

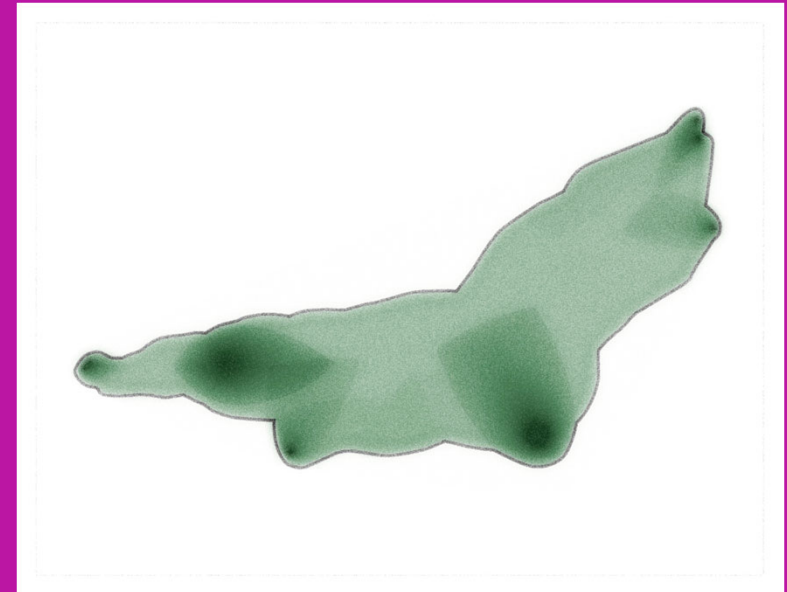
# Spatial units of analysis

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Use of activity space models in environmental health promotion

*Urban Experience - 7.2.2023*

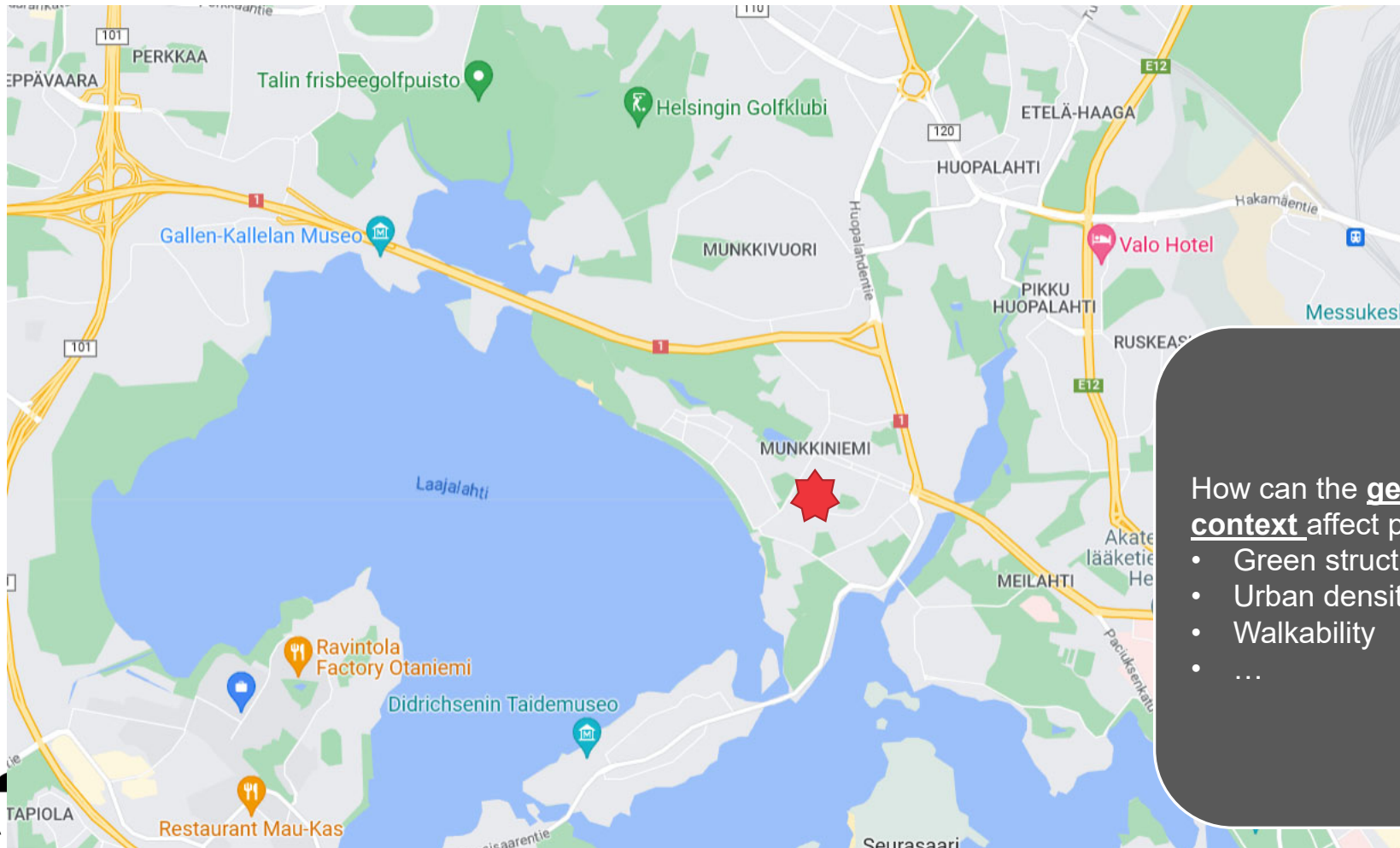
Kamyar Hasanzadeh, PhD



# **In this presentation:**

- **What is a spatial unit?**
- **How can we model it?**
- **Why is this important?**

# Person and place based analysis

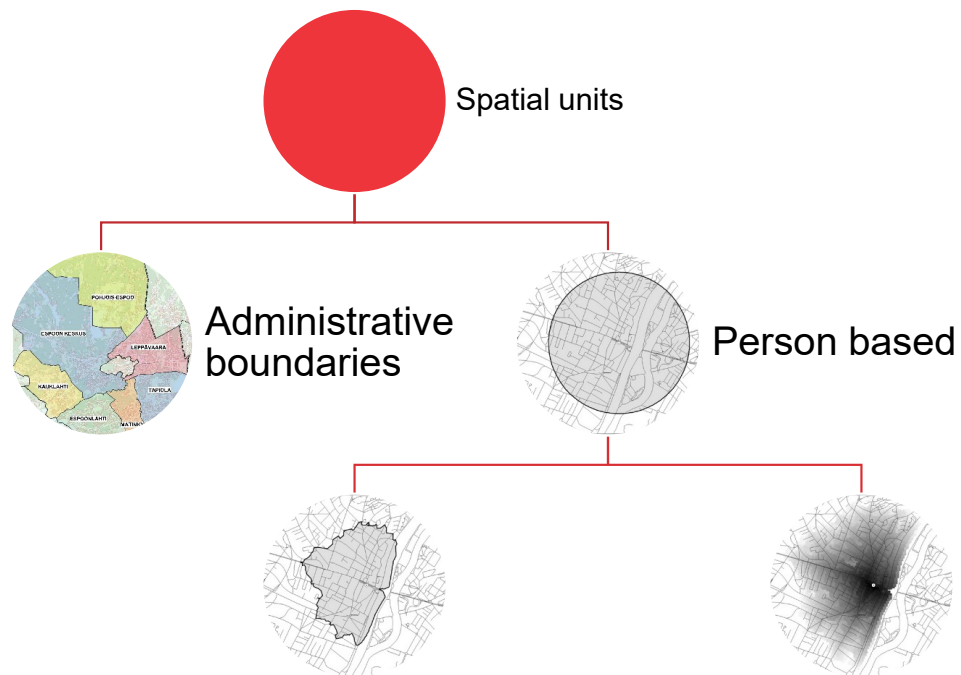


How can the geographical context affect people?

- Green structure
- Urban density
- Walkability
- ...

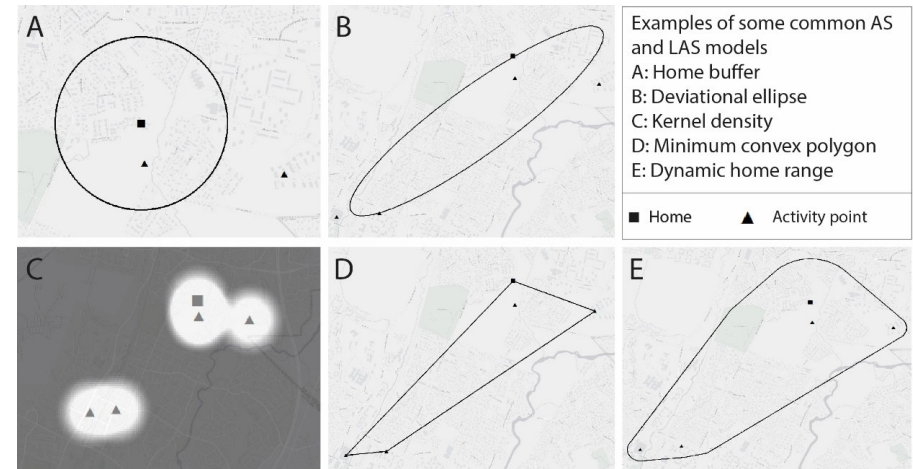
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# In literature...



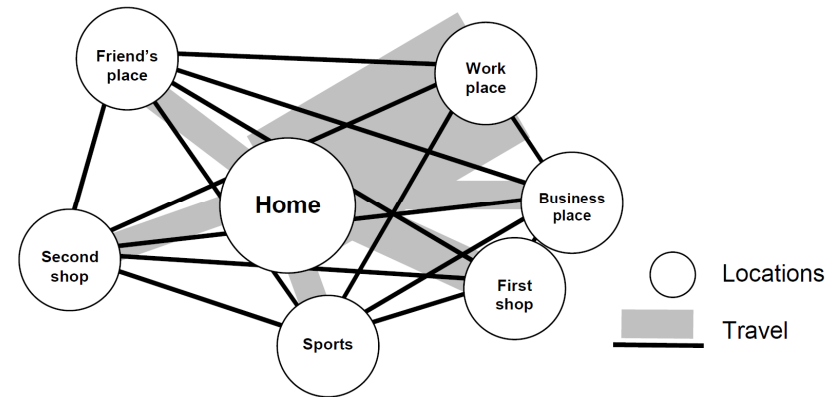
## Examples:

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



# What is Activity space (AS)?

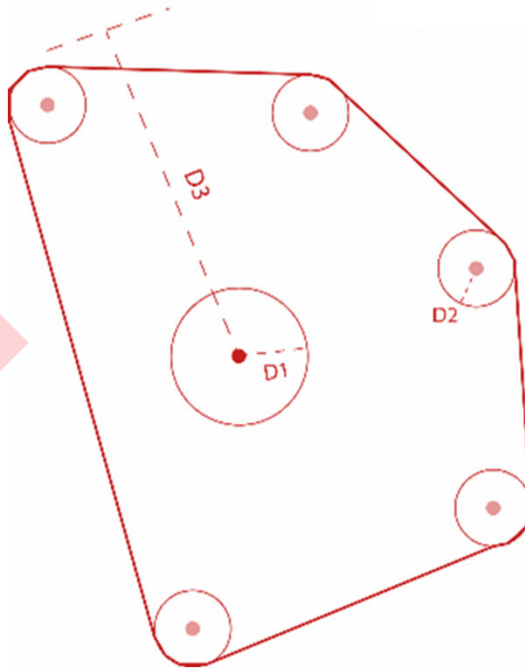
- Activity space is a set of geographically distributed locations which are physically contacted by individuals (Reynolds, 1971)
- First introduced in zoology (Burt, 1943)



Schönfelder and Axhausen (2002)

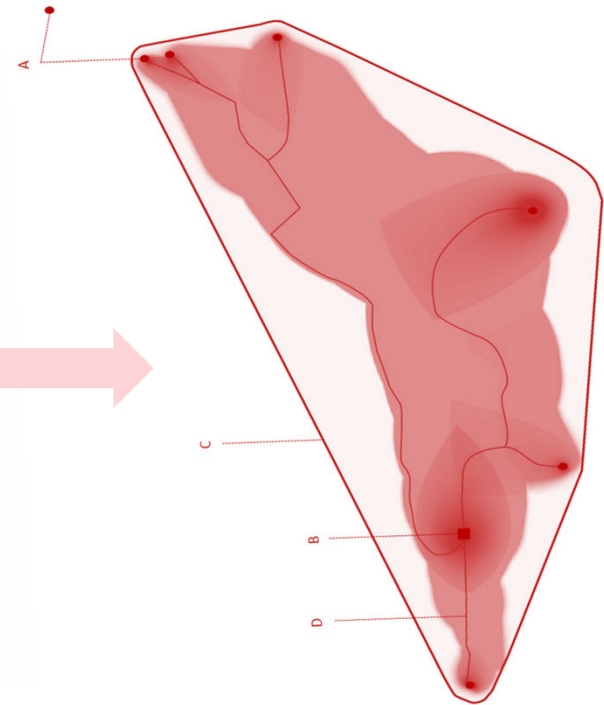


**Static buffer around home**



**Dynamic home range model**

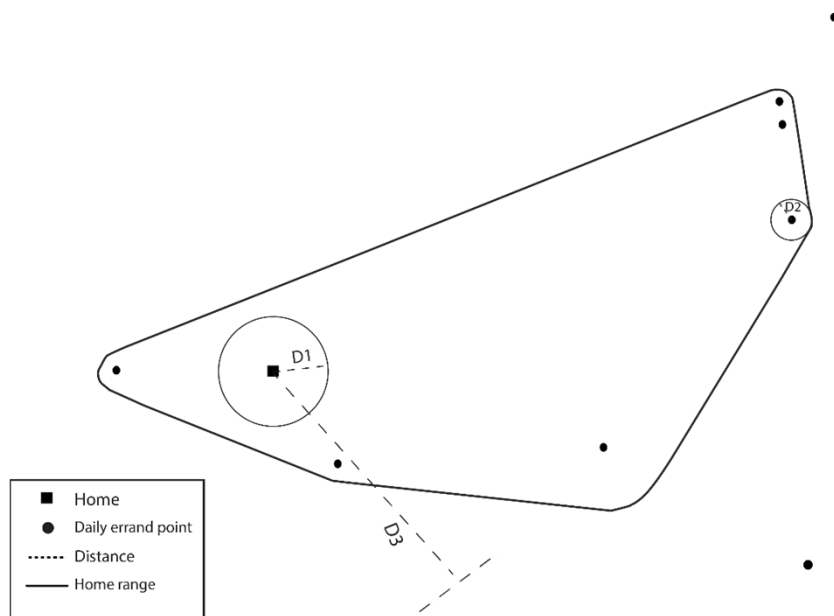
(Hasanzadeh et al., 2017)



**Individualized residential exposure model (IREM)**

(Hasanzadeh et al., 2018)

# Improved models (I): Home range

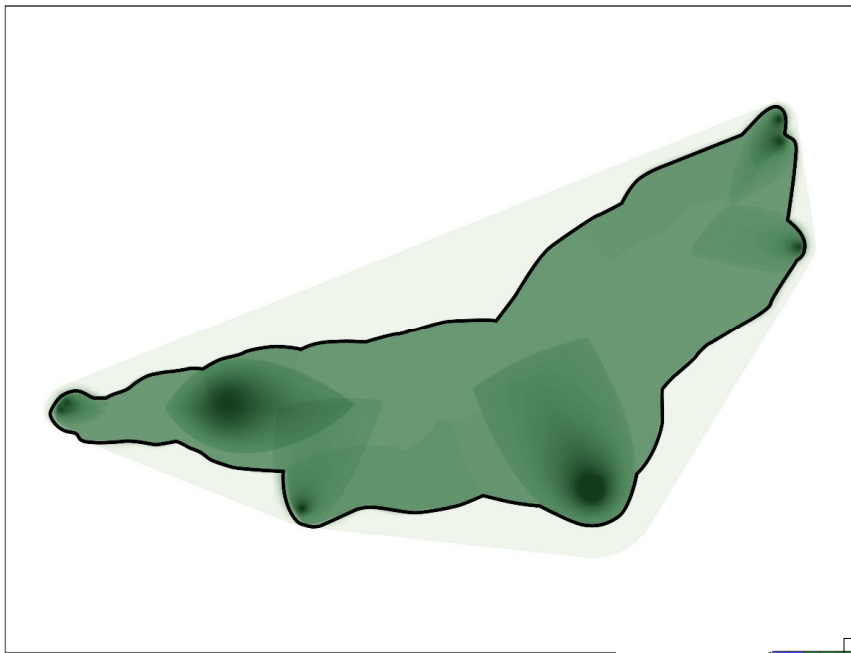


- A customized convex hull using three parameters: D1, D2, D3
- Systematically defined, individual specific

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

1: (Hasanzadeh, et al, 2017)

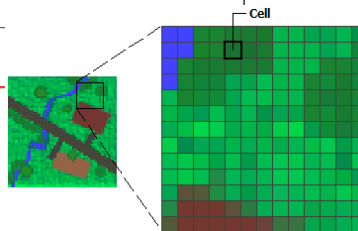
# Improved models (II): An individualized residential exposure model (IREM)



- 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**

1: (Hasanzadeh, et al, 2018)





*How does this all matter?*

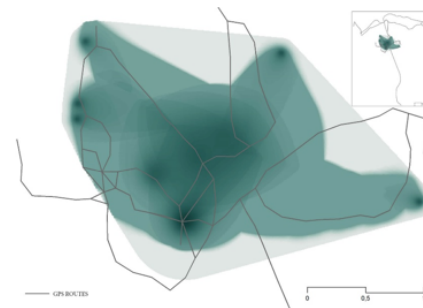
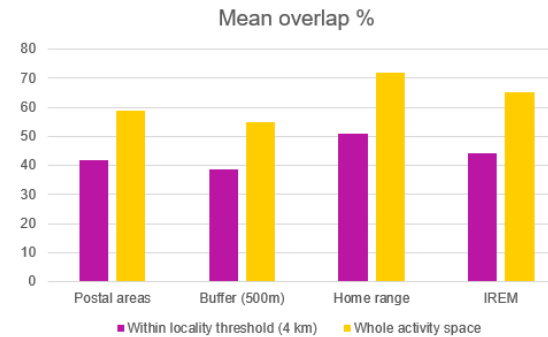


# Why it matters?

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

	Component 1 30%	Component 2 22%	Component 3 21%	Component 4 11%	Component 5 7%
Surface	.981*	-	-	-	-
Perimeter	.914*	-	-	.342	-
Total exposure	.956*	-	-	-	-
Major to minor axis ratio	-	-	-	.964*	-
Green area percentage	-	.910*	-	-	-
Green exposure ratio	-	.972*	-	-	-
Average green exposure	-	.959*	-	-	-
Average distance to DEP	-	-	.955*	-	-
Maximum distance to DEP	-	-	.931*	-	-
Percentage of DEPs inside neighborhood boundary	-	-	-.857*	-	-
Number of visits to DEPs per month	-	-	-	.899*	-
Number of DEPs	.377	-	-	.818*	-
Average exposure	-	-	-	.853*	-

- ◇ Size of LAS
- ◇ Greenness of LAS
- ◇ Exteriority of AS
- ◇ Intensity of LAS
- ◇ Elongation of LAS



		Health	Functioning	QOL	Happiness
Postal areas	Greenness				
	Size of AS				
	Walkability				
	Pedestrian/Cycling route				
Buffer (500 m)	Greenness				
	Size of AS				
	Walkability				
	Pedestrian/Cycling route				
Home range	Greenness				
	Size of AS				
	Walkability				
	Pedestrian/Cycling route				
IREM	Greenness				
	Size of AS				
	Walkability				
	Pedestrian/Cycling route				

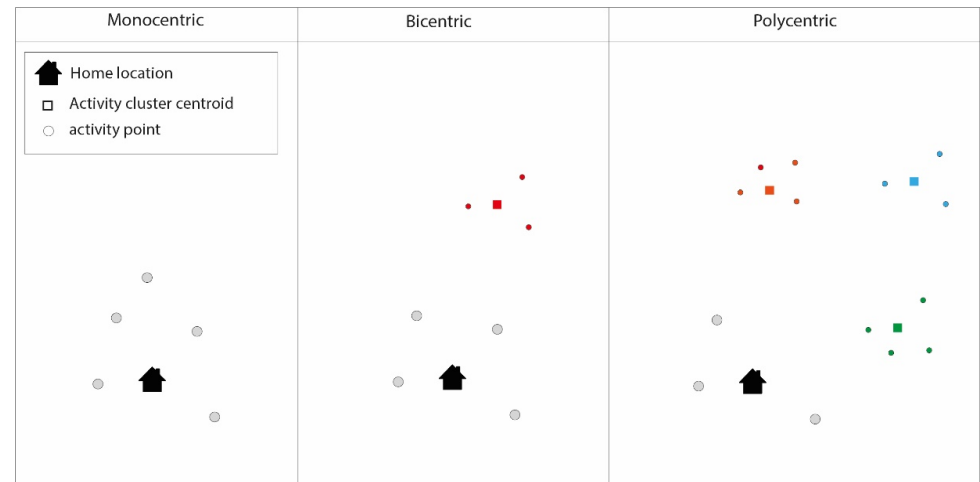
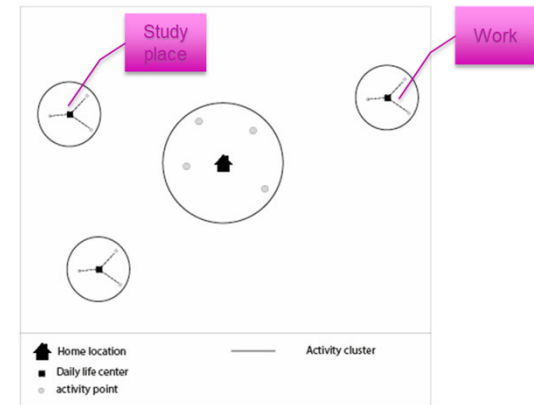
- Significant association, consistent with literature
- Significant association, inconsistent with literature
- Measurement not possible

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

Two sides of the coin?!

# Centricity of activity spaces

- activity spaces of individuals are not always concentrated around their homes, but can form clusters throughout the space (typically around individual's life centers)



# Conclusion

- **Are you doing GIS with person-based data?**
  - Think about the spatial unit of analysis you use
    - Know your data and context
    - Know the concept/phenomenon you're studying
    - Know what you are looking for
    - Consider your analytical possibilities

# Read more

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*.

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.

Hasanzadeh, K., Kyttä, M., Lilius, J., Ramezani, S., & Rinne, T. (2021). Centricity and multi-locality of activity spaces: The varying ways young and old adults use neighborhoods and extra-neighborhood spaces in Helsinki Metropolitan Area. *Cities*, 110, 103062.

Hasanzadeh, K. (2019). Exploring centricity of activity spaces: From measurement to the identification of personal and environmental factors. *Travel Behaviour and Society*, 14, 57-65.

## GIS tools and Python codes available:

Hasanzadeh, K. (2018). IASM: Individualized activity space modeler. *SoftwareX*, 7, 138-142.



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