Employing a geovisual exploratory post-analysis for interpretation of results of a spatial statistical method

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Traditional regression analysis describes a modelled relationship between a dependent variable and a set of independent variables. When applied to spatial data, the regression analysis often assumes that the modelled relationship is stationary over space and produces a global model that is supposed to describe the relationship at every location in the study area. This can be misleading, as the relationships in spatial data are often intrinsically different across space. One of the spatial statistical methods that attempts to solve this problem and explain local variation in complex relationships is Geographically Weighted Regression – GWR (Fotheringham et al. 2000).

In a global regression model the dependent variable is often modelled as a linear combination of independent variables, where a parameter belonging to each variable is assumed to be stationary over the whole area (i.e. the model returns exactly one constant value for each parameter). GWR extends this framework by dropping the stationarity assumption: the parameters are assumed to be continuous functions of location. The result of the GWR analysis are continuous localised parameter estimate surfaces, which describe the geography of the parameter space (Fotheringham et al. 2002).

The variability and behaviour of the parameters are influenced by the underlying spatial processes. In order to provide insight into the processes, the parameter surfaces can be visualised – this is usually done by univariate mapping, such as producing a choropleth map of each separate parameter surface. These visualisations serve as an informal inference tool (Fotheringham and Brunsdon 2004) for interpretation of the GWR results.

If the goal is to discover complex spatial and other multivariate patterns in the parameter space and form new hypotheses about the spatial variability of the parameters, simple univariate visualisations of the parameters might not be adequate. Instead, the parameter estimates can be regarded as a multivariate dataset, which can be examined in an integrated automatic-visual exploratory environment, as for example the one presented in figure 1, consisting of a Self-Organising Map and several multivariate and spatial visualisations (Demšar 2007). The exploratory approach can help answer questions such as “Do there exist areas of stability where all the parameters keep relatively constant values?”, or “Are there any predominant groupings of parameters that behave in a similar way everywhere in the area of investigation?”. Such analysis can also raise new questions about the spatial distribution of parameters.

The combined statistical-exploratory approach offers new insights into the results of the statistical method that would otherwise remain unnoticed and thereby facilitates analytical reasoning, which is one of the goals of visual and geovisual analytics (NVAC 2007).

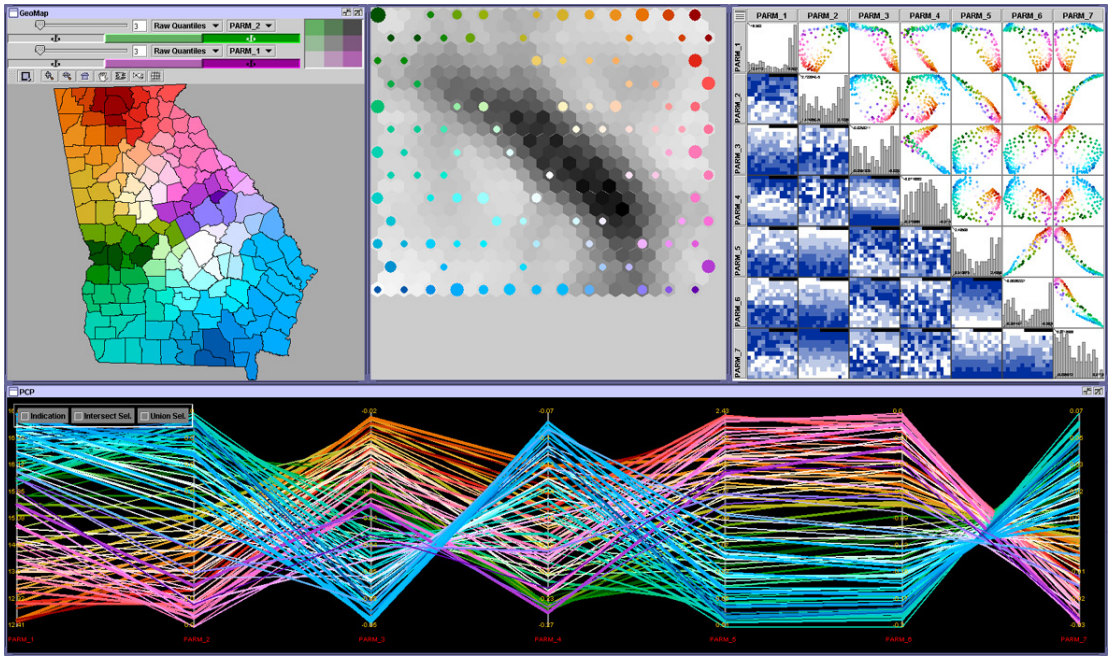

Figure 1: Examining the GWR 7-dimensional parameter estimate space in an integrated automatic-visual exploratory environment.

References

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