Geostatistical prediction in heterogeneous regions

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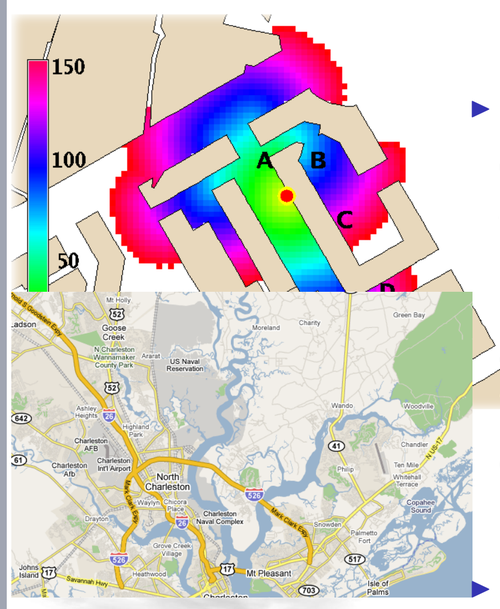
Heterogenous regions



- In classical geostatistics there exist the implicit assumption of the homogeneity of the region. Mainly due to the fact that the geostatistical model is based on the assumption that the correlation is a function of the Euclidean distance.
- However, there are situations where this assumption does not hold, because of the irregularities in the environment.

The cost surface

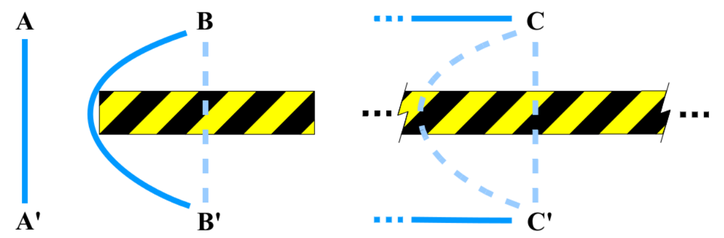
- This is a model of the (relevant) environmental features. Specifically, is a map representing how impermeable the region is, at each spot, to the phenomenon under study.
- In the limit, physical barriers get infinite cost, since no information flows through them.
- It must be built from knowledge of physical conditions, and/or expert asessment.
- This is one possible source of model uncertainty.
- From this surface, the cost-based distances are computed as the length of the minimum-cost path between locations.
- Cost-based distance to certain places can also play a role as covariates.

Further work

- This model could be used in combination with a deterministic simulator of the process, by applying it to the residuals from the available observations.
- This would be another source of model uncertainty
- Regarding the worked-out case of urban noise, unfortunately, there are no available open simulators for noise diffussion.

"Everything is related to everything else, but near things are more related than distant things"
Tobler's first law of Geography.

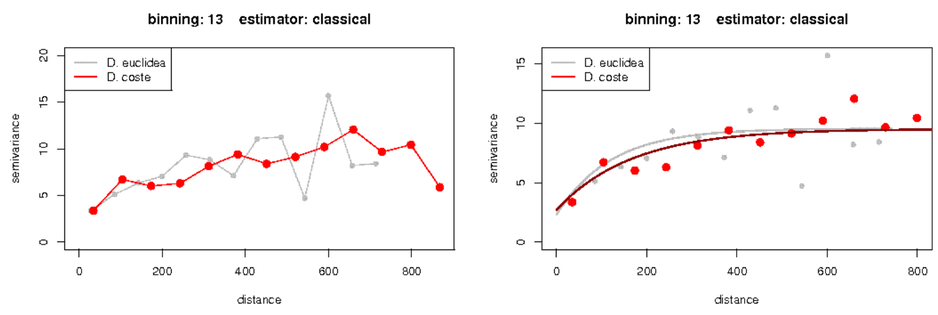
Cost-based distances



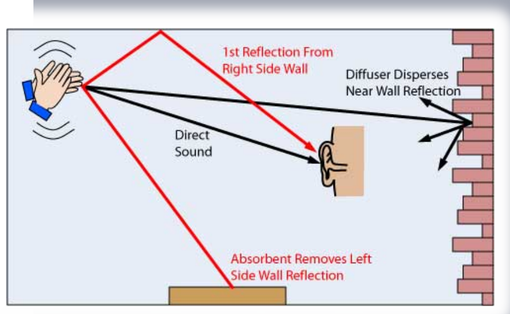
- We relax the Euclidean assumption and compute a distance measure that incorporates the physical characteristics of the environment.
- Rather than straight-line (Euclidean) distance, the Cost-based distance is computed along the minimum-cost path between locations.
- This reduces to Euclidean distance when the region is homogeneous.

Variogram estimation

- The variogram represents (inversely) the functional relation between the correlation and the distance.
- When Cost-based distances are used, we get a more regular empirical variogram, and detect a larger range of spatial dependency.
- By working in the bayesian framework the uncertainty in the variogram parameters is satisfactorily taken into account.



Worked-out example: Urban noise prediction
dataset and code: http://www.geeitema.org/guenmap/index.jsp?opcion=resultados&idioma=en



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