1. Workshop name/title (and acronym is applicable)

Modelling Space and Time with GAMS: spatially and temporally varying coefficient models

2. Description of the workshop by listing topic(s), objective(s) and planned outcome(s)

2.1 Topic(s)

Spatially vary coefficient models
Spatially and temporally varying coefficient models
GAMs (General Additive Models)

2.2 Objective(s)

The objectives associated with his activity are as follows. At the end of this workshop attendees will
1) understand the relative advantages of the General Additive Model family
2) be able to apply GAMs to spatio-temporal data, interpret and visualise the outputs
3) be able to use GAMs for prediction (what if scenarios) and inference (system or process understanding)

2.3 Planned outcome(s)

The workshop is a hands-on tutorial in which the participants are taught a new method or of analysing spatio-temporal data.

3. Abstract

GAMs (General Additive Models) provide a robust framework for many data science activities. GAMs perform as well as most machine learning models.

In addition to being able to model complex relationships in data with complex interactions and non-linearities in an intuitive way, they can handle and model different types of responses (unlike current brand leaders like multiscale GWR). The outputs provide easily understood measures of the relationship between predictor and response variables, and

how the outcome is modelled. Crucially for the spatial they can be adapted to generate outputs that show how, where and when relationships vary in space and time.

This hands workshop will introduce GAMs, provide the opportunity for attendees to undertake GAM analyses, to interpret and visualise the outputs, to apply a spatial GAM to quantify spatially and temporally varying relationships. Attendees are encouraged apply the GAM approach to their problem (please bring data!).

The workshop will have a strong hands-on element and attendees will need to have a relatively recent version of R/Rstudio and a basic understanding of R.

4. **Short description of the intended length (half or full day) and the format of the workshop**

Half day workshop

Coding in R

5. **Brief statement of the relevance of the workshop for AGILE**

This R workshop introduces a fast, dynamic and flexible approach for space time modelling. It covers recent work on spatially varying coefficient modelling, extending into the temporal dimension and fundamentally examines how space and stime should be incorporated into varying coefficient models (that is those that generate information about how, where and when processes varying spatially and temporally). This is core GISci.

6. **What is the approximate number of expected participants?**

30 but it could be more or less!

7. **Names and e-mail addresses of the organizing member(s)**

Leading AGILE member (or sponsor) and contact person:

Lex Comber (a.comber@leeds.ac.uk)

Contributing AGILE members (including the persons involved) – at least one seconding AGILE member is needed:

Rui Zhu (rui.zhu@bristol.ac.uk)

Contributing non-AGILE members (including the persons involved) – if applicable:

Chris Brunsdon (Christopher.Brunsdon@mu.ie)

8.   Additional information about previous workshops, if held.

I co-led a workshop at the AGILE 2019 conference in Limasol, "R for geovisualization, geoprocessing and geoanalytics" (not my title!).

This specific workshop builds on a previous workshop at CUMPUM 2023 in Montreal, extending from spatial urban informatics into space-time. The bookdown site here: https://bookdown.org/lexcomber/ggp-gam/ and the workshop summary here: https://www.cupum2023.org/workshops

9.   Expected resources needed

A room with desks, power sockets for attendees and internet access.

Attendees will need their own computer, basic knowledge of R. They will be provided with all materials needed to undertake the workshop. Attendees will be encouraged bring their space time problem / to thew workshop.

10. Other information

This is advanced methods that are either just published, in review or currently being worked up from conference papers:

Comber, Alexis, Paul Harris, and Chris Brunsdon. 2023. "Multiscale Spatially Varying Coefficient Modelling Using a Geographical Gaussian Process GAM."*International Journal of Geographical Information Science,* https://doi.org/10.1080/13658816.2023.2270285.

Comber, Alexis, Paul Harris, Daisuke Murakami, Tomoki Nakaya, Naru Tsutsumida, Takahiro Yoshida, and Chris Brunsdon. submitted. "Spatially Varying Coefficient Modelling with a Geographical Gaussian Process GAM (GGP-GAM)." *Geographical Analysis*, submitted.

Comber, Alexis, Paul Harris, and Chris Brunsdon. "Multiscale Spatially and Temporally Varying Coefficient Modelling Using a Geographic and Temporal Gaussian Process GAM (GTGP-GAM)(Short Paper)." *12th International Conference on Geographic Information Science (GIScience 2023)*. Schloss Dagstuhl-Leibniz-Zentrum für Informatik, 2023. https://doi.org/10.4230/LIPIcs.GIScience.2023.22

Comber et al. In prep. „Where, When and How? Spatially and temporally varying coefficient models using GAMs with Gaussian Process splines and Bayesian Model Averaging". Paper being written now!

Submission by e-mail to:

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