National scale spatial variation in artificial light at night

Daniel T.C. Cox, Alejandro Sánchez de Miguel, Simon A. Dzurjak, Jonathan Bennie and Kevin J. Gaston

Supplementary files

Table S1: Relationship between the aggregated classes used here, the landcover map aggregated classes and broad habitat.

Table S2: Relative importance of each variable in explaining levels of (a) light emissions, and (b) skyglow.

Table S3: Levels of (a) light emissions and (b) skyglow inside of National Parks in Britain.

Figure S1: Variation in the coefficient of independent variables for (a) light emissions and (b) skyglow.

Figure S2: Histograms and qqplots of model residuals for (a) light emissions, and (b) skyglow.

Table S1: Relationship between the aggregated classes used here, the landcover map aggregated classes and broad habitat. Where classes were aggregated we have noted the habitat structure that is likely to influence the passage of artificial light at night (ALAN). Adapted from the Centre for Ecology and Hydrology, Land Cover Map 2015: Dataset documentation, Table 1. Version 1.0, 6th April 2017.

Aggregate class	Number of pixels	LCM2015 Aggregate class	Broad habitat
Mountain, health, bog	59,720	Mountain, health, bog	Dwarf shrub health
			Bog
			Inland rock
Woodland (dominated by trees >5m high with a canopy of >20% cover)	39,692	Broadleaf woodland	Broadleaved, mixed and yew woodland
		Coniferous woodland	Coniferous woodland
Grassland (generally dominated by a cover <1.5m high, but also inclusive of hedges)	306,877	Arable	Arable and horticulture
		Improved grassland	Improved grassland
		Semi-natural grassland	Neutral grassland
			Calcareous grassland
			Acid grassland
			Fen, march and swamp
Water (minimal structures to block ALAN transmission)	5,871	Saltwater	Saltwater
		Freshwater	Freshwater
Coastal (rock / sediment)	7,707	Coastal	Supra-littoral rock
			Supra-littoral sediment
			Littoral rock
			Littoral sediment
Urban	30,678	Built-up areas and gardens	Built-up areas and gardens

Table S2: Relative importance of each variable in explaining levels of (a) light emissions, and (b) skyglow. We used spatially lagged X models to model the response against each predictor in turn for the same randomly selected subset representing 10% of the full dataset. Spatial weights distance for light emissions was 30 km and for skyglow was 130 km. We give McFadden's pseudo R squared for each model.
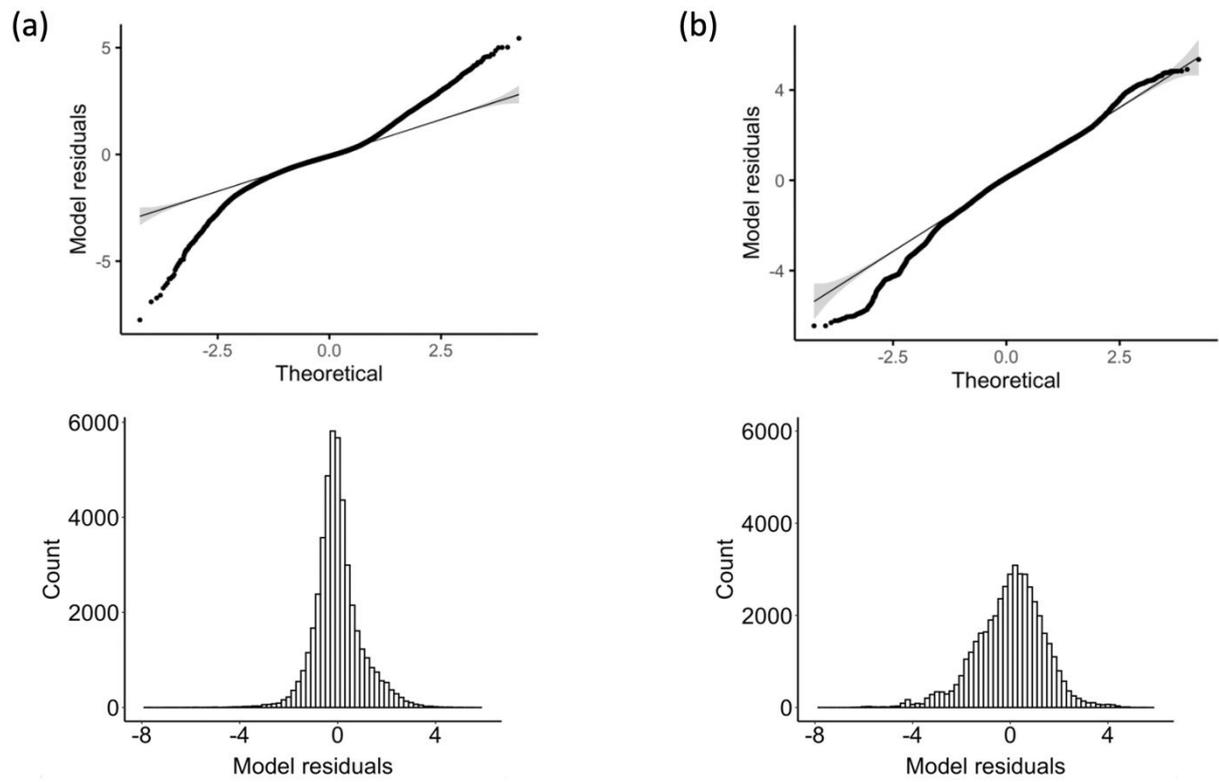
	Light emissions	*Skyglow*
Human population	0.43	0.15
Landcover	0.53	0.40
National Parks	0.03	0.01
SSSI	0.07	0.03
Roads	0.39	0.08

Table S3: Levels of (a) light emissions and (b) skyglow inside of National Parks in Britain. Values are calculated as the median artificial light at night across all 1 km² pixels in which the National Park polygon covered the centroid of the pixel.

National Park	*Area (km²)*	*Light emissions*	*Skyglow*
Dartmoor	95.6	0.11	0.07
Exmoor	69.2	0.12	0.04
Lake District	235.0	0.10	0.05
Northumberland	104.9	0.09	0.03
North York Moors	143.4	0.10	0.12
Peak District	143.4	0.04	0.44
The Broads Authority	30.0	0.19	0.19
Yorkshire Dales	218.6	0.09	0.06
New Forest	55.3	0.12	0.25
South Downs	165.0	0.12	0.22
The Loch Lomond and the Trossachs	186.6	0.06	0.05
The Cairngorms	452.7	0.08	0.01
Brecon Beacons	135.2	0.11	0.09
Pembrokeshire Coast	59.4	0.16	0.04
Snowdonia	212.2	0.12	0.04
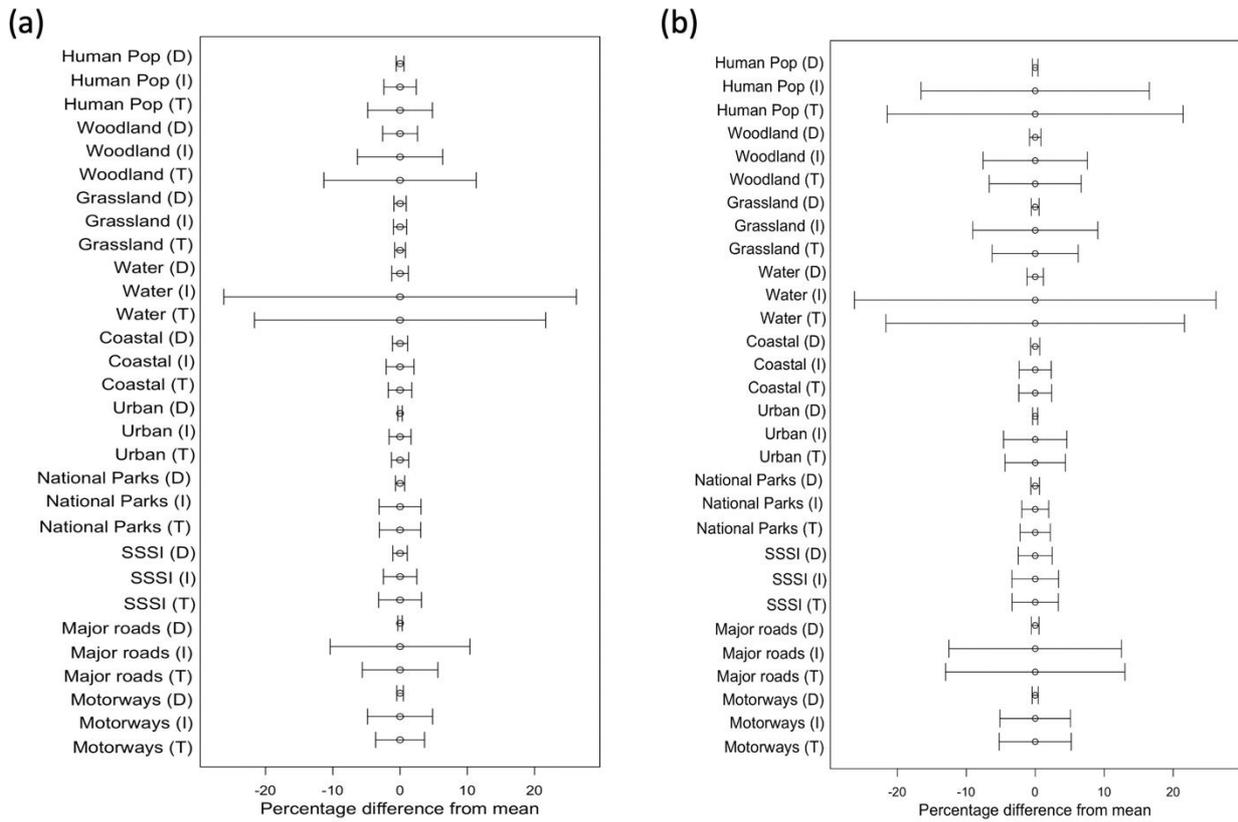
Figure S1: Variation in the coefficient of independent variables for (a) light emissions and (b) skyglow. To ensure computation times were tractable and to reduce spatial autocorrelation, SLX models were run on randomly selected subsets of 10% of the full dataset. We repeated this process on 200 randomly selected subsets and present variation across the coefficient for each independent variable. We show 95% confidence interval estimates relative to the mean of the coefficient estimates. Small confidence intervals show that there was little variation in the value of the independent variable between datasets, whilst large confidence intervals demonstrate a higher degree of variation between datasets.

Figure S2: Histograms and qqplots for model residuals for (a) light emissions, and (b) skyglow. Model residuals were generated for lmSLX models for light emissions and for skyglow for a randomly selected subset of 10% of the full dataset.