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PyLUR: A land use regression wizard for ArcGIS Pro

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Software

- Review
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Summary

Introduction

PyLUR is a Python toolbox for ArcGIS Pro (v2.2.4 or higher, Environmental Systems Research Institute (ESRI), Redlands, CA) that enables the development and application of land use regression models via a wizard style interface. Land use regression (LUR) is a commonly used technique in environmental sciences to analyse factors influencing pollutant levels and to predict pollutant levels at unmeasured locations. LUR is extensively used in studies on air pollution exposure (Molter, Lindley, Vocht, Simpson, & Agius, 2010a, 2010b), but it is widely applicable and has been used in fields ranging from water pollution (Kelsey, Porter, Scott, Neet, & White, 2004) to urban climatology [Heusinkveld, Steeneveld, Hove, Jacobs, & Holtslag (2014)).

Purpose of the software

The traditional approach to the development of a LUR model requires several steps: 1. The creation of a point dataset of known observation data for a variable of interest (such as nitrogen dioxide concentrations or air temperatures), which will be used as outcome variables. 2. Carrying out various spatial analyses of additional geospatial data with these point locations using geographic information systems (GIS) to extract potential predictor variables. 3. Data wrangling of extracted data from steps 1 and 2 into a format that can be readily used by statistical software packages. 4. Carrying out multiple regression analysis to obtain a best fit parsimonious model.

If done manually, steps 2 to 4 are repetitive and time consuming, making them inefficient and prone to error. PyLUR provides a wizard style interface that guides a user through the development of a LUR model without the need to access and run multiple tools and additional software packages. PyLUR largely automates steps 2 to 4, which significantly speeds up the model development process and reduces user error. Depending on the type and amount of data to be processed, and the available hardware, models can be developed in less than one hour. Furthermore, the output files produced by PyLUR ensure that the model development is well documented and reproducible. Lastly, PyLUR also makes the method available for a wider range of users.

In addition to developing LUR models, PyLUR can also apply a previously developed model to a new set of locations within the same study area. New locations can be defined by the user or can be based on a dataset containing regularly located points or randomly located points. Again, PyLUR largely automates this process with minimal effort from the user.

PyLUR is aimed at GIS specialists. It uses the ArcGIS Pro software, which is the most widely used commercial GIS software worldwide. PyLUR is based on the LUR methodology used

in the European Study of Cohorts for Air Pollution Effects (ESCAPE) (Beelen et al., 2013; Eeftens et al., 2012) as set out in the ESCAPE Exposure assessment manual (2010). Within air pollution research the ESCAPE methodology is used as the standard for developing LUR models. PyLUR also allows hybrid LUR models to be developed, based on an extension of the ESCAPE methodology that included the addition of satellite derived data and data from chemical transport models (K. de Hoogh et al., 2016).

Current application

PyLUR has been developed through the NERC Newton-DIPI funded Urban hybriD models for AiR pollution exposure Assessment (UDARA) study, which is a collaboration between the University of Manchester and Institut Teknologi Bandung. This study aims to develop air pollution prediction models for Indonesian urban areas and to analyse the effects of air pollution on health indicators provided by the Indonesian Family Life Survey.

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