Additional Materials

1. Methods - Total Petroleum Hydrocarbons

Each sediment sample was extracted with dichloromethane/acetone (1:1 v/v) using an accelerated solvent extraction (ASE 200 Dionex) operated at 100° C and 2000 psi. Extracts were dried using a TurboVap at 30°C and reconstituted in 1 mL of toluene. An aliquot was spotted on to silica rod (Chromarods-S III) and the rods developed for 35 min using *n*-hexane and 12 min with toluene and 2 min dichloromethane/methanol (9:1 v/v). The concentration of saturated and aromatic hydrocarbons was determined using an Iatroscan Mk6. This was calibrated for saturate hydrocarbons using pristine and aromatic hydrocarbons using triphenylene. The limit of quantification (LoQ) for petroleum hydrocarbons was 3 $mg.kg^{-1}$.

2. Methods - Spatial Modelling and Interpolation – stages i-iv

i) A series of IDW predictor variables were made up from all combinations of nearest neighbour values of 3, 5, 7, 9,11,13,15 and inverse power values of 0.1, 0.5, 0.9, 1.3, 1.7, 2.1, 2.5, 2.9 (56 combinations). For the training set the IDW predictors are calculated for each individual point using a leave-one-out strategy. An RF model was set up using the 56 IDW combinations as predictor variables for the determinand in question.

ii) The top 10 most important IDW combinations (measured in the RF model by the gini-index (38)) were chosen and combined with the deprivation data and used to produce a second RF model for the determinand in question. The second model was then subjected to the Boruta algorithm which selects out the significant predictors (compared to randomly shuffled predictor variables (39)).

iii) A third RF model using the significant deprivation and IDW predictors was then optimised to get the best value of "mtry" (the number of variables randomly sampled as candidates at each split in the decision trees used in the RF model (38)).

iv) Finally, the third optimised RF model was applied to 100 bootstrap resamplings of the original sampling points (recalculating the IDW predictors for each bootstrap resample) with each of the resampling rounds producing data on the model fit and predictions for the determinand in question on the prediction grid. The final determinand prediction values at the prediction grid were calculated as the median value from the 100 resampling rounds.

3.

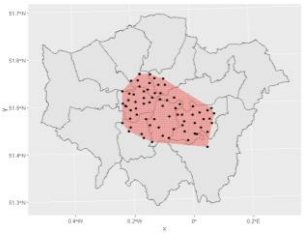

Figure S1 London Soil sampling points with a convex hull drawn round the points to define a prediction region and a prediction grid set out on 500 m squares.

4.

Table S1 t-test results comparing surface (0-2 cm) and subsurface (5-20 cm) geochemistry.

Surface	Subsurface	Data transformation	Test type	Significant difference		P value	report
TOC1	TOC2	No	two sided paired t test	Yes	TOC1>TOC2	$7.70E^{-13}$	<0.001
TPH1	TPH2	log10	two sided paired t test	Yes	TPH2>TPH1	0.001853	<0.002
PAH1	PAH2	log10	two sided paired t test	Yes	PAH2>PAH1	1.31E-05	<0.001
B[a]P1	B[a]P2	log10	two sided paired t test	Yes	B[a]P1>B[a]P2	1.11E-06	<0.001

5.

Table S2 Significant predictor values for black carbon (BC).

Determinand	Predictor	Importance
BC	P0.1N5	10.04
BC	P2.9N5	9.20
BC	P2.5N5	9.09
BC	P0.1N3	8.37
BC	P0.5N5	8.11
BC	P0.5N3	7.21
BC	P0.1N7	7.05
BC	P0.5N7	5.87
BC	P0.1N13	4.76

6.

Table S3 Significant predictor values for total organic carbon (TOC).

Determinand	Predictor	Importance	Determinand	Predictor	Importance
TOC1	P0.5N15	12.76	**TOC2**	P2.9N5	10.20
TOC1	P0.1N11	11.15	**TOC2**	P0.5N3	9.89
TOC1	P0.1N15	10.45	**TOC2**	P0.1N3	9.75
TOC1	P0.9N15	10.16	**TOC2**	P0.9N3	9.71
TOC1	P0.1N13	9.84	**TOC2**	P2.1N3	9.29
TOC1	P0.1N9	9.67	**TOC2**	P2.5N3	9.28
TOC1	P0.5N11	9.56	**TOC2**	P1.7N3	9.23

TOC1	P0.5N13	9.41	**TOC2**	P2.9N3	9.03
TOC1	P0.1N7	8.20	**TOC2**	P0.5N15	7.83
			TOC2	P0.5N11	6.97
			TOC2	Income	5.03
			TOC2	Wider	5.02

7.

Table S4 Significant predictor values for total petroleum hydrocarbons (TPH).

Determinand	Predictor	Importance	Determinand	Predictor	Importance
TPH1	P2.5N3	5.57	**TPH2**	P0.1N11	8.29
TPH1	P2.1N5	4.48	**TPH2**	Inc.OP	6.24
TPH1	P0.1N5	3.98	**TPH2**	P0.1N13	6.10
TPH1	P1.7N11	3.88	**TPH2**	Income	5.97
TPH1	Income	3.85	**TPH2**	P2.9N9	5.92
TPH1	Emplymnt	3.45	**TPH2**	P0.9N15	5.84
TPH1	Inc.OP	3.20	**TPH2**	P0.5N11	5.46
			TPH2	P0.5N13	4.95

8.

Table S5 Significant predictor values for benzo[a]pyrene.

Determinand	Predictor	Importance	Determinand	Predictor	Importance
BAP1	P0.1N13	6.58	**BAP2**	P0.5N15	9.22
BAP1	P0.5N13	5.87	**BAP2**	P0.1N15	7.29
BAP1	P1.3N5	5.18	**BAP2**	P0.1N11	7.20
			BAP2	P0.9N15	6.03
			BAP2	P0.5N11	5.87
			BAP2	P0.5N13	5.57
			BAP2	P0.1N13	4.77
			BAP2	P0.1N9	4.44

9.

Table S6 Significant predictor values for polycyclic aromatic hydrocarbons (PAH).

Determinand	Predictor	Importance	Determinand	Predictor	Importance
PAH1	P0.5N7	9.20	**PAH2**	P0.5N15	7.31
PAH1	P1.3N7	7.53	**PAH2**	P0.5N11	7.23
PAH1	P2.5N9	6.69	**PAH2**	P0.5N13	7.06
PAH1	P2.1N7	6.30	**PAH2**	P0.9N15	6.20
PAH1	P2.1N15	4.69	**PAH2**	P0.1N13	5.94
			PAH2	P0.9N13	5.22