# Geographically Weighted PCA: Introductions and Uses

A 1-day tutorial with lectures and practical exercises instructed by Dr Paul Harris (Eco-informatics Scientist, Rothamsted Research, UK) and Prof Alexis Comber (Chair of Spatial Data Analytics, University of Leeds, UK).

Description: In many geographical studies, principal components analysis (PCA) is applied without consideration for spatial effects, and in doing so, tends to provide an incomplete understanding of a given process. In such circumstances, a spatial adaptation of PCA can be adopted, one of which is geographically weighted (GW) PCA (i.e. GWPCA). The tutorial will introduce GWPCA and frame it within the wider GW modelling framework - where focus moves away from the popular GW Regression (GWR) model to GWPCA instead. Techniques are illustrated using environmental, remotely-sensed and social-economic data sets. Attendees will learn how to conduct and interpret a GWPCA, together with how to use its outputs for a variety of spatial problems.
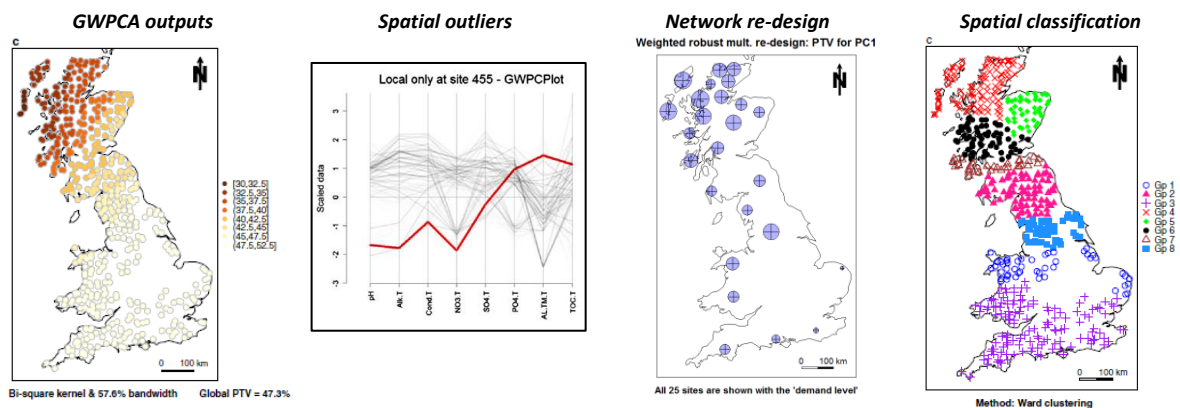
Detail: GWPCA is a localized version of PCA that is an exploratory tool for investigating spatial heterogeneity in the structure of multivariate data. It not only provides a useful investigative tool, but also lends itself to the many uses of PCA at a localised scale. The tutorial will demonstrate how to calibrate a GWPCA - including how to determine the spatial scale of each localised PCA, conduct associated tests, and ways to visualize the copious amounts of GWPCA output. Following this core introduction to GWPCA, the tutorial will present three key uses of GWPCA: (i) to detect multivariate spatial outliers; (ii) to optimally re-design a multivariate spatial monitoring network; and (iii) to provide multivariate spatial input variables to improve spatial classification accuracy – all extensions of GWPCA developed by the tutorial organisers.

Requirements: A laptop computer with R installed. Experience of R is essential for this tutorial, as is some rudimentary knowledge of statistics. Data and bespoke R code will be developed and shared as part of the tutorial and attendees are encouraged to bring their own data for analysis during the tutorial.

References

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Harris P, Clarke A, Juggins S, Brunsdon C, Charlton M (2015) Enhancements to a geographically weighted principal components analysis in the context of an application to an environmental data set. *Geographical Analysis* 47: 146-172

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