Spatial units of analysis

Use of activity space models in environmental health promotion studies

In this presentation

- What is a spatial unit?

- How can we model it?

- Why is this important?

Person and place based analysis

How can the **geographical context** affect people?
- Green structure
- Urban density
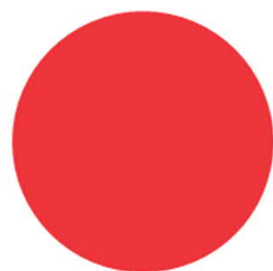- Walkability
- ...

Individualized place exposure

Examples:
- Administrative boundaries:
    - Postal areas
    - Census tracts
- Person based
    - Home buffers, Road network buffers, Kernel density estimation, standard deviational ellipses etc.
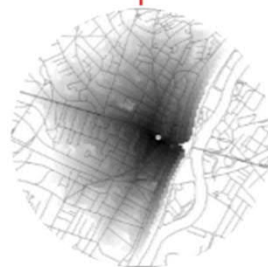
Spatial units

Administrative boundaries

Person based

Examples of some common AS and LAS models
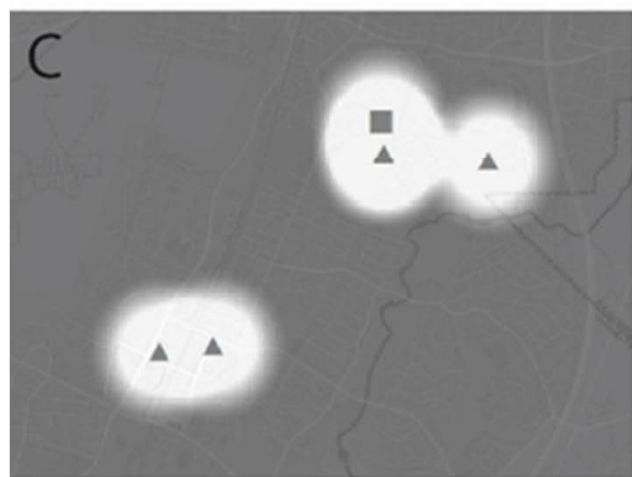A: Home buffer
B: Deviational ellipse
C: Kernel density
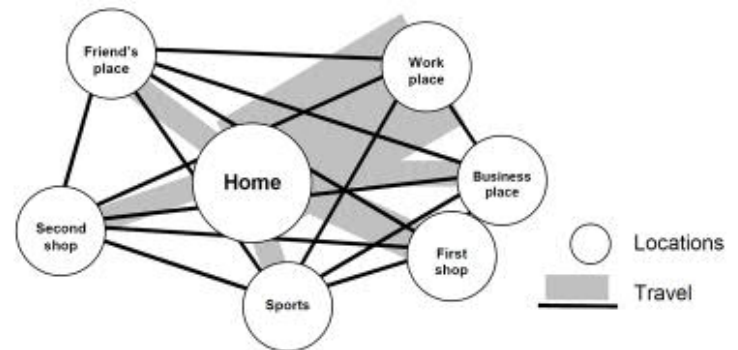D: Minimum convex polygon
E: Dynamic home range

■ Home   ▲ Activity point

What is Activity space (AS)?

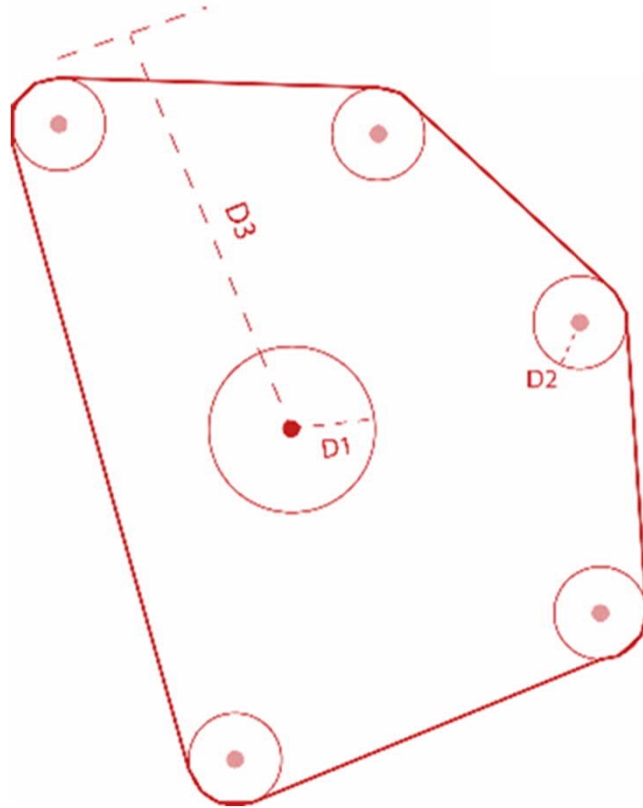- Activity space is a set of geographically distributed locations which are physically contacted by individuals (Reynolds, 1971)

- First introduced in zoology (Burt, 1943)

Schönfelder and Axhausen (2002)

Static buffer around home

Dynamic home range model
(Hasanzadeh et al., 2017)
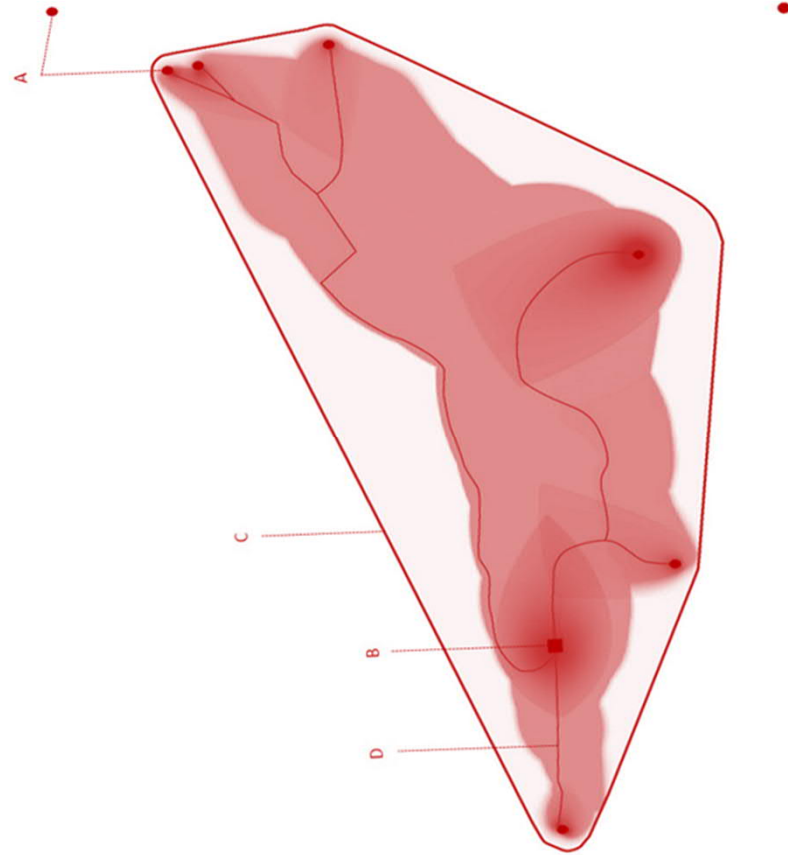
Individualized residential exposure model (IREM)
(Hasanzadeh et al., 2018)

Improved models (I): Home range

1: (Hasanzadeh, et al, 2017)
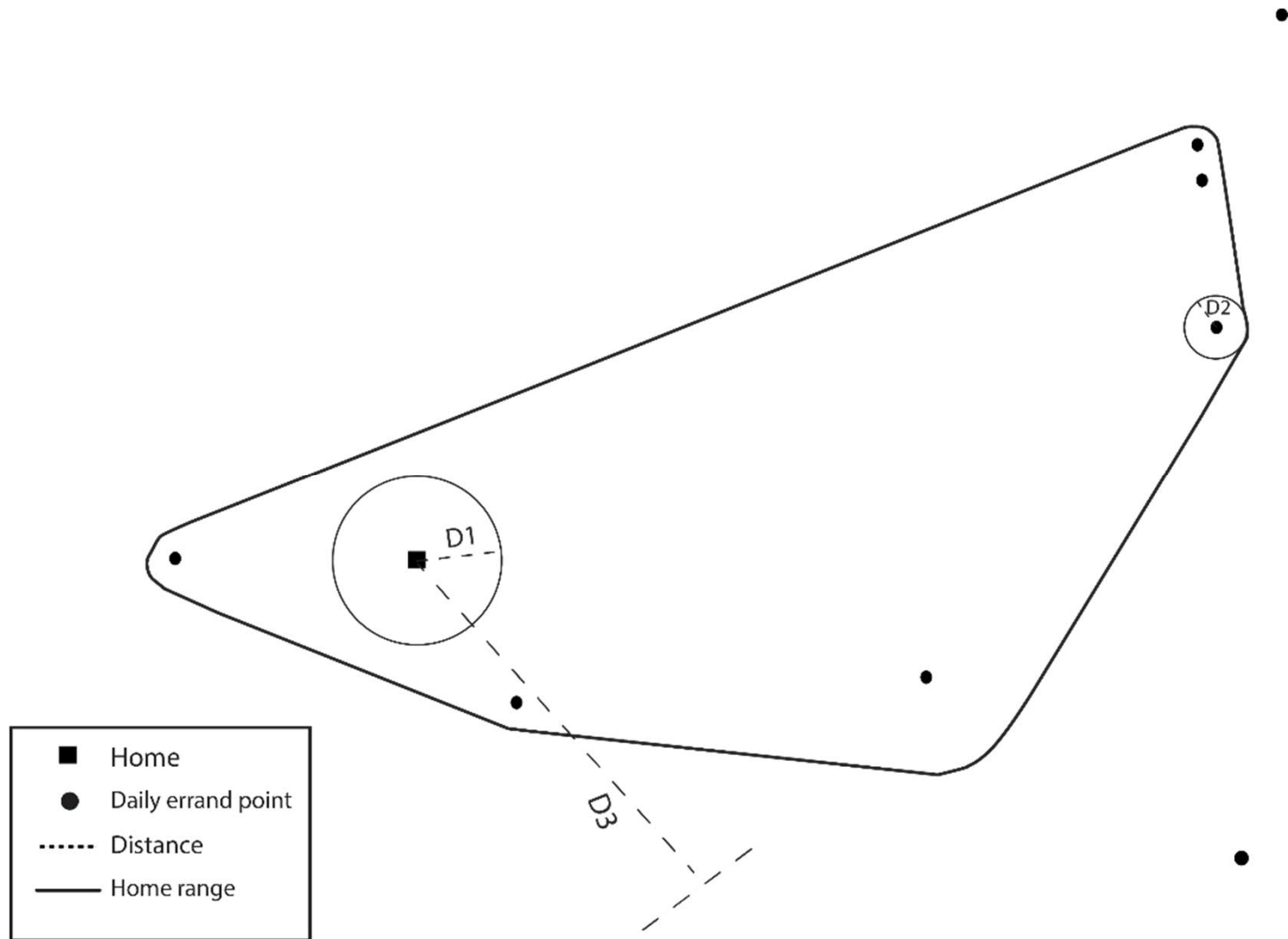
- A customized convex hull using three parameters: D1, D2, D3
- Systematically defined, individual specific

❑Are all areas equally accessible?
❑Are we equally exposed to all areas within our home range?

Improved models (II): An individualized residential exposure model (IREM)

Cell

(Hasanzadeh, et al, 2018)
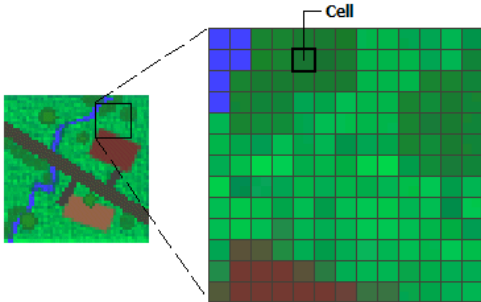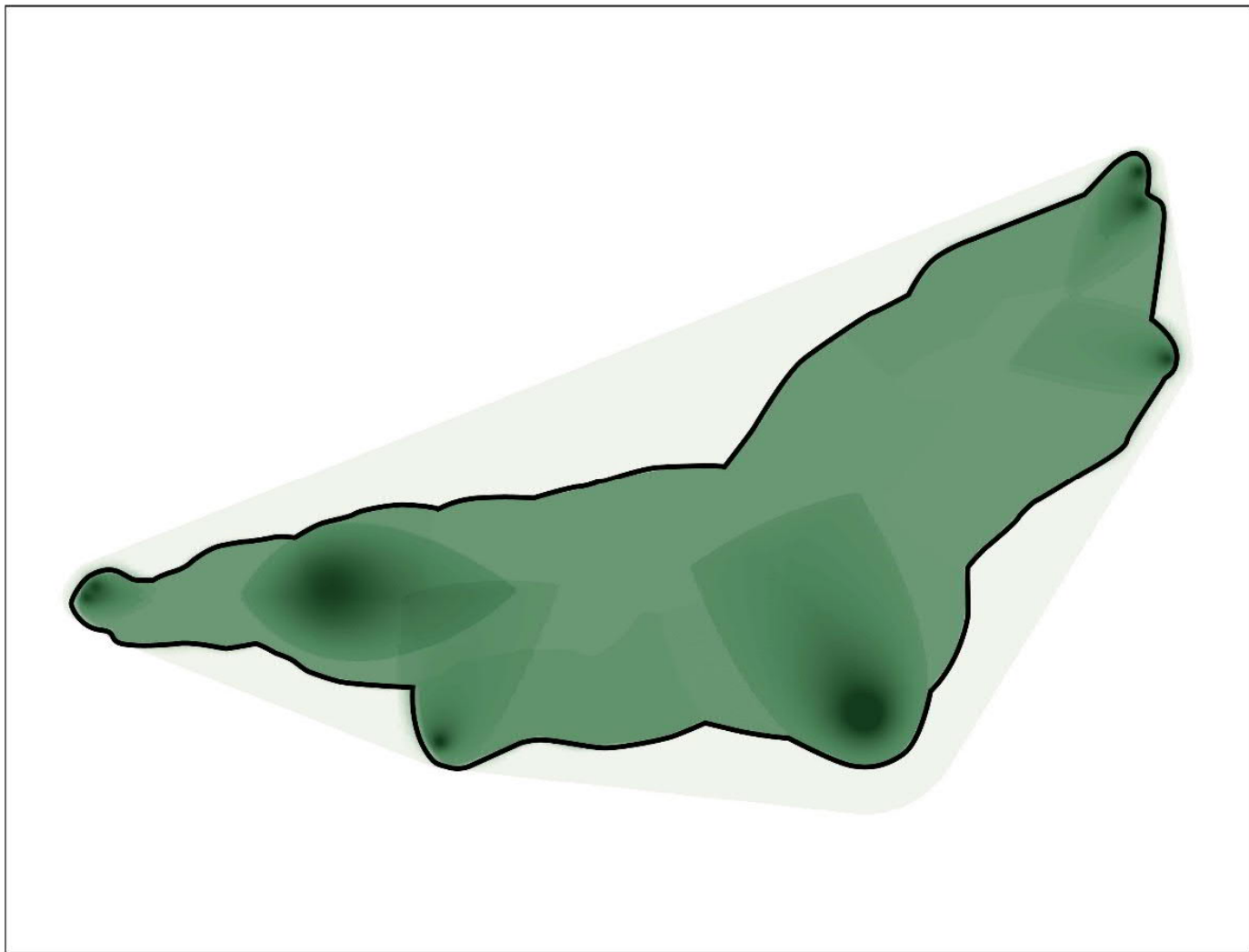
- The level of exposure can vary:
  - Frequency of visit, mode of transportation, path taken
- Activity space presented as raster
  - Weights assigned using the above three factors. Distributed using:
    A distance decay function (inverse distance weighting)
  - Spatially sensitive analysis of contextual factors

We can extract areas of high exposure
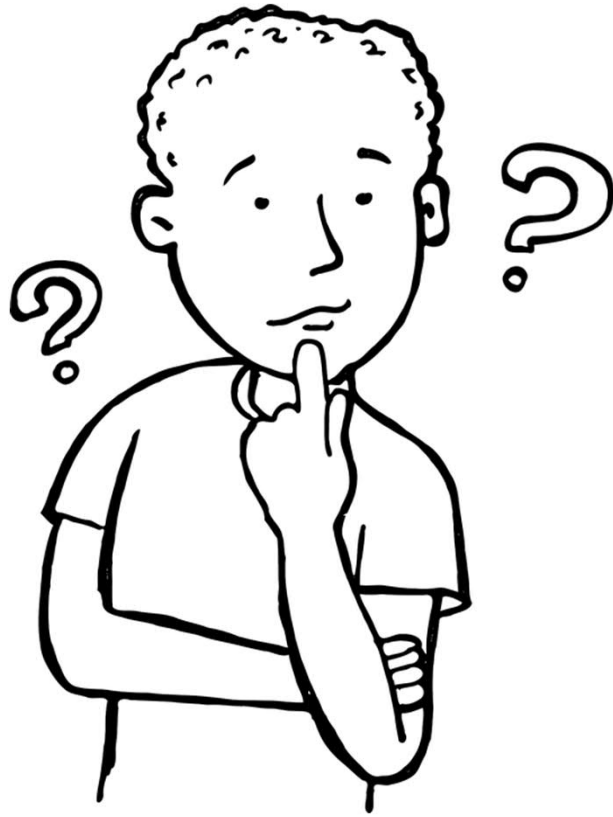
How does this all matter?

- Different models offer different level of accuracy and accordance with reality
- Different phenomena may be relevant to study at different scales
  - Different models can yield different results
  - Advanced models can enhance analytical possibilities
    - Models vary in their level of complexity

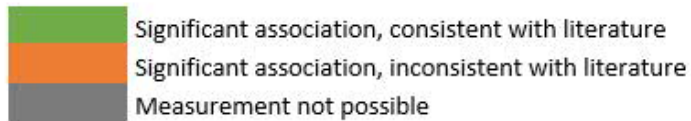|		Health	Functioning	QOL	Happiness
Postal areas	Greenness				
	Size of AS				
	Walkbility				Significant association, inconsistent
	Pedestrian/Cycling route	Significant, consistent	Significant, consistent	Significant, consistent	Significant, consistent
Buffer (500 m)	Greenness			Significant association, inconsistent	Significant association, inconsistent
	Size of AS	Measurement not possible	Measurement not possible	Measurement not possible	Measurement not possible
	Walkbility				
	Pedestrian/Cycling route				
Home range	Greenness				
	Size of AS				
	Walkbility	Significant, consistent	Significant, consistent	Significant, consistent	Significant, consistent
	Pedestrian/Cycling route	Significant, consistent		Significant, consistent	Significant, consistent
IREM	Greenness	Significant, consistent	Significant, consistent	Significant, consistent	Significant, consistent
	Size of AS	Significant, consistent	Significant, consistent	Significant, consistent	Significant, consistent
	Walkbility				
	Pedestrian/Cycling route				

Legend:
- Significant association, consistent with literature (green)
- Significant association, inconsistent with literature (orange)
- Measurement not possible (grey)

Two sides of the coin?!

QOL: quality of life
AS: activity space
IREM: Individualized Residential Exposure Model

Thank you!

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Read more:

Hasanzadeh, K. (2019). Spatial units of analysis: are there better ways?-An empirical framework for use of individualized activity space models in environmental health promotion research.

Hasanzadeh, K., Broberg, A., & Kyttä, M. (2017). Where is my neighborhood? A dynamic individual-based definition of Home zones. *Applied Geography*, *84*(C), 1–10. https://doi.org/10.1016/j.apgeog.2017.04.006

Hasanzadeh, K., Laatikainen, T., & Kyttä, M. (2018). A place-based model of local activity spaces: individual place exposure and characteristics. *Journal of Geographical Systems*. https://doi.org/10.1007/s10109-017-0264-z

Laatikainen, T. E., Hasanzadeh, K., & Kyttä, M. (2018). Capturing exposure in environmental health research: Challenges and opportunities of different activity space models. *International journal of health geographics*, *17*(1), 29.

Perchoux, C., Kestens, Y., Thomas, F., Hulst, A. Van, Thierry, B., & Chaix, B. (2014). Assessing patterns of spatial behavior in health studies: Their socio-demographic determinants and associations with transportation modes (the RECORD Cohort Study). *Social Science and Medicine*, *119*, 64–73.

GIS tools and Python codes available:
Hasanzadeh, K. (2018). IASM: Individualized activity space modeler. *SoftwareX*, *7*, 138-142.