Assignment 1

Vector Analysis: Production of variables at NO2 monitoring sites

The three variables chosen for the LUR model are – INTINVDIST (product of the traffic volume on the nearest main road with the inverse distance to nearest main road); GS100 (area of green space in a 100m circular buffer); and RD100 (sum of road length within a 100m circular buffer). The Model Builder routines to create these variables are shown below followed by the procedure.

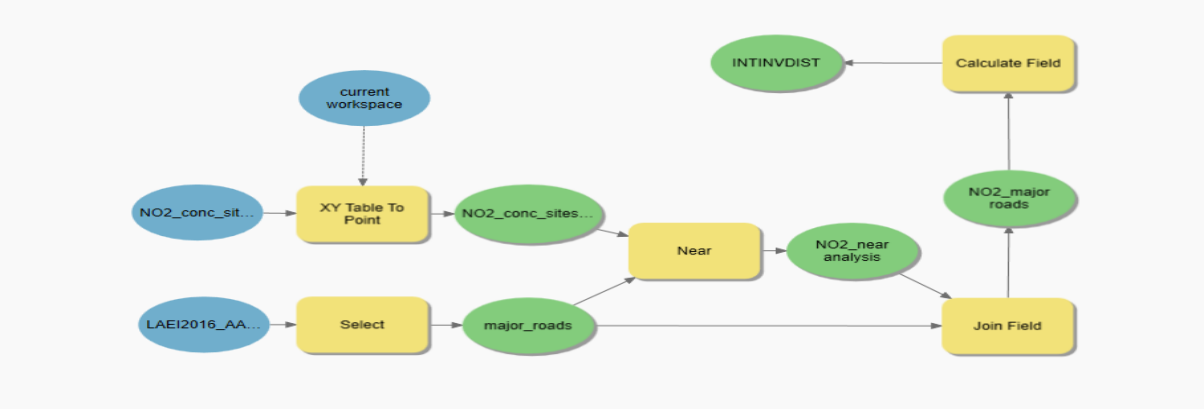

Fig. 1. INTINVDIST

NO_2 sites x,y displayed and a Near Analysis done with roads having AADT >= 5000 and the major roads were joined. A new field was added and calculated as INTINVDIST = AADT/ (Near Distance +1).

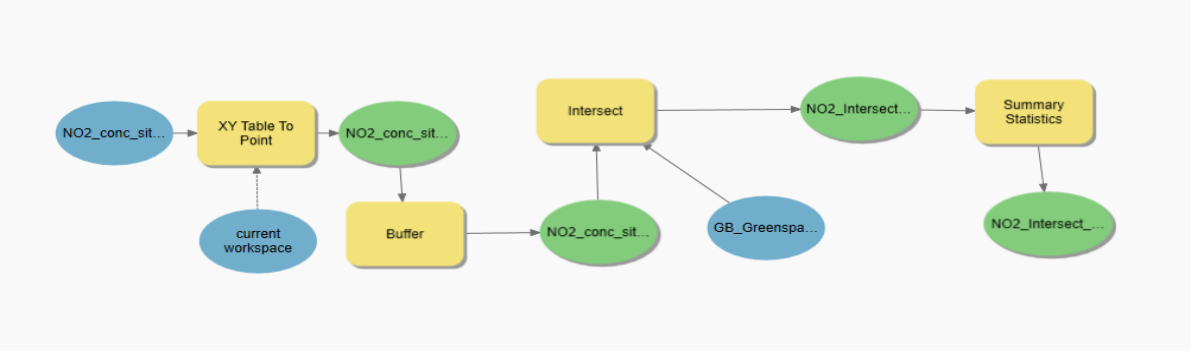

Fig. 2 GS100

Buffer Analysis with 100m catchment area around the NO_2 monitoring sites was intersected with the OS Open GreenSpaces to obtain the areas within the buffers, summed to get GS100 around each site.

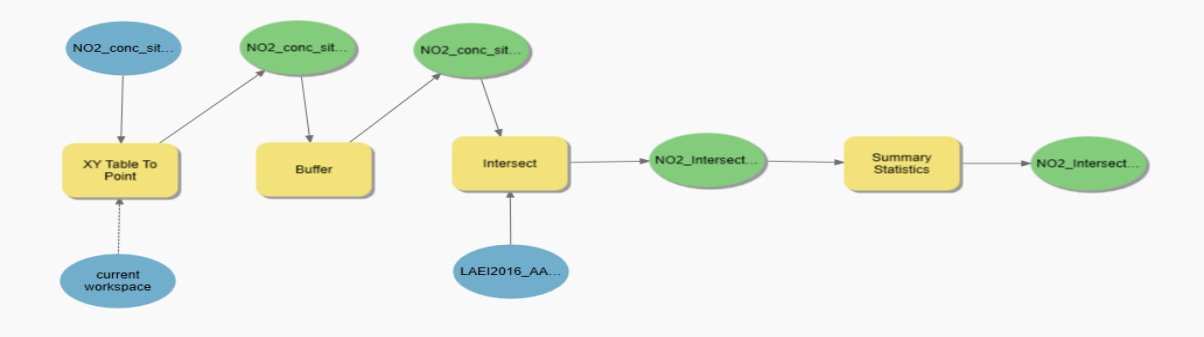

Fig. 3 RD100

Same procedure as GS100 was followed for the road network and summed to get RD100 for each site.

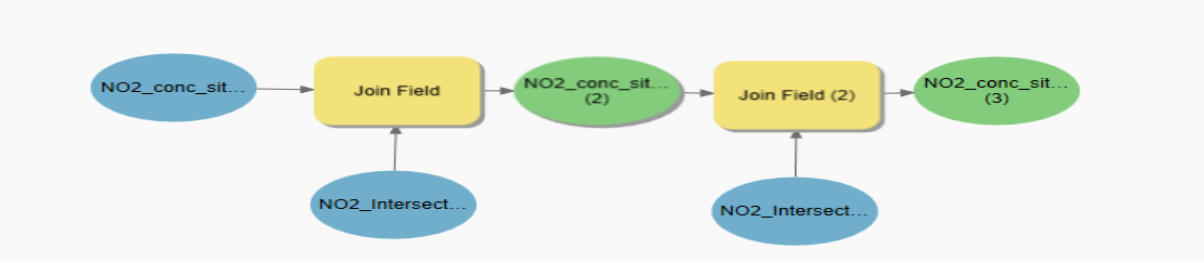

Fig. 4 Predictor Variables Join

The 3 predictor variables were joined and exported to a CSV to calculate the predicted NO_2 using:

$NO_2 = 44.55 + (INTINVDIST * 0.00090831) + (GS100 * -0.00077596) + (RD100 * 0.02206275)$

R was used to plot and calculate the statistics description, the correlation and the RMSE for the Measu red and Predicted NO_2 concentrations as follows (Measured NO_2 concentrations were transformed due to the data not being normally distributed):

```
 cor.test(Predicted_NO2, log10(Measured_NO2))
##  Pearson's product-moment correlation
##
## data:  Predicted_NO2 and log10(Measured_NO2)
## t = 5.4173, df = 49, p-value = 1.823e-06
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.4047046 0.7595096
## sample estimates:
##       cor
## 0.6120288
```

```
RMSE = sqrt(mean(no2_table$Measured_NO2 - no2_table$Predicted_NO2)^2)
```

```
## [1] 0.05448861
```

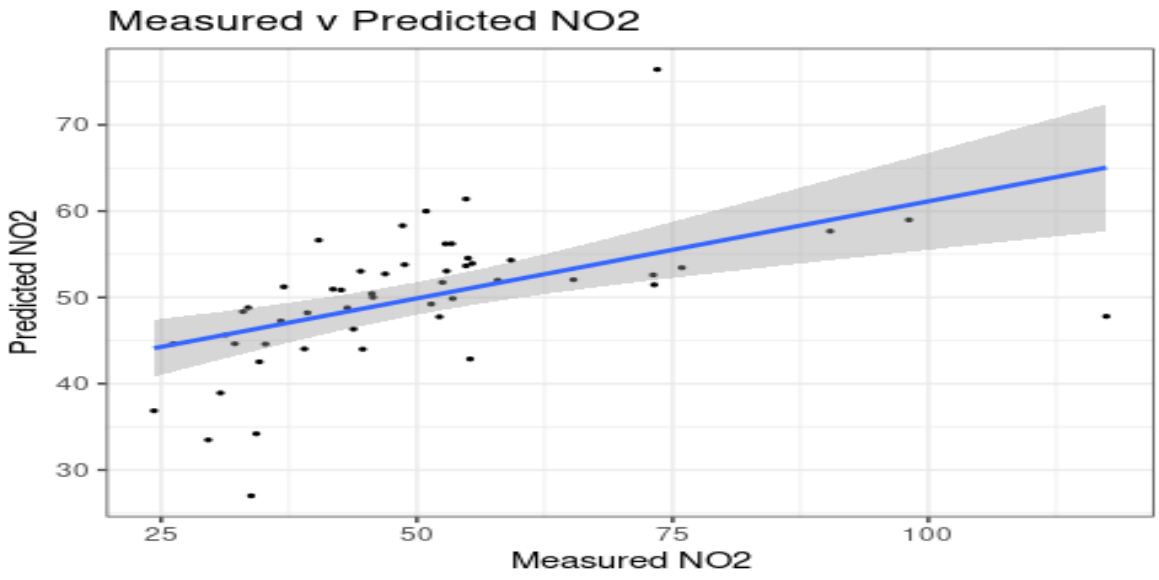

Fig. 5 Correlation NO_2

Raster Analysis: Production of layers for the NO2 surface

A point grid of 50x50m was created using a Fishnet for the city of London. A 5km^2 area was chosen in the city centre containing a high density of roads and considerable amount of green spaces and a polygon was created. The 2 files were intersected in Model Builder to make raster surfaces with the predictor variables for the area. The Model Builder routines are as follows:

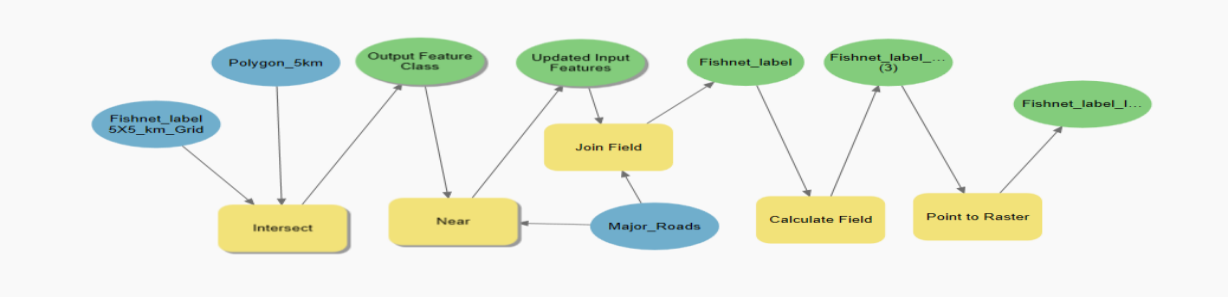

Fig. 6 INTINVDIST raster model

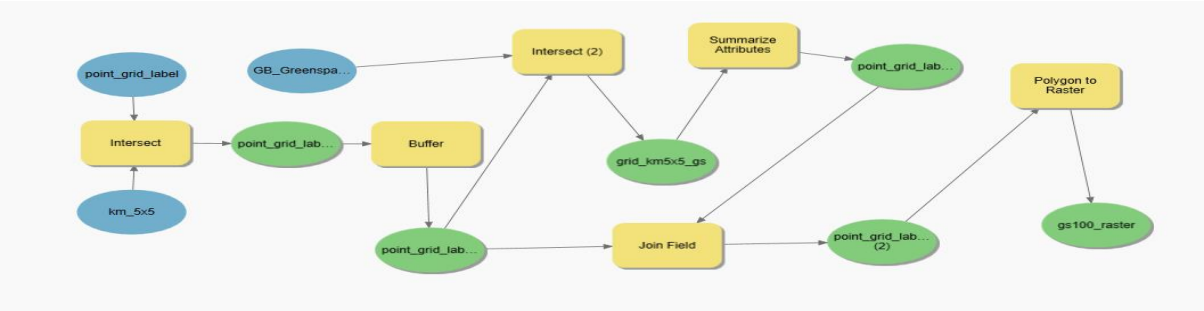

Fig. 7 GS100 raster model

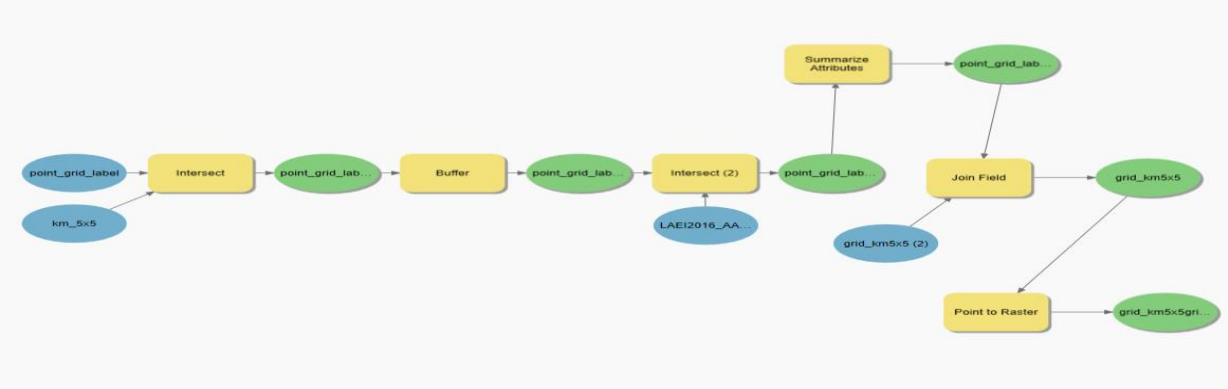

Fig. 8 RD100 raster model

Mapping of NO_2 concentrations

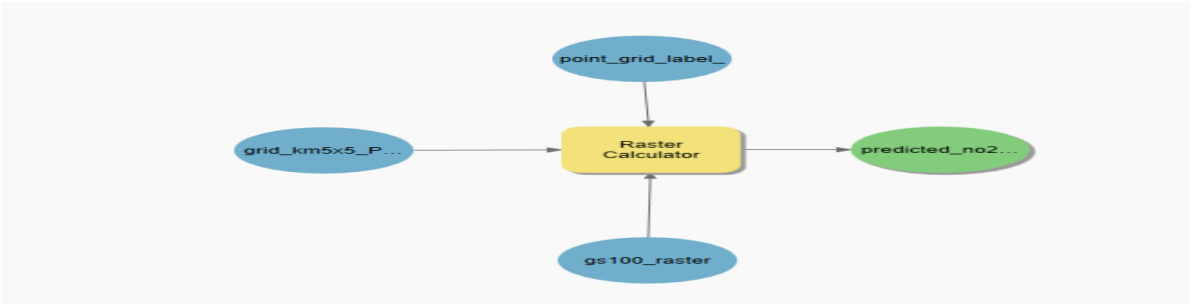

Fig. 9 Raster Calculator

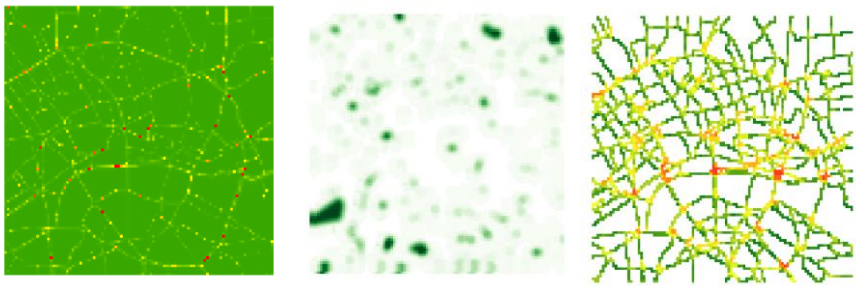

Fig. 10 Predictor Variables Raster Surfaces (L-R: INTINVDIST; GS100; RD100)

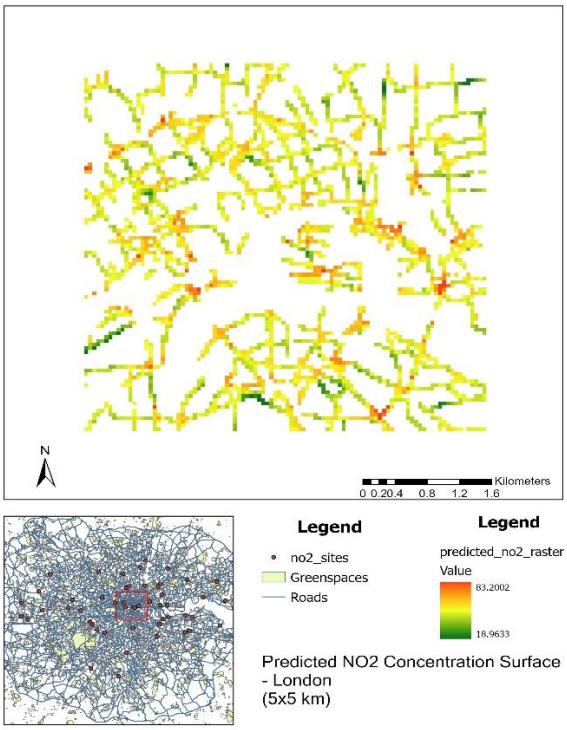

Fig. 11 Predicted NO_2 Raster Map

Critical Evaluation

In the final step of the creation of raster models for the predictor variables, had the tool "Point-to-Raster" been chosen instead of "Polygon-to-Raster" and "Polyline-to-Raster" for GS100 and RD100 respectively, a final smooth surface of NO_2 concentration would have been developed instead of the present surface where some points have missing data (Null values due to erroneous calculation in raster calculator). The area was chosen where 5 monitoring sites were present with a high road network density and a considerable amount of green space. This is since natural landscapes are considered to be sinks and would negate the effects of sources such as roads (Morley and Gulliver, 2018). However, there many more variables like "High Density Residential Land", "Area of Water" etc. that are considered in the ESCAPE Project developing LUR models for mapping air pollution at 36 study areas in Europe (Beelen *et al.,* 2013). For the study area considered in this report, the final surface confirms that major roads with 5000 vehicles per day act as sources (red) while greenspaces lower the NO_2 concentrations and act as sinks (green). This does not however, take into consideration the traffic lights and intersections where vehicles may be stationary for longer periods and hence have more emissions, while greenspaces may have water bodies that enhance the effect of the "sinks". Therefore, high RD100 may not always mean higher NO_2 concentrations and low GS100 lower concentrations.