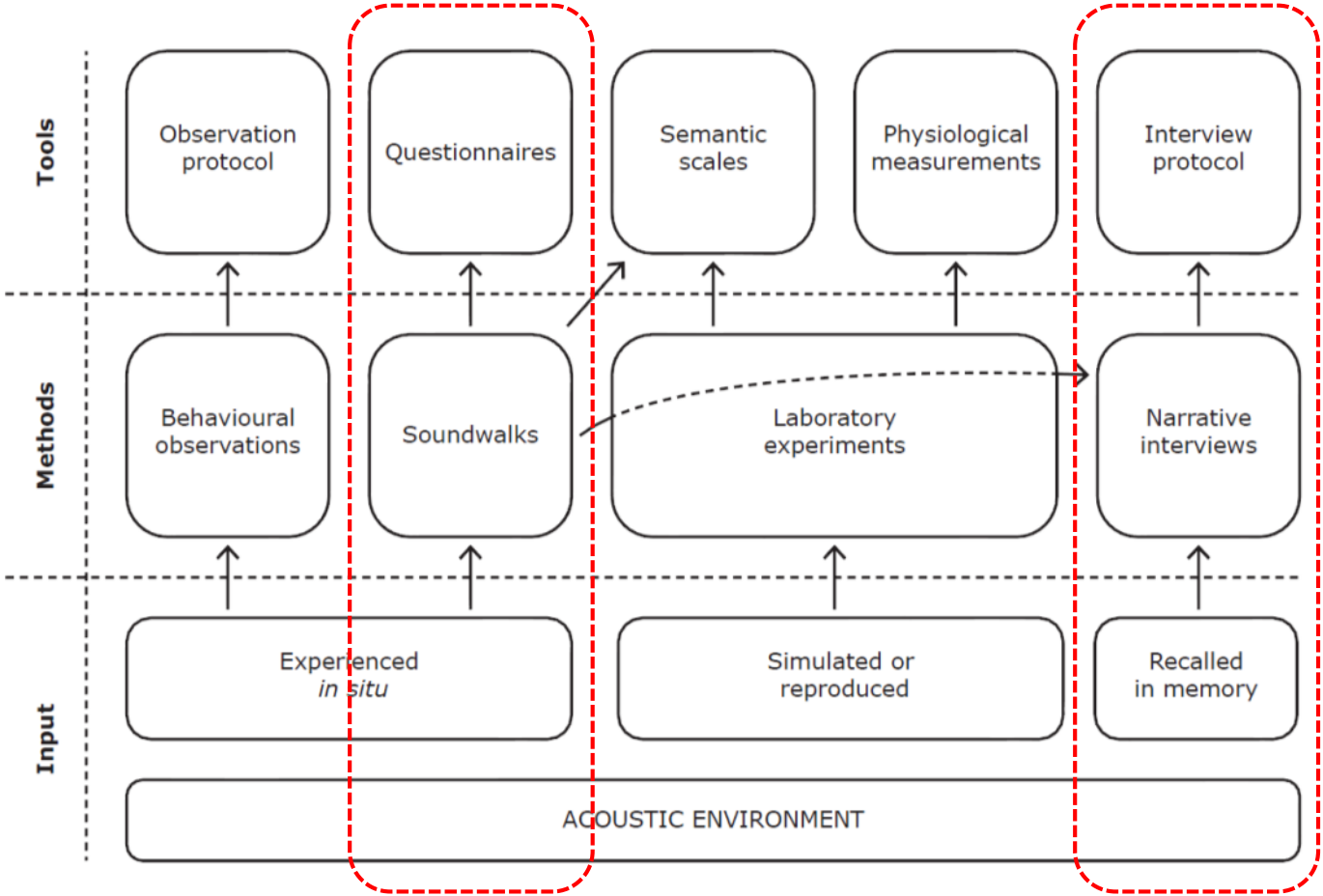
Aletta, F., Kang, J. and Axelsson, O. (2016) Soundscape descriptors and a conceptual framework for developing predictive soundscape models. *Landscape and Urban Planning,* 149, 65-74

Descriptor Category	Descriptor(s)	Indicator(s)	*Reference*
Noise annoyance	Unbiased Annoyance	Loudness, sharpness and fluctuation strength	*Zwicker (1991)*
	Noise annoyance	Loudness intrusiveness, sharpness and distortion of informational content	*Preis (1997)*
	Evaluation index	Loudness, sharpness, roughness, impulsiveness and relative approach	*Fiebig et al. (2009)*
Pleasantness	Pleasantness of noise	Loudness, sharpness, roughness and tonality	*Terhardt and Stoll (1981)*
	Unpleasantness of sound	Sound levels and the relative duration of categories of sound sources	*Lavandier and Defréville (2006)*
Quietness or tranquillity	Perceived Quietness	Slope	*Memoli and Licitra (2005)*
	Tranquillity	Sound levels and the percentage of natural features in a scene	*Pheasant, Horoshenkov, Watts (2008)*
Perceived music-likeness	Perceived music-likeness	Music-likeness (fuzzy)	*Botteldooren et al. (2006)*
Perceived affective quality	Pleasant, Unpleasant, Eventful, Uneventful, Calm, Monotonous, Exciting, Chaotic	*ongoing or not investigated*	*Axelsson et al. (2010)*
	Calm, Vibrant	*ongoing or not investigated*	*Cain et al. (2013)*
	Cacophony, Hubbub and Constant, Temporal	*ongoing or not investigated*	*Davies et al. (2013)*
	Restorativeness	*ongoing or not investigated*	*Payne (2013)*
Soundscape quality	Environmental Sound Experience Indicator	*unrevealed*	*Garcia Perez et al. (2012)*
	Sound Quality	L_{50} and L_{10}–L_{90}	*Ricciardi et al. (2015)*
	Appropriateness	*ongoing or not investigated*	*Axelsson (2015)*

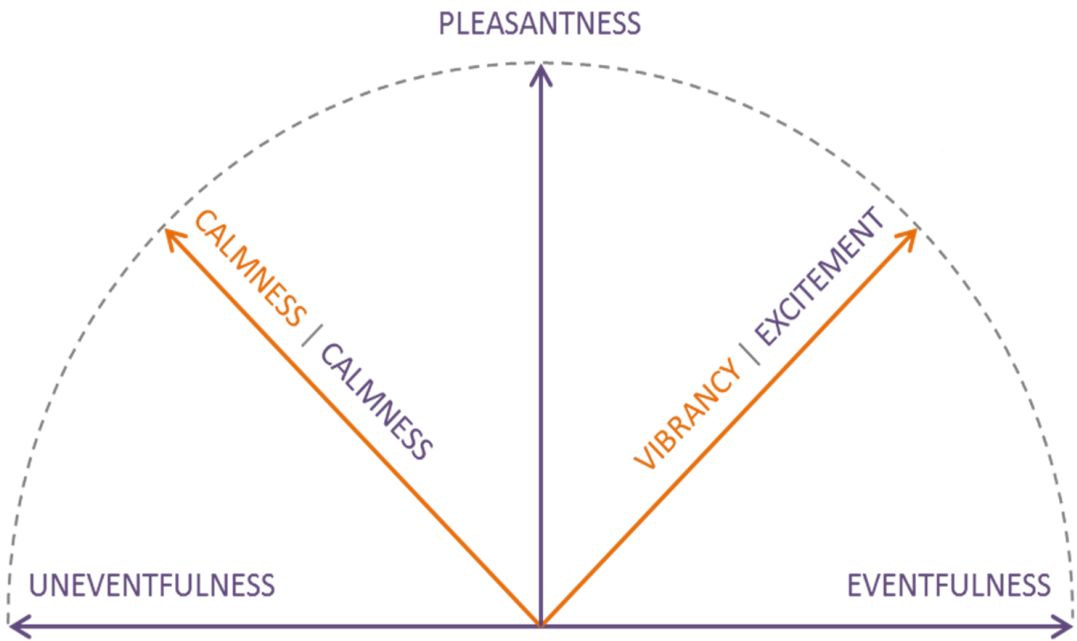
How can we develop *new* predictive models?



Collecting soundscape data



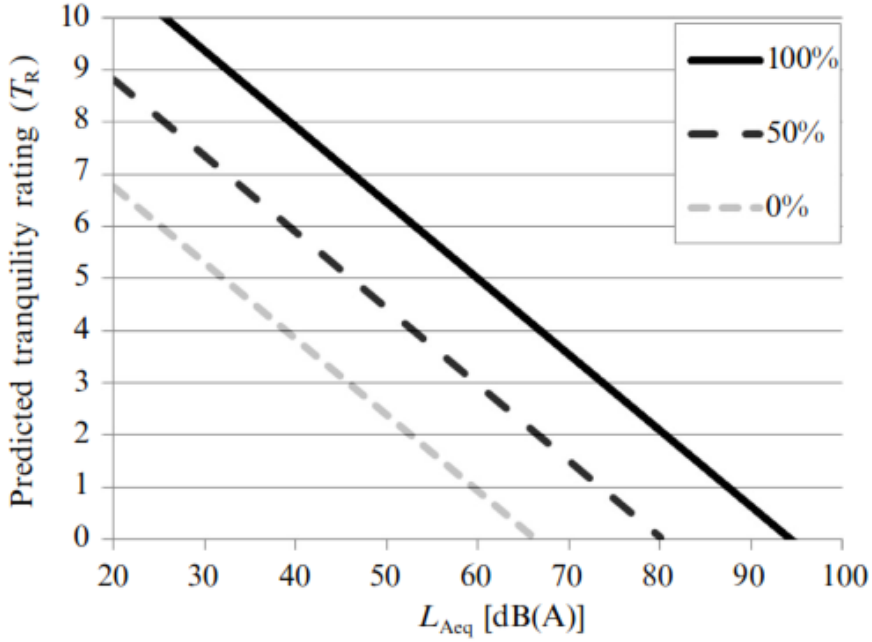
Two indicators-descriptors models examples: **tranquillity** and **vibrancy**

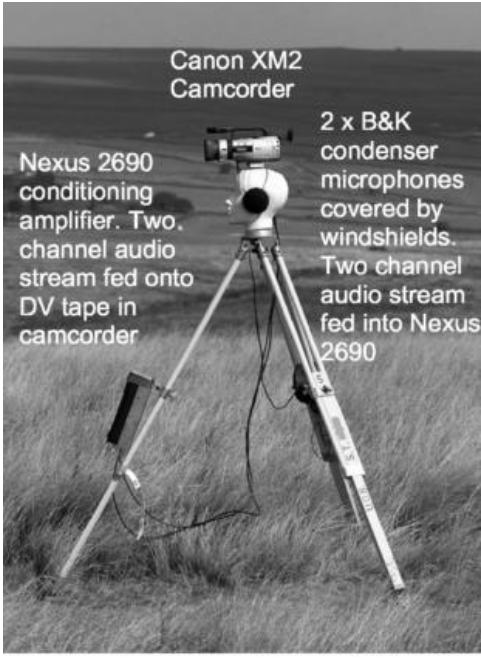


Axelsson *et al.* (2010)

Cain *et al.* (2013)

Tranquillity model



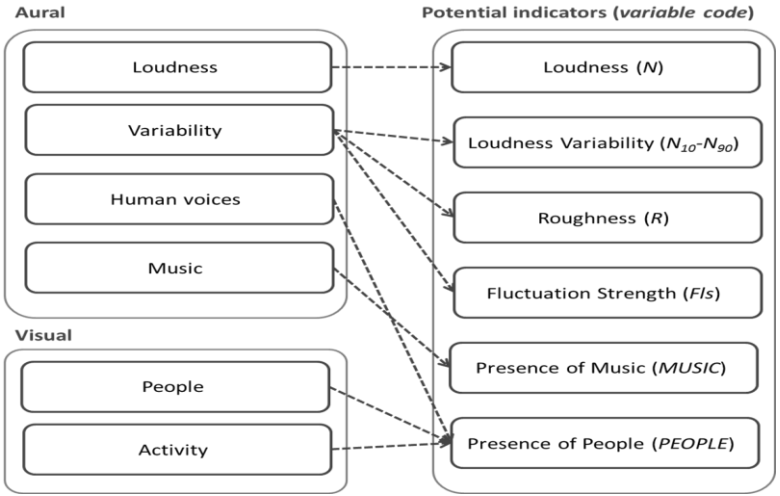


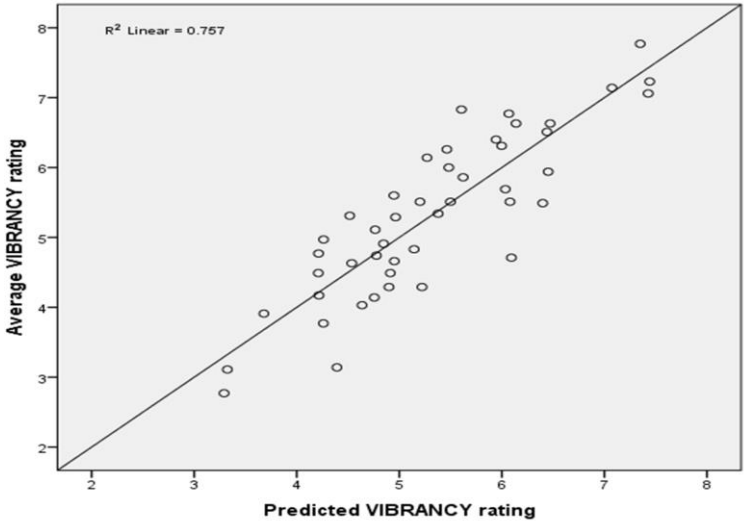
$$T_R = 9.68 + 0.041 N_{CF} - 0.146 L_{Aeq} + M_F$$

Pheasant, et al. (2008; 2010, inter alia)

Vibrancy model

Predictor	R^2 Change	Coefficient (β)
R	0.39	.682
PEOPLE	0.15	.436
Fls	0.07	.383
N	0.09	-.579
MUSIC	0.06	.272



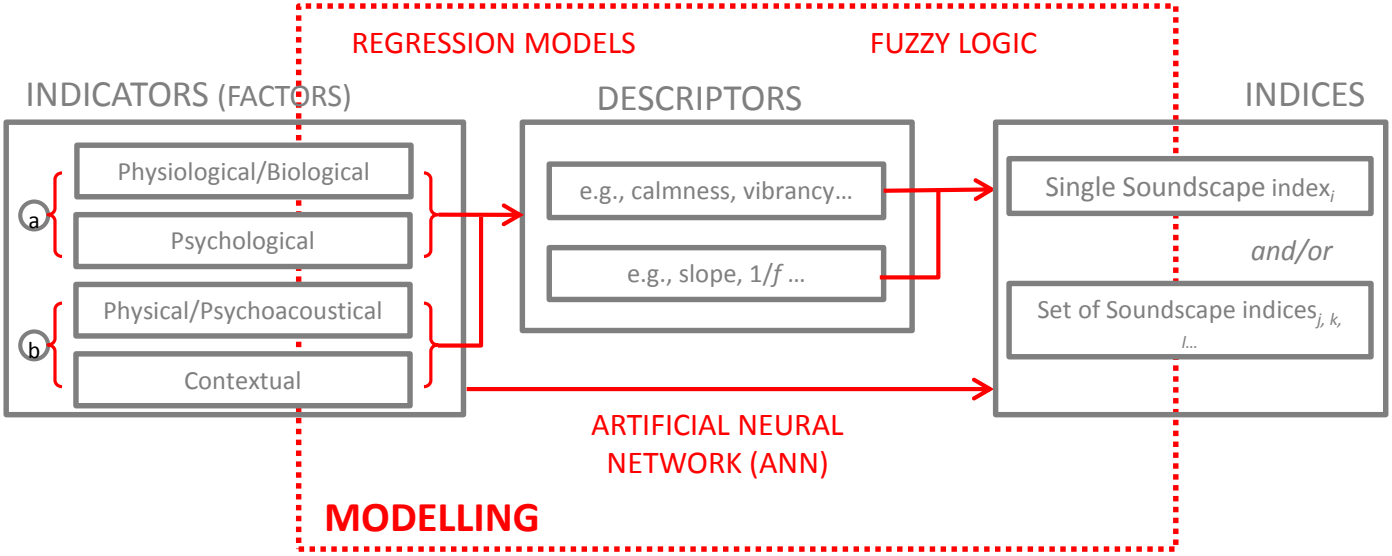


Aletta & Kang (2018)

Towards soundscape indices

ERC ADVANCED GRANT @UCL: “Soundscape Indices” (SSID)
2018-2013

Conceptual framework for the modelling and development of soundscape indices



Steps towards “soundscape indices”

- To characterise soundscapes;
- To determine key indicators and their influence on soundscape quality;
- To develop, test and validate soundscape indices;
- To demonstrate the applicability in sound environment management.

Field survey protocol

[APPENDIX C] QUESTIONNAIRE

To what extent do you presently hear the following four types of sounds?

SSI01 – Traffic noise (e.g., cars, buses, trains, airplanes)
[1 – 5] [Not at all; A little, Moderately; A lot; Dominates completely]

SSI02 – Other noise (e.g., sirens, construction, industry, loading of goods)
[1 – 5] [Not at all; A little, Moderately; A lot; Dominates completely]

SSI03 – Sounds from human beings (e.g., conversation, laughter, children at play, footsteps)
[1 – 5] [Not at all; A little, Moderately; A lot; Dominates completely]

SSI04 – Natural sounds (e.g., singing birds, flowing water, wind in vegetation)
[1 – 5] [Not at all; A little, Moderately; A lot; Dominates completely]

For each of the 8 scales below, to what extent do you agree or disagree that the present surrounding sound environment is…

PAQ01 – Pleasant
[1 – 5] [Strongly agree; Agree; Neither agree, nor disagree; Disagree; Strongly disagree]

PAQ02 – Chaotic
[1 – 5] [Strongly agree; Agree; Neither agree, nor disagree; Disagree; Strongly disagree]

PAQ03 – Vibrant
[1 – 5] [Strongly agree; Agree; Neither agree, nor disagree; Disagree; Strongly disagree]

PAQ04 – Uneventful
[1 – 5] [Strongly agree; Agree; Neither agree, nor disagree; Disagree; Strongly disagree]

PAQ05 – Calm
[1 – 5] [Strongly agree; Agree; Neither agree, nor disagree; Disagree; Strongly disagree]

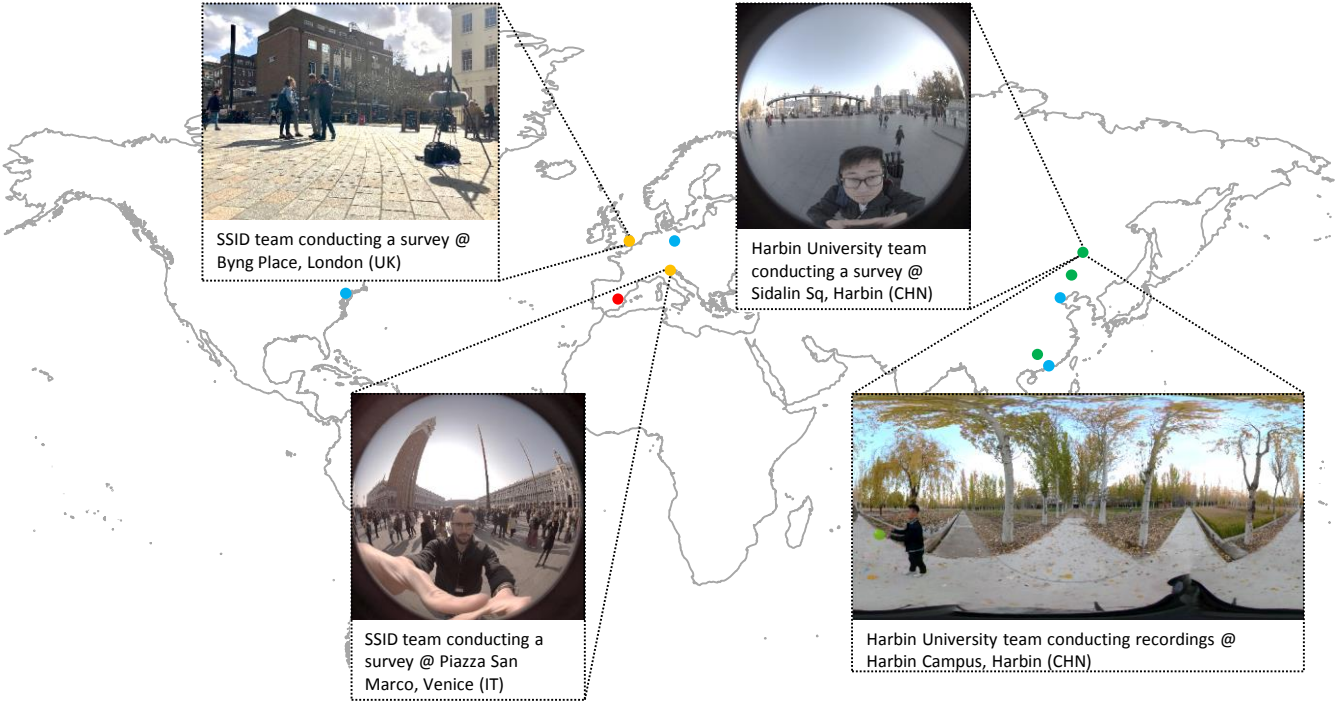
PAQ06 – Annoying
[1 – 5] [Strongly agree; Agree; Neither agree, nor disagree; Disagree; Strongly disagree]

PAQ07 – Eventful
[1 – 5] [Strongly agree; Agree; Neither agree, nor disagree; Disagree; Strongly disagree]

PAQ08 – Monotonous
[1 – 5] [Strongly agree; Agree; Neither agree, nor disagree; Disagree; Strongly disagree]

360 video and 1st order Ambisonics audio recordings for the Auralisation Lab + Monaural and binaural measurements

Field survey locations



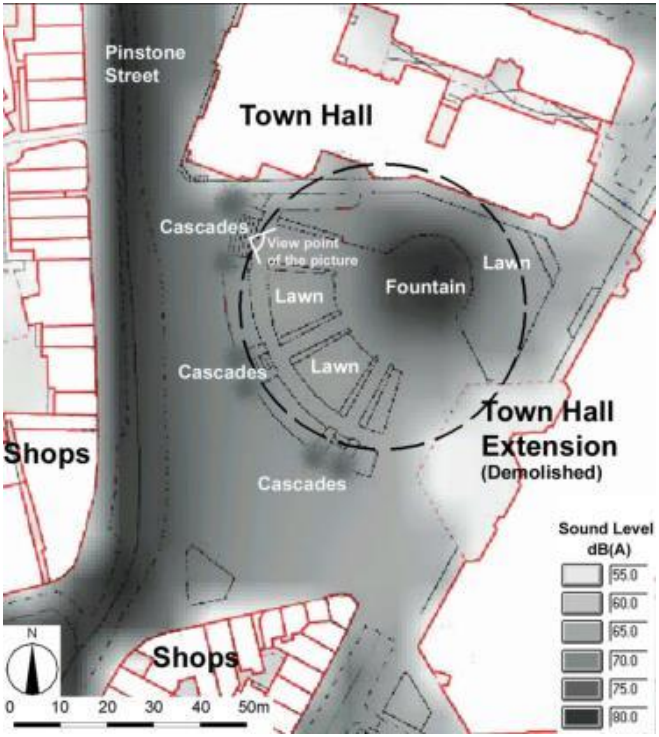
Auralisation lab

Prefabricated room that will feature a 12 speaker array for Ambisonics reproduction @UCL Here East

Soundscape mapping

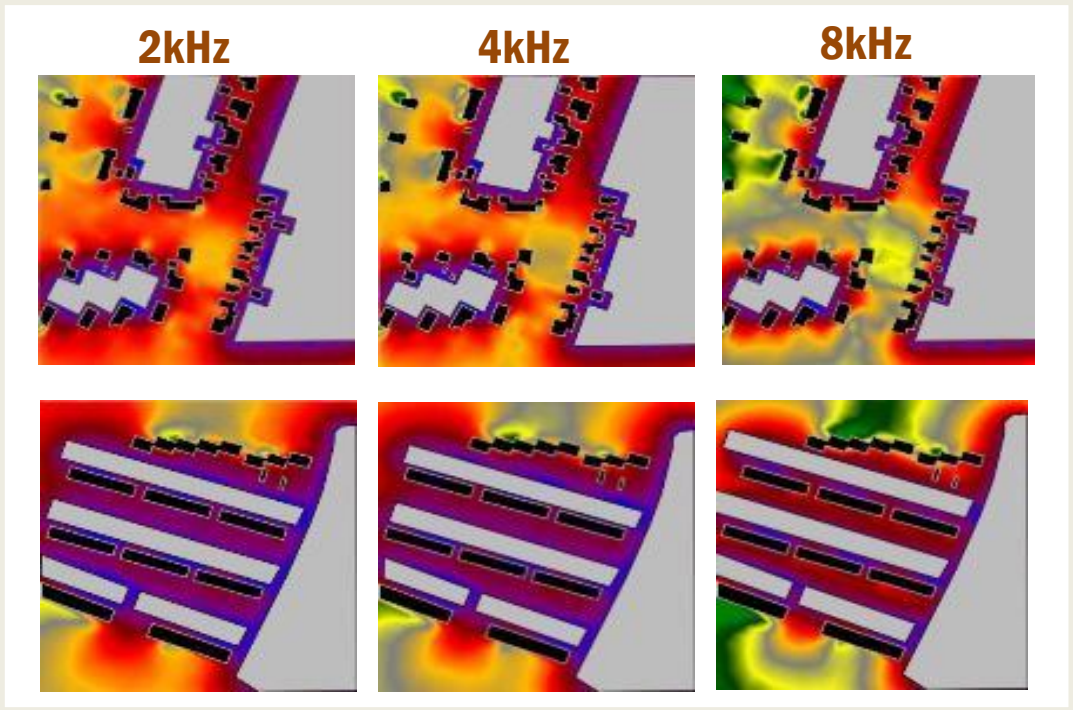
Kang, J., Schulte-Fortkamp, B., Fiebig, A. and Botteldooren, D. (2016) Mapping of soundscape. In: Kang, J. and Schulte-Fortkamp, B. (ed.) (2016) *Soundscape and the built environment*. Taylor & Francis incorporating Spon, London

Sound maps



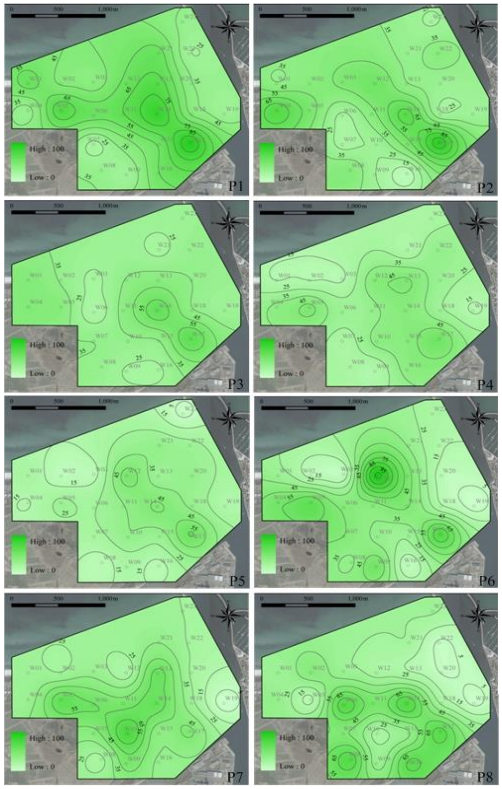
Yang, W. and Kang, J. (2005) Soundscape and sound preferences in urban squares. Journal of Urban Design, 10(1), 69-88

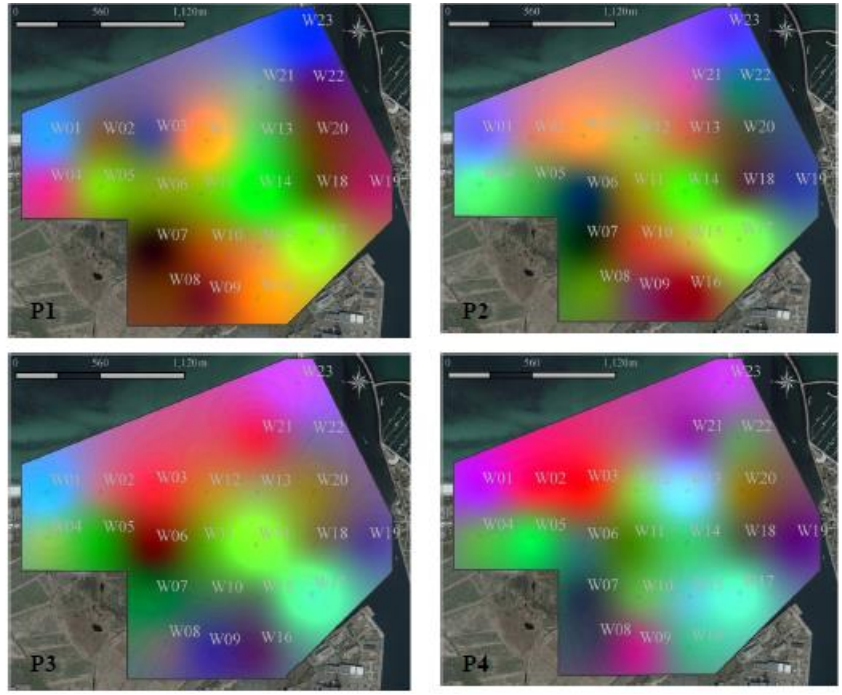
Noise mapping applied to “wanted” sounds



Hao, Y., Kang, J. and Krijnders, J. D. (2015) Integrated effects of urban morphology on birdsong loudness and visibility of green areas. Landscape and Urban Planning, 137, 149-162).

Sound sources perceived dominance maps

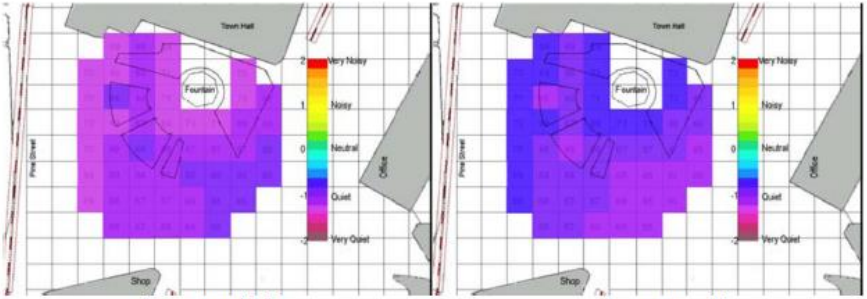




Perceived loudness of birdsong (Liu et al. 2013)

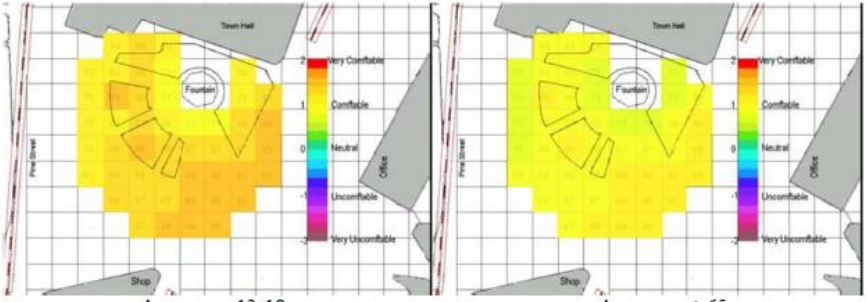
Liu, J., Kang, J., Luo, T. Behm, H., Coppack, T. and (2013) Spatiotemporal variability of soundscapes in a multiple functional urban area. Landscape and Urban Planning, 115, 1-9.

Soundscape mapping based on ANN



Age group 13-18 Age group >65

a. Sound level evaluation map

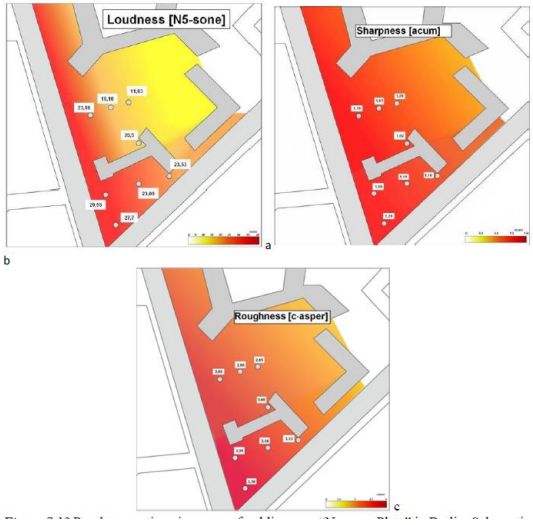


Age group 13-18 Age group >65

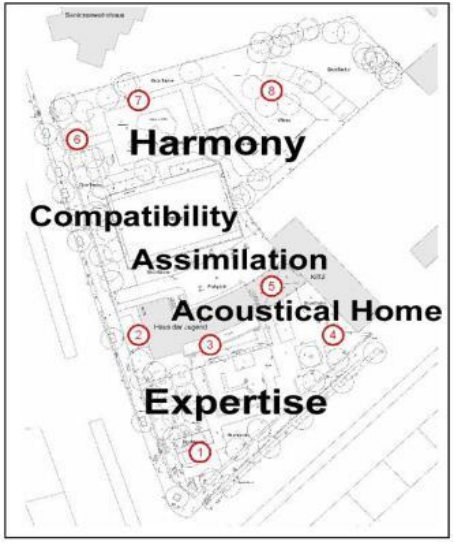
b. Acoustic comfort evaluation map

Yu, L. and Kang, J. (2008) Effects of social, demographic and behavioral factors on sound level evaluation in urban open spaces. J. Acoust. Soc. Am., 123(2), 772-783.

Psychoacoustic map & mind map

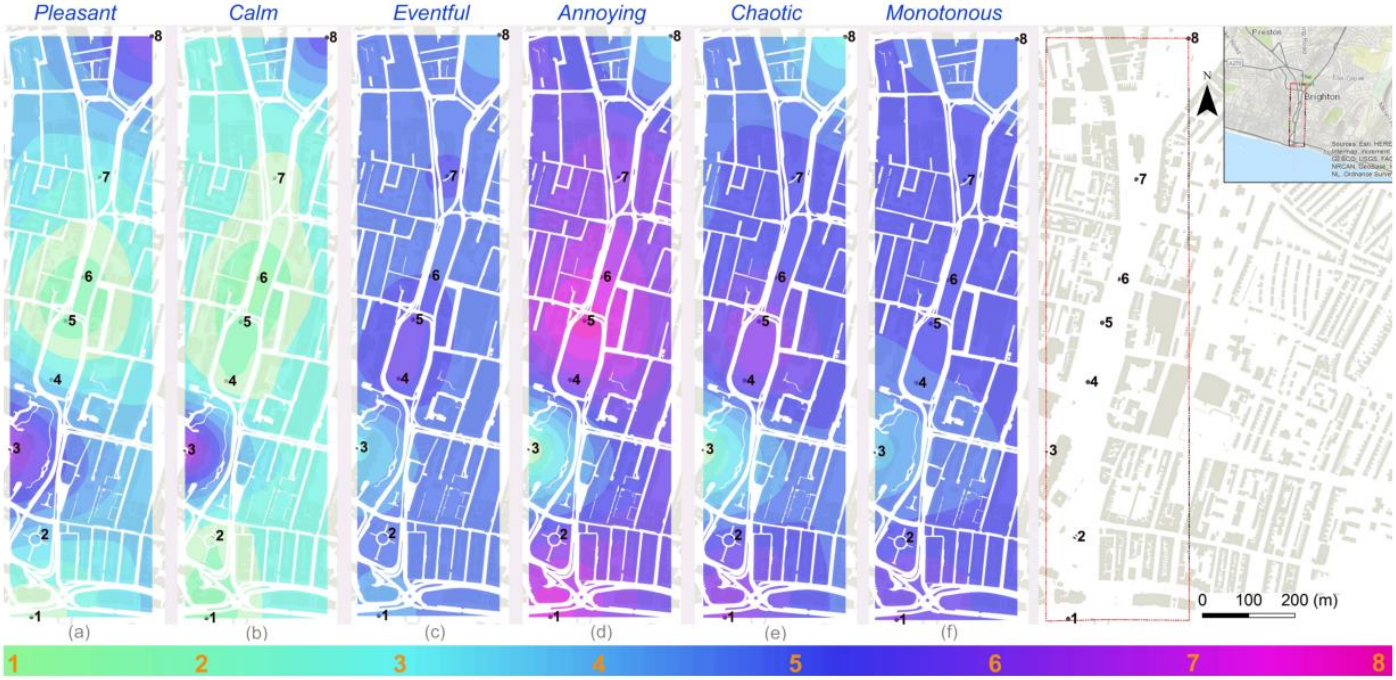


Psychoacoustic noise maps of public space “Nauener Platz” in Berlin. Schematic distribution of loudness (a), sharpness (b) and roughness (c) over the investigated area (Genuit, Schulte-Fortkamp and Fiebig, 2008).



Simplified mind map of public space “Nauener Platz” in Berlin. The numbers represent particular relevant locations indicated by residents in soundwalks. The terms represent core categories, which will have to guide the development of design of the investigated area.

Perceptual maps



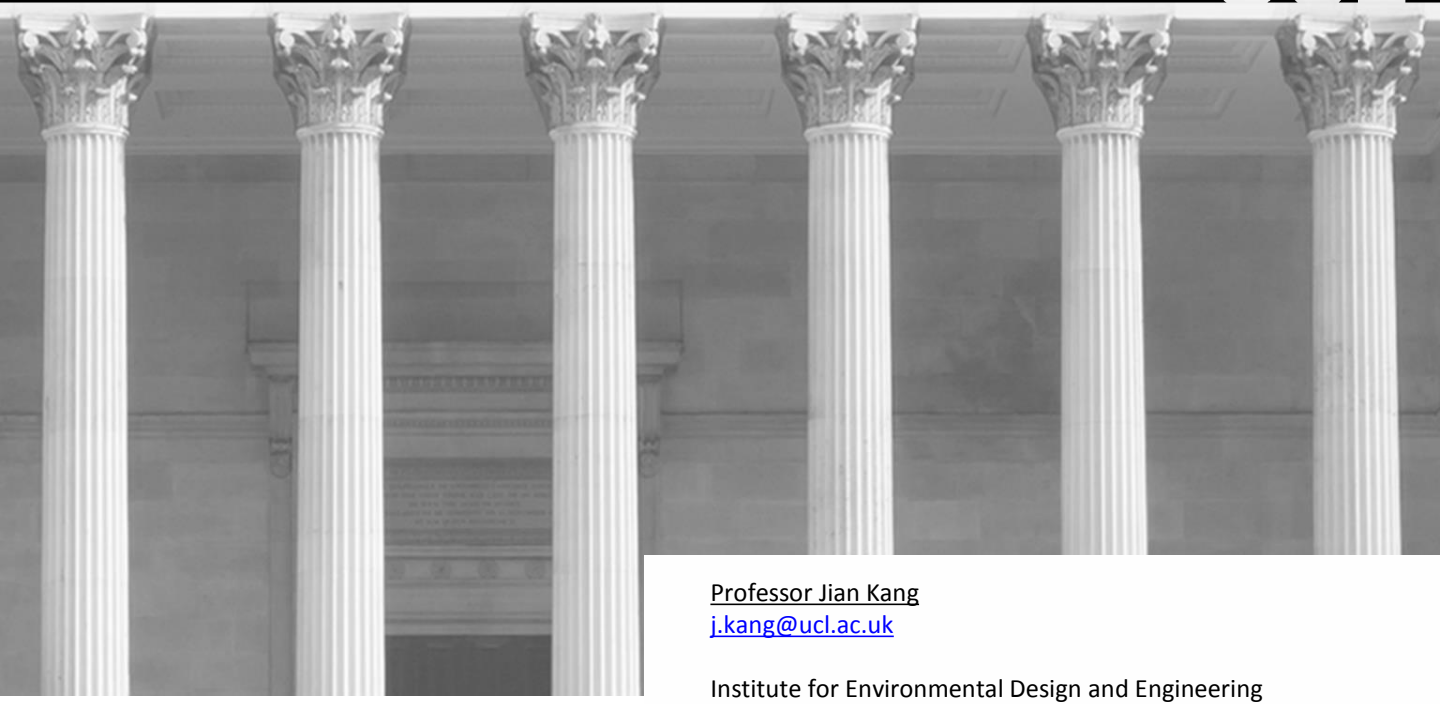
Kang, J., Aletta, F., Margaritis, E. and Yang, M. (2018) A model for implementing soundscape maps in smart cities. Noise Mapping, 5, 46-59.

Sensory maps relying on social media data

Aiello L.M., Schifanella, R., Quercia, D. and Aletta, F. (2016) Chatty maps: constructing sound maps of urban areas from social media data. Royal Society Open Science, 3. https://doi.org/10.1098/rsos.150690.

Concluding remarks

- Much work done in soundscape indicators and descriptors (need for a coherent framework)
- Need for developing soundscape index (operational tools)
- Feasibility of various soundscape mapping techniques (depending on scope and scale)



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