SPATIAL PREDICTION FOR AMBIENT PARTICULATE POLLUTION USING SPATAP MODEL

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Highlights: A model was established for PM_{10} prediction using a spatial approach named as SpatAP model. The SpatAp model is the improved version of the previous spatial model published by Ya'acob & Mar Iman (2020). The model has better specification with four significant predictor variables, namely RH, industry land-use, traffic count, and time for PM_{10} concentration prediction across Peninsular Malaysia.

Key words: *spatial prediction, GIS, particulate pollutant, land-use.*

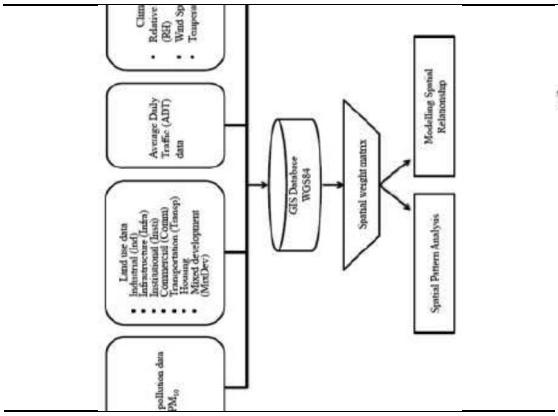
Introduction

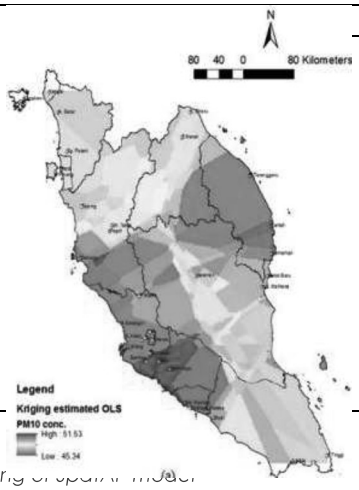
Ambient particulate concentration occurs to be associated with spatial influences. A variety of spatially related human-made activities cause the distribution of particulate pollutants over the geographic area. Air pollution patterns in Malaysia are yet to be more understood, primarily because vulnerable populations are more likely to live closer to pollutant sources and, most likely, closer to pollutant sensors (Geer, 2014). Concerns have arisen that question the suitability of air pollution status interpreted from stationary monitoring stations as a representative community exposure assessment living at other unsampled locations. Such environmental risk concern is appropriately addressed using advanced geographic information science and spatial modeling, as Jerrett et al. (2010) suggested. Thus, the spatial air pollution (SpatAP) model was established and executed to predict ambient particulate concentration captured by the stationary monitoring stations and other unsampled locations across Peninsular Malaysia.

Content

Tobler's first law of geography reveals that 'everything is related to everything else, but near things are more related than distant things' (Miller, 2004; Tobler, 1970). The law applies to the effective use of the SpatAP model. By incorporating Tobler's law, the SpatAP model expects air pollution levels to not be different between any nearby locality. Firstly, the similarities in the underlying social and economic processes might emit particulate pollution. Secondly, some atmospheric processes will suspend particulate pollutants over large distances and disperse the particulate pollutants from one place to another. Thus, this model's advantages were that it considered the spatial dimension of particulate emission over a 16-years time using land-use types, meteorological parameters, and traffic count as the predictor variables. Figure 1 shows the SpatAP model framework, which consists of parameterization of each predictor variable that spatially represents the 37 air quality monitoring stations. The framework also showed an execution of exploratory regression and Ordinary Least Square (OLS) regression for finding the most suitable predictor variables and final prediction model, respectively. The output from OLS prediction was mapped using kriging interpolation. Based on the significant trend of vehicle population and industrialization area found from the SpatAP model, it was predicted that ambient particulate tends to demonstrate spatial patterns. In other words, the model indicated an important spatial relationship that helps regulatory authority to understand to which extent people's activity's location relates to environmental quality.

Furthermore, the SpatAP model also highlights air quality, particularly the PM_{10} concentration across a particular geographic locality. Any monitoring activities using the model can give the status of current air quality by geographic sub-region. Subsequently, from this SpatAP model, we can identify the potential accumulation of particulate pollution for a specified duration of exposure to be used as a health risk estimation for the exposed population. We consider this model has innovation value because it added value to the current air monitoring routine by substantially contribute to a better understanding of potential exposure pathways in space overtimes. Also, the model has an added value of the related social distributions of particulate pollutants, leading to a better representative assessment of health effects. Besides, the estimation of particulate concentration caused by land-use types, traffic count, and climatic influences from the SpatAP model is significantly relatable to current rapid urbanization and industrialization happening not only in the Klang Valley region but also in another region of Peninsular Malaysia.





Log – Log		
0.53		
0.45		
0.003		
0.000**		
β	***p*-values**	**VIF**
6.8	0.007**	-
-1.55	0.003**	1.37
0.04	0.04*	1.38
0.03	0.01**	1.17
0.22	0.001**	1.07

Figure 1: Framework, estimator value, and output mapping of spatial model

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