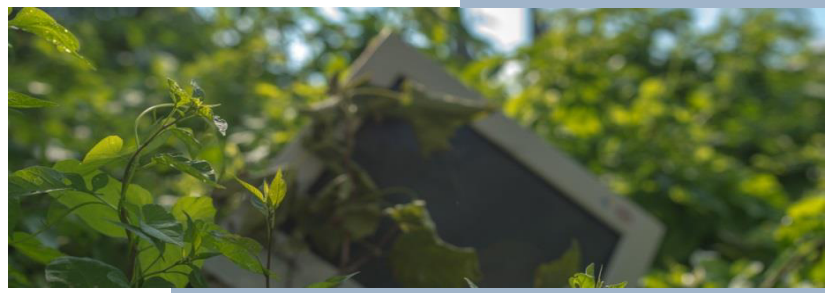
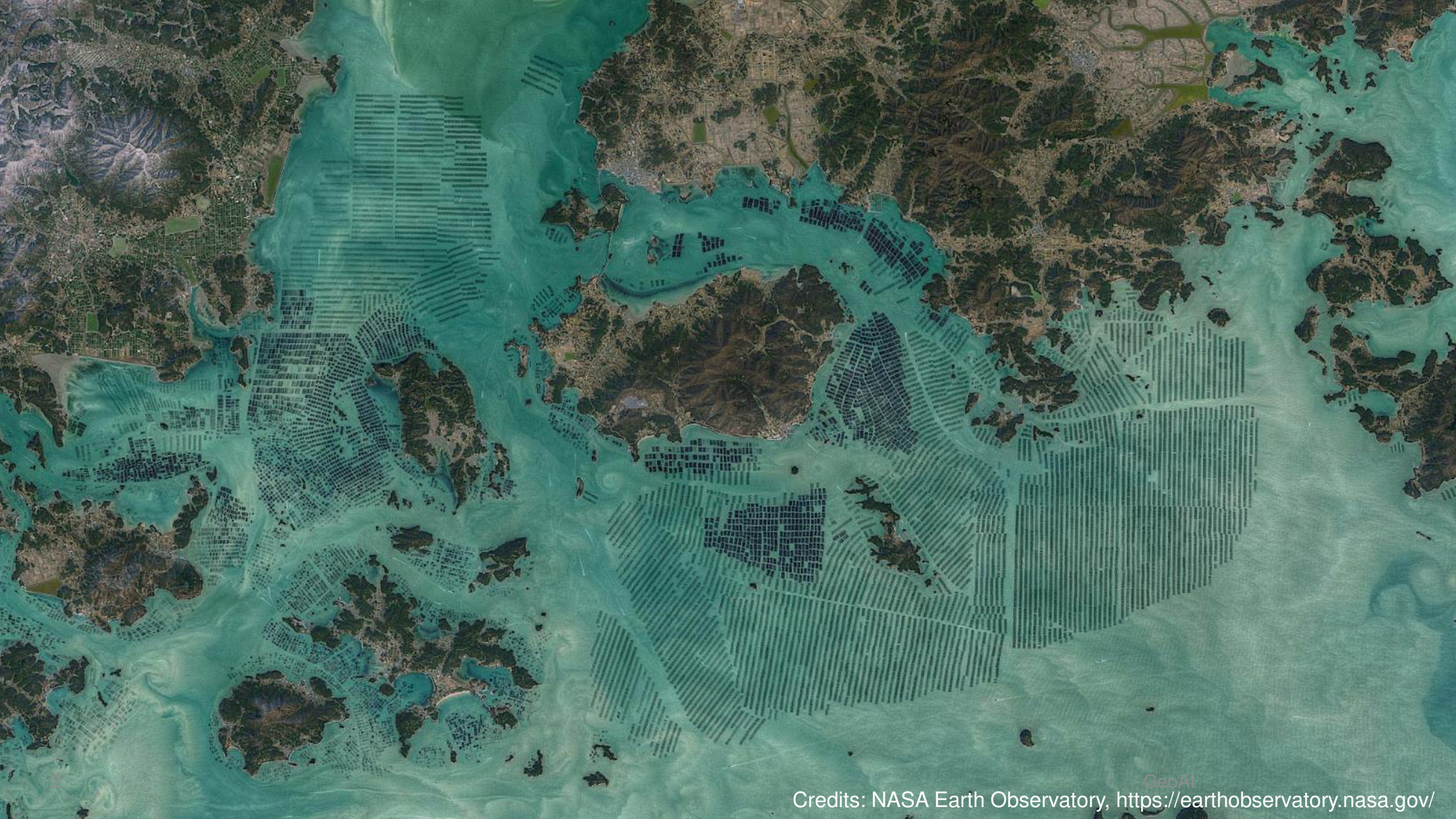
Philipps Universität Marburg

Unit 01 Space needs a scope

Introduction

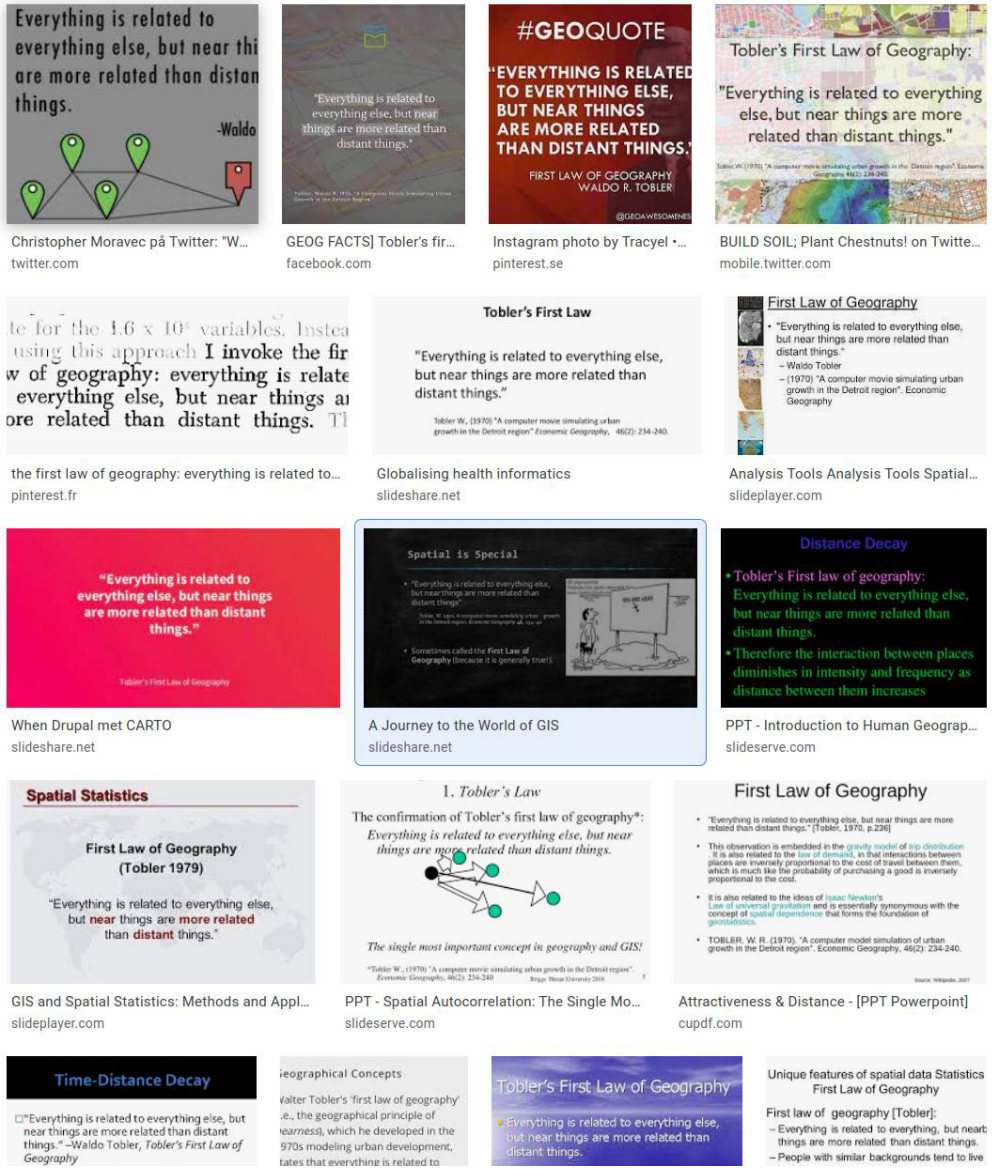




Credits: NASA Earth Observatory, https://earthobservatory.nasa.gov/

Axiom or Thesis?

"Everything is related to everything else, but near things are more related than distant things" Waldo Tobler 1970



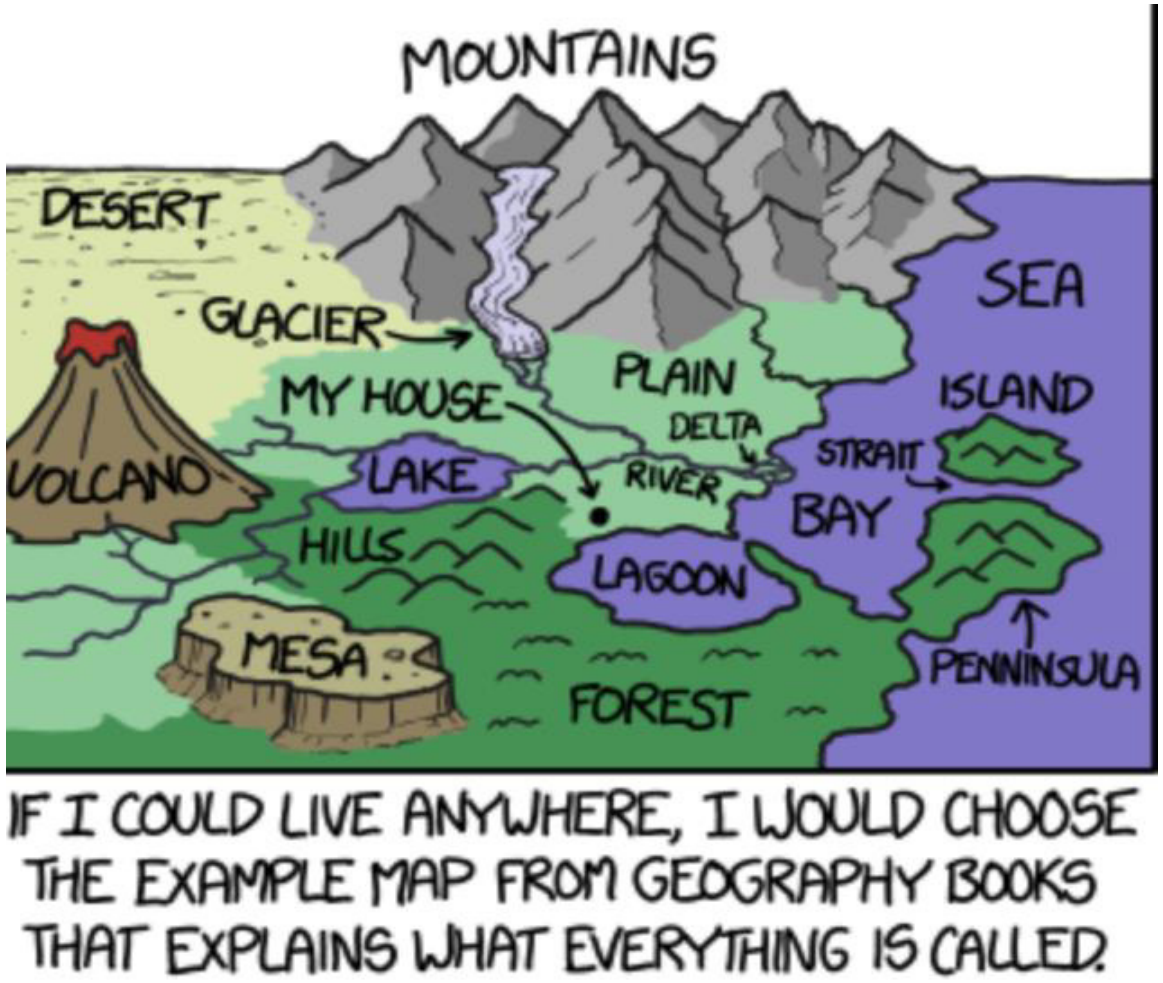
Credits: Google search images:

"Everything is related to everything else, but near things are more related than distant things"

Specific rules for specific situations

Central tasks that we will tackle in this session

- targeted and scale-dependent meanings of space (The World)
- an idea of distance and neighborhood
- an idea of influence with respect to this distance
- an idea of the digital representation of the XKCD "example map"



Credits: XKCD https://imgs.xkcd.com/comics/geography.png

See you next time!

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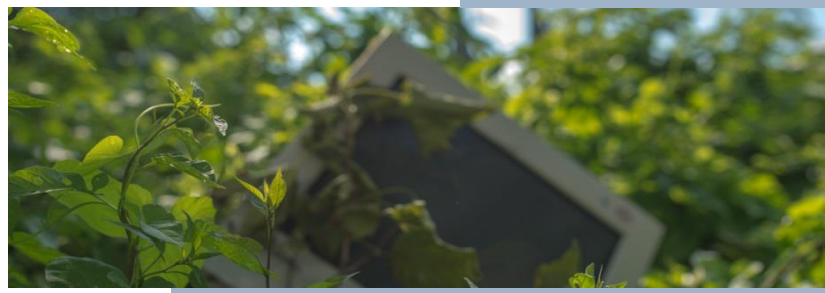
Distance, neighborhood and spatial interactions

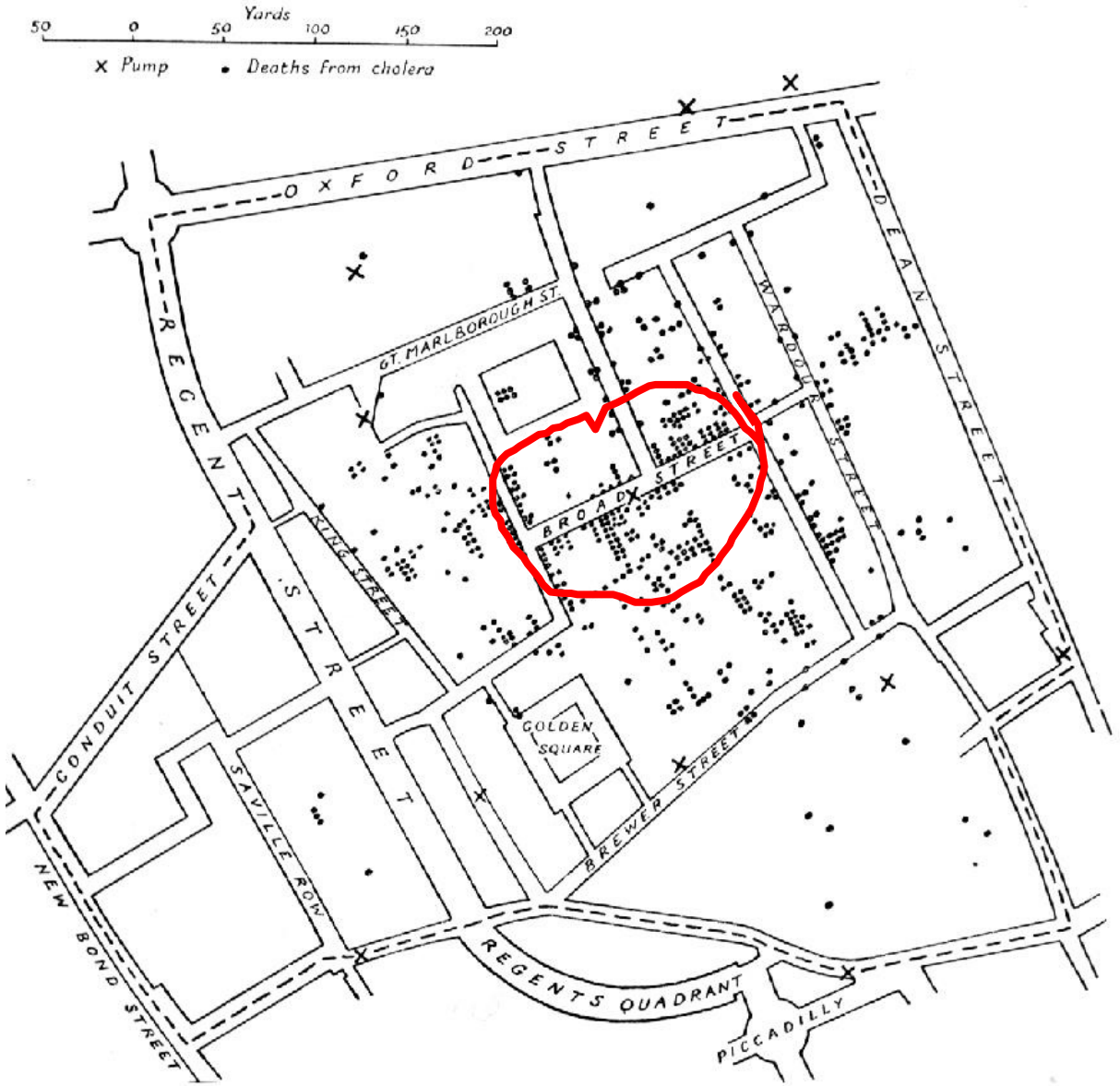


Dr. Snow and the spatial influence

- Mapping of cases
- Mapping of pumps

Intuitively, he concluded that:

The closer a house was located to the water pump on Broad Street, **the more** cholera deaths occured there



Credits: Snows cholera map (https://de.wikipedia.org/wiki/John_Snow

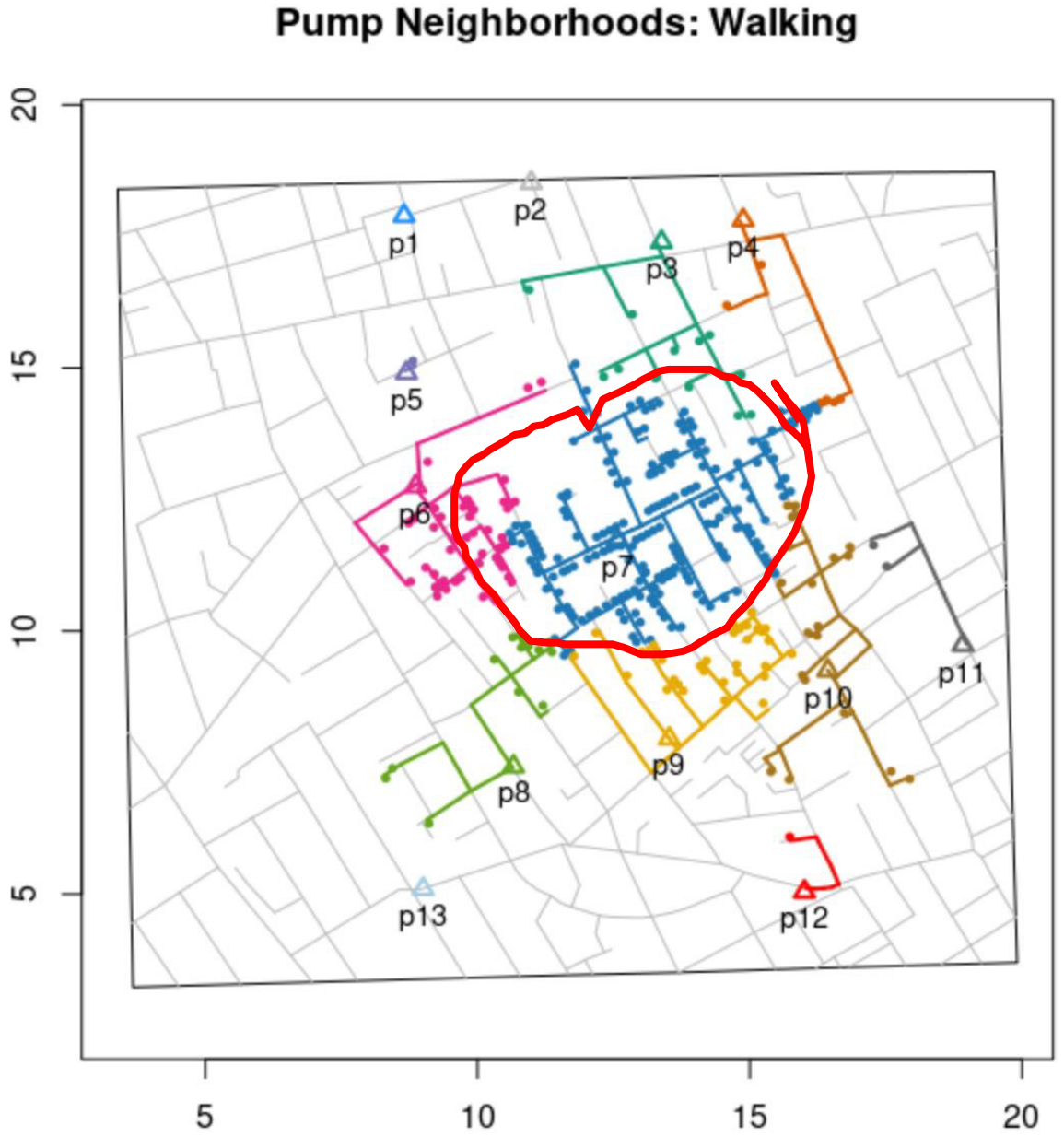
Modern Geoanalysis and Dr. Snow

Again:

- Mapping of cases
- Mapping of pumps

Quantitatively analyzing that:

The time and walking distance (you carry a bucket of water) is strongly related to the water pump on Broad Street (p7).



Credits: Peter Lindbrook https://github.com/lindbrook/cholera

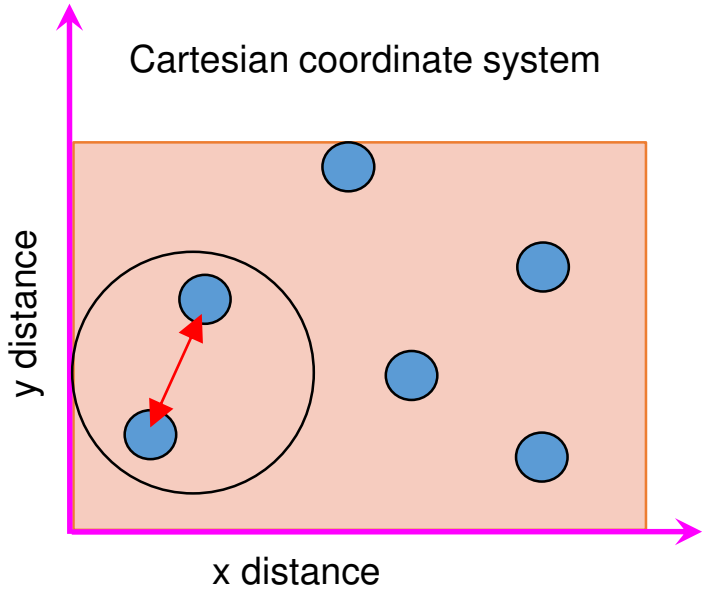
We need knowledge about space and its effect

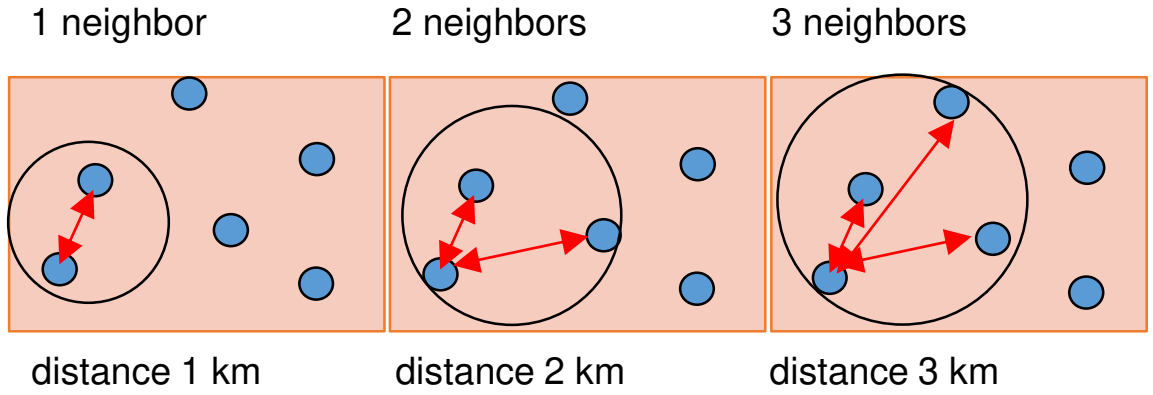
- Two points that are close together are not necessarily similar in (every) way
- Actors influence, judge and use static aspects of space differently
- Parametric models are being supplemented by self-learning methods of data analysis

Credits: https://pixabay.com/photos/cliff-sheer-person-suicide-1031187/

Distance and topology

- Distances are calculated using simple Euclidean geometry
- Topology (= neighborhood) indicates the relative position of objects to each other.
- Objects have a distance to each other and a positional relationship with each other.

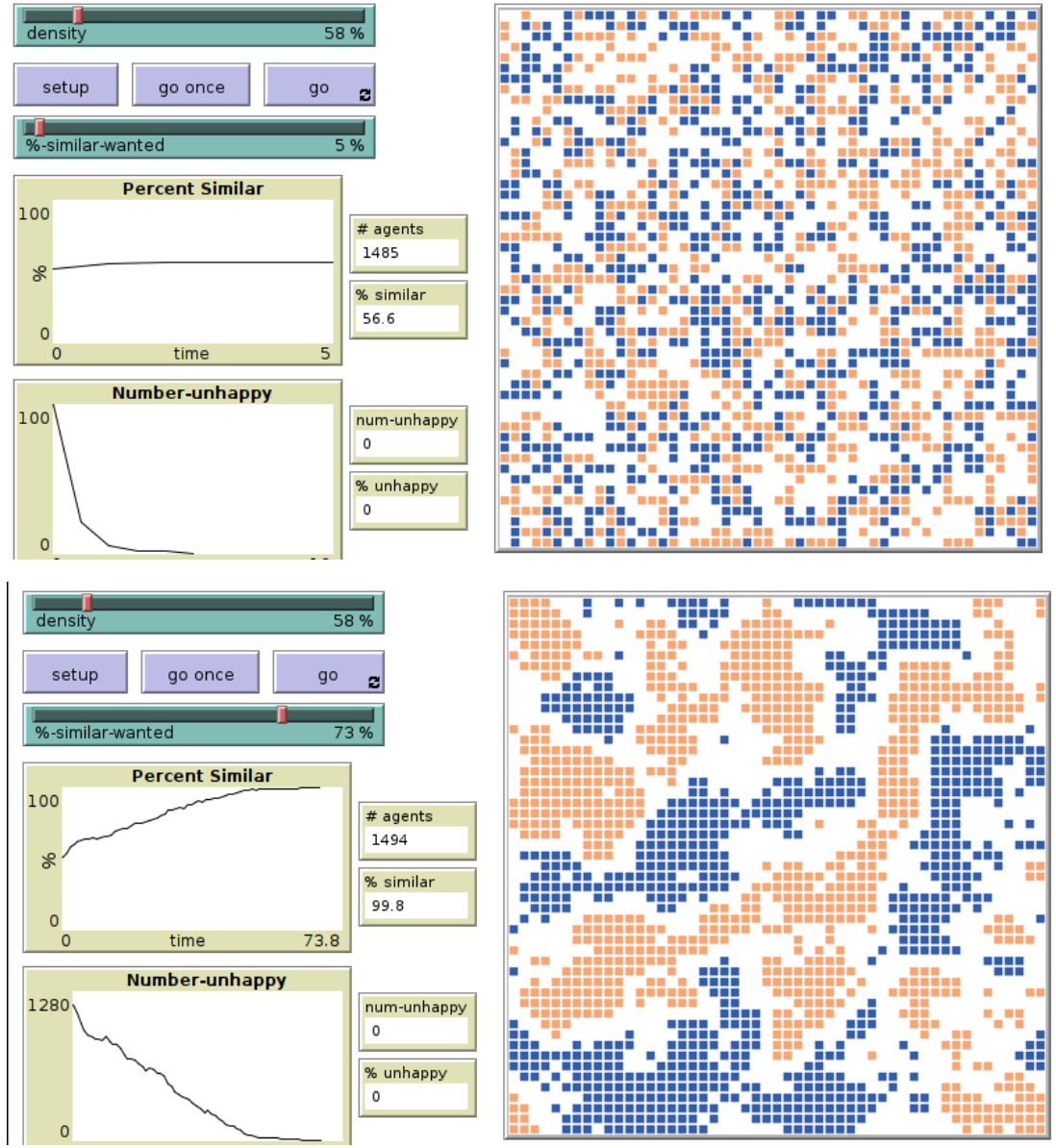




Credits: https://geomoer.github.io/geoAI

Distance and scale effect

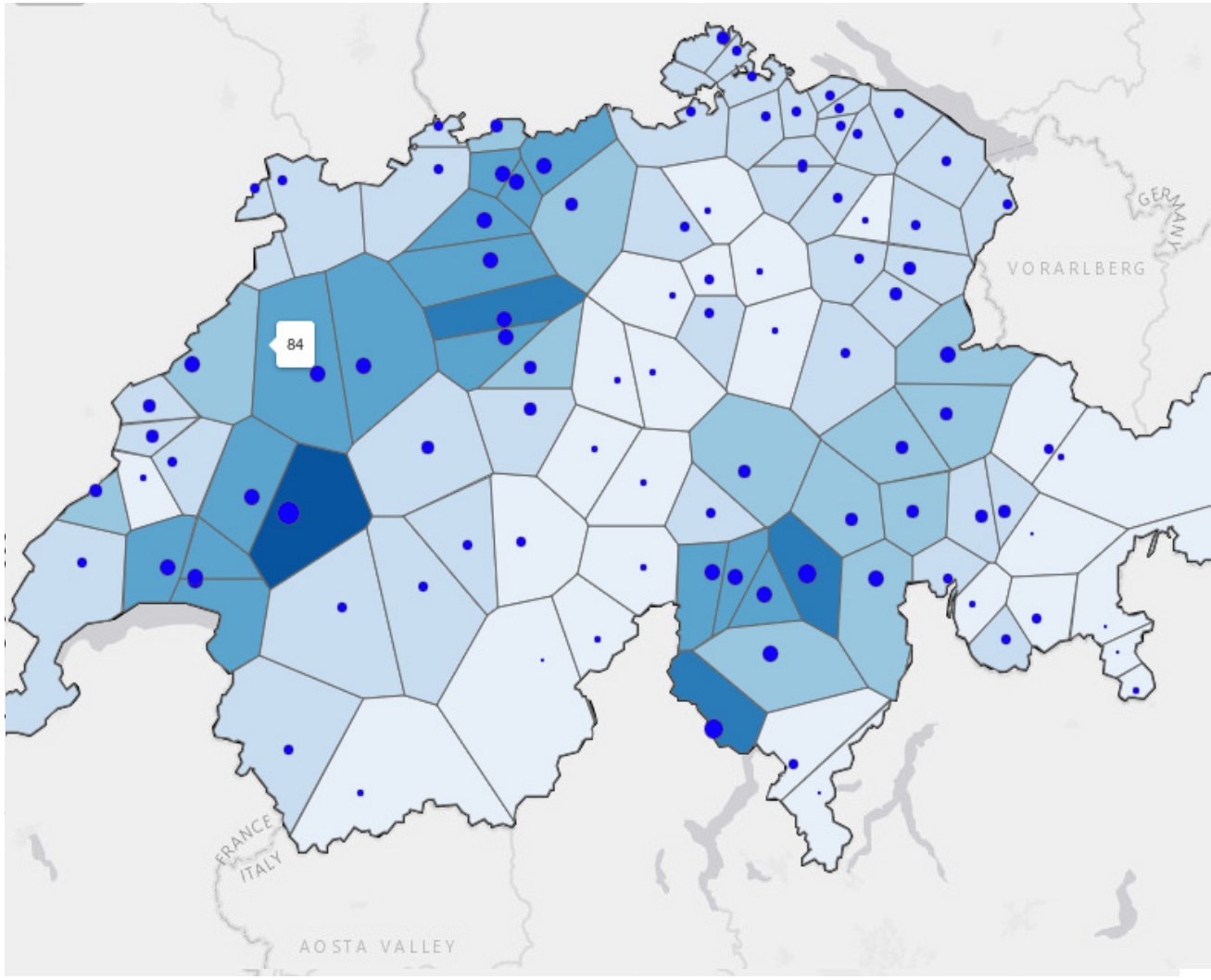
- Distance on two different scales. The local environment of each actor either causes it to remain in space or to migrate. This depends on the preference to have "same-colored" actors in the vicinity.
- Above, the preference is low and hardly any segregation takes place. Below, the preference is high and spatial patterns emerge
- But what does proximity mean?



Credits: https://ccl.northwestern.edu/netlogo/

Fillling the Gaps - Voronoi

- Data is often irregular and patchy
- Filling the gaps means assuming that each measurement point is significant for the area that is closest to it.
- The concept is called Voronoi tessellation and is based exclusively on Euclidean equidistance.

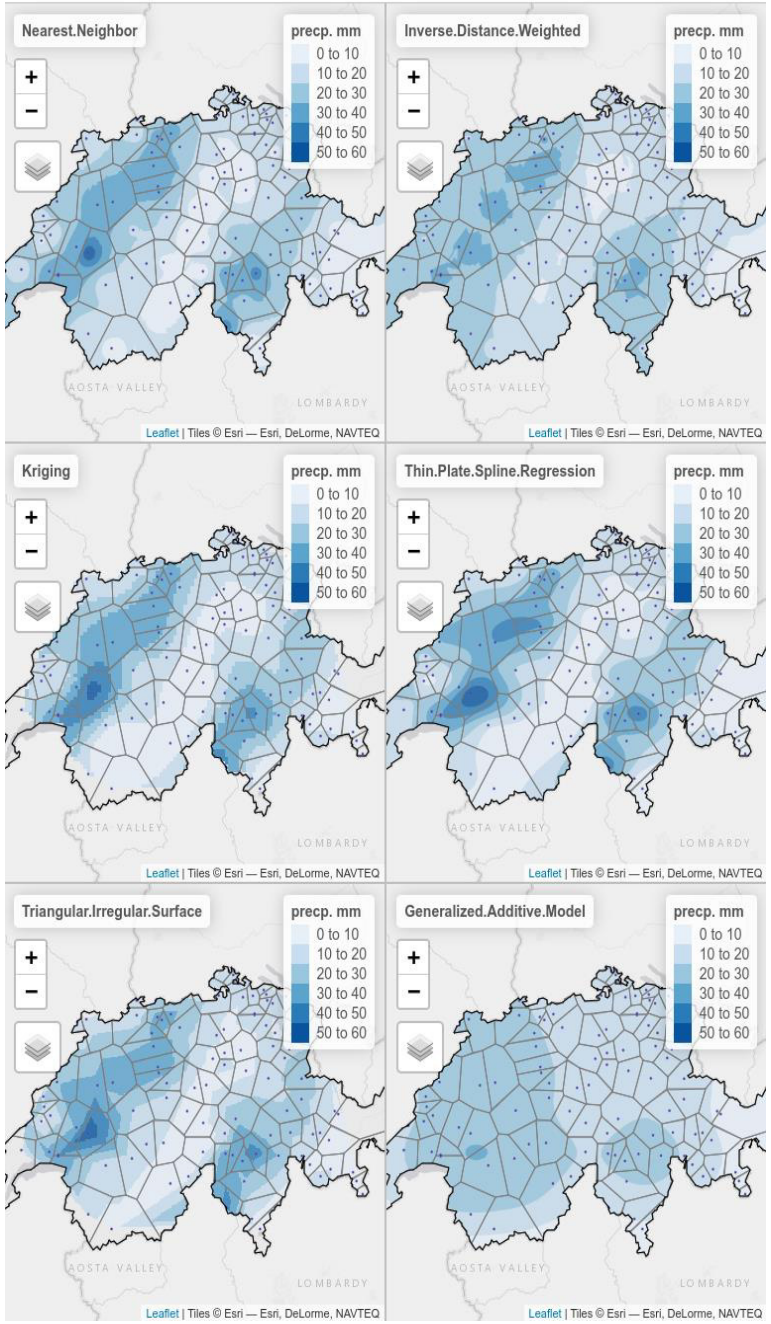


Credits: https://geomoer.github.io/geoAI

Fillling the Gaps

There are much more complex methods like:

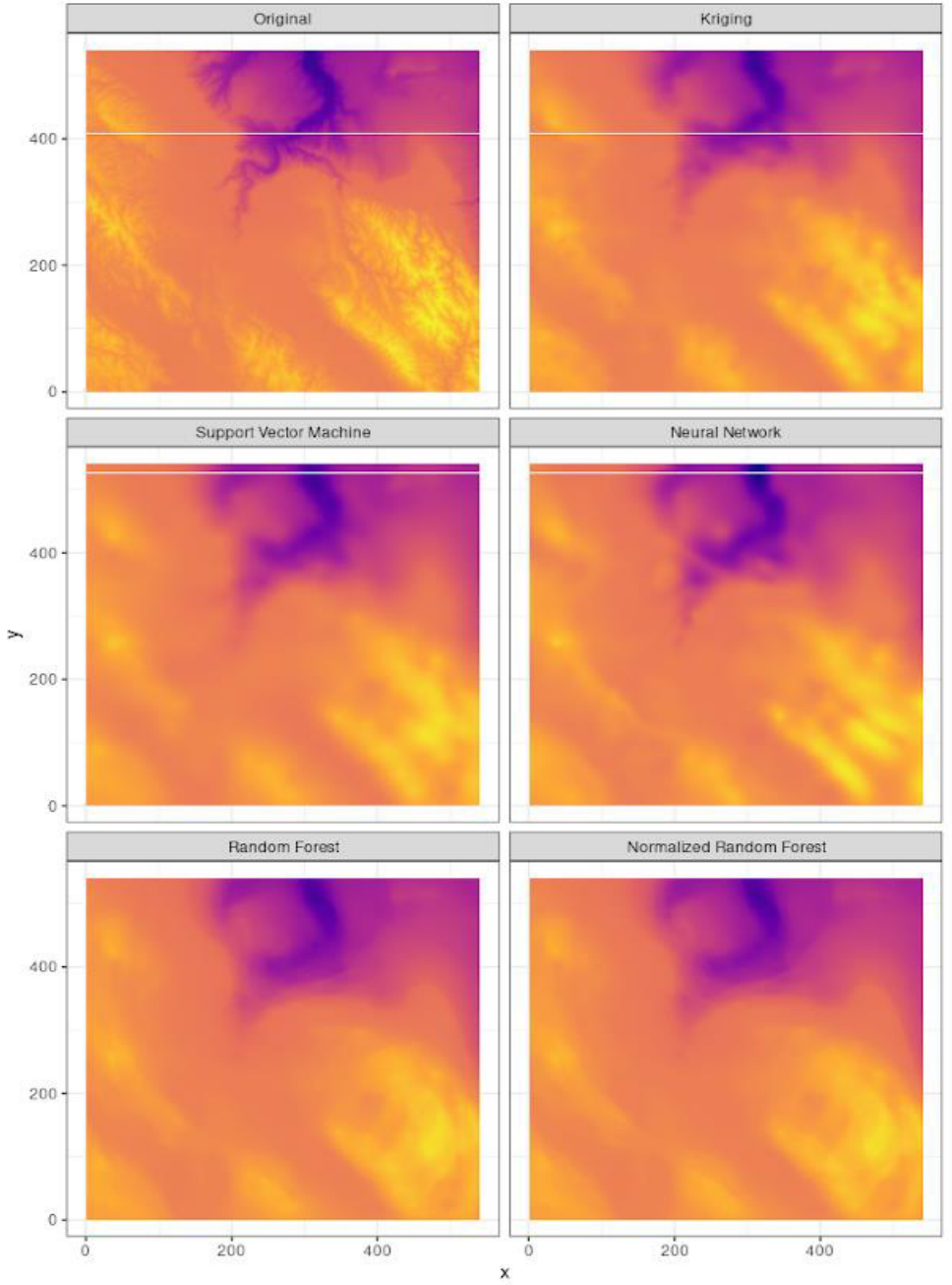
- nearest neighbor, inverse distance, kriging and spline TIN and GAM models
- Methods that use spatial autocorrelation and covariate information, i.e. sophisticated regression statistics
- These methods are far more efficient and differentiated



Credits: https://geomoer.github.io/geoAI

What about Machine Learning?

- ML can also produce spatial and temporal predictions
- Spatial autocorrelation, adding geographic distances and predictors can map much more complex relationships and dependencies.
- Fewer assumptions means that we are **learning from the data**



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See you next time!